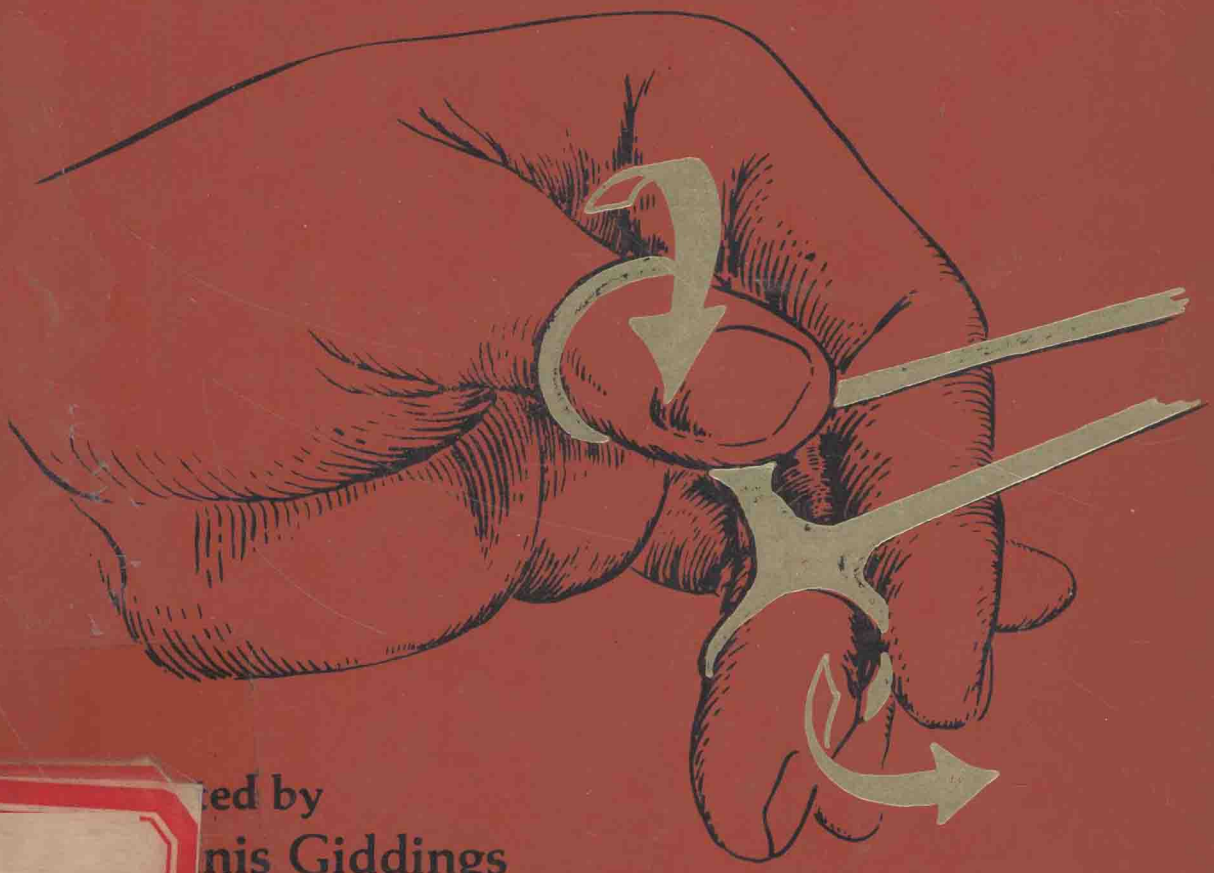
Surgical skills in patient care

Charles W. Van Way III
Charles A. Buerk



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Surgical skills in patient care

Foreword

Most medical schools categorize their curricula under two general headings: knowledge and skills. Like love and successful marriage, the two are inseparable. For example, a bright student may understand all the essentials of wound healing, but if he lacks the ability to place sutures or to tie knots, this knowledge, alone, becomes meaningless to the patient with a laceration.

Similarly, although we live in an era of specialization, critically ill patients cannot always wait for a specialist to insert an endotracheal tube or an intravenous line or to defibrillate a heart. Any professional who takes care of patients should become adept at these elemental techniques.

The authors have had a rich experience in teaching these skills to residents, medical students, and other medical personnel. From this background they have selected certain procedures that they believe to be basic to the care of patients—procedures that all who take responsibility for patients should know.

In this manual, concise instructions illustrated by drawings will help students gain confidence as they begin to perform these procedures and will reinforce this confidence as they learn that these techniques are based on solid clinical experience.

I believe that all who become familiar with this book will agree with the University of Colorado house staff and students that Drs. Buerk and Van Way present these important skills in an especially skillful way.

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Preface

In working with medical students, house officers, and hospital nurses, we have become aware of the obvious gap in teaching the everyday procedures of medical care. Such things as starting intravenous infusions, placing central venous catheters, performing thoracenteses, and caring for chest tubes form a large part of the activities of a modern hospital staff. And yet people learn these skills from those who are only slightly more skilled than themselves. Medical students tend to learn from interns, interns from junior residents, and student nurses from junior floor nurses. The net effect is to perpetuate ignorance.

As a result of this, we have become heavily involved in teaching these minor procedures to students at all levels. This book has evolved largely as an outgrowth of our effort. We have tried to collect in one place most of the procedures that are used by surgeons, internists, pediatricians, family practitioners, and other medical workers in the routine care of patients. To determine exactly how each procedure is best done, we have relied heavily on personal experience. In most cases, one or the other of us is personally expert in the procedure involved. Of course, we have consulted with our colleagues in other disciplines. When our methods differ from those generally accepted, we have tried to explain the rationale for the difference and to show why we recommend our techniques.

We hope that this text may be useful to the surgical house officer or even the practicing surgeon. But it is primarily intended for nonsurgical practitioners who have only an occasional need for surgical expertise or for expertise in very limited areas. We have written this book as well for medical students, residents, and other health practitioners, such as nurses, nurse practitioners, and physicians' assistants.

Progress has made surgeons of us all. Medicine cannot be carried out without the basic principles of aseptic technique and wound care, the skills of handling instruments and suturing lacerations, and the techniques of access to veins, arteries, and body cavities. The physician cannot always call a surgeon to put in a Swan-Ganz catheter; the family practitioner must sew up cuts and treat infected wounds. Perhaps this is to the good. Overspecialization serves our patients poorly, and Mother Nature is a notorious generalist.

Charles W. Van Way III

Charles A. Buerk

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CHAPTER 1

Aseptic technique

Medicine has advanced further in the last 100 years than in all the preceding years. The most important component of that advance is the ability to manipulate or operate on the human body without fear of infection. This ability makes possible intravenous therapy, invasive diagnostic procedures, injection of drugs, care of wounds, and the entire field of operative surgery. The basis for this ability is the group of techniques known collectively as *aseptic*, or *sterile, technique*.

The terms *aseptic* and *sterile* are often used interchangeably. The distinction between them is subtle. *Aseptic* refers to the complete absence of living microorganisms, as might be produced by autoclaving an instrument pack. *Sterile* also means the absence of living microorganisms, but includes production of such absence by means of chemical agents, as in preparing the skin through which an operation is to be performed. Historically, sterile technique was first carried out entirely with chemicals such as carbolic acid and phenol, which were used on instruments as well as on the skin. This was known as *antiseptic technique*. With the introduction of the steam autoclave and other techniques more effective than chemicals in sterilizing instruments and linens, the term *aseptic technique* was used to distinguish the newer methods from the older chemical methods. This distinction has been lost, however. Current aseptic technique relies on both chemical and physical methods for achieving sterility.

Aseptic technique is based on the premise that most infection is introduced into the body from outside. To avoid infection, it is necessary to ensure that any procedure performed on the body is done in such a way as to introduce no bacteria. The procedure must be done in a sterile field from which all living bacteria, including those initially present on the patient's skin, have been excluded. All instruments, sutures, and fluids must be sterilized. The surgeon's hands must be cleansed of all bacteria and encased in rubber gloves; or the procedure must be done without the surgeon's hands touching the sterile end of the instruments.

The principles of aseptic care are no less important in minor procedures than in major operations. Sepsis introduced through a venous cutdown can kill just as surely as infection introduced at the operating table. This chapter outlines the methods of preparing the skin, washing the hands, sterilizing instruments and fluids, and setting up the sterile field in which all procedures must be done.

Skin preparation

Because bacteria are normally present on the skin, it is necessary not only to mechanically clean all dirt from the skin through which the procedure is to be done, but also to render it sterile by means of some form of antiseptic solution. Several antiseptics have been used over the years.

The iodophors are best. They are a group of compounds in which iodine is combined with an organic molecule. They are available as detergent-containing solutions for washing the hands and as nondetergent prep solutions for preparing the skin. The iodine is released from its organic complex slowly enough to avoid burning the skin, but rapidly enough to kill bacteria. In the operating room, the skin is usually washed first with the detergent solution to remove dirt and oils. After the skin is dried, the nondetergent solution, which leaves a thin film of iodophor, is painted on the skin.

Iodine itself is an excellent antiseptic but is also somewhat toxic and may burn the skin. If used, it should be cleaned off immediately with alcohol.

Alcohol is widely used in preparing the skin for venipuncture and intramuscular injections. Alcohol is moderately effective in cleaning the skin; but it kills bacteria very poorly. The practice of swabbing the skin before an injection is probably unnecessary. Isopropyl alcohol and ethanol are the most widely used and are equally ineffective.

Mercury is also an effective antiseptic. Mercuric chloride is toxic to the skin. Merbromin (Mercurochrome) is widely used as an antiseptic but is ineffective. More effective are the organic mercurial compounds, of which thimerosal (Merthiolate) is the most widely used. They are relatively nontoxic but penetrate skin poorly; they are bacteriostatic rather than bactericidal. They do not kill spores. Skin sensitization may occur.

Ordinary detergent or soap solutions do not kill bacteria. But detergent solution with hexachlorophene added is often used (pHisoHex). This compound is a phenol. It has a mild antibacterial effect that is

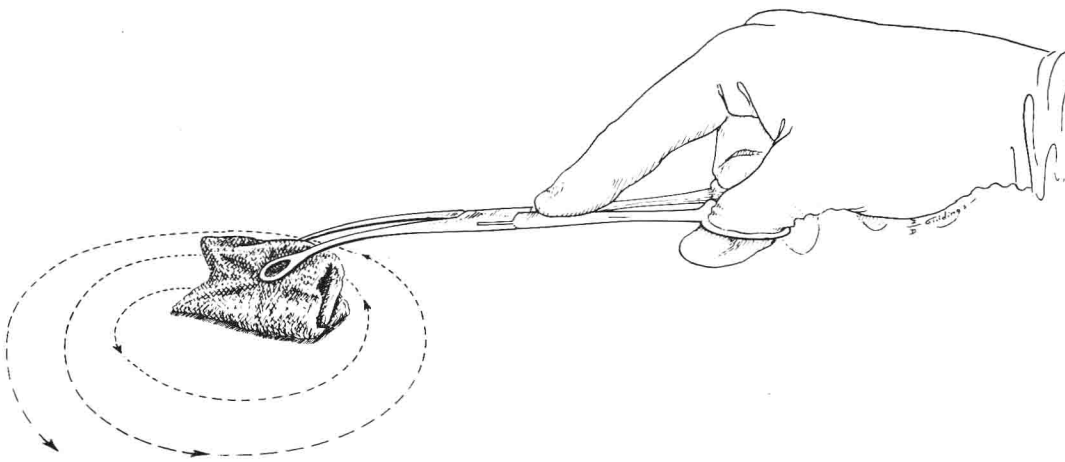

Fig. 1-1. Skin preparation.

cumulative; if hexachlorophene is used three or four times daily, the bacterial count on the skin becomes very low. It is often used as a surgical scrub solution.

Certain cationic, surface-active agents, of which the most common is benzalkonium chloride (Zephiran), are used in skin preparation. These agents are bactericidal and relatively fast acting. They have detergent action and penetrate tissue surfaces. But they are antagonized by soap, pus, and tissue fluids. On the skin, they tend to form a film under which bacteria may remain. They are slower acting than iodine. Because of their relatively low toxicity, they may be used on sensitive areas, such as the eye or the mucous membranes, where iodophors would be less desirable.

In preparing an operative field, the usual principle is to begin at the center and work outward (Fig. 1-1). An exception should be made for a contaminated wound, in which the skin surrounding the wound is prepared first and the wound cleansed last. In both cases, the area prepared should be much wider than the proposed operative field.

The time required for adequate skin preparation is 5 minutes. As the skin is cleansed with an iodophor-containing detergent, the residual bacterial count will drop markedly during the first minute and progressively less during the second and third minutes. After 5 minutes, the count will be minimal. Further skin preparation is nonproductive, although many operating rooms use a routine 10-minute scrub of the operative field.

Hand preparation

Despite the fact that the surgeon's hands are always covered with sterile gloves, it is mandatory that the surgeon's hands, as well as the skin of the operative field, be scrubbed. There are several reasons for this. The surgeon's hands may carry pathogenic bacteria acquired from other patients. Gloves often become punctured or torn during the procedure. Even without gross tears, small punctures often occur and are often unsuspected. Both the iodophors and hexachlorophene are commonly used for this purpose. They are prepared in combination with detergent to give a cleansing action along with the antibacterial action. Disposable, presterilized scrub sponges, impregnated with one or the other of these agents, are available. Of the two, iodophors are much more effective for a one-time use. Detergent solutions containing hexachlorophene are little more effective than detergent alone on first use. But the hexachlorophene accumulates on the epidermis of the surgeon's hands and, after 2 to 4 days of habitual use, reduces the bacterial count to 5% or less of the initial value. Because of this, it is widely used by surgeons. To be effective, it must be used regularly, several times a day.

In standard scrub technique, the hands are first mechanically cleansed (Fig. 1-2). Particular attention should be paid to the nails. Any visible dirt under the nails should be removed by vigorous brushing or by an appropriate instrument, such as a nail file or a plastic nail pick. Then a 5-minute scrub should be carried out, beginning at the fingers and working meticulously up the hand and forearm to the elbows. Here

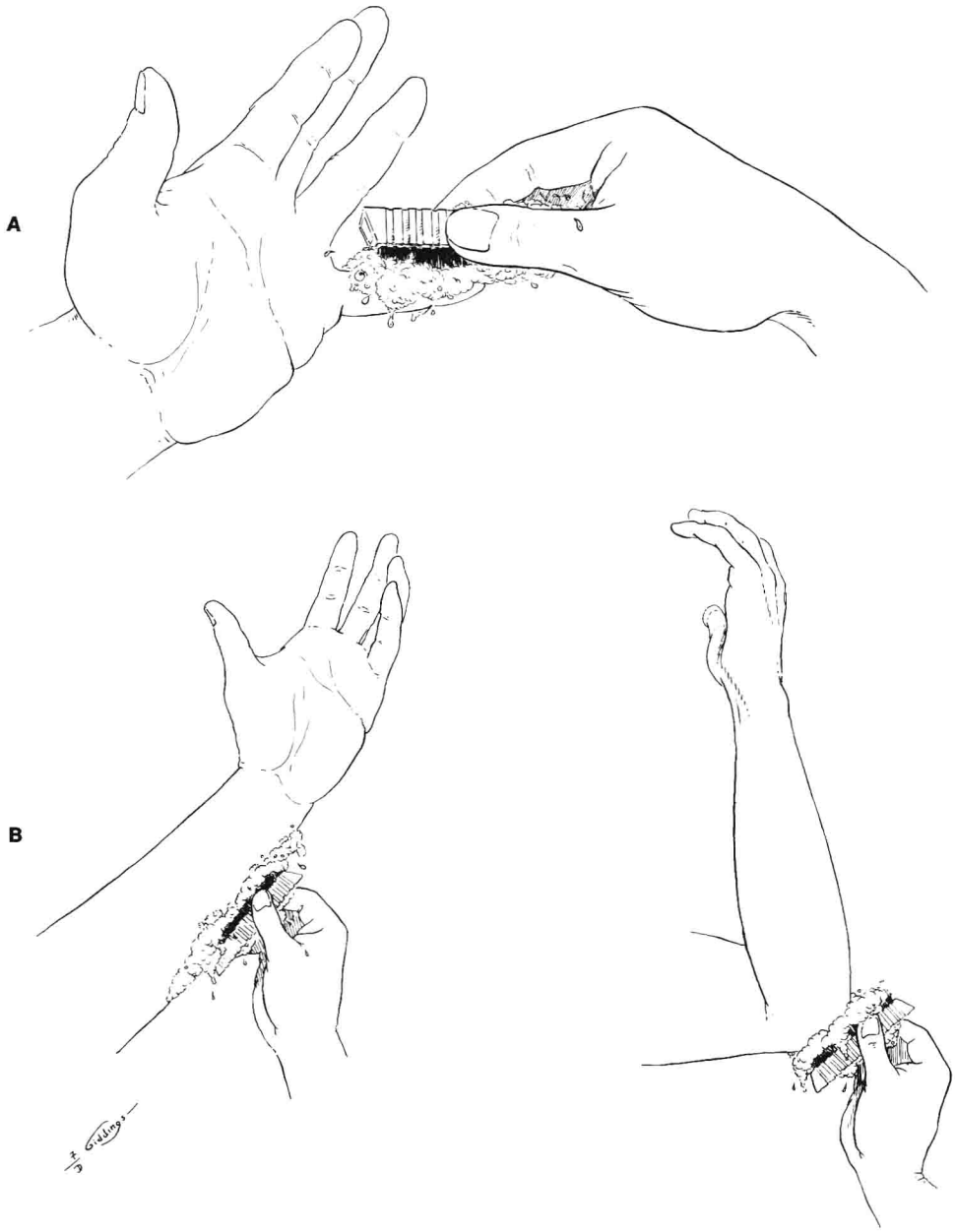

Fig. 1-2. A, Scrubbing fingers. **B,** Scrubbing hands and arms to the elbows.

again, some operating rooms specify a 10-minute scrub; but 5 minutes is enough.

After the hands are dried and the gloves put on, the hands usually begin to sweat. Bacteria are washed from deep pores up onto the surface of the skin. If an iodophor detergent solution was used, the bacterial count rises nearly to initial values after an hour or so. If hexachlorophene solutions have been used habitually, the bacterial count will remain low.

There is no justification to the practice of "saving" the scrub by keeping gown and gloves on between cases. There is also little point in reducing the length of scrub between cases, although a surgeon using hexachlorophene routinely can reduce the scrub between cases from 5 minutes to 3.

While the surgical scrub is usually believed to be primarily applicable to the operating room situation, all but the most minor procedures should be preceded by scrubbing the hands. It is discouraging to watch a physician roll up his or her sleeves, put on a pair of gloves, and proceed to place a tube in the chest or a biopsy needle in the liver without washing his or her hands.

Techniques of sterilization

Five techniques are commonly used for sterilizing instruments and fluids: steam autoclaving, ethylene oxide sterilization, soaking in germicidal solutions, irradiation, and millipore filtration of solutions.

Steam autoclaving is used for preparing instrument packs in the operating room and in central supply areas. The use of steam under pressure allows temperatures above that of boiling water; the steam is necessary to allow the heat to penetrate wrapped instrument packs. Generally, a temperature of around 120° C. (250° F.) with a pressure of 20 to 25 pounds is used for 15 to 30 minutes. Unwrapped metal instruments require only 15 minutes of sterilization, while wrapped linen packs require about 30 minutes. Indicators that change color after exposure to heat are wrapped inside sterile packs as a check on whether or not enough heat has been applied. But the indicators are not infallible. For example, steam will not penetrate between the jaws of a tightly closed clamp. Steam will also not penetrate small caliber, hypodermic needles unless a stylet or small wire is placed inside the needle.

Ethylene oxide is a germicidal gas that sterilizes at the relatively low temperature of 50° to 60° C. (120° to 150° F.). It is widely used to sterilize instruments that would be damaged by heat. Because the gas is toxic, it must be used in a closed container, ideally a specially designed autoclave. Humidification of 30% to 40% is required. An exposure of 3 hours or more is required to kill all bacteria and spores. Indicators similar to those used in steam sterilization are available. One major disadvantage of the method is that the gas permeates plastics and rubber. All instruments should be allowed to aerate for at least 24 hours before use. If such implantable devices as artificial valves or vascular prostheses are sterilized in this manner, an aeration time of 5 to 7 days should elapse between sterilization and use.

So-called cold sterilization, in which the instruments are soaked in solutions of formalin or iodophors, is widely used for instruments like cystoscopes, which are used daily. This method of sterilization is quite effective, although the instruments must be washed carefully.

Most manufacturers of sterile medical devices and intravenous fluids use high-dose gamma irradiation, usually from a cobalt source. This method is used in almost all prepackaged sterile supplies. It is virtually an ideal method, the only disadvantage being the high initial cost of the

equipment involved. It is especially suitable for plastics, which would be damaged by the heat of autoclaving.

In sterilizing fluids in small batches, as in the hospital pharmacy, millipore filtration is commonly used. In this method, the fluid is simply passed through a 0.22 micron filter, whose pore size will not pass any bacteria or spores.

The sterile field

When performing a procedure, the first step is to establish a sterile field. The instrument pack is opened, the hands are scrubbed, the gloves are put on, and the skin is prepared by using a ring forceps or large clamp and sponges in such a way as to avoid touching the unprepared skin with the sterile gloves. Towels are placed around the site of the procedure. At this point, there is a sterile instrument pack on the table and a sterile operative site is surrounded by sterile towels (Fig. 1-3). Anything needed during the procedure must be handed into the sterile field by someone outside it. For this reason, it takes a minimum of two people to do most procedures—one with gloved hands, working within the sterile field, and one with nonsterile hands, to pass supplies and instruments into the sterile field. Sterile supplies, needles, and such are always packaged so as to permit opening by a nonsterile individual and handing the sterile item into the sterile field.

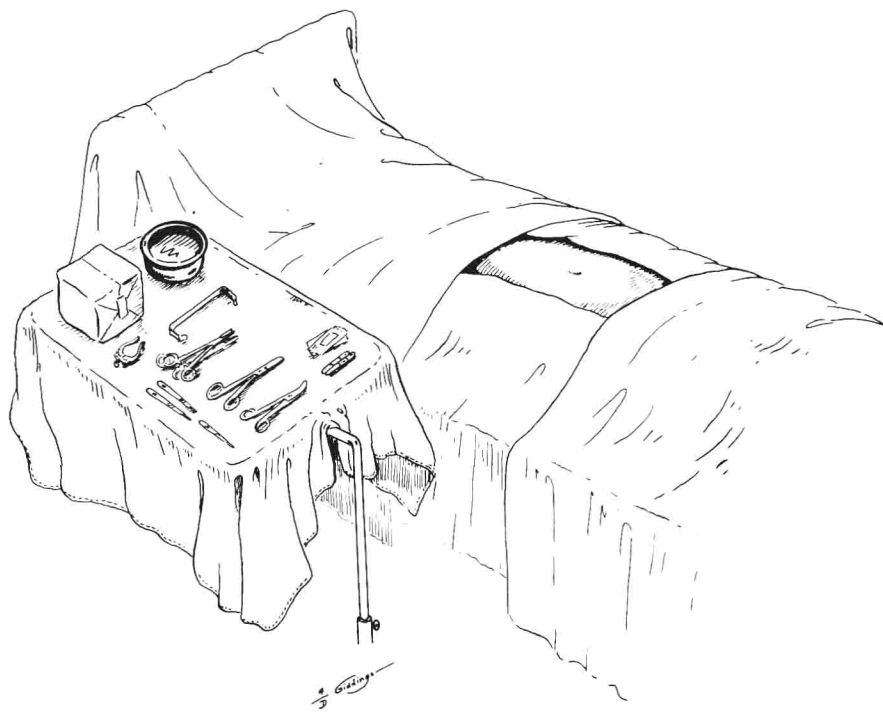

Fig. 1-3. Sterile table and sterile field.

Gowns, caps, and masks

When carrying out a sterile procedure, the practitioner should always wear a surgical cap and mask. The cap prevents nonsterile material from hair or beard from falling into the sterile field. The classic surgical cap is adequate for men or women with short hair, while long hair requires a more voluminous cap and a beard requires the "helmet" type of head-

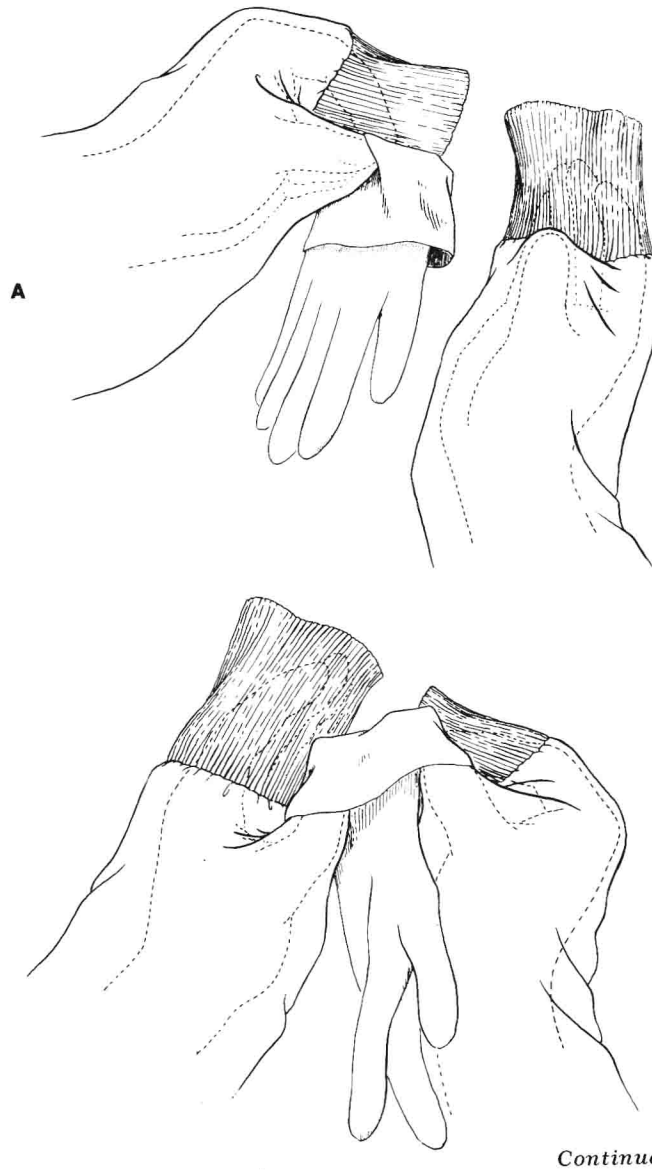

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Fig. 1-4. A, Left hand with gown picking up glove. **B,** Left hand putting gown on right sleeve; right thumb grasping through gown. **C,** Left hand (through gown) pulling right glove and sleeve over right hand. **D,** Right hand in glove, sleeve at wrist, and left hand still pulling down.

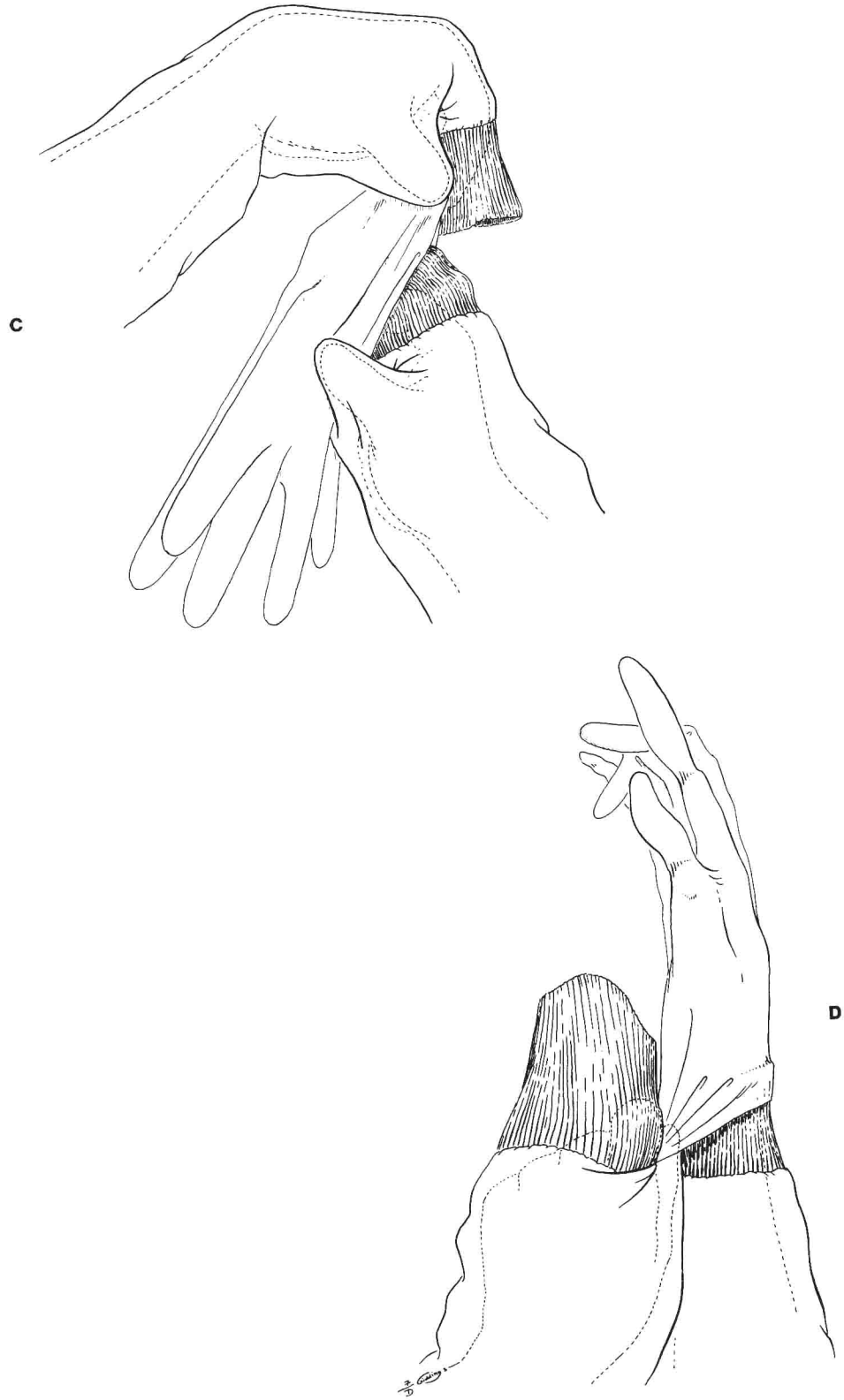

Fig. 1-4, cont'd. For legend see p. 7.

gear. Masks come in a variety of shapes and sizes, but the purpose of all is to prevent droplets of sputum from reaching the sterile field. Both caps and masks are generally made of paper and are disposable.

Wearing a gown is reserved for more extensive or lengthy procedures and when it is necessary to put the forearms into the field. It is difficult to do much suturing without inadvertently touching the suture material with the forearms. Procedures for which gloves are sufficient include suturing a minor laceration and performing a cutdown. Procedures that require a gown include repairing a large laceration and cardiac catheterization. Only that portion of a gown that can be easily seen should be considered sterile; this includes the lower portions of the sleeves and the front of the gown above the waist. While the whole gown is sterile in the beginning, it is easy to brush unknowingly against a nonsterile object with the sides, back, or lower portion of the gown.

Putting on gloves while wearing a gown is a technical skill in itself. The closed technique is universally used (Fig. 1-4). In this technique, the hands are kept within the sleeves of the gown. Pick up a glove with one covered hand and place it on the end of the other sleeve. Advance the other hand into the glove. With the gloved hand, pick up the second glove and place it on the end of the first sleeve. Advance the first hand into the glove. The technique is somewhat intricate, but is relatively easy to learn. The advantage is that, since the bare hand is never advanced beyond the end of the cuff, there is no way that it can contaminate the gown or the gloves.

In summary, aseptic technique is a body of techniques for ensuring that all bacteria are excluded from the sterile field in which the procedure is done. While the details may vary from procedure to procedure, the basic techniques must be followed in every invasive procedure.

CHAPTER 2

The tools of patient care

The instruments used by today's practitioners have evolved over the years as surgeons and physicians have developed new instruments or modified existing ones to meet certain demands and accomplish specific tasks. A knowledge of the basic instruments will greatly facilitate the minor procedures that all physicians and practitioners will be called on to perform. These instruments or minor variations should be found in all minor surgery packs.

Cutting instruments

The disposable scalpel blade attached to a standard handle is used primarily for incising the skin, though some surgeons use it for dissecting deeper tissues. Different sizes and shapes of blades are available for specific purposes, as are different sizes of handles. For most general work, a one-sized handle (No. 3) is used with the three most useful blades (Fig. 2-1).

The No. 10 blade is the most useful disposable blade for making skin incisions. Use the belly of the blade, not the point, when making the incision. As this instrument is extremely sharp, little pressure is needed when making the incision. The No. 15 blade is a smaller version of the No. 10 blade and is useful in making small incisions or when curved or precise incisions are necessary. It is used just as the No. 10 blade, but, because the belly of this blade is closer to the point, its cutting angle to the skin is increased. Always keep both of these blades perpendicular to the skin so that there will be no beveling of the skin edges. When using these blades hold the handle of the scalpel as depicted in Fig. 2-2. Because of the "flat" belly of the No. 10 blade, it is not usually held like a pencil. But when precise work is required, it can be manipulated as a pencil. Use the No. 11 blade for incising abscesses and other collections. Thrust it point first into the abscess and withdraw it in a sweeping motion so that the initial incision is enlarged as needed.

Scissors have undergone numerous adaptations over the years, one of which is the development of scissors designed specifically for the cutting of tissues. Typically these scissors have curved blades with a fine cutting edge and rounded points. *Mayo scissors* (Fig. 2-3) are heavy scissors designed for division of tougher structures, such as fascia and tendons, and come with either curved or straight blades. *Metzenbaum scissors* (Fig. 2-4) are much lighter and extremely useful in dissecting and cutting