Surgery and Healing in the Developing World

Glenn W. Geelhoed, M.D., FACS
Professor of Surgery
Professor of International Medical Education
Professor of Microbiology and Tropical Medicine
George Washington University Medical Center
Washington, D.C., U.S.A.

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Editor

Glenn W. Geelhoed, M.D., FACS
Professor of Surgery
Professor of International Medical Education
Professor of Microbiology and Tropical Medicine
George Washington University Medical Center
Washington, D.C., U.S.A.
Email: msdgwg@gwumc.edu
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Foreword

Surgery and Healing in the Developing World

The major thrust of this book is to present a collection of "how I do it" from 50 authors. The whole book is a valuable traveling companion for those attempting their first medical mission, or veterans of many such trips eager to better perform this art.

There is an occasional familiar name among the authors, Robert Blanchard, a remarkable Canadian academic surgeon. His chapter will bring readers up-to-date on surgical infections. Blanchard's experience extends into Pakistan and broadens our view of western commitment to medicine in the developing world.

Diane Downing and Ahuka Ona Longombe worked together with the editor among the iodine-deficient Azandies, a neglected tribe in Zaire (Congo). In Surgery and Healing we find them on their own, each doing other things; both exemplify common sense to an uncommon degree.

Longombe's "Study of the Epidemiology and Treatment of Fractures" and "Surgical Training of Nurses for Rural Areas" merit careful attention. He learned by doing it over and over again. Longombe's collaboration between equally well trained surgeons in Africa. Surgical improvisation is the result; it is often the most fun of all.

Diane Downing's chapter on "Tropical Nursing" demonstrates her experience perfectly. In addition to her experience she has a creative scientific mind and unquenchable spirit.

Given the timing necessary for "Surgery and Healing" I've yet to read, "Medicine Writ Large in the Raw, Without Power or Plumbing" which, as in three other chapters, are solely written by Glenn Geelhoed himself. These insights should be valuable.

On balance Glenn Geelhoed and his co-authors, give us a deep but unpretentious storehouse of good things to know about, surgery and healing in the developing world. Unquestionably, this is the right thing at the right time. We are grateful to all concerned.

Timothy S. Harrison

Preface

Surgery and Healing in the Developing World

There is a lot of very diverse world out there that needs healing, surgical and otherwise. As medicine in general and surgery in particular are getting more standardized in principle and practice led by technologic advances in the hyperdeveloped and over-serviced advanced First World nations, there are increasingly numerous and more impoverished peoples in the majority part of the world's "south" euphemistically referred to in the hopeful economic term "developing" who suffer lack of almost everything which is found in such redundancy in the neighboring "north."

What and Where Is "The Developing World"?

There may be many ways of drawing arbitrary distinctions among the dominant species on earth, what color the skin, what language is spoken, what religion practiced, what ethnic, political or geographic origins are claimed; but an increasingly obvious and widening gap is a simpler one: the "haves" and the "have nots." The tyranny of the dismal science that draws this simple economic distinction is what makes it so frustrating to have such citizens in such close proximity with such disparate advantages.

This is not the difference between economic systems—capitalism or communism, as examples—nor political systems—democracy versus oligarchy, as examples—nor means of livelihood, however they may have evolved historically—foragers, agrarian, industrialists or service providers, as examples. The tragically simple ratio of numerator to denominator applies to individuals, family units, classes and nation states: if the resources expand more than the population rise that they support, this means such a micropopulation enjoys a rise in its standard of living: by the definition to be used here, "The First World," with North America and the EEC coming immediately to mind as the development goal most emulated.

If both the wealth of the community and the population increase it supports rise commensurably, it may be defined as "The Second World" in terms of development, examples being much of South America and some of Asia. In this group of developing "wannabes" the standard of living remains somewhat static, even if the markers of the development may change from one generation to the next, as access to an automobile may serve as an example. In this group we might often see aberrations with markers from each environment on either flank of the development scale in what could be called

"poor, but modern", as for example, a tar-paper shack with a satellite dish.

In the "Third World" the math is brutally simple: the resources to support the population cannot keep up with the expanding numbers of people who must depend on them, so there is a very real and desperate fall in the standard of living. Classic examples of this stage are found in most of Africa and some parts of Asia and Oceana. In some instances in the demographic transition, this assumes the form of a catastrophic collapse, as the burgeoning population degrades its ecologic support, ruining the environment upon which it must depend, so that there is an entropic slide as the death rate rises to match or surpass the birth rate—a very late and tragic, but no less inevitable, form of population control.

The only way that such a population can be retarded in its decline into chaotic disorganization is through rescue, relief and rehabilitation from outside assistance. At present, most such "development agencies" are operating from the First World through whatever motivations but under donor-imposed rules and priorities, to try to rescue, or retard, or rarely reverse the entropic collapse in such populations.

Here is the discouraging fact of the geographic distribution just oversimplified in naming whole continents as sites of development: First, Second and Third Worlds can be found within as well as outside political boundaries. No more than do diseases carry passports, poverty knows no nationality. There are within a few blocks of the author writing these lines pockets of poverty comparable in these slums to those of any other Third World nation. In contrast, the reverse is often true as well, as was once pointed out to me by Elisa Garrido. She is the economist wife of my friend, Mozambican chief surgeon Ivo Paulo Garrido, author of one of the chapters in this book. As we drove through the streets of Maputo just after the Treaty of Rome was signed bringing to an exhausted end the eleven year civil war that had devastated the Mozambican nation to achieve the unenviable UN-designated title of "The World's Poorest Nation." Pointing to a Mercedes la Grande passing us (driven, in this case, by an international aid agency expatriate) Elisa said: "In the 'World's Poorest Nation' one can still always find the latest model of the biggest luxury items."

The frustrations and bitterness that comes from the long and envious look across this widening gap is apparent in many parts of the world—South Africa, Eastern Europe, Latin America, the US. The only way that even transient stability can be erected to barrier off the resentment of conspicuous greed by abject want is to put armies in between, either as arms of the state, as employed by some despot indigenous emperors (formerly seen in Romania or the "Central African Empire") or private armies financed by industrial wealth, whether legitimate or otherwise (examples in OPEC states or

Colombia). I once made the observation that the two full time jobs that I could see in Southern Africa were "Standing Guard" and "Lying in Wait", with sometimes the same ambitious individuals working in each sector, changing roles at the changing of the night shift!

We have neighbors in each camp, but they are disproportionately distributed globally. It is a commonplace to speak of all the things we have in common among "all God's children", but it is far more comfortable to speak of the disadvantaged in the abstract than in the smelly concrete. Most of the readers of this book regularly encounter a majority of their daily contacts in First Worlders, so it must seem that most or much of the world lives "like us." Not even close to us.

Most of the globe's citizens live and die without benefit of a physician's attention. More than 90% of the world's surgical needs exist outside Europe and North America, yet all our training and technology are geared to service this minority representation of the world's needs, while the vast majority of the world's needs for further surgical services are comfortably outside our view. The fact that you hold this book in hand means that you are interested in raising the blinds to look toward that larger world. There is a very great deal of it around you, often closer and more accessible than you might think.

But, you may say, " I have skills that are useful and could be employed to help, only if the very large system in which they have been developed comes along with them in an integrated team. Just what can you expect one person to do when taken out of his or her element and injected into a very foreign field facing such overwhelming demands with so little to offer? Surgery is a very labor- and equipment-intensive process, and we deal with concentrated effort invested in single individual patients, one at a time! Shouldn't these developing countries just forgo curative services such as surgery and concentrate on population-wide preventive services in public health instead?"

I would hardly be one to disagree with the primacy of public health approaches to populations there—or here—as a "wholesale" approach to health care needs. But what credibility would preventive services have when any curative services are denied or disparaged and these very visible and quite understandable indices of health care are declined to be offered since they may not be cost effective? It is fatuous if not cruel to make the specious statement "If only you were healthier, you would not be so sick just now!" akin to lecturing on the efficacy of safety belts to trauma victims in the emergency room. There is a very large role for surgeons in public health, sanitation, potable water and population projects based in two things that are quite viscerally apparent to the patient population: concern and credibility in curative care.

There may be at least one considerable advantage to practicing in a world of such constrained resources: we cannot use the first-world redundant excesses of material goods as a substitute for judgment. Ingenuity is not only rewarded, resourcefulness is a requirement! A favorite aphorism of my own in such settings is: "We have no money; therefore, we must think."

Healing in World Health

The title of this book might be faulted as rather expansive if not overly ambitious. I am willing to risk that stretching. "World Health" itself is a very ambitious term, and should be understood to cover the environment as well as the human populations which are a very major, but not the only living, part of this green globe. Much of what the surgeon achieves in gaining the confidence of patients one at a time can be translated to cooperative effort at addressing some of the other global oppressions of the environment including the population pressures and the pollution of despair. Surgery is one humanitarian activity embedded in and a very valued part of the whole society with which one inter-relates. You already have the basics—after all, anatomy and physiology are put together very much the same way in form and function on whichever side of any boundary that humans draw around themselves, and there is no society which I have yet encountered that does not value the direct intervention of surgical services—particularly when they are personally and urgently needed. This is the reason most of us got involved in the profession in the first place—because of the personal satisfaction of performing a demanding and needed service for which one can see an immediate and attributable result. Now, take that individual job satisfaction and enhance that patient population evaluation an order of magnitude up to a new plateau.

Medical service in general, and surgical services in particular, are a nearly ideal bridge across the many barriers human populations have used to separate us from others who may look, sound, believe or act differently. Most of those differences dissolve quickly enough during the immediacy of an acute abdomen. There is an acute and chronic deficiency of healing in the developing world of the surgical sort, and a lot of understanding can be drawn from human interaction seen in this model. There is a lot of receptivity to this sort of exchange on the part of the effected populations if the profession can make the effort to go half way in their direction. I have been privileged to observe as whole community self-help action efforts were initiated, including medical programs (an obvious correlate) population programs, (less apparent immediately) and an educational, arts and development program which flourished after the initiative demonstrated in a start-up surgical clinic. The infrastructure followed, rather than preceded the installation of the curative services which otherwise would be forever in retreat in the face of the

severe deficiencies of everything to support it, not least of which were the skills and materials thought necessary to be in place before the pyramid could be developed.

The Intents and Contents of this Book

You have brought your own motives; this book should suggest some help for you with the means. It may inspire you to confirm your commitment to go abroad, but would be a disservice if you arrived unprepared for what will confront you. A realistic, not very dreamy, encounter awaits you, and if this book gives a cushion in the culture shock of the first exposure to the unexpected, it is good preparatory reading.

In terms of motivation, four perspectives are offered along a spectrum of experience from medical student to surgeons very experienced in both First and Third Worlds upon retirement from busy practices in each. In answer to "What is it going to be like?" a very realistic answer to that question is the best preparation for a successful encounter without disillusionment. Tricks of ancillary trades add to the resourcefulness that can be brought to the field in laboratory, anesthesia, nursing services, and even such taken-for-granted supply of your own utility services such as water, electricity and basic materials like IV fluids and suture. Specific surgical treatments can be adapted to the resource constraints by applied ingenuity in a section on the tools and techniques that can be improvised to accommodate fundamental surgical principles. And an important component of the medical mission is the sustainability of it through the training and continuing encouragement and assistance to those who will carry on at the field site, passing on and indigenizing hope. Through your service, teaching and learning, lives should be enhanced on either side of the exchange. These goals are outlined in the intents and contents of this book.

The experience of traveling abroad to work as a volunteer is never a one-way exchange. It is a very intensive learning experience for the First World learner, who can appreciate fully that the principles and concepts he or she may have originally learned when they were married to a tool or technique in the system in which he or she originally learned it—now separated from the plumbing and abstracted in application to a very much larger sphere of medical practice, are you still in command of the concept and can you adapt it around critical pieces of the plumbing that may be missing? It is the ultimate in sophistication to use the simplest means to achieve a satisfactory end result. This skill is honed beyond most of our imaginations on a daily, nearly case-by-case basis by most of the Third World's practitioners, and this is a postgraduate course we must learn from them in an era of retrenchments as our own redundant medical resources are constricted to a higher outcome accountability.

It is that higher accountability that should be a feature in the motivations for many of us who will continue to look at the larger population of the globe's citizens. "World Class Surgeons" are much more useful near home base as well as abroad, not simply for the improvisations and ingenious techniques that can be carried back as skills learned as a gift from the third to First Worlds, but also in the approach to the increasingly diverse populations of patients closer to home. If protecting turf is a worthwhile investment of time and attention as the surgical world seems to be contracting around us in the over-serviced First World, it would seem that life is too short and precious to adapt the ACS motto *Omnibus per Artem* to such pursuits. But if one is interested in an ever-expanding growth industry with an ever-increasing demand for one's services, caring for and teaching others in operating on patients of the very diverse and disadvantaged world is highly gratifying and mind-expanding. It is a very contagious worthwhile experience for those who are motivated and prepared.

If it is an obvious truism that, ultimately, you cannot save your life, you have but two options—you can sell it or you can give it. If you are going to opt for the former, there never will be a return high enough to justify the exchange rate.

I do not know how long your life will take—it will take very little. But I do know how much it can give. It can keep on giving forever.

Glenn W. Geelhoed

CHAPTER 1

Preparation Time

Harvey Bratt

Now that you have decided, for humanitarian reasons, for adventure, for a religious medical mission experience, or just to broaden your horizons, it is time to look seriously into the decisions you must make to ensure that this will be the fulfilling experience that you wish it to be. And hopefully, this will be an experience you wish to repeat, perhaps many times. Be forewarned, the journey you are about to take may result in an "addiction" which will motivate you for years to come.

An important first decision is whether your spouse accompanies you. For several reasons, I would strongly advise that he/she come along if at all possible. Selfish reasons would include the companionship you are accustomed to, but of much greater importance is the sharing of the experience; this can be so meaningful to both of you in your personal interactions forever after. The same reasoning would pertain to other family members. Children (especially teenagers) are often welcome and can work in a wide variety of positions, ranging from general helpers to interpreters if they have language proficiency such as in Spanish or French.

Next comes the selection of the country you wish to work in. There are opportunities all over the world and you should pick a place or places in which you will most likely be able to work comfortably. If you strongly dislike hot weather, it would be a sizeable mistake to sign up to go to equatorial Africa. Conversely, if you despise the cold, Juneau, Alaska, would be a poor choice.

Many/most Third World opportunities will be associated with organizations which have resources and facilities to assist you in your planning. This is certainly true of most missionary organizations. One organization whose focus is strongly Christian is World Medical Mission (www.samaritan-purse.org); it lists opportunities all over the world. But some opportunities will require you to do many or most of the planning details yourself. Regardless of whether you must do your own arranging or whether you will receive organizational support, be certain to allow a considerable amount of time; details always take more time than expected and there may be numerous dips and detours and perhaps frustrations in the process.

When you have decided where you will be going, it will be very important to contact that hospital or clinic. It will be very important to clarify exactly what types of surgery you will be expected to perform. In most Third World settings, obstetrical and gynecological procedures will be very commonly necessary. Being a general surgeon, trained, in gynecologic surgery as well, I always found it helpful to observe or preferably scrub in on a few C-sections before going. In many areas, vesicovaginal fistulae are commonly found, secondary to prolonged obstetrical obstruction; reading in advance in this area may be helpful. Observation of some common plastic surgery procedures such as cleft lip repair will be helpful if this type of challenge may be expected. Also, a good basic surgical textbook, oriented to the area where you will

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be working, is of tremendous importance. I found Davey's *Companion to Surgery in Africa* very helpful. I assume it is still in print. It has many illustrations and is quite concise. Also, talking to a surgeon who has recently served the hospital you will be working in can be most helpful in planning your own event. This discussion can be very helpful in deciding whether to bring in your own favorite instruments and/or suture materials. Remember that you will not be able to send to surgical supply for whatever you need to handle unexpected problems that present themselves.

There are many resources available to help you in your planning. Centers for Disease Control put out a booklet called *Health Information for International Travel* and this is available through the office of the Superintendent of Documents, US Government Printing Office, Washington D.C. 20402. Shoreland Medical Marketing has a variety of informational products which are updated every year. Their *Travel and Routine Immunizations* appears to be very comprehensive and yet very concise. Their address is P.O. Box 13795, Milwaukee, WI 53213 The CDC (888-232-3299;www.cdc.gov) will fax updated health information. *The Medical Letter* (1000 Main Street, New Rochelle, NY 10801) has a very nice 12 page spread on "Drugs for Treatment of Parasitic Infections".

Travel Plans. Any full service experienced travel agency will most likely be able to help you with your travel plans. The greater their experience with international travel, (and especially experience with travel to Third World countries) the more expeditious and efficient will be their work for you. I am reminded of the time when we landed in Khartoum, Sudan to find that our supposed ongoing flight to Cairo, Egypt did not exist. If you wish to shop for the most economical fares available you may want to engage the help of a travel consolidator or a so-called "bucket shop". A helpful internet source is http://www.travel-library.com/rtw/html/rtwconsolidators.html.

Travel insurance is a good idea if you wish to be prepared for unexpected events on your trip. This will help you to avoid out-of-pocket expenses due to trip cancellation, baggage loss, airline strikes, medical emergencies and other unexpected incidents of travel. You can surf the web for organizations selling this type of insurance but one reference is www.travelguarantee.com/thetrip/. The travel agent you work with will have sources as well.

Visas. Many/most Third World countries require a visa. Assuming that you have a passport (if you don't, contact the passport office at your local US Post Office) the next step is to apply for a visa to your selected country. You can do this directly by writing to or telephoning the embassy of that country in Washington D.C. Be prepared to find that this process may be very slow and tedious. The office personnel in the embassy may well be nationals of that country and there may be significant problems in getting a good mutual understanding of what you wish accomplished. Efficiencies we expect from our governmental organizations will most probably not be found. You may wish to avoid this frustration by availing yourself of the services of one of many organizations that does this sort of thing on a regular basis. Travel Document Systems, Inc. based in Washington D.C. is one such organization that we find helpful in some of the more difficult visa application situations. Their website is www.traveldocs.com. There is a fee involved but it is often well worth it.

Diplomas, certificates etc. Be prepared to submit documentation of your medical credentials. Many Third World countries are very fussy about not only your medical diploma but about verification of your specialty certification as well. Most often, a copy (rather than the original) of diplomas and specialty certificates will suffice. It may be necessary to have them notarized to validate that they are true copies. A

prominent official stamp usually makes the document more acceptable to the bureaucracy of Third World countries.

Immunizations. Generally speaking, there are very few immunization requirements to enter any country in the world. One exception is the yellow fever vaccination. Many countries do require it of all incoming travelers. Others require it only if a person is travelling from a country where yellow fever is endemic. Yellow Fever is found in much of Africa, (excluding some parts of both North and South Africa) It is also found in many parts of South America. Yellow fever vaccination is available at county health departments and usually requires an appointment rather than walk-in.

But, even if there are few requirements for travel, many immunizations may indeed be strongly recommended. First of all, one's basic immunizations should be up to date. This includes tetanus-diphtheria, polio, and for those persons born after 1957, MMR (mumps-measles-rubella) as well. Tetanus-diphtheria is good for 10 years, but if one is coming at all close to the 10 year time, it would be a good idea to update it and be relieved of the necessity of a booster on the field if an injury should occur. There is a global polio eradication scheme in operation, but this has not yet been achieved. Polio should be boosted and IPV (as opposed to OPV) should be used to bypass the very small risk of contracting polio from the live virus. MMR too should be boosted if this has not been done since childhood. Hepatitis A vaccine should be given: the series consists of two shots 6-12 mos. apart but the first dose will protect for short-term travels to Third World countries if given 3 weeks before travelling. Doing medical work makes hepatitis B protection mandatory and most of us assume that all medical personnel have this protection. However, a recent CDC report shows that as many as 30% of medical personnel (those falling outside of OSHA regulations) have not been immunized. It should be noted too that Hepatitis B is endemic in the orient making it doubly important to have on board if working in this part of the world. Travelling and working in the middle belt of Africa encompasses the so called "meningitis belt" and the polyvalent vaccine Menomune (Sanofi Pasteur makes this vaccine) should be administered. Duration of protection is not precisely known, but this should be repeated every 3 years or thereabouts if travelling to this area.

Immunization against typhoid is available in both oral and injectable form. The oral product is manufactured in Switzerland and is available through Berna Products Corp located in Coral Gables, FL. It is a live vaccine and needs to be repeated only every seven years. Use of the oral preparation is preferable. There are two injectable vaccines available, one manufactured by Pasteur Merieux Connaught is single dose while the Wyeth Ayerst product requires two injections separated by one month. Cholera vaccine gives little protection, is somewhat reactogenic and therefore its use is not advised. There have been instances in Third World countries (in response to a cholera epidemic in that country) in which cholera immunizations have been suddenly mandated. It may be wise to carry with you a note from your personal physician saying that you should not have this immunization for medical reasons. If the status of protection against hepatitis A and B is unclear, antibody titers should be drawn to clarify this issue.

If working in the Far East, one should check with the CDC for their recommendation regarding Japanese encephalitis vaccination.

There are a number of simple items that should be carried with you since purchasing them on site may not be easily possible. These include simple pain medications, good quality sunglasses, mosquito repellent (should contain DEET), sunscreen

with a number greater than 15, Tums, (or its equivalent) an ointment for rash, simple bandages, a tweezers, lip balm, an ear syringe if you are prone to wax buildup, You may wish to ask your dentist for CAVIT to temporarily replace a lost filling. A Swiss knife provides one with many handy little tools. Post 9/11 this should be carried only in checked luggage. Carry with you your eyeglass prescription in case your glasses are lost, broken or stolen.

The matter of your water supply is of great importance. In much of the developing world, available water sources cannot be relied upon to provide safe water. It may be wise for you bring along a water purification device. There are many of these available, coming in all shapes, sizes and prices. At least one company has a "travel cup" available; it purifies water poured into it in 30 seconds and can be used over and over to a total of 60 gallons. This can be purchased from TEALBROOK in Hastings, MN. Their fax is 612-480-8786; email is tealbrook@aol.com. In general, any drinks made with boiled water, (tea, coffee, etc.) can be safely consumed; this should be true also of bottled beer or soft drinks. Ice cubes are always suspect since you cannot know their water source. Bottled water too must always be viewed with some question in that bottled water is no safer than its source, which may be very questionable.

Planning for leisure time is important. Take along tapes and cassettes but do take along a player which is or can be battery powered. (and take extra batteries). Electrical power in developing countries is usually not available on a full time and dependable basis. In one of the countries in which I have worked (the name of the country will remain unmentioned) the power company was named NEPA; on the basis of its sporadic performance, we took this acronym to mean "never enough power always". Take along enough books and magazines to carry you through as well.

A journal will help you very much in recalling details of your experience after you return. This may be a written journal or you may wish to dictate your journal into a recorder, which again should be battery powered. And take plenty of photos and or videos. Video has the advantage of timely narration. These will be priceless for you personally and will help you very much in sharing your experience with interested friends. When you get your photos back, write pertinent details on the back immediately; details become fuzzy much sooner than expected. Before taking photos however, be certain that doing so is acceptable to the people you are interacting with. Certain cultures believe that picture taking will bring a curse upon the person being photographed. Other cultures believe that these photos will be presented in a demeaning way in the First World and therefore are not at all interested in being photographed. One way of encouraging cooperation is to take along a polaroid camera; if you can show immediately what you have captured on film and can give them a copy, this will break down a lot of resistance and produce a lot of rapport. And do allow them to "dress up" for pictures; you will have many opportunities to get photos of everyday activities in everyday dress.

Malaria is a very real problem in many parts of the world. For many years, all four of the Plasmodium species were susceptible to chloroquine, which was well tolerated and quite inexpensive. It was used both for prophylaxis and treatment. As time goes on, however, more and more areas are showing resistance to chloroquine; this is especially true of *P. falciparum*. Therefore, the recommended antimalarial for prophylaxis in most areas no longer is chloroquine but Mefloquine. In the US, Roche markets this under the trade name Lariam. It is quite expensive. It must be taken once per week and must be started one week before arriving in a malarial area

and after return it must be taken for four weeks. Mefloquine has gotten bad press in Europe and many European countries recommend that chloroquine plus paludrine be used as a prophylaxis. Protection with this regimen is definitely inferior to that achieved with Mefloquin (which I have used repeatedly without side effects) and the newer Malarone (Glaxo Smith Kline). Malarone must be taken daily and is quite expensive.

There are several malaria self-test kits available today but none of them has proved entirely satisfactory. If you with to pursue this further, I would advise calling CDC in Atlanta directly and ask to speak to one of the experts in the Malaria Section. 1-800-311-3435 may be a helpful number.

CHAPTER 2

Surgery in Developing Countries

John E. Woods

Surgery in the developing countries may be one of the most rewarding and fulfilling experiences in a surgeon's professional life provided that his/her expectations are realistic.

The purpose of this chapter is not to persuade those who have such an inclination to undertake such an endeavor. Rather it is an attempt to provide a screening process whereby one can determine if this type of service is suitable for the individual surgeon. There is often a perception that overseas service, especially in countries with less well-developed medical systems, is a rather glamorous undertaking and one about which one might very well be enthusiastic. This may well be the case, but not too infrequently the experience for the ill-prepared is a negative one, prompting a volunteer to say "altogether an unpleasant experience and one that I will never attempt again," or "I simply could not work there again."

Without attempting to dissuade U.S. surgeons, my objective is to provide reasonable information about what such service entails—the obstacles, the frustrations, and the difficulties, as well as the fulfillments.[1]

Over the past several decades physicians, nurses, and paramedical personnel from the U.S. have frequently been involved in voluntary medical service overseas. With our increasing consciousness of the responsibility of the relatively privileged and affluent has come an increasing volume of volunteer work serving the indigent and underserved in developing countries. There are many organizations now involved in such care, varying from the large and well-organized such as AmeriCares, Doctors Without Borders, Operation Smile, to the smaller organizations, some supporting a single site. Some of these organizations provide partial financial support for the endeavors, but in the great majority of instances such missions are carried out at the volunteer's own expense, and not infrequently on vacation time. In addition to the clinical practice of surgery, medical volunteers have frequently participated in CME conferences overseas aimed at educating professionals in developing countries with support for indigenous care. Such legitimate professional educational activities are in some instances supported by parent organizations. Because of fewer time restraints, retired physicians will often have greater opportunity to serve.

Again, this chapter is prompted in part by the desire to provide information to physicians who have not as yet been involved in overseas service and who have a keen interest in doing so. It is hoped that the following considerations will better inform and prepare those who anticipate such service. This will provide only a brief overview of the basics both from the practical and philosophical perspectives.

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Philosophical Concerns

Motivation

There are many reasons for undertaking overseas surgical service. Among the reasons cited by various writers are such factors as to enrich personal growth as an answer to dissatisfaction with impersonal medicine, and as opportunity for ingenuity, creativity, and offering an example to young people without expecting monetary reward as incentives. A spirit of adventure, or desire for a new experience or relief of boredom, may sometimes provide the impetus for seeking such service. In themselves these motivations may not provide the staying power and persistence which are important in carrying out such missions under what may be very trying circumstances. As a longtime observer and participant in many such missions, it is my impression that a sincere desire to perform humanitarian service, whether on the basis of simple compassion or religious incentives, best serves those seeking such service.

Flexibility

From my perspective, the three most important considerations in overseas service are flexibility, patience, and accommodation. In developing countries, perspectives on time and efficiency are markedly different from those in the U.S. On many occasions anticipated schedules are totally disrupted and the only appropriate response is graceful acceptance and patience. It is important that as expatriates our respect for doing things in the mode of national physicians is apparent. Not infrequently, national physicians and coworkers may not in any way display their appreciation of such patience, but they will certainly note exasperation and display of temper and impatience. If the surgeon seeks to serve with the expectation of interruptions and delays, they are much more readily handled. These problems may on occasion be on the basis of well-meant attempts of national medical personnel who wish to help. Another very frequent frustration is in the form of poor and/or sporadically functioning equipment or the actual absence of equipment which is deemed necessary by the surgeon. These difficulties offer opportunities to adapt to challenges with new techniques and solutions that are practical and frequently essential outside the highly technical and convenient environment of U.S. medicine.

Cultural Sensitive Health Care

On first exposure to medicine and surgery in the Third and Fourth World countries, the words "culture shock" may very well apply. To say that things are different is an understatement in may instances. On a recent trip to a Caribbean island to provide staffing for a continuing medical education conference, those from the U.S. who participated were exposed for the first time to the practice of medicine and surgery in an island university hospital. My young colleagues described the condition seen as "mindboggling" from a perspective of patient care or a lack thereof, lack of medicine and equipment including sufficient beds, lack of staffing, and in general a medical environment that would be totally unacceptable from the U.S. perspective. Patients from other cultures and physicians as well may understand health, illness and medical care in ways that differ greatly from our health care providers' understanding. In relatively primitive cultures, many patients have beliefs that exist outside of biomedicine and they live by those beliefs. Health care providers from the U.S. and other more advanced countries may not agree with the logic of such beliefs

or the efficacy of the modes of practice, but they should acknowledge and respect them. Respect for local methods of treatment and their practitioners is important. Nationals often consider Western medicine to be ineffective against a wide range of physical illnesses, and especially useless in dealing with psychosomatic problems ranging from heartbreak to witchcraft. For many people in the developing world today the only available treatment is dependent on traditional medicine in curing, not only in the back bush but also in the economically deprived areas in cities.

A specific example of cultural differences in the practice of medicine overseas is the insistence in many Islamic countries that women be seen and treated only by female physicians or caregivers.

Communication

The inability to communicate freely with national patients and caregivers may be very frustrating. Not only are there concerns with verbal communication, but expatriate physicians should be aware that gestures which have one meaning to them may have an entirely different meaning in a different culture and on occasion may even be rude or offensive.

Understanding the importance of good translation and real comprehension on the parts of patients and national personnel, many organizations take special pains to insure the best possible translation. But there are many instances when this is not the case. A visiting surgeon needs to determine the degree of real understanding of the interpreter as well as of the patient, and it may be necessary to repeat oneself over and over again or to state the same thing in several different ways to be sure that what one is seeking to say is understood. Please remember also that speaking more loudly doesn't mean that we are speaking more understandably. A smile and an appropriate touch, though they are not substitutes for clear understanding, may help to transcend language barriers. Learning even a few phrases in the local language or dialect may be very helpful in establishing rapport.

Treating the Whole Patient

When communication is less than ideal and with marked cultural differences, it is easy to think in terms of the present illness or the presenting problem rather than in terms of the individual human being. To listen to the patient is every bit as important in the Third World as in the U.S. where polls indicate that patients' greatest frustrations are failure of their physicians to listen. A listening attitude is very helpful even when comprehension is presumed to be complete. A smile, eye contact, and even touching (within the cultural context) may increase the patient's confidence. The patient-physician relationship is further enhanced when interest is shown in other than strictly physical, for example family and work concerns.

In other words, patients the world over appreciate the same consideration extended to our patients nearer home. Unfortunately, in some situations the number of patients is so overwhelming that there is not the luxury of time to practice optimally. Even in such circumstances, however, empathy can be demonstrated and is thoroughly appreciated.

Practical Considerations

Finding the Right Opportunity

One of the most important aspects of overseas service is finding the right opportunity for the physician or surgeon to use his or her abilities optimally. It is important also for the surgeon to be familiar with the quality of postoperative care. For example, one of the major problems in most developing countries for a cardiac surgeon would be to find the cases and the diagnostic and therapeutic technical and nursing resources needed. A pathologist would scarcely be able to find enough work to justify his efforts in a small remote facility except by immediate conversion to a nonspecialist general practitioner. Most commonly the greatest needs in developing countries are for primary care physicians and pediatricians, and certainly for general surgeons and some surgical specialists such as orthopedists, ob/gyn surgeons, urologic and plastic surgeons, ENT specialists and ophthalmologists. Where possible it may be helpful to bring support personnel if this is acceptable in the host hospital or clinic. Operating and recovery room nurses are very often able to perform yeoman service which may compensate in part for inadequate nursing on the part of the nationals.

Operating Room Experience

Lack of materials and equipment are almost inevitable. With some of the largest and most well-established organizations, this is less apt to be true inasmuch as they are able to bring with them materials and equipment they expect to be in short supply. Many smaller missions, however, are constantly short of nearly everything, even such commonly used materials as gloves, sutures, gauze, bandages, syringes, etc. If possible, it is advisable for the surgeon to bring with him not only such supplies as are listed above, but also any special instruments that he may need in his particular type of practice. In my own experience, I have on occasion wished for what I thought were very basic instruments but very important for a certain procedure, only to find that they were not available and thus had to do with what was available and as a consequence, with less optimal results achieved. The surgeon should try to anticipate what he is going to need for any special procedures and, if possible, bring such instruments and equipment with him. Again, when possible, if equipment can be brought which will be left behind, this is especially helpful not only in the surgeon's own practice, but in the practice of those of the national surgeons who work there on a continuing basis. It is almost standard practice in developing countries to use disposable supplies and equipment (e.g., disposable cauteries) over and over again.

If the volunteer is bringing drugs, he/she should be aware that in some countries there are strict customs regulations prohibiting the introduction of outdated drugs. Since many drugs are perfectly safe and usable for several months after the expiration date, repackaging may circumvent this problem when it seems appropriate.

An affidavit from a parent organization indicating that the materials are for charitable use with some sort of official-looking stamp may be very helpful in passing through customs.

Use of Time and Other Concerns in the Operating Room

Many who practice surgery in the U.S. are accustomed to a relatively rapid turnover between cases or the use of more than one operating room to stagger cases and

use time most efficiently. This may be one of the most frustrating aspects of surgery overseas. Generally speaking, the nationals are simply not in a hurry, they do not move efficiently, and they often do not respond well to the pressure of an expatriate surgeon to do things more expeditiously. Few of us like to wait and we wish to use the time well when waiting, especially if there isn't a likelihood of spending time in discussion with a local surgeon. A paperback or some other reading material may help to ameliorate the long periods of time between operations.

One should also be aware that in many mission hospitals there is a paucity of blood for transfusion if indeed there is any at all, and even such basic equipment as suction and cautery may be missing. In my own experience there have been occasions when rather major operations were undertaken without benefit of blood, suction, or cautery. It is interesting what one can accomplish when forced by circumstances to do so. One should also be aware that the presence or quality of surgical assistants may be far less than ideal. Not infrequently one may be expected to perform a major procedure with only the help of the scrub nurse. This does lead to ingenuity in providing surgical exposure but it is surprising what can be accomplished that way, though it certainly slows down the procedure and makes it more difficult.

Surgical procedures may be modified considerably due to circumstances extant in a given hospital. Procedures which are very lengthy may be at increased risk where good and safe anesthesia is not available. For this reason, many surgeons who perform overseas will bring with them a trained anesthesiologist or a nurse anesthetist to enhance their practice.

Anesthesia

Under the circumstances prevailing in developing countries, the practice of anesthesia is considerably modified. Local anesthesia is much more commonly used and spinal anesthesia will also be used when possible because of the somewhat less intensive monitoring necessary. In some instances local practice differs from that in the U.S. even where good anesthesia is available on the basis of drug availability and expense involved. It is vital to have a good understanding of the quality of anesthesia and subsequent care before undertaking a lengthy procedure or one that requires special anesthetic skills. For example, microsurgical procedures which may take several hours are ill-advised on occasion not only for the lack of technical equipment and support, but for the length of the procedure and the subsequent careful postoperative monitoring that is appropriate. Thus, reconstructive procedures which in the U.S. might be carried out using a microvascular free flap would more commonly in the tropics or developing countries use regional or distant flaps, which are much more rapidly accomplished and do not require quite the intensity in monitoring.

Postoperative Care

In my experience this is one of the areas of greatest stress. Often the nursing support is not well trained or maybe unaccustomed to many of the procedures carried out by expatriate surgeons, and hence are not able to provide the appropriate care demanded. I can personally remember several patients who survived the surgery very nicely and in good condition who subsequently lost their lives because of inadequate suctioning, undetected bleeding, or inadequate monitoring of the airway. Not frequently, family members are entrusted with postoperative care to a significant extent. In addition, where special types of dressings or immobilization are

necessary, very careful explanations should be made to the nursing personnel with their full comprehension so that the operative result is not compromised. There are special concerns with some types of procedures even so elementary as skin grafting because the dressing materials available may be limited, and heat and perspiration may make graft survival less certain. In pediatric patients inability or unwillingness to maintain arm restraints may result in disruption of suture line—for example, in cleft lip. In many Third and Fourth World situations the surgeon should be mindful that Murphy's Law all too frequently applies: anything that can go wrong, will go wrong.

A complicating factor for short-term overseas surgery especially is that the surgeon may require a few days simply to grasp the situation appropriately and thus have inadequate time to implement the use of the knowledge he or she has gained. Needless to say, those who go for longer periods of time make a more satisfactory adjustment and are able to carry on surgical practice quite reasonably. It has been helpful to me, when on occasion I indulge in feeling sorry for myself, to realize that the national surgeons practice under these same conditions all the time without any hope of relief. This enhances one's respect and admiration for those who operate all of their lives under very difficult circumstances.

The above descriptions and cautions are not given with the idea of discouraging surgeons from practicing overseas. Rather the idea is to thoroughly prepare them as much as possible for what they may find because forewarned is forearmed. It is especially important for patience to be exhibited under trying circumstances, and if one knows what to expect it is easier to prepare oneself.

Long-Term Postoperative Follow-Up

In many situations this is simply impossible inasmuch as it is very expensive for some patients to travel, especially those that live at a distance, and they are not likely to return unless there is a specific problem. One is often left to judge what the ultimate outcome will be on the basis of what the immediate postoperative status of the patient is. Another problem is that any patient requiring postoperative routines on a relatively long-term basis may simply be noncompliant, either through lack of understanding or lack of appreciation of the importance. Postoperative situations which in the U.S. might immediately be brought to the attention of the surgeon or his staff may simply be neglected with unfortunate consequences. It is important to review each patient with a national staff physician before their discharge in order to provide the best follow-up possible under the circumstances.

Travel and Living Cost

Some large organizations pay most of the cost from airfare to living accommodations, but that generally applies only for long-term volunteers. Most frequently the volunteer bears the entire expense of travel, board, etc. It is advisable for the traveler to bring with him various medications such as those to treat bacterial diarrhea, amoebiasis, and giardiasis which are endemic in many areas, and also malaria prophylaxis may be important if appropriate. In addition to updating standard immunizations, the surgeon should ascertain the appropriate up-to-date immunizations that might be necessary to the particular area where he is traveling. These are usually available from medical travel clinics and for the particular area to be served.

Personal Benefits from Overseas Service

Despite all the frustrations and difficulties encountered in overseas practice, for well-prepared volunteer the experience may be extremely positive and gratifying. It is not uncommon for health care volunteers to report that they have gained far more from the experience than they felt that they were able to give. One is apt to return with a deeper appreciation and thankfulness for the benefits and resources that we have in the U.S.

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CHAPTER 3

A Commitment to Voluntary Health Care Service

Donald C. Mullen

Mission hospitals in the developing countries supply critical help to those areas where the governments financially are unable to sustain an adequate national medical program. In much of mission work in the developing countries, volunteers have always been a critical addition to that medical work. The call to medical mission service has never been limited to permanent career position in hospitals abroad. However in the past, generally, on the international level there has been the implicit assumption that full-time missionaries are necessary and volunteers have played a minor function. During the nineteenth and twentieth centuries the primary work of the church abroad was accomplished through the efforts of career professionals supported by either churches or other individuals, but the past 30 years there has been an ever increasing move to volunteerism in these critical areas of international health care. Now, as we move into the twenty-first century, it becomes increasingly more important for us to search for more ways to volunteer our talents in the medical mission fields of the world. Indeed, there is now great interest amongst physicians and other health care personnel in the United States and Canada to be a part of this service to our developing country friends in need.

Monetary constraints have limited the abilities of many church groups and other organizations to maintain large numbers of career workers in these frontiers. But, this is not all bad by any stretch of the imagination! This opens the door of opportunity for all members of the medical profession to contribute in a major way to help strengthen medical care in needy areas while at the same time gaining a personal dimension in broadening themselves into whole people who care about the needs of the less fortunate. Indeed, it has the potential of bringing missions closer to both individuals and congregations and renewing the excitement and joy which can be ours through relationships with our brothers and sisters around the world. Fresh new perspectives gained from our partners in the developing countries may also lead some of us to break out of a provinciality which in some areas may have weakened our spirit.

Volunteer Medical Work

Medical work in the developing countries is particularly appropriate for expansion of our volunteer networking. Health care work has always been effective in bringing people together. People who see caring hands personally concerned about their well being in mind, body, and spirit are much more open to closer personal relationships. Recently in the medical profession we have been blessed with many health care workers with a desire to serve in the capacity of short-term medical

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volunteers, and we hope many more will want to consider this broadening experience in their personal lives, both religious and otherwise.

When I took a month away from my practice of cardiovascular surgery in Kenya over 20 years ago, I had no idea the impact it would have on the rest of my life, and I have been blessed with the joy of service in many areas since then. One has to go only one time to catch the fever and the spirit of service abroad. As science, religion and medicine move closer and closer together after a couple hundred years of separation, interest in the spiritual aspects of medical care are being more and more emphasized not only by individual practitioners but in many of our great medical universities.

There are many different opportunities available to fit the needs of those health care workers in this country who want to expand their horizons. The secret is to align oneself with an organization or group in which one can work comfortably. There are many groups available, both Christian and secular.

A word of caution is warranted here. Not every successful health care worker in the developed world will necessarily be an effective volunteer in medical work in the developing countries. Individuals must determine for themselves whether they are suitable, both by self-evaluation of their own personality characteristics and by determining what appropriate skills they have which would enhance medical mission in the areas being considered. Many times emotions, values and attitudes may be barriers to appropriate behavior and cross-cultural learning and sensitivity.

Preparation, faith, adaptability, sensitivity and the nurturing of relationships are all important things to consider by all health care professionals contemplating exciting medical adventures, and each one of the elements will be now approached in more detail.

Preparation for Service

Positive experiences abroad are enhanced by proper preparation. A cross-cultural experience is by nature unsettling but can also be quite bewildering without the necessary preparation. Potential volunteers must study as much as possible by reading history, literature and issue papers regarding the country and the region where he or she will be working. One must try to develop some understanding of the context in which he or she is to function, not only by talking to others who have just visited there, but by corresponding with the people who are working there, if any, on a long term basis.

Current information about the local people's response to key issues in the area and an attempt to learn the attitudes in the community where the medical facility is located are always helpful. Knowledge of medical problems endemic to the area also enhance one's ability to contribute to the health care of the community and is a requirement for anyone going into sometimes disorienting situations.

Understanding one's own self and working on appropriate relationships with the nationals with whom they will be working as well as the group they go with from home is a key to good relationships. Contact with both groups before the trip will help prepare the way. Proper understanding of the personal medical risks involved is paramount to a good experience. Immunizations recommended by the CDC and appropriate malarial prophylactic preparation are essential. This will be discussed in more detail in another chapter in this book.

The Spectrum of Christian Faith

For both Christian and non Christian physicians going to mission hospitals, a word of advice. Diversity within the many churches we serve has always been a quality to be championed. However, wide differences in beliefs between the volunteer and both expatriate and national field workers and their local churches certainly has the potential to be disruptive. While these differences can often be challenging and stimulating and lead to interesting dialogue, it is best that basic theology and beliefs of the volunteer fit in with those of the people with whom he or she will be working. Since the volunteer will only be there for a short time, respect for the beliefs of others may be all that is necessary. It can also be true that many times some degree of diversity and openness results in growth and expansion of one's own beliefs in ways quite unexpected. The people in these foreign lands have much to teach us.

The purpose of our mission work is to maintain an appropriate witness in the community we serve. One's attitude toward mission thus becomes important in determining relationships with those we have come to serve. A respect for the standards of conduct of career personnel by the volunteer when we are working in established mission areas helps build long term relationships, and a sensitivity to local religious practices leads to smooth and appropriate interactions within these new relationships.

Adaptability

Different concepts of health care and levels of expectation in developing countries make it necessary that the volunteer expand his or her horizons in order to adapt to dramatic changes rapidly enough to gain a valuable new experience during the time of service. Medical care differs remarkably in many areas from the more developed and technologically advanced industrial nations. The primary determinant of the pattern of medical care in most of the developing countries is poverty. One must be prepared psychologically for these differences. Culture shock must be overcome with understanding and compassion.

The volunteer must be able to adapt to working with highly limited resources regarding equipment, procedures, facilities, and laboratory capabilities. The educational levels of the nationals will not be as sophisticated, and the support structure for the repair and maintenance of equipment is usually greatly restricted. Breakdowns, dull needles, and the reuse of disposable gloves when working in mission or government hospitals may be frustrating. Many times one must adapt to dealing with the uncertainty in diagnosis and treatment which depends on those "old fashion" methods of observation, experience and intuition. There also may be disease processes which are simply not treatable under local conditions and limitations of equipment or even the lack of available and appropriate referral sources. Frustration and helplessness require an adjustment to a different level of expectation as patience sometimes wears thin.

The volunteer must be adaptable enough to accept different living conditions, foods, and customs. The length of a short term mission would not be sufficient to make any change in these conditions. Longer term personnel who have a much broader experience within the culture would be more appropriate individuals to influence any changes they deem necessary.

Sensitivity

Insensitivity to the culture in which one is serving can be destructive to the entire mission. We do not have the right nor the insight to be judgmental and to expect the entire world to think as we do. Westerners in general, and Americans in particular, have a reputation for insensitivity and we have made many mistakes in relationships as we attempt to "westernize" the entire world. The really important thing to remember is that we are trying to be of service and make a positive impact whatever culture we go into, and that can be done in a nonthreatening and nonwestern way.

Although we may not appear to be condescending, it takes a special effort to avoid being insensitive. Many of our neighbors can "read" us very well. We may feel that we are not wealthy, but in the eyes of true poverty we appear rich. Our ways of doing things may appear better to us, but there is always a good reason for doing things their way. Working out of context sometimes makes it difficult to understand all the "whys." For a good experience and the development of long term relationships, one must develop a servant's attitude.

The rapid advance in medical technology has widened the knowledge gap separating medical workers in mission areas from modern medicine. Some of the people we work with in these areas, both mission doctors and nationals, may be outstanding in a primitive environment but also aware they have been unable to keep up with medical advances giving them a sense of being out of touch. Compromises in the standard of care sometimes have had to be made and short term people who may be shocked sometimes are too aggressive in suggesting change. The volunteer is in a unique position to develop empathy by facing the limitations that long term personnel deal with on a daily basis. With the proper attitude the experience becomes an opportunity to learn and a challenge to cope—not just a collection of reactive "horror" stories.

Nurturing Relationships

Nurturing relationships with nationals and members of the group with whom the volunteer is working may have a more lasting impact than accomplishing short term goals. For the nationals, knowing there are people who truly understand their problems and who will continue to care about them is showing them the love.

While it is natural to be "task oriented" when going into the developing world as a volunteer, one must realize that no program needs someone coming in on a personal crusade to make changes. One has a much more positive influence when the primary purpose is to be accepting and uplifting and to assume that there is a good reason behind most decisions, policies and actions which are made by the local people and the leaders of the group. Respect for all is important including differences in cultures and belief systems.

An attempt to learn some aspects of the local language while on the field almost always improves relationships because it shows interest. Obviously, a volunteer will not be able to develop much communicative ability in the short time available, but just learning common greetings and numbers in the vernacular will immediately convey the impression to nationals that one cares about them and respects their language and culture.

The impact of an outsider who actively confirms and supports people can be a dramatic breath of fresh air, and it does not require one to have been "on site" for a long period of time. It is one of the important roles a volunteer can easily fill. Most

volunteers return from the field feeling that what they have gained in terms of new perspectives and insights far exceeds what they gave.

The volunteer will be inundated with impressions, insights, feelings and questions that are important to his own growth as a person either religiously or individually. A daily diary recording all these experiences and impressions for future consideration and introspection will add to the experience. This is also a good way to begin to anticipate interpretive needs to help others learn when one returns from the field.

Finally, while in such different circumstances and having such unusual experiences and impressions, one must keep a keen sense of humor, have moderate expectations, develop a tolerance of ambiguity and foster the ability to cope with failure. With those kinds of attitudes, one will surely return a better person with the ability to share a good experience with others and enhance the church's competence in understanding other cultures.

As we all strive to improve our capability to live in a global community and to improve our relationships with others, there can be no better way to put our ideals into practice than to become a volunteer health care worker. The experience has changed many lives and it can change yours.

Resources

1. Liverpool School of Tropical Medicine. Pembroke Place, Liverpool L35QA, U.K.
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CHAPTER 4

International Surgical Education: The Perspective from Several Continents

Glenn W. Geelhoed

In the "global village," societies on each continent are almost instantly aware of advances in medical science and technology, and the demand for surgical health services increases with this awareness. As communication fans these health service expectations, there is additional awareness that health expertise and resources are not accessible to all the globe's populations, though each shares much of the susceptibility to disease in common with persons on either side of any borders—political, cultural, economic, racial, and linguistic. To ease the pressures brought about by this disequilibrium in supply and demand for specialized health services, the educational systems in several areas of the world have adapted to increasing demands for both quantity and quality of surgical services.

The globe is far too small for people, particularly health care professionals, to be provincial. Diseases do not carry visas, and poverty, want, and despair look very much alike on either side of any border. Our responsibility is to educate health care manpower for global health needs, particularly in the medical centers of the developed nations. Many of the students in various health care systems are patterning their careers after the role models they see in their own, perhaps atypical environments. Later they will experience environments that are quite different—geographically, socioeconomically, politically, and medically "exotic"—and their medical education should be relevant. This is true not only for the traveler, the Peace Corp volunteer, medical missionaries, and international business people, but also for the physician in community practice, to whom exotic problems may be brought on an increasingly regular basis because of the fluid nature of the world's transportation and communication. A broader vision is needed with a global perspective on health, health care, and medical and human problems across the globe without the confines of geographic, economic, or political boundaries. Although many of the advances in the developed world are quickly published through the developing nations, often the problems faced within these developing nations are unknown within the devel-

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Editor's notes: This article is based on presentation at a panel discussion on International Surgical Education, which was held at a recent Clinical Congress. Dr. Geelhoed served as chairman of the proceedings, which were sponsored by the Committee on Surgical Education in Medical Schools. Contributors to the article include: Samuel Adetola Adebonojo, MD, FACS, Professor of Cardiothoracic Surgery, University of Lagos, Nigeria; Jose Felix Patino, MD, FACS (Hon), Chairman, Departments of Surgery, Cetro Medico de los Andes, and former Health Minister of Colombia, Bogota; and Thomas S. Reeve, MB, BS, FRACS, FACS, Professor and Chairman, Department of Surgery, University of Sydney, Royal North Shore Hospital, Sydney, Australia.

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oped world unless there is an encroaching threat—such as an epidemic—or unless fear or fascination arouse curiosity about our neighbors.

To better understand the problems faced globally and the educational resources adapted to meet these challenges in several different systems, surgical educators from several continents were assembled and addressed the issues of international surgical education in order to respond to rising demands in quantity and quality of surgical services in an era of perceived resource restrictions.

Africa

Nigeria has the largest population in black Africa with as much as one-fifth of the continent's people. For a population of over 100 million people, located mostly in the rural countryside, there are fewer than 10,000 medical doctors, most of whom live and practice in large cities. Before 1948, most Nigerian doctors were trained in Europe and North America. Today there are 13 medical schools throughout Nigeria, nine of them in the nation's southern sections.

To improve the health of the Nigerian population, the medical schools have planned curricula to respond to the health care problems of that nation, even though the medical schools themselves were patterned after educational systems originating in quite different environments.

Admission to a medical school is through join-matriculation examination; classes of 50 students in the newer medical schools and over 200 in the longer established schools are common. These students spend two years in basic science and three years in clinical rotations. Although the government is exerting a lot of pressure to increase the intake of students, the limiting factor has been the infrastructure of facilities to accommodate the students. Surgery plays an important role in the education of all undergraduate medical students, since at the end of training they must be able to apply the surgical skills demanded of a general duty medical officer in a developing tropical country. Exposure to surgical illnesses and the development of fundamental surgical skills take place in general surgery and specialty rotations at different times in the curriculum for a total up to nine months of the medical school experience.

The undergraduate examination in surgery was modeled on the British system until more recently, when experiments in objective grading of multiple choice questions and clinical papers were begun. There currently is a very strong emphasis on a well-structured clinical examination. Because of a growing public concern about the length of the training program and the perceived need to produce more doctors at a reduced commitment in time, there is pressure to de-emphasize of basic medical science subjects. This public pressure for a devaluation of quality surgical education in exchange for immediate increase in physicians is an especially vexing problem in Africa. The urgency of public demand may be depreciating medical expertise in parts of the developed world as well. A story is told about Charles Elliot, the famed educator and past president of Harvard University (1869-1909), who was asked why Harvard had gained a reputation as the greatest storehouse of knowledge in the country. He replied, "In all likelihood, it is because the freshmen bring to us so much knowledge while the seniors take away so little of it."

South America

Disease patterns vary around the world according to geographic conditions, ethnic patterns, and socioeconomic development. Colombia is experiencing an increase

in both the diseases faced by the population and the levels of multiple service sophistication sought in tertiary care hospitals. Surgical services must be provided under a wide variety of technological settings, and "supplying the surgical needs of a developing country" has a sociopolitical connotation, for there are many determinants of available medical care. Eight years ago, an estimate was made that the developed world invested from $30 to $150 per capita per annum in surgical services, while the developing world invested between $1 to $5. In the interval, these figures have increased severalfold for the developed world, but for the developing world the data have remained unchanged and in some places have even diminished! As a means of increasing health coverage, especially in rural areas, priority investment in primary health care, including some fundamental surgical tasks, may be placed in the hands of paramedical personnel.

The development of health care in industrialized nations may be viewed in three stages. Challenges to public health and personal health services provided can be classified in the first stage as that of infectious diseases, malnutrition, and poor housing. The second stage is that of chronic diseases, such as cardiovascular and cerebrovascular disease and cancer; and the third stage is that of social environmental pathology—including accidents, alcoholism and other addictions, overnutrition, and associated morbidity of each.

If socioeconomic development and well-being result in average life expectancies that approach the maximum life span, acute illnesses have ceased to be a major medical problem and have been replaced by chronic illness. This development implies that the practical focus on health improvement must be on morbidity, not mortality, for natural death will occur near the maximum life span. The problem to be addressed is how to improve the quality of life through the compression of morbidity. Eventually, the current limits to longevity are societal, not medical, problems. Medical care systems in industrialized western societies are largely constrained to improving the quality of life. Developing countries face a challenge of coping simultaneously with all three stages, with just a fraction of the human and material resources available to their industrialized counterparts.

The epidemiology of surgical disease is characterized by the same three stages. But in developing countries there are unique complications that result from poverty, illiteracy, malnutrition, tropical infectious disorders, and abysmal limitations of laboratory and diagnostic equipment and hospital facilities. At least one component of this situation is scarcity of scientific information in libraries or access to international databases.

In addition, there are major differences in regional clinical pathology. For example, in a temperate climate a low-grade increasing colonic obstruction in an adult is most likely to be a carcinoma; this is not necessarily the case in a tropical climate, where amoébic dysentery and schistosomiasis are prevalent. This difference is significant because the carcinoma should be operated upon; with ameboma of the colon, the condition does not require surgery unless an emergency arises since effective treatment is available through nonoperative means. As a consequence, chronic gut obstruction in one area of the world or another should be investigated for different diseases with different treatments, and the mind-set fostered by clinical education would be different in different areas. "Geographic surgery" would focus on the circumstances and disorders unique to a given area that merit distinct emphasis.

These "exotic illnesses" usually require great sophistication on the part of the clinician in an area in which they are not prevalent; however, the practitioner in the rural setting at a small hospital that is devoid of technology is often better qualified to interpret the meaning of an acute abdomen accompanied by icterus, fever, and upper abdominal tenderness in terms of common disease prevalence.

There is an unfortunate trend toward the acceptance of lower standards for the practice of medicine under the slogan of a more "nationalistic medical care" for the less privileged nations of the world. Yet, we must face reality. Many nations cannot, even remotely, hope to duplicate the technological sophistication of the educational and service institutions of the industrialized nations. What solutions are possible to stretch the limited resources over the larger demands? It appears clear that geographic pathology has a socioeconomic connotation that cannot be overlooked. The concepts of clinical epidemiology and population-based medicine must permeate medical teaching, health planning, and service administration. Surgical training programs in a developing country must include sufficient exposure to such aspects of "general surgical care" as trauma, orthopedics, urologic problems, pediatric surgery, and obstetrical/gynecological surgery. As a result, in those areas of the world where conditions impose the requirement of an "overall general surgeon," training programs must be longer and not shorter than in the industrialized world.

A continuous flow of graduate students, faculty members, and research workers must be maintained in those areas of the world where high standards and ample facilities exist so that upon their return to the homeland these individuals can become intellectual leaders and effective multipliers of advanced knowledge. And, most important, the countries of the Third World must increase efforts toward the development of local and regional centers of high scientific quality that can serve both as nuclei for excellent training and as models of academic excellence. These countries should do so, freeing themselves of false complexes of intellectual colonialism or irremediable poverty, for they cannot accept a destiny of lower standards of medical care for their deserving citizens.

Australia

Australia is a pluralist society that emerged as a nation from a penal colony where Great Britain sent its excess prison population in 1788. With this unlikely background it has evolved a rather unique culture and political way of life. In this land of universal education, there has always been a desire to "bring back to size" those who are successful or larger than life. This behavior in Australia is referred to as "Tall Poppy Syndrome." The tall Poppy must be "felled" to promote satisfaction of the excessively average and almost guarantee mediocrity. Yet Australians have typically sought a "fair go" for everyone, and part of each of these beliefs has gone into the government's leaning toward a salaried, regulated health service.

Before 1948, surgery was a marketplace phenomenon in which most graduates went to the United Kingdom to train in surgery and other specialties. When the Royal Australian College of Surgeons was founded, it represented the recognized surgical certificate thereafter. Patients were private or in the public domain, and the surgeons who treated the latter were known as "honoraries" and proud of it. In 1948, the labor government attempted to introduce a National Formulary, but this first step toward promoting conformity was not accepted by practitioners. The failure of this system produced considerable anger among labor politicians. When next elected to power in 1972 after 23 years out of office, the labor government intro-

duced a Medibank scheme that had mixed popularity, leading to over-servicing by both patients and doctors. In 1975, when a conservative government was elected, private medical insurance with tax-deductible premiums was introduced, and this system continued until 1983, when the government again changed to labor. With this election came the introduction of Medicare, another money rather than health system. Doctor's fees are paid to the level of 85 percent from a 1.5 percent tax on gross income, and the tax deductibility of the premium has been withdrawn, which largely eliminates health from the cost-of-living indices. Hospital insurance is legal. Medical fee insurance is not. Therefore, to be operated upon by the surgeon of choice, patients must pay their levy and also pay for private insurance; for all practical purposes they are doubly taxed, so the option to choose is not encouraged.

The legislation that introduced Medicare brought about other restrictions that produced a profound disaffection between doctors and government. This alienation led to a number of problems involving the withdrawal of surgeons from teaching hospitals and some consequent instability in the system.

A major effect of the expansion of Medicare has been the reduction in public hospital funding; it also had a decided impact on teaching hospitals. There has been a profound reduction of elective surgery, and the term elective has become equated with unnecessary. The cost-related reduction in bed numbers and attendant reduction in the number of nurses have placed the teaching of undergraduates under severe stress; it is fundamentally impossible to train an appropriate number of postgraduate students in the current setting.

Despite widespread dissatisfaction with the system, the commitment of the teaching surgical professionals has been gratifying. Many of these individuals have made special arrangements to teach after having resigned hospital appointments. However, the major problem in the teaching of undergraduate surgery is the reduction in volume of standard elective surgery and surgical beds in hospitals.

The changes in the system have emphasized certain subspecialty areas as major concerns. Patients from one to 40 years of age who are traumatized constitute the most common admissions, and the whole field of trauma represents the cutting edge of the treatment of surgical disease. With respect to diagnostic evaluation and technology, the surgeon can ignore economics only at extreme peril.

Medical school admissions are being lowered by 20 percent and the Australian Medical Association requested a 30 percent reduction. At the same time that there is a mixed reduction in elective major and general surgery in public hospitals, there has not been a significant rise in private hospitals. Although the number of surgical admissions has remarkably diminished, the number of medical admissions has not decreased proportionately. All operations appear to have diminished with the possible exception of vascular surgery, which has increased minimally.

It remains for those of us in surgical teaching positions to capture the enthusiasm that our students have for learning and to promote surgery in its art and science in a manner that will foster and maintain that enthusiasm throughout the surgical careers of those who have chosen that path. Surgeons must not be deterred by aberrations in government policy from giving the best possible care to patients. To teach surgery is our special role. We cannot do so without paying attention to clinical detail, best demonstrated in that competent surgeon who shows concern for the patient, who is committed to the patient's care, and who maintains a good communication in a confidential atmosphere for all those involved.

Such a surgical milieu can be maintained regardless of government interference. However, access to the best technology and the highest economic return for individuals may take a buffeting before the former equilibrium is restored. It is possible that we will find ourselves on unsettled seas for some time to come, but that should not deter us from taking responsibility for the transfer of our surgical DNA to the next generation of surgeons.

Managing Change

Maintaining standards in an era of change requires flexibility, with a primary commitment to servicing the health care needs of the patient, without compromising the quality of care now rendered and the progress that might yet be possible in developing further surgical skills for treating and preventing disease. The developed world has a lot to learn from the developing nations on how surgical leadership can adapt and make up in imaginative resourcefulness what it lacks in economic support or public commitment. People all around the world look to surgeons' skills for help when they have a problem, yet do not want to divert a high percentage of resources to sustaining or advancing the surgical art through public commitment to education and research.

It was suggested by some in the discussion following each presentation in this program that the large population demands of Africa represent a call for down-scale commitment of the resources that cannot be matched in the technology-intensive tertiary health care centers of the developed world; that, perhaps, primary emphasis should be on basic health care, with centers of excellence such as those described in South America serving as role models. Another suggestion was made that Australia might represent some model of what future American surgeons could expect from the conflict between rising demand and diminishing resources, with government interest in controlling public use of surgical services.

Despite widely different educational systems and competitive pressures in the entry and development of surgical career patterns, the products of these various systems on several continents have remarkable similarity regarding their stated goals and objectives: with whatever resources, facilities, technology, and manpower the system affords, the highest quality of competent and compassionate surgical skill should be delivered; and surgeons should be taught to address the patient's problem, which remains the single focus of surgical attention in a wide variety of geographic, disease pattern, economic, and educational system settings.

At this juncture in history there is a good deal of enthusiasm for the concept of "Internationalism in Surgical Education." This is possible now more than ever before. The language of modernity, technology, and particularly medicine is English, so there are fewer barriers to communication of the healing arts. There is a common literature and even more rapid media to which nearly all professionals make reference.

This universalization of the standards of excellence means that nearly all people can appeal for the best possible quality where it means the most for them—in matters of life or death, and in the quality of their daily lives. The healing art is a nearly ideal transportable skill across artificial barriers among humans. If we recognize the real problems that isolate people naturally, such as disease, hunger, and want, we may be able to build bridges around political, economic, and religious systems that impose artificial barriers on people inhabiting this crowded planet. We have many neighbors we haven't yet met; they have heard of us, however, and what they know

about us gives them hope. To this universal hope we should respond, building more effective bridges across the many barriers.The mission of internationalism within surgery helps spread that new hope to peoples on all sides of the many artificial barriers and is an ideal bridge to understanding. Understanding is never wasted.

CHAPTER 5

Medicine Writ Large in the Raw, without Power or Plumbing

Glenn W. Geelhoed

How Can I Practice Surgery without the Tools that I Am Used to Using Available in a Setting I Do not Understand?

It is not easy. But, it is not impossible. Medicine is not professional "stuff" it is specialized information that is very easily portable and adaptable, even if its plumbing and power fixtures are not. Adaptation of fundamental principles makes far better sense for sustainability than the importation of fancy tools with embedded chips, or nursing the cast-off obsolete equipment discarded by First World facilities, often shipped (without spare parts) as "white elephants" to encumber the recipient. I have operated on each continent in settings which were not equipped with running water, autoclaves, electricity for light and power tools, relying often on the ingenuity of those who are already there and who did not think it odd that some indispensable (to my mind) piece of equipment was missing. Having never had the experience of the use of such *sine qua non* they struggled on with what they do best—getting the job done with what they can rig up at hand.

Scrub Sinks and Preop Prep

"Running water" is what I had described in my Congolese scrub sink when Kigale would run for the water. After masking with cloth mask and donning the cloth hats (in preparation for the later sterile cloth gown) I would scrub my hands and arms with a bar of soap and a scrub brush. I had previously proven in the decidedly First World setting of the National Institutes of Health that Rodac culture plates had proven that mild hand soap was as good as most other prepping methods, and was superior to stiff-bristle prolonged brush scrubbing with toxic bactericidal soaps. At the conclusion of the scrub, Kigale would pour the water from a pitcher over my hands for the rinse, and then a second pouring of a Hibiclens (or whatever other solution was available, usually reconstituted from powder and made up fresh locally) over the rinsed arms and hands.

The "theatre sister" had meanwhile prepped the patient over the area of the operative field. This did NOT mean a razor shave for hair removal. Again, in my First World studies of alternate skin prepping and hair removal methods in the first-world context of George Washington University Hospital, the lowest bacterial counts were obtained by means of the simplest skin preps and the worst were achieved through razor shave and iodophor patient skin scrub. Deprivation, in this instance, had made for superior preparation efficacy and timing, and our exotic "theatre time" is not cluttered with a lot of nonoperative ritual preceding getting directly to the

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problem. The skin is painted with an iodine tincture and is draped with the towels and sheets taken out of our "Third World autoclave"—the highly effective pressure cooker.

Sterilizing and Autoclaving Sheets, Instruments, Gowns, Gloves

No organisms survive the high pressure steam of our very practical autoclave—a large capacity pressure cooker, available from WHO and other international sources. The family participates in even this part of the "nursing services" by washing the drapes and other items by hand until they are clean and hung out to dry. The patient's family (who will later serve as the diet kitchen and nursing monitors and rehabilitation supervisors postoperatively) gather the firewood and get the water from the local stream to add to the "kit" picked and packed by the theatre personnel, whereupon the pressure cooker is put on the fire for the required period of time signaled by the indicator. This kit is every bit as sterile as any that has come out of any gas-operated autoclave and does not run the added problems of venting toxic gases from the kit and into the environment. Its cost of operation, given the abundant and cheap labor force in the developing world, is close to nil.

Surgical Gloves and Dressing Material

Anything labeled "Disposable" or "Single Use" in the developed world that might make its way to the developing world will be assured of seeing reincarnation into a long and useful life! "Disposable" means "Use and ReUse Until There Is Not One More Useful Purpose To Which This Discardable Item Can Be Put." This is especially true of surgical gloves. For those of you who may not have worked in such developing world settings, you may not recognize the "Glove Drying Tree" behind Kigale where she hangs out the used gloves after washing and twirling them to test them for leaks before packaging them up for the next cases.

Is it not illegal to reuse medical disposable equipment? Well, where are you at the time?

And does not reuse run the risk of transmitting communicable disease? Just what virus do you assume might survive a half hour of superheated steam in the doubled atmosphere of the pressure cooker?

The answer is that reuse of disposable equipment (and the permanent equipment, such as instruments, for that matter) is perfectly safe when you put the investment into the training of personnel in how to handle such devices rather than the presumably "fail-safe" materials-intensive systems of an affluent disposable society. It is one way that the redundant waste of the First World comes to be recognized as the aberration, and not the more reasonable practices of the "ROW"—"Rest of the World."

Good-hearted people back home have sent out to the field long strips of wound-up rolls of woven material which serve as bandages, likewise recycled after cleaning. Disposable gauze, if available at all, should come from local sources of production, like the "mechanics' waste" once did for fluffy bulk dressings in First World settings. Since tape is a premium commodity, many of the dressings are tied in place by their own knots or strings are substituted, or may be used in the fashion of the ancient and venerable Scultetus binder.

OR Lighting

We have all done operations under hand-held battery-powered flashlights, if there is the luxury of someone nearby to hold it and knows the direction into which to shine the beam to illumine what we are trying to see. This is a problem that has made this effort much greater than the fleeting glimpses of what we wish to see and thereby block the flashlight holder out of the line of sight of what should be illumined. There has to be a better way. There is.

There are optical headlamps many of you may have used which are often custom-fitted with loupes and other means of "designs for vision." This is the right idea, but the cost of such a system is more than the capital and operating budget of at least one busy operating theatre I know that works very well on far less.

For any of you who may be mountain climbers, you may be familiar with the Petzel type of headlamps, worn during the early starts (usually at midnight) on summit assaults. These make for nearly perfect OR headlamps at a cost, that does not carry the huge liability surcharge that comes along with the indication "for medical use" stamped on other lamps—even though these may be every bit as much "life-saving." A very well-used model is seen worn by Dr. Laji Varghese in Lady Willingdon Hospital, Manali, India where he wears it through a typical 30-case theatre list.

For a more permanent overhead light there are also solutions that work—even in the absence of an electrical outlet. Solar panels are useful in collecting daylight (remember that an equatorial environment will have a "perpetual equinox" in which twelve hours of sunlight are expected with the minor exception of periods of heavy rain). This primary sunlight energy can be stored in large storage batteries. These are often available as donations or at reduced rates to maintain the "cold chain" for vaccine refrigerators from multilateral donor agencies. The output from such a storage battery can be hot-wired to an overhead lamp—usually the rectangular automobile sealed beam headlamps work best. This is a quite satisfactory "OR Light" with the possible exception that it gets quite hot burning brightly next to the surgeon's ear. A full day's solar power does not quite translate to a twelve hour running of the lamp, however, and the surgeon would use this resource sparingly during only some critical parts of the case. For example, one would not turn on the light for a skin incision, if there are many more cases to be done that day, but would certainly use it while dissecting the ureters free during a hysterectomy for a large fibroid uterus. Twelve hours of sunlight gives about four hours of appropriately used illumination, given the size storage batteries that can be carried to a field hospital and reconstituted with their dangerous load of acid.

Suction to Clear the Field

Hemostasis is a principle more completely developed by those who operate without the backup of a blood bank and the lack of such abundant means of clearing the dissection field with unlimited sponges, use of electrocautery and suction with irrigation.

The latter is possible using a mechanical foot-pumped suction device. It is awkward for the surgeon in some instances to be pumping the suction while attempting to see and control a source of deep bleeding, but the foot pump can also be pumped by an aid. It works—and just enough. Like most things that can be jury rigged in Third World settings, there is not a lot of redundancy, and waste—of material, effort, and time are minimized with a limited margin for error. These constraints

often perfect operating technique, since there are few safety nets of consultation or redundant systems of substitution for surgical skill.

For fixed suction devices, such as receptacles for chest tubes after tube thoraco stomy, nothing beats the simplicity and reliability of water seal drainage. A bottle (not necessarily medical) is half-filled with water and two glass or metal tubes are inserted through the stopper, one advanced to nearly the bottom (which is hooked to the patient's chest tube) and one to just a few centimeters under the water's surface (the one open to the atmosphere). The difference in depth between the submerged depths of the two tubes is the number of centimeters of "water seal" for the thoracostomy. This simple system works flawlessly—until and unless—the bottle is broken, kicked over, or the patient is moved, and someone tosses the bottle on its side in the litter to go with the patient.

The way I might handle this is to tell the patient, that he or she is the guardian of the bottle and it must stay in just this position, and demonstrate how it must be and how it must not. I then make sure that someone else in the family also knows, and they are delegated to take turns around the clock making sure that nothing disturbs the genie in the bottle. Thus involved in their own care on their own terms, the frequency of finding a bottle lying on its side in the patient's bed with the fluid drained into the patient's chest and a sucking sound coming from the fluttering end of the atmospheric tube is somewhat reduced.

Cautery and Hemostasis

Electrocautery is a nonstarter. The small hand-held, battery-powered "disposable" pencil cauteries have been quite helpful, especially since I have scavenged the once-used items from First World ORs and reused them until they were disposed of only when they ran out of energy completely. I have also carried the skin staplers that had only a few fired from the capacious clip in developed world ORs, and been able to reuse such a device on multiple patients. Since these "single-use devices" are designed to be disposable and would self-destruct if the manufacturer were told that they are being reused, they cannot be reloaded with new batteries or clips. So much the worse for the manufacturer's imagination, and the better for your own ingenuity in coaxing new life and multiple purposes out of the disposable world's products!

Suture ligature is more commonly employed than cautery (and certainly more than topical hemostatic agents—just not worth it) in the settings of the developing world. The best means for applying sutures is by means of a suture threaded through the eye of a permanent needle, or, particularly, the use of "French-eye" needles for rapid suture loading. Swaged-on needles are, by nature, disposable, and they are also limited in the utility they have for a given patient. They must all be imported as "luxury items". We have even resorted to smuggling by volunteer physicians since they have been taxed at a tariff higher than their already exorbitant purchase cost. In two possible areas—vascular suture (which is fortunately rare to nonexistent in the developing world anyway), and ophthalmology, I would prefer to stay with permanent needles (resharpened and "unbent" periodically) and save considerable money through the simple labor of threading needles.

Almost all physicians working in Third World settings know the tremendous advantages of monofilament fishing line as a very useful "general closure" nonabsorbable running suture for fascial closure. One hospital in Tanzania switched to monofilament fishing line from specially prepared monofilament suture, and by the end of the year had realized cost savings enough to purchase a Land Rover as a

hospital ambulance. The fishing line is calibrated to a certain test weight breaking strength and comes in 100 meter rolls at the same price as a single swaged-on suture!

Skin Graft Knives and Reusable Resharpenable Equipment

I have found in my own personal experience, with not atypical perversity, that I do not abuse equipment that I will have to live with, as I know there will be no replacements. I frequently pry and stress with disposable needles, bending or even snapping them in First World ORs since there will always be another handed to me to test again the tensile strength of man, memory and equipment. I do not break a "permanent" needle, since I know I cannot abuse it, since there will not be another to replace it—perhaps that is what makes it, as it is called, "permanent." I must respect its uses and limits and its finite life if abused. Most good equipment does not wear out in indicated use. Almost all such require maintenance, however, to keep them useful—in the case of such needles and the next item to be discussed—they need to be sharpened.

Skin grafting is a frequent operation in tropical settings, for resurfacing burns, scars, tropical ulcers and necrotizing infectious complications. Every general physician should have the capability of skin grafting as one of the half dozen operations that each should know and be able to do.

Padgett, or Brown dermatomes and the compressed air supply to run them are distinctly absent in developing world settings. The Humbie knife may be available, and is appropriate technology for most of such settings but most often the best way to take a split thickness graft is to learn the freehand Thiersch graft method. This can be done without special ordering any kind of dermatome. A large, long carbon-steel breadknife is the device that is most useful for harvesting a split graft, provided it is sharp. It can be sharpened the same way that the barber-surgeons would have advised earlier in our profession's history—a leather strop. With a knife thus sharpened and an assistant holding the skin taut, a thin flap of skin can be lifted with this reusable blade.

Once again, all reusables are safe if well-maintained, and if *scrupulous*, *compulsive attention* is invested in the training and monitoring of the cleaning and sterilizing of each piece of equipment before any reuse. This is an important feature of any training program, since ALL equipment, whether marked *permanent* or *disposable,* is sure to be reused until it falls apart our obligation is, therefore, to make sure that it is cleaned, maintained and sterilized appropriately before its next use. This process, in my opinion, though perpetual, is not as insurmountable as the continuous procuring of unaffordable supplies from insecure sources. This system of reuse works for a very simple reason— because it must.

IV Fluids and Blood

Even if I had blood available for my use in Central Africa, it is unlikely that I would choose to use it for a variety of reasons that hardly need be spelled out to anyone attuned to the frequency of transmissible lethal blood-borne diseases in this area of the world. I must make policy decisions on what kinds of operations can be done and on whom to do them based on the fact that there is no blood bank and on the assumption that, with few exceptions, there are no available "walking blood bank donors" within the family that are suitable. Even before the spread of HIV seropostivity, there was the simpler fact of the Robin Hood policy of taking blood from someone with a hematocrit in the twenties to give to some relative with a

hematocrit in the teens. Splenic contracture in hypovolemia often showers the bloodstream with the plasmodia that are tissue hypnozoites, so that post-transfusion fever was the rule rather than the exception. All such patients with a post-op fever got a fever work-up after anti-malarials were given.

What can be done in the absence of blood or as a substitute or expander for it? First, most rapidly bleeding patients are making available the product they need at the same rate they will be needing it, and it is guaranteed type-specific and compatible. For young women with ruptured ectopic pregnancy, we routinely scooped the large mass of blood from the abdominal cavity, and—clots and all—squeezed it through a muslin filter directly into an IV bottle for infusion. This autotransfusion process, nearly specific for ruptured ectopic pregnancies is applicable in some rare instances in trauma. For all others, a substitute or expander is sought.

Albumin is out of the question as are most plasma products as unaffordable, unobtainable and unstorable. There are a few commercially prepared expanders such as the starch mixtures that might give the colloid function, but at a cost not much different from the protein already ruled out. Some physicians working in jungle settings where coconuts were plentiful and extreme necessity was pushing them to any kind of help they could get have reported to me that they infused coconut milk as a one-time emergency in patients who at least seemed to suffer no untoward effects of the infusion.

But, for almost all other patients, and for all of them for starters, some form of "white blood" will be necessary. Lactated Ringer's solution is the nearly balanced salt solution that is going to be the most useful, but is a heavy, breakable commodity to be transported into remote settings with a limited shelf life. In many settings, the mission hospitals have made their own IV solutions. In some settings, the clear plastic bottles are simply set out in the sunshine as a radiant means of reducing the bacterial count in the fluids, and it seems to work. A very successful project pioneered at the Kilimanjaro Christian Hospital I visited in Moshe Tanzania has used the reverse osmosis process to produce over a million liters of low-cost IV solutions.

The spectacular success of ORT, Oral Rehydration Therapy, has been a cornerstone of the GOBI program for WHO primary care (Growth charting, Oral rehydration, Breast feeding, and Immunization—now in the EPI "Expanded Program of Immunization.) Oral rehydration works not only for infants with diarrhea, but also for adults some of whom may have surgical conditions. For those who cannot take in oral salt solutions manufactured on the spot (a liter bottle of water with one bottle cap of salt and two caps of sugar), the same or similar solution can be administered by proctoclysis or "rectal drip." The fluid is retained, even in some instances in diarrhea, and can even get additional medications administered through this mucosal route. Old, unsterile IV bottles can be reused, and no need exists for sterile IV tubing as in the case with any intravenous infusion. There is less worry in comparison with the patient's family who reports that the whole liter of IV fluid ran in to their 15 kg child over the last few minutes. Homemade solutions are the rule for proctoclysis. Intravenous solutions that are sterile are still needed for one more method of fluid administration, particularly useful in a child with no veins that are not collapsed—subcutaneous clysis or intraperitoneal fluid administration. Although limited in its utility and only for an emergency immediate start on rehydration, subcutaneous clysis requires hyaluronidase in the fluid solution to develop the subcutaneous capacitance for significant fluid administration.

Fiberoptic Scopes, Image Intensifiers and Video-Enhanced Endoscopy

No way.

What Tools Work Rather Well and Even Get Better with Repeated Use?

Eyes. Fingers, ears—and the acumen between them.

This is the golden opportunity for clinical skills to flourish. There are two reasons for this. Almost no one presents with early stage disease, and the classic full-blown textbook picture (almost exclusively reserved in historic textbooks in the western world now) surround the healthcare worker daily. Some diagnoses are so obvious that they are apparent at a glance, in a living museum of physical findings. Far from being a "no-brainer" in terms of diagnostic challenge, the typical patient might cause you to scramble for your camera to record your own atlas of advanced pathology. When two-thirds of the gut is in the scrotum, the diagnosis of hernia is not very difficult, but the concepts such a hernia may recall to mind include the "loss of domain" and concern that the patient might not be able to breathe with the diaphragm when such a hernia is reduced. Now is the time to reach back into the hard disc memory banks for the names of entities that are recognizable at an informed glance: "sabre shins," "Charcot joints", "Argylle-Robertson pupils", "mulberry incisors" were just names to be memorized for test-taking until I encountered them all in a single day in a Nigerian outpatient clinic. Here one will encounter the throwback to the prepharmaceutical era of "organizing pneumonia", measles pneumonia, post-meningitic deafness or blindness, and the classic signs of vitamin deficiencies and protein/calorie malnutrition. In a later chapter, the exotic diseases rarely encountered outside the tropics can be sampled. But here it should be pointed out that the clinician should know the standard diseases encountered in the western world, but here encountered in much later from as they have run most of the natural history of the disease by the time they are first seen by a western-trained physician.

That is also true for the clinical skills that are needed. There will not be as much need for some special stain or recognition of which kind of trypanosomiasis or schistosomiasis species is causing the disease, as the careful use of the clinical skills in physical examination already in the possession of most of the healthcare workers who will come to this introduction already equipped. Know the western disease patterns well and be prepared to be surprised on how amazingly obvious many of the problems are simply on the basis of their late presentation. Record keeping is minimal, but significant, with most clinics using the equivalent of a 3 by 5 card as the patient's "chart". The life expectancy of a paper record is not more than two rainy seasons, though, so for personal interest, I have always carried a hand held tape recorder and some small personal electronic record keeping system as well as photography and a notepad. Many times in clinic, the "history" is taken through translators, but often it is as unnecessary as the lifting of an involved extremity with a self evident problem.

And these clinical skills improve while on the field and do not have a tendency to break down. Furthermore, they are quite capable of being transmitted, and passing them along to others gives a multiplier effect. The most useful clinical tools in the field hospital are the same ones that are longest lived and regenerative, as skill is synergistically passed along and communicated—-in each direction.

Appropriate Technology

Appropriate technology is the kind that will be emphasized for remote field hospital use. I have stressed the simplicity and elegant sophistication of some forms of low technology, since it is the most easily maintained and most highly effective. But "appropriate" does not always mean "low-tech"; some very useful high tech machinery is very useful if it is hardy, reliable, and gets information that cannot otherwise be obtained without resort to fragile and fallible techniques. For example, a battery-operated portable ultrasound is a highly useful device, supplanting much X-ray and all scanning for practical purposes in the settings with which we are here concerned. Small plastic plates coated with immunofluorescent antibody are highly useful in making diagnoses. I had already discussed the high utility of solar panel electrical generation. A laptop computer is a great way of storing large amounts of information in a compact space without the perishability of paper records and can be recharged through solar panel or D/C adapter to a storage battery. The great utility of photography and a small tape recorder have made them essential parts of every one of my trips.

The kinds of technology that work best are any that can be produced or serviced locally with a minimum of moving parts to "go missing." The fewer embedded chips the better, since one small part that malfunctions makes for an immediate pile of expensive trash, and our purpose for being out in this environment is not the diversion to field strip and service First World machinery.

What do you need to practice medicine effectively in a Third World setting? Always more than you do know now, but that is true also for the First World, and the intensity of this learning experience is one of the greatest of yields from traveling abroad. But, a much higher yield can be expected in the management of patient problems, especially considering the lack of alternatives the patients generally face. If I do not fix someone's hernia in Washington DC, the patient looking for an operation will be seen minutes later by another surgeon, often by health management plans or other providers elbowing to the fore claiming they had seen him first. If a similar patient's problem is not fixed in the setting where there is a doctor/patient ratio of >1/250,000 this rare encounter may be this patient's only hope. It is hard to fail in primary treatment of obvious illness. This experience must be one of the most rewarding in medicine, if seconded only by the thrill of witnessing healthcare protégés carrying on the successful sustainable practice of medicine that has been passed along.

CHAPTER 6

To My Son, the Urologist

Douglas Walter Soderdahl and Douglas Wayne Soderdahl

6/20/99

Dear Doug,

Had an idea to bounce off you. What about making our chapter a dialogue in the form of letters between father and son? That is, since you have not gone on a short-term mission, but likely would want to consider doing so in the future, you would have a number of queries of 'experienced' me. And so, the format would be:

"Dear Dad,

As I sit here with the remote control in one hand and a beer (root, of course) in the other, I am thinking about helping out urologically in far-flung parts of God's green globe someday. Since you have 'been there, done that', I wonder if you could kindly answer some of the questions that arise when these thoughts come up. Like, what's it really like? What could I expect to do? Is traveling difficult? What about language? Tell me what operating rooms are like? Are there ***any*** *similarities to what we have in Urology here in the States and 'over there'?"*

I think you get the drift. The queries, literally, are endless. You would help me as someone who has not done this, and probably would have questions that I wouldn't even think would arise owing to the familiarity of experience, for the most part a pilgrimage of many trials and many errors. You would be the prototypical surgeon in practice Stateside. The thrust of the book is to inform and to challenge folks like you to consider volunteering overseas. Let me know what you think.

Love, Dad

6/29/99

Dad,

That sounds like an excellent idea. Just about everyone I speak with says that they would love to do something like that, but they just don't know where to start. I can think of numerous questions that can be addressed for the chapter.

- How do you set it up?
- What to bring?
- What to read?
- How do I deal with problems outside my specialty?
- Will industry support me with equipment? How do I get it?
- Are there any tricks performing urologic surgery with inadequate resources and support?

Surgery and Healing in the Developing World, edited by Glenn Geelhoed.

- What are priorities for the local doctors that I can focus on during a limited stay?
- Whom do I contact to find out about recommended immunizations and prophylaxis?
- How do I deal with the language barriers?
- What do I need to do before arriving "in-country"?
- How can I leave a busy practice?
- What will I get out of it?
- How do I arrange follow-up for cases I do?
- What about malpractice insurance coverage and lawsuits?

I think this format will be a great way to convey the message that this type of undertaking is both possible and that it is highly rewarding.

Love, Doug

6

And so begins the collaborative effort on this chapter between father and son, both Board-certified Urologists. I, the senior, await the day my son can join me on a medical mission, for I know full well the value of exposure to the vagaries of medicine in developing nations. Thirty-five years ago I experienced a "reorientation of life" perspective and goals after a three-month term of service in Swaziland. Other mission sites over the years included New Guinea, India, Indonesia, the Ukraine, several island-nations of Micronesia, Bangladesh, Kenya, Gabon, Cameroon, Mongolia and the People's Republic of China. Tours have varied from two weeks to six months. Each in its unique way has reinforced the desire to share resources and expertise with those far, far less fortunate than we in the West.

At home, most American doctors would never think of working in places where vermin scurry about the operating room floor, supplies are so short that bloody gloves are washed, sterilized and reused until they break, and gratitude comes in smiles, tears of joy and occasional gifts from the village. But, oddly, in my experience the volunteers who labor under such daunting circumstances usually can't wait to repeat the effort. Simply, it seems that taking *your* two-week vacation, covering expenses out-of-pocket, and enduring formidable hardship make a significant difference, certainly for the recipients of your largesse, but also in your life. My barber calls it 'paying your dues', which reasonably well summarizes the whole undertaking. Gone are the onerous burdens imposed by a healthcare bureaucracy run amok. An American colleague says, "The most difficult thing about surgery is getting to do it!" Further, he observes, "Fully ninety percent of the world's surgical needs are outside of the U.S.A. and Europe." Welcome to medicine in its purest form.

Colleagues' reactions to my accounts of these missions include keen interest, surprise that such medical practice differences exist in the day of 'a global village', a polite hearing, an indifference to investment of self apart from a carefully-circumscribed agenda and a vague desire to 'just do it' without a clue respecting virtually any of the logistics of such an undertaking. "Wow!" "Unbelievable!" "Tell me more!" "How can it be?" "Oh, I'm so glad that you enjoyed yourself. It's good to help people so incredibly needy." "I wish that I could do that, but you know well enough how busy I am, how great the cost would be, how it would disrupt my family's life, how unprepared I am for the rigors of practice away from the familiar and routine." "I share your burden for the underserved in the developing/re-developing (e.g., the Ukraine) nations of the world, and I believe I'd like to help. Will you answer my questions?" Bottom line? Most physicians don't make it to volunteering, not because of lack of desire, but because they are bogged down in the myriad of details to make it happen.

Doug: **What is it like to work in the Third (even Fourth) World?**

Dad:

If a phrase can capture the difference between the technological marvels of modern medicine and what one finds in a Third World context, it's 'adjustment to lack', virtually any lack one can imagine. Lack of an adequate operating room, functioning equipment, pharmaceuticals and supplies, physician personnel, trained support staff, physical safety, a reliable power supply, potable water, laboratory/X-ray support, translators, anesthesia capability, diligent postoperative care, facility organization and management typify to varying degrees my experience. Poverty, malnutrition, high prevalence of HIV infection (exceeding 50% in some areas), whimsical government bureaucracies and late presentation of patients (often for economic reasons) can frustrate even the most heroic attempts to deliver quality care. Obstetric complications and trauma account for most surgical emergencies. For the urologist prostatic obstruction, urethral strictures, stones and vesicovaginal fistulae comprise the bulk of problems encountered. The emigration of trained national surgeons and collapse of national healthcare systems stress to a critical level some countries' health and well-being. In some instances a shocking greed, corruption and callousness at all levels of government sap the tenuous attempts to deliver medical care to individuals ravaged by socioeconomic chaos and physical disease.

Unquestionably, the medical mission scene is changing. With political independence many Third World governments aspired to some form of Western style of healthcare delivery. Under national pressure, missions handed over hospitals and clinics to national leaders, who shortly discovered that operating these institutions was beyond their resources. Presently in place in many instances is an 'on-again, off-again' relationship between government, missions and non-governmental organizations. Indefinite funding, "the West reaching out to the rest", however, is problematic. Moreover, money and other resources can be a source of tension. A Westerner suggesting a low tech or low cost solution may sometimes be accused of seeking to deprive Third World people of the best, which they surely are entitled to receive. A "cargo cult" mentality fluorishes in this setting.

Doug: **How did your interest in short-term volunteer medical missions evolve?**

Dad:

In 1965 Mom, a Registered Nurse, and I received a Smith Kline & French scholarship to serve three months in Swaziland, Africa. Even though assigned to anesthesia and dental duties on that mission, breaking free to scrub in surgery as often as possible, our eyes were opened and hearts burdened to minister to the medically desperate overseas. We devoted six months in 1969 to work in Papua-New Guinea, I functioning as sole general surgeon in a 400-bed acute care facility. For over a decade with the U.S. Army medical corps in Honolulu, as a urologist I led many humanitarian missions with residents and ancillary personnel throughout Micronesia. Then, in civilian practice in Honolulu, Mom, now a urology nurse, and I performed occasional missions overseas. But, the time to which we had looked forward (i.e., family launched, 'empty nest', 'mid-life crisis' — call it what you wish.) came in early 1995, when I retired from active Stateside practice to pursue medical missions in developing nations much of the time. In view of our experience in Swaziland over thirty years ago, we encourage and support as we are able those early in their medical careers to work overseas. Lives may be changed, as ours were.

Figure 1. The expatriate surgeon's credo: "Have text, will operate".

Doug: **What is a medical mission?**

Dad:

A medical mission, for my purposes, describes a term of work in medicine/surgery in a Third World context. It may take various forms, and on this point it is most helpful to define one's objective. Is the desire to cover a practice for a time? Is it to teach? Is it to lecture at conferences? Is it to assist with resident training programs for nationals? Is it to meet an urgent need, as recently occurred in the Balkans?

My objective has been to train general surgeons to perform urologic procedures appropriate to their situation. Of obvious and great benefit, Mom concomitantly teaches urologic nursing skills to the operating room, ward and outpatient personnel. Additionally, I participate eagerly in didactic teaching programs for all healthcare workers. For instance, it has been my privilege to serve on the faculty of the annual Christian Medical & Dental Society's (CMDS) Continuing Medical Education Conference, one year in Kenya, the next in Malaysia.

Further, I have worked with the fledgling Pan-African College of Christian Surgeons (PACCS), as it seeks to legitimize and create standards of performance for national residency programs throughout Africa. I fully agree with its overseers that the window of opportunity to participate in the training of national surgeons on that continent appears quite short. Sadly, medical graduates in Third World nations often are encouraged to travel to the West for higher qualifications at considerable cost. But the experience gained abroad is often of little relevance to and impractical

for the needs back home. Of course, the solution lies in local and regional efforts like those of the PACCS.

CMDS provides another avenue of service through its Commission of International Medical Educational Affairs (COIMEA), in which teams of specialists journey as invited guests to serve in medical schools and training institutions overseas for the purpose of education and relationship building. My terms in Mongolia and the People's Republic of China came about under COIMEA's aegis. Finally, an increasing number of American medical students and residents seek exposure to frontier medical practice, such that I envision serving as preceptor to these trainees on future missions.

Doug: **Can you flesh out a 'typical' mission for me?**

Dad:

During particularly interesting and fruitful times of growth, I journal. In answer to your query I share a small portion of my journal from Bangladesh in 1997.

'KIDNEY OF THE HIMALAYAS'... A JOURNAL

6/15: Arrived in Dhaka at midday; heat and humidity oppressive, people everywhere. The crush of the crowd, the filth, the beggars, the admix of odors make progress a bit arduous. Being Sunday in a Muslim country, it is a regular work day. I am thankful to be provided a driver to negotiate the congestion of vehicles, pedestrians and animals, where the largest vehicle has the right-of-way and the horn is as essential as the steering column.

6/16: It's off to Memorial Christian Hospital, 65 miles to the south of Chittagong, into arguably the most impoverished area of all of Bangladesh. I am impressed by an extremely labor-intensive effort to build, and repair, the road. Because little rock is available, workers manufacture bricks, which are then shivered by hand (hammered) at the roadside, to be used to support the overlying macadam. Indeed, labor IS cheap. No light or toilet paper in the unisex bathroom at the only gas station along the way. Reeking urine and feces guide me to the hole in the ground. Would have preferred the great outdoors, but then, in Bangladesh one is ***never*** *not being watched.*

The mission compound, located on the old Burma Road of World War II fame, perches atop a rise overlooking an alluvial plain extending out a bit over 10 miles into the Bay of Bengal. Quarters are comfortable and very affordable, but do note that if one wishes air conditioning in addition to the ceiling fan there is a small extra charge. Our bearer tends solicitously to our daily needs. Curiously, Bengali (local) cuisine is not normally prepared in the common dining area. Emphasis is upon fruit, vegetables, rice and a potpourri of beef, mutton, chicken and fish. Quickly I notice that the fare reappears at the table until either it is eaten or it spoils. The grounds are lush and carefully landscaped. Moss-covered paved-brick pathways can be a bit treacherous, especially now in the monsoon season, when it rains steadily from June to September.

The hospital, just inside the gate, has 55 beds, but since it serves a population of nearly 12 million, in actuality it functions much like a 150-bed MASH unit. Its career expatriate staff, 2 physicians and 5 nurses, aided by wonderful national workers, each day treat hundreds who make it past the triage medic at the gate. The facility, in an advanced state of disrepair, has open male and female wards, two operating rooms, a labor/delivery/postpartum area and a bustling outpatient

department. Insofar as possible, in deference to the culture, sexes are strictly separated. Most of the common textbooks, but not journals, are available. Only a couple nursing stations have sinks, above which hang wet cloth towels "to dry one's hands" (preferable to drip dry, it would seem). Monitors, as we think of them, do not exist, nor is there a ventilator in the hospital ... not even in the OR! A brace and limb shop, reputed to be the best around, fashions prostheses which look amazingly authentic.

Oriented to the customs and mores ... never do anything with the left hand; do not wear shorts; do not display affection in public; don't drink unboiled water; don't buy watermelon along the road ... it's injected with nonpotable water to increase weight. The work week is Saturday through Wednesday; 'church day' (day of worship) is Thursday for us, Friday for Muslims.

6/17: Rounds with staff at 0830 hours. Nurses, having considerable autonomy and authority as a result of keen clinical expertise and physician staff shortage, round first, provide necessary care and chart. Medics complete all history/physical records. Most impressive protocols have been developed, with 'routines' for just about everything encountered regularly (i.e., prepartum, postpartum, malaria, typhoid, etc.). We identify patients by bed number. The women's ward is much busier, owing to the large volume of complicated obstetrics. The large majority of routine deliveries occur in the village. Hepatitis B positivity runs about 25%. Village practitioners, qualified or not, love to administer injections, of course with used (not necessarily sterile) needles. Most patients are tested upon admission for HBV and HIV (not common yet), and if positive, flagged at the bedside by a prominent poster. We double-glove, naturally with recycled gloves, routinely. Only polio and diphtheria cases are isolated. The deadly falciparum malaria predominates in this region. Measles, malaria, malnutrition, pneumonia and diarrheal diseases constitute the major killers. Mattresses are made of coconut husks, rubberized and covered with a plastic for easier cleansing.

Saw a woman come in labor, prolonged and septic as a result of 'stick abortion', a form of partial birth abortion in which a green stick is poked vigorously into the head of the term fetus. Islamic faith teaches that abortion is sin. Yet, if prenatal ultrasound, available in the village but not in the hospital, documents a female fetus, abortion is justified as 'menstrual regulation'. Come to think of it, hypocrisy exists here just like back home!

We work in not only the poorest district in Bangladesh, but also the least literate (20% for male, less than 10% for female). Suicide is common, customarily by 'rice poison'. Opium use is increasing. Virtually all men smoke. Nobody is covered by health insurance. When a patient does not pay, a 'relief committee' comprised of a Hindu, Moslem and Christian (all nationals) meets to arrive at a fair settlement. Sometimes a 'broker' represents the family's case, for a fee of course. A hospital bed costs $1.25 per day, with medications and food additional.

With Tibet just 20 miles to the east of the compound, the ethnic, linguistic, cultural and religious admix is most complex and confounding. Here, in Bangladesh, the Indo-European and Tibeto-Chinese persuasions collide. Religious faiths include Islam, Buddhism, Hinduism and Christianity, but at a practical level most are animists or spiritists. That is, a great deal of energy is expended to placate the unseen, but exceedingly powerful, world. In the surrounding community, largely Muslim, rumors abound: 'Christians are evil.' 'The hospital gives Christians good medicine, but gives Muslims bad medicine.' 'The shots given

Figure 2. Surgeon's face mask doubles as a scrotal supporter.

inject a foreign religion.' The early single female missionaries were considered either lesbians or concubines, both designations, of course, highly repugnant to a Muslim's strict code of ethical behavior. A convert to Christianity pays a high cost ... rejection by family, ostracism by society, failure in business, and in some cases torture and even martyrdom. As a result there likely exists a sizable number of 'secret' Christians. Hmmmm ... not much different in the West, is it?

6/19: A running tab is part of the patient record. i.e., Is the patient/family paying or not? Saw a young male with malaria, worms, typhoid AND severe protein-calorie malnutrition! But what is his 'chief complaint?' Typhoid, not syphilis or AIDS, is the great mimic ... cerebral, abdominal and joint manifestations. Rickets is common, yet the government does not permit vitamin D and/or calcium preparations into the country for fear that foreigners would 'dump' inferior, useless and possibly dangerous drugs upon the populace. (Opium and marijuana can be purchased by anyone at virtually any shop in the villages surrounding our compound.)

The hospital's powerful contribution in the area permits remarkably aggressive and creative evangelism ... church planting, Bible schooling, translation work, hospital chaplaincy. Heart House provides accommodation and training for widows and handicapped men, truly the down and out in this society. Religious videotapes are shown daily on the wards, but since open broadcast would be considered indiscreet, and even rude, patients must request a 'pillow speaker' for private listening. Career missionaries say that more people are converted through the hospital's outreach than through all other evangelistic efforts combined. Around the world we see the disappearance of the career missionary physician and closure of mission hospitals. Because the future of expatriate missions in Bangladesh is uncertain at best, vigorous efforts are made to indigenize local congregations with the mission acting as partner, no longer as paternal benefactor.

6/22: I move into the full swing of hospital activities, including primary night call and the onslaught of exotic diseases in the outpatient department. Though there certainly is plenty of urologic pathology in the cachement area of 12 million, I do whatever needs to be done. Of course, the career staff and Bengali workers,

highly skilled and experienced, solicitously guide me as I steady my 'sea legs'. What a pleasure to assist a wonderful 'surgical assistant' with a 10th-grade education in the performance of complicated cleft lip/palate repairs and other remarkable reconstructive operations. He learned over a couple decades by watching career and short-term surgeons, as myself. Truly, we teach each other.

I cystoscope, using the laparoscope's camera/monitor for all to watch attentively, an elderly man with advanced bladder malignancy. Sadly, we have nothing appropriate to offer. How frustrating it is that patients present only as a last resort, having already tried home remedies, spiritual exercises, the village chemist's recommendations, the local medico's (sometimes even self-designated as 'quack doctors'!) prescriptions, etc. And, since women in this culture cannot consent to medical care, even for themselves, a family council often must be convened before approval is granted to present to the hospital. As a result, we walk in a 'valley of death', not in a 'valley of the ***shadow*** *of death'. And so much suffering preventable and/or treatable!*

I lunch with a man from Dhaka, who provides some shocking statistics: population of Bangladesh 120 million; annual growth rate over 2%; life expectancy 52 years; 1 doctor for each 6,000 people; 21 urologists in the entire country; 12,000 individuals for each hospital bed; 60% of the population homeless; 33% living in abject poverty; average caloric intake 1,250 cal/day.

6/23: Three deaths last night—a young lad who aspirated, a young woman with uterine rupture and a dead baby (4 days' labor, transverse lie) delivered by C-section. My surgical assistant tells me of his arranged marriage, the norm, and of how his wife 'does a good job', as though marriage is a business. He wishes for one of his 2 children, the boy of course, to attend medical school, but fees are beyond reach for all but the privileged few. Girls quit school after 6th grade, get married, bear children, toil at home, die. In the marketplace one sees only an occasional female, usually a widow without someone to shop on her behalf, or a prepubertal girl.

6/24: I perform my first spinal anesthetic in over 3 decades ... successfully! A lad with pseudovaginal perineal hypospadias appears in the clinic, and the medic tells me he knows of two others from the same village! Even though Bangladesh's life may be defined by waters tumbling from the 'rooftop of the world', the Himalayas, earning it the moniker 'kidney of the Himalayas', urinary stone disease is common. Lacking state-of-the art equipment, I train the general surgeon and assistants to 'cut for stone'.

6/25: I am invited out for dinner to the home of a wealthy man in a nearby village to celebrate the first birthday of his granddaughter. A wonderful feast for the stomach, as well as for the eyes. We eat with the right hand without any utensils whatsover, a hand cleansed intermittently in a basin delivered by the bearer of the home. A proper host never eats with his guests, but stands by to ensure that all is well for the honorees. Owing to a staggeringly high infant mortality, in some places babies are not even given an official name until age 1 or 2 years. Bengali men wear the punjabi shirt and lungi (like a lava lava) and women the sari (pronounced 'sharee' in Bangladesh).

6/26: Worship at the Bengali church, a 2-mile walk across the road. En route pass through a Christian development, settled mostly by Christian staff at the hospital. Muslims and Christians in the same village mingle to a significant degree only at the bazar or market. We also pass a blue and white mosque, adjacent to a murky pool of water, where the faithful bathe for ceremonial cleansing, often 5 or more times each day! Church is a cinderblock building with bright green or

Figure 3. A 650-pound surgical equipment/supply cargo stresses the bush plane and pilot.

red wooden louvers. Shoes/sandals are deposited at the door. We sit on the cement floor, women and children on the left, men on the right. Worship team leads with 3 varieties of drum and a harmonium (with imagination looks like an accordion on its left side). Hymnody is national, without tune, tone or rhythm ... like a chant ... sliding (gliding?) from note to note. NO air-conditioning, NO fans, NO breeze, an aching back.

With obvious pride a hospital employee shows me his 'clinic' in the bazar ... a shop with shelves and shelves of medicaments, where he works off-hours to supplement his meager income from the hospital. To be sure, the potential for abuse (self-referral, etc.) exists, but the matter is not an item of great concern, since the hospital can handle only a portion of those who come for care each day anyway.

The sights, sounds and smells of the bazar assault the senses: children playing in the filth of the sewage ditch; buses packed, inside and on the roof, beyond belief; 'restaurants' which redefine 'dirty spoon'; labs and X-ray facilities tucked here and there among the shops; an elderly woman homeopath cutting cocaine for eager consumers (The 'golden triangle' is not far away.); the betel nut/lime mix; ranitidine for 4 cents a pill; the 'bottled water' recycled; the barber shops' razors spreading HBV.

Heard of a 10 year-old girl raped by her uncle, admitted with torn vaginal vault and acute abdomen. Child abuse is high here, but the figures are soft. Further, it's unlikely that any action would be taken against the uncle, since he is a relative and any female within the extended family is fair game for any male urges.

The World Health Organization reports that of the professional blood donors in Dhaka two-thirds are commercial sex workers and half are intravenous drug abusers. Further, most hospitals in the country do not test blood prior to transfusion. We generally obtain blood from a family member.

Two patients presented simultaneously to the receiving area ... one a young man with blunt abdominal trauma, the other a young girl after undergoing a 'stick abortion'. Both required urgent surgical intervention, but facility limitations did not permit concurrent procedures. It seemed that a moral/ethical dimen-

sion should tip the decision in favor of the man. An attempt had been made to take an innocent life. The man's bowel perforation was quickly repaired. Then, when we returned to the surgical prep area, on the gurney beside the woman was a robust baby girl, and beside her a green stick with a string wound around for easy retrieval after the attempted abortion! Turned out, too, that the young lady had been married only 7 months with a full-term pregnancy, and further, there was a question of paternity.

Because modern drugs are too expensive, irregular and uncertain in supply, and possibly ineffective owing to microbial resistance, many patients favor traditional remedies. Indeed, different levels of ability to pay lead to different levels of quality of care. Traditional medical practices no doubt can be effective. Cultural relativism maintains that notions of healing should be interpreted within the particular world-view of the patient and his or her cultural group. Like their patients, traditional healers do not necessarily distinguish between subjective and objective symptoms, curing and caring, or measurable and immeasurable clinical data. They seem to focus upon relieving suffering, controlling symptoms, and restoring physical function as well as social and psychological well-being. My experience supports the idea that it is possible to combine the best of biomedical and traditional health practices so that a genuinely sustainable pattern of healthcare can develop, something unanticipated by health planners even a decade ago.

6/29: Noticed today that none of the patients, including babies, wears an ID bracelet. One incubator contained two unrelated female newborns. Has there ever been a mix-up? Who would ever know and/or care? An adoption would be no problem here, since one could simply walk out of the hospital with a baby of his or her choice (a male, of course). In OPD had patients named 'Muhammad Ali' and 'Taj Mahal'! A young man with a longstanding indwelling suprapubic tube for traumatic prostatomembranous urethral disruption declined definitive repair. Another man, 60 years of age, with dramatic rectal prolapse and BPH postponed surgical correction, preferring to suffer a while longer.

7/1: I'm on first call tonight. Received a call from an experienced Bengali nurse, who asked what I would recommend for a 3 year-old male (9 Kg) with acute onset of dyspnea without fever, cough or any other symptom. Having focused only on Urology for 3 decades, I volleyed back, 'What would you customarily do in such a case?' She replied with a number of suggestions. Of course, I eagerly endorsed her advice. A bit humorous, what with the formality and redundancy involving me in part of the care loop, but then I AM a full-fledged member of the team, a bit stretched out of my comfort zone, but exhilarated, too.

7/4: Independence Day in America, 3 days ago for Canada. Have been thinking about what changes Bangladesh really needs. The liberals wish to change the structure, but in my view will not succeed in what appears for all the world to be a fixed, closed system. The atomic approach, that is, ***one by one****, seems much more reasonable and effective, although undoubtedly slower. Ironic that her critics had been critical of the late Mother Teresa for her avoiding the massive, the impressive, the monumental, while tending to the hurting* ***one by one****. Surely something good, I think.*

7/6: As I returned from an early morning jog, I noted not only the milling of hundreds of hopeful patients awaiting the triage medic at the gate, but also a Muslim cleric conducting a prayer chant. In an area of incredible spiritual admix invisible battles abound.

Figure 4. Preoperative prayer ensures God's Hand on mine intraoperative.

7/8: Read in an English-language newspaper from Dhaka, Bangladesh's capitol, trade in human kidneys is thriving at the cost of some poor people, who are selling parts of themselves in order to earn money. Buyers of these kidneys turn to Bangladesh increasingly, because traffic in human parts is banned in most developed countries. Children, reports have it, are being kidnapped and killed for their organs, which can be sold in the international market at a high price. How shocking it is that such a practice might be occurring, but even more appalling to me is that the 'medical profession' participates in such a sordid scheme.

7/9: A dead baby found in a box in a hallway of one of the hospital's corridors. Such a shock and frustration that life seems so cheap here.

7/10: Got a great photo today in the OR ... the anesthetist sitting at the head of the patient with a fly swatter. A 'no fly zone', indeed! A 6-foot banded kreit, the '2-step snake', caught and killed near the surgeon's home tonight. The bitten victim takes 2 steps, then dies, they tell me. A young lady found a sizable frog in her toilet this morning, reminding one of the old timers of the day a cobra had come up through the toilet! He went on to comment, 'No problem until you sit down'! On-call surgeon awakened at 3 a.m. today. 'Patient in bed 13 is dead.' He went over to the hospital to check, because some of the nationals have difficulty reading blood pressures below 90 systolic! (Patient had died.) Serious rain now for nearly 24 hours. Have heard by word of mouth that the ***only*** *road north to Chittagong, 65 miles away, is flooding and in stretches washing into the Bay of Bengal. Submerged power lines endanger hospital functions, since generator fuel, trucked in from the north, has dropped to critical levels. Homes have disappeared under water and Bengalis have been swept to certain death in the Bay by surging currents. The experienced advise those needing to depart to make a break for it Saturday morning.*

7/12: We six (five men, one woman) in the Bronco, including two coolies to assist with our baggage, pray twice as we depart ... once in English, once in Bengali. Our driver remarks that Bangladesh is not really the 'kidney of the Himalayas', but the bladder. True enough.

Having progressed successfully about 10 miles, we reach a new, swiftly-moving river across the road. Our driver negotiates our way to get onto a large open lorry. Quickly, bags are transferred, good-byes are said, and we clamber aboard this 2-3 ton behemoth, whose driver was surely risking a cruise into the Bay with the vehicle and its precious cargo. However, the passage through 100 yards of invisible road was successful. We disembarked onto a waiting bus, on which we purchased a seventh seat for our bags, since we wanted them neither waterlogged in nor stolen from the baggage compartment. Interesting bus ... ancient, broken seats and windows, without air conditioning (temperature above 90 degrees, windows closed because of the heavy rain), without wiper blades, the floor dappled with spit (betel nut) and other body fluids. Interesting ride ... most everybody smoking, a disgusting blend of body odors, only one other female on board, a Muslim in traditional borka covering all but her eyes. The bus slowed, then stopped in a tiny village, where a snarl of trucks, buses, rickshaws, cattle, pedestrians precluded further passage. But, now about half-way in our journey, we definitely were committed.

We threaded our way through the jam in knee-deep water, each carrying a bag, for about a mile. Cycle-rickshaws, now on visible pavement, were eager to transport us the next leg. We passed villages under water, vehicles tipped over the edge of a road with NO shoulder. The locals were losing their crops (rice drowns), their homes, their businesses, and in some cases, their lives. After approximately 8 miles the road vanishes under water. We notice a line of Bengalis trudging single-file, bags atop their heads, through neck-deep water to the next land mass at least 2 miles distant. Several hundred Bengalis anxiously mill around this point of impasse, when a lone dugout canoe, powered by thrusts of a bamboo pole, appears. Upon landing, passengers quickly jump out. From out of the chaos and cacophony of a panicked crowd, presumably many of whom wished to embark the canoe for transit to the other side, appears a ***very tall****, distinguished Bengali man, taller than any local I had seen in my mission term. He speaks imperiously to the canoe's captain. A sea of heads turns in our direction. Before we had time to think of what being marooned in a remote, flooding Bangladeshi village might entail, we are hustled into the canoe. About 15 frantic Bengalis clamber aboard from the other side. As we move out from shore, I turn to salute in gratitude the man (an angel?), who had arranged this miracle, but despite his prominence he was not to be seen. Since the canoe's bow features a one-foot diameter hole, we all huddle in its stern. Baling, stabbing the bamboo pole into dying rice paddies, but mostly praying, we land safely nearly 2 hours later. A van takes us the final leg to the doorstep of the mission's guest house, over 7 hours and 65 miles from Memorial Christian Hospital!*

Having recounted the suspenseful exit from Bangladesh in some detail, I must say that within I experienced a strong surge of ambivalence as I departed a land in such desperate need for America, truly the land of plenty. Certainly, I contributed medical expertise and training. Lives were saved, yet so many were lost tragically to trauma, malaria, advanced malignancy, complications of pregnancy ... all against the backdrop of profound protein-calorie malnutrition, high suspicion of a Christian hospital's work in a Muslim country and an impoverished government's inability and/or unwillingness to provide even the rudiments of political stability and infrastructure. In my view, most heartbreaking of all, though, is the harsh reality of an unknowing and uncaring world marching lockstep into the marvels of 21st century technology."

Figure 5. Solar radiation reduces bacterial content of water. (Conroy RM et al. Lancet 1996; 348:1695-97).

Doug: **When would be a good time to work overseas?**

Dad:

Without hesitation I advise as soon as it is feasible for you to do so. Pertinent considerations include: flexibility to leave practice for a time, family contingencies and support, financial preparedness, length of term and lead time.

It is most likely prudent to start with a shorter commitment, perhaps two to four weeks. Remember to count the *total cost* (lost income, ongoing overhead expenses), not just air fare and room and board on site. If at all possible, travel with colleagues for an initial term or two. Short-termers may not be accorded as enthusiastic a welcome and even the needful guidance they had anticipated.

Doug: **Where can I work?**

Dad:

I would presume that all developing nations probably need your services. As they say, 'restrictions do apply', however, mostly owing to political considerations. Again, the location will vary according to one's objective (cover, train, administrate, lecture, etc.), time availability, preference for climate, second language skills, specialty, living situation, health and tolerance for stress in professional challenges. Because surgical practice challenges alone are substantial, even intimidating, I recommend that every other dimension in the mix of the mission be as user-friendly as possible.

Doug: **How can I arrange a surgical mission?**

Dad:

Resources to contact for potential missions include your specialty societies (in Urology, the American Urological Association, Societe' Internationale' D'Urologie and International Volunteers in Urology, for instance), the American College of Surgeons, the American Medical Association, the International College of Surgeons, the Christian Medical & Dental Society, church and humanitarian aid organizations. For instance, International Volunteers in Urology performs a strategic func-

tion in alerting potential volunteers to opportunities abroad, and also recently is coordinating donations of equipment and supplies. Much of medical mission work in developing nations is sectarian. Financial support may be available from such a group, humanitarian aid groups (e.g., Rotary Club), medical center grants, national government contracts (generally to work at indigenous facilities only) and from family and friends. For the past five years support for our projects has derived from donations to our account with The World Medical Mission (medical arm of Samaritan's Purse), although I fulfilled one government contract (Marshall Islands).

I acknowledge the helpful and gracious support of CIRCON/ACMI and Valley Lab/U.S. Surgical, both companies having consistently supplied loaner equipment for the training missions we conduct. A number of suppliers and hospitals have donated a large variety of items, *most* useful in the Third World, where rubber gloves may double as Penrose drains, surgical masks as perineal supporters and fishing line as suture. If you are unable at this time to consider a volunteer medical mission, I urge you to help those who go by donating medicines, sutures and other appropriate supplies from your office, clinic and/or hospital(s).

Planning well, even six to twelve months prior to a mission term, is critical. One cannot ask too many questions in order to match your expectations and needs with those at the point of service. My friend, Dr. Louis Carter, plastic surgeon from Chattanooga, TN and veteran in short-term mission work, has thoughtfully passed on to me a list of questions to ask, which I have adapted below.

Travel:

- What type of visa do I need?
- Where is the closest international airport?
- What airline(s) serve(s) the country best?
- Will someone meet me at the airport?
- Where will I stay the first night in-country?
- Will the hospital assist in local transportation?
- How should I label containers of medical equipment, and what should I say if questioned by customs officials?
- How many bags am I permitted? What are size and weight limitations?
- Will my sponsor provide a letter stating the nature of the mission for both the airline carrier and customs agents?
- Who arranges local/regional travel?

Medical practice:

- Will I require a medical or dental license?
- Will I require malpractice insurance?
- Will I require a work permit?

Living conditions:

- Will I stay in a guest house, an empty home or with a career worker?
- Will there be suitable accommodations for my wife and children?
- Will my/our meals be prepared by somebody?
- Is household help available? What is the cost?
- Do I need to bring food?
- What is the electrical supply, 110V or 220V? Is it reliable?
- Is it possible to borrow a step-down transformer?
- Do I need an uninterrupted power supply/outlet adapters?
- Who does my wash?

Figure 6. Overcrowded ward spills into hallway.

- What is the cost, if any, for room and board?
- Will I have access to e-mail? the Internet?
- Am I permitted to bring a satellite phone into the country?

Hospital:

- What individuals comprise the hospital staff?
- How many beds/patients? operating rooms? (Two patients per bed happens not to be unusual.)
- What are anesthesia capabilities? Are pulse oximeters available?
- Where and how are immediately postoperative patients monitored?
- Does the hospital have a back-up generator?
- Should I bring my own scrub uniforms?
- Is there a blood bank or transfusion capability?
- What tests does the laboratory perform?
- Can radiology provide the X-rays I need?
- What drugs typically appear in the formulary?
- Are translators readily available?
- Are there equipment and/or supplies I need to bring? (Do NOT assume the presence of materials critical to the satisfactory performance of your surgery. The urologist needs to inquire about suture, a chip evacuator, commonly available medications, JJ stents, grasping forceps, lubricating jelly, sterilization technique for endoscopes, availability of water for irrigation, irrigation tubing and specifications of the electrosurgical unit. On one compound we irrigated with filtered and boiled river water, sterilized scopes in a dilute iodine solution and kept a wary eye on a power source with wildly fluctuating current.)
- Are needles/syringes reused?
- Is it possible for the career surgeon(s) to make space on the operating schedule for the visiting surgeon?
- For teaching, is a slide/overhead projector available?

- What format does the hospital's VCR use? (NTSC, PAL, etc.)
- Does the center have a television, or better yet, a monitor for demonstrating endoscopic surgery?

General:

- Will I need special travel, health, accident or emergency evacuation insurance? (Check with personal insurer as well.)
- Will I require vaccinations?
- Will I require malarial prophylaxis?
- Will my wife also be able to work? Are there specific requirements for her to fulfill?
- How much money should I bring and in what form?
- What are contact numbers for emergencies? (telephone, fax, e-mail)
- What is the best time of the year to visit?
- Is the country politically stable?
- What is recommended reading to prepare for this cross-cultural experience?

Caveats:

- Assume nothing.
- Expect nothing.
- Be as self-contained as possible. (scopes and accessories, catheters, sutures, camera with monitor adapter, specialized or favorite instruments)
- Learn as precisely as you can what is expected of you. (lecture topics, case load, "problem cases", role in the operating room)
- Adapt to the hospital's routine with the exception of compromise of quality of patient care, and even then only after open discussion with appropriate colleagues and/or authorities.

Doug: **What tips do you offer the neophyte?**

Dad:

- Allow plenty of time in advance of the trip for set-up and planning.
- Locate an on-site point-of-contact to assist with logistics.
- Pay your way. Fiscal solvency in developing nations is an oxymoron.
- Bring ample personal medications and sundry needs.
- Be flexible. Be patient. EXPECT the unexpected!
- Debrief daily in order to draw maximum impact out of each person's experiences each and every day.
- Refrain from criticism and complaining. New, short-term workers should understand that it takes at least one year to understand the reasons that career personnel do things the ways they do. You are a *guest*.
- Be teachable. Your teacher may be a national with a tenth grade education, but superbly adept in surgical skills, or a nonphysician healthcare worker with a wealth of experience in tropical medicine.
- Ask your hosts about cultural do's and don't's. Gift-giving not infrequently generates awkward moments.
- Learn at least some of the national language.
- Eat local cuisine.
- Serve hard. Serve hard! Serve hard!!

Figure 7. Fifty million left homeless in Bangladesh' worst flood of the century.

- Cultivate a sense of humor.
- Stay on focus. Review your trip objectives (You do have them, right?) often to make certain you remain on track.
- 'Walk softly and carry no sticks.' The career worker stays on long after your dust has settled. Comport yourself so that in no way will his or her life be adversely affected.

Doug: **What about surgical education in developing countries?**

Dad:

For this answer I borrow from material kindly provided by Dr. Catherine DeVries, pediatric urologist in Augusta, GA and Director of International Volunteers in Urology.

Apart from local, regional and national surgical training programs, surgical education may be supplemented by expatriate colleagues. Their efforts can be separated into several categories.

1. *Sponsorship of surgeons in developing nations to meetings and training centers*. This approach involves identifying and supporting promising surgeons for advanced training. The rationale and hope is that these surgeons will return home in order to enhance quality medical care in situ. Regrettably, though, many never return, once having experienced practice in a substantially more advanced, and lucrative, setting. Subsidizing surgeons to attend major meetings may reduce incentive to stay outside the country of origin.
2. *Academic affiliations*. The International Federation of Surgical Colleges, through its links to surgical societies of many countries, fosters collegiality and sharing of resources. University medical centers, also, may have "sister programs" with counterparts around the globe.

3. Coordination to match surgeons to regions of need
   a. *Specialty organizations*. These are driven by a primary focus on professional specialty, although they may not be affiliated with either national or regional societies. In fact, these organizations do not usually have the direct sponsorship of their parent association, but rather participate in a liason role. They are nonprofit volunteer groups which in the United States operate under 501-C3 regulations. Examples include: Interplast, Physicians for Peace and Operation Smile (plastic surgery); International Volunteers in Urology (urology); Orbis, Lions Club (ophthalmology); Health Volunteers International Orthopedics Overseas (orthopedics); and Medical Training Worldwide (general surgery).
   b. *Regional interest organizations*. These groups have a primary focus on one region while developing new programs in others. Examples include: Physicians for Peace (Middle East); Carelift International, Surgical Aid to Children of the World (Eastern Europe); Medical Training Worldwide (Latin America); and The Friendship Bridge (Vietnam).
   c. *Religious associations*. Many churches sponsor hospitals and clinics which provide ongoing care, while at the same time hosting visiting specialists. Often these institutions provide the only care in economically and/or politically unstable countries. Examples include: Catholic Medical Missions, ISOH/Impact, The World Medical Mission, Lutheran World Services, Global Health Network, and Loma Linda University/Seventh Day Adventist program.
4. *Individuals*. Solo surgeons have for many years sought independently to share their skills with colleagues and patients. Indeed, they are the unsung heroes, working quietly as they do, in remote corners of the world in areas of incredibly desperate need without the social or financial support of larger organizations.
5. *Support organizations*. There is a type of nonprofit organization which specializes in sending supplies to locations where they are most needed. The supplies range from opened (unused) glove to computed tomography scanners. Examples are: Mano a Mano (Bolivia), American Medical Resources Foundation, Global Links, REMEDY, International Aid, Direct Relief International, Carelift International and International Children's Hospital.

Doug: **What do short-term medical missions accomplish?**

Dad:

At the place of mission many effects occur: relief for the career worker(s), training, comraderie and goodwill across cultures. How gratifying to receive an e-mail from a missionary general surgeon after our consultation visit, "Urology is always such a pleasant surprise. High success rate. Low complication rate. One area every surgeon should consider expanding into." And, another e-mail from a mission executive: "I think a boon to having people like yourselves volunteer your surgical skills is how it impresses many of the nationals on the field—certainly the patients you work with, but also many others who observe that you are willing to take time out from busy and, in many cases, lucrative practices, to travel around the world in order to donate your expertise to help any patient who is in need." By the way,

Figure 8. Rounding on the male ward in Bangladesh.

through cyberspace my practice now is worldwide, since I serve as a urologic consultant to virtually anyone 'in the trenches'. Then, too, the homefront can be impacted by your mission as colleagues and friends mobilize to assist in what, in fact, is a *team effort*. But, my experiences have taught again and again that the greatest results transpire within me—personal growth resulting from challenges; a better understanding of different cultures and people; an increased desire to advocate for those desperately needy, though voiceless, ones around the world; satisfaction expressed so eloquently in the happy smiles of patients treated as well as in the tears at the time of departure from our national brothers and sisters. To paraphrase, service IS its own reward.

Doug: **Why do you serve in volunteer medical missions?**

Dad:

This question is perhaps more important than any of those addressed above. Is my (your) interest to sightsee? to experience adventure? to escape the monotony, hassle and demeaning regulations of Stateside practice? to 'pay my dues' to the human race? to gain a world view? to impress my colleagues with a concern for the 'global village'? to enthrall co-workers with accounts of exotic diseases, strange (to Americans) customs and dramatic experiences? Or, is it in response to the abundant blessings from God upon America, in the domain of healthcare especially, a desire to share out of our bounty with those in profound need that defies accurate description? In my case, it's the last of the list. Although in the recitation of possible motives each is worthy to a point, only the last, in my view, will inspire and motivate one to 'keep on keeping on'.

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CHAPTER 7

Medicine and Surgery in the Third World

Lawrence Levy

Between two-thirds and three-quarters of the world's population live in the developing world, yet most of the money and other resources are in the so-called developed world. In almost every field the differences between the two are immense. What may be considered to be "no money" in one place might well be considered a fortune on the other side of the globe. Similarly in matters of housing and education and in consequence health, the difference is extreme. It is well accepted that good health has relatively little to do with the health services offered, but much to do with the standard of living and education. Where overcrowding is reduced, and clean water, good sanitation and adequate food are available, the health of the people improves immensely. Nonetheless people still suffer disease and sickness and the health services have a very large part to play in all societies, rich and poor, though the part there is to play differs immensely. In the developed world the emphasis is inevitably towards the curative side, so many, though not all, of the major "public health" problems having been controlled; by contrast, in the developing world the emphasis is inevitably much more oriented towards prevention and primary health care because of the nature of the disease patterns. However, this is not to imply that the therapeutic services have no place; they have an enormous part to play.

Using East and Southern Africa, with which the author is most familiar, as an example, though the situation is known to be very similar elsewhere, between 70 and 80% of the population is rural and agriculturally based. However in most cases the agriculture is of a simple nature rather than intensive profit-making cultivation. Despite attempts to provide machinery to assist with ploughing and harvesting, the majority of rural people are dependent upon the ox or the ass or human endeavour for motive power. The situation becomes much worse for these people in times of drought, as occurs from time to time throughout the Third World and as the draft power dies from lack of food and water. Despite massive efforts by governments to provide bore holes there are still large areas in which the water supply is, at best, parlous. Starvation in these areas is inevitable and endemic, and dirt diseases ever present. The author recently visited a rural health centre where water had to be brought daily in a barrel by wheelbarrow a distance of 2 km; when the strong man whose job it was to transport the water was off duty, that which could be carried by nurses in buckets was all that was available. This situation is repeated many times throughout the Third World. In many rural clinics at night only candle power is available, delivering a mother at that time can be a hazardous business for patient and attendant. It has been the aim of the Zimbabwe Health Services to provide sufficient points of access to the health care system that no person should have to walk more than 10 km to reach such a place. Regrettably, although enormous numbers of health centres have been built, there are sparsely populated areas where the

Surgery and Healing in the Developing World, edited by Glenn Geelhoed.

distance may be as great as 50 km. Transport to these points of entry to the health services or to the major centres may be lacking, though it is very much improved compared to what it was, but lack of roads and only rough tracks deter the owners of public transport from risking their vehicles in such circumstances. Health service operated 4x4s may seem the answer but again they are just as susceptible to damage on these tracks as are buses and other heavier vehicles. Then there is the problem of summoning an ambulance when it is needed; communications throughout the world are becoming better but where someone has to bicycle 25 km to reach a telephone to summon the only ambulance, it can be realised that help for the distressed person may arrive too late. Many a sick person or labouring young woman has been transported long distances across country by wheelbarrow, bicycle, litter or on a strong man's back in a desperate attempt to reach help.

Inevitably there are problems in staffing such rural health centres. Highly trained people who might be able to cope with a greater percentage of such emergencies do not wish to live and work in such circumstances, and in any event it is not as though an emergency situation of the sort just described arises every day. The problems of adequately staffing these rural points and their connection with the centre remain two of the major difficulties facing all Third World countries today.

By contrast the situation in the towns is somewhat better. Most large towns in Africa have some form of water reticulation and sewage system so that aspect is taken care of, but lack of housing with heavy overcrowding remains a very serious problem. Throughout the world there is a steady migration from the country towards the towns, where people feel that opportunities for employment are better, the social life is more attractive, and even that the ordinary amenities of running water and sewage disposal provide a step up from rural life. Medical services are invariably better in the towns where there is usually a hospital with medical staff, though they are always severely overcrowded. At least in the towns the health services are to hand and can be reached with much less difficulty than in the rural areas.

Not only do medical services have to be provided and be available, but people have to use them. It is well known that the greatest use of the health services in the developed world is not made by the poorest section of the population, but by the wealthier and better educated groups. Poor people have more important things to think of than a minor ailment which does not incapacitate them. In two surveys of health problems in the rural areas conducted 27 and 17 years ago in Zimbabwe, it was found that over 40% of persons casually examined had some sort of problem, albeit mild in most cases, that would have taken most persons of the First World to seek medical assistance. In the developing world there is therefore an enormous volume of work to be done both on the therapeutic and the preventive sides, but there are enormous restraints imposed by many factors. In these surveys those interviewed were specifically asked why they did not go for treatment, most said, "it does not bother me", others said they did not have the money for the bus fare or to pay for the treatment. The demand for health care is therefore less than might be imagined and indeed it came as a great surprise that so many people harboured some form of disorder without seeking treatment. Subsequent studies showed that ten times as much surgery was being done on the wealthier and better educated sections of the population compared to the equivalent number of the poorer people despite the apparent availability of the service. When this was first noted 25 years ago, we were very surprised; not so now that the reasons for the differences in demand are realised. However this is not the only problem in that regard.

Western type medicine has only been practised in Africa for about 100 years, whereas before that, for centuries, there had been and still are the "traditional heal-

ers". They constituted the medical services of the time and no matter how inadequate we may consider them, they are little different from how we will be considered by our successors in 100 years. Traditional healers are men and women who sometimes have inherited the title and facility from a family member or sometimes are self styled, and they practise a variety of suggestion and medicinal therapy using herbal remedies and some elements of witchcraft. Most illness has been interpreted as being the result of the displeasure of the ancestral spirits, or resulting from a spell cast upon the victim by some ill-wisher. Much time and money has been spent and will continue to be spent for many years by those afflicted in attempting to find from the traditional healers who is the miscreant who has wished the illness upon them. It is here that western medicine is at a great disadvantage—we know that we do not know the cause of certain diseases—the N'anga or traditional healer always knows. Our inability to provide an explanation as to "what (or who) caused it" puts western medicine at a grave disadvantage; after all, there has to be a cause and one should know it. So great is the belief in the powers of the traditional healers that few rural people come for hospital treatment without having visited the N'anga first. There is a traditional healer in almost every village, who is, in a manner of speaking, the local practitioner; it is understandable that he/she is visited first both for medication and to take care of the spiritual side. Thus western hemisphere style medicine has had, and still has, to prove itself against the established order. In Zimbabwe, the first western type medical and nursing services were set up by Mother Patrick and her nuns and by the doctors who accompanied the first column of white settlers into the country in 1890. Mother Patrick lamented the fact that the local people seemed very wary of the treatment offered by herself and her colleagues, though in retrospect that can hardly be a cause for surprise. It was after all an alien treatment offered by unwelcome settlers; before it could be accepted it would have to prove itself. Even today more than 100 years later a very large number of patients have already taken adequate steps to appease the spirits before coming to hospital, or do so soon after their admission and before anything is done to them.

A further problem for the rural person is the fear of the unknown which may be represented to them by the large building with lifts, trolleys, impersonal wards and staff dressed in white. Some who may never have been to a large town before suddenly find themselves transported into such a position. Today the situation is greatly improved from this standpoint, as nothing succeeds like success, and many of the successes of modern medicine have appeared almost miraculous. Consequently, the confidence of rural people has been steadily growing and the sick are certainly more willing to come to hospitals and receive seemingly exotic treatments than before. This author was infuriated when he learned that traditional healers were coming into the ward and advising the patients as to whether they should or should not, undergo surgery. This was a foolish attitude. These people enjoyed the confidence of the populace far more than this young western trained doctor, and only success with the cases in which the traditionalists had clearly failed would give progress. Even today many people come only when that failure has become obvious and western medicine is then given its chance as a last resort. Success is difficult under those circumstances because of the lateness of appearance of the patient at the hospital but it is only by that success that progress has been made.

In the developing world populations are growing rapidly, and continue to grow despite the onslaught of the AIDS virus. This growth in population is unfortunately not matched by an equivalent rise in productivity, in consequence of which there is

a steady loss of ground in the struggle between mouths to feed and food supply. This situation is being aggravated by the deaths of many very productive people in their thirties and forties, resulting in the labour force being dependent upon the young or the older people, both of whom are less capable of the output of the middle group.

Everywhere, money is the determining factor, and it was pointed out that what might seem "nothing" in the developed world might constitute a fortune in the Third World. Large sections of the population have little income so that direct taxation is not possible. Indirect taxation by sales taxes etc. can only raise a certain amount of money so that the national exchequer is inevitably shorter of finance than in the more developed world. This reflects itself on the health budget which exists in all countries in straightened circumstances. Thus money for salaries, supplies of all sorts and development is inadequate.

This situation may be rendered more parlous by the fact that the overall poverty of the people raises the temptation to take and enjoy something which is not properly one's own. The temptation to steal, particularly from someone as impersonal as the government, may be overwhelming and security in the hospital system can be very difficult, resulting in huge losses on all fronts.

Thus, in summary, in the Third World there are, by developed world standards, deficiencies all down the line. This results in high infant and maternal mortality rates, a high disease rate principally related to infection and trauma, a lower life expectancy, later arrival of the patient at the health services than is for the best, and only one slight advantage, fewer of the diseases of affluence.

Big adjustments have to be made by the physician arriving from the developed world if a good contribution is going to be forthcoming. On the surgical side instrumentation and anaesthesia may be adequate for routine surgical procedures, but exotic ones requiring intensive postoperative care may not be possible nor even desirable. Simple ways of doing procedures must be worked out using less complex instruments, but possibly demanding a higher level of manual dexterity, while there are some procedures which cannot be undertaken. It is useless to do a heart valve prosthesis operation on a person from far away in the country who has no access to anticoagulation and for whom a visit to the hospital may be a "one-off" event which cannot for financial reasons be repeated. A similar situation exists in relation to a shunt inserted for hydrocephalus where constant observation is required and indeed in almost every field of medical endeavour—why start a patient on anti-retroviral treatment if there is no money to continue the therapy? This may result in the accusation, as this author has been accused, of practising one standard of medicine for those in town, and another for those in the country. In a way that is so, but it is not the doctor's fault that the patient lives where he does and whatever treatment is offered has to be tailored to the social context of that individual. It has also to be understood that chronic illness is something which is beyond the ability of the extended family to manage. At one time we used to fool ourselves with the belief that "the extended family will look after him/her". We discharged paraplegic patients to their rural homes with that trite remark which excused us from doing anything else for the patient. We soon found that the average paraplegic patient sent to the country lives for less than one year and dies under appalling conditions—conditions which are now being repeated daily as the rural population struggles to cope with the onslaught of AIDS and the return of urban dwellers to their traditional areas to die. If someone is to care for the patient they have to be taken away from some other

essential task, fetching water, hoeing the ground, or finding firewood and then the whole family suffers.

On the medical side there is the problem of expensive drugs for cancer and other treatments let alone the need for haematological and biochemical examinations. Even diabetes, cheaper though medications for this condition have become, presents a problem in stabilisation. Where currencies deteriorate in value, ordinary drugs become unaffordable. The steadily increasing work load which is being imposed upon the hospitals by the AIDS pandemic has created daily intakes to some hospitals which have become unmanageable. Patients for whom prolonged admission would appear proper are having to be discharged the following morning to make room for the next intake which will appear that day. Paediatrically the same situation holds good because of the number of children born to HIV positive mothers while obstetrics and gynaecology is similarly inundated.

Recently the health services have started to experience a new problem. There has always been a steady brain drain of doctors from the underdeveloped world to the First World; now there is a drain of nursing personnel as well. It is clear that in many parts of the First World there have not been sufficient incentives to attract local young people into those fields, yet from the standpoint of a person in the Third World the salaries offered represent a glittering reward. A large number of young people, both trained and untrained, are leaving their homes and families to go there to work. Whereas this is of little consequence as far as the untrained person is concerned, because in most Third World countries there are more applicants for training than places available, it is of great consequence to a country when the trained people disappear.

The Third World feels that immense kudos arises from the fact that locally based training is considered good enough to allow their people to go to the First World to work, and we are very gratified about that. However to produce trained people ostensibly for the Third World who then go and live and work in the First World is of no value to the country that trained them. The moment one produces staff who are of an acceptable calibre and training to the countries of the northern hemisphere then one is fishing in the same pond as the Americans, British and others. Clearly in those circumstances, the bigger the bait the bigger and more fishes it will catch and national loyalty inevitably plays second fiddle to finance, or even to working conditions, in those circumstances. The Third World has to face the fact that if it is to keep its staff it either has to pay them at commensurate rates (which few countries can afford to do or they would not be Third World countries) or it has to produce staff whose qualifications are oriented specifically towards their needs and not the needs of the First World. This is something yet to be appreciated by many Third World countries struggling for First World status. Nursing, medical and paramedical training has understandably been modelled on the pattern of the western world and its acceptance by the authorities of that part of the world has been considered the yardstick of success by developing countries. However the training which equips a young person to work in a sophisticated centre may be entirely inappropriate to the requirements for running a rural health facility. For that an entirely different education and training may well be required. By training its medical and nursing staff along those lines, the countries of the Third World would not only have appropriately oriented staff which would be much better for themselves, but would also have staff who were not leaning towards the western world.

The question of instrumentation has been touched upon already. In all countries where the currency has been debased, imported materials become very expensive

and equipment and drugs of all sorts may be unavailable. "Appropriate technology" is the term applied to innovative methods of producing adequately functional equipment to do a task otherwise performed by expensive apparatus manufactured in the northern hemisphere. In the neurosurgical field a variety of such have had to be devised and include wire traction on the skull in place of tongs (originally devised by Dr T L Hoen of Bellevue/NYU), the Harare Shunt for the treatment of hydrocephalus and a simple stereotaxic device for intracranial needle placement.

In the orthopedic field the Association of Surgeons of East Africa sponsored its own simple external fixator which was developed by Professor Kenneth Rankin. In Uganda Mr. Peter Bewes designed skin graft knives using old safety razor blades and an old kitchen knife. Numerous "peg legs" and crutches for the amputee, wheelchairs of all sorts for the paralysed and many other devices of all sorts have been and still need to be devised.

This is appropriate technology without which many things would be impossible and much endeavour in the Third World would be unfruitful. To be successful in this environment the ability to work hard, to improvise and to be able to work on his/her own are essentials to a successful and satisfying practice.

To the highly trained and technically oriented surgeon or physician work in the Third World may be very difficult and even prove too challenging. Many doctors feel useless when faced with the absence of highly sophisticated equipment and modern drugs while the sheer volume of work which presents itself, once the doctor is known as a reliable and friendly practitioner, can in itself be daunting. Lack of equipment and drugs can be intimidating and requires innovative methods for the treatment of many diseases. Nonetheless the sick can and must be treated, and the grateful smile of the departing patient, as everywhere, is a satisfying reward for all the time and trouble lavished.

CHAPTER 8

Lab in a Suitcase

Christine A. King and James Kerr

Introduction

This chapter is aimed at those individuals travelling to and working in rural settings who are limited to what they can bring with them in a suitcase on an airplane. Individuals with no special training and limited equipment can perform many laboratory diagnostic tests. The scope of this chapter is limited to only those investigations that we believe are essential for basic patient care. We have tried to minimize the cost and size of equipment needed to perform the laboratory analyses described. Small equipment, however, may be expensive. We have tried to described both the costly and low cost alternatives when available.

The one question that we frequently get asked is "How big is this suitcase"? There is no one answer. In short, the suitcase is as large or small as you wish to make it. Those with greater funds will be able to fit more equipment into a smaller suitcase and increase the versatility of their lab without increasing the size or weight.

Equipment

A lightweight, portable, phase contrast microscope can be obtained from many manufactures. The microscope should be fitted with both a power light source and a mirror. This mirror can then be used in situations where power is not available or when the power fails. The microscope should be fitted to include a 10X, 40X and 100X objective and an oil immersion lens. Don't forget to bring oil immersion for viewing. These lenses will enable the investigator to view many pathogenic organisms including bacteria and some parasites. A hemocytometer, or counting chamber, for assessing numbers of cells as well as glass slides and cover slips should be included (Fig. 1).

Diagnostic tests including, but not limited to, MCV, Hb, Hct, electrolytes, PTT & PT levels, are difficult to assess without the aid of a photometer. Although expensive, some very good, light, small machines are available and should be considered when gathering equipment. Many of these machines will perform a wide range of diagnostic tests and require varied reagents. The amount of material needed and their servicing requirements may discourage individuals from considering this piece of equipment. Often such equipment can be purchased in the country visited and thus will allow for servicing and reagent access.

Many of the laboratory tests can be done with the aid of self-contained kits that not only provide instruction as to their use but also include all reagents necessary for the analysis. These kits have been widely used and are deemed reliable. One drawback of the kits is that many require refrigeration. If the destination is a place where

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Lab in a suitcase

Phase contrast microscope fitted with mirror & light source
10X, 40X, 100X and oil immersion objectives
*15 Urine collection bottles
Extra bulbs
Oil for viewing
*Hemocytometer
*100 glass slides
*100 glass cover slips
Syringes (1,5,10,50 ml)
Needles (16,18,20 and 22 G)
Sterile alcohol swabs
Citrate saline ~ 100 ml
*Pipettes
One 40-200 ml
One 100-1000 ml
*50 tips to fit each pipette
Maglite
10 candles
*30 pairs Gloves
Calculator
*5 ESR tubes
Pipette bulb
Vertical ESR stand
Timer
Tweezers
1 box kimwipes
100 ml graduated cylinder
25-50 blood transfusion bags with anti-coagulant
500 ml ethanol
1000 ml sterile distilled water
*20 small test tubes
*5 glass eye droppers
Leishman stain ~~100 ml
Field stain ~ 50 ml
Gram stain ~ 100 ml
Carbon Fuscin stain ~ 100ml
Xylene ~ 50 ml
HIV & Hapatitis B kit ~ 50 tests
Widal kit ~ 50 tests
Blood typing kit ~ 50 tests
Glucometer
100 b-HCG dipsticks
200 Glucose/dextrose sticks
200 Urine dipsticks
Extras:
Propane powered Coleman stove
Battery-powered portable photometer
Enzyme immunoassays, biochemistry and drug level for serum, plasma and urine

*All re-usable if cleaned and dried. Note: Reagents are required if stains are to bemade by the technician

power is not available, an alternate must be considered. Solar powered refrigerators are one possibility.

Much of the equipment listed in the suitcase has been chosen for its ability to be reused. All glassware, slides, ESR tubes, urine bottle, gloves, pipette tips, etc. can be cleaned, dried and reused. This recycling minimizes the amount of equipment that needs to be transported (Fig. 2).

Organizing and Setting Up the Lab

A clean, flat surface is necessary when setting up the lab. If a bench top or table is not available, a flat section of ground covered with a clean sheet will suffice. If a room is available, it will optimally include a power and water supply and refrigerator. Large windows covered with fly nets will make the working atmosphere more enjoyable and provide good lighting. In short, a simple room in either a building or dwelling will do quite nicely.

Figure 1. The phase contrast microscope.

Preparing Blood, Plasma and Serum

Various procedures will require different sample. If whole anticoagulated blood is needed mix (by inverting gently) 4.5 ml blood with 0.5 ml citrate saline. This will prevent clotting of the sample. If plasma is needed allow the anticoagulated blood sample to sit upright for 2-3 hours. The cells will sediment in the lower half of the tube with plasma on top. If a centrifuge is available, spin the tube at 1000 rpm for 10 min. To isolate serum, obtain a blood sample with no additives. Allow blood to clot for 1 hour and let sit upright for 2-3 hours to allow for separation of cells and serum. As with plasma, serum will be the top layer in the tube.

Blood Typing and Transfusion

One of the most important and potentially life saving procedures is blood typing and transfusion. It is important to quickly determine the blood type of the parent

Figure 2. Re-used glass urine bottles.

and donor if a transfusion is necessary immediately. Once a match is made, obtain the necessary blood and transfuse the patient in a timely fashion. The use of blood typing agglutination kits purchased and carried in the suitcase will allow for rapid typing. Follow instructions on the kit. Agglutination (clumping) of sample indicates blood type. If matched, isolate the blood using 16G or 18G sterile needles and prepackaged blood transfusion bags containing citrate to prevent coagulation.

Hematology and Serum Chemistry

A few tests have been chosen which are deemed essential to basic patient care.

Basic Blood Tests

Differential and TLC

These blood tests can be performed easily. After obtaining the anticoagulated blood specimen (mix 4.5 ml blood with 0.5 ml sodium citrate) from the patient blood films on a glass slide are made. This can be done by first putting a small drop of blood on one end of the slide and then, using another slide, smear the drop with the edge.

Leishman Stain

This staining procedure is widely used for distinguishing between different types of normal blood cells. Each cell stains in a different pattern when viewed under the microscope and will allow for easy identification. Note: The stains described will stain hands and clothing as well as bacteria. Do not wear good clothes in the laboratory, wear gloves when staining, and keep in mind that all stains are assumed to be toxic unless otherwise stated.

Leishman Stain Procedure

1. Prepare blood film.
2. Allow the sample to air dry for a few minutes.
3. Once dry, cover film with 10 drops of Leishman stain using an eyedropper and allow to sit for 30 sec.
4. Add 20 drops of water and let sit for 15 min.
5. Pick up slide with forceps and rinse in fast running tap water for 1 sec.
6. Allow to dry.
7. Examine under microscope using an oil immersion lens.

Microscopic Observation of a Leishman Stain

Differential: A good approach to observing any smear is to examine it under low power (10X) in a bright field for orientation. After focusing, work up to 40X and finally 100X. Be sure that the smear is not upside down, or focusing will not be possible. When doing a differential, count 100 cells in the following way to obtain the percentage of white cells (Fig. 3).

TLC: A TLC can be done by staining with Leishman's on a hemocytometer as opposed to a simple glass slide. The hemocytometer has grids on the slide which will allow for organized counting of cells. Though not as accurate as a machine, it will be more accurate than counting without the grid.

Erythrocyte Sedimentation Rate (ESR)

The ESR is a nonspecific indicator of disease that measures the rate of sedimentation of erythrocytes in anticoagulated blood over 1 hour. If various proteins coat

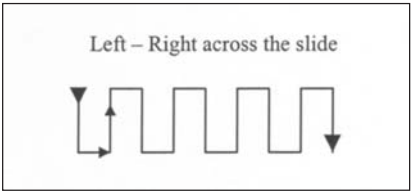

Figure 3. Manual counting procedure for differential analysis.

the red blood cells, they will stick together and result in a faster ESR rate. Obtain the anticoagulated blood sample using a pipette bulb and draw the blood into the graduated ESR tube. Place in a vertical stand and set the timer for 1 hour. Measure the level of sedimentation red cells in mm after 1 hour. ESR normally rises with increased age and anemia. Normal values can be calculated in men: (age)/2, and in women: (age+10)/2.

Blood Tests Requiring Kits

T3, T4, TSH, Creatinine, Amalyse, Bilirubin, PTT and PT

These tests require prepackaged kits that must be refrigerated at 4°C. All analyses can be carried out with plasma and/or serum samples.

MCV, Hb, Hct, Na, K, and Ca

These tests require specific reagents and a photometer. Most of the reagents need to be refrigerated at 4°C.

Glucose

A glucometer is required to measure serum glucose. Do not forget that a glucometer requires batteries.

Microbiology and Parasitology

Preparing a Smear

A properly prepared smear causes bacteria to adhere to a slide so that they can be stained and observed. The correct density of bacteria on the surface of the slide is essential to ensure reliable date. If too many bacteria are present and they overlap each other, bacterial will not stain properly. If too few, and they cannot be located on the slide.

1. The slide must be clean and grease-free. Clean the slide by breathing on it repeatedly followed by rubbing vigorously with a kimwipe or paper towel to remove the fog. When the slide de-fogs immediately after breathing on it, it is sufficiently clean.
2. To prepare a smear from a dry culture, place a very small drop of distilled water on the slide. After aseptically removing material from a culture, mix with the water. If the specimen is in dilute culture broth, place directly on slide. Note: very little sample is needed for a good smear.
3. Allow drop to air dry.
4. Pass the slide quickly through a flame three times to kill the bacterial and cause them to adhere.
5. Allow the slide to cool and then proceed with staining.

Bacteria

Important information such as shape and degree of motility can be obtained by observation of living bacteria with the light microscope. However bacteria are routinely stained with different dyes in order to reveal different properties and to enhance contrast for viewing with conventional bright field microscopy. The staining methods described kill the bacteria and prevent distortion of morphology upon dying. Thus samples can be spread onto a glass slide and air dried, then fixed to the surface by passing the slide quickly through a flame effectively killing the cells.

Pus, Sputum, CSF and Aspirates

The Gram Stain

The Gram stain is routinely used as an initial procedure in the identification of an unknown bacterial species. A species can be classified as Gram positive, Gram negative, or Gram variable depending on the ability of cells to retain the blue dye. Gram negative bacteria do not retain the dark blue color and appear red under the microscope. Gram positive bacterial do retain the dark blue color and thus appear blue under the microscope.

Gram Staining Procedure

1. Prepare a heat fixed smear of the culture you wish to examine.
2. Flood the smear with crystal violet (purple basic dye) using an eyedropper (30 sec-2 min).
3. Quickly and gently wash off excess stain with running water until the water runs clear (2 sec).
4. Flood the smear with Gram's iodine using an eyedropper (1min); repeat water rinse.
5. Decolorize with alcohol (10-20 sec or until the excess alcohol which flow off the slide is colorless).
6. Quickly and gently wash off excess stain (2 sec).
7. Flood the smear with red basic dye safranin using an eyedropper (30-120 sec).
8. Quickly and gently wash off excess stain (2 sec).
9. The smear is blotted (not wiped) to remove excess water, using bibulous (absorbent) paper or a paper towel. Allow slide to air dry before viewing.

Microscopic Observation of a Gram Stain

Focus as described in microscopic observation of a Leishman stain with the final step being observation under oil immersion (100X). The immersion oil is placed directly on the smear. Higher magnifications are needed in order to see detail, as at low magnification Gram-stained material looks like dirt on the slide. Bacteria are often concentrated in a ring around the original smear. Bright field oil immersion microscopy is necessary to see an undistorted image of any directly stained bacterial smear. A Gram negative or positive phenotype cannot be confirmed with certainty using only a dry magnification. After putting immersion oil on a slide, the high dry (40X or 100X) lens can't be used again unless the oil is removed. Blot slides to remove excess oil, dip in xylene several times to dissolve the oil film, and air dry. Note: xylene is hazardous, be sure to air dry in a well-ventilated area. Remember Gram negative appear bright red while Gram positive appear blue under the microscope.

Table 1. Selected common pathogenic bacteria

Gram + ve cocci	**Gram + ve bacilli (rods)**
Staphylococci	*Bacillus anthracis*
Staph aureus	*Listeria monocytogenes*
Staph epidermidis	*Clostridium tetani*
Streptococci	*Clostridium difficile*
Strep pyrogens	
Strep pneumoniae	
E. faecalis	
Gram - ve cocci	**Gram - ve bacilli (rods)**
Neisseria meningitidis	*Escherichia coli*
Neisseria gonorrhoeae	Salmonella
Shigella	
Yersinia pestis	
Bordetella pertussis	
Pseudomonas aeruginosa	
Mycobacterium tuberculosis	
Mycobacterium leprae	

The Carbol Fushion Stain

Mycobacterium tuberculosis (TB) is very prevalent in developing countries, therefore rapid identification is necessary. TB is stained using carbol fucsin staining and is known for its resistance to decolarization. If TB is suspected obtain sputum or CSF from the patient and make a smear on a glass slide. When making the smear remember not to make it too thick as this will distort the view.

Carbol Fucsin Procedure

1. Make smear of sample
2. Heat fix by passing through flame 3 times
3. Cover smear with carbol fucsin using an eyedropper, (1-2 min)
4. Heat fix smear by passing through flame 3 times
5. Wash with running water until water runs clear
6. Cover smear with 20% H_2SO_4, (2-4 min)
7. Wash with running water. Note: if still colored then repeat acid decolarization step
8. Wash with running water
9. Cover smear with methylene blue, (2-4 min)
10. Wash with running water until water runs clear
11. Heat dry and observe under oil immersion

Microscopic Observation of Carbol Fucsin Stain

Examine the slide in a manner similar to that described for the Gram stain in the previous section. TB is a Gram negative (red) bacilli (rod).

Blood

Widal Test for Salmonella Typhi *and Paratyphi (A, B and C)*

The Widal test is used to detect antibodies in the blood to the organism. This test can be performed with the aid of a manufacturers kit that contains both the necessary reagents and instruction on use. Serum or plasma can generally be used for detection. Consult the kt for specific instructions.

VDRL (Veneral Disease Research Laboratories)

VDRL is used to detect *Treponema pallidum* in patents suspected of having syphilis. This test can be done with the aid of a manufacturer's kit. Consult kit for details on procedure.

Urine Analysis

Urine can be collected in glass bottles. If a centrifuge is available pour urine into a glass test tube, and spin at 1500 rpm for 10 min. Pour off the liquid leaving the sediment behind. Remove sediment and place a small amount on a glass slid and cover with a slip taking care not to introduce bubbles. If no centrifuge is available allow urine to sediment for 3-4 hours then carefully remove all but the sediment and continue as above. Examine under microscope as for Leishman stain. Things to note include bacteria, casts, crystals, cells and yeast.

Parasites

Blood

The Field Stain

Field stain is commonly used to detect the presence of malaria parasites in the blood of patients exhibiting symptoms of the malaria. Although Leishman stain can also be used to detect the parasites, Field stain is easy to use and gives the best results. This stain will also detect trypanosomiasis and filaria. To detect parasite obtain anti-coagulated patient blood sample.

Field Stain Procedure

1. Make a thin and thick smear of patient's blood. (Note: Both smears must be stained and examined to ensure correct diagnosis).
2. Fix smear with heat for 3 sec.
3. Cover smear with solution A for 5 sec.
4. Wash smear with running water for 5 sec, or until water runs clear.
5. Cover smear with solution B for 3 sec.
6. Repeat wash.
7. Allow smear to air dry and view under microscope.

Microscopic Observation of Field Stain

Examine the smear under the microscope as previously described. Be sure to thoroughly examine the smear for a full 5 min before determining that it is negative. The parasite form will vary depending on the stage of the cycle and the type of malaria. A color atlas of malaria parasites should be included in the suitcase to enable comparison. The degree of infection can be determined by calculating the number of infected red blood cells. The more parasites present the more severe the disease.

Stool

Stool should be collected in a suitable clean container (depending on consistence). Make a smear on a glass slide and cover with a slip. View under the microscope. Examine for blood, cysts, ova and amoebas.

Acknowledgements

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CHAPTER 9

Lab-in-a-Suitcase: Saving Lives in Remote Corners of the Globe

Hollee D. Van der Veen and Milton B. Amanyun

The Lab-in-a-Suitcase evolved over ten years, beginning with the work of Dr. Kendall Smith in the mission field. The idea of miniaturization, port ability, accessibility of power, cost containment and reliability of results were beginning goals. International Aid, a nonprofit organization based in Spring Lake, Michigan took these beginning concepts and began many further improvements. The new technology represents a tremendous breakthrough in increasing access to health care by meeting the needs of early and accurate diagnoses. Working diagnoses are critical before courses of medical or surical therapy. Today, multiple regimes are available. Pathogens, bacterial, viral or parasitic, are known vectors of disease. Once the particular vector is identified, therapy can begin. Once the therapy is begun, the progression and regression of disease states can be monitored, gauging its effectiveness. This analysis is available with the Lab-in-a-Suitcase.

Born out of a need in remote sites, the Lab-in-a-suitcase has developed into a low cost, portable, accurate diagnostic tool, providing access to under-served populations. Lab-in-a-suitcase solves current challenges of power supply, level of technology, training, supplies and repairs.

The main components of the lab-in-a-suitcase include a sturdy binocular microscope with four objectives and thirty year anti-fungal warranty, a hematocrit centrifuge, a urine centrifuge, a Neubauer hemocytometer, ESR sedimentation rate, and digital field colorimeter, lending to the dexterity of the kit.

In order to carry out the demands of a modern society, the requirements for dependable electrical power for such things as diagnostic testing, needs to be present in a manner that will be effective for society. Examples of this are clearly evident with the recent power outages in Chicago and New York City.

We must also take into consideration the recent emphasis on the aspect of "man portable" power, consisting of generators, batteries and solar cells. The lab-in-a-suitcase represented in this report, personifies this generation of lighweight, photo voltanic solar cells, and environmentally safe Nickel metal hydride batteries (nigh). It provides 84 watt-hour (12 v7a) power source to run the portable laboratory. Energy for the power source will come from the microscope AC adapter (12V 5a), solar panels, or a car battery. Emphasis on the design of the power module, the weight of the overall unit, and maintaining the battery's performance. To accomplish these goals, the NiMH battery was selected in conjunction with thin film amorphous silicon solar panels made by United Solar in Troy, Michigan. Control for the power module consists of energy regulating circuitry, a gas gauge charging circuit, and an output regulator.

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The system is exempt of lead, acids and mercury, is environmentally safe, lightweight, self-charging, power storing, rugged, and a long lasting 12V power source allowing the portable laboratory to be used all over the world.

Because of these power components, the Lab-in-a-suitcase now contains the basic ingredients to carry out approximately 85% of the diagnostic functions of a laboratory. These diagnostic capabilities include a hematocrit, complete blood count, differential, urinalysis, chemistry profile, microscopy and ESR. The laboratory can be expanded or reduced depending on the needs of the user, choosing between fluorescent microscopy, AFB or gram stains, and immunology testing, inclusive of Hepatitis B, pregnancy, malaria, syphilis, tuberculosis and HIV panels. Included in the portable laboratory is an instructional manual and appropriate reference books.

The Lab-in-a-suitcase has a heavy-duty molded polyethylene suitcase with foam interior surrounding each piece of equipment, making transport to remote locations safe and easy. It can be brought to patients, generating immediate results, as opposed to the usual delays for acutely ill patients, who may need to be transported to a near hospital. This is a very important feature of the Lab-in-a-suitcase that will save lives!

Transferring Technology Simply

Components of Laboratory Equipment Kit (Plus Shipping and Handling)

Separate

Platt Luggage- foam lined suitcase for lab equipment $265
Binocular Microscope - 30 year anti-fungal warranty, $600
Field colorimeter, $400
Urine Centrifuge, $90
Hematocrit Centrifuge, $105
NiMH Pwer Pack (nickel metal hydride), $270
Solar Panel, $270
5 Am Adapter, $65
Manual, $50
Laboratory Equipment Kit (weight approx. 32 lbs), $1700 (without solar panel), $1900 (with solar panel).
Laboratory Supply Kit (weight approx. 30-32 lbs), $500
Complete Laboratory Equipment and Supply Kit (shipped in two boxes), $2200 (without solar panel), $2400 (with solar panel)
Laboratory Supply Kits plus shipping and handling (kits may be purchased through store catalog)
Binocular Microscope Supply Kit
$20, Extra bulb, immersion oil, box microscope slides, box cover slides
Hematocrit Supply Kit
$70, Laminated reader scale, capillary tubes (75 mm, 200/vile; EDTA), 1 box critoseal, disposable gloves, auto lance device, 100 lancets (for lancet device), 100 alcohol swabs, tweezers, powered chlorince bleach
Hemocytometer Supply Kit
$70, hemocytometer w/2 cover slides, 2 hemocytometer filters for mouth pipette, 2 latex tubes for pipettes, 2 WBC pipettes, powered chlorine bleach

Table 1.

Manuals Include	Optional Items
"Morphology of human blood cells" $45	Microscope case
"So you're going to collect a blood specimen", $5	Microscope bulb 12v
"Atlas of uring sediment" kit $30	Gram stain
"Manual of modern urine chemistry"	TB Quick
Stain Kit (3 step/3 bottles) $95	
"Diagnostic Microbiology-Bailey and Scott"	CBC Quick
Stain 16 oz, $20	
Intruction Manual	Reagents

Per request: glucose, BUN, Creatinine, TB, Albumin, Hemoglobin and standards. Note: We reserve the right to limit quantities Fees subject to change without notice. Shipping cost vary per individual needs. Taxes applicable without tax number. Revisions made 1-17-00). International Aid, Inc. 17011 W. Hickory St., Spring Lake, MI 49456, U.S.A. Ph: 616-846-7490/Fax: 616-846-3842. E-mail: vanderveenh@internationalaid.org

Hemotology Supply Kit

$45, 1 box slides, 1 box cover slides, drying rack, powered chlorine bleach, coplin jar (plastic, screw top), CBC quick stain, 16 oz (cannot be flown; hand carry only)

ESR Sedimentation Supply Kit

$55, ESR sedimentation rack, 100 sedi tubes, 22g stainless steel needles, powered chlorine bleach, 2 3cc syringes

Colorimeter Supply Kit

$135, 2 auto pipettes (5-25 ul) (200-1000 ul), pipette tips, 100 polystyrene culture tubes (12x75 mm), test tube rack, timer, powedered chlorine bleach

Urine Supply Kit.

$35, urine specimen cups (1 sleeve w/lids), urine micro-centrifuge tubes w/ attached lids/1.5 ml, 1 box (9 para 100) urine test strips, microscope slides/box, cover slides

Blood Collection Supply Kit

$70, 10 tourniquets, 5 vacutainer holders, EDTA vacutainer tubes, 100 needles, red top vacutainer tubes, powered chlorine bleach

CHAPTER 10

Establishing Electrical Power in Remote Facilities for Health Care

Jeffrey A. Mazer

Remote Electrical Power Is Readily Available through Photovoltaic Technology

In Western hospitals and clinics, medical delivery is heavily dependent on electric-powered devices. This is very different from the situation in many rural areas of the developing world where utility-supplied electric power is not available. In Mozambique, for example, with a population of about 16 million, 80% of the people live in rural areas and have no access to grid-connected electric power. In Kenya, about 88% of the people have no access to the utility grid. Indeed, it has been estimated that approximately two billion people (roughly 75% of the population in developing countries) have no access to any electric power.[1] This is a consequence of both poverty and logistics. For much of the developing world, the expense of extending a utility line from a central generating station to a remote facility is prohibitive. The cost varies with the local cost of labor and the difficulty of the terrain. In South Africa, for example, the extension of a utility line costs about US$ 8700 per kilometer. This is exacerbated by the anticipated low household demand for electric power in many poor rural areas, typically only about 50 kWh/month—a fact which assures an unacceptably long payback time for the utility company. In some developing areas, stand-alone diesel-electric generation is used for several hours per day. For a demand of only a few hundred watts, a small gasoline engine is sometimes used. Gasoline engines are less expensive than diesels, but have a shorter service life. In any case, with either gasoline or diesel engines, the cost of fuel and the challenging logistics of reliable fuel delivery to remote locations are often prohibitive.

Not surprisingly, the constraint of limited (or no) electric power has a dramatic effect on the available level of diagnostic and surgical technology in a rural clinic. Without electric power, even rudimentary equipment such as surgical lighting, suction pumps, refrigeration for vaccines and ice packs, autoclaves, optical microscopes, and water purifiers for potable water become highly unreliable if not totally inaccessible. The installation of a reliable and affordable on-site electric power generation system that is not dependent on the transport of fuel can substantially improve clinic effectiveness by enabling some of these appliances. And it allows radio communication with medical resources at distant medical centers.

Within the last decade, a major candidate for providing reliable electric power to remote clinics has appeared in the form of *photovoltaic (PV)* systems. Numerous countries in sub-Sahara Africa and in other parts of the world have installed modest

Surgery and Healing in the Developing World, edited by Glenn Geelhoed.

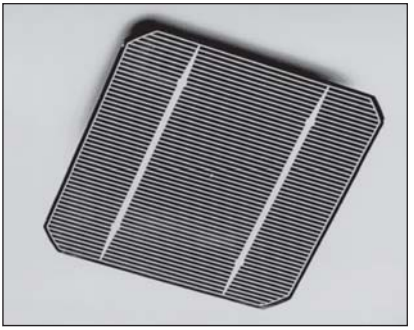

Figure 1. A 10 cm crystalline silicon solar cell before encapsulation in a module. (Photo by R. Mitchell, courtesy NREL/PIX.)

(less than one kilowatt) photovoltaic systems at small rural health clinics. Perhaps the most important application for PV at these clinics is that of reliable and stable electric power for vaccine refrigeration and maintenance of the vaccine cold chain. Vaccines must be consistently stored at temperatures between 0° and 8° C to retain their potency. There are now over 5000 PV-powered vaccine refrigerators in use worldwide. Unlike absorption refrigeration, fueled by propane or kerosene, PV-powered refrigerators are compressor-based and allow enhanced temperature stability for long-term vaccine storage. The technology is mature and endorsed by the Expanded Programme on Immunization of the World Health Organization.[2] The next most important applications of PV in these clinics are lighting and water disinfection. The need for lighting is obvious. But the water issue is often over-looked. The World Health Organization attributes *thousands of deaths daily* to water borne illnesses.[3] While there are several commonly used chemical methods for small-scale water disinfection, e.g., chlorine and iodine compounds, they often produce unwanted taste and odor and require long processing times. Faster, more effective, and more agreeable water disinfection processing can be obtained by electrical methods. These include ozone treatment and ultraviolet light exposure. Ultraviolet light irradiation easily deactivates bacteria and viruses, and there is no risk of over-dosage. Water disinfection systems specifically designed for use with PV are readily available and quite inexpensive.

Photovoltaic systems use photovoltaic cells (commonly known as *solar cells*) to convert sunlight directly into electric current (Fig. 1). The PV technology is inherently noiseless, pollution-less, and involves no moving parts. Others candidates for providing stand-alone remote electric power include wind turbine (windmill) systems and small hydro-powered (micro-hydro) systems. There have been a number of successful deployments of these technologies to power remote clinics. This is particularly true with wind power coupled to a diesel or PV system to form a *hybrid* power system. However, both wind and hydro systems are electromechanical in nature and require the upkeep of rotating machinery including electric generators. Additionally, their applicability is highly geographically dependent—many areas of the world do not have the required wind or running water resource. For these reasons, they are not as elegant a solution for many remote clinic-size energy requirements as that provided by the photovoltaic option. Indeed, many remote clinics will not need more than 2000 watt-hours (2 kWh) of electric energy per day. With this in mind, the present chapter will focus on the description and explanation of small stand-alone photovoltaic power systems suitable for remote health care facilities.

The sun radiates immense power, i.e., energy per unit time. Most of the sunlight reaching the earth's surface has a wavelength between 300 and 2000 nm. (By com-

parison, the visible spectrum is between 400 and 700 nm.) Because of the great distance between the earth and the sun, the intensity of the sun's radiation is greatly attenuated by the time it reaches the earth. At the earth's surface at sea level on a clear day, when the sun is near the zenith, the incident *power density* (watts/cm^2) is about 100 mW/cm^2. This is equivalent to 1 kW/m^2. At elevations of 2000 meters above sea level, the power density can be as high as 120 mW/cm^2. As the elevation increases, more and more of the solar insolation is in the energetic blue end of the spectrum. (This is why people easily get sunburns when they travel into mountainous regions.) In remote locations with frequent sunny days, the generation of electric power through photovoltaics becomes very attractive. As an example, in central Uganda, the average daily solar *insolation* (illumination intensity) on an annual basis is about 6.5 kWh/m^2. If that sunlight falls on a 1 m^2 photovoltaic system with an overall system efficiency of 10%, a total of about 0.65 kWh of energy per day would be recovered for useful work. This would be sufficient to drive five 20-watt high-efficiency compact fluorescent lamps for six and a half hours per day. Many sunny (not necessarily tropical) parts of the world are well-suited for PV remote electrification.

Certain tropical areas can experience less average sunlight during the year than many cooler areas on the globe. An example is the coastal region of Equador. Though it is positioned on the equator, this region averages only 4.0-4.5 kWh/m^2/day due to inclement weather. By comparison, southern Mongolia at 45° north latitude is cool and windy, but averages 5.0-5.5 kWh/m^2/day because of the very dry cloudless conditions. Maps of average daily incident solar energy are readily available.[5]

The heart of any photovoltaic system is the solar cell. Solar cells are large-area semiconductor devices. They are governed by physical principles similar to those seen in transistors and other devices common to the microelectronics industry. The first solar cells were fabricated and extensively studied in the mid 1950s at Bell Telephone Laboratories. Those cells were made from silicon wafers and had sunlight-to-electricity power conversion efficiencies of about 6%. Modern cells are about 15% efficient. Today, solar cells are used to generate electric power in a variety of remote terrestrial environments.[5] The most common applications are water pumping in isolated villages (Fig. 2), as well as village lighting and telecommunications (Fig. 3). In 2003, worldwide production of photovoltaics for terrestrial use came to about 744 megawatts. The photovoltaics industry worldwide is growing quickly.

Because the power density of sunlight is low, the power output of an individual commercial silicon solar cell is only about 3 watts per cell. And the voltage output of an individual commercial cell is only about 0.5 to 0.6 volts. These characteristics are insufficient for most practical applications. To deal with this, cells must be electrically connected together to yield a useable output power and voltage. This connection takes the form of a *module* (Fig. 4). Most modules have 33 to 72 cells. However, the largest module now on the market has over 100 cells and produces over 300 watts of power. The module structure also provides mechanical support for the cells and protection from such environmental hazards as hail stones and water ingression.

The module is the minimum deployable photovoltaic unit. Commercial photovoltaic power is always sold in the form of modules, and never as individual cells. A group of modules is referred to as an *array* (Fig. 5). In their brochures and marketing literature, photovoltaic module manufacturers quote prices in terms of *cost per watt* ($/W) for the module. The end-user can buy modules directly from a module manufacturer; but more commonly, business is done by way of a *system integrator*. A system integrator obtains the modules and all of the associated module mounting,

Figure 2. A 1-kilowatt PV deployment provides water pumping (*Photo courtesy NREL/PIX.*)

Figure 3. A 2-kilowatt PV deployment provides village electricity. (*Photo courtesy SEIA.*)

energy storage, and control equipment (the so called "*balance of system*" equipment or "*BOS*") and connects everything together. After a quote has been provided and a contract agreed upon, the system integrator installs the complete photovoltaic system. The end-user is advised on how to maintain the system, which is usually only battery hydration and module cleaning. The whole process of installing PV is fairly simple. Installation of a system for a clinic can be done in one day.

Photovoltaic modules come in two generic varieties: those made from *crystalline silicon wafers* and those made from *thin-film semiconductors*. Crystalline cells have historically been manufactured from wafers that are cut from large ingots, or from ribbons that are solidified from a silicon melt. The wafers are square in shape, about 250-300 microns thick, and between 100 and 250 cm^2 in area. In 2003, crystalline

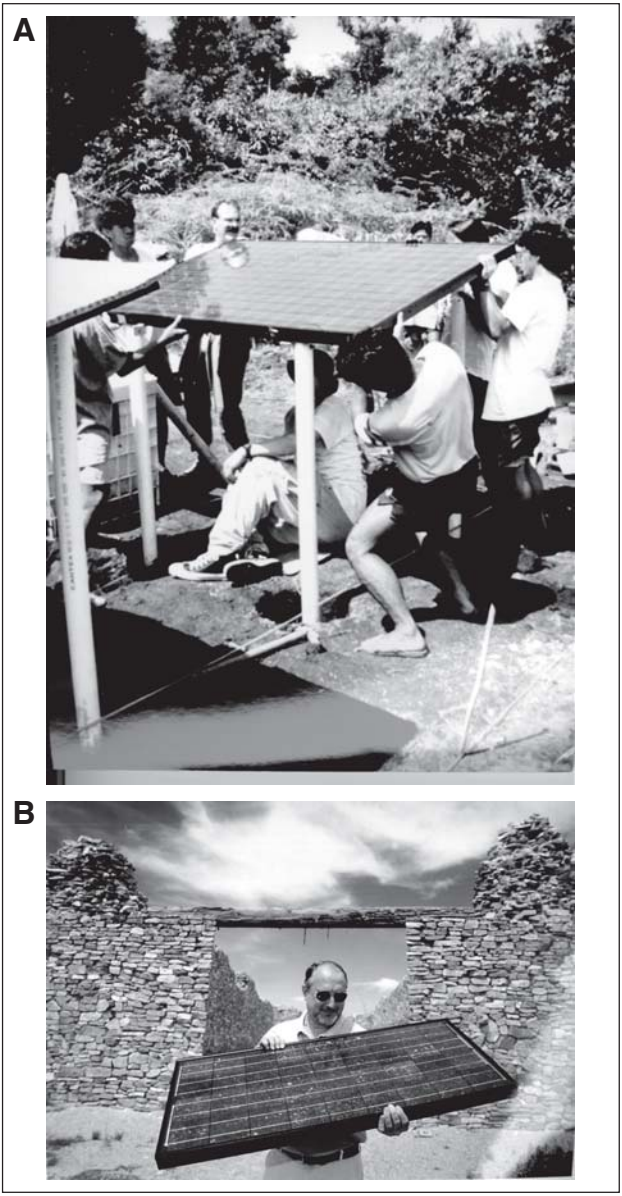

Figure 4. Photovoltaic modules: A) A 300-watt polycrystalline silicon module is part of an array at a remote facility in Borneo (*Photo by S. Thornton, courtesy NREL/PIX*); B) This 45-watt module is easily carried to a remote site (*Photo courtesy U.S. Department of Energy.*)

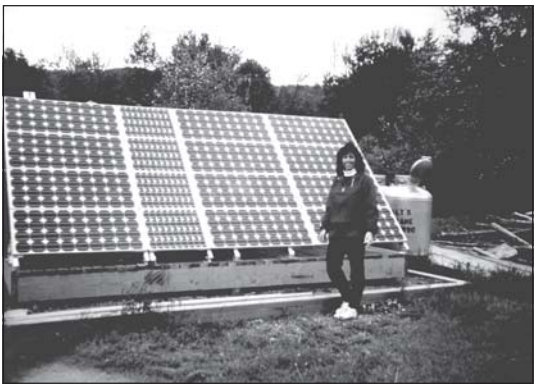

Figure 5. A number of modules are electrically connected to form an array. This array supplies about 1 kW of power. (*Photo courtesy NREL/PIX.*)

silicon accounted for about 90% of all module production. The modules achieve about 14% sunlight-to-electricity conversion efficiency.

Thin-film modules, on the other hand, are a newer approach to photovoltaics which has generated much excitement. They often take the form of *amorphous* silicon deposited on an inexpensive substrate, e.g., rigid glass plate or flexible stainless steel ribbon. Production of commercial modules started in the mid-1980s, and some of these products are now integrated into roofing shingles. Amorphous silicon modules have efficiencies between 6% and 8%. In the late 1990s, two other thin-film PV technologies started to receive much attention, namely, modules made from cadmium telluride (CdTe) and modules made from copper indium gallium diselenide (CIGS). Conversion efficiencies for modules made from these materials are about 8% and 10%, respectively. Because of maturity and performance, it is safe to say that modules made from crystalline silicon wafers will remain the dominant PV technology through at least the year 2012, and perhaps well beyond.

In 2003, crystalline silicon and thin-film modules were selling for about the same retail price—*US$ 3.00 to 3.50/watt*. From the purchaser's standpoint, the major difference between the crystalline and thin-film options is found in the module warranties—and, by implication, the likely reliability of the technologies. Because of the maturity of the crystalline silicon technology, these modules now come with 25- to 30-year warranties. Crystalline silicon modules are very robust and are not expected to suffer more than one percent total rated power degradation per year. Thus, a 25-year warranty assumes the module will achieve at least 75% maximum power output after 25 years in the field. And this is probably a conservative estimate. On the other hand, as of 2003, thin-film modules still have shorter warranties.

Balance of system equipment includes *batteries* for storing solar energy, a *charge controller* to allow correct charging and discharging of the battery, a *current inverter* for producing alternating current (if any AC appliances are in the clinic), circuit breakers or fuses for safety, *mounting hardware* for securing the array, and *electrical wiring*. All of these things are necessary to make the entire system work. The BOS is *independent* of the particular module technology. It is determined by the required performance and environment of the system. Some items in the BOS are not as

robust as the PV modules. Batteries, in particular, may last as little as one year to as much as ten years. Inverters last from 5 to 10 years.

Initial expense for the balance of systems *can be equal* to the cost of the modules. The most expensive items in the BOS are the batteries and the current inverter (if AC power is required). While inexpensive shallow-cycle automotive batteries are often used to store solar energy, deep-cycle PV industrial batteries (sometimes referred to as marine batteries) are much preferred from the standpoint of reliability and battery life. Unfortunately, these batteries are four to eight times as expensive as a car battery with equivalent storage capacity. As of 2004, the installed price for an 800-watt photovoltaic system, with the full BOS equipment, is about US$ 6,000. (Delivery is extra.)

Initial expenses can be kept down by hiring competent local personnel for the installation, as opposed to foreign technicians that must travel long distances. Fortunately, the major PV module manufacturers and system integrators have installation representatives throughout the developing world. A final installed system cost of about US$ 8-9 per watt is impressive when one considers that the system will function with only a few interruptions for at least 20 years. Most of those interruptions will be of the preventive maintenance variety, e.g., battery and inverter replacements. Maintenance costs for an 800-watt clinic system are in the range of US$ 800-1200 every six years or so. In general, the best way to keep replacement and maintenance costs to a minimum is to start off with the best components. While photovoltaics is not yet competitive with central-station power found throughout the industrialized world, the cost and characteristics of a small PV system provide an outstanding trade-off between expense and reliability in a remote setting.

The greatest impediment to converting a remote clinic to photovoltaic power is the initial cost. A number of developing nations have responded to this by establishing formal programs for equipping remote clinics with PV power systems. These include, in various degrees of deployment, 600 systems in South Africa (supported by the national Independent Development Trust), 150 systems in Mozambique (supported by the Solar Energy for Rural Health Facilities project of the Norwegian Development Agency), 113 systems in Cuba (supported by the Cuban Government), and 54 systems in Gambia. These deployments are usually less than 1 kW in power. Additionally, Peru, Indonesia, Zambia, Eritrea, and Myanmar each have at least several hundred PV powered vaccine refrigerators in operation. The ministries of health in Mexico, Panama, and Brazil have also installed numerous PV powered vaccine refrigerators. While there are several well-known organizations that assist in the placement of remote PV power, e.g., the World Bank and the U.S. Agency for International Development (USAID), these efforts are oriented toward large-scale programs involving many clinics. The World Health Organization (WHO), and its subsidiary, the Pan American Health Organization (PAHO), have been very involved in the placement of PV vaccine refrigeration, but mostly from the standpoint of providing logistical and engineering support, rather than funding. Both WHO and PAHO publish literature explaining the installation of photovoltaic systems. The PAHO has a catalog (English and Spanish editions) that lists approved equipment, including refrigeration, for health care facilities. For political reasons, all of these organizations must work through the ministries of health in the respective countries of deployment.

For the physician wishing to equip his/her individual clinic with PV power, the best way to obtain financial help is through nongovernment organizations. This

means private charities, churches, nonprofit foundations, etc. Since child vaccination programs are a major objective of remote health care, organizations that support such efforts are good candidates for providing financial assistance. In general, charitable organizations are most likely to assist in PV deployment when the request for aid is made in the context of extending health care, rather than in the context of technology demonstration. There are some organizations, e.g., the Winrock Foundation in Washington, DC, and Solar Energy International in Carbondale, Colorado, that sometimes assist with in-country logistics even if they do not contribute funding. The ministries of health and the embassies of individual countries are good starting points for information about in-country help.

Equipment and Characteristics of Small Photovoltaic Systems

All solar cells produce direct current (DC). This is the mode of current that is supplied by a battery, as opposed to the current from a wall outlet in a home or commercial building. A wall outlet supplies 50- or 60-Hertz alternating current (AC). If alternating current is desired from a PV system, a small electronic device known as an inverter (current inverter) must be employed to change the direct current into alternating current. Both DC-output and AC-output photovoltaic systems are common, and the decision to configure the system one way or the other is based on the types of electrical loads that will be powered by the system. It is advisable to avoid the use of AC equipment if this is convenient, because the inversion process of DC into AC is only about 90% efficient. However, some applications require AC power, either because the given piece of equipment operates most reliably in an AC mode or because DC compatible equipment is not available. This includes most tools with electric motors and any piece of equipment that uses a built-in transformer. To provide flexibility, many remote clinic PV systems are designed to supply both DC and AC.

In any case, whether the object is supplying DC power or AC power, or both, the system is always interfaced to a battery bank. That is, the DC output from the PV modules serves the immediate purpose of charging batteries, and those batteries in turn will supply power for DC appliances and for DC-to-AC inversion. Except for a few applications such as daytime water pumping, one seldom finds small remote PV arrays without a battery interface. There are two reasons for this that are particularly germane to a clinic.

First, remote clinic applications require uniform power for lighting and medical appliances. This result cannot be accomplished without a battery interface because the output of a photovoltaic array is approximately proportional to the intensity of the sunlight. Direct connection of the array to the loads will result in wildly varying power as the sun is transiently obscured by clouds and (less quickly) as the sun climbs and falls in the sky. Additionally, telecommunications and other equipment are sensitive to small voltage variations and can be damaged if the voltage is not regulated. A battery and charge controller combination will maintain a constant output voltage. Secondly, a battery interface is necessary for PV energy storage so that the clinic can function after dark when the modules have no output. The only cheap and simple way to allow functionality after dark is with rechargeable batteries. And there is also the related issue of *autonomy*, i.e., the ability of a PV system to maintain power during extended periods of inclement weather. It is not unusual for tropical environments to experience several continuous days of extreme cloudiness and rain on a seasonal basis. Consequently, most PV systems intended for a tropical

Figure 6. A bank of batteries in an acid-proof container stores energy from a 1-kW PV system. (*Photo by S. Thornton, courtesy NREL/PIX.*)

clinic will be designed with enough battery storage to allow at least several days of operation without any sunlight at all. The more critical the application, the greater is the storage capacity that must be built into the system.

Several different battery technologies have been used for PV storage, with the nominal 12-volt flooded lead-acid battery being the most common. This is the same type of battery found in automobiles. However, unlike automotive batteries, a flooded lead-acid battery specifically designed for PV purposes is able to survive many hundreds of deep discharge cycles—up to 80% discharge—without loss of storage capacity. As indicated above, these batteries are known as *deep-cycle* or *PV-industrial* batteries. The 80% discharge survivability feature is important from the standpoint of allowing the system to have several days of autonomy, on a frequent basis, without ruining the batteries. During good weather, the battery will be brought back to full charge every day. For 50% depth of discharge, a really good deep-cycle PV battery will survive over 3000 cycles at 25°C. With provision for a few 80% discharges every now and then, that's about nine years of service. Automotive batteries, by comparison, will fail after only a few 50% discharge/charge cycles.

Like an automotive battery, the special PV battery tends to lose water through the outgassing of hydrogen and oxygen toward the end of the charging phase. Periodic addition of water is necessary to maintain the correct electrolyte level (measured through specific gravity) around the plates. This is easily checked with a hydrometer.

If funds are available and the batteries can be readily obtained, the best approach for the PV powered clinic is to use the deep-cycle flooded lead-acid battery described above (Fig. 6). From a practical standpoint, though, this is often not possible. Most developing countries do not manufacture PV-dedicated batteries. The battery expense and import duties can be prohibitive, and government restrictions can be very frustrating. Some countries, e.g., India, require the use of only domesti-

cally manufactured batteries. More often than not, the clinic PV system will wind up using conventional thin-plate automotive batteries. This saves a lot of initial expense and is an easy way to proceed. However, the depth of cycling of the batteries must be carefully controlled. These cheap batteries can be expected to last only one year at the 20% discharge level, and maybe two years at the 10% discharge level, with temperature at 25°C. Overall, the system is not as reliable as with the PV-dedicated batteries and has little autonomy.

Regardless of the choice of battery, the single biggest cause of PV system failure is battery failure due to inadequate hydration. The battery is often the weak link in the PV chain. The user needs to be sure the system integrator has carefully explained exactly how the batteries are to be maintained. There are unfortunately many good PV arrays in developing countries that have been abandoned due to unnecessary battery failure. *High temperature quickly degrades battery lifetime* because of the accelerated plate corrosion. Keep the batteries in a cool enclosure (20°-25°C) and be sure to follow the manufacturer's instructions for periodic hydration.

A word of caution: the room or enclosure holding the batteries must have some ventilation. Toward the end of the charging phase, a flooded battery can produce an oxygen/hydrogen gas mixture. There is the potential for explosion or acid dispersal. Always use caution around batteries. Eye protection should be worn while servicing the battery bank.

All PV systems are designed with some method for electrically isolating the battery from the array at night. This is necessary so that battery energy is not wasted by reverse flow of charge into the array when the sun goes down. Most systems allow the user to program disconnect/reconnect times into the charge controller. Other systems have a manual on/off switch.

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Both solar cells and PV modules have peculiar characteristics that are helpful to keep in mind when purchasing a system or when comparing one system against another. One such characteristic of all solar cells is the dependence of their power output with the load they are driving. That is, the power which is delivered into the electrical load (lighting, medical appliances, etc.) is dependent on the size of that load. (This is contrasted with internal combustion engines.) Figure 7 shows a pair of typical current vs voltage curves at the terminals of the array. The two curves correspond to different illumination levels. For each curve, there is a point near the knee of the curve that maximizes the product of current and voltage, i.e., maximizes the output power. This is called the maximum power point and is dependent only on the size of the load. *The efficiency claimed by a module manufacturer, or by a system integrator for an entire system, is always in reference to the maximum power point of the module (or system).* In this regard, efficiency claims always assume an optimal load. When a PV system is designed, the system integrator will configure the load so that the array stays near the maximum power point.

On the module level, a curious characteristic is the dependence of power output on module obscuration. The output of a module is drastically degraded by partial shading. If even one cell in the module is completely shaded from the sun, the output of the module can fall immediately by as much as 80%. This phenomenon is reversible, and modern modules are expected to immediately regain full power output when the partial shading is removed. To assure optimal performance, though, it is important that all of the modules in an array receive full exposure during sunlight hours. Common sources of shading are trees, fence posts, and bird droppings.

Heat build-up around an array also affects a PV system because of the degradation of solar cell output with increasing temperature. The temperature effect does

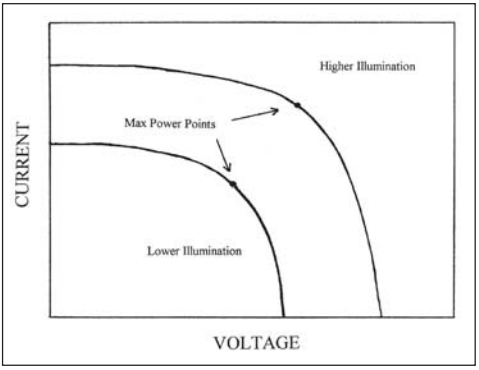

Figure 7. Current vs voltage curves for high and low illumination levels. The system is designed to operate near the maximum power point regardless of illumination level.

no damage to the module, and it is completely reversible when the module cools down. But it should be avoided to optimize performance. With this in mind, it is important that modules not be mounted flush against a roof when deployed in a tropical location. Even if the ambient air is only 25°C, the module can easily reach 60°C due to absorption of the infrared part of the spectrum by the module back plane (usually rigid polyvinyl fluoride) and the roofing material. For a roof-mounted array, the installer will always allow at least 10 cm of ventilation space between the array and the roof. More frequently, an array will be mounted on angle iron or steel pipes that are fixed in concrete supports (Fig. 8). This assures stability in wind storms and allows for plenty of ventilation that will keep the array cool.

Figure 8. Modules at a clinic in Sundarbans, West Bengal, India, are fixed to a frame and anchored in concrete. (*Photo by J. Welch, courtesy NREL/PIX.*)

Table 1. Example of equipment for a PV-powered remote clinic

Appliance	Mode	Power (Watts)	On-Time (Hrs/Day)	Daily Energy (Watt-Hrs)
Vaccine refrigerator/freezer	DC	60	5-10	300 - 600
Ten 18-W fluorescent lamps	DC	180	5-10	900 - 1800
UV water disinfector	DC	60	1	60
Optical microscope lamp	AC	15	1	15
Centrifuge	AC	150	1	150
Suction pump	AC	60	1-4	60 - 240
Autoclave	DC	660	1	660
VHF 2-way radio	DC	30	1	30
19-inch color TV	AC	60	1-4	60 - 240
VCR	AC	30	1-4	30 - 120

Application of a Photovoltaic System in a Remote Clinic

Figure 9 shows a schematic diagram for a complete photovoltaic system suitable for a remote clinic. The system supplies DC power from the batteries and AC power from the inverter. Table 1 lists the appliances that might be found in a relatively well-equipped remote clinic[7] powered by the PV system in Figure 9. For this clinic configuration, the total daily energy consumption is between 2300 and 4100 watt-hours. In many tropical locations, an 800-watt PV array could meet this de-

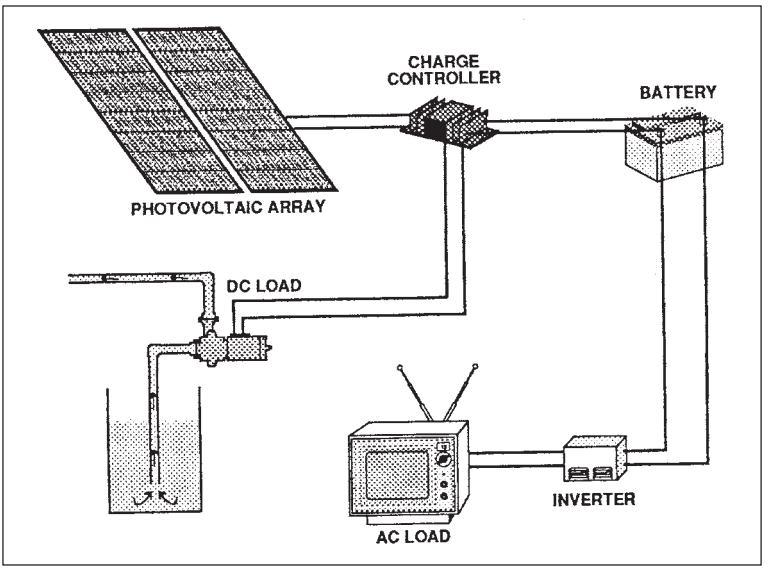

Figure 9. Schematic of a small PV system that supplies both DC and AC power. (From *Maintenance and Operation of Stand-Alone Photovoltaic Systems,* Sandia National Laboratories, 1991.)

Figure 10. A 55-liter vaccine refrigerator (with 34-liter freezer) specifically for use with PV power. The crated shipping mass for export is 91 kg. (*Photo courtesy Sun Frost.*)

mand while keeping a bank of batteries sufficiently charged to allow several days of autonomy. The system would also have DC and AC outlets for discretionary low-power equipment. Because an 800-watt system costs about US$ 6,500 installed, many remote clinics will not be able to have all of the equipment in Table 1. While the list in Table 1 is somewhat opulent, there are a number of PV-powered clinics with similar equipment now in operation. Examples include four remote clinics in Chocó Province on the Pacific Coast of Colombia. The inclusion of color TV and VCR might appear superfluous, however they serve as important teaching tools for community public health. At some clinics, TV/VCR community theaters also serve as revenue generators to help support the clinic.

The design of the entire PV system places an emphasis on energy efficient versions of all appliances. Repair services for a remote clinic are not readily available, and PV-compatible equipment must be designed for long-term reliability as well as energy efficiency. This adds to the initial expense but assures a system suitable for a harsh environment. Of particular importance to the mission of the clinic are the vaccine refrigerator, lamps, and water purifier system, all of which are available in high-efficiency versions specially designed for use with a PV system. An excellent list of photovoltaic equipment manufacturers and contractors is found on the Internet at www.seia.org. (Click on "Buy Solar".) Most of these companies have local representatives in various developing countries.

The World Health Organization distributes product information sheets available on the Internet that describe vaccine-related equipment suitable for remote clinics.[7] The WHO recommends that PV-powered vaccine refrigerators have their own dedicated modules, separate from the array that supplies power to other appliances in the clinic. This is to minimize the likelihood that an accidental overload from other appliances in the clinic might deplete the battery bank and subsequently cause a failure in the cold chain.

Several companies make rugged PV-dedicated vaccine refrigerators. Most of them also have an ice-making capability so that they can be used to store tissue samples and freeze ice packs. Two models, in particular, are discussed here. One is the Model RFVB-134a manufactured by the Sun Frost company (Fig. 10). This unit has a 55-liter refrigeration compartment and a 34-liter freezer compartment that can hold 12 kg of ice. It is specifically designed to run off a 12-volt battery which is charged by a PV system. Under the conditions of 2 kg ice production per day and an ambi-

ent temperature of 32°C, the daily energy consumption is only about 430 Wh. A single medium-to-large PV module, with its own battery storage system, would provide sufficient power. Several thousand Sun Frost refrigeration units have been manufactured. They are now deployed in over 50 countries with mean time between failure (MTBF) over 10 years. The approximate cost of the Model RFVB in 2004 is US$ 1700 plus shipping. This model is officially approved by the World Health Organization. A complete Sun Frost system, with dedicated PV module, is about US$ 2800, plus shipping. Another example is the Model SFRF-6 made by the Simpler Solar Systems company. This is a chest type refrigerator/freezer with a total capacity of 179 liters. It costs approximately US$ 1540 plus shipping. A large number of these have been sold to clinics in Africa. Vestfrost (a Danish company) also makes a popular PV-powered refrigerator.

Historically, water disinfection has been accomplished by chemical processes or by boiling. Recently, disinfection by ultraviolet (UV) irradiation has become popular. This method allows throughput of hundreds of liters per hour from a highly reliable, low-power, compact system. The UV light is supplied by a mercury vapor lamp with a strong emission at 254 nm. The lamp is similar to commercial fluorescent glass tubes used in homes and offices, except that the glass tube is not internally coated with phosphor which would absorb in the UV and emit visible light. It is fortuitous that such lamps are readily available and inexpensive because micro organism absorption and germicidal effect are maximum at about 260 nm. The World Health Organization has developed a standard of performance for official approval of water disinfection systems. This includes the capability of processing contaminated water so that an input concentration of 100,000 colony forming units (CFUs) of *E. coli* per 100 ml is reduced to less than 1 CFU per 100 ml at the water outlet.

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Water itself is highly transparent to UV light. Absorption is by the particles and organisms in the water. Thus, for UV water disinfection, it is appropriate to speak of dose in terms of energy per unit area, rather than energy per unit volume. For a sample of water a few centimeters deep, a dose of 80 milijoules per square centimeter (80 mJ/cm^2) will disable 99.995% of waterborne viruses and bacteria. However, UV treatment alone will not disable microorganism cysts with protective coverings such as Giardia and Cryptosporidium, nor will it disable larger organisms such as amoebae and worms. A preirradiation filter must be used to remove such organisms and also to remove fine turbidity. This can be done with a 2-micron or 5-micron particle filter. Sometimes a sand filter can be used for this purpose. A carbon filter can be used if chemical contamination is also present.

There are now several UV water purification systems on the market. One example of a very successful water disinfection system is the UV Waterworks model manufactured by WaterHealth International, Inc, (Fig. 11). The energy requirement for this unit is about 10 Wh per hundred liters, making it ideal for a PV-powered environment. The standard model can provide enough drinking water for 500-1500 people per day. One of these units at a clinic can insure safe drinking water for an *entire village*. After preirradiation filtering, the system works by allowing a continuous stream of gravity-fed water to flow into a shallow stainless steel pan. The water is exposed to the UV light for 12 sec and receives a minimum dose of 80 mJ/cm^2. Extensive independent laboratory testing has confirmed the effectiveness of the disinfection. The disinfection unit has a mass of only 7 kg and the whole system is easy to set up and use. Maintenance is minimal and includes replacing the UV lamp every year, and the transformer every 5 years. An interesting safety feature of the UV

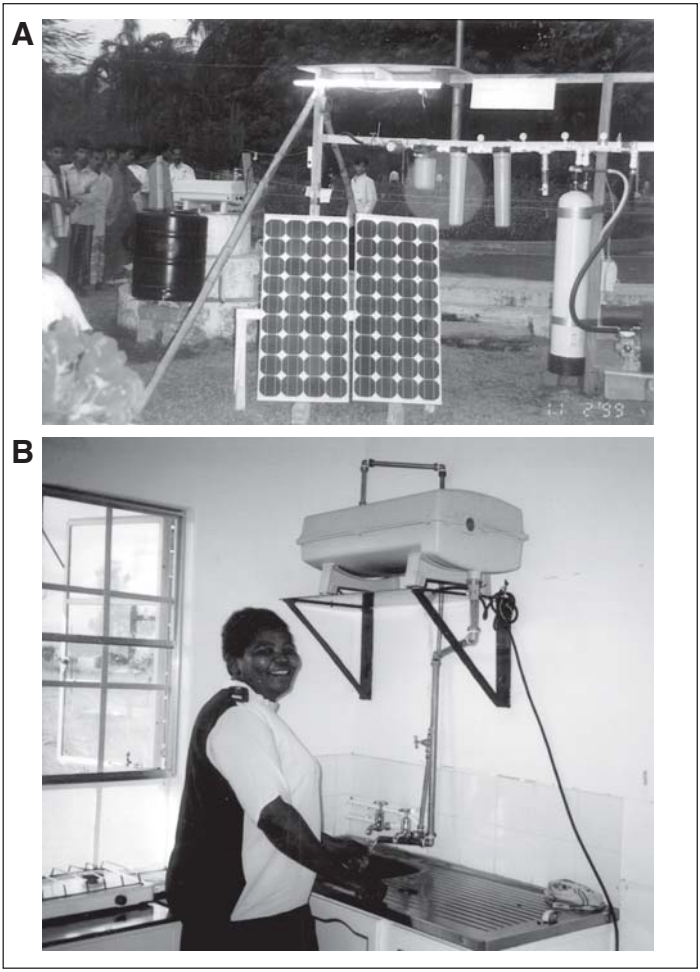

Figure 11. A UV water disinfection unit specifically for use with PV power. A) UV unit with predisinfection filters in Bangladesh; B) UV unit at a facility in South Africa. (Photos courtesy WaterHealth International, Inc.)

Waterworks is that the input water is automatically shut off if electrical power is lost or if the UV lamp is not sufficiently warmed up for full radiation output. Many of these systems have been deployed in Bangladesh, the Philippines, and other tropical countries.

After discussing the system requirements and geographical location with the user, the system integrator will calculate four figures-of-merit to correctly size the system. These are the expected minimum daily solar energy for the given geographical location, the required average daily watt-hours (which is energy), the required daily

ampere-hours (which is charge), and the required battery autonomy. The first two values relate to the array size. The last two values relate to the battery capacity. From these four values, the appropriate array size and battery size will be calculated. Software including climate data for various locations is available to help in system sizing. The customer can leave all of the calculations and design to the system integrator.

Summary

Small photovoltaic systems, on the order of 800-1000 watts, are becoming quite popular for electrification of remote health care facilities. This is attributable to their proven high reliability, independence from the challenging logistics and cost of fuel, safety, lack of pollution and noise, and reasonable price. These systems can provide both DC and AC power for lighting and all kinds of small medical appliances. As of the year 2004, there are hundreds of remote clinics that are completely electrified with photovoltaic technology, and thousands of clinics that have PV powered vaccine refrigerators. The technology is steadily evolving in terms of an increasing warranty lifetime for modules and a decreasing cost per watt ratio for complete systems. In the last few years, the market has seen more and more products specifically designed for use with PV systems and more companies to sell and install systems. While most photovoltaic modules are manufactured in the developed countries, manufacturers have representatives in developing countries who can perform the actual installation of a system. Much installation is done by companies that specialize in system design and equipment integration. After installation, the easy required maintenance consists mostly of battery hydration. Current trends predict a continuing expansion of PV deployment for remote health care. This interesting semiconductor technology is proving to be of great assistance in providing electricity-dependent medical services in remote areas of the developing world

Biography of Jeffrey Mazer

Jeffrey A. Mazer, Ph.D., is a semiconductor engineer with particular interest in photovoltaic devices and systems. He has published a tutorial book on crystalline photovoltaics with Kluwer Academic Publishers (1996). His email address is pv-engineer@starpower.net.

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CHAPTER 11

Tropical Nursing

Diana Downing

When locating to a new geographcal site and seeking to be an effective nurse among a new ethnic group, I have found it most helpful to conduct a cultural assessment in a systematic approach. As I become more familiar with the individuals, this knowledge base will be modified, but it gives me a framework for better communication and understanding. Culture refers to values, beliefs, customs, attitudes and behaviors that are shared by a large group of people and are passed from generation to generation. These deeply rooted characteristics are difficult to change, and affect the person's view of health and illness. The Andrews/Boyle Transcultural Nursing Assessment Guide is useful. The tool assesses the following:

- Cultural affiliations: birth site, tribe, cultural group.
- Values orientation: beliefs concerning lifestyle, work and leisure ethic, death and life, stigma associated with current illness, education, privacy, how is change perceived.
- Cultural sanctions and restrictions: how are emotions expressed, modesty, clothing, restrictions to surgery, fertility and deliveries, naming the baby, gender issues between the patient and healthcare provider, promiscuity and polygamy, male and female circumcision, taboos of subjects discussed, spitting, left-handedness.
- Communication: language spoken and written, verbal and nonverbal expression, eye contact permitted, is an interpreter needed for the healthcare provider, how does the patient prefer to be addressed; when counting—does one begin with the index finger or pinky or thumb, is the mother tongue used for the educational language, what are acceptable hand signals (for "come here", height of a person or animal).
- Health-related beliefs and practices: causes of disease (punishment, hex, pathogenic organism, yin/yang), concept of body size, shape and color, name and description of diseases, what promotes health, cultural healers involved, perception of Western medicine, what is the appropriate "sick role", family planning.
- Nutrition: significance of food and eating, social or solitary activity, timing and frequency of meals; how foods are procured, prepared and by whom; fasting, religious mandates, identify foods which are supportive or ruinous to good health.
- Socioeconomic considerations: social support and network, family participation, wage earner, insurance, ability to obtain healthcare and transportation for same, measures of success, child labor isssues.
- Organizations providing cultural support: (when in a multicultural setting): churches, schools, NAACP, clinics, government.

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- Educational background: highest educational level of patient and affect it has on his healthcare; effectiveness of written materials, learning styles (through story telling or demonstrations, auditory or visual learners), choice of which language used for teaching (usually mother tongue most effective).
- Religious affiliation: affect of one's religion on health or body image, special rites or blessings, healing rituals, religious healers, role of religious leaders (priests, imans, monks, elders, pastors), superstitions (not naming the infant until the cord falls), icons, scarring.
- Cultural aspects of disease incidence: genetic or acquired conditions prevalent (hypertension, sickle cell anemia, Tay-Sachs), increased resistance to particular diseases (malaria in sickle cell).
- Biocultural variations: physical features, height, weight, supranumery digits
- Developmental considerations: care of babies and elderly, perception of aging, assessing children's growth, discipline (Andrews MM, Boyle JS: *Transcultural Concepts in Nursing Care*, Second Edition. Philadelphia: JB Lippincott, 1995).

The goal, in transcultural healthcare, is to preserve the positive or neutral cultural behaviors affecting health and modify the behaviors negatively affecting wellness in a manner that respects the heritage and preferences of the individual.

Professional Diversity in Transcultural Nursing

It has been my priviledge to participate in transcultural nursing, being ever mindful of the mission that placed me in that setting. Often, the flight to "lands far away" to provide healthcare in a Third World culture begins with the realization, during childhood or young adulthood, that we as westerners have unlimited resources compared to the majority of other populations of the world, promoting our desire to share the knowledge and skills we possess. The richness we gain in friendships with those of another culture, the insight into self, and gained appreciation for life far outweigh inconviences or perceived sacrifices on our part. A driving force for me was the compassion modeled by my parents during their interactions with less fortunate, as well as stories and photos my parents' peers related as they cared for others worldwide. Travelogs, such as the adventures by Martin and Osa Johnson in Borneo and Kenya, gave rise to my desire to become acquainted with people of other cultures, and to assist them toward longer and more comfortable lives. Nursing seemed to be the key to open this door. I have not been disappointed!

Nursing is a diverse profession, but when engaged in the tropics, the diversification seems unlimited and vital. Roles of the nurse include that of practicioner (diagnosing and treating), administrator, educator, midwife, public health nurse, mechanic, parent, host or hostess, student, member of a greater society. Depending on the remoteness of the clinic or hospital, these roles widen to fit the needs. The broad scope of work needed is a reminder to stay focused on the productive aspects of health promotion and disease prevention in a culturally sensitive approach.

Preparation for Nursing Experience

Nursing in Third World countries is often delivered in sites with few physicians, if any, to consult. This necessitates thorough preparation in understanding the process of diagnosing and treating diseases. Several years of nursing experience is helpful, and becoming a Nurse Practicioner or completing courses in tropical medicine, anesthesia or midwifery are recommended.

Language acquisition is imperative, as communicating effectively is vital to providing medical and nursing care. The books *Language Acquisition Made Practical* (*LAMP*) or *Language Learning and Mission* by Elizabeth PhD and (the late) Thomas Brewster, PhD are extremely practical and helpful guides in learning and using languages. The Wycliffe Summer Institutes of Linguistics are superb in language training. Tapes of some of the more common languages are also helpful. On site, a fearless language coach is invaluable for correcting pronounciation, inflection and idiom. In the beginning, a list of helpful common medical phrases enables one to memorize quickly and get started with patient care. We all have our horror stories of mispronouncing a word leading to unintended meanings! Practice giving health instructions and taking histories with someone who won't mind.

A library for personal reference, teaching, mental refreshment and stimulation is valuable. Have available great texts on subjects such as surgery (I appreciated Dr S. Swartz' surgical textbook), medicine, pediatrics, a PDR, *Manson's Tropical Diseases*, *CPR* by American Red Cross, *Midwifery*, public health, nursing, accounting and economics (how to write grant applications!), immunizations (*Epidemiology and Prevention of Vaccine-Preventable Diseases* by CDC), anthropology, children's books for young visitors. To remain current in the field of medicine, subscriptions to medical journals such as the *British Journal of Tropical Medicine*, are invaluable. For teaching, it is essential to have a stock of visual aids and charts on nutrition, childbirth, transmission of disease, hematology and parasites, oral rehydration, skin and eye diseases, etc. Also books for recreation are appreciated: spiritual and historical bios, poetry, art, sports, handiman's journal, encyclopedias and world atlas, history of music or whatever is of interest to the individual.

Providing Equipment and Supplies

A tremendous challenge in tropical nursing is to remain within budget yet viable as a healthcare institution. Having a team of friends ever on the lookout for used equipment in good repair is a great asset. A quick look around our O.R. showed used tables (nonelectric), stainless steel basins and bedpans that had been replaced with plastic supplies elsewhere, glass syringes no longer used, glass thermometers. As hospitals merge or downsize, often this equipment is given away. In a Stateside O.R. or labor and delivery, sterile equipment that is opened but unused is discarded. A collection box in the supply room can amass enough equipment to supply a Third World hospital for a year or more, as labor costs for resterilizing are cheaper than purchasing it. This method is great for collecting suture, catheters, sponges, ace bandages, gloves, drains. Inexpensive wraps for reautoclaving equipment can be sewn from muslin or cotton sheets. I used fabric of various colors to color-code the wraps and covers to make repackaging easier.

A treadle sewing machine can be a nurse's best (almost) friend in setting up a hospital by sewing the patient and fenestrated drapes, equipment and instrument wraps for autoclaving, Mayo stand covers, glove wrappers, curtains. For maternity, I enjoyed sewing baby blankets and shirts. I had a carpenter make little cribs to accommodate the buggy-sized mattresses I had brought from the States, then sewed soft flannel fitted sheets.

One elderly gentleman whose chest was burned in a flareup while huddled in front of an evening fire, routinely pulled off his bandages and picked at the wounds. I sewed several cotton vests with ties that remained secure between dressing changes until the burns had healed. For mobile village clinics, keeping equipment handy

and organized was a challenge. I sewed a folding table-sized mat with pockets for holding a stethoscope, BP cuff, note papers, pens, paper clips, patient registery, etc, each pocket was velcro-closed. It opened out on the hood of the car, providing an instant nurse's desk. Disposable hand wipes for village work are quick, effective, and won't mold like wet washclothes.

Care of the Infant and Child

Care of the premature infant is an acute challenge in a nontechnical setting. Great efforts and planning are required to provide adequate prenatal care to support full-term babies. If the government doesn't have a standardized prenatal visit card for following the pregnancy, one can be easily created and copied. Treatment of existing conditions such as STDs, malaria, anemia, parasites, and TB should begin as early as possible, even prenatally if the woman presents herself to the clinic.

During prenatal visits, in addition to the usual monitoring, the waiting time can be used to great advantage to include teaching of public health measures (handwashing, oral rehydration therapy, use of latrines, safe drinking water, prevention of AIDS), care of the Mom and newborn, and safety issues. Stressing an alcohol-, drug- and smoking-free pregnancy can make the difference between a viable and a lost pregnancy. Alcohol is the leading known teratogen. As the initial contact with the healthcare system for many women is during pregnancy, planning is needed to make this experience user friendly and helpful to her. Prenatal care includes prevention of infections, malaria prophylaxis (Chloroquine 250 mg base weekly is effective), iron supplements, prenatal vitamins, iodine replacement (1 ml Lipiodol IM) if she is in an iodine deficient location. If the mother hasn't been immunized against tetanus, she can receive the tetanus-diptheria (Td) vaccine at seven months gestation and a booster at eight months (a month between the first and second injection). This schedule will provide the newborn with transplacental antibodies to prevent neonatal tetanus if born out of asepsis. Also, Hepatitis B vaccine can be given during pregnancy, and at birth for the neonate. Temperatures greater than 39.5° are associated with pregnancy loss and CNS anomalies in the first trimester and preterm labor in the last trimester; many of these febrile episodes can be avoided with malarial prophylaxis and treatment of infections.

Careful obstetric histories often reveal very sad outcomes, many of which could have been prevented. For a history of spontaneous abortions early in the second trimester, an incompetent cervical os may be diagnosed. This can be easily treated, even in outlying clinics, with a cervical cerclage, enabling the pregnancy to continue to term.

Care of the premature infant in a low-technology environment can be successful. Maintaining an adequate body temperature of 37° can be accomplished with a warm water bottle, or if that isn't available, warming some bricks at the edge of a fire. These, of course, have to be wrist-tested to ensure they are a safe temperature for the infant, then wrapped in a baby blanket and placed alongside the infant. They are particularly useful for the cold tropical nights. The family enjoys learning and following through with this technique. One day a young mother with a seven pound baby greeted me at the maternity, having walked for over 50 miles to show me her "newborn". The baby had been born prematurely in the village, many weeks before, and she had kept the tiny preemie warm with the heated bricks—she was so pleased the villages' talking drums had passed on this new idea.

Premature neonates, under 1650 grams usually have to be gavage fed, aiming for 120 kcal per kilo per day. I have found the 15" Fr. 5 tube to work well, gravity

feeding slowly to encourage retention of the feeding. Often the mother or a relative can express breast milk until the baby is strong enough, and the sucking/swallowing reflexes are coordinated. The neonates of cretins and hypothyroid mothers are very delayed in their sucking reflexes, and these babies need gavage or preemie bottles with the intake monitored carefully. The cretin mother's production of breast milk is usually delayed by several weeks, necessitating supplementation to ensure a weight gain of at least 25 grams per day. She also needs careful training in breastfeeding skills, as, while the milk production is a natural process, the skill to coordinate baby's mouth to the areola usually needs to be taught and monitored. The joy that the mother experiences with having a satisfied and growing baby is worth all the midnight and early morning hour trips over to maternity to feed these tiny newborns!

One significant influence on having full term babies and healthier children is the level of education of the mother. According to the World Bank studies in 25 countries, even one to three years of maternal schooling reduces child mortality by about 15 percent. Educated women are more likely to access prenatal care, delivery assistance, and information on health and safe drinking water. For this reason, maternal education was encouraged during the prenatal visit classes, well child clinics, and community meetings. I worked closely with the local school teachers to assist in the health education curriculum, maintain the health of the students and faculty, and obtain supplies for the school. One of the best investments for health promotion is education of children, particularly girls as their education affects the lives of their offspring to a greater extent than that of the fathers.

Immunization clinics are profoundly important to protect the lives of the babies and children. Often these children are already poorly nourished, anemic, immunocompromised, and a childhood illness which may cause a mild illness for a child in a First World environment, often proves fatal for a Third World child. The ever present challenge for vaccines is transport and storage which maintains the cold/freezing temperatures required. This is particularly difficult in hot climates. The refridgerator models with solar energy have worked well if maintained properly. Immunization, growth and development records are vital for the parents to protect and present at the clinics. The measles vaccine can be safely administered to a baby of six months of age during an epidemic if a second dose to raise the antibody level is given after 12 months of age. This vaccine is highly efficacious, providing protection within seven days and saving the lives of many, many children.

The nursing career in a Third World country is extremely diverse, requiring creative approaches to time-honored principles of application, constantly assessing the outcomes. The satisfaction and joy exceed the frustrations when one reflects on the healthier and more comfortable lives one has touched.

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CHAPTER 12

Communication in the Third World: A One-Way Street

Jim Bascom

Over the last decade there have been radical changes forced by the Internet and the exponential growth of health sciences information. We see an increasing speed of change in economic, political and social sectors that seriously impact health services. Much of the impetus for the acceleration is atributable to the maturing of applications of the computer, especially in communication. The developing world benefits and suffers at the same time from the effects of technical and scientific progress. Too often we see chaos come out of well-intended but inappropriate order.

In 1985 the developing world and the countries at the end of the era of communism were banned or increasingly unable to access Western mainstream medical information particularly as presented in paper journals and texts. The problem had achieved crisis proportion. At the same time they were either politically prevented from publishing their own material or excluded from publishing by the rising cost of paper and ink while their own economies were failing. Research was increasingly short of funds, and the citations of literature from developing countries decreased 40% over the next ten years.

At this time I was working in Saudi Arabia and our well-funded library was cutting journal acquisition because of cost. I joined with a young computer expert, and we put archives of medical journals on CD-ROM discs in an effort to provide a cost effective and paperless media thus facilitating the distribution and storage of information in the health sciences. This provided a collection of about 10 journal archives that were a first in full text searching and included all images. However by 1990 the Internet was becoming a communication wonder. In 1990 to 1994, while living in Romania we placed computers and modems in medical libraries at seven universities that established Internet access. This facilitated communication with the rest of the world that for decades had been banned except in a very controlled and limited way. Within two years the uniqueness of the computers we introduced was gone. The universities and individuals had acquired computers and were connected to the Internet and developing their own applications and access.

By 1994 the CD-ROM discs produced by our company and others were being transcended by the increasingly cheaper useful content available on the Internet.

In 1995 I started visiting Tajikistan in Central Asia as part of program funded by USAID and administered by the American International Hospital Alliance (AIHA). This program matches individual hospitals in the USA with similar institutions in the NIS (New Independent States) and Russia. In both Romania and Tajikistan I worked primarily with the universities of medicine to again connect the schools with the rest of the world via the Internet. Civil chaos reigned in Tajikistan and the

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program eventually had to be terminated. While working with the universities there and in Romania it was becoming increasingly evident that there was huge innovation and brilliant adaptation on the part of the professionals to cope with socioeconomic problems. Civil war claimed Dr. Yusuf B. Ishaki, Rector of the Tojik Medical University, as a victim of assassination. These severe circumstances were stifling any efforts to continue delivering health care to the population. To some extent they had been innovating for years within a system of health care that was intent on limiting services and cost in inhumane ways. There was no recognition of the brilliance of these efforts or discussion of legitimizing the innovations with Ministries of Health that were still emulating the past. I tried serveral mechanisms to surface the good efforts without success. Indeed the notion of surfacing these efforts was anxiety-producing given the firm hand of the government still present.

In 1998 I initiated efforts to publish a journal of international health that has its goal the introduction of a body of literature that was derived from the "Third World" with an emphasis on surfacing these unique and worthy efforts to deliver the highest level of care in the milieu of social, political, and economic depression and often chaos. This effort is ongoing but fraught with attitudes of wanting to replicate the research and reports of the Western literature and a diminished sense of worth regarding the local efforts to cope. I have since expanded the communication and participation of developing areas to include Indonesia. The representation of Indonesia as the largest Islamic country in the world and regarding population the fourth largest country in the world is miniscule in the world literature. Hard times have fallen on Indonesia, and although it is recovering it has a long way to go. Our efforts to generate literature for the journal have resulted in some response. More importantly is the notion of an electronic (Internet-based) journal has caught the imagination of the Indonesian Medical Association that is starting its own journal, JIMA (*Journal of the Indonesian Medical Association*) on the World Wide Web in year, 2000. Success has been realized in a little different way than anticipated.

This saga is related to illustrate an evolution in "developing country" communication. Priorities over the last 15 years have been shifting very quickly driven by the technology of computers and the Internet. We started with delivering Western originated information on paper and progressed to CD-ROM, and then to the Internet. The next step in that journey is beginning to occur which is the legitimization of presentations of journals from the developing areas so long excluded from the world literature. The University of Norway is hosting the publication of the *Ethiopian Medical Journal* and other initiatives are being planned for Zambia that has tried and, for economic reasons, repeatedly failed to publish their national medical journal. The initiative to publish reality in cancer therapy for India is just starting with the *Austral-Asian Journal of Cancer* that is discussed further on in this chapter. Both the *British Medical Journal* and *Lancet* have been especially supportive of initiatives to support publication of material from developing areas. *Pediatrics*, the official journal of the American Academy of Pediatrics, has along with other US based journals, been leaders in innovation from being the first to offer a CD-ROM-based archive of its journal to publishing its journal in other languages and now offering both a paper and Internet-based journal.

There is still a role for the paper based journal, but it is difficult to define the role in a context any wider than local or national distribution. Each country is unique in computer accessibility and stages of development. The fact remains that paper publishing is relatively expensive, difficult to store and cumbersome to move about.

Communication and the rising dominance of the computer as the interface has deeply affected every aspect of health information management from library function to the publishing industry's struggle to redefine their business in the context of the Internet. This degree of change is so pervasive and fast that it is difficult to make definitive observations. A recent BMC software advertisement state "The constant and rapid changes in technology have left room for only two kinds of e-businesses: The quick and the dead." The following is an attempt to highlight trends.

Change has two faces: constructive and destructive.

Constructive

1. Low cost and high speed of communication globally. Information distribution and access is affordable for anyone with access to a computer. Memory devices and speed of processing are at technical peaks of practical utilization. Obviously, we haven't seen the end of spectacular development, but we have reasonably affordable and useful tools.

Pax Americana is global and all sectors of development are deeply affected. Communication is bridging barriers once thought to be impenetrable. The ease with which the barriers are collapsing is surprising. We are poorly prepared to deal with the magnitude and speed of change. But the change is real and must be engaged. A universal language (English) is de facto. The acceptance and functionality of the universal language is slower because of the human factors and a slower learning curve than the speed of change. Two solutions are being pursued: teaching the universal language and using the computer to translate rapidly. The latter has been a fascinating exercise in high cost, intellectual challenge, and limited results. Computer translation is the classic convergence of technology and human complexity. The fact remains that a universal language for communication in the health sciences is a necessary presence. A multitude of applications for managing health science information are emerging. Useful content should now be the focus. Four areas of understanding from exploration are resulting:

1. Categories of users (professionals, lay public, vested interest organizations, etc.).
2. Applications of the multimedia possibilities.
3. Mega-databases of diverse information.
4. The financial resources to sustain the application.

These areas of understanding will always be modified as technology and use expands, but over the last five years the bridge of legitimacy and functionality has been crossed in applying new technology for information handling. The rock of paper-based, peer-reviewed journal articles has turned to dust of confusion as we reconsider the functionality of the basic scientific article format itself.

Destructive

1. The glut of information has variable veracity. We have seen the exponential growth of information for several decades. Now the mix and anonymity of sources demands the user to be selective and very careful. No better example can be offered than the prurient email, "Fate of the Founding 56", circulated to the news media that distorts and dissembles the fate of the signers of the Declaration of Independence. The saga of misinformation using a historic event illustrates the pitfalls for even cynical experienced columnists. See "Web snares unwary columnist", 16 July 2000, by Sue O'Brien, editor of *The Denver Post* editorial pages.

(sobrien@denverpost.com). The health sciences literature is not bereft of such "dicey" examples.

2. The constant new versions and variety of software pushes up the cost and diminishes the ease of communication. This is especially a problem for colleagues in developing areas that need to have stability for purposes of containing cost, of hardware and software. It is interesting that in some developing countries the cutting edge of software and technical application is maintained in advance of one's own pace.
3. The gap of "haves and have-nots" (basically an economic designation) is expanding faster as the speed of change accelerates. This does not mean that advances are not occurring in the developing countries, but it does mean that "catching up", in a conventional sense, is increasingly impossible. Catching up is the issue central to this chapter and is discussed further on.
4. The gap in access to information via the Internet by developing areas is not so much the issue as is the abject lack of participation by professionals in developing areas. The research base for conventional health science endeavors is huge and expanding in economically developed countries. It is small, as a result of decades of neglect, and shrinking in developing areas. The information and research in developed countries is so dominant it excludes and dismisses research generated in developing countries. The participation of developing countries in the mainstream health sciences literature is nearly invisible. "Lost Science in the Third World" by W. Wyatt Gibbs in Scientific American, August 1995, pages 92-99, documents the severity and rationales of the problem.

Questions and Answers:

1. Does the developing world have anything worth saying?
2. Who speaks for the developing world?
3. What is the content, assuming usefulness in what is submitted?
4. What format is suitable for developing country submissions?

The evolution of information priorities has been slowly changing over the last 15 years. In 1985 there was no question about the need for access to developed nation's information in any form from books and paper journals to citation indices. Over the last 4 years access to the literature in an electronic format via the Internet has provided cost effective, fast access. What is emerging is a need for realistic reporting and research by and in developing countries. The need for information from the West obscured the gross deficiency in reporting by developing countries. Health care is a global concern and affects all countries regardless of economics of political boundaries. It is also a reality that most of the world's population has access to marginal health care services. This level of health services is going to persist for several generations and indeed is increasingly catastrophic. HIV in Africa is forcing reevaluation of how the rich nations are going to relate to the poor nations in matters of health. This dilemma can be expanded to many other areas of health sciences like malaria and tuberculosis.

British Medical Journal's "news extra" (BMJ 2000; 320: 1692 (24 June) reports from New Delhi a very important insight and perspective that has been too long in coming. Although the new journal, *Austral-Asian Journal of Cancer*, is focused on cancer it "is expected to provide a forum for devising palliative care strategies for developing countries." Dr. M Krishanan Nair, director of India's Regional Cancer

Centre in Kerala said, "The journal should stimulate a search for cancer strategies compatible with the socioeconomic realities in developing countries." He states what is evident, that doctors in developing countries often prescribe advanced drug therapy protocols discussed in Western journals. "This has jacked up treatment costs to such levels that cancer care has become inaccessible to a large number of patients. The great majority of tumours in developing countries are diagnosed late, and resources are directed at treating incurable conditions," said Dr. Mohammad Al-Jarallah, who is Kuwait's health minister and also a consultant surgeon and the journal's joint Editor-in-Chief. The full article provides several eye opening examples and insights.

This is an excellent step forward in dealing with the realities of health care in developing countries. The communication of alternatives demanded by the socio-economic realities is worthy of credible useful reasearch of the highest order. The complexity of developing countries' circumstances demands the best and brightest to address the problems. Developing countries, much like the term Third World, denies the uniqueness and individuality of each nation and region. Resources and problems vary so widely as to make the terms meaningless and counterproductive. We must learn to be discerning and specific when entering the arena of country and regional health matters. The *Austral-Asian Journal of Cancer* should be a beginning of communication and a field of research that is originated by professionals in developing countries and is about developing country health matters.

The challenge is to combine the information gleaned from the Western sources and the information generated in developing areas to apply to developing nations problems. The result should be a credible, legitimized body of research, articles and reports that has its place in the mainstream of global health sciences communication. This body of information will go beyond the visiting experts from the West who arrive and define the problem in Western terms then vanish. This will begin to put meaning and purpose into developing country-based professionals who are often highly frustrated by the technology and costly protocols they read about on the Web or other Western sources. Evidence-based practice is not widely affordable when the evidence is generated in an affluent community. Problem- and reality-based research and a new relevant body of literature and communication is needed.

It is a time of change and progress. The literature as we have known it is in flux. Information is being distributed globally by a variety of facilitated technologies most of which are computer-related. Content is the issue rather than the technology of communication. Admittedly the Internet is not fully developed, and there are many problems with the technology of the computer. But we have a tool that is so fast and cheap that it is not waiting for someone to use it but rather it is the driving force of change. As individuals and organizations adopt the technology, the forms of information exchange grow and modify our needs and the formats for information communication. The following is a list of innovations in communication devices and results of applications of the technology that are changing the way we obtain and use our information.

1. Standard articles in the health sciences archived in online databases or on CDROMs and other memory devices.
2. The National Institutes of Health proposed database that will include not only peer-reviewed articles but expert-reviewed articles and work in progress reports that will allow updating as research progresses. Virtually all submissions will be included and categorized. Commercial publishers are developing similar mega databases of information.

3. Live computer-mediated telemedicine consultations. Already implemented in some areas and a step away from more common use internationally.
4. The email-based communication that has exponentially grown over the last decade.
5. Disaster assistance and management via the Internet.
6. Multiple ".com" services for information access and sharing of opinion or consultaion in real time chats or more conventionally email-based.
7. Individual urgent requests for medical or monetary assistance distributed through organizational entities. These are variable in credibility, and one should be cautious with response.

These and many other worthy mechanisms and programs are exploring the landscape of health sciences communication and information management. This exploration is nowhere more urgent and potentially productive than in the developing, redeveloping and emerging health professional communities worldwide. It is for the talented and competent professionals residing in these areas to use the tools available and let their voices be heard and their dignity confirmed.

CHAPTER 13

Anesthesia in the Third World

John F. Williams

Introduction

Anesthesiologists in developed countries practice their art in highly sophisticated technologically advanced operating rooms. The latest in modern technology is immediately at their disposal. Trainees feel very comfortable in an almost space-like environment. Access to partial concentrations of oxygen and carbon dioxide, automatic blood pressure readings, air conditioning, compressed medical gasses (including oxygen), blood oxygen saturation and constant beat to beat measurement of heart rate, just to name a few, are taken for granted daily.

As a physician trained in anesthesiology in the United States, I have been privileged and humbled by the vast opportunities and unique challenges all anesthesia practitioners (physician, nurse anesthetist, resident, anesthesia technician, certificate graduate, etc.) are afforded in the developing world.

The practioner should be well aware that the presence of invasive monitoring, $ETCO_2$ monitors, gas monitors and even ventilators may be rare or nonexistent. When some of this equipment is available it may not have been calibrated since it left the factory or arrived in the host country. Simple luxuries like air conditioning are frequently absent in the operating rooms of developing countries. Temperature monitoring can be critical, particularly in children. I have seen and experienced myself, team members drenched in sweat, necessitating fellow team members circulating with cold water and cold towels for the back of the neck.

Preparation for Anesthesia Care in a Developing Country

Evaluate your resources:

- Equipment
- Supplies
- Personnel

Evaluate local resources:

- What type of facility will you be working in?
- Equipment available
- Personnel available

Responsibility of anesthesia personnel:

- Set up operating room/station
- Preoperative evaluation
- Delivery of anesthesia-operative care
- Postoperative care
- Conservation of equipment
- Reuse of supplies

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What and How Much Do I Bring?

The answer to this question requires significant forethought, discussion with the surgeons and nurses and knowledge of the concomitant medical diseases that might be endemic to the population you intend to operate on.

Some locals, particularly in rural areas, but certainly in some large cities as well, do not have compressed oxygen tanks, nitrous oxide, or inhalation agents, such as italothane or isoflurane. When ventilators are available the lack of parts and/or timely maintenance can present significant problems. It is incumbent upon the anesthesia providers to ascertain with as much certainty as possible, the need to transport alternative anesthesia delivery systems. Although the literature is replete with alternative delivery systems,[1-4] the injunction by Whitten[5] "KIS KIS" (keep it simple, keep it safe) certainly summarizes an important principle for the delivery of anesthesia care.

At a minimum, each anesthesia provider should personally bring a tool box consisting of your own laryngoscope handles, as assortment of blades and batteries, of endotracheal tubes, suction catheters, your favorite tape, essential emergency drugs and alcohol swabs (Table 1). Additional blood pressure cuffs, intravenous (IV) tubing, syringes, needles, breathing circuits, reducing values for oxygen cylinders, scavaging hoses, portable monitoring equipment, vaporizers (must be packed with extreme care), and ventilating bags packed separately should be transported as well. Anesthesia providers should also personally pack enough scrubs, masks, hats, gloves, shoes covers, and other items of personal preference.

The answer to the problem of what to bring is, again, partly resolved by determining the types and number of surgical cases to be performed at a particular site. The author has volunteered with Operation Smile International, Norfolk, VA since 1988. The George Washington University Department of Anesthesiology Annual Mission to Mexico 1984 to 1988 and conferred with colleagues who have volunteered with Interplant and Operation Orbis. On average these organizations perform 6-10 operations per day.[6,7] With two of these organizations approximately one-third to three quarters of the cases would be infants and children,[8,9] most involving facial deformities. Cases involving upper and lower abdominal surgery would require more time and fewer cases would be done per day.

Although commercially prepared resuscitation kits are available and can be used separately, the author prefers using a separate drawer in the tool box to include drugs that deal with emergency situations, i.e., cardiac arrest, cardiac dysrhythmias, malignant hyperthermia, shock, etc. A specific code or crash box must be located centrally and in the PARR. The usual anesthetic drugs and local anesthetics are in another drawer: atropine, thiopental, muscle relaxants, reversal agents, naloxone, ketamine, etc.

It is critical for volunteers to understand the circumstances in which they will be working. The author's maxim has been and continues to be "anything that can go wrong, will eventually go wrong." This however does not have to detract from a wonderful experience for the volunteer and a significant contribution to fellow human beings. Volunteering in a developing country is not an experience for everyone. The volunteer can be overwhelmed by literally hundreds of variables and situations unlike anything they have experienced in their home countries. Many underdeveloped countries have unspeakable poverty, malnourishment and diseases that the volunteer has only read about. It is very easy to become overwhelmed by the needs of not only the patients, but their families and communities as well. It is critical for the providers to take care of themselves and their team members' needs.

Table 1. Anesthesia tool box

Stethoscope	Regular
Precordial stethoscope – pediatric – adult	Magill forceps
Esophageal stethoscope – pediatric – adult	Headstraps – pediatric – adult
Face masks – pediatric – adult	Tape
Nasal and oral airways – full set	Batteries for laryngoscope
Laryngoscope handles – pediatric – adult	Bulbs for blades
Blades	Stylets for endotracheal tubes
Maci 1, 2, 3	Scissors
Miller	Blood pressure cuff
Endotracheal tubes – pediatric – adult	Flashlight
RAE	Temperature strips

Each provider should contact their local traveler's clinic or a physician familiar with health guidelines for foreign travel, and the U.S. State Department to determine necessary immunizations and travel restrictions.

Each provider should be certain that they are current with their immunizations for polio, tetanus, hepatitis, measles, mumps, and rubella.

The Evaluation of Local Resources and following sections have been modified with permission from Anesthesia in Operation Smile's Cleft Lip and Palate Interdisciplinary Training Manual 1999.

Evaluation of Local Resources

As soon as feasible, upon arrival at the local site, you should begin an assessment of local resources by visiting the hospital operating theatre. Request that the local chief anesthesiologist accompany you as well as the clinical coordinator and the biomedical technologist to:

1. Evaluate how much bottled or wall outlet supplied oxygen is present and available at the site and how many large oxygen cylinders (H cylinders) are available for the set up of individual anesthesia stations. Is the primary oxygen supply centralized? Are there wall outlets?
2. Determine what electrical supply there is and what it is capable of and that you can provide multiple outlets of appropriate voltage for each operating table.
3. Decide which operating rooms are best and where each table will be placed.
4. Develop a floor plan in consultation with the clinical coordinator that details which rooms will serve as preoperative screening, supply. preoperative holding, and the Post Anesthesia Care Unit.
5. Do a walk-through of the path of a typical patient going through the process to be sure there a smooth transition from station to station.
6. Explain to the local personnel that you assign one anesthesia provider per table and ask if and in what capacity they would like to be involved. Encourage collaborative efforts, but always have an approved team member at each table for every case.
7. Insist on overall supervision of every anesthetic delivered. You are responsible for every patient's safety.
8. Visit the blood bank to ensure that adequate blood will be immediately available for emergency transfusion.

Table 2. ASA* physical status

Category	Description
1	Healthy patient
2	Mild systemic disease – no functional limitation
3	Severe systemic disease – definite functional limitation
4	Severe systemic disease – that is a constant threat to life
5	Moribund patient unlikely to survive 24 hours with or without operation

*American Society of Anesthesiologist

Setting Up the Operating Room

1. Decide which operating rooms to use.
2. Decide if locally available anesthesia machines are to be used.
3. Decide exactly where the operating tables will be placed. Placing two operating tables in the same room is advantageous in that it allows one to practice a team approach by cross-utilization of personnel and equipment.
4. Ensure that gas lines and electrical outlets (extension cords and multiple outlets strips) are accessible at each table.
5. Determine which sites will have central piped-in oxygen and which will require freestanding oxygen cylinders.
6. Locate the necessary H cylinders and place them in the appropriate places.

Screening

Patients will be seen by a surgeon first to determine if an operation is necessary, then routed to you.

1. Do a preoperative evaluation on each patient considering age, current health, coexisting diseases, medical history, and family history of a bleeding disorder, and a physical examination including careful evaluation of the airway. Use the standard American Society of Anesthesiology classification system to assign your patient a risk category (Table 2).
2. Refer patients with complicated medical histories to the pediatrician or internist.
3. Carefully evaluate chronic or subacute medical conditions during the screening process and immediately prior to surgery.
4. Carefully evaluate patients for the presence of upper respiratory infections.
5. Record a set of vital signs for each patient during screening. These should include: temperature, heart rate (HR), respiratory rate (RR), blood pressure (BP) and oxygen saturation (SpO_2).
6. Have blood drawn on all patients to check their hemoglobin.
7. Have a blood sample drawn on every patient scheduled for abdominal thoracic, goiter, C-section, and gynecological procedures. This sample is to be held in the blood bank for use in case there is a need for an emergency transfusion.

Operating Room Schedule

The surgical team leader, clinical coordinator, anesthesia team leader, and medical records coordinator will meet after screening is completed to plan the OR schedule for all five days of the scheduled mission week. This allows all screened patients to find out if and when they are scheduled so they will have time for personal training.

There are several basic rules for Operating Room scheduling.

1. Schedule an ASA I patient as the first case for each table on the first operating day. This is done so that any unresolved problems with the operating room table or anesthesia set up can be resolved with the least possible impact on the patient or the mission.
2. Schedule the youngest children as first cases each morning.
3. After the first morning, schedule complicated or long cases in the morning rather than the afternoon.
4. Consider not scheduling children less than one year of age unless an experienced pediatric anesthesiologist is available.

Preoperative

A. NPO guidelines
   No solids, milk or food after midnight
   Clear liquids are allowed three hours prior to surgery (individual variations to be determined by the anesthesiologist)

B. Quality resource management and personnel

1. Proper management of anesthesia personnel is critical to mission success. Determine the expertise of all of the team members as early as possible. first by asking questions about training and current expertise, and then by observation during the mission.
2. Assign the most difficult cases to the most capable practioners.
3. Delegate one extra anesthesiologist for every five operating tables to serve as the "floater" (n+1). This person should be one of the most experienced members of the team. The "floater" person will serve as: second team member for the inductions, trouble shooter, PACU supervisor, emergency assistant, break giver, and operating room manager (along with the clinical coordinator). If the number of operating room tables exceeds five, two free anesthesiologists are necessary (n+2).
4. Consult with the pediatric anesthesiologist for all emergencies involving children and consider this person the final authority on critical anesthesia decisions, regardless of who is serving as team leader.
5. Discourage independent operators. All missions are team efforts. We often operate in a difficult environment with unfamiliar colleagues and equipment. We must make a collaborative effort to ensure the highest-level safety. To this end, the following methods should be employed for each anesthetic delivered:
   - Use of a precordial stetoscope is required.
   - A pulse oximeter is required for all pediatric cases.
   - The pulse oximeter must be placed on the patient prior to induction.
   - Two anesthesia providers must be present on the patient for each induction for children.

- The halothane countdown
  a. The second anesthesia provider will call out halothane percent (%), heart rate, and oxygen saturation every 30 seconds until the patient is intubated and the halothane vaporizer setting is <2%.
  b. Document the presence of end-tidal carbon dioxide ($ETCO_2$) after every intubation.
  c. Avoid deep extubation.
  d. Call for help as soon as a serious problem is suspected.

C. Anesthesia supply management

1. Set up a central supply room for the bulk supplies.
2. Review the adequacy of supplies for the anticipated numbers of patients.
3. Ideally each anesthesia site will be supplied with a standardized anesthesia box based upon the Operation Smile model that includes many of the supplies needed by the anesthesia provider at the bedside. Each anesthesia provide should be assigned one of these boxes at the beginning of the mission for use at the bedside for the entire mission.
4. A code box must be prepared for each mission. It includes the standard drugs and supplies necessary for Advanced Life Support and is compact enough to be transported rapidly to the patient's bedside. It will be kept in the PACU.

Delivery of Anesthesia

In many underdeveloped nations anesthetics are administered by personnel with limited training, inadequate and poorly serviced equipment and unreliable supplies. Originally Oxford Miniature Vaporizers (OMV) or Epstein Macintosh Oxford vaporizers (EMO) were transported to underdeveloped countries.

The use of modern, sophisticated machines currently in use in most hospitals in the US are unsuitable and have usually met with failure.

Over the years halothane has become the anesthetic of choice. This has led to safe use of the commercially available halothane vaporizer. It does not require compressed gas for operation. Instead, the vacuum created by the patient's spontaneous or manually delivered breath draws room air over the inhalation agent and vaporizes it. Supplemental oxygen up to 100% can be added through a side nipple but is not essential for all cases.

A. Preinduction

1. Ensure that the pediatric medical specialist briefly reexamines all pediatric patients and asks patients appropriate questions to ensure that no significant changes have occurred since screening, prior to transporting the patient to the operating room.
2. Use premedications only if absolutely necessary in children. A mask induction is the method of choice for children ≤ 10 years of age. Intravenous (IV) inducations are generally recommended for older children and adults.

B. Induction and intubation

The use of muscle relaxants versus deep intubation should be dictated by the skill, experience, and comfort of the anesthetist with the chosen technique. Generally muscle relaxants are discouraged when ventilators are not available.

1. If possible, have local staff who speaks the child's language/dialect accompany the patient for the induction. Instruct this assistant about soothing techniques prior to separating the child from the parents.
2. Perform a thorough machine check, including the presence of working suction, prior to induction.
3. Succinylcholine and atropine should be drawn up and epinephrine and lidocaine immediately available at the bedside.
4. Two anesthesia team members must be present for each induction with a child.
5. Ensure that the halothane administration is performed by the second anesthesia provider for all children.
6. The use of muscle relaxants versus deep intubation should be dictated by the skill, experience and comfort of the anesthetist with the chosen technique.
7. Auscultate both sides of the chest and the epigastrium to ensure proper depth of tube placement after intubation. RAE endotracheal tubes, because of a set length, are more prone to endobroncheal placement.
8. Tape the endotrachael tube (ETT) securely midline under the lower lip.

Preinduction Adult

Frequently because of difficulty with language and the danger of administering the wrong drug or the incidence of the incorrect dose being too high, premedication is frequently omitted. However, the use of premedication should be dictated by the skill, expertise, and comfort of the anesthesia provider with the chosen technique.

Induction and Intubation

1. Place any monitoring equipment, blood pressure cuff, ECG, pulse oximeter, temperature strip.
2. Place intravenous line prior to induction.
3. Succinylcholine and atropine should be drawn up and lidocaine immediately available.
4. Intravenous or mask induction with halothane.
5. Auscultate both sides of the chest and epigastrium to ensure proper depth of tube placement after intubation.
6. Protect eyes with lubricant and tape.
7. Place temperature strip.

C. Maintenance

1. Maintain the patient at the appropriate surgical depth while allowing the patient to spontaneously ventilate, if appropriate.
2. Do not leave the room of an anesthetized patient under your care unless appropriate coverage has been arranged.
3. Monitor all patients by
   - Precordial stethoscope
   - Continuous pulse oximetry when available
   - Vital signs recorded every 5 minutes (every 3 minutes in children < 2 y/o). Vital signs include: heart rate, respiratory rate, SpO_2 and blood pressure (electrocardiography (ECG) and end tidal carbon dioxide ($ETCO_2$) when available)

- Temperature should be recorded every 15 minutes (more frequently if elevated or rapidly changing)

D. Pain control

1. If the surgeon will perform local infiltration, the standard solution is lidocaine 0.5% + epinephrine 1:200,000. The maximum doses of this solution is 10 mg/kg of lidocaine, with the overriding recommendation that during halothane anesthesia, no more than 10 mg/kg of epinephrine be infiltrated.
2. Local anesthesia and/or infraorbital nerve blocks are usually sufficient for control of pain after lip repairs.
3. Use intravenous nalbuphone judiciously. It is recommended for palate repairs and burn scar revisions for postoperative pain control in the appropriate patient.

E. Emergence and Extubation

1. Do Not Deep Extubate Patients! Be certain the patient is awake prior to extubation.
2. Ensure the patient has a patent, unsupported airway, has a stable SpO_2 (>95%) on room air without CPAP, and is maintaining his/her own airway before transporting him/her to the PACU.

Postoperative

A. Post Anesthesia Care Unit (PACU)

1. Record the patient's vital signs on the anesthesia form upon arrival to the PACU. The attending nurse will provide a set of vital signs immediately.
2. If the patient is stable, give the salient details to the attending nurse; then return to the operating room to set up for your next case.
3. Assist as needed in the PACU (e.g., a patient with an airway emergency). Remain to assist until you are no longer needed.
4. Ensure that all babies and young children remain in the prone position for 4 to 6 hours postoperatively to facilitate drainage and for detection of occult hemorrhage.

B. Record keeping and quality assurance

1. Use a standard Anesthesia Form to be included in every patient chart. This should be filled out in detail just as you would do at home.
2. A perioperative events log. During and immediately after the operation, detail the appropriate events and write detailed explanations if untoward events occur. If we do not accurately know what problems occur, we cannot offer solutions. Quality assurance is one of the most important parts of the mission.

Common Complications and Preventing Potential Problems

Difficult Airway

1. Call for help immediately if an unanticipated difficult airway is encountered.
2. Place the patient on 100% oxygen and continue to ventilate by bag/mask utilizing positioning of the head and neck, jawthrust, and oropharyngeal airway placement, and continuous positive airway pressure (CPAP) to maintain the mask airway.

3. Awaken the patient if you are able to ventilate them adequately by bag/mask, but are unable to intubate them.
4. Immediately call for surgical assistance if you cannot ventilate the patient. If the patient desaturates and bradycardia ensues, an emergency cricothyroidotomy or tracheotomy is indicated.
5. Do not hesitate to implement Pediatric-Advanced Life Support procedures when indicated.

Laryngospasm

Laryngosoasm is a forceful, involuntary spasm of the laryngeal musculature caused by stimulation of the superior laryngeal nerve, the sensory innervation of the larynx. It may occur during an inhalation induction, usually by aspiration of secretions from the oropharynx. It is most likely to occur as an immediate postextubation event but may also happen later in the Post Anesthesia Care Unit (PACU) as the patient wakes up and aspirates blood or oropharyngeal secretions.

Early extubation during the interval between deep anesthesia and fully reacting is when laryngospasm most commonly occurs.

Laryngospasm must be diagnosed early and treated rapidly. Signs include the inability to ventilate the patient despite the application of positive pressure by bag/mask and rapid onset of oxygen desaturation.

Treatment Includes

Institute prolonged positive pressure ventilation and jaw thrust. A small dose of intravenous succinylcholine (0.25-.05 mg/kg) may be necessary along with controlled ventilation. Intramuscular succinylcholine (4-6 mg/kg) is effective in patients without intravenous access and in whom conservative measurers have failed.

Partial laryngospasm occurs more commonly and usually calls for less drastic measures. It is characterized by inspiratory or expiratory "squeaks" and can usually be overcome with positive pressure ventilation. Laryngospasm must be rapidly overcome to avoid postobstructive pulmonary edema. This condition, caused by high negative intrathoracic pressures generated by spontaneous ventilation against a closed glottis, is a major cause of morbidity in our patients. It can be diagnosed by the presence of rales over the lung fields and, in extreme cases, pink frothy fluid (pulmonary edema fluid) coming from the airway. Additional signs include tachypnea (respiratory rate greater than 60/min), grunting, retractions, and low oxygen saturation. If laryngospasm occurs it must be treated immediately and aggressively, with the institution of controlled ventilation with positive end expiratory pressure (PEEP) and an intravenous diuretic.

Halothane Overdose

The most common cause of mortality on Operation Smile missions is from too much halothane during induction. It is a problem that can be avoided if one remains aware during induction of where the halothane vaporizer is set in relation to the patient's vital signs. This awareness, part of the vigilance required to practice safe anesthesia, is too often lost in the crush of too many cases, too little sleep, jet lag and/or a difficult airway. To solve this problem we have introduced the Halothane Countdown, detailed in "Preoperative" section.

The signs of halothane overdose include loss of pulse oximetry, muffled or absent heart tones, severe hypotension, a pale or dusky patient, and cardiac dysrhythmias.

Treatment Consists of the Following Steps

1. Call for help! Two anesthesia providers must attend all inductions.
2. Turn off the halothane vaporizer and flush with 100% oxygen.
3. Hyperventilate the patient with 100% oxygen.
4. If heart tones are absent over the precordium by stethoscope, immediately initiate chest compressions.
5. Administer epinephrine 10 mg/kg by intravenous or intra-tracheal route.
6. If the patient does not recover rapidly, continue Pediatric Advanced Life Support procedures.

Malignant Hyperthermia (MH)

Nonspecific early signs

- Elevation of the end-tidal CO_2, unexplained tachycardia, tachypnea, sweating, cyanosis, and overheating of the soda lime.
- Hypertonus of the skeletal muscle. After succinylcholine, either failure of skeletal muscle to relax or intense masseter spasm should arouse suspicion and be considered an indication to postpone surgery.
- MH may occur later during anesthesia, after the use of potent agents, commonly halothane.
- A rapid rise in body temperature.

Biochemical changes include a severe metabolic acidosis, severe respiratory acidosis, and possible elevated serum potassium. Generalized muscle rigidity, ventricular arrhythmia, cyanosis, and increasing body temperature are highly predictive of an impending MH crisis.

Therapeutic regimen:

1. Call for help!
2. Discontinue all inhalation anesthetics.
3. Discontinue surgery.
4. Hyperventilate the lungs with 100% oxygen.
5. Administer bicarbonate 1-2 mEq/kg.
6. Administer dantrolene 2.5 mg/kg IV (must be mixed with sterile water).
7. Start cooling techniques; i.e., ice to surface, nasogastric, intravenous, wound, rectal.
8. Change the anesthetic circuit and soda lime if possible.
9. Ventricular dysrhythmias usually respond to treatment of acidosis and hyperkalemia. If not, administer procainamide 20 to 30 mg/min IV until the arrhythmia is suppressed or hypotension ensures, or the QRS complex is widened by 50% of its original width or a total of 17 mg/kg has been given.
10. Titrate further doses of dantrolene as required (maximum dose 10 mg/kg)
11. Maintain urinary output. Monitor urine output, serum potassium, calcium, arterial blood gases, and clotting studies.
12. Follow creatine phosphokinase, calcium, and potassium until they return to normal.
13. Observe patients for disseminated intravascular coagulation (DIC). Monitor patients in the ICU for at least 24 hours.

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CHAPTER 14

Outpatient Assessment of the Pregnant Patient: Dilatation and Curettage

Kedrick D. Pickering

The encounter with an anxious bleeding pregnant woman is a common occurence for any physician exposed to the general practice of medicine. The surgeon working in the developing world will undoubtedly be so exposed. The outpatient assessment of such a patient should be interpreted in the culture and clinical context in which the surgeon is working. It is common for women in the developing world to interpret any episode of vaginal bleeding as a normal menstrual period, this even in the context of other obvious manifestations of a pregnancy. It will often take the most patient and tolerant clinician to convince some women that they are, in fact, pregnant.

Because bleeding in pregnancy can be a very ominous sign, leading to massive hemorrhage with complicating sepsis, it is useful to be equipped with the knowledge to diagnose and subsequently treat abnormal pregnancy.

This chapter deals with the diagnosis of pregnancy and its complications in the outpatient setting. Careful history, taken using a high index of suspicion, is necessary; it is useful to remind one's self that a sexually active female with a period of amenorrhae is pregnant until proven otherwise.

An abnormal pregnancy often requires a surgical approach to management. This chapter deals with the diagnosis of those patients who will benefit from a dilatation and curettage, a procedure that can be successfully performed under local anesthesia.

This everyday procedure for a regular gynaecological practice, "dilatation and curettage" would be a useful tool in the hands of the surgeon in an isolated area.

Introduction

There are three cardinal features of pregnancy:

1. Sexual activity (with or without contraception)
2. Amenorrhae
3. Enlarged uterus

Pregnancy can, of course, be confirmed with a positive urinary gonadotrophin. There is however, an equivocal zone before six weeks of amenorrhea, rendering the test false negative in some critical situations.

It is a safe clinical approach that any bleeding in pregnancy is abnormal, especially in the first trimester. An abnormal intrauterine gestation and extrauterine one require a different approach in surgical intervention, the former a dilatation and curettage, the latter a laparotomy.

Dilatation and curettage is a process of removing the contents of the uterine cavity. In the modern era the procedure can be performed safely under both general

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Table 1. Common causes of vaginal bleeding in early pregnancy and in the nonpregnant state

Pregnant	Nonpregnant
Incomplete abortion	Myoma
Threatened abortion	Salpingitis
Hydatidiform mole	Cervical polyps, cervicitis, carcinoma
Tubal pregnancy	Endometral polyps, hyperplasia, endometritis
Corpus luteum cyst	Haemorrhagic ovarian cyst
Chronic cervicitis	Endometriosis, adenomyosis
Carcinoma	Blood dyscrasias

and local anaesthesia. The latter has the advantages of needing less operating room personnel and being quicker in terms of operating time. In the hands of the meticulous surgeon neither anaesthetic method has distinct advantages surgically. The major disadvantage using local anaestesia is that of an uncooperative patient who poses a definite risk of uterine perforation and its related complications. A planned approach to reduce this risk is dealt with later in the chapter.

Indications

Dilatation and curettage is performed for either diagnostic or therapeutic indications. Removal of the uterine contents can result in the restoration of normal function or it can lead to the further assessment and then treatment of the patient with abnormal genital bleeding. As in most other surgical intervention preoperative assessment is critical to success.

History

The history is very important in establishing the etiology of abnormal bleeding. Particular attention should be paid to the general nature of the bleeding, including the interval, duration, amount of flow, association with cramping, and passage of clots or tissue. The patient herself can usually distinguish between bleeding episodes that are compatible with a normal menses and those episodes that are unlike a regular menstrual period. However, if the patient is unsure of pregnancy or actually denies it, this fact provides a challenge.

A number of confusing terms are used to describe patterns of abnormal bleeding. These should be avoided as far as possible.

The history must include the details of medication. Patients may have taken drugs (glucocorticoids, estrogens or progestational agents) or local remedies for various indications. Patients on oral contraceptives may have breakthrough bleeding or bleeding because of discontinuing the medication at unusual times in the cycle.

Particular attention must be paid to the obstetrical history: pregnancy exposure, the number and outcome of previous pregnancies, the ages of children, and contraceptive usage. It is the nulliparous female in whom pregnancy was unplanned or unwanted that creates the diagnostic dilemma.

The hallmark of an excellent history is the determination of whether the bleeding is anatomic or organic in nature and whether it is superimposed on an ovulatory cycle or associated with anovulation. This information may give an early indication of pregnancy. What the patient says about the problem is also important, as thera-

peutic management will depend on the severity of the bleeding, whether it interrupts her daily life or is only an annoyance, with specific regards to her plans for the pregnancy. The management approach to the patient with a wanted pregnancy is different from the approach to the woman who does not desire pregnancy in whom home remedies would probably have been used to terminate it.

On the important differential diagnosis of ectopic pregnancy, a quick and accurate diagnosis of ectopic pregnancy is urgently needed, but often difficult. The clinically stable patient continues to pose a diagnostic predicament. The menstrual history is helpful in making the diagnosis but few other conditions present in such a varied, confusing and misleading manner. Spotting or bleeding with pelvic pain in a sexually active female, contraception or not, together with a unilateral pelvic tenderness plus or minus a palpable mass should always arouse suspicion of ectopic pregnancy. A high index of suspicion is the hallmark for making the diagnosis. Ultrasound, of course, if available helps. Confirmed pregnancy, with an empty uterus on ultrasound, in the presence of the foregoing signs, confirms the diagnosis of ectopic pregnancy.

Physical and Pelvic Examination

A complete general examination is optimal in any patient with bleeding in pregnancy. Many of these women will need to undergo anaesthesia, so their general health is important to assess. The patient's body habitus and nutritional status are assessed. Evidence of chronic illnesses or endocrinopathy, signs of blood dyscrasias such as ecchymoses or petechiae, and the condition of the skin must be checked. The abdominal examination should be documented, noting specific areas of tenderness and presence or absence of peritoneal irritation. The patient may indicate that there is pain in the shoulder.

The pelvic examination identifies vaginal and cervical lesions and confirms that blood may indeed be coming through the cervical os. The presence of products of conception protruding from the os is diagnostic of threatened or inevitable miscarriage. Local reasons for abnormal bleeding, including benign and malignant neoplasms, infectious diseases of the vagina or cervix, cervical polyps and ulcerated lesions may be identified. The careful bimanual examination may reveal myomata uteri, ovarian masses and tumors, ectopic pregnancy, or complications of an intrauterine pregnancy.

Rectovaginal examination will help to exclude a pelvic mass and tenderness in the cul-de-sac. Culdocentesis at this time will help in the diagnosis of a bleeding ectopic gestation; the cardinal feature is the presence of unclotted blood.

Anaesthesia

The procedure can be easily carried out under local anesthesia

1. Meperidine (pethidine, demerol) and diazepam (valium) intravenously
2. Cervical block—2% lidocaine solution intracervically at 5 and 7 o'clock.

There are several advantages

1. Minimal personnel—surgeon and nurse (or ancillary staff)
2. Outpatient—reduce cost
3. Less time consuming
4. Reduce risk of perforation (in cooperative patient)

Both techniques can be employed together or can be used separately. Meperidine (50-100 mg) and diazepam (5-15 mg) can be administered intravenously slowly. Both drugs can be given via the same syringe simultaneously with no adverse effect.

Diazepam causes an acute phlebitis which can be minimized by giving the drugs slowly (1 mg every 2 minutes). The dose of drugs depends on the clinical setting (size of patient and history of prior drug use). In over 15 years' use of this technique the author has not seen a case of respiratory depression or anaphylactic reaction. The commonest side effect is that of skin irritation.

Cervical block (10 ml of 1% or 2% lidocaine solution) is performed by direct injection of the drug at the fifth and seventh o'clock (5th and 7th) position on the cervix. It is important to ensure direct injection into the tissue rather than intravenously. This can be avoided by the usual precaution of intramuscular injections, pulling back on the plunger before injecting. Intravenous lidocaine at this dose can lead to cardiac arrhythmia with potentially fatal consequences. The uncontrolled diabetic with an incomplete miscarriage is a prime example for using a cervical block alone.The cervical block is best performed after cleaning and draping the patient in the lithotomy position.

Surgical Technique

The usual preoperative assessment for any patient is necessary in these situations. It is helpful if the patient can have a shower prior to the procedure. This helps to reduce the risk of infection, therefore improving the overall success of the procedure.

This is the standard set:

- Medium trolley—for instruments and dilatation and curettage pack
- Prep trolley—for cleaning of patient with cleansing lotions
- Mini bowl set
- Dilatation and curettage pack and vaginal pad
- Dilatation and curettage set
- Cleansing lotion– 1. Savlon
  2. Normal saline
- Extras—hibitane cream
  - Two (2) lithotomy poles
  - Stool for surgeon
  - Specimen container with formalin if necessary
- Dilatation and curettage pack—sterile
  - One (1) pair of leggings
  - One (1) towel
  - One (1) peri-towel
  - Two (2) packs of gauze
  - One (1) vaginal pad
- Dilatation and curettage set—sterile
  - One (1) sponge holding forceps
  - One (1) Auvard's vaginal speculum
  - One (1) Simms vaginal speculum
  - One (1) metal catheter
  - One (1) set of uterine dilators
  - One (1) uterine sound
  - One (1) ovum forceps
  - Two (2) vulsellum
  - One (1) tenaculum
  - One (1) double-ended curette
  - One (1) sharp curette

One (1) packing forceps
One (1) bowl set: one (1) large kidney dish
Two (1) medium kidney dish
One (1) small kidney dish
Three (3) gallipots
The modified set (plus standard trolleys and bowl set etc.)
Perineal towel
Sterilized gauze packs
Sponge holding forceps
Auvard's weighted speculum
Cervical dilators
Tenaculum
Sharp curette
Additionally for suction curettage –
Suction machine (or regular wall suction)
Suction tube
Suction catheter (e.g., large bore nasogastric tube or endotracheal tube)

Procedure

There is no need to shave the patient. Anaesthesia having been administered, the patient is placed in the lithotomy position with slight Trendelenburg. The assistant can monitor and give encouragement and support to the still anxious but otherwise cooperative patient.

The patient is then cleaned using four pieces of gauze, two savlon and two normal saline. The initial swabbing is only for the external genitalia, from the mons pubis, upper one-third of thighs, perineum and anal area. The second savlon gauze is used for cleansing the vagina and cervical area. The procedure is repeated with normal saline, which also helps to reduce irritation to or of the genitalia.

The anterior lip of the cervix is firmly grasped with a single-toothed vulsellum, tenaculum or Allis' clamp. The author's personal choice is a single toothed tenaculum (Fig. 2), the vulsellum (single or multiple toothed) increases risk of traumatic bleeding. The posterior vagina is retracted by the weighted speculum, which is utilized to provide good visualization. The cervix is dilated with a series of dilators. In the case of dilation for evacuation of an incomplete abortion, the cervix should be dilated in millimeters to a number equal to the number of weeks of uterine size although this may not be necessary if suction curettage is employed (discussed later). It is essential that both the internal and external os be dilated with the dilators.

With the cervix on firm upward traction, using the left hand, the thumb can be used to help exposure by further pressure on the weighted speculum (Fig. 1) If desirable, and certainly recommended, suction curettage can be performed at this stage. It is also at this stage that an ergotocic agent such as intravenous ergometrine can be administered. This has the advantage of inducing contractions, actively reducing uterine size during the sharp curetting phase. A sharp curette can be inserted into the uppermost portion of the cavity to ensure evacuation of the cornual areas. It is essential that a thorough systematic curettage evaluating the entire cavity be carried out. The curette is inserted to the fundus, and gently, then actively, scraped along the cavity. Transverse or circular scraping assures better sampling of the entire cavity, and the surgeon should feel comfortable when a uniform scraping sound is experienced.

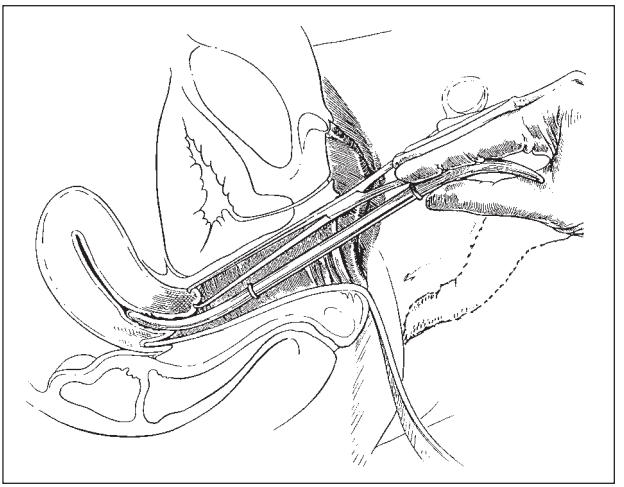

Figure 1. Dilatation and curettage. The anterior lip of the cervix is grasped.

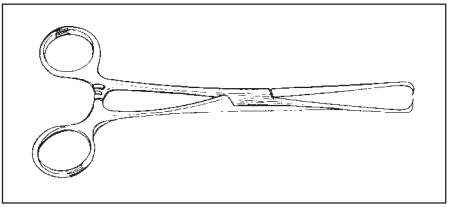

Figure 2. Single toother tenaculum.

Complications

The main complications arising from dilatation and curettage are:

1. Hemorrhage
2. Uterine perforation
3. Infection
4. Miscellaneous—Asherman's syndrome, infertility

Anticipating excessive blood loss is critical in keeping this to a minimum. The evacuation of the uterus after an incomplete first trimester miscarriage is different from an incomplete second trimester loss. The latter is notorious for hemorrhage, which can easily lead to hypovolemic shock. An intravenous line with an ergotoxic agent (pitocin or ergometrine) readily available is imperative with second trimester evacuation. This is even more important in the presence of a septic uterus, a situation that renders the contractile ability of the myometrium reduced.

Furthermore, the surgeon must always be prepared to perform a bimanual massage of the uterus as an adjunct to facilitate uterine contraction and subsequent

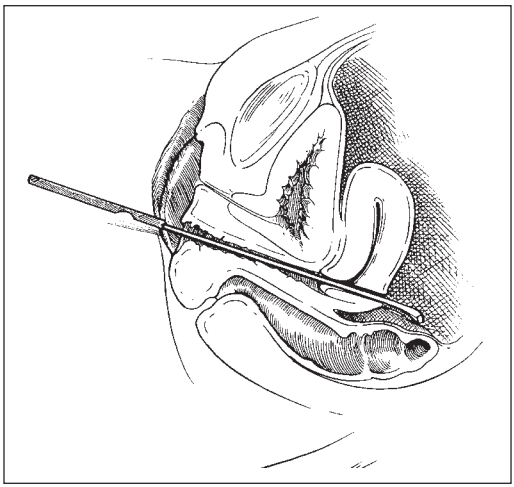

Figure 3. Dilatation and curettage. Uterine perforation in the retroverted uterus.

involution. This procedure will serve well the surgeon who is already handicapped by lack of available transfusion services.

Uterine perforation is probably the most feared complication of dilatation and curettage (Figs. 3 and 4). This can range from innocuous and benign to potentially disastrous and fatal consequences. It occurs most frequently in the pregnant uterus at the time of uterine sounding and or dilatation of the cervix in the pregnant or nonpregnant retroverted uterus. Again, the key to reduce these risks is to recognize the possibilities and choose the patients carefully.

In an uncooperative patient performing a dilatation and curettage under local anaesthesia is already a complication. An alternative approach using a general anaesthesia is prudent. The patient's history usually gives a clue, and the pelvic examination confirms the size and position of the uterus. If the patient is anxious and nervous and denies or does not readily admit to sexual activity, this should alert the surgeon to potential problems.

Uterine perforation can be managed conservatively if detected early. This should be done as an inpatient with an intravenous line, no oral intake and monitoring of vital signs regularly for about a 24-hour period. Persistent or worsening pelvic-abdominal pain may indicate the need for a more aggressive management. Signs of peritoneal irritation such as rebound tenderness in the presence of a temperature rise may indicate a perforated bowel, which would require surgical intervention through laparotomy.

Sepsis is a constant companion in an abnormal pregnancy. Patients commonly present to the clinic after having tried home remedies or local therapies. Although uncommon in the developed world, tetanus is still seen as a complication in the developing world. Human immunodeficiency virus (HIV) is the new and probably most worrisome infective agent for surgeons working in these areas and taking all necessary precautions is prudent.

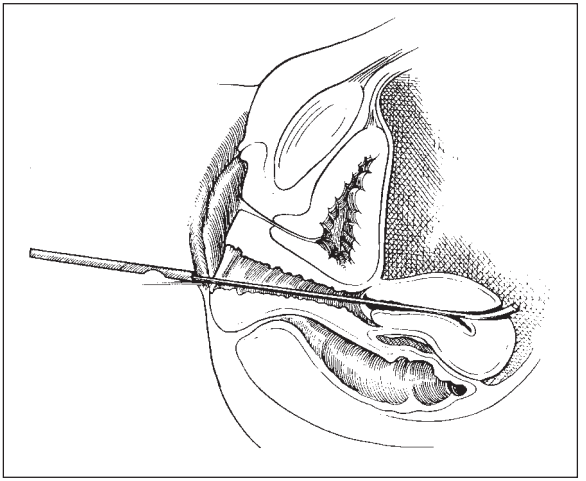

Figure 4. Dilatation and curettage. Uterine perforation.

Regular aseptic techniques are the key in the prevention of infection. There are no substitutes for simple handwashing, careful preparation of the surgical field, draping and sterilization of equipment, no matter how modified the technique employed. Broad spectrum antibiotics are a most useful adjunct but should be reserved especially if limited supplies exist. These are, of course, imperative in the patient already septic.

Long-term complications from perforated uterus that was managed conservatively are rare. If further surgical intervention was necessary then the nature of the specific situation determines the outcome. Secondary infection can have devastating long-term effects, especially infertility. The cultural and local connotations may vary but it is often a social stigma for the individual, which may prove to be a lifetime burden. The surgeon should remember this and take whatever precautions can be taken to minimize this late sequelae.

Asherman's syndrome, although uncommon in everyday gynecologic practice, results from an overzealous evacuation and sharp curettage of the suterus. This results in excessive denudation of the endometrium with scarring, scanty menstrual flow and infertility. It is more commonly seen in curettage for diagnostic purposes but can also be the consequence in any instance where excessive sharp curetting is performed.

Urinary tract infections can best be avoided by minimizing the need for catheterization and encouraging voluntary voiding preoperatively.

Dilatation and curettage is a very simple operation that can restore the patient to normal functioning in a relatively short time. It can easily be one of the most rewarding procedures the surgeon will perform. Bleeding in the pregnant patient is oftentimes frightening for them, the risk of miscarriage and the sequelae that follows, oftentimes a great burden on the individual. The complication of bleeding in pregnancy with or without surgical intervention can be fatal. The successful outpatient management approach is useful knowledge for the surgeon in an isolated area.

Suction Curettage

This is a useful adjunct to sharp curettage. It is especially helpful for the surgeon not experienced in the techniques of dilatation and curettage since it minimizes the risk of perforation.

Curettage in the first and second trimester can be assisted by this procedure. The procedure can be facilitated by use of soft malleable instrumentation rather than the regular suction curettes which are metallic. Using a regular suction catheter after dilatation, the uterine cavity can be partially evacuated. This reduces the time and effort to complete the evacuation process.

The suction catheter can be substituted for using a large bore nasogastric tube by simply creating additional openings at the distal end ~1/4-1/2 cm in diameter. A solitary opening at the proximal end would facilitate the actual suctioning. In the second trimester, particularly if the cervix is already dilated, an endotracheal tube can also be used. This adds the benefit of removing large amounts of tissue and reducing blood loss. In both circumstances, even in the hands of the inexperienced surgeon, there is minimal risk of perforation. The uterus contracts more readily and also aids completion of the "dilatation and curettage" by the sharp curette.

Suggested Reading

1. ACOG Practice Bulletin - Early Pregnancy Loss # 212 1995.
2. ACOG Practice Bulletin - Methods of Midtrimester Abortion #109 1987.
3. Bayer SR, Solo-Hunnicutt JA. Dilatation and curettage and cervical conization: Operative gynaecology. WB Saunders, 1993.
4. Corson SL, Sedlacek TV, Hoffman JJ. Greenhill's Surgical Gynaecology Year Book Medical Publishers. 5th eds.
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CHAPTER 15

Basic Obstetrics and Obstetric Surgery in a Mission Setting

F. L. Dutton and Glenn W. Geelhoed

Introduction

In this chapter a rather narrow focus will be placed upon surgical interventions in pregnancy. We begin therefore with the reminder that obstetrics generally deals with the care of the mother throughout her pregnancy, labor and the puerperium (by convention, up to six weeks postpartum). In a still larger sense, as pointed out in Williams *Obstetrics* (20th Edition), obstetrics is actually "concerned with the reproduction of a nation, because it is concerned with all the physiological, pathological, psychological, and social factors that profoundly influence both the quantity and the quality of new generations of citizens."

Most issues related to prenatal care and pediatric health need to be addressed in the community during the prenatal period, if not preconception, and should be entrusted to community health workers and midwives (the word " obstetrix" is in fact Latin for "midwife"). Although development of community health programs, pregnancy education, and prenatal surveillance is outside the scope of this chapter, midwives also provide essential services at operative deliveries, both as surgical assistants and in performing neonatal assessment and resuscitation. Their training and education may be one of your greatest responsibilities and most significant contribution to the health of the community.

Phases of Obstetric Management

Medical actions aimed at maximizing obstetric outcomes can be organized chronologically:

A. Prepregnancy measures.
   These target safety, nutrition, sanitation.
B. Prenatal care.
   Includes surveillance for infection, identification of risk factors for preterm labor, pregnancy-induced hypertensive disorders, potential for cephalopelvic disproportion and dystocia. One also aims to detect multiple gestations, malpresentations, ectopics, and abortions or fetal demise.
C. Labor: First stage (onset of active labor through full dilatation).
   This includes the diagnosis of labor, the subsequent identification of dysfunctional labor, and indications for operative delivery.
D. Second stage (from full dilatation through delivery).
   Proper management requires recognition of secondary arrest disorders, and indications for operative delivery.

Surgery and Healing in the Developing World, edited by Glenn Geelhoed.

E. Third stage (delivery of the placenta).
   One must recognize problems with the placenta, and avoid/recognize uterine inversion.
F. Fourth stage (stabilization of the mother).
   Management of this stage includes recognition and repair of lacerations and management of postpartum hemorrhage.
G. Puerperium (up to six weeks postpartum).

One may encounter potentially fatal hemorrhage, infection, hypertensive disorders, and thrombotic or amniotic fluid emboli.

Obstetric surgical interventions may be called for in any of the four stages of labor.

General Surgical Principles

Prepare Yourself

Plan every operation in your mind, step-by-step and communicate the plan to your assistants. In the context of this chapter, the operation may be any of the following: (1) surgery for ectopic pregnancy; (2) vacuum or low forcep assisted delivery; (3) symphysiotomy; (4) primary or repeat Cesarean section (low transverse, classic vertical, or extraperitoneal), with or without uterine artery ligation, Lynch suture for atony or hysterectomy.

Consider how to act if you encounter any of the common complications of the procedure you will undertake. At a minimum, these include bleeding, infection, incidental damage to viscera.

Establish clear methods for communicating your needs and intentions intraoperatively. Discuss anticipated problems and probable solutions with your assistants before the case.

Determine risks to the surgical team: HIV, HBV, etc. Be sure that the team remains alert to these problems.

Formulate a plan for anethesia/analgesia: Pudendal, local, general. The availability of epidural anesthesia (or of an anesthetist) may be considered a luxury.

Prepare the Patient

With gravid patients, surgery is often not elective, but nevertheless can be anticipated. If patients are near term but not in active labor there may be an opportunity to improve hydration and nutrition and to treat fevers and infections preoperatively. When the need arises, make best efforts to explain the procedure and its indications, risks and benefits to the patient and her family.

Nausea is likely with abdominal surgery and especially with manipulation of the uterus. Take steps to avoid aspiration of gastric contents. Give 30 cc of bicitra p.o., and/or consider ranitidine 50 mg IM one hour prior to surgery, or 150 mg p.o. Q6 hrs preceeding an elective procedure. Also consider placement of an NG tube to aspirate gastric contents and provide a neutralizing lavage.

If laboratory is limiting, obtain a blood sample to determine hematocrit with or without the aid of centrifugal force and also test formation of a "wall-clot".

Assess hydration status by physical exam and through recording of oral intake vs. urine and stool output. Make appropriate adjustment for insensible losses in current environmental conditions.

Obtain historical information, including exposures to TB, HIV, HBV. Prior obstetric history is critical, including proven prior birthweights. Include a complete

review of systems in your physical assessment, as this may be your only medical record.

Complete the Procedure

Clean the patient very well. Antiseptic cleanser is essential, but the field will NOT be sterile. Positioning is key, as in any surgery. With obstetric patients, preferred position is dorsal supine, with a leftward tilt (in an effort to avoid the supine hypotensive problem). In Cesareans, a small amount of Trendelenberg will be desirable, both to bring the baby out of the pelvis and to employ gravity in holding the gut out of the operative field. The patient's respiratory function must be closely watched. If the operating table is improvised, one may need to arrange for the placement of removable blocks to achieve both the left tilt and a few degrees of Trendelenberg.

Avoid entering through infected tissue. If you do need to cut through infected tissue, consider delayed primary closure of the wound to avoid abcess formation. One principle of microbiology is that contamination increases with exposure time. This is one reason to work as quickly as safety allows.

Blood loss is also proportional to operative time. Many experts will assert that time should not be spent in efforts to control bleeding from minor vessels when entering the abdomen for a Cesarean. Much of this bleeding will cease spontaneously, and the rest can be controlled prior to closure after the baby has been delivered. Of course, it is helpful to observe the course of more major vessels and to ligate, cauterize, or avoid transecting them whenever possible. If bleeding affects visualization in the operative field, it should be attended to. The duration of anesthesia, the onset of pain, and the rate of complications, are all also proportional to operative time.

Provide Postoperative Care

After a vaginal birth, with or without vacuum or forceps assistance, explore the uterus to remove clots, placental fragments, membranes. After operative deliveries, provide IV hydration. If NPO, place a Foley and monitor fluid input and output. Provide pain control. Encourage early breastfeeding (both for baby's well being and to encourage oxytocin release and uterine involution). Encourage coughing and provide chest physiotherapy to stave off atelectatic fever. Encourage early ambulation and frequent position changes to reduce the risk of thrombotic events. Be vigilant for signs of the four major causes of mortality in obstetrics: hemorrhage, infection, hypertension and its sequellae, and embolism.

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Prenatal Management

Management of Early Pregnancy Bleeding

For the purpose of this discussion, early pregnancy bleeding will be defined as bleeding that occurs within less than 20 weeks of the mother's last menstrual period.

There are two prominent entities in the differential diagnosis of bleeding in the first half of a confirmed pregnancy: spontaneous abortion and ectopic pregnancy. Both are common, the latter is quite dangerous and will be dealt with separately. Bleeding may also have an infectious etiology or result from trauma. Less common etiologies include molar pregnancy and underlying coagulopathy. Hypothetically, bleeding may also result from luteal phase defects and the "vanishing twin" syn-

drome. We will focus on spontaneous abortion and ectopic pregnancy, which commonly require surgical intervention.

Spontaneous Abortion

In most studies the incidence of bleeding in the first 20 weeks of pregnancy is high. It can be documented in up to 40% of all recognized pregnancies. About half of these pregnancies will end in spontaneous abortion.

A small amount of bleeding, consistent with a "light" period, may occur at the time of the first missed menses. This is believed to be bleeding at the site of implantation and is without significance (except that it may confound the patient's estimate of her last menstrual period). If the patient reports cramping, and/or if the bleeding continues, the prognosis for maintaining the pregnancy is poor.

If a doppler stethoscope is available, listen for fetal heart tones (audible a 12-14 weeks). Heart tones become detectable with a fetoscope around 18-20 weeks. If transabdominal or transvaginal ultrasound is available, try to locate the sac (cardiac activity is detectable around 7 weeks.) Perform a speculum exam to identify the source of the blood, followed by a bimanual exam to elicit tenderness suggestive of an infectious process or an ectopic pregnancy.

Irrespective of fetal cardiac activity, if you observe bleeding through a closed cervix, the clinical diagnosis is threatened abortion. The patient may rest at home if she appears to be stable and reliable. If she needs to travel far or appears to have bled or be bleeding a great deal, admit her for continued observation.

If the cervix has begun to dilate, the diagnosis is inevitable abortion. There may be products of conception (POC) in the cervix. Removing these with a ring forceps or other instrument may significantly relieve your patient's cramping pain. POC in the cervix may also cause a vasovagal attack, in which case the patient may appear to be in shock. Removing the POCs in such a case is curative.

A complete abortion expels all products of conception—fetus, sac and placenta. The cervical os will be closed. No surgical intervention is required. In an incomplete abortion, the os is open, and the placenta is most often the retained part. An incomplete abortion, in which you elicit symptoms or signs of infection, is a septic abortion. A missed abortion by definition has occurred eight weeks or more prior to its recognition. The patient has not bled or experienced other symptoms. If this occurs in the latter half of pregnancy, she is at significant risk for disseminated coagulopathy. Fortunately, over 90% will spontaneously enter labor within four weeks of fetal demise although this delay lengthens with the gestational age. Management of spontaneous abortion differs with gestational age as described below. After 20 weeks, loss of a pregnancy is considered to be intrauterine fetal demise (IUFD).

First Trimester

Threatened Abortion

Withold surgical intervention. Supportive measures only. Patient need not be admitted if reliable and living nearby.

Inevitable or Incomplete Abortion

Supportive measures. Type and cross-match blood. Watch the patient for no more than 24 hours. Proceed to evacuate the uterus sooner if bleeding is severe or if you can prove by history or exam that POCs are retained.

Complete Abortion
No surgical intervention is necessary.

Second Trimester (Through 20 Weeks)

Threatened Abortion
Admit the patient for observation and support.

Inevitable or Incomplete Abortion
Wait for the fetus to pass. If the abortion remains incomplete, make the patient NPO, establish IV access and begin fluid resuscitation. Administer methyergine and/or begin an oxytocin drip. If the POCs still are not expelled, you must evacuate the uterus. Place the patient in dorsal lithotomy position, prep and drape, and administer appropriate anesthesia. Empty the bladder.

If you are unable to insert your finger, dilate the cervix cautiously with Hegar or Pratt dilators. Then try to perform a digital evacuation ("finger curettage") of the uterus, using your nondominant hand to press down on the fundus as in a bimanual exam. Consider careful use of a curette as a last resort since there is a risk of perforating the uterus, especially with a septic abortion. If you must use a currette, administer an ergot amine which will contract the uterus and reduce the risk of perforation. Gently scrape the uterine walls until you have released the retained POCs and perform a final bimanual exam to explore the uterine cavity. You may need to use polyp forceps or sponge forceps to remove adherent pieces of placenta. Monitor the patient overnight. If bleeding persists, use methyergine or an equivalent drug IM or IV, and/or oxytocin if available.

Management of Late Pregnancy Bleeding

Worrisome causes of antepartum bleeding in the third trimester include placenta previa and abruption. More commonly, a small amount of bleeding can be traced to bloody show (labor is beginning), or vaginal lesions (lacerations, condyloma, etc.) Both placenta previa and abruption can lead you to the operating theater to perform a Cesarean section.

Placenta Previa

This condition exists in about one in every 250 pregnancies. Bleeding from placenta previa is typically painless. It can occur suddenly and need not be associated with activity or trauma. Onset is typically early in the third trimester when change in the lower uterine segment begins.

To make the diagnosis, perform a careful speculum exam to confirm the source of the bleeding and attempt to determine the amount of cervical dilatation. Monitor the fetus by whatever methods are available. Monitor for contractions. If ultrasound is available, determine the location of the placenta. If previa is confirmed, management will involve a Cesarean section. If the fetus is beyond 37 weeks by good dating, proceed to section. If the bleeding is severe and unabated, the mother becomes hemodynamically unstable, or the fetus becomes distressed, proceed to Cesarean section regardless of fetal maturity. If, however, the bleeding becomes controlled and the fetus and mother appear stable, manage expectantly by placing the patient on bedrest, observation, and avoidance of sexual intercourse.

Rarely, bleeding from ruptured vasa previa will be encountered. This is recognizable if you have access to a microscope and some Wright's stain. Bleeding in placenta

previa is from lakes of maternal blood, whereas bleeding from vasa previa involves the loss of fetal blood, which is even more serious. Fetal blood can be recognized as nucleated red cells picked up with Wright's stain. Section is indicated secondary to fetal distress.

Abruptio Placentae

Abruption occurs about twice as often as placenta previa, about one in every 120 pregnancies. It classically presents as painful vaginal bleeding. It may be precipitated by maternal hypertension, drug use, or trauma. It can also occur with sudden emptying of the uterus as in rupture of membranes in a case of hydramnios or after delivery of the first of a set of multiples.

To make the diagnosis, proceed as with a suspicion of placenta previa. Perform a careful speculum exam to confirm the source of the bleeding and attempt to determine the amount of cervical dilatation. Monitor the fetus by whatever methods are available. Monitor for contractions. If ultrasound is available, determine the location of the placenta to rule out previa and look for a clot between the placenta and the uterus. Even in experienced hands, ultrasound is only about 50% sensitive in recognizing abruption. If your ultrasound rules out previa or a low-lying placenta and bleeding is significant, the diagnosis is abruption.

Begin fluid resuscitation of the mother. Deliver by Cesarean section if the fetus is mature, distressed, or labor has begun.

Management of IUFD

If the fetus dies before 20 weeks of gestation, it is defined as a spontaneous abortion and managed as described in (A) above. After 20 weeks of gestation, loss of the pregnancy is termed intrauterine fetal demise.

The diagnosis of fetal demise can be confirmed in a variety of ways. Fortunately, there is no need for haste, since, it is reasonable to practice expectant management for up to one month after the fetal death. Assuming that fetal scalp electrodes and abdominal or transvaginal ultrasound are not available to you, suspect fetal demise when fetal movements are not appreciated by the mother or palpated by the examiner and fetal heart beat cannot be auscultated while following the patient for up to one month. The uterus will fail to grow and may in fact shrink. If the fetus has not been expelled after one month, consider cervical ripening and induction of labor. Monitor her clotting time. Also consider the possibility that the pregnancy was an abdominal ectopic which she will be unable to expel. A simple mechanical method for dilating the cervix to 3 cm is by placement of a Foley catheter, passing the catheter through the cervical os and inflating the balloon with 30 cc of saline. Tape the Foley to the patient's leg under gentle traction. When the Foley falls out, the cervix has dilated to 3 cm. By clipping of the tip, the Foley can also be used to instill dilute prostaglandins into the uterine cavity for induction of labor (e.g., 100 μg/ml PGE2, delivering 1-2 ml Q2 hours, titrated to achieve effective contractions.)

If the baby died during an obstructed or otherwise complicated labor, it may be difficult to complete the delivery. An assisted delivery or destructive procedure may be needed. If still undeliverable, a Cesarean section is indicated.

Ectopic Pregnancy

As mentioned in (A) above, a dangerous source of bleeding (and generally, pain) in the first half of pregnancy is an ectopic implantation. This occurs in roughly 1% of all pregnancies. Overwhelmingly, implantation is in the fallopian tubes. More

rarely, and more dangerously, implantation occurs intra-abdominally or in the cervix.

The timing of onset of symptoms of an ectopic pregnancy roughly reflects the location of the ectopic. If implantation is in the isthmus, rupture is typical at 4-6 weeks. Thus, one of the dangers of an ectopic is that rupture may occur before the patient is even aware of her pregnancy. Those in the distal two-thirds of the tube typically rupture at 6-10 weeks or develop into a tubal abortion into the abdomen at 8 to 14 weeks leading to hematocele. In the cornu and in the abdomen (e.g., on the ovary), an ectopic pregnancy may survive to 20 weeks without symptoms.

The Unruptured Ectopic

If you are equipped with laboratory and ultrasound, it may be possible to diagnose ectopic pregnancy early and prior to rupture. Using abdominal ultrasound, a pregnancy is detectable at seven weeks gestational age, when hCG levels should be 5000-6000 mIU. Using transvaginal ultrasound, pregnancies are detectable at hCG levels as low as 1500 mIU/ml. Finding a gestational sac in the uterus is helpful in ruling out an ectopic.

If you have been able to identify an unruptured ectopic pregnancy, it may be managed expectantly if (1) the hCG titer is falling, (2) the ectopic was less than 4 cm in size on ultrasound, and (3) it is located in the tube (i.e., a tubal abortion has occurred). Alternatively, medical therapy with methotrexate is possible. The indications for methotrexate are an unruptured ectopic, less than 4 cm in size, without cardiac activity and with hCG titers below 10,000 mIU/ml. Give a single dose of methotrexate, 50 mg/M^2 IM. Repeat hCG levels in 3 and 6 days to confirm appropriate decline.

Rupture of an Ectopic

Acute rupture presents with sudden severe lower quadrant pain. The patient will begin to show signs of hypovolemic shock. She is likely to be nauseated and faint. Begin fluid resuscitation and perform a pregnancy test if materials are available. Be aware of the sensitivity of the test kits you use to avoid being fooled by a false negative test. Perform a gentle vaginal exam and bimanual exam—cervical motion tenderness, tenderness or fullness in the posterior cul-de-sac palpated via the posterior fornix, and adnexal tenderness that is greater on one side are all among the possible findings on exam (but may be absent in over half of the cases). Consider performing a culdocentesis and/or peritoneal aspiration to look for blood in the cul-de-sac and in all four quadrants.

In an area where HIV is epidemic, blood transfusion may not be an option. Commit to surgery soon and operate quickly to minimize blood loss. In developed countries, laparoscopy is the preferred surgical approach, since it is associated with lower risk of infection, adhesion formation and other morbidities. However, assuming that equipment and expertise for laparoscopy will be uncommon in the mission setting, a laparotomy approach is described below.

In the OR theatre, position the patient and establish anesthesia. Do not use spinal block. Place a Foley and prep and drape for either a transverse or a low midline incision. Make your incision and enter the abdominal cavity essentially as described for Cesarean section (VI. C. below). Explore to locate the diseased tube. Pack the intestines away. Free the diseased tube of adhesions and clot. Clamp the fallopian tube proximal to the ectopic, incorporating mesosalpinx extending to the midpoint of the ectopic within your clamp.

Grasp and elevate the distal portion of the tube. Place a second clamp across the distal portion of the tube, again incorporating mesosalpinx, and bringing the tips of the two clamps together on the mesosalpinx at the midpoint of the ectopic. Cut along your clamps to release the ectopic. Use catgut suture to ligate behind each clamp. You may perforate the mesosalpinx to do this in bites. Doubly ligate and confirm hemostasis. Remove packs, irrigate the pelvis and close the incision in the usual manner.

Managing Labor

Normal Labor and Delivery

A review of this vast topic is beyond the scope of this brief guideline. However, the following few suggestions may be useful to you if you are inexperienced in obstetric management.

Clinical Pelvimetry

Complete an assessment of clinical pelvimetry prior to or early in labor. The goal is to anticipate cephalopelvic disproportion (CPD), a leading contributor to dysfunctional labor and dystocia.

1. Assessment of the pelvic inlet: The best estimate of the adequacy of the pelvic inlet is obtained by measuring the diagonal conjugate. This is easiest to do in late pregnancy when tissues are more distensible. Either place the patient in stirrups or put a firm pillow under her buttocks for the exam. Place your middle and index fingers in the vagina, and use the tip of your middle finger to palpate the sacral promontory. Mark the lateral edge of your hand just where it emerges from beneath the pubic arch. To reach the promontory, you will probably have to press the knuckles of your third and fourth fingers into the perineum below. Measure the total length from the finger tip to your mark. This is the diagonal conjugate, from which you can subtract 1.5 cm to estimate the diameter of the pelvic inlet between sacral promontory and the inner surface of the symphysis pubis (obstetric conjugate). A diagonal conjugate of 12.5-13.0 cm (obstetric conjugate of 11.5 cm) is considered adequate.
   Note: If the head is engaged, the inlet is adequate! With the vertex at the level of the spines (usually 5 cm below the inlet), the biparietal diameter (3-4 cm above the vertex) must almost certainly be below the pelvic brim (inlet) as well.
2. Assessment of the pelvic outlet: Premeasure the width of your closed fist at the nuckles, then use your fist to measure the biischial diameter by placing your closed fist between the ischial tuberosities. A diameter over 8 cm is considered adequate. Also assess the pubic arch. You should be able to fit two fingerbreadths beneath the symphysis, and the pubic rami should curve outward to create a broad arch. The descending inferior pubic rami should form an angle of 90-100 degrees. Palpate the sacrum and coccyx for curvature and flexibility. If the sacrum and coccyx are angled forward, this results in narrowing of the sacrospinous notch and pelvic diameters. If angled back, the result will be a shorter and roomier pelvis.

3. Assessment of the midpelvis: The midpelvic diameters are not directly accessible to clinical pelvimetry. However, be alerted to a possibly narrow midpelvis if the ischial spines are prominent, the pelvic sidewalls are felt to converge, the biischial diameter of the pelvic outlet is narrow, and the curve of the sacrum and coccyx is shallow. The transverse diameter of the midpelvis at the ischial spines should exceed 10 cm.
4. A pelvis with a narrow pubic arch, prominent spines and converging sidewalls, and with the sacral tip angled forward (an extreme "android" pelvis in the Caldwell-Moloy system) should lead you to anticipate a difficult vaginal delivery.

Positioning

The position of the laboring patient will reflect local custom. Basically, any comfortable position is acceptable except the supine.

The rationale for use of the dorsal lithotomy position is the purported mobility of the sacroiliac joint, which is thought to shift in this position to increase the diameter of the pelvic outlet by 1.5 to 2.0 cm. The same effect is achieved by the squatting position favored by many societies. Squatting has the intuitively obvious advantage of maximizing the force of gravity to assist with labor. The disadvantage is difficulty controlling the delivery (e.g., flexion of the head). In one study, this resulted in more labial lacerations, although significantly fewer perineal lacerations were encountered.

Intrapartum Fetal Assessment

If external electronic monitoring is not available, fetal heart tones should be auscultated. In low risk pregnancies, auscultate every fifteen minutes, following a contraction. High risk pregnancies require closer scrutiny, with auscultation every five minutes. These observations must be recorded. Be alert for decelerations, especially in association with changes in baseline. Repeated decelerations may be tolerated for the short term if return to baseline is rapid. Repeated decelerations, especially those which begin after the peak force of contraction has been reached, should be treated by altering the position of the patient and administration of oxygen. Persistent and prolonged decelerations should lead to an evaluation for assisted or operative delivery.

Normal Delivery

In vertex presentation, the head and neck must extend to deliver under the symphysis pubis. Controlling this process will reduce labial and perineal trauma and thus your burden of surgery. As the head is delivering, lightly oppose this extension by using the fingers of your upper hand to gently flex the head away from anterior structures (clitoris, urethra, labia). As the head delivers, grasp with this hand to control the degree of extension and speed of delivery of the head. As the head clears the ring of vulvar tissue, instruct the woman to stop pushing so that you do not have a violent expulsion of the shoulders and trunk.

While controlling extension and delivery of the head with your upper hand, use your other hand to support the perineum in an effort to minimize stretching and tearing as the head and trunk are delivered. Further control may be obtained by employing the modified Ritgen maneuver. In the modified Ritgen, as the head forces open the introitus to a diameter of 5 cm or more, use your toweled hand to exert

pressure on the chin of the fetus through the perineum. This gives you better bimanual control of the process.

After checking for a nuchal cord and suctioning the mouth and nose, deliver the trunk and shoulders in a controlled fashion while maintaining your support of the perineum.

Clamp and cut the cord, and deliver and dispose of the placenta, according to local traditions.

Recognizing Dysfunctional Labor

Maternal death due to obstructed labor and/or ruptured uterus are rare in developed countries but may be common where obstetric help is limited. King, et al, cited an incidence as high as 70% in some areas.

The "partogram" or "partograph" described by WHO is a derivative of the Friedman curves describing the normal progression of labor in terms of cervical dilatation and descent of the presenting part. The purpose of following the progression of all labors in this way is to recognize "obstructed labor" and then to manage it appropriately. It is therefore essential that a labor curve be initiated for all patients who may be in labor. After her initial detailed exam, the patient should be reevaluated every 2-4 hours.

Although the parameters of the Friedman curve were developed in the west, they are not believed to vary among different ethnic groups. In the table below, the numbers represent the mean duration of each stage and the maximum duration that you should tolerate before intervention should be planned.

Record the progress of labor on a partograph or labor curve, and learn to use this tool to recognize when it is time to intervene and help the mother complete her labor. (Partographs designed by WHO are premarked with "action" lines to aid in recognition of obstructed labors. Obtain these or produce your own and teach their use to the community providers.)

In addition to the partograph/labor curve which records information regarding dilatation and station, you need also to consider position, presentation, moulding or caput, and the adequacy of maternal contractions and pushing. Over-riding all of these factors may be your recognition of a distressed condition of the fetus or mother.

You will be able to recognize several different patterns of dysfunctional labor. These are tabulated below with suggested responses for management.

Dysfunctional Labor Patterns

Prolonged Latent Phase (See Table 1)

Prolonged latent phase may be subdivided according to hypotonic vs. hypertonic uterine activity. When latent phase is prolonged despite active uterine contractions, the patient may benefit from seconal or other medication to allow her a period of rest. If her latent phase is prolonged due to hypotonic uterine activity, an oxytocin drip and or artificial rupture of membranes (AROM) may be appropriate.

Protraction of Dilatation

Cervical change at a rate below the minimum indicated in Table I may be treated by artificial rupture of membranes (assuming that the head is well-applied) and/or institution of a pitocin drip. Lace of cervical change over a period of two hours is clear evidence of protraction of dilatation.

Protraction of Descent

Descent at a rate below the minimum indicated in Table 1 may be treated with an oxytocin drip. More than one hour without change of station is evidence of protraction of descent. This may be due to CPD, uterine dysfunction, or fetal malposition. It may be useful to palpate for descent of the presenting part while you assistant provides fundal pressure with a contraction. If good descent is possible with external help, CPD is less likely as an etiology of the protraction.

Arrest of Dilatation

If dilatation has plateaued for 2 hours or more, and is unresponsive to AROM and pitocin with no cervical change after 3-4 hours, the patient should be readied for Cesarean section.

Arrest of Descent

If descent has halted for an hour (multipara) or two (primipara) and is unresponsive to pitocin, operative delivery is indicated. If vacuum-assisted delivery is inappropriate (the head is too high), plan to do a cesearean or symphysiotomy. (Perform symphysiotomy in limited cases of CPD, as described below.)

Note: Protraction and arrest are identified in the face of adequate uterine contractions. In the absence of an intrauterine pressure catheter, you will have to rely on your own judgment and that of your midwives to determine that contractions are indeed adequate.

Prolonged Second Stage

After two hours of full dilatation, even if intrapartum fetal assessment is reassuring, you will need to assist the delivery. As discussed below, forceps deliveries are dangerous without experience, and vacuum-assist may be the most appropriate. Sym-

Table 1. The stages and phases of labor

STAGE I:	From onset of true labor to full dilatation
	10 hours average, 25 hours maximum for primiparas
	8 hours average, 19 hours maximum for multiparas
	Latent phase (contractions with slow cervical change)
	6 hrs/20 hrs primipara,
	5 hrs/14 hrs multipara.
	Active phase (begins at 3-4 cm dilatation)
	Phase of maximal dilatation
	3 cm/hr average, 1.2 cm/hr minimum (primips)
	6 cm/hr average, 1.5 cm/hr minimum (multips)
	Deceleration phase (also phase of maximal descent rate)
STAGE II:	From full dilatation to delivery
	30 min average, 120 min maximum (primips)
	10 min average, 45 min maximum (multips)
STAGE III:	From delivery of the infant to delivery of the placenta
	5-30 minutes for all patients
	Beyond 30 minutes is considered “retained placenta”
STAGE IV:	Stabilization of the mother

physiotomy may be appropriate if the cause is clearly mild CPD. In the face of failed vacuum-assist or severe CPD, you must go to Cesarean section.

Shoulder Dystocia

By definition, shoulder dystocia is the failure of the shoulders to deliver spontaneously after delivery of the head. This is a true obstetric emergency. It may occur in from 1-5% of deliveries and is very unpredictable. Anticipate dystocia in cases of known fetal macrosomia or maternal diabetes. Begin to suspect a developing dystocia in cases of prolonged second stage labor. In all cases, your patient should begin her delivery with an empty bladder. Recognize dystocia when the head is delivered (with or without difficulty) and the ring of vulvar tissue then appears to form a snug collar around the neck of the fetus. The head appears to be held tightly against the vulva and/or appears to retract (the "turtle sign"). The usual amount of gentle downward traction will not disimpact the anterior shoulder, which is stuck behind the pubic symphysis.

You or your assistant should begin to count time upon delivery of the head. If you encounter the "turtle sign" or encounter difficulty delivering the anterior shoulder within the first 30 seconds, declare a dystocia. Do this without conveying a sense of panic to your patient. Your assistants should have been drilled in the responses that you will now direct.

Your next actions will depend upon whether or not you anticipated the dystocia (in cases of fetal macrosomia and/or maternal diabetes), and upon whether or not the patient has received epidural anesthesia. A suggested sequence would be as follows:

1. At 30 seconds, if the shoulders are not delivered with ease or a "turtle sign" is encountered, inform your assistants that you are managing a dystocia. DO NOT employ fundal pressure, DO NOT increase your traction on the head and neck of the fetus.
2. Evaluate the need for an episiotomy, which may be helpful if there is a component of perineal resistance as well. Try to accomplish delivery with the next uterine contraction using the following maneuvers.
3. McRobert's maneuver: Your assistants should immediately see that the patient's hips are sharply flexed into an exaggerated lithotomy position - help her to grasp her legs and pull her knees towards her chest. Maintain your grasp of the baby's head and watch and feel for any signs of spontaneous restitution.
4. Suprapubic pressure: Simultaneous with the maneuver above, the assistant standing on that side of the patient where the fetal spine is thought to lie should deliver suprapubic pressure in an oblique and cephalad direction, attempting to disengage the impacted shoulder from the symphysis pubis while you continue to apply gentle downward traction on the head and neck.
5. If unable to deliver with McRobert's maneuver and suprapubic pressure, turn the patient from the supine lithotomy position to assume a hands-and-knees position (Gaskin's maneuver). In this case, DO NOT allow her hips to flex sharply. Redirect your traction appropriately to lift the anterior shoulder away from the symphysis and deliver the fetus. (It would also be reasonable to employ Gaskin's maneuver as your first intervention, especially in cases where you have anticipated a dystocia, rather than discovered one intrapartum.)

6. If still unable to deliver, an assistant may be asked to slide the fingers of one hand between the fetus and the symphysis pubis to create a "ramp" to assist with delivery of the anterior shoulder.
7. If still unable to deliver, place your hand behind the posterior shoulder of the fetus and try to rotate the shoulders through an arc of 180 degrees until the opposite shoulder is released. This is the Wood's maneuver.
8. Consider next an attempt to deliver the posterior arm. Slide your hand to the humerus of the posterior arm and palpate the elbow. Maintain flexion at the elbow and sweep the arm across the chest of the fetus to enable you to grasp the arm and deliver it past the ipsilateral side of the head with your other hand. You can now rotate the shoulder girdle to deliver the other shoulder.
9. If you are still unable to deliver the fetus, you must consider either deliberate fracture of the anterior clavicle (either by pressing the clavicle against the pubic ramus or by hooking the clavicle with your finger), or symphysiotomy (as described below).
10. The Zavinelli maneuver, manual return of the fetal head to the pelvis and subsequent delivery by Cesarean, is too problematic to be described here.

If you have strong reasons to anticipate a shoulder dystocia (e.g., known or suspected fetal macrosomia), the American College of Obstetricians and Gynecologists recommends execution of the McRoberts maneuver (maximum bilateral hip flexion) and simultaneous suprapubic pressure while crowning is occurring, and immediately delivering the shoulders and thorax without pausing for suctioning of the oropharynx.

Following a difficult shoulder dystocia, be prepared for uterine atony and hemorrhage.

The Placenta

Your primary concern with the placenta is to ensure that it is delivered completely! As indicated previously, this should be accomplished within 30 minutes of delivery of the infant. Signs that delivery of the placenta is imminent include an apparent lengthening of that part of the cord that has been delivered, a rush of blood from the vagina that signifies separation of the placenta from the uterus, and a palpable firming of the fundus of the uterus. When you are ready for the placenta exert gentle traction to the cord, while applying suprapubic pressure (a Brandt-Andrews maneuver) in an effort to prevent uterine inversion. After delivery of the placenta, explore the uterus to ensure that no clot or fragments are retained, and begin vigorous fundal massage to encourage contraction of the uterus. If bleeding continues or is excessive (greater than 500 cc), consider administration of one of the following agents as available: (a) methylergonovine, 0.2 mg IM, with repeat Q2-4 hours as needed; (b) 15-methylprostaglandin F2, 0.25 mg IM, repeated Q 15 minutes to a maximum of eight doses if needed; or (c) oxytocin, 10 units IM.

Placenta Accreta, Increta and Percreta

Delivery of the placenta may be complicated by an unusual adherence or attachment of the placenta to the myometrium (accreta, increta, or percreta), such that spontaneous delivery of the placenta is impossible and manual removal results in hemorrhage and/or inversion of the uterus. The incidence of such abnormal placentation is not well known. Estimates range widely but average about one per 2500

deliveries. Bleeding may initially be scant, while delivery of the placenta by strong traction may result in copious hemorrhage. If this occurs, and your exam of the placenta reveals missing cotyledons or fragments, you must explore the uterus to locate these fragments and attempt their removal. In cases of accreta/increta/percreta, no cleavage plane will develop and the fragments will remain adherent. If bleeding has become profuse, treatment is immediate hysterectomy. If the abnormal placental attachment was subtotal and bleeding appears to be slight, a trial of conservative management may be considered. This involves removing as much placenta as possible and packing the uterus. Couple this with administration of oxytocin or ergot amines as available. In well-equipped hospitals, the risk of abdominal surgery is less than the risk of death with conservative management so the choice between conservative management and hysterectomy will depend not only upon the relative degree of hemorrhage but also upon your clinical environment.

Uterine Inversion

Incautious delivery of the placenta by traction on the umbilical cord without performing the Brandt-Andrews maneuver to keep the uterus within the pelvis may result in uterine inversion. Uterine inversion is also a likely complication of efforts to deliver an adherent placenta as in cases of accreta/increta/percreta as discussed above. Management of uterine inversion depends upon whether the inversion is partial or complete, and on whether the placenta can be separated easily or remains adherent. In any case, support from anesthesia and immediate treatment of hypovolemia is essential.

If the placenta is easily separated, an inverted uterus may be replaced immediately by pushing up on the fundus with your fist or palm. Direct force towards the umbilicus.

If the placenta is adherent, and if the inversion cannot be replaced immediately, administer a tocolytic agent to relax the uterus. Next, separate the placenta and push the uterine fundus up through the cervix. Once the uterus has been replaced, stop the tocolytic and give oxytocin. Bimanual uterine compression should be maintained until hemorrhage is controlled.

If a contraction ring has formed that prevents replacement of the uterus, you must take the patient to your operating theater, rapidly prep her and enter the abdomen by laparotomy. Place a traction suture in the fundus, and pull the uterus back into the abdomen with the help of further pushing from below.

Obstetric Lacerations

Lacerations of the vagina and perineum are categorized as follows:

1. First Degree: Lacerations of the fourchette, skin, and vaginal mucosa that do not penetrate the underlying fascia or muscle. If these do not bleed, leave them unsutured. If sutures are required, use 4-0 gut in simple interrupted sutures.
2. Second Degree: Lacerations that penetrate the skin and vaginal mucosa to involve fascia and muscle of the perineal body, but do not damage the rectal sphincter. Close the vaginal mucosa and submucosa using 2-0 or 3-0 in a continuous locked suture. Tie this off or drive the needle under the hymenal ring to emerge at the top of the perineal laceration and set it aside. Use a separate piece of suture material to place a few interrupted sutures reapproximating the deeper fascia and incised muscles of the perineum.

Place a second layer more superficial to these in a running unlocked subcutaneous fashion from the hymenal ring to the apex of the laceration (here you can pick up the suture used to close vaginal mucosa, avoiding an additional anchoring stitch and knot). Finally, continue using the same suture to complete the closure subcutaneously, sewing up from the caudal apex until the skin is closed.

3. Third Degree: These lacerations penetrate the overlying tissues to involve the anal sphincter. The external anal sphincter is composed of three bundles of muscle fibers, the subcutaneous, superficial, and deep fibers. The subcutaneous fibers form a ring enclosed in a capsule of tough white connective tissue which you may often see exposed but undamaged in a deep second degree laceration. If this capsule is invaded or the muscle incised or ruptured the laceration is third degree. Place strong single sutures in the anatomical superior, anterior, posterior, and inferior portion of the muscle. Try to include a bit of fascia and capsule on each side of the ruptured muscle. Do not tie until all four sutures are placed and you can test your closure by pulling them snug (your assistant will be important here in holding the untied sutures and helping to gently reapproximate prior to tying off the suture). Ideally, the muscle should overlap slightly when reapproximated. Place a few careful deep sutures to reapproximate fascia over the sphincter muscle and avoid tension on overlying sutures. You may then complete the repair as with a second degree laceration above.

   Extreme caution must be exercised to avoid driving the needle through rectal mucosa. You may encounter bleeding from branches of the inferior rectal artery. Stop this with interrupted or figure-of-eight sutures in the usual fashion.
4. Fourth Degree: Exposes the lumen of the rectum. If you have access to your operating theatre, transfer the patient to the OR and complete the repair there with support of anesthesia. Obtain good exposure to see the extent of the tear in the rectum. Close the rectum with a series of interrupted 3-0 or 4-0 suture placed at about 5 mm separation. Perform a rectal exam to confirm that you have closed the entire defect. Next, approximate a layer of fascia over your repair. Finally, reapproximate the anal sphincter and complete the repair as described above.

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Your patient may have delivered elsewhere and come to you with a laceration that is more than 24 hours old. If this is the case, you must delay the repair. Treat her with BID 2 hour soaks in half normal saline until healing is well begun. She can continue this treatment until epithelial regeneration is complete and infection has cleared. King et al recommend waiting three months before attempting repairs and undertaking them then only if referral is not possible. Minor lacerations will heal by secondary intention during this period and may require no further attention. For planned repair of old third and fourth degree lacerations, consult an atlas of gynecological surgery.

Operative Obstetrics

A. Assisted delivery
B. Symphysiotomy

C. Cesarean section
C1. Transverse
C2. Vertical
C3. Special cases
Postmortem Cesarean
Extraperitoneal Cesarean
C4. Hemorrhagic complications
Uterine artery ligation
B-Lynch suture for postpartum hemorrhage
C5. Cesarean with hysterectomy

Assisted Delivery

Definition and Indications

A single approach to assisted delivery will be considered here, that of vacuum-assist/extraction. Forceps deliveries require expertise that is rare among nonobstetricians, and in fact forceps experience is declining among those currently trained in OB-GYN. In a mission setting, applying forceps for anything but an outlet extraction would be far more dangerous than performing a Cesarean section. At the outlet (scalp is visible without separating the labia), a vacuum-assist may do just as well, and has definite advantages for the nonspecialist.

Use of the vacuum avoids injury that might occur secondary to misapplication of the forceps. However, do not think that the availability of a vacuum-assist allows you to forgo a careful assessment of the station, position and attitude of the fetal vertex. You need to identify the occiput, since that is where the vacuum should be applied.

Assisted delivery is indicated when there is delay in the second stage, in other words, an arrest disorder when the cervix is fully dilated. Using your partograph, you will consider assisted delivery when there is an arrest in second stage lasting over 30 minutes in a multipara, or one hour in a nullipara. If the arrest is due to an occiput posterior position or to asynclytism, vacuum can be put to good use. Rarely it may be necessary to consider an assist prior to full dilatation if there is fetal distress. An assist may also be appropriate for an exhausted mother or one with a surgically scarred uterus or cardiovascular disease, in both of whom the effort of pushing should be minimized.

Success requires adequate uterine contractions, a vertex presentation with less than 1/5 of the head above the pelvic brim, and palpable descent of the head with contractions and maternal effort. You may have your assistant or midwife apply fundal pressure with pushing to confirm that further descent of the head is achievable.

Vacuum-assist is contraindicated if there is severe CPD; vacuum cannot overcome this. (You may discover CPD by failing a trial of vacuum; these patients go to Cesarean section.) The risk of intracranial hemorrhage precludes the use of vacuum to deliver a preterm infant; if these babies become distressed a section is required.

Procedure

Identify the posterior fontanel and confirm the position of the head. Apply the vacuum cup to the vertex, preferably over the posterior fontanelle, and create the vacuum. Allow a few moments for caput to form within your vacuum cup. Pull steadily with controlled traction and be prepared to control delivery of the head. A

sudden expulsion when resistance of the perineum is overcome results in lacerations. Do not make more than three attempts at vacuum-assisted delivery. If possible, attempt vacuum-assist in the OR so the patient can go immediately to section if extraction fails.

Symphysiotomy

Definition and Indications

Symphysiotomy (separating the pubic symphysis to increase pelvic diameters) deserves discussion as an alternative to Cesarean section for the relief of obstructed labor that is due to mild or moderate cephalopelvic disproportion (CPD). This procedure is not in the armamentarium of obstetricians in the developed world but may yet have a limited place in the mission setting. For example, one might consider symphysiotomy as an emergency procedure when clinical pelvimetry suggests that an obstructed labor pattern is due to mild CPD, and Cesarean section would be difficult or dangerous under existing conditions. Among the advantages of the procedure one can count the facts that there will be no need for abdominal surgery and no uterine scar. Future deliveries should be much easier.

The chief indication for symphysiotomy—failure to make progress in labor, associated with CPD with the head too high for vacuum-assist (or after vacuum-assist has failed)—presupposes that adequate clinical pelvimetry and Leopold's assessment have been completed to support the diagnosis of CPD. The procedure is contraindicated in severe CPD. A Cesarean is the patient's only option in this case. It is also inappropriate in the setting of malpresentations with one exception. It may be useful to release the aftercoming head in a difficult breech delivery. It may also be contraindicated by maternal body habitus, e.g., obesity and/or musculoskeletal abnormalities of the legs and/or spine. It won't enable you to deliver a macrosomic fetus.

Perform a vaginal exam to assess the degree of cervical dilatation and the station and position of the presenting part (which must be the head!). Symphysiotomy is performed at full dilatation and is always accompanied by an episiotomy. If the head has descended such that 1/5 or less is above the pelvic brim, you should be able to deliver the baby without symphysiotomy. If the head has stopped descending with 2/5 above the brim this is an indication for symphysiotomy. With 3/5 of the head above the brim, King et al recommend the following assessment: attempt to pass a finger between the head and the pelvis. If you are unable to, the CPD is too great for symphysiotomy to be useful. If it passes easily, symphysiotomy isn't called for. If it passes with difficulty, symphysiotomy may be appropriate.

Procedure

Position the patient in lithotomy position. Her legs must be secured in such a way that they will not further abduct when the symphysis is cut. This would result in painful injury to the sacroiliac joints. Place a stiff catheter in her urethra, which will be used to displace the urethra out of the path of your incision.

Cleanse and prepare the skin over the symphysis in the usual fashion. Infiltrate with 1% lidocaine plus epinephrine (15-20 cc, maximum 7 mg/kg body weight). With your nondominant hand, reach into the vagina and displace the urethra and catheter. While holding the urethra out of harm's way, locate the joint, and cut down to its full length. Maintain hemostasis and avoid the bladder. Next, divide the

joint using a scalpel to incise carefully and gradually until the joint opens. Do not allow more than 3 cm of separation. Assistants to support the patient's legs at this point are essential.

In conjunction with an episiotomy, this procedure should allow immediate delivery of the baby. You may require vacuum-assist, but DO NOT use forceps. Strain on the sacro-iliacs must now be diligently avoided.

Repair the symphysiotomy with subcutaneous and subcuticular sutures. Repair your episiotomy in the usual fashion. Leave a Foley in place. The patient should not attempt to walk for 48 hours so DVT prophylaxis will be appropriate. She should be fully ambulatory by days 7-10. The symphysis should heal well, leaving an expanded pelvis that should facilitate future labors.

Cesarean Section

In the developed nations, the Cesarean is the most common major surgery, constituting 20% of births in United States and even higher elsewhere (e.g., Taiwan). Cesarean is also the most common emergency surgery in the mission setting. Practical knowledge of this procedure will therefore be of very high yield.

There are two key decisions to be made en route to performing a Cesarean section. (1) When is a Cesarean indicated? (2) What type of Cesarean is indicated (low transverse, classic vertical, or more rarely, extraperitoneal Cesarean or Cesarean-hysterectomy). The risks and benefits of these related procedures are distinct, should be understood and when appropriate should be explained to the patient and her family.

Indications for Cesarean are described in C1 and C2 below. Cesarean is indicated in cases of footling breech, breech with unfavorable pelvimetry, transverse or brow presentation. Cesarean is the only option for placenta previa and abruption. Contraindications to Cesarean include a head that is deeply engaged in the pelvis (either push it back up Zavinelli-like or consider a symphysiotomy), and fetal demise (in which case a destructive operation is far safer for the bereaved mother).

Low Transverse Cesarean Section (LTCS - or Lapara-Trachelotomy)

Indications

A common indication for LTCS is dysfunctional labor (dystocia). Dysfunctional labor patterns include (1) primary dysfunction (failure to achieve a normal rate of dilatation in the first stage) and (2) secondary arrest of dilatation (arrest or failure to maintain a normal rate of dilatation in the first stage), both of which patterns must be recognized by use of a labor curve or "partograph". Dysfunctional labor also includes secondary arrest of descent, e.g., the patient achieves full dilatation but is unable to bring the baby's head (in vertex presentations) down to the ischial spines after two hours of pushing. In the latter case, LTCS should be considered if progress is not made after the following interventions.

a. Empty the bladder by use of a straight catheter.
b. If the patient is tired and pushing efforts inadequate, provide moderate fundal pressure with contractions and see if descent is gained.

If the presenting part remains 3/5 or more above the pelvic brim, outlet forceps or vacuum extraction are inappropriate, and symphysiotomy would be problematic. Section is indicated.

Further indications include transverse lie (especially back down) or other malpresentation (e.g., footling breech), history of prior classical uterine scar, and fetal intolerance of labor (e.g., documented repetitive late decelerations). Clear fetal distress (e.g., prolonged bradycardia) is an indication for classical Cesarean.

There are two components to the Cesarean surgery, the abdominal incision (laparotomy) and the uterine incision. In a low transverse approach, the uterine incision is made in the lower segment and thus is termed a trachelotomy. This approach requires modest dissection of bladder from myometrium. There is some risk of lateral extension to the uterine vessels and inferior extension into the cervix.

Advantages generally include less uterine bleeding, easier repair, less likelihood of scar rupture, less danger if rupture does occur, and less adhesion of bowel or omentum to the uterine scar (the uterine wound is actually outside the peritoneum).

Procedure

This fundamental procedure will be described in some detail.

Consider giving perioperative antibiotics. They are of proven value if available. Cheapest will be metronidazole, 1 gram administered rectally and repeated Q8 until surgery is accomplished. Establish IV access. If epidural or spinal anesthesia is available, this should be established. (Cesarean has also been accomplished with local anesthesia.) A Foley catheter should be placed in the bladder.

Position the patient in dorsal supine with a 5° leftward tilt (to avoid hypotension secondary to caval compression). Swab the abdomen with antiseptic solution, preferably povidone iodine.

Drape the Patient

Confirm the efficacy of your anesthesia and hemodynamic stability of your patient, and begin the procedure.

Perform a Pfannenstiel incision to enter the abdomen. This begins as a low transverse skin incision two fingerbreadths above the symphysis pubis. Use the anterior superior iliac spines to orient yourself laterally. The incision should be 10-12 cm wide (a bit more than the length of your index finger). Carry the incision down through the fascia, taking care to hold the knife perpendicular to the surface of the patient, until the rectus sheath is identified. Watch for the superficial inferior epigastric vessels as you incise laterally. You may be able to avoid transecting these, or at least ligate or cauterize them before they are cut. As mentioned previously, some experts will pay little attention to bleeding from other smaller vessels unless it hinders visualization.

Once the anterior rectus sheath is identified, retract the subcutaneous tissue laterally using your finger or a Richardson-type retractor. Clear a strip of sheath approximately two cm wide. In a primary Cesarean section, it will be relatively easy to clear off the sheath, and there should be very little bleeding. Make a transverse nick across the midline in the sheath, using the scalpel. Just expose the underlying muscle; do not cut it. Grasp the fascia at this nick using pickups, elevate it, undermine with Mayo scissors and extend the incision laterally using the scissors, curving cephalad as you cut laterally. Extend just beyond lateral rectus borders.

Grasp the lower edges of the anterior sheath with Kocher clamps and elevate it.

Separate underlying rectus muscle from the sheath by digital blunt dissection. While your assistant elevates the fascia using the Kochers, and depresses the rectus

bellies with his other hand, cut down the aponeurosis using Mayo scissors. Stay close to muscle to avoid creating a button-hole defect.

Repeat this at the superior margin of the fascial incision.

Using blunt dissection, separate the rectus muscles in the midline to expose transversalis and peritoneum. It may be necessary to separate the pyrimidalis muscles (when present) by sharp dissection.

Elevate the transversalis fascia and parietal peritoneum with two hemostats or pickups.

Check beneath the tent for adhesions, then enter sharply using the Metzenbaum scissors. Extend the incision slightly by digital blunt dissection, and visualize the bladder.

Extend the peritoneal incision superiorly and then inferiorly down to just above the bladder reflection. Take this tissue down carefully in layers near the bladder.

Palpate the uterus to locate the lower segment and position of the fetus. Note: the uterus is normally dextro-rotated by the sigmoid colon. Reinspect the bladder and place the bladder blade. The blade should be retracted gently by your assistant.

Grasp the visceral peritoneum at the vesicouterine fold midline, tent it up, enter sharply with Metzenbaum scissors, then elevate, undermine and extend with the scissor, curving cephalad. Grasp the inferior margin of the incised vesicouterine fold with a clamp and bluntly dissect the bladder away from the uterus for about 1.5-2.0 inches (don't extend to over the vagina). This is the bladder flap. Keep your finger pointing down towards the lower uterine segment to avoid penetrating the bladder. If more room is needed, cut lateral to the midline through separate layers. Continually reexamine the bladder. Reposition the bladder blade.

Palpate the uterus again to confirm the position of the fetus and possibly that of the placenta. If the head is impacted (as is common with arrest in the OP position), have an assistant place one hand in the vagina and push the head up from below before you initiate your uterine incision. A transverse lower uterine incision approximately 2 cm long is then made 1-2 cm below the prior position of the fold in the vesicouterine peritoneum, and at least 2 cm above the detached bladder. This is the Kerr incision. Its chief advantage is placement in the noncontractile portion of the uterus, reducing the subsequent risks of scar rupture. Make the incision carefully, layer by layer, rubbing the incision with your finger tip and/or clearing with suction after each pass of the scalpel to avoid cutting the fetus. One disadvantage is the chance of extensions of the incision into this thin, nonmuscular layer. These extensions may involve the uterine vessels and are most likely when a long labor has taken place and the head is impacted in the pelvis. Extensions down towards the cervix and laterally towards the uterine vessels can largely be avoided by taking care to score the myometrium near vertically at the lateral extremes of the Kerr incision, then extending the incision bluntly by placing your index fingers at the angles of the incision and retracting towards the patient's shoulders. Alternatively, place two fingers in the Kerr incision to protect the fetus and umbilical cord, and extend the incision laterally and cephalad using bandage scissiors. Watch out for extension to the uterine vessels! If these are cut, you must open the broad ligament and clamp them to avoid hematoma formation and resulting ureteral compromise.

Make sure the uterine incision is adequate, or it will extend itself by tearing when you deliver the fetus. Amniotic membranes, if intact, will bulge through this incision. Nick these to release amniotic fluid and expose the fetus. Insert one finger between the head and the lower uterine flap to release suction. If the head still needs to be pulled up, some suggest doing so initially by lifting up with pressure on the

outside of the lower uterine flap, to reduce the risk of tears. Place the fingers of your dominant hand between the head of the fetus and the lower segment and begin to deliver the head. Have your assistant provide fundal pressure to assist.

Once the head is delivered, suction the nose and mouth (use deep suctioning with a DeLee if meconium has been noted). Deliver the shoulders and body, clamp the cord twice and cut it, then hand the baby to the midwife or other birth attendant for assessment and resuscitation.

If the placenta is encountered anteriorly and is partially incised, quickly separate it from the uterus and deliver the baby around it. Clamp the cord quickly to minimize blood loss.

Start an oxytocin drip or injection or inject ergometrine.

Massage the fundus of the uterus while providing gentle traction on the umbilical cord to help separate the placenta. You may place your palpating hand inside the peritoneal cavity. If necessary, place your hand into the uterus and shear the placenta from the wall of the uterus to facilitate its delivery.

Wipe out the uterus with a dry gauze pack, and have the placenta inspected to make sure that it is complete. It is common for the uterus to be delivered through the abdominal incision and covered with a wet gauze in order to facilitate closing the uterine incision. This is associated with increased nausea and in some venues increases risk of contamination. Consider leaving the uterus in situ. If you do, you will need good lighting and a good assistant to suction or blot frequently in order to maintain good visualization of the incision. Place clamps at the angles of the incision. It may serve you well to place additional clamps around the cut edges of the uterus, both to control bleeding and to help with visualization, especially if extensions or tears have taken place. Place clamps only as necessary, as this process extends operating time and the clamps can get in your way. Also, clamp only the edges of the incision to avoid incorporating a ureter.

Close the uterus in one or two layers using # 0 or #1 absorbable suture. Gut is generally preferred. Vicryl is associated with a four-fold greater risk of subsequent scar separation than chromic gut. Palpate the uterine vessels lateral to the uterine incision and place your first suture just lateral to the angle of the incision while avoiding the uterines. Take full thickness of myometrium and work towards the midline using a running locked suture. Most advise excluding the endometrium and peritoneum from the repair. Repair the myometrium in two layers if it is very thick. Use a second, imbricating layer (either horizontal Lembert's or vertical Connel's) if necessary to achieve complete hemostasis. Additional interrupted or figure-of-eight sutures may be needed to control bleeding. Look for bleeding sites, clear the gutters, and inspect the adnexa.

It has been reported that there is less pain and quicker return of bowel function if visceral *and* parietal peritoneum are left open (Hull and Varner, 1991; Pietrantoni, et al, 1991). No increase in adhesions was noted when this course was followed (Tulandi et al, 1988). However, many experts now close peritoneum and reapproximate rectus bellies with two or three loose interrupted sutures in the belief that this does reduce the formation of adhesions between bladder and anterior structures. The anterior rectus sheath is closed with interrupted sutures 1 cm apart or, more commonly, with a continuous nonlocking suture of dexon, vicryl or permanent suture material. Some surgeons will lock the first stitch at the angles.

Close the fat/Camper's fascia and subcutaneous tissue with simple interrupted O suture if the incision is more than 2 cm deep. This is proven to reduce abscess

formation. Consider placing a drain for 48 hours if the patient is obese. Bohman et al, 1992; Naumann et al, 1995 report that this decreases wound disruption.

Close skin with vertical mattress sutures of 4-0, or staples if available, or (if you feel that there is no tension on the wound and very little risk of infection) a running subcuticular 4-0 suture.

Classical (Vertical) Cesarean Section (Lapara-Hysterotomy)

Indications

The classical Cesarean section (Sanger incision) involves a midline vertical uterine incision from the lower uterine segment to the fundus (and is generally preceeded by a vertical skin incision as well). Once a classical Cesarean procedure has been performed, there is a great danger of uterine rupture with subsequent pregnancies, even before onset of uterine contractions. Fortunately, indications for a classical Cesarean are relatively rare. Some of these will be anticipated, and others encountered only after the patient has entered labor or an operative delivery is underway. They include the following:

Anticipated Indications

1. Hysterectomy is indicated following delivery (e.g., carcinoma of the cervix)
2. Transverse lie of a large fetus, especially with limb presenting or back down.

Urgent Indications

1. Preterm breech (use low vertical uterine incision)

Emergent Indications

1. Fetal distress
2. Postmortem

Intraoperative Indications

1. During a primary or repeat Cesarean that was planned to be LTCS, adhesions are encountered that make it unsafe to attempt dissection of the bladder from the lower uterine segment.
2. At laparotomy a large myoma is encountered in the lower uterine segment.
3. During a repeat Cesarean indicated for a prior classical incision, and that was planned to be LTCS, you notice that the prior classical scar has healed poorly.
4. At laparotomy you encounter a placenta previa which extends anteriorly, or you encounter many thick veins on the lower segment (a sign of placenta previa or low anterior placenta).
5. You encounter a small breech fetus and an unthinned lower uterine segment.
6. You encounter a poorly developed lower uterine segment, one that can't allow a large enough incision to safely deliver the fetus (similar to a preterm breech).

Procedure

As with the primary LTCS, consider giving perioperative antibiotics, establish IV access, provide anesthesia, and place a Foley catheter. Position, prep and drape the patient essentially as for a LTCS. (In both cases, the antiseptic wash should be

extended well above the umbilicus in anticipation.) Again, confirm the efficacy of your anesthesia and hemodynamic stability of your patient and begin the procedure.

Create a vertical midline skin incision with 1/3 of the incision above and 2/3 below the umbilicus. Either skirt the umbilicus with your incision or retract the umbilicus laterally as you approach with the blade from above. The incision can then be extended vertically without the need to circumlocute the navel. The latter method is quicker and runs less risk of creating a beveled incision.

Carry your incision down through the underlying tissues to identify the anterior rectus sheath. Clear off the sheath in the midline and make a nick through the sheath with your scalpel. Elevate the sheath with forceps and extend the fascial incision cephalad, then caudad using scissors. Separate the rectus muscles in the midline and enter the peritoneum essentially as described for a low transverse approach. If adhesions are encountered, take these down with great care to avoid bowel. Palpate the uterus and center it. Place moist packs on either side of the uterus. Identify the bladder. You may not be able to create a bladder flap. In many indications for the classical section there either will not be time for this or adhesions will make it impossible. However, you may be able to reflect the bladder downwards in ideal cases to include the lower uterine segment in your incision.

Begin a vertical midline incision in the uterus starting just above the point of attachment of the bladder and carry this cephalad for a total length of 10-12 cm. In the thick upper segment, this will require several passes with the knife, taking care to remain in the center of your original incision. Upon entering the cavity of the uterus, put down the knife, place two fingers of your nondominant hand in the wound and and use bandage scissors to extend the incision. There will be many bleeding myometrial vessels, most of which can be dealt with after delivery of the fetus. You may encounter the placenta. Try not to cut it. You may be able to separate it partly from the uterine wall in order to work past it. Use due haste.

Find a leg and deliver the fetus as in a breech delivery. Start pitocin. Deliver the uterus through the abdominal incision, hold it in a warm moist gauze, and deliver the placenta. Remove any remaining membranes, clots and other debris with a dry swab.

The vertical incision is in thick myometrium, and it will be necessary to close this in two layers. Close the inner half of the myometrium with a continuous suture of 0-chromic gut. Close the outer layer with the same suture using interrupted, figure-of-eight, or a running locked suture. It will be important to have your assistant compress the uterus to enable you to reapproximate the muscle layers without putting tension on your suture. Close the serosa with 2-0 chromic gut. The rest of the operation is completed essentially as described above in section (C1).

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Special Cases

Postmortem Cesarean

The outcome of this approach depends entirely upon the speed of your decision to perform the procedure, followed by an equally rapid classical Cesarean section. Commit to the procedure immediately upon maternal cardiac arrest. Deliver the baby by a classic vertical Cesarean approach. It should take you only seconds to incise the skin and fascia, continuing directly into the uterus. Good retraction by your assistants will be critical. Deliver the baby either as a vertex or a breech, depending upon the presenting parts that you may encounter. Begin neonatal resuscitation immediately.

Extraperitoneal Cesarean

This procedure was described in the early 20th century as a means of excluding infected uterine contents from the peritoneum. It may still have its place if you are bereft of antibiotics. Essentially, enter the abdomen through a vertical midline incision, but do not enter the peritoneum. Identify and grasp the median umbilical ligament and work from here to mobilize the parietal peritoneum superiorly and laterally for several centimeters in the plane of her lower uterine segment. Incise the peritoneum in this plane, keeping close to the bladder reflection. Grasp the parietal peritoneum at the vesicouterine fold and elevate and incise the posterior parietal peritoneum to join the anterior incision that you have just completed. Mobilize the peritoneum off of the lower segment. Free enough peritoneum to allow you to place a continuous suture through the peritoneum to create a purse-string closure of the superior edges of the peritoneal incision. This should be without tension and form a tight closure.

Reflect the bladder downward and complete a low transverse Cesarean section in the usual fashion. When closing, leave a drain over the suture line. King et al recommend introducing a second drain on the opposite side to enable intermittent irrigation and suction drainage of the extraperitoneal space.

Hemorrhagic Complications

Massive bleeding that does not respond to oxytocin and fundal massage and is clearly not due to retained fragments or to unattended lacerations will require further surgical management. Your choices include hypogastric artery ligation, uterine artery ligation, placement of the B-Lynch suture, and hysterectomy.

Uterine Artery Ligation

This procedure requires less exposure and dissection than internal iliac artery ligation and is clearly your first choice to avoid a hysterectomy. It may become necessary following Cesarean, or you may find it necessary to perform a laparotomy to tie the uterine arteries to treat severe postpartum hemorrhage after vaginal birth.

Deviate the uterus away from the side to be ligated. Use a large curved needle and 0-chromic suture. If the ligation is necessary following a Cesarean, place your suture below the level of the uterine incision. Enter the myometrium medial to the uterine artery and exit behind the uterus and broad ligament. Incorporating myometrium in this way avoids the ureters and any risk of avulsing the uterines. You will also compress inferior branches of the artery. Reload your needle and penetrate the broad ligament from posterior to anterior in a bare area. This avoids laceration of a vessel while providing a guarantee that the artery will be incorporated in your knot. Tie for hemostasis. Clear the uterus of clots and debris and observe.

You may need to place one or two more sutures, in particular if your first was not tight enough or failed to incorporate a major branch of the artery. If bleeding is lessened but still continues despite placement of several sutures, consider ligation of the ovarian artery adjacent to the cornua. If bleeding is from the placental site following Cesarean, as in accreta/increta/percreta, you will need to oversew any rent in the uterus and place figure-of-eight sutures in the implantation site. In this situation, ligation of the hypogastric (internal iliac) arteries may be necessary, as described below.

Internal Iliac Artery Ligation

The placental implantation site may derive a significant portion of its blood supply from cervical and vaginal branches of the internal iliac artery, and thus bleeding from the placental site may not abate with uterine artery ligation. To ligate an internal iliac artery, you need to establish good exposure. Locate the pulsating common iliac artery, and open the overlying peritoneum. Dissect down to the bifurcation, and carefully incise the sheath of tissue covering the internal iliac artery. Pass a suture beneath the artery and tie. Confirm that pulsations in the external iliac continue and take great care not to lacerate an adjacent great vein. Successful ligation will reduce pulse pressure to the implantation site but not eliminate it. Bilateral ligation may be required.

B-Lynch Suture

If bleeding following a low tranverse Cesarean is due to an atonic uterus that has not responded to uterotonics (or you are without recourse to these), an alternative or adjunct to ligating the uterine, internal iliac, or ovarian arteries may be placement of a suture designed to compress the uterus as described by B-Lynch, Coker, Lawal et al in 1997.

Exteriorize the uterus and ask your assistant to perform bimanual compression. If this is effective in reducing the hemorrhage, you can anticipate a good result with placement of the suture. The technique has been described by B-Lynch essentially as follows. Load a 70-80 mm round bodied needle with a long suture of #2 chromic or plain gut. (Others have described success using 0 vicryl suture.) Drive the needle into the lower uterine segment approximately 3 cm below and slightly medial to the angle of your uterine incision. Reload your driver and now seek a point in the uterine cavity that is about 3 cm above the uterine incision and 4 cm from the lateral edge of the uterus. Loop your long suture over the fundus and down towards the cul-de-sac. Locate a point 4 cm from the lateral edge of the uterus and immediately below your uterine incision and drive the needle through the posterior lower segment to reenter the uterine cavity. Draw the suture snug while your assistant provides compression. Now locate a point on the posterior uterine wall that is located symmetrically on the opposite side, visible beneath your transverse incision and 4 cm medial to the edge of the uterus. Drive your needle through to emerge from the posterior surface of the uterus. Again pause for compression of the uterus and to draw the suture snug. Now loop the suture over the fundus and bring it down to a point 3 cm above and slightly medial to the angle of your uterine incision. Drive the needle through the myometrium to emerge again in the uterine cavity. Reload your needle driver and bring the needle through from within the uterine cavity at a point 3 cm below the incision and again 4 cm from the lateral edge of the uterus. Continue to compress the uterus and draw your suture snug. Tie the two ends securely and close the uterine incision in the usual fashion.

Cesarean with Hysterectomy

Hysterectomy following a Cesarean is essentially the same technique as standard total hysterectomy (consult a gynecologic surgery text) with the following special considerations.

1. Although the uterus is to be removed, the uterine incision must still be closed for the sake of hemostasis.
2. Anticipate a large amount of edema and thinning of the lower segment, especially if the patient had been allowed to labor prior to her Cesarean.

3. There may be many large and dilated veins. You may compress these to drain them, which may help you to avoid lacerating them.
4. You will need to employ more clamps as you work down the sides of the uterus and cervix as compared to a nonpregnant uterus.
5. The ureters will be dilated by pregnancy and more difficult to palpate.
6. The cervix will most likely be effaced, and thus special care needs be taken to ensure that you have excised the cervix and created a vaginal cuff.

Suggested Reading

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CHAPTER 16

Pointers for American Surgeons Going to the Developing World

Donald E. Meier and John L. Tarpley

Philosophy

American surgeons going for the first time to developing world (DW) countries are immediately impressed by the lack of "essential" equipment and supplies, different standards of cleanliness, and the lack of an identifiable organizational plan in the operating room where they are supposed to work. The degree of developmental deficit varies from country to country and from hospital to hospital within a given country. The easiest defense mechanism for dealing with the inevitable feeling of hopelessness is to determine when the next flight leaves for home, get out of there as quickly as possible, and write the trip off as an error in judgment. That is certainly the easiest solution, but in our opinion not the best one. We offer a few suggestions for you to try before giving up and heading for home. Attitude is vital; join in as a partner and coworker. Treat your fellow physicians with respect. The first advice is the proverbial, "Make sure it's broke before you fix it." Study the systems presently at work in the hospital, realizing that these systems have evolved for a reason and may end up being the best solution to the problem. Don't jump to the conclusion that everything you as an American surgeon do is good, and everything "they" do is inferior. Find out from the local health care providers what their perceived needs are. If you work hard to provide solutions for unperceived problems, the changes you attempt will not last as long as the cloud of dust your vehicle makes as you leave for the airport.

Only when you have adequately assessed the existing situation can you formulate a plan for gradual change. The longer you can stay in the situation the better chance you will have of making significant changes that will last after you have returned to America. Be sure that the end result is worth the windmills you will have to fight to get there. Return to the same hospital at a later time. You will have more knowledge of the situation, and your advance planning will be much more specific after your introductory trip. With a little bit of assessment and planning and a lot of patience, you can indeed make a significant contribution to surgical care in developing countries around the world, especially if you understand that the most important contribution you will make is in the area of training physicians, nurses, and other health care workers. The old proverb of giving a man a fish and letting him eat for a day or teaching him to fish and letting him eat for a lifetime is nowhere more true than in DW health care. We like to take that proverb one step further to say that if you teach a man to *teach others* to fish, then the whole community can eat for a whole lifetime.

Surgery and Healing in the Developing World, edited by Glenn Geelhoed.

Therefore if you can teach a DW doctor your surgical techniques and then inspire her to teach other physicians the same techniques, eventually you can work yourself out of a job and head for another "fishin' hole".

Practicalities

Sterilization

Sterility is a relative term in many developing world hospitals, as sometimes things are "more sterile" than at other times. There are several techniques for achieving sterility in a developing world situation: autoclave, pressure cooker, boiling water, soaking in antiseptic solution, and gas sterilization. The ideal is autoclaving, but autoclaves are expensive and difficult to maintain. They are not, therefore, universally available. Another method to achieve similar results is to use as large a pressure cooker as you can find for instruments, gowns, and linens. If this is the best technique available to you, then, in order to minimize waste of sterile supplies, only the people touching the patient should wear sterile gowns. The scrub technician should wear gloves alone and concentrate on not contaminating the instrument field with his nongowned body. Instruments can be boiled between cases as a "flash autoclave".

Boiling does not kill spores but it does kill the organisms proper. Soaking is a tried and proven method for sterilization. Our soaking solution in Nigeria is made up of methyl alcohol (methylated spirit) and a detergent. It is important that all particulate matter be washed from the instruments before soaking them. Ethylene oxide gas sterilization kits are commercially available in the USA, but they are expensive and cannot be transported on airplanes. If money is available and if you

Figure 1. "Edify and Teach". Visiting urologist Jenny Franke invests in Nigerian physicians Drs. Ebenuwa, Adeniran, Oladiran, and OlaOlorun. A series of visits to the same locale enables one to significantly elevate the delivery of care in a specialty and gain new friends and colleagues.

have time to ship by ocean, gas sterilization systems can be ordered from H. W. Andersen Co.

A gas sterilization system can be improvised using an otherwise-useless refrigerator that still has a good airtight seal. An electric light is placed inside the refrigerator next to a bowl that has a couple of formaldehyde tablets in it and another bowl with water. The formaldehyde vaporizes and sterilizes everything in the sealed refrigerator. This certainly would not meet American hospital standards, but it has been successfully used in "bush" hospitals where commercial gas sterilization systems are not available. A technique that is common in less developed areas but foreign to American operating room culture is the use of transfer forceps. The forceps, which can be any kind of grasping instrument, are kept with the tips of the instrument soaking in an antiseptic solution. Whenever a sterile instrument needs to be transferred from one place (a soaking solution pan) to another (a sterile OR instrument table) the transfer forceps are used. Remember, sterility is relative!

Equipment

Most of the equipment you find in DW hospitals won't approach any American hospital standards. The hemostats, needle drivers, and forceps are usually "sprung". These instruments can, however, be used for some if not most of the basic operations you will perform. It is best to carry a good set of basic instruments in your suitcase to use for any operations that require more precise manipulations. We recommend needle holders, tissue forceps, hemostats, and an assortment of scissors, especially fine curved iris scissors. If you protect them with your life, they will last a long time and make your difficult cases a lot more fun. There are some other pieces of equipment that will improve your outlook on life during your tenure in the DW. A fiberoptic headlight is phenomenally useful. A small unit will fit into a part of a suitcase and is well worth your time in packing it. Many regions where you are going use 220 volt current, (necessitating) and you will need to take along a transformer of some kind. Try to take the smallest and most light-weight one that will do the trick for you. (Talk to Radio Shack about travelers' transformers.) An electrocautery is quite useful but most units are bulky as well as heavy. They also require a relatively heavy transformer. If you are going to do very extensive dissections, it is well worth the excess baggage charge; but, believe it or not, hernias and appendectomies can actually be performed without an electrocautery. Operating loupes are quite valuable for older surgeons (like the authors) when performing precise operations such as pediatric cases and tendon/neurovascular repairs. Disposable operating tourniquets can be obtained from most American operating rooms and are quite helpful in DW situations. A standard football or bicycle pump can be used for inflation. With a little imagination a manometer can be placed in the system using a 3-way stopcock with all 3 ways opened.

After the correct pressure is obtained while pumping, the tube going to the tourniquet proper is clamped securely. The pressure that you set will be maintained quite well as long as the tourniquet has no leaks and the clamp is tight enough. A rechargeable cordless drill can be gas sterilized after proper charging and used on low speed (to prevent burning of the bone) for orthopedic cases requiring a lot of drilling such as external fixator placement. An assortment of drill bits from a US hardware store is also helpful.

Supplies

"Disposable" should be deleted from your DW vocabulary. Almost all supplies, with proper resterilization, are reusable. Improvisation is a necessity. Surgical gloves can be washed, powdered, placed in metal cans, and sterilized in an autoclave. Disposable gloves can thereby be used for at least 3-4 cases. In an attempt to limit the waste of surgical gloves, plastic bags, which are ubiquitous and cheap in the DW, can be used as gloves for dressing changes and rectal examinations (sometimes double bagging is indicated!). A very functional colostomy bag can be constructed from a tin can, a plastic bag, two pieces of inner tube rubber, and a piece of string.

Until recently suture in America came in double packets. Often there were excess sutures "opened" on the operating table. In reality only the outer packet was opened and the suture inside the inner packet was still quite sterile (by DW standards). These unopened inner packets were often thrown away. Many American hospitals, however, now save these inner packets for use by DW hospitals. Suture manufacturers are now changing the way they wrap sutures and this abundant supply may not be available for DW hospitals. After sterilization monofilament nylon fishing line (the cheapest generic kind available at discount or sporting goods stores) makes excellent permanent surgical suture. Twenty-pound test is equivalent to 0-nylon and works quite well for abdominal wall closures and hernia repairs. Four- or six-pound test is good for skin closure. Needles with a threadable eye are not nearly as convenient to use as swaged-on ones, but they are available, even in the USA. You can fit a lot of needles of various sizes in a small part of a suitcase. Regular sewing thread in an appropriate size can be sterilized and used as a multifilament suture for bowel anastomoses. Unfortunately, we have not found an adequate substitute for absorbable sutures, and we remain dependent on commercial suture, whether donated, recycled, or purchased.

Other helpful improvisations include the use of toilet paper for cast padding and the use of rolled gauze and gypsum powder to make cast roll (plaster of Paris) (Fig. 2).

Rolled bandages constructed from strips of old bed sheets make an excellent substitute for Kling or Kerlix extremity bandage rolls. Orthopedic traction units can be constructed using pulleys (stick a few small cheap ones in your suitcase), rope, and paint cans filled with various amounts of cement or rocks to achieve the desired weight (Fig. 3).

Practice Peculiarities

Many of the disease processes that an American surgeon encounters in a DW situation are the same ones that he sees in America. They are usually, however, in a more advanced stage at presentation, and the diagnosis and treatment must be completed with limited resources. The best, and often the only, diagnostic modalities are a history (usually through an interpreter) and a physical examination.

X-rays, if available at all, are often prohibitively expensive. Therefore unless an X-ray is truly going to change your management, it is probably not indicated. Fluoroscopy is a luxury found only in the more advanced DW hospitals. Ultrasound is becoming more available, but functioning CT scans are found only in the most sophisticated centers. The American surgeon must therefore be willing to make significant decisions based on minimal data. Exploratory laparotomy becomes the most specific diagnostic modality for intra-abdominal problems.

Figure 2. "Roll your own". If you do not have a supply such as rolls of POP, improvise. What is the challenge? What are the available resources?

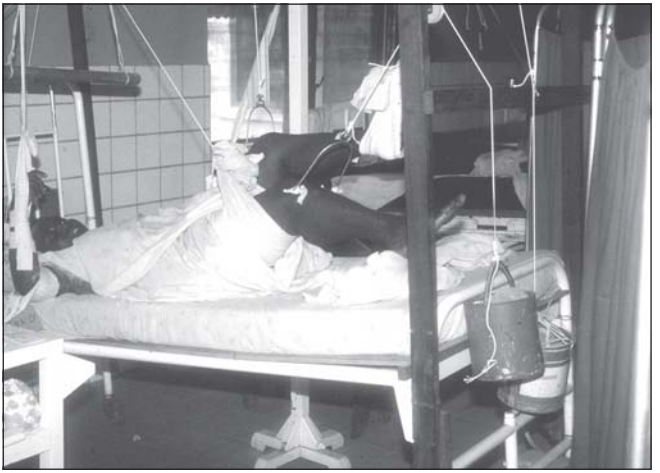

Figure 3. "Ropes, Pulleys, and Physics". Orthopedic surgeons are a rarity in most of the developing world. Adapt your treatment to the appropriate level of technology at your host hospital. With each visit develop the infrastructure to elevate the level of practice.

Anesthetic capability varies dramatically between DW hospitals. A pulse oximeter fits well into a small area of a suitcase and is a wonderful contribution to the safety of patients in a DW country (Fig. 4). Local and regional anesthetics can be use extensively. Ketamine, which is inexpensive and safe, is often used as the sole anesthetic agent in children. It can also be used effectively in adults, but diazepam should be added in adults to moderate emergence reactions.

Figure 4. "Essential equipment". Every hospital, whether in the developed or developing world, needs pulse oximeters, especially in the OR and recovery room.

American general surgeons are comfortable handling most intra-abdominal problems in the DW. One unfamiliar problem, however, is perforated typhoid enteritis. These patients have usually been ill for over a week and are grossly septic, volume depleted, and malnourished. The best plan of attack is volume repletion, antibiotics (whatever is available), and operation. The simplest operation is debridement and primary closure of the perforation. If perforations are multiple, resection of the affected segment should be considered. These patients are ill for several days postoperatively, and many of them go on to develop multisystem organ failure. The mortality rate is as high as 35%.

Inguinal hernias are ubiquitous in the DW, many of them quite large. The American surgeon going to a DW country needs to forget that Dr. Lichtenstein ever existed. A good Bassini or Cooper's ligament repair in the DW is much more appropriate than sticking in a piece of mesh. Utilize a generous relaxing incision to decrease tension. If a prosthetic patch is absolutely required, harvest the appropriate size of fascia lata from the patient's ipsilateral thigh. Fascia lata is available, affordable, sterile, and versatile. (Additionally, we have utilized fascia lata additionally to close chest wall defects and dural deficits).

Patients with malignancies tend to come late in the course of their disease. Chemo- and radiotherapy are often not physically or economically available, and operation is the only chance for cure. However, because of late presentation, most operations are directed at palliation i.e., toilet mastectomy for breast cancer and bypass procedures for pancreatic or gastric carcinoma (Fig. 5).

Figure 5. Breast cancer can lead to tetanus. Fifty-three per cent of breast cancer patients in our Nigerian hospital in the '80s presented with skin or chest wall involvement, Stage IIIB.

Many patients in the DW present with pus in the extremities or the body wall. In addition to routine skin and subcutaneous abscesses, osteomyelitis, pyarthrosis, and pyomyositis are everyday occurrences in a DW general surgery practice. Almost all abscesses should be drained widely (ketamine is your greatest ally here) and left open to heal by secondary intention. Antibiotics appropriate for staphylococcus are expensive, if available at all, and should never be used as a substitute for wide drainage. It is important for the DW general surgeon to know a safe approach to all bones and joints in the body. Hoppenfeld's *Exposures in Orthopedics* provides such an approach and is well worth the investment. Hand infections are common, and familiarity with proper drainage techniques for felons, paronychiae, and tendon sheath/palmar space abscesses is vital.

Men with urinary retention present frequently to DW hospitals. The three main causes are: benign prostatic hypertrophy (BPH), prostatic cancer, and post-inflammatory urethral stricture. The first step in management should be an attempt at passage of a urethral catheter. If catheter placement is successful, urethral stricture is probably not the etiology of the obstruction. After drainage of the dis-

Figure 6. "Burns last for a lifetime." Survivors of serious burns usually have contractures. Knowledge of Z-plasty releases, flaps, and skin grafting can restore function and cosmesis.

tended bladder a digital prostatic evaluation can usually distinguish between BPH and cancer. If cancer is diagnosed, the treatment options are estrogen administration or castration. The technique of open suprapubic prostatectomy can be mastered by an American general surgeon, and this operation can bring great fulfillment to both the patient and surgeon. We recommend a Malement removable pursestring technique in order to minimize blood loss. If a urethral catheter cannot be placed in a man with urinary retention, the etiology is likely urethral stricture. Filiforms and followers can be safely used by general surgeons, but attempts to dilate without use of a filiform is dangerous and should not be attempted by surgeons unfamiliar with urethral dilatation techniques. If catheterization cannot be achieved with filiforms and followers, the safest and most effective emergent procedure is a suprapubic cystostomy, which can be performed using an open or percutaneous technique.

There are many patients with burn scar contractures. Basic techniques for contracture release (Z-plasty) and skin grafting are essential. Knowledge of a few basic muscle and fasciocutaneous flaps increases the surgeon's options for effectively treating soft tissue trauma (Fig. 6).

Don't assume your patients have been immunized against tetanus. The most trivial wound can be lethal. Always immunize. Debride widely. Be quick to leave wounds open unless conditions are ideal. Think like a military surgeon.

Perhaps the greatest challenges are patients with burns and spinal cord injuries. Management of such devastating injuries will vary greatly by locale, economics, and the infrastructure available—or not. Seek the guidance and input of the physicians at your host hospital. Heroic effort on a hopeless cause can deplete scarce supplies needed for patients who can recover. Think "triage" and couple realism with your idealism.

Travel Tips

Because the success of your medical experience may be dependent on having the minimum basic supplies and equipment required for your surgical subspecialty, find out in advance your baggage allowances and restrictions. Most airlines permit each passenger to carry two items, weighing up to 70 pounds each. Extra bags may be permitted for an additional fee, but most airlines require notification several days before the flight of the exact number of excess pieces. Sturdy boxes such as those obtained from truck rental agencies and heavy duty plastic footlockers make excellent supply carriers. Be cautious about excessive amounts of drugs and ask your host to find out if permits are required for drugs as well as supplies. Airlines do not permit dangerous or flammable items and some medical supplies fall into these categories. As already mentioned above, the electrical variations in many areas necessitate transformers for electrical items which hopefully will be available at the host institution. Check before you travel. If possible, consider leaving behind any bulky item as a gift.

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CHAPTER 17

Training to Serve the Unmet Surgical Needs Worldwide

Robert J. W. Blanchard, Ronald C. Merrell, Glenn W. Geelhoed, Olajide O. Ajayi, Donald R. Laub and Edgar Rodas

This chapter derives from the Panel sponsored by the International Relations Committee of the American College of Surgeons and presented on October 25, 2000 at the 86th Annual Clinical Congress of the American College of Surgeons.

Introduction

At the beginning of the third millenium after Christ, the world's population passed the six billion mark. An estimated one-third of our world—2 billion people—still lack basic surgical care! In this chapter we attempt to address the question, "How best may surgical needs be met in a sustainable manner within resources available for training in less-developed populations?" Our goal is to raise awareness of the enormous unmet needs for surgical care in less-developed regions and to suggest alternate training methods to help meet the needs. In many developing countries, surgical training programs are patterned after North American or European programs. This tends to encourage subspecialization and may not produce surgeons adequately trained to manage the broad spectrum of surgical needs for which people attend their local district hospitals. A complete roster of surgical specialists cannot be made available in most district hospitals throughout the world. Therefore, the surgeons serving in these hospitals require training and experience that encompasses a broader range of surgery than is provided by the usual programs for training general surgeons.

Global Surgical Need in an Education Context

Robert J. W. Blanchard

Surgeons set the agenda for surgical training and, hence, surgical care throughout the world. We may not always get it right and that is why we should review these issues.

Part of the problem is that surgeons like to pursue the more complex technologies and specialization. This pursuit does not match the needs in many parts of the world because in less developed regions there are far too few surgeons to care for the populations' needs, let alone pursue advanced technologies. Ethiopia, Tanzania, and many other countries and regions have 1% of the number of surgeons than Canada has per unit population. This severe lack of surgeons results in a corresponding lack of surgical care provided to the population. For example, using the most conservative estimates of need for Cesarean sections, over 90% of women requiring Cesarean

Surgery and Healing in the Developing World, edited by Glenn Geelhoed.

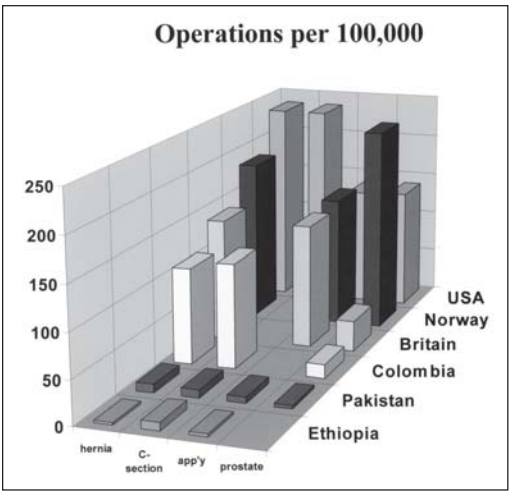

Figure 1. Annual number of operations per 100,000 population.

section do not receive this life-saving operation in parts of Pakistan[1] and much of Eastern Africa.[2] Many women unable to receive Cesarean section die in childbirth, often due to rupture of the uterus. The babies all die. The agonies and complications of benign prostatic hypertrophy are shared by men around the world but, in many countries, most men suffering from this problem find no relief and many die from obstructive uropathy. It is unconscionable that people are still dying of untreated acute appendicitis 120 years after Kroenlein, Fitz, and McBurney described its surgical cure. Data for trauma care are sparse but there is much to indicate that an already bleak situation is deteriorating.

While the health systems in North America and Western Europe are able to offer more, and increasingly sophisticated, specialized surgical care, many of our world's populations have no access to care of even the most common surgical illnesses.

The bar graph (Fig. 1) displays the disparity between the surgical "haves" and "have nots" for hernia repair, Cesarean section, appendectomy, and prostate surgery. The graph also shows that there is a graduated supply of surgical care throughout the world. This indicates a need to direct remedies in a manner tailored to local situations.

Without doubt, there is a desperate lack of surgical care in much of our world. We could declare that this is a problem for governments and health agencies to solve. However, in reality, surgeons in all countries can do much to bring about improvement in the availability of basic surgical care. Surgeons can play an important role through encouragement, advice and planning. Without strong input from surgeons, governments may do little or do unhelpful things. An important area for involvement by surgeons is in the realm of surgical training. The present approach to surgical training aggravates the unmet surgical needs in many parts of the world because general surgeons are not being trained to meet the bulk of surgical problems. This deficiency is one which surgeons everywhere can help improve.

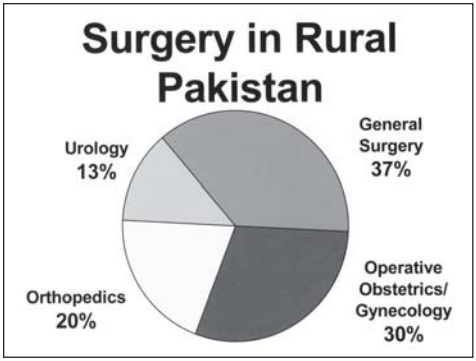

Figure 2. Breakdown of types of operations performed in district hospitals of Pakistan.

What is not helpful in many deprived regions is for surgeons from advantaged countries to descend briefly with a load of equipment to demonstrate a few highly technical operations that cannot be reproduced or maintained in the region visited. This creates a sense of inadequacy on the part of the local surgeons and their patients. It is better to encourage the local surgeons to provide the best possible care within resources that can be sustained.

A detailed survey of district hospitals in remote rural Pakistan documented the spectrum of surgery carried out in hospitals far from specialized care.[1] There were 52 doctors doing surgery in 19 hospitals, performing almost 24000 operations in one year. An important finding was that there were only 98 different types of operations being done. Less than half of the patients (37%) required operations included in the usual modern General Surgery training programs! Thirty percent of the operations were operative obstetrics or acute gynecology. Simple orthopedics accounted for 20% and basic urology 13% (Fig. 2). A general surgeon can manage this scope of surgical cases comfortably if he or she receives broadly-based training which includes operative obstetrics, acute gynecology, hot orthopedics and basic urology along with the general surgery. Unfortunately, the General Surgery training programs in Pakistan did not provide this scope of training. Rather, the training programs in Pakistan were much like those in North America. This is the situation in other developing countries also.

In each population, decisions should be made regarding whether to transport all of the patients to large multispecialty centers or to provide care in regional centers with suitably trained surgeons. Issues such as distances, transportation facilities, surgical facilities with staff, and cost will assist in making these decisions.

Whatever systems may be devised for the varied needs of different regions, the following principles should be followed:

- The surgical care must be effective and safe.
- The surgical care must be widely accessible, either by transport systems or by regional centers.
- The surgical care must be affordable within the local and national capacity.
- The surgical care must be appropriate for the local situations: infrastructure, such as supply of electricity, communications, available laboratory and pharmaceutical capacity etc. have to be considered in planning.

- The surgical care system must be locally sustainable. Repeated provision of services by external visiting surgical teams cannot take the place of permanent and affordable local programs.

Failure to Meet Surgical Needs:

Glenn W. Geelhoed

It is important to keep the idea of healing as broad as possible. Some still argue that surgery has no role in health care in developing countries because it is extremely labor- and cost-intensive. The contention is that the focus ought rather to be upon prevention. However, acceptance of prevention programs by a population rests on the credibility won by curative care.

One need not travel to less-developed countries to experience "Third World" health problems. Many parts of our developed world have health concerns more in common with those of developing countries. A number of health care professionals who have never left North America have a great deal of "Third World" experience; for example, in sections of Chicago, or Anacostia in Washington D.C. Parts of Harlem in New York share more with the *katchi abadis* (squatters' districts) of Karachi than with first-order centers of the world. Many extremely poor countries have been dealing with health problems using far fewer resources than are available in the USA. So, in humility, we can ask of them, "What can we learn from you?" People in such places recognize that they have no money, and therefore they must be innovative and imaginative. So the question is "what can we do today to learn how we might help specific needy populations?" For example, perhaps the biggest health care resource in some parts of Nigeria might be a road to get people to a hospital.

What, if any, roles may North American surgeons fill in going "there" and trying to help? One advantage medical personnel have is that the discipline is readily translatable into other cultures: anatomy and physiology stay the same. This may not be true for lawyers, accountants or business people. Surgery is highly regarded everywhere. Medical education in most countries uses the English language. Teaching that will produce new teachers in a sustainable way can provide lasting benefits.

One of the obstacles is the lack of facilities, including electrical power and plumbing, to say nothing of endoscopes, CT scanners, etc. Many western surgeons have difficulty imagining how to function without these "necessities" despite the fact that surgery has been practiced effectively for generations in their absence. In America there may be competition for patients amongst provider groups or even surgeons. However, in much of the world, there are so few doctors that no competition exists for surgeons willing to provide affordable care. Surgeons going from the West to poor regions often face surgical challenges they have never seen before; for example, the need to perform a Cesarean hysterectomy. Surgeons from the West also learn from their Third World colleagues how to handle bigger problems with fewer resources in a much larger population. In order to ensure that surgical care programs are sustainable, it is important to translate the responses to need into local indigenous resources. While adhering to basic principles, it is quite possible to simplify many of the essential components: sterilization can be done in a pressure cooker, adequate lighting can be powered by solar panels supplying automobile headlamps, etc.

Mind the Gap

Travelers on the London underground railway periodically hear the warning, "Mind the gap". In this "golden age of surgery" the gap is widening between people in the developed world and those in the rest of the world. In sub-Saharan Africa only one of 15 women needing Cesarean section have access to any health care personnel.[2]

In many countries, such as Mozambique, the present needs are such that enough trained physicians and surgeons simply cannot be supplied within many years, if ever. Even if a dozen medical colleges could suddenly appear, the supply of surgeons would not meet the needs for decades. What can be done in the meantime and in the absence of sufficient medical trainees? In parts of Congo and Mozambique nurses or technicians are the only "surgeons" available. With appropriate training, guidelines, and supervision these workers provide good surgical care within the scope of their capacities where otherwise no surgical help would be available. Common procedures such as hernia repair, drainage of abscess, and Cesarean sections are competently managed by these surgical technicians. In Mozambique such a trained technician is called a *technicus chirurgicus*. These technicians are trained intensively for a year to provide surgical care for five acute problems: abscesses, acute appendicitis, intestinal perforations, strangulated herniae, and Cesarean sections. They do not perform any elective surgery and transport patients with these problems to the city when possible. Twenty such technicians have been deployed in rural regions of Mozambique with an average of 520 operations per surgeon. Is this a return to the "barber-surgeon" and surgical mayhem? Such a program could result in disasters if not properly set up and supervised. In fact, the outcomes of the surgical care by the *technicus chirurgicus* surgeons has been equivalent to that of the central hospital.[3] In other countries and regions, similar alternate arrangements have been proven to function well and to provide much relief from morbidity and mortality which would otherwise not be provided at all.

What can we as the American College of Surgeons do? It is clear that something more must be done to provide surgical care to the huge populations that at present have no surgical care. The important change is that the lack of surgical care in the Third World is now on the agenda, and we can continue to discuss and wrestle with how best to provide help for the unmet needs.

An Educator's Perspective: Curriculum, Resources and Tools

Olajide O. Ajayi

To satisfy unmet surgical needs worldwide, the perspective of the educator in the training of a surgeon is the sum of four goals. They are:

1. the selection of appropriate candidates for training,
2. the setting of standards for course contents and the duration of training,
3. the provision of effective methods for the transfer of theoretical knowledge and the acquisition of practical skills, and
4. the determination of the end result of these measures through examinations and certification.

The aim in the long term is the emergence of young, innovative surgeons adequately motivated and technically competent to take and execute decisions based

on good judgment and sound scientific knowledge. While the pattern of practice varies with levels of socio-economic development, the educator's primary focus in differing circumstances is the search for amendments within the extant realities of means, resources, and tools such as will provide appropriate training and enhance access to affordable and effective surgical services.

Curriculum

A good curriculum in any setting must:

1. reflect the local disease patterns;
2. recognize that geographical pathology is not static;[4]
3. enrich clinical experience by expanding the variety and volume of clinical exposure;
4. encourage originality and flexibility by enhancing the reasoning process through didactic teaching, rotating clinical experience and continuing medical education;
5. promote professional confidence through the acquisition of technical responsibilities;
6. provide the opportunity to keep abreast of developments elsewhere through personal communication, participation in local and international conferences and access to selected journals, articles and monographs;
7. inculcate the spirit of enquiry through research and encourage the critical self-appraisal of performance, and
8. foster the development of team spirit and a sense of commitment to teach others.

A curriculum thus crafted evolves over time even when resources are apparently unlimited. It is seldom an instant creation.

Basic Science

The need to support and develop methods that achieve excellent outcomes in sustainable and affordable ways may require a greater understanding of the necessity for a wider breadth of basic science than has hitherto been generally recognized.

Basic Skills

The acquisition of basic skills built on sound scientific knowledge which allow for professional self-development and adaptation constitute the core of good training. "Rural surgery", may demand greater skills, experience and deftness given the scanty facilities available and the limitations of ancillary staff. The broad-based training necessary for service in rural and under-doctored areas include the acquisition of skills in emergency obstetrics and gynecology, local and regional anesthesia, pediatric surgical emergencies, urology, otorhinolaryngology, some radiology and ultrasonography. The spectrum of surgical diseases in a typical rural community as illustrated in Table 1 includes the unsolved problem of infections and infestations and the unmet challenges which Anthony Barker aptly described as the surgery of infection and neglect.[5]

New Dimension

The emergence of new Third World pandemics of noncommunicable diseases like trauma, cancer, cardiovascular and renal diseases continuously adds to the already unmet "old" surgical needs. The combined challenges of the new and the old

Table 1. Surgical operations in Eruwa (1983-2000)

External Hernia Repair	4610
Excision of Superficial Lumps	962
Laparotomy for Peritonitis	748
Caesarian Section	534
Hydrocelectomy	486
Prostatectomy	278
Intestinal Obstruction	155
Vagotomy and Drainage	95
Orchidopexy	94
Sequestrectomy	90
Thyroidectomy	88
Insertion of Chest Tube	71
Major Open Fracture	48
Splenectomy	17
Nephrectomy	11
Miscellaneous	200

Courtesy: Awojobi OA, 2000.

needs add new complicating dimensions to training in developing countries. A Continuing Medical Education (CME) Program for the training and retraining of core staff in a surgery unit should be an essential feature of the curriculum.

Management Skills

Other factors which affect the standards of surgical training and practice particularly in developing countries include the poor or misguided management of scarce resources. Management skills should include strategic planning and evaluation, personnel man

Resources

Manpower

Du Plessis identified a sound economy as "the primary requirement" in health development.[6] The need to focus on manpower development is crucial given the appalling surgeon/patient ratios in nearly all Third World countries. Manpower is more than the availability of doctors or surgeons. A critical mass of health workers is necessary to provide the environment for learning and training. Even then, the available personnel is inappropriately distributed between the urban and rural areas.

Funding

The persistent underfunding of healthcare affects the performance and motivation which can be expected from the educator and the extent to which the trained 'core' staff can be retained.

Conceptual Failure

The new emphasis on Primary Health Care (PHC) complicated the issue of resource allocation within the diminishing resources of Third World countries. It brought with it the misconception of an inexpensive, affordable, accessible and efficacious health system. A health system was advocated especially for developing coun-

tries based on three tiers with a referral system. Surgery suffered greatly in the scheme and layout because of its perceived expensive needs and apparently disproportionate consumption of available resources. The implementation of the PHC concept is in troubled waters because:

1. it has not reduced the cost of healthcare nor has it changed the health indicators in most developing nations;
2. it has advocated community participation without recognizing community interests;
3. it has failed to give practical expression to the holistic concept of healthcare as illustrated by a tripod, two legs of which have, at best, been immobilized by collapsed economies and the debt burden.

What has yet to be fully appreciated is the extent to which confidence in modern scientific medicine has been undermined and confidence in the PHC itself lost by the failure to quickly respond to trauma, surgical, obstetric and other life-saving emergencies particularly in developing countries.

Tools

Medical Attendants

The issue of lower level manpower development in surgery has been extensively debated in developing countries. The choice in many instances has often been between a technician-performed surgical service or none at all. The sum of the depth of feeling among protagonists of lower level manpower is as expressed by Garrido who, against a background of Mozambique's doctor/population ratio of 1:40,000 and surgeon/population ratio of 1:400,000, wrote as follows:

"In under-serviced developing areas, the preeminent concern is the overwhelming need for health care services and the resource constraints that deny medical care to many, in some instances most, of the population. Our responsibility is first to see that services are rendered to the desperately needy, and then to upgrade the quality of those services. In this continuing crisis, with increasing desperation brought on by pressures of a burgeoning African population living and dying in poverty, life-saving expediency using all possible means is a more ethical medical response than professional Puritanism.[3]" He admitted however, "the decision to perform major surgical interventions is frequently more difficult than the intervention itself."

Paramedical Staff

This kind of reasoning is further encouraged by the proven value of nonmedical personnel and general practice physicians trained to perform specific duties in the domain of surgery. The popular example is the experience in Gambia where nurses were trained initially to extract cataracts under supervision and their skills were upgraded to include lens implantation (Faal H, personal communication, Feb. 1999). The acquisition of a single skill, however, does not constitute the art and science of surgery. The general practice physician is not translated into a surgeon by a 6-month program in surgical and obstetric emergency as confirmed by the McGill Ethiopia Community Health Project which proved unsustainable after the first and only course of training.[7]

Local Training

For some decades now, local training programs have emerged in developing countries with the assistance of older and established surgical colleges in the United States, Canada, Europe and Australia and New Zealand. The advantages included:

1. The larger number of surgeons that could be trained above what established colleges or institutions can accommodate;
2. The assumed benefit of training in the environment of future practice;
3. The opportunity to upgrade local facilities to meet training needs;
4. The availability of the service of trainees during their period of the training;
5. The control or limitation of the problem of trainees not returning to their countries of origin at the end of training.

The difficulties, however, include:

1. The need to meet globally acceptable minimum standards of training,
2. The lack of sufficient trainers working under suitable conditions;
3. The lack of facilities to meet and sustain locally designed programs and adequate minimum standards;
4. The need to organize and guarantee continuing education programs for teachers and trainees.
5. Inability of most people to pay for services even in the government-owned hospitals.

Specialization

Specialization is progressing worldwide. The fragmentation of surgery which accompanies specialization may have very limited use in overcoming or reducing the unmet surgical needs in most parts of the world.

Stratification of Specialists

The other advocated tool to meet surgical manpower needs in developing countries is the stratification of the endpoints in training.

"The stratification of the endpoints in training programs will have to be handled with care. A downward review of standards to increase the quantity of specialists undermines the value of training and the determination of a credible 'minimum' surgical standard. In a milieu of rapidly changing technology and advancement in the medical sciences, a 'minimum standard' of surgery will need to be defined first. Stratification is socially divisive in concept and diverts attention from issues that need solution. Producing a medical or surgical or nursing 'technician' cheaply, quickly, and superficially has been tried (before) and discarded".[8]

Options

What then can we consider as the desirable tools to assist? What has been our experience with them?

a. Travel Fellowships for young surgeons to centers in the developed countries. These have proved invaluable to the few who can benefit. Recipients returning have encouraged and stimulated younger colleagues by sharing their experience and reporting developments in centers visited.
b. Access to biomedical information through book and journal donations. There is the difficulty in selecting appropriate books and journals. The cost of postage can be considerable.

c. Assistance in the development of local training programs through short-term clinical teachers and demonstrators. This has been the most visible area of successful intervention. The assistance of the International Federation of Surgical Colleges and the Association of Surgeons of Great Britain and Ireland in the genesis of the West African College of Surgeons is an example. The determination of international standards through the examination processes was facilitated by the nomination and sponsorship of examiners by the Royal College of Surgeons of England in the early stages. By this mechanism, a reciprocity was established at some levels in the diploma awarded by the two colleges. The relationship ceased during the bleak period of the Nigerian dictatorship and can now be resuscitated.
d. Organization of courses, workshops, seminars and visiting lectureships. This is widely reported in the Pacific zone and in South America mostly mediated by the Royal Australasian College and the American College of Surgeons-respectively. The numerical strength of the College Chapters in various countries is an important factor in the Americas. Many African colleges, groups and associations are beginning to look inwards in this effort because of the unwillingness of foreign teachers to enter unstable regions.
e. Provision of appropriate audio-visual teaching and learning aids. The preferred options in this kind of assistance are in the areas of basic and applied sciences. Clinical situations particularly in operative surgery are less useful.

Models for Appropriate Training: Model I—Cross-Cultural Training Teams

Donald R. Laub

One model which is successfully meeting the need for training initially in plastic surgery and also providing a high standard of surgical care is Interplast, an independent foundation. Members have made over 600 trips to various parts of the world and performed over 40,000 operations while providing training to local physicians and surgeons.

This model is based on five principles:

1. Humanitarianism can be compatible with educational goals and, in fact, humanitarianism ought to be taught as an educational goal.
2. Foundations (US 501.C.3) are effective means for such humanitarian service and useful partners with universities. Some benefits include the fact that foundations can assume the liability for foreign programs that universities are becoming chary of assuming. Moreover, separate fund raising is possible along with the pride of ownership that occurs when a foundation helps a university.
3. Internationalization of surgical teams and the training of residents is an important goal. Representatives of two, three or more countries multiply ideas and innovations.
4. Recipients become providers. Providers teach recipients in one country who then, in turn, become provides and teachers often in a third country, and so on.

5. A curriculum based on "task achievement" outcome works better than a "time in service" approach.

Interplast was established as a foundation in order to meet the training needs of Stanford University residents and evolved to meet the surgical needs of developing countries but with humanitarian motivation. The program then began to provide role models for trainees of both American and the developing countries involved. The final evolution was to mount educational programs. The educational programs flowed from the motivation of a surgeon (a) to help people and (b) to teach. Powerful psychic income occurs in fulfillment of the reason why we became physicians in the first place—the "doctor instinct". A professional is one who applies his/her skills for the benefit of others. The good feeling that this produces is the psychic income which becomes the motor driving the programs.

In this model, there are two primary teaching goals: (1) to develop psychomotor skills, i.e., how to do surgery. This takes 2 years. (2) to develop an attitudinal behavior change which takes place over 5 years. Two additional benefits occur: recipients become providers and teachers and life-long professional relationships are developed.

There are two models: one for teaching in the University hospitals and the other model for district hospital level surgery. The following will outline the district hospital model.

The basic outline includes the following:

1. Intermittent trips, monthly or quarterly rotations depending on the specialty.
2. A team of four to twelve visiting professionals, each with a counterpart from the host country.
3. The curriculum is a serious commitment on the part of all.

Intermittent trips allow participation of busy professionals. The team achieves more than a single surgeon could do. Moreover the team reaches a high level of achievement similar to that of an athletic team accomplishing what they have not done before. The experience of working in a team is greatly appreciated by the participants along with the satisfaction of achieving something worthwhile.

An advantage of the Foundation-University relationship is the ability of the foundation to provide liability insurance, community support and background funds. The University provides the staff and skills as well as the young, idealistic trainees. It is possible to acquire team members from several countries bringing a wealth of additional experience and widening each member's friendships. Moreover, the teams are multi-professional including nurses, anesthesiologists, pediatricians, surgeons in various specialties, technicians, and so forth.

The curriculum of the district surgeon consists of parts from many specialties. The curriculum is divided into tasks or operations as needed and requested by the trainee hosts. These tasks are filtered and selected depending upon whether a particular task is considered to be teachable by the providers.

The following is a brief outline of the District Surgery Curriculum:

- General Surgery: Trauma; Laparoscopy; Wound care; Secondary level General Surgery
- Orthopedics: Fractures; Club foot; Bone healing
- Plastic Surgery: Burns; Repair of lacerations; Cleft lip repair
- ObGyn: Child birth; D&C; Infections;
- Community Health: principles
- ENT: facial fractures

- Neurosurgery: epidural and subdural hemorrhage.

When all the boxes are marked as completed, the trainee is declared competent in facial fractures, for example. There is a similar sheet for every task or operation.

An important question arises as to whether infrastructure aid should be provided from the outside to augment sustainable local resources. This needs careful evaluation for each situation. Great caution should be exercised concerning the provision of bricks and mortar.

This program has demonstrated the benefits of cross-cultural cooperation and assistance. Medicine has no political boundaries and the "doctor instinct" is conducive to helping others. Money becomes a secondary motivator. The advantages of nonprofit foundations have been demonstrated as a good option for this type of program It allows pride of ownership and benefits the university through collaboration. Participants learn how to be happy without money or advanced technology; they develop lifelong professional relationships; they participate in humanitarianism as role models for the trainees.

Somos bueyes en la misma yunta. (We're all oxen pulling the same yoke.)

Los barcos son seguros en los puertos, pero no fueron hechos para estar alli. (Boats are safe in the harbors, but they weren't made to be there.)

Models for Appropriate Training: Model II—Mobile Surgery

Edgar Rodas

The term "unmet surgical needs" has connotations which vary depending on where you are. In America it could mean lack of the latest technical machines or lack of the exceptionally skilled surgeon performing extremely sophisticated operations. In many parts of the world, "unmet surgical needs" is a matter of life and death for hundreds of thousands of persons.

I received a call one night some years ago from a small town in the mountains. A young pregnant woman with severe abdominal pain had arrived there after six hours on horseback. There was no surgeon in the town so I traveled six hours by car and three more hours on horseback only to find a young woman dead along with her dead unborn child. Figures help our *minds* to understand the problem, experiences make our *hearts* understand the problem and can change one's life. There is a huge gap in the availability of care and the gap is widening. On one hand, we have conquered space and deciphered the genetic code. On the other hand, thousands of women and children are dying because they have no access to timely surgical care.

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The majority of people live in rural areas and small towns often with no roads or with almost impassable roads. On the other hand, in the same developing world, there are large and modern cities. The differences are startling. A surgeon going from the USA to conferences in some developing countries may get the wrong impressions. He or she will see beautiful presentations in impressive facilities with state of the art equipment, including robotics and binocular video surgery. Unfortunately, these facilities serve a small fraction of the population.

Since much of the population cannot travel to the surgical facilities, we have envisaged and developed a program of mobile surgery. Initially we faced objections and criticisms including concern about infections, lack of blood transfusions, etc. In fact, it is recognized that nonhospital bacteria are less resistant to antibiotics than hospital acquired organisms. Blood transfusions are required extremely seldom. Subsequent analysis of outcomes have laid to rest the objections.

We built an operating room in a 24 foot van. A larger truck could not negotiate the narrow winding Andean roads in Ecuador. It contains a small operating room with adequate lighting, anesthesia equipment, electrosurgical unit and basic monitoring instruments. Another room is for the surgeons to scrub and for storing medical supplies. There are two tents, with oxygen, suction and monitoring devices: one for preoperative preparation and one for postoperative care.

A local doctor performs initial screening of patients. A complete history and a physical examination are performed and informed consent is acquired. On a set schedule the mobile unit sets out to the designated villages and sets up in a suitable location in the village to perform the scheduled operations as well as any emergency procedures that are required. Sometimes surgeries are performed in small country hospitals when facilities permit. Locations visited have included sites in the Amazon jungles, coastal lowlands, and high Andean mountain regions. Practical obstacles have included road obstructions due to landslides and other unexpected barriers. On one occasion an overhanging rock ledge had to be dynamited to permit the truck to pass.

Besides the provision of essential surgical care that would not otherwise be available, the program includes research, teaching, and telemedicine consultations. The research has demonstrated the effectiveness and safety of this approach as well as acquiring valuable statistical information. The teaching component has been valuable for both Ecuadorian and foreign students.

Summary

Ronald C. Merrell

Surgeons are concerned about the problem of unmet surgical needs in our world as demonstrated by the almost 600 Fellows and Residents who filled the auditorium for a panel discussion in the 2000 Congress of the American College of Surgeons. The many comments and questions confirmed the conviction that surgeons are "doers" with a great desire to be helpful. Unfortunately, there was insufficient time to deal with the large number of insightful suggestions. Some of the themes that arose during the discussion period are as follows:

- Establish a list of resources for service in less-developed countries. This could be published periodically in the Bulletin and added to the ACS Web page.
- Provide links in the Web site to organizations involved in needy regions.
- Establish a list of activities that the ACS is doing for underserved regions and populations
- Establish a booth for International Surgery in the Scientific Displays at the annual Congress meetings. Invite international organizations to participate.
- Develop a register of experienced and available advisers to help develop or design sustainable training programs suitable for needy regions.

- Establish an institute or committee for the study of appropriate need-oriented and affordable evidence-based surgical training suitable for various national circumstances.
- Establish seminars or colloquia for Third World surgeons to share experiences and techniques for solving surgical problems with innovative inexpensive measures.
- Encourage governments and colleges to provide for the main surgical needs before moving to more complex and expensive options.
- Establish a clearing-house with advice for surgeons traveling overseas to cover such matters as liability insurance, health needs, malarial and other prophylaxis, etc.
- Explore options to assist new trainees with managing student loans and other matters in order to facilitate their involvement abroad.
- Promote the establishment in General Surgery training programs of a "rural" training stream with a broader scope of experience.
- Consider programs to bring patients from unserved regions to North America for surgical care.

The needs in our world for surgical care are growing and the supply is dwindling. We can do better. We must do better.

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CHAPTER 18

Guide to the Operating Theater on $25 a Patient

Glenn P. Verbrugge

In many hospitals in the developed world, operations in the theater are preceded by very expensive preoperative evaluations and the cost of the operation itself may exceed several thousand dollars US. For example, resection of a rectal malignancy may be preceded by a CT evaluation of the liver and pelvis, an endoscopic ultrasound and an extensive cardiac work-up. Monitoring in the theater, the reusable equipment and the disposable supplies add large amounts to the final bill, to say nothing of the labor costs.

By contrast, for hospitals in the developing world, the entire cost for evaluation and operating theater expense must be in the range of $US20-$US30 per case. In many countries the annual federal health budget is less than $US1 per person per year. And yet high quality of surgery with very satisfactory outcomes is possible even in these situations.

In this chapter the emphasis will be on cost-saving measures that do not compromise quality as well as modifications and improvisations that may be necessary in a developing world environment. One key to excellent outcomes is an emphasis on strict sterile technique. Hospitals must strive for an infection rate of less than 1.5% for clean surgical cases. Monitoring the uncomplicated hernia infection rate is a useful marker since virtually all hospitals perform a large number of these operations. There can be no compromise on standard measures for assuring sterile technique, and these are not expensive. Restricted access areas where street clothes and shoes are not worn add no cost. Closed gloving techniques where one's fingers never touch the outside of the surgical gown add no cost and yet are not strictly practiced in some theaters. Many of these theaters employ reusable masks, but this is probably not a major contributor to infections unless a foreign material such as a metal plate is being used. (However goggles and fine micropore masks are part of universal precautions especially important in an era of HIV and hepatitis C.) Flying insects can pose a problem. All windows must be screened and carefully checked for perforations. Some hospitals add plastic stringers to hang from the top of doorways to discourage flies. An expert with the fly-swatter is invaluable. For the pesky fly that will not settle down, a spray by the anesthetist of succinylcholine will quickly paralyze the insect.

An autoclave in good working order is essential. Unfortunately, many hospitals are reliant on one autoclave. A breakdown of this equipment would force closure of the theater and delivery rooms and would compromise many routine procedures. A very useful backup device to keep on hand is a large pressure cooker of the type used for canning. The packs are put in a stainless steel platform above the water, and

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autoclave tape or other markers can assure full sterilization. The author spent some time at a hospital in the rain forest where all autoclaving was done with a pressure cooker on a wood-burning stove.

Gas sterilization is very useful for items that cannot tolerate the high pressure steam of autoclaving. Yet the actual equipment for this can be very expensive. And the standard chemical used for this, ethylene oxide, is a very flammable solution that cannot be transported by air and is unavailable in many developing countries. Every day in many places in the developing world disposable equipment is used and discarded after each operation, often at a cost of several hundred dollars (US). However, equipment such as electrocautery pencils and laparoscopic trocars are being reused in hospitals with severe cost restraints after sterilization with formaldehyde. Several studies have confirmed the efficacy of re-use. A very economical chamber for this sterilization is an old refrigerator with a good seal on the door. Leaving equipment overnight in a stainless steel pan, exposed to 5% formalin fumes or paraformaldehyde tablets in a refrigerator can be a major cost-saving practice. One protocol uses 7 g of formalin tablets per cubic meter. A light bulb in the refrigerator helps the vaporization process. The area around the refrigerator must be well-ventilated for the periods when the chamber is emptied and the sterilized equipment rinsed with sterile water or saline and aerated. A minimum of 12 h is recommended, and all organisms are killed within 24 h, including HIV. Some hospitals will use soaks during the day for equipment such as laparoscopes, cystoscopes and connecting cords but do a gas sterilization with formalin at night. Equipment such as disposable trocars and cautery pencils will be used only once between formalin sterilizations.

Most cost-conscious hospitals where labor costs are quite inexpensive reuse sterile gloves. The heavier orthopedic gloves are especially useful for this practice. And, on the other hand, good surgical gloves should not be wasted on routine dressing changes. Instead, plastic bread bags which are cheap and readily available are excellent for dressing changes, doing rectal exams and for generalized protection of the examiner for evaluating such areas as groin and axilla or for other contacts with bodily secretions. A pocket in the white coat should be kept full of them.

In addition to strict sterile technique, high quality surgery with good outcomes requires high quality monitoring in the theater. Continuous electrocardiography may not be available in some centers, but all hospitals should invest in a continuous oximetry monitor. These monitors carry a warning that they should not be used with flammable anesthetics. If ether is a mainstay inhalation for a hospital, the battery-operated rechargeable model is probably safe and will be one of the best $US1,000 investments the hospital can make. Regular blood pressure monitoring and continuous auscultation of the precordium through a single earpiece stethoscope add to safety.

The cost-conscious hospital can save a great deal on suture in a number of ways. In places where nylon might be used, fishing-line will substitute nicely. Skin can be closed with 4 pound test line. Fascia can be closed with 12 pound test line. If retention sutures are desired, 20 pound line works well (and large buttons from the market work well as bridges for tying these). At least four square knots (5 throws) should be used for the fish-line. A board 18-inches long with a V-notch cut at each end is used to wrap the nylon or to lay it straight for autoclaving. It is best to autoclave only that amount of nylon needed for one case so that autoclaving is not repeatedly done on the same nylon. The nylon is threaded onto small cutting needles for the skin and round-body needles elsewhere. The author and many colleagues have used

this for many thousands of procedures without suture-related problems. When the author mentioned this to a professor of surgery, he commented that he had always known that the fishermen got the best nylon!

Spools of silk can be similarly autoclaved, then threaded onto French-eye needles for bowel surgery, again at great cost savings. There are situations in many operations where absorbable sutures must be used. In these cases, a surgeon must get used to doing almost all tying using an instrument tie. One should be able to do a hysterectomy with three or four packets of absorbable suture total, discarding only 3-5 cm per tie. Visiting surgeons from abroad often need to have this emphasized.

The local fishing or camping store must be visited also for the purchase of a battery operated headlamp for the inevitable time when the power goes off. Headlights that use 1.5-volt batteries and can be focused are very effective and inexpensive. A separate theater light made from an automobile headlight and connected to a 12-volt battery is a valuable standby in many theaters worldwide. A system in which this light comes on automatically when power fails is ideal. A portable foot-powered suction machine complements this for those occasions when power is lost during an operation.

Re-sharpening of all instruments, particularly fine plastic and ophthalmic scissors, will greatly prolong the life of these expensive surgical tools. One excellent small instrument sharpener is made by Reciprocating Honing Machine Corporation, 1301 E. Fifth St., Michawaka, IN 46544 (email: rxhoning@michiana.org) and retails for about $1,250. Hospital networks can pool resources and save a great deal with this investment.

Economizing in the Laboratory

Most theaters in the developing world depend on a functioning lab for some essentials. A packed cell volume (hematocrit) is a basic preoperative screen for any procedure requiring more than local anesthesia. If a tourniquet is to be used in an area where sickle cell disease is common or if there is anemia on the packed cell volume, a simple sickling test, using 2% sodium metabisulphite should be performed. A hemoglobin electrophoresis is ideal but will greatly add to the cost. A Wright's stain for a differential is another readily available, inexpensive test with a great deal of information on RBC morphology and platelets as well as the WBC differential.

Not infrequently, the surgeon and anesthetist will need a potassium level on a person who is dehydrated or who has had a great deal of emesis or diarrhea. The equipment for this test may be non-functioning or reagents unavailable. Use of an ECG machine or cardiac monitor will be very helpful. If a short strip shows a T wave and there are no U waves, the likelihood is that an adequate level of serum potassium is present for induction of anesthesia. On the other hand, the presence of spiked T waves or a U wave mandates further therapy directed at potassium normalization before anesthesia is safe.

A blood bank is essential for some operations, but no blood should ever be used without good history and an HIV antibody screen on the donor. Every surgeon in the developing world can recite stories of tragedies that ensued when that policy was not followed. There are situations in which a hospital may have run out of typing sera for determination of basic blood type. In this circumstance a laboratory can make its own anti-A and anti-B if it knows of one person with type A blood (and therefore an anti-B serum) and another with type B. There is no substitute for the Coomb's test, but in a life and death situation in a male or gravida 0 female, blood

can be crossmatched one time without it. It should be emphasized in the developing world where coronary artery disease is rare, most patients can tolerate a packed cell volume of 20% or even less if adequate intravascular volume is maintained.

The preferred blood transfusion is, of course, autotransfusion. The operating theater on a very tight budget (the nature we are discussing) would not have access to the very expensive cell savers in many modern theaters but can certainly afford a stainless steel soup ladle.

Blood in the abdomen from a ruptured tubal pregnancy or ruptured spleen, for example, where there is no contamination from a ruptured viscus, can be rapidly scooped up—without hemolysis from suctioning—run through a gauze filter and infused through a blood-giving filter.

A good microbiology lab is helpful, especially if antibiotic abuse is prevalent. Such a lab however may be unavailable, and there are helpful hints to be obtained from a Gram stain. A positive blood culture may be assumed if one spins a packed cell volume microhematocrit tube and breaks it at the buffy coat and finds organisms in the buffy coat. If an odor is present on an intraabdominal abscess, one can assume there are anaerobes present. The Gram stain can predict the type with fair accuracy that, if it is a gram negative bacillus, it is likely to be Bacteroides. If it is a Gram positive coccus, it is likely an anaerobic streptococcus. If it is a Gram positive bacillus, then one of the Clostridium species is likely present.

In this era a glucometer should be in every lab even though the reagent strips are expensive. When a history suggests a need, spend a strip. Make sure the nocturia is from benign prostatic hypertrophy and not diabetes if you are planning prostate surgery.

In an ideal world there would be many tests available in every lab. Yet in many countries the entire health budget per capita is spent with one basic lab test per person per year.

Anesthesia Cost Containment

A complete discussion of anesthesia is beyond the scope of this chapter, but there are some areas where cost savings can be safely achieved. There is not a surgeon practicing in the developing world who has not said, "Thank God for ketamine." The author was present at the first announcement of the drug by pharmacologists at the University of Michigan in the early 1960s. Not even they could have predicted how many lives worldwide would be saved with ketamine anesthesia. A wide range of operations from reconstructive to emergency surgery to obstetric and routine general surgery are possible with ketamine at relatively low cost. Ketamine is best used with anticholinergics like atropine to decrease secretions. In adults the addition of diazepam will reduce the incidence of emergence phenomena. Oximetry adds greatly to the safety of ketamine. If hypoxia occurs, airway manipulation with a jaw thrust usually is all that is required although occasional oxygen by mask is necessary as well. Surgeons and anesthesiologists must recall however that this anesthetic is contraindicated with increased intracranial pressure, a history of seizure disorders, uncontrolled hypertension and procedures in the upper airway such as bronchoscopy for foreign bodies. In these situations the least expensive alternatives are local block if feasible, spinal anesthesia if appropriate, ether or fluothane. The newer drugs like ethrane and propofol would rapidly bankrupt a hospital. The author is aware of and has seen in use a technique to do two consecutive cases with one vial of spinal anesthetic, particularly with the less readily available long-acting agents

such as pontocaine. After the first dose of 1 ml or less is drawn up, a sterile cotton ball is used to cover that vial for use a couple of hours later. While not ideal, this does work if a hospital is down to its last vials.

An oxygen concentrator is very cost-effective, especially in areas where bottled oxygen is difficult to obtain or is very expensive. An oxygen concentration of over 30% can be achieved reliably. With a cost-effective operating theater and laboratory and anesthesia service in place, let us now consider specific disease entities where cost-savings and improvisations can be made. For a comprehensive review of the basic work-up and treatment of these diseases, standard texts and other chapters of this book should be consulted.

Burns

Care of burns is an extremely expensive, time-consuming process. Yet burns occur all too frequently in areas where cooking is done on open fires. Mortality is often high and the morbidity of a tragic fire can lead to a lifetime of misery. Aggressive treatment can limit those however. After the resuscitation phase, aggressive wound care can make a major difference in the outcome and can save long-term costs. For example, early excision and grafting of a third degree burn greatly speeds up the healing process. A skin grafting blade is used to progressively shave off the nonviable outer layers till a healthy, bleeding bed is apparent. One must be sure all nonviable dermis is shaved off, even if it necessary in some places to go to the subcutaneous tissue. It can be especially advantageous in the hand and foot. Burns over 15-20% probably are not candidates for this method which is associated with considerable bleeding, but the technique greatly accelerates healing and reduces cost. Dressings are applied and primary grafting are done in a day or two. There is a huge difference in the costs of various dermatomes. Brown dermatomes are favored by many surgeons but are expensive, require a pressure power source and use fairly expensive blades that can be used only a few times. The Padgett is also popular but relatively expensive. The very popular Humby knife is an excellent substitute and should be in every operating room in the developing world. But the cost of their blades is significant too, and at times they will be "out-of-stock', an all too frequent phrase in many places. The Weck dermatome fills a big vacuum in that it is inexpensive and uses very inexpensive blades. The drawback is the maximal width of only 5.5 cm for the graft. Meshing or "pie-crusting" can increase that however. An assistant has to create tension and a slight convex curve to facilitate its use (Fig. 1). The author greatly favors use of the povidone iodine solution as the lubricant for taking the graft rather than sterile mineral oil which has been found to stay in the graft site for a prolonged time. The povidone-iodine solution is applied immediately before taking the graft.

Topical therapy for second degree burns not treated with early excision can be very expensive and the widely used silver sulfadiazine is difficult to keep in stock if major burns are being treated. One readily available and inexpensive substitute is that of honey gauze which has compared favorably with other standard topical agents. The gauze is prepared by dipping sterile gauze in slightly warmed, unprocessed honey. The honey gauze is covered with absorbent dressing and changed every 2 days. Needless to say, mosquito nets must be used for all burns and certainly all those being treated with honey. For very superficial second degree burns, amniotic membrane rinsed with saline and then soaked in antibiotics has worked as well as the very expensive porcine xenograft, but in an era of rampant HIV in many areas, this is probably not safe, even if the donor's HIV status is known to be negative. Superficial

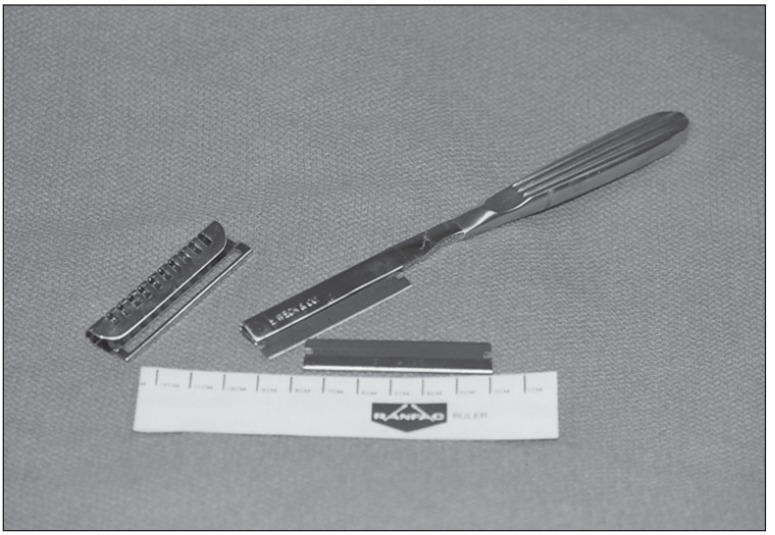

Figure 1A. The Weck dermatome is a very useful tool as a back-up to more expensive dermatomes and blades. A width of 5.5 cm is possible and various thicknesses are possible by selecting the appropriate depth guard. It is especially useful for small grafts, but very large areas can be covered at minimal cost, especially with meshing or "pie-crusting", by taking repeated strips.

second degree burns can be treated by gentle washing with water three times a day, leaving the burns open under a mosquito net.

Hepatoma

Few cases are sadder to see than the many younger patients who present with hepatocellular carcinoma generally associated with chronic hepatitis B infection. An attempt at resection generally taxes scarce resources and is rarely curative. Palliation almost equal to surgery can be achieved by ethanol injection. Generally at least a 50% concentration is used and injected under direct vision or ultrasound guidance if available. One large study averaged 49 cc per case. Recent studies have shown that hepatomas in females are often estrogen-receptor positive. Qualitative assay for receptors can be done if available and empiric treatment with tamoxifen is used.

Hernias

Hernias usually can be repaired with fairly inexpensive techniques assuming mesh is not used. Generally mesh should be reserved for recurrences with major fascial weakness. With regional or local anesthesia, standard repairs of the Bassini type work for most indirect inguinal hernias and a running 12-pound test fish line works well. The Shouldice repair with similar suture works well for direct hernias but unfortunately has a higher incidence of pain post repair. Marlex or Prolene mesh work very well but add markedly to the cost. Giant hernias are becoming less com-

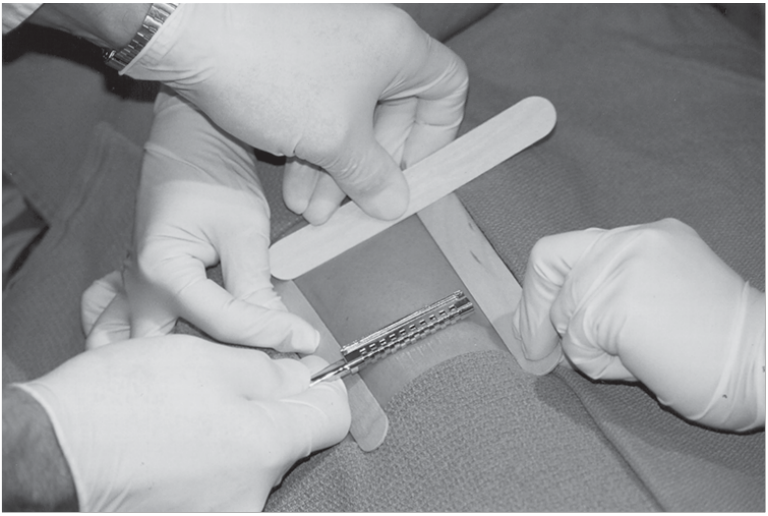

Figure 1B. An assistant must put tension at right angles to the direction of the graft, and the surgeon applies tension ahead of the Weck dermatome, moving the sterile tongue blade as he or she takes the graft. If any fat is evident, too much pressure is being applied to the dermatome.

mon but do need preoperative pneumoperitoneum or creation of a counter hernia in the upper abdomen leaving the peritoneum intact. The latter is done mainly if the tension is much greater than anticipated after reduction of bowel. It should be mentioned that in older patients with giant hernias, an orchiectomy greatly speeds the repair if the patient will agree to that.

Intestinal Resection

The stapler has added to the speed of repair of intestinal resections, but the cost of one fire of one stapler is equal to the cost of 4-5 operations. Handsewn anastomoses usually can be done in about 12 minutes so the time saving is not excessive, except in very low anterior rectosigmoid resections. The author favors a two-layer anastomosis using the inexpensive 3-0 silk on French-eye needles for the seromuscular layer (Lembert type) and a single running inner layer with absorbable suture for the inner layer. This is brought anteriorly as a Connell suture, and at the halfway point it is cut and held. The same suture is used in the same manner for the other half…with great savings in cost.

Orthopedics: Savings in the Cost of Plaster of Paris

Sizable cost savings can be realized if a hospital makes its own plaster of Paris rolls. Gauze rolls and gypsum powder are purchased separately. The gauze is rolled out onto a table. Gypsum powder is sprinkled generously on the gauze, and then the gauze is tightly rolled for use then or later.

Orthopedics: Osteomyelitis

Most osteomyelitis cases present late, and antibiotic therapy is a waste of time and money. It should be reserved for cellulitis or soft tissue infection. Instead the involved bone is widely unroofed, provided the involucrum is solid, and sequestrum removed, and the wound is packed open. Granulation begins with the clean healthy marrow, and the wound eventually closes from the deep portion out.

Pyloric Stenosis in Infants

Hypertrophic pyloric stenosis is a common condition in most populations, and surgical pyloromyotomy is the optimal treatment if safe pediatric anesthesia is available. The cost of the diagnostic work-up can be greatly reduced if reliance is placed on the use of aspirate of stomach contents. If the volume is greater than 5 ml after the child has been NPO for 4 hours, the likelihood of pyloric stenosis is high. A palpable "olive" or positive ultrasound (if available) clinches the diagnosis. If the aspirate is less than 5 ml, pyloric stenosis is unlikely. This approach saves the cost of barium X-rays and avoids unnecessary surgery.

Trauma

There probably is no area where the difference in care between "third" and "first" world medicine is greater than in trauma management. Trauma care often is very expensive and advanced technology very helpful. Yet, much can be accomplished with fairly basic principles and practice. The "poor man's" CT scanner is a scalpel! Following the basic ABCs of trauma care aggressively is lifesaving and more economical. The sooner bleeding is stopped, the less the run on the blood bank, the less ARDS, et cetera. Basic principles like neck stabilization and splinting of fractures are good medicine and helpful with costs. If real-time ultrasound is readily available, this is a very useful, inexpensive diagnostic modality for early detection of bleeding in the abdomen (and chest). Diagnostic peritoneal lavage can be accomplished easily anywhere in the world. If a peritoneal dialysis catheter is not available, one can make a couple of side holes in a 14-18 gauge angiocath and insert this while injecting saline into the abdomen. After infusing 1 L NS or lactated Ringer's solution, the aspirate can be analyzed. If >10,000 RBCs per high power field are seen, lasparotomy is indicated. Alternatively, one can try to read newsprint through the infusion tubing during efflux and if letters are not legible surgery is advisable. Analysis of the fluid for WBCs, bacteria and amylase may be useful. A detailed description of treatment for every traumatic injury is beyond the scope of this chapter.

Tropical Ulcer

Relatively minor trauma can lead to chronic tropical ulcers that are progressive and occasionally, after time, become malignant. The infection is polymicrobial and can include fusobacteria, aerobes, and spirochetes. Aggressive debridement, dressings with Silvadene or dilute povidone iodine solution (1:100), followed by skin grafting, is the most cost-effective way of treating these as opposed to months and years of dressings. Granulation tissue can be stimulated in relatively clean wounds with granulated sugar. If the ulcer is in an area where a muscle flap can be rotated onto the ulcer bed after debridement, long-term results are especially good. For the Buruli ulcer caused by the atypical *Mycobacterium ulcerans*, a surgical approach is also more effective than medical therapy alone.

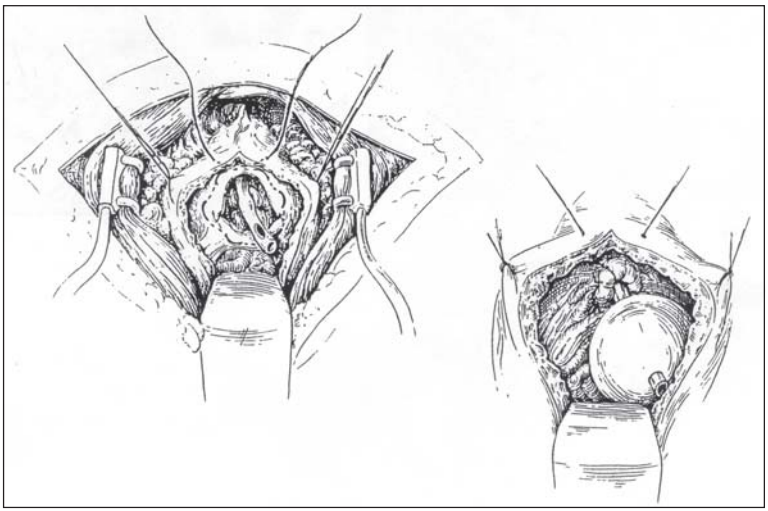

Figure 2. Placement of the Malement purse-string suture. After removal of the prostate adenoma by the supra-public technique, and after placement of figure of 8 sutures at 4:30 and 7:30 (staying away from ureteral orifices), a purse-string suture is made in the bladder neck, brought out through the abdominal wall and tied over gauze or large buttons, thereby tightening the neck over a Foley catheter. The suture is removed after 48 hours. (With permission of Lippincott-Williams Wilkins. Glenn JF, ed. Urologic Surgery.)

Typhoid Enteritis and Perforation

Typhoid fever is a devastating illness when untreated. Often patients do not present until the most serious complication, enteral perforation, has occurred. Most reported studies in the developing world still describe a 10-25% mortality. Early surgical therapy has far better survival rates than medical therapy alone. The addition of total parenteral nutrition has improved survival considerably but is prohibitively expensive for many hospitals. Though an ileostomy might allow earlier feeding, most surgeons prefer closure, resection or bypass. If more than one perforation is present or imminent, bypass or resection of ileum 10 cm proximal and distal to the involved area is recommended. If there is recurrent perforation as evidenced by fecal drainage, reoperation and ileostomy offers the only hope of salvage, albeit slim. For all cases of typhoid perforation, broad spectrum antibiotics covering anaerobes and specific anti-Salmonella therapy, e.g., chloramphenicol, trimethoprim sulfa or, in adults, quinolones, are needed, and there is really no economical substitute. Public health efforts to improve the water supply and sewage disposal are the long-term solution, albeit a logistically difficult one.

Urology-Suprapubic Prostatectomy

Readers are referred to a urology text for the many urologic conditions one encounters worldwide in every hospital. One cost-saving technique that is very useful for the surgeon who must do prostate surgery but lacks the equipment or training for trasurethral surgery is the routine of the Malement suture (Fig. 2). This consists

of a nylon pursestring suture around the bladder neck which is brought out the abdominal wall and tied over gauze or a button. It is removed 48 h later. This technique guarantees more sleep for the surgeon but also saves a great deal of costs for irrigation fluid, blood transfusions and nursing care. It also reduces complications.

Summary

In the US 13% or more of a very large gross national product is spent on health care. In many countries, less than 1% of the national budget is spent on health care. Much of this should be spent on preventive care and healthy water and sewer systems. Yet many health conditions will require surgery, regardless of how much education and prevention is emphasized. It is truly possible to do many operations at a total hospital cost of $US25 per case with appropriate measures in place where labor costs are inexpensive. Cost-cutting efforts in the developed world are gaining new emphasis. It may well be that the men and women who have labored hard and long in the developing world will have much to teach their colleagues abroad.

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CHAPTER 19

Orthopedic Surgery

Richard C. Fisher

Introduction

Orthopedic surgery in the developing world is characterized by a unique set of medical problems and a lack of standard diagnostic and therapeutic equipment with which to work. There is a wide spectrum of available facilities from country to country and within countries from urban to rural areas. The situation in each location thus has a unique set of parameters. To work successfully in this environment requires a thorough knowledge of basic medical principles and fundamental surgical skills. For orthopedists, the necessary skills include a thorough understanding of the anatomy and pathophysiology of musculoskeletal processes including fracture mechanism, fracture healing, and infection. Skills in the closed treatment of common fractures and the application of traction are essential. The surgical principles of tissue handling, sterile technique, and wound management are necessary in an environment with extremely scarce resources and high complication rates. The American Orthopedic (AO) principles involving internal fixation of fractures are sound and useful even if the essential equipment is not always available. The functional treatment of injuries, as taught by Dana, Brown, and Sarmiento, is critical to the overall success of patient care in developing nations.

X-ray equipment is pivotal to orthopedic care. Often older more basic X-ray machines function best in this environment as they are more reliable and require fewer repairs. The ability to perform certain operative procedures is often predicated on whether X-ray equipment is available in the operating room.

There are many innovations possible. One hospital in Bhutan uses a portable unit that can be disassembled and taken to all parts of the hospital and, in times of crisis, to different parts of the country. X-ray film is extremely expensive and in many areas it is cut into small pieces large enough only to include the area of injury. Finger X-rays might be taken on a 5 x 8 centimeter piece of film greatly extending the number of exams possible.

Many orthopedic procedures can be treated either operatively or nonoperatively depending upon the facilities available. The concept of a "safe operating room" is useful for such decision making. Important variables include trained operating room personnel, trained surgeons, a sterile environment, safe anesthesia, sterile instruments, proper implants, and functioning X-ray equipment. If the required resources are not available, alternative methods of treatment should be sought.

It is necessary to understand the cultural norms of the area in which one is working. Many societies require the squatting position for social functions. Hip prosthesis or fusion may be less acceptable than an excised femoral head in these areas. Amputations should be carefully considered as they create unacceptable social

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stigma in certain cultures, and generally, prosthetic availability is limited. It is often not essential to correct all angular deformity and shortening following long bone injuries as long as the patient gains sufficient function to provide a livelihood for himself and his dependents. An extremity with slight angulation and shortening that heals solidly without infection is preferable to attempting perfection without the proper equipment ending in a disastrous result.

There are many lessons to be learned from patients and colleagues who live and work in this environment. The challenges and rewards are endless for those willing to participate in the improvement of medical care for all on the global scale.

Trauma Care

Musculoskeletal trauma is increasing worldwide due primarily to the increase in motor vehicles available, and an increasing urban population. The Burden of Disease Project predicts that motor vehicle injuries will be the third leading cause of morbidity and mortality worldwide within the next two decades. Many patients from motor vehicle trauma fit into the polytrauma injury patterns. The protocols for dealing with these patients in North America and Europe include early and aggressive stabilization of pelvic and long bone fractures as part of the resuscitation protocols. A study done comparing trauma outcomes in the developing world with a U.S. trauma center showed the time to arrival at the hospital in the developing world was less than 24 hours in 41% of patients, one to seven days in 44%, and greater than one week in the remaining 15% of patients. It is clear that many of the most severely injured patients did not survive the trip to the hospital, but in addition, early stabilization was simply not possible in the majority of patients. If patients are seen early, very often the ability to perform sophisticated procedures such as internal pelvic fixation and interlocked intramedullary rods is not available because of the lack of equipment, X-ray, and a safe operating room environment. Other methods must clearly be employed.

External fixation has provided one of the great benefits to trauma care throughout the developing world and can be used for pelvic and long bone fractures. It is a technique that can be taught to technician level personnel using improvised equipment and has provided a means of salvaging many otherwise unsalvageable limbs. Figure 1 shows a homemade fixator placed in a patient with an unstable pelvic fracture.

Femoral Fractures

The treatment of femoral fractures provides an example of the innovations necessary in treating severe injuries when resources are limited. It is possible in the correct environment to place intramedullary femoral rods using an open retrograde technique. This can be done without X-ray control and provides an effective treatment method if a safe operating room environment is available. Use of percutaneous intramedullary locking rods is usually precluded by the lack of expensive implants as well as the required X-ray equipment. When any doubt exists as to the safety of operative stabilization, traction treatment should be considered. There are many different methods that are being used throughout the world and perhaps the most common is either skin or skeletal traction in a Böhler frame. Minimally trained personnel can easily arrange these materials, and the frames are usually available in most provincial level hospitals. Skin breakdown, fracture malposition and delayed healing have been a problem, but if these are attended to, the patient can be treated satisfactorily with little or no X-ray resources needed. Traction weight can be determined by leg length measurements and alignment judged visually.

Figure 1. A locally made external fixation device being used to stabilize a pelvic fracture.

Other traction methods include balanced suspension using felt slings or Thomas splints, Neufeld (roller) traction, simple straight leg traction with or without an antirotation boot, and Perkin's traction. The latter is an especially useful method as it allows the patient to sit up in bed and move the knee and hip joints. Perkin's traction is easily arranged by removing the springs from the bottom half of the bed allowing the mattress to bend down. Traction from a tibial pin pulls off the end of the bed with or without a pulley (Fig. 2). The flexed position of the hip and knee while sitting controls femoral rotation and maintains hip and knee motion. Many

Figure 2. Perkin's traction being used for a fractured femur. The mattress is bent the patient's knee. It can be elevated to normal position for reclining.

of the usual complications associated with traction at bedrest can be avoided by this mobility. When the patient reclines, boards hold up the bottom of the mattress. By 6 to 8 weeks fracture healing has usually progressed sufficiently to allow application of a brace cast, and the patient can leave the hospital using crutches. Perkin's traction also works well for elderly patients with intertrochanteric hip fractures. The fracture can be well controlled and the mobility permitted helps to prevent the complications associated with bed rest in this age group. As fracture healing progresses, many patients are able to stand up in the space between the mattress and the end of the bed allowing them to regain muscle strength and balance.

Tibial Fractures

Plaster cast application remains the basic treatment for tibial fractures. Functional treatment regimes with immediate weight bearing are appropriate when satisfactory plaster is available. Delayed unions can be managed by osteotomy of the fibula and continued plaster treatment. External fixation works very well for unstable tibial fractures. It is particularly useful with open fractures as it allows access to the wound for dressing changes and skin grafting. The pin and plaster technique can substitute for external fixation if necessary.

Calcaneal traction on a Böhler frame is used for complex tibial fractures, but it is more difficult to manage than external fixation. Open treatment using plates or rods is rarely indicated because of the danger of infection and the lack of equipment.

Joint Injuries

For comminuted intra-articular fractures secondary to gunshot wounds or other high energy trauma are common (Fig. 3), surgical reconstruction in the best of circumstances often does not yield a satisfactory result. When resources are limited, treatment with immediate active range of motion can result in a satisfactory functional

Figure 3. Severe intra-articular fracture which was treated with removable splints and early range of motion.

outcome. Dana first proposed this concept and outlined the principles underlying the method of continuous passive range of motion. Injuries such as those in Figure 3 can be treated using a removable splint initially with range of motion exercises beginning within a few days of injury. When necessary, functional traction which will allow active motion can be used in place of the splint. Olecranon traction works well in certain elbow injuries involving the distal humerus. Our experience indicates that joints regain stability and remain sufficiently free of pain to allow functional activities.

Surgical Techniques

Open fractures require early wound debridement and lavage to prevent secondary infection. It is a significant challenge to teach the proper technique in all cultures. Principles include removing all devitalized tissue, copious lavage, allowing the wound to remain open, redebridement of the wound as necessary and closure by suture or skin graft only when all tissues remain viable and clean. The temptation to close wounds early is universal and must lie somewhere deep in our intuitive self. The technology for accomplishing proper wound debridement is simple but does consume some resources including operating room supplies and personnel time. Studies done in Africa comparing irrigation fluids indicate that boiled water is just as effective as other more expensive processed solutions for wound lavage. Internal fixation of open fractures in this environment should be avoided.

Certain fractures do better when treated with internal fixation if a "safe operating room" is available. These include tension type fractures involving the olecranon and patella. The tension band technique requires simple and inexpensive implants, can be accomplished through small incisions, and does not require intraoperative X-ray. Kirschner or other smooth pins and 18 gauge stainless steel wire are all of the implants necessary. The resulting fixation is stable enough to allow early range of motion in most cases (Fig. 4). The technique is applicable for fractures of the oleranon, patella, proximal humerus, and medial malleolus.

The Rush rod is another simple but effective device which has a variety of uses in orthopedic care. They are available in variety of diameters and lengths with a hook

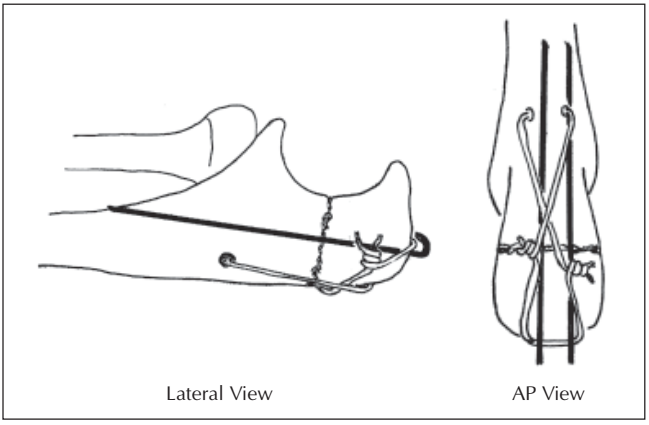

Figure 4. AP and lateral view of the tension band technique in use for an olecranon fracture.

on one end and a point on the other. Because they are somewhat flexible, they provide alignment but not necessarily rigid fixation. They can be inserted percutaneously for treatment of most long bone fractures but are most useful for fractures of the lateral malleolus, radius, ulna and humerus.

Infection

Musculoskeletal infections are endemic throughout the developing world. Polio, leprosy, tuberculosis and pyogenic osteomyelitis are major causes of disability in all such cultures. Polio and leprosy primarily involve the neurologic system, and surgery is directed at the secondary musculoskeletal deformities. Tuberculosis and pyogenic infections directly invade bones, joints and the spinal column and thus damage both mobility and structural integrity of the skeletal system.

Polio has been greatly reduced worldwide and current efforts are aimed at complete vaccine prevention of new polio cases in the near future. When the acute disease is completely erradicated, there will be residual deformities to be dealt with for many years to come. Corrective surgery is usually done electively and in concert with a rehabilitation program which includes bracing, walking aids, and other mobility aids such as special wheelchairs. Simple percutaneous tendon releases or muscle-tendon lengthening followed by locally adapted splints will yield significant functional improvement for most patients. More complex surgery involving arthrodesis and tendon transfers should be attempted only if the local resources permit.

Musculoskeletal deformities in the leprosy patient are secondary to the loss of motor function and sensation principally in the terminal portions of the extremities. It is estimated that there are about 1.6 million people worldwide afflicted by leprosy although the disease is now treatable by combination antibiotic therapy. Like polio, the musculosketetal deformities are treated electively and involve arthrodesis and tendon transfers. Most leprosy surgery is done in designated centers where resources and expertise can be concentrated and focused on this population.

It has been estimated that the world prevalence of tuberculosis has reached 32% or about 1.8 billion people. In the developing countries, perhaps one-third of the population with tuberculosis will have involvement of the musculoskeletal system, principally the spine and lower extremities. Tuberculous infection of major joints is treated similar to management of pyogenic infections with open drainage of the abscess, antimicrobial therapy and restoration of function when the infection is controlled. Often, because of the indolent nature of this infection, much joint destruction has already occurred by the time the diagnosis is made. In such cases arthrodesis following the initial debridement will provide satisfactory function in major weight bearing joints.

Spinal tuberculosis usually begins in the vertebral body causing significant bone destruction and kyphotic deformity. Notoriously, the cartilage of the disc spaces is preserved until late and with extension of the infection, paraplegia occurs commonly from either bony deformity or direct extension of the abscess into the epidural space. Numerous protocols have evolved for dealing with the tuberculous spine surgically and include abscess drainage through either a costotransversectomy approach or a transthoracic approach. In the latter, anterior bone grafting using a rib or fibula is the common procedure. The anterior aspect of the spinal canal can be decompressed through either of these incisions if spinal cord involvement has occurred. In areas where such surgery is not possible, medical treatment alone is used along with brac-

Figure 5. Chronic osteomyelitis with involucrum formation around a diaphyseal sequestrum.

ing or bedrest. Although the effect of pure medical management is debated, in many areas, it is the only alternative and does offer very acceptable outcomes in most cases. An often-used protocol in areas where surgery is not possible or difficult involves medical treatment for one month observing the change in the neurologic exam. If the neurologic deficit disappears or improves significantly, then medical therapy is continued. If the exam deteriorates on therapy, then surgical treatment is sought, either locally or by transporting the patient to an appropriate facility.

Pyogenic osteomyelitis is endemic worldwide and commonly presents in the chronic phase following a hematogenous origin. Other causes include spread from a contiguous wound that occurs iatrogenically or from trauma or secondary spread from a septic joint. In some locations the hospitalization rate for musculoskeletal infections approaches 45% of all orthopedic admissions. At least three-quarters of the patients presenting with osteomyelitis are in the chronic phase of the disease at the time of presentation. The hematogenous form usually begins on the metaphyseal side of the epiphyseal plate with proliferation of bacteria in the post-capillary sinusoids. This progresses to abscess formation within the bone. If not treated, the infection will break through the cortex, spread under the periosteum, and eventually form a draining sinus. In this progression, the periosteum is lifted from the bone and the infection spreads up the diaphysis. The periosteal new bone forms the involucrum and the remaining portions of the cortical bone becomes a sequestrum (Fig. 5). The principles of surgical treatment for osteomyelitis are similar to that for other infections. Before abscess formation occurs, treatment with antibiotics is often successful. Once the abscess has formed, it should be surgically drained and antibiotic treatment initiated. Once the sequestrum has developed, formation of

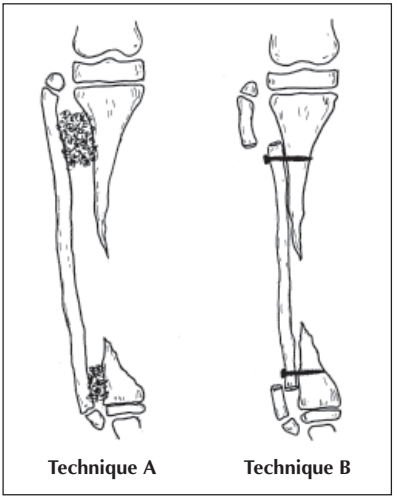

Figure 6. Bypass grafting for an unstable tibia following destruction by osteomyelitis. (Redrawn from: Fisher R. Selected Conditions in the Developing World. ICL 49, American Academy of Orthopaedic Surgeons, 2000.)

the surrounding involucrum is essential to the skeletal stability of the limb. The sequestrum should not be removed until the involucrum has developed sufficiently to stabilize the extremity. If involucrum formation is prevented by severe infection or by early aggressive surgery, skeletal integrity will be lost. The limb will lose its normal length and contour and weight-bearing may not be possible. Although the infection will not be obliterated completely until the sequestrum has been removed, it can be controlled by debridement of the abscess cavity and antibiotic therapy.

The process of involucrum formation may take up to two years. Patients often present after initial treatment with recurrent drainage caused by a retained sequestrum. The infection may have been quiescent for many years without signs or symptoms. Debridement of the sinus tract and removal of the sequestrum often will control the present symptoms. However, the infection might again remain quiescent for years, only to redrain in the future. Treatment with antibiotics in this population usually is reserved for coverage during and for a short time after surgical debridement. Long-term antibiotics use in chronic osteomyelitis probably does not have a place in the treatment regimen.

Once large portions of the diaphyseal bone are lost because of either insufficient involucrum formation or aggressive surgical removal of an immature involucrum, reconstructive surgery with bone grafting is necessary to restore skeletal support of the limb. If the tibia is involved, the fibula usually hypertrophies to compensate. Fibula-to-tibia bone grafting above and below the tibial defect allows weight transfer through the fibula bypassing the tibial defect, (Fig. 6) To repair femoral defects, bone graft must be placed through the infected and avascular soft tissues. This is much more difficult and less successful than bypass grafting described for tibial defects.

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CHAPTER 20

Chronic Pyogenic Osteomyelitis in a Rural Area: The Aggravating Factor of Underdevelopment

Ahuka Ona Longombe

Abstract

Chronic pyogenic osteomyelitis is a common pathology in rural under-developed areas. In North-East Zaire. Patients usually present in the advanced stages of the disease due to financial or social reasons. This disease often necessitates length and costly hospital stays, not to mention the loss of productivity due to time missed from work or school. It is very important that the healthcare worker in such an environment be able to educate the general population, as well as be able to properly diagnose and treat the disease in order to minimize the negative consequences.

Introduction

Chronic pyogenic osteomyelitis (CPO) unfortunately still remains a common pathologic orthopedic condition in our daily practice. This fact is attested to by other authors[1,2] working in underdeveloped countries who have repeatedly reported on the high frequency of this pathology. On the other hand, this disease is a rare pathology in developed countries.[3,4]

CPO has always been a disabling disease in tropical and rural areas and has been a hindrance to the WHO objective "Health For All By the Year 2000". It can, however, be prevented. From the personal point of view, I shall always remember the mother of one of my patients who burst into tears as her daughter was being admitted to the hospital for the second time. She told me that she had already sold all her own clothes for her daughter's medical care, and that if things continued the child's father, brothers and sisters would have to do the same.

In this study we will show that CPO continues to be widespread in our area even though there is a lack of data on this pathology. We will also demonstrate that treatment is costly not only in terms of money, but also time, and this is a hindrance to our country's development as we enter the 21st Century.

Material and Methods

This study was carried out at the Evangelical Medical Centre (EMC) of Nyankunde, which is a 250-bed reference hospital situated in North-East of Democratic Republic of Congo. Despite the degradation of almost all the vital infrastructure of our country, the EMC has the only functional osteorticular surgery service and orthopedic rehabilitation centre in this part of the country.

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Table 1. Distribution of patients according to sex

Sex	Number Affected	Percentage
Male	66	51.97
Female	61	48.03
Total	127	100.00

CPO thus strikes both sexes equally in our area.

The study is comprised of two periods, the first is from January to December 1994 (102 cases). The second period is prospective, from January 1995 to November 1996 (25 cases). This made for a total of 127 cases in all. The ages of our subjects were between 0 and 16 years old. We classified our data according to the sex of the patient, the site of CPO, duration of hospitalisation, financial cost and the patients' proximity to a health care facility.

Results

Sex

See Table 1.

Affected Bones

Out of the 25 patients studies (second phase of the study), there presented with foci of CPO in two different bones simultaneously. These pairs were tibia-fibula, femur-tibia and scapula-humerus. This accounts for the total of 28 cases in Table 2.

Duration of Hospital Stay

The duration of hospital stay ranged from 7 to 375 days, with an average of 88.1 days. The number of hospital admissions ranged from 1 to 4 times, with an average of 1.7 times. Thirty-three percent of patients had been admitted to the hospital at least twice (Table 3).

Table 2. Distribution of infection according to site

Affected Bones	Number of Cases	Percentage
Tibia	16	54.14
Femur	7	25.00
Fibula	2	7.14
Mandible	1	3.57
Scapula	1	3.57
Humerus	1	3.57
Total	28	100.00

The tibia and femur are the most commonly affected bones.

Table 3. Amount of time spent at the hospital

Hospital Stay	Average	Range
Number of days	88.10	7 to 375
Number of Admissions	1.70	1 to 4

Financial Cost

Because of the daily rise in inflation during our country's socio-economic crisis and monetary reform, we made our calculation of the financial charges in US dollars. The average cost of a day in the hospital was $ 2.77 per patient. The total cost of taking care of CPO ranged from $ 49.48 to $ 563.84 per patient, with the average being $ 243.89. This price was comprised of the hospital bed, bandages, medication and surgical operations. At our hospital, the patients' nutrition is their own responsibility, with exceptions being made only for the very poor.

Distance of Patient from Health Centre Hospital

Our patients came from 42 localities in North-East of Democratic Republic of Congo, which were classified as follows (Table 4). Group A: those coming from our village itself (Nyankunde) or from the immediate surrounding area (Bunia, Tchomia, Mongwalu, etc). This area has a reference hospital with a physician in charge. Group B: those coming from localities where there is a health centre or post headed by a nurse. Group C: those in localities where there is no health centre or post. The villages of Group C are 2-5 km away from the hospital, health post where appropriate care could be obtained. We excluded all cases of bone infection after an open fracture.

Discussion

CPO has been and will remain a medical and social problem in our area. It's high frequency puts us back, as it were, into the "preantibiotic" area. At the dawn of the 21st century, it is inconceivable to have such a high occurrence of a preventable disease.

It has been shown in previous studies of CPO[5,6] that there was a male predominance, and that the bones of lower limb (femur and tibia) were the most often affected. Our study did not show a male predominance, but rather the distribution between the sexes was almost equal. This indicates that the poor working conditions in our area do not spare women. As stated by Ogunjumu,[5] barefoot walking, hard

Table 4. Distribution of patient localities

Group	No. of Localities	Percentage
A	12	28.57
B	20	47.62
C	10	23.81
Total	42	100.00

physical labour, and neglected microtrauma all contribute to the predominance of this disease in the lower limbs.

What are the short and long term consequences of CPO? The average of a hospital stay was 88.1 days. Children and adolescents would thus lose 3 months attendance, which represents one-third of the school year. Our average length of stay is much higher than that found by Burgess in Nepal back in 1982 (33 days). This difference can easily be explained by the fact that our patients' lesions were generally more severe at the time of presenation, due to the fact that most of them delayed treatment as they lacked the means to pay for the cost of medical care. Thie prolonged absence from school severely affects the education of youth, who are the hope the future development of a nation. The young person becomes handicapped from a physical and intellectual point of view, while the country waits for his contribution, which, perhaps will never come.

Our country is also presently stricken by an economic crisis that had far-reaching effects in many areas. Consider that the salary of a university professor receives less than $20 US per month, and that of a physician employed by the state is less than $15. How then is a poor, simple villager supposed to find the means to care for his or her child when a university professor or physician would be unable to do the same?

The cost of $2.77 per patient per day at our hospital was much higher than that found by Burgess[6] who had a cost of $0.79 (50 pence sterling). As emphasized above, the reason for this high cost is due to the severity of the lesions, which demanded longer, stronger and more frequent treatment. This situation causes an entire family to become deeply indebted in order to fund medical care.

The patients who came from villages or localities where there was either a physician or nurse able to adequately care for osteomyelitis accounted for 75.55% of the cases. So why then, despite this availability of healthcare, do patient come to us in such an advanced stage of osteomyelitis? Many reasons are possible among which are the ignorance and traditional beliefs which lead patients to consult folk doctors before they come to the health centre or hospital. From the medical teaching standpoint, it is necessary to stress to young physicians and nurses that a febrile state can mask other things (for example CPO) and does not necessarily indicate a malaria!

CPO is a frequent pathology that strikes our youths and children during their active period of life. Due to the long term consequences such as physical handicap, depleted socio-economic ressources and therapeutic difficulties, we agree with Ogunjumo[5] that a policy of rigorous intervention is necessary.

From our perpective, in order for us to have victory over this disease, the following preventive strategies must be employed:

- We must take into account the fact that nurses play a role of major importance in our health system.[7] It is necessary to insist during their training (both pre- and post-graduate) on early and adequate treatment of acute osteomyelitis.
- We must also see health education as the first and foremost responsibility of all medical personnel to the population that they follow.
- We must realise that only a general improvement in socio-economic conditions will enhance a country's development and subsequently the standard of medical care. If these improvements do not take place, CPO will continue to be a rampant attestation to our poverty and underdevelopment.

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CHAPTER 21

Study of the Epidemiology and Treatment of Fractures in Rural North-East of Democratic Republic of Congo

Ahuka Ona Longombe, M. Mbusa, K. Diyo, M. Kakule, K. Kasindi and M. Duani

Abstract

Fractures are a very common occurrence in rural tropical areas. Young males are the group most frequetly affected, and suboptimal management at the time of a fracture can have serious consequences on a patient's subsequent development and productivity. Most fractures can be treated conservatively with surgery being needed in only a few extreme cases. Paramedical personnel can be of great help in the non-surgical treatment of fractures such as plaster casting and traction.

Osteoarticular surgery (traumatology and orthopedics) is one of the surgical specialities which requires particular attention because future physical function will depend on adequate appropriate care immediately available to patients. In rural Africa, the struggle for survival does not allow one to be physically handicapped for that would reduce the potential of the entire family to support themselves. Primary care in orthopedics-traumatology must constitute an important part in primary health care in general. Is it really necessary to have a surgeon (whether he be a generalist, traumatologist or orthopaedist) treat an uncomplicated fracture of the tibia?

In several rural regions, patients acquire physical handicaps simply due to inadequate primary care at the time of the trauma.[1] It is in this context that we have undertaken this study, which will examine the epidemiology and treatment of fractures found in the rural African area. The purpose of the study will be to (1) gather data on the epidemiology and treatment of fractures found in our area and (2) clarify appropriate interventions which prevent or diminish useless handicaps.

Patients and Methods

This study is prospective, from February 1995 to November 1996—a total of 22 months. It was carried out at the Evangelical Medical Centre of Nyankunde, DRC, which is a 250-bed reference situated in North-East. The facility has a good Orthopedics-Traumatology service led by a General Surgeon (AOL) and assisted by an experienced team of paramedical personnel.

This study includes all the patients consulted on our service during the specified period.We excluded all patients having fractures of the vertebral column (which require specific therapeutic interventions) as well as luxations. Only patients having fractures confirmed by radiography were retained. All traction and casting not re-

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quiring delicate orthopedic manipulation were done by nurses. We had a total of 193 patients representing 216 fractures in our study.

Results

The analysis of our study population gave the following results.

Distribution According to Sex

Men are thus more commonly affected than women, and this is probably due to their lifestyle and work.

Distribution According to Age

Causes of Fractures

Falls and motor vehicle accidents represent the two biggest causes of fracture in our area. The latter is probably due to the poor condition of roads, as well as transportation in nonmaintained vehicles that are overloaded with passengers. In the other category, we put pathological fractures (4 cases), animal bites (3 cases), work accidents (3 cases) and fractures in the newborn at the time of delivery.

Site of Fractures

There were 193 patients treated on our service, and they accounted for a total of 216 fractures, as 12 of the patients had 3 or 4 fractures. The four most commonly fractured bones are the femur, tibia, fibula and humerus.

Foci of Open Fractures

Twenty-four patients out of 193 (or 12.44%) presented with open fractures, as shown in Table 4. The tibia-fibula represents the most common open fracture site, because of the lack of protection by soft tissues.

Methods of Treatment

The most commonly used therapeutic modalities in our area were plaster casting alone, traction followed by plaster casting, and rest with analgesics (a total of 82.9% of the cases). The other methods of treatment were relatively rare. Surgical treatment (osteosynthesis), the placement of an external fixator of an external fixator, and delicate reduction of fractures were done by the surgeon (AOL). The other types of treatment were performed by nurses (plaster casting and traction).

Discussion

Males represent the sex most often stricken by fractures (66.84% of our cases). This causes a disruption in the life of the African family where men still represent the primary source of income. The 16-60 years old age group represents 59.02% of our fractures. This age range is the time in which there is greatest professional activity, and hence injuries sustained during this time have great consequences on the survival of the family and that of the community in general.Only 6.44% of our patients are beyond 60 years old as compared to the study found in Stiffman[2] who had found that 33% of his patients with fractures were at least 60 years old. Our data indicate that fractures affect a much younger and more active population in our area. The femur (19.44%), humerus (16.67%), and the radius and ulna (7.41%) were the most fractured bones in our study. This finding agrees with that of Rooser[3] and Hoaglund and Duthie[4] who found bones cited above to be the most commonly found sites of fractures.

Falls, in general, constitute the primary cause of fractures in our area (a total of 39.38% of our cases). Traffic accidents came in second position with 29.02% of cases. It is important to stress that in rural area such as ours, the poor state of the roads, the age vehicles, and the drivers recklessnes and drunkenness at the wheel are all factors in motor vehicle accidents.

In 12.44% of cases, patients presented with open fractures. In more than half of these cases, the tibia and fibula was the site of the fracture. This can cause very serious complications in developing countries due to the potential for infection.

More than 90% of our patients were treated conservatively. The choice of therapeutic modality is one of the most crucial points in the care of patients with fractures in underdeveloped countries. We believe that the advice given by Anderson[7] is very relevant in our area, for the choice of fracture depends upon the experience and judgement of the surgeon, and surgical treatment must be reserved for difficult and unstable fractures. Due to the shortage of orthopedic surgeons, and of necessary materials for open reductions, Duraiswami[8] has noted that in fracture luxations of the ankle, every effort should therefore be made to aim at perfect reduction by manipulation, followed by immobilisation of the injured part in plaster.

Even in developed countries, open reductions are not done without complications. Failure of the bones to heal after setting of the plates,[10] weakness of the affected bones[11] and refractures occur.[12] Moreover, it is possible in our work environnment to obtain a satisfactory treatment of fractures with simple and elementary material, as Bewes[13] and Ebong[14] have shown.

This study can help us to draw practical lessons for people who work in rural areas where most of the time the physician finds himself abandoned, alone and overworked. (1) Paramedical personnel can render tremendous services in the making of plaster and the setting of traction if well supervised. (2) Most fractures can be treated conservatively, and the required training for young physicians and paramedical personnel must be oriented towards providing experience in this area. This will help to diminish numerous physical handicaps encountered in the bush and also help to avoid many amputations.[15]

This study of the epidemiology and treatment of fractures has shown that they are frequent in distant rural areas. Men are stricken more often than women, and both sexes are affected during the productive periods of life. Children under the age of 16 years are most affected, and they can suffer serious consequences on their development, or they may become handicapped. Falls and traffic accidents represent the most frequent causes of fractures; and they can be improved only with widescale community effort, improvement in living conditions, and also amelioration of transportation and roads.

From the therapeutic standpoint, we are convinced that many fractures can be reduced orthopedically with satisfactory results, and surgery should never be recommanded unless its benefits outweight those offered by conservative treatment. Open reductions require sophisticated equipment and qualified personnel having an extensive knowledge of anatomy and physiology which in rural tropical areas such as ours is an extremely remote possibility.

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Surgeon, I would like to work in the same conditions as my western colleagues; but since I don't, I must work in our conditions with a single purpose: that of obtaining the same results, and perhaps even overtaking them some day.

CHAPTER 22

The Prevention and Treatment of Landmine Injuries in the Developing World

James C. Cobey

The Size of the Problem

Recognizing that the world is polluted with landmines, especially in, but not limited to developing countries, is essential if one wants to assist in teaching surgical skills in the developing world. Large tracts of land have been rendered unusable from the presence, or just as limiting, the perceived fear of landmines. According to data of from Physicians for Human Rights (PHR) and the International Committee of the Red Cross (ICRC), close to 70 countries are contaminated with mines with close to 500 injuries a week or 24,000 a year. Peasants foraging for wood and food or tilling their fields are particularly at risk. Children herding livestock are vulnerable since they often traverse many fields looking for pastures. There are an estimated 250,000 mine victim amputees worldwide. Most of these have not gotten a prosthesis. Almost half of these injuries kill the patient while the other cause massive pain and crippling.

The landmine problem is not just in developing countries. Active mines from World War II are discovered in Europe every year. Egypt is trying to develop land west of the Nile, but is limited until mines left by the English and Germans are cleared. Farmers in South America and throughout the world use mines to protect their crops. Russian has dropped mines in Georgia on the Chechnya border. Most of the newly independent countries of the Caucusus are afraid to live without mines on their borders stating that if the United States still feels that landmines are useful, they do to. In fact a conference in Tiblisi, Georgia in December 1999, a Ukrainian ex-military engineer felt his country needed "intellectual mines" that would kill humans but not livestock. He even recommended increasing the explosive charge to reliably kill the victim so as not to leave amputees who are a strain on the rehabilitation systems in many countries!

History

The concept of mines as explosive below ground goes back to at least the 15th century when attackers would dig tunnels (mines) under a city wall to plant explosives below the city. Mines really became a major weapon in the 20th century to stop tanks, which had been invented to breach the trench warfare of the First World War. Antipersonnel mines were designed initially to prevent the removal of antitank mines. Soon after their development antipersonnel mines started to be used on national borders as on the Finnish-Russian or Thai-Cambodian borders. These "hidden kill-

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ers" have been used to protect power lines, railways and other infrastructure from terrorism of insurgents in many countries. It was felt that these tools were a lot less expensive than human guards.

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During the Vietnam war the United States and other countries developed many new forms of this weapon which rather than just killing one person as a bullet, would injure or kill a number of soldiers carrying a victim to safety. In the early 1960s the United States also introduced a new class of mines known as remotely deliverable mines, or "scatterables" to stop the flow of men and material from North to South Vietnam. Weighing only 20 g, these mines would flutter to the ground without going off by impact. They were detonated by the compression a foot and had just enough explosive to tear it off. Many of the US mines were moved by the opposing forces causing one-third of the American casualties to be from mines—often American ones.

The United States also developed the M18A1 Claymore mines which has become one of the most commonly copied above ground fragmentation mine in the world. Originally designed to be used only on command, it is often rigged with a trip wire to make it victim-discharged like a true mine. This weapon propels 700 steel balls outward with a 60 degree arc killing at a distance up to 50 meters.

There are three basic types of mines. First the simple mine buried just below the ground which is set off by pressure. The small ones are antipersonnel mines, the larger are antitank or antivehicle mines. Then there is the carefully aimed shrapnel mine usually set of by a trip wire. These may bounce up and kill or injure at a long distance. Lastly, remotely deployed mines from shells or from helicopters have polluted vast tracts of land thoughout the world. These butterfly on small mines often look like toys and injure children as well as adults when they are picked up as toys.

The newest version of mines are often called by the euphemistic term "submunitions". These are often cluster bombs which are shot ahead of helicopters to "pacify the land" to avoid loss of these expensive gunships. In many areas of Kosovo in the recent conflict up to a third of these bomblets did not explode and became defacto very strong mines.

In any case we have a worldwide problem of injuries that will need the skills of surgery in developing countries. As important all traveling expatriot surgeons must, as the local populace knows, fear ever step especially off the side of a road.

How to Assess the Problem

Before one, as a surgeon or anyone trying to help the landmine victims in a country, can reasonably work, one must have at least moderately accurate data of the size of the problem and the capability already existing in the country to handle and rehabilitate the injured. Too often well meaning physicians and many non governmental agencies (NGOs) jump into a country to help without diagnosing the problem or disease (the land mine epidemic).

To avoid wasting valuable resources or time of well meaning volunteers, PHR, together with many other groups including the World Health Organization (WHO), the ICRC, and others have developed a simple set of epidemiological tools to assess any countries epidemic and care capacity.

This set of tools *Measuring Landmine Incidents and Injuries and the Capacity to Provide Care* which is published as a manual, can be obtain from PHR.* These tools

*100 Boylston Street, Suite 702, Boston, MA 02116

are an effort to standardize data collection. The tools can be used easily and quickly to get accurate data and can be repeated every few years to measure change.

The first tool is a Hospital Data tool design to either prospectively or retrospective gather data on all mine victims with details on outcomes and the demographics of the injury. This tool can be set up as a surveillance system from ongoing reporting of hospitals to ministries of health and then to WHO and the Geneva International Humanitarian Demining Center. From personal experience ongoing data collections systems are hard to maintain due to fatigue of the permanent staff data collectors. Repeated short surveys using the same tool with record reviews by outside NGOs may be able to get more reliable date.

The second tool is the Community Survey tool which actually uses standard sampling methods to do field studies in local villages and towns. This latter tool is essential to pick up, what we expect from experience, is the close to half of the victims that never survived long enough for hospital care. These tools together can quickly let any health planner or outside agency know the extent of the mine problem in the country. The community tool also gives data on the perceived fear of mines. If a community thinks a field is mine infested, that land is of no use until inspected inch by inch with metal detectors or dogs.

The third tool or Hospital Capability tool measures a country's capacity to handle the surgical needs of victims. This assesses the hospital's water and electrical systems as well as laboratory and blood systems. This tool is really a hospital inspection of the physical plant and documents the surgical staffing of a hospital. Many donors want to give aid to landmine victims, when their most important gift may be helping out the infrastructure of the medical system. This tool cannot document well the motivation of a hospital staff but does determine manpower needs. Surgeons wanting to help victims of landmines often are most useful teaching their peers in developing countries how to accomplish good surgery with minimal equipment.

The fourth tool is a Prosthetics Center Capability tool to physically assess prosthetic facility capacities. Before one starts new prosthetic programs, one must know in detail the number and production capacity already in the country.

The last tool is the Social Reintegration tool to measure the effectiveness of all of the above work. Here victims found from hospital discharge data or rehabilitation units are interviewed to see if they are using their prostheses and if they are back in school or working. This last tool is the most important. It is not enough to say that surgery has been done or thousands of prostheses made unless these interventions are actually successful in returning a mine victim to a fully participatory citizen of his country and for his or her family. In some areas we found that no one was using their above knee prostheses. In another country we found victims with three or four prostheses from different shops and none were being used. Without feedback of an intervention, donors may be wasting their efforts in poorly designed projects.

Treatment of Injuries

For surgeons simple basic skills are needed and should be taught for treating mine injuries. The International Committee of the Red Cross (ICRC) has classified three patterns of injuries:

Pattern 1 injuries are blast injuries caused by stepping on a mine which usually results is the loss of one leg and often injures the other leg and genitalia. Dirt, clothing ,and mine fragments are driven into the leg and surrounding tissues.

Pattern 2 injuries are caused by above ground mines,usually detonated by a trip wire. These mines cause chest and abdominal injures often to two or three people in

the area. Often these are lethal depending on the distance of the victim from the mine.

Pattern 3 injuries result from handling mines. This may from attempting to disarm them or playing with them as toys. The injuries often cause loss of one or both hands or blindness.

The initial treatment of these injuries is basic good trauma care, if the patient arrives in time. Remember that half of the victims never get care. In many countries the patient is two or three days from a surgical facility by horse drawn cart. A tourniquet may be placed on an extremity and left on for a day or two. In many countries in rural hospitals there may be no anesthetics, antibiotics, or blood unless the patient or his family has cash to pay for them. Most bedside nursing care including feeding is done by family. Without that family care, the patient may well die.

If the patient does arrive, he is probably in shock. In many hospitals prebottled IV fluid is too expensive. It is easy to make a still in most hospitals to make distilled water to locally manufacture IV saline and dextrose solutions.

The ICRC has made many videos and written many manuals on extremity trauma. Their basic philosophy is to radically debride the wound initially remembering a mine forces dirt up into the extremity underneath skin flaps and muscle planes. Dead dirty tissue may be well proximal to the initially perceived wound. Debride and dress the wound open. Then bring the patient back to the operating room in four or five days for dressing change, redebridement, and possible closure. Do not change dressings on the ward. The ward is not as clean as the OR and dressing changes are painful and really, even if "wet to dry" do not debride a wound well. Only return to the OR earlier if there are signs of sepsis.

In the experience of the ICRC, whose field hospitals are much better equipped than many rural surgical hospitals, most mine victims are in the hospital for an average of a month.

Rehabilitation

Once an amputee is discharged, hopefully he will get a prosthesis. In many developing countries there is no good tax base, so rehabilitation facilities may exist, but production may be very low as the prosthetists are often not paid. A great deal of prosthetic work is done by voluntary nongovernmental organizations (NGOs). Making a prosthesis once for a patient is not enough. All parts wear out and need repair. These desperate war torn countries need permanent prosthetic industries to care for the disabled. The ICRC and Handicap International (HI), as well as many other groups, do excellent training of local staff to make strong, well-fitting prostheses out of locally available inexpensive materials that can be repaired easily. Maintaining these shops is difficult once the outside agency leaves.

Clearing Mines

Mine clearing is the only effective way to prevent injuries in many countries. Mine detection can be done my metal detectors or dogs. Both methods are expensive. Once a mine is suspected as being present, the mine clearing must probe the ground inch by inch to find the mine and destroy it. Most alerts by mine detectors are false positives from shells or bottle caps. Mine clearing therefore is slow and dangerous. New methods to detect mines are being developed, but no new technology yet equals the hand method. Big mine clearing machines are good to get most of the mines out of the ground for military breaching of a mine field but are not thorough enough to allow a field to be farmed.

The Ban

The true vaccine for the landmine epidemic is a ban on all hidden explosive weapons. It is truly immoral and cruel to put an explosive in the ground and walk away from it. After Physicians for Human Rights and Human Rights Watch carried out a study in Cambodia in 1991, the International Campaign to Ban Landmines was started. The ICBL, with the help of many midsize countries, developed the Ottawa Treaty in 1997, which became recognized international law in September 1998. This treaty simply makes it illegal to manufacture, sell, use, or stockpile mines. Over 90 countries have ratified it. Until the United States ratifies it however, other countries will have an excuse to keep using these weapons of mass terrorism. Most mines in the meantime will be found leg by leg and will require the need of surgeon to save the victim's life.

Until the world is cleared of mines, all surgeons should treat mines as an epidemic. One must make a diagnosis of the size and nature of the problem before treatment can start. Physicians for Human Rights strongly recommends obtaining a copy of its standardized tools and using them before starting victim assistance.

Suggested Reading

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CHAPTER 23

Cleft Lip and Palate Surgery in Developing Countries

William P. Magee

Introduction

Thousands of children around the world are born with facial deformities. These children live in a world of isolation and shame, hidden away from society. Until my wife and I established Operation Smile in 1982, these children were offered no hope of a normal, productive life.

Operation Smile, Inc. is now a private, not-for-profit, volunteer medical services organization providing reconstructive surgery and related health care to indigent children and young adults in 20 countries around the world. Operation Smile provides education and training to physicians and other health professionals to achieve long-term self-sufficiency.

Operation Smile brings together health professionals with the public and private sectors to provide voluntary care to improve the quality of life for the children, families and communities that share in the Operation Smile experience. By creating international and national partnerships, Operation Smile builds trust, bridges cultures and bestows dignity at home and abroad.

Strategic Program Goals

Develop, implement and evaluate medical and educational programs, policies, and plans to provide reconstructive surgery for increasing numbers of children with facial, congenital and other deformities.

Strive for self-sufficiency in mission countries by providing enhanced education and training to increasing numbers of medical professionals.

Expand existing and generate new avenues of volunteer support for mission and goals.

Promote and support research that will discover the cause and identify strategies to prevent congenital and other oral-facial anomalies requiring reconstructive care.

Strategic Organizational Goals

Develop the infrastructure, including the future organization structure required, to provide centralized policy direction, decentralized planning and implementation to support the continued growth.

Develop, implement, and evaluate development and public relations programs, policies and plans to support the continued growth of Operation Smile.

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There is much more to be done. There are still several thousands of children in need of reconstructive surgery for such deformities as cleft lip and palate, burn scars, and club feet. We here at Operation Smile want to ensure that these children get the help they need. If we can continue to help these children, we strengthen their families and communities. By educating and training the medical professionals, we enhance and strengthen the support of the medical systems within their countries.

In-Country Approach

To fulfill the continuing need of medical treatment for children living with deformities, a system of identifying and evaluating potential mission sites was formed. Once the need has been determined, a team of approximately 40 volunteer medical professionals and staff are sent to a mission site. Patients with the most urgent problems are scheduled first, creating a schedule that typically allows for the treatment of approximately 150 patients. Following surgery, the patients receive close follow-up treatment and therapy tailored to their individual needs.

During the mission, Operation Smile trains in-country medical professionals in reconstructive care, enabling local medical professionals to carry on the work of Operation Smile. This cycle of education, in addition to the annual missions, brings self-sufficiency and availability of care to medical communities families and governments alike.

Often, the countries we visit do not have the appropriate means to treat severe facial deformities. Hence, our World Care program was created as a supplement to the medical missions. The objective of this program is to bring these patients to the United States where they can receive the benefits of our advanced surgical procedures and medical facilities.

Many American children are also born with cleft lips and palates. In addition to providing reconstructive surgery, Operation Smile's domestic programs offer treatment for dental problems, facial deformities, scars, burns and severe birthmarks.

Currently, we have 29 chapters in the United States. These chapters are vital to our continued growth, as they raise funds, recruit volunteers and raise public awareness in support of medical missions. Operation Smile's vision has spread across the world – more than 20,000 volunteers offer their time, knowledge and skills.

In concert with the chapters, Operation Smile's Youth Program demonstrates the ability of youth around the world to put their minds and hearts together to accomplish wonderful things. This program provides students, through first-hand experience, the opportunity to learn about the true spirit of volunteerism. Students in "Happy Clubs" across the United States have worked with their local chapters to raise awareness and funds for medical missions.

Operation Smile steadfastly believes in team spirit and effort. The accomplishments of Operation Smile would not be possible without the cooperative efforts of our dedicated volunteers, donors and staff.

Medical Surgical Missions

Despite the efforts of medical and other health care professionals throughout most of the developing nations, there is a profound need for specialized medical and reconstructive surgical care for indigent children and their families. Children living with facial and functional deformities also suffer a barrage of other medical complications such as malnourishment, hearing loss, infection and other diseases. The backlog of children living with deformities and the lack of trained specialists in reconstructive surgery overwhelms the health care systems in these countries.

Operation Smile screens requests from developing countries for assistance by analyzing the critical needs, the adequacy of host country hospitals to support medical surgical missions on an annual basis, the commitment of medical personnel, and the logistical feasibility of bringing in a team of specialists for the purpose of performing medical procedures and training. Also critical is the potential commitment of the local business community to support a medical surgical initiative and the host government's willingness to facilitate the missions.

Operation Smile makes a five-year commitment to each mission country. During this period, the purpose of medical surgical missions is three-fold:

To reduce the backlog of children living with facial and functional deformities by providing reconstructive surgery and related health care services for indigent children.

To assist the mission countries in achieving self-sufficiency in reconstructive surgery through education and training of medical professionals, so they are able to provide reconstructive surgery for hundreds of children during mini-missions throughout the year.

To build leadership and an infrastructure within the mission countries that will contribute to volunteer support and funding for the missions, enabling in-country volunteers to sustain the program long-term and continue the mission of Operation Smile to treat needy children.

The medical professionals who volunteer their time to participate during the medical surgical missions include plastic surgeons, ear/nose/throat surgeons, orthopedic surgeons, anesthesiologists, pediatric intensivists, emergency room and family practice physicians, dentists, nurses, child life specialists, physical therapists and speech therapists.

At one site, during a typical mission, a team will screen 300-500 children living with deformities and other medical complications. Over a five-day period, the team will work extended hours to provide surgery for an average of 150 children. Operation Smile sends teams to two or three sites in several mission countries and brings all medical supplies and equipment so as not to place an undue burden on the local health care systems. During the surgery week, volunteers work hand-in-hand with the local medical professionals to build an atmosphere of trust and friendship that ultimately benefits children who need surgery.

Medical Mission Planning

For every mission being staged, there are hundreds of details to be coordinated, planned and executed in order to insure a safe and efficient mission. The following is an example of the timeline and issues addressed by Operation Smile prior to the departure of any volunteer medical team. Protocols, government restrictions, geography, time zones, and cultures all play enormous factors in planning. Communication is essential and will facilitate the smooth operation of the team once it is united at the host destination.

Fact-Finding Trips

Operation Smile generally conducts fact-finding visits at least six months prior to a mission to a new country, or site. While 12 or even nine months prior would be preferable, host country conditions and funding often limit the possibility of this ideal.

Table 1. Operation Smile Mission Timeline

Mission:
Coordinator:
Mission Dates (Advance):
Mission Dates (Main):
Post-Op Return Date:

Mission Task	Time Due Before Mission	Actual Due Date	Date Completed
STEP 1			
Develop concept plan			
Write final concept plan			
Determine development needs			
Determine mission profile			
Conduct fact-finding	4-6 months		
Determine team composition	9-12 months		
Determine slot allocations	6-9 months		
Identify hotel for volunteers	6-12 months		
Transportation: determine requirements	6 months		
Education: determine requirements with Education Manager	2 weeks		
Contact in-country counterpart for education programs planning with Education Manager			
Determine licensure requirement	6 months		
Hospital relations: OR, recovery, post-op			
Locate bottled water			
STEP 2			
Determine visa requirements			
Introduce OS to particular Embassy			
Arrange in-country logistics			
Identify possible candidates for teams			
Identify and choose team leader positions			
Determine old/new volunteer mix			
Notify chapter of slots (give them 2 months to fill)			
Select airline carrier (with Travel Department)			
Provide requirements to ship cargo to Warehouse Manager			
Remind chapter of their slots			
Block seats (airline)			
Fill chapter positions	4 months		
Fill all team slots for a final team list	4 months		
STEP 3			
Obtain visas	6 months-2 weeks		
Contact team leaders with information on education topics			
Educate team leaders (books, ed roles, etc.)			
Prepare custom papers for shipping cargo			
Ship cargo	4 months-3 weeks		

Table continued on next page

Table 1. Continued

Mission Task	Time Due Before Mission	Actual Due Date	Date Completed
Arrange travel to and from mission site			
Send first packet (welcome letter, forms to return to OS)			
Collect team information			
Collect licensure information			
Provide information to appropriate in-country person			
Collect visa information with mission handouts			
Send anesthesia tape (to new anesthesia)	3 months-2 weeks		
Send passport info to invitor (volunteer database)			
Prepare rooming list/distribute			
Collect travel info from team			
Determine mode of transport			
Obtain invitation letter (country, hospital)			
Complete travel worksheet			
Pack supplies and equipment for shipping			
Train medical records personnel			
Contact youth sponsor			
STEP 4			
Pack supplies and equipment for shipping	8 1/2 weeks		
Send information to Embassy for visas	6 weeks		
Send second team packet (informational)	6 weeks		
Development schedule	4 weeks		
Youth: identify youth activities and schedule	4 weeks		
Receive visas from Embassy	3 weeks		
Clear US customs	5 weeks		
Food/water: arrange meals	4 weeks		
Secure transportation, airport, hotel	4 weeks		
Receive course online from team presenters	4 weeks		
Secure rooms, attendance, AV equipment	4 weeks		
Prepare plaques, gifts			
Arrange rest, tour day (usually first Sunday)	3 weeks		
Cut airline tickets	4 weeks		
Review and revise airline tickets	3 weeks		
Send tickets to team members with final packet	2 weeks		
Send final packet (tickets, visas, patches)	2 weeks		
Order team name pins/patches	8 weeks		

The purpose of the visit is two-fold. There is a fund-raising aspect of the visit which helps assess the level of in-country financial support. Secondly, the mission coordinator must address and evaluate issues of accessibility, feasibility and logistics. All information collected during a fact-finding trip must be carefully documented and reported. The findings will determine the supplies shipped, team size, equipment needs and ultimately will serve a vital link in the success of a mission.

Even when conducting a mission to a repeat site, Operation Smile recommends a site visit and a thorough review of the on-site situation.

Operation Smile's fact-finding team for a first time site consists of

1. Plastic Surgeon*
2. Anesthesiologist*
3. Development Officer
4. Mission Coordinator

Operation Smile's team for an assessment of a repeat site consists of:

1. Anesthesiologist*
2. Development Officer
3. Mission Coordinator
4. Plastic Surgeon (if possible)

*Ideally, the team leaders for the missions fulfill these rolls. If not, they must be team leaders from other missions.

Creating a Patient-Friendly and Family-Oriented Environment

During Operation Smile missions, we encounter hundreds of patients and families seeking surgical care. Unfortunately, by virtue of the pervasiveness of facial deformities around the world there are always children turned away, and our volunteers face more work than can be done during a mission. Providing safe surgical care for the correction of facial deformities is our business and our passion, but creating an environment that respects families and patients during this process does not happen by itself. There are simple and purposeful ways that complement the Operation Smile process and create a family and patient-friendly environment.

The keys to creating a secure and comfortable environment for patients and families include doctor availability, use of translators and a working knowledge of the sensitive issues, culturally and medically, for patients and families.

Photography

Many of the patients who seek care from Operation Smile are uncomfortable with their appearances. Most team members want to take photographs to document their experience and some need to provide their chapter, club or sponsoring organization with a presentation at the conclusion of their mission. Since many missions already have a team photographer specifically charged with documenting the mission, it is important not to jeopardize this task. Sensitivity towards patients and families includes courtesy and basic thoughtfulness. You can successfully document your mission experience while respecting patients and families:

Ask permission to take a photograph (learn the phrase in that language).

Form a relationship (through play or conversation) with the person or people you are photographing.

Follow a specific patient/family through the mission (allowing you to form a relationship).

Before and after photographs tell the best story, but monitor the timing of such photographs.

*A patient may be more receptive to having a *before* picture taken after they have been selected for surgery (versus during the screening process when they are unsure if they will be chosen).

Table 2. Fact-Finding Checklist

1. Immigration, Customs and Authorizations

1a Visas
How are they obtained?
Through which office?
Is there a fee?
Duration/Type of Visa?
Time for processing visa?
Information required?
Are forms readily available?
Can photocopies be used?
How many copies needed?
Any nationality restrictions?
Are there exit taxes?

1b Customs
How will cargo be sent?
What is the procedure?
What forms need to be completed?
What is the cost?
Process length?
Responsible person for receipt of cargo?
Lists/descriptions needed for customs?
Any substances restricted?

1c Authorizations
Are licenses, etc. required to bring supplies/equipment in the country?
Are there any restricted substances?
Is authorization from the Health Ministry required for us to enter country?

2. Transportation

2a Air Transportation
Where should team land?
What day should team land?
What is the local flight schedule?
How can reservations be made locally?
Can someone help us get the lowest rates for the local flights?
Who will meet team at airport?
How can we get in touch with them?
Are there exit fees or taxes? If so, how much?

2b Ground Transportation
Where will you meet the contact person?
Do we have train and bus schedules?
Transportation for Advance team and how many on team?
Transportation for Main team and how many on team?
Transportation for extra baggage and material?
Travel time to site?
What is the cost?
Transportation to get back to airport for _____ people available?
Transportation for extra baggage and material arranged?

Table continued on next page

Table 2. Continued

3. Professional Licenses

3a Physicians
Are temporary licenses required?
How is that done?
Can it be done from the U.S.?
Is there a fee?
What credentials are necessary?
Is proof of professional license in the U.S. required?

3b Registered Nurses
Are temporary licenses required?
How is that done?
Can it be done from the U.S.?
Is there a fee?
What credentials are necessary?
Is proof of professional license in the U.S. required?

3c Ancillary Medical Personnel
Are temporary licenses required?
How is that done?
Can it be done from the U.S.?
Is there a fee?
What credentials are necessary?
Is proof of professional license in the U.S. required?

4. On-Site Hotels and Meals

4a Interim Hotel
Is an interim hotel required at the airport for the night of arrival and night before departure?
How many rooms are required?
Location
Description of rooms (bathrooms, etc.)
Cost – with and without group discounts
What services are available (phones, fax, laundry, restaurant)?
Any service charges or taxes?

4b Hotels
Is an interim hotel required at the airport for the night of arrival and night before departure?
How many rooms are required?
Location
Description of rooms (bathrooms, etc.)
Cost – with and without group discounts
What services are available (phones, fax, laundry, restaurant)?
Any service charges or taxes?

4c Meals
How many meals at hotel?
How many meals at hospital?
Total cost of meals?
Can the hospital or Health Ministry cover that cost?
Are bottled water and beverages available?
What is a typical meal?

Table continued on next page

Table 2. Continued

5. On-Site Transportation

23

Transportation from hotel to hospital?
Transportation to official events and receptions?
What is the cost?
Can the hospital or Health Ministry cover the cost?
Can cars or minibuses for VIPs or media crew be rented?
If so, at what cost?
On which side of the road do you drive?
Can a driver be hired for the VIPs or media crew?
At what cost?

6. Patient Needs and Mission Goals

What patients would the country/site like us to help?
Have any other similar medical missions been conducted in the area in the past year?
If so, who, when and where?
What does the country/site want from us for each of these fields?
Plastic surgery
Craniofacial surgery
Microsurgery
Burns
Anesthesia
Orthopedics
Neurosurgery
ENT
Nursing
Pre-Hospital Care
Dental and Dental Hygiene
Speech Pathology
Physical Therapy
Bio-Medical Engineering

7. Hospital Facilities

7a Screening Area
Lights, tables, chairs, electricity, medical equipment, etc
7b Medical Records
Charts system, compatibility, location of charts, etc
7c Laboratory
Hematology, Biochemistry, Blood Bank, etc
7d Holding Area
Admission the night before for larger surgeries?
Appropriate size for patients and families?
Can family eat while waiting for surgery?
Possibility to do patient education?
Pre-op checklist and IV line?

Table continued on next page

Table 2. Continued

7e Operating Room
How many rooms?
How many can we use?
Size of each?
Standard equipment?
How many OR tables?
Air conditioning or heating?
What solution is used for cleaning the rooms?
Any operating room theater or video capacity?
Number and location of electrical outlets?
Voltage?
Number and location of oxygen outlet?
Type of gases available?
Type of gas connectors?
Number of lights?
Any portable lights available?
Wall suction?
Instrument trays?
Electrocautery?
Location and size of the supply room.
Possibility of locking the supply room?
Please obtain or draw a plan of the OR.

7f Recovery Room
How many beds?
How many beds available to us?
Standard equipment?
How many beds available?
Air conditioning or heating?
What solution is used for cleaning the rooms?
Number and location of electrical outlets?
Type of electrical connectors?
Voltage?
Number and location of oxygen outlets?
Type of gas connectors?
Number of lights?
Wall suction?
Please obtain or draw a plan of the RR.

7g Post-Op
How many beds?
How many beds available to us?
Any isolation beds available?
Who provides the meals to the patients?
Can the family stay with the patient overnight?
Who provides the meals to the family?
Is there linen available?
How many nurses during the day, evening, night?
Do nurses know CPR?
Do nurses know airway management?

Table continued on next page

Table 2. Continued

Sinks on the ward?
Is there an ICU?
What equipment is available in the ICU?
Is overnight ventilation possible?
Is there a physician available at night?
How do you get in touch with the night call?

8. Materials and Supplies

8a Transportation and Supplies
Who will be in charge of receiving the materials?
How will the materials be transported from the airport to the hospital?
Where can the materials be stored?
Who will have access to that room?

8b Inventory of Materials and Supplies
Are there ample supplies of:

- Dressings
- Sutures
- Medications
- Antiseptics
- Antibiotics
- Lidocaine
- Anesthetic Gazes
- Opiates
- IV fluids
- Surgical gowns
- Surgical drapes
- Sterile gloves
- EKG
- Defibrillator
- Suction machines
- Pulse oximeters
- Basic surgical trays
- Other

8c Materials Needed
Is there specific equipment that you need that would have a significant impact on the health care delivery in your hospital?

9. Medical, Administrative and Diplomatic Contacts

9a Provide contacts — List all the names and titles of contacts that you met and please add a comment about their importance and feelings for OS if appropriate. Please write the addresses, telephone and fax numbers

9b Hospital Personnel — It is extremely important that you obtain the name of the contact person for each specialty (Administrators, Chief Plastic Surgeon, Chief Pediatrician, Chief Anesthesiologist, Head Nurse, etc.)

Table continued on next page

Table 2. Continued

9c Local Medical and Professional Associations Representatives

National medical association representatives
Local ministry of health
National ministry of health
Town officials
Provincial government representatives
National government and foreign affair department representatives
Customs and immigration officials
Hotel manager and transportation
Representatives
US Embassy and Consulate Staff

10. Anesthesia

10a Personnel and Techniques

Anesthesia team composition (MD, CRNA)
Common techniques used by local anesthesiologists
Common medications used for general anesthesia
Common medications used for local anesthesia
Common fluids used
Common anesthetic problems (Anemia, TB, malnutrition, parasites, enzyme deficiencies, etc.)

10b Materials

Anesthesia machines (models, age, origin, state of maintenance)
Oxygen (quality of supply, reliability of delivery, connectors type, etc.)
Nitrous oxide (quality of supply, reliability of delivery, connectors type, etc.)
Other anesthestic gases
Inhalational agents commonly used
Vaporizers used and connectors
Filtering system?
Supply of filtering agent?
Ventilation circuits commonly used
Blood bank capacity and turn over time
Wall suction
Intra-op lab test (HGB, lytes, PT/PTT, etc.)
Blood gas machine
Recovery Room
How many nurses are in the RR?
What is the patient/nurse ratio?
Can you have intubated patients in the RR?
Can you have ventilated patients in the RR?
Do RR nurses know CPR?
Do RR nurses know airway management?
Do you feel comfortable bringing sleeping patients into RR or do you always wake them up in the OR?

Table continued on next page

Table 2. Continued

11. Dental Facilities

23

The following information must be solicited directly from on-site or the designated support dentists and/or dental laboratory technicians rather than from hospital administrative or surgical personnel, as they typically understand very little about the requirements of providing dental care.

11a Dental Requirements

What dental care is expected other
than the support of plastic surgery services
with extractions and fabrications
of obturator and/or prosthetic appliances?

a. Restorative
b. Extractions
c. Surgery
d. Prosthetic
e. Preventive

11b Dental Facilities

Is there a dental treatment room/clinic available for use?

a. On-site
b. Distance from OR
c. Transportation of patients
d. Hours available
e. Equipment in clinic?
f. Dental chair(s)
g. Dental light
h. Handpieces
i. X-ray equipment

Where will dental screening be done?
Is there a dental laboratory available for use?

a. On-site?
b. Distance from OR, distance from dental clinic area
c. Transportation of patients, if needed?
d. Hours available?
e. Equipment in clinic?
f. Polishing lathe?
g. Laboratory handpiece?
h. Electric supply? (type 120, 220, AC, DC, etc.)
i. Converter/transformer available?

11c Local Dentists

Are hospital and/or local dentists available to work as counterparts with the team?
When and how often?
How many?
To help in clinic environment with extractions and impressions?
To help in OR with extractions?
To help in dental laboratory with oburators?
To provide post-mission follow-up and adjustments?
Are hospital and/or local dental laboratory technicians available to work with the team?
When and how often?

Table continued on next page

Table 2. Continued

How many?
Pour models?
Make clasps and bend ortho wires?
Process self-cure acrylic for obturator?
Provide post-mission repairs?
Are hospital and/or local dental hygienists or trained dental assistants available to work with the team?
Are there speech therapists/ pathologists available to work with patients at the time obturators are delivered?
Provide names, titles, addresses and telephone of local dental personnel and counterparts with whom we will be working.

11d Dental Education/Training/Continued Support

Is there a desire to provide lectures or continuing education for hospital and/or local dentists? Other groups?
Specific topics requested?
Type of slide projector available
Number of dentists in local organization who may attend
Are there needs for dental programs in local schools?
Specific topic(s)
By dentist and/or dental hygienist?

11e Dental Supplies

What dental supplies and equipment should OS bring to support the mission?
Is there a need for specific dental equipment, supplies that would significantly improve the dental care provided by that public dental clinic after the OS mission departs

12. Education

What subjects would be of greatest value?
a. Plastic Surgery
b. Craniofacial Surgery
c. Microsurgery
d. Anesthesia
e. Nursing
f. Pre-Hospital Care
g. Speech Therapy
h. Bio Medical Engineering
i. ENT
j. Orthopedics
k. Neurosurgery

How do you want the lectures to be organized?
Where are the lectures to be given?
Do you have a slide projector?
Do you have a video machine?
What format?
Do you want to walk rounds?

Table continued on next page

Table 2. Continued

13. General

13a General Comments
What is the currency used?
Which credit cards can be used?
Can travelers checks be used?
Do they accept bank notes?
Can money be wired into the country?
Where can money be exchanged?
What is the rate at the time of the fact-finding?
How stable has the rate been over the last year?
Which financial institution should we deal with?
When are they open?

13b Health concerns to the mission members
What is the incidence of blood transmitted diseases in the population (AIDS, Hepatitis, etc.)
What is the incidence of other infectious diseases in the population (TB, Yellow Fever, etc.)
What vaccination is recommended for travel in your area?
a. Malaria
b. Cholera
c. Polio
d. Diphtheria
e. Dengue Fever

13c Diplomatic considerations

13d Political considerations

*An *after* photograph in which the patient has fully recovered from anesthesia and is aware of the change in their appearance can be very effective (versus an *after* photograph of a patient still recovering from anesthesia).

Addressing Patients

Language barriers are present in all mission situations. If English is spoken, it is often spoken by professionals and not necessarily by the families and patients who come for surgery. Operation Smile ensures the accuracy of patient identification, despite language barriers, by issuing every patient an identification number that corresponds to a medical chart number. In many countries, the differences between English and the native language can be great, so the temptation to address patients as numbers or according to their medical conditions is very real. There are times during a mission when accuracy and efficiency dictate that patient numbers are the best way to refer to patients. That being said, every effort should be made to address patients by name when possible. First name, last name, nickname, mispronunciations – any effort to personalize the process is always appreciated by families and patients.

Screening

Screening is a selective process. There are patients that will be chosen for surgery and those that will have to be turned away. Keeping the inherent stress of this pro-

cess in mind during screening is important. Providing patients and families with accurate, honest information is essential. Although we work with our in-country partners ahead of the mission to identify patients suffering from cleft deformities, it should not be assumed that patients and families understand the specific surgery that may be performed. A child may have a cleft lip but a parent may be more interested in having the child's ear microtia addressed. Misunderstandings can be especially common with patients suffering from multiple deformities or syndromes. Accurately portraying the surgical result is also important. It is important that patients and families are given a realistic sense of the surgical outcome. *Stating and restating the specific care and likely result throughout the screening process serves to reduce possible misunderstanding and disappointment.*

Screening Suggestions

Assign a translator to a nurse, an in-country volunteer or the speech/dental team members at the end of the screening process to inquire specifically if patients and families understood the screening process. It is also important that they understand the possible surgery that will be performed and when/how they will be notified if they are selected for surgery.

Arrange for medical team members to be available at the notification site to address the needs of patients/families that have been chosen as well as those that have not been chosen for the surgery schedule. Have patient charts available to answer specific questions from patients and families.

Screening Priorities

Priority 1: Primary Repair of Cleft Lip—All Ages

This procedure can be accomplished safely, quickly and with near-guarantee of vastly improved appearance and the restoration of a normal face and smile. The mission team should complete all primary lip cases that are healthy enough for surgery. The safe minimum age and body weight of the patient depends on the setting, equipment and experience level of the anesthesia staff and the safety of the recovery room and surgical floor setting.

Priority 2: Primary Repair of Cleft Palate—Ages 1-6

These cases have the greatest success in enabling the patient to develop normal speech. The operation can be done safely in most children over 12 months. The younger the patient, the better the chance of developing normal speech, even when no speech therapy is available in the country.

Priority 3: Primary Repair of Cleft Palates—Ages 6-Adult

When possible, older children and adults will have the opportunity for reconstruction. While perfect speech is not likely, a great deal of improvement can be achieved safely and in a short period of time. Additionally, the psychology benefits to the patient are enormous. These patients will require good follow-up and must be told that additional surgery may be necessary. Primary pharyngeoplasties in conjunction with palatoplasties may be beneficial in this patient population.

Priority 4: Secondary Repairs of Lips and Palates

If time allows, and priority 1, 2, and 3 patients have been accommodated, secondary repairs can be scheduled. Each case should be considered on its merits and the benefits compared to competing cases.

Priority 5: Other Conditions

Despite the temptation to try to help patients with severe hand deformities and burn contractures, the team should avoid cases requiring prolonged anesthesia, extensive grafting and prolonged, complicated follow-up or rehabilitation. Most sites will not be able to provide the follow-up care or therapy necessary for the patient to gain functional improvement or an improved appearance. If for political or other reasons those cases cannot be avoided, be very selective as to what is done and advise patient and family on the potential for little to no improvement. Identify a local surgeon who understands the complexity of these cases and is willing to assure the necessary follow-up.

Surgery

The surgical week can also be a very stressful time for families and patients. Keeping babies and small children content during preop, surgery, and post-up can be times of confusion and uncertainty. *Providing patients and families with information about the preop process, surgical and anesthesia procedures, and post-op care and expectations are all ways to alleviate unnecessary stress for patients and families.* Keeping waiting patients and families out of post-op areas is a good way to minimize views of post-anesthetic patients and post-op patients who may have swelling and bleeding – which can often upset waiting patients and families.

Surgery Suggestions

In sending patients to surgery, the anesthesia provider or nurse receiving the patient should confirm the procedure and review post-op expectations and procedures with the parent/guardian.

Explain pain-management and common after-effects of surgery immediately as patients and families arrive in post-op. Arm restraints, blood spit up, tongue stitches, etc., should be discussed when the patient arrives in post-op. It is very important to cover these issues with the parents/guardians/patients as early as possible after their arrival in the unit. In many cultures, spitting and vomiting blood can be viewed as a sign of impending death, so a lack of accurate information can cause great concern. Simply treating post-op symptoms without addressing the concerns of families can cause undue confusion, worry and tension. *Operation Smile recommends that translators are specifically assigned and designated to work in the post-op area.*

The surgical and anesthesia team leaders will make the surgical team assignments. These assignments should specifically designate which surgeon, anesthesiologist, operating room nurse and instrument person will be working together in a specified operating room at a specified table. Previous mission experience as well as experience and comfort level with pediatric cleft lip and palate patients should all be taken into account when making surgical team assignments.

Not all criteria are set in stone. Some patients may have traveled extraordinary distances or may have been screened and rejected several times in the past. These patients deserve special consideration if time and safety permits.

CHAPTER 24

Outreach Dentistry: A World of Wonder Awaits in the Golden Anniversary of General Dentistry

Glenn W. Geelhoed

It is very gratifying to be asked to address a subject that has been the focus of my professional and personal commitment for several decades, and one I can attest to be a communicable contagion based on the experience of a large number of young professionals I have led abroad into adventure in developing world health care. None of these idealists has made his or her "last trip" into such an environment! Further, this is a highly appropriate way to celebrate the Academy of General Dentistry's "Golden Anniversary" with a heightened awareness that the professional skills and approach to oral health are a trust to be further developed and passed along in a humanitarian response to needy persons in environments less privileged than those in which we have been beneficiaries. The challenge facing the next fifty years to the century mark of the Academy will be one we will be less able to teach than to learn from others in lesser developed parts of our world who have greater experience with necessary skills we will have to master quickly*: how to handle larger volumes of patients with greater problems for effective outcomes using far fewer resources*.

To accomplish this goal, we cannot turn in our usual recourse to higher technology, but must rely instead on creativity and imagination for adaptation and improvisation to meet the vastly larger human need with expanded ingenuity. The overwhelming burden that sometimes confronts first-timers in facing the needs of the developing world sometimes results in the paralysis of despair at responding at all. Some of them may seek to limit their response to only a small boutique enclave of patients most like us in socioeconomics, patterns of health, illness and language, and in urban settings and facilities most nearly like those with which we have become familiar in training and practice in the developed world. This limited response strips the volunteer of the essential and rewarding experience of "sharing the burdens, miseries and joys of the world's majority citizens" and also impoverishes the creative experience of adapting what one really knows of fundamental principles—oftentimes stripped of power and plumbing, which were rarely present in the formative evolution of the profession—and allows one the professional pride of "owning" the concepts when applied in vastly different settings to the unique solution of human problems.

A favorite phrase I have used to describe this process of adaptation across large gulfs of socioeconomics, language, culture and technology is: *we have no money; therefore we must think.* In the western world, reliance upon technology or pre-packaged solutions—almost irrespective of the uniqueness of the problems—is often a

Surgery and Healing in the Developing World, edited by Glenn Geelhoed.

substitute for careful practice, well thought out. "If you do not know what to do, do what you know how to do." Professional practices are often more repetitive, defensive and redundant in resource superfluous environments. Few parts of the world can afford such luxury of redundant over-care, including our own, so that the purity of practice based in principle rather than simply iterative applications of technology is a refreshing new look to be learned abroad and carried back home. "Minimize variation" may have been the industrial efficiency principle proposed for manufacturing practices by Edward Deming, but that shows disregard for the fact that pathologic processes may occur somewhat uniformly, but they do so in highly variable *people.* "Ask not," said Sir William Osler "What kind of disease this patient has, but what kind of patient has this disease."

Increasingly, our world is peopled with ever more diverse populations—not just recognized in traveling abroad, but in the stream of the world's mobile citizens who find their way into our office doors closer to home. This intensive course in not just tolerating, or accommodating, but reveling in, the diversity within the human family that constitutes our patient population pays valuable dividends for the practicing "home anthropologist" in each of us.

The "one size fits all" industrial widget model of "zero variation" medical and dental practice may have consequences beyond the burnout seen in professional disaffection. This may account for the paradox of medical and dental care at this point after the turn of the millennium: *never have we been able to do so much for such few privileged people, who have never been less satisfied with the care they experience!*

On particularly frustrating days in clinical practice I have occasionally burst out: "The only difficult thing about the practice of surgery is getting to do it!"[1] The layers of obstructionists between the professional and the patient, which have proliferated in the name of regulatory control, cost containment, quality assurance, and legal standards of care have removed the immediacy of professional satisfaction we certified problem-solvers were proud to enjoy after separating a patient from a problem. The new brokers that complicate, if not always enhance, patient care have certainly dampened the enthusiasm with which some of us have recommended to our successors our own branch of the healing arts. If any of these unsettling doubts or professional restlessness may occur to you from time to time as you are pursuing your domestic practice—or within the Academy itself at its half century point—I have an antidote to recommend: *welcome to the world of wonder in Outreach Dentistry!*

Outreach

At the outset, may I remind you that "outreach" is not only the practice of traveling to the far corners of the world and encountering very different people in an exotic culture, and rare and unusual tropical problems with which you have limited experience at home—all this may be true in some minority of instances, and we will look into those for the features of fear or fascination they may hold for each of us. I use the term "developing world" or "Third World" to describe the disadvantaged circumstances in which people live within or outside geographic or political boundaries. In parts of Africa, I can point to the highest standards of First World health care that would be enviable in my environment on Pennsylvania Avenue; but, I point out that there are parts of Anacostia, no further from me now as I write as are the paradigm practices of some parts of the Washington DC community, that have far more in common with the slums of Lagos than they do with the "world capital"

with which they are contiguous. First and Third World environments are more cultural and socioeconomic descriptors than political and geographic ones as barriers, and that is part of the good news—since such barriers are susceptible to bridging with human will and ingenuity.[2]

One element of "outreach" that may not have been intentional in this ecumenical attempt to induce a non-dentist to describe outreach dentistry may include a tacit admission that there are dental needs so insatiable in the greater world at large that the Academy may recognize at least one surgeon who has been backed into pulling teeth and doing procedures for which his education has been, charitably described, "informal"—strictly ad hoc on the job training. This may underscore the point that there is a critical shortage of skilled personnel in much of the world, even at a time when the redundancy of health care personnel in some of the "over-developed" world has reduced many of us to degrading squabbles over turf, marketing, advertising, "patient capture" or referral claims. When there is so much unmet need in the world at large, it is humbling and expanding to look out from the more narrow confines of our self-limited spheres.

Labor Intensivity in the Health Professions and in Third World Manpower Supply

Dentistry, almost as much as surgery and psychiatry, is a very labor-intensive process, often dedicating a very large amount of professional labor invested in individual patients one at a time. The Third World is not at all short on labor. That there may be some lack of skills to the labor force that is present is actually encouraging, since an outsider can contribute greatly in helping to upgrade the local health-empowered community health workers without having to create the infrastructure de novo. Almost any professional who has had some experience in organizing his or her own thoughts and practice can contribute exactly that much to the less developed world that may not have got even that far in organizing an approach, to, say, oral health. Sometimes, even minimal or starting improvements are met with almost immediate and visible results that are gratifying. As I once explained to students who had accompanied me into the chaotic social dissolution in the wake of a tragic civil war in Central Africa—"Well, let's get started, and don't be discouraged! Remember, you cannot fall off the floor."

If someone has a very bad tooth ache in the developing world, the fact that there may be no dentist at hand does not mean the suffering individual does not seek relief. In fact, there are already established methods of health-seeking behavior in almost every community on earth. I had encountered one such woman who had walked several days in the remote Congo jungle to come to see us as the people who reputedly could help her with a dental abscess, after she had already made appropriate responses of her own in trying to get relief—including the use of a special medicinal herb called "mzawa" in applying it to her face to get some relief (Fig. 1A). Her own locally known remedy was unknown to me, and subsequent cuttings (Fig. 1B) of the plant have been transplanted, investigated, and shown to have some properties that are both anti-inflammatory and topically analgesic. Her acute and urgent problem and her own ingenuity in seeking relief had taught a method previously unknown to a distant professor allegedly come to her environment to teach.

The transport of a high technology system into remote parts of the world with the expectation that it would continue to function and sustainably produce the results expected in the First World setting, where the power grid and maintenance

Figure 1. An indigenous woman in the Democratic Republic of the Congo (ex-Zaire) had walked several days to seek help for a dental abscess; but, she was not without here own resources, passed along in oral tradition. A) She had applied a paste concocted from an herb "mzawa", which on later investigation (B) appears to have analgesic properties previously unknown to this investigator of ethnobotany.

contract are most likely intact, is often a fatuous undertaking. The best way to keep such a system working at a great remove from its origin is to transport with it the entire civilization, which had given rise to its invention in the first place. The well-meaning gift of high technology equipment is rarely as beneficial to the recipients as to the donors. And some "high maintenance" donations become White Elephant gifts if they subtract from the manpower and resources already stressed to keep up with the more prosaic priorities of the majority of patients' problems.

An example of one such gift to an impoverished nation was apparent to me during 1996 when I was the Senior Fulbright Scholar for Southern Africa. I was working in Hospital Central de Maputo, the largest (and only teaching) hospital in a nation of 28 million souls. This central large hospital had no penicillin, aspirin or bed linen following the devastation of 11 years of civil war, but they did have an MRI scanner, gift of a European nation that had essentially given a "foreign aid donation" to the employees and owners of the large medical technology firm that had sent the scanner to Mozambique—where electricity in the nation's capital was anything but a reliable commodity. If the funds represented by the extravagant gift were given in a form that could have been utilized according to the priorities judged by those closest to the problems, the hospital may have functioned more usefully than it would have to with a devastated operating budget and one island of First World technology of dubious utility in the center of the morass inspiring more envy and anger than hope for the brief duration of its function.

International Medical Education—A Two-Way Exchange

Fortunately, the most portable commodity across borders and languages and cultural or social systems is information, and the hope that comes from the empowerment to use the information to the betterment of the people afflicted with problems. When this knowledge is applied in local systems according to the judgments of priorities of those managing the afflicted in their own system of health care,

therefore, this is nearly synonymous with international medical education. That education process is not at all a one way process with the First World teaching the third, but is a win/win exchange in which both sides benefit, each judging their own side to be the disproportionate beneficiary. Each has much to learn from the other, including that most important lesson for us as the First Worlders learning how to do more with less.

But, a more subtle learning happens over a period of interaction with what I call the "subcultural giants" I have discovered in many parts of the world. Another term used by the international NGO's (non-governmental organizations) is synonymous—"positive deviants." These are the indigenous people who, rather than being overwhelmed by the despair of being able to do anything about the huge burden of illness and lack of resources, with which they are supplied, set about doing something about it. These are people who have almost nothing—and are more than willing to give it all in hospitality to those who come from affluent areas of the world to help. "Gifts from the poor" have taught me and my students much about the spiritual richness of people who may seem to be so impoverished that they have none of what might be considered the basic necessities of life—undistracted by such material bounties as we would expect as the bare minimum, they do not just survive, but thrive. They sing, they dance, they celebrate life and they respond in generosity to their guests who may seem to have fallen from another planet as far as the differential in material goods is measured. It is humbling and inspiring to hear the consistent responses of my accompanying health care workers—particularly the medical students and residents, who uniformly report that these encounters are life-changing experiences, having learned perhaps less from their professor than the resilient grateful people who are our patients. Transcultural contact with such patients is not only an inspiration for the idealistic young at the entry level to the profession, but is a sure cure for the jaded veteran who may have forgotten why he or she got into the healing arts in the first place.

Regional Differences in Dental Problems and Oral Health Services in a Global Pattern of Need

Oral health ought to be a component integral part of any proposal for PHC, Primary Health Care.[8] However, dental care needs vary in regional populations according to poorly understood and frankly unknown epidemiologic factors that appear to be cyclic.[6] Dental caries as an example of a specific form of oral pathology, peaked earlier in the last century I virtually all populations world-wide and has undergone reduction without very coherent explanation.[6,14] Dental caries have come back up in incidence in some developing countries[10] equally inexplicably. In contrast, periodontal disease appears to have increased in this same time period, with an excessive burden in developing countries.[9]

Even more variable than the disease patterns are the differing health care systems evolved to meets these needs. Some form of socialized health care in most countries on earth is commonly found in place on paper, particularly for public health and sanitation facilities. But, the "nation-state" as a formalized social structure is largely a first-world phenomenon, and in many developing nations, the idea of 'nation" is a figment anywhere outside the capital. The population that expects to rely on their government to feed, clothe house or care for their health, education, and welfare is going to be disappointed more often than not in the majority of the nation states in which I have worked, in which I have had little or no contact with any form of

official national government once my passport had been stamped. The "T. A." ("Traditional Authority") carries the awesome responsibility of the citizens' welfare in many places I have worked, most recently in rural Malawi, and this has largely been the default entity of the extended family in a tribe or language and cultural system, rather than simply residents or transients in a given geographic or jurisdictional area. Given such a patchwork, there is a variable service, often marked by two classes of service: one is a public façade of basic health care to include oral health care, and a second is one is which the citizens can opt above this level of care by purchase of services in a private market for them. Cost-Sharing is one method of bringing the services found in the latter back into the former, but as it was tried in Tanzania, it reduced dental services, particularly preventive or restorative services, by over one-third when the patient was required to co-pay.[7] In many areas of the world, such as the aforementioned Malawi, the missions, churches or other charitable organizations furnish more than half of the medical and dental care, (two-thirds of the quality institutionalized care), largely supported by non-governmental outside expatriate donor help. Even the vast majority of the central government's own expenditures, particularly for health care, are directly funded by outside donor aid in such nations as Mozambique and other members of the HIPC group (Highly Indebted Poor Countries.) Colonial systems of health care have failed[11] to keep up with the demand for services, particularly in light of the two factors afflicting developing nations' imbalance of need and resources—the unsustainable burgeoning population, with unchecked fertility resulting in malnutrition and collapse of social structures under the burden of this broad population pyramid's base—and new disease entities that carry an even more devastating acuity of illness, such as the African AIDS pandemic.[15] Even ex-patriates, capable of paying for oral health services, are frequently unable to find such services in remote regions, sometimes portrayed humorously for a first-worlder who knows that he or she can get out to where such services will be available,[12] but not at all a light-hearted matter for those with no place else to go.

What, Then, Can We Do?

Against the somewhat gloomy view of the world's rather deteriorating standards of health and health care, with oral health conditions often being in the vanguard as elective sources of postponable morbidity rather than urgent causes of mortality, what can *we* do? We know little about the specific conditions the patients over there might have and even less about the people who suffer from them. We have no idea of the kinds of personnel, equipment, and facilities for care, nor even means of getting ourselves and the equipment there and the authorization to do so. Fortunately, you are not the first to feel motivation to help but uncertainty how to carry out this response. Colleagues around you can express what they have learned in carrying out short-term missions.[5] There are many resources that can facilitate your expertise and instinct to be of assistance—twin capabilities in any motivated health care helpers.

What you may encounter will be unlike almost anything you are used to from your training or current practice in a developed world context. But, as reviewed earlier, the *principles* of practice are universal, and anatomy, physiology inflammation and healing are much the same on any side of any other artificial border we might try to draw between one human and another, and health care is a nearly ideal bridge over such barriers.[2] You may have to improvise, and exercise ingenuity[13] in how to make the resources available into the kinds of support for the same prin-

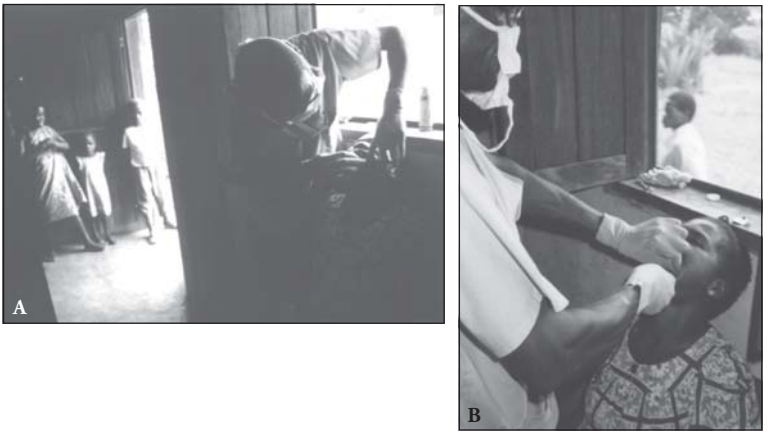

Figure 2. A patient's head extended back over the "dentiste's" flexed knee on a straight-backed chair (A) at an open window for sunlight allows efficient extraction, and also allows quite a few community kibitzers to admire or make comments on this technique (B).

ciples, and the most impressive instructors in how to stretch the available resources over the much greater need are the indigenous practitioners who have had to be pursuing this skill all f their lives in such an environment. A minimalist approach can have maximum rewards in seeing what are the limits of the healing response to our interventions in setting s where there are fewer support systems.

What Can I Do Without My Essential Tools and Techniques?

Learn new ones. An autoclave can be made to function at any altitude and any power source from a pressure cooker (Fig. 11) or instruments can be boiled (Fig.5B) Even the gloves used can be recycled in such a system (Fig 12) in a system that is labor intensive and short of materials.

A crooked knee can be the headrest on a straightback chair (Fig 2) for use of available light. If more light is needed, solar power (Fig 10) can be harnessed, or battery-powered headlamp can be used. A mechanical dental chair is a good use of transported obsolete first-world technology (Fig 4) in distinct contrast to equipment requiring microchips or reliable electrical power. Local anesthesia is the principle from of analgesia employed in many of these pain-tolerant populations, but systemic analgesia and even general anesthesia is safely administrable as well (Fig. 7) provided it is monitored by pulse oximetry. Nonin Medical Products makes a very convenient battery powered pulse oximetry unit which is highly recommended for this purpose.

Open-air dentistry may take place alongside curbside barber shops, ear cleaners and kiosk salesmen in some parts of the world, as seen in Lhasa, Tibet (Fig 3) This "low-overhead" space doubles as advertising for the indigenous practitioner in flora that may be more friendly than many of our selected inpatient germs, but the point is made to show that dental outreach is less limited by the facilities in which it "takes

Figure 3. A low-overhead no-frills office is often encountered, as in this street scene of a Tibetan dentist in operation at an intersection curbside.

place" than, for example, radiology, and the practitioner is less dependent on an intact team and system around him or her

Extractive services are often needed in high volume, and can be carried out successfully in short-term missions (Fig. 9). The kinds of oral pathology seen include inflammatory, neoplastic and congenital (Fig. 8). Because of the late stages in which many of the diseases present, extractive services are in high demand. But some restorative services are also possible, and fit particularly well in an educational program in which someone is trained to follow up n the techniques used in on-the-job training (Fig. 2).

Figure 4. A primitive, but quite functional dental suite can be put together from the obsolete products of First World dental practices, as seen here in the mechanical dental chair set up in the Congo when it was no longer useful in the United States. However castoffs with microchips embedded, or non-replaceable fuses, valves, circuits or dependence on maintenance or electrical reliability are often more like "White Elephants" that encumber practice, as well as being very expensive to arrive at their destination as long-distance trash disposal.

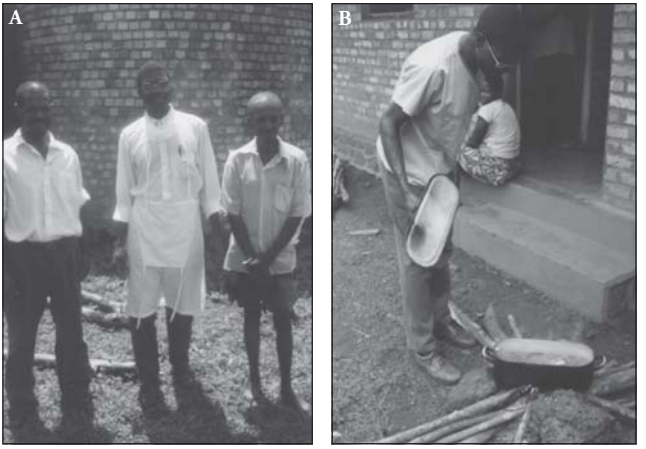

Figure 5. Andre' the Dentiste, now employed in his newer profession encounters his colleagues from a transient attempt at a short-term "extractive profession" also based on dentition. (A) (—see reference #3) Andre' is working at his functional but simple sterilizer (B) for his dental instruments, when he had an unexpected encounter with companions from long ago when they had survived harrowing experiences together as Congolese elephant poachers, before the much younger Andre' had succeeded in learning skills as a "bush dentist."

Education is one of the very valuable activities engaged in any foreign medical mission. The education process, as noted earlier, is always a two-way street, with major beneficiaries on each end of the exchange. The information and skills can be carried through borders without weight restrictions or tariff protections and left behind for the benefit of a whole second generation of continuing education. The accompanying first-world medical and dental students and residents (Fig. 6) can obtain earlier and larger volumes of patient experience under supervision than might be possible elsewhere, and the second-order training of para-medical personnel among the "Positive Deviants" previously described are a useful indigenous benefit to the concerted educational objectives which should be built-in to every program and not incidental to it.

Figure 6. I assist my senior medical student Eric L. Sarin, prior to his entry into a premier surgical residency, in his first mandibular block and dental extraction in Kaza, Spiti Valley, Himachal India.

Figure 7. Anesthesia is most often local or regional injections, and systemic analgesia may use injectable Ketamine; general anesthesia for short time periods is also possible with simple, and safe compact vaporizers, checked against a battery-operated Nonin pulse oximeter.

Figure 8. The kinds of oral pathology seen include dental caries (A), oral neoplasms (B) and congenital abnormalities (C).

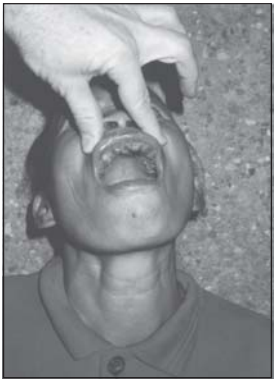

Figure 9. One of the Tboli patients in Southern Mindanao Philippines undergoing extraction in the queue of 535 patients so treated in half the professional time of our Outreach Dentist; the other half of his time was in carrying out the fluoridation treatment programs for several thousand school-age children to prevent the same kind of treatment for them later.

Figure 10. My quite functional "operating lamp"—a Toyota headlamp, hotwired from a solar panel on the thatched roof, which trickle charges the storage battery. (A) On the Equator, one experiences a perpetual equinox, with only the clouds of the rainy season to interrupt the solar power supply. With a modest-sized panel, twelve hours of daylight can generate about four hours of O. R. illumination, and a battery-powered climber's headlight (B)furnishes a directed beam for close work; auxiliary lighting (C) is always an option in a labor-intensive environment.

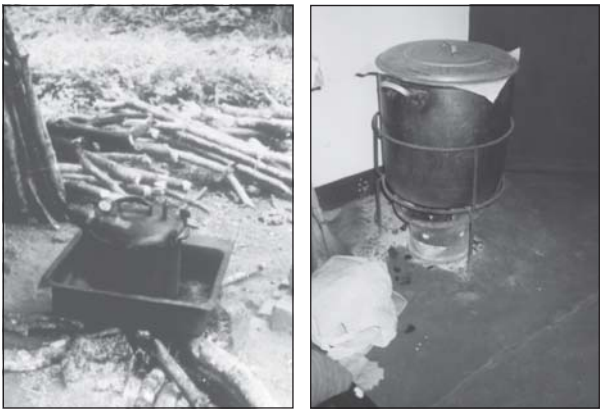

Figure 11. A pressure cooker autoclave (A) overcomes the problems of steam temperature at higher altitudes, and can utilize local materials and energy sources; in the South Cotabato region of Mindanao, Philippines, burning coconut shells fires my "autoclave" (B).

Figure 12. "The glove drying tree" may not be familiar to professionals working in the First World, but all "disposables" are recycled until they fall apart in the developing world, and surgical gloves are a prime example of a useful recycling that can be done safely when well cared for.

Figure 13. Buddhist patients hum their mantra as their dental extraction is swiftly cared for, as in this example in a monastery in Taboo, Spiti Valley, Himachal, India.

What Are the Hazards and Risks in the Pursuit Outreach Dentistry?

There are many minor hassles in attempting to carry out the same kind of practice that one has become accustomed to at home; but, if that were the objective, to "clone" your stateside practice, there would be little need for travel. In fact, I would encourage the volunteering of services at local free clinics in underserved areas of most parts of the home country. It is an excellent introduction to the kinds of patients, the late stages of the neglected diseases they bring to medical and dental attention, and much easier logistics in carrying on a sustained part-time volunteerism.

Figure 14. The shocking event that interrupted my takeoff on a far-flung medical and dental mission to the Himalayas after I was ready to board, having checked in my medical equipment and drug supply when I witnessed the hijacked airliner strike the Pentagon on September 11, 2001.

Travel across borders, of whatever kind, brings one in contact with something new and different—and not only of the pleasant surprises variety. This brings out the best of most of us under some stress of the little details that can go awry. One of the only essential ingredients I have recommended to those traveling with me is to have an "infinite threshold for frustration." It is not likelihood that all the careful plans that were made might go "aft agley," it is a certainty. When it happens, we must respond as do the people we are serving must on a more regular basis than we, when bereft of certain equipment or "essential" support services. They are experts in "making do without," and the improvisation that comes from simplifying details down to fundamental principles is a good exercise we often miss by layers of fail-safe redundancy.

Yes, there are exotic diseases to which one may be exposed, but that is also the case at home as well. The same standards and precautions that are "universal" should be observed for practice in either environment to safeguard your own health as well as that of others close to us. Good travel medicine entails the use of immunizations against the diseases one is expected to encounter, such as a yellow fever vaccination and up to date hepatitis and more common immunizations such as tetanus. Antibiotics, such as a broad-spectrum quinolone, should be carried and used very sparingly, if at all, for traveler's diarrhea or upper respiratory ailments. (I have carried Bactrim and rehydration salts packets for traveler's diarrhea, and have given out the latter, but never yet used the former; the same applies to the use of Acetazolamide as prophylaxis or treatment of acute mountain sickness in my Himalayan and Andean expeditions.) Anti-malarial prophylaxis is essential in the tropics at lower altitudes and particularly in the rainy season. One of the plans one might consider is to carry a "PEP Kit" ("Post-Exposure Prophylaxis Kit") for potential viral inoculation, and leave it behind in the clinics one sets up if unused.

But, one should expect to encounter more frequently what one already knows and should be familiar with than that which is exotic and new to a First World practitioner. The surprises will be in what later stages of untreated and neglected disease already familiar to the practitioner from first-world experience these patients present, rather than in the unexpected encounter with leprosy or rabies or other diseases for which most travelers carry a book to look up details they had once learned but soon forgot in the absence of such patients in regular practice. It is true that there are some endemic diseases such as filariasis or schistosomal diseases, but the oral health problems will be very much more commonly presented to the medical mission participant with which he or she is very familiar except in the context of these unique patients in which they present very late in a pain-tolerant population that makes few complaints about what they view as a common human condition.

I have fond the principle risk to the participants who have joined me is that the experience itself becomes habit forming! As was reported of me in a review of the exotic experiences I had accumulated: "Dr. Geelhoed's proudest achievement may be that he has never taken any of his medical proteges on their *last* medical mission."[4]

What about the New World Plague of Terrorism and Political Instability with which these Poor Countries Are Notoriously Rife?

I had written this article in response to the AGD's request for their special fiftieth anniversary edition before packing up and planning to leave on a multi-venue

medical mission in September of 2001. I had packed all of the medicines I would be taking and the instruments for the surgical and dental practice I would be leading in the Himalayas, and had checked all of these supplies in at Ronald Reagan National Airport in Washington DC. I was just boarding the plane for the first leg of my journey just before 10:00 AM on the morning of September 11, 2001. I looked up startled to witness the off-course approach of an American Airliner off the Potomac River noise-abatement approach as it crashed into the Pentagon. As was much of the world, I was stunned by this event, and knew that the world would not ever be the same after this fateful day. I was holding my camera, prepared for the events a half world away, and reflexly took a few shot of the drama unfolding before my eyes (Fig. 14).

With all air traffic stopped, we were herded out of National Airport, trapping all my medical supplies still in the baggage check-in aboard the plane that never flew that day. I witnessed a large number of people whose plans were disrupted, but it seemed that each one of us, as we were told to flee into the Metro Underground stations as after-explosions were still rocketing upward over us and debris, smoke and hot gases were still falling on us, soiling us from the Pentagon fall out—yet no one was pushing and shoving to get ahead of any other. Businessmen with carryon luggage on Smarte Carts, simply took suitcases off the trolleys and helped elderly overweight passengers onto them to wheel them to safety.

The Ultimate in Misunderstanding: A Higher Barrier to Be Bridged

I thought of the community that had come together under the crisis of that moment that had continued later in the weeks that followed the strikes on New York, Washington and a field in Pennsylvania. I had been headed toward a troubled land, the Spiti Valley, a high arid mountain valley adjacent to Afghanistan and insinuated along the roof of the world between India and Pakistan who had also had recent troubles. And now, the everyday violence of distant intolerances had come home to America

Eventually, I made my way by Amtrak train and rental car to take the first international flight to leave (flown by Lufthansa several days later, now overpacked with the medical bags I could only claim after a delay of several days from the still-closed Ronald Reagan National Airport) and made my way among few other passengers on board entering long lines of additional security checks through Frankfurt and Delhi to Chandrigarh by train and a rented car and driver through Simla to Kaza, Spiti, threading my way through the Kunzum-La Pass (elevation 4.551 meters) to begin my repeat medical mission in clinics held in or near Buddhist monasteries. As I completed the mission, I was caught up in the fireworks a half-world away from where I had started, as cruise missiles streaked across the mountains into the neighboring Taliban-controlled Afghanistan. Somehow, I had moved from one end of the world to another in a peaceful medical mission among devoutly religious Buddhist patients in a remote setting isolated along the Roof of the World, to be caught up as an eyewitness in the caldron antithesis of humanitarian activity on each end.

Most medical and dental professionals, after addressing the diagnosis and treatment of a problem of such personal or social magnitude, would ask a reasonable question confronting this and any other human problem in their practice. How might this have been prevented? Surely, if there is mutual understanding, such terrorist acts should be far less likely, since one would not wish todestroy the life and

livelihood of a fellow human one knows and one from whom one has learned and shared life's problems and potentials. The effort one puts into bridging barriers is not a guarantee against conflict, but of better ways of resolving such differences. As long as one or more populations are isolated on this common carrier we call planet earth, misunderstandings and frank hatreds are allowed to simmer and perpetuate. For any one of us to make some effort to reach out and understand the suffering of others and attempt to help, is one more barrier bridged. Iteratively, one patient at a time, one practitioner at a time, one population after another, and one prejudice dispelled we all benefit in better understanding of each other and the common human condition in which we all share. The AGD is celebrating a Golden Anniversary. What better way to commemorate this milestone than to reach out to the world of wonders awaiting hope and help?

How can anyone of us not be involved in "Outreach"?

Understanding is never wasted.

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CHAPTER 25

Dentistry

David Foskett and Anthony M. Vandersteen

Introduction

Good primary preventive dentistry in the developed world, for instance the addition of fluoride to drinking water and the promotion of good tooth brushing, has still far from eliminated disease of the teeth and gums. In the developing world dentists are not widely accessible to patients, hence you will be faced with dental and gum disease as well as surgical disease of the oral cavity. In this review, we describe simple dental care appropriate to rural economies. Suitable preventive dentistry using basic equipment is described. How to diagnose and treat tooth decay and gingivitis is illustrated with simple algorithms and photographs. These simple methods are within the grasp of medically trained personnel and can be of great benefit in the absence of a fully trained dentist.

The Teeth

There are thirty-two permanent teeth, four upper and four lower incisors, two upper and two lower canines, four upper and four lower premolars, and six upper and six lower molars (Fig. 1).

A child will have grown twenty milk teeth by around the age of two. Between the ages of six and twelve, these are replaced by permanent teeth. The incisors cut food into smaller particles whilst molars chew the food, increasing its surface area and mixing with saliva to enable swallowing and initiate digestion.

The visible surface of a tooth consists of hard enamel. A layer of dentine separates enamel from the pulp of nerves and blood vessels. The root of a tooth is anchored to the maxillary or mandibular bone by the fibers of the periodontal membrane (Fig. 2).

Toothbrushings and Oral Hygiene[2]

Equipment

A wooden twig with a splayed end or attached toweling will make a suitable toothbrush. Toothpaste powder can be made from a one to one mixture of salt and sodium bicarbonate (Fig. 3).

Method

Teeth should be brushed from the gums to the tips of the teeth, at least ten times. The top surfaces of the teeth should also be cleaned. Encourage brushing for a minimum of two minutes twice daily, after breakfast and before going to bed.

Surgery and Healing in the Developing World, edited by Glenn Geelhoed.

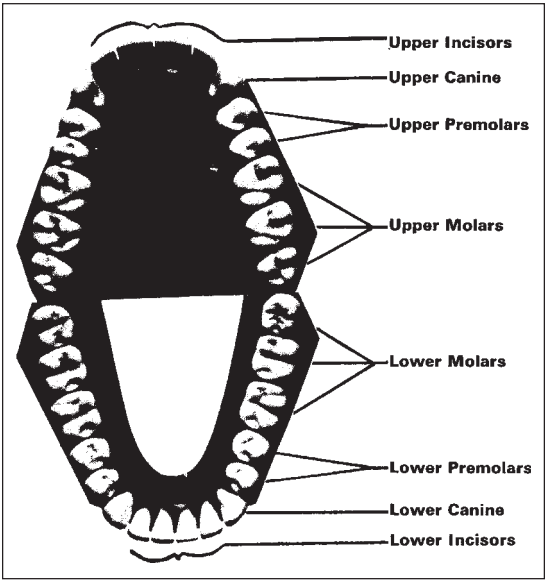


Figure 1. The adult teeth and palate (Ref. 1, pg. 3).

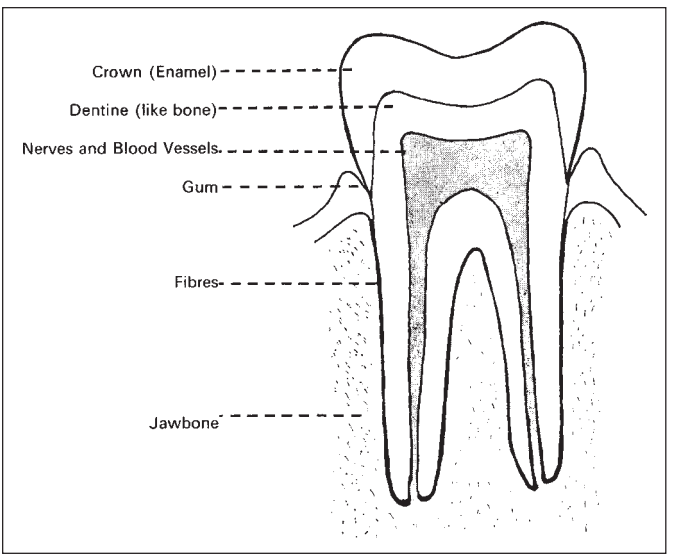


Figure 2. The structure of the tooth (Ref. 1, pg. 4).

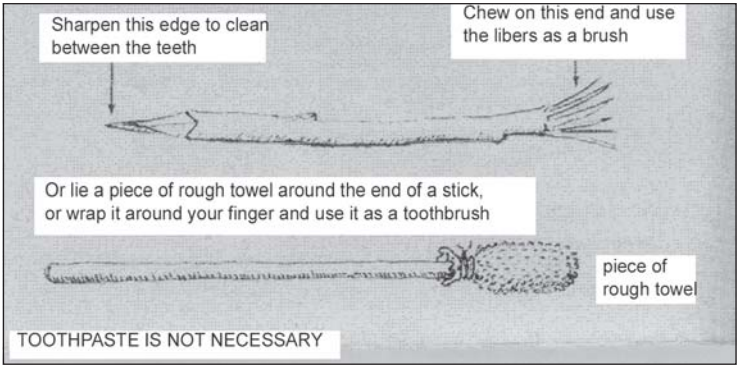


Figure 3. Toothbrushes of simple materials.

Children are especially vulnerable to tooth decay and should be encouraged to eat firm, fibrous fruit and discouraged from eating sweets, cakes, and drinking sugary drinks.

Treatment of Gum Disease

Poor oral hygiene results in food being left in between the teeth. This provides a good medium for bacteria, which produce enamel-destroying acids. Inflammation of the gums (Gingivitis) is worsened by hardened plaque (tartar) and may progress to destroy the periodontal membrane. The teeth will fall out as a result. A first step in dental care is to promote good oral hygiene. A scaling tool with point and spoon (Fig. 4) is used to scrape off tartar; temporary pain and bleeding may result from this procedure. Immediately after scaling, the patient should rinse thoroughly with 0.2% Chlorhexidine mouthwash. Antibiotic cover is required for those patients with a history of heart disease (see below).

The margins of gums may become acutely ulcerated, the breath smells and the gums bleed. Treat with accurate application of 5% chromic acid taking care not to let it drip onto skin or healthy tissue. Advise the patient to keep his mouth clean, rinse with salt solutions and prescribe an antibiotic (a Beta-lactam antibiotic is normally sufficient).

Gingivitis may be caused by malnutrition; gum softness may be a sign of vitamin C deficiency (scurvy).

Dental Caries and Tooth Extraction

Diagnosis of Caries

A caries appears as black lesion and during dental examination. Skim the dental probe over the surfaces of the teeth, it will catch on the edge of a carie.

The extent to which you treat a diseased tooth will depend upon the availability of local dental services. Temporary fillings can be useful in prolonging the life of a tooth until the patient can reach a dental surgeon. Temporary fillings are only suitable for filling small dental caries. If there is pain on percussion with the end of a mouth mirror, the pulp is infected and extraction is indicated unless the patient can be referred to a dental surgeon for root canal treatment.

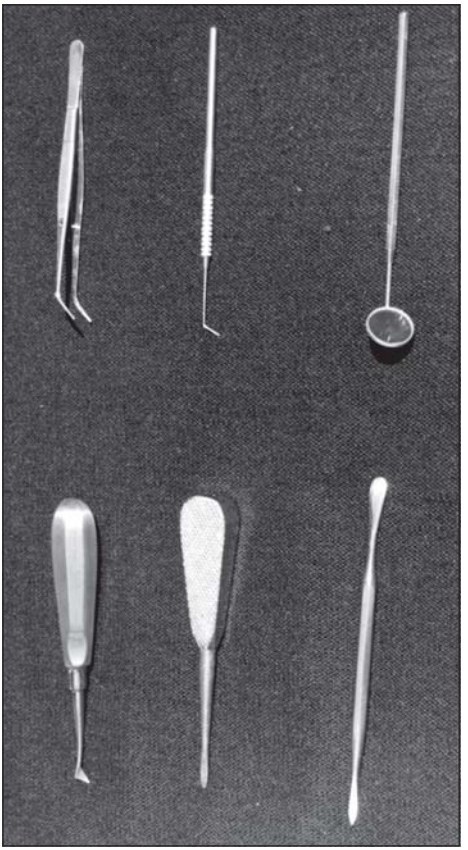


Figure 4. Basic dental instruments.

Filling Material

Some types are available as a paste and require no preparation. An example of a material you can mix yourself is zinc oxide and oil of cloves. On a clean glass surface mix the powder into the liquid with a spatula until a thick dough like consistency is achieved.

Prepare the tooth by cleaning out the hole with a dental excavator (Fig. 4). Try to make the base of the carie wider than the tip to prevent the filling from falling out. Keep the tooth as dry as possible while inserting the filling. Pack the space between the tooth and the cheek with a cotton wood pad. For the lower teeth also put cotton wood between the tooth and the tongue. Hold the pads in place with one hand while drying the cavity with more cotton wool. Pack the filling material into the cavity using a small flat bladed instrument. Make sure the cavity is will filled and firmly packed down, trim any excess. Remove the cotton wool and ask the patient to bite down firmly on their teeth. Temporary fillings will dissolve slowly over time, but they can last for up to several months.

If it is not possible for the patient to access a dental surgeon then extraction will be necessary to prevent further decay and pain. There are a few dental and medical contraindications to extraction:

1. A history of severe bleeding after previous extractions or a family history of bleeding disorders, require referral to a specialists.
2. A history of heart disease (Congenital, Rheumatic valve disease or a prosthetic valve) requires antibiotic cover (amoxycillin 3g po, 1 hour preop). A large dental abscess will produce extensive bacteraemia after extraction, refer to a specialist if possible.
3. Teeth which are buried, impacted, displaced or ankoylosed (attached directly to bone) are difficult to extract and should be left to a dental surgeon.
4. Removal of diseased milk teeth must be followed by insertion of a spacer by a dental surgeon within three months.
5. Hyperthyroidism is an absolute contraindication to tooth extraction.
6. Patients with diabetes should have their blood sugar levels well controlled before attempting any dental surgery.

Local Anaesthesia

This is vital to prevent the patient experiencing severe pain during the procedure. The nerve supply to the teeth is located on the lingual and labial side of the tooth and through the pulp. All three sets of nerves must be anaesthetized.

Materials

2% Lidocaine with Epinephrine (1:200,000), max dose 20 ml for 70 kg patient. This is equivalent to 6mg/kg. For known hypertensives and diabetics, epinephrine is contraindicated and 2% Lidocaine should be used (max dose 10 ml for 70 kg patient or 3 mg/kg). Although dental cartridge syringes with a 26-gauge needle are ideal, other types of syringes can be used along with a narrow gauge needle (24/26 gauge).

Method

The usual precautions regarding local anaesthesia apply. Never insert the needle completely into the tissue, as it may break off and become extremely difficult to remove. Test the anaesthesia by probing the gum adjacent to the tooth to be extracted. If pain is still felt, repeat the infiltration, without exceeding the maximum dosage.

Infiltration Method

Two injections are necessary at the inner (lingual) and outer (labial) aspects of the tooth adjacent to the root of the tooth to be extracted.

Labial Injection

Insert the needle at the point where the gum joins the cheek, to a depth level with the base of the root of the tooth. For the third molar, insert the needle at the proximal molar and insert diagonally. Inject 1.25 ml of lidocaine + epinephrine.

Lingual Injection

Insert the needle opposite and 1 cm towards the center of the palate, at a shallow depth. Inject enough anaesthetic solution to change the color of the gum to white (Fig. 5).

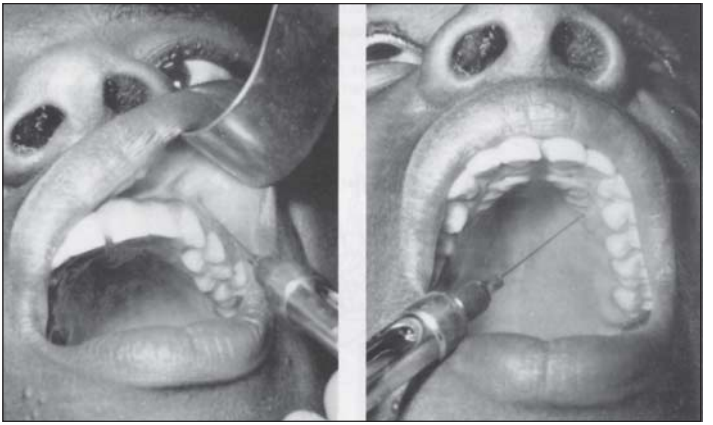


Figure 5. Local infiltration (Ref. 1, pg. 13).

Nerve Block for Lower Molars

Blocking the inferior alveolar and lingual nerves is required whenever extracting a lower molar or premolar tooth. The patient should be positioned with wide-open mouth, and with the upper surfaces of the lower teeth horizontal. For the removal of a lower right molar, locate the retro-molar fossa with your left index finger. This is the depression found on the anterior surface of the ascending ramus of the mandible. The lateral ridge of this landmark is bone while the medial ridge is fibrous. Lay the syringe on the surface of the lower fossa, 1 cm above the right 3rd lower molar. Insert the needle horizontally until the mandible is reached, withdraw off the bone and inject 2.5 ml of 2% lidocaine with epinephrine (see guidelines). This is the block for the inferior alveolar nerve. Withdraw the needle, but not completely. With the tip of the needle still under the mucosa, pivot the syringe barrel so that it lies on the surface of the right lower molars and inject 0.5 ml of the solution to block the lingual nerve. Remember to also block the nerves locally by infiltration as described above (Fig. 6).

Extraction

Preparation of the Tooth for Extraction

Use a periodontal elevator to retract the gingiva around the tooth. Gently luxate the tooth with a straight elevator using the bone as a fulcrum. This will break the periodontal fibers and loosen the tooth.

Upper Incisors and Canines

These teeth have a single root, push the tooth towards the maxilla and gently rotate around the long axis of the tooth. Having broken the fibers of the periodontal membrane, the tooth will loosen and should be extracted downwards.

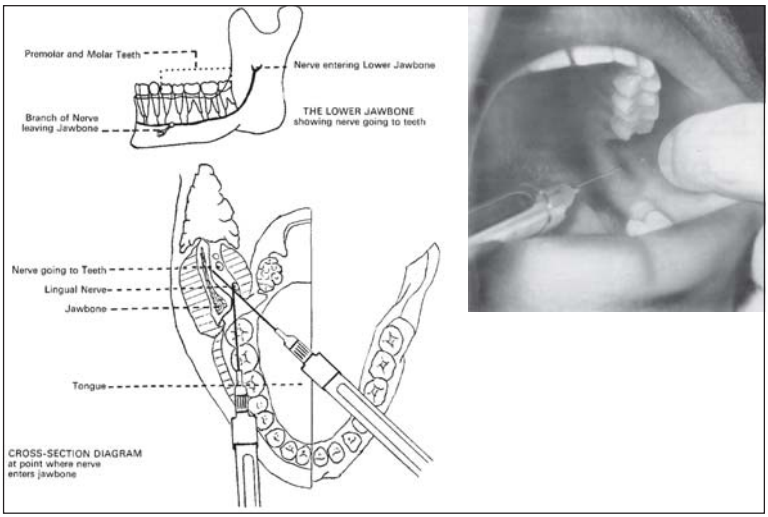


Figure 6. Root block diagram and photo (Ref. 1, pg. 15, 16).

Upper PreMolars

Be gentle, as these teeth have delicate roots. Push the tooth towards the maxilla and make small side to side rotation movements. After loosening, extract downwards.

Upper Molars

These teeth have three roots, two are on the labial side and one is on the lingual side. Ensure that you select the correct forceps and apply them with the grooved side on the labial side of the tooth. Support the alveolus of the tooth between your finger and thumb, to minimize the chances of breaking the tooth or fracturing the maxilla. Apply upward pressure combined with side to side rocking motions, finally drawing out the tooth downwards and labially.

Lower Teeth

The lower molars have two oval roots, the other teeth all have single roots. Apply downward pressure, rotate and rock the tooth until it is loosened and extract towards the cheek (Figs. 7, 8).

Post Extraction Care

Immediately following the extraction, the patient should rinse their mouth once to remove any residual matter. Approximate the medial and lateral sides of the empty socket and apply a gauze pack. The patient should be instructed to swallow all blood and saliva. Ask the patient to bite down on the pack 15-30 minutes. The patient should continue to swallow all blood and saliva for the first twelve hours and to only consume cold solids or liquids with the opposite side of the mouth. After 24 hours, begin rinsing with warm salt water and continue for 5 days.

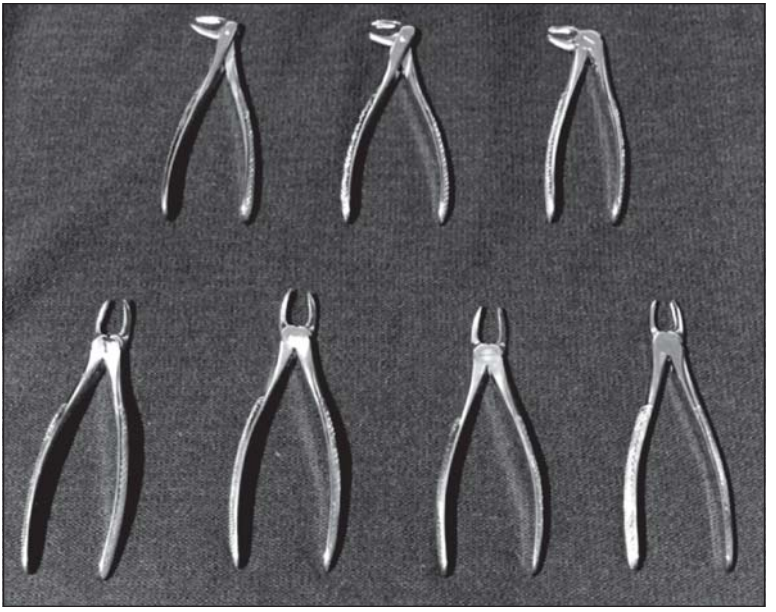


Figure 7. Extraction forceps. Correct positioning of the forceps for extraction.

Figure 8. Using an inclined plane elevator (Ref. 1).

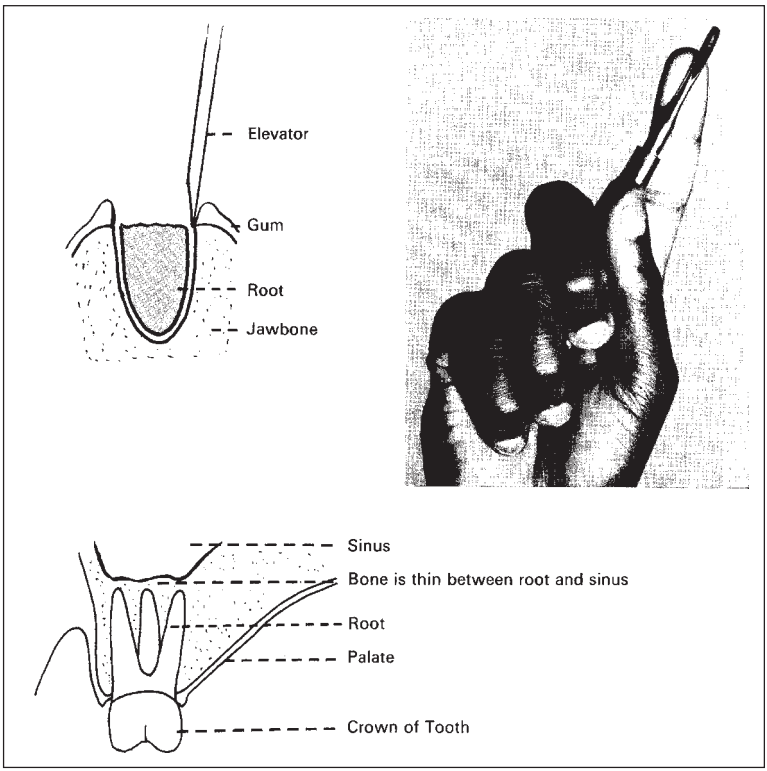


Figure 9. Using an inclined pane elevator (Ref. 1, pg. 21).

Complications of Extraction

1. If the tooth breaks and large piece (greater than 1/3) is left in the socket, it should be extracted by leverage with an inclined plane elevator. Smaller fragments may be left in the jaw (Fig. 9).
2. Fracture of the maxilla can form a fistula opening to the maxillary antrum. A mucoperiosteal flap is required (see Ref. 5).

A dry socket means that a blood clot has not formed properly. Clean socket with a syringe of sterile, warm water. Insert cotton wool soaked in iodoform antiseptic and instruct the patient to rinse with warm saline daily and remove the dressing after three days.

Bleeding socket. After 24 hours of continued bleeding, suture the socket.

Acknowledgements

We would like to thank Dr. Nebu Philips, BDS for assistance with the preparation of this manuscript, and the production of photographs. Figures 1,2,5,6 and 9 are adapted with kind permission of the MMA.

CHAPTER 26

Reconstructive Surgery in the Tropics

Harold P. Adolph

Useful and practical flaps must be:

1. Simple
2. Quick
3. Dependable
4. Easily raised and applied
5. Able to solve a difficult problem with only one major operation
6. Easily learned and taught
7. No inconvenience for the patient

These requirements are necessary because the number of patients requiring help is always greater than the number of helpers available to help them. The supplies are usually limited. The procurement of staff and drugs are frequently problematic. The economic feasibility of each treatment must be constantly reviewed.

In some locations only 15% of hernia patients will ever have operative repair during their lifetime. In many locations only 1 in 20 women with obstructing labor can receive the C-section she needs. The large number of patients needing help dictates the operative choices. In these pages we want to promote only one operating room visit per patient to maximize the number of patients that can be helped.

The choice of operative technique chosen will be affected by the postoperative care available in hospital. Usually limited intensive care is available because of the ratio.

Of nurses, nurses aids and physician assistants to the number of patients being compassionately cared for.

The surgeon will want to incorporate many technical safeguards against the most common complications. This will maximize favorable outcomes:

In a step by step process these surgical points will be emphasized and illustrated.

Surgeries where the expected blood loss will exceed 1000 cc must usually be refused.

It is important to use all the preoperative, intraoperative, and postoperative autologous blood transfusion techniques available. These techniques have allowed coronary bypass surgery to be carried out without a single homologous blood transfusion. This surgery formerly required an average of 16 units.

This change was necessitated because of the significant risks of infectious disease transmission.

500 cc of blood is taken from the patient weekly two or three times before surgery. Iron supplements and vitamins are given. The hematocrit should be kept above 20.

At the time of surgery and just after anesthesia is administered two more units are removed and replaced rapidly with normal saline with 5% glucose in a ratio of 3

Surgery and Healing in the Developing World, edited by Glenn Geelhoed.

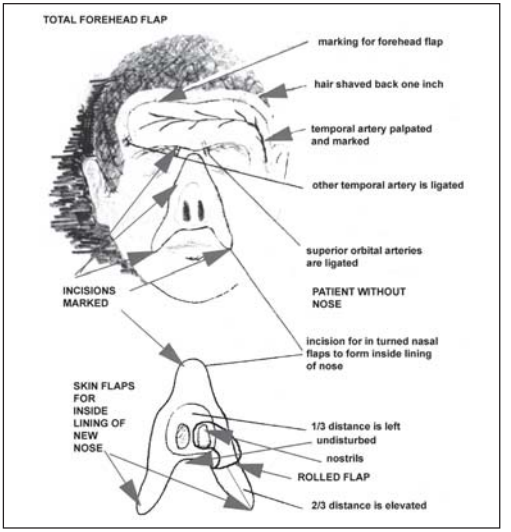


Figure 1. 1) Use skin hooks after the skin incision is made. 2) Left the skin and subcutaneous tissue. 3) Roll elevated flaps toward nostrils and suture.

to 1. With the removal of 1000 cc of blood 3000 cc of normal saline would be given quickly.

A surgical technique that diminishes the loss of blood is used. This would include the use of electrocautery or prompt clamping and ligation of bleeders.

The suctioning of blood lost during the procedure is combined with an anticoagulant for prompt reinfusion to the patient after this phase of surgery is completed.

The restoration of function and overall appearance will be stressed. Exacting cosmesis achieved only by the use of more time-consuming free flaps are not discussed. They are difficult to perform and require frequent postoperative Doppler evaluations.

Reconstruction with a Total Forehead Flap (Fig. 1, 4-9, 11, 13-17)

The forehead flap is an axial pattern flap because its blood supply comes from a major blood vessel, the temporalis artery. This artery passes near and anterior to the tragus of the ear and then across the forehead as shown in the line drawing.

The flap is very dependable because the circulation through this single artery and vein allows the surgeon to elevate the entire forehead skin and subcutaneous tissue at one time without fear of flap loss.

It can be used for the reconstruction of the

1. The entire nose
2. The central face
3. The upper lip
4. A single side of the face
5. The lower face

Figure 2. Loss of nose from "noma" in infancy.

Figure 3. Forehead flap for nasal reconstruction. Turn over paranasal flaps for under surface and inside lining of nose.

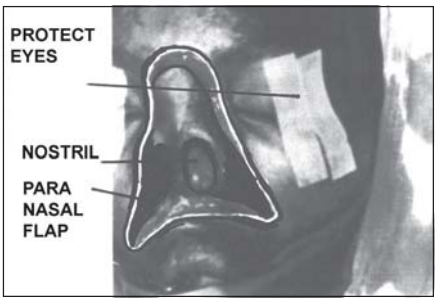
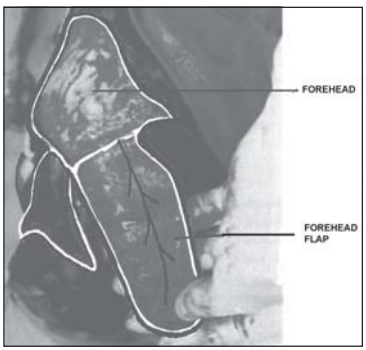


Figure 4. Total elevated forehead flap based on left temporalis artery.



Let me guide you through a typical operation such as a complete nasal reconstruction using a total forehead flap.

1. An anterior and lateral preoperative picture is taken for study and analysis. Sketches are an alternative.
2. Give a general endotracheal anesthesia using ketamine as an I.V. drip. This is made up from 10 cc of ketamine containing 50 mg per cc and placed in 500 cc of normal saline with 5% glucose. This makes up an I.V. with 500 mg of ketamine in 500 cc of normal saline with glucose. For the induction of a 70 kg man, give 140 drops per minute. Maintenance is given at 70 drops per minute. An appropriate dose of atropine would be 0.5 mg. Intu-

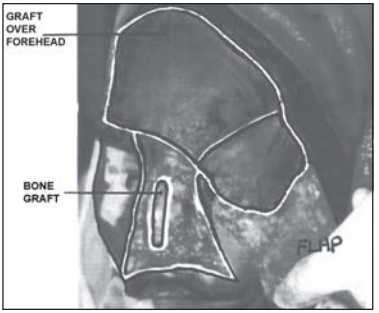


Figure 5. Split thickness skin graft from anterior thigh taken with Humby manual grafting knife over forehead donor area. Bone grafts over the turn over flaps.

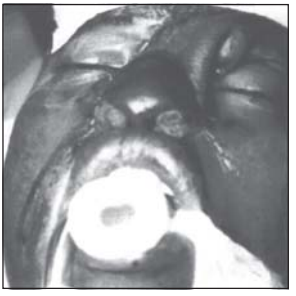


Figure 6. Postoperative appearance after forehead flap is sutured.

Figure 7. Forehead flap. Lateral view at 3 weeks when flap will be divided. Personality of patient has changed.

bation can be completed with 1 mg per kg of suxamethonium. The average adult dose is 50 mg. Valium at 5 to 10 mg I.V. will help with the emergence phase. The drip can be stopped approximately 10 minutes before the end of surgery.

3. The hairline is shaved back one inch and marked carefully. You do not wish to transplant a hair-bearing region on the scalp or forehead to a hairless portion of the face.
4. The most convenient location for the split thickness skin graft donor area is the anterior thigh. The skin between the inguinal ligament and knee is carefully prepped circumferentially. A very thin application of sterile mineral oil is placed over the donor area as well as the instrument. The new blade is positioned and the correct uniform thickness verified by vision and

Figure 8. Forehead flap. Five weeks after surgery.

Figure 9. Forehead flap. Six and one half years later.

palpation. With an assistant supporting the thigh and assuring a maximal skin surface presentation to the skin grafting knife, the instrument is brought up the thigh from knee to groin with a smooth back and forth movement. The split thickness skin graft is covered with normal saline soaked sponges. Floating the grafts in normal saline is thought to remove some important components of the graft. When the area for grafting is ready, the skin grafts are laid out atraumatically. Circumferential sutures are placed for stabilization. Small openings in the split thickness graft are made prior to application. The skin graft is placed against a sterile wood block while multiple small incisions are made across its surface with a sharp knife.

5. A dressing is placed over the anterior thigh donor site. Use a nonstick vaseline gauze covered with dry sterile gauze and a wrap around bandage for the donor site. The outer nonvaseline dressing is removed at 5 days.
6. An incision is made over the iliac crest from the anterior superior iliac spine laterally for 8 cm. The periosteum is elevated on the superior and inferior surface of the iliac wing. Using a sharp chisel a 6 cm and 3 cm segment of bone is removed.

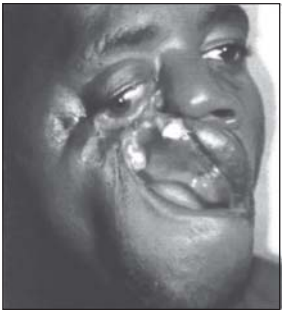


Figure 10. Loss of right mid face from "noma" as infant. Right eye has vision maintained.

Figure 11. Forehead flap over iliac bone graft for one stage right face replacement.

Figure 12. Loss of left side of face from "noma" as infant.

Figure 13. Left side of center face replaced with forehead flap. View one year post operation.

Figure 14. Bilateral cheek flaps have been turned in for inside upper lip replacement. Forehead flap is ready for overlying lost upper lip.

Figure 15. Forehead flap at time of division at 3 weeks for upper lip replacement.

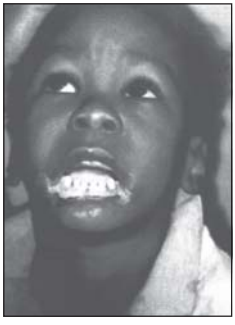


Figure 16. Complete loss of lower lip resulting from "noma".

Figure 17. Forehead replacement after turn up of flap from chin for inside lower lip and lip margin.

Place the chisel across the crest of the ileum 1 cm from the anterior superior iliac spine. The chisel should pass deeply into the bone for 3 cm. Place the chisel across the iliac crest again 6 cm farther along the iliac crest. The chisel should penetrate 3 cm into the bone. Join the two vertical incisions on both the inner and outer surface of the ileum.

The thin presenting and most superficial portion nearest the anterior superior iliac spine is used for attachment to the nasal bone. The thicker lower limb of the L shaped bone graft farthest from the iliac spine joins to the maxilla in the midline where the nasal septum would normally be. Smaller sections of bone from the bone graft taken from the iliac crest are placed laterally to support the flare of the nares. This is all on overlay over the turned in flaps used for the very important inside lining of the nose. Without this inside lining, the bone graft will become infected and disappear. The nose, without the bone support, will shrink and shrivel up. It will no longer keep a normal nose profile.

7. The forehead flap is elevated.

A. Use pressure on each side of the incision. Start at the distal portion of the flap and move proximally. Place clamps on the multiple bleeders on the nonflap side or use a continuous absorbable running suture for hemostasis along the nonflap incision margin. The running suture also decreases the forehead area requiring grafting. Place three sutures in the distal flap margin to atraumatically elevate the flap. This approximates the fascia and subcutaneous tissue with the skin to avoid small vessel injury.

B. Bevel this incision away from the flap to avoid a prominent demarcation of skin graft with the scalp skin margin and to avoid injury to vessels supporting the flap skin.

C. Take special care not to damage the periosteum over the frontal bone as elevation of the flap is continued in an easily seen and developed plane just above this.

D. If more flap length is needed the incision can be continued proximally over the middle of the temporal muscle in the scalp hair and onto the face in front of the tragus of the ear.

E. The flap can be covered with a moist saline sponge after folding it back over a gauze roll to avoid kinking while the operation progresses.

F. Secure good hemostasis with a continuous running suture, being careful not to injure the vessels supplying blood to the forehead periosteum.

G. Place the thick split thickness skin graft over the forehead and suture it in place.

H. A sterile wet dressing will hold this in place while the rest of the operation is done.

I. Bilateral nasolabial flaps are turned over on themselves. These are based superiorly and swung superiorly. Dermal and skin sutures close the nasolabial donor areas.

J. A superior turnover flap is made from the remaining skin in the midline above the future nose. Leave 1/3 of this undissected proximally for adequate flap circulation. Elevate 2/3 of the total flap distance for turning over for the inner nasal lining.

K. The turn in flaps are sutured with absorbable sutures.
L. The bone grafts previously taken from the iliac crest are appropriately shaped in the form of an L. This is attached to the nasal bone superiorly and inferiorly to the junction of the two maxillae in the midline with nylon sutures after drilling holes in the notched bone graft.
M. The forehead flap is now uncovered and placed over the reconstruction without tension and sutured in place.
N. The flap is first folded together in the mid-distal portion to cover the bone graft and form the nostrils.
O. Tubing is cut and sutured in place to maintain an airway.
P. The flap is divided after 3 weeks and the proximal tubed or folded portion is cut from the new nose and replaced on the forehead after gently removing the attached split thickness graft now covered by the replaced proximal forehead flap. The superior nasal section is inset.
Q. Usually from the very first day after looking into a mirror, the patient's whole personality takes on a brightness and happiness that can only be imagined.
R. The donor forehead area replaced with split thickness skin graft does not produce an unfavorable cosmetic result. Besides many people have the forehead normally covered by turbans, hats, or headscarves when they are in the market or with their friends.

Fritchie Flap (Figs. 18,19)

This flap can be easily carried out under local anesthesia for adults and ketamine I.V. drip for infants and small children.

The flaps main use is for the replacement of upper or lower eye lids which may have been lost in burns, trauma or overly aggressive "trichiasis surgery" where an ellipse of skin is removed to help treat severe entropion. This is blinding the patient secondary to eyelash movement on the exposed cornea.

1. The greatest danger is to make the flaps too short and too thin. They should be one-third longer and wider than you think needed to make them just right.
2. The flap can be drawn out starting from the lateral canthus and progressing superiorly onto the forehead.

Figure 18. Fritchie flap in place in left upper eye lid. Flap taken from termporal skin lateral to eyebrow.

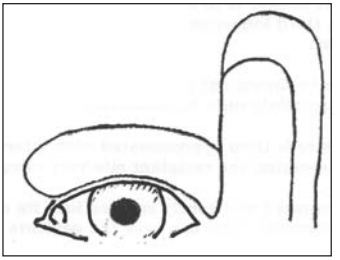


Figure 19. Fritchie flap. 1/3 longer and 1/3 wider than apparent measurement.

3. The donor site is then approximated with interrupted dermal and skin suture after preparing the recipient site very adequately.
4. The flap is rotated and gently sutured into its new home as an upper or lower replacement. This can save the patient's eyesight.

Deltopectoral Flap (Figs. 20-26)

This is also an axial pattern flap. Its blood supply is based on 3 branches from the internal mammary artery, which can be seen to exit the first, second, and third intercostal spaces lateral to the sternum. The arterial and venous supply to the flap is just superficial to the pectoralis major and minor fascia. This fascia therefore should be elevated with the flap.

The usual reason for using this flap is for post 'noma' facial reconstruction of the cheeks and upper or lower lips (Fig. 10, 12). It can also be used effectively for burn

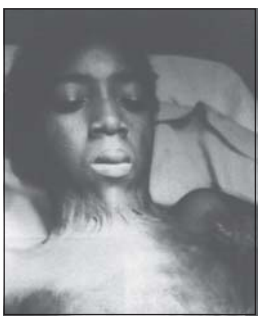
Figure 20. Giant congenital nevus on right cheek.

Figure 21. Deltopectoral flap in place after excision. Patient under general naso-endotracheal anesthesia.

Figure 22. Deltopectoral flap at 3 weeks just prior to division.

Figure 23. Just after division of deltopectoral flap under I.V. Ketamine anesthesia.

Figure 24. Post 3rd degree burn. Scar contracture of anterior neck.



contractures of the anterior neck. This makes a complex full-thickness reconstructive technique with prolonged postoperative management replaceable using a single-stage contracture release and flap placement.

The incision for this flap runs from the sternum just under the clavicle and extends to the mid-shoulder. The distal 3 or 4 inches of this flap needs to be as wide as it is long on the- anterior shoulder.

Operative Procedure

1. A general endotracheal anesthetic is used with I.V. suxamethonium and I.V. ketamine for induction and maintenance.
2. A split thickness skin graft to cover the future exposed area on the shoulder, because it cannot be closed primarily, is taken and this area is dressed and bandaged.

Figure 25. One stage release and single deltopectoral axial pattern flap use

Figure 26. Dectopectoral flap. Note that the proximal donor site can be closed primarily. The distal shoulder area is closed with a split thickness skin graft.

3. After the appropriate measurements are carried out, the flap is elevated.
4. Movement of the head is necessary at this stage in the operative procedure.
5. The bleeding vessels are grasped and ligated or cauterized as the flap is elevated starting distally over the shoulder and progressing proximally toward the sternum. The underlying fascia is included.
6. After the junction of the deltoid and pectoral muscles is reached, it is important to include the pectoralis fascia with the elevated flap as mentioned previously as the supporting vessels lie superficial to that.
7. Sharp dissection is used to within one inch of the sternum. At this point the tissues should be carefully and gently spread with a blunt dissecting scissors to avoid injury to the vascular supply.
8. The donor site can be partially closed primarily with nylon mattress sutures leaving an area about 4 inches in diameter over the anterior shoulder for skin grafting.
9. This is sutured in place after circumferentially running a suture to decrease the exposed area to be grafted.
10. The recipient site is then prepared with turn in cheek, or anterior neck flaps for the oral surface of the required tissue defect. Usually three turn in flaps from the area near the defect in the cheek can be carried out. The three areas for donation of inner cheek lining are superior, lateral and inferior. The flaps are elevated with skin hooks. Two-thirds of the flap is elevated. The proximal one-third is left undisturbed and undissected to preserve adequate blood supply. These flaps are then joined as shown in the second and third photo and in the diagrams.

11. This is done only after complete release of any trismus is carried out. Sometimes the fixation of the mandible preventing the opening of the mouth is secondary to scar contracture. Other times there may be bony growth joining the mandible to the maxilla.

Sometimes the condyle of the mandible is fused to the temporal bone of the temporomandibular joint. The scar and bony overgrowth can be resected. Another solution is a resection of a 1 cm segment of mandible ramus so that a false joint will develop allowing movement.

At other times a 2 cm section of the zygomatic arch needs to be resected and the temporalis muscle taken from the outer surface of the temporal bone through a longitudinal incision and placed as a lining of the maxilla or mandible to prevent recurrent trismus and bony reapproximation.

If placement of an endotracheal tube is not possible at this point, a planned tracheotomy is done so that a good airway can be maintained during surgery and for the first five postoperative days. A parent or friend can be taught to give good postoperative tracheotomy care when other staff are not available.

12. The Deltopectoral flap is then sutured in place without tension and the proximal portion is tubed or skin grafted as indicated.
13. Large sutures of nylon are taken between the face and neck to encourage the patient to refrain from pulling on the flap by head and neck movement. Elbow splints are used until the patient is fully awake.
14. After two weeks the patient is encouraged to compress the proximal pedicled flap between the thumb and fingers to encourage distal vascular ingrowth. By blocking the principal blood supply for short time periods of 30 seconds repeatedly, vessels from the surrounding area of the in-planted flap are stimulated to help out.
15. The flap can be safely divided under I.V. ketamine drip anesthesia at three weeks
16. If the tubed pedicle is not needed in the recipient area, it can be replaced in its original location.
17. The breast in women is only slightly elevated by this operation. This is not to the extent of bothering or disturbing the patient who is always very appreciative of the significant help given to his or her facial appearance.

Latissimus Dorsi Myocutaneus Flap (Figs. 27-29)

This flap can be used by taking the entire muscle with split thickness skin graft applied to it or it can be taken with both the muscle and its overlying skin. It is based on the thoracodorsal artery from the third portion of the axillary artery. The artery is on the deep side of the muscle.

Its primary uses are for replacement of all the skin of a major portion of the neck for treating burn contracture, chest wall coverage problems and breast or chest wall reconstruction.

1. The operation is done under general endotracheal anesthesia in the lateral position so that the latissimus dorsi donor site can be included in the prepped area on the same side as the expected skin and tissue defect.
2. Split thickness skin grafts are removed from the thigh or thighs and expanded to cover the entire donor back area from the lower scapula to the iliac crest and from the midline of the back to the posterior axillary line.
3. The flap is elevated by marking and incising the skin overlying the latissimus dorsi muscle en bloc and elevating this from the underlying tissues without any shearing force between the skin and muscle.

Figure 27. Severe burn scar contracture right neck.

Figure 28. Latissimus dorsi right back donor area 2 weeks after surgery.

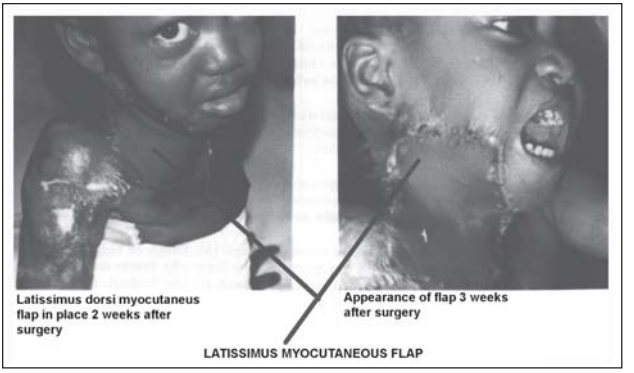


Figure 29. Latissimus myocutaneous flap.

4. This is achieved by hemostat held traction sutures which are sutured on the margin of both muscle and skin being elevated.
5. A subcutaneous pocket is developed that joins the donor area to the recipient area of the neck, chest or even portions of the face.
6. The branch of the thoracodorsal artery to the serratus anterior muscle is divided to extend the range of the flap to its new recipient area.
7. The latissimus dorsi myocutaneus flap is replaced while the recipient area is fully prepared.

8. The flap is then passed gently through the subcutaneous tunnel without tension on the vascular pedicle and without shearing forces between the skin and muscle or rotation. It is then sutured in place with interrupted sutures.
9. The expanded split thickness skin grafts are applied to the donor area of the back after decreasing the size by circumferential suture.
10. The restored function and appearance of this myocutaneus flap is not mitigate by the posterior back and chest scarring.
11. The nerve to the latissimus dorsi muscle may be divided if atrophy of the muscle is desired.
12. If the myocutaneus flap is being used for breast or chest reconstruction, primary closure of the donor area can be carried out
13. If the muscle alone is being used to replace the function of the biceps muscle, the nerve is carefully preserved.

Intercostal Flap (Fig. 30)

This flap is based on several intercostal arteries. It is used especially if a full thickness chest wall defect results after tumor excision and a good cover of fascia lata or prefabricated mesh is needed. Usually this will be secured from below the defect, and the donor area will have split thickness skin graft applied as illustrated.

Superficial Epigastric Artery Flap (Fig. 31)

Although this flap is most commonly considered a random flap, it is based on the superficial epigastric artery and vein which supplies a large area of skin and subcutaneous tissue just superior to the inguinal ligament and lateral to the midline of the lower abdominal wall. The superficial epigastric artery and vein are the large vessels seen at the time of open inguinal hernia repair. The flap can be almost 5 inches in width and 10 inches in length. It is. It is especially useful for the coverage of the dorsum of the hand.

1. The flap is elevated starting distally at the level of the umbilicus. Working proximally, the skin and both layer of subcutaneous tissue are elevated from the rectus abdominal muscle fascia with special care. Spread in a vertical direction with a blunt nosed scissors dissector as approach is made to the inguinal ligament.

Figure 30. Intercostal flap from immediately below defect. Split thickness skin graft on donor area.

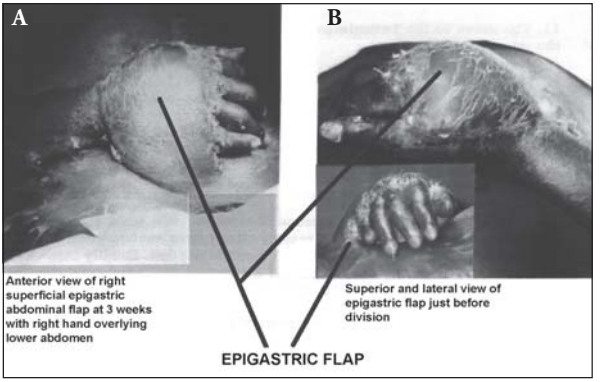


Figure 31. Epigastric flap. A) Anterior view of right superficial epigastric abdominal flap at 3 weeks with right hand overliying lower abdomen. B) Superior and lateral view of epigastric flap just before division.

2. The abdominal donor area is closed with interrupted nylon mattress sutures over an interrupted Scarpa's fascia closure using absorbable suture.
3. The injured hand is then placed comfortably where the flap will cover the defect without tension.
4. Large nylon sutures are used between the forearm and abdominal wall to limit movement of the injured hand in relation to the axial pattern flap based on the superficial epigastric artery.
5. The flap can be divided after three weeks.

The Groin Flap (Fig. 32)

This flap is categorized as an axial pattern flap and is based on the superficial circumflex iliac artery, which passes laterally and inferior to the inguinal ligament and laterally toward the anterior superior iliac spine. This flap is useful for coverage of various portions of the hand. It's principle advantage is its comfort for the patient. A portion of the iliac crest can be carried with the flap to replace a lost thumb. The skin and subcutaneous tissues are normally thin and not bulky so that hand coverage including portions of the fingers is quite feasible. Great care is necessary as one comes over the proximal sartorius muscle where the superficial circumflex artery can be first visualized. The flap is divided at 3 weeks.

The Paravulvar Flap (Figs. 33-38)

These flaps are based on vessels coming from the pudental artery and vein lateral to the rectum and anus. They are used most frequently for repair of vesicovaginal fistula when the anterior vaginal wall is inadequate. Also over a neo-urethral repair when the urethra is nonexistent and must be reconstructed or when the vaginal opening is stenotic from trauma, infection and or previous vulvectomies. It can easily be used to make a neovagina or enlarge the vaginal orifice.

Underlying the vulva is fatty tissue that can be used separately over a two layer interrupted vesicovaginal fistula repair before the anterior vaginal wall is closed. This increases the chance of successful repair. This is secured through a longitudinal

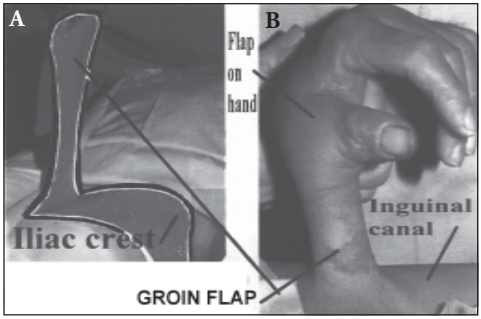


Figure 32. A) The elevated groin flap based on the superficial circumflex. B) Groin flap covering a denuded portion of the thumb and hand at 3 weeks.

incision over the vulva. The fat pad is dissected from close to the symphysis toward the rectum.

When neither the anterior vaginal wall, the posterior vaginal wall, nor the rectum remain intact after delivery, a rectal pull through can be carried out along with bilateral ureteral sigmoid inplants. The paravulvar flaps can then be placed over the pulled through rectum to make a new posterior vaginal wall over this neo-rectum. This will make the patient completely continent after only one operation.

1. Under spinal anesthesia with the patient prone and the hips flexed and abducted, the vesicovaginal fistula is repaired. The flap is marked lateral to the vaginal opening. When the vagina needs enlargement, the patient is placed in the lithotomy position as illustrated.

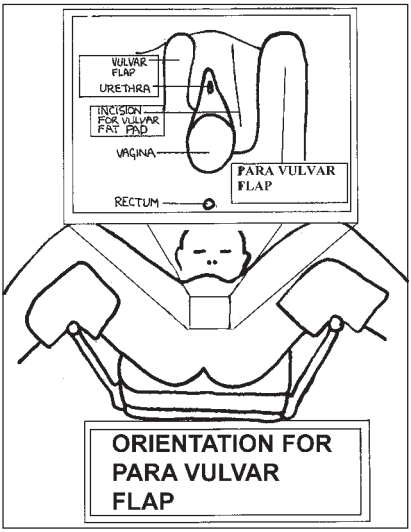


Figure 33. Orientation for paravulvar flap.

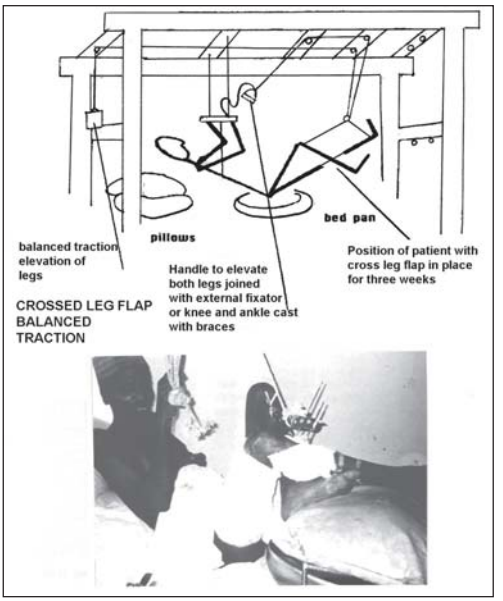


Figure 34. Orientation for paravulvar flap.

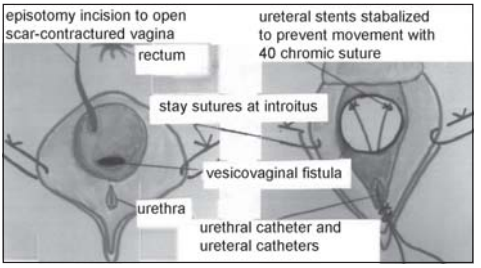


Figure 35. Left) Vesicovaginal fistula. Right) urethral stents through urethra into ureteral orifices stabalized with 40 chromic suture.

2. Based on the pudental vessels from latera1 and deep to the rectum, a flap 4 cm by 8 cm long can be elevated starting distally over the pons near the origin of the inguinal ligament. This flap will include the adductor fascia, as the main supporting vessel lies directly superficial to this.
3. All the skin and subcutaneous tissue is taken. Proximally near the lateral rectal area, the tissues are spread gently with a blunt dissecting scissors.
4. The donor area can be closed primarily with a running dissolvable suture.
5. At the base of the flap, an incision is made into the vagina where the flap will be placed.

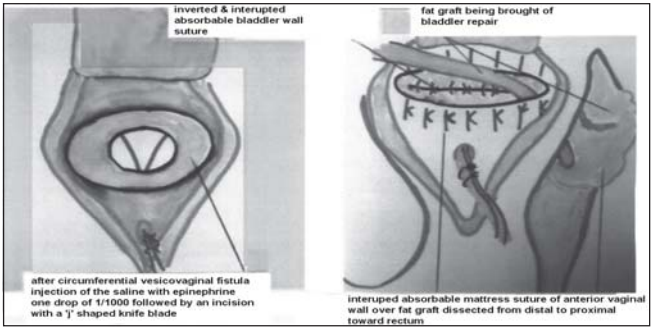


Figure 36. Left) After circumferential vesicovaginal fistula injection of saline with epinephrine one drop of 1/1000 followed by an incision with a 'J' shaped knife blade. Right) Interupted absorbable mattress suture of anterior vaginal wall over fat graft dissected from distal to p roximal toward rectum.

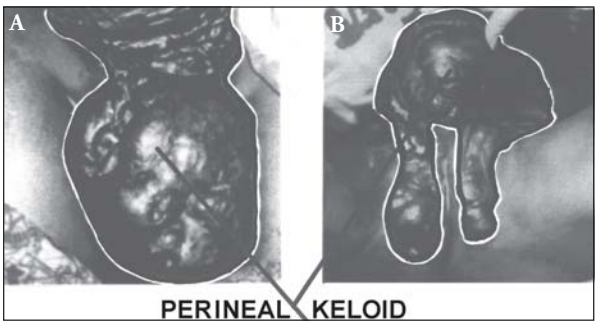


Figure 37. A) Large perineal and lower abdominal keloid 10 years after post delivery infection. B) Perivulvar keloids on the same patient.

Figure 38. Same patient after resection of all keloids.

6. Deep absorbable sutures joining the flap to the surrounding vaginal wall must all be preplaced. When they have all been are tied, the flap will gently overlie the vesicovaginal fistula repair or widen and extend the vagina.
7. Twice a day perineal care is given. The patients usually have a catheter draining for 2 weeks before being ready to go home.

Tensor Fascia Lata Myocutaneus Flap (Figs. 39A,B)

This flap is located on the lateral aspect of the thigh. Its length can extend from the greater trochanter to three-fourths the distance to the knee joint. The vessel supplying this muscle comes in anteriorly about 4 cm below the greater trochanter and 10 cm below the inguinal ligament.

It is very helpful in relieving burn scar contractures located in the inguinal region as well as replacing sections of the lower abdominal wall.

1. The flap is elevated starting distally and inferiorly. It includes the tensor fascia lata with the skin and subcutaneous tissues.
2. The plane of dissection is very easily developed immediately beneath the tensor fascia lata and includes its muscle belly.
3. The donor site can be closed primarily with interrupted nonabsorbable mattress sutures.

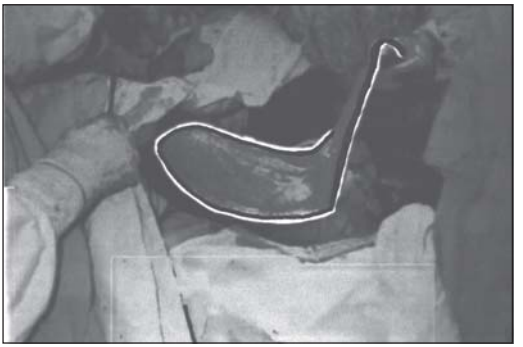


Figure 39A. Elevated left tensor fascia lata myocutaneus flap. Donor area will be closed primarily.

Figure 39B. Reconstruction using a right rectus femoris and left tensor fascia lata myocutaneus flap.

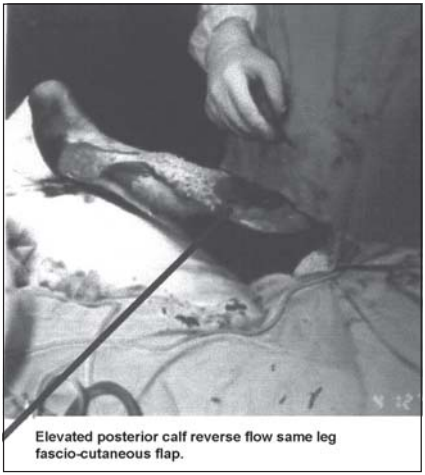


Figure 40. Elevated posterior calf reverse flow same leg fascio-cutaneous flap.

Fascio-Cutaneous Flaps (Figs. 40-46)

Posterior Calf for Cross Leg Application

This flap receives an excellent blood supply proximally near the popliteal space. It can easily extend within 10 cm of the ankle.

1. Split thickness skin grafts are taken immediately after the spinal anesthetic is started.
2. The flap is most easily elevated with the patient in the prone position.
3. Start distally and leave the greater saphenous vein in place. Dissect beneath the fascia by clamping and ligating the perforators.
4. The flap will include the fascia overlying the gastrocnemius and soleus muscles.
5. A circumferential running suture where the incisions were made secures the expanded split thickness skin graft in place after the operated area is decreased in size.
6. The split-thickness skin graft is also attached to the back of the flap for 10 cm. By doing this no exposed tissue remains after attaching the flap to the opposite leg.
7. At this point in the operation, the patient is best operated upon while in the supine position.
8. If external fixators are available, they can be placed in both tibia. Firmly secure both legs in the best position to prevent distraction, kinking or movement of the cross the leg flap. Three weeks are needed while the fascio-cutaneous flap is developing a new blood supply from the recipient area. Well-padded casts with wooden struts can also be used. The knees and ankles need to be secured in the most comfortable position. The patient will have practiced this position many times before surgery.
9. The external fixators make the patient much more comfortable and greatly facilitate nursing care. This is done with elevation of both legs in an orthopedic style bed along with ropes, weights, and pulleys.

Figure 41. Fascio-cutaneous flap. Showing application of flap to area on left medial ankle.

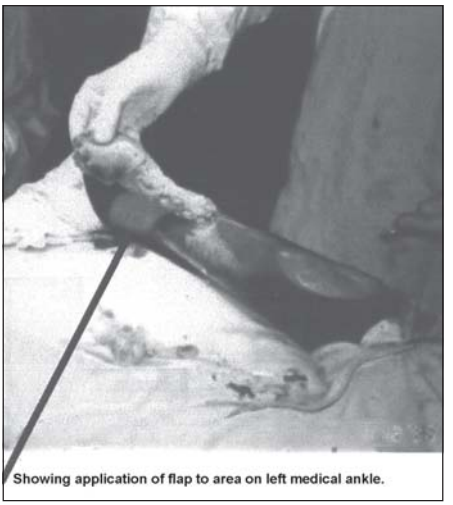


Figure 42. Fascio-cutaneous flap. Healing on the same patient 2 weeks later.

10. The dressings are usually undisturbed for the first week when the operative areas are cleansed and dressed daily.
11. The split-thickness skin donor area on the anterior or posterior thigh is taken down to the single nonstick layer overlying the donor area after the first week. It is then left undisturbed.
12. The flap is divided at 3 weeks and the transferred pedicle can be used and inset on the recipient lower leg if no dissection or manipulation is done.

The Reverse Flow Posterior Calf Same Leg Fascio-Cutaneous Flap

This flap is identical to the previous one except that its base is distal. The distal blood supply must be left undisturbed. It is used for nonhealing ulcerations of the

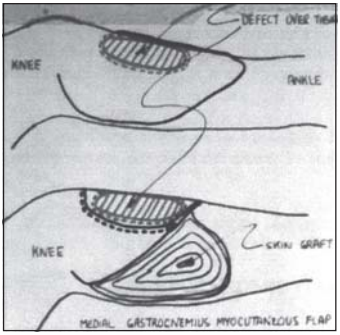


Figure 43. Diagrammatic presentation of fascio-cutaneous flap from lateral aspect below knee for anterior upper tibial deep tissue loss.

Figure 44. Fascio-cutaneous flap. Complete healing at 6 months. Injury was associated with bullet wound and fracture.

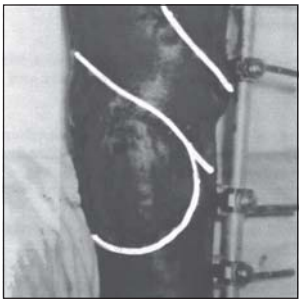


Figure 45. Immediate fascio-cutaneous flap from lateral lower leg to defect in anterior lower leg with associated compound fracture of tibia and fibula.

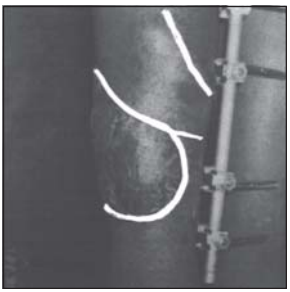


Figure 46. Fascio-cutaneous flap. Complete skin healing in the same patient at 1 month.

anterior and medial lower leg, which don't respond to simpler treatment or when the patient refuses a cross-leg flap solution. The patient must agree to a slight thickness of the lower leg postoperatively. The rotation of the flap to the desired recipient area must be done without tension or twisting. It is released from its base only enough to make this possible. After 6 weeks the transferred pedicle can be, flattened or thinned, but only if less than one half of the surface area is done at a time.

Lateral Fascio-Cutaneous Flap for the Same Leg

This flap includes both the skin and subcutaneous tissue and the fascia overlying the muscle. It can be longer than two times its width. It is most frequently used to cover the lower tibia after an open fracture. One must be sure not to use this flap if these tissues have been damaged in any way by the trauma causing the fracture or tissue loss. It must be made one-third longer than you think is necessary for tension-free coverage of the defect. The donor area is skin grafted at the same time as the surgery. If the associated fracture is immobilized with external fixators, these will need to be placed in such a way as not to interfere with the transfer and placement of this fascio-cutaneous flap. It is the fastest and easiest way to cover a difficult area of the tibia where there is significant loss of skin. It is much easier and much less bloody than the use of the reverse soleus or gastrocnemius muscle flap of the lower leg. Becoming proficient with these flaps will mean that many more patients will regularly be assisted to improved function, appearance and health. It is hoped that you will bring much joy and relief to patients and their families by these operations

Cleft Lip Repair (Figs. 47-56)

1. The anesthesia for children can be with ketamine. For adults, a local field-block anesthesia works well.
2. Measure the distance between the commisssure and cupid's bow carefully preferably with calipers.
3. Mark this point so that both sides of the lip will be of equal length.
4. Measure the distance from the collumela to cupid's bow on the normal side. This distance must be matched exactly in your repair of the cleft lip.
5. Make the markings for the incision as shown in the diagram.
6. Following Tennison's technique of cleft lip repair:
7. Make the marking a to 2 exactly equal to a' to 2' as pictured in Figure 55.
8. Make the marking 1 to 2 exactly equal to 1' to 2'.
9. 2' will fit into the notch between point a and 1 on the cleft side.
10. Make 1 to 3a equal to 1' to 2', which is also the same as 1' to 3' on the good lip side.
11. Make the incisions with a sharp knife without cutting the oral mucosa.
12. Make the incision in the lips between 3 and 4 and also 3', 2' and 4'. It is good to leave extra lip on the cleft lip side so that the area of the repair will have fullness. This prevents an indentation or 'whistle' deformity.
13. Make the incision at 45% to line 1 to 3 rather than at 90%.
14. Suture the mucosa together starting at the nostril with 5-0 chromic and progress to the posterior lip margin.
15. Undermine the margin of the nose on the cleft side beneath the muscles anterior to the mucosa until the nose can be brought towards the midline.
16. Measure the opening and circumference of the good nostril and make sure the cleft lip nostril will have a similar circumference.

Figure 47. Millard style operative repair of unilateral cleft lip.

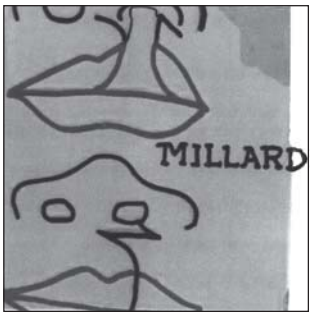


Figure 48. Left unilateral cleft lip.

Figure 49. Cleft lip repair. Immediate postoperative appearance with steri strips and tincture of iodine cotton pledget in left nostril as stent.

Figure 50. Cleft lip repair. Postoperative appearance at one week.

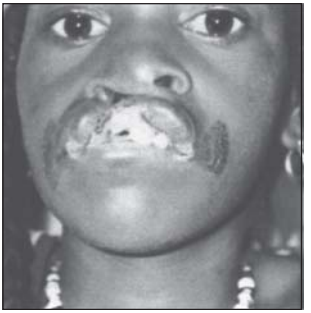


Figure 51. Right unilateral cleft lip.

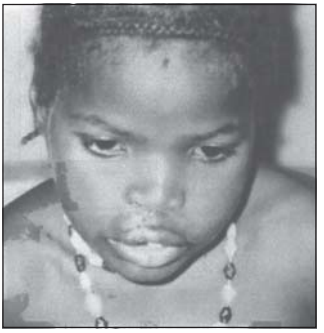


Figure 52. Cleft lip repair. Postoperative appearance of unilateral right cleft lip.

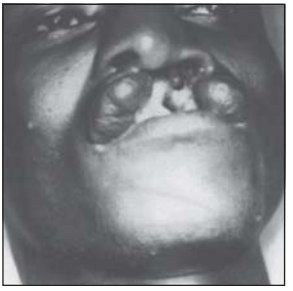


Figure 53. Preoperative left unilateral cleft lip.

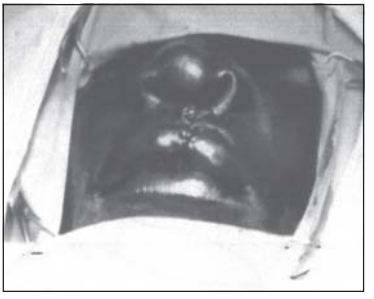


Figure 54. Post Millard repair of left unilateral cleft lip.

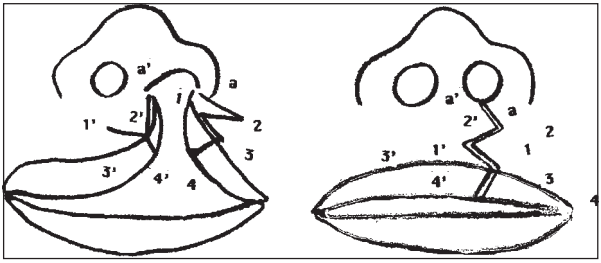


Figure 55. Left) Tennison's technique of cleft lip repair. Right) Make the incisions with a sharp knife as indicated after careful measurements. Place stay sutures at 4 and 4'. Make each length equal to its partner after closing the mucosa. Dissect deep to the nasal alae to release it. (a' to 2' must be equal to 2).

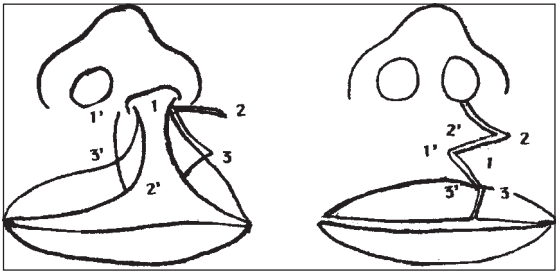


Figure 56. Left) Giraldes technique of cleft lip repair. Right) 1' to 3' must equal 1 to 3. The final nostril openings must be equal. The resulting lip margin should have a fullness.

17. Separate the skin from the muscle on both sides of the cleft with a sharp knife for a distance of 0.5 cm.
18. Approximate the muscle layers starting with a to a'.
19. Then approximate the muscle layers of 2 to 2', 1 to 1', 3 to 3', and 4 to 4'.
20. Place additional sutures of absorbable 3-0 vicryl if necessary.
21. Approximate the skin with interrupted 6-0 chromic sutures.
22. Place antibiotic cream over the incision and tincture of benzoin on either side of the repair out onto the cheeks.
23. Place steristips across the repair gently approximating the upper lips so that tension on the incision is demonstrated.
24. Place a small catheter in the nostrils and suture them in place with 5-0 chromic to maintain a good airway.
25. Place a protecting gauze over the incision with tape.
26. Use an elbow arm restraint on babies and small children.
27. Watch the patient closely the first 6 hours and then slightly less closely the next 18 hours.

Scrotal Elephantiasis (Figs. 60-63)

This problem may come from chronic filariasis. It is also present with chronic infections of the scrotum. Included with this is the 'water pot' perineum associated with gonococcal urethritis and stricture.

Have at least two units of blood available. The operation can be done after one week of careful skin preparation, which includes potassium permanganate soaks and twice a day sitz baths. Spinal anesthesia with the patient in a supine position works well. Calibrate the urethra with a urethral sound. Pass a catheter into the bladder. Apply a tourniquet, a #30 catheter, at the base of the scrotum and penis. The blood loss can be astounding. Make planned skin flaps on the adjacent normal skin for use in reconstructing the shaft of the penis as well as a cover for the testicles.

Make the skin incision that will remove all the diseased edematous and diseased skin. Rescue the testicles and lay them on the abdominal wall. Remove the remaining mass with care to the urethra. The urethra has been protected and identified with the urethral catheter already. Make a continuous suture of interlocking 2-0 vicryl in the pattern of an 'H' in the deep perineum. This will ligate the many large vessels, which have supplied blood to the large elephantiasis mass. This 'H' will be on each side of the urethra, beneath the urethra, and extending down on each side toward the rectum.

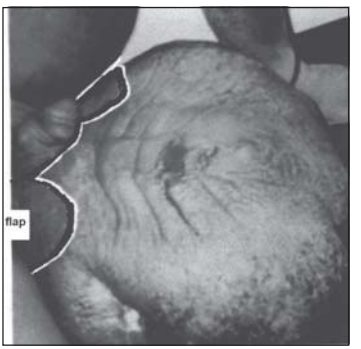


Figure 57. Giant elephantiasis of scrotum.

Figure 58. After resection of elephantiasis of scrotum.

Figure 59. After dissection of skin flaps, testicles, and urethra with catheter tourniquet.

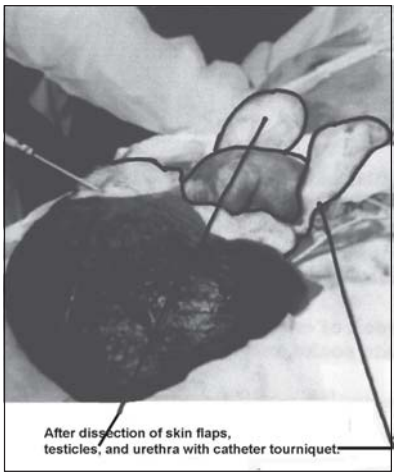


Figure 60. Postoperative appearance of the same patient.

The flaps are now brought together to cover the shaft of the penis and to cover the testicles which are replaced in their normal position. This is done with deep interrupted absorbable sutures.

The skin is approximated around a penrose drain.

Estlander-Abbe Flap (Figs. 61-66)

This flap is used for establishing oral continuity after traumatic or operative loss of the lip and mouth margin. One-third of either the upper or lower lip is used to replace up to one half of the opposite lip and mouth margin. It works because the marginal labial artery, which runs on the inner surface of the lip, can easily support the circulation of an entire segment of the lip. If this vessel is carefully preserved, the lip section can be moved with ease to its new and needed position without difficulty as shown in the accompanying picture.

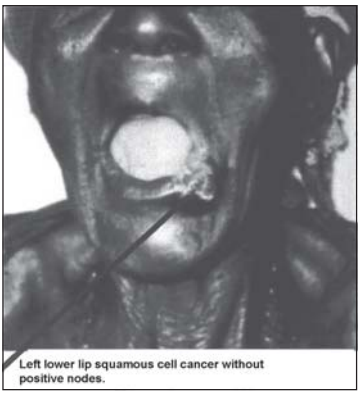


Figure 61. Left lower lip squamous cell cancer without positive nodes.

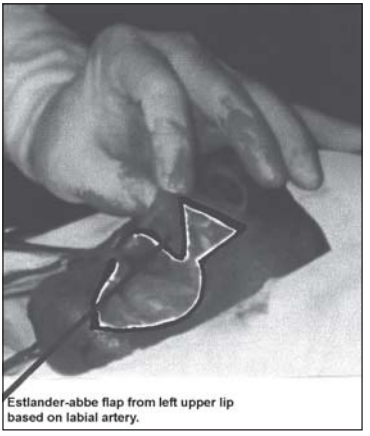


Figure 62. Estlander-Abbe flap from left upper lip based on labial artery.

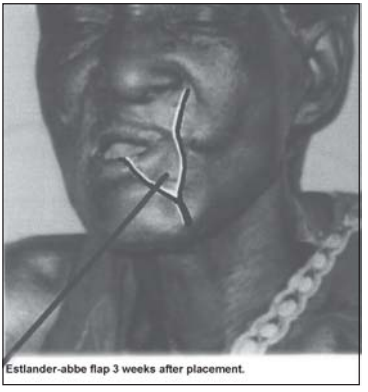


Figure 63. Estlander-Abbe flap 3 weeks after placement.

Figure 64. After Estlander-Abbe flap from right upper lip for commisure. Later lower lip cheek flaps have been turned in.

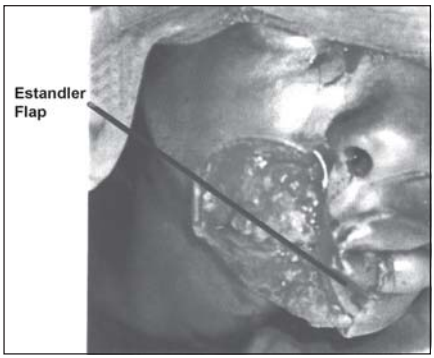


Figure 65. Estlander-Abbe flap. Lateral view of turned in cheek skin flaps.

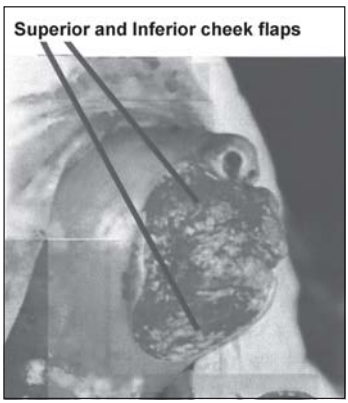
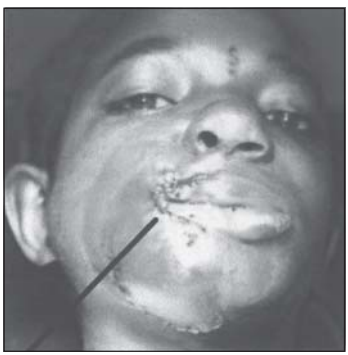


Figure 66. Frontal view of patient one year after surgery—commisure adjusted.



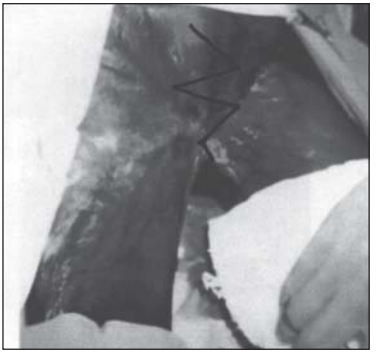


Figure 67. Z-plasty. Severe scar contracture of perineum approximating both medial thighs.

Figure 68. Multiple Z-plasties used in surgical treatment of this patient.

Z-Plasty (Figs. 67, 68)

Figure 67 shows a woman who has a scar contracture, which has pulled her two legs together. She is completely unable to walk because of this. The scar was the result of a severe burn of the perineum and upper medial thighs.

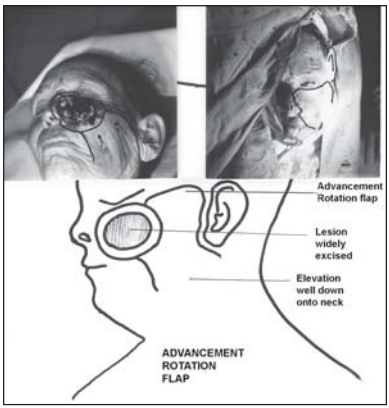
A spinal anesthetic is used. The patient can be operated on in the supine position. The skin of the contracture is cut in a zig-zag fashion with the angles being at forty-five degrees for both the anterior and posterior scar. The inverted 'V' of the lower skin in then sutured into the 'V' of the upper scar as pictured. Both deep and superficial skin sutures are used.

Advancement Rotation Flap

Figure 69 shows a woman with a lesion on her left cheek after it has been made dark with various herbs. The pathology report showed that this was a neglected basal cell skin cancer.

After a wide excision, the skin and superficial subcutaneous tissues are raised laterally all the way to the tragus of the ear and inferiorly well down on the neck. The dissection is kept superficial in a plane previously infiltrated with 20 cc of 0.25% xylocaine to which one drop of epinephrine has been added. The facial nerves will thus be protected. The blunt nose scissors dissector is used with its tip toward the skin. The skin is then incised lateral to the defect and high on the left cheek. It

Figure 69. Advancement rotation flap.



is continued downward in front of the ear. This will enable this entire block of skin and subcutaneous tissue to be moved forward and upward. Deep sutures are taken to position the advancement flap in its new position. Skin sutures, which pass from the border into the subcutaneous tissue to attach to the subcuticular margin of the flap and back through the skin of the border, are helpful. A penrose drain is used with advantage for the first 48 hours.

Complications

A. Bleeding, hematoma formation, and seromas.
B. Infection of operative and donor areas.
C. Necrosis of the distal portion of flaps.
D. Lack of attachment of the flap to the new site.
E. Airway obstructions
F. Corneal injury to the eyes.

Prevention and Treatment of Complications

A. Careful hemostasis is especially important in reconstructive surgery. This includes tender loving care of the tissues with prevention of desiccation by covering the operative sites and flaps with saline soaked laparotomy pads. The use of an appropriately sized penrose, glove, or finger drain for the first 48 hours is frequently wise. It is a good rule to make sure that all bleeding is stopped before the operation is terminated. If unexpected bleeding does develop, take the patient back to the operating room promptly. Don't procrastinate hoping that surgery will not be necessary.
B. Infections
    a. With strict attention to detail,
    b. Careful handling of tissues,
    c. Great emphasis on the adequate cleaning and sterilization of all instrument, drapes, gowns, and gloves,
    d. Special care not to crush or burn tissues and
    e. The liberal use of traction sutures and skin hooks,

The infection rate should be less than 5%.

Prevention of infection is not usually assisted by the use of antibiotics before, during or after surgery in reconstructive surgery in the tropics. For treatment, a

Gram stain can be taken, infected sutures removed, and collections of pus or hematomas drained.

C. Necrosis of the distal flap.

If care is taken to follow the directions for each flap elevation, distal flap necrosis and loss should not happen. Other tips to follow should include:

a. Avoid stretching and tightness. Don't reach too far from the site of origin.
b. Use of large sutures near the flap to discourage patient movement during the healing process.
c. Use of a skin graft on the back and under surface of a flap if tubing the flap seems tight.
d. Careful dissection with the blunt-nosed dissecting scissors in the direction of the vessels being saved.
e. Elevation of local flaps, leaving one-third of the length unelevated and undissected.
f. Avoiding tight peripheral sutures when attaching the flap to its new location.
g. Sutures from recipient site to subcuticular layer of the flap then back to recipient skin can make a significant difference in distal blood supply.
h. Making sure that a wide surface of attachment is present for the newly placed flap.

D. Failure of flap attachment to the new site.

The ways to avoid this problem are as follows: Increase the surface of attachment for the flap by the use of well-vascularized turn over flaps.

It is good to have a second and third alternative flap plan that can be adopted if the first plan fails. An excellent third flap is the biceps flap elevated from the shoulder towards the anticubital space. Even though it is an antegrade flap its vasculature is excellent. Early surgeons used this flap for nose replacement. It's lower 10 cm portion is raised, and a skin graft is placed on its under surface as well as the upper arm. Further elevation is done three weeks later for a total length of 20 cm.

E. Airway Obstruction.

The surgeon must take a major role in the anesthesia in the tropical setting. Packing used around endotracheal tubes for operations about the mouth is a source of problems even when long black stay sutures are used to mark them. With trismus and the inability to open the mouth, airway obstruction can be a major problem. Don't hesitate to use a tracheotomy for 5 days. Associate this with good teaching to the patient's family members and the on-duty nursing and auxiliary staff. It is possible to operatively remove the cause of trismus before intubation of the patient while an I.V. infusion of ketamine is given along with atropine premedication for the increased secretions, which will come from the use of ketamine. Placing a plastic tube and suturing this in the nostrils will assist in maintaining an airway for operations on the nose.

F. Corneal injury.

During any operation with the patient under general anesthesia the eyes must be protected along with any nerve which could be affected by long pressure. This is especially true during operations on the face. Tape the eyelids closed with steristrips or suture them closed with 6o chromic suture. This will protect the cornea. Do this after the application of eye antibiotic ointment is used.

CHAPTER 27

Factors Influencing Geographic Distribution and Incidence of Tropical Surgical Diseases

Ricardo Cohen, Frederico Aun and Glenn W. Geelhoed

Introduction

Geographical distribution constitutes the definitive feature in the term "tropical surgery." The reductionist view might be that tropical surgical diseases are those occurring between 23.5* N (the latitude of the summer solstice for northern hemisphere dwellers, or the Tropic of Cancer) and 23.5 S (the latitude for the winter solstice for the same northerners, or the Tropic of Capricorn) and the 47* wide Equatorial belt of the globe in between. The demography that lies within this linear geography may be described in terms of even starker simplicity.

"The tropics" happens to be where the majority of the world's six billion people live,[1] so that tropical surgery, far from being a narrow slice of the needs for surgical services, represents the principle human need for surgical services. It also happens that this area of greatest need is where the fewest resources are located with respect to skilled manpower, socioeconomic and political capital, referral capability, technology and educational and institutional resources. Therefore, the world's greatest need for surgical services is mismatched by the scarcest surgical resources on earth.

It is a truism that has become tragically commonplace in this era of a global HIV pandemic that diseases do not carry passports, so that the exotic and classically considered "tropical" abnormalities may show up in any emergency room, doctor's office or, worse, unsuspected share any public transportation or facilities that may spread contagion. Raising awareness[2] of the tropical medical threats in a shrinking world[3] with all the implications for global health and security[4] have been recent and increasingly urgent themes in professional and public media. If not for sympathy for those suffering in tropical environments, but in fear of the threats of emerging infectious diseases for which resistance to standard therapy appears to have come along with migration, health care workers everywhere are increasingly alerted to a need to know the patterns of tropical illnesses and how they may be different from the behavior learned in temperate environments.

Patterns and Pitfalls

Poverty is a feature that may be the most dominant underlying cardinal condition in tropical illness, superceding some of those that have been the focus of biomedical research as those presumed to be more biologically determinative ones. It is a common feature underlying malnutrition, poor facilities and maldistribution of manpower and other equipment resources, and ignorance—which is a basic feature

Surgery and Healing in the Developing World, edited by Glenn Geelhoed.

of the late presentation of illness and the lack of hygiene and sanitation that may contribute to communicable disease. It is fatuous to suggest that economic development will resolve the differential in the morbidity of tropical populations (for which a contrary witness is seen in many urban industrialized environments); but it is also a Pollyanna cruelty to await economic development before proceeding with methods of mitigating surgical tropical disease. There are methods of dealing with shortages of skilled labor and materials that circumvent through ingenuity what may be lacking in other resources,[5] and oftentimes these improvisations are the kinds of surgical tricks that are a lesson that the First World visitors must learn from the tropical healthcare workers: "How to handle larger volumes of sicker patients with fewer resources" is a postgraduate course many of us need to study from those veterans of longer experience in making do with what they have.

The first pitfall to be avoided here is the despondency that whatever can be offered in face of such overwhelming need would be inadequate, so why even bother to try? The single requirement for working in the developing world is a nearly infinite threshold for frustration—with patients' problems, with the limitations of staff, with the inadequacy of resources by the standards of the First World redundancy many of us had become quite comfortable with in other settings. In fact, almost any contribution made in several small ways toward improvement gives very notable and immediate rewards. As a surgical colleague would often say in such circumstances, "You cannot fall off the floor," and the encouragement to start is one of the best contributions that can be offered from a colleague who has been there before.

A second pitfall (which one source[6] calls the "commonest pitfall in diagnosis") is the assumption that an immigrant must import his diseases with him. With only a few notable exceptions, most Western diseases flourish in the tropics, but their presentation may be modified by environmental and other factors. Common conditions occur commonly, although they may have an uncommon appearance in an unfamiliar setting.

Priorities are rearranged in the tropical setting, where a period of experience can "reset" the pattern recognition that is such a consistent feature of physician behavior as efficiency accumulates with experience. When the author first plunged into the exhilarating experience of tropical medicine and surgery in the developing world over three decades ago,[7] the carefully learned reflexive behavior had to be relearned in the setting in which these patterns were now quite different. For example, right lower quadrant pain in a young male has a rather circumscribed differential diagnosis in the First World setting, whereas it would nearly invariably mean something else in the Nigerian bush hospital setting where I found myself shortly after I had learned the pattern revolved around appendicitis where I had been only shortly before in a US University hospital. I made lists of the rare and exotic diseases I would see and added them to my clinical collection. But, I shortly picked up another, and possibly more valuable habit—I listed in my notepad the very common conditions afflicting patients that filled over two-thirds of the inpatient beds and three fourths of the outpatient office visits that I was *not* seeing in the tropical setting. These conditions were not subtle and therefore easy to overlook, or not seen because they required some special diagnostic testing that was absent, nor overwhelmed by other problems that prevented them from ever developing, because of, for example, foreshortened lifespan. These conditions were simply *absent.* In the example of appendicitis, there was one patient who had once developed appendici-

tis and sought treatment at the hospital in the Nigerian bush—and he was a very rare white visitor, a Peace Corps Volunteer from the Bronx!

With this shift in patterns of recognition of common incidence conditions, I had learned of first-world rarities that might even have been nonexistent in my prior experience and listed them, but was even more impressed by the conditions with which I had become very familiar, strikingly absent. Both the causes of death and the incidence and complications of the infectious diseases called "tropical" were quite apparent in this setting, but to practice surgery, one needed to know the Western—or universal—fundamentals of surgery, and improvise in putting them into practice in the modifications required by the resource constraints. This "reprogramming" has been an essential part of clinical practice learning in each subsequent venue in which I have worked in the tropics.

Presentation

Pathology is often late in its presentation to the attention of health care workers. This is a simple statement often reiterated in regard to tropical surgery conditions. What it means is that, far from being a challenge, diagnosis is often apparent at a glance, or a sniff, and not necessarily by a physician. Few of the primary presentations are subtle. The findings are so obvious, that simply exposing, or pointing is all the "History and Physical" examination needed in many wordless encounters without need for translation. An adult with a cleft lip or a child with an extremity bent in a right angle are not diagnostic dilemmas. An outcast woman sitting outside the clinic door and reeking of urea-splitting organisms hardly need be examined to determine that she has a long-standing vesicovaginal fistula.

Some of these unfortunate patients presenting in such a late stage of disease afford a fascinating "window" on the natural history of some conditions never allowed to deteriorate before repair in other, more fortunate, parts of the world. I had once seen a man with a rather unique situation that was at first puzzling—a scrotal ileostomy. I then realized I was looking at the natural history of incarcerated inguinal hernia that strangulate with the only unlikely outcome that could still result in his survival.

I had encountered unusual physical findings associated with filariasis that were advanced features of the disease. The "hanging groin" was not a clinical feature I had encountered before my experience in filariasis endemic areas, where I had also learned of onchocerciasis nodules appearing everywhere where a tumor might be suspected, including intracranially. I discovered chyluria and a number of other late stage features of several of the filarial complications.

When I had accommodated the spectrum of filariasis, I saw it everywhere, even where it was not. I had encountered elephantiasis of the extremities in areas where I thought it odd that there had been no filariasis being recorded. One such patient was seen in Ecuador, where he was completely disabled by the distortion of his legs, and only later did I learn that the characteristic elephantiasis I had identified as filarial in origin could also result for silica lymphangitic obstruction in pedoconiosis, or "mossy foot"[8] for which an entire surgical treatment and prevention project is supported in an Ethiopian hospital.

Environmental Conditions

There are but two seasons in the tropical latitudes, marked by extremes of inundation and desiccation, with illnesses and hygiene conditions reflecting water-borne

or water-lack cycles. The dry and rainy seasons have special implications for tropical surgery and the spoilage of some equipment and the kinds of environmental conditions that will compromise patient hygiene.[9] The tropical days do not vary in length as much as they do in the temperate zones, so that the tropics should not be thought of as a European or North American summer day, but more like an Equatorial equinox in these latitudes, with limited periods of daylight during which much of the work must be accomplished in the scarcity of artificial illumination. This also has implications for the surgical workload that is often limited by the daylight stored as solar power.

The other geographic features that determine the micro-climatic conditions include altitude, proximity to the sea, rivers, lakes or deserts, prevailing wind and monsoons or harmattans, and volcanic or rainforest soils. Altitude has a major role in the ambient temperature, a circumstance that has impressed itself on me as I have stood on "Equatorial glaciers" on multiple points around the earth's high mountains well within the tropics, as, for example, at 00.00 on Kilimanjaro. It has seemed to me to be confusing and perhaps an unfair or unkind trick, if not inexplicable, that one can suffer both frostbite and the rigors of a malarial fever in the same setting.

Volcanic soils, the notoriously poor soils of rainforests with little organic nutrients or soluble minerals within them, and mountain soils have been inadequate as sources of both micronutrients and any sustainable yield of macronutrient calories. These marginal lands have very limited carrying capacity, yet are pressed as home for ever increasing density of populations. One result of these conditions is endemic hypothyroidism and goiter around the globe's equatorial belt[10] in areas of iodine deficiency disorders. Iron deficiency is compounded by the burden of helminthic disease, such as hookworm[11] which causes additional attrition in energy and its utilization in learning and industriousness.

Floods may affect some parts of the tropical world when no rain has been experienced, if they are within the pattern of some much larger movement of wind and water—such as the flooding of the Sudh in the Sudan from the Nile's output of highland Ethiopia precipitation, or the Himalayan-generated monsoon seasons half a world away. These global patterns are subject to periodic perturbation also, as has been seen with the worldwide disruption following El Nino.

Endemic Disease of Surgical Consequence, Superimposable on these Geographic Constraints

It has been well-known since the time of Manson that malaria is a mosquito-born illness and that the patterns of much of tropical disease could be unlocked by a knowledge of the entomology that underlay some diseases. This was not only true for the plasmodia in their distribution with the seasonally cyclic Anopheles mosquito breeding and feeding patterns, but second and third order diseases as well. There were diseases directly related to the malaria—such as the nephritic syndrome of blackwater fever—but also those genetic traits selected by the partial resistance conferred by hemoglobinopathies that also produced blood dyscrasias such as sickle cell disease and Mediterranean hemoglobinopathies.

One of the pioneers of the kind of epidemiology that led to clues as to the origins of some kinds of tropical noncommunicable disease was Denis Burkitt, whose Great Safari in a continuously-repaired station wagon brought back information of the incidence, frequency, and pattern of an unusual maxillo-facial and visceral child-

hood malignancy correlated with latitude, altitude, rainfall and other patterns of geographic propinquity. It is now possible to integrate this GIS (Geographic Information System) into public health research into the control of tropical disease using the GPS (Global Positioning System) and other readily available technology.[12] Burkitt had extended his observations made in tropical environments in an attempt to explain the relative scarcity of certain disease conditions in the tropics with the alarming abundance of the same disorders in the developed world outside the tropics.[13]

Patients May Be as Different as the Diseases, in the Tropics

Whatever the presumably known vector of some of the tropical diseases, there may be some general conditions that affect the people living in the tropics, even those who remain, for the time, healthy. The normal neutrophil count for the healthy African living in Nairobi is 2,400/cm^3 [14] or the albumin/globulin ratio may be reversed compared to Western standards. Given the differences in nutrition and genetics, it should not be interpreted as substandard to consider the majority of African births to be of low birth weight or the growth curves in childhood not measure up to a European norm.

To use the Sir William Osler aphorism: "Ask not what kind of disease does this patient have, but what kind of patient is it that has this disease?" It may be well to recognize the limitations of some of the surgical arts to fix some fundamental parts of the patients' problems. It may be that the patient has an enormous hernia of the type in which the majority of the gut may be in the very grotesquely enlarged scrotum. To repair such a hernia may seem like a technical tour de force, but it may also mean that the patient cannot breathe after all that bowel, which had lost abdominal domain, is pushed back up under the diaphragms and resulted in respiratory insufficiency—hardly a favor in exchange for a hernia repair. There may be many such examples in tropical patients in which we have a particularly good "hammer" in our surgical tools for the directed repair of an immediate problem which may cause further dislocations in the patient's adaptations[15] This is not a reason to forego the immediate curative care for which surgery is remarkably effective, but to be culturally sensitive as to the social context of this from of the healing art on which the credibility of a good deal of primary and preventive practice rests.

The Coming Plague—of Development

In some of the "emerging economies" in the tropics, there is an economic stratification of those, particularly in urban areas, who have adapted the First World's lifestyle and acquired some similar pattern of wealth in consumption. Such "economic development" which is easily measured in the terms that generate numbers economists use in such evaluations as that of the World Bank[16] may lead to the accelerated onset of the First World plagues, largely absent in the tropics—hypertension, coronary artery disease, degenerative diseases of the CNS, and metabolic consequences of excess.[17] In one review of changing patterns of disease in the new South Africa, an alarming accelerated epidemic of obesity and hypertension reflected the dark side of this new urban economics, with the extremely constrained health care resources already stretched thin that would have to be stretched beyond the elasticity to cover the medical and surgical complications of this new wave of tropical noveau-diseases.[18] Such a labor and materials and capital-intensive epidemic for palliative care might even dwarf the staggering requirements anticipated for the burden of HIV-associated disease in the tropics.[19]

What Can—and Should—Be Done to Try to Balance the Surgical Skill Supply and Larger Needs in Tropical Surgical Care?

There are no shortages of challenges in tropical medicine[20,21] and these problems of daunting size and scaling up at an increasingly rapid rate are particularly true of tropical surgery. In a nation such as Malawi,[22] the population and its surgical needs have recently doubled, and little else in that nation has, with a physician:population ratio of less than 1:80,000, one of the least well-supplied in the world. That is considering that less than 35 of the 84 physicians are Malawian and the majority are expatriate physicians serving as missionary doctors. Few of these are trained surgeons, yet all must confront surgical problems, never less than 15-25% of the patients attending one of the two dozen hospitals. The credibility of a great deal of the primary and preventive care effort rests in the capacity and care for the acute surgical curative need—such as the ever-present obstetric disasters, the worldwide plague of trauma, attending both transportation and inflicted violence.

A realistic view of the political and economic overload resting on surgical care is described by an indigenous Indian surgeon in a specialty hospital in the nation's capital[23] and it may not be pretty with the day-to-day frustrations of someone trained in First World settings to adapt to the high demand and short supply of a developing world facility, but the reward in attempting to serve under such conditions is also quite clear. One suggestion is for the First World in the temperate zones to develop "world-class surgeons"[24]in collegial collaboration with those working in tropical surgery in order that they may exchange specific expertise and learn from each other in the various adaptations each must carry out in practice in very different settings and resource environments.

Another suggestion is for a chair of tropical surgery[25] as a legitimate specialty interest for consideration. But, with the rapid expansion of the need and demand for surgical services in this major section of the world's people, it may be that a new cadre of surgical primary care ancillary personnel will need to be specially trained to do a limited number of the emergency procedures where there are too few surgeons or rapid transfer systems to get such patients to a center for specialized care. Such a "Tecnicos Cirugicos" system has been well implemented in Mozambique[26] and has been supported by Royal College of Surgeons leaders.[27] The tropical surgical world is not pausing for new initiatives before exponentially expanding its tropical surgical needs.

A Two-Way Educational Process in Collegial Collaboration

Tropical surgery is a fascinating and challenging personal and professional commitment. It is involved, to be sure, with the exotic—illnesses secondary to schistosomiasis, a trematode, or onchocerciasis, a filarial worm, or atypical sarcomas or lymphomas despite a relative paucity of emerging epithelial carcinomas. It shares with the temperate zones the same numbers of congenital malformations, and an intensifying plague of trauma, but has unique infectious surgical problems, with an underlying poverty of resources that complicates both the disease and its care, and requires resourcefulness to improvise and adapt for successful solutions. This is a very fruitful area of clinical investigation and skilled improvisation in new techniques for more efficient delivery. Many of our tropical surgery colleagues have been there far ahead of us and we have much to learn to catch up to address a problem

each of us must face daily no matter where our surgical interests lie—the care for ever greater numbers of more intensely ill patients with fewer resources committed in redundant overservicing. This educational effort might be well invested in sharing the tropical surgical burden with colleagues worldwide in the innovations that are helping adapt to the large surgical patient population amid the tropics, and the majority of the world's underserved population.

Creativity and ingenuity is the ultimate surgical skill when applied to pressing human problems. As we once considered a very imposing surgical challenge, the following thematic phrase was exchanged in planning the care for a number of needy patients: "We have no money; therefore, we must think!"

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CHAPTER 28

Population Dynamics of Surgical Tropical Diseases

Ricardo Cohen, Frederico Aun, Glenn W. Geelhoed and Eric L. Sarin

In the tropical areas of the world live the largest human populations with the highest growth rates and the youngest population pyramids. These facts have immediate implications for the incidence of disease and the needs for medical and surgical services. Because of the skewed age curve of the population (many tropical countries have the median population age represented by teenagers!) relative to temperate populations, which have a proportionally larger burden of older population and may even have zero population growth, disease incidence will be remarkably different. For example, the latter populations will have a larger burden of degenerative and malignant diseases of cardiovascular, CNS and GI and musculoskeletal abnormalities that are acquired later in life, whereas the tropical populations will have a higher proportion of congenital, communicable and traumatic illnesses largely on the basis of the age distribution of the respective populations. Venereal diseases would not be expected to be a major concern in a geriatric population, whereas the teeming populations of urban youth in many tropical port cities are a virtual hothouse for such epidemics.

Disease Prevalence Influenced by the Skewed Population Pyramid Some as Cause, Some as Effect

Communicable diseases include those considered tropical diseases by their distribution, which are to some degree cause, and even to a greater degree effect of the population dynamics. Malaria is a disease with a very high incidence in most tropical areas, with a morbidity and mortality differential that is directly attributable to this age differential. The death rate is highest among the young who may not have yet acquired a relative immunity to the lethal forms of the disease from frequent exposure to the morbid illness that may be partially protective for forms such as cerebral malaria of the falciparum parasite. The high wastage of the under-five population has fueled an immemorial desire for high fertility and a heritage of large families, based in the only social security that can be considered by many residents of weak or failed states or warring communities.

Trauma is a great common denominator between the developed and developing world. Mechanized transport may be faster in the developed world, but is surely more hazardous in the developing world, and the environmental risks of farming, forestry and the unfortunate high risk of violence from crime and warfare in unstable states makes trauma cases a surgical staple in any tropical theatre list.

Given the population pyramid and the high fertility rates, another staple of operative treatment that is often under-appreciated by some volunteers who have not

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operated in tropical environments before is the high number of obstetric disasters and surgical requirements for operative deliveries or ectopic pregnancies. A surgeon working in the tropics rarely has the luxury to refer or to decline participation in such heroic feats outside the bounds of the usual surgical residency training programs in the developed world as "accouchement force'", seemingly endless series of "pussy pelves" and the desperation of septic abortion or late labor fetal demise.

Adaptation, Given the Stresses of Environmental Concommitant Conditions

A well known example of persistent disease patterns that continue to be conserved despite apparent natural selection pressures that might have eliminated them from being passed along are the genetic hemoglobinopathies. If we consider sickle cell anemia, for example, this disease has a considerable mortality associated with it particularly under some hypoxic stresses, and it would no doubt have been eliminated from the human gene pool were it not for the heterozygous carrier condition of sickle cell trait which can carry a relative immunity to red cell parasitism from the malaria parasite. So, in areas of higher malaria endemicity, sickle cell trait would be conserved. This is also true for some of the thalasemias adjacent to the Mediterranean and other genetic illnesses which have been linked with pressure from other environmental factors.

It is a worthwhile question to ask in our meta-analysis of medical and surgical treatment of tropical disease, if we as therapists may also be factors in the natural selection process, changing the nature of disease patterns not only from successful treatment patterns that would, it is hoped, enable the postoperative patient a chance to survive and mature to develop later degenerative diseases seen more commonly in the developed world's older populations. But, it may also be that we are operating in an environment in which larger factors are also determinative of survival of those who may receive treatment, and the disease patterns themselves. As an example from one of the author's experience, consider the case of endemic hypothyroidism and cretinism in Central Africa. (Nutrition article, Dec 1999 and editorials referenced here.)

If hypothyroidism is a disease (and almost all developed world physicians would agree that it is since it subtracts so much human energy and individual development potential) why has it been conserved? And, as it seems to have been conserved in a distribution pattern that follows the tropics and high mountain or central rainforest or desert areas of the world. These are areas also of endemic poverty in lands with scarce resources. Which is chicken, and which is egg? Are the people poor because they are hypothyroid or hypothyroid because they are poor? And is it coincidence that the tropical areas of least energy resources is also the hypothyroidism endemia?

It may be that hypothyroidism is a metabolic disorder which may represent an adaptation to areas of scarce resources (at least it is obvious that cretins could not survive in a cold harsher climate in which a much higher metabolic level of activity and energy utilization were required), and correcting the hypothyroidism in a patient or a population that must remain in and contend with these marginal environments may create metabolic maladaptation, if other steps are not taken to mitigate the energy shortfall in macro calories after restoration of the micronutrient iodine, for example (Nutrition articles).

Such thoughtful metanalysis of the demographic and epidemiologic transitions that populations go through in the process of development had inspired Maurice

King to consider the human tragedy of "demographic entrapment" in which a population could not transit through the development phase quickly enough to get early control of the death rate by medical means, but before the economic development resulted in a control of the birth rate. The interval population explosion might outstrip the resources of the marginal environment, and cause such pollution and degradation that the "world health" suffers and entropic collapse. This is a somber reflection of the artificial nature of medical and surgical care in bringing down the death rate in the absence of any economic development that might eventually curb the population growth, such that the tragic outcome may be an environmental collapse and a subsequent rise in the death rates to balance the high birth rates in a near stable population. (Maurice King "The Demographic Entrapment of Mankind") Such a consequence of medical and surgical care in the marginal environments of some tropical populations should make us cautious to mitigate not only the consequences of the tropical disease we encounter, but also our intervention in it. Survival and medical care are ideally parts of public health and hygiene, and the latter is part of an overall development to bring out full human potential, which is sadly sacrificed or cut short too often in the tropical parts of the world (Reference "Out of Assa: Heart of the Congo").

CHAPTER 29

Metabolic Maladaptation

Glenn W. Geelhoed

Abstract

Endemic hypothyroidism has been studied in a Central African population in remote Congo (ex-Zaire) to determine the prevalence, severity, causes and potential control of this disorder, with questions as to why this disease is conserved and whether it confers any adaptive advantage in this resource-constrained environment. Iodine deficiency, cassava goiterogens and selenium deficiency were found to be the factors implicated in the severe hypothyroidism expressed in congenital cretinism and high goiter incidence in this isolated population, which continues under observation following medical intervention.

Profound hypothyroidism was encountered in whole village populations as measured by serum TSH determinations ranging from very high to over 1000 I U, and thyroxin levels ranging from low to undetectable; cretinism rates were as high as 11% and goiter incidence approached 100%. Assessment of endocrinologic status, caloric requirement, energy output, fertility and ecologic factors was carried out before and during iodine repletion by depot injection.

Hypothyroidism was corrected and cretinism eliminated in the treatment group, with goiters reduced in most instances (with regrowth exhibited in some who escaped control) and some symptomatic goiter patients were offered surgical treatment for respiratory obstruction. Individual patient benefits were remarkable in development expressed in improved strength and energy output.

The social and developmental consequences observed within the collective groups of treated patients were remarkable for an increase in caloric requirement and a dramatic increase in fertility which led to quantitative as well as qualitative increase in resource consumption. Micronutrient iodine repletion was not accompanied by any concomitant increase in macronutrient supply, and hunger and environmental degradation resulted.

It may be that the highly prevalent disease of hypothyroidism is conserved in areas of greatest resource constraint, in which it happens to be found in highest incidence, because it may confer adaptive advantage in such marginal environments as an effect as well as cause of underdevelopment. It may limit energy requirements, fertility, and consumer population pressure in closed ecosystems that could otherwise be outstripped. Single factor intervention in a vertical health care program not sensitive to the fragile biologic balance and not part of a culture-sensitive development program might result in medical maladaptation.

Surgery and Healing in the Developing World, edited by Glenn Geelhoed.

Introduction

This chapter deals with hypothyroidism in central Africa in an Azande population in Northeast Zaire. Hypothyroidism affects the individual victims of this disorder as well as the collective society in which this metabolic deficiency has inhibited socioeconomic development. If this metabolic disorder is a disease affecting both individuals and secondarily the society which they compose, several questions arise: why has this disorder arisen and been conserved within this population? Has hypothyroidism conferred advantages as well as disadvantages to the individuals and society affected? How will the control of hypothyroidism affect both individuals and their society?

The hypothesis to be explored is that the medical condition known as hypothyroidism is conserved in resource-poor environments. It has been, in fact, an adaptation to micro- and macronutrient insufficiency. Observations made in a longitudinal study of a population in an environment of iodine deficiency are analyzed before, during and after intervention in treating hypothyroidism, and the effects in both individuals and their society are described from both the disorder and its treatment.

Comparative data are collected from a geographically nearby population—the Efe, often called "pygmies" in the literature[1]—who were studied similarly, but without the specific medical intervention program of iodine repletion, to serve as an "external control" group for the treated Azande population. Data obtained before iodine treatment was initiated (a "historical control") and from the group of Azande studied but not treated ("concurrent control") were the comparisons within the Azande population serving as "internal controls."

The study was carried out personally under the auspices of a mission station associated with Africa Inland Mission but without major funding sources or sponsorship. Some volunteer labor was contributed through the organization World Medical Mission, which, along with the study's volunteer participants, donated some of the supplies.

The initial population survey was undertaken with the objective that medical intervention to correct hypothyroidism might improve the well-being of those treated and result in collective social and cultural benefits from the relief of this biologic inhibition to development. Acting upon this mission objective from the perspective of a medical relief effort has brought about expected medical and sociocultural benefits for individuals treated. There has also been a considerable unexpected impact of treatment on the population under observation following treatment. From the consequences—-both positive and negative—-of intervention in this sample population, conclusions are drawn regarding human adaptation to this resource-poor environment and the role of both hypothyroidism, and medical intervention to correct it, as possibly being maladaptive in this environment of endemic hypothyroidism.

A corollary of the hypothesis is that medical intervention may have deleterious effects in the long term on the population's health if the malady treated has had adaptive advantage and has therefore been conserved within such a population.

Hypothyroidism in the Adult and Child

What Is Hypothyroidism?

Hypothyroidism is a disease characterized by decreased secretion of thyroid hormone resulting in subnormal regulation of metabolism. Its *consequences* are low energy output, obtunded mentation and decreased caloric utilization. In the adult,

compensatory *goiter* may develop in response to pituitary recognition of this subnormal metabolic state and appropriate increase of thyroid stimulating hormone (TSH). In the infant, the greater human tragedy of *cretinism* may ensue, which is failure of development in neurologic, stature, cardiovascular and sensory faculties with retardation of all growth milestones and permanent developmental arrest.[2]

In terms of the individual, particularly at the stages of fetus, infant, and childhood, "development" refers to physical and functional growth and differentiation, so that stature, senses, strength and learned psychosocial capabilities are able to proceed in the growth pattern characterized by growth "milestones" (e.g., age norms for height, weight, when first beginning to sit up, walk, talk, weaning). Hypothyroidism is a condition that retards these development processes and in severe cases permanently stops them. In terms of a society, "development" refers to the socioeconomic complexity and productivity characterized by appearance and differentiation of specialized social institutions, literacy, gross domestic product, and consumption and processing of resources. Hypothyroidism has its highest global incidence in populations described as "lesser developed" in these socioeconomic uses of the term development. The consequences of hypothyroidism make it understandably classified as a disease with quite apparent implications for retarded development of both individuals and the culture of the society affected.

Hypothyroidism can be studied by measuring hormones in the blood (thyroid hormones would be low, thyroid stimulating hormone would be elevated), presence and degree of goiter and cretinism, and metabolic rate estimation through calorie consumption. As goiter and cretinism are terms describing hypothyroidism in the adult and child, these terms are defined below, since each may be assessed in the field without reliance on laboratory analyses of hormone assays, the results of which are often determined and reported much later.

Goiter is defined as an enlarged thyroid gland, a swelling in the anterior inferior part of the neck which may be palpable (typically when the size exceeds twice the adult median thyroid gland size of 18 grams), visible (typically when the size exceeds four times the adult median thyroid gland size, or around 75 to 100 grams), and sometimes massive, occasionally grossly distorting the anatomic configuration of the head, neck and chest (in some instances exceeding a kilogram and approximating the size of the patient's head). Goiter may cause problems for the individual that bears it ranging from disfigurement, discomfort, cough, difficulty swallowing to the life-threatening complication of obstruction of breathing.

Cretinism is defined as congenital hypothyroidism and has even more significant consequences than goiter in human development. As described below, cretinism represents the arrested or retarded intrauterine development of an infant born with significant impairment ranging from retarded growth and developmental milestones to stillbirth from insufficient energy utilization and suppressed metabolic development.

What Causes Hypothyroidism?

The majority of the *causes* of hypothyroidism are known and most are readily correctable. The most prominent cause in Africa and many other areas is *iodine deficiency.* Iodine is a dietary trace element that could be made available, is cheap and should be capable of repletion in the intake of those who are deprived of it by geographical remoteness from sources of this trace element.[3] Lesser common causes of hypothyroidism in some societies are substances known as *goitrogens.* These factors are substances that prevent organification of iodine into thyroxin. The effect of

some of these goitrogens, for example, thiocyanates, can be mitigated by either avoiding the dietary vegetable products that contain these thiocyanates through a shift of dietary starch staples or changing the way some foodstuffs are prepared to reduce goitrogen content.[4] A third cause of hypothyroidism among those factors known or suspected include dietary deficiency of cofactors necessary for reduction of iodide, including a trace element antioxidant, selenium, either present in a varied balanced diet or capable of fortification, like iodine, in a dietary supplement.[5]

Where Is Hypothyroidism Found and Why?

Geographic features that correlate with regional iodine deficiency include soils of volcanic origin with low iodine (eg, some Indonesian Islands).[6,7] Soils leached of iodine by glacial action (eg, Great Lakes, Alpine central Europe, Andes, the Himalayas), or leached by periodic inundation and elution of water-soluble nutrients (eg, equatorial and tropical rain forest) are poor in iodine content. In the ex-Zaïre (now renamed the Democratic Republic of the Congo) study area, the combination of lava substrate and cyclic inundation (leaching) is an explanation for the iodine-poor environment.[8] Additionally, this remote Central Africa location is far removed from natural sources such as iodine-rich seafoods or commercially fortified products such as iodized salt.

The extent of hypothyroidism is a serious global public health problem.[9] Nearly a *billion* people, or a fifth of the planet's inhabitants, are affected—the majority of them in marginal deficiency that inhibits their reaching their full potential (75%), but many manifest this hypothyroidism through goiter (20%—or a number approaching the size of the US population) and a tragic residual of cretinism (3.5 million) who might never develop but who are suffering a permanent preventable retardation.[10] In fact, iodine has been called the "mind-protector".[11] The population affected by hypothyroidism is among the poorest of the peoples of the globe, distributed in those tropical, mountainous or volcanic regions which are least developed with populations with the least potential for developing the resources of these environments.[12,13] These foci of "geologically induced goiters"[14] are places where geologic features allow prediction of probable hypothyroidism; in the world today, these areas are found nearly uniformly to be lesser developed regions of the world. This disadvantage is based at least in part on the lack of energy, ambition and resourcefulness which are characteristic of the hypometabolism of hypothyroidism, sapping the human resources, whatever the limited potential of the natural resource environment.[15-17]

The World Health Assembly has recognized this coincidence of iodine deficiency disease in the underdeveloped regions of the world and at its 43rd assembly in May of 1990 established the goal of elimination of iodine deficiency disease by the year 2000.[3] The ICCIDD (International Council for the Control of Iodine Deficiency Disorders) has been working toward the achievement of this global goal, now nearly approaching the deadline of the timetable for its accomplishment.

Consequences of Hypothyroidism

The consequences of hypothyroidism are severe. The causes are known and correctable. Why is it that this disease has persisted? It seems by some coincidence that it most severely affects the poorest of the world's populations in the areas that are most resource-depleted, and this fact would tend toward a question of whether this association was cause or effect. It is true that poverty and hypothyroidism appear congruent on the world's map of geographic medicine. If the disease of hypothy-

roidism is maladaptive, how is it that it has been conserved? And, particularly since the modern advent of global health programs for prevention of serious disease, why cannot this disorder be eradicated? Since such a goal has been stated and acted upon with a timetable set for elimination of hypothyroidism, what are the likely possibilities that it will be successful, and what are the probable consequences if it should succeed or fail?

How Can Hypothyroidism Be Studied?

Prior to any understanding of how deficiencies in the environment and human disorders may be related, the best approach is to define, describe and measure aspects of the environment and the affected society before evaluating the role of one isolated factor such as iodine in human growth and potential. Understanding how much deficit is due to the identified micronutrient and how repletion might change both individuals and the society might come later with a cumulative assessment of the changes in form and function.

From the perspective of my interest in the biological, environmental and cultural adaptations of remote populations and with a professional background in surgical endocrinology, I had sought out the most significant endemias of hypothyroidism to attempt to address the questions of the endemias' characterization, why hypothyroidism is conserved, and the individual and social consequences of hypothyroidism and its correction. One of the most severe endemias so far recorded on earth is the study region of this investigation in Central Africa. The area selected for this study of endemic hypothyroidism is in the upper reaches of what was called "Bas-Uele", first recognized by colonial district officers when this area was "Congo Belge" and then reported by several Belgian investigators through preliminary surveys.[18]

When an isolated factor in this region is selected as the independent variable in a study of a population, it is possible that other events in the environment may be changing as well i.e., the factor cannot be completely isolated. To identify as completely as possible covariables and to the degree possible examine untreated controls within the study population adds strength to the associations depending from the independent variable—in this instance, the micronutrient, iodine.

If observations made in a population are compared with reported historic data in the same population, there is no control for the cofactors that may be brought in with the independent variable. A parallel social group in the same region and an internal untreated control group within the same population studied contemporaneously constitute a better control for these unknown cofactors' confounding influence. The same investigators observed different ethnic groups in a different geographic area in the population survey. In these other populations, the micronutrient iodine was not repleted even though other medical intervention was introduced for services to the other control population. This second population was compared with the study group under longitudinal surveillance.

Where Was This Study Conducted?

This study was conducted in an Azande population through longitudinal study of profoundly iodine deficient populations in the Uele region of northeast Congo (at the time, designated "Zaire"). This region, defined below as "Sasaland" (because of the hereditary chieftainship of the region bearing the Azande family name "Sasa"), is in a remote part of Central Africa in which little study or intervention had previously been carried out or reported.

In this region, endemic hypothyroidism is both highly prevalent and profound in its consequences on the juvenile and adult members of this affected community. This society and its members are as severely affected as any group on earth according to the standards of the International Council for Control of Iodine Deficiency Disorders (ICCIDD) and should, therefore, be significant beneficiaries of The World Health Assembly resolution at the 43rd assembly in May of 1990 to eliminate iodine deficiency disease by the year 2000. Before implementation of this goal, however, a survey of a very significant endemia such as that described in this Uele region under study in the Congo could assess not only the impact of the disorder within the population but also what might be expected to result from successful intervention in treating this disorder.

Micronutrient repletions might not be the only thing going on in the society during the period of this observation. But some estimation can be made as to whether the disease, or its treatment by iodine repletion alone unmitigated by any other introduction of micro- or macronutrient supplementation, might be maladaptive while noting any other concurrent programs in other micronutrient enrichment, macronutrient expansion, and general development assistance. In addition to iodine repletion, raising the metabolic rate by iodine correction of hypothyroidism might be mitigated by an increase in caloric intake concomitant with iodine administration.

In some isolated societies such as a few of those represented in Central Africa, the Equatorial rain forest is an environment in which water, fuel energy and calorie-dilute food stock are adequate and accessible, yet human energy resources are relatively less well developed. This has led these cultures to subsist on what can be extracted or produced locally without a good deal of their consumption being based on tradegoods that might be brought in from elsewhere, since few exportable unique resources are available in these environments.

Extricative industry is very limited, since the forest does not recover after timbering, no pasturing or agronomy is productive because of the poverty of the soil and abundance of predators, mineral resources are absent here compared with the wealthier "Copper Belt" region elsewhere in Zaire in the Kasai Province, and fruits, rubber or other exotica have not thrived when introduction was attempted.

There are only two native substances in the environment for which a world market exists—one animal and one vegetable, extracted from the root of an indigenous tree. The first is "White Gold" the ivory from elephant poaching that has been the highest "value added" industry, and the second is "rauwolfia" the root extract formerly used to produce anti-hypertensives. The international pressures to devalue the ivory trade had resulted in increased intensity of poaching younger bulls and elephant cows to keep up with the falling prices as the herd was decimated; rauwolfia has been preempted by newer generations of synthetic anti-hypertensives and rauwolfia harvesting is now obsolete. The collapse of these two external markets has returned the population to the subsistence that has always been its mainstay, with the very rare export of the only remaining forest product, palm oil, inadequate in yield to maintain trade routes through which it can be transported.

This pattern of subsistence, particularly if marginal, has favored less complex societies that appear to be less economically developed by Western standards. This underdevelopment could result from deficiencies in natural resources or in human capital and energy resources whether internal or external to the society.

Hypothyroidism is a fundamental metabolic cause of decreased human energy utilization, and may constitute one of the chief inhibitions to development.[19] Its role in underdevelopment should be understood before applications of concurrent development programs are initiated in environments where this disorder is endemic. A motivation for understanding iodine deficiency disorders is the tragic loss of human potential for development in populations that are severely affected.

This region is in equatorial central Africa in a region subserved by an Africa Inland Mission (AIM) station based in Nyankunde. The region along the Northeast border adjoining the Central African Republic in the drainage of the Uele tributaries is at some remove from other Zairian endemias previously well described such as those near Lake Kivu on the other side of the equator.[20]

The subprefecture in which the study was carried out is among the group of Azande headed by the hereditary Chief Sasa in a part of Zandeland referred to as Sasaland. This is an area of volcanic rocky savanna adjacent to small riverine tributaries of the Uele, that are far removed from any major navigable river or road transportation. In this region, subsistence farmers engage in hunter-gatherer activities from village settlements connected by footpaths.

The Zande culture has been the subject of many studies including the classic works of Evans-Pritchard. The Azande are a Nilotic people that migrated down from the Sudan in the pre-European colonial period and subdued the population of Bantu peoples that had migrated into this region some unknown number of generations before. The Azande were considered resident throughout all historic periods.[21]

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The local Bantu are represented principally by the Basili, who had intermarried with the ruling overlords of Azande chiefdom. The original Azande conquerors set up a dynastic dominance while intermarrying with the indigenous Bantu peoples they had conquered. The royal bloodline has been successively diluted over ten generations within the hereditary rulers of the region, but the culture and language dominance of Azande has expanded under their semi-autonomous administration in contemporary Congo (ex-Zaire). The majority of the population is primarily of Bantu origin and phenotype although the royal family is still distinctive in these respects. With this mixture of genes that are predominantly Bantu and a ruling culture that is predominantly Azande, Zandeland encompasses an estimated population of two million scattered in isolated groups throughout northern Congo (ex-Zaire),[22] the Central African Republic, and the Sudan. An estimated census of the Azande in the subprefecture under the rule of chief Sasa, estimated by the chief himself, is that 40,000 subjects inhabit the region of Sasaland in which the study was carried out.

As a comparison with another population, the so-called "Pygmies" of the Ituri forest, with which this group of Azande have little contact, have also been sampled. This latter population is of different genetic and cultural background but has been resident for a prolonged period of time in a geographically contiguous environment based in similar volcanic geology and subject to the same periodic cycles of wet and dry seasons of the Equatorial rain forest.[23] Medical care was brought to these populations from the same AIM base from Nyankunde but without a population-wide medical intervention program in hypothyroidism.[24] Measurements were carried out in this distinctive group as a control. Measurements made among the Efe and Lese, collaborating hunter-gatherers and agriculturalists, respectively, in pygmy societies, included incidence of goiter (Table 2) levels of thyroid hormones T_4 and T_3 as well as TSH and urinary iodine excretion (Table 3) and correlation of goiter and fertility (Table 4).[25]

Table 1. Simplified classification of goiter assessment after the recommendations of WHO

	WHO Goiter Classification
0	No goiter
I	Palpable, not visible
II	Visible with neck extended
III	Visible with neck flexed; massive

The soil of the region under study is very poor in both organic content and several measured micronutrients. The results of the soil analysis[26] demonstrated that the selenium analysis showed less than half the minimum adult requirement, roughly equivalent to similar reports of selenium soil deficiencies in the great basin of China where selenium deficiency disease was first reported in its greatest incidence.[5] Principal among the micronutrient deficiencies are iodine, iron and selenium.[27] As is true in most equatorial ecosystems, the vast majority of organic material and the recycling of it in the structure of foodchains within the canopy takes place above ground level and depends very little on nutrient absorption from the thin volcanic rocky soil exposed to periodic cycles of inundation and desiccation.

The staple diet of this population include principally root crops, predominantly cassava. This staple, which can be stored year-round as a dried woody root, is varied with foraged forest products, peanuts and plantains and with occasional supplementation from animal fats and proteins from hunting.

Samples of the food stock brought to the local market for barter were obtained and analyzed for iodine content which was uniformly low, as was that found in the rather scarce quantities of local salt. The principal caloric intake consists of a once-a-day evening meal of pounded cassava root prepared after soaking it in a stagnant pool to soften the pulpy root. This bulk diet is rich in fiber, poor in calories and vitamins. One of the principal vitamin deficiencies is vitamin A, and when combined with the micronutrient deficiencies in iron, iodine and selenium, the total macronutrient protein-energy is of marginal adequacy. To define caloric balance as stable weight on a given protein-energy intake, an approximate calorie count was carried out on a group of adults and children estimating the proteins and caloric content of the energy-dilute foodstock, based mainly in cassava meal. This caloric survey showed some adults to be in caloric balance at around 800 to 1000 calories per daily intake, while children were suffering significant malnutrition from marginal caloric intake.

In addition to the few micronutrients supplied by the cassava, there is the problem of a toxic component as well since a goitrogen, cyanide, is present in the cassava. This does not so much cause as exacerbate the iodine deficiency from the environmental scarcity of iodine. The preparation method of cassava is important, since, particularly in the dry season, it is soaked in pits that have an increasing cyanide content over the season. Running streams that might be preferable for preparation are not always available and might cause the loss of some of the food stock if it escaped downstream during soaking. Assays of water, soil and foodstocks along with local salt (when available) have shown profound iodine deficiency, as well as an increase in cyanide content in the preparation of the cassava when soaked in stagnant pits.

Table 2. Goiter distribution among adjacent populations of Efe and Lese to compare with Azande groups

Goiter		0	Ia	Ib	II	III	Total
Efe	Female	42	2	1	1	0	46
	Male	41	1	0	0	0	42
	TOTAL	83	3	1	1	0	88
Lese	Female	68	12	8	27	10	125
	Male	69	1	1	9	3	83
	TOTAL	137	13	9	36	13	208
Others	Female	21	4	1	7	3	36
	Male	27	4	2	8	1	42
	TOTAL	48	8	3	15	4	78

From this table, goiter incidence among tribes was: Lese 34.1%; Immigrant members 38.5%; Efe 5.7%. There is significant difference between the Efe and Lese (Chi Square = 72.26, $p < 0.001$) and also between Efe and the others (Chi Square = 48.90, $p < 0.001$). There is not significant difference between the Lese and the others (Chi Square = 0.45, $p > 0.1$). Goiter incidence among women examined: Lese 45.6%; Immigrant 41.7%; Efe 8.7%

Table 3. Thyroid function tests and iodine excretion in urine in different populations of adjacent Zairian residents

Parameter	Unit of Measure	Efe	Lese	Others
T_4	µg/dl	12.1 (5.6) n= 5	11.4 (2.0) n= 16	10.3 (2.0) n= 19
T_3	ng/dl	224 (81)	179 (24)	174 (47)
TSH	mU/l	4.1 (0.8)	2.1 (1.4)	1.8 (0.7)
UIE	µg/l	40.5 (13.4) n= 2	22.8 (14.7) n= 9	33.5 (29.9) n =11
IGF-1	ng/ml	61.1 (43.0) n= 26	152.8 (65.9) n= 10	127.8 (62.4) n= 9

To be synthesized into thyroid hormone, elemental iodine must first be taken up in the body and reduced to iodide in which form it can be incorporated into thyronine, an organic biochemical reaction. This preliminary process in thyroid hormone synthesis is referred to as "organification" of elemental iodine and is necessary for thyroid hormone production. When enriched in the cassava soaking process and ingested, the cyanide is metabolized to thiocyanate in the body, a compound that blocks organification of iodine, exacerbating the relative iodine deficiency by blocking the thyroid's ability to synthesize thyroid hormone in a dose-dependent fashion. Both iodine concentration and cyanide concentration are dose-dependent in their effect, the iodine in thyroid hormone synthesis and the cyanide in the toxicity that impedes this synthesis. In fact, thiocyanate is the product used medically to block overactivity of the thyroid gland; however, dietary intake of even enriched cyanide content would not get to the levels of thiocyanate employed therapeutically for the same purpose to treat hyperthyroidism.[28]

Table 4. Goiter rates and impaired fertility in Zairian populations

	Bas Uele	Haut Uele	Ituri Forest	Nyankunde
People Examined	522 (%)	412 (%)	83 (%)	84 (%)
Primary Sterility	125 (23.9)	51 (12.4)	12 (14.5)	4 (4.8)
Secondary Sterility	150 (28.7)	27 (6.6)	2 (2.4)	14 (16.6)
Incidence of Goiter in Female Population (%)	83.3 n = 1127	73.2 n = 621	55.4 n = 195	12.5 n = 168

Cassava is a New World product, and probably arrived in this area not long before or with the Azande migration into it. Cyanide content of cassava is not unique to this root crop, but its concentration in this species is higher. Exclusive or dominant intake of this calorie source would accentuate the problem of iodine deficiency but not create it. Those who are more affluent in this society and who may depend less on cassava as a principle intake (for example, the ruling Azande families) still are not free of goiter or cretinism, and in fact, Chief Sasa himself and the ancestral portraits of the ruling chiefs before him exhibit very prominent displays of goiter.

The Chief's brother, also bearing the royal name Sasa, is of comparable age, but exhibits stunted stature, lumbar lordosis, splayed stance, clumsy gait and the other features of congenital hypothyroidism. He is deaf-mute, retarded in intelligence, capable of limmited self-care. His TSH is 718 IU/ml, T_4 0.2 and T_3 16; for comparison, those values for the author serving as a control are: TSH 3.7 (Nl: 0.5-4.0 uIU/ml), T_4 6.21 (Nl: 4.00-11.00 µg/ml), T_3 125.7 (Nl: 70.0-220.0 ng/dl).

Hypothyroidism in the Uele endemia is due to iodine deficiency. This iodine deficiency effects newborns severely in congenital cretinism and adults with acquired goiter through the compensatory mechanisms of the pituitary's TSH stimulation of the thyroid gland hypertrophy. Despite compensatory efforts the iodine deficient population remains hypothyroid, and even marginal iodine deficiency is made worse by the cyanide content in the principle staple source of calories, the cassava, which also acts as goitrogen compounding the effects of iodine deprivation.

Hypothyroidism—A Metabolic Disease

The effect of hypothyroidism is reflected differently in the adult or child, and this clinical difference will be investigated in this area of very high endemic affliction of both age groups.

In the human adult, hypothyroidism is characterized by low energy output, inactivity and subnormal metabolism. The thyroid itself undergoes compensatory hypertrophy into a goiter, an enlarged thyroid gland, sometimes enormously expanded with grotesque disfiguration of the throat and neck. The development of a goiter is a compensatory mechanism. In response to the effects of severe iodine deficiency, the pituitary gland secretes excess thyroid stimulating hormone (TSH), which partially mitigates the effects of the deficiency. Goiter may also result from other concomitant stimuli that are called goitrogens, most of which act through similar mechanisms by making what little iodine is available less so. Some goitrogens exacerbate iodine deficiency that might otherwise be compensated for by the mitigating hypertrophy of the thyroid gland.[29]

If there is a marginal iodine supply taken in from the environment, and the thyroid is unable to synthesize enough thyroid hormone from the rate-limiting deficiency in iodine. The pituitary response to this hypothyroidism may make possible enough TSH-stimulated hypertrophy in the now goitrous thyroid gland to trap and organify more of the minimally present iodine to bring the patient's thyroid hormone secretion closer toward euthyroid normal status. Goiter therefore is a compensatory response to the pituitary stimulation that mitigates hypothyroidism. Circulating thyroid hormone is brought closer to normal by means of the extra secretion of this anatomically abnormal goitrous hypertrophy. Though this compensatory goiter might approach normalcy from hypothyroidism, it never can achieve normal metabolism since to do so would quench the pituitary TSH stimulation that brought about the thyroid overgrowth. Further, the other substances referred to as goitrogens can interfere with iodine uptake and incorporation in thyroid hormone, making a relative iodine deficiency profound, despite TSH-mediated pituitary compensatory efforts. Some types of goitrogens may also directly stimulate the thyroid gland to hypertrophy.

Despite the enlarged thyroid gland, therefore, thyroid hormone production never rises to normal in these individuals who have failed in this compensatory effort, as reflected both by measure of their low thyroid hormone in circulation and the increased TSH hormone levels—both of which define hypothyroidism based on the laboratory definition of diagnostic criteria.

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Through the simple means of clinical staging of goiter development by gross observation promulgated by the World Health Organization (Table 1). Despite the goiter—the attempt on the part of the much enlarged thyroid gland to trap as much as possible of the sparse iodine that the environment can deliver—-this patient and most others in any area of severe iodine deficiency will still be hypothyroid. This is manifest by their low energy utilization in clinical estimation of hypothyroidism and the measurements that can be made in such individuals of the decreased thyroid hormone and much increased TSH. These levels reflect attempts, even if inadequate, of this compensation. Goiter, therefore, is an adult manifestation of iodine deficiency, and the hypothyroidism that is still demonstrable reflects the inadequacy of even the hypertrophied gland to overcome this environmental micronutrient insufficiency.

In children, congenital hypothyroidism has far more profound consequences for human development in the arrested or retarded development potential qualitatively described as "cretinism". Far from reaching their full potential in normal childhood development, cretins may assume the appearance of a protracted infantilism for lack of physical—-and particularly mental—-development. Cretinism and care of affected individuals imposes an additional burden on the often scarce resources of the Third World settings in which iodine deficiency, goiter and cretinism are endemic.[30]

Cretinism may take two principal forms, either through the predominant manifestation of the "neurologic cretin" or "myxedematous" form. The neurologic cretin is usually retarded, sometimes profoundly, often is deaf, with stunted stature and growth and unusual gait, station and reflex responsiveness.[31] Myxedematous cretins often express the impairment by additional manifestations of puffy edema collections and cardiac congestive failure. There may be some mixed congenital manifestations of both forms in some cretins. For reasons that are unknown, the proportion of neurologic to myxedematous cretins is quite different in different geologic locales. The vast majority of cretins in the Assa area are of the myxedematous form,

the reverse of the situation in Karawa, another region of severe hypothyroidism endemia in Zaire 1000 km distant from the region under study.[22]

Some cretins exhibit a vacant unblinking glazed affect and fail to accommodate to glabellar taps ("blinks" that a normal individual would erase in tachyphylaxis). Some have characteristic gaping open-mouthed facies with protruding tongue, splayed feet, broad-based stance, exaggerated lumbar lordosis, nape kyphosis and stunted broad digits. Characteristic cutaneous patterns on digits and palms are dermatoglyphic markers of endemic cretinism.[32] Development milestones are inappropriately delayed for chronological age as can be seen for retained primary teeth even while secondary teeth have erupted and delayed sexual maturation in which ovulation may begin sometimes after 30 years.

How Was This Study Conducted?

Measurements and Morphology Applied in Endemic Hypothyroidism

The methods of the population survey and random selection of intervention arm of the hypothyroidism study began with a population of 400 patients studied from 1984-87, expanded to 700 patients under observation from 1987-90 and carried forward from 1990 to the present, following the investigators leaving the field after 4,000 patients were treated (representing 10% of the population of the Sasaland subprefecture).

Random selection of patients first entered into the study was controlled for representative age distribution and equal representation of village and forest habitation along with balanced sex distribution.

Goiter measurement in the population surveyed is by clinical classification according to the WHO scale. Beyond the WHO classification in rapid assessment through the scheme listed in Table 1, well-practiced clinicians examined each individual patient and estimated in grams the size of the goiter present at the time of examination. Repeated assessment of 400 and more patients not only sharpened the precision of this estimation, but these same clinicians also had the benefit of the next, more accurate, goiter measurement—-the weight of the excised specimen estimated earlier—-on a gram scale after removal. This clinical estimation is combined with photography done in front and profile views against a metric grid to support the clinical estimation when confirming the serial observations.

The most ingenious of the goiter measurements to be adapted in this low technology setting of observations in field study involves goiter perimetry by tracing. A sheet of tissue paper is applied to the contours of the hyperextended neck and an outline of the palpable limits of the goiter is traced. This tracing is stored in the patient's record and is also digitized by a calibrated perimetry wheel. The images of the traced goiter are compared at intervals along with changes in the perimeter recorded, clinical estimations, and photographic evidence (Table 9).

Further measurable observations may be made of the adults and the children in an affected population that reflect iodine deficiency and hypothyroidism as well as a baseline characterization of the people in whom it occurs. Measurements obtained in the study of individuals affected include the anthropometry, height, weight, age, vital signs and neurologic determinations including reflexes and grip strength. Further determinations are made to assess goiter, both presence and size and any change over the time of the longitudinal study. Blood and urine samples are collected for

assessment of hypothyroidism in an assay of the level of thyroid hormone, TSH, as well as nutrient elements such as iodine, selenium and thiocyanate.

In addition to these morphologic measurements, serum assays were carried out on blood drawn from each of the subjects entered into the study, the blood hand-centrifuged and refrigerated by solar-powered "vaccine refrigerator" until frozen by kerosene freezer for later sample determination. These measurements included iodine, thyroid hormones (T_4 and T_3), and TSH by radioimmunoassay, serum protein, selenium, iodine and thiocyanate by chemical assay and spectrometry. Similar elemental studies were run on urine, thyroid tissue and hair samples for iron, selenium, and iodine. In some subsamples, and for other purposes, HIV antibody determinations were done by radioimmunoassay. HIV seropositivity turned out on later examination to be undetectable in samples at the earliest samplings, but in the time period covered by the study, the virus entered the population through other geopolitical circumstances of the movement of outsiders through this previously isolated area in organized ivory poaching and counter-raiding[33] with the last determined incidence approaching 2.9% seropositivity.

Each of these goiter estimates was carried out on unselected members of whole village populations covering a wide spectrum of ages. All of the village of Ebale and most of Assa and Ndamana were surveyed. Each individual was followed over time with serial measurements made quarterly on a baseline of the population survey and continuing in the intervention trial. Individuals were assigned a number on entry into the survey, that was given to them on a small wooden block worn like an amulet.

The assessment scale for populations described as marginally, significantly or profoundly affected is shown in Table 5. By these assays of blood and urine constituents, the majority of children in the population surveyed were profoundly iodine deficient.[3]

Results of Population Survey

Goiter prevalence was nearly universal. WHO Class III goiters predominated (Table 1). In one village, not one adult who was not a cretin could be found without a goiter. Most of the population experienced the goiter itself as a benign condition and accepted it as normal. Even some carved wooden figures or dolls were represented with goiters. A nearly random photograph of any group of people would reveal obvious WHO Class III goiters apparent at a distance in nearly all. The estimation by one chief headman in a village called Ebale is that the population surveyed is 95% inclusive of his village population. This high prevalence of goiter appeared evenly spread through each decade of life.

An even more tragic preliminary finding from the population survey was an incidence of cretinism as high as 11% of the population. This number reflects the prevalence, that is the number of surviving cretins, and discounts those so severely retarded as to not have survived birth or infancy. A potential bias was uncovered in the anomalously lower incidence in the village of Ebale when one of the elders from the village noted our special interest in two of the severely retarded neurologic cretins examined during the surveillance visit. This community leader said that he had been unaware of our interest in seeing all of the cretins, as well as those with goiters. Some cretins had been hidden outside of the village since they were not the "citoyens" of which the village was necessarily most proud. But when reassured that all of the population was to be included in village surveys, they understood that meant 100% of the accessible population. Once we expressed an interest in the entire population,

Table 5. Assessment of severity of iodine deficiency disorders in children

	Marginal	Significant	Profound
Urinary Iodine/ Creatinine Excretion	50	25-50	> 25
Goiter	20%	20-30%	> 30%
Serum T_4	3-8	3	very low
Serum TSH	4-6	6-10	10

a number of other cretins were presented, bringing the total up to the 10% that had been observed in other villages.

Some of the cretins were capable of limited self-care, but others were a burden on the society since they were unable to gather food or firewood or draw water. However, to the extent that they were able, they were well incorporated into the society, and if trainable for minimal duties, were considered part of the community by necessity.

Measurements of thyroid function as determined by thyroxin and TSH in serum at population baseline revealed significant hypothyroidism in all the population and profound hypothyroidism in many. Even averaging in one hyperthyroid individual encountered in a population of 50 (Table 6), the mean for the thyroxin determination (normal 4.5-12.5 μg/dl) was 3.12. Many individuals were encountered with thyroxin values of less than 1.0. Thyroid stimulating hormone levels averaged 48.36 (normal 0.3-5 uIU/ml). A group of 50 individuals in one group of compounds that consisted of a small nameless village near Ebale was sampled in its entirety, and the data from these individuals are presented in Table 6. Many individuals in this group of 50 illustrated in Table 6 had TSH levels well over 100, and in other individuals within our population survey previously unheard of levels of 1000 were encountered for TSH in profoundly hypothyroid individuals. Thyroid hormone levels found in a random selection of 11 cretins in this village demonstrate this profound hypothyroidism: TSH mean of 312.48 and T_4 mean of 0.88 (Table 7).

Intervention: Iodine Repletion, Goitrogen Reduction, and Thyroidectomy in Selected Instances

Goitrogenesis is principally due to iodine deficiency in this area. Contributing factors, such as the presence of goitrogens in the foodstock, that basically interfere with organification of iodine might make possible intervention through dietary advice. A global admonition to reduce their intake of the principal source of calories would be fatuous and cruel, since this population is in marginal caloric balance to begin with. The poor Equatorial soils of the rain forest support few grassland crops, and one of the principal advantages of cassava is the low human energy requirements for its gathering and semi-cultivation.

Even if alternate food stocks were available or introduced, and if they could be sustained in the marginal soils of the Equatorial rain forest, it would lead to the classic "chicken and egg" dilemma. To invest the higher human energy needed for a much later yield of higher calorie basic food staples would not be easy given the current marginal subsistence levels, even if such substitution were ecologically possible.

Table 6. Population survey data of 50 persons before and after intervention and follow-up reveals a baseline T_4 averaging 3.12 (with many less than 1.0) and TSH averaging 48.36 (with many above 100) before any iodine repletion efforts

	T_4 normal 4.5-12.5 μg/dl			TSH normal 0.3-5 μIU/ml		
Person	**Pre-Inj**	**1 Inject**	**2 Inject**	**Pre-Inj**	**1 Inject**	**2 Inject**
1	3.6	8.0	6.6	25.5	3.2	2.2
2	15.8	6.8	6.3	1.2	1.1	0.5
3	4.3	10.5	5.1	2.1	0.6	2.3
4	6.9	8.3	7.6	2.8	0.4	0.8
5	1.7	5.3	6.3	4.0	3.4	0.2
6	5.0	5.5	8.8	4.3	2.3	0.8
7	1.4	3.2	6.9	8.3	3.6	1.5
8	1.9	6.9	8.0	2.4	4.4	1.6
9	0.7	13.3	3.7	217.1	3.7	51.5
10	0.6	11.5	3.8	320.1	0.6	7.1
11	0.2	7.7	7.9	331.1	2.2	0.9
12	0.2	7.7	8.2	45.5	1.1	0.4
13	0.1	9.4	9.6	746.1	1.6	1.0
14	0.1	8.7	9.8	132.6	0.4	0..8
15	3.8	8.4	8.2	4.7	3.	0.9
16	1.2	6.0	7.44	20.8	3.4	4.9
17	2.6	5.3	8.9	7.7	14.9	3.5
18	1.7	4.0	10.2	7.4	5.9	0.8
19	6.2	7.3	7.1	2.7	1.0	0.7
20	0.7	2.8	9.1	159.1	54.2	1.4
21	0.4	4.3	8.0	120.6	1.7	3.2
22	3.3	3.6	6.7	10.1	4.5	3.9
23	3.7	11.4	7.9	3.8	2.0	3.9
24	1.6	6.6	2.7	7.5	1.1	3.6
25	0.6	6.0	2.7	26.2	2.6	0.5
26	5.2	4.2	4.6	3.4	2.0	7.9
27	2.8	9.3	3.3	8.0	1.4	3.5
28	3.3	5.4	2.1	2.2	1.0	1.7
29	2.7	5.6	2.0	8.9	5.1	5.1
30	2.0	2.9	8.5	3.8	2.8	0.2
31	3.1	6.1	2.9	4.0	3.5	0.8
32	1.3	8.7	5.2	15.2	5.6	1.0
33	1.4	4.1	1.3	34.4	3.7	16.1
34	1.6	9.7	8.0	3.5	1.3	3.4
35	4.5	6.8	4.2	1.4	1.3	9.5
36	3.2	5.9	6.3	4.5	1.8	1.8
37	2.8	6.3	4.0	3.8	1.3	1.9
38	3.8	1.9	4.3	1.5	1.1	8.8
39	4.4	4.9	4.9	3.0	3.8	7.4
40	1.0	4.6	4.6	32.3	1.1	5.6
41	4.5	6.0	5.5	4.1	5.5	2.5
42	0.4	7.0	4.7	55.1	17.9	2.8

Table continued on next page

Table 6. Continued

	T_4 normal 4.5-12.5 μg/dl			TSH normal 0.3-5 μIU/ml		
Person	**Pre-Inj**	**1 Inject**	**2 Inject**	**Pre-Inj**	**1 Inject**	**2 Inject**
43	3.0	6.0	5.3	0.8	1.7	5.2
44	4.9	2.8	5.3	2.1	1.1	3.0
45	5.6	7.3	8.0	1.8	1.1	0.6
46	8.7	8.1	9.5	1.9	2.6	0.6
47	2.9	8.0	6.2	3.1	1.3	4.6
48	3.3	10.2	6.3	2.2	2.5	15.0
49	5.5	4.5	5.2	2.2	0..3	3.2
50	6.0	5.7	7.4	1.4	1.4	0.8
Mean	3.12	6.61	6.14	48.36	3.91	4.21
1 SD	2.68	2.45	2.25	123.81	7.83	7.57

When the author has gone hunting with members of this population, volunteers to carry meat back from a kill are numerous. The parts most eagerly sought after are fat, often viscera, with offal preferred over lean skeletal meat. This reflects a craving for higher energy food value in animal fats. This craving for animal fats is rarely satisfied, given the marginal grazing capacity, the high incidence of trypanosomiasis, and the heavy natural predation on and by large mammals in this wilderness area. Leopards and lions make livestock husbandry impossible, besides luring the predators close in to human habitation with the easy prey as bait. Elephant and buffalo herds can destroy a whole village's collection of shambas in a single night ruining a year's effort at clearing and gardening. Hunting and gathering remain the principal sources of occasional high energy foods, and for a more predictable source of calories, palm oil is collected. Fats from animal or vegetable sources have similar

Table 7. Thyroid hormone and TSH of a population of cretins

Name - Specimen	T_4	TSH
1. Panzio	1.0	171.7
2. Ruta	0.2	248.4
3. Jamboli	0.9	216.8
4. Malingo	0.8	392.9
5. Isolongu	0.4	395.0
6. Fongosende	1.2	586.6
7. Kufuo	1.5	40.6
8. Gasikpio	1.6	133.5
9. Anibotibe	0.8	628.8
10. Ngbogbo	0.8	337.0
11. Nafuo	0.5	287.7

T_4 Normal: 4.5-12.5 μg/dl; Mean: 0.88; SD = 0.4. TSH Normal: 0.3-5 μIU/ml; Mean: 312.48; SD = 181.3

energy content, but more craving develops for animal fat because of its flavoring and as an intermittent unreliable supply of a special treat.

Most high energy foods are seasonal and do not store well for the five months of dry season so the bulk of the population continues to subsist on cassava. Despite its low energy input, it has a low energy capacity to which an adult in this environment is marginally adapted, given the hypothyroidism. Children, even *with* hypothyroidism, are macronutrient deprived as well as micronutrient deficient in iodine and have few energy reserves for enduring any intercurrent illness from the infectious agents that abound in this environment.

A high percentage of the world's food stock, in the field or in storage, is consumed by rats. In this region baboons and buffalo, as well as rats, deplete the supply of rice and peanuts but leave the cassava root in the field and in storage.

As dietary substitution is not always effective, perhaps advice on preparation of the dietary food staple would be appropriate. Rather than soaking the cassava roots in stagnant pits, encouraging preparation by soaking it in running streams would seem to dilute and diminish the cyanide content in the course of the cassava preparation. This advice is counterintuitive to the majority of the population who would be principally concerned with losing some part of their food store in running water. This counsel was called "zungu za wazungu," in Swahili for the "white man's madness," as were a number of other of nonacculturated suggestions. Even if this advice were accepted by an educable population who could understand the reason for its recommendation, it could not be generally followed. The tropics are marked by two distinct seasons—the rainy season and the dry season—and advice on soaking in running water would be impossible half the year.

If macronutrient supply is marginal and alternate preparation methods are impractical, what other methods might be employed to relieve the iodine micronutrient deficiency? In the developed world, the public health problem of iodine deficiency has been addressed by the simple, but largely effective, global response of replacing the deficient micronutrient in a ubiquitous, cheap, required nutrient. With the same rationale as adding fluoride to water or vitamin D precursors to milk for consumption by the population at risk, iodized salt was instituted over a century ago. This simple additive solution largely brought the problem of cretinism and goiter under control in the Western world, usually beginning with the high-frequency areas affected, such as the Great Lakes region of the United States or volcanic mountain regions of Europe.

Iodine supplementation through iodized salt might be delivered by commercial food production methods and transportation systems in the market mechanisms of a cash economy. But the same geographic features of mountainous and/or rain forest terrain which isolate remote areas of the globe also expose food stocks to decomposition in periodic wet and dry cycles. These would reduce iodine content even if distribution systems were available. Salt itself becomes a precious commodity under these circumstances, and if available, would be unlikely to be given to vulnerable segments of the population, particularly children who may not have yet acquired or developed a taste for this scarce and climate-sensitive condiment. Here men eat first—children last—so foods cooked with salt would likely be consumed long before the children were served. In a barter society, commodities introduced from the outside become precious and are often hoarded for exchange by the relatively wealthy. Salt and soap are *the* exchange commodities in Sasaland, which increased the value and decreased the consumption of salt, skewing its distribution to the wrong end of

the risk population distribution. Thus, even when and if it were possible to iodize, protect and deliver salt to the region, consumption patterns would mitigate against achievement of the desired outcome.

The most successful method of control of goiter and cretinism in this population turns out to be depot iodine repletion. Elemental iodine dissolved in poppyseed oil at a concentration of 480 mg per ml is already constituted in a product called Lipiodol, originally produced for lymphangiography. A depot injection of this iodized oil intramuscularly can completely replete iodine stores to eliminate iodine deficiency for a period of up to five years.[34] Compliance is not a problem, nor does one have to worry that such iodization will not be shared with infants or childbearing women since it is administered by the thyroid investigation team. Since the team was in control of the injection process, the needles and syringes were sterilized and the risk of HIV transmission was controlled by nonreusable needles that were destroyed. There were no alternative sources of readily available iodine within this population. In addition, there was essentially no traffic or commerce from outside the group since there was no transport or marketing of any goods to outside groups in a largely cash-less economy. There were no other iodine sources available for barter within the Bas-Uele region.

Results of Depot Iodine Repletion Intervention

The population survey was completed for baseline determinations. Longitudinal study was carried out through serial observations at quarterly intervals, except when moved up to one month to avoid the most difficult travel periods within the rainy season. Iodine repletion study was then begun for the treatment arm of the population under surveillance. The independent variable was the injection of 480 mg of elemental iodine in one ml of poppyseed oil in adults; children were treated with 0.5 ml, or 240 mg of iodine. Randomization was done by assignment from a book of random numbers to the serial distribution of "latte", or wooden tag amulets. The treated group was compared with an untreated control population. The measurements of goiter, thyroid function, and other morphologic measures are reported herewith.

Measurements of thyroxin and TSH in one sample population of 50 patients are seen in Table 2. In contrast with the baseline in the untreated population at time zero, similar measurements done at six months and at three years following Lipiodol injection showed a doubling of the mean thyroxin levels into normal range and a six-fold reduction in mean TSH determinations. Thus, hypothyroidism was resolved within a very short time following iodine repletion and remained in normal range for three years.

In correlation with this change in thyroid hormone measurement that normalized from hypothyroid ranges documented before treatment, changes were observed in goiter that were equally impressive (Table 9). As noted when compared from baseline control, goiter perimetry measures shrank remarkably when compared at six months following Lipiodol injection, yet increased significantly once again by the three years' determination. At three years, the goiters were still remarkably smaller than they were before treatment, but did not normalize as remarkably as the persistent improvement in thyroid hormone determination.

Additionally there was a morphologic finding of an "escape" from the early beneficial effects of iodine repletion on goiter size which was a surprise discovery. Nearly all goiters uniformly shrank in their planimetry measures, but in serial observations some appeared to escape this early control and regrowth was experienced, (see also

Table 12). An analysis of 45 such patients who exhibited this regrowth is seen in Table 8. In this subgroup of 45 patients who exhibited this goiter regrowth, it was noted that the planimetry was reduced to half of the pretreatment measurements within six months of injection. Of those studied at three years follow-up, the goiter had returned to preoperative size, a significant change in each direction.

That hormone levels remained in the normal range during regrowth of goiter shows the better compensation of thyroid hypertrophy when iodine has been repleted. In the absence of adequate iodine, pituitary TSH stimulation of goiter formation could mitigate severe hypothyroidism but could never completely compensate bringing thyroid hormone levels to normal without sufficient iodine substrate. Following Lipiodol injection, this deficiency was relatively corrected and the compensation is reflected in thyroid hormone levels holding near normal, even while goitrogenesis reflects the extra effort expended in maintaining them near normal.

Despite these morphologic markers of improvement in most of the patients, the subgroup that experienced goiter regrowth posed a new medical problem. A goiter, even a massively enlarged goiter that hangs down between the breasts in front of the manubrium, may be inconvenient and cosmetically disfiguring, but these complaints were minimized in this population. There was little functional derangement caused by an exophytic goiter. However, if such an enlarged gland shrank, retreated into the thoracic inlet, and then regrew, compromise to the airway and food passages became a real and increasing problem. As a consequence, patients were selected from the subgroup of those exhibiting intrathoracic regrowth and offered thyroidectomy for reduction of the morphologic as well as functional consequences of goiter regrowth.

Thyroidectomy for Selected Patients with Goiter Regrowth After Iodine Repletion

Carrying out a major operation in the conditions of a remote bush makeshift operating room might appear to be a formidable undertaking because of this low-technology environment. Previous reports suggested that it was possible for successful surgical therapy to be undertaken in remote settings[35] including the environment created at Assa.[36] Furthermore, the morphologic manifestation of goiter may be even more immediately life-threatening than the functional consequences in hypothyroidism if respiratory obstruction ensues.[37]

With the special challenges of tropical surgical conditions, subtotal thyroidectomy was undertaken in a select group of patients (Table 9). As it may be helpful and instructive in how an effective low-technology operating room environment may be improvised under such circumstances. Instruments and surgical sheeting were prepared in a pressure autoclave heated over a wood fire for which both firewood and water were gathered from the forest by family members. The operating room light consists of a solar panel on the thatched roof which trickle charges a storage battery wired to a used automobile headlamp. Using local and regional anesthesia in this very patient and long-suffering population, cervical block was used in the majority of patients and intubation with draw-over ether in ambient air. Inhalation anesthesia was used in some with difficult airway compromise. Rigorously adhering to surgical principles while improvising appliances as needed,[38] subtotal thyroidectomy was safely undertaken in a group of 38 patients.

Pretreatment with oral Lugol's iodine solution was used to help decrease the hypervascularity of these iodoprival glands. Patients who are profoundly iodine deficient have a very high probability of serious hemorrhage from the hypervascular

Table 8. Goiter planimetry was reduced in half for 43 patients who subsequently regrew back to original 6 at 3 years follow-up

Pre-Lipiodol	6 Months Post-Lip	36 Months Post-Lip
36 +/- 15 cm (n = 45) p .001	18 +/- 10 cm (n = 25) p .001	36 +/- 12 cm (n = 17) p .001

Not all 45 patients had reached three year followup at time data were analyzed, and ten were lost to followup.

glands and should not be operated without iodine pretreatment. Patients who are cretins are fragile in the perioperative period, and it is recommended that they be brought to euthyroid function by thyroid hormone replacement. Following iodine and hormone supplementation, the preoperative patients that have been prepared for surgery undergo subtotal thyroidectomy leaving 20 to 30 grams thyroid remnants (approximating the size of a normal thyroid) attached to an intact blood supply with care that parathyroid circulation be undisturbed and the recurrent laryngeal nerves identified and protected. Using this technique, the thyroid function was preserved with removal of up to a kilogram of redundant gland with close follow-up observation during recovery for a period of 48 hours for airway protection.

The results of thyroidectomy appeared satisfactory for most patients with surgical mortality reflecting the fragility of some of these patients. While one of the goiter patients was awaiting treatment in the absence of the surgical team, death occurred from airway collapse in this patient with a compressive goiter. A second death occurred from hyperthyroidism, made possible by iodine repletion in "Jod-Basedow's syndrome". Jod-Basedow's syndrome is hyperthyroidism acquired in a previously hypothyroid patient when iodine is "fuel added to the fire." In the hypothyroid patient with iodine deprivation, some autonomy may take over in thyroid hormone synthesis by this enlarged thyroid that allows escape from pituitary control. But, no synthesis of thyroid hormone can be achieved until iodine repletion. In a rare few patients this permits a flare of overproduction of thyroid hormone over-riding the pituitary shutdown of TSH usually seen in hyperthyroidism.

Assessing the Outcome of Intervention in Morphologic Changes

Changes in form were dramatic in many of the measurements made. Thyroid hormone levels uniformly increased and remained elevated with TSH suppressed through the longitudinal follow-up. Goiters shrank remarkably following depot iodine but regrew on later continuing measurement. Some of these patients selected underwent operation for reduction in risk of this structural compromise to their airway.

The changes in function were even more remarkable than those changes noted in form. No more dramatic change was observed in the morphology of patients with already established goiter or cretinism than one very encouraging fact very early on in the study: in comparison with the control group, there was not one cretin born in the group of women treated by iodine repletion! The control arm of this investiga-

Table 9. Subtotal thyroidectomy was carried out in 38 patients for indications and results illustrated

Indications for operation:	
Impending airway obstruction	10
Massive Lipiodol-resistant glands	21
Chronic draining sinuses	2
Patient dissatisfaction with appearance	5
Thyroid gland removal median 0.5-1 kg (largest 1.8 kg)	
Thyroid gland remnant 20-30 grams	
Deaths:	
Surgical	3
1 postoperative airway obstruction (cretin)	
1 postoperative pulmonary embolus	
1 collapse second postoperative day, cause uncertain	
Medical	2
1 suffocation	
1 thyroid storm	

Patients undergoing thyroidectomy. Thirty-eight adults, representing 50% compliance of the 76 recommended for medical pre-operative preparation with at least four days Lugol's solution (10 drops in water three times a day). Local anesthesia and cervical block (all), with Ethrane supplementation (four).

tion was immediately stopped for all women of reproducing age and was broadened for inclusion of most children approaching school age.[39]

Forty village leaders conducted a survey at ten years from the first intervention (June 1993) and unanimously reported remarkably positive changes in each of the individuals that had had iodine repletion. With respect to each individual treated, there was qualitative improvement (with the already noted exceptions of the complications of hyperthyroidism that were made possible by iodine repletion—a condition known as Jod-Basedow's syndrome—and complications due to regrowth of intrathoracic goiter or other postoperative events). Statements made by those administering the program within Sasaland were very enthusiastic. Kongonyesi, the untiring logistical assistant for the extended project, said, "Thank you for the goiter project. It heals people very much, their minds and bodies as well." Of the other health initiatives attempted within this decade and this region, it is the most successful program in terms of compliance, sustainability and behavioral changes.

The immediate effect of medical intervention in relief of hypothyroidism is dramatic in individual terms. With the rare exception of some medical complications of overactivity (as in the rare events of Jod-Basedow's syndrome) the effects of iodine repletion in nearly all individuals seem positive. Converting from the low-energy hypothyroid state to normal metabolic rate is a revolution in development potential measured in the individual patient. The individual successes within the program can be viewed in summation in smaller groups of that population before looking at the overall impact.

Neuromotor response change was measured by several functions. Table 10 demonstrates the results of testing the grip strength with the right hand (the Azande of the Congo are permitted to only be right-handed) dynamometer for a population sample (n=50). Three years following iodine repletion, the mean was 24.88 kg

Table 10. Grip strength indicators measured in treated and untreated populations

	Treated Population	Untreated Population
Number	50	17
Mean	24.88 kg	22.0 kg
Standard Deviation	18.5	14.6
Variant	4-42	2-48

Treated population is measured 3 years post-Lipiodol injection. Neuromuscular assessment as measured by hand dynamometer grip strength testing. The size of the dynamometer was adjusted to fit the individual's hand, and recorded to the nearest 0.5 kg.

(SD=18.5) A random sampling of the untreated population (n=17) shows the mean to be 22.0 kg (SD=14.6); the dynamometer was calibrated for each person tested.

Neuromotor function improvement was measurable in the forearm reflex activities: hypothyroidism is a status of depressed reflexes and subnormal response to neuromotor stimulus. The investigator's own reflex is assumed to be normal and the subject's rate of response is compared to it. Two plus is normal, one plus is delayed, and zero is profoundly retarded or absent. Three plus is brisk in rate of response and four plus is hyperactive. In a population sample of 100, 51% began at a normal response level and maintained that for 3 years following iodine repletion (Table 11). The 26% that began at a low response level increased to a normal level; there were none that remained at a low level of response. A subset of 10% responded initially at a high level, but at the 3 year marker dropped to a low level, substantiating other findings that the severe hypothyroidism treated by the 438 mg of Lipiodol does not maintain euthyroid parameters for 3 years.

Fourteen individuals of the original population treated (n=413) were hoarse prior to the iodine repletion; of these, 13 (92.8%) improved to a normal voice level within 6 months post-injection. The one woman remained hoarse until she was treated surgically—a subtotal thyroidectomy relieved her of an 830 gram goiter.

Three of the mute (but not deaf) cretins began talking within six to twelve weeks post-injection. As all three lived in distant villages (more than 35 km) they were not influenced by the research team nor did they receive increased village attention, thereby escaping the Hawthorne effect. Several began drawing and many of them used tools for the first time. The Hawthorne effect is noted when members of the studied population alter their behavior to produce the outcome thought to be desired by the researchers.

The "Downside" of the Iodine Repletion Program In Individuals and the Society—Possible Negative Consequences of Changes

There are few notable negative effects of iodine repletion when judged by morphologic criteria in the individual as well as the individual functional results.

Measurements in form and function have shown dramatic change when viewed in the individual or in subgroups. These functional changes are not limited to the

Table 11. Forearm reflex activity measured pre- and post iodine repletion

Randomized population of 100		
Pre-Treatment Reflex	**Post-Treatment Reflex**	**Number**
normal	normal	51
low	normal	26
low	low	0
normal	low	2
high	normal	9
normal	high	2
high/normal	low	10

Assessment made at 3 years post-Lipiodol treatment

experience of individual patients, however, but in iteration become more than the sum of individual improvements within the community comprised of these individuals previously suffering hypothyroidism. Some of these functional consequences may be surprising when considered collectively even if predictable when viewed individually since correction of hypothyroidism allows increased energy output and development, but also demands increased caloric input and creates remarkably increased fertility and enhanced resource consumption.

The measurements of hypothyroidism, goiter and fertility in the neighboring Efe and Lese population showed that they were similarly affected with hypothyroidism (Table 3).[25] Fertility was low in both the study population at the outset of the survey and in the Pygmy population as exhibited in the Table 4.[40] Fertility is multifactorial, with component parts being the rate of secondary infertility based in pelvic infectious disease, caloric sufficiency with adequate nutrients to accumulate a fat surplus in women sufficient to commence and sustain ovulation, and other factors such as duration of breastfeeding.[41] There is no evidence that the rate of pelvic inflammatory disease or breastfeeding practices changed during the study interval in the population under surveillance, but fertility certainly increased.

Not only did fertility increase, but maternal and infant mortality decreased, resulting in an overall increase in the population. Each of these population members were also increased consumers, since caloric intake adequate for the minimal energy output of a cretin is not adequate to sustain a person with normal thyroid status and normal metabolic demands. The caloric requirement increased by at least a third for each of the individuals treated when they were relieved of hypothyroidism, and the increased number of these enhanced consumers has meant greater demand on the environment within the study area. Food production from that which is grown or gathered was marginal at the time of the original survey and not remarkably increased despite efforts to do so following medical intervention and the notable population increase during the period of the study.

The effects of medical intervention on the society as a whole have tempered the conclusions of an overall success in terms of individual improvement following medical intervention. As dramatic as the measurements of morphologic markers in individuals, the functional consequences were no less impressive both for individu-

Table 12. Changes observed in goiter and hypothyroidism with iodine repletion by depot injection

Pre-Lipiodol	6 Months Post-Lip	36 Months Post-Lip	Lipiodol
Goiter Planimetry	36 +/- 16 cm (n = 149) p .001	19 +/- 13 cm (n = 86) p .001	30 +/- 12 cm (n = 59) p .001
T_4 Hormonogenesis (norm 4.5-12.5 μg/dl)	3.49 +/- 2.82 μg/dl (n = 96) p .001		6.59 +/- 2.53 μg/dl (n = 54) p .001

Not all 149 patients had been followed three years at data analysis, and 23 were lost to followup

als and the society composed of those affected when hypothyroidism was corrected. Energy output increased, learning ability improved, coordination and skills increased and efficiency and ambition were demonstrated in initiation of some development projects planned and initiated following this medical intervention.

However, so did energy requirements. Subsistence based on a once daily cassava staple is no longer adequate, and enriching dietary elements are sought with special hunger for animal fats. Ground nuts were in higher demand but required more energy input in cultivation and soil improvement. More of the forest surrounding the small village was slashed and burned for increased garden plots, and people walked further for food, firewood and water. Even in this region of sparsely settled scarce resources, there were scattered groups encroached upon by the expanding demands of the coalescing compounds in Sasaland.

And Sasaland is no longer small! Compounds have become villages and villages have become crowded. A letter sent by a chief informant announces in amazement: "It seems every woman is pregnant." Fertility has soared, even among cretins whose anovulatory cycles had previously limited their fertility and whose stunted stature had made vaginal delivery impossible, requiring C-section. Not only has fertility increased dramatically, but elimination of neonatal cretinism has caused the stillbirth rate to plummet. Both maternal and infant survival rates have changed dramatically from the previous era when cretins were laboring to deliver cretins, often with the loss of both.

The population has doubled within the eight years of the initiation of treatment, and the new members of this population pyramid, heavy at the base, are both quantitatively and qualitatively much better consumers.

The most readily observable change has been in the environment. What had been a series of forest clearings with scattered hut compounds have become a large confluent regional village, and there is considerable degradation of what had been a typically luxuriant tropical forest ecology. Four streams, no longer adequate, are now also polluted. Latrines had been built but are now crowded past capacity, and children, particularly, do not use them. Agricultural intensification is unlikely because of scarce poor soils on mostly volcanic rock, now denuded of much of its forest cover through slashing both for firewood and more garden space.

The dire economic circumstances of civil warfare in Zaire's general economy and its hyperinflation had little effect on the people previously since foraging for almost all their needs, they were outside the cash economy. Now, some families are sending

forth migrants to try to find whatever urban job environment for which their unskilled distant rural experience may have qualified them. The nearest city is far away with uncertain transport; the beginning point of any mechanized transit mode is several hundred kilometers away. Such transport would require cash in an unstable currency rather than barter which has been their usual economy. If they return, they may bring back deadly social diseases as one has already.[33]

Discussion

Human Ecology Dependent on Environmental Factors

Biologic adaptation to environmental factors is not a new concept in human ecology.[42-44] Trace elements, especially iodine, are well studied in their distribution in the terrestrial environment[45] and in their variation in human nutrition.[46] Soil resources may directly effect human habitation in the tropics in their organic component[47] and micronutrients.[48]

Iron and cobalt are necessary parts of human dietary intake to supply substrate for hemoglobin synthesis, and anemia can crudely influence human capacity for aerobic calorie utilization also, but less directly than the rate-limiting supply of iodine on metabolism which is finely attuned through thyroid hormone synthesis and secretion. Iodine is a necessary component of the metabolic regulator itself, and iodine deficiency has an amplified effect greater than that seen with macronutrient calorie deficiency or micronutrient deficiency such as iron, which only indirectly contributes to a normal metabolic rate.

Disease Disadvantages

It is very easy to understand how certain conditions called "diseases" adversely effect human energy utilization, often by interfering in normal regulatory processes that control energy expenditure. A classic example is fever, which entails excessively high energy consumption not typically purposefully directed and quite often injurious when uncontrolled, such as in febrile seizures in children.

This is true for many, if not most, infections and parasitic infestations; it is highly likely for degenerative diseases that are inflammatory, proliferative (such as buildup of atherosclerosis), neoplastic (almost all cancers can lead to the end of the individual's life) and degenerative diseases that lead to loss of organization and coordination (such as neurologic disorders and strokes).

Disease Conferring Advantages

Despite the counter-intuitive nature of the concept, certain diseases are seen to confer advantages on the human host, usually in reference to some particular environmental stress. If the advantage is not evident to an affected individual, it might be seen as beneficial in conveying a survival advantage to future offspring. Perhaps the most clearly elucidated of these groups of "adaptive diseases" are some forms of blood dyscrasias. These include enzyme deficiencies such as G6PD (glucose 6-phosphate dehydrogenase) and cholinesterase deficiencies.

Best described are the hemoglobinopathies[49] such as sickle cell anemia, thalassemia, Mediterranean fever, and polymorphous forms of each. These abnormalities in hemoglobin synthesis can lead to deformation of red-blood cells, anemia and circulation disorders that may be lethal diseases in and of themselves, but particularly under the additional stress of hypoxia, such as that which occurs at higher altitudes or during arrested or slowed circulation. Using the example of true sickle

cell anemia, there is no adaptive advantage of the homozygous patterns of the disease no matter where its victim lives. Sickle cell anemia is a classic unmitigated disease with enough associated morbidity that it should have been naturally selected out of the population as distinctively disadvantageous.

Genetic Predetermined Disease

But two factors coincide to conserve this disease. First is the fact that it is not a classic Mendelian dominant characteristic; it requires sickle hemoglobin inheritance from both parents for the true sickle cell disease. The heterogyzote is not severely effected by disease, and is instead characterized as having "sickle cell trait". This detectable abnormality confers a survival advantage on the person who bears it, given the second factor in the environment-—malaria. The often lethal falciparum malaria parasite cannot readily infest the red cells composed of sickle trait hybrid hemoglobin, so this heterozygous condition confers a relative resistance upon the carrier to malaria infestation. Sickle cell trait, therefore, is favored in tropical regions of high falciparum endemnicity, whereas people with the sickle cell anemia are susceptible to lethal anemia crises and people with normal hemoglobin are susceptible to a lethal form of malaria. The sickle hemoglobin is a disease conserved, therefore, because it confers adaptive advantage to coexistant falciparum malaria—-and the incidence of the two diseases can be drawn on coterminus maps.[49]

Acquired Disease

Two important distinctions are drawn in comparison with the "conserved diseases" of sickle cell hemoglobin and hypothyroidism that make them remarkably different. The hemoglobinopathies are familial and are inherited as genetic characteristics. In fact, the genetic mutation in the case of sickle hemoglobin has been defined down to a "point mutation" in a single base pair that gives rise to the synthesis of the abnormal sickle hemoglobin. Penetrance and expression of the sickle gene is high and sickle cell anemia "breeds true", with little evidence of amelioration of the disease state by other biologic adaptations. Hemoglobin status is genetically determined, does not remarkably interfere with fertility and is congenital—-a term that will be used to mean literally that one is "born with" the condition. Genetic differences that can be passed on and environmental adaptive advantage are the two kinds of ingredients evolutionary biology can work with over time to select in, or out, those genetic predeterminants that are more, or less, adaptive.

Hypothyroidism is acquired. Within an adult individual's lifetime—or, indeed, within a short period of treatment—it can be abolished—and was, within a generation of iodized salt introduction in the West, and within the period of observation in this study. Earlier, and largely discredited, suggestions[50] held that there may have been "a genetical [sic] factor in endemic goiter", but this has been disproven by several lines of evidence. First, hypothyroidism is a state of reduced fertility, with the more profound the hypothyroidism, the less able the individual to reproduce. Second, the disease is curable in the adult, and no transmission of the disorder then occurs in the offspring.

But, is not cretinism congenital? Yes, in the sense that the term's literal meaning is to be "born with" the disorder; but it is not genetic and familial. Cretinism is a disease *acquired in utero*, and such profound failure to develop may occur that cretinism may be irreversible at the time it is recognized and treated after birth. Even cretin women, if they are iodine repleted and should happen to become pregnant,

can be delivered of a neurologically, metabolically normal offspring, even if the treatment came too late in the mother's life to reverse the mental retardation experienced in her own period of *in utero* development.

An example which can be used to illustrate a nongenetic acquired abnormality in the adult that might also be present congenitally in a child is hypertrophy of the heart muscle, the myocardium. In sports medicine, athletes are seen who after a period of conditioning and training have developed myocardial hypertrophy in order to compensate for the increased demand of the work load of distance aerobic effort, such as marathon running. The same abnormality may be found in the newborn with a ventricular septal defect at birth, whose myocardium hypertrophies to accomodate the increased flow of shunted blood. In both instances of hypertrophy of the myocardium, and in the similar phenomenon of thyroid hypertrophy, some genetic traits may have rendered the individual more susceptible to the stress, but the abnormality is fundamentally an acquired one, and it can be eliminated from the somatotype by treatment without the genotype conveying this trait in the absence of similar stress.

Without a genetically determined trait that would be transmissable through unimpaired fertility, evolutionary biology lacks the two levers of natural selective advantage under circumstances of environmental stress.

Nutrient Environmental Stress

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One of the environmental stresses that has been common in nearly all parts of the world at one time or another has been caloric insufficiency. Famines have occurred from pole to equator under environmental circumstances from drought to glaciation. There is little suppportable claim that starvation induces hypothyroidism, but rather that those who have hypothyroidism are better adapted to reduced calorie intake. Iodine deficient environments have the highest incidence of hypothyroidism—-acquired, not inherited, in such a micronutrient milieu—and in such environments hypothyroid individuals could better withstand what would be for individuals with normal metabolism, macronutrient insufficiency.

As with the endocrine manifestations of diabetes, that even in the adult acquired form has a genetic predisposition, there may be a genetic predilection for goiter or for cretinism in some instances. The fetus seems to preferentially sequester more than the maternal share of iodine-—and this is evidenced by the large goiter growth during pregnancy of some women under observation in this study who delivered babies who were marginally compensated, or at least not florid cretins. Cretinism was prevented by a shifting of the scarce iodine to the fetus at a cost of a more severe adult acquired goiter; this compensation may be genetically predetermined.

This would reflect an acquired biologic adaptation to energy-resource-poor environments on the part of those individuals whose energy requirements were minimized by their depressed metabolic rates acquired by micronutrient iodine deficiency. Decreased fertility is a collective biologically acquired response that further decreases demand on caloric resources.

Coincidence, merely by chance association, is an improbable explanation for the fact that hypothyroidism is found in highest incidence in the world's calorie resource-poor regions. Coincidence is also a less satisfactory explanation that these regions of endemic hypothroidism have not developed as intensely into complex societies, taking into consideration the effect of this decrease in human energy utilization.

Biologic Adaptation

Biology is not the only human factor modifying these environments or the activities within them. Environmental biology alone[51] is not the single, or even most important, adaptive response. Beyond this acquired biologic adaptation are the inheritable variation advantages of natural selection processes of classic Darwinism,[52] and beyond that still are the social[53] and cultural.[54] Each of these other adaptive processes might require separate legitimate study and each may be more powerful than the acquired biologic adaptation. Cultural response can be employed to overcome biologic disadvantages.

Medical Intervention as Maladaptive

One such cultural response is medical intervention. But if medical intervention disturbs the metabolic adaptation through micronutrient repletion without also addressing the consequence of macronutrient sustainable repletion, it is inappropriate. A "vertical program" focused on micronutrient iodine repletion alone, whether in the confines of this population under study or in a global campaign solely for eradication of iodine deficiency, represents medical intervention that is metabolically maladaptive.

The Limits of Medical Intervention in Improved Development

The Congo (ex-Zaïrian) population under longitudinal study in Sasaland is adjacent to the Ituri population of Efe and Lese who have been resident in the region for much longer than the Azande. The Efe and Lese live in an environment of similar iodine deficiency. Yet as noted in our observations (Table 3) the goiter prevalence among the Lese was 34.1% and Efe 5.7% compared with 83% in Bas-Uele (Table 4) and nearly 100% in Sasaland. Goiters found among the Efe and Lese were of smaller size by WHO classification than the nearly uniformly large WHO III goiters in Sasaland.

Only one previous report has noted the anomalously low endemic goiter prevalence among Efe Pygmies.[24] Explanations of the difference in prevalence rates among the nomadic and village-settled Pygmy populations are presumably due to some adaptive mechanism within the Efe. As noted in Table 3, a pituitary factor is demonstrated since both TSH and insulin-like growth factor are significantly correlated with ethnic origin-—both peptides relating to metabolic rate, and each respectively correlated with goiter and growth in stature.

In the pretreatment population surveys among Azande (Table 6) hypothyroidism is noted by a mean T_4 of 3.12 μg/dl that more than doubles after iodine repletion to 6.61 μg/dl. The very elevated TSH in response to this hypothyroidism is more than 10-fold increased over normal (mean 48.36 uIU/ml) before treatment, but drops by over 1000% to a normal mean of 3.91 uIU/ml after iodine repletion among the treated Azande. By contrast, the Efe were less hypothyroid (12.1 μg/dl thyroxin) than Lese (11.4 μg/dl thyroxin); both groups had much better thyroid hormone values than the Azande. They also exhibited normal TSH values. Furthermore, they had a much lower goiter rate (Table 2) with less than 5% for Efe and 35% for Lese compared with 100% for a comparable sample population of Azande.

The measurement that might partly explain the low incidence of goiter in Efe is the higher urinary iodine, nearly twice the level of that seen in Lese. But, a very interesting datum pointed out herein (Table 3) is the highly significantly lower

insulin-like growth factor-I (IGF-I) levels among the Efe, less than half the values for either Lese or Azande. This growth factor IGF-I as well as TSH are low in Efe, and each has implications speculated upon as the reason for diminished stature among Efe.[1] It may also mean that IGF-I is a required cofactor for goitrogenesis, which Efe have less of than Lese, and both express less than Azande.[55-57] Azande, except for those who are cretins, have a height and stature comparable to other Bantu populations in Central Africa.

The Efe may have evolved a cultural means of mitigating hypothyroidism through an interdependence which furnishes a greater variety of micro- and macronutrient food resources.[58] Reliance on a monoculture, particularly one that is low in calories, profoundly deficient in iodine, iron, selenium, vitamin A and protein, and contains a goitrogen that may be further concentrated in its preparation, renders the Azande peoples within this study population vulnerable to hypothyroidism.

The Efe interdependency with Lese may give them a greater variety of food resources than the Azande experience. The lower rates of hypothyroidism and goiter observed within the Lese than the Azande demonstrate may reflect the greater variety of food resources, including enough iodine to bring their thyroid hormone levels up to nearby Efe levels (Table 3) but through the hypothyroidism-induced compensatory mechanism of goiter incidence in one-third of the Lese. The Lese may either be more dependent on cassava foodstock and its goitrogen potential than Efe, or the Efe, if they have a comparable cassava intake as Lese do, are selectively spared by the combination of low TSH and IGF-I factors for goitrogenesis.

Although each of the three populations lives in an iodine-deprived environment, only the Azande are nearly exclusively dependent on cassava with its goitrogen and the Azande demonstrate both extremely high TSH and normal IGF-I with resultant nearly uniform goitrogenesis. The Efe may lack one of the factors necessary for predictable goiter formation in the low IGF-I levels they exhibit, even if they were exposed to goitrogens and depended on a less varied source of caloric intake.

Conclusion

Changing one aspect within this ecologic adaptation—namely micronutrient iodine repletion—without modifying means to improve nutrition in macro- and other micronutrient sources constitutes a further maladaptive stress upsetting the marginal benefit of low energy utilization and requirements.

When evaluating the effect on an individual of iodine repletion in the correction of hypothyroidism, medical intervention seems to have a very obvious and overwhelmingly positive beneficial consequence with exceptions that are considered complications. When viewed from the perspective of the society of which these individuals are a part, the negative consequences of medical intervention in hypothyroidism become more prominent.

Spokespersons for the Azande population under study—-including those not involved as participants such as Chief Sasa—-are uniformly appreciative of the medical intervention program in hypothyroidism when viewing the results in individual lives. But they have expressed increasing complaints about the circumstances of their poverty, environmental degradation, crowded conditions, hunger, restlessness, not interpreted as related in any way to the hypothyroidism intervention, though coincident in onset.

In much the same way as evaluation of morphologic consequences of intervention in an iodine-deficient population can have beneficial, detrimental and surprising consequences, (e.g., goiter regrowth through some other mechanism in escape

from iodine repletion), the functional consequences in the society have been even more so, since this micronutrient deficiency is embedded in a society adapted to marginal macronutrient supply. Isolated correction of one deficiency disorder may uncover others (as already suggested with vitamin A), and create a transient maladaption if carried out in the absence of an overall development program.

A surgical intervention program for goiter reduction would not be meaningful except in the context of a medical program for the control of other disorders, and both of them combined would be more meaningful in the context of a public health program in which iodine deficiency control is one element of a more extensive program. The control of this micronutrient deficiency itself is meaningful when viewed in the context of overall development in human potential and resource utilization in the environment in which these deficiencies are encountered. Beyond measurement comes understanding of the context in which iodine deficiency disorders have been conserved, and careful intervention should include close support and observation of predictable as well as unanticipated consequences that may be encountered.

The observations of this longitudinal study in hypothyroidism, and intervention in at least one of the factors giving rise to it, lead to a conclusion that hypothyroidism itself has adaptive advantages for resource-poor environments in which micro- and macronutrients are deficient. It is in just such environments that hypothyroidism has its greatest prevalence, where low human energy utilization is compatible with survival.

The reversal of this hypothyroidism, correctable by medical intervention, has changed both individuals and the society in this remote resource-scarce environment. It is an instructive lesson in both the potential and limits of medical intervention in a complex human social problem.

It may be that hypothyroidism, though considered a disease-—and surely disadvantageous to development in individual and collective social terms-—is adaptive to resource-poor marginal environments. In this equatorial environment, the need for clothing, shelter, energy fuels, and high energy foodstuffs is all quite limited, and hypothyroidism fits in these unique circumstances. Because it is adaptive to such a marginal environment, it has been conserved, and not by coincidence does it appear in the world's poorest populations in the most marginal of habitats. It not only limits energy requirements, but also fertility and population pressures that might otherwise outstrip resources available.

The Azande peoples who were the principal subjects of this study are relatively recent arrivals in this region compared to the much longer resident Efe and Lese. They are also more severely affected by the consequences of iodine deficiency, with exposure to this deficit comparable among each of these groups in the same environment. This may reflect the better adaptation of the longer-term residents in accomodating this nutritional stress, suggesting such improved adaptation might also become possible for the Azande, even if no major change in iodine availability were to occur.

The biologic balance between energy resources available and those consumed in human activity may tilt on the fulcrum of iodine. In an environment in which caloric potential is marginal, the concomittant deficiency of this trace element, iodine, may fix a lower "set-point" in the steady state for conservation of energy balance. This biologic balance should be appreciated before a cultural intervention is initiated that might upset the adaptive features that allow this balance to be drawn. Medical care in such circumstances may be maladaptive and should be undertaken

cautiously as a component of a culture-sensitive development program to mitigate the change in this adaptive metabolic pattern.

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Diane C. Downing R.N.

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CHAPTER 30

Nutrition and Development in Africa Risk: Factors on Either Side of the Fulcrum Balance

Glenn W. Geelhoed

The hallmark evidence of malnutrition in the developing world is the tragic inadequacy of macro- and micronutrients for the energy requirements of a majority of some populations. It may be a short, brief leap in perceived economic development to obesity, the characteristic malnutrition disease of the developed world. The meta-analysis of trends in Sub-Saharan Africa published in this issue of *Nutrition* by Walker, Walker and Adam examines the rather abrupt nature of this transition in energy imbalance in the process measured as development by most economic indicators. As many diseases as follow in train behind the underlying debility of malnutrition, it is well to look ahead to the spotty nutritional over correction occurring in developing world populations to project what further illnesses are becoming more prevalent following the epidemic of noveau-obesity. The burden of illness that follows this new wave of malnutrition is much more costly in terms of health manpower and technology investments in single individual's care, as the model of any First World hospital filled with consequences of metabolic, cardiovascular, CNS and renal degenerative disorders would predict.

It is important to emphasize that "Third World" a descriptor of populations living both *within* and *outside* any political border and reflects much more coercive social, economic and cultural motives and their stigmata than is reflected by a passport. Economic transitions occur much too rapidly to have their consequences attributed to genetic change—indeed, many of the changes noted are intragenerational, and distinct from the aging process. This genetically "given" status is actually encouraging, since it suggests that the acquired abnormality may be based in learned, and unlearnable, behaviors, an epiphany which is actually empowering to medical and public health practices of prevention.

One model of coerced transition may be the tragedy of African enslavement over the centuries preceding this millennial pause for historic reflection. If Africans were taken from their home environments and cultural practices and transshipped to the new world for their labor, the few generations that have passed since this practice was stopped cannot account for the remarkable difference in the incidence of noncommunicable diseases prevalent in the new world setting and nearly unknown at their origin only an evolutionary eyeblink before. An African-American investigator has published[1] the hypothesis of why, for example, black citizens of Washington DC should have a rate of hypertension, diabetes, renal failure, stroke and certain cancers that is several times higher than that of their neighbors of nonAfrican origins, while

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such conditions were rare to nonexistent only four to six generations ago in an African setting. The harshness of the Middle Passage in the slaves/molasses/run triangle may account for this as an "evolutionary knothole" through which this unnatural selection occurred, if the tragic losses of this harsh traffic differentially favored a "stingy gene." Such a hypothetical gene or some combination that conferred metabolic characteristics that gave survival advantage though the conservation of calories, salt and water might be accountable for the new rash of metabolic disease in changed circumstances of mineral, energy, and foodstuff abundance.

The authors' evidence in their review of recent changes in urban African morbidity might be used to postulate that the whole of the Sub-Saharan population of Africa may have been strained through a similar nutritional knothole, through the less geographically discrete and historically more protracted process of high infant mortality and differential death rates from diseases when starvation is comorbid. Rather than blaming a bad deal of the genetic deck, it seems there might even be an innate protective effect, since obesity, hypertension, diabetes and stroke rates have soared, but another "big ticket" first-world plague has lagged behind: coronary heart disease, thankfully, has not kept pace, even as the other diseases bypassed the rates in Europeans in similar environments. Their warning, however, is as dire as the predicament is inevitable: although currently overshadowed and retarded by the infectious plague of HIV/AIDS, that, uncontrolled, is holding back development in much of the Third World, and is pulling some emerging economies back toward the more primitive nutritional patterns, the impending rise of the coming plague of First World-pattern cardiovascular disease will be an even more crushing burden.

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It is refreshing to read an honest appraisal of conventional wisdom—which assumes that we have, or are soon gathering, enough information to make major efforts at prevention eradicate the big killer first-world diseases as effectively as we have controlled, say, smallpox. As nebulous a risk factor as is called "life style" seems to be correlated with a number of diseases, and is well worth working on to attempt to reduce some risks. But the authors go on to state a politically unpleasant, if correct, fact: we understand very little of the majority causes of coronary heart disease and breast cancer and even such an apparently obviously preventable condition as dental caries. All around our world, the environment is changing much faster than any genetic drift could occur. Just at the time we have made an enormous investment in the human genome project, we might come to the realization that, at least with respect to nutritional balance, a lot more of our disease burden is Lamarckian than Mendelian. We need to look up from our micro-analytic preoccupations and take the long view,[2] and such meta-analytic reviews are helpful.

Other microenvironments have been examined as suggested laboratories of the often unanticipated downside of development.[3] One example that shows the economic dislocation of sudden passive wealth has lead to the world's highest adult onset diabetes, hypertension and renal failure rates within a generation of the phosphate mining exploitation of the Pacific Island of Nauru, the UN's smallest member state, for now among its wealthiest per capita, and with a population being eroded as much as the mining of the island's base is by this recently acquired morbidity.[4]

In a comparative study of populations within Mozambique over time, Maputo province had relatively good records a century ago showing essentially no evidence of hypertension and its consequences in this relatively urban province, in which now the leading noninfectious cause of death in adults are these same hypertensive consequences.[5] This might be a lesson to some of us attempting to replete certain

micronutrients, through vertical programs in rural areas such as Nyasa Province in the same country where most of these hypertension consequences are still rare. Promotion of, for example, iodized salt, is clearly intended as a means of combating iodine deficiency, but it may not be seen (perhaps because it is too obvious) that it is first of all a social marketing—of salt. In a population that has been chronically short of both, we should monitor not only the laudable reduction in goiter and cretinism as the benefits we seek, but also the changes in rates of blood pressure abnormalities and perhaps the start of other evidence of urbanization patterns of morbidity, reflected from the century earlier warning from Maputo Province and the onset of possibly preventable epidemics associated with development. Untoward consequences of medical relief and rehabilitation programs should be looked for and honestly reported, even while the laudatory objectives are so easily and rapidly reported.[6]

No one should be advocating a retro-dedevelopment, much less celebrating the health advantages of destitution from the privations attending famine, war, overpopulation pressures or economic oppression. "Development", however is usually assumed quite comprehensively (unfortunately, by many economic advisors,) summed as the iteration of the measurable data of consumption. Consumption of increasing numbers of resources in health care might be viewed as a positive marker of development (particularly by those who receive the benefit of these services—and lest it be forgotten, these nearly always include the professional providers), but the need for such services should fit on the debit scale in such a meta-analysis of nutritional development, for which focus the authors are to be congratulated.

Is it the role of healthcare personnel and health educators to point out such tradeoffs that should be mitigated in any development program? Some clearly think not[7-9] and that such "collateral damage" should be relegated, at best, to other specialists. But, it seems, at least in Southern Africa, that the very health care personnel who should be the foot soldiers of this preventive program, who are the most embedded in the culture,[10] are those most severely afflicted by these "diseases of development." A campaign in the Republic of South Africa to send public health nurses through the schools to warn against the problems of obesity and in case finding for diabetes and hypertension had to be called off, when every single one of the experienced public health nurses (thus, employed professionals) who pitched up to be sent out on the campaign was, herself, morbidly obese![11] Many of the surprised health personnel did not understand why the preventive program would be contradicted by its very emissaries. It was explained that obesity, far from a stigma, was part of the desiderata of development, like a big house or a motorcar, a mark of achievement, a presumptively apparent negative serology in the context of the dreaded "Slim," and evidence particularly for a woman, implying a man who cared for her, or at least a disposable income, invested in her overconsumption and underexertion.

Such cultural blind spots may have been prevalent in prior decades of First World overachievers, who were really only certifiable as excelling type-A executive class after their coronary bypasses. First world hospitals boasted about the superior high-technology care invested in such individual cases of preventable disease. These may be first and emerging Third World *res ipsa loquitor* cases of health professionals in transition, dazzled by the immediate economic and technologic numbers, turning blind eyes over the downside of development and the untoward consequences of "advances" in nutritional development and health care.

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CHAPTER 31

Uterine Ruptures in Rural Zaire

Ahuka Ona Longombe, K.M. Lusi and P. Nickson

Summary

Uterine rupture with its deplorable sequelae constitutes a major obstetrical problem in the rural area of Africa. The maternal and perinatal mortality remain high as a result, mainly due to the lack of early and adequate care for these patients. Multiparity of the major predisposing factors. Prevention must necessarily include the availability of family planning advice, improved organization of and access to maternal care, and good supervision during delivery and the post-partum period. The general improvement of the overall socio-economic conditions is a precondition to the improvement of access to care.

Introduction

Uterine rupture is unfortunately still a common event in African rural areas.[1-4] Its decreased incidence in the West[5] is because of the excellent supervision of pregnant women. Uterine rupture still poses a great problem in African countries. There are several reasons for this. First, prenatal care is commonly inadequate or inaccessible, with consequent failure to detect many high risk pregnancies, especially those of grande-multiparous women. Secondly, the lack of a good health infrastructure for the correct and rapid transfer of these patients makes their prognosis precarious in rural areas. Lastly, the continuously deteriorating socio-economic conditions mean that health care has now become a luxury. In this chapter we describe the problem of uterine rupture in a rural hospital in North Eastern Zaire and underline the gravity of consequent perinatal and maternal mortality.

The Study

A retrospective study was carried out at the Centre Médical Evangélique (CME), Nyankunde, in North Eastern Zaire—a referral hospital with 250 beds providing support for several other district hospitals and many health centres and health posts.

The analysis covers the period from 1 January 1980 to 31 December 1992 (13 years), and includes 76 cases of ruptured uterus necessitating surgical intervention at Nyankunde.

Results

From a total of 21,599 deliveries conducted in our maternity department (5.8 cases per year, and a mean of 1 rupture: 284 deliveries) we have had 76 cases of uterine rupture within 13 years. All of these patients were admitted as emergencies, none being booked for delivery at our hospital. Most were referred from outside the

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Table 1. Incidence of ruptured uterus

Year	Uterine Ruptures	Total of Deliveries	Annual Incidence of Ruptured Uterus
1980	3	1649	1/550
1981	3	1851	1/617
1982	4	1816	1/454
1983	1	1900	1/1900
1984	3	1955	1/652
1985	6	2027	1/338
1986	4	2192	1/548
1987	11	1918	1/174
1988	5	1327	1/265
1989	13	1244	1/96
1990	9	1323	1/147
1991	3	1246	1/415
1992	11	1151	1/105
TOTAL	76	21,599	1/284 (mean)

Health District of Nyankunde. Accordingly it is impossible to establish the actual incidence within each Health District.

The apparent increase of incidence seen over this period (Table 1) may be attributed to a deterioration of socio-economical conditions, but it is also partly due to increased professional maternity care and subsequently more frequent referrals from other health districts. Previously many more women would have died at home without the knowledge of the medical centres.

Aetiologies

Of 76 uterine ruptures, 55 (72%) were primary ruptures, and were mainly due to mechanical causes (obstructed labour). Twenty-one patients (28%) had a secondary rupture following previous uterine surgery (Caesarean section 19 cases, myomectomy two cases).

Interventions and Maternal Mortality

Of 75 patients who received surgical interventions, 42 (56%) had a repair of the uterus while 33 (44%) of the cases had a hysterectomy. One additional patient arrived dead and had only a postmortem exploration (Table 2).

The indication for a hysterectomy was rupture of the uterus which would have been difficult to repair, the occurrence of a second rupture (denoting therefore the

Table 2. Interventions and maternal mortality

Intervention	No. of Cases	Deaths
Uterine repair	42	5
Hysterectomy	33	7
Total	75	12

Table 3. The gravida of 41 of the 76 patients included in our study was as shown

Gravida	1	2-5	> 5
Case No.	3	24	14
Percentage of all ruptures	7.3	58.5	34.2
Uterine ruptures as % of all births	0.15	0.59	0.85
Frequency	1:657	1:169	1:117

fragility of the organ) or the presence of an old infection of the uterus and peritoneal cavity, with gangrene of the uterus, or an acute generalized peritonitis leading to septicaemia.

Twelve patients died (18.3%; 1:1621 deliveries); death was usually due to haemorrhagic shock and/or septicaemia. In our study we found five vesical injuries associated with a frank haematuria which needed vesical repair. Three patients had a repair of the uterus and the remaining two, a hysterectomy. None of these patients died.

Gravida

Table 3 shows that of 41 patients for whom gravida was recorded, 38 were women who had previous pregnancies. One patient was having her eleventh delivery. Only three patients were primigravidae. Of the 76 women uterine rupture, 34 (44.7%) did not have antenatal care.

Study of Weight and the Neonatal Mortality

Information was obtained on 60 infants, 48 (80%) of whom were stillborn. The weight of the infants born from the women in our study varied from 1000 to 4700 g with a mean of 3185 g.

Discussion

Uterine rupture remains a serious obstetrical problem in medical practice in rural areas in Africa. We have found an incidence of one rupture in 284 deliveries during a retrospective study carried out in our maternity department, but this includes a large number of cases referred from outside our health district. Lusanga-Nkwey et al.[4] Found in an urban area in Zaire (Kinshasa) that there was an incidence of one rupture in 2029 deliveries. Although there is an obvious increase in professional maternity care, one reason for such obstetrical problems is that in rural areas many deliveries are still done at home by untrained midwives, and transfer to hospital is often very late. A further contributing factor is the failure by midwives at health centres to recognize high risk pregnancies. However, these factors do not explain the high incidence of uterine ruptures in our area, which is between that cited by Nasah and Drouin[5] in Cameroun (1/528 deliveries) and the Nigeria incidence of 1/112 deliveries cited by Heij, Te Velde and Cairns.[6] The African incidence is higher than those encountered in developed countries[7-10] where there is only one rupture in 1500-2500 deliveries. The incidence at Nyankunde was expected to be high due to the fact that it is a referral centre covering a wide area. The vast difference in incidence between developed and developing countries is due to the early identification and monitoring of pregnancies at high risk in the industrialized countries. In Africa, as stated by Cazenave and Barnaud,[11] 60% of pregnant women are never seen in the course of pregnancy. Galloway[12] agrees with this statement: 'Even

if the law says that all deliveries must be done in a maternity of hospital, it has been found that about 60 to 80% of deliveries in Zaire are at home, done with the help of a traditional midwife'. In our own health district, probably only 20-25% are home deliveries.

From the aetiological point of view, the primary uterine rupture is that most commonly encountered (72.4% of cases in our series). The remaining ruptures originated from an already scarred uterus, of which 85.7% were old caesarean scars. A similar frequency of different types of rupture was reported by Lambillon et al.[13] In Belgian Congo and also by Vaudin et al[14] in Rwanda.

The maternal mortality is high in our study (18.3%) compared with Shreve and Russo[10] who cited between 3-11% and Nasah and Drouin[5] who recorded only 8.5% mortality in their study in Cameroun.

The perinatal mortality is also high (80%), and is greater than those put forward by Nasah and Drouin[5] and Shreve and Russo[10] which are, respectively, 58.6% and between 20-30%. The mean weight of the newborns was 3185 g, compared with 2500 g in Cameroun.[5] With the above authors we agree that, in the case of premarurity, the rupture often occurs in former caesarean scars.

Table 3 shows the influence of the woman's gravida on the occurrence of the uterine rupture. This agrees with the studies of all the authors consulted.[3,7,10] The grande-multipara is at greater risk than those in the first to fifth pregnancy.

Care remains a subject of controversy in the literature: repair or hysterectomy? Each method has its defenders: repair has been recommended by Nasah and Drouin[5] and also by Dodson[7] who suggests that hysterectomy following rupture is associated with a high morbidity and mortality. The opposite position is taken by Hibbard[9] who finds that hysterectomy is the best treatment in most cases of complete uterine rupture. We believe that the general state of the patient and the local conditions in the course of the surgical exploration must dictate the treatment. We have found that patients who had a hysterectomy had a higher mortality rate than those who had uterine repairs. Evidently, those who required hysterectomy were already at greater risk of death since their condition was already worse than those who had a repair only.

Conclusions

Uterine rupture remains an important problem in Africa. Maternal and perinatal mortalities remain high and pose particular problems to solve in difficult working conditions. Grande-multiparity appears to be the major predisposing factor.

Treatment must be dictated by the general state of the patient and also by the conditions found at the time of surgical operation.

This very serious problem would be better prevented than treated. Prevention however, depends on adequate family planning advice, prenatal care, early detection of high risks and competent maternity care and follow-up.

In situations with multiple socio-economic, and political constraints (technical, cultural, professionnel, material, accessibility, etc), a realistic system for prevention is elusive. Nevertheless, we have established the following strategies, in the hope of reducing the incidence of ruptured uteri in this and neighbouring health districts by 50% within years:

1. An experienced midwife, together with a specialist obstetrician will be invited to evaluate the midwifery care given in the hospitals and in rural health centres and to establish guidelines for the monitoring and transfer of

patients with high risk pregnancies. The use of partographs will be encouraged.

2. The Institute Panafricain de Santé Communautaire (IPASC), in collaboration with the Obstetric department of Nyankunde Hospital will conduct 6 monthly workshops for midwives responsible for rural health programmes within the Nyankunde Health Districts as well as other neighbouring districts.
3. A survey will be made of the communication system between health centres and their district hospital, and with Nyankunde through the 'Flying Doctor Service'. Necessary improvements will be made where possible.
4. Each case of ruptured uterus will be used as a case study to see where the weaknesses in the system are and how they can be avoided in the future. Particular attention will be given to constraints expressed by patients in reaching adequate medical care.
5. Family planning advice and follow-up will be combined with maternal and child health programmes, using an awareness-raising approach. Grande-multiparous women will be encouraged to deliver in hospital.
6. A prospective study will be done by nurses who have studied at IPASC of the outcome of all women with high risk pregnancies, with special reference to the time interval between the detection of a complication and the transfer of the patient to a referral centre.

We would like to anticipate that the problem of ruptured uterus will disappear in the years to come, but we cannot be confident while the constraints abound. Awareness-raising and addressing problems caused by inadequate care and poor communications should reduce the incidence of ruptured uterus in the area.

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CHAPTER 32

Vesicovaginal Fistula of Obstetrical Origin in Northeast Democratic Republic of Congo (DRC): The Experience of the CME Nyankunde

Ahuka Ona Longombe

Introduction

The Vesicovaginal fistula (VVF) of obstetrical origin remains a frequent pathology in developing countries. It is a disabling illness and generally strikes young women, often in the course of their first pregnancy. The sad condition of women with a fistula (who are often also poor and semi-literate) results in social stigma, and reminds us of the inadequacy of maternal care and the failure to detect high risk cases within the context of Primary Health Care (PHC).

In DRC, the present political and economic crisis has hit almost all of the vital sectors of national life, including the health infrastructure and has resulted in the lack of organisation of PHC activities and decrease in the purchasing power the population. Prices have risen exorbitantly with the continuous and very rapid devaluation of the currency, thus making health care unaffordable to many people. Roads are in a deplorable state and many villages are now inaccessible. A perturbation of PHC activities means that maternal and child health care, including antenatal care, have become almost non existent, while in some areas they have never existed.

Obstetric complications such as VVF, while elsewhere may be an academic problem rarely seen in practice,[2,3] are everyday occurrences in our area. Given the lack of data on this pathology in the Northeast of DRC, it was necessary to carry out a study with the following objectives:

1. To understand the extend of VVF within a specific geographical area in the North East (NE) of DRC,
2. To report on the experience of the Centre Médical Évangelique (CME) at Nyankunde, int the treatment and care of VVF.

Location

The study was carried out in the Province Orientale (the Northeast of DRC-map 1), which covers an area of 529,000 square kilometers. This region is subdivided into four Districts (Bas-Uélé, Haut-Uele, Ituri and Tshopo) which are, in turn, each divided into Rural Health Zones (47 Districts Health for the whole region).

The CME Nyankunde is a general referral hospital with 250 beds situated in the District (Sub-region) of Ituri. It ensures the supervision of 11 hospitals and more

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than 50 Health Centres throughout the Province Orientale (and into North-Kivu) within the framework of its activities organized by its Flying Doctor Services (FDS).

Methodology

A Study in North-Eastern DRC

In 1992 a study was conducted of all women who had a loss of urine per vagina following a difficult delivery, regardless of duration of the illness, and who presented for consultation during surgical visits in Province Orientale (see 'location' above). All cases of VVF of surgical origin or other pathology were excluded.

The Experience of CME Nyankunde

In addition, a retrospective study was made from 1988 to 1998, showing the experience of CME Nyankunde Hospital, with the VVFs in this hospital.

Results

A Study in the North-Eastern DRC

The VVF of obstetrical origin has been found in all the Province Oriental: Bas-Uélé (Zones: Aketi, Ango, Bili and Bondo), Haut-Uélé (Zones: Aba, Dungu and Pawa), Iture(Zones: Aru, Bunia, Mandima, Mambasa, Nyankunde and Tchomia), and Tshopo (Zones: Bafwasende and Benalia).

In total, 80 cases of VVF were seen during the surgical visits made in 1992. This number does not include patients seen within the Rural Health Zone of Nyankunde. This study does not reflect the complete picture since no systemic research has been done. It only concerns patients who came to outpatients consultations.

Of these patients 62 out of 80 (77.5%) had a fistula for more than 2 years. The longest duration was found in a women of 46 years old in Bondo Zone who had a VVF since 1962 (30 years) and who was operated on only in November 1992.

The Experience of CME Nyankunde

a. Annual frequency: From 1988 to 1998 (11 years) 96 patients were received at the CME Nyankunde hospital with the diagnosis of VVF (a frequency of 8.7 cases per year).
b. The frequency of the associated rectovaginal fistula RVF: 12 of the 96 VVF patients (12.5%) had an associated RVF.
c. Therapeutic methods used: Anatomical reconstitution by a vaginal plasty was done in 94 cases, while ureterosigmoid transplantation was done for the remaining 2 patiens.
d. Results of vaginal plasty (Table 1)

Comments

In 1992, we consulted 80 cases of VVF in certain Health Districts (Health Zones) in the region of Province Orientale (15 of 47 Health centres). This partial study does not reflect the real situation, as it concerns only patients who came for ordinary consultations without an established organisation of systematic research of VVF. If we suppose there is a minimum of 4 to 5 urogenital fistulae per year, per Health Zone, we would expect to have about 200-250 new cases of VVF occurring in Province Orientale each year. In addition to that number, there would be those who were

Table 1. Number of the operation necessary before satisfactory results were achieved

Number of Operations Necessary for Each Patient	Cases (N=94)	Percentage
1	66	70.2
2	15	16.0
3	6	6.4
4	7	7.4

In addition to the 94 cases that eventually had satisfactory healing, five had surgery which was never successful. This includes four patients who had been operated on more than 4 times.

old cases but had delayed in coming for treatment, giving a high prevalence of cases of VVF in Province Orientale. This can easily explained because of:

The lack of medical coverage.

The socio-economic crisis preventing patients in rural areas from being able to pay for medical care, and hence, hesitating to come for treatment.

The bad state of the road system which inhibits early transfer and thus increases the risk of VVF.

The lack of trained medical personnel able to cope with the problem, leaving the monopoly of treatment to those working in the university hospitals in the major cities, where few benefit from the services.

The lack of appropriate equipment to operate in adequate conditions (instruments for this kind of surgery, adjustable operating tables, a good anaesthesia, etc).

The VVF, therefore, remains a serious public health problem in the region Province Orientale. From the experience of the CME Nyankunde Hospitals, the following comments can be made:

The annual frequency of surgically treated cases in this center could considerably increase if a surgeon was trained in special surgical care needed for these patients.

12.5 percent of our patients present simultaneously with a VVF and VesicoRectovaginal Fistula.

This percentage is close to that described by Docquier[4] in Niger. This association extends the hospital stay, as the patient often requires a colostomy before the VVF is tackled.

From the therapeutic point of view, the preferred surgical technique for the repair of VVF is the anatomical reconstitution of urogenital passage. Palliative methods (uretero-sigmoid transplantation) have been used by numerous authors, notably Aziz[5] in Pakistan. We would expect that the indications for such methods would decrease with improved training and experience of those involved in case management. For example, ability to perform muscular plasty[6] would reduce the numbers of palliative operations.

Our success-rate after the first attempt of repair is low compared to other studies. This is problably due to the late arrival of our patients who subsequently require

surgery for an extended vesicovaginal fibrosis, which reduces the chances of success. The lack of trained personnel able to cope with adequate postoperative care of VVF results in complications such as the fall of the vesical probe.

The VVF constitutes a serious health problem in the NE of DRC. The care of patients with this problem is difficult because of the lack of an institution with medical and paramedical personnel able to manage the care satisfactorily. The only logical attitude is prevention, by adequate organisation of antenatal clinics, with detection and early referral of high-risk pregnancies. This would help to decrease the incidence of the VVF.

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CHAPTER 33

Ophthalmology

James Kerr and Christine A. King

Introduction

In the developed world the field of ophthalmology utilizes many high-tech therapies. The advances of modern technology enable us to correct previously disabling conditions through the use of lasers and ultrasound. These advances are of benefit to many but cannot compare with the benefits offered by patching a lazy eye or correcting myopia with glasses. In areas where people have been deprived of these services, it is the simple interventions that make the difference.

This chapter is designed to help medical professionals with little ophthalmic knowledge make the most out of whatever materials are available. This chapter describes the basic procedure for eye examination with details on how to handle patients who use different languages. Common causes of the red eye are explained and ophthalmic emergencies highlighted. Simple procedures for making glasses and eye-drops are described and equipment recommended. To conclude, the basics of eye surgery are discussed and three operations described.

Examination

Any member of the team who is familiar with these methods can perform the eye-exam. It is often helpful to train others to conduct this exam as it is easily performed and can isolate the majority of ophthalmic pathologies. As with any examination a full history will help to determine the areas on which to focus the exam. Important factors to elucidate include trauma, irritation and pain, visual impairment or loss, and the speed of onset of these symptoms.

The examination itself can be divided into: visual acuity, external examination, extraocular movement and ophthalmoscopy.

Visual Acuity

Visual acuity should be assessed initially in the right eye, then repeated for the left. The patient's hand may be used to obscure the untested eye. Care should be taken that the palm of the hand is used as patients may peep through their fingers. Glasses should be worn if they are normally used. Acuity is measured using a Snellen chart traditionally at a distance of 6 meters (20 feet). Charts are available in many languages and varying sizes (e.g., half size which should be read at 3 meters), however the most universal chart is one based on symbols not characters. One symbol that is commonly used is a "c", the break in the black circle being rotated so it is facing up, down, left or right. The perceived direction is indicated to the examiner using simple hand gestures (Fig. 1).

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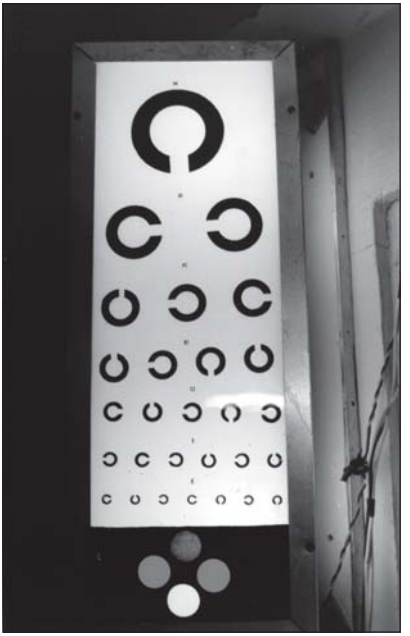


Figure 1. Symbol Snellen chart.

Snellen charts are designed so that a normal-sighted individual can read the top line at 60 meters, the next line at 36 meters, the third at 24 meters, and so on through 18, 12 and 9 meters. The final line should be readable at 6 meters. Using this method acuity is recorded as 6/60 if only the first line is described correctly and 6/6 if all lines are correct (i.e., the same as 20/20 of measured in feet). The first figure of this nomenclature denotes the standard distance from the chart (NB a half-size chart at 3 m would be recorded as a standard chart at a distance of 6 meters), the second is the last line accurately read (i.e., 60,36,24,18,12,9 or 6).

If the top line is read incorrectly at 6 meters (i.e., vision is worse than 6/60), the patient should be brought closer to the chart in stages of 1 meter. If the patient only identifies the top symbol correctly at a distance of 3 meters the correct result would be recorded as 3/60. If the vision is below 1/60 the patient should be asked to count fingers at 0.5 meters. If this also fails, try perception of hand movement. If hand movement is not recognized, close the curtains (or find a dimly-lit room) and record light perception.

If a patient has subnormal vision (i.e., less than 6/6) their vision should be checked for refractive errors (Fig. 2). To do this a card with a pinhole should be placed in front of one eye and vision should be retested. An improvement indicates that there is a refractive error that should be treated with the prescription glasses. Acuity measurement should only be perfomed by qualified personnel. For further details, see standard texts.

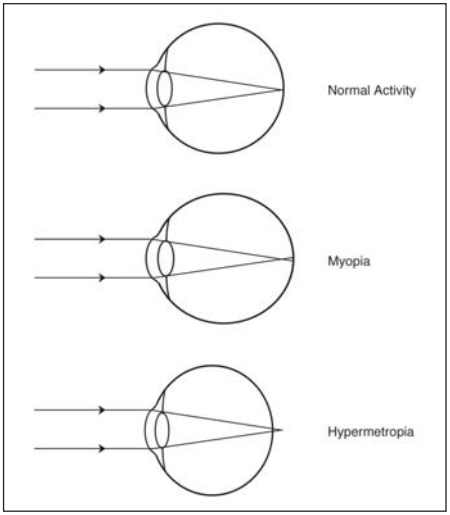


Figure 2. Refractive errors.

External Examination

The lids should be checked for symmetry, ptosis, inflammation and swelling. Conjunctivae should be inspected in good light and any inflammation or sub-conjunctival hemorrhage noted. Corneal opacity and edema should be assessed using the light from your ophthalmoscope. Corneal abrasions and ulcers can be detected using 1% fluorescein drops. The pupils should be examined for equal size and reaction to light and accommodation. Finally the lens should be inspected for any opacity (found in cataracts).

Eye Movements

The patient should be asked to focus on the tip of a pen, or similar object, and to indicate if they experience blurring or double vision (diplopia) at any time. The pen should then be moved up, down, left and right then diagonally between these positions (Fig. 3). If diplopia is experienced the site at which it is most severe should be recorded.

Squints

Testing for squints (strabismus) is conducted initially by shining a torch between the eyes. The reflection of light should be in the same position relative to the pupil in both eyes. If this is not the case, a squint is present. A cover test can also be perfomed (covering each eye alternately). A manifest squint is detected if the uncovered eye moves as the other eye is covered. A latent squint is detected if the covered eye moves when its cover is removed.

Treatment is initially aimed at correcting any refractive errors that may be present. If this fails to correct the squint, the good eye may be patched to encourage the use of the squinting eye. (NB Never patch an eye for more than 2 hours per day in a child under 7 years old.) If this also fails, referral for surgery is appropriate.

Correction of a squint is vital before 2 years of age as after this time permanent neurological changes will have taken place causing the “bad” eye to become lazy.

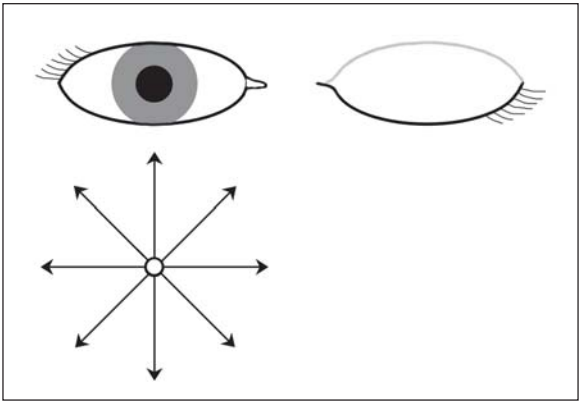


Figure 3.

Ophthalmoscopy

The eye should be examined using an ophthalmoscope to detect retinal or other intraocular pathology. Ideally this should be performed in a dimly lit room with the patient sitting comfortably.

Tonometry

Intraocular pressure can be measured using a tonometer (Fig. 4). This simple procedure is a valuable screening test for glaucoma which, untreated, may cause blindness. The patient should be positioned prone and lidocaine drops administered in both eyes. The lids should be retracted and the tonometer applied to the center of each eye in turn. The reading should be recorded in mmHg and the tonometer cleaned.

Common Calls

Chronic Glaucoma (Open-Angle)

This condition is caused by intraocular pressure that is above 21 mm Hg. Optic disc cupping with capillary closure results in nerve damagex followed by field defects. Those affected most are Afro-Caribbean, myopic or have a positive family history.

Treatment is primarily betataxolol 0.5% drops used twice daily. These are β-blockers that reduce the production of aqueous humor (use with caution in asthma and heart failure as systemic absorption occurs). The aim of treatment is to reduce intraocular pressure to 21 mm Hg or less. If this cannot be done with betataxolol, referral for surgery is indicated. Pilocarpine 0.5% drops 4x daily may be used when surgery is not possible (miosis, blurring of vision, brow ache and, rarely, retinal detachment are all recognized side effects of pilocarpine).

Choroiditis

Choroiditis causes blurred vision with a gray or white patch visible on the retina. If left to progress a choroidoretinal scar may be seen. Choroiditis may be caused by tuberculosis, toxoplasmosis and toxicara. The cause should be determined (CXR, serology, Mantoux) and the patient treated accordingly.

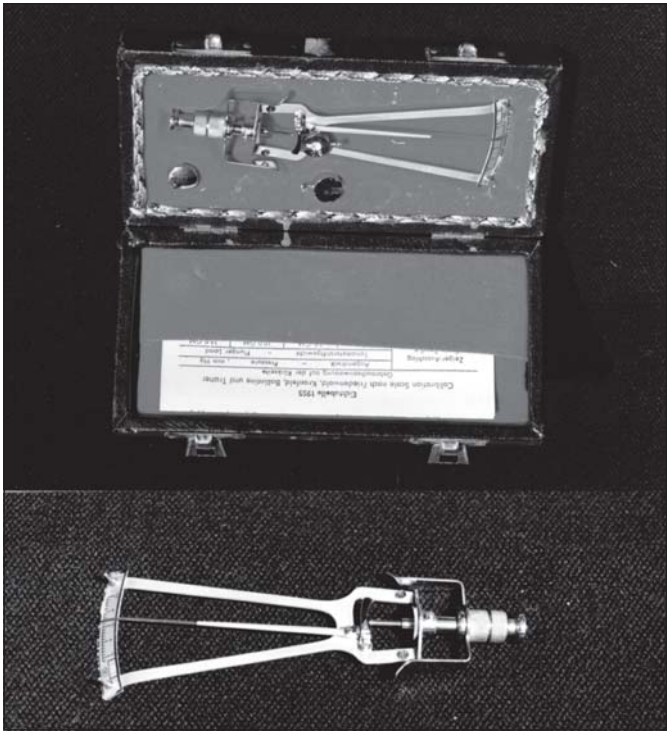


Figure 4. A tonometer.

Loss of Vision

Cataracts

Cataracts are diagnosed easily, blurred vision being the predominant symptom. Most cases will need nothing more than close monitoring. If debilitating, surgery (if available) is the treatment of choice. Blood glucose should be measure in any patient presenting with cataracts to exclude diabetes mellitus as a cause.

Temporal Arteritis

Temporal arteritis causes sudden painless loss of vision, usually accompanied by tender scalp arteries and jaw claudication. An ESR of greater than 40 is also usually seen.

Prompt corticosteroid therapy may help save the other eye. Initial doses of 40-60 mg daily should be continued until remission of disease activity when doses can be gradually reduced to 7.5-10 mg daily. Relapse is common if treatment is discontinued within three years.

Retinal Artery Occlusion

Retinal artery occlusion results in acute loss of vision with an afferent pupillary reflex defect (loss of direct response to light). Typically on ophthalmoscopy a cherry-red spot can be viewed at the macula of the retina. There is no dependable treatment, but if seen within one hour of onset applying firm pressure to the eye and releasing suddenly may dislodge an embolus.

Acute Glaucoma

This is an important cause of visual deterioration and usually presents with ocular pain (see below).

Pink-Eye

This is a common complaint, with numerous pathologies. Most cases can be treated simply and effectively. The key is to determine if they eye needs urgent attention. The most serious problems involve acute degradation of acuity, severe pain and slow or absent pupillary reflexes. These symptoms should be assessed in the presenting patient and the cornea examined.

Conjunctivitis

Conjunctivitis is predominantly bilateral and does not affect acuity or pupillary reflexes. Discharge may be present (greater amounts in bacterial conjunctivitis) and can stick the lids together. Allergic, viral and bacterial causes are common. All are usually self-limiting. Treatment of bacterial conjunctivitis is with antibiotic drops (e.g., gentamicin 0.3% every 3 hours, 0.3% ointment at night).

Iritis

The patient will complain of acute pain, blurred vision, photophobia, and redness. There may also be excessive lacrimation and a small or irregular pupil. Pain will increase when the pupils are caused to constrict by accomodation. Treatment is with steroid drops (prednisolone 0.5%, 1 drop every 2 hours) to reduce inflammation and cyclopentolate (0.5%, 1-2 drops every 6 hours) to prevent the lens adhering to the iris. Treatment should be closely monitored.

Acute Glaucoma (Closed-Angle)

Glaucoma commonly presents with an initial phase of blurred vision or halos followed by acute uniocular pain. Pain may be accompanied by nausea and vomiting in servere cases. This pain is caused by a drainage blockage in the anterior chamber of the eye, causing intraocular pressure to rise above 60 mm Hg (normally 15-20 mm Hg). The cornea will appear red and hazy; the pupil is fixed and dilated.

The treatment of choice is pilocarpine 2-4% drops hourly with acetazolamide 500 mg STAT followed by 250 mg every 8 hours. After symptoms settle the patient should be treated as for chronic glaucoma.

Manufacturing Antibiotic Eye Drops

It is cheaper, and very simple, to manufacture your own antibiotic eye drops. The drops should be prepared in multiuse containers using aseptic technique.

Most antibiotic drops can be prepared using normal IV preparations diluted with normal saline to the required concentration. These drops will remain stable for the same period as for IV solutions (see product data sheets). One solution that is prepared slightly differently is gentamicin forte. This can be produced by adding 2

ml of 40 mg/ml IV gentamicin to 5 ml bottle of commercial guttate gentamicin (3 mg/ml).

Administering Eye Drops

Valuable time and materials can be wasted while trying to administer eye drops to an uncooperative patient. A simple, yet effective method is as follows

Position the Patient Prone

Ask the Patient to Keep Their Eye Open

Administer the require drops slightly medially to the eye, on the nasal canthus. This usually prevents the blink reflex. If the patient insists on closing their eyes it is of little consequence. The drop will run into the eye as soon as it is opened.

Glasses on a Budget

A simple pair of prescription glasses can make a world of difference to individuals with poor acuity. One major factor preventing the uptake of glasses is their cost. However, it is quite possible to make a pair of prescription glasses for under $10. If facilities do not exist to grind and shape lenses, glasses of standard strengths can help to improve sight in the majority of patients. Many optometrists in the developed world collect unwanted glasses for distribution to those in need. Contacting these companies can lead to new sources of glasses for your patients. It is also beneficial to buy-back glasses from individuals who change prescription. This provides an incentive for patients to keep up to date with prescription changes and can provide a supply of cheap glasses for reuse, reducing overall costs.

Manufacturing Glasses

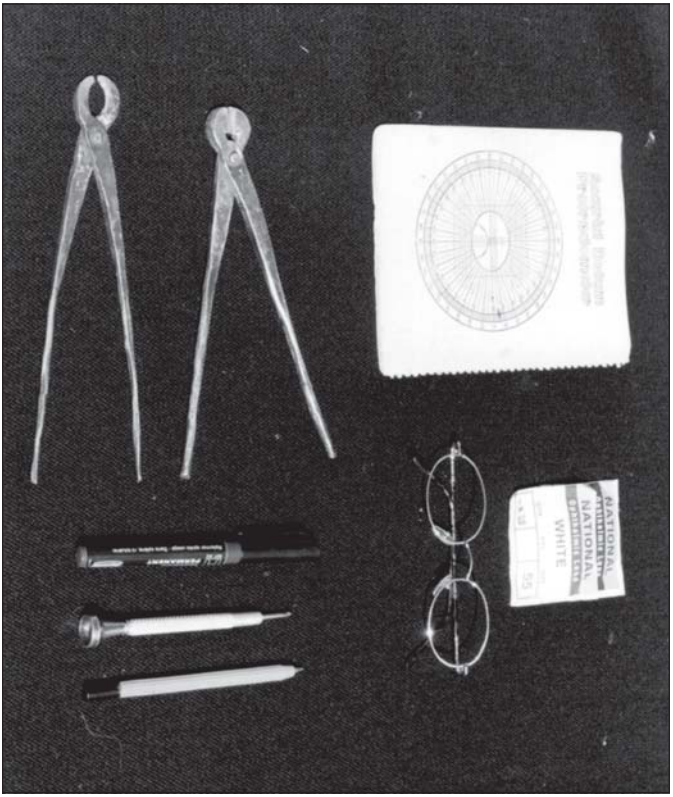
The description of glasses manufacture that follows is designed as a basic guide to making glasses with a minimum of equipment or expertise. People who are familiar with this process should modify it based on their previous experience.

Equipment (Fig. 5)
Standard glass lenses (ranging in power)
Permanent marker pen (and acetone for removal)
Axis chart
Diamond-tipped pen (for scoring glass)
Pliers
Sturdy gloves
Protective eye-ware
Glass grinder or alternative (see later)
Optical polishing cloth
Selection of frames
Small durable flat-head screwdriver

Method

Preparation

After determining the patient's prescription the correct lens (or best available, it is always best to under-correct a defect in acuity) and desired frame should be selected. Sturdy gloves and protective eye-ware should be used at all times to prevent possible injury. The right and left lens should be so marked using the permanent marker.



33 Figure 5. Equipment.

Axis Measurement

If required the axis of the lens can be determined. This can be achieved by using the exact opposite lens from your optometrist's set (i.e., if the patient's lens is +2.5, select a -2.5 lens from your set with the axis premarked). The two lenses should then be positioned and rotated until the axes align (this is when the overall effect of the two lenses is zero. A simple check is to focus on an object through both lenses then move them back and forth by approximately 5 cm. This should not distort your focus if they are correctly aligned). Once the axis is determined it should be marked as two points on either side of the lens.

Axis Examination

Position the lens on a standard axis chart. Any deviation from the standard axis (due to astigmatism) should be marked as a line across the lens (Fig. 6).

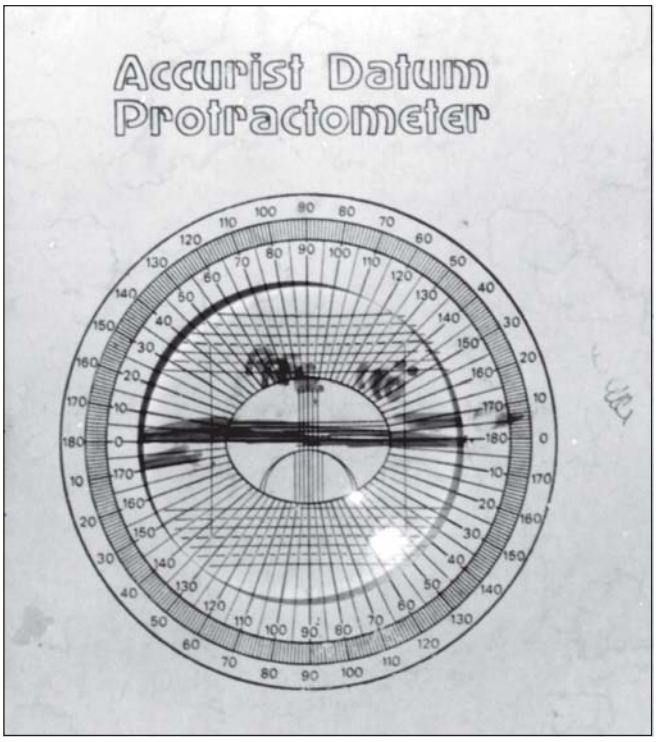


Figure 6. Axis determination.

Lens Size Approximation

Place the lens against the frame in the correct position. The marked axis line should be parallel to the horizontal axis of the frame and in the center of the vertical axis. The lens shape required can then be indicated using a permanent marker to draw around the inside of the glasses.

Cutting

The diamond-tipped pen should be used to score around the outside of the desired lens shape (Fig. 7). Once complete the pliers should be used to remove the outer portion of the lens (practice first with plain glass).

Shaping

A diamond-coated glass grinder is used for finishing the edges of the lens. Great care should be taken not to overgrind the lens. Determine the correct shape by comparing with the frame regularly. No sharp edges should be left on the lens.

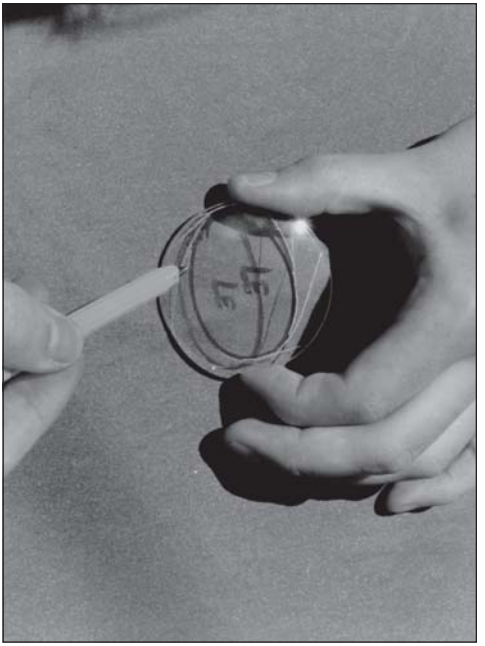


Figure 7. Cutting.

Completion

The final stage is to fix the lens in place, tighten the frame and polish the lens. This process should take approximately 30 minutes per pair of glasses.

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Other Possibilities

It is possible (although laborious) to use a manual glass grinder or diamond-coated file for shaping the lens. This will significantly decrease the set-up costs but will be extremely time-consuming if several pairs of glasses are to be made. Plastic lenses can also be used; a cheap way of cutting them is to use a hacksaw, and shaping can be accomplished using a standard file.

Eye Surgery

If you have received no special training, the operations you can safely perform on the eye are limited. The following section aims to give a basic grounding in eye surgery as well as describing some of the simpler operations when referral is not possible.

Basics

Ocular tissues are delicate, and eye surgery requires delicate instruments. Do not attempt surgery with the large instruments containing in a basic set; have an oph-

thalmic set prepared. All instruments should be sterilized in an autoclave before reuse but, for emergency sterilization, instruments may be immersed in 70% ethanol for 1 hour. Good illumination is invaluable; a bright focused beam is required and should be backed up with head-light. Fine sutures are required. It is advisable to practice using them before you are required to do so in an emergency situation. 8/0 is the smallest suture that can be practically used without a microscope. Before surgery, the patient should be treated 24 hours with antibiotic eye drops. On the day of surgery, irrigate the eye with sterile saline and mark on the patient the eye to be operated on. The lashes should be cut to minimize the risk of infection.

General anaesthesia is recommended for major intraocular surgery and for children. Otherwise regional anaesthesia, such as facial (7^{th} cranial nerve) and retrobulbar blocks, may be used.

Postoperative care for extraocular surgery consists of changing the dressing on the first day after surgery and using 1-2% tetracycline ointment for 7-14 days. Sutures should be removed after about 5-14 days. Intraocular surgery requires greater postoperative care, and patients should remain in hospital for 5 days more. Clean dressing and appropiate medication should be applied daily. Conjunctival sutures should be removed after one week, corneoscleral suture after 3 weeks.

Entropion Repair

Temporary relief from trichiasis can be gained through removal of the lashes using forceps under local anaesthesia. If the condition has progressed to entropion (where the lid margin is also inverted), surgery is required.

Procedure

The lids should be cleaned with sterile saline and the area draped. Topical anaesthetic should be applied to the eye. Local anaesthetic (lidocaine) should be injected into the lid at two points along a horizontal line midway between the lid margin and the eyebrow.

Evert the lid and grasp the tarsal surface with forceps. Incise the palpebral conjunctiva 2 mm from the lid margin. Undercut the tarsal plate on both sides of this incision, including the entire lash-baring area. Insert two 4/0 mattress sutures through the lid and the larger tarsal flap. This will pull the flap inferiorly, everting both the lashes and the lid margin. The distal tarsal flap should remain unstitched.

Cataract Extraction

Cataract extraction is primarily an operation to improve sight but may also be performed to relieve secondary glaucoma. Patients with bilateral cataracts should be operated on when their vision is less than 6/60. If the patient is blind in one eye and has a cataract in the other, surgery should be delayed until the patient has difficulty coping on his or her own. If surgery is performed before this time, there is the risk of complications leading to complete blindness.

Cataract extraction may be perfomed in small hospitals but should only be done by doctors who have received the appropriate surgical training. The following guide is designed only to help you remember the stages in such an operation. On admission the patient should receive standard preoperative care in addition to acetazolamide 250 mg orally, 8 hours and 2 hours before surgery. Intracapsular extraction is less technical and less prone to complications, and is therefore recommended.

Procedure

The patient should be sedated and anaesthetized using facial and retrobulbar blocks. Local anaesthetic drops should be applied to the eye, which should then be massaged, with the lid closed for one minute. The patient should be prepared with providone-iodine from hairline to chin and draped accordingly. The eye should then be irrigated with copious amounts of sterile saline.

Retract the lids using an eyelid speculum. If one is not available, insert two 3/0 silk suture into the upper lid, just above the lash line, and one suture in the lower lid, just below the lash line. These sutures can then be held with haemostats to provide adequate lid retraction.

Locate the conjunctiva at the edge of the cornea that is nearest the patient's supraorbital margin. Grasp with toothed forceps. Locate the superior rectus tendon and anchor with 3/0 thread. This causes the eye to rotate downwards. Incise a semi-circle in the conjunctiva at its junction with the cornea. Separate the conjunctiva, dissecting using conjunctival scissors. Make a further incision, within the margin of the first, cutting through approximately half the corneoscleral tissue. Insert an 8/0 suture crossing this incision at its midpoint.

Open the anterior chamber with a No. 11 blade and continue to extend the corneoscleral incision using corneal scissors. Have an assistant gently lift the 8/0 suture. Grasp the iris, withdraw carefully and remove a small piece with iris scissors to perform a peripheral iridectomy.

Grasp the anterior lens capsule with capsule forceps and gently extract. If the capsule ruptures, remove the nucleus and wash out with sterile saline.

Tie the prepared 8/0 suture and place at least four others at the corneoscleral incision. Reform the anterior chamber by injecting a small amount of air. The conjuctiva should be drawn to form a flap, covering the suture line. Secure the conjunctiva in place with two 8/0 sutures, one at either side of the incision margin. Remove the rectus suture. Inject gentamicin 20 mg subconjunctivally and apply tetracycline 1% eye ointment. Dress with a sterile pad. Tetracycline 1% eye ointment should be used daily for 5 days, with hydrocortisone 1% eye ointment being used in addition from day two. If treatment can be supervised, hydrocortisone ointment may be continued for 2-3 weeks. Sutures should be removed after 2-3 weeks and glasses provided.

Enucleation

Surgical removal of the eye should only be considered in patients who have a malignant intraocular tumor or a painful, completely blind eye. Eye trauma is not an indication; the damage should be repaired as best possible, and the patient referred.

In the case of the blind painful eye, an alternative to enucleating the eye is to destroy its sensory nerves. This can be achieved by giving a retrobulbar block using 1 ml of 2% lidocaine and leaving the needle in place. When the block is effective, 2 ml of >50% alcohol should be injected. The orbit will become severely edematous for 7-14 days. Chloramphenicol drops should be used 4x daily, for 7 days. This treatment is not definite, and the condition may relapse and require further injections.

Procedures

Regional anaesthesia, using a retrobulbar block (> 6 ml lidocaine) and a facial block, is possible but general anaesthesia is preferred.

Incise the conjunctiva at its junction with the cornea using fine scissors and continue until the cornea has been 'circumcised'. Lift the conjunctiva from the sclera using blunt dissection. Identify the four rectus muscles and capture them with a muscle hook. Cut each muscle leaving a small stump attached to the globe. Repeat for the obliques and free the globe from the fascial sheath using blunt dissection. Draw the globe forwards and identify the optic nerve. Pass curved forceps behind the globe and clamp the nerve. Cut between the globe and the forceps with curved scissors. Do not tie off the nerve, apply gauze and pressure until the bleeding stops. Close the fascial sheath first, using a purse-string suture, followed by the conjunctiva, using simple interrupted sutures. Wash the socket with 0.5% chloramphenicol. Apply a sterile pad and pressure bandage. Tetracycline 1% eye ointment should be used daily for 8-12 weeks.

Acknowledments

We are grateful to Dr. Laji Varghese of Lady Willingdon Hospital for his support and guidance. Many thanks go to Jasmin Devi for her expertise and assistance.

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CHAPTER 34

Accommodating Deficits in Material and Assistance

William L. Barrett, Laji Varghese and Malini Anand

Introduction

The aim of this chapter is to summarize our experience at the Lady Willingdon Mission Hospital in the Indian Himalayas where resources are scarce and pathology is abundant. Two general surgeons perform approximately 750 operations annually in this hospital, encompassing all areas of surgery apart from cardiac. In addition to regular hospital operations, surgical camps are organized four times per year in rural mountainous areas where there is otherwise no formal surgical care. Our methods may not be optimal, but experience has shown them to be safe and beneficial. Our hope is that the methods described in this chapter may provide an example of ways to conserve and recycle resources and inspire confidence to try new practices through our recommendations and experience.

Great benefit can be offered with modified methods and tricks. One must, however, responsibly and carefully weigh the potential risks and benefits when offering less than optimal care. When organizing a surgical camp, rather than setting up a separate, new facility, it may be of greater benefit to all if efforts are coordinated with local health care systems and practitioners. It is important not to undermine existing local health care systems with temporary services. Preexisting facilities should be utilized if available and modifications of traditionally accepted practices may be employed when no other reasonable alternatives exist. One must always be mindful of the Hippocratic principal, "do no harm."

Building the Surgical Team

Nothing can replace an abundance of skilled and qualified individuals. At times, however, one must make do with the few people available. With sincere motivation and proper direction most will rise to nearly any challenge.

Three Person Team

Nearly all aspects of operations can be completed with three people: a surgeon, and two operating room technicians. At the Lady Willingdon Hospital, a single technician runs the two-room operating suite. This technician maintains and sterilizes equipment and attire, selects tools for cases and organizes transport of the patient to the operating room. During the procedure one technician monitors the patient, maintains anesthesia and manually ventilates the patient if necessary, while another, scrubbed in, acts as the surgical assistant and scrub nurse. These technicians can be trained in a relatively short period of time through observation and limited formal teaching.

Surgery and Healing in the Developing World, edited by Glenn Geelhoed.

Figure 1. Surgical gloves drying in the sun.

The surgeon oversees anesthesia while operating. If additional bodies are necessary in the operating room, nearly anybody can learn quickly how to bag a patient or hold a retractor. It has been encouraging to witness the speed at which people learn these new tasks.

Anesthesia

Spinal anesthesia with xylocaine and bupivicaine and regional blocks are frequently utilized because they require minimal patient monitoring. When giving spinal anesthesia, the patient is loaded with 500 mL of intravenous fluid and an alpha-agonist vasocontrictor should be kept available for rapid administration. The surgeon can monitor the patient's airway by leaving his or her head uncovered. If general anesthesia is required, a combination is typically chosen from a selection of thiopental, ketamine, succinylcholine, ether and halothane.

Rural Camps

When setting up surgical camps in rural areas, a team of three individuals is also sufficient. A surgeon and an assistant perform the cases, while the nurse is typically in charge of equipment and acts as a circulator. In addition, a local health worker may be used for monitoring of the patient.

Methods of Coping with Deficits in Equipment

Equipment shortages can be handled by reusing everything possible. Described here are methods we have used for sterilization of equipment at the Lady Willingdon Hospital and during our surgical camps.

Gloves

After use, gloves are thoroughly washed and allowed to dry in the sun (Fig. 1). they are then soaked in a sterilizing solution and autoclaved for ten minutes. The gloves used during surgical procedures are made of relatively thick latex, similar to orthopedic gloves; thinner latex gloves do not withstand the autoclaving process. Even when thick gloves are used, it is important to inspect them for integrity following sterilization.

Gauze

Gauze can also be resterilized and reused. It is washed, bleached, refolded and then autoclaved. If it is too shabby to use as a gauze sponge it can be used for other purposes. For example, it can be transformed into a wad by tying it into a ball, and

Figure 2. A wooden armboard.

then be used to apply betadine during the prep, or to wash the patient at the end of the procedure.

Instruments

Although not recommended by authoritative sources, in our experience there have been no known problems from boiling instruments for twenty minutes when an autoclave is not available. This option may be important during surgical camps. Because of the slight risk of HIV and hepatitis resistance to boiling, careful judgement will be necessary to balance the risks and benefits of this practice—especially in areas where HIV and hepatitis infections are common.

Armboards

An armboard is easily fashioned out of a four foot length of 1 inch x 4 inch wood (Fig. 2). This can be positioned under the patient's bedding material and the arms of the patient anchored with rubber tubing.

Drapes

Plastic, rather than cloth, sheets are used as drapes at surgical camps. These can be cleaned and dried quickly and then boiled for ten minutes. In the presence of an autoclave, newspaper can be sterilized in an autoclave.

Gowning

A reusable plastic apron and sterile surgical sleeves may be used instead of traditional OR scrubs (Fig. 3). These can be cleaned more quickly than a full surgical gown, minimizing surgical down time.

Battery-Powered Headlights

When reliable lights are not available, battery-powered sports headlights provide an adjunct or alternative (Fig. 4). Some feature halogen bulbs and can be focused to provide a narrow of wide beam of light. In areas where power outages are common, wearing a headlight as a backup is a good idea. Petzl and Princeton Tec make good headlights that cost between $20 and $60. In our experience the Petzl Zoom has proven itself to provide a strong, versatile, long-lasting beam.

Figure 3. A surgeon wearing the plastic gown and sterile sleeves used in the surgical camps.

Foot-Powered Suction

Foot-powered vacuum devices work well when electric suction is not available and provide good backup when power fails (Fig. 5). If possible, it's a good idea to have two on hand in case a large amount of suction is required.

Surgical Technique

Careful, rapid surgical technique and minimal tissue manipulation reduce the chance of wound infections. Speedy operations also decrease fluid resuscitation needs. Additionally, rapid technique allows for procedures, including laparotomy, to be done under spinal anesthesia. Instrument ties are nearly always employed to conserve valuable suture material.

Figure 4. A surgeon wearing a battery-powered sports headlight.

Figure 5. A foot-powered suction device.

Fishing Line for Skin Closure

Standard six-pound test nylon fishing line can replace 3-0 nylon or prolene suture material (Fig. 6). It is cut into usable lengths and autoclaved. Prior to use, it is threaded twice through a free curved cutting needle. This material is used to close the skin and can also be reliably used to close fascia in abdominal closure or herniorraphy.

Cotton Thread to Replace Silk Suture

Standard cotton sewing thread can be used in place of silk. It has been used for the serosal closure in two layer bowel anastamoses and has also been used for skin closure. Sterility is achieved through autoclaving.

A Note on Laparoscopy

Laparoscopy is used occasionally, but in our experience the benefits of this technique have not been found to outweigh the associated difficulties and risks in our patient population. Our patients do not request laparoscopy and do not place much importance on minimizing the size of scars at incision sites. In addition, the

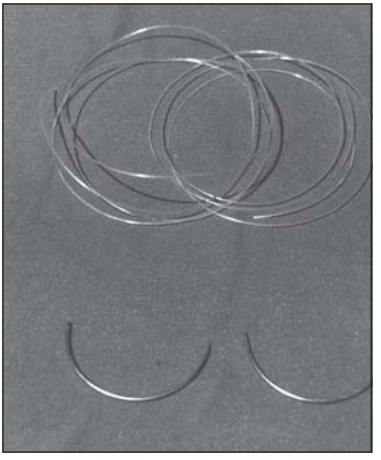


Figure 6. Sterilized six-pound-test nylon fishing line used for skin closure.

Figure 7. A clamp holding a standard straight razor blade used for harvesting skin grafts.

complex, costly maintenance and use of the equipment has been limiting: small or large system malfunctions delay procedures making simple operation more difficult, reliable technical assistance has not always been available, and fogging of the lens during cold winter months has been a problem. These factors have swayed us away from regular use of this technology.

Tricks

With the unavailability of advanced medical technology and equipment, more basic equipment and materials can be manipulated for use as substitutes. Described here are some common substitute procedures and materials that have been successfully utilized at the Lady Willingdon Hospital.

Skin Grafts

In place of using a dermatome, skin grafts are harvested with a straight razor blade held with a standard clamp (Fig. 7). The graft is harvested by holding the blade at a 10-15 degree angle and sliding forward with a sawing motion.

Closed Suction Drain

To improvise a closed suction drain, two holes can be cut into the side of a small feeding tube and attached to a length of IV tubing (Fig. 8). This is then attached to an IV bottle to create a vacuum using suction applied through a needle that is then removed.

Intraosseous Needles

A 16 or 18-gauge spinal needle can be cut obliquely 1 inch from the hub to make an Intraosseous needle. This can be used during fluid resuscitation of a baby or small child.

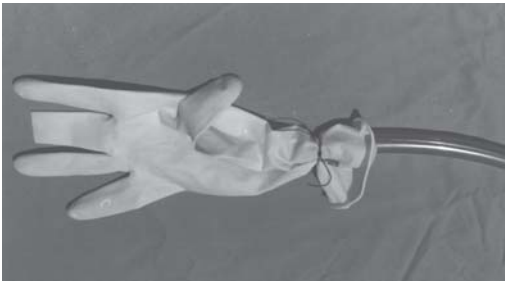


Figure 8. Picture of close suctioned drain apparatus. A rubber glove used as a Heimlich valve on a chest tube.

Heimlich Valve

The tip of a finger can be removed from a rubber glove to act as a one-way Heimlich valve after attaching to a chest tube (Fig. 8). The chest tube can then be allowed to hang at the patient's side. If the finger (valve) is staying open on its own, it may be dampened to make it stick shut.

Foreign Body Removal

Removal of foreign bodies may be performed using a variety of commonly available medical supplies and some creativity. For example, a coin in the esophagus has been removed by passing a Foley catheter beyond the coin, inflating the balloon and then slowly withdrawing the catheter. In addition, a ureteral stone removal spiral basket has been used to remove bronchial foreign bodies form children. The configuration of the basket allows ventilation while the basket is in the airway.

Fluid Resuscitation of Baby

If desperate to establish intravenous access and no Intraosseous needles are available, a baby can be turned and held upside down, fluid infused into its rectum and the buttocks taped shut. After 30-60 minutes, veins should be visible and a standard IV can be started.

Versatile Tool

A Leatherman, or similar multi-tool, can be very useful in the surgical camps (Fig. 9). The Leatherman Wave has proven itself to come in handy on numerous occasions. Most multi-tools have saws and files that can be useful during orthopedic procedures. Having one sterile and available is prudent if instruments are short.

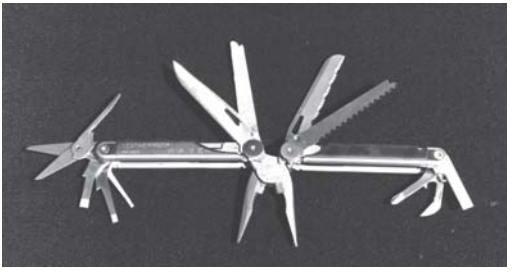


Figure 9. A Leatherman Wave multi-tool used during surgical procedures.

Figure 10. A hand under the sterile drape holding a retractor.

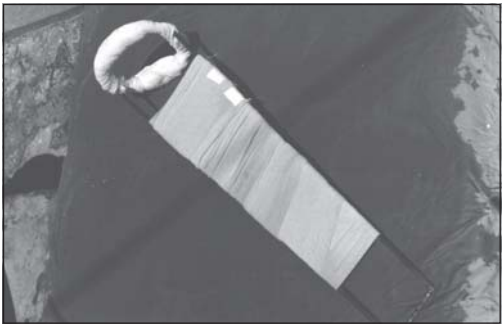


Figure 11. A Thomas splint made with a custom welded metal frame.

Extra Hands

When a retractor needs to be held but an extra hand in not available, the person monitoring the patient can place his hand under the drape and hold a retractor without placing his hand on the sterile field (Fig. 11). This is especially useful to retract the right costal margin cephalad during gallbladder surgery.

Thomas Splint

For femoral fractures, a Thomas splint can be fashioned with a wood or welded metal frame. Rope can be attached to the leg with an ace bandage and adhesive tape. It is important to apply equal pressure around the leg to prevent excessive compression in one place.

A Note on Sutures

Most basic procedures can be completed with the following sutures: 3-0 silk, 0 and 2-0 catgut, 2-0 and 3-0 vicryl and six-pound-test fishing line. We regularly perform laparotomy, cholescystectomy, herniorraphy, ureteral stone removal, Cesarean section and hysterectomy using only these suture materials at the surgical camps. It is important to have free needles with eyelets also available.

Results

Below is a table of the last 500 operations performed at the Lady Willingdon main hospital and surgical camps utilizing the methods described in this chapter (Table 1). The table shows that a vast array of surgical cases can be performed with

Table 1. The last 500 cases performed at the Lady Willingdon Hospital and LWH-run surgical camps

Procedure	Number of Cases Performed
General Surgery Cases	
Cholecystectomy	77
Exploratory laparotomy	28
Appendectomy	22
Herniorraphy/hydrocele	20
Procedure on (P.O.) stomach	12
Hydatid cystectomy	10
P.O. common bile duct	7
P.O. colon	7
Mastectomy	4
Splenectomy	2
Other	7
Total	**196**
Obstetric and Gynecology Cases	
Cesarean section	62
Hysterectomy	50
P.O. fallopian tubes	15
Oophrectomy	8
Other	7
Total	**142**
Urology Cases	
Operation for stone	24
Orchiectomy/pexy	9
Prostatectomy	8
Nephrectomy	6
P.O. bladder	5
Hypospadias repair	5
Other	8
Total	**65**
Orthopedic Cases	
ORIF	14
Debridement	12
Amputation	4
Hardware removal	3
Osteotomy	2
Other	11
Total	**46**

Table continued on next page

modified techniques. It also may serve as a guide for what cases a general surgeon can be expected to perform in a typical community.

Conclusion

Modern surgical practice has adopted numerous rituals and dependence on advanced technology and abundant resources. While ideal in a modern, well-funded setting, this type of surgical practice is often impractical or impossible in other set-

Table 1. Continued

Procedure	Number of Cases Performed
Head and Neck Cases	
Tonsillectomy	14
Mandiblular fixation	5
Thyroidectomy	3
Submandibular gland excision	2
Thyroglossal duct removal	1
Parotidectomy	1
Other	2
Total	**28**
Plastics, Thoracic and Neurosurgery	
STSG	7
Cleft lip/palate	6
Release of contracture	4
Resection of rib	2
Burr hole	1
Elevate skull	1
Other	2
Total	**23**
Total number of procedures	**500**

tings. In this chapter, we have proposed a method of delivering surgical care that is less labor- and resource- intensive, yet still provides excellent outcomes. Through exploring and utilizing this alternative, we can make surgical care more widely available, reaching even those who do not have access to well-established hospitals.

It goes without saying that running surgical camps or setting up new permanent surgical facilities in rural areas present significant challenges that should not be overlooked. Among these are assuring a sterile operating environment, spending time to train "helpers" if they are not part of the surgical team, and thinking about access to follow-up care should postoperative complications occur. The risks and benefits of providing care to a patient in a less than ideal setting should be weighed carefully. However, our experience at the Lady Willingdon Hospital has taught us that given thorough thought, planning, and creativity, surgical practice in areas of limited resources can be very successful in providing care to those who otherwise would receive none at all.

CHAPTER 35

Abscesses and Other Infections Treated by Surgery

Robert J. W. Blanchard

Introduction

Infections and infectious diseases remain among humanities greatest enemies. The burden of disease due to infections is enormous and does not exempt people of any age nor socio-economic stratum. While many in the developed parts of our world suffer greatly and lives continue to be lost due to infections, the burden is much greater among people living in less-privileged parts of the world.

Antibiotics have not altered the need for surgical treatment in many of the most debilitating and lethal infections. The approach to surgically treated illnesses in wealthy and developed societies has changed dramatically in the past two decades propelled by advances in organ imaging and minimally invasive techniques. However, most members of our human race live in regions where the new technologies and techniques are unaffordable and will remain unaffordable for years if not decades. This sad fact does not mean that infections requiring surgical care can not be treated in the underprivileged regions. It also does not mean that new and untried techniques are required. What is necessary is to apply the old and proven techniques and approaches for application where costly equipment and scarce expertise do not permit the more advanced approaches.

Unfortunately, effective application of the tried and true affordable measures is hampered by three factors:

- Many recent surgical trainees in developed countries have little opportunity to observe and practice the (old) purely operative techniques;
- Surgical training in less-developed countries is often based on curricula and techniques derived from developed countries;
- Trainees tend to learn surgery in their countries' tertiary centers where advanced techniques are used so the trainees may not be exposed to the more common situations in District Hospitals where advanced technologies do not exist.
- In this Chapter we briefly describe some of the important or common infections which require surgical treatment, and present some approaches to the diagnosis and treatment which can be carried out in most district hospitals.

Definitions

Infections requiring surgical care include nearly every kind of abscess as well as spreading infections causing tissue necrosis or life-threatening toxemia. The latter

Surgery and Healing in the Developing World, edited by Glenn Geelhoed.

type of infection includes necrotizing fasciitis, cellulitis, gas gangrene and peritonitis.

An abscess is a localized collection of pus surrounded by acute, and sometimes chronic, inflammation. A superficial abscess presents as a new painful swelling which is tender, red, and hotter than adjacent skin. (tumor, dolor, rubor, and calor). Most abscesses are treated by surgical incision and drainage. The trick is to make the diagnosis and to provide the best possible drainage with the least tissue destruction. Necrotizing fasciitis is bacterial infection destroying deep connective tissues as it produces toxins and anaerobic conditions facilitating the spread of the causative organisms. Cellulitis is a similar infection involving fat and subcutaneous connective tissue. Gas gangrene involves skeletal muscles. It is caused mainly by Clostridium perfringens which induces ischemic and anaerobic conditions suitable to this organism. The organism elaborates lethal systemic toxins. Managing cellulitis and necrotizing fasciitis may require extensive tissue ablation and therefor great tissue loss. Gas gangrene usually requires amputation or extensive muscle excision. Because the battle is to save life, the horrible cost is worth the prize.

Burden of Disease

All surgical infections which occur in developed lands also occur in the tropics. However, some infections which are relatively common in tropical regions are quite unusual in the northern hemisphere. One example is pyomyositis, a large abscess in the muscle layers usually of a limb. Tuberculous abscesses are common world-wide and becoming more common in North America associated with the resurgence of tuberculosis related to AIDS. Amebic liver abscesses are relatively common in Africa, Asia and South America.

Differences in Management

Modern "hi-tech" systems permit percutaneous drainage of deep abscesses using local anesthesia and small tubes. The procedure is guided by computerized tomography or ultrasonography. While this is less traumatic for the patient than open drainage, it is not always successful and resort to open drainage is still sometimes required. The diagnosis of all but superficial abscesses and cellulitis without the help of modern imaging can be difficult and tentative. In such situations, the suspicious site needs to be explored surgically. This requires judgment, careful clinical examination and observation. The process benefits from experience and careful surgical technique. After all, the old approaches have been widely successful and we still resort to them when all else fails. While modern invasive radiology has revolutionized the treatment of deep abscesses, especially of the abdominal cavity and retroperitoneum, it has been less successful in the thorax and in some superficial sites.

Operations to drain abscesses may often be performed under careful local anesthesia, using tetracaine or similar anesthetic. We devised a small rack to hold inverted bottles of anesthetic so that the surgeon can access the anesthetic on his own thereby relieving the nurse for other tasks after she has wiped the stoppers of all the vials with antiseptic (Fig. 1).

Figure 1. Wall rack for vials of local anesthetics.

Body Regions and Surgically Treated Infections

Head and Neck

Nodal Infections

These conditions are more common in children than in adults. A primary site should be sought especially in the tonsils, teeth, and skin of the head, face and neck. Management of infected cervical lymph nodes depends on whether the nodes have developed abscesses or not. If not, antibiotic treatment is indicated. If the nodes have formed an abscess, surgical drainage is necessary. Signs of acute abscessed bacterial adenitis include the usual four signs but these may be present without abscess formation. Careful examination should be made for *fluctuance*. Fluctuance is detected by palpation with the fingers of both hands gently pressing on the swelling to determine a site of shifting softness in the overall zone of induration. Treatment then involves infiltrating local anesthetic into the skin overlying the region or regions of fluctuance and performing incision and drainage of the abscessed node or nodes. Be careful to avoid being squirted by pus under high pressure: wear glasses and keep your mouth closed. The incision need not be very large and a cruciate incision is not necessary unless the cavity admits more than the tip of the little finger. Keep in mind that a superficial neck abscess may communicate with a deep subfascial abscess (collar-button abscess) in which case the deeper component should be evacuated by careful dilatation of the communicating tract using a Kelly forceps. A soft drain should be inserted into the deeper cavity for several days. Attempts should not be made to excise abscessed cervical nodes.

Tuberculous Cervical Adenitis

Tuberculous cervical adenitis (old term: "scrofula") should be distinguished from non-specific cervical adenitis as the treatment is different. Usually, there are signs of pulmonary tuberculosis to help make the diagnosis. Most tuberculous abscesses are "cold", i.e., they do not manifest heat, redness nor tenderness. These latter signs occur when the tuberculous nodes become secondarily infected by pyogenic bacteria. For tuberculous adenitis, the treatment is appropriate antituberculous chemo-

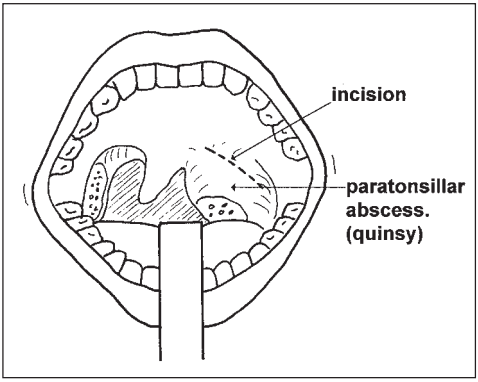


Figure 2. Paratonsillar abscess (quinsy).

therapy. The infection and swelling will gradually subside. If the nodes are large, painful and fluctuant, drainage by a large-bore needle is helpful. Open drainage should be avoided as it is not necessary and leads to secondary infection. If incision is made for open drainage and typical caseating or thin opalescent fluid contents are found, the fascia and skin should be closed after evacuation of the abscess contents to prevent secondary infection. If secondary infection has already occurred, pack the abscess open. If the tuberculous adenitis has already drained spontaneously, the sinus tracts may be enlarged surgically to provide more efficient drainage since secondary infection will have already occurred.

Boils

Boils on the head and neck are potentially more dangerous than elsewhere, especially those located in the central part of the face because of possible deep infection of the paranasal sinuses and pyogenic thrombosis of the saggital sinus. Boils are treated by incision and drainage after local or topical anesthesia. For large or recurrent boils, a cruciate incision is beneficial.

Carbuncles

A carbuncle is a local group of boils forming sinuses and gradual necrosis of overlying skin. They are more common in people with diabetes mellitus and where there is poor hygiene. Diabetes mellitus must be ruled out or treated urgently. Antibiotics, usually penicillin, are indicated especially in diabetic patients. If the carbuncle is enlarging or becomes fluctuant, incise and drain it under local anesthetic removing any necrotic skin or subcutaneous detritus. A carbuncle on the face requires urgent surgical debridement if it fails to respond quickly to penicillin because of the risk of deep spread and possible cavernous sinus thrombosis.

Paratonsillar Abscess (Quinsy) (Fig. 2)

Since the discovery of penicillin, this entity has become much less where there is ready access to medical care. However, in many parts of the world it remains a very common problem. Diagnosis is made for a patient who complains of pain in the throat and one side of the neck and has difficulty talking and swallowing if there is a distinct swelling in the anterior or posterior fauces on the same side. Treatment for

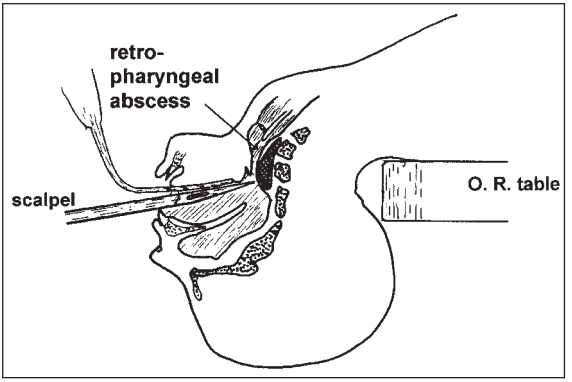


Figure 3. Head-down position to drain paratonsillar or pharyngeal abscesses in a child.

adults and older children is drainage under local anesthesia with the patient sitting. For small children, Ketamine or general anesthesia may be required. If the abscess is large, consider positioning the child with the head hanging upside-down over the end of the operating table to prevent the child from inhaling pus (Fig. 3). The same approach can be made for drainage of retropharyngeal abscesses. In all cases, Yankauer suction must be ready to aspirate the pus.

Dental

Caries and periodontal abscesses are common in poor societies Teeth destroyed by caries should be extracted unless a dentist is available who may be able to provide a better solution. Periodontal abscesses can be drained by inserting a probe along the tooth into the abscess. A persistent mandibular or mental sinuses should prompt examination of the teeth. Usually there will be a severely carious tooth above the sinus (Fig. 4A, B). When the tooth has been extracted, the sinus will close. Repeated curretting of the sinus will not solve the problem until the tooth is extracted.

Parotitis

Acute bacterial parotitis presents as a hot, tender, painful mass in front of the ear. Usually there is obstruction of the salivary duct and pus and redness may be seen at the duct opening in the cheek adjacent to the second upper molar tooth. Penicillin,

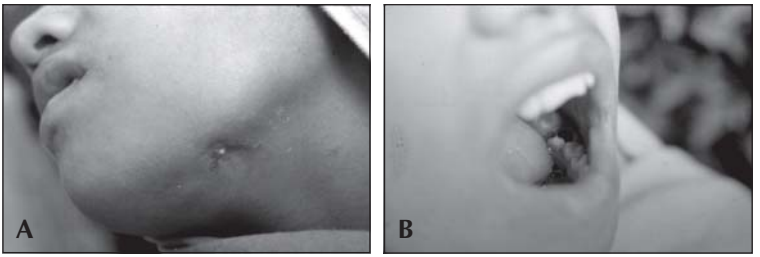


Figure 4. A) Chronic mandibular sinus; B) Carious tooth causing the mandibular sinus.

Figure 5. Ludwig's angina.

1 million units q4h I-V, should be started and chewing gum used to stimulate salivation. If these fail to bring improvement in 48 hours, multiple incisions through the capsule of the parotid gland should be made to drain abscesses. Fluctuance may not be present due to the tough parotid capsule. Surgeons not familiar with parotid surgery should refer such cases to a surgeon who is experienced, if possible, because of the risk of damage to the facial nerve. If referral is not possible, incise the skin vertically just anterior to the ear and extend well down over the mandible. The parotid capsule is incised transversely in line with the nerve branches and a hemostat inserted and opened to allow drainage of pus if present. This should be done in several sites over the gland and the wound packed open.

Deep Cervical Abscess and Ludwig's Angina

Often caused by abscessed teeth (Ludwig's angina) or lymph nodes, deep cervical abscesses may become large enough to obstruct breathing. Drainage is by incision with a scalpel and insertion of a Kelly forceps to open a drainage tract (Fig. 5). A soft drain is inserted if the cavity is large.

Mastoiditis

Mastoiditis is now rare in developed countries but continues to be relatively common in poorer societies where treatment of middle ear infections is late or not available. Differentiating acute or chronic mastoiditis from post-auricular node infection or from a furuncle in the external canal can be difficult. In mastoiditis, there is often hearing loss and pulling on the ear may not be painful as it is in acute otitis. In chronic mastoiditis, there is often a cholesteatoma in the external canal. This is a stinky white mass of desquamated epithelium protruding from the antrum through the perforated ear drum. If the infection has perforated the cranial cortex producing a subperiosteal abscess, the abscess can be drained using local anesthetic. Complete clearance of the mastoid air cells of pus and debris requires experience as there is danger of perforating the dura or the sigmoid sinus or damaging the facial nerve.

Scalp

The scalp is remarkably resistant to infection. However, boils, carbuncles, and ulcers may occur as well as infected wounds. These may require drainage or debridement which can usually be performed using local anesthetic.

Skin and Subcutaneous

Skin infections are often related to trauma. Boils and carbuncles (see above) may occur in any part of the body.

Cellulitis

Cellulitis affecting the subcutaneous fat and connective tissues presents as a discrete region of redness, increased tension (induration), tenderness and heat. There is no fluctuance and the area involved is larger than with most abscesses. Various bacteria may cause cellulitis but Staphylococcus aureus and Streptococcal species are most common. The patient may be obviously ill with high fever. To rule out an abscess, and to obtain fluid for Gram's stain or culture, a needle on a syringe may be inserted into the area and aspiration attempted. If no pus is found, treat as cellulitis. Even a tiny amount of fluid or tissue obtained should be examined for bacteria and ideally for antibiotic sensitivity. Penicillin is the drug of first choice in most settings.

Anthrax

Anthrax affects especially people handling livestock. It appears as a discrete ulcer with a dark, almost black center and surrounding vesicles. Treatment requires excision of the lesion and skin-grafting if the area is large.

Nodal Infections

Nodal infections occur in the main node-bearing regions, the axillae, neck and groins but may occur in other regions. Diagnosis is as for other superficial abscesses and treatment is incision and drainage, usually using local anesthetic and taking care to avoid other structures in the region such as the axillary or femoral vessels and nerves.

Fasciitis

Fasciitis is a deeper infection involving the deep fascia and connective tissues. It is often related to infection in some other adjacent structure. Treatment requires incision of the skin and fat overlying the infected tissues and debridement of all necrotic tissues, leaving the wounds open with a sterile pack. Several incisions may be required and overlying dead skin and fat should also be removed.

Tetanus

Tetanus occurs when the spores of Clostridium tetani bacteria gain entrance into the soft tissues. The organism proliferates in an anaerobic environment such as deep puncture wounds or dead tissue. The organism produces a toxin, tetanospasmin, which fixes to central nervous system neurons causing intense tetanic spasms of skeletal muscles in response to afferent stimuli such as light, noise and movement. The spasms are extremely painful and exhausting, sometimes inhibiting breathing to the point of anoxia. The classic sardonic "smile" or grimace is diagnostic (Fig. 6). Treatment[1] begins with stabilizing the patient and protecting the airway. The patient should be protected in a quiet, dark environment. Urgent surgical care is the debridement of all devitalized tissues in any wound or wounds. Give 3000-6000 units of human antitoxin, if available, by intramuscular injection. Metronidazole 500mg q8h should be given orally or intravenously. Narcotics help relieve pain and benzodiazepines reduce the frequency of spasms. Suction and tracheotomy instruments must be readily available in case of need. Death may occur from severe spasms or over-sedation.

[1] Tetanus: pathophysiology and management. Ernst ME, Klepser ME, Fouts M et al. Ann Pharmacother 1997 Dec. 31;1507-13.

Figure 6. Sardonic smile of tetanus.

Gas Gangrene

This deadly infection, caused by the obligate anaerobe Clostridium perfringens, causes a rapidly progressive necrosis of muscle tissue and release of toxins. The only hope for cure is immediate complete excision of all involved muscles, often requiring amputation of limbs.

Pyomyositis

Pyomyositis is bacterial infection with abscess-formation in one or more muscles, especially the larger muscles. It is uncommon in wealthy communities and relatively common in poor tropical countries. Signs include swelling, pain, tenderness and redness over the muscle(s) with fever and loss of function. Usually the bacteria are sensitive to penicillin. Treatment involves intra-venous penicillin or cloxacillin followed by wide incision and drainage, packing the wound open or inserting large drains. If the patient does not recover following this treatment and becomes more septic, examine for undrained abscesses and change to clindamycin plus gentamicin, if available, or chloramphenicol.

Osteomyelitis

Osteomyelitis is far more common in poorer than in affluent communities. Early diagnosis and immediate treatment are the ideal but this is seldom achieved in most parts of the world. Thus, many patients present with chronic osteomyelitis manifested by sequestra and sinuses and they face long-term or permanent disability. Therefore early diagnosis and treatment are imperative. Diagnosis of osteomyelitis usually starts with a sick child who is limping or unable to use the affected limb. There may not be redness in the earliest and most treatable stage. However, there is tenderness and usually swelling over the affected part of the bone. Any child with a fever and a painful limb should be suspected of suffering from osteomyelitis and urgent diagnostic drilling of the bone should be done. Treatment of early osteomyelitis is early exposure and drilling of the cortex in several sites with a 2mm drill bit (Fig. 7). Only this will reveal the early infection by pus extruding from one or more drill sites. Children under age one often have an associated septic arthritis which must also be drained. At any age, osteomyelitis of the upper end of the femur tends to be associated with pus in the hip joint which needs to be drained. If osteomyelitis is confirmed, the wound is packed open and antibiotics started. As soon as a culture is obtained, start cloxacillin or oral chloramphenicol and, if necessary, change to a more appropriate antibiotic based on the culture sensitivities. Antibiotics should be

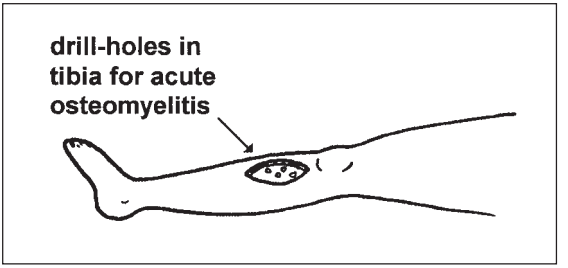


Figure 7. Drilling cortex of bone to diagnose and drain acute osteomyelitis.

continued for 3 weeks or longer if pus continues to drain. Management of later stages of osteomyelitis requires experience in exploring and unroofing the sequestrum within the encasing involucrum (Figs. 8A, B).

Breast

Acute Breast Abscess

Breast abscesses appear in two typical manners: acute abscesses, which usually occur during lactation, and more chronic or recurrent abscesses. During lactation, a cracked nipple may lead to breast infection usually due to Staphylococcus. If detected within a day or two, antibiotics and breast pumping may clear the infection.

Figure 8A. Chronic osteomyelitis with involucrum encasing dead sequestrum.

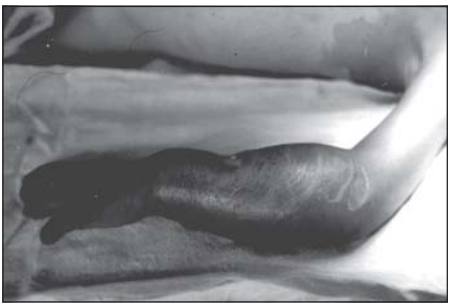


Figure 8B. Chronic sinus and swelling in the same little girl.

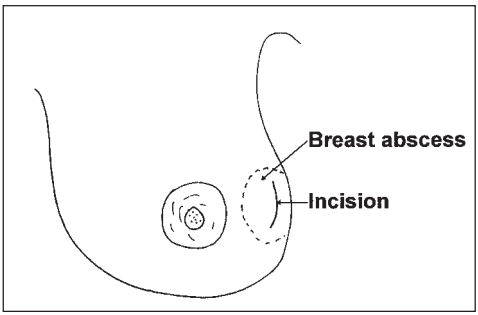


Figure 9. Breast abscess incision.

However, if there is no improvement within 48 hours, the inflamed area should be incised and any pus drained in order to avoid destruction of glandular tissue. Do not wait for fluctuance in the breast before incising the tender mass (Figs. 9 and 10). Inflammatory breast carcinoma may mimic breast infection but fever and throbbing pain are not present with cancer. Needle biopsy is indicated if inflammatory breast cancer is suspected.

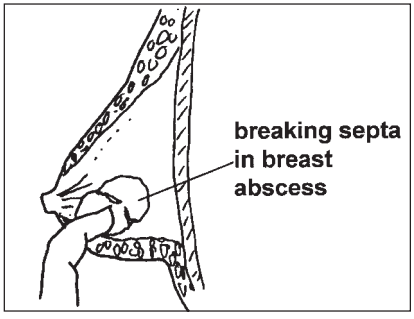
Subacute and Recurrent Breast Abscess

Breast abscesses not associated with lactation may be due to duct ectasia and periductal mastitis. Abscesses related to these conditions tend to be located in the periareolar regions. A sinus may develop at the margin of the areola and the nipple is often inverted. The condition tends to relapse even after incision and drainage until the affected ductal tissue is removed. This is done by inserting a probe into the sinus and out the duct at the nipple. An ellipse of skin is removed along with the underlying sinus and infected ductal tissue (Fig. 11).

Axillary Abscess

Axillary abscesses usually begin in lymph nodes. Sometimes the abscess lies deep to the pectoralis major muscle. The incision is best made vertically parallel to and one centimeter lateral to the edge of the pectoralis major muscle. Blunt dissection is used to approach the abscess staying medial to the axillary vessels.

Figure 10. Breaking septa to open loculi in breast abscess.



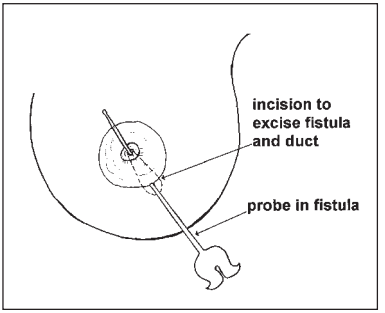


Figure 11. Excision of chronic breast sinus and infected duct.

Hand

Hand infections may cause disastrous disability if they are not adequately and quickly treated.

Fingers

Infections under and around the fingernail may require excision of part or all of the nail. Infections in the pulp space (felon or whitlow) should be drained with lateral incisions and not through the palmar surface of the finger-tip to avoid tender scars in the sensitive surface of the finger. The incision should be in the dorsal half of the finger to avoid the digital nerve and should avoid contact with the bone (Fig. 12). An abscesses in the tendon sheath of a finger is called "tenosynovitis". It produces severe swelling of the finger. The finger is in a semi-flexed position and cannot be flexed or extended without severe pain (Fig. 13). There is tenderness at the base of the finger in the palm. Incisions to drain tendon sheath abscesses should be made on each side of the finger between the joints at the ends of the finger creases (Fig. 13).

Deep Hand Abscesses

Most hand abscesses occur in the superficial or deep palmar spaces which surround the tendons in the hand (Fig. 14). The first manifestation of palmar abscess may be swelling on the dorsum of the hand. When the back of hand swells in a painful hand, consider the likelihood of palmar space infection. Incisions to drain

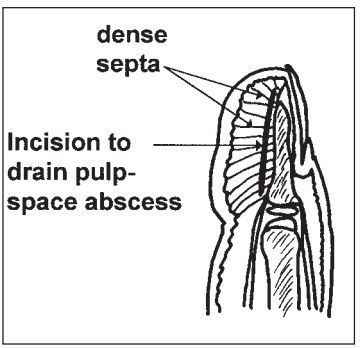


Figure 12. Incision for draining pulp-space abscess (felon).

Figure 13. Tenosynovitis and incisions to drain tenosynovitis.

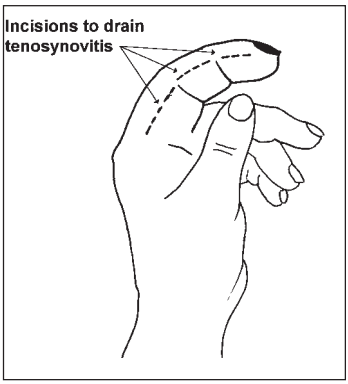
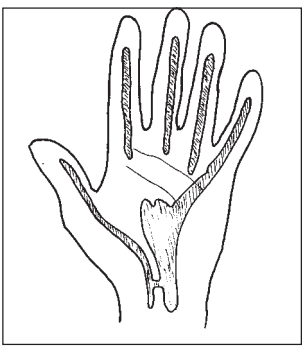


Figure 14. Tendon sheaths in the hand.



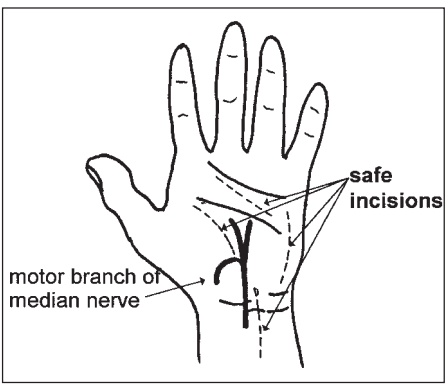


Figure 15. Sites of safe incisions in the palm.

deep palmar abscesses should be located in the palm over the area of greatest tenderness when possible. Once the abscess is entered, insert a finger or forceps to determine the size of the abscess and where additional incisions may be made to provide adequate drainage. See Figure 15 for safe incision sites.

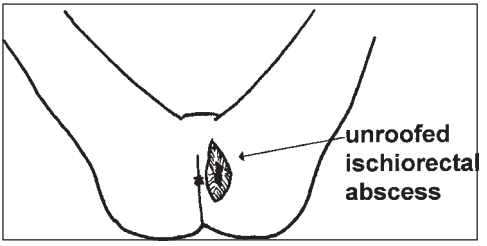


Figure 16. Unroofed ischiorectal abscess.

Perianal/Perineal

Superficial abscesses and boils are common in this region and require local drainage only. Recurrent boils may indicate an underlying condition such as diabetes mellitus. Deeper infections are potentially dangerous and must be diagnosed early and treated aggressively.

Ischiorectal Abscess

These abscesses occur in the deep fat of the ischiorectal space. The patient may give a history of pain on defecation followed by increasing pain and swelling, usually at one side of the anus. Tenderness becomes so severe that the patient is unable to sit comfortably and even walking is painful. Examination reveals a tender hot mass which may or may not be red. The above symptoms and signs are sufficient to indicate incision and drainage of the abscess. Fluctuance is a late sign and surgical drainage should not await fluctuance in this region. Drainage can be provided under local anesthesia, injecting 0.5% tetracaine liberally along the line of incision and widely in the fat over the abscess. However, general anesthesia provides more comfort for patient and surgeon in the exposure and drainage of all loculi and cavities. The surest approach is to do a wide incision unroofing the entire abscess. Removal of an ellipse of skin helps keep the cavity open (Fig. 16). The cavity is then packed loosely with a single piece of sterile gauze. (Insertion of more than one piece of gauze into a large abscess sometimes results a piece of gauze inadvertently being left in the wound.) The large gaping wound will take several weeks to heal but leave a surprisingly small scar. Some experienced surgeons may opt, in defined circumstances, for a smaller incision and insertion of a drain. This latter approach facilitates early discharge home and may avoid admission to hospital, but it may also lead to inadequate drainage and recurrence of the abscess. Intravenous antibiotics should be administered immediately prior to drainage to minimize the risks of bacteremia associated with the procedure. Cultures of the pus should not be affected by this. Choose antibiotics, such as chloromycetin or a combination of gentamicin and flagyl, to cover aerobic and anaerobic gut organisms. In every case, the patient should be advised that a fistula-in-ano may develop later.

Perineal Abscess

Perineal abscess may be a variant of ischiorectal abscess located anterior to the anus. It may also, in males, be due to trauma to the urethra or impacted urethral calculi. Gonnorrhea or tuberculosis may produce perineal abscesses. Drainage should be as for ischiorectal abscesses.

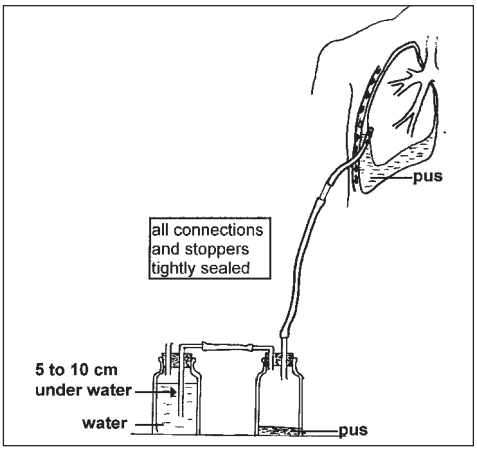


Figure 17. Two-bottle water-seal drainage for the pleural space.

Bartholin's Abscess

Bartholin's abscess usually occurs in a pre-existing cyst of one of the greater vestibular glands (Bartholin's glands) at the introitus of the vagina. A tender mass is present deep to the labium majus on one side of the vaginal outlet. Treatment is incision and drainage. If possible, marsupialize the infected cyst by opening the cavity and suturing the lining to the skin. This may not be possible due to inflammation, in which case marsupialization may be done at a later stage.

Deep Abscesses

In this section, we briefly discuss the abscesses which occur in or around the thoracic and abdominal cavities. Diagnosis of deep abscesses has been a major challenge and, even with modern imaging technology, diagnosis is sometimes difficult and tentative. Where advanced technology is not available, we are forced to resort to old and time-tested methods to achieve a diagnosis and embark on effective treatment. Exploratory laparotomy for intra-abdominal infections is an effective diagnostic *and* therapeutic technique, albeit an invasive one. We could still more often use this "technology" in "hi-tech" centers when persistence with one imaging test after another fails to reveal the problem and causes undue delays and adverse outcomes. There is a useful role for ordinary X-rays.

Pulmonary

Empyema, is an abscess in the pleural space. It is much commoner in poor regions than privileged populations due to the tardy or absent diagnosis and treatment of pneumonias. Tuberculous empyema is also relatively more common in poor populations. Therefore the surgeon in developing regions needs to know how to manage these problems safely and effectively. Untreated empyema will produce a collapsed lung trapped in fibrous tissue with eventual severe respiratory disability.

An early empyema which has not developed a thick fibrous peel can be treated by tube thoracostomy. Diagnosis of an early empyema is based on the observation that the fluid pus will shift when the patient is placed in lateral decubitus position for X-ray. Drainage is necessary, using a tube and a water-seal bottle arrangement (Fig. 17). Before inserting the intercostal tube, confirm the site and diagnosis with a

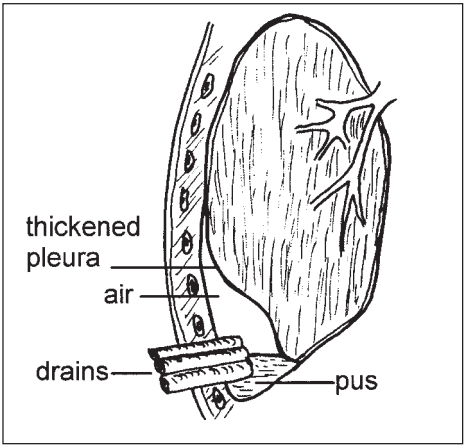


Figure 18. open chest drainage with large tubes

21 gauge needle on a syringe to aspirate for pus. If the empyema is more chronic and has developed a thick pleural peel, resection of a segment of rib is required in order to produce an open thoracostomy. The opening should be made in the most dependent part of the abscess and maintained by inserting into the opening three large rubber tubes tied together (Fig. 18). This must be maintained until the cavity has disappeared which may take several weeks or months. A more permanent procedure is the creation of a skin flap to keep the cavity open, the Eloesser technique. This requires experience.

Treatment of lung abscesses is more difficult and requires training and experience in lung surgery.

Intra-Abdominal Infections

Intra-abdominal infections may present as generalized peritonitis or as localized abscesses. Abscesses are often more difficult to diagnose than peritonitis. In this section, we discuss the more common intra-abdominal infections requiring surgical treatment.

Bacterial Peritonitis

Bacterial peritonitis is a lethal infection involving the linings of the peritoneal cavity. In Western countries a common cause is diverticulitis but this condition is rare in developing regions. On the other hand, peritonitis due to tuberculosis or typhoid is more common in the developing world. Perforation of the stomach or gut and pelvic inflammatory disease (PID) are the other common causes of peritonitis. Usually the patient is severely ill and has a persistently high fever. The abdomen is acutely tender and there is involuntary guarding, usually with "rebound tenderness". Often the abdomen is silent, on auscultation for two minutes, due to paralytic ileus. There may be absence of liver dullness on percussion due to free intraperitoneal gas from a perforation. In tuberculous peritonitis the abdomen may feel "doughy" (flabby and slow to rebound after indentation) and the patient is usually wasted and feeble, complaining of a long-standing abdominal pain.

Where possible, abdominal X-rays in the supine and upright positions should be made. Free intraperitoneal gas indicates perforation of stomach or intestine. Exploratory laparotomy is indicated, without further diagnostic procedures, once fluid

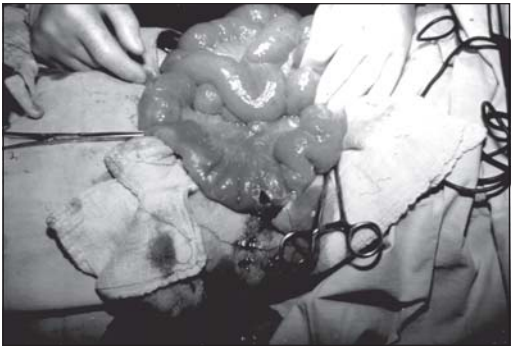


Figure 19. Typhoid perforation of the terminal ileum.

and electrolyte resuscitation have been achieved. If there is no free air, a diagnostic open peritoneal lavage can be done under local anesthesia in the midline one-inch below the umbilicus after draining the bladder by catheter to rule-out or treat a distended bladder and avoid damage to the bladder. If pus or intestinal contents are returned after lavage with a litre of warm sterile saline, explore the abdomen or refer the patient for exploration immediately. If perforated peptic ulcer is suspected, start the incision in the upper abdomen. Otherwise use a long midline incision to give full access to the abdomen.

At exploration, examine the entire abdomen and subphrenic regions and the entire length of the intestines. To treat a perforated duodenal ulcer, a patch of attached omentum is sutured over the perforation without attempting to suture the hole closed. A similar method may be used in early typhoid perforation (usually of terminal ileum as in Fig. 19) if there are no more than three sites of perforation and

Figure 20. Pott's (tuberculous) abscess of the thoraco-lumbar spine appearing as a round shadow.

minimal inflammatory reaction. Usually, however, it is best to excise the segment of ileum and make an ileostomy and mucus fistula. After all perforations have been closed and pus removed, the abdomen should be lavaged liberally with *warm* sterile saline and aspirated dry before closing the abdomen. No drains are placed in the peritoneal cavity, but the skin and subcutaneous tissues are packed open with gauze to be closed 3 to 7 days later unless there are signs of wound infection, in which case the wound is left open to granulate and heal on its own; that is, by "second intention".

Intra-Abdominal Abscesses

Intra-abdominal abscesses occur most commonly in the right lower quadrant due to appendicitis. The other usual sites are the left lower quadrant, the pelvis, and the subphrenic spaces.

Appendiceal Abscess

Appendiceal abscess occurs as a result of an untreated or ruptured acute appendicitis. So we missed the diagnosis of appendicitis?—don't despair; we still have another chance to cure the patient. The patient is usually ill and febrile but may be remarkably free of symptoms for some time. A tender mass is usually felt in the right lower quadrant and there is often tenderness to the right on rectal examination. An unusual late manifestation is the spontaneous external drainage of the abscess, usually in the region of the right groin. If examination of the left side of the abdomen does not reveal signs of peritonitis, we should attempt to drain the abscess without entering the abdominal cavity. This may be done under local anesthetic, especially in thin patients. A transverse skin incision over the lateral and inferior aspect of the mass is deepened to the level of the peritoneum. At this level, attempt to enter the abscess bluntly with a finger. If this fails, try a blunt (Kelly) forceps carefully controlling the depth of penetration—avoid the dreaded plunge. Once pus is encountered (whew!), gradually open the tract to permit insertion of a large drain. A sump drain is ideal for large intra-abdominal abscesses (see Fig. 23, below). If the abscess has developed a sinus tract to the skin, this may be explored and gradually enlarged to permit insertion of a drain. The cavity may then be irrigated with sterile water or saline.

Pelvic Abscesses

Pelvic abscesses are caused by a variety of gut or gynecologic infections. The patient is usually very ill and feels pain in the low abdomen and sometimes in the perineum. Defecation or micturition may produce pain. Dyspareunia is common. Abdominal examination may be unhelpful except to rule out peritonitis or other abdominal problems. Rectal and vaginal examination are usually diagnostic. Simultaneous examination of the rectum and the vagina, with the index finger in the vagina and the long finger in the rectum, will clearly outline the site of an abscess in the recto-uterine recess. It will also help define the best approach to drainage. If possible, drain deep pelvic abscesses through the vaginal vault. A hanging speculum is extremely helpful. Insert a 21 gauge spinal needle on a 5cc. Syringe into the bulging site and aspirate only a small amount of pus. Aspiration of too much pus collapses the abscess and makes incision into the abscess more difficult and dangerous. If no pus is aspirated, try another site. If no pus if found, abdominal exploration may be indicated.

Liver Abscesses

Liver abscesses may be bacterial, fungal, or parasitic (usually amebic). Diagnosis is not easy without computerized tomography or ultrasound. Where these technologies are not available, exploratory laparotomy is effective for diagnosis and treatment. When a liver abscess is encountered, insert a moderately large-bore needle into the abscess and aspirate using a 20cc to 50cc syringe. If the material is creamy pus, open the abscess and place a large drain. If the fluid is dark reddish-brown, it is probably an amebic abscess. In this case, aspirate as much as you can by needle without opening the abscess and begin treatment with Flagyl. If the patient has a history of dysentery and a palpable upper abdominal mass that moves with respiration, careful percutaneous needle aspiration may be performed to avoid laparotomy for amebic liver abscess.

Subphrenic Abscesses

Subphrenic abscesses are difficult to diagnose and harder to find without exploration. Many interesting and sometimes helpful techniques have been devised to detect the site of subphrenic abscesses and to drain them without exploration. Usually, however, it is best to perform an exploratory laparotomy and to drain the abscess with a sump drain (see figure 23, below).

Retroperitoneal Abscesses

Retroperitoneal abscesses may be caused by tuberculosis, especially of the spine or kidneys. Other causes include pyelonephritis or perforation of a part of the gastrointestinal tract such as the appendix, cecum, duodenum, or colon. Necrotizing pancreatitis is a serious but less common cause. Retroperitoneal abscesses are uncommon but dangerous because they are difficult to diagnose and treat and the infection spreads readily in the retroperitoneum. Symptoms are those of severe bacterial infection with high spiking fever and malaise. Tuberculous abscesses may produce less severe symptoms. There may be a palpable mass in the abdomen and localized tenderness in the abdomen or costo-vertebral angle. Plain X-ray of the abdomen may show loss of the psoas shadow on the affected side. Leukocytosis is present and pyuria occurs when the kidney is responsible. Ultrasonography is helpful in making the diagnosis. Psoas abscess is a characteristic variant of retroperitoneal abscess. The patient will have pain on attempting to fully extend the leg at the hip and will tend to hold the leg in partial flexion at the hip. Sometimes a mass or sinus may eventually appear just below the groin as the psoas abscess "points" to the skin surface. Treatment of retroperitoneal abscesses is surgical drainage. The causative infection must be found and the source treated. To drain a retroperitoneal abscess use a flank incision, taking care to avoid entering the peritoneal cavity. Insertion of one or more large sump drain(s) (see figure 23, below) is necessary to eradicate the abscess. After culture of the pus, appropriate antibiotics may be used if the fever does not subside. If tuberculosis is the cause, complete anti-tuberculous treatment must be provided.

Sinuses and Fistulae

A sinus is an abnormal tract which opens onto an epithelial surface, usually the skin. Most sinuses are due to chronic infection in a deeper structure. Some sinuses are congenital, such as the thyroglossal duct sinus. Tuberculosis is a common under-

Figure 21. A) Tuberculous abscess of the cervical spine destroying the third cervical vetebra and causing quadriplegia. B) After drainage of the abscess, traction, and fusion of the spine. C) Recovering from quadriplegia.

lying cause of sinuses from a number of organs, bones, joints, etc. Sinuses may be treated by opening the tract for better drainage and by curetting the lining of the tract to remove granulation tissue. A fistula is an abnormal communication between two epithelial surfaces such as the bowel and the skin. Fistulas are usually caused by perforation of a segment of bowel with recovery from the acute infection and persistent draining from the perforated site into another hollow viscus or onto the skin. Fistulas require management of the site of perforation by open surgery. This requires skill and experience.

Tuberculosis

Tuberculosis is resurgent and becoming the scourge it once was, even in wealthy communities. It may mimic almost any other serious acute or chronic disease and therefore should be considered in the differential diagnosis of a wide variety of clinical problems. The presence of chronic cough, especially with bloody sputum, along with typical chest X-ray findings will alert us to the possibility of tuberculosis in some other part of the body. However, many patients present with tuberculosis of the GI tract, the GU tract, or a bone or joint without the pulmonary symptoms so we may miss or delay the diagnosis and treatment. Timely diagnosis and appropriate treatment are important to prevent death or severe disability. Even patients with Pott's paraplegia may recover if the tuberculous abscess compressing the spinal cord is drained (Fig. 20). Such patients should not be abandoned without an attempt to drain the abscess (Fig. 21 A,B,C). This requires experience.

Figure 22. Leprosy (Hansen's disease).

Figure 23. Severely-burned insensate feet in a man with leprosy.

Leprosy

Leprosy (Fig. 22) is usually a slowly progressive infection that destroys sensory nerves, thus preventing the patient from feeling his or her extremities being injured or burned (Fig. 23). Chronic or acute abscesses are drained as necessary. Most of the surgical role in this infection is reconstruction along with physiotherapy and measures to prevent further damage.

Sump Drain

We have discussed the use of a sump drain for intra-abdominal and retroperitoneal abscesses. A most useful and simple sump drain is pictured in Figures 24 and 25a and b. The principle is to aspirate pus or fluid without sucking on tissues. An outer sheath keeps tissues away from the holes of the suction tube so that they are not obstructed and so that bowel or other vulnerable structures are not injured by the suction. Holes in the outer sheath allow pus and fluid through to the suction drain. The outer sheath is open to air to prevent the formation of a vacuum which would suck tissue up against the holes in the outer sheath. If the inner tube becomes plugged, it is easy to change while leaving the outer tube in place. Once the abscess is reduced to a tract, the inner tube is removed and the outer tube left as a passive drain to be withdrawn gradually.

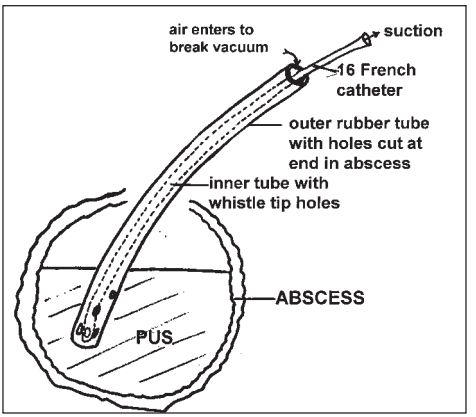


Figure 24. Diagram of a simple and effective sump drain.

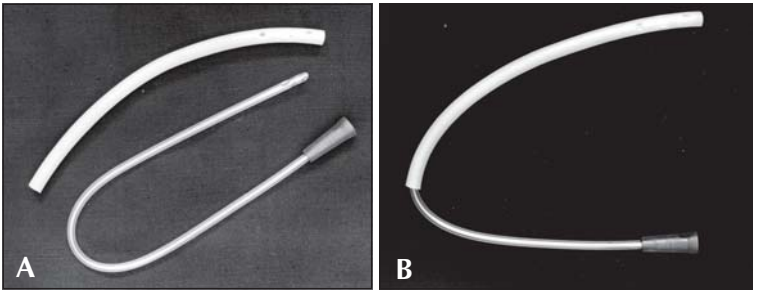


Figure 25. A) and B) Sump drain made from two simple tubes.

Indispensable Texts

The following texts are invaluable sources of practical advice and helpful diagrams outlining surgical treatment of a wide variety of problems encountered in less-developed parts of the world:

Primary Surgery Volume One, Non-Trauma. Eds. Maurice King, Peter Bewes, James Cairns, Jim Thornton. Oxford Medical Publications.

Primary Surgery Volume Two, Trauma. Oxford Medical Publications.

CHAPTER 36

Surgical Training of Nurses for Rural Areas: Necessity or Aberration?

Ahuka Ona Longombe

In Northeast Zaire (the Haut-Zaire Region) 7.6 million of the 10 million population live in the 44 rural districts where only 5 of the 44 specialist physicians practice. At the Centre Medical Evangelique in Nyankunde selected nurses have undergone an 18-month course of training in surgery. They are then capable of performing all the commonly encountered and some of the less frequently seen urgent surgical operations and some routine surgery. An account of their work in remote areas is given.

Introduction

Surgery is a discipline which requires a high level of academic study and practical training. It should not be left in the hands of charlatans or the unskilled. This requirement has meant that in developed countries surgery is reserved for qualified career surgeons with junior doctors gaining limited experience only under strict supervision. The situation is quite different in developing countries, however, where there is an acute lack of appropriately trained medical personnel. In the deep interior of these countries, there are glaring inequalities between the towns and rural areas. Such inequalities have been denounced clearly in the Declaration of Alma Ata.[1]

In developing countries there is an uneven distribution of qualified medical personnel; 80% physicians work in towns while the remaining 20% serve the rural areas where most people live.

How do we manage the resulting situation in the African bush? In this chapter we give our point of view and our reflections on the surgical training of nurses at the Centre Medical Evangelique (CME) at Nyankunde in Zaire and illustrate our discussions with the results of surgery by three nurses trained at CME.

Centre Medical Evangelique (CME), Nyankunde

CME, Nyankunde is a disctrict hospital with 250 beds which is situated in the North East of Zaire (Haut-Zaire Region). The hospital acts as a referral hospital with specialist services. The catchment area covers a large part of Eastern Zaire, particularly Haut-Zaire and North KIVU Regions which have a population of more than 10 million.

CME Nyankunde is organised under four clinical services (surgery; gynaecology-obstetrics, internal medicine and paediatrics). In addition there are departments of community health, ophthalmology, dentistry-stomatology, a labora-

Surgery and Healing in the Developing World, edited by Glenn Geelhoed.

Table 1. Distribution of health zones

Area	Health Zones	%
Rural	44	93.6
Urban	3	6.4
TOTAL	47	

Table 2. Distribution of specialist physicians

Area	Specialists	%
Rural	5	12.5
Urban	35	87.5
TOTAL	40	

tory for medical analyses and histopathology and a large central pharmacy. The referral services are used by more than 15 hospitals and many health centres.

In principal CME has always preferred to have specialists at the head of each service. In reality, however, the lack of specialized surgical personnel (a gynaecologist-obstetrician in particular) means that all the surgical disciplines (general surgery, orthopedics-traumatology, gynaecology and obstetrics, urology…) are shouldered by one general surgeon.

CME, Nyankunde plays a very important role in the training of newly arrived missionary physicians, young Zairian physicians and of paramedical personnel working in the Northeast (NE) of Zaire. For some years practical training in surgery for nurses has been given. These nurses are then sent to isolated health centres where, in general, medical help is nonexistent.

The Haut-Zaire Area

Zaire is a very large country, situated in the centre of Africa. It has an area of 2,345,000 square kilometres and is administratively divided into 11 regions, of which Haut-Zaire is one of the largest, with an area of 529,000 square kilometres (a little smaller than France and four times the size of Malawi). Haut-Zaire is divided into four rural subregions (Bas-Uélé, Haut-Uélé, Tshopo, Ituri) and one urban subregion (Kisangani). Of the 306 health Zones (districts) in Zaire, 47 lie within the Region of Haut-Zaire.

Haut-Zaire has a population of approximately 8 million inhabitants, of whom only 400,000 live in Kisangani City, the Region's capital, giving a rural/urban population ratio of 20:1.

The distribution of human resources for health services in Haut-Zaire (Tables 1, 2 and 3) shows clearly that rural areas are overloaded and at a disadvantage in relation to surgical care as compared with urban areas.

The surgical workload becomes impossible with inevitable negative consequences for those living and working in the most isolated area. For this reason we have developed a programme of practical surgical training for nurses working in rural areas. The programme began in 1990.

Table 3. Distribution of surgeons

Area	Surgeon	%	Population	Ratio
Rural	2	20	7,600,000	1/3,800,000
Urban	8	80	400,000	1/50,000
TOTAL	10		8,000,000	

Profile of Surgical Operations at Cme NME kunde

In order to have the profile of surgical operations encountered in our hospital, we present the situation as of 1989 which immediately preceded the start of our programme. We had the advantage of having a gynaecologist/obstetrician at that time (for 6 months), as well as two surgeons. An analysis of 918 operations, is shown in Table 4.

Gynaecological and obstetric surgery accounted for 49.5% all the cases, followed by general surgery (18.2%) and orthopedic-trauma cases (14.3%). The other disciplines were relatively less frequent. Details are given in Table 5. The routine operations represented 83.5% of all surgery (743/890), while emergency surgery accounted for only 39.2% of cases. Anaesthesia with Ketalar, and spinal and local anesthesia represented 85% of all anaesthesia used in our hospital, while general anaesthesia with intubation was given to the remaining 15% of patients (Table 4). Our programme of practical training for surgical nurses was based on the information given in the above tables.

The Programme of Surgical Training for Nurses

Aims

To allow a nurse working in an isolated situation to cope with vital surgical emergencies in order to save lives.

Table 4. Distribution of operations by speciality

Specialist	Operations	%
Obstetrics	268	29
Gynaecology	186	20
General surgery	167	18
Orthopedics-Traumatology	131	14
Plastic surgery	55	6
Urology	51	5.5
Ophthalmology	29	3
ENT	14	1.5
Neurosurgery	10	1
Thoracic surgery	5	
Vascular surgery	2	
TOTAL	918	

Table 5. Routine surgery* (890 cases excluding ophthalmological operations: 28)

Operation	Number	%
Caesarean section	170	22.9
Dilatation and curettage	95	12.8
Herniorrhaphy	53	7.1
Hysterectomy	44	5.9
Skin graft	34	4.6
Diverse Biopsies	34	4.6
Tumour excision	33	4.4
Tubal ligation	33	4.4
Salpingectomy	32	4.3
Laparoscopy	26	3.5
Fracture reduction	24	3.2
Appendicectomy	17	2.3
Bone nailing	15	2.0
Hydrocelectomy	14	1.9
Ovarian cystectomy	14	1.9
Amputations	13	1.7
Drainage of the ATO & Adhesi	12	1.6
Sequestrectomy	12	1.6
Colostomy	11	1.5
Obstruction of the bowel	10	1.3
Other laparotomies	32	4.3
TOTAL	743	

To help to decrease the surgical burden of the surgeon/physician (often busy and alone) in our rural hospitals.

To be able to perform some basic operations which do not require advanced surgical training and which can be performed in isolated areas and a long way from centres of reference.

Conditions for Admission to the Programme

A nurse with a diploma (4 years after 4 years secondary school) or a degree (3 years university) preferably with at least two years of nursing experience.

Recommended by a community where the necessity of surgical assistance in the health centre has clearly been shown.

Where the isolation of a rural health centre and the distance from a referral centre does not mean total inaccessibility should emergency assistance be required (e.g., at least an airstrip should be available).

The assurance of supervision by the district medical officer.

Distribution of Time Per Service During the Training of Surgical Nurse (Total Duration: 18 Months).

Maternity: 1 month

Cleanliness of the operating room and of materials, and familiarity of surgical instruments (2 weeks).

Table 6. Distribution according to the type of Anaesthesia used

Type of Anaesthesia	Number	%
Ketalar	387	42.2
Spinal	329	35.8
General with intubation	137	14.9
Local	65	7.2
TOTAL	918	

Anaesthesia (6 weeks)
Minor surgery, anaesthesia and consultation (1 month)
Assistance in minor surgical cases, consultations and ward rounds (1 month)
Major surgical operations (7 months).
Responsibility; for surgical emergencies and routine operations (3 months)

At the end of his or her stay, the nurse must be able to do all the urgent, routine surgery, and then some of the urgent sugery which is seen less frequently. Finally he/she is involved in elective routine and nonroutine surgery.

Results

By the end of their training, the nurses had given local anaesthetics (4.7%), spinal anaesthesia (69.6%) and to give a general anaesthesia using Ketalar (25.7%). They were able to do endotracheal intubation, but this is less important as their health centres would have the facilities for this.

Seven nurses have already been trained since we initiated this programme. Up to now all these nurses have worked in remote places in the bush, the most distant ones

Table 7. Type of work done by the three nurses

(a) Surgery Performed

Station	General Surgery	Orthopedics	Gyn-Ob	Urology	Total
Adi	211	25	159	2	397
Aru	73	0	119	0	192
Aungba	36	3	35	2	76

(a) Type of Anaesthesia Used

Station	Local	Spinal	Ketalar	Other	Total
Adi	20	275	102	0	397
Aru	8	34	50	0	192
Aungba	3	54	19	0	76
TOTAL	31	463	171	0	665

working on the border between Zaire and Sudan; that is, 1,300 km away from Kisanga and 450 km from Nyankunde. For the moment we have five nurses in training (with a short programme of orthopedic training).

The nursing background (A2=4 years of training in a nursing school as secondary level or A1=3 years in a Technical Medical University College) means that they are already familiar with basic elementary professional techniques such as venipuncture for intravenous fluids, vesical probind, and resuscitation methods. In their previous Health Centres, they had gained experience in conducting consultations and in the differential diagnoses of obstetric cases. They are able to perform normal deliveries, to apply a vacuum extractor and, especially, to diagnose different complications indications for caesarean section. Upon this background we have built the practical surgical training of 18 months.

The nurses are able to do most of the surgery listed in Table 5 except laparoscopy. They perform reductions of fractures and pinning of bones. Briefly, they are able to do urgent and routine surgery including gynaecology-obstetrics, general surgery and traumatology.

Discussion

Nurses can usually be found in remote areas in Zaire. The lack of available medical personnel in isolated health districts means that much of the medical work is done by the nurses. Our results show that much of the urgent, vital and routine surgery can be done by nurses, provided that they are specifically trained.

To allow nurses to do surgery is not without precedent in the history of our country. One will remember that at independence, hospitals (and surgical centres) were left to personnel with only basic practical training, who treated all illnesses and often managed operating theatres. Sometimes the only surgeon was the orderly. The situation has not changed in some areas of our country where the lack of specialists in surgery is critical. A well-trained surgical nurse, as shown by our results, can help enormously and can save many lives.

The training of nurse practitioners has been attempted in other countries, especially in general medical areas, with encouraging results.[3] The duration of the training, longer in our programme than in the Ethiopian experience, can be explained by numerous factors, amongst which is the basic level of training of our nurses (3-4 years) which is less than that of doctors (7 years). That period allows us to establish surgical aptitutde that we believe to be necessary for someone who will eventually work in an isolated area, without him/her assuming unauthorised responsibilities.

The specialisation in surgery for nondoctors is gaining popularity throughout Africa. We cite the experience of the Malawi Orthopedic Project which trains Orthopedic Clinical Officers, who offer services of tremendous value in that country.[4]

Given the services that nurses trained in surgery can give in the remote areas of our country, we believe that their training enables them at least to do urgent, vital and routine surgery such as caesarean sections, laparotomies for ectopic pregnancies and manage trauma patients. This is a necessity for some African countries where there is a critical lack of surgeons. We cannot compare ourselves with rich countries which have sophisticated infrastructures and sufficient qualified medical-surgical personnel. We encourage consultations such as those at the recent conference in Blantyre[5] where ideas and experiences can be exchanged and a policy of orientation in surgical disciplines in the tropics can be formulated for nondoctors. Poverty and the limitation of resources, as well as the potential competence of nurses, have encouraged us to use this option.

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CHAPTER 37

Training of Medical Assitants in Mozambique for Surgery in a Rural Setting

Ivo Paulo Garrido

It is a great honor and pleasure to address this crucial meeting on the future of surgery in Africa, on the subject of the training of medical practitioners and other health workers for surgery in a rural setting in Mozambique.

To understand the solutions that we have been seeking in Mozambique one has first to understand the harsh realities of the health situation in my country.

Mozambique is an underdeveloped country where more than 70% of the population (of about 16 million) live in rural areas. The Mozambique health services cover less than 30% of the population and are particularly scarce in the rural setting. The doctor/population ratio is 1:40 000 and the surgeon/population ratio is 1:400 000. At present there are fewer than 300 medical doctors in Mozambique and they include: 7 surgeons, 1 neurosurgeon, 4 orthopedic surgeons, and 12 specialists in obstetrics and gynaecology. None of these specialists works in the rural areas. The number of doctors in postgraduate training in surgery is 4 and in orthopedic surgery 1. These numbers are not likely to increase in any substantive way in the near future.

The scarcity of doctors in general and the extreme scarcity of trained surgeons and other professionals with sufficient surgical training poses the problem of coping with the unmet needs of surgical care of the population living in the rural areas. To address these concerns in an expeditious way the Ministry of Health of Mozambique was obliged to start a 3-year training course in surgery for assistant medical officers (tecnicos de cirugia).[1] The first group started their training in 1984. Three groups (totalling 50 trainees) have now concluded their training programmes.

The main aim of the course is to train assistant medical officers to deal with surgical emergencies and to perform lifesaving operations such as reduction of strangulated hernia and salpingectomy for ectopic pregnancy. Diagnosis and management of cold surgical conditions for elective repair are not a priority. Candidates are selected from among the best assistant medical officers available who have at least 5 years of experience.

The first 2 years of training take place in Maputo (the capital city) and are concentrated on didactic and practical teaching. The students have daily lectures and rotate on patient wards in surgery, orthopedics and obstetrics and gynaecology. Around 40% of their learning time is spent in casualty to acquaint them with all kinds of surgical emergencies, in particular trauma and surgical infections.

The last year is spent in a 250-bed provincial hospital, and the teaching is essentially practical. The students work under close supervision of a general surgeon.

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Only those students who pass the written, oral and practical examinations at the end of the second year are admitted to the third year.

Twelve years ago Nordberg wrote in the *British Medical Journal*[2] that a victim of a strangulated hernia in Africa had a 1 in 8 chance of receiving any surgical care, let alone of a real surgeon's performing surgery. Unfortunately the situation in general has not improved since then, and there is evidence that it has in fact deteriorated further. One obvious potential emergency resolution of the problem is the delegation of major operations to health staff not formally trained as medical doctors.

The training of nonmedical personnel to perform certain health care tasks has long been advocated.[3] Laboratory services (including blood cross-matching) and the administration of general anaesthetics can be safely delegated to nonmedical staff. It has been successfully demonstrated in parts of Africa and Assia[4-6] that trained nurses and medical assistants can undertake surgical procedures. In June 1996 the *British Journal of Obstetrics and Gynaecology* published a paper entitled "A comparative study of caesarean deliveries by assistant medical officers and obstetricians in Mozambique.[7] This study of more than 2,000 consecutive caesarean deliveries showed that: (i) there were no differences in the indications for caesarean delivery between the two groups; (ii) the surgical interventions associated with caesarean delivery did not differ in the two groups; and (iii) the only significant difference was in the incidence of superficial wound separation caused by haematoma, which was slightly higher in the group operated on by the assistant medical officers.

The study concluded that training selected medical assistants to perform caesarean delivery, even on patients in poor condition, is justified in settings where doctors are scarce.

The major advantage of the option we have taken is that it saves lives. On the other hand, we acknowledge that it is an option with increased risks for the patient under treatment.

Although our experience shows that a technically safe laparotomy can be performed, in settings without major surgical facilities. It is frequently more difficult. That is why we insisted on close supervision of assistant medical officers before they are allowed to work entirely on their own.

Yet the delegation of major surgery to nonmedical personnel remains a matter of controversy. Traditional professional rules are challenged and limits of responsibility altered. There may be reasonable grounds to doubt whether such delegation is compatible with safety. There may be an excess of medical manpower available in some over-serviced areas of the developed world in which squabbles may result in subspecialty jealousies about who is qualified for or excluded from doing what. In under-serviced developing areas, the preeminent concern is the overwhelming need for health care services and the resource constraints that deny medical care to many, in some instances most, of the population. Our responsibilities are first to see that services are rendered to the desperately needy and then to upgrade the quality of those services. In this continuing-crisis with increasing desperation brought on by presures of a burgeoning African population living and dying in poverty, life-saving expediency using all possible means is a more ethical medical response than professional puritanism.

Although we acknowledge strong medical opposition to such developments, in Mozambique we believe that in areas where there are no doctors and people are dying by the thousands for want of care, it is surely better to provide second-class health care service than none at all.

This paper was presented at a symposium on surgery in the rural setting held during the insugural meeting of the Pan African Association of Surgeons, Elephant Hills Hotel, Zimbabwe, 31 August-5 September 1996.

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CHAPTER 38

Training Surgeons in the Developing World

David C. Thompson

Introduction

For the purposes of our discussion, we will define a surgeon as a physician who has received special and extensive training to enable him to correctly diagnose surgical disease, skillfully and safely perform the right operation for a wide variety of surgical problems, and recognize and treat the complications that his operations may sometimes produce.

According to this definition a surgeon is not simply a doctor who operates. If he were, or if a physician could become a surgeon simply by performing a large number of operations badly, there would be little need today for any physician to receive formal surgical training.

Family practice physicians are not surgeons, but because in many countries there are not enough surgeons for all of the operations that need to be done, for practical reasons they can and should learn to perform some operations safely and well. Like surgeons, they should have a clear understanding of both their capabilities and limitations.

Because surgeons literally hold the lives or well-being of their patients in their hands, and because they also hold the keys to maintaining high surgical standards in their communities, surgeons should be trained to do at least seven things well:

1. maintain a high level of interest and concern for the welfare of their patients;
2. correctly diagnose surgical disease;
3. adequately prepare patients for surgery;
4. plan for appropriate anesthesia;
5. perform the right operation safely and skillfully;
6. assure the patient's postoperative recovery;
7. pass on surgical knowledge and skills to others who are qualified.

Western Models of Surgical Education

There is a belief in much of the developing world that the training of surgeons should be left to academic surgeons working in technologically advanced hospitals, preferably in advanced countries. This policy has produced a significant number of surgeons who now practice not in the developing countries that desperately need their skills, but in the wealthy countries in which they were trained. Those few who out of a sense of duty or loyalty return home after completing their training usually find themselves in a radically different medical setting. To practice the surgical skills

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that they have learned they must first retrain themselves. Some eventually abandon surgery altogether, but most eventually return to the country where they trained. It should therefore come as no surprise to anyone that in most developing countries there exists today a severe shortage of well-trained surgeons.

Some countries have belatedly recognized this problem and have established their own surgical residency programs modeled after what is done in Europe or North America. These models require an abundance of academic surgeons and surgical specialists. Since developing nations have a shortage of both these resources, the model has worked poorly and few qualified surgeons have been produced. What works so well in wealthy nations has for the most part proven to be a costly and embarrassing failure in the developing world.

The Importance of Vision

With few exceptions, the very same governments that are struggling to train enough qualified surgeons for their populations are either actively discouraging private and church-related hospitals from helping or are doing nothing to encourage them to help, despite their proven ability to do so. The reasons for this have more to do with national pride and satisfaction with the status quo by practicing surgeons than with the quality of surgical education or the surgical needs of their populations.

In many developing countries, a significant portion of all surgical services are provided by surgeons working in private or in church-related hospitals. In some cases, these hospitals provide some of the best surgical care available. These hospitals are usually staffed by either expatriate surgeons or indigenous surgeons trained in North America or Europe who have retrained themselves in order to practice surgery under more difficult circumstances. They are often experienced in surgical education and are motivated to teach other doctors what they know.

Expatriate surgeons supported either by mission boards or outside agencies usually are usually on fixed salaries and may find it advantageous to train others to perform surgery because it lightens their workloads without reducing their income. In contrast, surgeons employed by government hospitals may be so underpaid that much of their income must come from their outside private surgical practices. The shortage of qualified surgeons in their communities may allow them to demand and receive exorbitant fees for their services. Since training others to perform surgery is time-consuming and has the potential to produce competition and reduce income, they may have little interest in training other doctors to become surgeons.

Until governments in these countries have the vision to pay academic surgeons enough to free them from private practice and to reward them for training surgeons, surgical education in government hospitals will remain a low priority, regardless of what model of surgical education is followed.

In the final analysis, the greatest obstacle to providing more and better surgical education in developing countries may not be a lack of qualified teachers or of adequate surgical facilities, but of vision. If practicing surgeons confine themselves to preserving the status quo because it benefits them or because they are unwilling or unable to consider the needs of their poorer countrymen, the obstacles to training enough qualified surgeons in developing countries will remain intractable. Unless someone dreams about what could be done using resources that exist and that are already on hand, surgeons who could do something to help will remain committed to the status quo. This unwillingness to dream and to take risks for a better

future disheartens capable surgeons in both public and private hospitals and discourages them from fighting for change.

Before surgeons in the developing world can talk about abandoning inappropriate models of surgical education, they will need to visualize new models that do not involve legions of highly-paid expatriate experts and vast governmental expenditures. Existing public and private resources can and should be tapped immediately. Private and public institutions should cooperate with each other to develop local and regional surgical societies, strengthen existing international surgical societies, and articulate their vision to the press. Only then will the dream of training enough surgeons to meet the needs of the developing world be realized.

A Workable Model for Surgical Education in the Developing World

The model described in this section has been used with success in several rural African hospitals. It involves one primary surgeon at a single hospital who serves as the primary teacher, a varied number of visiting, short-term surgeons, and a structure for providing systematic teaching in general surgery, anesthesia, and the appropriate surgical subspecialties.

One Primary Teacher (Program Director)

In this model, the primary teacher or Program Director of a hospital-based surgical training program should be a fully-trained, thoroughly experienced general surgeon with credentials from a recognized international surgical society. He or she should also be licensed to practice medicine in the country where he serves. Because of the magnitude and number of obstacles the Program Director is certain to encounter in this undertaking, he should be passionately committed to training young doctors to become qualified general surgeons.

A Program Director should be someone willing to stay at his post for four years or longer to assure adequate continuity. If we take as a given that it takes more than one surgeon to train another, the Program Director needs to arrange for other qualified surgeons to come short term to share in teaching the residents, both in the operating room and in the classroom.

If the most important aspect of mentoring is the example set by the mentors, it stands to reason that the Program Director and the visiting faculty that he recruits be individuals of high moral and ethical quality.

Visiting Faculty

Since surgical training programs in the developing world are unlikely to have more than one surgeon, if surgical training is to even occur alternatives to the western model need to be developed. The two most likely solutions appear to be (1) sending residents to several different hospitals to work with different surgeons during their training, (2) using visiting faculty, or (3) a combination of the two.

Rotating Residents Between Hospitals

The idea of moving residents around or trading residents between two or more hospitals sounds very appealing, but there are a number of problems that unless the two hospitals are in the same country and not too far apart make it difficult if not impossible to put into practice. The first is that most residents come with families that they are understandably reluctant to leave behind for months at a time. The

cost of moving the entire family to other location or country can exceed the cost of supporting a resident for an entire year. And if a resident does agree to leave his family, the primary training hospital must continue to house the family he left behind. If a trade between hospitals is involved, both hospitals must also find additional housing for the visiting residents and provide the necessary furnishings. The additional cost of feeding a resident away from his family adds even more to the expense.

Residents are usually young adults with the sexual drives and appetites common to all young adults. Separating families in areas of the world where communication is difficult or prohibitively expensive at a time when young husbands and wives need to remain emotionally close has a high potential for destabilizing their marriages. Rather than putting the well-being of these families at risk, Program Directors should do everything possible to support these families and strengthen and improve their residents' marriages.

Other problems with residents around from hospital to hospital has to do with the difficulties encountered in obtaining visas, work permits, and official authorization to practice medicine in another country. It may take six months to a year and considerable expense for a resident to establish those rights at the primary hospital. Each time he moves he must start all over again. The financial and emotional drain and the time involved can become a major impediment to learning. Some of these problems would be eliminated, however, if two or more participating hospitals were in the same country.

Using Short-Term Faculty

The number of experienced, board-certified surgeons traveling to countries in the developing world to work for weeks or months has grown considerably over the past few decades and continues to increase. Many private and church-related hospitals receive a steady stream of volunteer surgical specialists in the course of a year. Almost all of them pay their own expenses and provide their services at no cost. Their time and expertise are a precious resource that should be tapped to train surgeons. The North American pool of volunteers has grown so significantly over the past few years that in some cases Program Directors can invite those specialists they need the most to train their residents. If the host hospital is able to provide comfortable housing, these visits can be carried out at no cost to the hospital and without disrupting residents' families. These visits also provide a powerful and compelling example to residents.

Visiting surgeons who are board-certified in their area of specialty who come and teach residents in both the operating room and in formal lectures for periods of two weeks or longer should be considered as faculty for those residents. Their names should be included in the residents' training records, and the material they teach should be included in their yearly in-service examinations.

Until the developing nations of the world have an abundant supply of academic surgeons who are able and willing to train the numbers of surgeons their countries need, the use of volunteer visiting faculty in this way may well be the best solution yet to provide a broad range of teachers and surgical expertise to residents being trained at one-surgeon hospitals.

Qualifications for Surgery Residents

Experience in the developing world has shown that nurses with little more than a sixth-grade education can be trained to do complicated surgery safely and competently. If surgical training simply involved training people to perform operations competently, training surgeons would be easy. But to master the seven areas listed at the beginning of this discussion a surgeon must also know anatomy, physiology, surgical pathology, pathophysiology, pharmacology, and not a little internal medicine. He should be able to decide when to operate, when not to operate, and what operation to perform. He must know how to avoid major complications, and after the operation he must know how to keep his patient alive until he recovers, recognize complications when they occur, and know how to treat them. Finally, he must be able to do all of this in a variety of medical settings, some of them primitive.

Not all doctors are teachable, however. Those who learned some surgery by doing it or who have had a small amount of on-the-job training may consider themselves to be surgeons already. They may only want to find a hospital or an organization willing to give them a diploma for what they already know.

Before a student surgeon begins his training, he and his teacher must have the clear understanding that if the student is going to become a qualified surgeon he will have to start his training all over again from the beginning. This understanding should be written into a contract renewable yearly that both parties sign. It should also be restated in more detail in a "Resident's Manual" in a way that clearly establishes what is expected of both the resident and the Program Director. More will be said about this later.

Curriculum

The curriculum should include nine major elements:

- spiritual and ethical training,
- a systematic textbook-based study program,
- yearly in-service examinations,
- monthly, written case reports or research projects and operative logbooks
- a surgical library with a study area,
- weekly teaching conferences,
- direct supervision of preoperative and postoperative care,
- learning in the operating room under expert supervision, and
- "rotations" essential for surgical practice in the developing world.

Spiritual and Ethical Development

The medical ethics that underlie the practice of medicine as it is generally practiced (with some exceptions) in the Western world are not universally appreciated or practiced in the developing world. Medical students studying in the developing world may learn about the Hippocratic oath but may never see it practiced in their learning environment or incorporate it into their system of core beliefs. But without a system of medical ethics that protects patients' rights and insures that physicians will act responsibly and truthfully for the patient's benefit, the whole practice of modern surgery begins to fall apart.

In some developing countries where there are few physicians, patients may be so desperate that they will give up virtually all of their rights in order to receive a doctor's services. This inevitably leads physicians into carelessness and arrogance and harms both patients and the quality of care. In any training program for sur-

geons, as much attention should be given to developing character and to developing ethical conduct as is given to developing clinical skills. Both are vital to a surgeon's eventual success.

The Hippocratic oath used to be the mainstay of ethics in medical practice in the West. Unfortunately, accountability to a higher authority is not part of the oath. Ethical training may begin with this famous teaching but should not be limited to it. Physicians need to be accountable to each other, to their patients, to the appropriate government officials, and to their Creator.

In more developed countries, the conduct of physicians is not only spelled out in written laws but systematically enforced. Patients' rights are upheld by courts of law. This underlines the importance of teaching residents what the law says about a patient's rights and the rights and responsibilities of physicians. They should be strongly encouraged to respect and obey these laws, even if those laws are ignored by everyone else and are not uniformly enforced. Questions about these laws should be included on their examinations.

Learning about laws and insisting that residents respect them during their training is not enough, however, because laws are an external motivating force that may not always be there. If in some countries these laws are ignored by the medical community or rarely enforced, why should physicians persist in swimming upstream? Unless the motivation to practice medicine ethically is internalized, the newly-trained surgeon will eventually weary of the fight, follow the crowd, and drop to the lowest common denominator of surgical practice.

What motivation could be stronger than uniformly enforced laws, the threat of lawsuits, or the need to satisfy wealthy patients? In the Western world the most powerful influences have been the Judeo-Christian teachings that physicians are accountable to God for their actions.

Neglecting the spiritual and ethical dimensions of a surgeon's training may in the end produce doctors with good surgical technical and medical skills more interested in practicing surgery for their own benefit than for the benefit of their patients. In countries or communities where there are few safeguards, this can prove devastating to patients, to good surgical practice, and to passing surgical knowledge on to other qaulified individuals.

A Systematic Textbook-Based Study Program

Although residents usually read about the cases they encounter on a daily basis and read for their case reports, there needs to be a systematic study program that covers all important and pertinent areas of general surgery. Residents may not become expert in plastic surgery or orthopedics, for example, but they should have some understanding of these fields for future reference. To insure this, Program Directors should select a well-respected and widely used general surgery textbook and establish a systematic reading program for their residents to follow. In a four-year residency program, the reading program should go through most if not the entire textbook twice. It may be helpful for the Program Director to give a weekly quiz and review for the residents the assigned material in a weekly conference.

Yearly Examinations

Residents should not only systematically study an assigned textbook but should be tested over what they have read and heard in formal lectures, on rounds, in the outpatient clinic, and in the operating room. Program Directors should choose a

testing method that works well for their situation. One model that has proven useful is to give residents weekly or biweekly examinations over subjects they are studying and learning, review their answers with them afterwards, and choose questions from these examinations for the yearly in-service examination.

Residents at different levels may be given the same examination but graded differently, depending on their level of training. An alternative would be to give a different examination to each level of residents.

Monthly Case Reports or Research Projects and the Resident's Operative Logbook

Students at all levels learn truth more quickly and completely if they discover things themselves. Monthly written case reports or research projects help residents to find answers themselves to problems they encounter during their training. Requiring written reports teaches them to organize their thoughts and gives Program Directors the opportunity to teach residents how to write papers for medical conferences or for publication.

Program Directors need to give residents some direction with these projects, such as an outline, a sample case report, or a sample research project. They should insist that reports be turned in on time. Residents who turn in reports late should be excused from operating until they have completed their report. When these reports are turned in the Program Directors should write appropriate comments to give guidance. Grading is probably less important than insisting that a resident's reports improve year by year until by the end of his training his reports are good enough to be accepted for a local surgical society meeting or a regional medical publication.

Research projects should be simple and not last more than three or four months until the resident has more experience. The Program Director should help his residents set these projects up so that time is not wasted on hopelessly flawed studies.

Residents should also be required to keep a log of all of the operations they either perform, first assist, or teach to younger residents. This will enable the Program Director to keep track of areas that need more attention.

Since some governments require proof of academic performance, these case reports, studies and operative logbooks should be collated into yearly notebooks and kept as a record of each resident's academic performance and development.

The Surgical Library

It is the Program Director's responsibility to develop a surgical library and to make it available so that residents may read and research whenever needed. It should include appropriate textbooks in the following categories:

- anesthesia
- ENT
- general surgery
- head and neck surgery
- neurosurgery
- obstetrics and gynecology
- ophthalmology
- pediatric surgery
- plastic surgery
- radiology
- surgical nursing

- thoracic surgery
- transplant surgery
- trauma
- urology
- vascular surgery
- current atlases of surgery in as many of the above categories as possible

Textbooks in other areas of medicine should also be included for reference:

- cardiology
- EKG interpretation
- gastroenterology
- internal medicine
- oncology
- pediatrics
- pharmacology

Up-to-date library materials should also be included in the library, either through the Internet or by subscribing to *Selected Readings in General Surgery*.

Weekly Teaching Conferences

If a Program Director cannot find the time for regular teaching conferences during the week, something is seriously wrong with his priorities. The best way to deal with overwork is not to work harder or with greater and greater efficiency, but to get help. In the developing world, the best way to get that help is to train people to do your job as well or better than you can do it. Unless one is planning to simply train surgical technicians, teaching conferences are an absolute necessity.

There should be no less than one hour a week devoted to formal teaching. Two hours a week are better. When visiting faculty come to teach the residents there should be three to five one-hour formal teaching sessions a week, depending on how long the teaching faculty surgeon plans to stay.

The following is a suggested list of the kinds of teaching conferences that should be held:

- mortality and morbidity: once a month
- oral presentations and discussions of written case reports or research reports: once a month
- a review of assigned reading with a written quiz: twice a month
- special sessions for problem areas: whenever needed

The residents should actively participate in planning the mortality and morbidity conferences and in making oral presentations of their written case reports or research projects.

Direct Supervision in the Preoperative and Postoperative Care of Surgical Patients

Residents first need to learn how to work up and present them properly. This is best done in an outpatient or emergency room setting where a resident sees the patient first, takes a history and does a physical examination on his own before presenting the case to an attending surgeon. Other learning opportunities occur when other services request surgical consults. History taking, physical examinations and presenting skills are taught somewhat vigorously to medical students in North America but may be neglected in some developing countries.

Preoperative and postoperative care is best taught by making frequent rounds with the attending surgeon on patients hospitalized in the surgical wards and in the recovery room, and by encouraging residents to make quick end-of-the-day rounds on their own. Once their assessment skills are adequately honed, residents should be given the responsibility of making rounds on their own once or twice on weekends. Until they are senior residents, they should always be instructed to call in an attending surgeon if there is a question or a major complication.

Operating Under Expert Supervision

Residents need to operate—not just watch—to learn surgical techniques. Of course, they should begin by learning basic skills, but as rapidly as possible they should begin handling and using suture scissors, needle-drivers, forceps, the scalpel, dissecting scissors, and the electrocautery pencil for both coagulation and cutting. During the first few weeks of training it may be appropriate to concentrate on sterile technique, gowning and gloving, setting up instruments on the table and Mayo stand and prepping and draping the patient. A week or two can be devoted to assisting and watching, *but as soon as the resident shows proficiency in these areas he must be allowed to perform a part of the operation*. For example:

Week 1:

- Introduction to the operating environment
- Preparing the patient for surgery (position, monitors, etc.)
- Scrubbing, gowning and gloving
- First or second-assisting in surgery
- Learning to tie knots
- Moving the patient from the O.R. to Recovery
- Recording operations in the resident's logbook

Week 2:

- Learning to choose and open sterile packs
- Learning to drape the table and Mayo stand
- Laying out the instruments
- First-assisting in surgery
- One and two-hand knot-tying
- Learning to instrument tie
- Doing part of the skin closure

Week 3:

- Learning to give spinal anesthesia
- First-assisting in surgery
- Closing the skin using instrument ties
- One and two hand knot-tying practice
- Writing post-op orders
- Checking on patients in Recovery throughout the day and reporting back

Week 4-12:

- Learning to give spinal anesthesia
- Learning to use ketamine anesthesia
- Learning to use local anesthesia
- First-assisting in surgery

- Closing the subcutaneous tissues the skin
- One- and two-hand knot-tying practice
- Writing postop notes and postop orders
- Checking on postop patients throughout the day and reporting back

As soon as a resident masters a technique or a skill, he should be challenged by his teacher to advance to the next level of technical expertise. Residents learn faster and better by doing than by watching, even if they attempt and fail.

By no later than the third month, first-year residents should have enough skills to begin doing some part of every operation under supervision. As the resident progresses, he should do an increasing percentage of the operations that he is familiar with. By the end of 12 months, a first-year resident should be able to do *at least* the following procedures from start to finish:

- Spinal anesthesia
- Ketamine anesthesia (IM or IV)
- Local anesthesia
- Small, simple hernias (inguinal, umbilical, epigastric)
- Removal of small, superficial, benign soft tissue tumors
- Incision and drainage of subcutaneous abcesses
- Incision and drainage of phelans, simple finger abcesses, and nail removal
- Closure of simple lacerations
- Plastic suture of small to medium facial lacerations
- Venous cut-downs in the antecubital fossa and the ankle
- D & C's
- Bartholin cyst I&D with marsupialization

This is not a complete list and is only meant to be a guide. The point is that surgery residents should be taught to operate *as early as possible in their training* and not at the end of their residency. This gives attending surgeons enough time to build a resident's skills so that by the end of the fourth year the resident will be able to safely and competently perform invasive and complex operations and will have the skills to learn new operations on his own.

Essential "Rotations" for the Developing World

Since most one-surgeon hospitals will have only one surgical service for all surgical patients, residents will not rotate onto different services during their training. Instead, they will encounter a mix of patients with problems in all of these areas. It is up to Program Directors to assure that their residents receive adequate training in each area by either teaching them himself or by inviting other surgeons to come help him.

General surgeons in the developing world rarely have the luxury of practicing their specialty within the narrow limits that are defined in the West. Few hospitals are staffed with more than one surgeon, and if they are it is unlikely that they will have more than one or two surgical specialists. For example, few localities have enough urologists to deal with everyone with urinary strictures or prostatic enlargement causing urinary retention. Few towns or small cities will have an orthopedic surgeon on hand to deal with serious fractures. Where surgical subspecialists are lacking, if patients with these kinds of problems are going to receive competent help it will usually fall to family practice physicians or to general surgeons to fill the gap.

This is equally true in the area of anesthesia. Surgeons working in the developing world do not always have the luxury of working with an anesthesiologist or a trained anesthetist. Although it is far from ideal, in these situations it is only the surgeon

Table 1. Surgical experience of trainees

Rotation	% of Training Times	Months*
• General & thoracic surgery	38.6%	17
• Gynecology	14.6%	6
• Urology	13.6%	6
• Orthopedics	13.6%	6
• Pediatric surgery	5.7%	2.5
• Neurosurgery	5.0%	2.5
• Plastic surgery	4.5%	2
• Anesthesia	2.2%	1
• ENT/ophthalmology	2.2%	1
• Vacation (1 month/yr)	-	-
TOTAL:	100%	44 months

*percentage of 44 months of training

who is able to competently and safely administer an appropriate anesthetic who will be able to perform a required operation anywhere at any time.

The following is a suggested breakdown of surgical training for general surgery residents in the developing world:

Making the Model Work

The Length of Surgical Training

How long should it take to train a surgeon? There is no absolute answer because residents learn at different speeds. Nevertheless, if the goal is to train qualified general surgeons to an internationally recognized level of competence, the process will require a minimum of four to five years. This is as true in the developing world as in the West.

The Teaching Environment

The teaching environment needs to include an adequate operating room with autoclave capabilities, a recovery room, a surgical ward, an outpatient clinic with emergency management capability (or an emergency room), a conference room, and a surgical library.

Although a surgical training center should have the skills and equipment necessary to perform general, inhalational anesthesia whenever indicated, the operating room does not need to be equipped with a wide array of the latest in instrumentation or sophisticated equipment to serve well. Nor does it need a large staff of support personnel. Most operations requiring only a spinal anesthetic where blood loss is minimal and where the operating time is under 90 minutes can be carried out with three people: a circulating nurse who monitors the pulse and blood pressure, a resident or surgical assistant, and the surgeon. While a pulse oximeter and automatic blood pressure monitor are helpful, they are not absolutely essential. Many surgeons have their circulating nurses monitor the patient's pulse and blood pressure manually, chart the results and announce them loudly every five minutes. If patients develop problems a fourth person can be added to the team in minutes.

Operations that last longer than 90 minutes, are complicated or potentially life-threatening in one way or another or involve significant blood loss indicate the need for an additional assistant with training in anesthesia. This is of course also true for patients who are unstable or who require general anesthesia.

Surgeons have performed complicated and difficult surgery in a wide variety of primitive settings, some of which may be important for surgeons in training to experience. Almost any clean, well-ventilated, screened and well-lighted room (including a tent) will serve as an operating room. The table only has to be long enough and high enough, narrow, sturdy enough, and well-padded to protect the patient. Operating room lights can be fashioned out of 12-volt automobile lights or standard fluorescent lights in parallel or attatched to a square wooden frame. Although air-conditioning has many advantages, it is not strictly necessary. If the operating room is kept dust-free, a clean electric or battery-powered fan can cool both the patient and the surgeons without significantly affecting the postoperative infection rate. Suction can be provided by small electrical vacuum pumps (even a vacuum cleaner attatched to a suction cannister) or by foot-operated pumps.

Suture material can sometimes be a problem. Residents should gain experience with as many suture materials as is practical. They should also learn to use "fishline" sutures. This kind of suture is made for 36 inch lengths of locally available fishline. The precut lengths are soaked in a sterilizing solution and removed and rinsed with sterile water as needed. These suture materials require that an appropriate selection of sterile surgical needles be included in the autoclaved surgical packs.

A wide variety of techniques are used around the world to sterilize surgeons' hands and forearms prior to gowning and gloving. In the developing world some have resorted to boiling water in basins for surgeons to use in scrubbing themselves and their patients. Our experience has not demonstrated that sterile water has any advantage over scrubbing and rinsing with clean but untreated river or rain water in preventing the development of postoperative infections.

The Resident's Manual and the Yearly Contract

Below is a suggested list of subjects that should be spelled out in a manual for the resident:

The Resident's Manual

1. Responsibilities of the resident
   - A. Supervised and unsupervised ward rounds
   - B. Night and week-end call
   - C. Limits of responsibility
   - D. Team leadership
   - E. The resident's operative logbook
   - F. Preparing and presenting monthly written case reports or research projects (include examples)
   - G. Hospital rules and regulations
2. Responsibilities of the Program Director
   - A. "Hands-on" training from day 1
   - B. Formal teaching conferences
   - C. Reviewing and correcting written papers
   - D. Preparing in-service examinations
   - E. Developing the surgical library, ordering textbooks

   F. Establishing a systematic textbook-based reading program
   G. Providing yearly certificates following promotion
   H. Insuring the health and well-being of residents and their families
3. Working with visiting surgeons (faculty)
4. The weekly work schedule
5. The chain of command
   A. When the Program Director is present at the hospital
   B. When the Program Director is away
   C. With the Administrative Director (if there is one)
   D. With other hospital physicians
   E. With hospital personnel
   F. Disciplinary procedures
6. Outlines for monthly written case reports or research projects
7. The printed reading schedule
8. Requirements for spiritual and ethical development
9. English language training requirements (where applicable)
10. Time off and vacations
11. Requirements for promotion and graduation

The yearly contract should be between a resident and the Training Center. It should include a statement to the effect that the undersigned understand what is written in the document and agree to abide by it, followed by the date, their signatures, and the signature of a witness. It should probably cover the following subjects:

For the Resident:

- An agreement to abide by the hospital's written rules and chain of command;
- An agreement to respect the hospital's employees;
- An agreement to abide by the rules, duties, and responsibilities laid out in the Resident's Manual;
- An agreement on the amount of salary, health, and housing benefits to be provided by the hospital;
- An agreement to abide by the Program Director's decision in regards to promotion or dismissal.

For the Training Center:

- An agreement to abide by the hospital's written rules and chain of command;
- An agreement to abide by the rules, duties and responsibilities laid out in the Resident's Manual;
- An agreement on the amount of salary, health benefits, and housing benefits to be provided by the hospital;
- An agreement about the procedures to be followed if the Program Director sees that a resident is behaving unethically, is insubordinate, or is falling behind academically or in the development of his clinical and surgical skills.

The contract should be signed by the resident, his Program Director, and the hospital administrator. Spelling out these responsibilities in writing will avoid misunderstandings, provide stability and discipline, and enhance everyone's performance.

Requirements for Promotion and Yearly Certificates

A Resident's Promotion to the Next Level Should Depend on Three Criteria:

1. ethical and subordinate conduct
2. academic performance
3. the development of clinical and surgical skills

A resident who frequently behaves unethically or who is insubordinate to either his Director or the hospital authorities should not be promoted and should probably be dismissed.

Academic performance should be measured by the results of the yearly in-service examination, by the quality of the resident's monthly written reports or research projects, by his completion of assigned reading, and by his level of participation in teaching conferences. A resident who fails in one or several of these areas and is marginal in the others should not be promoted. He could either be given the opportunity to repeat the year or dismissed.

Clinical and surgical skills may be more difficult to judge, but if a resident is clearly lagging or repeating again and again the same clinical or operating room mistakes, he should probably be given the opportunity to repeat the year.

When a resident is promoted he should receive an attractive, signed certificate of achievement certifying that he has completed that level of surgical training. Ideally a high official from the Ministry of Health or Education should sign the certificate along with the Program Director, but if these officials are not interested in issuing or signing such a certificate or it if the request could create problems for the training program, the certificate should be signed by the highest officials within the institution. Whenever possible certification should fall under the auspices of an international medical or surgical society to provide additional credibility.

When a resident completes all four or five years of residency training the same holds true for the diploma he is awarded. It should not be a simple certificate, but should be a high-quality document that reflects the significance of his achievement to anyone who sees it.

To protect the residents and the institutions that train them, the requirements for promotion and graduation should be included in the signed, yearly contract and the Resident's Manual.

The Importance of English

It is an inescapable fact of life that the majority of the surgical literature in the world is in English. Most medical conferences are held in English, and most visiting faculty speak only English. Program Directors should do everything possible to provide for their residents at least their major surgical textbook in a language with which they are comfortable. But unless their residents are already fluent in English they should provide an opportunity for them to learn English and should probably insist that they develop fluency in English. This will help them immensely to be able to communicate directly with visiting faculty, read English textbooks and journals, read articles on the Internet, and understand what is said during medical conferences where English is the primary language.

Attending National and International Medical Conferences

Ideally, surgery residents should attend one or more medical conferences a year. Although the limiting factor will usually be financial, Program Directors should do everything they can to make it happen.

Attending regional and international conferences enables residents to network with other physicians, gain experience in critiquing papers that are presented, present their own papers, and learn from others. It also legitimizes well-conceived and organized surgical programs and allows other physicians to take the measure of surgeons in training. It may even encourage other surgeons to help in some way to improve a training program and improve its standing in the medical community.

Conclusion

Some surgeons working in the developing world have concluded that the obstacles to training adequate numbers of qualified surgeons for their countries are insurmountable. As a result most have quietly trained nurses to operate. Others have trained doctors to operate but have felt incapable of training them to their own level of competence without help. Others have simply been the best surgeons possible without training anybody. Because of an ongoing and increasingly severe shortage of surgeons none of these choices have done much to make quality surgical care more available or affordable to the average citizen in the developing world.

Despite the apathy or even antipathy of governments or of the surgical community as a whole, we believe that in countries where there critical shortages remain a surgeon working alone can and should reproduce himself. He is more likely to be successful if he networks with other interested surgeons both within and beyond the borders of his country of service and if he associates his effort with an international surgical society dedicated to surgical education. The establishment of the Pan-African College of Christian Surgeons is an example of surgeons working in hospitals throughout the continent of Africa creating an association to develop surgical residencies in existing hospitals. These efforts to increase and upgrade surgical education in the developing world deserve the enthusiastic support of both private and government surgeons and of national and international surgical societies.

CHAPTER 39

Mobile Surgery

Edgar Rodas and Edgar B. Rodas

Introduction

In this age of technology, informatics and communication, those of us who have access to these amazing tools, have a great advantage and can utilize them for our well-being and benefit. However, we cannot overlook the immense disparity that exists between first and Third World countries. Therefore the word "globalization" should make us reflect on the responsibility we must all share for bridging the immense gap between these worlds.

In the medical field, an ongoing challenge in developing countries is acquiring the means to reach the majority of the population and offer them the advances and benefits of today´s science and technology. We have been able to equip and staff the major hospitals with near the same capabilities as those seen in developed nations. However due to the widespread geographical location of the patient population, high costs, and inadequacy of roads and communications, these benefits are unfortunately reachable to only a small percentage of the population, leaving the majority of those in need without coverage or access to, even the most basic healthcare needs.

As surgeons working in the developing world, our duty is not only to take care of the patient population that can easily reach us, but rather to search for ways to reach out and treat those unable to attend our institutions.

History and Fundamentals

The concept of performing operations on the field is certainly not new. In ancient times it is known that a rudimentary type of surgery was in place. One of the many examples constitute our ancestors, The Incas in the Andean mountains of South America. Skilled individuals in this culture performed trephinations in an attempt to heal certain conditions although with little success. In the seventeen century many military surgeons, such as the Frenchman Ambroise Pare, were bound to take their instruments, knowledge and art into the battlefields and carry out gross surgical procedures in a desperate attempt to save the wounded men.

In modern days MASH (Mobile Ambulatory Surgical Hospital) units have proven to be superb examples of the efficiency of mobile surgical care. In times of peace, several mobile healthcare delivery systems have also been organized and assembled with the use of technology. These mobile systems take advantage of the various means of transportation available to reach underprivileged areas worldwide.

Parting from the needs of our people, a nonprofit institution (CINTERANDES) was born and the concept of Mobile Surgery (MS) was developed, in part inspired by the effectiveness and experiences observed in several of the above mentioned mobile systems. Advances in surgery and anesthesia have enabled us, with the help

Surgery and Healing in the Developing World, edited by Glenn Geelhoed.

Figure 1.

of technology and ingenuity, to custom build an operating room in a van, making possible to transplant our selves and our medical capabilities from the fixed medical centers to the underserved suburban neighborhoods and country side communities.

Over the past five years The CINTERANDES Foundation in cooperation with the Medical School of the University of Cuenca (Ecuador) has introduced into the Andean mountains, Coastal region and Amazon jungle of Ecuador a different and innovative method of surgical care, Mobile Surgery (MS).

Rather than taking selected patients who require surgery to a hospital, we bring a fully equipped operating room to the communities where the operations, recovery and postoperative follow-up take place.

Overcoming The Roadblocks

Despite facing many hurdles and disadvantages the project has been successful in providing specialized medical treatment to people that otherwise have had no option for attending their surgical needs. In many aspects we believe that we not only met our expectations but that we have well surpassed them by integrating components that were not thought of when the program first spun its wheels.

On a 24 foot Isuzu van, an operating room and a preparation room were installed (Fig. 1). We could have used more space, but a bigger vehicle is difficult to drive in the winding and narrow Andean roads. The operating room is equipped with an operating table and light, anesthesia machine and monitoring equipment, suction, electro surgical unit, a Mayo and side table. Compartments for medicines and surgical supplies were built in the walls of the room. And lately with continuing support and help of our friends in the USA we have been able to equip our Mobile Surgical Unit (MSU) with laparoscopic equipment and low bandwidth telemedicine capabilities. The unit contains also a preparation room with a scrubbing sink, an autoclave and cabinets for supplies. A bathroom is also used as a changing room.

We have simplified the trays to contain only the indispensable instruments. There are three types of basic sets: one for major surgery, such as cholecystectomy and hysterectomy. (To these sets we add the specific instruments according to the type of

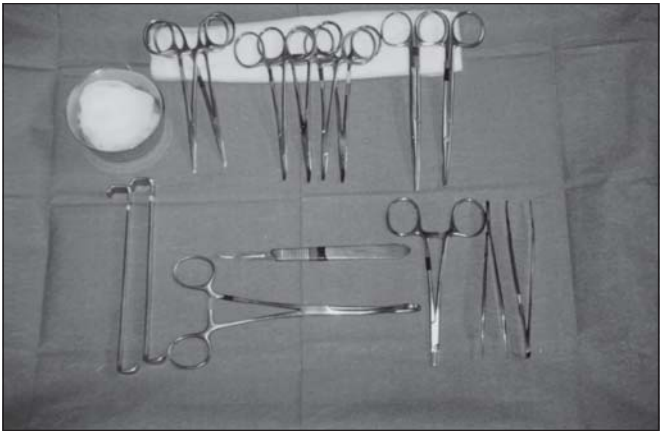

Figure 2.

operation), another for herniorrhaphy and similar operations in adults and a pediatric tray (Fig. 2).

We frequently use "home made instruments" that come from the ingenuity of our colleges either from our country or abroad. For instance, skin hooks made of an applicator and hypodermic needles. Suction drains made of I.V. tubing and syringes to create the vacuum mechanism. Safety pins of different sizes are used as auto static retractors (Fig. 3). Rubber bands kept with slight tension around the intestine and held by a hemostat are used as intestinal clamps.

Program Strategy

Rural doctors contacted by our personnel do the first screening of patients with surgical problems. Initially they worked with children in local schools but later we had requests from adults, so we cover patients of almost all ages.

When the rural doctor has selected a group of patients, a surgeon and an anesthesiologist from The CINTERANDES Foundation go to the area to make the preoperative consultation, a carefully history and physical examination are carried out, the accuracy of the diagnosis is checked, laboratory and image exams are requested when necessary. Based in numerous reports and our experience, we do not ask for routine laboratory or image tests.

Selection of patients is very important. We do not take individuals with additional pathology, patients of very advanced age or when we anticipate a complicate operation. Once patients have been selected we explain to them or their parents the operation and its risks, as well as the risks of leaving the pathology unattended, we give the preoperative instructions and decide the day we are going to bring the MSU for surgery.

The day of the operation the MSU is properly cleaned and sterilized. It is parked next to a health center, a school or a community house where a preparation room and a recovery room are arranged. Sometimes we arrange these facilities in two tents. Patients are again interviewed and examined to make sure they followed the preoperative instructions and did not develop any additional pathology as respiratory or intestinal infections. Children are sedated with 0.4 Midazolam/kg. per os.

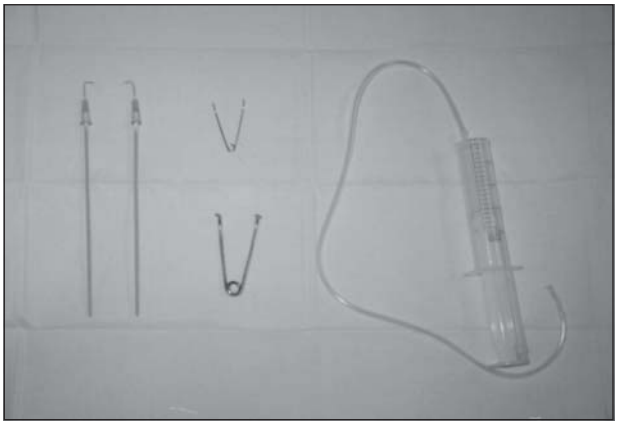

Figure 3.

Children are given general anesthesia plus local or troncular infiltration of Bupivacaine to control postoperative pain. Adults are operated most of the times under epidural or local anesthesia and some times under general anesthesia.

The operation is carried out meticulously (Fig. 4) and according to a prestablished protocol. Patients are carefully controlled until they recover and sent or taken home when they fulfill discharge criteria that have been determined, when there is no risk of anesthetic or immediate surgical complications.

They are left in charge of the local medical team but a surgeon and anesthesiologist of CINTERANDES are continuously available by phone for consultation.

Figure 4.

Telemedicine

Lately we are using the support of Telemedicine. We have conducted preoperative and postoperative interviews with patients with two computers communicated through standard telephone lines or Internet. We have also transmitted pictures of lesions or diagnostic images (X-ray pictures or sonograms) and we have conducted telementoring sessions during laparoscopic operations performed in the Ecuadorian Amazonic jungle and projected life in Yale University a New Haven CT.

We have also established telecommunication during surgery with the Department of Surgery of the Virginia Commonwealth University.

Teaching

Besides serving rural and suburban communities, we have a teaching program for medical and nursing students and surgical and anesthesiologist residents. We are affiliated to the University of Cuenca-Ecuador and we constantly receive visiting students from several universities of the United States, as well as students from Europe and Latin America.

Besides teaching them the art and science of surgery and anesthesia we try to awaken in them the principles of solidarity and compassion for our fellow men and women.

Research

We are always conducting some research programs comparing the mobile system with the standard hospital care, regarding to complications, costs and patient acceptance. We also study alternative surgical and anesthesia procedures, looking for excellence in our health delivery system.

Results

After six years of work with an excellent motivated and trained voluntary team and the growing support of our communities, we have performed over 3.000 operations in General, Urologic, Gynecological, Reconstructive and Ophthalmologic surgery (Tables 1 to 7) at a much lower cost and with greater patient´s acceptance. We take care of people that otherwise have few possibilities of access to surgical care and we do in their own habitat, taking very little of their working time and their family´s. Special bonds are created between the members of the team sharing this humane adventure and between the team, local doctors and patients. Also the relationship between the patient and his or her family is strengthened after closely sharing the surgical experience and participating in the postoperative care.

We have had no mortality and the complications rate comparable with the most advanced medical centers in the world. We have contributed to the education of several promotions of students and residents and have received over one hundred foreign students. Over a dozen articles have been published about our experience and research programs in journals and books from Ecuador and the United States.

The Future

We believe that Mobile Surgery should be expanded. We have already contributed to a similar program in Honduras and the Ministry of health from Ecuador has under way a plan to expand the system.

If Surgery, with its need of sophisticated technological support can be brought out of the hospital any other branch of medicine can. A mobile system of school health and general medical care is starting in our Country.

We have realized that surgery, because its immediate, objective and sometimes spectacular results is an excellent mean to gain credibility and confidence from the community opening the door for other programs whose benefits are not obvious for the general population, but have a deeper long term impact like nutrition, health education and maternal and child care.

We are currently developing a pilot program on Human Development to follow Mobile Surgery in rural and suburban communities.

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CHAPTER 40

Public Health Problems on Burma Frontiers: A Window into a Nation in Crisis

Myaing Nyunt

In 1999, I spent about 2 months in areas on the western border of Thailand with Burma, working with a group of physicians and local staff from the Shoklo Malaria Research Unit (SMRU) as part of an elective medical school rotation. The SMRU is a nonprofit, field-based operational research organization, primarily providing malaria diagnostic and treatment services, antenatal and delivery services, and a comprehensive family planning and AIDS/HIV education program to populations living in the area since 1984. The populations include ethnic Karen refugees from Burma in several camps along the Burma and mobile migrant workers, mostly from Burma.

The Karen people, one of the largest ethnic minority groups in Burma, have been living on the mountainous, forested western border areas of Thailand for many years, either in small villages or in refugee camps. Shoklo refugee camp was set up in the late 1970s, with a population of about 6,000. The SMRU first set up a clinic in the camp in 1986, providing malaria management and antenatal care. The camp was attacked and destroyed in a cross border raid by the Burmese military in 1996. Most of the refugees from the camp were moved to a new camp called Mae La in a more secure part of Thailand. Now Mae La camp has a population of 33,000 refugees. The camp is supported by nongovernmental organizations from several countries including the U.S., and medical care is mainly provided by the Medicins Sans Frontieres (MSF) and the SMRU.

Burma is a country of about 40 million people and several ethnic groups. It gained independence from the British government in 1948 and enjoyed democratic freedom until 1962 when the military took over power. Since then Burma has been ruled by a military dictatorship of one form or another, and political instability, military repression and severe economic decline have forced many of its people to migrate into neighbouring countries, especially Thailand. Many ethnic resistance groups, including Karen, Kachin, Mon, Shan, Karenni, and Arakanese, have been fighting against the central Burmese government unsuccessfully for their freedom. The fighting has also created many refugees.

In 1988, there was a nation-wide, pro-democratic uprising that involved people of all walks of life and all ethnic groups in Burma. The movement was brutally crushed resulting in thousands of deaths and massive migration of mostly young people into Thailand. A general election was held in 1992 when the National League for Democracy, a leading opposition party won a landslide victory. The military,

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however, refused to transfer power and put Aung San Suu Kyi, the leader of the party and winner of the Nobel Peace Prize under house arrest.

I was one of the many people who fled Burma in 1988. I was in my last year of medical school in Burma, about 7 months away from graduation. I spent 2 years on the Thailand-Burma border and in Thailand, working as a medic and helping set up medical facilities for newcomers who were struck by malaria and other illnesses. I left Thailand in 1990 to take refuge in England, and immigrated to the US in 1991. I graduated from George Washington Medical School in 2000. I continued my education at the Johns Hopkins School of public health and obtained a masters degree in 2001. I am now working as a medical house officer at Johns Hopkins Bayview Medical Center in Baltimore.

As I mentioned above, I went back to the Thailand-Burma border in the last year of my medical school to work with the SMRU, my first trip back to the area in 10 years. The fundamental situation on the border had not changed much since I left. The main difference is that there are more people in greater desperation and in more need of help—and also many more outsiders providing help.

There are now some 100,000 refugees living in camps along the border with Thailand, and there are estimated to be more than 1 million illegal immigrants from Burma living inside Thailand. This has an impact not only on the social and economic structure, but on the management of medical problems in the area.

The "border population" can be seen as a mosaic of various communities linked by cultural and/or geographical similarities: Thai nationals (the majority are ethnic Karen) who have settled in the area for years; refugees in established camps who have fled political repression and conflict in Burma; and migrant workers from all ethnic groups (Shan, Karenni, Karen, Mon and Burman) who travel back and forth across the border in search of work.

In recent years, the challenge of medical management for all three groups, especially malaria control, has grown. In the refugee camps, that challenge has largely been met thus far. In collaboration with the medical NGOs working in the camps, the SMRU has managed to develop a strategy of malaria control resulting in a dramatic reduction of mortality and morbidity related to malaria, as well as the protection of existing medicines against resistance developed by the parasite *Plasmodium falciparum*. In well established refugee camps in this area such as Mae La, the health situation has been improved, and the impact of malaria associated mortality and morbidity has been significantly reduced since 1986, when the SMRU and MSF began provision of medical services, which include weekly antenatal screening of blood smear, prompt treatment, and health education. Before the introduction of antenatal services to the camp population, severe malaria during pregnancy was a major cause of maternal and fetal mortality. The annual maternal mortality directly related to malaria was greater than 1%. There has not been a single death from malaria in pregnant women living in the Mae La camp since the introduction of the antenatal clinic (McGready and Nosten, 1995).

The health situation outside these refugee camps, however, is of a different standard.

The migrant worker population in particular greatly complicates the task of the Thai malaria control programme because of language barriers, cultural differences and access difficulties. As a result, many individuals remain out of reach of the otherwise highly efficient malaria control efforts. Unlike refugees, the migrant workers are highly mobile, and the majority do not have access to basic health care.

The major problem with diagnosing and management of malaria in the migrant worker population on the Thai-Burma border is the instability of the population itself—although the diagnostic method is relatively simple, it still requires significant establishment i.e., lab equipment, skilled personnel. A large percentage of this population is exposed frequently to the infection and is not reached by medical personnel easily. Most people in the area are familiar with the common symptoms of malaria, and are willing to self-medicate presumptively whenever they have a bout of fever. Antimalarial drug use in the population in this area therefore takes the form of indiscriminate and unsupervised self-medication. This is believed to be the major driving force behind the development of resistance to the last remaining antimalarials. (Luxembruger et al, 1996).

As a result, today the world's most resistant malaria strains are found along the eastern and western borders of Thailand. Along the western border of Thailand, *P. falciparum* has become resistant to most of the available antimalarial drugs. The pregnant population suffers most from this because only very few antimalarial drugs are indicated in pregnancy. The only drug that is recommended in pregnancy is quinine, which has a failure rate more than 35%. Alternative treatments are limited either by lack of information on the safety of the drugs on human pregnancy or their poor efficacy (White, 1998).

Many factors compound the difficulties in the management of malaria. The clinical features of malaria are nonspecific, making the kind of clinical diagnosis that is most convenient and possible in the setting of this population unreliable. Presumptive treatments that are common in this population, and the instability of the population both contribute to the multiple drug resistance problems and to complications of the disease that can be serious, even fatal. Treatment options are severely limited, especially for pregnant women, and the development of new antimalarial drugs and of a vaccine is not likely in the foreseeable future (White, 1998).

Several studies have shown that the same resistant strains found on the Thai-Burma border are also appearing in Cambodia, Burma, Laos and Vietnam. These problems move across borders in southeast Asia as people move across borders. Just as HIV/AIDS moves along drug trafficking routes across Burma's borders to neighbouring countries, drug-resistant malaria also travels, fueled by the practices of migrant workers who are not reached by health workers. We learned recently that there are hundreds of patients with severe, cerebral malaria in Myit Kyee Na, a city in northern Burma—an example of a problem spreading from the Thai-Burma border back into Burma. The combination of an ideal environment for the growth of malaria parasites, infected patients with sub-therapeutic concentrations of anti-malarial drugs in the blood, and the travel of those patients in and out of the area contributes to the increasing level of resistance.

But malaria is far from the only problem on the Thai-Burma border. When I was working with the SMRU at Mae La and the mobile clinics, part of my frustration came from patients with other common, manageable, treatable medical problems such as hypertension, heart failure, skin infections, etc. It was almost a relief when we had a patient with fever and positive blood smear for malaria. The SMRU is a malaria research unit and the mandate is to diagnose and treat malaria. It is poorly equipped with clinical and logistical support for any other medical problems. Therefore whenever we saw patients with "other medical illnesses" the level of stress would go up. Is it justifiable to refer this patient to other medical facilities? Who is going to pay for it? When should this patient be sent? How long should you wait? How much

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time can you buy before a real emergency arrives? These questions were compounded by even greater complications when we were at mobile clinics seeing migrant workers, since these people had no legal status in Thailand, making it almost impossible for them to be transferred to other medical facilities. Even in my limited experience, I have seen much waste of life due to delayed management caused by the lack of logistical support for nonmalaria care.

I came back to the US after 2 months of an incredible amount of learning, excitement, frustration, and sadness on the border. That first trip motivated me to read and research more about malaria and other tropical diseases, and to be curious about how NGOs work with the population on the border.

Five months later, I was invited by the International Rescue Committee (IRC) to help with medic training in another group of refugee camps near Mae Hong Son, a small border town located on the northern border of Thailand with Burma. The IRC is a US organization, based in New York, that provides considerable support in humanitarian crisis situations all over the world including Burma.

Working with the IRC was a slightly different experience. I worked exclusively with medics doing bedside teaching and training on basic wound care and trauma management. The common problems we saw were similar: mostly infectious diseases ranging from HIV to malaria and dengue; from typhoid, to diarrheal diseases to septic abortion, from pneumonia to skin and eye infections. We also saw a significant number of patients with untreated or unrecognized hypertension, heart failure, and renal failure.

When I was with the International Rescue Committee, I worked closely with a Burmese-Canadian doctor named Win Myint Than. She has been trying to develop a training system that adopts the health system setup in rural Burma where you have one doctor per township of a large population. This is an umbrella system in which many multipurpose health workers including health officers, nurses, midwives, medics, lady health visitors work in the community under the supervision of the doctor they do health education, diagnosis and treatment, referral, transport. By emulating this system on the border, we not only make it easier to reach every little corner of the community there, but we set ourselves up to go back into Burma one day and to fit right in to the effective preexisting system, but with newer and more up-to-date skills and information.

I have gone back and forth between the US and the border area a few times now. Aside from my experiences with the SMRU and the IRC, I have also worked at a medical clinic, Mae Tao, led by Dr. Cynthia Maung, that deals exclusively with illegal migrant workers from Burma.

Throughout the Thai-Burma border area, there are also, in my humble opinion, three huge hidden silent problems. One is chronic malnutrition. I don't remember how many patients with B1 deficiency I saw; many are either pregnant women or new mothers. In America, we see B1, a very basic vitamin, deficiency only in patients with chronic alcoholism. A second hidden problem is psychological trauma—mostly the trauma of fleeing and fighting and witnessing atrocity and bloodshed, and in a significant number of cases, the trauma of domestic violence. That is strongly related to my third problem: addiction to alcohol and drugs.

These problems are made worse by the almost complete absence of basic health education. I met many people who still believe that malaria comes from eating bad bananas. I met many mothers who strongly believe that they should not give any fluid or food to kids with bad diarrhea and who sadly watch their kids slowly fade

away. I met many frightened young people who did not know they cannot get HIV from handshaking and touching the infected person.

The obvious language and cultural barriers are one of the obstacles NGOs face in conducting public health education on the border. The border population is complex, with people originating in different areas carrying a strong sense of ethnic identity and their own health belief systems. Between care providers and the local population there is also a gap in understanding and perception of human diseases. In such circumstances, there is almost a complete lack of continuity of care. As a result, the effectiveness and sustainability of the health education system on the border is less than optimal, despite much effort in terms of money and manpower.

The greatest frustration in dealing with these medical challenges along the Thai-Burma border is the knowledge that all are rooted in problems inside Burma—the political and social conditions that drive people across borders and the lack of basic health care infrastructure and education in the country. Knowing that for every malaria case we could treat, five more would be coming from Burma with no knowledge of how the disease spreads and how to avoid drug resistance. Knowing that for every migrant worker we could teach to avoid AIDS, more would be coming already infected with the virus. Knowing that under present conditions in Burma, we cannot hope to set up inside the country even the inadequate health infrastructure that exists in the border region today.

One measure of the problem inside Burma is that there are very few reliable measures of the problem. Comprehensive public health research is impossible in a country where official statistics have been known to be inaccurate, and institutions independent of the government cannot freely operate. But UN estimates suggest that between 400,000 and 700,000 people are infected with HIV out of a population of 45 million, making Burma one of the four hardest hit countries in Asia, along with India, Cambodia, and Thailand. Burma has an estimated half million heroin addicts, and the HIV infection rate among IV drug users is the highest in the world, according to the WHO.

We know that Burma has multiple risks and vulnerabilities: needle sharing among addicts; an unsafe blood supply and lack of universal precautions in health care settings; heterosexual transmission facilitated by a growing local commercial sex industry; the trafficking of Burmese women and girls into the regional sex industry; untreated STDs; very low condom use and availability; cultural traditions that deter people from talking about the behavior that spreads AIDS, though they don't seem to prevent people from engaging in the behavior itself.

Under normal circumstances, we could devise strategies to deal with each and every one of these vulnerabilities. Unfortunately, each and every one would require a national effort strongly backed by the government of Burma. The government, to this point, has shown little interest in such an effort. Public health needs of the Burmese people have been systematically neglected. Instead of growing to meet a public health emergency, Burma's public health infrastructure has been shrinking. The problem has not been one of poverty—but of priorities.

I saw some of it growing up and in my years as a medical student in Burma, but the situation has grown worse in the last decade. According to the UN, Burma spends 222 percent more on its military than on health and education combined. Only three countries in the world have a worse ratio. The number of hospital beds in the country declined by one-third between 1986 and 1996 at a time when the military doubled in size. Burma is an epicenter of the southeast Asian AIDS crisis,

but the ruling regime has consistently denied the extent of the problem; it has denied the existence of prostitution, which is rampant and growing. Until a few years ago, condoms were illegal in Burma; even now, they are restricted and unaffordable. In 1996, Burma's National AIDS Program budget was estimated to total $50,000 US dollars. There have been virtually no public information campaigns on AIDS prevention.

Moreover, the lack of resources devoted to health care combined with many years of repression have driven countless medical professionals out of the country. Independent medical organizations that once existed, such as the Burma Medical Association, have come completely under central control, with politically suspect members kicked out.

A second problem in the past has been that Burma's ruling military has generally denied that the AIDS epidemic exists. Senior officials have repeatedly stated that reports of the extent of HIV infection, as well as of drug use and of prostitution, are part of an outside plot to discredit and destabilize their country. Very recently, one of the military junta leaders, Khin Nyunt conceded for the first time that the problem is real, and researchers have obtained from the government its first relatively honest survey data, revealing, for example, that a majority of sex workers and IV drug users in Mandalay are HIV positive. But it is still far from clear if the government as a whole is committed to discussing the problem openly.

Finally, and perhaps most important, some government policies have contributed to the spread of the disease, both within Burma and across its borders to Thailand, China and India. Since there is no free press and the government is deeply suspicious of any activity beyond its ability to control, ordinary citizens can do little to spread information against the disease or to organize themselves to fight it. Widespread corruption and official tolerance encourage the drug trade within Burma. Then there is the military's fight against ethnic minority peoples on Burma's frontiers—it's so called "four cuts" policy—which involves forced population transfers, village and crop destruction, and terror tactics including rape and executions. These policies have pushed hundreds of thousands of civilians off their land. Perhaps most important from the point of view of the AIDS epidemic, they have driven thousands of women across Burma's borders into the regional sex industry.

Studies among sex workers in Thai brothels where Burmese women predominate have found HIV rates of 50-70%; similar rates are now being reported for brothels inside Burma. There have been press reports that Burmese sex workers returning home have been imprisoned in camps by the military; in some cases, women who appear healthy have been sold back into prostitution by the officers who run these camps. In recent years, the military government has given considerable autonomy to its regional commanders. In the Shan State, along the Chinese border, the regional command openly runs gambling casinos that offer sex services (Chris Beyrer, 1999).

Every one of my public health colleagues along the Thai-Burmese border has thought about working inside Burma. There are a small handful of NGOs operating within the country, as well as several UN agencies, though under many restrictions. Each struggles with the ethical dilemma of how to help the innocent people of the country without getting too involved with the authorities who are responsible for their suffering. For some governments, the answer is "constructive engagement"—providing direct assistance to the military regime and urging it to invest in the welfare of its people. For now, international organizations like the World Bank and

most western governments refuse to provide such aid, but there are those who argue this should change. They argue that the humanitarian situation inside Burma is so bad that they cannot wait for democratic change before taking action. Once there, they hope to be able to function without government interference.

Many of them, however, have faced severe restrictions and rules imposed by the regime that interfere with their ability to work effectively with the local population. The regime often harasses and intimidates those who try to work closely with foreigners. It is hard to evaluate whether more good or harm is done by humanitarian organizations working inside Burma under current circumstances.

There are certainly urgent needs that must somehow be met now: from cleaning up Burma's blood supply, to distributing AIDS test kits, to making antiretroviral drugs available to HIV positive mothers to prevent transmission to their children. But whatever individual agencies do to meet these specific needs, I don't believe they can do anything under the current circumstances that will "solve" Burma's public health problems. There is no strictly public health solution to the public health problems of the Burmese people; no strictly humanitarian solution to the humanitarian crisis they face. Burma itself must change. It needs institutions that are committed to serving their people and a people who are free to help themselves. Otherwise, international aid can serve as little more than a bandaid.

The question those who favor providing assistance within Burma must ask is whether the aid will make it easier for the government to divert even more funds away from health and education, thus prolonging its rule and the very suffering we wish to alleviate. I believe there will be times when the answer to that question will be no—when small scale NGO efforts inside Burma can provide limited benefits to local populations. But often, the answer will be yes, and in the long run outside help is not an answer in the absence of internal change.

I think it's interesting that the junta leader Khin Nyunt's recent admission of Burma's AIDS crisis came during an easing of tension between the military and the democratic opposition, led by Aung San Suu Kyi. Even a small improvement in the political climate seems to have improved the climate for an honest discussion of Burma's public health needs. We cannot pretend that the health of Burma's people can be separated from the health of its society; we must wish for, and work for, improvements in both.

Suggested Reading

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CHAPTER 41

Medical Adventures in the Nigerian Bush

Glenn W. Geelhoed and Sally E. Geelhoed

It was January 19, 1968—a date usually celebrated in our family as the birthday of one of us—as the single engine plane bounced down the airstrip at Takum Christian Hospital. The date was celebrated this year, however, because it marked the end of our long trip and the beginning of our Smith Kline and French Foreign Fellowship. We had waited a few days in Lagos, the capital of Nigeria which we had not intended to visit. We were en route from Rome to Kano in the north of Nigeria when the pilot of the big VC-10 announced that we were going to overfly Kano because the harmattan had hit, reducing visibility for landing to less than one hundred yards. Theharmattan is the season in the first few months of the year when the weatehr is dry and the winds bring the Saharan sands south to blot out the sun. We had ample opportunity during our weather-enforced layover to observe the harmattan atmosphere; in the early part of the dry season the air is a bit too thin to farm but too thick to breathe.

But after waiting a few days we broke through the haze to land near the site of our fellowship near Takum, Nigeria. Takum Christian Hospital was our foreign sponsor where we had chosen to work during our University of Michigan senior selective period, supported by the foreign fellowship awarded us by the Association of American Medical Colleges. And the work started fast. An hour after my birthday arrival we were making rounds on the wards, where the medical superintendent, Dr. Ed Stehouwer showed us a few of the teaching cases he had been saving for us. Before anything was done for the patients he had held for us, two patients with incarcerated inguinal hernias presented themselves as emergencies and each of us assisted in one of the repairs. We were to become a little more familiar both with herniorrhaphies and with the pace of bush medicine before three months were over!

Dr. Stehouwer and his wife are the only physicians in the hospital compound, and the mission hospital in turn is the only health resource in the entire district where we were, in the eastern Benue River region of Northern Nigeria. There were two other hospitals at a considerable distance from Takum, but one was without any physician on its staff and the other converted into a military institution, both reflecting the political and social disruption of the Nigerian civil war. Takum Christian Hospital had quite a large population to draw from due to the circumstances of the times, therefore it had reasonably adequate facilities in order to accommodate these patients. There were male and female medical and surgical wards, maternity and pediatric wards, contagion and private room wings, and a group of tuberculosis patient huts for long-term inpatient treatment. Besides the space occupied by the pharmacy, laboratory, administrative, X-ray, theater and outpatient rooms, the patient space totals about 200 beds. Just how many patients are hospitalized at any given time is only approximated by the number of beds, however, since the ward

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designations for some patients may be "bed 18" and "bed 18 1/2", the "1/2" representing the floor mat space between beds filled by supernumerary patients. The fundamental medical care is of amazingly good quality; the patients lack no essentials for the management of treatable diseases, and the treatment is faster without the frill of university technique. Diagnosis is a sophisticated as the best physical examination, although the trained laboratory boys are helpful in diagnosing many treatable disorders and are astute than we were in differentiating parasitic diseases. The native nurses serve as "house staff" and interpreters for the local vernacular tongues, translating the questions in history-taking into Hansa, the lingua franca of Northern Nigeria, or into English the official language of the country. In the outpatient clinic the nurses screen from about 500 patients those patients whom the doctor should examine (averaging about 50), treating the remainder for obvious maladies such as most infectious diseases. On the wards the nurses perform most of the treatment functions, freeing the physician's time for only the sickest patients. As an example of one function the MD delegates, everyone in this primitive society is intimately acquainted with death, and since death is such a common experience, it does not require the presence of an observer entitled with an MD to pronounce it. No certification is required so the doctor does not have the added paperwork of vital statistics.

Our computers had to be reprogrammed according to the cardinal signs that signify disease entities other than those familiar to us in medical center civilization. Right lower quadrant abdominal pain meanes appendicitis in Ann Arbor (a disease not seen during our stay) but it means amebic cecitis in Takum. Hematuria is almost never a warning of urinary tract neoplasm, but usually signifies bilharzia. Right upper quadrant abdominal pain does not mean gallbladder disease—nearly unheard of in the bush—but should alert one for amebic abscess of the liver. We had to discard a number of our more common pathognomonic patterns in favor of local predominance of pathology. In medical school terms it might be said that zebras more common than horses in Africa (Table 1).

Mnemonics are formulated as check lists to run down causes of postoperative fevers in the United States, but none of them includes the most common in Nigeria—malaria. It might be postulated that in response to operative stress the spleen contracts, a physiological reaction at infuses leukocytes into the circulation; but in this part of the world the circulation is also showered with the tissue phase protozoa carried by everyone. Whatever the theory, postoperative fevers respond so dramatically to chloroquin that it is often given as routine prophylaxis. In many patients the spleen is not only palpable, but visible. We collected an interesting series of splenomegaly patients that have an idiopathic enlargement of the spleen that in some cases become so big as to fill the abdomen and enter the pelvis. After ruling out all causes of splenomegaly, they fit the diagnosis described in the literature as "tropical splenomegaly".

Infectious Disease Mortality

Many exotic diseases we encountered we were unacquainted with except as illustrations in books about classic diseases disappearing from civilization. It is interesting to consider that the chief causes of mortality and morbidity in this primitive culture are the infectious diseases—the great showcase of modern medicine in which civilization displays the control achieved over disease. The control that Western culture has accomplished over these preventable and treatable diseases presupposes a great deal more technology than just possessing chemotherapy. Before infectious

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Table 1. During our stay in Takum, Nigeria, many diseases impressed us as endemic in or unique to the area, whereas other familiar diseases were conspicuously absent

Common Diseases	Uncommon Diseases
Pyomyositis	Arthritis
Myocarditis	Coronary artery disease and angina
Tropical ulcers	Arteriosclerosis obliterans
Lobar pneumonia	Pulmonary emphysema
Pertussis	Diphtheria
Endemic goiter	Grave's disease
Periodontitis	Dental caries
Typhoid fever	Thrombophlebitis and pulmonary emboli
Hypertension	Strokes
Hepatic and renal failure from native medicine	Cholecytitis
Hepatitis	Appendicitis
Head and neck tumors and sarcomas	Actinic skin ulcers
Cervical carcinoma	Breats carcinoma
Anemia, hemoglobinopathies and hookwork	Toxemia and eclampsia

disease can be subdued in the bush there must be all the ancillary services necessary for the delivery of life-saving health care to underdeveloped peoples—such as communication, transportation, education, sanitation and other riders that accompany a healthy economy. We had the opportunity to experience the frustrations and opportunities of public health service in this developing country as we will describe below. But to demonstrate the need for control of infectious disease, we kept record of the mortality during our stay (Table 2) pointing out that infectious disease is the leading killer. Of the 75 inpatient deaths that occurred while we were there, the majority were late-coming infectious diseases that are both treatable and preventable.

Parasitic Morbidity. Parasitic problems also caused a great deal of morbidity. Filariasis is almost universal; on several occasions during operations adult filaria would crawl out of the wound. A random droplet of blood or skin snip suspended in saline in the majority of patients would demonstrate the active filaria under the microscope. The lymphatic blockage of these adult worms and resultant elephantiasis may indirectly contribute to the high incidence of other endemic disorders in which the common denominator is tissue stretching—such as some of the hernias, scrotal skin necrosis and cutaneous ulcers.

One of the most common filaria in the area is Onchocerca volvulus (O.V.) carried by the plentiful Simulum fly. O.V. produces a wide spectrum of pathology, probably the most devastating of which is blindness. In a village near Takum 5% of the population were blind secondary to the pigmentation deposited through cornea and iris during the migration and death of O.V. larvae. In Takum itself, the leading casue of blindness was trachoma and corneal scarring secondary to entropion. Subcutaneous nodules are very common, and we occasionally saw the "hanging groins"

Table 2. Total number of deaths during our stay: 75

Pneumonia	9
Tetanus	7
Anemia	7
Heart failure	7
Tuberculosis	6
Malnutrition	5
Infantile dehydration	5
Liver failure and ascites ("Drank native medicine")	4
Abdominal neoplasms	3
Prematurity	3
Hepatitis	3
Ruptured uterus	2
Encephalitis	2

One death was casued by each of the following: Rabies, snakebite, burn, hemorrhage, pyelonephritis, skull fracture, bladder neoplasm, tracheal stricture, carcinoma of cervix, postpartum septicemia, fractured neck, dissecting abscess of thigh

redundant skin heavy with swollen inguinal lymph nodes from O.V. infestation. Skin on the legs often is depigmented in patches where the Simulium fly bit the patient. Treatment O.V. infestation is hazardous and uncomfortable, since many patients develop reactions to the allergenic parasites when they are treated. Treatment is most often futile even if it were pushed for cure, since the patient becomes rapidly repopulated with O.V. So the risk of blindness, extensive elephantiasis, and some of the common afflictions that may be related to O.V. Keeps increasing the longer the host and parasite cohabit.

An example of one affliction that may be related to filariasis that abounds is tropical pyomyositis. It seems that all protoplasm, living and dead, festers under the tropical sun. Many patients suffer from multiple deep abscesses that seem to be confined to major muscle groups of the trunk and limb girdles, not found distal to elbows, knees or neck. This distribution has led to some speculation that the abscesses result from filarial plugging of vessels of a caliber found only in the muscle sin which the disease is found. Regardless of the etiology, patients frequently present with hot painful abscesses that are near to bursting. On a particularly "pussy" day in the outpatient clinic, one can knife a dozen such abscesses. Before these closed space infections open sinus tracts to the surface, they dissect and do much damage to soft tissue and bone, resulting sometimes in multiple pyarthroses. One woman who looked very debilitated and elderly at age 26 had an ulceration at her knee and a small sinus at her hip. After probing each with the suspicion that they might be connected, I unroofed the sinus. The hip to knee incision revealed an anatomic dissection with shiny bone and muscles individually hanging in free air—all the fascial connective tissues had been dissolved away by the dissecting purulence.

To point out other examples of the morbidity secondary to infectious diseases, we reviewed the inpatient and outpatient diagnoses which were summarized in Table 3. It can be seen that preventable parasitic diseases constitute the bulk of the disability in this part of the Nigerian bush.

Table 3. Morbidity of Parasitic Diseases, 1967

Diagnosis	Outpatients	Inpatients
Falciparum malaria	2125	53
Hookworm	1447	41
Filariasis	1234	11
Onchocerciasis	601	12
Schistosomiasis hematobium	554	45
Ascariasis	538	15
Chronic tropical skin ulcer	433	38
Diarrheal dehydration	364	227
Amebiasis	250	124
Scabies	163	4
Pulmonary TB	125	97
Trachoma	46	9
Yaws	30	0
Typhoid fever	0	16

Surgery

Surgical therapy is a particularly gratifying mode of health care under the primitive conditions of bush medicine. Only a few simple diagnostic steps are necessary to recognize acute or morphological lesions that are treated by the immediate and definitive cure of surgery. An operation circumvents the sociologic impediments of communication, education and all of the facilities of civilization such as transportation, the absence of which makes chronic medical management impossible. Surgery stands next to the antibiotic therapy of infectious disease as the most successful form of medicine that can be practiced under limited control of patient environment.

Surgery is not without its problems under primitive conditions, however, and much of the postoperative care taken for granted in medical centers is missing. An example of one difficulty experienced constantly was with the surgical essential of blood transfusion. Before an elective procedure in an anemic patient could be scheduled, the patient would be sent to his compound until he could accumulate a token payment for the operation, but also, and more importantly, round up friends and relatives to serve as blood donors. The latter blood requirement was the rate-limiting factor in the speed with these surgical patients returned. Most often, their acquaintances were quite reluctant to part with the blood in which they invested a great deal of man's life spirit. Many of them were quite justified in their animistic reluctance to give blood because the Robin Hood blood bank policy was to take from those with hematocrits in the twenties and to give to those with values in the teens. A prominent man in Takum was brought to the hospital one Sunday afternoon suffering from a massive gastrointestinal hemorrhage. The strong men and boys quickly faded into the bush after carrying their friend to his bed, leaving only old women and pregnant mothers at the bedside. After we pumped the intravenous fluid and pumped out the coffee ground material in the patient's stomach, we turned our attention to regrouping his companions for blood typing. They were so hard to find that in the time it took to find a couple of donors their friend exsanguinated and died. In some acute hemorrhages such as that occurring in ruptured ectaopic pregnancy, the unavailability of blood causes us to resort to the simple trick of auto-transfusion; i.e.,

Table 4. Surgical procedures in which we participated totaled 249 operations; the total excludes minor procedures in the outpatient clinic, listing only operations done in the theater, including:

Herniorrhaphies	60
Dilatation and curettage	27
Extensive incision and drainage	21
Caesarian section	13
Hydrocelectomy or orchiectomy	13
Extensive skin grfat	12
Sequestrectomy and orthopedic operations	11
Ophthalmologic operations	11
Ovarian cysetctomy	8

Lesser numbers of other operations were performed: hysterectomies, biopsies, lipomas, vagotomies and pyloroplasties, thyroidectomies, insertion of chest tubes, repairs of vesicovaginal fistulas, ruptured uteri, ectopic pregnancies, plastic reconstructions, amputations, cystostomies, and removal of lumps and bumps ranging from onchocercal nodules to a bullet.

the blood found at laparotomy was sucked out of the peritoneal cavity, filtered and returned to the patient by vein.

In addition to the unusual technique sof transfusion, fluid therapy generally was unique. The most common route for rehydration was by clysis, proctoclysis or "rectal drip" being the route most frequently used in adults. Because this fluid route was not parenteral. Sterile equipment was unnecessary and used intravenous bottles and tubing could be reused economically with fluids tailor-made on the spot with clean salt, sugar and boiled water. This also avoided he complications of precarious intravenous therapy under the conditions of substandard nursing staffs; one never had to worry about a patient gurgling under a rapid infusion from an unintended intravenous, or about circulation open to the infusion of air or sepsis. The solutions by clysis were remarkably well retained, even if the primary illness were diarrhea. We experimentally administered a few drugs by this route cautiosly, and they seemed to be effectively absorbed through the rectal mucosa. Hypodermoclysis was used occasionally in infantile diarrhea. The standard intravenous route was used during operations and in our critically ill patients.

Perhaps the most sophisticated surgical procedure performed was for an infant. A baby boy was delivered by one of the midwives one night, and was found to have abdominal distension the next morning. A quick check revealed an imperforate anaus as the etiology for the infant's distress. Referral of such a patient was impossible, since there were no means of getting the patient to any of the medical centers on the opposite side of the divided country. The patients always refuse colostomy, a temporary operation that makes them social outcasts for the rest of their lives. So the alternative in this infant with anal atresia was to do something definitive or nothing. After a quick huddle over a few of the textbooks, we opted for the former, and performed Takum Christian Hospital's first abdominoperineal pull-through!

The operations performed durign our term are listed in Table 4. Hernia repairs are seen to be the staple major operations, and a variety of every other surgical subspecialty procedure except major thoracic and neurosurgical operations Some of the biggest operations were gynecologic, including repair of a ruptured uterus with

twins floating free in the abdomen, and pelvic laparotomies for large ovarian tumors.

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A minor operation that is of major importance in a discussion of surgery in tropical medicine is skin grafting. Two prevalent conditions that represent constant demand for skin coverage are cutaneous ulcers and burns. There is a special outpatient clinic of 50 to 100 patients per week who are being treated for tropical ulcers. These are hideous lesions that start abruptly as vesicles that expand, slough large areas of skin surface, and then granulate slowly with periodic flares of refractory infection. They are treated vigorously with antibiotic cleansing and frequent dressing changes. The craters of the ulcers granulate under this treatment, but often cause deeper invasion of sepsis, a portal of tetanus, severe contracture deformities if they occur over a joint surface, and a few chronic ones go on to degenerate into squamous cell carcinomas that require wide excision or amputation. Some of these tropical ulcers might have been mycobacterial, but the majority of them seem to be simply primary staphylococcal lesions abetted by the environmental filth with which they were immediately contaminated, as well as the gore of primitive remedies that passed for folk medicine plastered to them. To hasten epithelialization of these deforming ulcers, many were admitted for treatment and then covered with split thickness skin grafts.

The tropical ulcers and the burns were then treated similarly, with silver nitrate soaked dressings until grafts could be planted on clean granulation beds. The one interesting detail about the burns seen is that all the patients we treated for severe burns, with the exception of infants, were epileptic. The children were usually accidentally dropped into cooking fires from their perches on their mother's back or were burned when the wind shifted the bush fires that are set by hunters to drive out game. But the adults all came in with the story that the patient fell into the fire in a fit. The incidence of open fires and seizures was so great (a few patients had the only seizure of their life over a fire) that I presumed there was some explanation for this common pattern. The one I would like to believe is that fire is epileptogenic and the seizure si triggered as the patient gazes into the flickers of the evening fire in the darkness of his smoky hut. But another possible explanation was said to be a native medicine remedy for the seizures that proved the victim to be spirit possessed—exorcism by fire. Whichever explanation be true, many epileptic patients first appeared for treatment with extensive burns.

Interesting native practices facilitate surgery. Tribal markings on face, chest and abdomen, particularly ornate in women, identify the tribe and status of the natives near Takum. In women with elaborate patterns of periumbilicla concentric rings I always tried to close abdominal incisions by coapting the tribal markings cross-hatched at right angles. I had fears that the new abdominal scars that came by a European ahnd might have altered the significance of the decorative insignia with unintended meanings. "Early ambulation" is also a practice that was not worked out in theory, but has the beneficial effect of cutting down on complications of postoperative recovery such as pneumonia and decubiti. Stasis, phlebitis and embolic phenomena were completely unknown, as might be expected from rather athletic patients who walk out of the operating theater and return to farming in a few days. Surgicla therapy was not only immediate and definitive for the Nigerian patient, but the lack of many of the facilities of civilized hospital bed-care often contributed to its success.

Obstetrics

Obstetrics is interesting in Africa because phsyciians get to see only the complications that childbirth can afford, since all routine obstetrics, from antenatal care through delivery, is handled by the native-trained midwives. The complication rate was high, however, not so much because of the midwifery, but because the local tribes had android pelves, nutrition—especially as regards anemia—was poor, and the native women generally gave themselves a "trial of labor" amounting of several days before coming to the hospital. Because of these prolonges obstructed labors, complications uncommon in civilization were everyday occurrences in the bush. Vesicovaginal fistulae were plentiful and persistent problems. At one time there were seven patients in the hospital awaiting repair or rerepair of vesicovaginal and rectovaginal fistulae, as well as many of such outpatients wandering about as pitiful social outcasts searching for blood donors while they passed the time for the immediate postpartum inflammation to subside. Destructive deliveries were done on those patients who had labored for so many days that they came to the hospital after fetal death. The most dreaded complication with a high mortlaity rate was the common story of some woman who had labored a few days in the bush without progress, but was brought to the hospital when her labor abruptly stopped, her abdomen swelled, and she became shocky. On one such patient, immediate abdominal section revealed twins floating free in the abdominal cavity. Ruptured uteri accounted for the majority of obstetric mortality.

The midwives are taught to use the Maelström vacuum extractor in lieu of forceps to assist difficult deliveries. Another technique, practiced in this region in preventing the necessity for an even higher number of abdominal deliveries, is that of the symphysiotomy. Loosening the ligaments at the symphysis pubis by a careful percutaneous incision saved half of obstructed labors form Caesarian section. Once done, the symphysiotomy also corrected cephalopelvic disproportion for the patient's next pregnancy. Caesarian sections remained a surgical staple, however running second only incarcerated hernia repairs as the most common emergency operation. We each performed one of obstetrics' more demanding maneuvers, delivering two patients who were in labor with transverse lie malpositions by internal podalic versions—another method to obviate abdominal delivery in selected patients.

We first presumed we would be treating many women with demands for birth control assistance in circumstances where the need for population limitation was so obvious. Much to our surprise, the reverse was true—had not limits been placed on such use of the physician's time, it would have been to easy to become involved in running a full-time infertility clinic. The greatest sociologic and economic disgrace among the natives was to be barren. Most of the girls of the area were married by menarche; marriage was declared when a down payment on the bride price was agreed upon, the standard bridewealth being 25 pounds—half the price of a prize Fulani cow. From the time the bride price arrangement was made to menopause or death, the prematurely aged girls were expected to produce a child every other year. They would request help for fecundity if they did not live up to this schedule, imposed upon the women by an immemorial tradition which was based on the grim survival statistics of the bush. To insure survival of a few children. A dozen births were once mandatory; now half of these babies can be expected to mature. The stress of this population growth rate is no doubt the casue of some of the social, economic, and political strains evident in such an underdeveloped country. It was not without

a twinge of farsighted guilt that we performed hysterosalpingograms and other studies designed to restore fertility to patients in whom we thought contraceptive measures were better indicated.

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Public Health

Some of the most interesting experiences we enjoyed were in trekking on preventive medicine missions into outlying villages. Our welcome was always enthusiastic, and entire district populations would turn out for the mystic touch of the 'bature' mai magani' (the visiting white man of medicine). The Chief of Jibu led out his whole town's population to welcome the guests who were visiting to organize a new outpost dispensary. We made rounds at several of the dispensaries in outlying villages, staffed and supplied by Takum Christian Hospital. The 'dispensers' are the general practitioners of the bush, trained at the hospital in the diagnosis and treatment of the everyday tropical disease, and taught to send into the hospital serious cases and emergencies. They settle into the widely scattered communities with their chest of medicine and treat what they can, storing up their problem cases until the doctor can make dispensary visits. The dispensers literally "drum up" patients for the day when the doctor's schedule of visits is radioed to the scattered stations. A long line of the sick and a thick crowd of the curious always greeted us during our overnight treks to the dispensaries.

Another type of public health practice was our trip to areas where there were not even rudimentary dispensaries, in which we accompanied a public health nurse in rural preventive medicine visits. These were largely for immunization and public health lectures on basic principles such as sanitation, encouraging the people to build and use latrines to prevent the transmission of parasitic epidemics. The instruction was carried out with the help of rather graphic charts illustrtaing proper hygiene in the performance of several body functions. One of the most important achievements of these visits was the massive number of inoculations given. Tetanus, smallpox and pertussis were widely distributed in these high risk populations, and BCG was given as protection against several endemic mycobacteriae—tuberculosis, leprosy, and some forms of cutaneous ulcers. Perhaps the most dramatic preventive measure was in the introduction of measles vaccination to theis highly susceptible population. Measles is a dreadful disease among these tribes that have not been exposed to it. Some of the sickest children we saw suffered from the acute stages of measles with pneumonia, extensive rashes, high fevers, conjunctivitis and stomatitis; some of the most pitiful children were those with the late complications of measles developed after surviving the acute exanthem with blindness, deafness, diffuse encephalitis, and spasticity. The measles immunization program took on a grave urgency after we were exposed to a small epidemic of measles.

As a bonus of our public health side trips into outlying villages, we often returned with gifts from the patients we treated—a few yams from some families, a bull's horn from another, and usually a loud squawking rooster. I always felt as uncomfortable as the chicken when this disgruntled gift was presented, since we knew this was a significant gift which might have been a whole family's protein intake for a month. But there was no refusing their hospitality because they were too elated that the threat of measles and tetanus was lifted form their hut to worry about malnutrition.

Medicine

The fellowship offered experience with a wide spectrum of medicine, with a high volume of patients with most of the diseases known to civilized countries as wella s exotic afflictions. Tuberculosis, as an example, was widespread, with an inpatient colony and a whole outpatient clinic full of complications of TB. We saw scrofula, Pott's disease, lupus vulgaris, and enteric tuberculosis as well as complications of pulmonary TB such as pneumothorax, massive hemoptysis, and heart failure. One of the most feared admission diagnoses written on a new patient's chart was the simple phrase "drank native medicine". The local medicine men believed in rigorous purgatives for any disorder, and would administer caustic potions as remedies for most diseases. The "native medicine" was a potent nephrotoxin and hepatotoxin, which caused a rather rapid failure in the patient whatever his original disorder might have been. As seen in Table 2, "drank native medicine" figured prominently in the mortality bills, most of the patients becoming jaundiced and then progressively obtunded in liver failure and uremia.

One of the most fascinating medical problems with which we became familiar with the management of snakebite. A common hemotoxic snake that accounted for almost all of the victims we treated was the common viper, *Echis carinatus.* We heard of, but did not see, victims of the tree snake, the dreaded green mambs; its potent neurotoxin was instantly lethal far before ineffectual hospital care could be provided.

The Echis venom, however, antcoagulated the victim ot the extent that hemorrhage occurred at every interface with the patient's environment. The patients had time to get to the hospital after being bitten, but arrived with hematuria, melena, hemoptysis, gingival bleeding, and profuse bleeding from the envenomation site and other superficial skin abrasions. Since most of the victims arrived later than a few hours after being struck, our therapy was not so much directed at getting the venom out (as with cruciate incisions, tourniquet, and so forth) as toward neutralizing the local and systemic effects of the venom already circulating. The bites would usually be on the hand or feet, and the most common victims were farmers working the earth and children playing in the grass. There would be enormous swelling of the extremity that had been bitten; in a few cases the edema caused such tension that the arterial supply was compromised. These cases were treated by fasciotomies to restore blood flow, and the others were wrapped and elevated. Since there existed no precise knowledge of where the venom acted in the clotting mechanism, a specific treatment was not available. However, antivenom for the Echis toxin was available and was injected regionally and systemically. If blood could be obtained, it was given to the patient as well. Some of the unproven treatment such as injection of Vitamin K and steroids were used in those patients who did not respond to the antivenom.

I wanted to obtain a few Echis specimens for my own interest, and many of the patients obligingly brought in the snakes they killed after they had been bitten. I wanted a live snake, however, instead of only the skins of the snakes that had bitten patients. I figured the Echis venom could be investigated to see where it acts in blood clotting, not only so that treatment for viper victims would be more rational. But also because this purified venom might make a wonderful therapeutic coagulant. But for reasons of quite understandable fear, no patient could be persuaded to procure the live venomous specimen for me!

The exposure to worls health problems that this fellowship afforded has great shock value. The fellowship placed in perspective the narrow world of esoteric medical care in the health centers of civilization by showing us the other side of the 10th century world health enigma—population masses dying of disease that can be simply controlled. It was a kaleidoscope of specialty practice, practically reinforcing the forgotten points of medicla school lectures, as we ran through the spectrum of health practices every day. It was the high point of our clinical education, and an experience enjoyable enough to be contagious.s

CHAPTER 42

Wanted

Glenn Geelhoed

Fully 90% of the Worlds' Surgical Needs Are Outside of the U.S.A. and Europe

On one particularly frustrating day, while struggling with the intermediaries between caregiver and patient, I blurt out, "the only really difficult thing about surgery is getting to do it!" Perhaps this thought has also occurred to you.

First World-Trust

Increasingly many of us have felt redundant in a surfeited society where less and less of our actions may have anything directly to do with a patient's health. Today, patients must navigate a maze of regulators who consider surgeons and their procedural experties a large part of the problem of, rather than solution to, patient problems and the societal burden of cost.

Surgical practice once involved us as physicians to be close partners in assisting the patient in parting company with or coping with his or her disease. However, in our current era, planregimented "providers" are presented to panels of "health care consumers," and brokered by third party payors who restrict the choices of each side and may have an agenda that supersedes the interests of either provider or consumer. For many surgeons caught in this transition of care, surgical practice in this hyperdeveloped "First World" has become less rewarding, and has prompted professional disaffection.

FACS Perspective

These observations are hardly new to any of the readers of the *Bulletin* pages. Some surgeons have sought early retirement, and others have undergone mid-career changes.[1] To those who have sought a future in a surgical career, admonitions have gone out cautioning supersaturation in a market of a redundant workforce and oversupply of services for which training programs should be curtailed. All of us in surgery have worked hard to achieve the privilege of assuming responsibility for the surgical patient, practicing *omnibus per artem*, as the ACS seal puts it succinctly.

In *A Miracle and a Privilege*, Dr. Francis D. Moore recounts the magnificent development of the surgical art in its golden era of the second half of the Twentieth Century.[2] Many of us who have shared the enthusiasm for the art of surgery have asked ourselves the questions that have been quite reasonable during the long efforts to acquire our skills, but have been getting increasingly discouraging responses evident in our rapidly changing workday patterns.

There is an enormous need worldwide for surgical services, and especially for the judgment and healing wisdom of seasoned surgeons. This is especially true for large

Surgery and Healing in the Developing World, edited by Glenn Geelhoed.

numbers of patients who will have no access to surgical, medical, or even primary health care. Moreover, the broad spectrum of urgent patient problems encountered throughout the world is acutely weighted on the side of surgical care, for which any expertise is in critically short supply.

With the huge and increasing volume of patients requiring such services, but never getting them, there is every reason for surgeons to be leaders in the field of primary and preventive care. The profession of surgery is not limited to the operating room, since a large proportion of patients would be benefited by not undergoing marginal operation. Facing an overwhelming queue of patients who might benefit from surgical services, it is highly unlikely that the surgeon would extend the envelope of those upon whom operation might be performed, but critical judgement would exercise careful selection.

I have said to my students and residents that I know a market that may represent the greatest growth industry in the medical marketplace: If you are operating in the Third World on patients who are incapable of paying, competition for that kind of "provider" status seems to melt away at the same rate that the patient volume keeps increasing.

It was George Bernard Shaw who said, "Do not attempt to save your life; you will not succeed." There are only two alternatives—you can spend it (and no rate of exchange is worth it at any price) or you can give it. The Third World is an appropriate and ever-expanding beneficiary of this giving for those of us who have enjoyed more than our share of the First World's bounties, and paying back some part of the humanitarian dues that are overdue is rewarding in itself.

Readers of the *Bulletin* have perhaps noticed a pattern in a series of articles over the recent past, from historical notes on working in Gabon with Albert Schweitzer;[3] changing surgical practice patterns after retirement and teaching in Tanzania and Zimbabwe;[4] surgery on the edge of the desert in Galmi, Niger;[5] specialty or short-term practice under the auspices of missions, humanitarian organizations, or aid agencies;[6] and paired lifetimes of medical adventure.[7]

There are many organizations set up to facilitate volunteer short-term opportunities for American physicians and surgeons, which provide exhilarating and educational experiences that are often more immediately beneficial to the donors than the recipients of this aid. For the population served, one of the disservices that might follow beyond the immediate benefit is the elevation of expectations, which are then frustrated after the visiting health team leaves—unless the expertise has been left behind in some indigenized care. To achieve sustainable health care capacity, international surgical education is a far greater benefit, and the "pairing" or organizations that may be more partner than patron is a more successful long-range plan.[8]

Web Resources

Below are selected websites for agencies and resources for surgeons wishing to offer their skills to nations in need:

Agency for Health Care Policy Research = http://www.ahcpr.gov/—Home page for a major government sponsor of research related to clinical practice outcomes and policy. Though primarily concerned with domestic research, some of AHCPR's work is concerned with international research, comparative studies, and cross-national practice standards. Entering the word "international " in AHCPR's search engine can access studies with international relevance.

American Medical Student Association/Foundation = http://www.amsa.org/—Home page for AMSA, with links to the AMSA foundation's International Health

Studies Center (//www.amsa.org/international/ihscmain.htm) for both domestic and international service and elective opportunities, and to the International Health Action Group (//www.amsa.org/tf/inthlth/). These and other AMSA websites provide one of best single source of information on field placements, travel advice, study tours, residencies, international health activisms, and much more, along with links to may organizations and sources of information relevant to service and study abroad. Students can purchase a printed directory of "IH Electives for Medical Students".

American Society of Tropical Medicine and Hygiene = http://www.astmh.org/ Home page of ASTMH with listings of overseas opportunities (with many links to organizations and information about locations, type of work, financial arrangements, contacts), travel clinic directory, funding and fellowships, newsletter, and more. The *Am J of Tropical Medicine and Hygiene* provides an extensive listing of overseas opportunities at approximately three-year intervals, and whole text copies of recent issues are provided online.

Centers for Disease Control, International Health Program Office = http://www.cdc.gov/ihpo/homepage.htm#—Home page of CDC's unit responsible for international health activities. Information is provided on current projects, global health plans and services, programs staff rouster, IHPO capabilities, information resources and country-specific information, information for travelers and consular information sheets, CDC global partners, and links with other organizations. (Also see http://www.cdc.gov/travel/travel/html).

Child and Family Health International = http://www.cfhi.org—Provides placement opportunities for medical students in years or four in two different locations in Ecuador. Includes a student handbook with much information about the sites, the country, what to expect, and indications of other resources.

Christian Connections for International Health = http://www.ccih.org/ —A membership organizations (about 20 listed) that promote "international health and wholeness with a Christian perspective." Lists contacts, articles, trip reports, books, and teaching resources.

Ethical Issues in International Health Policy = http://www.hf.uib.no/i/Filosofisk/ethica/bank2.html— Describes a collaboration since 1992 in medical ethics between the University of Colombo and University of Oslo; provides full text discussion papers and extensive links to papers prepared by other organizations on current issues of equity, financing, privatization, costs, service delivery.

Global Health: Making Contacts = http://www.pitt.edu/HOME/GHNet/GHNet.html —Contains a gold mine of resources and projects designed to develop the architecture for a health information structure for the prevention of disease in the 21st century. The global health resources section [http://www.pitt.edu/HOME/GHNet/GHMC.html] has a long list of governmental and nongovernmental agencies and organizations, people, academic institutions, and organizational directories relevant to health. The sections are conveniently grouped according to major mission, affiliation, type, etc.

Health Volunteers Overseas = http://www.cybertech.mall.com/hvo1.html — Under the auspices of HVO, I recently set up General Surgery Overseas, which is a good source for *Bulletin* readers who wish to volunteer their services. Located in Washington, DC, HVO's telephone number is: 202/296-0928.

Institute of Medicine (National Academy of Sciences) = http://www2.nas.edu/iom/ —Institute of Medicine's home page. Sections of relevance include: IOM pro-

gram activities; external links; board on international health (and the board publication list).

International Development Research Council = http://www.idrc.ca —Home page of IDRC, Canada's agency for funding development research, including many health-related projects. Provides information about current and recent projects, program initiatives, publications, and training and funding opportunities. Much important research has been carried out with IDRC support.

International Health and Traveler's Medicine = http://www.intmed.mcw.edu/travel.html —Produced by the Medical College of Wisconsin/Milwaukee, this web page provides a source of information for international travel, including links to other organizations.

International Healthcare Opportunities Clearinghouse = [http:/library.ummed.edu/ihoc/] —Home page of the University of Massachusetts Medical School's website designed for health care professionals and students interested in volunteer work, employment, or studying with underserved communities at home or abroad. The site provides: extensive listings of organizations with internet links; a list of online resources, courses and books; and information about how to get funding. It now has a search engine that can locate organizations according to country, level, and discipline of personnel accepted, language capabilities, level of support required or provided, religious affiliation required or not, duration of placement, and other variables; provides links to home pages of organizations where available.

International Medical Corps = http://www.imc-la.com/index.htm —"IMC is a private, nonsectarian, nonpolitical, nonprofit humanitarian relief organization established in 1984 by volunteer U.S. physicians and nurses."

International Health Care Research Guide = http://www.health.ucalgary.ca/ —Center for Advancement of Health at the University of Calgary has provided an online resource that includes: an international health care researcher database, links to may of the medical school and faculties around the world, a directory to health care research site around the world, and more.

International Health Medical Education Consortium = http://www.unmc.edu/community/ihmec/ —An organization assisting in medical student placement in the Third World. IHMEC headquarters in Chapel Hill, NC: 919/962-0000, e-mail: ihmec@med.unc.edu.

International Red Cross = http://www.icrc.ch —Home page of this venerable organization. Includes a country-by-country listing of activities and special sections on topical issues such as civil wars, disasters, landmines, etc.

John Hopkins University School of Public Health = http://www.sph.jhu.edu/ —Home page of the School of Public Health. See http://ih1sph.jhu.edu/ for the homepage of the Department of International Health for complete information about the objectives, activities, and courses of the four divisions that make up one of the largest and oldest academic departments devoted to international health education and research.

Library of Congress Country Studies = http://lcweb2.loc.gov/frd/cs/cshome.html#toc. —Provides detailed and authoritative information on many of the countries of the world prepared by the Federal Research Division of the Library of Congress. The website has an impressive search engine that can search across the database for any combination of words, rank the hits in order of closeness to your search terms, and then provide links to the desired text. The LoC homepage is http://lcweb.loc.gov/.

MacArthur (The John D. and Catherine T.) Foundation = http://www.macfdn.org/ —Home page of one of the largest U.S. foundations, with a large commitment to national and international health, development, and population issues. The MacArthur Foundation Hot Links page provides links to resources in the nonprofit and philanthropic world, to organizations in each program area, and to grantees.

Medexplorer =http://www.medexplorer.com/medexplr.htm —A search engine that is specific to health. Besides providing a search capability, it contains approximately 30 subject categories that can provide quick access to topics of interest.

Pan-African College of Christian Surgeons = e-mail, 21cma@lbv.win-net.org or 102760.2314@compuserve.com —An organization to provide training programs for Africans within Africa, so as not to deprive their home countries of their services.

Population Institute = http://www.populationinstitute.org/index.html —Home page of a NGO institute working to alert policymakers and the public about the key issues relating to population growth and to the need for population stabilization.

Rockefeller Foundation = http://www.rockfound.org —Provides information about the foundation, its programs, grant recipients and amounts awarded, and sites where research is being done.

Ford Foundation = http://www.fordfound.org/ —Provides information on one of the largest U.S. foundations active in national and international health.

Robert Wood Johnson Foundation = http://www.rwjf.org/main.html —Home page of one of the largest U.S. foundations specifically oriented toward health issues.

Shoreland's Travel Health Online = http://www.tripprep.com/index.html — Sections include: Country profiles (health, economic, crime, climate, and other data); travel medicine provider (lists of physicians in various states and foreign countries specialized in travel medicine); general travel health concerns; preventive medications and vaccines; summaries of travel illnesses; and U.S. Department of State publications.

Travel Medicine, Inc. = http://www.travmed.com —A physician-directed company providing travel health information and products for domestic and international travelers, including a travel clinic directory.

UNICEF = http://www.unicef.org/ —Home page to the United Nations Children's Fund with pages covering publications, statistics, activities, and more. United Nations and related organizations = http://www.undcp.or.at/unlinks.html —Index and links to all agencies within or related to the U.N. system.

U.S./DHHS = http://www.hhs.gov —Home page of the U.S. Department of Health and Human Services, the principal federal agency concerned with health services and data in the U.S. Information about the Office of International Health and the International Health Program Office can be accessed, as International health Affairs through the DHHS home page.

U.S./U.S.AID = http:www.info.usaid.gov —Home page for the U.S. government agency that conducts foreign assistance and humanitarian aid to advance the political and economic interests of the United States. Provides a wealth of information about accomplishments, programs, publications, and more.

World Bank = http://www.worldbank.org —Home page to the World Bank and its constituent regional and specialized banks, which together represent the principal multinational sources of funding for developing countries. The WB group provides substantial support to health, nutrition, and population programs, pub-

lishes many cross-national reviews, research studies, and country profiles, and provides a large amount of statistical information on all the countries of the world.

World Health Organization = http://www.who.ch/ —Home page to WHO, with access to all its divisions and programs, and links to other relevant

Trauma is a common denominator across developed and developing worlds, but in developing nations, there is no infrastructure of trauma care systems and teams. Trauma surgeons in the First World are a familiar with the experience of operating from the scalp to the soles, and with medical and surgical obligation to know and treat all disordered vital organ systems in between. Primary care of the injured is a prime surgical service. To an even more notable extent, a surgeon operating in the developing world must rapidly become a universal surgeon, since he or she might be called upon to treat and to operate in areas considered to be under the jurisdiction of multiple specialties.

All surgeons need to know and frequently practice the surgical care of obstetric disasters. Ruptured ectopic pregnancy is frequent in areas with a great deal of pelvic inflammatory disease.

Upon my last trip to Swaziland I was asked if I wouldn't mind seeing to a somewhat urgent problem that might need attention before the elective surgical list that I had drafted. I then walked into my first case, on this last visit to Swaziland, to find myself doing a caesarian hysterectomy! I need not add that this was the first of these procedures I had done, or even heard of, but I though it the right thing to do for an eight-month pregnancy with a one-month dead fetus and a very dilated pus-filled rupturing uterus. To quote a lesson learned from my Peter Bent Brigham surgical chief, Dr. Francis D. Moore, "the sickest patients tolerate the biggest operations if, but only if, they pay immediate metabolic dividends. "Subsequently, I was happy to see the rapid turnaround experienced by this patient. Unnecessary operations are not common in Third World settings; very necessary operations that go forever undone are more likely the rule.

In a survey of health care in sub-Saharan Africa, appalling facts were uncovered: if a patient has a strangulated hernia, the chances of seeing any kind of health care personnel—surgeon, or doctor, or even trained health worker—in the village are one in eight; and a woman who needs a caesarian section in sub-Saharan Africa has a one in 20 chance of having it done.[9] The carnage that follows this unmet surgical need is evident in the reeking outcasts with vesicovaginal fistulas or recto-vaginal fistulas, some with perineal cloacas. For the repair of these obstetric sequelae, there is a hospital devoted to this problem in the Sudan, with hundreds of patients waiting for these surgical services at any given time. There are even more women who have not been so fortunate as to experience this treatment, and they are buried in graves all across the continent of Africa.

One of the more common emergencies among male patients is acute presentation with an incarcerated hernia that has been long neglected. As already noted, very few of these patients can obtain surgical services, even when they have an immediate threat to life.

I once saw a patient who survived such an acute abdominal catastrophe. When I first saw him, he had a spontaneous scrotal colostomy, the one outcome that might be the rare exception to an otherwise lethal complication of ubiquitous hernias.

Advanced diagnostic laboratory and imaging studies are not usually available where patients live —as electricity or a reliable source of clean water may not be available either. Nonetheless, there is a diminished need for such facilities, since

most pathologic presentations are not subtle, having been long neglected and not at all early in manifestation. Furthermore, the acuity of the physical diagnosis increases with experience, relying upon eyes, fingers, ears, and (not infrequently) nose.

Many surgeons trained in exclusively First World environments express some anxiety about encountering Third-World problems. They are reticents to encounter what are often viewed as exotic diseases for which no training or experiences equip them. However, knowledge of Western disease entities in atypical or advanced presentations is more useful than a complete "retooling" for the tropics.

Even more remarkable than the exotic and unusual diseases that one encounters in the Third World is the longer list of the degenerative diseases that fill four-fifths of our First-World hospital beds that are *absent* in the Third World. Perhaps there is some pattern in lifestyle or behavior that contributes to the absence of such diseases that are so common in the western world, such as gastrointestinal cancer, atherosclerotic complications (such as stroke, hypertension, and coronary artery disease), degenerative central nervous system disorders, inflammatory bowel disease, hemorrhoids, varicose veins, and peripheral vascular disease.[10]

We may learn a vital lesson from practitioners in the Third World: They have become experts in dealing with much more severe health problems in ever greater populations of people with fewer resources, and this is a "postgraduate course" we may need to master quickly as the resources invested in curative health care of degenerative disorders stop expanding in the First World.

There are fascinating special disease condition in Third-World environments that are not only interesting to study, but often yield to some ingenious management methods.[11] there are but two season and dry season, present different disease patterns and also complicate the care of open wounds. Water is often either absent or present in excessive amounts. In addition to dangers from the endemic malaria seasons, the postoperative patient may experience some blood loss and then postoperative fever. Blood banks are rare to absent. Blood replacement is rarely available except for immediate transfusion from family members, often in parabiotic circulation after a quick cross match, with blood donors reluctantly parting with some hemoglobin that may be only one or tow grams higher than that of the recipient. When postoperative patients have had some blood loss, they typically have splenic contraction and autotransfusion from this reservoir, and along with the blood infusion comes a shower of plasmodia from tissue phase. So most postoperative fevers are automatically treated with chloroquine in areas where drug resistance has not yet made it less useful.

The families are very much involved in the care of the patient, constituting most of the nursing, all of the dietary kitchen, and a good deal of the monitoring. It is the family who gathers the firewood and the water from the stream that goes into the pressure cooker autoclave for sterilizing the instruments, drapers, and laparotomy pads for operation—all of which are reused, as are the gloves, needles, and every other disposable product in the materials-intensive First World.

Endemic goiter and cretinism is an interesting metabolic response to iodine deficiency in some geographic areas. Additionally, some dietary staples, such as cassava, have the capacity to prevent utilization of the scarce iodine that is taken in, exacerbating the problem of goiter. Repletion of iodine alone may not be the only solution to this problem, but iodine administration does seem to have had a remarkable effect in lowering the tragedy of complete development failure in cretinism.[12]

There are skilled practitioners in parts of the Third World who continue to operate, often heroically, against the daunting demand and with meager resources. Not all of them have been to medical school, or even to any kind of professional school. Surgeons with formal training in all aspects of surgical care are rare in Third World environments, and where they do exist is typically the urban centers. There are few surgeons, aside from dedicated missionaries, in places such as rural Africa. When I had visited and worked with Charles Woodrow, MD, FACS, in Maurrere, Northern Mozambique, my presence doubled the number of Fellows of the American College of Surgeons in Mozambique, a nation of 28 million people that counts a total of four Mozambican surgeons. There is one Malawian surgeon, in a nation of 18 million souls.

In Tanzania, for example, there were less than 100 specialist physicians, and all of them, with a few exceptions, were in the capital of Dar es Salaam. Apart from missionary physicians, there were no Tanzanian surgeons outside the capital.

Urban Africa may be growing rapidly, for better or worse, but most of the third-World population is resident in the rural areas where they eke out subsistence in hunting, gathering, or stoop-labor agriculture.[13] As the standard of living rises in a small segment of the urban population, disease patterns, health care, and social behavior change as the gap between urban and rural widens. Even as some improvement has been noted in third-World productivity (as measured by an increase in gross domestic product), this marginal increment has been overwhelmed by the much greater increase in population growth, and the standard of living has continued to fall. The distance today between First -and third-World standards of living and that of our own colonial times, and it is apparent in each of my succeeding visits, over now more than three decades, to the Third World that this gap widens.[14]

The First World has been producing superb surgeons with highly developed skills that have generally been exclusively dedicated to the care of only 6 percent of the world's population. Fully 90 percent of the world's surgical needs are outside of the U.S. and Europe.

Many of the American surgeons in practice today have noted a shift in their practice pattern and satisfaction in surgical service—they seem busier than ever with required paperwork, but less patient care, with some surgeons operating less than one full day per week. Redundancy in surgical services may be expensive, and a large, fixed, and idle capacity may be a waste of a precious resource in worldwide scarcity of supply.

There exists a great, even overwhelming, need for our surgical services. Their statement is less true than ever before with respect to the practices in our home environment, and more true than ever before with respect to an expanding and needy world. Students sitting in medical school classrooms today are not likely to find their immediate neighborhood pleading for their specialty services. If they have an interest in surgery, it will not be because of an overwhelming need and demand for those services in almost any urban or even rural part of North America or Europe, or the major capitals of South America or Asia. Surgical services are needed where people live, and increasingly these are the regions of the world in which surgeons are absent.

We have enjoyed the rapid advance and maturation of surgical technology in much of the First World; but can this truly be called the golden age of surgery, when whole nations have no qualified surgical services? World-class surgeons who have dedicated *omnibus per artem* and find themselves redundant, or the superfluous

"outliers" in the health care scheme, might reconsider the reward for the practice of their art where they are needed. There is a world of need awaiting, and a number of organizations that are ready to help meeting than need.

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CHAPTER 43

World Health

Glenn W. Geelhoed

International Advocacy for a Global Patient Population

Theme: Foundations of Change

Population, the Environment, and Culture

Medicine has been thought of as professional "stuff": products and services that can be produced in one world and shipped off to be delivered—or imposed—on another, literally dropped from the air on some societies.

It should be axiomatic, after all, that human anatomy and physiology are put together rather much the same way on either side of any artificial boundaries we continue to draw among human populations, whether geographic, ethnic, linguistic, religious, socioeconomic or cultural. Therefore, it follows, medicine is an export commodity that should work very much the same wherever administered, and this simple delivery process should be a great humanitarian benefit to populations around the world. It is, after all, my tool, I know how to use it, the world needs my expertise and services, so step aside or assist me in making the world a better place to live through my single-minded devotion to the application of my art through the global efficiency of "vertical health care programs. "Trust me, I'm a doctor, and I am on my way to enhance "world health."

If this is not a caricature of Bernard Baruch's axiom of the "one tool" toiler, it can exemplify the fallacy of the generalization of expertise. Medicine, at the turn of the millennium, is not "stuff" but is nearly pure *information*—note the absence of value-added terms for which we might hope, such as *knowledge* or *wisdom*—the most rapidly and freely portable commodity of our era, even surpassing the legendary vermin and viruses "that do not carry visas" in migrating throughout mankind. The history of medicine is not specially apart from the history of ideas in which it is imbedded in the cultures on either side of the "caring" and "cared for" exchange.

Epidemic diseases have often been metaphors for social disorder, while biologic science has steadily de-mystified diseases in a reductionist search for the simple elements, the Koch's Postulates, interfering with which had achieved spectacular conquests in control of some disorders. Races for the Cure may be one example of the sanguine hope within this engineering model that with enough support, yet another disease element will be found, controlled, and like smallpox, relegated to historic extinction. The demand spray-painted on the Pennsylvania Avenue sidewalks around my medical center announces "Act Up is Watching: We Demand an AIDS Vaccine!" To this simplistic fix I might respond: "Well, we have penicillin, therefore there is no more gonorrhea." My good friend, the late Denis Burkitt used to throw out this

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challenge: name for me a single disease for which improvements in diagnosis or treatment have *reduced the incidence* of the disorder.

A response, thought to be primitive, early on in the medical anthropology of struggle with disease invasion is "Why?" Why me? Who has sinned, that this visitation should have fallen upon us? Who has inflicted this evil upon us? With enough resources invested in the micro-analysis of the process, a taxonomy evolves to answer the questions of "How?" "What have we done wrong?" kinds of questions are typically replaced with "How might this disorder be prevented?" as further information is accrued and manipulated. This "information science" has led to control of some diseases, but eradication of few, and before we might take the next step toward mastery of health, the more mature question "why?" reemerges. One of the most renowned founding fathers of reductionist anatomic pathology, Rudolph Virchow, had this surprising insight: "Whenever mass disease occurs, it is a result of 'disturbance of human culture.'"

To enter this meta-analysis into causation of disease may seem to some to be outside the limits of the license to practice issued to Virchow the pathologist, Geelhoed the surgeon, or you the reader, among all of us sharing the morbidity and mortality that makes us human...and potential consumers of medicine's resources. But it may give us some insight to address the paradox of modern medicine at the millennium: never have we been able to do so much for such complex and serious diseases so effectively, using such sophisticated and costly technology and manpower resources to manipulate this information, for a privileged population in this country which has never been less satisfied with health services. And these inadequate, even if redundant, services apply only to the over-cared-for first-world population, which lives contemporaneously with many more global citizens who cannot enjoy even so much as a fraction of a percentage of the care that is wasted on the other side of the north/south border. As the stentorian tone of the disembodied voice warns us as we approach the station in the London tube: "Mind the Gap!"

How can we advocate "world health" for a global population when there are such gaps in socioeconomic and cultural milieu in which the same medicine is to be practiced?

I may use an example from my own experience relating to the large part of the global population which is hypothyroid, for reasons of iodine deficiency or its impaired utilization, and which, presumably, might be readily treated by replacing the simple, ubiquitous, cheap micronutrient iodine. "This much we know, and this we can do, so let us achieve universal coverage in this vertical health care program, with a target date of the millennium" declared the World Health Assembly of 1990. This is a classic medical model of "one ill, one pill, one bill" with simplicity as its largest appeal. Just how difficult can that be? The target date was not achieved, and the problem, far from eradicated, may have grown larger in the interval—as quite typically occurs in vertical health care programs that appeal for programmatic funds.

I conducted such a program of iodine repletion in a profoundly iodine deficient population in Central Africa, and stayed on—some might say, too long— to observe the results. The iodine repletion works: cretinism was eliminated and giant goiters shrank, and those that were troublesome for airway management were operated for demonstrable relief. This could be a model of success in vertical health care programs, achieving real and measurable results nearly immediately.

But I stayed on to ask the further consequences of success or failure in the more difficult terms of humanitarian benefit, beyond the morphologic and functional

results measurable in blood chemistries and goiter size. What happened to the individuals and the collective society of which these treated individuals were a part? An increase in metabolic rate was accompanied by an increase in caloric demand —I created hunger. Hypothyroidism is a low fertility state; a population explosion followed the vertical health care program accompanied by a midwifery program which together with the iodine repletion eliminated cretinism and decreased infant mortality rates. A larger quantitative population of qualitatively enhanced consumers resulted, with greater demands placed on the marginal rainforest environment and ecologic collapse. I had done my job, within my professional best standards, and why then is the world not necessarily a better place to live? Could it be that single-factor intervention in a vertical health care program that is not sensitive to the fragile biologic balance and not part of a culturesensitive development program might result in *medical maladaptation?*

Let us return to the question "Why?" If the poorest 20% of the globe's population, located in a tropical and mountainous equatorial belt of resource-constrained marginal lands, is where the 20% of the globe's hypothyroid population lives—-which is chicken, and which egg? Are these billion people poor because they are hypothyroid, or hypothyroid because they are poor? And, if, you and I would agree, hypothyroidism is a disease, and prevents people from realizing their full potential as human beings (as exemplified in the extreme case of cretins whose development never really gets started), *why has it been conserved?* Would not the population of hypothyroid people have been eliminated in any competition for resources long ago?

In some other instances of diseases that persist, such as hemoglobinopathies (sickle cell anemia is an example), it appears that such diseases were conserved on areas of the map only where other parasitic problems with a worse outcome were superimposed on the same global map (malaria, in this case, to which the anemia conferred a relative resistance). Could it be that the hypothyroid population may have a natural adaptation to the world's low resource environments through their low fertility and decreased caloric requirements of this acquired disorder? And might medical intervention through a single focus on the hypothyroidism in such populations, without sensitivity to the cultural and ecologic context in which it was found might cause more harm than good?

This example in a remote population may serve as a laboratory model of our own environment. In a far more complex society, we are still dependent on the eager and early applications of the triumphs of the medical model, "medicalizing" all social problems addressed typically with some simplistically targeted treatment and the gratuitous prologue "if they can put men on the moon, we can at least..." and then we are puzzled and perplexed by persistence and proliferation of the medically "conquered" conditions.

Humility in health care requires us to loiter long enough past our headliner triumphs to be still observant and honest when the later consequences of our many publicized victories are evaluated in the context of the humanitarian enhancement of lives in individuals and the societies composed of them. To date, we in the First World have absorbed far more medical resources, with greater ecologic impact and with still less health satisfaction than the underserved populations we might little understand, but still seek to advocate in "world health."

CHAPTER 44

Treating Others: Human Sciences in Theory and Practice

Glenn W. Geelhoed

How Can We Treat Others?

Most theories of ethical behavior assume interaction among equals with principles of respect for autonomy without patronizing the recipient of services, especially when the relationship appears asymmetric. If one of the parties is empowered by authority or expertise and the other disadvantaged, there are additional burdens of caution in respect of conduct involving power imbalance, whether that authority is conferred by intentional systems—such as institutions of state, education, economic or moral/religious suasion—or by some biologic factors—such as age, strength, or the capability of the healer—the assumptions of a fundamental equality residing in the human personhood on each side of the interaction remain intact, generalized through Kantian principles or Golden Rules governing the caregiver, ruler, or authority figure over the disadvantaged, but equally autonomous human being helped or subjugated.

This may have seemed a self-evident principle despite nearly universal exceptions in its applications. At no time in the contentious eras of empires, or economic colonialism was symmetry self-evident to support the theory, and even less so today with the magnification of differences in political, economic and life/death/health power enhanced by technology and applied to help or hurt one side of the bipolar relationships. These disparities have become ever more exaggerated despite the curbs civilizations have placed upon excesses in mistreatment, and today there is a greater gulf between the treaters and treated in the complex of technology-assisted societies. When these economic and power disparities are within the borders of any given state, there may be codified rules set down by the society as formalized in a state or judicial entity or standards set by professional societies of practitioners. When the relationship occurs across lines of recognized states or rules promulgated by ethnic or religious common assumptions, the theory governing the practice of "treatment" becomes less clear and often exhibits sphere clashes in deontology.

A Case in Point

I have been involved in the practice of health care for over a third of a century, and in the professional capacity of caring for the sick, I have had a special interest in populations that are further disadvantaged by poverty in surroundings of very meager resources in which subsistence itself is often difficult. While some of these destitute people (whom I might come to consider as "patients" in attempting to treat them) live within the same citizenship I share, most have been abroad. I further lead

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other people, students or other graduate health care givers, who join me in treating people across very large gulfs in economics, technology, religious, language, education, social and political boundaries. I have both practiced treatment, and sometimes reported the results of my observations in so doing on how treatment modified both the treater and treated.

At least one of these reports recently published has drawn a considerable storm of protest as to the methods and permission of treatment of a group I had represented as my intended beneficiaries in a medical aid project in Central Africa. After an initial acceptance with some enthusiasm for the intent and effect of the proposed health care intervention, a minority opinion was raised, not once, but on three consecutive peer reviews. The opinions of the demurring reviewers can be taken from the titles "Moral Maladaptation" and "Medical Imperialism" of editorial opinions, claiming higher authority, quoting Nuremberg Trial principles and international political processes in organizations with or without the imprimatur of the United Nations. These ethicists made the claim that another universally accepted form of "due process" was not followed or was unacceptably modified in the constraints of the conditions under which the treatments were conducted. It is true that the majority of the reviewers found the reports acceptable and some even thought the process described might explain elements of human species development and differentiation. The misunderstanding or misrepresentation of the "undertaking to treat" had given me pause, however, to reconsider by what right we might ever undertake to intervene in the circumstances of another, and endeavor to take it upon ourselves "to treat" when nearly all such treatment would involve quite different "others," and a nearly inevitably wide gulf across which advocacy must function with imperfect information and limited understanding.

How might the Human Sciences help to illumine this controversy and prevent the theoretic paralysis that might otherwise lead to practice solipsism?

Theory Constraining Practice

Practice patterns have evolved over time to describe, and then prescribe ethical behavior of those who treat others. These principles have been encoded in such supra-statal professional creeds as the Hippocratic oath, or a methodology known in anthropology as participant observation, or in Kantian ethics as treating all subjects as entities who are not means toward some end but an end in themselves with applications of any actions based in generalizable principles one might wish to have acted upon in one's own treatment. This may be simplified in the Golden Rule. As generalizable as such a first principle might be, it might be caricatured in some extraordinary real-world circumstances: "I want to treat as I might wish to be treated, if only I were not sick and starving just now as you seem to be."

The fundamental modification of the observed means that even the allegedly noninterventive practice of participant observation can come under considerable critical pressure for interference in the lives of those observed. The somewhat contrived controversy over the genetic research among the Yanomami Indians that has recently embroiled many institutions has resulted in the reexamination of similar questions of the ethics of anthropologists' behavior in ethnography alone, if not in directly invasive actions into the lives of the communities under observation.

The paternalistic assumption that we, older, perhaps, at least more knowledgeable if not wiser heads know what is best for not just individuals, but whole populations, underlies quite a number of actions taken in public health, with even some recent authors alleging that there has been a failure of trust in not taking the impera-

tives of social engineering far enough. Autonomy is one principle, but an outright ban on smoking or the casual use of alcohol might be a far more effective "treatment" of a population than the individual damage repair after the fact of abuse of any such agents. There must be some constraints on the side of both goods and rights, and the freedom to pursue what happiness each can seek in some activities may lead to what could be called "other" victimless crimes." Self-infliction, however, quite frequently burdens the society at large—and the caregivers in particular—for which they might have a self-interest as well as altruistic opinions on the restraint of personal freedoms to pursue certain excesses. The full circle is turned when we might exercise such care of an individual or population that we permit them to do nothing at all lest they expose their lives to any danger from experiencing life's vagaries, while being constrained by such respect for the autonomy of others as to be unable to take any action in treatment for any at any time. The reductio ad absurdum would be that we should not even be acquainted with the "other", since just observing them and knowing they exist might be interference in their autonomy, and ignorance of their existence would further relieve us of any obligation to intervene in their welfare. Surely, the Human Sciences must have a role in steering us out of such a theoretic impasse for a practical resolution of how to represent, respect and relieve others and assist them in rehabilitation for empowerment in self-actualization.

Post-Colonialism, Neo- and Otherwise

The subaltern may speak, but not usually through one of their number being lifted up above the mass becoming a neo-colonialist speaking for the voiceless masses through amplified positions in the colonizers' world. Advocacy must recognize otherness, and acknowledge that it is never possible to perfectly represent despair from comfortable agencies within the developed world. I have run into a problem with advocacy becoming agency, transforming quickly to ownership in perpetuity of a human problem, with a guarantee of failure in treatment in order to keep the problem and agency budget growing. If advocacy means representing the downtrodden, there should be a rapid transition to work the advocate out of a job rather than enshrine it in perpetuity as a goad to the conscience and purses of the comfortable. Chauffeured limousines of aid agency advocates have the look of self-interest above representation—doing very well by doing good. Advocacy is better tolerated if the representation is over against the interests of the society—and over the advocate's own; that does not mean that the sincere are always effective, but the inverse is hypocritical.

It is not simplistic to say that the way to treat the inequities of post-colonialism is to get beyond it. Institutionalization of a second-class status is reinflicting the injury and again enshrining dependency in perpetuity. The goal of good treatment is not to create compliant patients, but to produce empowered healthy healers. A successful treatment may be a threat to the agency, but not to the person who is treating. Agency ought to be a self-limited condition extinguished by its success.

All Men Are Created Equal

Perhaps, but that equality is not very apparent now, however far we stand from that creation. And, the inequities in resources, capabilities, richness of life-world and experience grows ever more disparate, since it is difficult to cultivate some of the finer expressions of the Human Sciences while engaged in a desperate struggle for subsistence. It takes a certain consumer surplus of capital, of energy, of leisure to dedicate a higher proportion of our attention and effort to the nonvegetative func-

tions of staying alive, and in many human populations, one hundred percent is not enough to insure that basic fact of life. It is easy, when surrounded by the misery of such "inhumanity", (if one stays, without fleeing to much more comfortable surroundings) to get a "glow in the dark" opinion about one's own humanitarian instincts. It often seems it is easier to share in the miseries of the world as a short-termer knowing that one can go back, retreating into the comforts of excess, and cultivate the finer arts and sciences which are luxuries not easily afforded by the destitute. While there is nothing particularly ennobling about abject poverty, it is often surprising what "gifts from the poor" may be learned in listening to the destitute who have been stripped of many of the distractions of excess things and remarkably focused on the fundamentals of adaptation for survival.

Many of the resources of these resourceful people are a spiritual strength that keeps them indomitable under crushing circumstances, creating a human science of their own out of the hardscrabble life at the margin. It is hardly to be romanticized since it is not often pretty or sentimental. They have not been treated well by circumstances, most often outside their control, but they remain subjects, and not objects, and create an art, and a culture. After openly acknowledging the wide inequalities that exist among men, that allows me to come to them even if they cannot come to me, there is a self-interest in our interaction that each side realizes. We may each try initially to exploit each other as representatives of some other world for an advantage in our own. They may seek to work their way into my confidence for medical or economic advantage as special adoptees. The advantage for me now added to those preexisting reasons for such adventure excursions into the unknown may now include representing them through actualizing such shared experience to report in a dissertation for whatever advantage that may be outside their world. These secondary gains aside, from each end of our interaction, acknowledged and then superceded, there evolves a special understanding across language, culture, economics and the boundaries of our respective life-worlds. This understanding may seem to be its own reward on either side, beyond the immediacy and busyness of the preemptory demands of their having a special-purpose friend or my having " field informants."

If there is a key of some sort in understanding the "other" it is probably not to be derived by some data determined by the kind of measurements I have carried out, however instructive these may have been in illumining a few micro-analytic glimpses into the survival adaptations which may keep these people functioning when I, or others, might not, by simply giving up in the face of such want as to drive to despair. It may be from the bilateral sharing of some understanding of what human qualities we may communicate through whatever different means we have each learned—through song, or art, or bushcraft appreciation of the world about them that I may have studied, but they know from an existential perspective.

There are agencies with agenda to supply "vertical care programs", some of which may literally involve some stuff pushed out of the back of an aircraft over some such population. "Aid utilization" means the expenditure of certain funds budgeted and a smooth outflow of resources, whatever their effect might be. Analyzing the overall results in the human population so treated beyond the "aid uptake" measures that are the end of the "evaluation" process might get some sets of micro-analytic numbers by which success can be declared, given the specific target and the brackets set out in advance for achievement of what would be called a measurable success. But, it would be unlikely that an aid project would be stopped, given the feedback that the humanitarian results were a decrease in the welfare of the population so treated.

This is called a "pipeline problem", that there is an interruption of the outflow of funds in aid utilization. I have encountered multiple projects, which should have been interrupted on the basis of a decrease in the well being of the people treated, but they would not be, since the aid project was a benefit program to the donors. Examples of such "treatments to the First World donors" might be farm surplus transshipment programs that are price support benefit programs to Iowa farmers; infant formula donations that were a gift to Swiss Nestle; or the preposterous donation of an MRI scanner in a Mozambican Hospital without Band-Aids, bed sheets or penicillin—a gift from the German government to Siemens.

How Would the Other Treat Him or Herself, and How Might He or She Treat Us as the Other?

I am quite literally an "ET" falling from another planet into the cultures I visit. How am I treated? I am a resource to be exploited, to be "conned," to be coopted, ingratiated—in other words, exactly as I might treat them. After we have had a lot more experience of each other, we each find that the rather direct and primitive approach is ineffective—since we have both been around "others" before, and we must try a bit more sophisticated approach through bargaining, barter, and arrive at some sort of mutualism in a symbiotic relationship, recognizing that they are the local experts and I am in their territory. They recognize that I must have the edge on resources, since, after all, I got there from half a world away, and seem to have some sort of outside world support system, in which they would like to share.

What would they want for themselves? They would like to have just a little of the advantage that I apparently have had, since, if only they had, then they too, could be like me—since I seem to be empowered, and capable enough to take care of most of my problems and some of theirs as well. And how well might they do if this were an opportunity given to them? If the entire gross national product of the USA, the largest economy the world has ever seen, were dropped as a donation into Africa, it would disappear without a ripple visible a generation hence. If they had just half the opportunities I have had, of course, they would find their own voice, and not become like me, but a better they. They would not need advocacy, except for opportunity. That choice to be able to develop much more of their full human potential is perhaps the most common of the human links that makes for understanding despite wide inequalities among others.

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CHAPTER 45

The Impact of a Volunteer Medical Mission on the Attitudes, Knowledge Base, and Reported Humanitarian Motivations of a Group of Medical and Public Health Students

Glenn W. Geelhoed

Introduction: Service Learning in a Medical Mission and Its Effect on Entering Health Care Students

What is the effect of "service learning" in health care students' personal growth and understanding in helping poor and needy patient populations in a time of acute distress? The people of the island of Hispaniola have just suffered the worst natural disaster in Caribbean history. In response to this need, a team of eighteen volunteers were mobilized for a medical relief mission beginning in the Dominican Republic, (DR) and continuing on across the rugged border into Haiti for hard-hit populations in each country. The team arrived in Santo Domingo, the DR capital and concentrated on the devastated border town of Jimani, where 450 bodies were recovered from the flood and mudslide occurring in late May, an estimated ten percent of those who disappeared. We worked for a week in two refugee camps, one for Haitian immigrant squatters who were homeless, and the other a resettlement for Dominicans who could prove prior citizenship, and then also in the shell of the "Hopital General Melenciano," also damaged in the mudslides through the town, which had just been cleared of mud and debris for us to use as our base of operations.

We then proceeded through rather chaotic connections through the nearly impassable eroded "roads" into the Central Plateau of Haiti, and repeated the process in Haitian populations of the Creole-speaking rural poor using the Project MediShare base in Thumonde previously set up by team leaders last year in a GWUMC affiliation. We carried medical supplies in setting up our mobile clinics throughout Marmonte District (previously "given" to me by the Haitian Health Minister last year) using SUV's rented from and returned to Haiti's capital of Port au Prince. Our clinics were set up in rural churches beyond public services of electrical, plumbing or transportation services and all consultations and medicines were rendered free to the eligible populations. We treated 761 patients in the DR settings and 1,058 in Haiti with the team of supervised first-time clinicians, and carried on an intensive

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medical education program based in case presentations and consultations with the team leader in each location.

In the paper submitted at the outset of this medical mission, the proposal had been to research and evaluate attitudes and changes in the health care students through this process of service learning, based in the sparse literature on this subject, but with the urgency of increasing pressures to carry out such missions in settings of need. While abroad, an American Medical Association (AMA) resolution had reached me (Appendix E) strongly recommending service learning as a component of medical education. The findings of such research as proposed in the prior paper might be useful in supporting (Appendix C) or modifying such recommendations.

The Question: What Is the Effect of a Volunteer Medical Mission on Entering Health Care Students' Attitudes, Knowledge Base, and Reported Humanitarian Motivations?

This research question was translated into the interview questions appended as questionnaires A and B for self-assessment before and after the medical mission to the beleaguered island of Hispaniola, filled out immediately before arrival, and upon leaving by the appended instruments completed on the outbound and returning flights. Each were supplemented by detailed individual interviews throughout the mission, and recorded in narrative on tape recordings, text from notes immediately transcribed, and in photojournalism of many of the clinical interactions of the subject students and the patient population we were intent on treating. The personnel (Appendix D) engaged in this study were aware of the plan and purpose of its being carried out and were offered the option of not participating in the study even if they wished to continue as part of the mission, a consent reflected in their voluntarily filling out the questionnaires and volunteering their views in interviews. None of the students chose not to participate. One hundred percent of the population, therefore, responded in both questionnaires and no statistical derivations were necessary on a unanimous sample.

Data Presentation Questionnaire "A" Responses

From the pretrip questionnaire, language capabilities were limited, with seven participants alleging "some" knowledge of Spanish, but only two of those were fluent enough to function as patient interpreters and that was limited to the DR. Two attested to knowledge of French, which was of no use until we reached, only briefly in transit, the capital of Port au Prince, and only one of the student participants was fluent in Creole, and several local translators were impressed into service to maintain four clinical teams.

Six of the students alleged to have done something like this before, but except for two of them, the experience had been largely as an observer in a setting in which they had no capacity for even beginning professional interaction with patients. Of those thirteen who had been abroad before, only four had been in true developing world settings, and two of those as tourists. In answer to how each had decided to come along on this trip, six participants said it was quite an adventure they anticipate, three said they had nothing better to do for the summer, two responded that it was potentially a great experience and the price was right as a subsidized mission, three responded that they had always wanted to accompany me on such a mission, and after many prior incompatible calendar conflicts, this one finally fit, and two

said it was by chance association when a friend had told them about it, and they had responded "Why not?"

As for a group that had never been together before, three pretrip meetings were convened, one at the team leader's home, where introductions were made for ten of the travelers, a second at a restaurant for fund-raising at which several more had met others for the first time, and the third meeting was near school for distribution of the check-in medical and surgical kits for each to carry to the airport the weekend before takeoff at which six of the group were present, five of whom had been at the prior gatherings. With these limited pretrip meetings within a month of the mission, each participant was asked "How many of our group do you know very well?" The answers varied from "Zero"—"including the team leader"—three, "One"—four, "Two"—three, "Three"—one, "Four"—four, and "Five"—one. These answers (with one respondent leaving the question blank) were remarkably different after two weeks of intensive working together, and the team rotations were set up such that no one individual would not have worked closely for at least two full days with every other.

Motivations for making this trip when expressed in advance varied from a generic wish to have some kind of 'experience"—nine, "to appreciate what I have"—one, "to help people" or to "give back"—four, "to learn"—one, or "vacation"—one! When asked in advance how each thought now that this experience might fit their career plans, responses were "Don't know"—three, "Career development" or "Resume'"—eleven, or to "Help decide among professional options'—two.

Whether each thought already at takeoff that they might be interested in another medical mission abroad, the prejudgment was "Don't know"—four, and "Definitely yes"—twelve. As to where that mission might be, the group spontaneously listed Africa with frequency, but this may be prejudiced since the team leader is an Africanist with longstanding experience in that continent and a number of them expressed an interest in coming on this mission specifically to get to know the leader to persuade him to carry them along into what he had described as "the deep end of the pool" and expressed, even as preclinical freshman, the ambition to be "operating in Africa" as they had heard reported surgical experience by previous senior medical students on prior African missions. Of the responses elicited, a return to Haiti (before being there) was "Yes"—two, 'Africa'—four, "Both Haiti and Africa"—six, and "Don't know"—three.

What were the pretrip expectations? "Don't know"—ten, "to have fun"—four, "An adventure"—one, and "Hard work"—one, with all but two of these probably representing "tabulae rassae." And what would they like to look forward to having seen and done upon returning? "See HIV and discuss health policy"—two, 'Hands on patient contact experience"—six (these certainly would not be disappointed!), "Having done 'Everything'", —five, "a long-term commitment to Haiti"—one, and "Blank"—two, each quite reasonable responses in an as yet unknown situation.

There were many anxieties, some of them spelled out with great specificity: "Violence and insecurity'—six, "Not having enough medicines, and, even more distressing, certainly not knowing enough to avoid injuring some patients through ignorance,"—four, "Mosquitoes!" ("They do spread disease, you know")—two, "Language barrier and miscommunication"—one, "Diarrhea—an inevitable!"—two, "Nervous about being in and interacting with big groups"—one. A question designed to see if the students were ripe for self-analytic appreciation of this experience, "How do you think this experience will change you?" brought the responses:

'Unknown"—three, "It certainly will, I am confident, but I do not know how"—one, "It will be humbling, between the awesome capabilities of medical leadership, and the patient subsistence of the poor Haitians,"—two, "I just know it will make me a better person,"—six, "It will result in personal growth, and get me a letter of reference,"—three, and "Enlightenment,"—one.

For hardships anticipated, the group ranked a series of imagined barriers to be overcome: "Cold showers,"—one, (that would be a nonissue in some occasions where none were available,) "Too big a group for me to feel comfortable,"—one, with one already attesting to "Some personalities within the group,"—one, "Not being able to help, particularly sick kids, because I don't know anything at all and am powerless,"—one, "the language barriers,"—five, "Cultural differences, in patients, and inside the team!"—two, "Mosquitoes", again,—two "Being so far away without my boyfriend,"—one, "How will I ever be able to describe this trip and what I have seen and done when I get back?"—one, and "The hardest thing for me to do will be leaving, when so much still remains to be done,'—one. Asked to prejudge the likely most memorable part of the experience, the group responded: "Unknown,"—five, "How desperately poor people live in ways we cannot yet imagine," –four, 'Seeing new and exotic diseases and conditions with no prior experience in managing them,"—three, "The new knowledge I will be carrying back," having discussed the intensity of the learning experience with others on my prior missions,—one, and "the friends I will be making among the team and among the patients I hope to be seeing,"—three.

In all their anticipation, members of the team were anxious and eager in approaching what was for all but one of them an unknown environment and experience, yet keenly interested in participation to the fullest extent possible, already hoping to join in on other future missions, returning to the as yet unseen Haiti or anywhere the next mission might fit in with their schedule and career enrichment.

Responses to Questionnaire "B" on Returning

It was a very different group of individuals who got back onto the plane to leave Port au Prince. To some degree they were also a team, whereas they had been largely strangers before and had their own anxieties amplified by finding out that the others knew no more, and many of them considerably less, than what they did that might help the people whom they would be encountering. Some of this early anxiety was reflected in flippant banter, some in gallows humor, and some good natured ribbing for some of the more obvious mistakes. As I checked the group in as a bloc to also allow excess luggage check-in for all the medical and surgical supplies we were carrying, I asked each for their passport, and brought them in two by two. We found out that due to heightened security, no boxes could be checked, and each of the Med Packs were carefully packed and sealed with my license attached to each. If we opened the boxes the organization and security of the medicines would no longer be secure. We solved that problem by my purchasing several oversize duffel bags on the spot from American Airlines, and packing the Med-packs in their original boxes inside the duffel bags checked in through a different agent than the one who had told us all boxed items had to be emptied out into bags. The straggling late-comer came rushing in late, with a backpack. I asked him for his passport, and he gave me a blank stare. We are headed through two foreign nations in a heightened security mode and he had never even though of carrying a passport! I checked his bags in as mine, and made a later flight for him to Miami and Santo Domingo, and then made a special

taxi arrangement for him to catch up with us guided by cell phones in the DR. From that point on, before any of our group moved to a new location, each would call out his name, and announce that they had his passport and bags under their control.

In contrast to the few who knew their fellow teammates, and only a couple before the trip, each responded differently on the post-trip questionnaire B: now the numbers of the team that each knew "really well' numbered "seven"—one, "ten,"—three, "eleven"—five, and "all"—seven, with one commenting that the level of trust he now had was previously only experienced in family because of the intensity of the shared inconveniences and the patient problems. In response to the question of how the experience matched expectations, there was a unanimous chorus of superlatives, with no one of them neutral or negative. The terms used were: "amazing," "incredible," "far exceeded my grandest expectations," "tremendous," "great," "far more rewarding than I could have hoped," "strong," :"how about 'overfill' instead of 'fulfill?'" Each one was positive in how the trip fulfilled their motivations for making it, and all responded that they would do it again, one adding "in a heart beat." Where they would wish to go, as a concrete expression of their willingness, over half said back to Haiti, three fourths added Africa to that return trip, and several added "on your next trip wherever," one adding "ASAP, I'm hooked!"

In answer to whether many of the things each was hoping from the outset to do were done, the typical answer was "no. much more!" All were surprised at the high volume of supervised hands-on care, and many expressed amazement at the high quality and intensity of the medical education component. When asked what they hoped to do that they did not get to do, answers included "meet Paul Farmer,"—two, "observe or participate in a surgical procedure,"—one, "hike, explore and sightsee more, (still stuck in adventure tourist mode)—two, and "drive"—one; the others said they had done all they had hoped and more, and there was no item they had hoped for that they did not get to do—ten.

At the outset in briefings both before and during the early parts of the trip, I explained there were three aspects to the mission, and they were in order of priorities: A) Patient care, which would not be compromised, and that there was no "third world standard" by which any treatment would be considered "nearly adequate, considering the circumstances and amateur clinicians;" B) Medical education, which was a rare and intensive opportunity and not an elective process from which anyone might absent their participation, and upon which they would also be evaluated; and C) Adventure travel and living almost in the conditions of our patients, which would require flexibility and adaptability, with no accommodation for the special requirements of first-worlder's consumption "needs." How this trip ranked according to the three aspects was asked in three questions, given this up-front list of priorities. The critical health care delivery part was judged "great,"—fourteen, and "adequate,"—three. The medical education component over which we had somewhat more control, however, was a grand slam, all sixteen students professing that this part was great, with a few stating they had never learned so much. The adventure travel and cultural accommodation was ranked "awesome,"—one, "great," –six, "adequate,"—five, with four complaining that there was too much time being pounded around in long bus rides.

For those who had changes to suggest in the trip (and six had none), nine said that the BRA arrangements in the DR suffered by comparison and should be foreshortened in favor of Haiti, and one thought there should be a longer time period spent in each. The most important question from the perspective of this researcher

was "How has this trip changed you?" Each had their own individual way of responding: "I got more perspective in two weeks of this than in the 22 years prior." "I learned to appreciate more what I have and am motivated to return to help others." "I was humbled, and energized to learn more." "I am less a selfish brat." "I have learned so much more about not just medicine, but also the world in which most people must live." "I wanted to construct a hospital." "This trip inspired me." "I should now appreciate what I have." "I grew as an individual." "I feel good and am proud." "I have grown, but I am not sure just how much until I am back and have time to reflect on what I have seen and done." "This was a reality check, causing me to appreciate everything, taking nothing for granted." "I will now have a greater appreciation for everything." "I officially have Haitian fever." "It has made me reconsider my career directions."

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Discussion of Results

This critical question of analyzing a change in self, which preconditions the responses for the set that follows on how the future might look different on the far side of this experience, had made most all of them respond that they are eager to get back to plan their next experience, and also to encourage others to go based on their own transformations in this experience. Many had experienced some minor inconveniences of traveler's diarrhea and I treated one of the young men for lobar pneumonia from which he recovered completely, after reporting that his most memorable event had been "that I almost died. But, then, I didn't so I am eager to come back." None of the group experienced any of the violence or any robberies that had been the chief concerns expressed by several before the trip. The inconveniences (cold showers!) as a pretrip concern vanished, as did those showers, in some part of the trip when the conditions of those around made such cavils forgotten. Yes, mosquitoes made both the pre and post-trip lists of the fears that were actually encountered, but "not so bad, once you distract your mind from it."

Among all the comments about the trip being awe-inspiring and life-changing, only one comment was even slightly negative in the desired outcome not having been achieved. The assessment is quite possibly true for both the participant and the team leader in evaluating this person's performance, and probably had to do with the self-image and information base carried to the field reflected in the pretrip questionnaire and the self-introductions at the outset. This individual probably had the weakest overall grasp of the medical issues, patient care, and experience of health care practiced in a foreign environment, not excepting the college students without either medical or public health backgrounds. When we were all asked to introduce ourselves at the outset, she told the group in only five words; "I'm a Global Health Consultant." This astounded me, from someone who was unqualified to take care of any single patient for any given health problem, that she might consider this to be a credential for taking on whole populations of patients and being paid to give them advice on the basis of so slender a knowledge base. During the course of the mission, she had very limited contributions, but when she did, they were global answers regardless of misunderstanding of the right questions; "e.g., what we should really be doing here is just distributing truckloads of condoms."

She expressed an interest on questionnaire A in "Seeing first hand the medical aspect of public health," but was overwhelmed by the volume of patients, the intensity of their problems, and the huge information load required in beginning to address any one of their myriad problems, and eventually objected to so much hands-on

health care and her impotence in the face of the peoples' problems In Questionnaire B she wrote that she was disappointed, since she had wanted "… to talk with the Minister of Health and discuss many of the public health issues for the Ministry in each country…" and give them advice. With this orientation and capacity, she is well on her way toward the career in "Global Health Consulting" I had decried in the previous paper, concerning policy-making administrative generalists whose health beat consists of derivative conferences in Geneva and world capitals, without experience or capability in any real world health concerns. Even she, however, lauded her first real world, largely observational, health care experience as "very educational!" [*sic*] and said that she learned a lot from the team leader and everyone participating, although she had some reservations about how some patients were treated, as, for instance, when photographs of an extremity were obtained in one instance without a second explanation and request for permission.

The most special things learned were often images, learning that even very sick and poor people smile, and even more often than their pampered teammates. A woman collapsing in a rigor of a post-partum malaria rigor was supine at our team as a chicken was passed over her, in a healing ritual. That chicken clucked loudly and laid two eggs. None of the students mentioned the special Voodoo Ceremony conducted for us, allegedly the first such mixed participant cultural ceremony in the memories of the old-timers of the Central Haitian Plateau. The performance was much less real than were the patients' everyday lives and their struggles. In response to one question "What is the one most special thing you learned?" my own words came back with their own experience now informing the earlier statement repeated without content: "Gifts from the poor." When facing such threats as their first time encounter with untreated tuberculosis, several responded to the "most special thing" question with the catch phrase I had borrowed from Paul Farmer: "O for the P"= "Options for the Poor." "It is true," I had pointed out in our pretrip briefings, "That at times you will be acutely uncomfortable, and deprived of all you are used to, but remember, you will be leaving, so what 'O for the P' can you bring them to make their lives better as a result of your encounter as they must remain behind in the conditions you seek to leave?" Most of the participants reflected on their experience in such terms when summarizing their reaction to this intensive encounter with their own fears, the unfamiliar and ambiguous, and a population isolated by language, economics, and disease. Most of the bridging over the gap between team and afflicted population was made by the adults and children of the citizens of Hispaniola coming more than half way toward the learning students, in the "Gifts from the poor."

Learning from "Service Learning" by these Entering Health Care Students

In the prior paper proposal reviewing the ambiguous role of the humanitarian enterprise,[1] it was found that the majority of the studies in the literature relate to evaluation of the subject population in relief efforts, judging the impact on the "target population." In this study, the goal as had been set out in the proposal of the preceding paper has been to evaluate the impact of a volunteer medical mission on the attitudes, knowledge and motivations of entering health care students in unfamiliar settings.

In the context of the prior readings detailed in the preceding paper, it was assumed that the medical mission would produce a mixed report of the impact on the

subject populations as estimated by the criteria of Taylor-Ide and Taylor and Wright.[2,3] By unofficial recording, there were no major complaints on the part of the patients cared for despite long waiting queues in tropical heat, and occasional short falls in medical supplies with which to treat them. To the contrary, there were open displays of affections and gratitude at nearly every mobile clinic we had held, and much overt response from many patients and their representatives relayed through translation. This experience is not for everyone, and perhaps volunteering for such mission service self-selects a different kind of individual than might be the frequency of humanitarians in an unselected entering health care team. So, a bipolar response was anticipated from the participants when asked for the effect of this kind of experience upon them personally, with part of the group declaiming that they wanted no part of such an experience of deprivation and inadequacy again. This was emphatically not the case when the evaluations and interviews were analyzed. The results were expected to be mixed, with one of two typical responses being that the kind of patient population represented by the Haitian poor was frustrating and thoroughly disagreeable and not to be repeated by any health care professional who would like more control over the environment in which they hope to take care of the sick and with higher predictability on the yield of this effort. This kind of biphasic response was predicted on the basis of the literature review previously carried out and reported in the prior paper.

From personal experience on many prior missions, I had assumed a mixed reaction to exposure to hardships and deprivations in dealing with a mission set up to travel "into harm's way," where the unexpected is the norm and the kind of student preselected for health care education, often on the basis of a somewhat rigid discipline and compulsions may sometime decompensate when the environment and his or her own reactions to the setting and problems may be out of control. There were only minor mutterings about the "disorganization" and changes in expected scheduled plans, and that was from the students least secure in their knowledge base or capacity to carry out a flexible approach to patient care, and even these students adapted under the example of others in the group.

Not everything went right during this trip, including the long rides on very difficult eroded roads, with one instance in which a rendezvous with previously reserved vehicles was delayed for a day, and the vehicle delivery longer still. A big bus was rented to solve the immediate problem, but was still not a comfortable mode of transport to arrive at our Haitian base late to start up our most intensive clinical experience. At the time each hungry, weary and exasperated participant might have been snapping at each other for getting any one of us into this situation, but for the people we had come to see, who cannot escape worse than inconvenience. This kind of educational experience might be considered inefficient when compared with a well-organized classroom approach to, for example, the teaching of parasitology and tropical medicine. But nearly every student testified that this service learning was the most intensive educational process they had ever encountered and had learned more in this two week period than in any intensive seminar setting. The AMA-motion on recommending such service learning (Appendix E) on the basis of this research into the self-reported changes in knowledge, motivations and behaviors would appear to be strongly supported as a valuable addition to the enrichment of most health care students' education in a very real world setting. This kind of service learning might be the kind that Benjamin Rush had wished for in the quote cited by Link (see Ref. 4, p.132): "I wish a society could be formed to humanize physicians."

I submitted the pretrip proposal paper and the post-trip report of the health care students' responses to the global health authority on this subject, Carl Taylor;[5] his congratulatory response and analysis, coupled with a report of his own mission at the same time as ours is appended (Appendix F.) The self-evaluation provided by each participant before and after the service learning experience conveyed the change in each that each hoped had humanized what had otherwise been a somewhat selfish and pampered protected first world consumer. If this self-analysis is correct and sustainable, the effort should be a universal prescription in medical education and not just an elective for a self-selected group already motivated for service learning.

The data derived by this research into the health care students' responses to their first medical mission would provide support for the universal integration of such experience into the health education curriculum that Carl Taylor had advised.[6] This service-learning encounter may have been even more life-changing for the first-world health care students than it may have been for the third-world Haitian refugees each had come to serve.

Appendix A

Questionnaire Filled in on the Outbound Flight before the Medical Mission for Flood Relief Victims of the Dr/Haiti of Hispaniola

Name, Age, School, Year and Date

1. Languages: Spanish: French: Creole: Ethnic origin:
2. Have you ever done anything like this before?
3. If yes: When? Where" What was your role? How did you like it?
4. How did you decide to come on this trip at this time?
5. How many of our group do you know very well?
6. What do you think is your primary motivation for serving in this medical mission?
7. How will this kind of experience fit into your career plans?
8. Do you think now that you will attempt another medical mission?
9. If yes, In the same? or another site?
10. Have you traveled abroad in the last ten years?
11. If yes: First world destinations? Third world countries?
12. What are your expectations?
13. What would you like to do that you are looking forward to reporting upon returning?
14. What are you anxious about? What are you eager that you NOT encounter?
15. How do you think this experience will change you?
16. What do you think will be the hardest thing for you to overcome or to enjoy least?
17. What do you think now will be the most memorable part of the experience?
18. Do you keep a diary? A tape recording or dictation?
19. Photo log? Film? How many rolls? Digital?
20. What role would you like to have in reporting the experience of our mission upon returning?

Appendix B

Questionnaire to be Filled Out on the Return Flight from the Dr/Haiti Mission

Name and Date

1. How many of our group do you NOW feel you know really well?
2. How did this experience match your expectations? What was unexpected?
3. How well did this trip fulfill your motivations for making it?
4. Are you thinking now of making another such trip in the near future?
5. If yes, How soon? To what destination? Under what auspices?
6. Did you do many of the things you were hoping to do at the outset/
7. What did you NOT get to do that you had hoped to?
8. What is your opinion of the A. Health care component of this trip?
9. What is your opinion of the medical education component of this trip?
10. What is your opinion of the adventure travel/accommodation component?
11. What would you change?
12. How has this trip changed you?
13. Do you think this trip or change in you will have an effect on your career?
14. Did you encounter any of the fears you were anxious about? Or add new ones?
15. How many rolls of film, digital disc exposures, audiotapes, notepads, cards or letters did you produce during the trip? What souvenirs did you carry back?
16. What would you advise someone following you on the next trip to do?
17. What is the one most special thing you learned?
18. Describe the most memorable patient you encountered.
19. Have there been any important people who have influenced what you learned this trip?
20. What would you say in summary of your experience on this trip?

Appendix C

Justification for Investment in Medical Student International Medical Education Experiences

In encouraging new applicants for medical student service abroad in developing nations, we have conducted an annual student-led review of the experiences of the available student "veterans" who report to their underclassmen about these life-changing experiences. Those who have reported formally this year (N= 80 of the partial list, and still accruing) have stated that it had been among the most valuable experiences in their medical school careers, with a number reporting that it was the single most intensive and rewarding medical learning experience of their lives. Many have spontaneously opined that this experience was life- and career-altering and nearly all reported that their attitudes toward patients of different origins, economic and social status were changed to be more expanded, inclusive and appreciative.

The motives for such applicants to service abroad have been varied with three major themes: (1) A unique opportunity to get early and extensive responsibility for a wide variety of patient care under extraordinary constraints of technology and skilled manpower shortages for the treatment of common and exotic diseases in

unusual settings; (2) A very intensive learning experience in another culture across language, economic, political barriers to health care access, in a profound orientation of their place in the world as health professionals in the context of global needs; (3) A medical and cultural adventure in a formative period in their career before the crushing obligations of time and intensity in post-graduate specialization and increasing domestic and financial commitments.

The constraints toward wider participation in these highly valued experiences by a larger number of students included: (1) financial burden (remarked by nearly all, but by many as the single most insurmountable barrier); (2) lack of encouraging mentor or network of connections that might authorize and support a high value educational experience in unfamiliar settings; (3) fears of personal insecurity regarding health concerns or safety in unstable environments.

In addressing these concerns, I have offered mentoring to all, and encouragement for most who are fit volunteers for such service on appropriate motivations; however the financial constraints are the ones that have most strained both student and faculty resourcefulness. I had previously assured each applicant who has sought eagerly to participate with two basic rules: (1) I will never provide them with the first dollar for their support, and after their good faith "best efforts" at collecting sponsorship, (2) money alone will not be the reason that they do not go. With the swelling number of applicants and growing number of participants, the mentoring and personal supervision are nearing their elastic limits, and the financial assurances have been exceeded. Many qualified applicants have been turned down on the basis of the inability to complete the minimal required financial costs of the travel. A basic scholarship for students competitively arranged for partial support of their travel expenses will make it possible for selected qualified applicants to experience this kind of medical school epiphany that I consider one of the most singularly valuable lessons of their entire medical careers.

Appendix D

Medical Relief Mission to the Dr/Haiti Personnel

Glenn W. Geelhoed, M.D., Team Leader, the only Licensed Practitioner
Huda Ayas, Office of International Medicine, Administrative Director
Laurie Kates, GWUMC, rising senior medical student, first team captain
Mike Williams, Howard University Junior Medical Student, previously in DR
Duc Minh Vo, GWUMC, rising senior Medical Student, third team captain
Lindsay Eisler, GWUMC, rising sophomore medical student
Vesta Salehi, GWUMC, rising sophomore medical student
Anisha Dua, GWUMC, rising sophomore medical student
Siavash Foolidian, GWUMC, rising sophomore medical student
Anthony Adelkun, GWU first year Med Student
Bryan J. Schaaf, MPH student, former Peace Corps Volunteer Thumonde
Sonbol Shahid-Salles, MPH student, Iranian-born and Spanish-speaking
Martha Wood, MPH recent graduate, employed in NGO
Neely Dahl, MPH student, anticipating Peace Corps appointment
Suzie Zeiger, Haitian Creole translator and Spanish translator helper
Zeb Whitaker, an EMT, active in Shenandoah Search and Rescue
Adam Benzig, EMT, Paramedic, potential PA applicant
Sarah Caton, GWUMC Microbiology Employee and premed student

Itinerary

AA # 713 19 Jul Mon DCA—MIA 8:30 AM—10:59 AM
AA# 783 19 Jul Mon MIA—SDQ 12:53 PM—3:09 PM
Santo Domingo-Jimani—overland via Elias Pinas to Thumonde & Cange
AA # 1908 30 Jul Fri PAP—MIA 2:45 PM—5:51 PM
AA# 2258 30 Jul Fri MIA—DCA 8:03 PM—10:29 PM

Appendix E

Dear SL colleagues,

At its annual meeting in June, the American Medical Association House of Delegates called for the introduction of "Service Learning in Medical Education" as a "key component" in medical schools' curricula. The resolution asked that such experiences include "collaboration with a community partner to improve the health of the population." After discussion, the resolution was expanded to include residency programs. Below is the final wording of Resolution 321 - Service Learning In Medical Education:

RESOLVED, That our AMA support the concept of service learning as a key component in medical school and residency curricula; and be it further.

RESOLVED, That these experiences include student and resident collaboration with a community partner to improve the health of the population.

A team from the University of Missouri Kansas City School of Medicine, led by Community-Campus Partnerships for Health member Stuart Munro, authored the original resolution and submitted it to the Section on Medical Schools. (The team included Stuart Munro, Gary Pettett, Linda Johnson, Harry Jonas and the Dean, Betty Drees).

Although AMA policy lacks the authority of policies adopted by the bodies that accredit medical schools and residency programs, they reflect a broad-based professional opinion and represent a significant endorsement of service-learning in medical education. To learn more about service-learning in medical education, please visit the Community-Campus Partnerships for Health website at http://depts.washington.edu/ccph/servicelearningres.html Community-Campus Partnerships for Health is a nonprofit organization that promotes health through partnerships between communities and higher educational institutions. Check out our website at www.ccph.info Join us for our first-ever international conference being cosponsored by CCPH and The Network: Toward Unity for Health, October 6-10, 2004 in Atlanta, GA USA on Overcoming Health Disparities through Partnerships

Appendix F

Glenn-Thanks it was refreshing to read your two emails and get the feel of your excellent medical missions for medical students. It reminded me much of the dozen or so that Dan and I ran in remote valleys of Nepal 30 and 40 years ago with a summary report in what used to be called The American Journal of Medical Education ??? It is most rewarding and I used to say what you are saying that this is the most direct way of producing life changing in the careers of young health professionals. Keep it up. You asked my opinion of this draft and I will be blunt. It is great for true believers, but not yet sufficient to convince the skeptics. Perhaps most problematic is that it is much too long and repetitive, trying to drive in your main points. Those with doubts would never follow you through your very logical arguments. So could you cut the theory and concentrate on the positive real life change experiences

with facts not opinions of what really happens? You mention 80 individuals you have surveyed, what numbers do you have indicating change? Thanks for the very kind quotes from our book. It does focus on the community and scaling up rather than the individual professional, but it is wonderfully exciting to feel community change the way we also have been seeing students change. I attach a field report. Carl

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CHAPTER 46

Field Notes on the Clinical, Public Health, Geographic, and Political Features of a Typical Day in a Himalayan Medical Mission

Glenn W. Geelhoed

Day Two at the Thicksay Gompa Clinic with the Public Health Programs for School Children in Addition to the 160 Patient Clinic followed by the Exciting Excursion to as High as Anyone Can Go by Road on Earth Anywhere: 18,380 Foot Khardumgla, the Karakorum Pass, July 22, 2000

Field notes from a typical day on a Himalayan medical mission have been picked, nearly at random, to reflect the kind of day-to-day activities of a medical mission, and our thinking about them as they happen. One of the most routine parts of any scheduled clinic is the unpredictable, with rapid learning being a component part for the beginning students and the experienced leader alike.

I had led a group of medical student s and residents on a trek into Ladakh, "The Kingdom in the Clouds" of Himalayan India. We had scheduled our first clinics in Thicksay Gompa, a district health center within the Buddhist Monastery near Lei, Ladakh's capital. The opening ceremony, deployment of students and supervisors in several clinic rooms with translator's and a centralized pharmacy for our drug dispensing had been accomplishment on the first day, and both the clinic staff and the waiting patients in the registration queue had some idea of what to expect in this process.

A group got up for an early departure to go to the Thicksay Gompa, allegedly in time for the 6:00 AM prayers by the monks. I had just come from a gompa at the Leh Palace, and had heard the mantra in many other monasteries, most notably the one at the Everest Trek route where Tensing Norgay's son had stopped for his prayers before summiting Everest on the David Brashear's IMAX film "Everest". So, while the students went to hear the morning prayers chanted by the monks, I got an early start in organizing the clinic—an event witnessed by the prospective patients in the community, so that they came running to be early in the queue.

So, we hit the ground running. This time we rotated teams a bit, with my own coverage still over Elizabeth Yellen and Amy Hayes in one room, but John Sutter had gone to be supervised by the local clinic director Dr. Ahmed Patoo, and I would wait for his call as a consultant to his room, and Sonia Szylck had asked that I be her

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supervisor and consultant in the front room that John Sutter had occupied yesterday. I would then float between the room manned by Bill Barrett and Christine King, who requested to stay together as a team, and Jonathon Schoen and Hadley Abernathy, which I suggested be reconstituted to move Hadley up front, and move in the other local doctor as their translator who might enlighten them on local approaches to common problems. I also knew that when the mob of curious school children arrived there would be a rush of bodies of the worried well crowding more than a hundred patients with some form of complaint, and at that time we could move Hadley, a teacher, and Amy, a former teacher before becoming a medical student, out into the courtyard for the public health presentations with a translator team.

The Full Monty: Clinic Processes 160 Patients with a Target of Completing by 2:00 PM for the Excursion of the Afternoon

We tried to pick up the pace in going through the patients' problems, since the hallways were jamming up with large crowds of colorful people waiting rather patiently and curiously. Sonia was able to do this better than Elizabeth, perhaps because she was less cautious, not having a longer list of worries to be missing the larger list of things Elizabeth had to exclude, picked up in her extra year in GW medical school. I supervised the two of them quite closely for every patient, and would drop in on every third patient being seen by the two physicians, Bill and Jonathan who handled their flow rather well.

We saw the same variety of patients, with Tb, congestive failure, acute respiratory infections, musculoskeletal complaints—principally osteoarthritis of the knees, with the ever-present moxabustion scars indicting where they hurt. It seemed that osteoarthritis may have been common, and present in more than one set of joints, but it was usually the knees that patients complained about first. "Why is that?" asked one of the students. "With respect to serious functional incapacitation, you have seen an Asian toilet?" I responded.

There was a lot of epigastric distress, differentiated about evenly between peptic and biliary problems. A lot of this was acid reflux disease, presumably because Helicobacter pylori was endemic and increasing in the area, but we had been told that with increasing westernization of the diet in the area as more contact had continued with the outside world, the biliary tract problems of cholecystitis were increasing in the last few years as well. The local hospital is getting the equipment for the laparoscopic removal of gall bladders!

Progress! This means they are developing ever more sophisticated technology to deal with problems they had never experienced until they had developed to the point of getting the Western problems in concert with the west sending them not only the disease, but the methods of treating it! Next we will be able to handle atherosclerosis, gastrointestinal cancers, and strokes with renal failure here, since they will have "developed " sufficiently to be able to not afford to take care of these diseases either!

This means that medical marketing is an almost perfect model of an economic export system, creating demand for services that become indispensable along with the technology for half way solutions. Degenerative diseases of civilization create a lifetime demand for their management, since they are not ever cured—why not prevented? And, if there are areas of the world where they have not yet developed,

why not learn from them what they are doing right? A far more effective means of health promotion would be to invest in some preventive measures, so that their health strengths might be used, to be exploited to help control their problems. Ladakh is in transition here, since they have a rather good basic health state, with a health care infrastructure that might help maintain that with some form of primary care without a lot of frills for services not yet fully required.

What this means within a health care education system is that students are always concerned when accompanying me that they know too little about exotic tropical diseases, in which I may be particularly well versed, and they are looking for the rare and endemic conditions not seen elsewhere in their US medical school experience. There is a chart on the wall of the clinic room I am using with Elizabeth and Amy that shows the early changes of leprosy, a disease that piques the interest of the medical student from the US since it sounds so Biblical and pestilential that we MUST have some exposure to this ancient scourge. But, what about this rather ordinary garden-variety litany of diseases we have been treating all day?

To this point, now 300 outpatients along in our two day clinical experience, (the first two days of the professional experience, and the entirety of the clinical experience of at least five people in my entourage) there has not been ONE patient with any form of unusual tropical disease requiring treatment! As had been pointed out to me thirty three years ago in Nigeria when I was first starting out at the level of a senior medical student in an environment in which tropical disease was endemic then, and even now, is that to practice medicine in a developing world setting, the preparation needed is a very good basic understanding of the pathology of the western worlds' endemic disease patterns with which we should already be familiar, and then note two exceptions: The disease patterns are seen in later classic presentation in more advanced stages when first encountered because of the lack of early secondary intervention in them. And, second, there are any number of diseases of degeneration that these populations do NOT have that fill over two thirds of the US hospital beds. Now, what can we learn from them to avoid the greatest causes of morbidity in the US health and illness pattern?

One young monk had fallen on his outstretched right hand and sustained a Colles fracture-this would have been a simple fix with plaster sugar tongs splint, but there was no plaster for casting here and we had to send him on with his diagnosis—which he had made before we did. A local practitioner would make a splint of locally available materials, such as bamboo—lightweight, resilient and strong.

We had a few developmental retardation patients at least one of which looked post-meningitic to me. The little kids with ear infections and GI distress with diarrhea do not look different than they do anywhere else, but they did have one feature which occasioned a short discussion of the advantages and disadvantages of being born at altitude.

Being born a Kenyan from the highlands may make it possible for you to expect to win the Boston marathon from the additional "blood doping" of an aerobic advantage. But, as seen with nearly all the little kids in Peruvian Andes, they have rosy red cheeks with what looks like frostbite of those cheeks. I suggested they consider the difference in the hematocrit of these small kids with their own, and consider whether acquired polycythemia was an adaptive response or not, and at what point too thick a blood made it possible that flow could became sluggish, however well it could hold on to oxygen. That the medical students could practically apply a lesson in renal erythropoetin and blood rheology while standing in a clinic in Thicksay

without electricity, let alone flow photometers; makes this "laboratory" an ideal medical school classroom!

Our Public Health Presentations which Draw Out Large Swarms of Children, as Well as Political Health Officials

As we were working diligently on the large numbers of patients still waiting in the hallways, a bus drove up and delivered us half a hundred school age kids. Then another, then another, and suddenly we were looking at a couple of hundred Ladakhi kids pushing and milling about, none of whom had any problem to be diagnosed, but each had heard that there was free stuff and expertise to be had for the claiming. Now, we can "Put Prevention into Practice!" We counted up the number of bottles of vitamins we had and held out fifteen to be saved for the clinic. We then counted up how many toothbrushes we had and held out a few for the clinic. Then we organized all the kids who came out to the courtyard with the Thicksay Monastery rising on its hillside directly behind the clinic and had them squat in the afternoon sun, which mercifully went behind a cloud cover.

It was time for the Hadley and Amy Show, complete with blowing bubbles and stick on cartoon "tatoos." I was introduced by Bill Norton who mainly said how happy it made us all to be here. I then said that while we were in the clinic we had seen the good facilities and personnel and what they could do to help if one was sick, but that we had seen several areas that might be more easily prevented than treated. I listed eye problems, skin problems such as scabies, which could be corrected with good hygiene, and dental caries, which could be helped by good oral hygiene. I urged them to good diets and vitamins, and their completion of the EPI (Expanded Program in Immunization). I then introduced Amy and Hadley and they had a series of games and interactions with the kids who responded as kids would anywhere-even if they were squatting in formation in regimented rows, the boys in two columns of white-shirted uniforms on the right, and on the left the girls in three columns of purple headcovers and sweaters—the school uniform.

Before the public health message was over, the kids were blowing bubbles, pasting on tatoos, with the happy faces of kids anywhere with some small disposable toys. Along with this they got a toothbrush and toothpaste with instructions in dental hygiene. They got vitamins and a lecture about good diet. They were told how to wash their hands and faces and how often. They were shown where the clinic was to get their immunizations up to date. This process was repeated at a later arrival of another large contingent. At a lower level over a broader scale, it may have accomplished more good for health than our diagnostic screening and treatment.

The large numbers of kids seemed to draw a number of officials who were involved in getting them here or in giving permission for our medical mission in the first place. I met the district medical officer, the "block officer" for the 32 health care centers in the Leh/Ladakh block, and a number of other people who were eager to be seen and associated with the group but were reluctant when I said I would introduce them and they could explain to the children in Ladakh just what it was that they do to help them. But, at least they all got recognition.

After taking a number of pictures of Hadley and Amy in action with the scenic backdrop of a large audience of kids (which will never hurt their medical school applications) I scurried back inside to cover the last rush of patients in to see Sonia and Elizabeth, and then took care of a half dozen stragglers myself who had got in just before the cutoff to allow us to be packed up at 2:00 PM and gone by 3:00 PM.

This almost happened. In what seemed like record time for this group, we got everyone into a lunch room by 2:20 and packed out by 3:15, until we had to stand at the door of the locked bus and await the last of the good-byes and last straggler climbing aboard to leave by 3:40 PM which still made it touch and go for our clearance of the four o'clock cutoff for the Karakorum Highway considering one more loitering stop at he Hotel Khangri.

As High as Anyone Other Than I Had Ever Been, We Make it Up and Over Leh, Along the Karakorum Highway to Arrive at the World's Highest Road Pass for Any Motorized Vehicle—The 18,380 Foot Khardungla

We made it to the police checkpoint where we all had to produce passports and get checked in and were grateful that it did not seem that the guard noticed that we were after 4:00 PM. While waiting I had punched in the GPS for the Checkpoint CHEC 34* 15.17 N, 77* 37.12 E This makes the checkpoint 7.08 miles from Leh at 194*, most of that short distance being nearly straight up with a lot of miles in zigging and zagging on Himank's masterwork Just beyond the checkpoint as we zigged and zagged on switchbacks up and over spectacular views of the valleys and barren dry mountains of the Karakorum Range with a backward glance at the Himalayan Range and the dominant mountain Stok Khangri facing us across the Leh Valley, we passed a depot for the Himank equipment. There is a monument to the men who died in the construction of the Karakorum highway= a total of 1594.

As we went higher and the air got cooler, we pulled on sweaters or jackets. We saw some endemic birds—the snow pigeon I had seen in Nepal with its extra wide and long wings with a broader surface area to support flight in this high mountain country, and the Chukar Partridge—-native to this area of the Himalayas and which I have hunted as exotic imports on the Eastern Shore of Maryland and in other hunting (and tasting) pursuits. We also saw yaks and Zoes, that cross between the bull yak and the female cow. Like mules, these hybrids are sterile, but they do a lot of the heavy hauling up at this level.

Our ears were popping and our throats parched, but our eyes were wide open, agog at the splendors of the sight below us. I told Jonathan Schoen who was sitting behind me, that now all the vaunted "Fourteeners" of Colorado were below us, and we had almost a mile to go to get to the highest pass through this Karakorum Range. A few of the newcomers to this sport got a touch of mountain sickness, and went straight to bed upon our return home to our Hotel Khangri. We passed through a carved niche in the rocks, the "Gatung of Nabia," which means the "garden of Nabia." If "Nabia" is someone out there, he must be chuckling all over, since the "Garden" is a sheer rock face wall below, with three truck carcasses lying in ruins a long way down. It would seem that I could see these wrecks quite easily without help, and the additional black flags on poles hung over the crash sight were redundant, although they were there to warn off all evil spirits, which had obviously visited this place at least several times judging from the wrecked truck bodies representing tombstones down at the slope's downside.

We arrived at the pass KARA 34* 16.80 N, 077* 36.04 E, making it only 7.80 miles by the numbers of miles from Leh as the crow flies, and at 18,380 feet the site of the world's highest temple. There were other designations there-such as the site of the world's highest motorcycle raid, military action, etc. But there were other signs pleading for harmonization. We got out and even ran around a bit, to get the experience of what it is like to be at the highest point any of the group (with the excep-

tions of the drivers and me) had been before. It was good for a headache and a hollow hunger in a number of the group who were not again seen until morning, since they went to bed upon return without getting up for dinner.

We talked about the effects of altitude [and also of attitude,] and what could be done to relieve AMS (Acute Mountain Sickness.) We talked about the other three consequences: HACE, HAPE and HAFE. These acronyms stand for High Altitude Cerebral Edema (most usually lethal) High Altitude Pulmonary Edema (requires treatment from a Gamoff Bag or immersion in what I figured to be about two to three meters of water) and High Altitude Flatus Expulsion (remember that all gas expands as the pressure decreases—including that trapped in spaces such as sinuses and dental cavities!).

We posed for lots of pictures, and looked over the Pakistani side of the Karakorum Range and could see K-2 and the three Gasherbrun Peaks. We were at a glacier and could see the avalanche activities along its margin.

An Editorial Note Appended in Order to Get This Message Off in the Possible Morning Emailing From "High Life" and "Cyberia" in Leh

[I will have to send this message off just now, since the power is so irregular that I cannot depend on it to type from any of the erratic electricity supply I might have stored in the ThinkPad. The electronic connection by means of the still more erratic server at "High Life" is only possible first thing in the morning when the phone lines just might possibly enable connection for email. I am planning to go out for a high run just now, so I am going to give this incomplete unproofed and un-Spell Checked disc to Bill Barrett to send along with the title of the subsequent magnificent day when we had me in a setting of stunning beauty in a storm cloud background with chortens and gompas in the foreground as a professional photographer followed me in search of the perfect light—-which came to us as a beneficence never before experienced by the professional photojournalist's lifetime attempt to capture the perfect photograph—-which we hope may now be done. I will explain more of that when I can get back to whatever may provide a reliable source of power and message transmission.].

An Addendum Note to the Narrative of this Day at the Height of the Himalayan Experience in Terms of the Karakorum Roadway, Before I Go on to Describe the High Points of Our Experiences in Leh—and a Few "Low Points" I Did Not Want to Transmit to You by Email Until we Were Out of Danger

This part did not get transmitted by email, and need not have, since I could await a time when I could spell check it and also deliver you a few recent facts that might otherwise have proved quite disquieting if I simply transmitted them by email without the context in which they were experienced. I did not feel we were in imminent danger in Leh, although there had been a combination of deaths just preceding our visit, which had the army, and police on heightened alert and had made for the imposition of a curfew. I thought I might explain this situation, but only after we were all safely out of the area. To balance these notes, you must also remember that it was an experience immediately followed by a set of supreme experiences that a few

of our group and one professional that came to visit the following day described as "ecstatic," and a highlight of his life as a spiritual experience.

Current Events Background in International World Affairs

I will describe the details of what is in the background in Ladakh where we now are, and in Himachal, to which we are going. There is a curfew in effect, due to some recent events in which there have been several deaths, determined to be murders. This would hardly be news if our group were visiting Detroit, but since we are in the pacific and tourist-friendly environment of Ladakh, it has caused quite a stir.

On "Purity"

We are in a highly militarized piece of India along the "LOC" = "Line of Control," with India wedged in to this very remote and isolated high ground amid occasionally openly hostile enemy neighbors. To one side is Pakistan "Land of the Pure", an Islamic state created when the division of the Raj occurred (see "Freedom at Midnight.") "Paki" means "Pure" in Urdu, as "Amrit" means "pure" in Hindi (compare the Sikh's Golden Temple over the Pool of Healing Waters at "Amritsar.").

Near the other borders is the nation of Afghanistan—"under new management." Following the Russian invasion of Afghanistan and their subsequent withdrawal from their own version of Vietnam, the Taliban, a religious reactionary faction of militant Islam took over Afghanistan. They are regularly using rather archaic concepts of divinely inspired authority—particularly as related to the role of women in a Koranic society—and want to enforce their idea of "purity" across the mountain borders. They have made incursions regularly into the area of Himachal above Manali, and they target particularly European or American tourists or adventure trekker/climbers, knowing that this is the second source of considerable income to the province of Himachal that they are interested in disrupting economically. There are many posters all over Manali about persons "Gone Missing" (to use the fine Briticism phrase) while on trek in the Pir Punjal. When I was climbing through the Vayas Kundh two years ago, I had encountered some rather well-armed "shepherds" who were attempting to stay just out of sight of us, but were obviously shadowing us to make sure that nothing untoward happened to their prized tourist guests with the possibility of the Taliban creeping around in the mountains who operate under their own direct revelation from Allah, and know of only one form of Koranic punishment for the Infidels. So, although diminished until recent fears were fanned to life again, there has been less high altitude terrorism against foreign nationals along our trek route inspired by outside forces.

On another side is the occupied territory of Tibet under the control of the Peoples' Republic of China—a subject of occasional wars over the past half century, and a still active dispute with "Free Tibet" posters all around Leh, referring, of course, *only to* the Chinese-occupied area of the former Tibet, never to the equally occupied area of Indian control of the pieces of Tibet along the high Tibetan Plateau *this side* of the Himalayas. Military exercises are held here with regularity to claim sovereignty and to serve notice on the near neighbors that India has the military strength and the high numbers of expendable troops to engage in any conflict at great cost (estimated at over a million dollars US per day.) There is an overwhelming superiority in numbers if one compares the billion Indians and the size of their potential army they could recruit against the Pakistani military, which may be better equipped, but with a nation of about 80 million to draw from. But, this military manpower advantage

India may have is staggered by the sheer size of the largest nation on earth—the one and a quarter billion Chinese—toward which India has to keep flexing its military muscle to discourage any adventurism over the dismembered Tibetan borders.

Now, about that Pakistani border across which we were looking today—over the Khardungla highest mountain pass on earth and the site of the highest warfare ever conducted—I had been musing when looking over at K-2 that it was not that long ago that I had been at Muree in Pakistan looking back into India over the pass from the flanks of the same K-2 in the Karakorum Range. There has been a fair amount of saber rattling—not to mention actual shooting of heavy guns—across the disputed territories of Pakistan and India in the unresolved matter of the Kashmir that both claim. The most recent events in this unresolved war are the matter of Kargill. The longest lasting consequence is that matter of the "Bomb."

Kargill is not far from us here at Leh. If we do not turn south on the 472 km road to Manali we will be taking in another day, we would be going straight to reach Kargill near the prominent feature behind me here-Stok Khangri—the pretty snow-capped mountain that is 6,400 meters at my backdrop, begging to be climbed with a probable three day up and two day down brief excursion on crampons—and the namesake of our hotel Khangri. Kargill is the reason the imminent Indian photojournalist, Raghu Rai, was last up here to cover the battles of Kargill.

Kargill was the "world's highest altitude turkey shoot" that went on from the July until October of this past year 1999. The Pakistani army encroached in the high mountain passes and set up reenforced bunkers with accurate artillery pieces set up to shoot down on any army coming from the Indian side. The officers of the Indian army were leading forces of proud predominantly Punjabi troops, and urged them to not be intimidated by the "high ground advantage" of the Pakistani positions, but to approach them on a steep climb head on. This resulted in a huge number of casualties, since the Pakistani gunners had all the time and the advantages of a precise ballistic pattern they could work out as many different regiments of Indian army came into the Kargill valley and marched into certain doom from the high gun placements which could not even be seen. In a case of superb lower ranking army ingenuity over arrogant officers' stupidity, the Indian army eventually climbed hand over hand to the fixed Pakistani gun placements and blew them up, after a very high casualty rate. The Indian army won, but not without casualties that were horrific—-and that is all within the last year.

This belligerence escalated with global implications when the sabers that were rattled went nuclear. While talking a good nonproliferation game, the Pakistanis blew theirs (the first "Islamic Bomb") first to show the superior number of Indians did not intimidate them. With an enormous US pressure on India not to follow suit, the recently installed BJP party could not tolerate this loss of face, and only a few days later, India blew its nuclear bomb (it never really confessed to having previously) underground in Rajasthan. So within a week, and solely for domestic political purposes with enormous international implications, there were two new members of the "Nuclear Club" of Nations, and these freshly blooded from firing conventional warheads at each other. So, this is the global background for events in this area of the Roof of the World as a context for a few of the recent events that had heightened tensions for quite other reasons.

Killing the "Other" Islamic Revenge on Buddhists and

Old-Fashioned Robbery of Trekking Foreigners

Four days before our arrival in Ladakh, a nasty event took place that had the military on higher alert, with a midnight to 5:00 AM curfew in Leh and other parts of Ladakh when we arrived. Three monks were killed in a murder that was carefully planned and then carried out, even though everyone seemed to be trying to head it off by cooling the reactionaries. A Buddhist monk near Leh had made a comment, that the Koran "should have said" something in an interpretation heard by a group of Moslems from the Shey area. The monk's superior, the Chief Lama of the Gompa, had already apologized for his monks' reinterpretation of the Moslem scripture and had sent a notice to the newspaper recanting this statement —but just ask Salmon Rushdie whether such niceties constitute an exculpatory "I'm Sorry!" within Islam, or any plea of artistic license to say "I was only kidding, or was just making a literary point!" Despite the apologies, the Moslems banded together and returned to murder the three Buddhist monks who had been present during this incident, which the Moslems regarded as a blasphemous offense.

It was feared that there might be an anti-Islamic backlash in retaliation for this counter-blasphemy of murdering Buddhist monks in their Gompa, which is the reason there is a heightened tension of security with an even invasive military presence here that is the reason for the nighttime curfew.

If that were not bad enough, nearly simultaneously, another sordid incident occurred that made each of the manned posts at the bridge crossings and mountain passes on higher alert, with soldiers carrying ammunition clips in their automatic weapons and checking passports and plans of passing trekkers. Four days before our arrival, a German tourist was killed in the mountains while on trek just North of Manali. It seemed that two German men were trekking and met up with an English fellow who trekked along with them for a ways but separated when they each rolled out in their sleeping bags at different campsites. When the Englishman continued on in the morning, he came upon the body of one of the German men and the other was also found, badly injured but still alive. It seems that some local "dacoits" had tried to kill them both in an old-fashioned robbery attempt.

When I had been in Northern Ireland and in South Africa during their very intense struggle with terrorism, such an event would have been called—with the British penchant for understatement if not humor— an "ODC." When I had asked in Belfast what the meaning of the term "ODC" meant when applied to a casualty coming into the Queen Mary Hospital, he smiled and said "Just an 'Ordinary Decent Criminal' Old Boy, to distinguish these blokes from the dastardly terrorists who sometimes do a rather similar sort of thing."

So, I am in Leh, Ladakh with a few issues of some tension having preceded my arrival—each of which might resemble a terrorist campaign, but turn out to be religious bigotry and ODC at work.

The Official Welcome Mat for the Medical Mission Despite These Background Distractions

To contrast what that may mean to us and our work, I immediately point out that we were joined at dinner upon our return from the Khardungla (at least for those of us still interested in eating rather than going directly to bed holding both temples with a nauseating pounding headache from not yet having acclimatized to this altitude and its brief excursion by Tata to 18,380 feet, and the limited exertion

that we are slowly building up to) by the Chief Medical Officer of all of Ladakh Province. I had met him twice before. He had seen me along with his "Bloc" supervisor who had been one of the people who had come during the "public health show" we had put on for the kids at Thicksay Gompa. During dinner, we traded speeches and toasts, in which he thanked us all sincerely, and invited us to full participation in whatever activities we would like in his province. He had expressed surprise that a group, who had worked all day in a clinic setting, still had the interest, energy and enthusiasm to take off for Khardungla after a full day of work. He asked me to return on an expanded itinerary, and such plans were made during the later dinner, involving a helicopter approach to some very distant remote populations in Ladakh in far corners of the Himalayan mountains and a trek out after the medical missions in such camps. This proposal was made for next year at this same time, and the Chief Medical Director of Ladakh, Dr. Dawa, approved them on the spot.

So, as a reluctance to send you by email what might be misunderstood as a hostile territory for which I should, once again, be getting combat duty pay, I thought I would separate this note as to how it is that we are here under military curfew. This curfew is based in a couple of events, that are, of course, unfortunate, but do not have any ill will directed toward us. To the contrary, there seems to be a limitless good will toward our mission and toward each of us personally, and there will be even greater recognition of that not only in Ladakh, but internationally, since I understand that the premier photojournalist of India, Raghu Rai, may be coming to Leh tomorrow to try to follow me through at least part of the medical mission. He had called after being commissioned by George magazine from New York to do a documentary coverage of me and to obtain a "perfect portrait" in a setting here on the Tibetan plateau. He had explained that he had difficulty with altitude, and therefore could not go on with us, as we planned to be departing a day later for Tso Morari, where he could not follow, because of his limited tolerance for altitude, which he based in his poor lungs. But, despite failures of communications and some of the details of making such arrangements, he may try to catch up with us tomorrow as we are moving to a new clinic setting for a venue of a medical camp in a village called Chuchot, situated just below the peak on the slopes of Stuck Khangri. Come on along tomorrow to see if we all arrive in the same place near the same time, as our saga continues in the experiences of the Himalayan High!