

SAFE SURGICAL CARE AT PRIMARY CARE HOSPITALS IN DEVELOPING COUNTRIES¹

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Safe surgical care can be provided at "primary care" hospitals in developing areas if appropriate conditions are established and proper techniques and guidelines are employed. This article provides a summary overview of what is required to provide sound surgical care in these settings to large numbers of people urgently needing attention of this kind.

Introduction

Surgical care is an important aspect of hospital care in developing countries. Such care must often be given in primary care hospitals and must often be rendered by health care workers with little surgical training. This article is written for both a fully-trained surgeon who plans to practice in a Third World setting and for the nonsurgeon who works full-time in such a setting and must deal with surgical problems.

It is important to define some commonly used words so that the reader will have a precise understanding of the situations and concepts being described. The term "surgeon" will be used in a generic sense to describe any health care worker who is capable of performing one or more surgical operations. A "primary care" hospital is a hospital located in a remote region of a country with limited physical and technical resources. Such a hospital must possess at least the minimum space, equipment, and qualified personnel needed to deliver the basic care described in this article. Finally, a "developing" country is one striving to achieve its as yet unrealized potential for industrial production, com-

munication, transportation, advanced technology, and advanced education. Some of the concepts set forth in this article are also applicable to remote areas of the so-called developed countries, although advanced communication and transportation systems in those countries generally make secondary and tertiary medical care readily available.

Surgical care must be put in perspective within the overall health care picture. From a traditional medical standpoint, surgery is presumed to play a major role, being a highly visible aspect of hospital care. In fact it plays a minor, though significant, role in the overall picture of health care and health maintenance for a given population. Other determinants of health—such as immunization programs, preventive sanitary measures, prenatal care, nutrition, housing, and pediatric care—are less dramatic but more important in maintaining the health of a people (1).

Despite this fact, however, access to formalized medical care as provided by hospitals does play an important role in the health of people whose diseases are congenital or have not been prevented (2); and surgical care plays a fundamental role in hospital care. Moreover, surgery is important at a primary care hospital—particularly because patients come to such a hospital with well-established patterns of cultural and familial behavior. As a result, they are often unwilling or unable to go to secondary or tertiary hospitals for care. It is thus necessary that referral to other centers for surgery should be infrequent, especially since the surgical problems

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involved are usually simple and can be handled locally if proper attention is given to detail. This article will offer some guidelines for preoperative selection, intraoperative conduct of basic operations, and postoperative care, with emphasis on safety throughout the process.

Other articles have been written on this subject—including articles on optimal use of operating theaters (3) and how to minimize the cost of operations (4). Another article of this type describes a very helpful method for classifying a large number of operations into five categories on the basis of the personnel, anesthesia, instruments and equipment, type of operating theater, and length of hospitalization needed (5). Nevertheless, these works do not provide the basic information needed by those who are actually delivering such care. This article makes an initial attempt to do that by considering elements of preoperative care, intraoperative conduct, and postoperative care. Some of the principles stated, which may seem elementary to the fully-trained physician, are included for the sake of completeness.

Selection of Patients and Procedures

Cesarean Section

Perhaps the most important surgical procedure that must be done well and safely in a primary care hospital is cesarean section, since it is a common procedure that is usually performed emergently. In this case patient selection tends not to be a factor, since the circumstances of obstructed labor dictate the need for the procedure. However, it is worth noting recent development of the obstetric concept that vaginal delivery is possible following cesarean section if the section was performed for indications other than cephalopelvic disproportion. Thus, the old adage "once a section, always a section" is no longer generally accepted. The alternative procedure of symphysiotomy may be better than cesarean section in some situations because of its ease of performance and requirement of little equipment (6). For either of these operations to

be successful, a thorough knowledge of anatomy and a gentle surgical touch are required.

Other Procedures

Most surgical procedures are elective. So how does one select which procedures should be done at primary care hospitals, which need to be referred and done elsewhere, and which need not be done at all? It seems reasonable that common surgical problems that are easily resolved can and should be managed locally. Some problems that must be managed locally include lacerations, abscesses, common fractures, acute obstetric problems, acute abdominal emergencies, and occasionally appendectomies. The techniques used to perform operations for these conditions, which can be learned quickly, must be grounded in a thorough knowledge of anatomy, physiology, and patho-physiology. Common elective surgical problems such as groin hernias, foreign body extractions, skin tumors, and pelvic masses can be handled locally if basic surgical procedures can be mastered.

Abdominal emergencies should be approached through a midline incision. Lacerations should be repaired with the goal of approximation of the skin without tension no later than eight hours after injury. Fractures should be splinted with the bones approximated in anatomic alignment. Open reduction of fractures should generally be avoided, due to the risk of infection.

More complex cases of a benign nature—such as intraoral masses or chronic eardrum perforations—can be electively referred to a secondary hospital. Cases of advanced malignancy or end-stage organ failure can be treated symptomatically until death.

Preoperative evaluation of elective surgery cases is very important. Each patient who comes in for an elective operation should be screened for chronic renal, hepatic, pulmonary, and cardiac disease. These conditions, which can usually be detected by means of a thorough history and physical examination, should be treated before the operation. In addition, open wounds and acute infections should be treated and resolved before the operation.

The staff that performs surgery in a primary care hospital may be broadly defined as including physicians, nurses, and theater technicians (7). Within this setting, the important prerequisites for the "surgeon" include intelligence, diligence, knowledge of the appropriate anatomy, and technical facility—rather than formal credentials or degrees. (Examples of straightforward operations that can be performed under these circumstances include hernia repairs, tuboligations, vasectomies, and excision of skin lesions—8.) Therefore, one role of a formally trained surgeon working in a primary care hospital should be to find and train suitable people. This frees the physician to perform other tasks, including more complex operations and administrative duties.

As this suggests, even though a given health care worker or physician may have limited surgical training or experience, this does not prevent him or her from successfully performing a limited number of procedures. Indeed, all personnel involved should be trained to deal with emergent surgical conditions that are life-threatening. One such condition is hemopneumothorax arising from chest trauma. Patients experiencing this can usually be saved by a simple tube thoracostomy decompression to three-bottle drainage without need of suction. The tube should be large bore (#32 or #34 Fr.) and should be placed over the rib in the anterior axillary line at the fourth or fifth intercostal space. Other important techniques that should be mastered include midline celiotomy for control of intraabdominal hemorrhage and the proper procedure for cesarean section.

The fundamental principles of hemorrhage control, adequate drainage of abscesses, and simple suture approximation should be well understood. Among the most basic of these principles:

- Hemorrhage can almost always be controlled by direct pressure. Use of a tourniquet proximal to a bleeding point should only be used when direct pressure fails.
- Abscesses should be drained widely and in the most dependent portion. They should be packed open to heal from the base up to the skin.

- Lacerations should be copiously irrigated to remove foreign bodies. The deep tissues should be approximated with absorbable fine sutures to eliminate dead space and take tension off the sutures in the skin. The skin should be closed with fine sutures so that the edges are everted. If any question of future infection exists, the wound should be packed open with sterile dressings.

In a similar manner, the fundamentals of hernia repair, cesarean section, appendectomy, and midline celiotomy should be well understood. Standard surgical atlases can be consulted for details of technique. The ideal time for learning these procedures in developing countries ought to be during the last years of medical school, since opportunities for residency training are limited.

A final point that deserves reemphasis is that a thorough history and physical examination—resulting in the generation of a differential diagnosis—provide the foundation for safe surgical care in any setting. These are especially important in developing countries, where infectious diseases abound and may mimic conditions requiring surgery. For example, abdominal masses due to localized inflammation of the gastrointestinal tract (i.e., ameboma, tuberculoma) may masquerade as malignancies. Occasionally, a therapeutic trial with the appropriate antibiotic is a wise course of action prior to elective resection of such a mass.

Disease Patterns

Surgeons trained in the developed world may find themselves confronted with an unaccustomed spectrum of diseases while working in the developing world (9), because the frequency and severity of disease processes are markedly different in the two settings. Also, conditions commonly requiring surgical attention may be highly dependent on geographic location and the population's genetic makeup. Examples include the problem of esophageal motility due to Chagas' disease in South America and the problem of cleft lip and palate in remote Central American Indian populations.

Eating habits also affect the frequency of disease presentation. For example, the incidence

of colon cancer in most developing countries is quite low while that of colon volvulus is high, due to the high-fiber, low-fat food that is consumed. Therefore, health care workers in a given locale should be aware of the common problems in their area and should be prepared to deal with them. After identification of these problems, it may be appropriate to send a given health worker to a specialized center to learn specific procedures. Another approach is to import surgeons with special expertise to perform operations for a limited period (10) and to train local personnel. Merely importing surgeons to do operations on a temporary basis can be helpful, but this cannot be expected to have a lasting effect on the level of surgical care available on a day-to-day basis.

Emergencies

Surgical emergencies must naturally be considered in a different light from elective surgical problems. They can and should be handled safely by individuals with minimal surgical training if common sense is employed, and if basic anatomical and surgical principles are followed. For example, a patient with a strangulated hernia containing necrotic bowel should be treated by celiotomy, reduction of the hernia, and exteriorization of the necrotic bowel through the celiotomy incision. The bowel is then resected after closure of the midline incision around it, and the patient is left with a controlled enteric fistula that will require later closure. The general principle of not opening distended or necrotic bowel within the peritoneum, as developed by early surgical pioneers, remains a good guide for minimally trained surgeons, since death is the most likely outcome of fecal contamination within the peritoneum.

Equipment and Laboratory Services

In order to provide adequate surgical care, each primary care hospital should have an operating theater, at least one autoclave for sterilization, appropriate garments and drapes, a basic laboratory, and a medical library. Two

different lists of versatile instruments provide minimal sets of essential tools for several different operations. Table 1 lists the necessary instruments for routine herniorrhaphy. These instruments can also serve for performing appendectomies, circumcisions, or incision and drainage of abscesses. Likewise, the instruments listed in Table 2 for celiotomy can be used for cesarean delivery, cholecystectomy, or bowel resection if necessary. In addition, equipment packs for dilatation and curettage and for vaginal delivery must be available, functional, and sterile, since miscarriages and deliveries are frequent.

Other specialized surgical instruments such as vascular clamps, otorhinolaryngologic instruments, and various devices such as vascular grafts or ventriculoperitoneal shunt catheters are generally inappropriate for a primary care hospital. Such instruments are rarely if ever used and are very expensive. On the other hand, a peri-

Table 1. Herniorrhaphy instruments.

Instrument	No. needed
Kelly hemostat	6
Mosquito hemostat	4
Scalpel handle	1
Metzenbaum scissors	1
Straight suture scissors	1
Towel clamp	4
Retractors:	
Army-Navy	2
Richardson	2
Needle holder	1

Table 2. Celiotomy instruments.

Instrument	No. needed
Kelly hemostat	6
Self-retaining retractor	1
Kocher clamp	6
Right angle clamp	2
Long Metzenbaum scissors	1
Straight suture scissors	1
Set of malleable retractors	4
Paen clamp	4
Scalpel handle	1
Towel clamp	4

toneal dialysis catheter can be very useful if the hospital personnel know how to insert and use it. (Such use presumes the capability of measuring serum creatinine and potassium.)

Another very important and necessary piece of equipment is a steam autoclave. Various sizes and models are available, and it is a good idea to have at least a large and a small one. If possible, the autoclaves should be located in a separate "central supply" room. This arrangement permits all equipment and supplies to be cleaned, sterilized (if necessary), stored, and accounted for when used. An inventory can then be kept, and items can be replaced as they wear out.

The actual operating theater must be kept clean, must be kept free of flying insects, and must have adequate lighting and an adequate suction machine. Staff members should not be allowed to enter the operating theater in street clothes or street shoes.

The ongoing need for adequate linen implies a major commitment from the hospital laundry in order that clean caps, masks, shoe covers, trousers, shirts, and dresses together with sterile operating gowns and drapes be provided. This task may be very labor-intensive, but it does not require skilled labor.

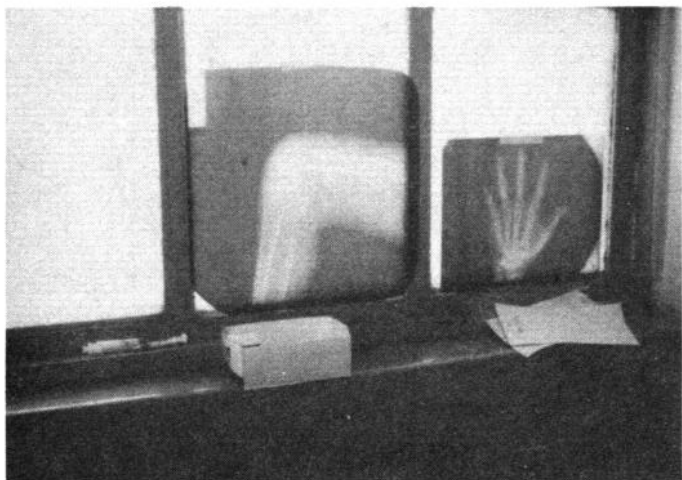
Basic laboratory facilities are another important adjunct to good surgical care. Most primary care hospitals should be able to perform a pre-operative urinalysis, a complete blood count, and coproanalysis. Because of the high incidence of anemia and intestinal parasitosis, as well as the need to screen for renal disease, these are very important tests. Blood-typing and cross-matching are also essential if transfusion is expected. In some locations, type-specific blood is transfused because of the homogeneity of the population's blood type and the consequent low risk of transfusion reaction. If these circumstances prevail, such a policy will rarely result in a transfusion reaction and should be relatively safe; however, since the crossmatching procedure can be done simply and inexpensively (11), it seems reasonable to perform it routinely. Also in regard to blood transfusions, "packed" red blood cells may be given if the cells are allowed to settle out by gravity for two to three hours

before administration (12). This simple technique of gravity separation, which requires only time and refrigeration, can be very important for a patient with severe anemia and associated congestive heart failure.

Certain other laboratory tests may be helpful if available but are not essential for adequate care. These tests, in order of importance, include serum glucose, serum electrolytes, blood urea nitrogen, serum creatinine, blood clotting studies, liver function tests, and serum calcium.

The availability of laboratory tests for diagnosis of infectious processes is important, with the specific tests needed being somewhat dependent on local disease patterns. In general, however, simple slide examinations of bodily secretions for *Mycobacterium tuberculosis* and Gram's positive and negative bacteria should be available. Also, the procedure of examining blood smears for malaria parasites should be in the armamentarium of tropical hospitals. The capability to culture various bacteria, although not absolutely essential, can be helpful in selected cases of patients with persistent abscesses or nonhealing wounds. (A simple incubator, culture media, and instructions for media preparation are available and relatively inexpensive. Even if precise identification is not possible, the technique of culturing a bodily secretion on an agar plate with an antibiotic disc may prove useful in selecting the appropriate antibiotic.)

The availability of roentgenograms (see photograph) is frequently useful and occasionally indispensable in dealing with surgical problems. While simple fractures may be treated without them, complex fractures and conditions such as peptic ulcer disease and cholelithiasis require the use of roentgenograms for confirmation prior to operation (13). Esophagogastroduodenoscopy carried out with portable equipment may substitute for roentgenograms (14), but this procedure requires special expertise to perform and interpret. The two drawbacks of obtaining roentgenograms are the cost of the equipment and film and the necessity of training someone to run and repair the equipment. However, these difficulties can be overcome by an innovative and assertive approach. That is, the equipment costs can



The window in the operating theater of an Ecuadoran hospital serves as an improvised X ray viewbox.

be considerably reduced by purchasing second-hand machines from tertiary care hospitals; and since the basic techniques for taking roentgenograms are not difficult to learn, only a brief training period is required.

A medical library should be available for consultation by the health care staff. Although a library may seem an extravagant indulgence for a hospital with limited resources, it is actually essential for the continued upgrading of the hospital workers' skills. Texts on general medicine, pediatrics, infectious diseases, and obstetrics should be available along with standard surgical texts and atlases. (One good surgical text and one good atlas are all that are required.) Possession of such a collection is especially important in a setting where little consultation with specialists is possible and some operations are infrequently performed.

In sum, fundamental elements required for sound preoperative preparation and safe surgical care are proper instrumentation and linens, an operating theater, a laboratory, and a library. Within this context, the needs and resources of any primary care hospital must be carefully evaluated prior to purchase of medical and surgical supplies.

Safe Anesthesia

A necessary prerequisite for safe performance of operations is competent anesthesia. If one is

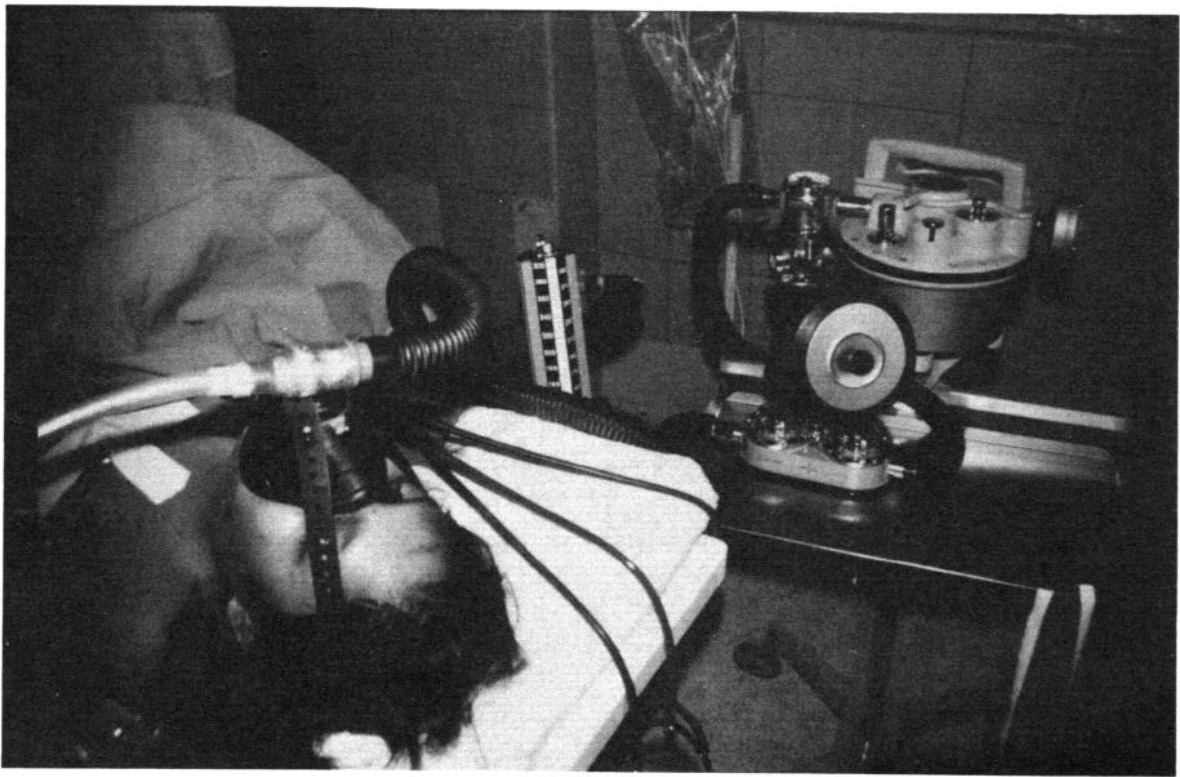
seeking to perform surgical procedures with maximum effectiveness and maximum safety, then the anesthetic techniques used must reflect that aim. One good approach is to use regional anesthesia whenever possible, spinal anesthesia when appropriate, and general anesthesia with ether for most other cases (15). It should also be noted that within the primary care setting the surgeon may be called upon to assume responsibility for providing anesthesia and so should be familiar with the techniques and agents used.

Ketamine is an excellent anesthetic for short procedures because it preserves blood-pressure and maintains airway reflexes better than other intravenous agents (16). One example of an instance where it is often useful is in dilatation and curettage.

Ether is preferred over the halogenated anesthetics if inhalation anesthesia is required, because of its generally wider margin of safety and because it can be given in air. It is best delivered by a simple, sturdy draw-over vaporizer such as the E.M.O. (Epstein-Macintosh-Oxford) apparatus shown in the accompanying photograph (17). One drawback to using ether is that the use of electrocautery is relatively contraindicated. However, electrocautery is a luxury for most operations and can usually be dispensed with.

Meticulous attention to a patient's airway is essential, both during anesthesia and in the immediate postoperative period. This may require endotracheal intubation or may be accomplished by simple head positioning to maintain an open airway during mask anesthesia. The first postoperative hour is a critical period for complications. Vital signs should be taken and respiration observed every fifteen minutes during this time. The patient should be placed in the lateral position to minimize the risk of aspiration should vomiting occur.

A word should also be said about the use of so-called advanced equipment and drugs. Such use is to be discouraged for two reasons. First, it is dangerous to the patient—because the equipment frequently is nonfunctional or poorly understood or the drugs are outdated and poorly understood. Second, such drugs and equipment



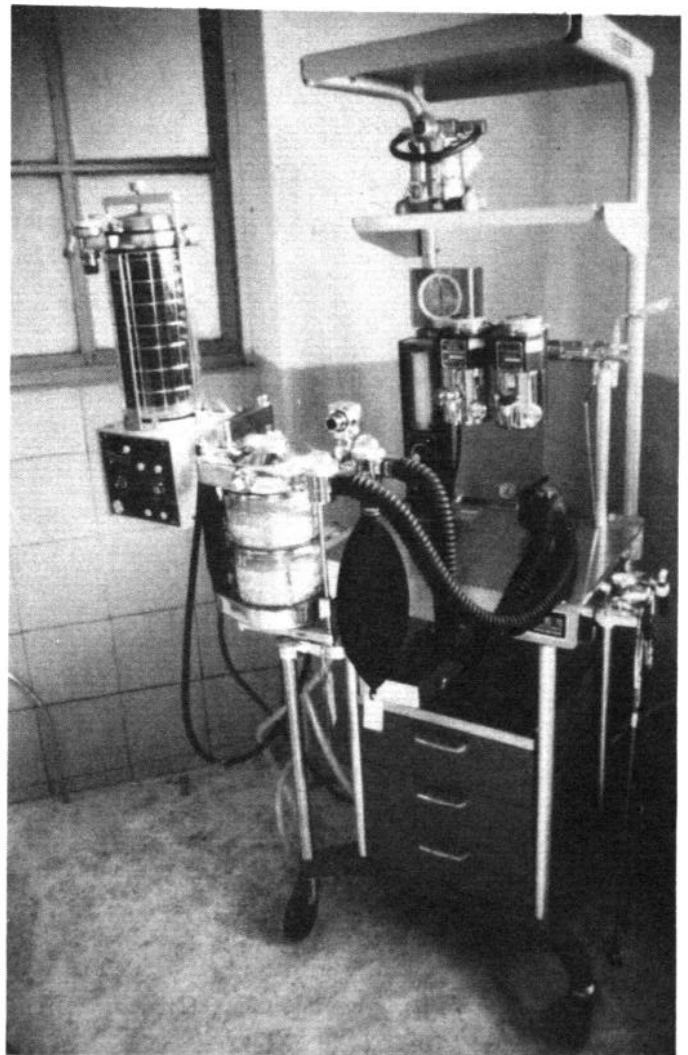
An E.M.O. vaporizer in use.

will tend to be used rarely, and will therefore be wasteful of scarce resources. To be a little more specific, equipment such as a complex anesthetic ventilator (see photograph) is expensive, requires periodic maintenance, and demands a compressed gas (usually oxygen) for its operation. With such drawbacks, it is impractical to use. Obviously, in choosing an anesthetic technique and making purchases, safe patient care at a reasonable cost, rather than professional pride, should be the overriding consideration (18).

Patient monitoring during anesthesia may be limited to recording blood-pressure, listening to the heart, and monitoring urine output and blood loss. However, examination of pupillary size and reactivity is very important when using ether anesthesia and should be performed frequently during a procedure. Other monitoring devices—such as EKGs, arterial lines, or central venous pressure catheters—are generally not available and are usually not missed.

Postoperative Care

Obviously, the surgeon's responsibility does not end when the patient leaves the operating theater. Careful attention to airway management, fluid balance, respiratory function, wound



An expensive "advanced" anesthetic machine that proved useless because compressed oxygen was not available.

status, and adequate pain relief are important. One must also anticipate possible postoperative problems in order to avoid them. With no equipment present to provide artificial ventilation, vigorous pulmonary toilet must be instituted early in order to prevent atelectasis and pneumonia. (These pulmonary complications are less common in the developing world than in the developed world, perhaps due to the physically active life led by most of the people.) More generally, the surgeon must assess the postoperative requirements of a patient undergoing a given operation and refrain from performing a procedure if proper facilities and equipment needed in postoperative care are unavailable. For example, elective thoracotomy should be avoided in a setting where there are no ventilators and no suction machines for postoperative chest tube evacuation.

Since biochemical testing is limited or unavailable, bedside clinical assessments must be performed frequently and carefully in the postoperative period. Ward rounds should be conducted at least twice daily in the first few postoperative days. If skilled nursing care is unavailable, the surgeon may have to provide such care and teach the techniques involved to others. Examples of such techniques include care of urinary catheters, treatment of open wounds, and performance of tracheostomies.

Finally, followup of some surgical problems is important. This may be difficult because of people's natural reluctance to return to the hospital if they are feeling well. In addition, followup may also be impeded by transportation problems. Even so, in deciding which patients need to be followed it seems reasonable to include at least those with malignancies who have a chance for recurrence and those with chronic infections like tuberculosis. Such patients should be seen postoperatively in order to assess the need for possible reoperation and to ensure the success of continued antibiotic treatment.

Routine histologic examination of surgical specimens is an unnecessary and costly procedure. Each specimen should be carefully inspected grossly in the operating theater, and an assessment of malignancy risk should be made at that time. Removed masses that stand a reasonable risk of being malignant should be sent out for histologic examination.

In this same vein, a good system of communication between the primary care hospital and one pathology laboratory should be established to facilitate consistent, efficient reporting. It is perfectly possible to accomplish this by mail (19). When the histopathologic report indicates the need for postoperative chemotherapy or radiotherapy, attempts should be made to persuade the patient to undergo such therapy.

SUMMARY

Safe surgical care can be provided in primary care hospitals in the developing world. A careful preoperative evaluation utilizing a thorough history and physical examination, supplemented by a few basic laboratory tests, should provide the basis for proper selection of patients. The simplest appropriate procedure must then be selected and performed under sterile conditions with basic instruments. Safe and effective

anesthesia must be available as a prerequisite for safe surgery. Finally, diligent postoperative care with attention to detail must be provided. By following these guidelines, adequately trained health care workers—whether they be surgeons, general physicians, nurses, or other workers—will be able to provide safe and adequate first-level surgical care to people who urgently need it.

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PAHO ASSISTANCE TO MEXICO FOR EARTHQUAKE RECOVERY

The Pan American Health Organization pledged an additional US\$300,000 in aid to Mexico in October 1985. The funds are to assist the country's Ministry of Health in the wake of the tragic 19 September earthquake.

PAHO's Director, Dr. Carlyle Guerra de Macedo, explained that "We want to help the Mexican health authorities in the vital coordination and planning of reconstruction efforts in Mexico," adding that, "we must work to restore crucial health services as rapidly as possible." The funds are in addition to US\$100,000 pledged by WHO and \$100,000 initially set aside by PAHO when the earthquake struck Mexico.

At its recent XXXI Meeting (see News), PAHO's Directing Council asked the Director to take all available measures to assist Mexico in recovering from the tragedy. The Council also urged all countries to provide Mexico with disaster relief and reconstruction assistance.