General surgery at the district hospital

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Chest, abdomen, and gastrointestinal tract

[1]For detailed descriptions of obstetric and gynaecological procedures, see *Surgery at the district hospital: obstetrics, gynaecology, orthopaedics, and traumatology* (Geneva, World Health Organization, in preparation).

Preface

This handbook is one of three[1] to be published by the World Health Organization for the guidance of doctors providing surgical and anaesthetic services in small district hospitals (hospitals of first referral) with limited access to specialist services. The advice offered has been deliberately restricted to procedures that may need to be carried out by a young doctor with limited experience in anaesthesia, surgery, or obstetrics, using the facilities that can reasonably be expected in such hospitals. Wherever possible, the drugs, equipment, and radiodiagnostic and laboratory procedures described conform with WHO and UNICEF recommendations.

Although the handbooks contain detailed descriptions and illustrations, the advice they offer is no substitute for practical experience. The reader is expected to have been exposed to all the relevant techniques during undergraduate or early postgraduate education. When necessary the text indicates which patients should be referred for specialized care at a higher level, as it is important to developing health services that young doctors and their superiors understand the limitations of practice at the district hospital.

It has, of course, been necessary to be selective in deciding what to include in the handbooks, but it is hoped that any important omissions will be revealed during field testing. WHO would also be pleased to receive comments and suggestions regarding the handbooks and experience with their use. Such comments would be of considerable value in the preparation of any future editions of the books. Finally, it is hoped that the handbooks will fulfil their purpose – to help doctors working at the front line of surgery throughout the world.

The three handbooks have been prepared in collaboration with the following organizations:

Christian Medical Commission
International College of Surgeons
International Council of Nurses
International Federation of Gynaecology and Obstetrics
International Federation of Surgical Colleges
International Society of Burn Injuries
International Society of Orthopaedic Surgery and Traumatology
League of Red Cross and Red Crescent Societies
World Federation of Societies of Anaesthesiologists
World Orthopaedic Concern.

[1]Also available: *Anaesthesia at the district hospital*; and in preparation: *Surgery at the district hospital: obstetrics, gynaecology, orthopaedics, and traumatology.*

Acknowledgements

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Introductory note

This handbook describes a limited number of surgical procedures. They have been chosen as appropriate for the doctor who does not have a formal surgical training, but who nevertheless has experience, gained under supervision, of all the relevant techniques. With the exception of vasectomy, which may be an important part of national family planning programmes, the procedures included are considered essential for saving life, alleviating pain, preventing the development of serious complications, or stabilizing a patient's condition pending referral. Operations that require specialist skills or that could add unnecessarily to the doctor's workload have been avoided, and simple but standard surgical techniques have been selected whenever possible. Nevertheless, certain procedures that may appear technically difficult (for example resection and anastomosis of the small intestine) are included because they may offer the best chance of saving a patient's life.

FUNDAMENTALS OF GENERAL SURGERY

For details of radiodiagnostic and laboratory techniques and drugs appropriate for the district hospital, the reader is referred to the following WHO publications:

Manual of basic techniques for a health laboratory. 1980.

PALMER, P.E.S. ET AL. *Manual of radiographic interpretation for general practitioners (WHO Basic Radiological System)*. 1985.

WHO Technical Report Series, No. 689, 1983 (*A rational approach to radiodiagnostic investigations*: report of a WHO Scientific Group on the Indications for and Limitations of Major X-Ray Diagnostic Investigations).

WHO Technical Report Series, No. 770, 1988 (*The use of essential drugs*: third report of the WHO Expert Committee).

1

Basic principles and techniques

Surgical operations must satisfy three basic conditions: the wound must be inflicted without pain; haemorrhage must be arrested; and the wound must heal. It is especially the ability to ensure wound healing, by means of aseptic treatment, that has given impetus to modern surgery. Indeed, the necessity for asepsis regulates the conduct of surgeons, the "ritual" of operation, the form of instruments, and even hospital design and construction to such an extent that it is often taken for granted. Yet an understanding of the practical details of this system is imperative for any surgeon.

Asepsis

The most important cause of impaired wound healing is infection. Microorganisms reach the tissues during an operation or during changes of dressings or any other minor interference with the surgical wound. They are carried and transmitted by people (including the patient and anyone else who touches the wound or sheds organisms into the surrounding air), inanimate objects (including instruments, sutures, linen, swabs, solutions, mattresses, and blankets), and the air around a wound (which can be contaminated by dust and droplets of moisture from anyone assisting at the operation or caring for the wound).

The aseptic treatment of a wound is an attempt to prevent contamination by bacteria from all these sources, during the operation and throughout the first week or so of healing. Modern methods of preventing infection in "clean" wounds also include the use of surgical techniques designed to make the wound less receptive to bacterial growth: *gentle handling, sharp dissection, good haemostasis, and accurate apposition of the wound edges without tension when the wound is being closed.* Bacteria can never be absolutely eliminated from the operating field, but practicable aseptic measures can reduce the risk of contamination to an acceptable level.

Asepsis is influenced by innumerable details of operating technique and behaviour. The probability of wound infection increases in proportion to the number of breaches of aseptic technique. There is no great difficulty in applying this technique to a single operation, but in practice the surgical team will be gathered for several operations — an operating list. Between operations the theatre floor is cleaned, instruments are resterilized, and fresh linen is provided. Potential breaches of aseptic technique can be minimized by proper ordering of patients on the list so that "clean" operations are done first. The longer the list the greater the chances of error; the risk of wound infection therefore increases as the list proceeds. For this reason, the surgeon should carefully consider the length and order of the list. A list system should not be considered at all without a certain minimum of equipment and a well-trained theatre staff.

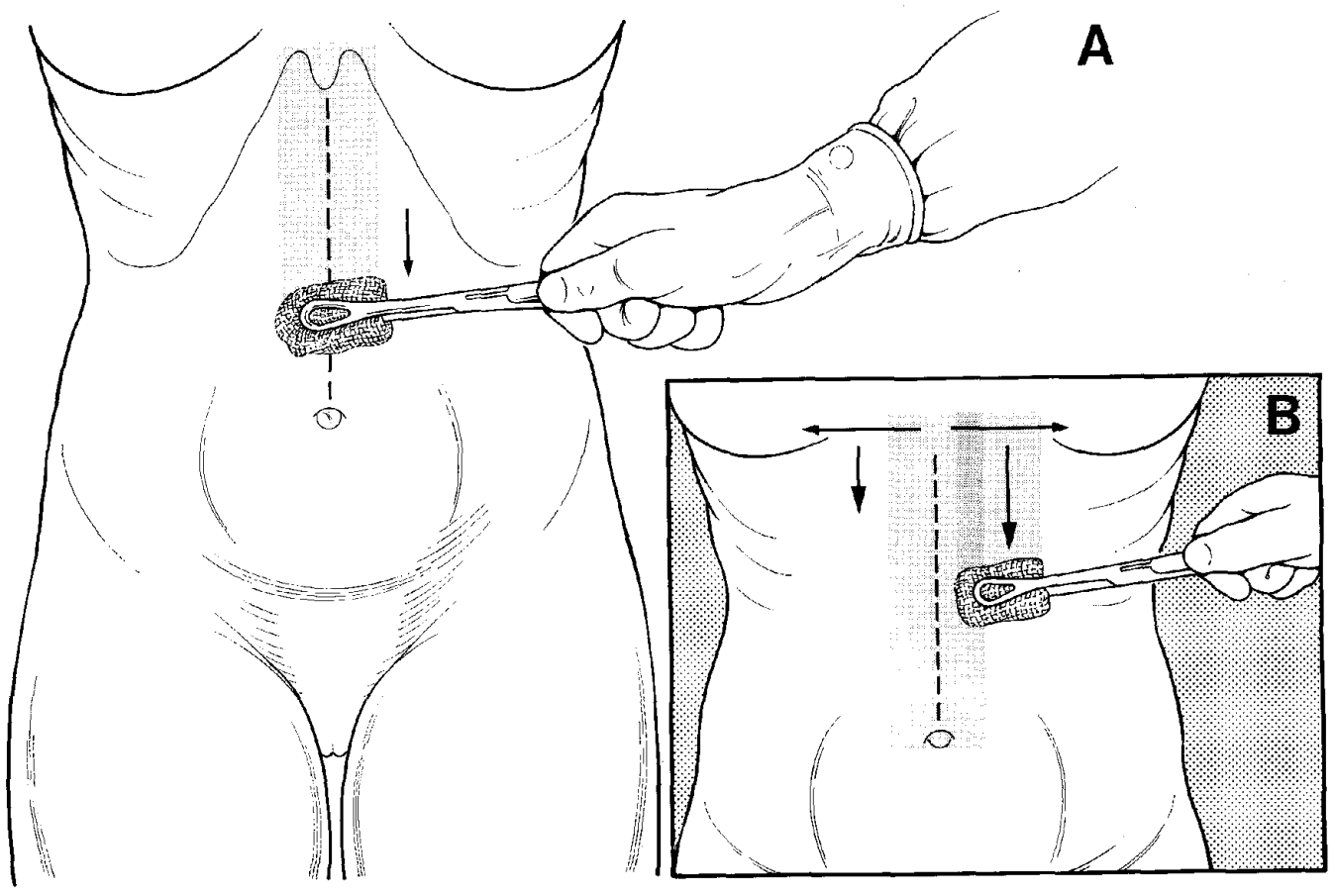

Fig. 1.1. Preparation of the skin with antiseptic solution. Working from the centre of the operating field (A) to the periphery (B).

Certain types of surgery, which are beyond the scope of the practice described here, require an exceptionally strict aseptic routine. But for the most part, safe surgery depends on well-tried and well-understood systems of asepsis, which are practicable in the district hospital. Asepsis depends on personal discipline and careful attention to detail, rather than on antibiotics and complicated equipment. There is no doubt that the level of discipline in operating theatres has declined since the dangers of wound infections have been mitigated by antibiotics. Antibiotics, however, play little part in actually preventing wound contamination. This remains to be achieved by attention to people, inanimate objects, and air.

Preparation for surgery

The patient

The patient's stay in hospital before an operation should be as short as possible. Therefore, any tests and treatment that could prolong the preoperative stay beyond 24 hours should be carried out as outpatient services, if possible. Before the operation, correct gross malnutrition, treat serious bacterial infection, investigate and correct gross anaemia, and control diabetes. As a *routine*, measure the patient's haemoglobin level and test the urine for sugar and protein.

Skin preparation

The patient should bathe the night before an elective operation. Hair in the operative site should not be removed unless it will interfere with the surgical procedure. If it must be removed, clipping is preferable to shaving (which can damage the skin) and should be done as close as possible to the time of operation.

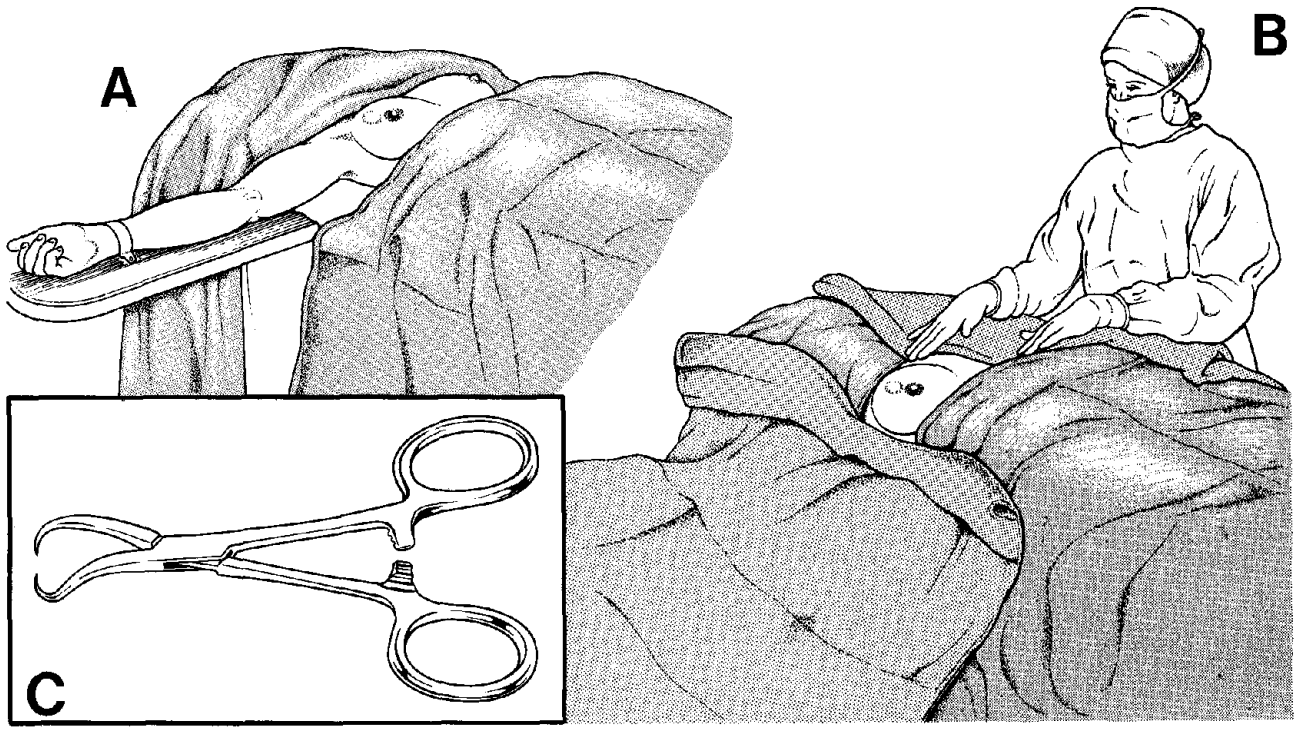

Fig. 1.2. Draping the patient. The operating field is isolated (A, B) and the drapes are secured with towel clips (C) at each corner.

Just before the operation, wash the area around and including the operative site, and prepare the skin with antiseptic solution, starting in the centre and moving out to the periphery (Fig. 1.1). This area should be large enough to include the entire incision and an adjacent working area, so that you can manoeuvre during the operation without touching unprepared skin. Ethanol 70% (by volume) is recommended as an antiseptic, except for delicate skin, such as that of the genitalia and near the eye, and for children; 1% cetrimide (10 g/litre) is an alternative, as is 2.5% iodine in ethanol (25 g/litre).

For major operations involving an incision and requiring the use of the operating room, cover the patient with sterile drapes, leaving no part uncovered except the operative field and those areas necessary for the maintenance of anaesthesia (Fig. 1.2).

Duties towards the patient

It is your duty to discuss with the patient the need for surgery and to explain in simple terms the nature of the proposed operation. Ensure that the patient understands, particularly if the operation involves amputation of a limb, removal of an eye, or construction of a colostomy, or will render the patient sterile, for example hysterectomy for a ruptured uterus. You *must* obtain the patient's (or, if necessary, a close relative's) informed consent for the operation. It is your responsibility to ensure that the side to be operated on is clearly marked; recheck this just before the patient is anaesthetized. Also check that all relevant pre-operative care, including premedication, has been given. The patient's notes, laboratory reports, and radiographs must accompany him or her to the operating room.

The surgical team

Anyone entering the operating room, for whatever reason, should first put on clean clothes, an impermeable mask to cover the mouth and nose, a cap or hood to cover all the hair on the head and face, and a clean pair of shoes or clean shoe-covers.

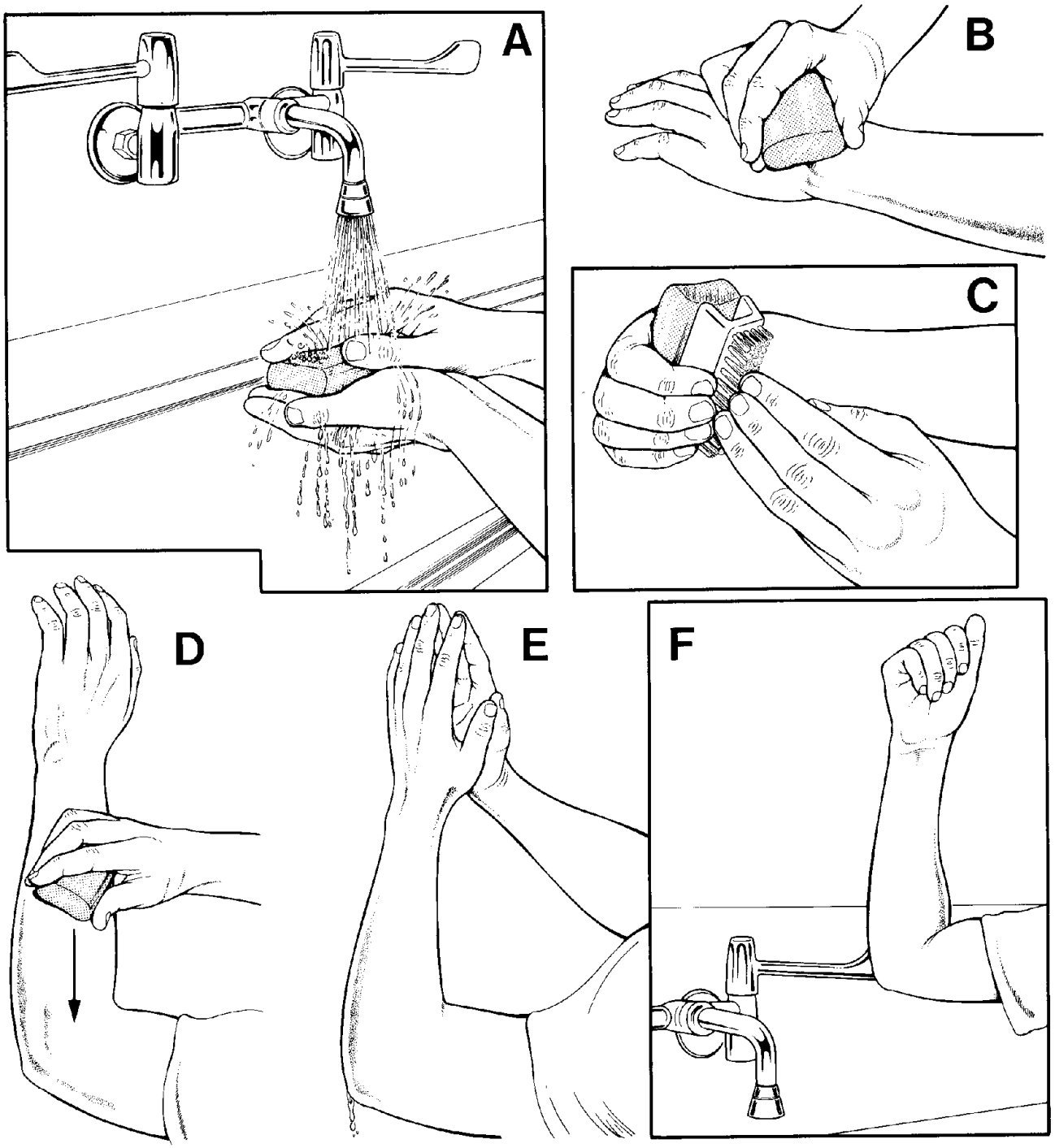

Fig. 1.3. Scrubbing up. Washing with soap and running water (A); further application of soap (B) before scrubbing the fingernails (C); washing the forearms with soap and running water (D); position of hands and forearms at the end of scrubbing to allow water to drip off the elbows (E); turning off the tap with the elbow (F).

Scrubbing up

Before each operation, all members of the surgical team — that is those who will touch the sterile surgical field, sterile instruments, or the wound — should cleanse their hands and arms to the elbows, using soap, a brush (on the nails and finger tips), and running water (Fig. 1.3). The team should scrub up for at least 5 min before the first procedure of the day, but between consecutive clean operations a minimum of at least 3 min is acceptable.

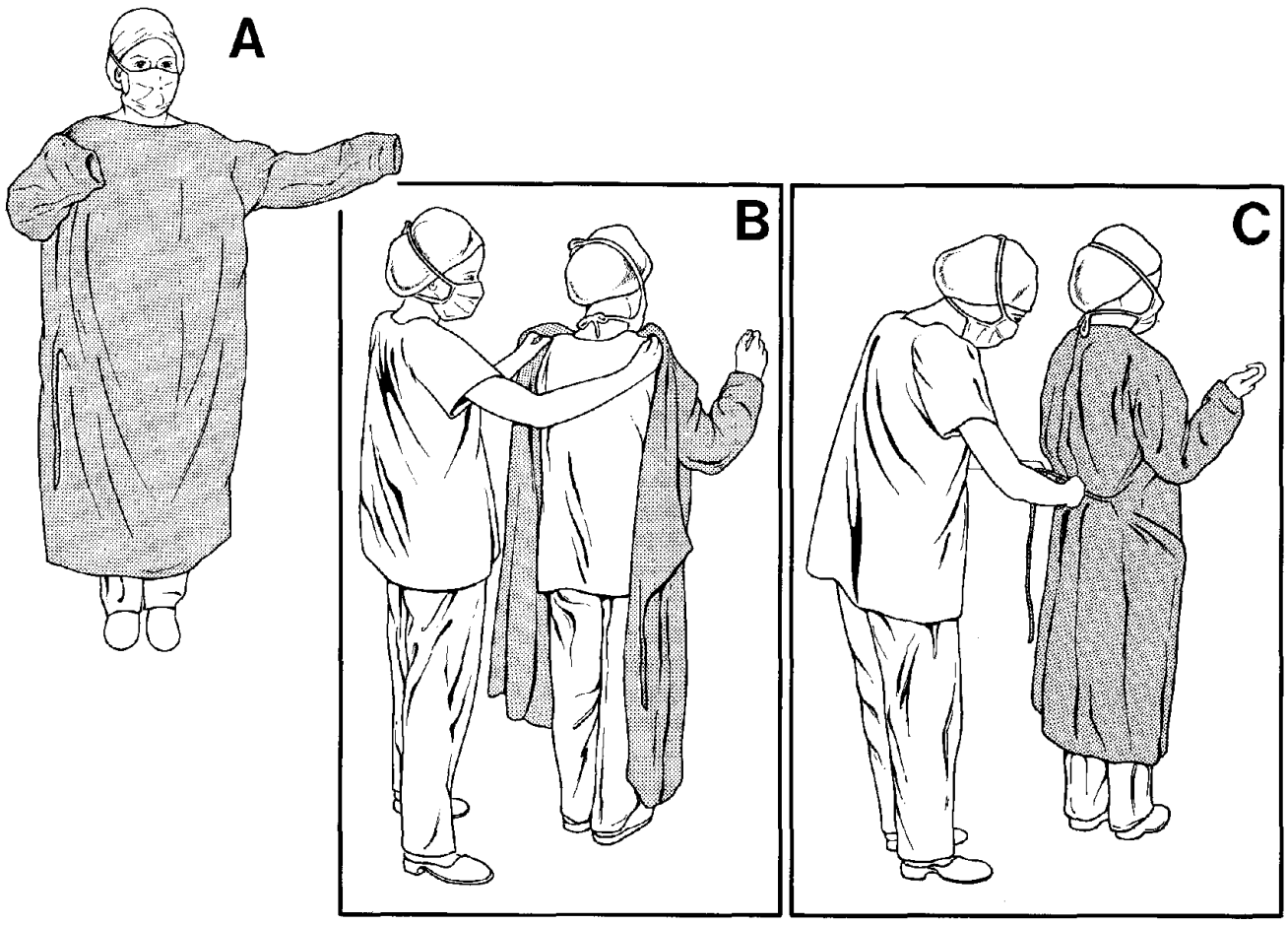

Fig. 1.4. Putting on the sterile gown (A); an assistant adjusts the gown (B) and ties the straps (C).

After scrubbing their hands and drying them with sterile towels, the members of the surgical team should put on sterile gowns and sterile gloves (Fig. 1.4 & 1.5). A glove punctured during the operation should be promptly changed.

The operating room

Keep all doors to the operating room closed, except as needed for the passage of equipment, personnel, and the patient. Keep to a minimum the number of personnel allowed to enter the operating room, especially after an operation has started. Clean the operating room between operations, and more thoroughly at regular intervals, according to procedures established by the hospital. When necessary, the operating room may be disinfected by mopping the floor, swabbing down the walls, and wiping all furniture with a liquid disinfectant, *diluted as recommended by the manufacturer.* Sterilize all surgical instruments and supplies.

Sterilization

The methods of sterilization in wide use are autoclaving, exposure to dry heat, and treatment with chemical antiseptics.

Autoclaving

At the district hospital, sterilization should be largely based on autoclaving (Fig. 1.6A,B). For efficient use, an autoclave demands a trained operator in regular practice and depends heavily on good maintenance. Most autoclaves in current use are too large and too complicated, and carry high maintenance costs. It is therefore hoped that more effort will be put into developing smaller and simpler autoclaves that require little maintenance and are possibly solar-powered, especially for use in isolated rural hospitals in developing countries.

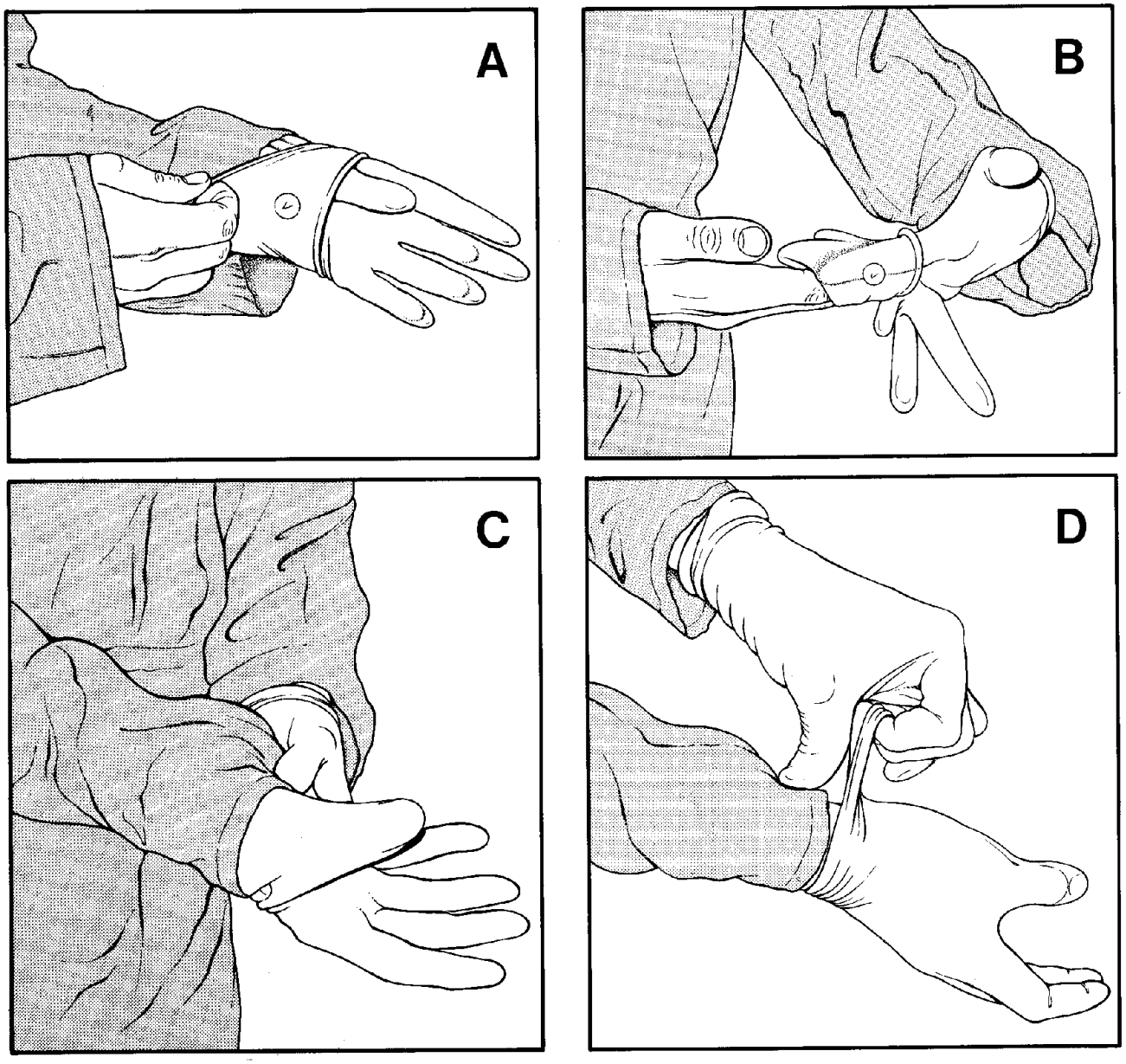

Fig. 1.5. Putting on sterile gloves. Starting with one hand (A) and proceeding to the second (B); folding the sleeves of the gown (C) and tucking them into the gloves (D).

The selection of a suitable autoclave requires serious consideration not only of the cost but also of servicing needs and the expected work-load. Desirable features of an autoclave are a horizontal cylindrical drum, a single circular door, a small chamber capacity, and a short cycle, especially for the post-sterilizing phase. In general, the smaller the capacity, the shorter the whole process and the less the damage to soft materials. It is often more practical to use a small autoclave several times a day than to use a large machine once.

The basic operational criteria for an autoclave are steam at 100.0 kPa (750 mmHg) above atmospheric pressure and a temperature of 120 °C maintained for 15 min (or for 30 min for packs). Appropriate indicators must be used each time to show that sterilization has been accomplished. At the end of the procedure, the outsides of the packs of instruments should have no wet spots, and the moisture retained by each pack should not cause more than a 3% increase in its weight.

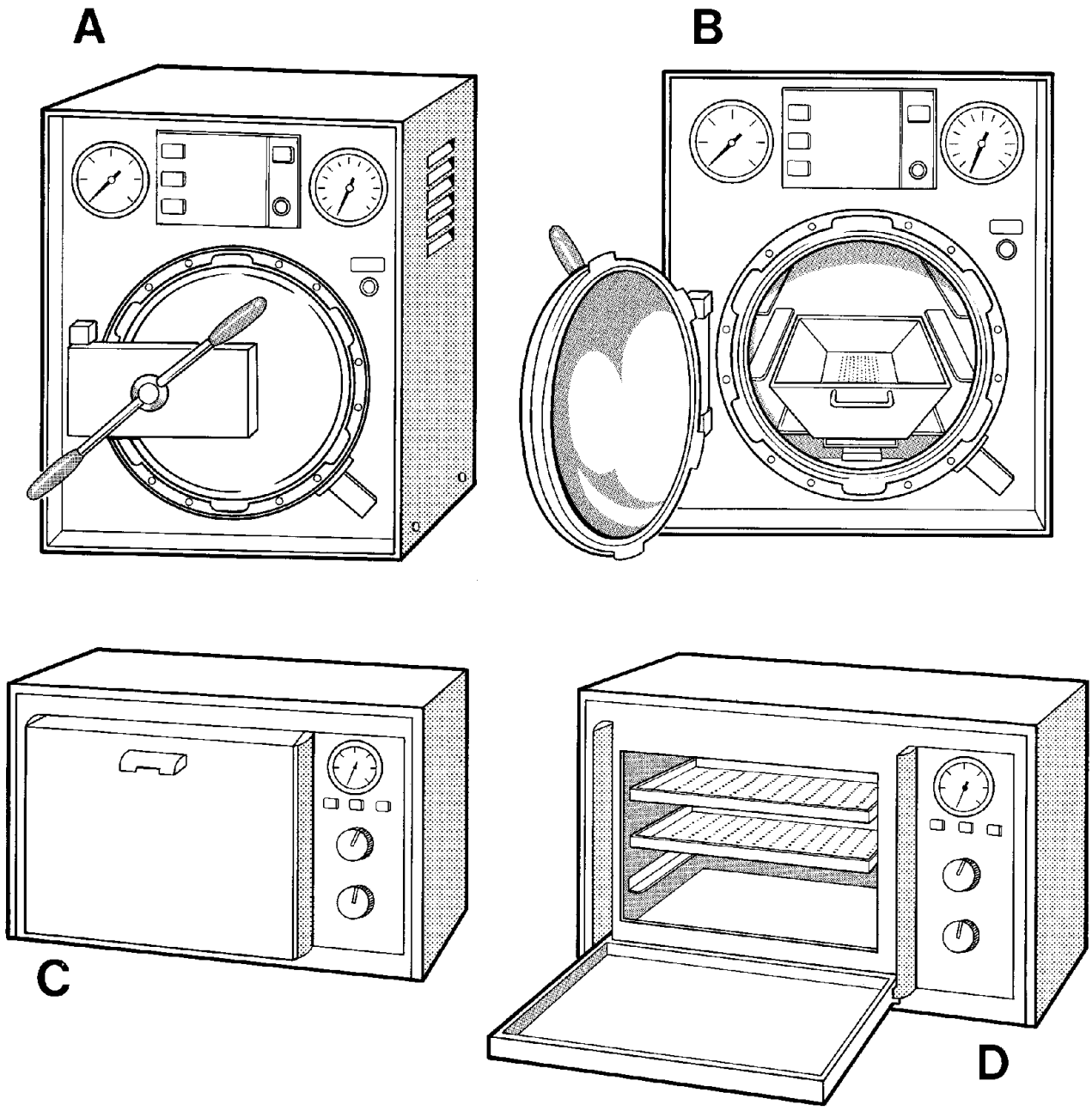

Fig. 1.6. An autoclave (A, B); a hot-air oven (C, D).

Dry heat

Sterilizing by hot air is a poor alternative to autoclaving since it is suitable only for metal instruments and a few natural suture materials. The oven most commonly available is of the type used by bacteriologists to sterilize laboratory glassware (Fig. 1.6C,D). Instruments must be clean and free of grease or oil. They are then sterilized by exposure to a temperature of 170 °C for 2 hours. A fan to circulate the hot air within the oven will improve the efficiency of sterilization.

Other methods

Boiling of instruments is now regarded as an unreliable means of sterilization, and it is not recommended as a routine in hospital practice.

In general, instruments are no longer stored in liquid antiseptic. However, sharp instruments, other delicate equipment, and certain catheters and tubes can be sterilized by exposure to formaldehyde, glutaral (glutaraldehyde), or chlorhexidine. If you are using formaldehyde, carefully clean the equipment and then expose it to vapour from paraformaldehyde tablets in a closed container for 48 hours. Be sure that this process is carried out correctly. Glutaral is a disinfectant that is extremely effective against bacteria, fungi, and a wide range of viruses. Follow manufacturers' instructions for use.

When normal methods of sterilization fail

Failure of an autoclave or a power supply may suddenly interrupt normal sterilization procedures. In such circumstances an antiseptic technique will allow some surgery to continue.

Immerse towels and drapes for 1 hour in a reliable antiseptic such as aqueous chlorhexidine, wring them out, and lay them moist on the skin of the patient. Gauze packs and swabs can be treated similarly, but should be rinsed in diluted (1:1000) chlorhexidine solution before being used in the wound. During the operation, gauze in use should be rinsed from time to time in this solution. Immerse instruments, needles, and natural suture materials in strong antiseptic for 1 hour, and then rinse them in weak antiseptic just before use.

Before entering the operating room, put on a clean, dry surgical gown or apron; if you are a member of the surgical team, pin a moist antiseptic towel over this. Wash gloved hands for 5 min in strong antiseptic and rinse them in a weak solution of the same. If gloves are not available, wash the bare hands for at least 5 min in clean, preferably running water and steep them briefly in 70% ethanol. Allow them to dry before touching the wound.

Prevention of transmission of human immunodeficiency virus (HIV)

All body fluids from a person infected (or suspected of being infected) with HIV should be considered potentially infectious. HIV may be transmitted: (1) by needles or sharp instruments contaminated with blood or body fluids and not properly sterilized; (2) by contact between open wounds, broken skin (for example caused by dermatitis), or mucous membranes and contaminated blood or body fluids; and (3) by transfusion of infected blood or blood products, semen donation, and skin or organ transplantation. The prevention of HIV infection requires special attention to these means of transmission as well as the strict application of aseptic routine.

Most of the small number of reported infections of health workers with HIV have resulted from injuries caused by needles (for example during recapping) and other sharp instruments. After use, disposable needles and scalpel blades should be put into a puncture-proof receptacle, preferably containing a sodium hypochlorite disinfectant. Reusable needles should also be placed in a special container of disinfectant before being cleaned and sterilized.

Surgical gloves prevent transmission of HIV through contact with blood, but there is always the possibility of accidental injury and of a glove being punctured. Thick gloves should therefore be worn when needles and sharp instruments are being cleaned. Where HIV infection is prevalent among patients, needles and instruments should routinely be soaked in a chemical disinfectant for 30 min before cleaning.

Linen soiled by a patient who is or may be infected with HIV should be handled with gloves and should be collected and transported in leak-proof bags. It should be washed with detergent for 25 min at a temperature of at least 71 °C. If this is

not possible, it should be soaked in a hypochlorite disinfectant before washing.

Liquid wastes, such as blood and fluids removed by suction, should be carefully poured down a drain connected to a sewer or into a pit latrine. Otherwise, they should be chemically disinfected. Solid waste should be incinerated or disposed of in a pit latrine; chemical disinfection may be a temporary expedient.

Proper sterilization of all surgical instruments and supplies is crucial in preventing HIV transmission. All viruses, including HIV, are inactivated by steam sterilization (autoclaving) for 20 min at 100 kPa above atmospheric pressure or by dry heat in an oven for 2 hours at 170 °C.

Several points of aseptic routine applicable to members of the surgical team are also particularly relevant to the prevention of transmission of HIV:

- Areas of broken skin and open wounds should be protected with watertight dressings.
- Gloves should be worn during exposure to blood or body fluids and the hands should be washed with soap and water afterwards.
- Frequent use of ethanol or other antiseptics on the hands and arms should be avoided, because it may lead to broken skin.
- Protective glasses should be worn where blood splashes may occur, as during major surgery; if the eyes are inadvertently splashed, they should be washed out as soon as possible with saline.

It should be appreciated that the whole purpose of the aseptic method is to prevent transmission of infection, and that strict attention to every detail of asepsis, with special care to avoid accidental injury during operation, is the best protection against HIV.

Surgical methods and materials

Anaesthesia

It is the anaesthetist's responsibility to provide safe and effective anaesthesia for the patient. The anaesthetic of choice for any given procedure will depend on the anaesthetist's training and experience, the range of equipment and drugs available, and the clinical situation. For a detailed discussion of anaesthetic techniques suitable for the surgical operations described here, see Dobson, M.B., *Anaesthesia at the district hospital* (Geneva, World Health Organization, 1988).

Operative technique

The surgical team should strive to handle tissues gently, to prevent bleeding, to minimize dead space and the amount of devitalized tissue and foreign material in the wound, and to work efficiently to avoid prolonging the operation unnecessarily. Plan the incision to give adequate exposure. Incise the skin with bold sweeps of the belly of the knife, while stretching the skin between the thumb and fingers of the other hand (Fig. 1.7). Control initial oozing of blood from the cut surfaces by pressure over gauze. Individual bleeding vessels may be caught in fine forceps and twisted off or ligated with fine catgut or fine thread (Fig. 1.8). Cut the ligature short. As a routine, use a reef knot, but make a triple knot or a surgeon's knot if additional security is required. Avoid diathermy near the skin. Similarly deepen the wound to reach the target organ, making sure that the wound is laid open along its whole length. A clean knife is commonly used to gain access to a body cavity, for example for incising the peritoneum.

Close the operation wound in layers with catgut, thread, or nylon (but avoid thread in potentially contaminated wounds because it can form a focus for infection). Use different types of sutures as appropriate, for example simple, interrupted, continuous, mattress, or purse-string. Aim to bring the wound edges

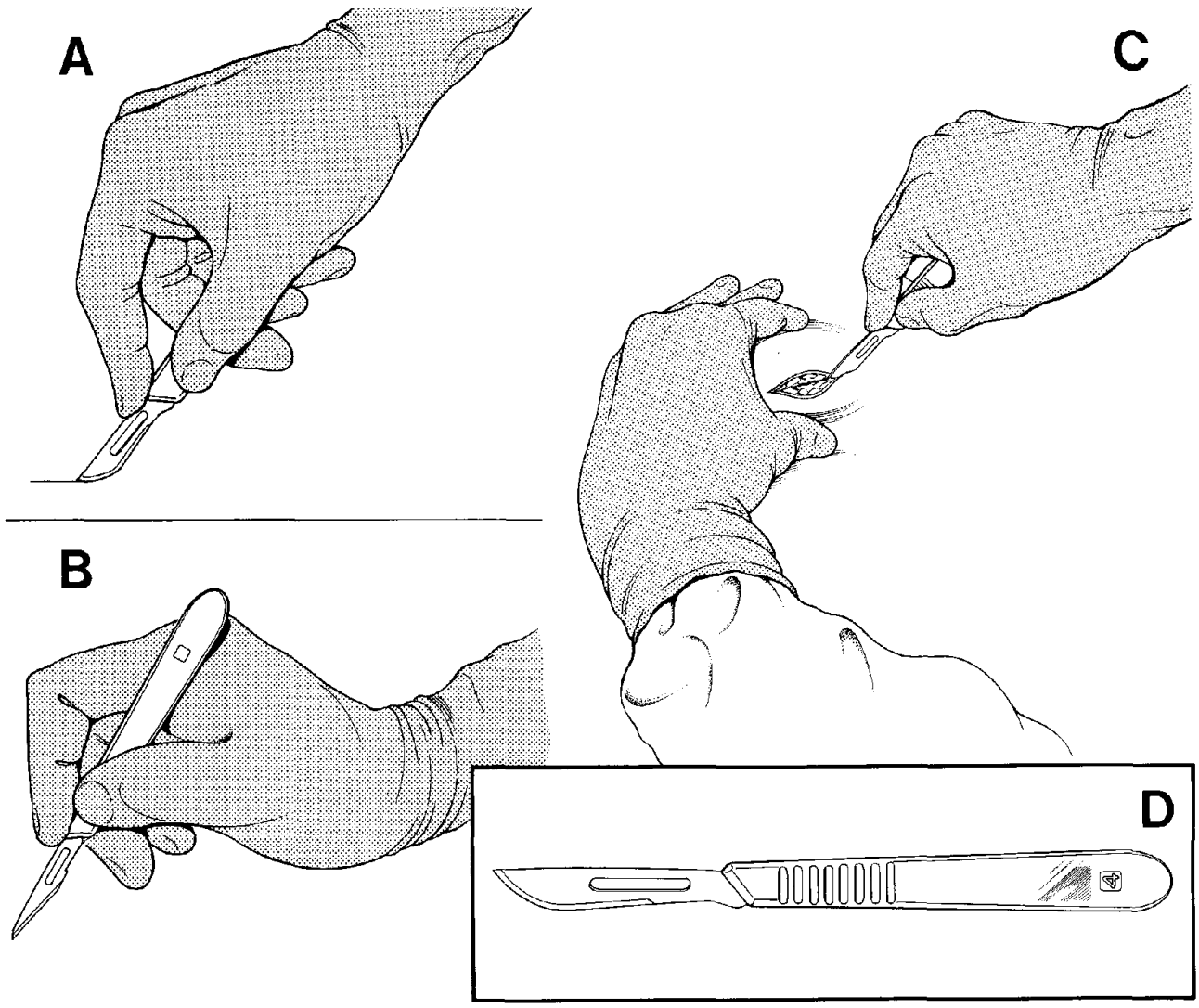

Fig. 1.7. Making an incision. Alternative ways of holding the knife (A, B); stretching the skin between the fingers and thumb (C); a skin knife (D).

together loosely, but without gaps, taking a "bite" of about 1 cm of tissue on either side and leaving an interval of 1 cm between each stitch (Fig. 1.9A–D). Remember that a "suspect" (possibly contaminated) or grossly contaminated wound is best left open and lightly packed with plenty of dry gauze, with sutures inserted for delayed primary closure after 2–5 days (Fig. 1.9E,F).

Suture materials

Sutures and ligatures consist of absorbable or non-absorbable materials. Catgut remains the most popular absorbable material because of its pliability and superior handling qualities. Chromic catgut lasts for 2 or 3 weeks in the tissues and is excellent for ligatures and for approximating tissues, though it is no longer used for closing abdominal wounds and in other situations where prolonged support is needed, because of the rapid loss of tensile strength as it is absorbed. Plain catgut is absorbed in 5–7 days, but is useful when healing is expected within this period, and for suturing the bladder mucosa.

Non-absorbable materials include braided lengths of natural products (such as silk, linen, and cotton) and synthetic monofilaments (such as nylon and polypropamide). Choice among these materials depends on cost, availability, indi-

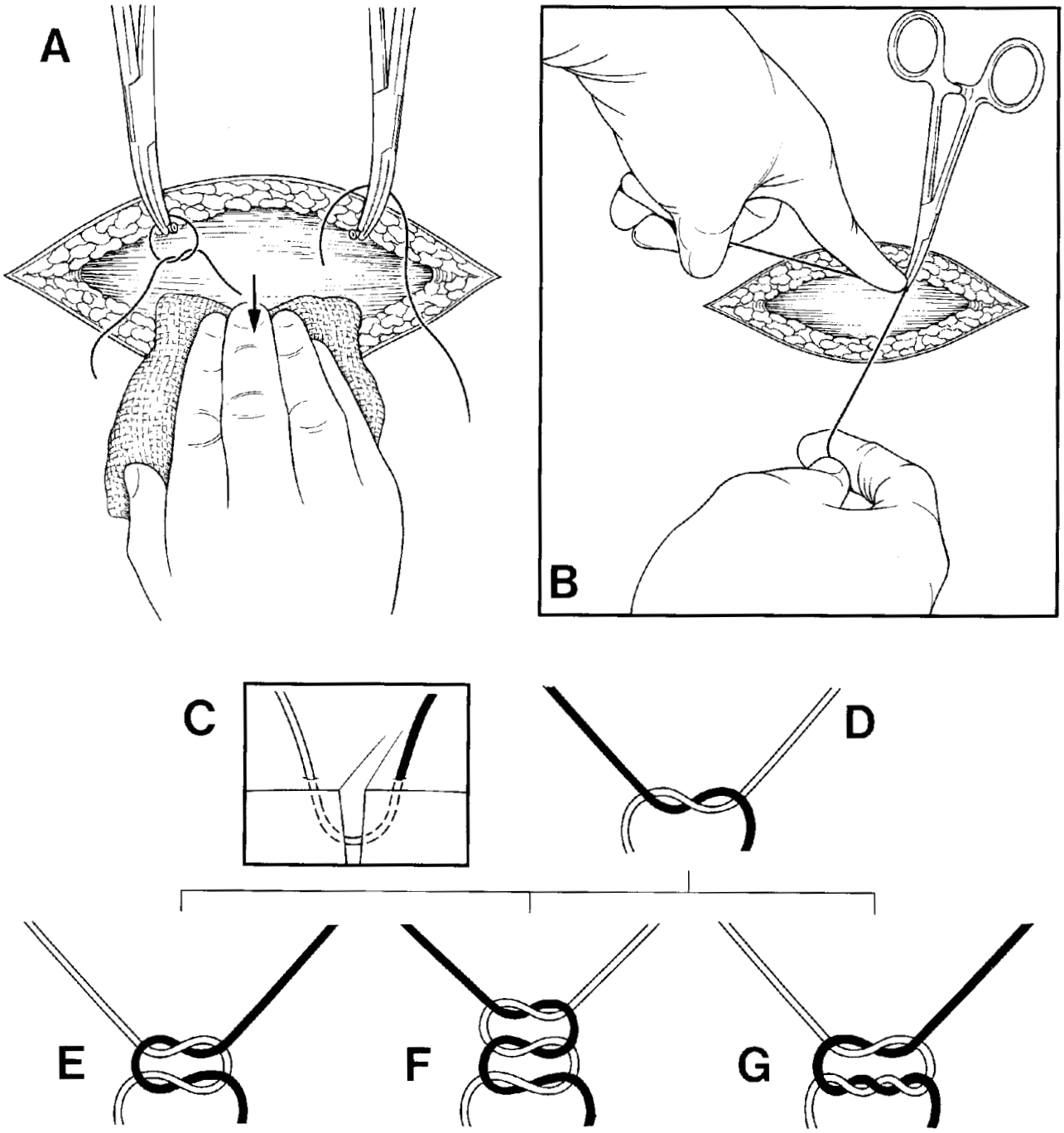

Fig. 1.8. Control of bleeding by ligation and by pressure over gauze (A); the ligature knot is pushed well down (B); suture ready for tying (C); making a knot (D): a reef (square) knot (E); a triple knot (F); a surgeon's knot (G).

vidual preference in handling, security of knots, and the behaviour of the material in the presence of infection. In this book braided materials are referred to as "thread" and synthetic monofilament materials as "nylon".

Never use thread for sutures deep in a wound that may be contaminated. Monofilament nylon, however, may be left in the deeper layers; it is better used as a continuous stitch, as its knots are less secure than those of thread. All varieties of suture material may be used in the skin. Thread is easier to use for

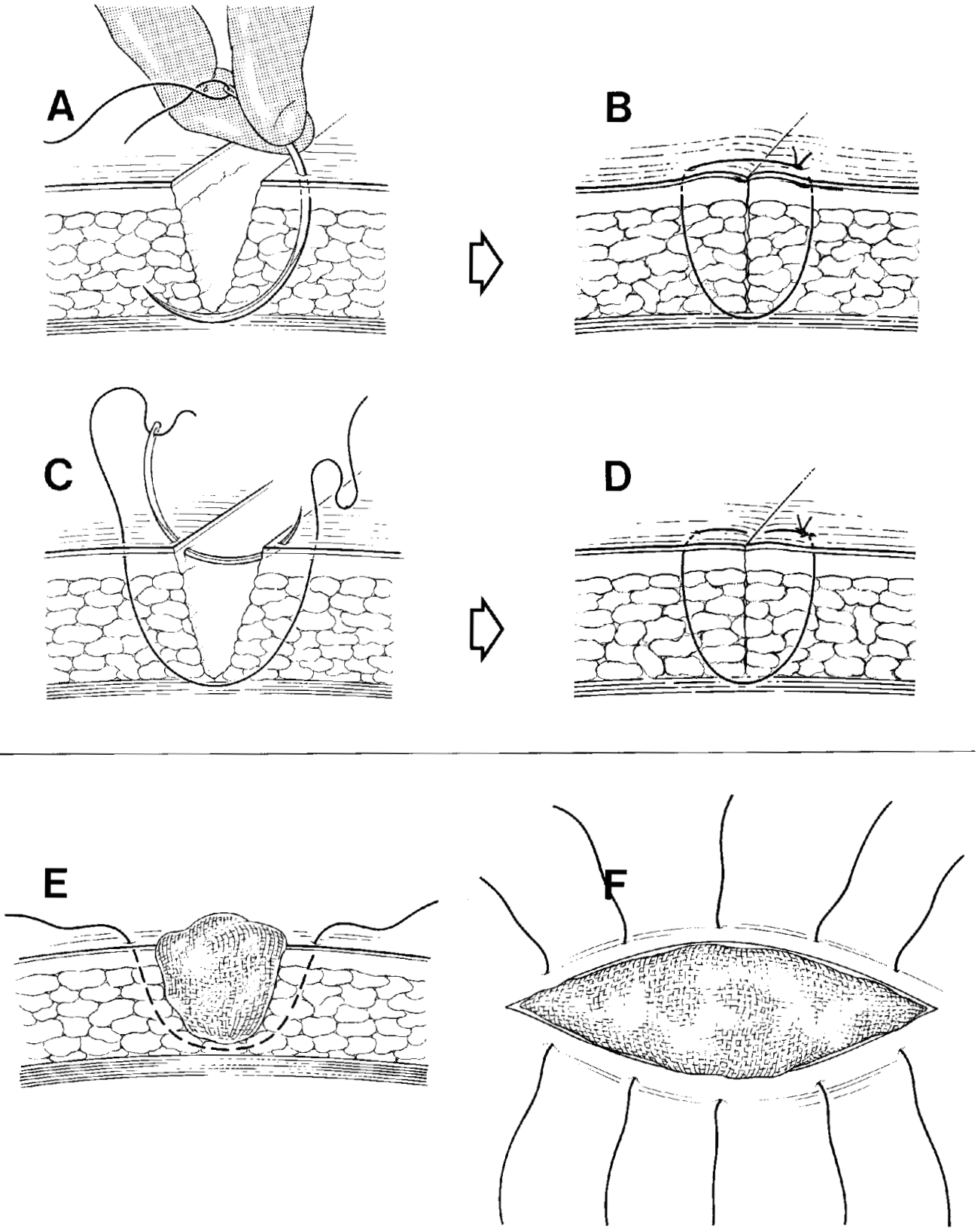

Fig. 1.9. Skin closure. Inserting and tying a simple stitch (A, B); inserting and tying a mattress stitch (C, D); packing a contaminated wound and inserting sutures for delayed primary closure (E, F).

interrupted stitches, while nylon marks the skin least and is convenient for continuous stitches. Use absorbable material in the urinary tract to avoid the encrustation and stone formation associated with non-absorbable sutures.

Size and strength of materials

Sutures are graded according to size on two scales: an old system that runs upwards from 0 to 4 and downwards to about 6/0, and a metric system running from 0 to 8. Most surgeons continue to use the old gauge, and this is referred to throughout the text; a rough conversion table is given below.

Old	6/0	5/0	4/0	3/0	2/0	0	1	2	3	4
Metric	1	1.5	2	2.5	3	4	5	6	7	8

Most common operations can be completed with suture materials between sizes 3/0 and 1. The strength of sutures varies little between the usual materials.

Use of drains

Drains are no substitute for good surgery, but when indicated, they should be retained for no longer than 72 hours. The ideal drainage is by suction, but when this is not available you may substitute a corrugated latex drain running into a closed colostomy bag (Fig. 1.10). When neither suction nor a colostomy bag is available, use a corrugated drain running into gauze dressings, though this is far from satisfactory. India rubber drains should not be used.

Use of antimicrobial drugs

Treatment of infections

Patients often present with infections requiring treatment with antimicrobial drugs or develop such infections after operation. When antimicrobial treatment is indicated, keep in mind several principles:

- systemic rather than topical agents should be used, except for the eye;
- narrow-spectrum antimicrobial drugs directed against specific organisms should be used whenever possible, as broad-spectrum drugs can lead to superinfection and favour the selection of resistant microorganisms;
- the choice of a particular agent from a broad group of antimicrobial drugs should depend on the target microorganism, if known, and its drug sensitivity, and on factors such as the drug's antimicrobial spectrum, record of use in the clinic, safety, efficacy, and potential to favour the selection of resistant organisms;
- cost should determine the choice of drug when microbiological, pharmacological, and other relevant properties are similar for several agents;
- antimicrobial treatment should be discontinued as soon as the patient's clinical condition permits.

Prophylaxis

Parenteral antimicrobial prophylaxis should not be routine, but is recommended for operations associated with a high risk of infection, for example bowel resection. It is also recommended for operations after which infection, although not a frequent problem, can have severe or life-threatening consequences (for example craniotomy). In addition, antimicrobial prophylaxis is essential for patients with valvular heart disease, who are at risk of developing bacterial endocarditis as a result of transient bacteraemia from instrumentation in the mouth or other parts of the body.

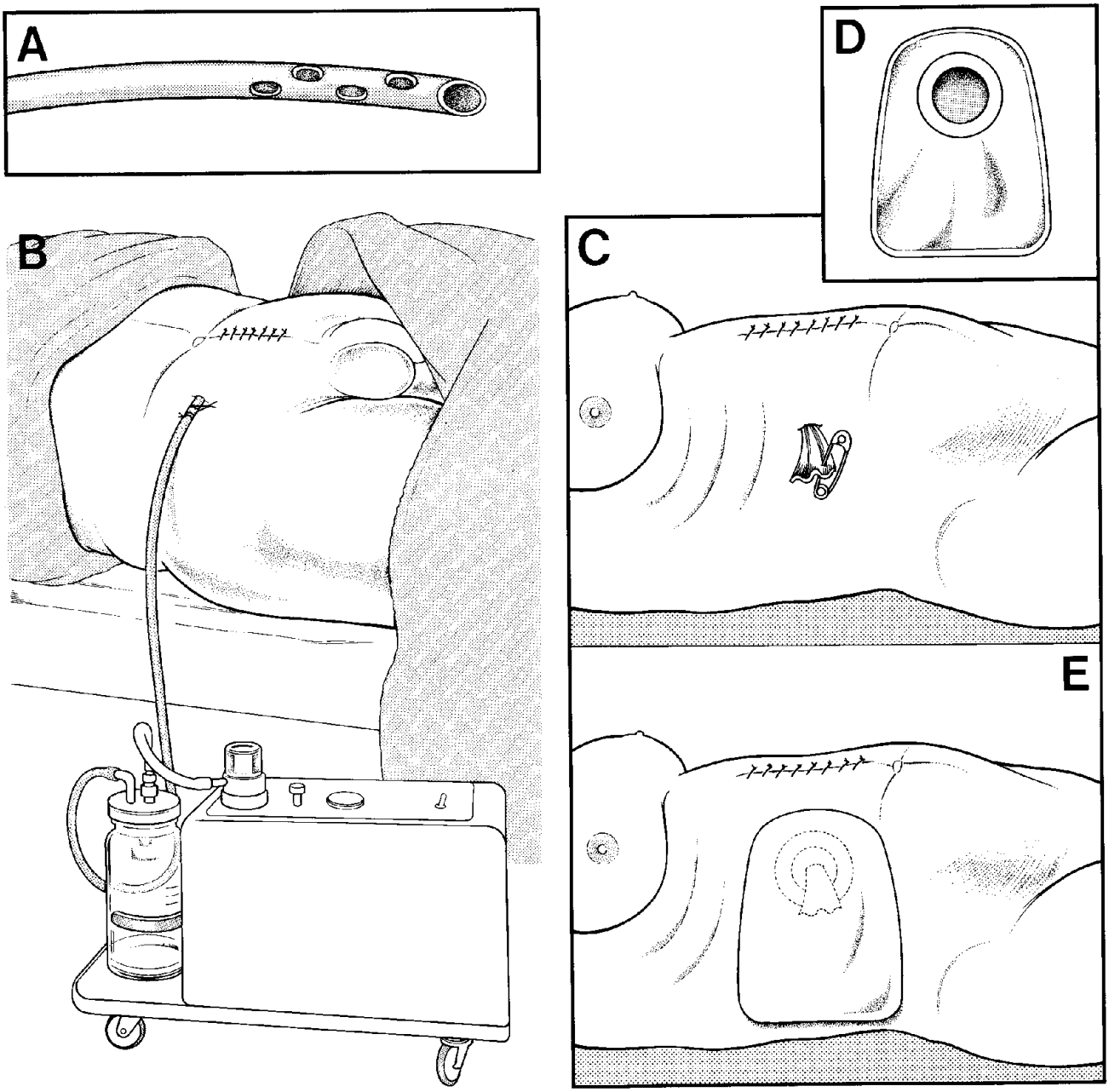

Fig. 1.10. Drainage. Drainage by suction through a tube with several holes (A, B); a corrugated latex drain (C); drainage into a colostomy bag (D, E).

Start parenteral antimicrobial prophylaxis immediately before the operation and continue it for 1–2 days.

Wound care

Generally, do not close wounds by primary suture if they are or may be contaminated, and do not touch an open wound directly with bare, unsterilized hands. A repaired wound can be regarded as sealed after 24 hours, and dressings may then be changed without sterile gloves but with a "no-touch" technique.

Remove dressings over closed wounds if they become wet or if the patient shows signs or symptoms suggestive of infection, for example fever or unusual wound pain. After removing the dressing, inspect the wound for signs of infection and sample any discharge for bacteriological examination.

Records

Keeping accurate records on patients is the doctor's responsibility. Write down all clinical information about the patient immediately after such information is obtained. Indicate the date and time for every record made, and ensure that all records are legible and easily understood. Notes on surgical procedures undertaken, including the findings at operation and instructions on postoperative management, must be recorded without delay at the end of every operation. Specific mention should be made of the operation as being either "clean", "clean–contaminated", "contaminated", or "dirty and infected". This will allow for an evaluation of postoperative wound infection rates. Such evaluation, which should be the regular duty of one member of the hospital team, permits assessment of the application of aseptic routine within the hospital.

Even ward patients who are not seriously ill should be assessed at least once a day and progress notes made, if only to indicate that there has been no change in the patient's condition. On discharging the patient from the ward, record the definitive diagnosis and give instructions about his or her further management as an outpatient. Remember that clinical notes are important for review and discussion to determine how patients (including future patients) should be managed, for insurance and medico-legal purposes, and for research.

Wound débridement

Débridement is a procedure used in the initial management of non-surgical wounds to remove dead tissue and foreign material in order to facilitate healing. Wound toilet and débridement are systematic procedures, applied first to the superficial and then to the deeper layers of tissues. Gentle handling of tissues will minimize bleeding, which can be further controlled by local compression or by ligation of the spurting vessels.

Anaesthesia should be provided as appropriate. If necessary, clip or shave hair from around the wound. Wash the wound with toilet soap and water, irrigate it with physiological saline, and scrub the surrounding area thoroughly (Fig. 1.11A,B). There should be no soap left in the wound. Meticulously remove any loose foreign material such as dirt, grass, wood, glass, or clothing and prepare the skin with antiseptic. It is generally wise to extend the wound longitudinally to reveal the full extent of damage. Excise only a very thin margin of skin from the wound edge (Fig. 1.11C).

Excise all dead tissue from the wound (Fig. 1.11D,E). Dead or devitalized muscle will be dark in colour and will be soft or easily torn and damaged; it will not contract when pinched with toothed forceps or bleed when cut. Remove all adherent foreign material along with the dead muscle. In cases of compound fracture, remove only very small, obviously free fragments of bone, provided that their removal does not affect the stability of the fracture. It is unwise to strip muscle and periosteum from a fractured bone.

Vessels, nerves, and tendons that are intact should be left alone after the wound has been cleansed. Ligate divided vessels regardless of whether they are bleeding. Large vessels that have been damaged and contused may need to be divided between ligatures, but first test the effect on the distal circulation by temporary occlusion of the vessel with tape or rubber clamps.

Loosely appose the ends of divided nerves by inserting one or two fine, black silk stitches through the nerve sheath. Tendon ends may be similarly fixed to prevent further retraction. Formal repair of nerves or tendons is best undertaken later, if possible by a specialist surgeon.

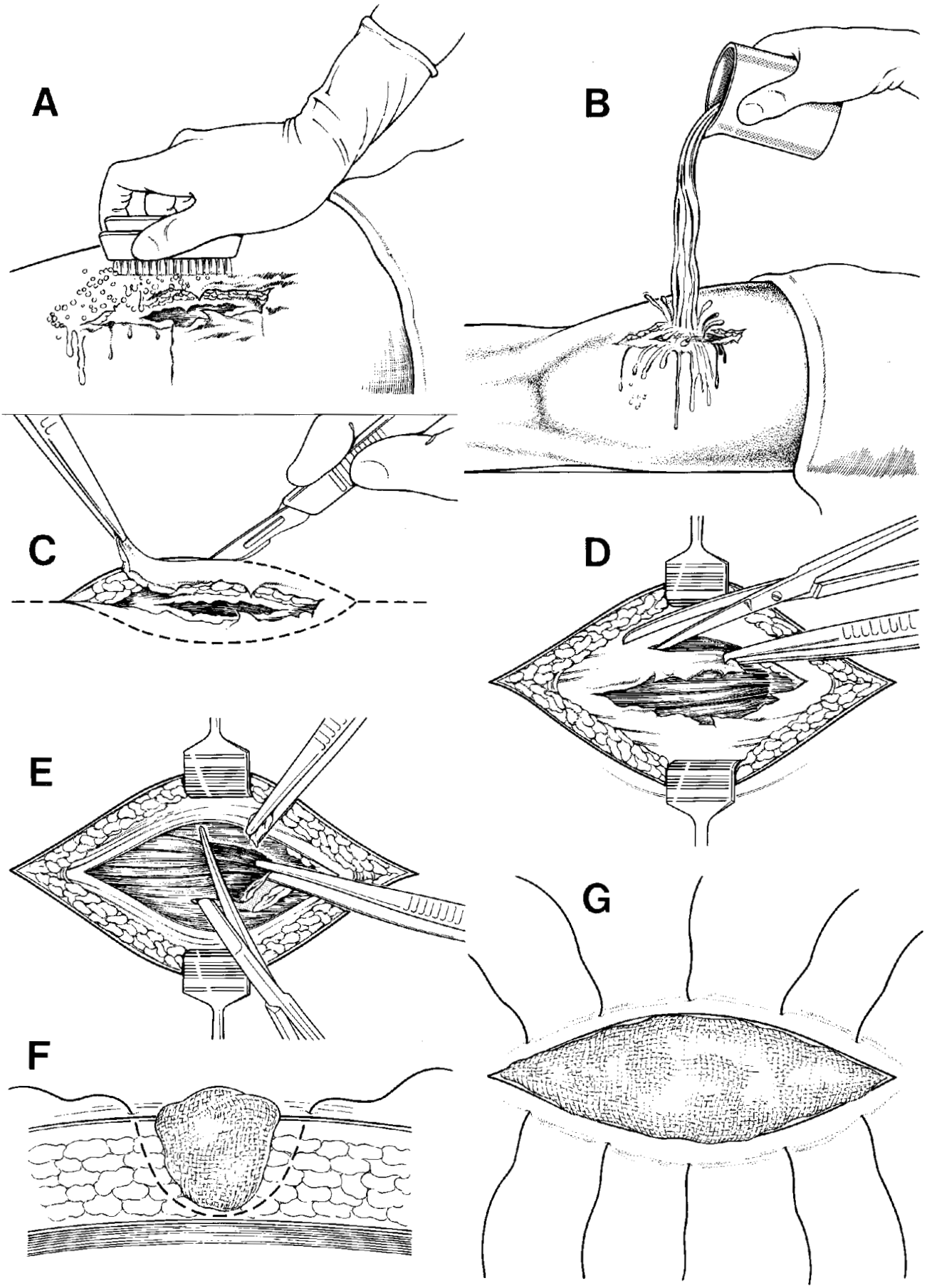

Fig. 1.11. Wound débridement. Washing the wound (A, B); excising a small skin margin (C); excising all dead tissue (D, E); inserting stitches, which are left untied, and packing the wound (F, G).

Generally leave the wound open after débridement, inserting stitches but leaving them untied for delayed primary closure 2–5 days later (Fig. 1.11F,G). Pack the wound lightly with dry, sterile gauze. Always administer tetanus prophylaxis.

Incision and drainage of abscesses

Infections with abscess formation are a major problem in many developing countries. Treatment is often delayed or inadequate. Yet there are few surgical procedures that have as dramatic results, in terms of the patient's satisfaction and confidence in health staff, as the prompt and adequate drainage of an acute abscess.

Incision and drainage of an abscess are indicated if there is evidence of localized pus: throbbing pain; hot, local swelling with tight, shiny skin; and marked tenderness. Fluctuation is the most reliable sign, though it may be absent in a tense or deep abscess. Interference with sleep is a pressing indication for surgery.

For more specific discussion of mastoid, peritonsillar and retropharyngeal, neck, breast, appendicular, and perianal and ischiorectal abscesses, see pages 74, 84, 85, 98, 134, and 148, respectively.

Assessment and preoperative management

If in doubt about the diagnosis, confirm the presence of pus by needle aspiration. (An aneurysm may mimic the features of an abscess, but it pulsates and lies in the line of a major vessel.) Measure the patient's haemoglobin level and test the urine for sugar and protein.

Equipment

See tray for *Incision and drainage of abscess*, Annex 1.

Technique

Prepare the skin with antiseptic, and give a local anaesthetic if necessary. Perform a preliminary needle aspiration to confirm the presence of pus if this has not already been done (Fig. 1.12A).

Make an incision over the most fluctuant or prominent part of the abscess, in a skin crease if possible (Fig. 1.12B). Take a sample of pus for bacteriological examination. Introduce the tip of a pair of sinus or artery forceps into the abscess cavity and open the jaws to improve drainage (Fig. 1.12C). Explore the cavity further with a finger to break down all loculi (Fig. 1.12D).

It may be necessary to extend the incision or convert it into a cruciate form to deroof the abscess completely (Fig. 1.12E,F), but take care not to open up healthy tissues or tissue planes beyond the abscess wall. The abscess cavity can then be cleaned with swabs soaked in saline or antiseptic solution.

Introduce a large corrugated drain, positioning it well into the depth of the cavity. A counter-incision may be necessary to ensure free and dependent drainage. Fix the drain to the edge of the wound or counter-incision with a stitch of 2/0 thread, and mark it with a safety pin before cutting off the excess drain. Dress the wound with several layers of gauze, the gauze of the deeper layers having been first soaked in antiseptic solution and wrung out. Leave the drain in place for about 2 days, until a track has formed through the tissues or until the drainage is minimal. Alternatively, pack the abscess cavity with a ribbon of petrolatum gauze, leaving one end outside the wound, marked with a safety pin. Control excessive bleeding from the cavity by tight packing with dry gauze; this may be removed after about 12 hours and replaced with a petrolatum gauze pack or a drain.

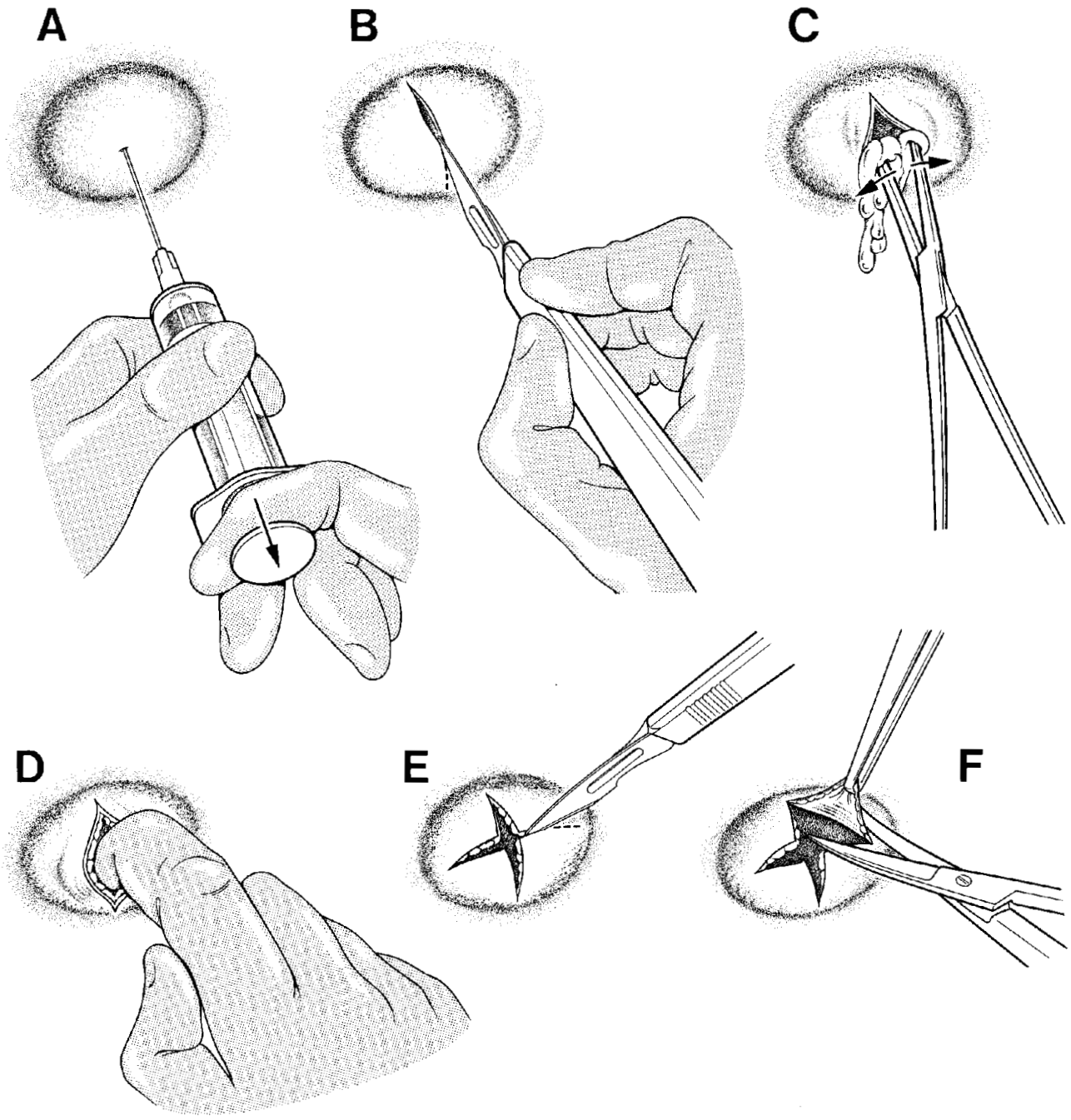

Fig. 1.12. Incision and drainage of abscess. Preliminary aspiration (A); incision (B); introducing the tip of a pair of forceps to improve drainage (C); breaking down loculi with a finger (D); further incision (E); trimming the corners of the cruciate incision to deroof the cavity (F).

Too small an incision and failure to provide free drainage are common mistakes in this procedure, leading to chronicity or recurrence of the abscess. The wound edges must not be allowed to close while the abscess cavity remains.

After-care

Treatment with antibiotics is unnecessary, unless there is evidence of spreading infection with signs of toxicity or unless the abscess is in a region of crucial importance, such as the hand, ear, or throat.

Split-skin grafting

Skin is the best cover for a raw surface caused by, for example, trauma or burns.[1] The recipient area for the graft should have healthy granulation tissue with no evidence of infection.

Equipment

See tray for *Skin grafting*, Annex 1.

Technique

The patient should be given a general anaesthetic.

The most commonly used donor site is the anterolateral or posterolateral surface of the thigh. First clean the selected donor site with antiseptic and isolate it with drapes. Apply petrolatum or liquid paraffin (mineral oil) to lubricate the area. Hold the assembled skin-grafting knife (Humby) (Fig. 1.13A) in one hand and press the grafting board against the patient's thigh (or alternative donor site) with the other hand. Instruct an assistant to apply counter-traction to keep the skin taut by holding a second board in the same manner. Cut the skin with regular back-and-forth movements while progressively withdrawing the first board ahead of the knife (Fig. 1.13B).

After cutting a length of about 2 cm of skin, inspect the donor area: homogeneous bleeding confirms that the graft is of split-skin thickness; exposed fat indicates that the graft is of full thickness, i.e., too deep, in which case you should check the adjustment of the blade. As the cut skin appears over the blade, instruct an assistant to hold it gently out of the way with non-toothed dissecting forceps. Place the newly cut skin in saline and cover the donor area with a warm wet pack before dressing it with petrolatum gauze. Spread out the cut skin, with the raw surface upwards, on petrolatum gauze (Fig. 1.13C).

If a skin-grafting knife is not available, the graft can be taken with a razor blade held with straight artery forceps. Start by applying the cutting edge of the blade at an angle to the skin but after the first incision lay the blade flat.

Before applying the skin graft, clean the recipient area with saline. Wet the graft frequently with saline to prevent it from drying out. Do not pinch it with instruments. To graft a large piece of skin, first suture it in place at a few points and then continue to place sutures around the edges of the wound. Sutures are not necessary for a small piece of skin.

Haematoma formation under the graft is the most common reason for graft failure. It can be prevented by applying a "bolster" dressing made of moist cotton wool moulded in the shape of the graft and tied over the graft with sutures. As an alternative, make several small perforations in the graft (Fig. 1.13D), or cut the graft into small pieces (postage-stamp grafts) and place them a few millimetres from each other to leave space for bridging during the re-epithelization process.

After-care

Hold the graft in place with petrolatum gauze, unless you have already sutured it and applied a bolster dressing. Then apply additional layers of gauze and cotton wool, and finally a firm, even bandage. Leave the graft undisturbed for 2–3 days unless infection or haematoma is suspected. Change the dressing daily or every other day thereafter (a bolster dressing will no longer be needed by this stage), but never leave the grafted area uninspected for more than 48 hours. If the graft is raised, puncture it to release any serum underneath. Otherwise interfere as

[1] For further details of the treatment of burns and other forms of trauma, see *Surgery at the district hospital: obstetrics, gynaecology, orthopaedics, and traumatology* (Geneva, World Health Organization, in preparation).

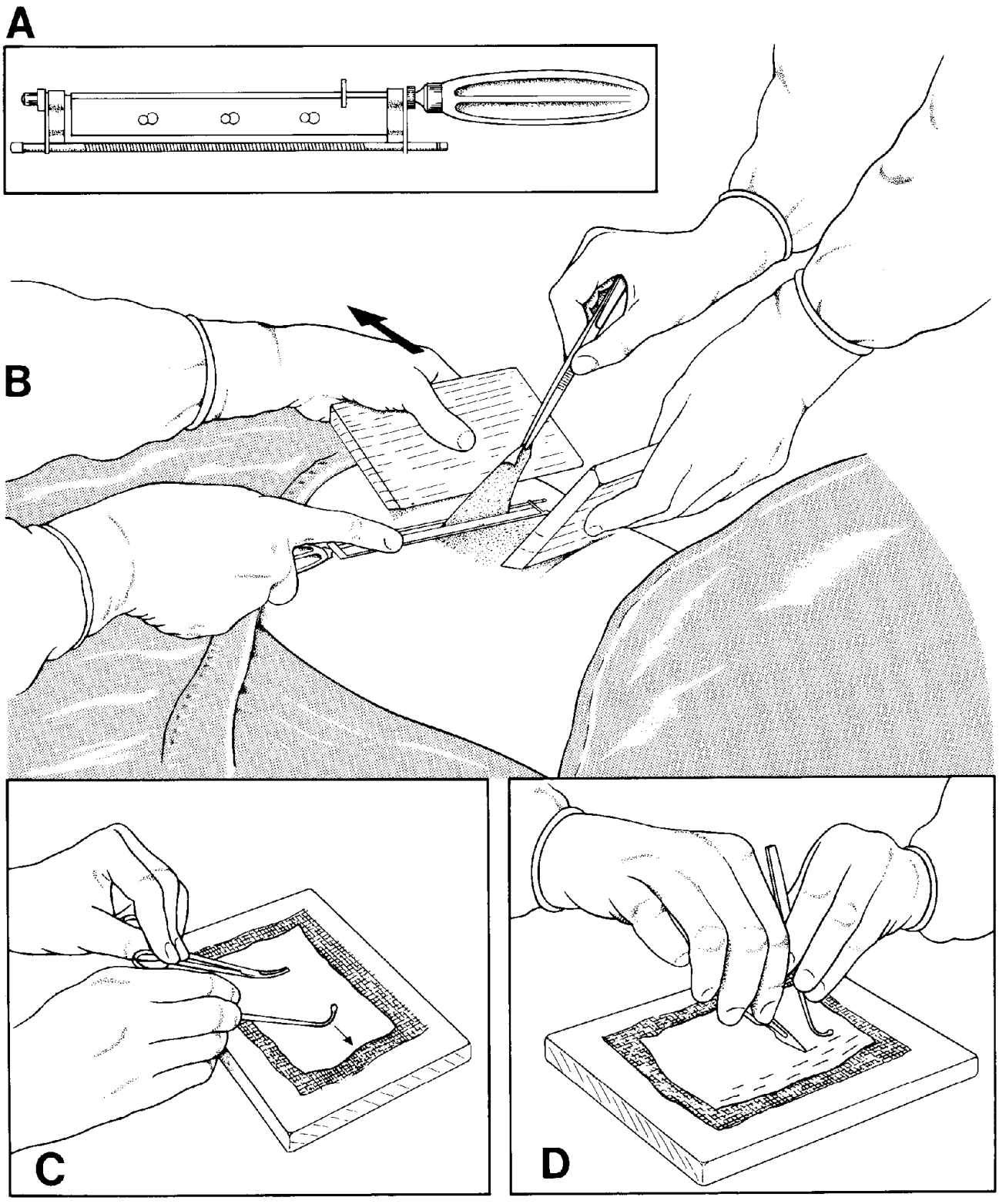

Fig. 1.13. Skin grafting. A skin-grafting knife (Humby type) (A); cutting skin (B); spreading out the cut skin (C); making perforations in the graft (D).

little as possible. It may be possible to expose the graft to the air at this early stage if the area can be protected by splints or mosquito netting, but only if there is adequate nursing supervision. After 7 to 10 days, remove any sutures, wash the grafted area, and lubricate it with liquid paraffin (mineral oil) or petrolatum.

The second week after grafting, instruct the patient in regular massage and exercise of the grafted area, especially if it is located on the hand, the neck, or one of the limbs. These exercises should be continued for at least 9 months. To prevent burn contractures, apply simple splints for flexure surfaces and keep the grafts under tension using whatever means is available. For example, simple tongue depressors can serve as finger splints and plaster of Paris can be used for extremities.

2

Fluid and electrolyte therapy, blood transfusion, and management of shock

Fluid and electrolyte therapy

Normal distribution and composition of body fluid

The amount of water in the healthy body depends on the size, weight (particularly lean body mass), and sex of the individual. Body water is usually expressed as a percentage of body weight and is approximately 60% in men, 50% in women, 65% in children older than one year, and up to 75% in neonates. The water present within the cells, intracellular fluid, accounts for 40% of the body weight in men. The extracellular fluid makes up 20–25% of the body weight in men and 40–50% in neonates, and is subdivided into plasma and interstitial fluid. Physiologically, these three compartments of body water are interdependent (Fig. 2.1).

Plasma contains proteins (chiefly albumin) and ions (mainly sodium, chloride, and bicarbonate). Water and electrolytes move freely between plasma (intravascular compartment) and the interstitial fluid, but plasma proteins enter the interstitial fluid only when the capillary endothelium is damaged, for example as a result of septic shock or burns. The protein in plasma is responsible for the intravascular colloid osmotic pressure, a major determinant of the movement of fluid across the capillary endothelium. Only a small proportion of the body's potassium is present in plasma, but the concentration of potassium ions is crucial to cardiac and neuromuscular function.

Interstitial fluid has an ionic composition similar to that of plasma. If there is a water deficit in the intravascular compartment, water and electrolytes pass from the interstitial compartment to restore the circulating blood volume. Electrolyte solutions, such as physiological (normal) saline and Ringer's lactate solution (Hartmann's solution), can pass into the interstitial space when they are administered intravenously. For this reason, they are effective in raising the intravascular circulating volume for only a short time if there is a deficit of fluid throughout the extracellular compartment. Blood, plasma, and colloids used as plasma substitutes, for example dextran, hydroxyethyl starch, and gelatin solutions (which are known as "plasma expanders"), remain in the intravascular compartment longer and are therefore more effective in maintaining the circulation.

Intracellular fluid has a different ionic composition to extracellular fluid. The main cations are potassium and magnesium, with phosphates and proteins as the major anions.

After intravenous infusion, the water contained in physiological saline tends to remain in the extracellular compartment, but the water contained in glucose solutions is distributed throughout all body fluid compartments, the glucose being metabolized. *Never* give pure water intravenously, as it causes dangerous haemolysis.

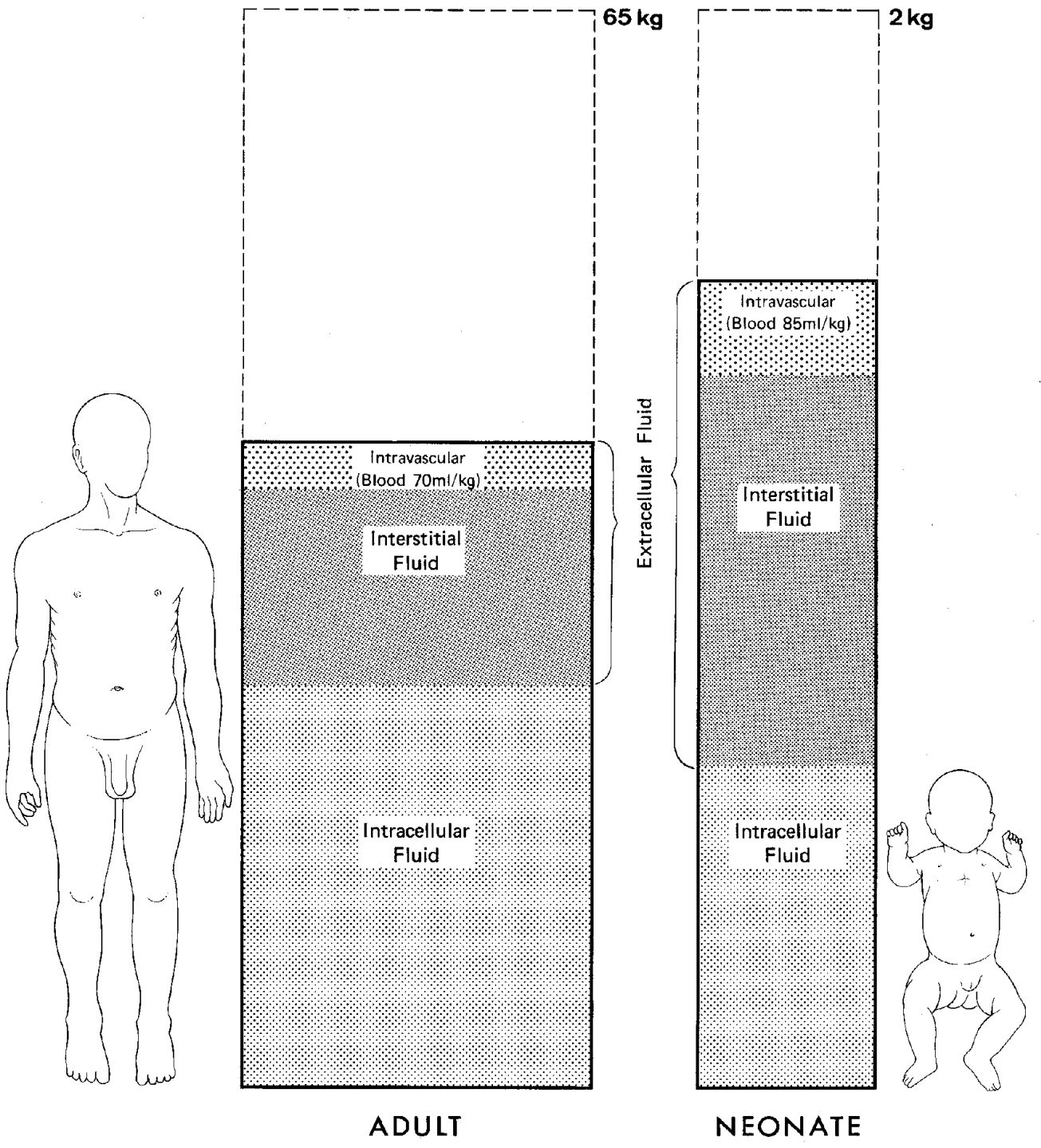

Fig. 2.1. Fluid compartments of the body.

Daily water and electrolyte exchanges

In the normal individual, the amount of water and electrolytes excreted each day balances what is taken in in foods and fluids (Tables 1 & 2). The kidney regulates, to a large degree, the volume and composition of body fluid. To a lesser degree the skin and lungs affect water losses, but do not regulate them.

Acid–base balance

Hydrogen ions (H^+) and large amounts of carbon dioxide (CO_2) are produced during the normal metabolic activity of the body. The hydrogen ions are discharged into body fluids, and the carbon dioxide combines with water to form carbonic acid (H_2CO_3).

The body has extremely efficient mechanisms for buffering acids, but in disease these mechanisms are often disturbed. Of the buffer systems, the bicarbonate/carbonic acid system is the most important, but proteins, and especially

Table 1. Average daily water exchanges (in ml) in an adult male

	Tropical countries	Temperate countries
Loss		
Through lungs and skin	1700	1000
In urine	1500	1500
In faeces (variable)	200	200
Total	3400	2700
Gain		
Water of oxidation	200	200
Net requirement	3200	2500

Table 2. Average daily losses of sodium and potassium (in mmol) in an adult male

	Tropical countries	Temperate countries
Sodium		
Urine	114	80–110
Sweat	16	0
Faeces	10	10
Total	140	90–120
Potassium		
Urine	47	60
Sweat	Negligible	0
Faeces	10	10
Total	57	70

haemoglobin, are also important as intracellular buffers. The normal plasma pH of approximately 7.4 is maintained within narrow limits through these buffering systems, through the control of carbon dioxide elimination by the lungs, and through the regulation of plasma bicarbonate (HCO_3^-) concentration by the kidney.

Disturbances of body-fluid status

Changes in the volume or composition of the body fluids (which may occur before, during, or after surgery) can cause a severe physiological disturbance and should therefore be corrected promptly. The volume changes seen in surgical practice often affect the extracellular fluid. This fluid may be lost not only externally, for example through external haemorrhage, but also internally through sequestration (translocation or redistribution) into injured tissues, as in patients with burns, crush injuries, peritonitis, or an obstructed loop of the bowel. This internal redistribution of the extracellular fluid, at times referred to as fluid loss into the "third space", is often overlooked, yet it can markedly reduce the circulating fluid volume.

How to assess volume depletion

Take a detailed history from the patient or from his or her relatives and make a careful examination to determine the nature and approximate amount of fluid lost; the diagnosis should be mainly clinical. The clinical state of the patient depends on the amount and rate of fluid loss, the underlying or associated disease, and the efficiency of compensatory mechanisms. Reliable tests for determining the amount of fluid lost are not available; in particular, the concentration of sodium ions in the serum can be misleading. Nevertheless, the patient's blood can yield useful information: the blood urea concentration may

Table 3. Mass concentration of components of a solution of oral rehydration salts (ORS)

Component	g/litre
Sodium chloride	3.5
Trisodium citrate, dihydrate[a]	2.9
Potassium chloride	1.5
Glucose, anhydrous[b]	20.0

[a] *Or* sodium hydrogen carbonate (sodium bicarbonate) 2.5 g.
[b] *Or* glucose, monohydrate 22.0 g; *or* sucrose 40.0 g.

Table 4. Substance concentration of components of a solution of oral rehydration salts (ORS)

Component	mmol/litre
Sodium	90
Potassium	20
Chloride	80
Citrate[a]	10
Glucose[b]	111

[a] *Or* bicarbonate 30 mmol/litre.
[b] *Or* sucrose 117 mmol/litre.

be elevated if there is an uncorrected deficit of extracellular fluid, and the severity of dehydration (loss of water and electrolytes) may be indicated by the haemoglobin concentration or erythrocyte volume fraction. The dehydrated patient is usually thirsty with a dry mouth, sunken eyes, and reduced skin elasticity; the blood pressure may be low, associated with a small pulse pressure and tachycardia. If the fluid loss is acute and severe, the patient may develop hypovolaemic shock. Urinary output may be low and the relative density (specific gravity) of the urine high.

Treatment of fluid imbalance

If the patient is suffering fluid loss but with minimal signs, administer fluids orally, unless contraindicated; a solution of oral rehydration salts (ORS) in water is suitable for this (Tables 3 & 4). In patients with burns, oral rehydration salts are a useful supplement to fluids given intravenously. The ideal solution to infuse is one whose composition most closely resembles that of the fluid lost. Replace the fluid already lost, administer fluid for daily maintenance, and anticipate and replace any continuing unusual losses. Remember that patients receiving fluid and electrolyte therapy, except those with diarrhoea, are not likely to pass faeces, so daily requirements must be adjusted accordingly. Table 5 shows the main features of the commonly available replacement fluids.

In patients suffering fluid loss and showing obvious signs, it is convenient to begin replacement by infusing a balanced salt solution such as physiological saline (containing sodium chloride at 9 g/litre) or Ringer's lactate solution. In hot countries, water loss is proportionally greater than electrolyte loss, so infuse balanced salt solutions with caution and consider infusing 5% glucose (50 g/litre) as well. Insert a bladder catheter and measure the hourly urinary output and its relative density (specific gravity). Adjust the rate of infusion and the total amount of fluid in accordance with the patient's response, as indicated by the trend in the symptoms and signs, and in particular by the hourly urinary output and the jugular venous pressure. The ideal urinary output is at least 0.5 ml/kg of body weight per hour. Record clinical observations and assess the effect of therapy hourly. Establish a fluid input/output chart, and give clear, written

Table 5. Commonly available replacement fluids

Fluid	Ions (mmol/litre)			Carbohydrate (g/litre)	Energy content (kJ [$kcal_{th}$])	Uses
	Na^+	Cl^-	K^+			
Blood[a]	140	100	4	5–8	NA	Blood loss
Physiological saline (9 g/litre)[b]	154	154	0	0	0	Blood/extracellular fluid loss
Hartmann's solution (Ringer's lactate solution)[c]	131	112	5	NA	NA	Blood/extracellular fluid loss
Glucose 50 g/litre	0	0	0	50	837 [200]	Dehydration
Glucose/saline (glucose 40 g/litre + sodium chloride 1.8 g/litre)	31	31	0	40	669 [160]	Maintenance of electrolyte and water balance
Sodium bicarbonate 84 g/litre	1000	0	0	0	0	Acute acidosis
Dextran 70 in physiological saline	144	144	0	0	0	Intravascular replacement
Polygeline	145	150	0	0	669 [160]	Intravascular replacement

[a] Also contains Ca^{2+} at 2.3 mmol/litre.
[b] The same as a 0.9% solution.
[c] Also contains Ca^{2+} at 3 mmol/litre and lactate at 28 mmol/litre, which is converted to bicarbonate and is therefore useful for correcting acidosis.
NA, not applicable.

instructions about the infusion programme; it is preferable to update these instructions every 6–8 hours rather than only once a day, as losses and requirements may change rapidly.

Treatment of electrolyte imbalance

Hypernatraemia (an excess of sodium ions in the serum, which can be confirmed by a blood test) may be caused by infusion of excessive quantities of saline or by tube feeding without sufficient water supplementation. Associated clinical features are restlessness, tachycardia, dry, sticky mucous membranes, and often an elevated body temperature. Correct hypernatraemia by salt restriction and an intravenous infusion of 5% glucose in water.

Hyponatraemia may follow the intravenous infusion of large volumes of salt-free fluids, such as glucose solutions. It can also follow oral or rectal administration of large amounts of water or other salt-free fluids. It is a recognized complication of water enema in infants and children, especially in those with Hirschsprung's disease, and any form of enema in children and infants should therefore be avoided. The affected patient is lethargic and hypertensive, with tachycardia and cold extremities; oliguria or even anuria is present. Treat hyponatraemia by restricting the patient's water intake. Do not give hypertonic saline infusions in an attempt to "normalize" the level of serum sodium.

Imbalances of serum potassium concentration have more serious clinical consequences than those of serum sodium concentration. Potassium is crucial to cardiac and neuromuscular functions, and its level in serum (3.5–4.5 mmol/litre) varies with the acid–base status and renal function of the individual. Hyperkalaemia may occur after severe trauma (including burns and surgical operations) and in patients suffering from acidosis, various catabolic states, and acute renal failure. Although the patient may complain of nausea, vomiting, abdominal colic, and diarrhoea, the symptoms are a poor guide to hyperkalaemia. The electrocardiogram usually has a peaked T wave, a widened QRS complex, and a depressed S–T segment; dysrhythmias are more likely than usual and may lead to cardiac arrest. Give specific treatment intravenously, in the following sequence:

- 20 ml of a 10% (100 g/litre) solution of calcium gluconate, over a period of 20 min;
- 100 mmol (8.4 g) of sodium bicarbonate in solution (in an acidotic patient this will encourage the entry of potassium ions into cells);
- 100 ml of a 50% (500 g/litre) glucose solution, with insulin at 1 International Unit for every 5 g of glucose.

Recovery of cardiac function is usually prompt with this treatment. If the patient's hyperkalaemia is due to acute renal failure, refer the patient immediately after resuscitation, if possible. If referral is not possible, begin peritoneal dialysis.

Hypokalaemia often results from prolonged administration of diuretics or excessive losses of fluid through the gastrointestinal tract, for example in cases of prolonged diarrhoea or vomiting. The patient has flaccid limbs, reduced tendon reflexes, and paralytic ileus. The electrocardiogram shows a flat T wave and a depressed S–T segment. An adequate urine output (0.5 ml/kg of body weight per hour) must be established before correction of the potassium deficit is started. Potassium is given as potassium chloride mixed in the drip fluid: add 40 mmol of the salt to 1 litre of either saline or 5% glucose. Infuse this fluid very slowly so as to deliver not more than 40 mmol of potassium per hour, and estimate the serum potassium concentration after giving every 40 mmol. The bottle of fluid containing potassium chloride must be clearly labelled. Never give a concentrated solution of a potassium salt by direct intravenous injection.

Blood transfusion

Transfusion with whole blood is generally indicated in cases of acute, severe blood loss amounting to over 15% of blood volume. However, the decision to proceed with transfusion should be taken only after careful consideration of the risk of transfusing blood contaminated with infectious agents, including human immunodeficiency viruses.

It is not necessary to replace all lost blood with blood. To reduce the requirement for whole blood after acute blood loss, infuse plasma expanders such as dextran, hydroxyethyl starch, and gelatin solution, if available. These plasma expanders, however, cannot transport oxygen. They can also interfere with the cross-matching of blood, so blood samples should be taken before infusion.

If anaemia is recognized before surgery, it is best to investigate the cause and treat it appropriately. But in an emergency you may have to correct the anaemia by slow transfusion, preferably with packed red cells. Take particular care with haemostasis during the operation. Measure the blood loss and replace this with whole blood. If you anticipate a loss of more that 500 ml during the operation, group and cross-match donor blood in advance.

Technique

Clearly record the reasons for transfusion. Also record the history of previous transfusions, as well as any reactions to these. If the patient is a woman, record the history of any previous pregnancies, including miscarriages, stillbirths, or infants who suffered from haemolytic disease of the newborn. Finally, record the patient's current or last known haemoglobin level.

Take 10 ml of venous blood from the patient with a dry syringe, and allow it to clot in a dry, sterile specimen bottle or tube clearly labelled with the date and the patient's name, hospital number, and ward. Venepuncture may be difficult in

infants, so use a heel stab instead, and allow 10–20 drops of blood to drip into a sterile tube. Except in emergencies, make requests for grouping and cross-matching of blood at least 24 hours before the proposed transfusion. This will help avoid errors and will allow time to obtain blood and carry out any tests indicated by the patient's condition.

Ideally the blood used for transfusion should match the patient's own blood group. To avoid risks to future pregnancies or transfusions, always use Rh-compatible or Rh-negative blood for premenopausal female patients. If there is difficulty in obtaining blood, especially in an emergency, apply the following rules:

Group A patient:	ideally give blood group A, but you may give group O.
Group B patient:	ideally give blood group B, but you may give group O.
Group AB patient:	ideally give blood group AB, but you may give group A, B, or O (in that order of preference).
Group O patient:	give only blood group O.

Even if these rules are followed, it is still important to cross-match the serum of the patient against the red cells of the donor (compatibility test) to make sure that the blood is safe to give.

Store blood for transfusion in a special refrigerator at 4–6 °C until the time for transfusion. There is an increased risk of sepsis if the blood is artificially warmed; it will reach room temperature as it passes down the giving set. Do not transfuse blood if it is purple, if the plasma layer is pink, or if the date of transfusion is more than 21 days from the date of donation. Always use a giving set with a filter, and start transfusion slowly until about 200 ml have been given. For an anaemic patient use a slow transfusion rate throughout the procedure, but do not allow longer than 4–6 hours per unit of blood because of the risk of sepsis in blood kept at room temperature. Limit the transfusion of whole blood to 20 ml/kg of body weight for infants weighing less than 25 kg and to 10 ml/kg for neonates (up to 1 year old).

Complications

The manifestations of transfusion reactions vary, but pyrexia (at times with rigor) is common, and the patient may develop oliguria or anuria after a severe reaction. If a reaction occurs, stop the transfusion at once and investigate the cause. The reaction may be due to incompatibility between blood-group antigens and antibodies (ABO incompatibility); transfusion of haemolysed blood (for example blood older than 21 days); transfusion of infected blood; transfusion of blood containing allergens; accidental injection of air with the blood (causing air embolism); overloading of the circulation; or transfusion of blood containing (non-ABO) antigens or antibodies incompatible with the antibodies or antigens of the patient.

Certain diseases can be transmitted in the blood. They include malaria, syphilis, trypanosomiasis, leishmaniasis, viral hepatitis, and acquired immunodeficiency syndrome (AIDS). Always test for syphilis, and in endemic areas also make blood films to check for malaria, trypanosomiasis, and infection with *Leishmania donovani*. It is hoped that appropriate screening tests for viral hepatitis and for AIDS will soon be widely available.

Autotransfusion

Autotransfusion, i.e., using the patient's own blood for transfusion, is a convenient, useful, and safe procedure in cases of massive internal bleeding. The main

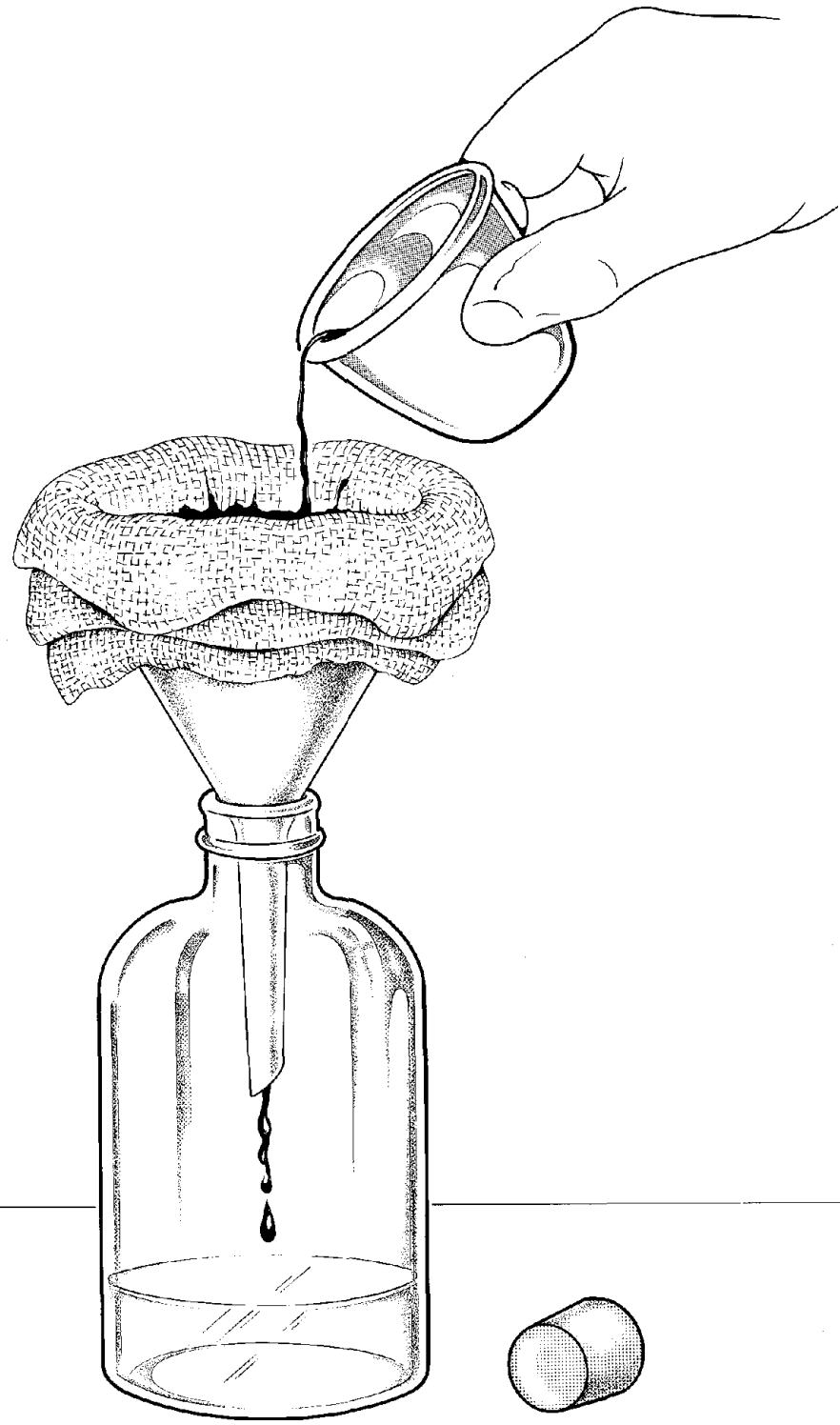

Fig. 2.2. Filtration of blood (for autotransfusion) into a collecting bottle containing anticoagulant.

indication for autotransfusion is a ruptured spleen or a ruptured ectopic pregnancy, although it can also be used in the case of a large haemothorax. The blood is collected from the peritoneal (or pleural) cavity, filtered, and mixed before use with citrate to prevent coagulation.

Equipment

Specific equipment requirements are two or three sterile, 0.5-litre bottles with stoppers, each containing 60 ml of 3.8% sodium citrate (38 g/litre) or 120 ml of "acid–citrate–glucose" solution (containing trisodium citrate dihydrate, citric acid monohydrate, and glucose); a large sterile funnel with eight layers of sterile gauze for filtering; and a sterile gallipot or jug.

Technique

Scoop out blood from the abdominal cavity with a gallipot (do not use a sucker), filter it through the gauze in the funnel, and allow it to drain into the collecting bottle (Fig. 2.2). Mix it gently with the anticoagulant by tilting the bottle from side to side. If any clot particles drain through, refilter the blood. Then stopper the bottle. The blood is now ready for transfusion into the patient.

Contraindications

Do not use this procedure for blood that has been in the abdominal cavity for more than 24 hours, or if the blood is or may be contaminated, as for example in a patient with bowel trauma.

Complications

Complications are unlikely provided that sterility is maintained throughout autotransfusion. Rarely the blood may become haemolysed or contaminated. Contaminated blood can give rise to septic shock or even septicaemia.

Shock

Shock is a useful clinical diagnosis, but it lacks a clear pathophysiological basis. Some degree of hypovolaemia is usually present, as after haemorrhage or the loss of other body fluids, for example because of acute burns. The patient suffering from hypovolaemic shock is often anxious; the pulse is rapid and thready, the blood pressure low, and the skin cool and clammy; and the extremities are often cyanotic. In addition, the patient's urinary output is reduced. Normovolaemic shock may occur as a complication of massive sepsis. In most cases its features are similar to those of hypovolaemic shock, but sometimes the patient is confused, with an increased (rather than reduced) peripheral blood flow, as indicated by warm, pink, and oedematous extremities.

Management

Treat or control the cause of shock: arrest haemorrhage from wounds by firm pressure over a sterile dressing, and incise and drain an abscess without delay. Simultaneously begin the correction of circulatory and metabolic disturbances.

Delay in restoring the circulating volume of a patient with hypovolaemic shock can rapidly cause severe irreversible damage to the kidney and the brain. Therefore, insert a wide-bore cannula or the largest available needle (for example 14-gauge/2.0 mm) into a large vein in the cubital fossa or into the external jugular vein, and immediately start infusion of physiological saline or Ringer's lactate solution, since these fluids are usually readily available. (The infusion solution may be changed later, if necessary, ideally to the fluid that most closely resembles the fluid lost, and the infusion may be transferred to the long saphenous vein when there is time for a surgical "cut-down" at the ankle.) Elevate the patient's legs to increase venous return, but do not lower the trunk and head, as this impairs breathing. Measure and record the patient's pulse rate and blood pressure every 30 min.

Insert a catheter into the bladder to measure the hourly urinary output. This variable and the jugular venous pressure (estimated clinically) are indicators of the patient's fluid status and cardiac output (unless there is cardiac failure). Continue fluid replacement until the urinary output is at least 0.5 ml/kg of body weight per hour and the jugular venous pressure indicates adequate filling of the venous circulation.

Metabolic acidosis due to circulatory failure will subside if fluid replacement is adequate.

If no urine is draining, first check that the catheter is not blocked by measuring the circumference of the abdomen and performing bladder washout. Provided that the bladder catheter is patent, persistent anuria in a patient with restored

circulation (normal blood pressure, adequate filling of the jugular veins, and pink, warm extremities) suggests acute renal failure. If possible, refer the patient immediately for further treatment; otherwise begin peritoneal dialysis.

In cases of shock due to massive sepsis (septic shock), manage the patient as outlined above, but also take a blood sample as soon as possible for a direct smear examination. Leukocytosis and immature granulocytes in the smear will support the diagnosis. Give a broad-spectrum antimicrobial drug or a combination of antimicrobial drugs selected according to the most likely organisms responsible for the sepsis. Gentamicin with metronidazole is a useful initial combination. Metronidazole may be best given as a suppository, since the preparation for intravenous injection is more expensive.

FACE AND NECK

3

Primary care of wounds of the face

Although the doctor at the district hospital is usually expected to treat patients with small facial wounds, patients with large wounds or wounds associated with tissue loss should normally be referred for specialized care.[1]

If referral is necessary, first ensure that it is safe to transport the patient. Maintain a clear airway, if necessary by tracheal intubation or tracheostomy. Arrest any obvious bleeding. If immediate referral is impossible, confine treatment of extensive wounds to thorough cleaning of the wound area and tethering of the wound edges using local skin landmarks as a guide for alignment.

General principles

When you are treating facial wounds, whether minor or serious, your priority is to keep the patient's airway clear at all times. Remember too that a severe facial injury may be associated with other injuries, which may also require your attention.

The choice of anaesthetic for the patient will normally depend on the nature of the injuries, but general anaesthesia is preferable in children. Use good lighting and fine instruments when examining and treating wounds of the face; ophthalmic instruments are ideal for this. Unless the wound is near the eyes, clean it with soap and water, while protecting the patient's eyes, and then irrigate it with saline. Make every attempt to preserve tissue, especially skin, but remove all foreign material and all obviously devitalized tissue. A small, soft brush will facilitate this process.

Always administer tetanus toxoid. Cellulitis, a potentially serious complication, can be prevented by meticulous surgery and by prophylactic benzylpenicillin 600 mg (10^6 units) given twice a day intramuscularly.

Equipment

See tray for *Minor operations*, Annex 1, and add the following ophthalmic instruments:

Eyelid speculum, 1
Eyelid retractors, 2
Forceps, 0.5 mm or 0.9 mm, toothed, 1
Forceps, 0.5 mm or 0.9 mm, non-toothed, 1
Straight ring scissors, 1 pair
Small needle holder, 1
Scalpel handle with No. 11 blade, 1

[1] For discussion of the care of facial wounds with associated bone injuries, see *Surgery at the district hospital: obstetrics, gynaecology, orthopaedics, and traumatology* (Geneva, World Health Organization, in preparation).

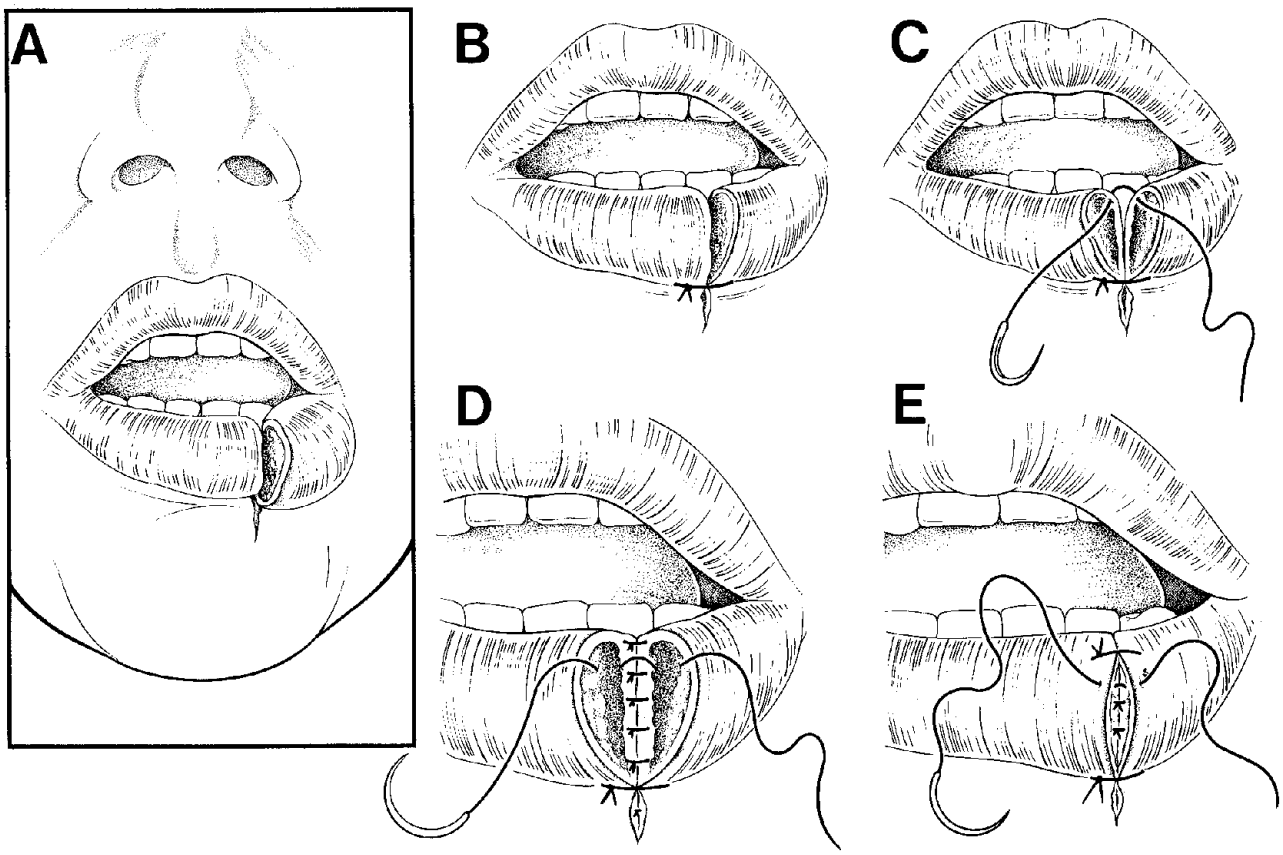

Fig. 3.1. Repairing a lip wound. The wound (A); the key suture ensures anatomical alignment (B); repair in layers: mucosa (C), muscle (D), and skin (E).

Lip

Lip injuries are common. It is safe not to suture small lacerations of the buccal mucosa, but advise the patient to rinse the mouth frequently with salt water, particularly after every meal.

For an isolated laceration of the lip that requires suturing (Fig. 3.1A), local anaesthesia is usually adequate. Proper anatomical alignment is essential for wounds that cross the vermilion border. Achieve this by planning the first stitch to join the border accurately (Fig. 3.1B). This region may be distorted by swelling caused by local anaesthetic, so to ensure accuracy, premark the border with gentian violet.

After this key suture has been inserted, repair the rest of the wound in layers, starting with the mucosa and progressing to the muscles and finally the skin (Fig. 3.1C,D,E). Use fine, interrupted sutures of 4/0 or 3/0 chromic catgut for the inner layers and thread or monofilament nylon for the skin.

Tongue

Most wounds of the tongue require no suturing and heal rapidly, but you may need to suture lacerations with a raised flap in either the lateral border or the dorsum of the tongue (Fig. 3.2). Suture the flap to its bed with 4/0 or 3/0 buried, catgut stitches. Local anaesthesia is usually sufficient.

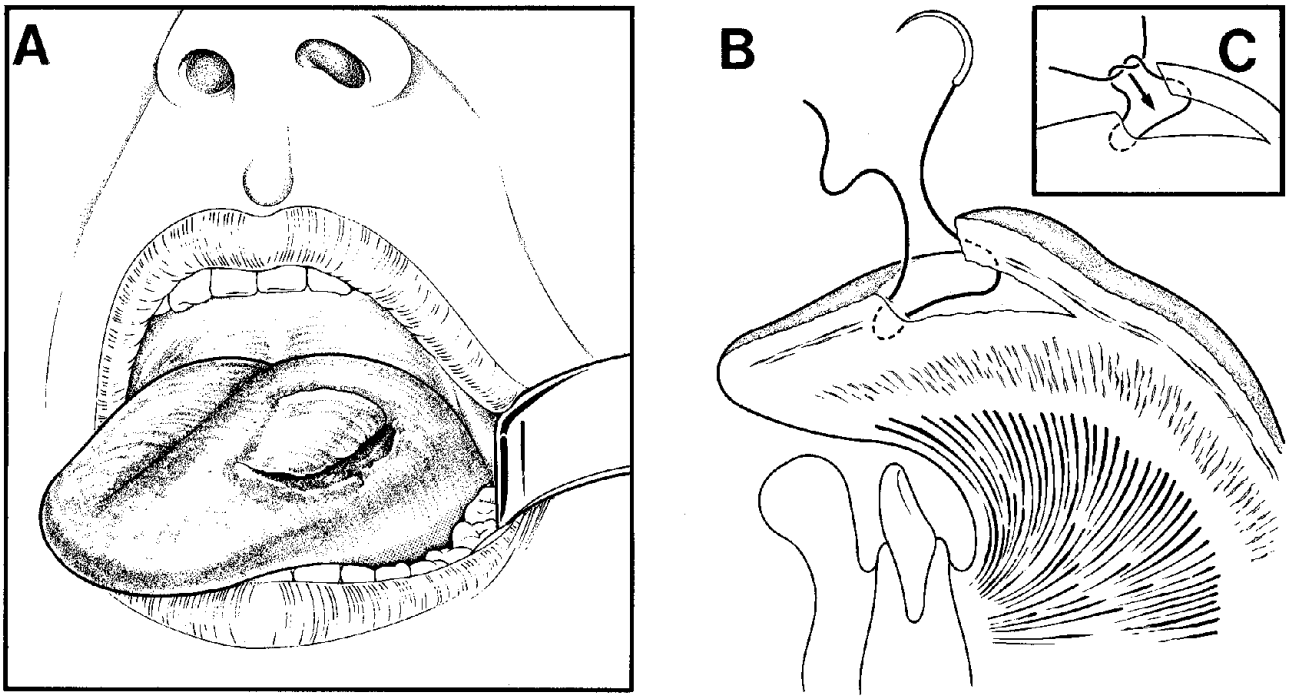

Fig. 3.2. Repairing a laceration of the tongue. The wound, with flap (A); suture of the flap to its bed (B); the knot is buried as the suture is tied (C).

Instruct the patient to rinse the mouth regularly with salt water, until healing is complete.

Ear and nose

The three-dimensional curves of the pinna and the presence of cartilage can present difficulties in the repair of ear injuries. The wounds are commonly irregular, with cartilage exposed by loss of skin. Use the folds of the ear as landmarks to restore anatomical alignment.

After the patient has been anaesthetized, as appropriate, close the wound in layers with fine sutures, using catgut for the cartilage. Dressing is important: the pinna should be supported on both sides by moist cotton pads and firmly bandaged to reduce haematoma formation (Fig. 3.3).

Make every attempt ot cover exposed cartilage either by wound suture or by split-skin graft (see page 33).

The principles of repair of ear lacerations also apply to wounds of the nose.

Complications

Wounds of the ear and nose may result in deformities or necrosis of the cartilage.

Cellulitis of the face

Cellulitis of the face, which can be a complication of facial wounds, carries the serious risk of cavernous-sinus thrombosis, so the patient's initial response to treatment with antibiotics is best observed in hospital. The organisms responsible are likely to be penicillin-sensitive. The patient must resist squeezing or otherwise manipulating any infected foci on the face, even if such foci are small.

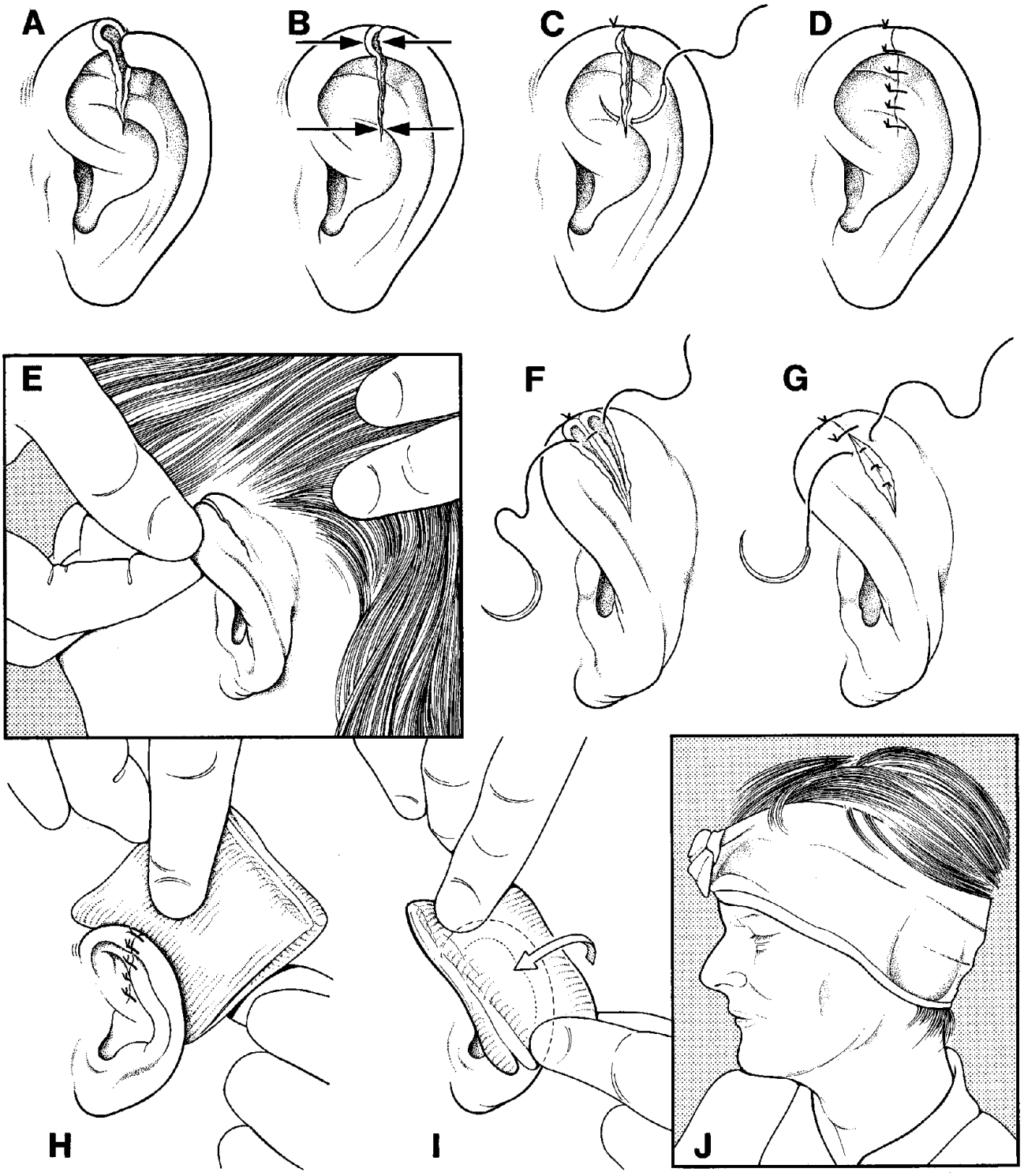

Fig. 3.3. Repairing a laceration of the ear. The laceration (A); anatomical alignment (B); skin suture of the anterior surface (C, D); the laceration as seen from the back, after suture of the anterior surface (E); suture of the cartilage (F); completing skin suture (G); dressing the wound (H–J).

If severe oedema suggests involvement of the cavernous sinus, attempt to prevent thrombosis by administering heparin, 5000 International Units every 8 hours by subcutaneous injection.

4

Eye

The purpose of eye surgery at the district hospital is to save sight and to prevent the progression of eye conditions that could produce further damage if left untreated. The surgical correction of squints and the treatment of congenital cataract should not be attempted.

Basic principles and procedures for eye surgery

Ocular tissues are delicate, and eye surgery requires careful operative procedures with maximum precision. Good lighting is essential for safe surgery, and magnification by means of an operating loupe (×2 or more) is always advisable.

When the patient is admitted to hospital, carefully examine the eye and test visual acuity. Look for infection in the eye, including the lacrimal sac, and treat this as necessary. Check for raised intraocular pressure. Avoid elective surgery if the patient has hypertension or severe diabetes, or is undergoing long-term treatment with anticoagulants or steroids.

Twenty-four hours before surgery, wash the patient's eye and start treatment with antibiotic eye drops. On the day of the operation, carefully irrigate the eye with fresh sterile saline and, if intraocular surgery is planned, cut the lashes. Clean the eyelids and surrounding skin with soap or cetrimide. Properly mark the eye to be operated on, and recheck this just before surgery.

Use of eye ointment and eye drops

Eye medication may be required both before and after surgery. Eye ointment gives a more prolonged action than do eye drops and can be used, for example, after surgery on the eyelid. Avoid steroid-containing antibiotic preparations and restrict the use of preparations containing steroids in combination with other eye medications unless they have been prescribed by an ophthalmologist.

Measurement of intraocular pressure

If you suspect a rise in the patient's intraocular pressure either before or after surgery, measure the pressure by means of a Schiötz tonometer. With the patient prone, instil anaesthetic drops in both eyes. Instruct the patient to look up, keeping the eyes steady. With your free hand gently separate the lids without pressing the eyeball, and apply the tonometer at right angles to the cornea (Fig. 4.1). Note the reading on the scale and obtain the corresponding value in millimetres of mercury or kilopascals from a conversion table. Verify readings at the upper end of the scale by repeating the measurement using the additional weights supplied in the instrument set. Repeat the procedure for the other eye. An intraocular pressure above 25 mmHg (3.33 kPa) is above normal but not necessarily diagnostic. Values above 30 mmHg (4.00 kPa) indicate probable glaucoma, for which the patient will need immediate referral or treatment followed by referral. It is very important that the tonometer be regularly cleaned and maintained, to avoid false readings.

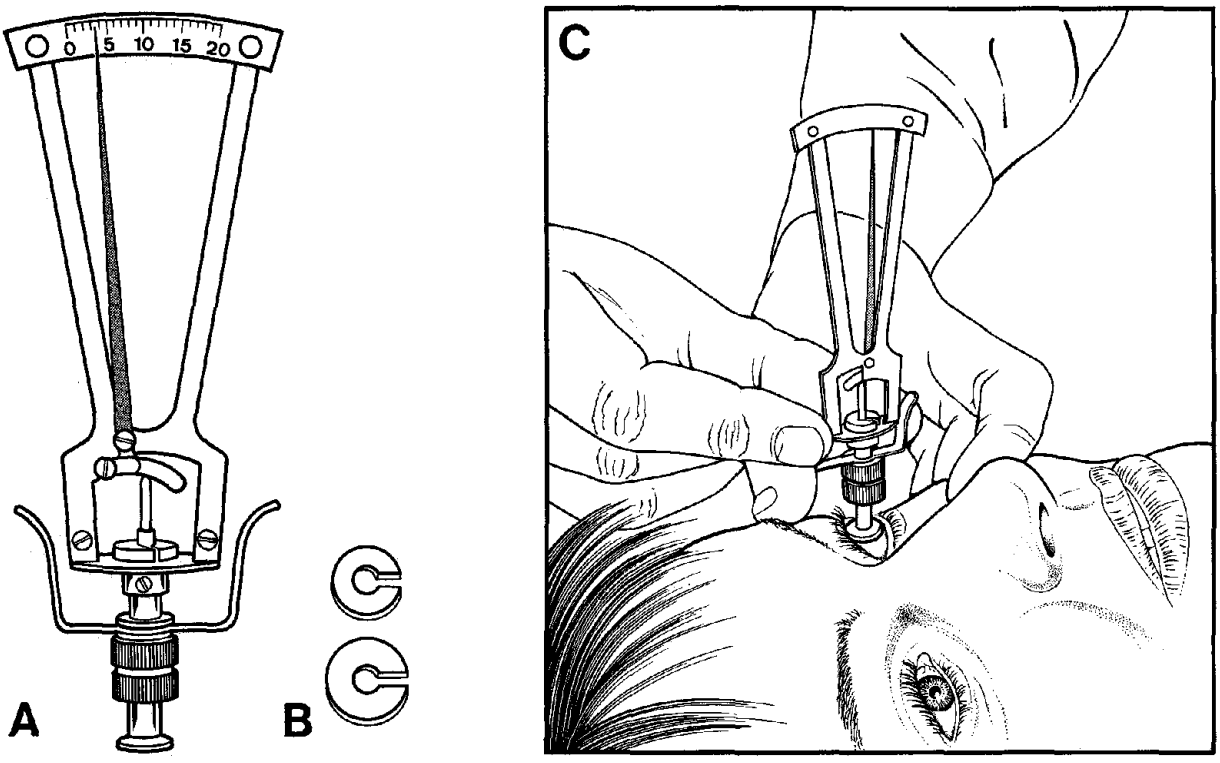

Fig. 4.1. Measuring intraocular pressure. Schiötz tonometer (A); additional weights (B); separating the lids and applying the tonometer to the cornea (C).

Care of instruments

Most instruments used for eye surgery are delicate and should therefore be handled with special care. Clean all instruments after surgery and sterilize them before re-use. Sterilize sharp instruments using appropriate chemical solutions such as chlorhexidine and glutaral; sterilize other instruments using an autoclave or dry heat. In an emergency, instruments may be sterilized by immersion in 70% ethanol for 1 hour.

Anaesthetic techniques

General anaesthesia is normally recommended for major intraocular surgery, for example for enucleation of the eye, and for children. Otherwise conduction (regional) anaesthetic techniques are usually suitable.

Always instil anaesthetic eye drops, for example tetracaine 0.5% (5 g/litre), before surgery.

Facial block

To produce facial block for intraocular surgery, inject lidocaine into the area 2 cm in front of and below the tragus of the ear (Fig. 4.2A,B). As an alternative, infiltrate the supraorbital and infraorbital branches of the facial nerve by injection along the orbital margins (Fig. 4.2C).

Retrobulbar block

The purpose of retrobulbar block is to anaesthetize the eye and also to prevent its movement. Use this block only for major intraocular surgery, and only if general anaesthesia is not available and the patient is already in grave danger of going blind. Always be aware of the possible complications of this technique. Retrobulbar block is to be particularly avoided if the patient has perforating injuries of the eye, as it can cause a dangerous increase in the volume of orbital contents, which may cause tissues to extrude from the eye.

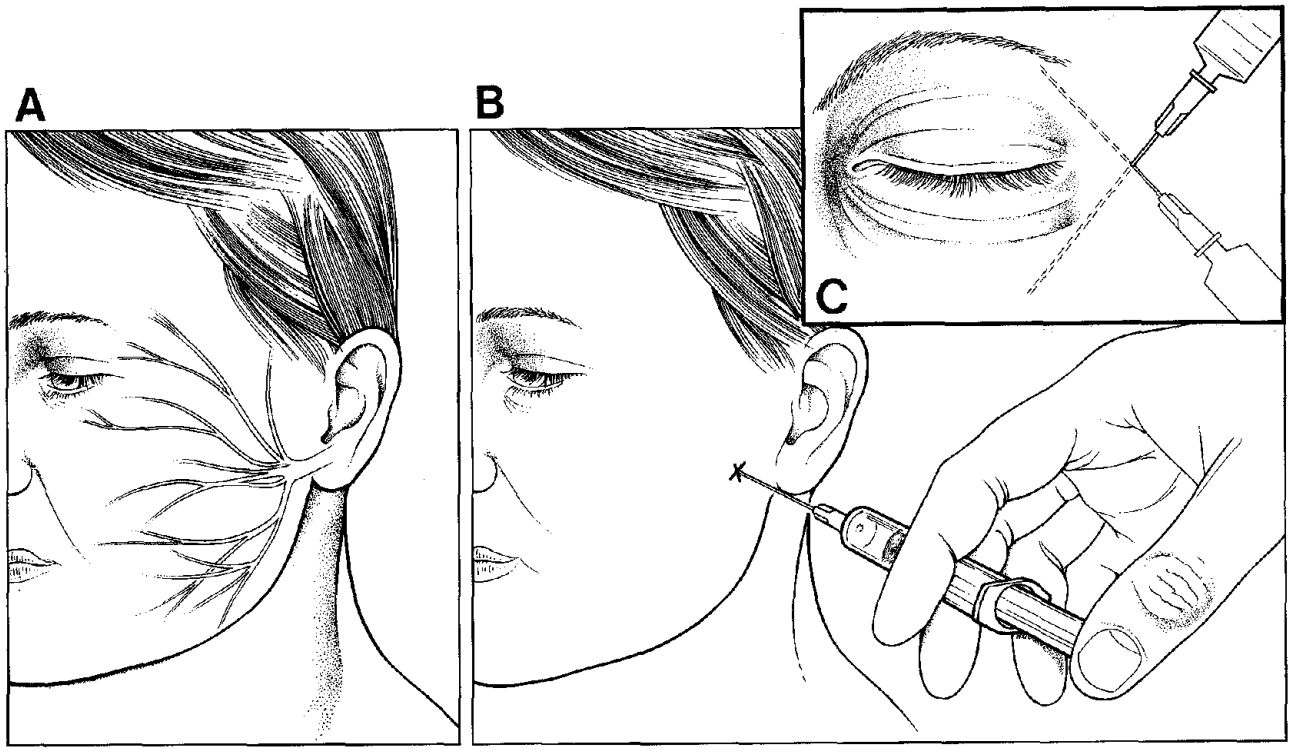

Fig. 4.2. Facial block. The facial nerve and its branches (A); injecting local anaesthetic in front of and below the tragus of the ear (B); as an alternative, injecting local anaesthetic along the orbital margins (C).

Retrobulbar block is effected by injecting 2.5 ml of 2% (20 g/litre) lidocaine into the cone formed by the rectus muscles. With the patient supine, palpate the orbit of the eye to locate the lower outer border. Introduce a 23-gauge, 2.8 cm needle vertically at this point (Fig. 4.3A). Penetrate the skin and then the orbital septum; resistance will be encountered as the needle passes through each of these two layers. Once the tip of the needle is lying below and behind the globe, angle the needle in the direction of the junction between the roof and the medial wall of the orbit (Fig. 4.3B,C). Introduce it further and penetrate the muscle layer, which will be indicated by a slight resistance. Draw back the plunger of the syringe (to make sure that the tip of the needle is not in a vein) and inject the local anaesthetic. It should flow freely. Resistance may mean that the tip of the needle is lodged in the sclera, in which case move the tip of the needle slightly from side to side until it is disengaged.

If the needle has accidentally entered a vein, resulting in haemorrhage and a rapid swelling of the orbit, abandon the procedure. Delay the operation for at least 1 week, after which it can be performed with the patient under either a repeat retrobulbar block or, preferably, general anaesthesia.

Postoperative care

Postoperative care for the patient who has undergone extraocular surgery is quite simple: change the dressing the day after surgery and apply tetracycline 1% eye ointment daily for about 1 to 2 weeks. Remove sutures as indicated, after about 5–14 days.

After intraocular surgery, the patient should remain in hospital for at least 5 days. Strict immobilization is usually unnecessary, but the patient should avoid physical strain during the week following surgery. Dress the eye daily and apply appropriate topical medication. Remove conjunctival sutures after a week and corneoscleral sutures after about 3 weeks.

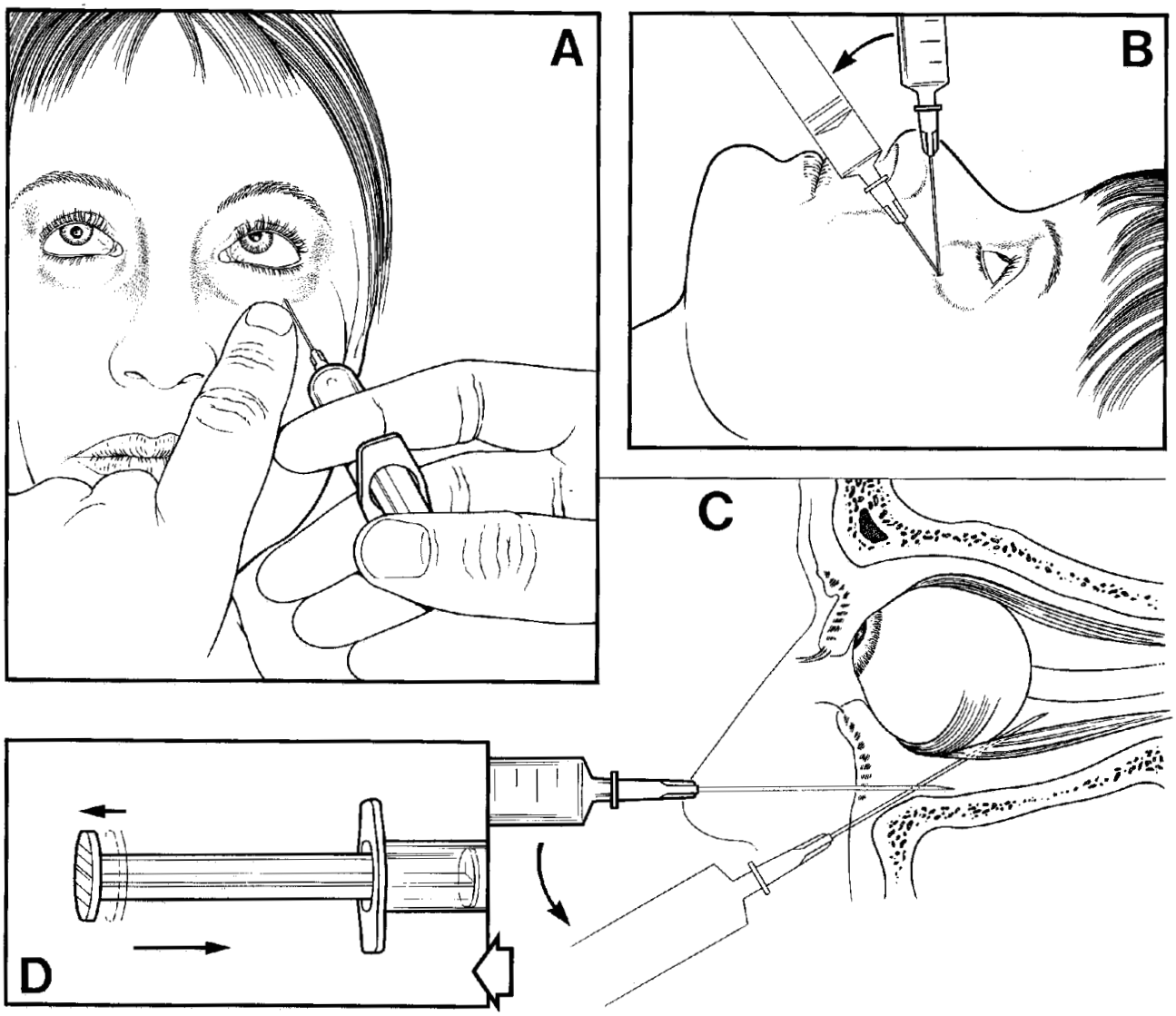

Fig. 4.3. Retrobulbar block. Palpating the lower orbital margin and introducing the needle perpendicularly, close to its outer corner (A); angling the needle towards the junction of the roof and the medial wall of the orbit behind the globe (B, C); drawing back the plunger as the needle penetrates the muscle (D).

Postoperative complications

Possible postoperative complications of intraocular surgery include infections, prolapse of the iris, flattening of the anterior chamber, and intraocular haemorrhage. The patient who develops any of these will require prolonged hospitalization. Further management will depend upon the complication, but may include systemic or local administration of antibiotics, revisional surgery (with or without excision of the iris) with suturing, pressure-bandaging, or immobilization to re-establish the anterior chamber and reduce intraocular bleeding.

In cases of postoperative infection, such as active corneal infection with hypopyon, a subconjunctival injection of gentamicin (20 mg) may be given daily until there is improvement. Use a 2 ml syringe with a small hypodermic needle. First anaesthetize the conjunctiva with tetracaine drops, and then lift it slightly with the tip of the needle. Give the injection in the lower half of the bulbar conjunctiva (Fig. 4.4).

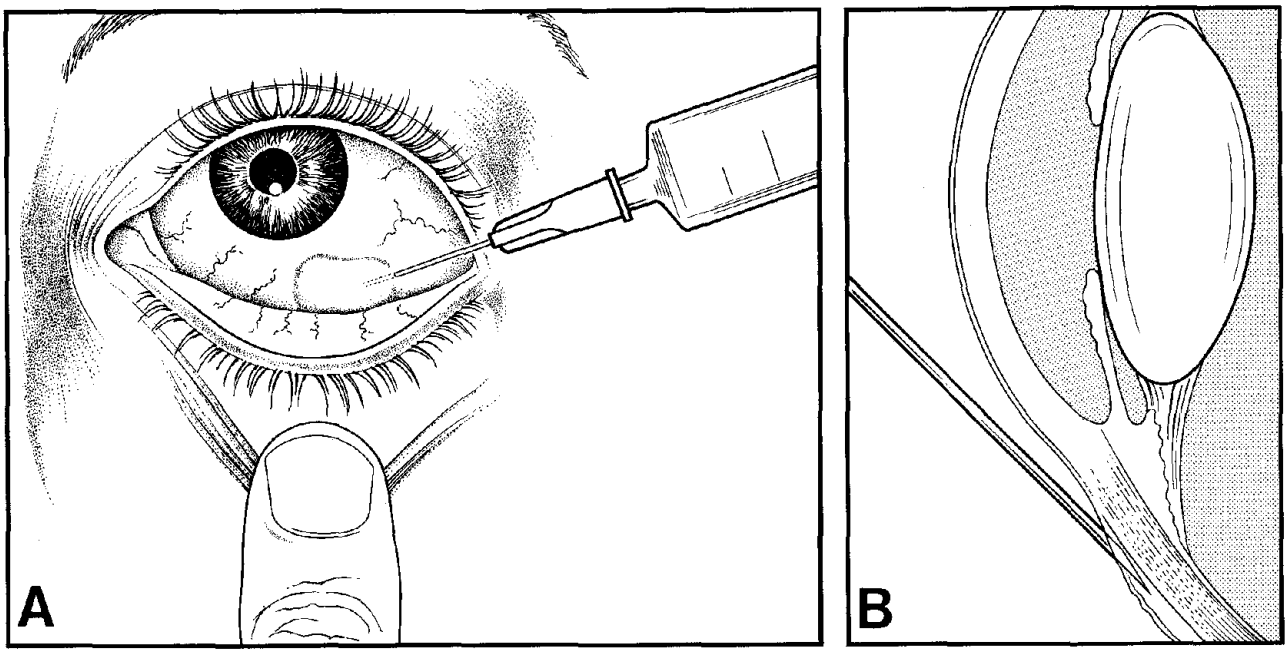

Fig. 4.4. Subconjunctival injection into the lower half of the bulbar conjunctiva with a small hypodermic needle.

Ocular trauma

Eye injuries are common and are an important cause of blindness. Early diagnosis and proper treatment are imperative if blindness is to be prevented.

Superficial injuries

Equipment

See tray for *Tarsorrhaphy*, Annex 1, and add 2% sodium fluorescein, an eye spud, a 27-gauge needle, a syringe (2 ml) with a small hypodermic needle, and several cotton-tipped applicators.

Technique

Superficial injuries of the eyelid, conjunctiva, or cornea do not require surgical intervention. Providing that no foreign body is present, copiously irrigate the eyelid and eye with sterile physiological saline and apply tetracycline 1% eye ointment. Dress the eyelid and eye with a simple sterile eye pad, with the eyelids closed. Leave the dressing in place for 24 hours, and then re-examine the eye and eyelids. If the injury has resolved or is improving, continue applying tetracycline 1% eye ointment three times daily for 3 days. Otherwise inject gentamicin subcutaneously and arrange to refer the patient.

Small foreign bodies may be embedded superficially in the conjunctiva or cornea. If a foreign body is embedded in the conjunctiva, wash it out with sterile saline or, after administering a topical anaesthetic, wipe it away with a sterile, cotton-tipped applicator. Eversion of the lid may be necessary to expose the foreign body. If you suspect a corneal foreign body, first instil two drops of 2% sodium fluorescein to make the foreign body (or breach of the epithelium) easier to detect. Remove a superficial corneal foreign body with an eye spud or a 27-gauge needle, and then manage the eye as for a superficial injury.

If the cornea remains infiltrated after removal of a foreign body, instil atropine 1% eye drops or ointment once daily, apply tetracycline 1% eye ointment every 8 hours, and give a subconjunctival injection (Fig. 4.4) of gentamicin 20 mg daily (after applying a topical anaesthetic) for 3 days. Refer patients with corneal

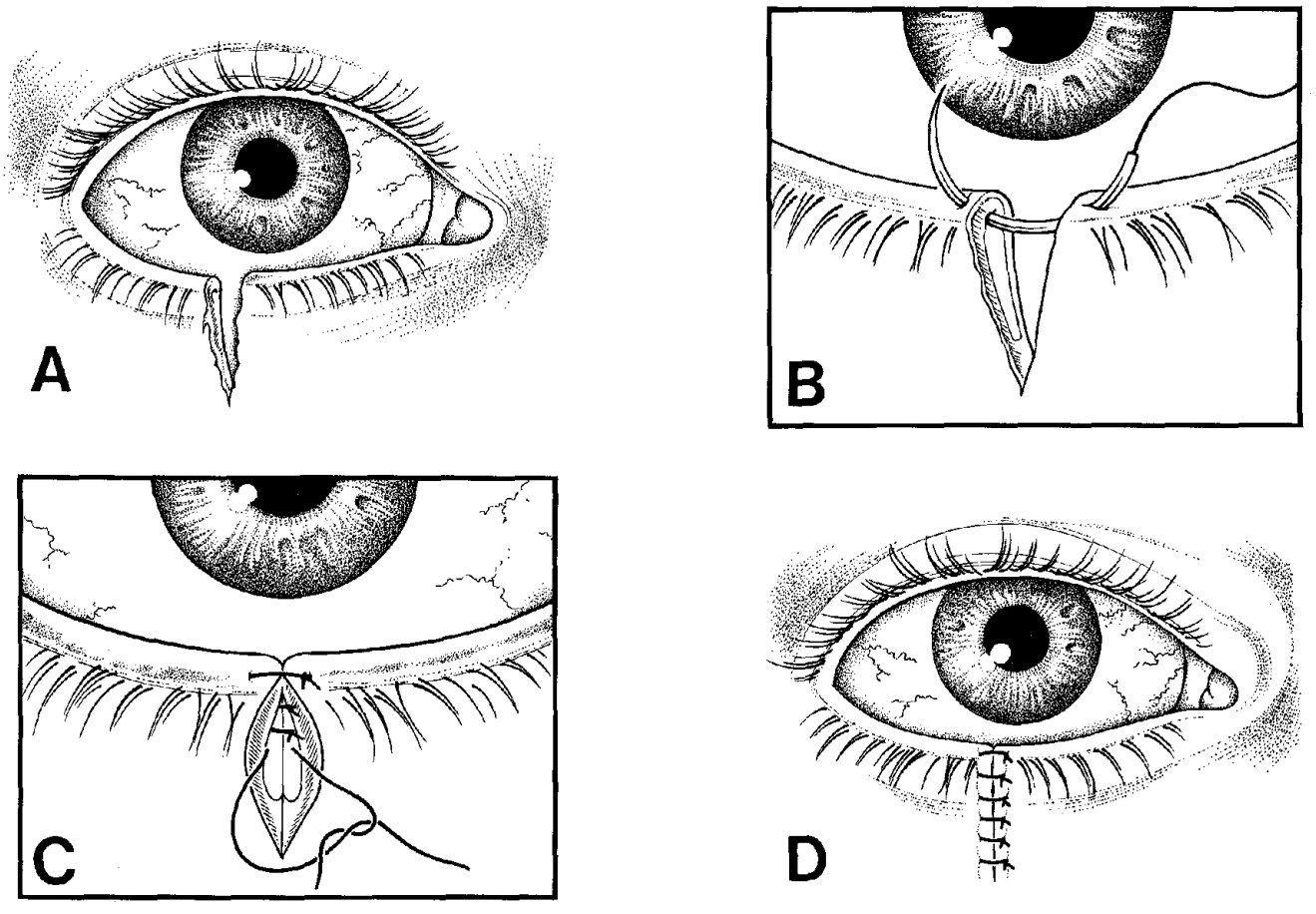

Fig. 4.5. Repairing a laceration of the eyelid. Laceration (A); inserting the key suture to align the lid margin (B); suturing the conjunctiva and tarsus (C, the knots are tied away from the eyeball); suturing the skin and muscle (D).

foreign bodies that cannot be removed and patients who show no decrease of corneal infiltration after 3 days of treatment.

Admit to hospital any patient with inflammation of the globe with hyphaema (blood in the anterior chamber). Place the patient at complete rest, with sedation if required, and patch both eyes. If intraocular pressure is elevated, as indicated by a total hyphaema or pain, administer acetazolamide 250 mg orally every 6 hours. Examine and dress the eye daily. If the hyphaema has not clearly improved in 5 days, refer the patient.

Lacerations and penetrating injuries

The patient should be anaesthetized as appropriate.

Equipment

See tray for *Cataract operation*, Annex 1, and add 6/0 thread and catgut.

Eyelids

Make every attempt to preserve tissue, but carry out wound toilet and, if necessary, débridement. Do not shave the brow or invert hair-bearing skin into the wound. If the laceration involves the eyelid margin, place an intermarginal suture behind the eyelashes; precise alignment of the wound margins is essential (Fig. 4.5A,B). Carry out the repair in two layers: the conjunctiva and tarsus with 6/0 catgut, and the skin and muscle (orbicularis oculi) with 6/0 thread (Fig. 4.5C,D). Tie suture knots away from the eyeball.

Lacerations involving the inferior lacrimal canaliculus require canalicular repair, so the patient should be referred for specialized surgical management. If this is impossible, repair the lid margin and laceration as described above.

Immunize the patient against tetanus with tetanus toxoid and give penicillin systemically.

Globe

Manage perforation of the cornea without iris prolapse and with a deep anterior chamber by applying atropine 1% eye drops or ointment and by administering gentamicin, either in 1% eye drops or as a subconjunctival injection of 20 mg (after a topical anaesthetic has been applied). Dress the injured eye with a sterile pad and examine it daily.

After 24 hours, if the anterior chamber remains formed, apply atropine 1% and tetracycline 1% eye ointment daily for another week. If the anterior chamber is flat, apply a pressure bandage for 24 hours. If there is no improvement, suture the cornea after applying a topical anaesthetic.

A patient with perforation of the cornea with iris incarceration and with a deep anterior chamber should be treated in the same way.

Manage corneal or corneoscleral laceration with prolapse of the iris, lens, or vitreous body by excising the prolapsed intraocular elements (with the patient anaesthetized as appropriate) and then closing the corneal and corneoscleral wounds with 8/0 thread. If possible, refer the patient to an ophthalmologist. If referral is not possible, treat the patient postoperatively with atropine 1% drops or ointment and with gentamicin 20 mg injected subconjunctivally (after a topical anaesthetic has been applied). Dress the injured eye with a sterile pad and shield for 24 hours. Change the dressing and apply atropine 1% and tetracycline 1% eye ointment daily for 1 week. Remove the sutures after about 1 month.

Posterior rupture of the globe is to be suspected if there is low intraocular pressure and poor vision. Instil atropine 1%, protect the injured eye with a sterile pad and shield, and refer the patient to an ophthalmologist.

If, on the basis of X-ray and clinical examinations, you suspect the presence of an intraocular foreign body, apply atropine 1%, dress the eye with a sterile pad and shield, and refer the patient to an ophthalmologist.

All patients with injuries to the globe should be immunized against tetanus.

Extraocular surgery

Removal of chalazion

Chalazion is a chronic inflammatory granuloma or cyst, usually the size of a small pea, within one of the tarsal glands of the eyelid. Surgery is indicated if the swelling is long-standing and does not respond to local medical treatment. The condition sometimes recurs in adjacent glands.

Equipment

See tray for *Removal of chalazion*, Annex 1.

Technique

After establishing topical anaesthesia with 0.5% tetracaine, inject 1–2 ml of 2% lidocaine around the chalazion through the skin. Apply the chalazion clamp with the solid plate on the skin side and the fenestrated plate around the cyst, tighten the screw, and evert the lid. Incise the cyst at right angles to the lid margin and remove its contents with the curettes (Fig. 4.6). Remove the clamp and apply pressure on the lid until bleeding stops. Apply tetracycline 1% eye ointment, and dress the eye with a pad and bandage. Apply ointment daily until the conjunctiva is healed (about 5 days). It is usually unnecessary to re-examine the patient unless there is a recurrence.

Tarsorrhaphy

Tarsorrhaphy is the surgical joining of the upper and lower eyelids to close the eye partially, as a temporary protection to the cornea. Tarsorrhaphy is indicated in cases of facial nerve paralysis or when there is a loss of corneal sensation.

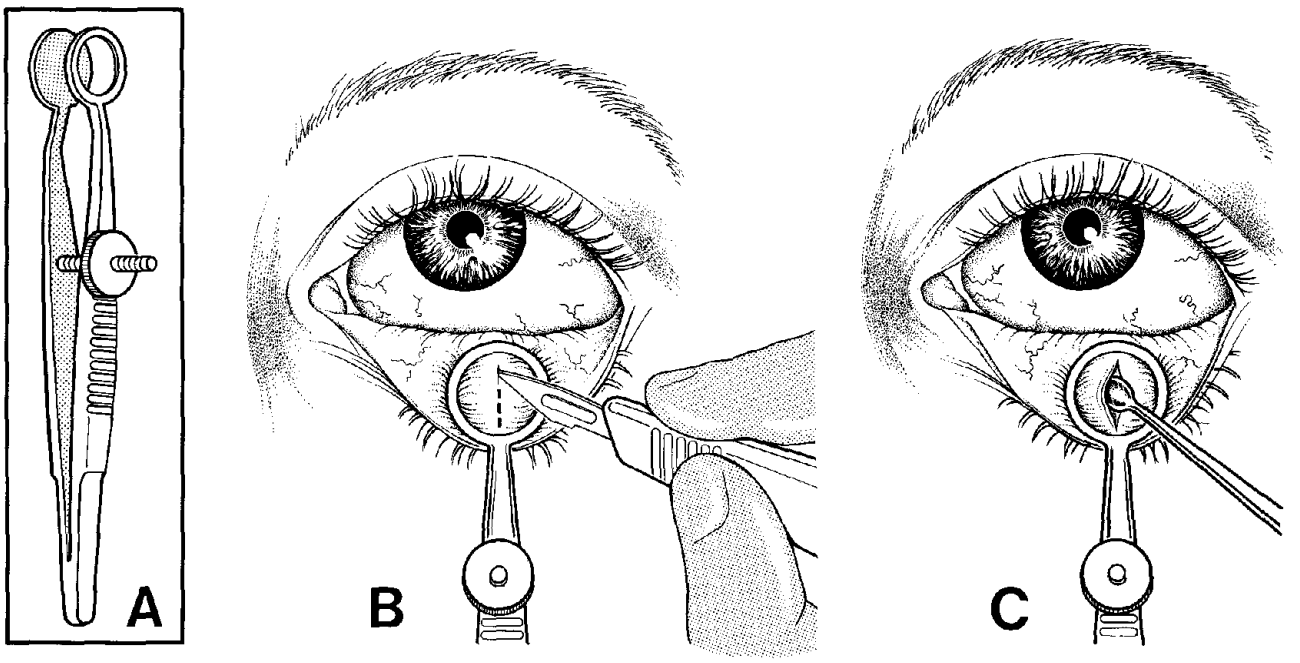

Fig. 4.6. Excision of chalazion. Chalazion clamp (A); incising the cyst after applying the clamp (B); removing the contents with a curette (C).

Equipment

See tray for *Tarsorrhaphy*, Annex 1.

Technique

First determine the length of join required (Fig. 4.7A). After administering a topical anaesthetic, infiltrate each lid with 2 ml of 2% lidocaine. Incise to a depth of 2 mm along the grey line of both lid margins in the lateral canthus (Fig. 4.7B). Join the two lids by inserting mattress sutures of 4/0 thread passed through rubber tubing about 5 mm below the lash line (Fig. 4.7C,D). Apply a sterile eye pad and secure it with adhesive tape. Remove the sutures when the lids have united, after about 14 days.

Apply tetracycline 1% eye ointment daily until the stitches are removed.

Opening a tarsorrhaphy

Once the tarsorrhaphy is no longer needed, the eye may be opened. After administering a topical anaesthetic, infiltrate the upper and lower lids with 2% lidocaine. Pass one blade of a pair of scissors posterior to the adhesion and one anterior, and separate the lids with a single cut.

Treatment of trichiasis and entropion

Trichiasis is a condition in which the eyelashes grow inwards and irritate the eye. In entropion the lid margin is also inverted, and rubs on the cornea (Fig. 4.8A). The most important and common cause of these conditions in many developing countries is trachoma, usually affecting the upper eyelid; other features of trachoma may also be apparent, for example pannus formation.

Equipment

See tray for *Treatment of entropion*, Annex 1.

Technique

In cases of trichiasis, epilation can give temporary relief, but surgery may become necessary if the condition progresses to entropion. There are various techniques for surgically correcting entropion. The procedure described here is simple and widely used, and closely resembles the one described by Trabut, for which standard instrument sets are available.

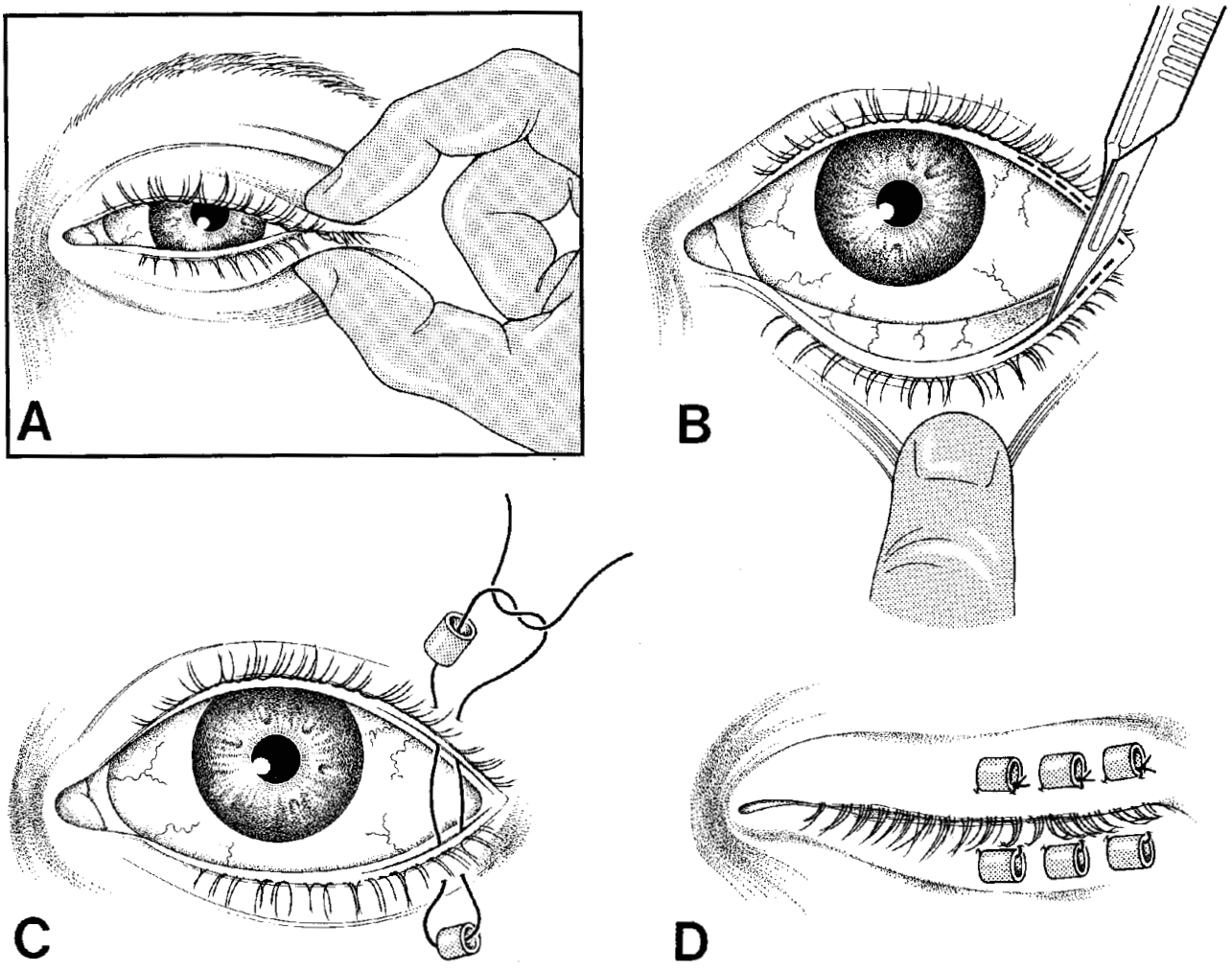

Fig. 4.7. Tarsorrhaphy. Estimating the length of join required (A); incising along the grey line of the lid margin (B); joining the lids with mattress sutures passed through short pieces of rubber tubing (C, D; about three stitches are usually sufficient).

Clean the eyelids with sterile saline and apply drapes. Administer a topical anaesthetic and infiltrate 2 ml of 2% lidocaine (1 ml at each of two points) midway between the lid margin and the eyebrow (Fig. 4.8B). Next evert the lid and hold the tarsal surface exposed with forceps. Make an incision in the palpebral conjunctiva, approximately 2 mm from the lid margin (Fig. 4.8C); a supporting plate (or eyelid clamp) will facilitate this. Raise the larger tarsal plate as a flap from the lid by undercutting as far back as the insertion of the levator palpebrae muscle; also undercut the smaller segment to the lid margin (Fig. 4.8D,E). It is important to incise and undercut the tarsal plate in the entire lash-bearing part of the lid. Now insert two mattress sutures of 4/0 thread through the skin and the larger tarsal flap, and make a knot at the skin surface (Fig. 4.8F–I). Leave the distal tarsal flap unstitched. Apply a sterile eye pad, followed by another pad and a bandage.

After-care

Apply tetracycline 1% eye ointment daily for 2 weeks. Remove sutures after 8 days. Inpatient care is necessary for patients who have had simultaneous operations on both eyes.

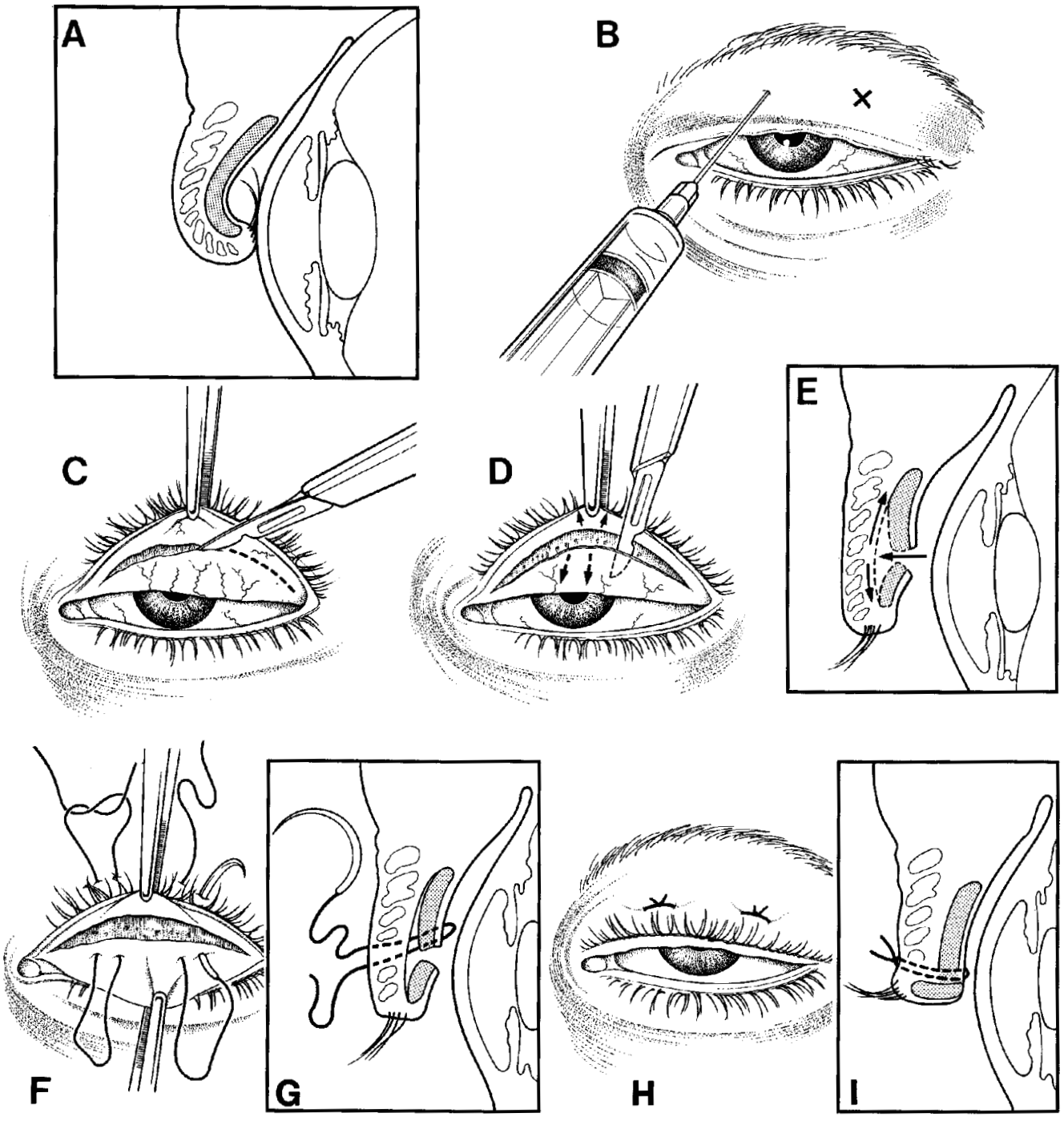

Fig. 4.8. Correction of entropion. Entropion (A); infiltrating the lid margin with local anaesthetic at two points (B); incising the palpebral conjunctiva of the everted lid (C) and raising flaps of tarsal plate (D, E); inserting two mattress sutures through the skin and the proximal (larger) tarsal flap (F, G); tying the stitches (H, I).

Excision of pterygium

A pterygium is an overgrowth on to the cornea caused by a chronic degenerative change in the conjunctiva. It is triangular, with its base at the limbus and its apex pointing towards the centre of the cornea (Fig. 4.9A). Advanced pterygium can lead to loss of vision.

Small pterygia should be left alone. Only where the pterygium extends to the central optical zone of the cornea should surgery be considered. Surgical results,

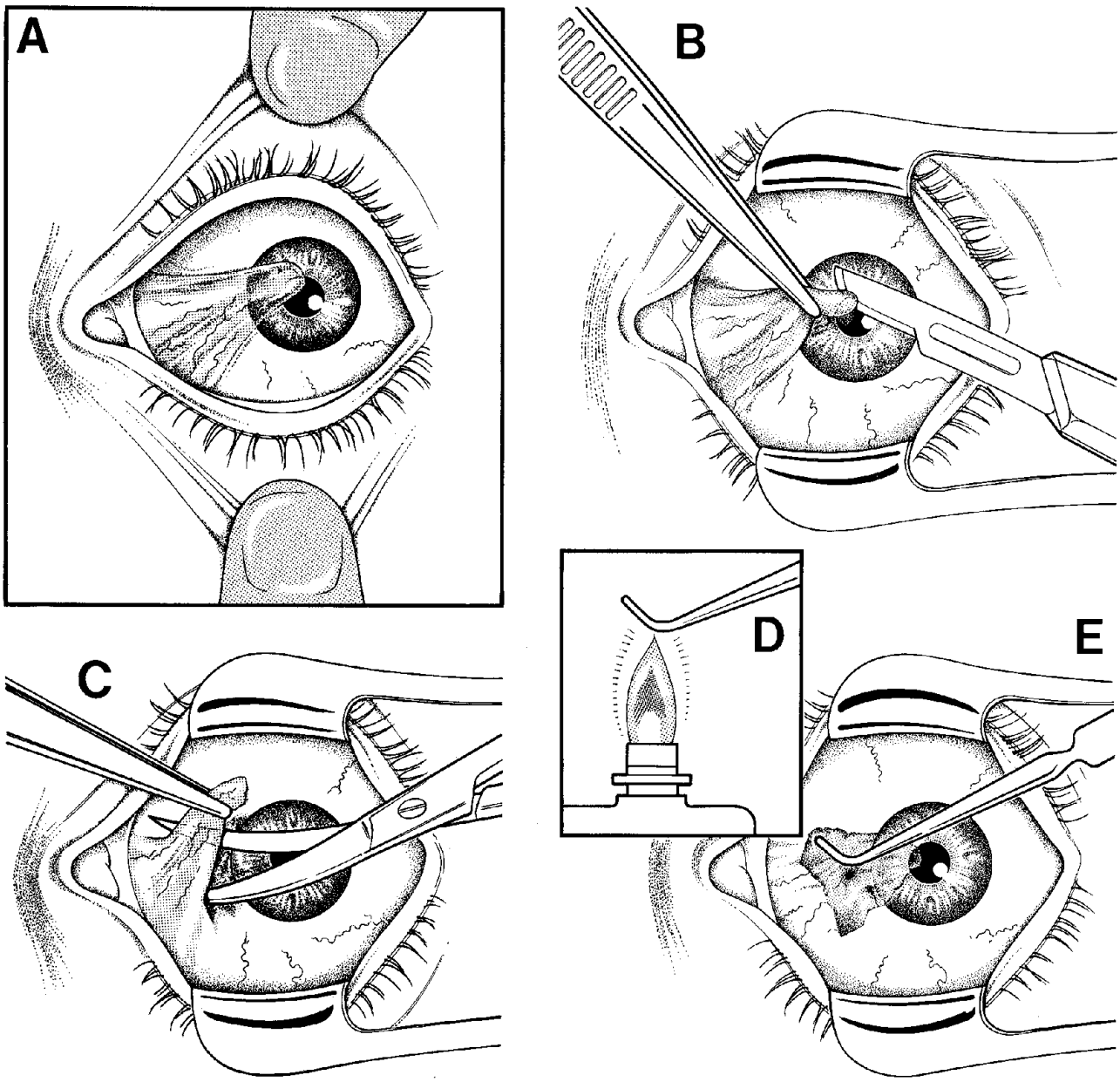

Fig. 4.9. Excision of pterygium. Characteristic shape and site of a pterygium (A); freeing the head of the pterygium from the cornea with a pterygium knife (B); excising the pterygium with conjunctival scissors (C); hot-point cautery (D) is used to stop bleeding from the bare area of the sclera (E).

however, are generally poor and recurrences are frequent, so patients whose pterygia require excision should be referred. If referral is impossible, proceed as follows.

Equipment

See tray for *Excision of pterygium*, Annex 1.

Technique

Apply 0.5% tetracaine topically and infiltrate the subconjunctiva with 1 ml of 2% lidocaine.

Grasp the neck of the pterygium and free its head from the corneal surface using the pterygium knife (Fig. 4.9B). Excise the freed pterygium with the conjunctival

scissors 4 mm from the limbus (Fig. 4.9C), leaving a bare area of sclera. Stop any bleeding with hot-point cautery (Fig. 4.9D,E). Apply tetracycline 1% eye ointment and dressings. Continue daily application of the ointment and of fresh dressings for 1 week. If there is a recurrence after surgery, the patient must be referred.

Intraocular surgery

Cataract extraction

Although cataract extraction may be performed in district hospitals, it should be done only by general practitioners who have received the necessary training or by ophthalmic surgeons through an "outreach" programme. The following description is intended solely as an *aide-mémoire* for persons who have previous experience of the operation.

Cataract is an opacity of the crystalline lens of the eye. Minor lens opacities are extremely common, but more extensive lens opacities interfere with light passing through the crystalline lens and therefore reduce vision. Most cataracts occur in the elderly; they are usually classified as "senile" cataracts and their causes are unknown. Congenital cataract, which affects infants and young children, can cause lifelong blindness if left untreated. However, surgical treatment is more difficult than for senile cataract, and patients suffering from congenital cataract should therefore be referred. Also refer patients with cataracts secondary to trauma and those with cataracts complicating other ocular or systemic diseases, for example corneal opacity.

Serious visual impairment due to bilateral senile cataract that interferes with the patient's daily activities is the main indication for surgery at the district hospital. It is not necessary to operate on unilateral cataract if there is useful vision in the other eye. If both eyes are badly affected, operate first on the eye with the poorer vision. In general, operate only on patients over 50 years of age.

Diagnosis

The criteria for diagnosis of cataract are a history of progressive loss of vision and an absence of or a markedly diminished red reflex from the fundus of the eye, as viewed with an ophthalmoscope.

Assessment and preoperative management

If surgery is indicated, first take the history of the illness and assess the patient's vision, particularly as to accurate light projection. Examine the eye, including the reaction of the pupil to light. Check the red reflex and determine the intraocular pressure. Carefully wash the patient's face when he or she is admitted to hospital. Apply tetracycline 1% eye ointment and atropine 1% every 8 hours to the eye to be operated on, up to the time of surgery. This treatment should be started at the latest 24 hours before operation. In addition, give acetazolamide 250 mg orally 8 hours and 2 hours prior to surgery.

Equipment

See tray for *Cataract operation*, Annex 1.

Technique

Intracapsular cataract extraction (extraction of the cataract within its capsule) is recommended here, as extracapsular cataract extraction is technically more difficult and prone to complications such as corneal damage, infection, and opacification of the posterior capsule.

After sedating the patient, produce facial block by the injection of 2–3 ml of lidocaine 2% into the temporal portion of the upper and lower lids over the orbital rims, and inject a further 2 ml of lidocaine into the retrobulbar area. Achieve topical anaesthesia with one drop of tetracaine 0.5%. To help lower intraocular pressure, massage the closed eye with a finger for 1 min.

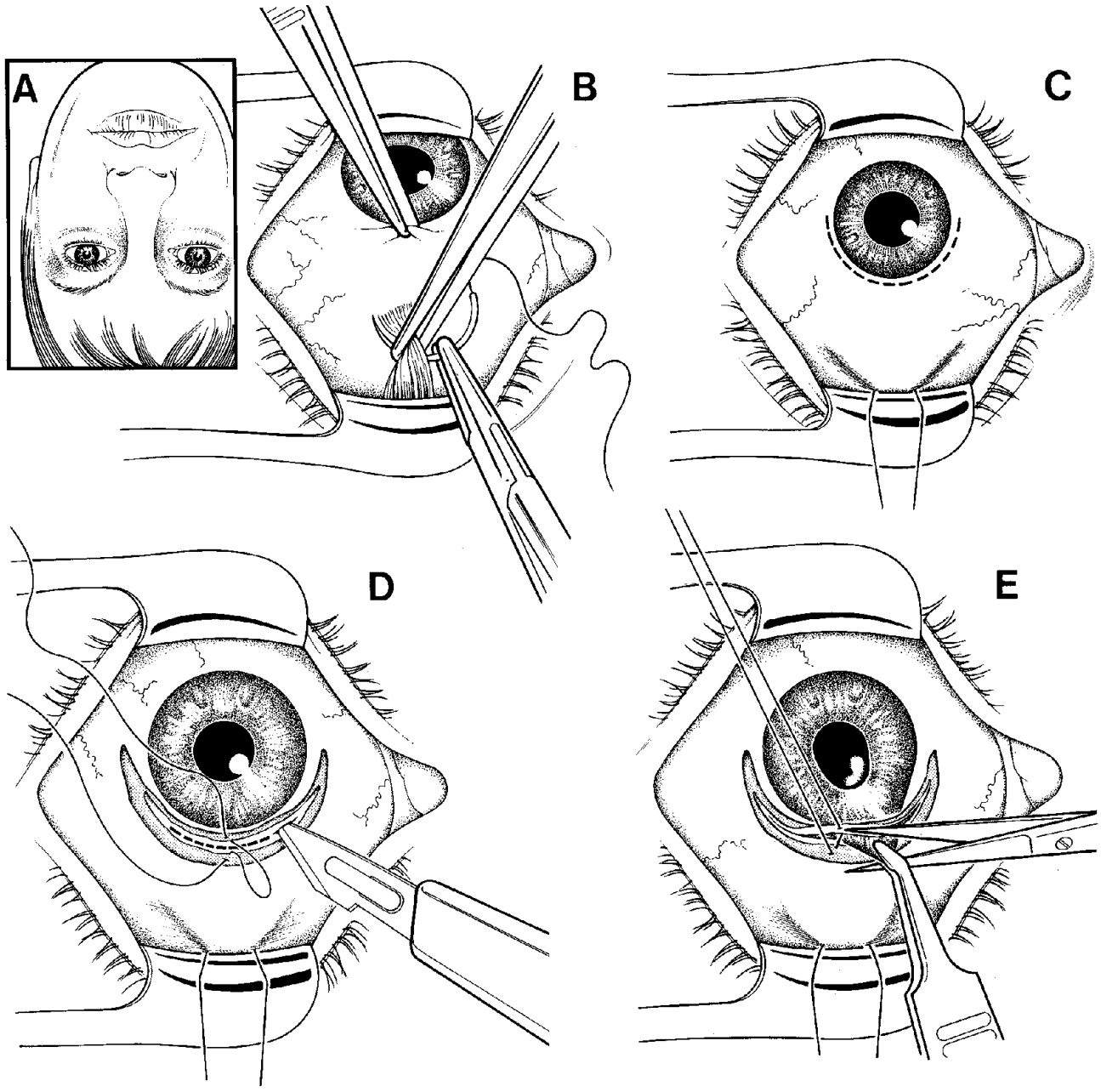

Fig. 4.10. Intracapsular extraction of cataract. Position of the patient (A, as seen by the surgeon at the head of the table); turning the eye down and passing a suture beneath the superior rectus tendon (B); site of conjunctival incision (C); incising along the limbus and inserting a suture across the groove (D); excising a small piece of the iris (E).

Clean the ocular adnexa and face with 1% cetrimide and drape the surgical field with sterile towels. Irrigate the surface of the eye and fornices with sterile saline.

Stand at the head of the operating table, so that the patient's face appears upside-down (Fig. 4.10A). Insert an eyelid speculum for lid retraction. With toothed forceps, grasp the conjunctiva at the edge of the cornea in the region of 12 o'clock,[1] and turn the eye down (away from you). With another pair of forceps,

[1]To interpret references to 12 o'clock, 9 o'clock, etc., imagine a clock face superimposed on the patient's cornea, with 12 o'clock nearest the patient's supraorbital margin.

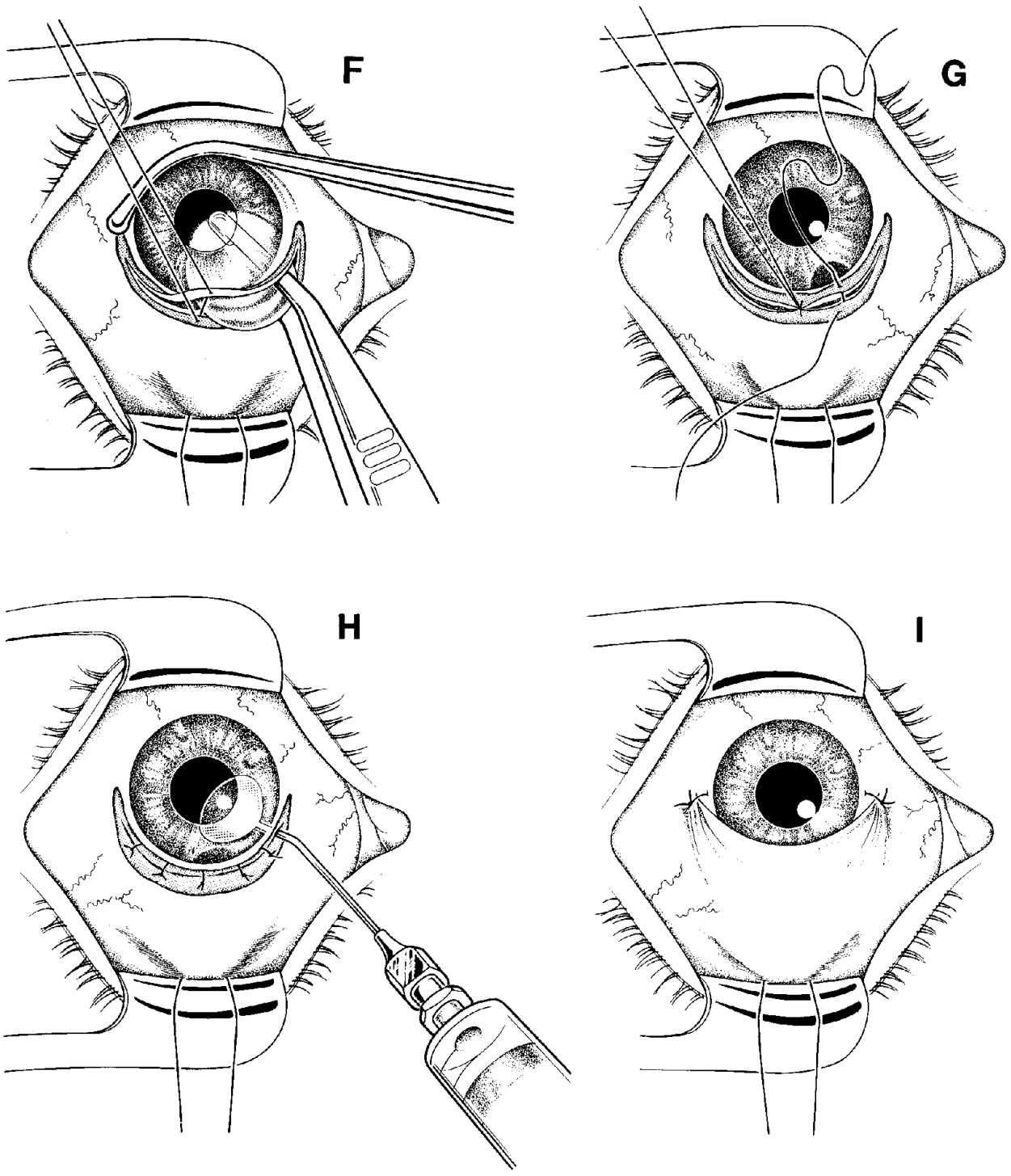

Fig. 4.10. Intracapsular extraction of cataract *(continued)*. Extracting the lens (F); tying the preplaced suture and inserting further sutures to close the corneoscleral incision (G); reforming the anterior chamber by injecting a small air bubble (H); drawing the conjunctival flap down over the wound and anchoring it (I).

grasp the superior rectus tendon through the conjunctiva, about 8 mm behind the first pair of forceps. Lift the tendon from the globe and pass a piece of 3/0 thread beneath the tendon, taking care not to puncture the sclera (Fig. 4.10B). Clip the suture to the drape above the eye so as to rotate the eye downwards and away from you. (Do not clip it too tightly.) Incise the conjunctiva at the limbus from 9 to 3 o'clock (Fig. 4.10C), and then separate it from the limbus with conjunctival scissors. Achieve haemostasis with hot-point cautery.

Make an incision perpendicular to the surface of the globe from 10 to 2 o'clock along the limbus, cutting through one-half to two-thirds of the depth of the corneoscleral tissue; insert an 8/0 thread suture across the groove at 12 o'clock and loop it aside (Fig. 4.10D). Open the anterior chamber with a No. 11 blade or keratome, and extend the corneoscleral section along the groove using corneal scissors.

Ask an assistant to lift the cornea gently with the looped suture, while you grasp the iris at its base at 12 o'clock, with iris forceps. Gently withdraw the iris outside the incision and excise a small piece at its base with iris scissors, to form a peripheral iridectomy (Fig. 4.10E). Avoid routine intraocular irrigation, but keep the cornea moist. As your assistant gently lifts the cornea, extract the lens by grasping the anterior lens capsule at 6 o'clock with capsule forceps and pulling it out while applying light pressure with a muscle hook at the inferior limbus (Fig. 4.10F). If the lens capsule ruptures, remove the lens nucleus with capsule forceps or a vectis while you apply pressure at the limbus at 6 o'clock and posteriorly to the wound at 12 o'clock. Wash out the remaining lens material with sterile saline.

In the event of prolapse of the vitreous body, the anterior chamber may be freed of vitreous material by either aspiration or excision, followed by sponging.

Draw down and tie the preplaced suture, and place at least four additional 8/0 thread sutures at regular intervals to close the corneoscleral incision (Fig. 4.10G). Through a cannula on a syringe, inject just enough air behind the cornea to reform the anterior chamber (Fig. 4.10H). Draw the conjunctival flap down over the cornea and anchor it at 3 o'clock and 9 o'clock using 8/0 thread (Fig. 4.10I).

Remove the superior rectus suture and inject gentamicin 20 mg subconjunctivally. If gentamicin is not available, crystalline benzylpenicillin 12 mg (20 000 units) may be given. Apply tetracycline 1% eye ointment in the inferior fornix, and dress the eye with a sterile pad and shield.

After-care

After 24 hours, at the first change of dressing, carefully inspect the eye for evidence of early postoperative complications such as a cloudy cornea (due to oedema), a shallow anterior chamber, or hyphaema.

Administer atropine 1% eye drops and tetracycline 1% eye ointment daily for 5 days. Add hydrocortisone 1% eye ointment from the second postoperative day. The patient may be discharged after 5 days. Hydrocortisone application can normally be continued for another 2–3 weeks, but only if treatment can be supervised. The patient should make postoperative follow-up visits at 2 weeks, 6 weeks, and 6 months.

Remove the corneoscleral sutures after 2–3 weeks, with the patient under topical anaesthesia if necessary, and provide spectacles for aphakia at 6 weeks.

Complications

If the patient develops a shallow anterior chamber with air behind the iris, fully dilate the pupil with atropine so that air may re-enter the anterior chamber.

If there is a shallow anterior chamber with a suspected wound leak or a gaping wound, apply a pressure bandage for 2 days. If the wound is obviously leaking, place additional corneoscleral sutures, preferably with the patient under general anaesthesia.

If hyphaema develops, pad the eye bilaterally and prescribe bed-rest for 5 days.

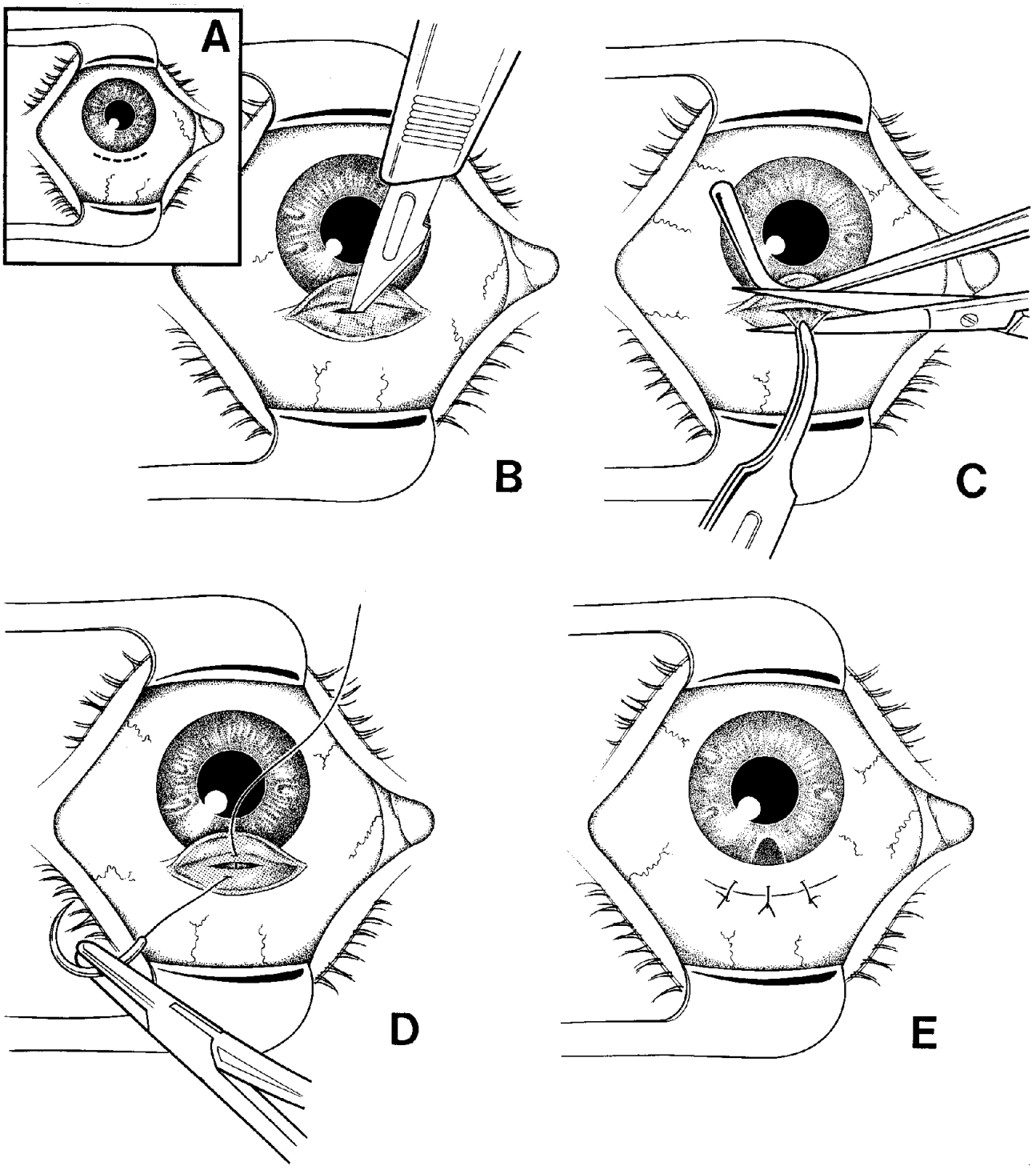

Fig. 4.11. Peripheral iridectomy for acute angle-closure glaucoma. Site of incision above the upper limbus (A, as seen by the surgeon at the head of the table); opening the anterior chamber by incision in the corneoscleral junction (B); excising the prolapsed part of the iris (C); closing the corneoscleral wound (D); the conjunctival flap is replaced and sutured (E).

If there is prolapse of the iris, excise the iris and resuture the corneoscleral wound, preferably with the patient under general anaesthesia.

In case of infection, administer a topical anaesthetic and inject gentamicin or penicillin subconjunctivally.

Treatment of acute angle-closure glaucoma

Acute angle-closure glaucoma is an ocular surgical emergency, and its management should be prompt, with the aim of lowering intraocular pressure rapidly by a course of drugs. Immediate management is followed by surgery (peripheral iridectomy). Administer acetazolamide orally in an initial dose of 500 mg, followed by 250 mg every 6 hours. Instil one drop of pilocarpine 2% into the affected eye every minute for 5 min, then every 15 min for 1 hour, and then hourly until the tension is controlled. Give suitably flavoured glycerol 1 g/kg of body weight orally daily.

It is best to refer the patient, but if this is impossible, undertake curative surgery after intraocular pressure has been reduced to less than 25 mmHg (3.33 kPa).

Equipment

See tray for *Cataract operation*, Annex 1.

Technique

Prepare the patient as recommended for cataract surgery, but do not use atropine.

Stand at the head of the operating table, so that the patient's face appears upside-down. Make a 10 mm incision in the conjunctiva, 4 mm above and parallel to the upper limbus (Fig. 4.11A). Undercut the conjunctiva and reflect it onto the cornea. Achieve haemostasis with hot-point cautery.

Using a No. 11 blade, make a 4 mm incision perpendicular to the surface of the globe in the region of 12 o'clock in the corneoscleral junction. Deepen the incision to open the anterior chamber (Fig. 4.11B). Gently depress the conjunctival flap over the cornea, thus causing a small peripheral part of the iris to be prolapsed through the incision. Excise the prolapsed part of the iris (Fig. 4.11C), and then gently return the rest of the iris to its original position. Close the corneoscleral wound with a single 8/0 thread suture (Fig. 4.11D). Replace the conjunctival flap and suture it with two to three stitches of 8/0 thread (Fig. 4.11E).

Apply homatropine 2% eye drops, tetracycline 1% ointment, and a sterile eye pad to the eye. Continue to give the patient acetazolamide 250 mg every 6 hours for 2 days.

As acute angle-closure glaucoma is often a bilateral disease, the patient should be referred for investigation and, if necessary, treatment of the other eye. Until referral, give the patient pilocarpine 1% eye drops to instil daily into the untreated eye.

Enucleation of the eye

Enucleation of the eye is the surgical removal of the entire globe.

The prospect of losing an eye can have a devastating emotional impact on both the patient and his or her relatives. The decision should be taken only after a very careful consideration of the state of the affected eye, when all efforts to save the eye have failed, and when the eye is clearly useless. Seek the opinion of an ophthalmologist, whenever possible. If this is not possible, consider enucleation only for painful eyes with long-standing, obvious, and complete blindness (no perception of light). Always give a careful explanation of what is involved to the patient and relatives concerned, and obtain the patient's written consent to surgery. In cases of ocular trauma, always attempt to repair the globe and then refer the patient to an ophthalmologist.

Equipment

See tray for *Enucleation of the eye*, Annex 1.

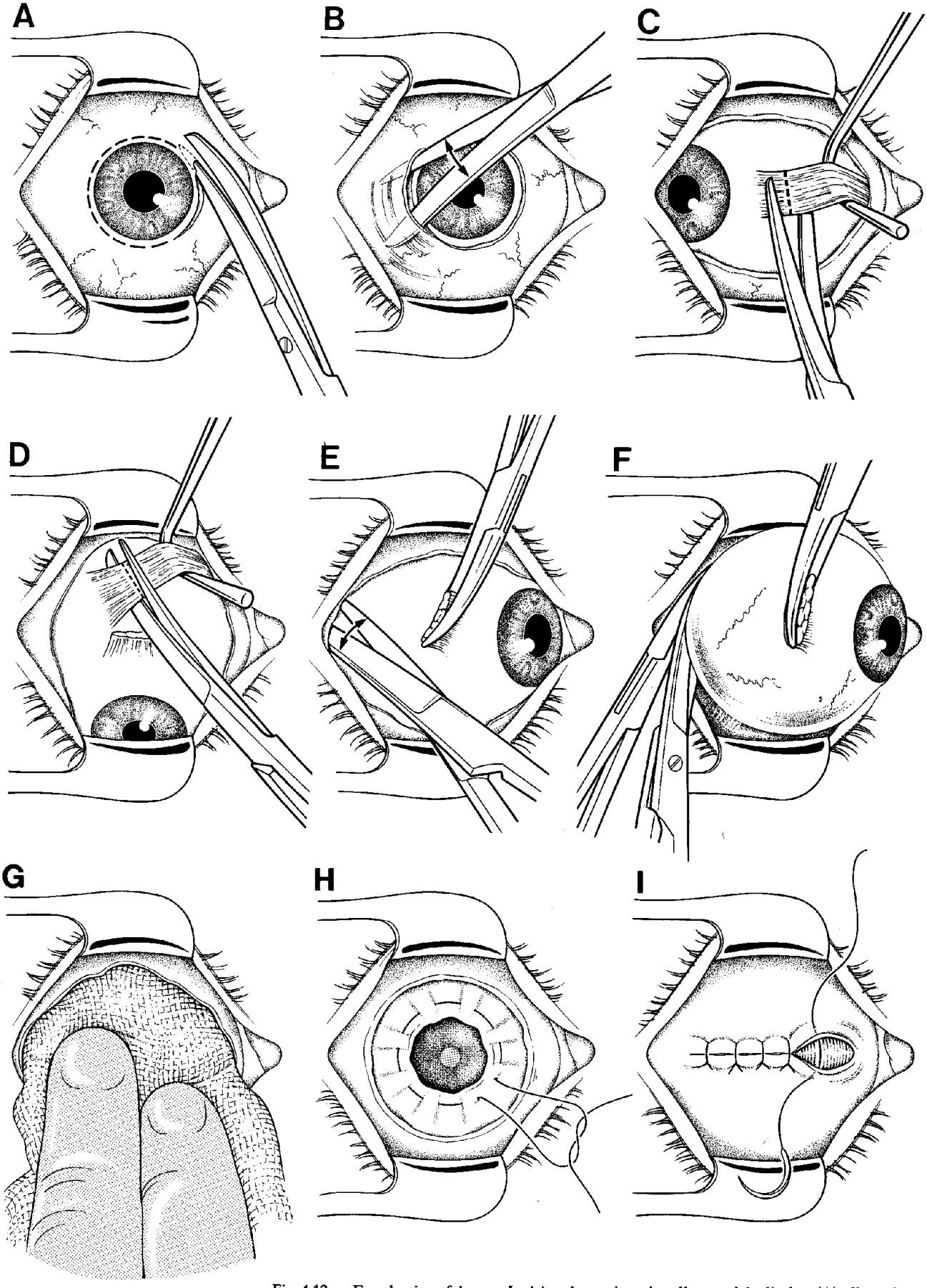

Fig. 4.12. Enucleation of the eye. Incising the conjunctiva all around the limbus (A); dissecting the conjunctiva and the fascial sheath from the sclera (B); identifying and cutting the rectus muscles, leaving a small fringe on the globe (C); identifying and cutting the tendons of the oblique muscles (D); freeing the globe from the fascial sheath (E); identifying, clamping, and dividing the optic nerve (F); applying pressure over gauze after removing the globe (G); closing the fascial sheath with a purse-string suture (H); suturing the conjunctiva (I).

General anaesthesia is preferable, but retrobulbar block with infiltration anaesthesia of the eyelids is an alternative. Also give a topical anaesthetic.

Technique

Stand at the head of the operating table, so that the patient's face appears upside-down. Incise the conjunctiva with scissors all around the limbus (Fig. 4.12A). Lift the conjunctiva and fascial sheath (Tenon's capsule) from the sclera by blunt dissection with scissors (Fig. 4.12B). Identify the rectus muscles and isolate them with a muscle hook. Cut each muscle, leaving a small fringe on the globe (Fig. 4.12C). Next identify and isolate the tendons of the superior and inferior oblique muscles with a muscle hook and cut them (Fig. 4.12D). With a steady hold on the fringe of the medial or lateral rectus to stabilize the eye, free the globe from the fascial sheath by blunt dissection (Fig. 4.12E). Identify and clamp the optic nerve with curved forceps. Cut the nerve between the globe and the forceps with enucleation scissors, but do not tie off the nerve (Fig. 4.12F). Apply pressure over gauze until all bleeding is stopped (Fig. 4.12G). Close the fascial sheath with a purse-string suture of 4/0 chromic catgut (Fig. 4.12H), and suture the conjunctiva with interrupted 5/0 or 6/0 plain catgut (Fig. 4.12I). Apply tetracycline 1% eye ointment, a sterile eye pad, and a pressure bandage.

After-care

Administer analgesics to relieve pain, and apply tetracycline 1% eye ointment daily for at least 8 weeks. The patient can later be referred for the fitting of a prosthesis.

5

Ear

Removal of foreign bodies

Children often insert foreign bodies, such as beans, peas, rice, beads, fruit seeds, or small stones, into their ears. Accumulated ear wax can be confused with foreign bodies and is common in both adults and children.

Equipment

See tray for *Removal of foreign body from the ear*, Annex 1.

Techniques

Administer a basal sedative before proceeding.

Syringing the ear will remove most foreign bodies, although it should be avoided if the foreign body absorbs water, for example grain or seeds. A foreign body can also be removed by gentle suction through a soft rubber tube introduced into the ear to rest against the object (Fig. 5.1A,B). The procedure is simple, painless, and usually effective.

As an alternative, an aural curette or hook may be passed beyond the foreign body and then turned so that the foreign body is withdrawn by the hook (Fig. 5.1C,D). This requires a gentle technique and a quiet patient; children should therefore first be adequately sedated or be given a general anaesthetic.

A mobile insect in the ear is, at the very least, irritating. Before removing the insect by syringing, immobilize it by irrigating the ear with glycerol.

To remove accumulated ear wax, syringe the ear with a warm, weak solution of sodium bicarbonate. If the wax remains, instruct the patient to instil glycerol drops several times a day for 1–2 days before you attempt further syringing.

Myringotomy

Myringotomy is the incision of the tympanic membrane, usually to drain pus from the middle ear. The main indication for myringotomy is acute otitis media when there is severe intractable pain despite treatment with analgesics, a markedly bulging membrane, a poor response to 24–48 hours of antibiotic therapy, features suggestive of early mastoiditis (swelling and tenderness), or facial nerve palsy. Relief of pain after this operation is often immediate and dramatic.

Assessment and preoperative management

Measure the patient's haemoglobin level and test the urine for sugar and protein. Obtain a radiograph of the mastoid bones to check for possible mastoiditis, and take a sample of the discharge from the ear for bacteriological examination. Continue treatment with analgesics and antibiotics.

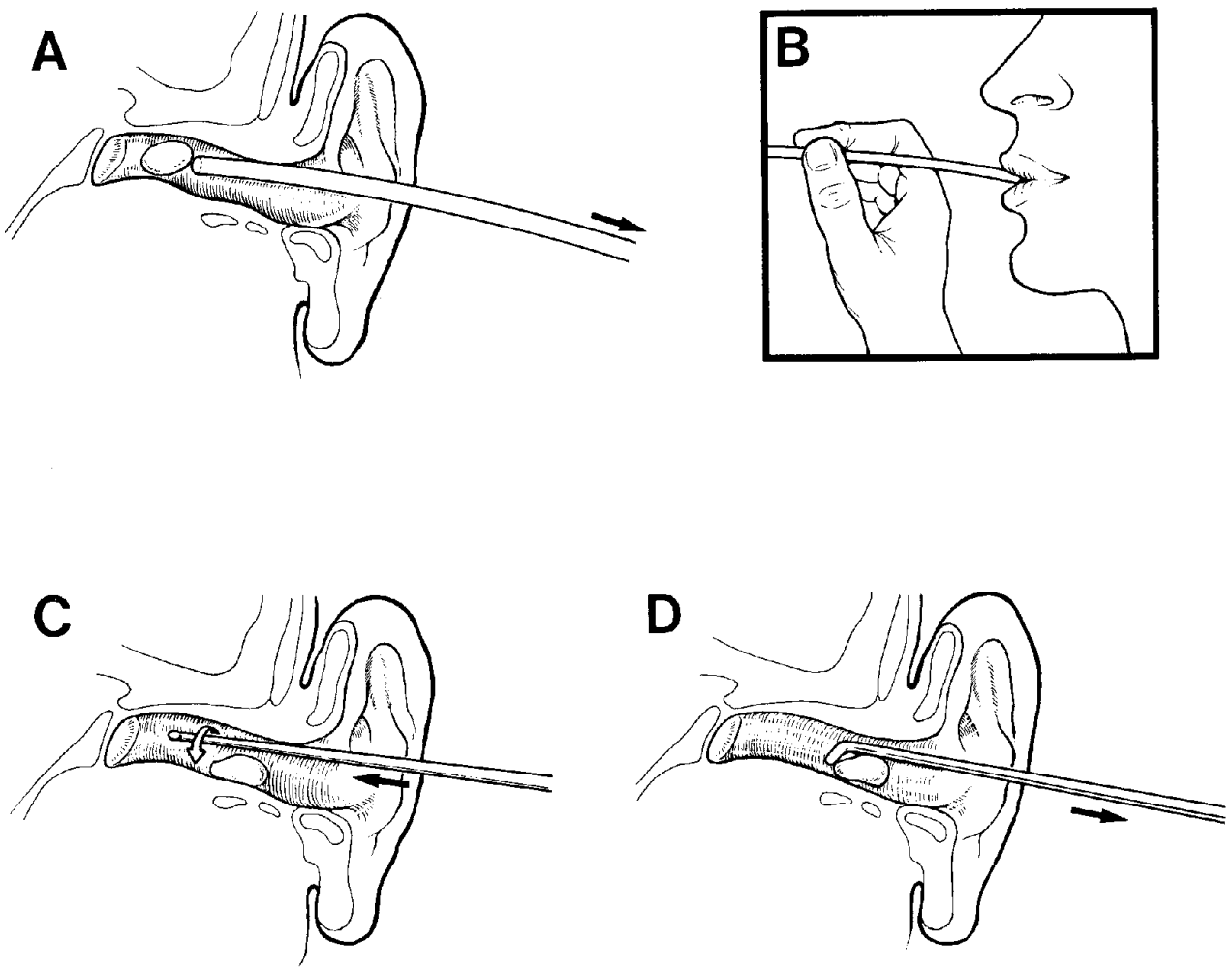

Fig. 5.1. Removal of a foreign body from the ear. Removal by suction (A, B); removal using a hook (C, D).

Equipment See tray for *Myringotomy*, Annex 1.

Technique General anaesthesia may be used, but local anaesthesia is often adequate. Sedate children before administering a local anaesthetic. Prepare the skin of the pinna and the external auditory canal with an antiseptic solution and, if local anaesthesia has been chosen, infiltrate the external canal with 1% lidocaine. Insert a speculum and view the bulging membrane (Fig. 5.2A). Using a scalpel with a partially covered blade, make a curved incision in the antero-inferior quadrant of the membrane to let the pus drain (Fig. 5.2B,C), and take a sample for bacteriological examination. Clean the ear and apply a cotton-wool dressing.

After-care Continue the administration of antibiotics and analgesics. Keep the auditory canal dry, and change the dressing when necessary.

Acute mastoiditis with abscess

This condition is usually a complication of acute otitis media.

The patient, usually a child, complains of fever and of pain in the affected ear, with disturbed hearing. There may be a discharge from the ear. Characteristically

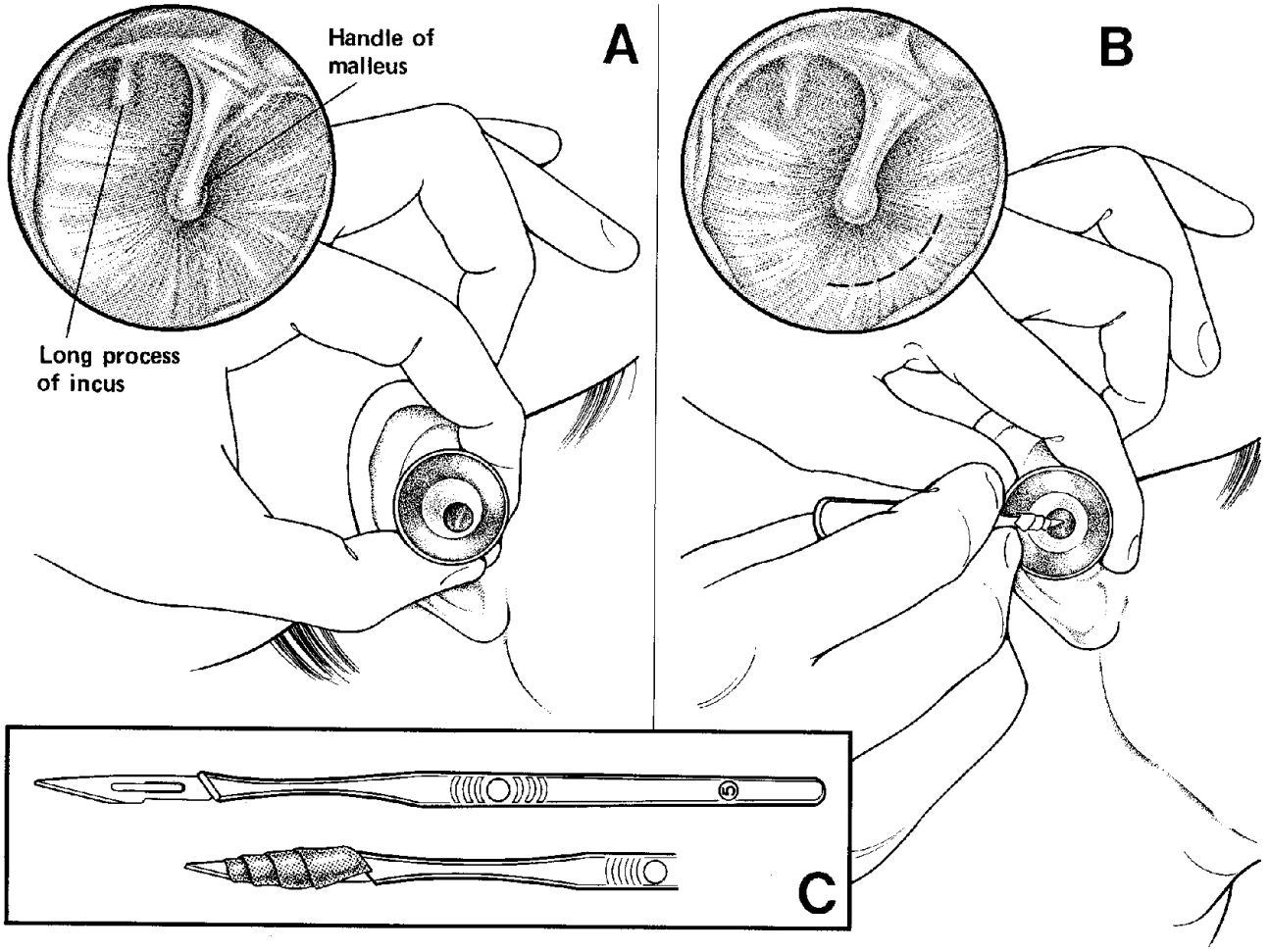

Fig. 5.2. Myringotomy. The tympanic membrane as seen through an auriscope (A); incising the membrane (B) using a scalpel with a partially covered blade (C).

there is a tender swelling in the mastoid area, which pushes the pinna forward and out.

Treatment

Although the ideal treatment is exposure of the mastoid air cells, this operation is usually beyond the scope of the doctor at the district hospital, who should treat the patient only to relieve immediate pain and tension by simple incision and drainage of the abscess down to the periosteum. The patient should then be referred.

Assessment and preoperative management

Measure the patient's haemoglobin level and test the urine for sugar and protein. A radiograph of the mastoid bones (both sides to allow for comparison) will show clouding of the affected bone. If there is a discharge from the ear, take a sample for bacteriological examination. Treat the patient with analgesics and antibiotics.

Drainage of mastoid abscess

Equipment

See tray for *Incision and drainage of abscess*, Annex 1.

Technique A general or local anaesthetic should be given, in addition to basal sedation. Make a curved incision over the most fluctuant part of the abscess or, if this is not obvious, at about 1.5 cm behind the pinna. Deepen the incision to the periosteum or until pus is found. Take a sample of pus for bacteriological examination and establish free drainage. Apply petrolatum gauze or a small, corrugated drain, and dress the area with gauze.

After-care Continue the administration of antibiotics and analgesics, and change dressings as necessary. Remove the drain after 24–48 hours.

6

Nose

Control of epistaxis

Epistaxis (nosebleed) often occurs from the plexus of veins in the anterior part of the nasal septum (Fig. 6.1A). In children it is commonly due to nose-picking. Other causes include trauma, the presence of a foreign body, Burkitt's lymphoma, and nasopharyngeal carcinoma.

Equipment

See tray for *Control of epistaxis*, Annex 1.

Technique

With the patient in a sitting position, administer a mild sedative. Remove any blood clots from the nose and throat. Pinch the nose between fingers and thumb or with a clothes-peg, while applying ice-packs to the nose and forehead. This usually stops the bleeding within 10 min. Should bleeding continue, pack the nose with cotton wool, soaked in ice-cold water and wrung out, and repeat the above procedure.

Rarely bleeding may continue even after this treatment. If this happens, apply pressure to the nasopharynx either by packing it with gauze ribbon or, more effectively, by inserting a Foley balloon catheter. If you decide on the latter method, lubricate the catheter, and pass it through the nose until its tip reaches the oropharynx. Withdraw it a short distance to bring the balloon into the nasopharynx. Inflate the balloon with water, just enough to exert an even pressure but not to cause discomfort (5–10 ml of water is usually adequate for an adult, but use no more than 5 ml for a child). Gently pull the catheter forward until the balloon is held in the posterior choana (Fig. 6.1B). The balloon should flatten slightly as this is done. The catheter can then be secured to the forehead or cheek in the same manner as a nasogastric tube. It can be removed after 48 hours.

Removal of foreign bodies

Children often insert foreign bodies into the nose. Visualize the foreign body, determine its nature, and ascertain its position before making any attempt to remove it.

Equipment

See tray for *Removal of nasal foreign body*, Annex 1.

Technique

First sedate the patient and then proceed gently. The best method of removing a foreign body depends upon its nature. To remove a foreign body with rough

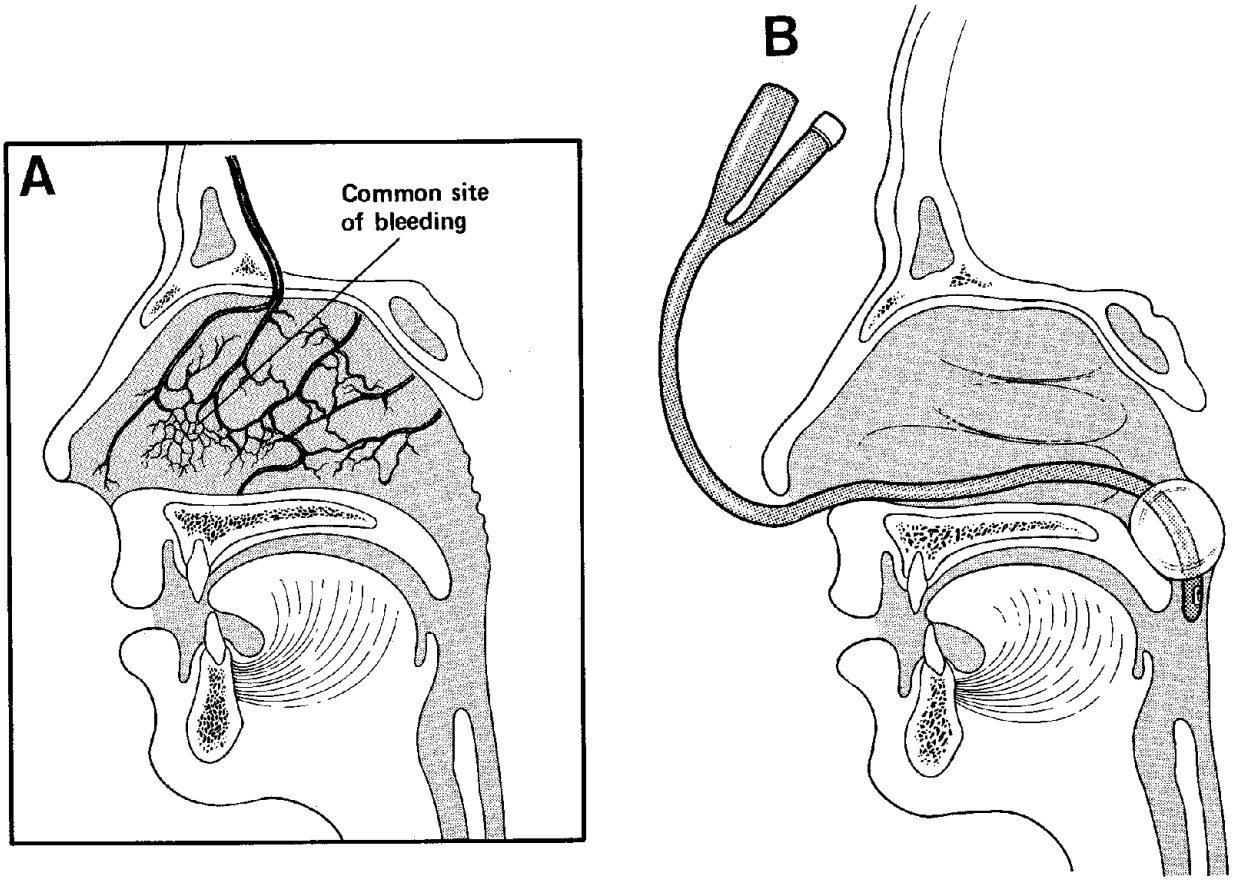

Fig. 6.1. Epistaxis. A common site of bleeding (A); controlling the bleeding with a Foley catheter (B).

surfaces, use angled forceps, or pass a hook beyond the foreign body, rotate the hook, and then draw out the object in front of the hook. Other types of foreign body can be withdrawn by suction, through a soft rubber tube introduced into the nose to rest against the object.

7

Teeth and jaws

Extraction of teeth

Extraction is the best way to drain an apical abscess when there are no facilities for treatment of the root canal. Otherwise, a tooth should be removed only if it cannot be preserved, if it is loose and tender, or if it causes uncontrollable pain.

Immediate first-aid treatment for dental pain can be afforded by cleaning the painful socket or cavity and applying oil of cloves; pack a painful socket with cotton wool soaked in oil of cloves and a tooth cavity with a paste of oil of cloves and zinc oxide.

Assessment and preoperative management

Identify the offending tooth. Take appropriate precautions if the patient is suffering from any other medical conditions such as valvular disease of the heart (which would require prophylactic antibiotic cover), bleeding disorders, or diabetes. It may be helpful to obtain a radiograph of the jaw. Check the patient's haemoglobin level and test the urine for sugar.

Explain the procedure to the patient and obtain permission to remove the tooth.

Equipment

See tray for *Extraction of teeth*, Annex 1.

Dental forceps are designed to fit the shape of the teeth including their roots; accordingly, forceps come in sets of six appropriate shapes, but the inexperienced operator will find it simpler to rely on one pair of universal forceps for the upper jaw and one for the lower (Fig. 7.1A–D). Remember that the upper molars have three roots, two buccal and one palatal, whereas the lower molars have two, one mesial and one distal. The upper first premolars have two roots side by side, one buccal and one palatal. All the other teeth are single-rooted.

Technique

Local infiltration analgesia should usually be sufficient for extraction of all but the lower molars, which may require a mandibular nerve block. Occasionally general anaesthesia may be appropriate.

Administer a sedative to children and anxious adults. Seat the patient in a chair with a back high enough to support the head. After the patient has rinsed the mouth, swab the gum with 70% ethanol. To effect local infiltration anaesthesia, insert a 25-gauge, 25 mm needle at the junction of the mucoperiosteum of the gum and the cheek, parallel to the axis of the tooth (Fig. 7.1E). Advance the needle 0.5 to 1 cm, level with the apex of the tooth, just above the periosteum.

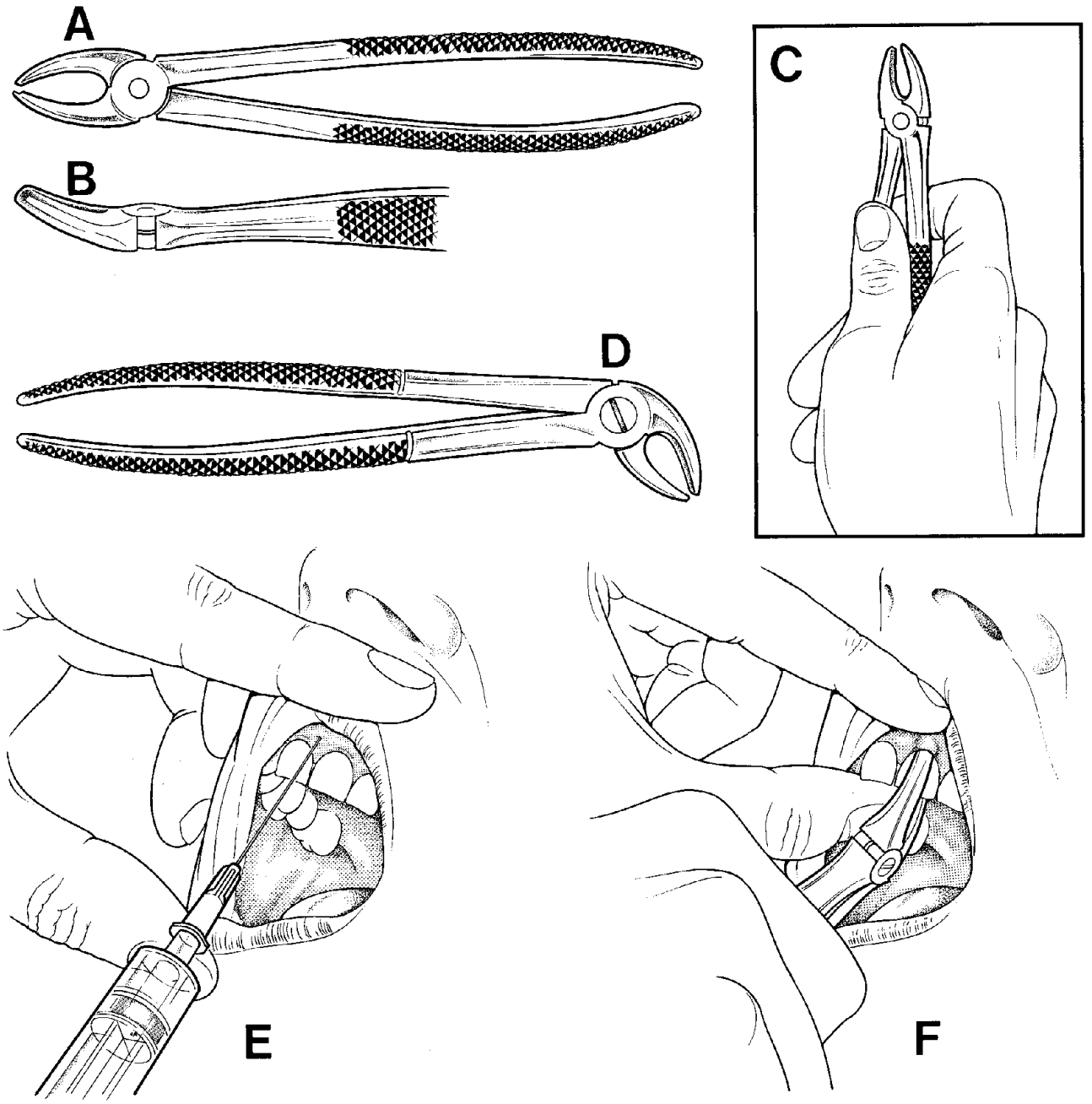

Fig. 7.1. Extraction of teeth. Upper universal forceps from above (A), from the side (B), and as held in the hand (C); lower universal forceps (D); injecting local anaesthetic (E); extraction (F).

The bevel of the needle should face the tooth. Infiltrate the tissues with 1 ml of lidocaine and epinephrine and repeat the procedure on the other side of the tooth. Wait at least 5 min and confirm the onset of numbness before handling the tooth.

If you are right-handed, stand behind and to the right of the patient when extracting lower right molar or premolar teeth. Face the patient, to the patient's right, when working on all other teeth. Separate the gum from the tooth with a straight elevator. While supporting the alveolus with the thumb and finger of your other hand, apply the forceps to either side of the crown, parallel with the long axis of the root. Position the palatal or lingual blade first. Push the blades of

the forceps up or down the periodontal membrane on either side of the tooth, depending on which jaw you are working on (Fig. 7.1F). The secret of successful extraction is to drive the blades of the forceps as far up or down the periodontal membrane as possible.

Firmly grip the root of the tooth with the forceps and loosen the tooth with gentle rocking movements from buccal to lingual or palatal side. If the tooth does not begin to move, loosen the forceps, push them deeper, and repeat the rocking movements. Avoid excessive lateral force on a tooth, as this can lead to its fracture.

Carefully inspect the extracted tooth to confirm its complete removal. A broken root is best removed by loosening the tissue between the root and the bone with a curved elevator. After the tooth has been completely removed, squeeze the sides of the socket together for a minute or two and place a dental roll over the socket. Instruct the patient to bite on it for a short while.

After the patient has rinsed the mouth, inspect the cavity for bleeding. Repair lacerations and arrest profuse bleeding that will not stop, even when pressure is applied, with mattress sutures of 0 catgut across the cavity. Warn the patient not to rinse the mouth again for the first 24 hours or the blood clot may be washed out, leaving a dry socket (with the risk of alveolar osteitis). The patient should rinse the mouth frequently with saline during the next few days.

A simple analgesic may be needed when the effects of the local anaesthetic have worn off. It is worth warning the patient against exploring the cavity with a finger, explaining that the numbness is temporary and will last only for an hour or so. Haemorrhage after dental extraction is a common emergency and can usually be controlled by simple pressure over the socket or, if necessary, by suturing the gum. Haemostatic substances have little advantage over simple pressure. If gross dental sepsis occurs, administer penicillin for 48 hours and consider giving tetanus toxoid, if necessary.

The barrel bandage

The barrel bandage (vertical jaw-bandage) is a useful, temporary support for the fractured mandible and can also serve to maintain pressure on a bleeding tooth socket. Take a length (about 150 cm) of a bandage 7.5 cm wide made of a non-elastic material such as cotton. Find the middle of the bandage length and place it under the patient's chin. Bring the ends to the top of the head and tie them, making the first loop of a reef knot (Fig. 7.2A). Loosen and separate the loop, placing one half over the forehead and the other half behind the occiput (Fig. 7.2B). Take the ends from just in front of the ears up to the top of the head, and tie them securely with a reef knot (Fig. 7.2C,D).

Fractures of the jaw

Fractures of the maxilla require specialist care, but mandibular fractures can often be treated in the district hospital. Fractures of the ramus and the condyle of the mandible are usually closed and require little reduction. Fractures of the body of the mandible are usually compound, through the alveolar margin, and necessitate immobilization, which can be achieved by direct wiring between the teeth on either side of the fracture or by interdental wiring between the two jaws (providing that the upper jaw is stable).

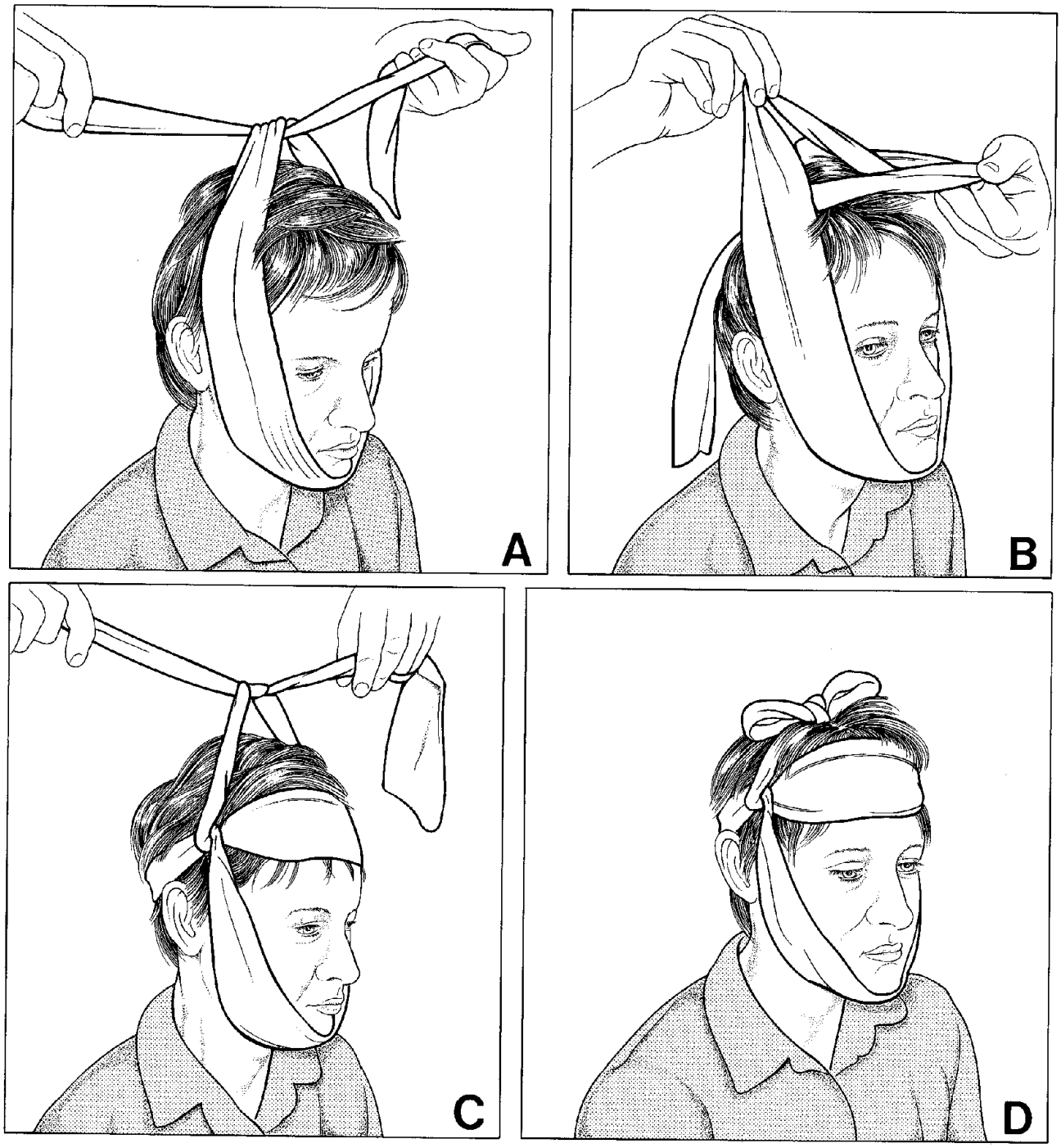

Fig. 7.2. Application of a barrel bandage.

Diagnosis and treatment

If the patient presents with a suspected mandibular fracture, note any altered dental occlusion and, if necessary, confirm the fracture by X-ray examination. Check for other injuries, and decide on the priorities for treatment. Keeping the airway clear is most important; the patient should therefore be nursed lying on the side or in a sitting position with the head well forward. Give penicillin and tetanus toxoid.

With the maintenance of a clear airway and the administration of antibiotics, the patient's condition can be expected to improve considerably in the first 24 hours.

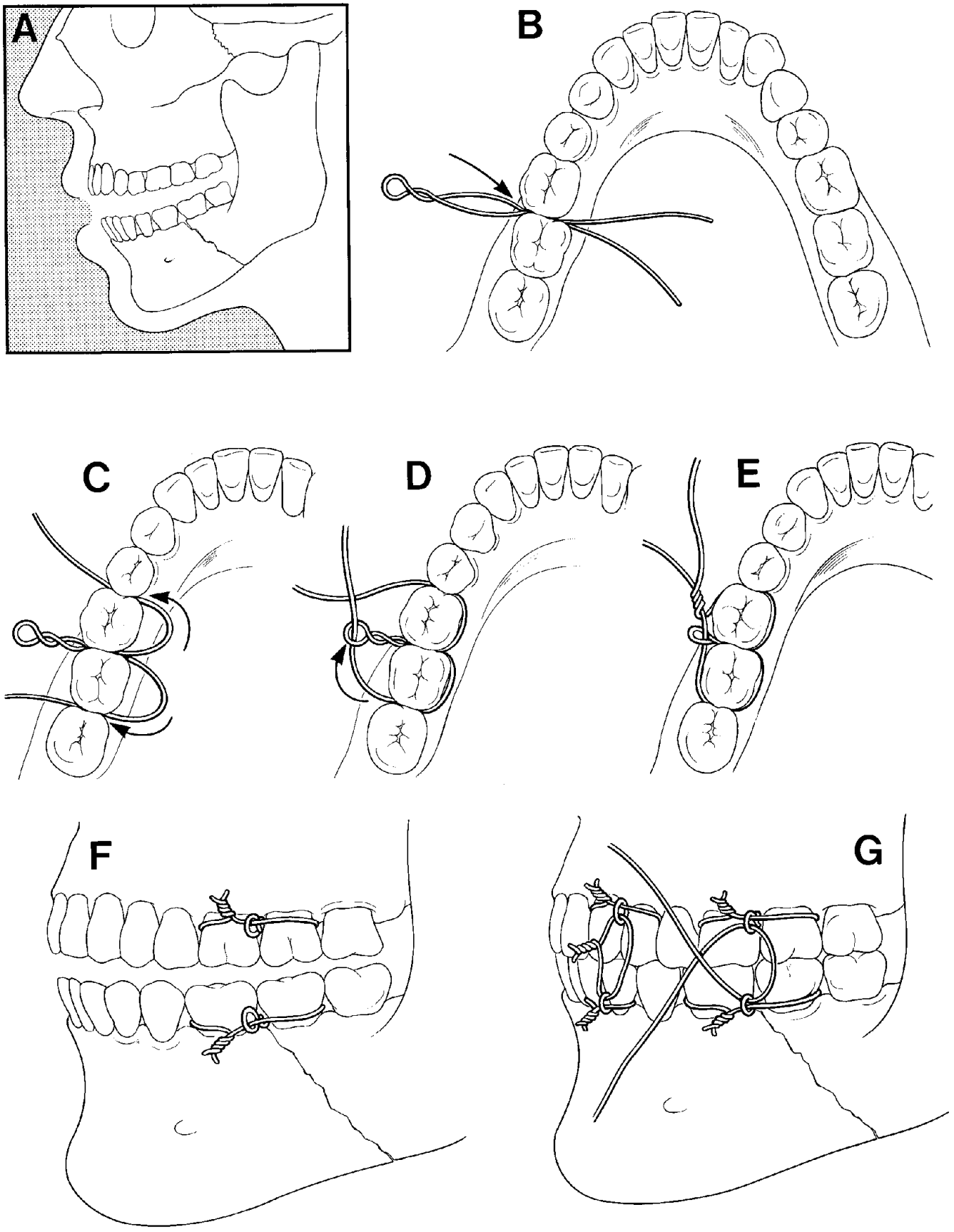

Fig. 7.3. Treatment of mandibular fracture by interdental wiring. The fracture line across the mandible (A); inserting the looped wire between the healthy teeth on either side of the fracture (B); bringing the ends of the wire back around the teeth (C), inserting one end through the loop (D), and twisting the ends together (E); the procedure is repeated on the upper jaw (F); the jaws are then wired together, additional teeth having been wired together if necessary (G).

The only urgent indication for wiring a mandibular fracture is instability of a comminuted fracture through the incisors. In this instance, the tongue may need to be held forward temporarily by a stitch through its tip and the teeth wired immediately. Otherwise wiring can be delayed until the patient's condition is stable.

Interdental wiring of the jaws

Equipment

See tray for *Interdental wiring*, Annex 1.

Technique

After sedating the patient, you may gently insert interdental eyelets without anaesthesia, but nerve block (of the inferior alveolar nerve) and infiltration anaesthesia are much preferred. General anaesthesia is an alternative but, should the patient present with an airway that is difficult to manage or with a full stomach, it will be extremely hazardous if the anaesthetist is inexperienced.

Clean the patient's mouth. Examine the jaws for any obvious wounds, which should be sutured. Locate the fracture (Fig. 7.3A) and reduce it as far as possible. If there is any doubt about the viability of a tooth in the fracture line, remove it. The method of wiring the jaw will depend on the state of the remaining teeth. Choose the nearest two healthy teeth, one on each side of the fracture line, and pass a 16 cm length of wire (twisted to make an eyelet on the buccal side) between them from the buccal to the lingual side (Fig. 7.3B). Pass the ends back to surround the teeth, carrying one end through the eyelet and then tightening it by twisting it against its fellow (Fig. 7.3C–E). Cut the excess wire short and bend it away from the lip to lie flush along the jaw. Repeat the procedure on a matching pair of teeth in the upper jaw (Fig. 7.3F). Fix the mandible to the maxilla by wiring the upper and lower eyelets together immediately or, if there are any worries about the patient's airway at the end of anaesthesia, at a later session (Fig. 7.3G). Additional teeth may be wired together if necessary.

After-care

The jaw should be kept immobilized until the fracture unites: 6 weeks for an adult but only 3–4 weeks for a child. During this time, the patient should continue to brush the teeth regularly, except perhaps for the first few days when the mouth can be gently syringed. The patient's diet must, of course, be fluid or semi-solid.

8

Throat

Non-emergency operations on the throat (in particular tonsillectomy) should not be attempted at the district hospital.

Incision and drainage of peritonsillar abscess

Peritonsillar abscess (quinsy) is a complication of acute tonsillitis. The patient develops a rapidly progressing pain in the throat which radiates to the ear of the same side and soon becomes unbearable. The neck is held rigid, and there is associated fever, dysarthria, dysphagia, drooling of saliva, trismus, and foul breath. Clinical examination will confirm fever and will usually reveal cervical lymphadenopathy on the side of the lesion. Local swelling causes the anterior tonsillar pillar to bulge and displaces the soft palate and uvula towards the opposite side. The overlying mucosa is inflamed, sometimes with a small spot already discharging pus. Keep in mind the possibility of diphtheria or glandular fever.

Assessment and preoperative management

Measure the patient's haemoglobin level and test the urine for sugar and protein. Administer antibiotics and analgesics.

Equipment

See tray for *Incision and drainage of peritonsillar/retropharyngeal abscess*, Annex 1.

Technique

Administer a basal sedative and place the patient in a sitting position with the head supported. Surface anaesthesia is preferable and will avoid the risk of inhalation of the abscess contents, which can occur under general anaesthesia. Spray the region of the abscess with 2–4% lidocaine. *Never* use ethyl chloride for this purpose, as the amount absorbed by the patient cannot be properly monitored.

Keep the tongue out of the way with a large tongue depressor or ask an assistant to hold it out between a gauze-covered finger and thumb as you proceed. Perform a preliminary needle aspiration (Fig. 8.1A), and then incise the most prominent part of the swelling near the anterior pillar (Fig. 8.1B). Introduce the point of a pair of artery forceps or sinus forceps into the incision, and open the jaws of the forceps to improve drainage (Fig. 8.1C). Provide suction, if necessary.

After-care

Instruct the patient to gargle with warm salt water several times a day for about 5 days. Continue the administration of antibiotics for 7–10 days and analgesics for as long as necessary.

Incision and drainage of retropharyngeal abscess

This abscess occurs mainly in children, with tuberculosis as the underlying disease. It is usually a complication resulting from infection of the adenoids or

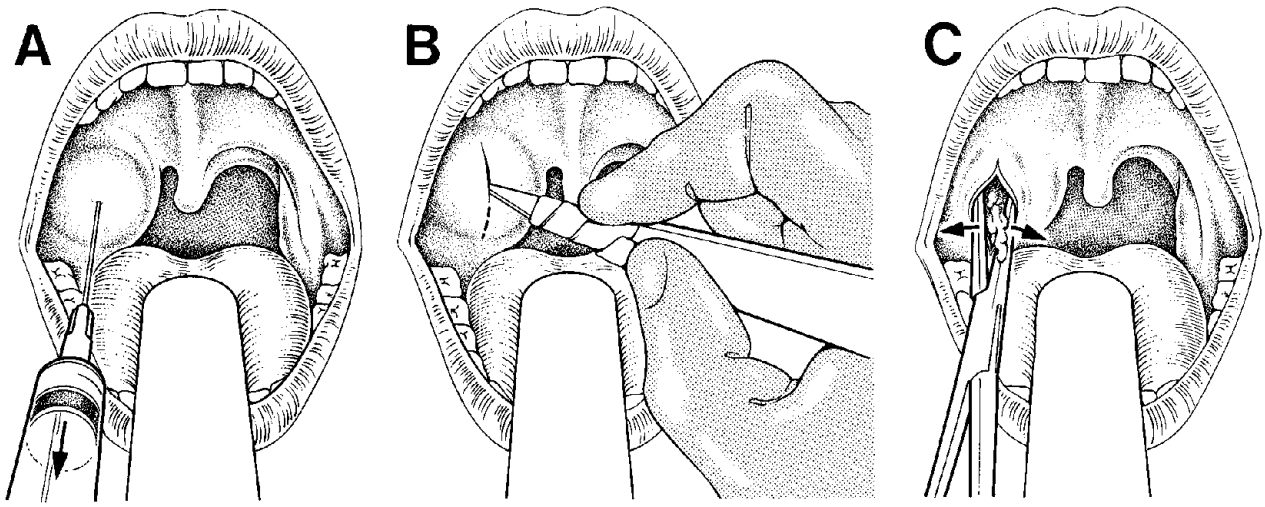

Fig. 8.1. Incision and drainage of peritonsillar abscess. Preliminary aspiration (A); incision (B); drainage (C).

the nasopharynx. The child refuses nourishment, has a changed voice and cry, is generally irritable, and suffers from croup and fever. The neck is held rigid and breathing is noisy. In the early stages of the abscess, physical examination of the pharynx may detect no abnormality but, as the condition progresses, a swelling appears in the back of the pharynx.

Assessment and preoperative management

A lateral radiograph of the soft tissue will reveal a widening of the retropharyngeal space. X-ray the chest and the cervical spine to check for tuberculosis. Measure the patient's haemoglobin level and test the urine for sugar and protein. It is also useful to obtain white-cell and differential white-cell counts, determine the erythrocyte sedimentation rate, and test the skin reaction to tuberculin (Mantoux test).

Administer antibiotics and analgesics. A patient suffering from tuberculosis will require further treatment.

Equipment

See tray for *Incision and drainage of peritonsillar/retropharyngeal abscess*, Annex 1.

Technique

Administer a basal sedative with the patient lying down and the head of the table lowered. Spray the back of the throat with local anaesthetic and instruct an assistant to steady the patient's head. Keep the tongue out of the way with a depressor.

A strictly midline swelling is more likely to be tuberculous and should be aspirated, not incised. If the swelling is elsewhere, incise the summit of the bulge vertically. Introduce the tip of pair of sinus or artery forceps and open the jaws of the forceps to facilitate drainage. Provide suction. Take a specimen of pus for bacteriological tests, including culture for *Mycobacterium tuberculosis*.

After-care

Instruct the patient to gargle regularly with warm salt water. Continue the administration of antibiotics and analgesics.

Incision and drainage of acute abscess of the neck

Some abscesses in the neck are deeply situated or arise from lymph nodes, and require a careful and possibly extensive surgical dissection with the patient under

general anaesthesia. However, because the neck is a complex and important anatomical region, surgical intervention at the district hospital is not recommended, unless the abscess is acute and clearly pointing, when the surgical procedure is limited to simple incision and drainage. In children, an abscess of the neck should be treated by repeated aspiration before it points.

Assessment and preoperative management

Once the diagnosis has been confirmed by aspiration, carefully examine the patient's mouth and throat, particularly the tonsils, to exclude a primary focus.

Measure the patient's haemoglobin level, test the urine for sugar and protein, and obtain a white-cell and differential white-cell count. If tuberculosis is suspected, especially in children, obtain a chest radiograph and test the skin reaction to tuberculin (Mantoux test).

Equipment

See tray for *Incision and drainage of abscess*, Annex 1.

Technique

A small, superficial abscess may be evacuated by aspiration using a syringe with a wide-bore needle.

Large abscesses of the neck require incision and drainage under general anaesthesia. Place the incision in a crease, centred over the most prominent or fluctuant part of the abscess. Spread the wound edges with a pair of sinus or artery forceps to facilitate drainage. Take a sample of pus for bacteriological tests, including an examination for tuberculosis. Remove any necrotic tissue, but avoid undue probing or dissection. Insert a soft corrugated drain and a few stitches to bring the wound edges loosely together around it. The drain may be removed in 24–48 hours. Hold dressings of gauze swabs in place with adhesive tape.

After-care

Ensure that the patient gargles regularly with salt water, and provide analgesics, as necessary. Should a discharge from the wound persist (as evidenced by sinus formation), refer the patient.