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first aid

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First Aid

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Contents

Introduction

Essentials of first aid. First aid is a combination of the emergency medical measures used in case of sudden illness or accident. The first aid rendered on the spot or as the victim is being transported to medical facilities may vary and is classified as follows:

(1) *unskilled first aid* rendered by a layman who often has none of the necessary means or medicines;

(2) *qualified first aid* (before the arrival of a doctor) rendered by a specially trained medical worker (medical technician[1], nurse, laboratory or dental technician);

(3) *first aid rendered by a doctor* who has the necessary instruments, apparatus, medicines, blood and blood substitutes, and so on at his disposal.

An accident is an injury to a body's organs or an impairment of their functions as the result of an unexpected effect of the environment. It is often impossible to notify the emergency ambulance service promptly after an accident and so the first aid rendered on the spot or before the victim is moved to medical facilities is extremely important.

Accident victims, their relatives, neighbours or passers-by often seek help at the nearest medical institution such as the chemist's shop, the dentist, laboratory, epidemiological station or kindergarten whose workers must render help immediately. For this reason, the curriculum

[1] The term in Russian and German is **feldscher**, which indicates a medical worker who has specialized medical training. A feldscher can render first aid before the arrival of a doctor at obstetrical units and can act as an assistant physician in therapeutic and prophylactic institutions. *Tr.*

for training this category of workers includes a special course on the main symptoms and complications of various injuries and sudden illnesses.

First aid (before a doctor arrives) includes the following three steps.

1. Either the external hazard (electrical current, high or low temperature, compression with heavy objects) must be removed or the victim must be removed from the hazardous environment (water, burning premises, premises with accumulated poisonous gases).

2. First aid must be rendered to the victim according to the seriousness and type of injury, accident, or sudden illness (this may involve arresting the bleeding, dressing the wound, artificial respiration, heart massage, or administration of antidotes).

3. The victim or patient must be immediately transported to medical facilities.

The general first-aid measures listed in step 1 commonly involve the effort of the victim alone or with help. Since the victim may die if not removed from the hazardous environment, first aid must begin with the measures outlined in step 1. The longer a victim remains in the hazardous conditions, the more serious the injury will be.

The first aid measures in step 2 are rendered by medical workers or by people who have learned the main symptoms of injuries and special first aid techniques.

Step 3 is of particular importance. The transportation must be prompt and correct, i. e. the patient or victim must be transported in the safest position for the given illness or injury. An unconscious or a vomiting patient, for instance, should be transported on his side; bone fractures must be immobilized. Victims are transported in special transport facilities – ambulance vans or airplanes. When these are not available any means found in a given situation may be used. In extreme cases an injured person may have to be carried in the arms, or on a

standard or improvized stretcher, or on a blanket.

Transportation may last from several minutes to several hours. The medical worker, in addition to arranging for safe and speedy transportation and moving the patient from one transportation means to another, should render medical aid en route and prevent complications that may develop from vomiting, movement of fractures, overcooling, jolting, etc.

The importance of first aid can scarcely be exaggerated. Timely and correct first aid not only saves lives but often facilitates the successful treatment of the disease or injury, prevents grave complications such as shock, wound suppuration, or general blood poisoning, and minimizes lost working time.

First-aid stations. In the USSR first aid is rendered at special medical facilities – first-aid stations and emergency aid units (e.g. traumatological and stomatological). The tasks facing first-aid stations are complex and varied: to render first aid in cases of injury and sudden illness, to take emergency cases to hospitals and women in childbirth to maternity homes. Ambulances must answer every call. The physician or medical technician in the emergency ambulance that arrives at the scene of an accident renders first aid on the spot and ensures the skilled hospitalization of the victim or patient.

The emergency ambulance service is constantly improving and developing. At present this service is provided in all large cities and has at its disposal specialized resuscitation vans equipped with modern facilities for rendering highly qualified first aid. Doctors and medical technicians serving in the vans can perform transfusions of blood or blood substitutes, external heart massage and artificial respiration using special apparatus, and can give anaesthetics, antidotes, or other drugs at the scene of an accident or in the van en route to the hospital. These vans have considerably improved the emergency

aid and made it very efficient.

First-aid stations have at their disposal specialized teams to deliver patients promptly and efficiently to hospital, to answer the calls of the doctors at out-patient departments, medico-sanitary units, and emergency-aid units, and to serve patients from these establishments.

A huge network of out-patient departments, medico-sanitary units, polyclinics, and obstetric points render emergency aid to the residents in their localities during the day. The doctors in polyclinics treat patients at their homes though in the case of grave illness or accident they render them first aid, determine whether hospitalization is necessary, and what type of transportation to use.

Wherever the victims of an accident or sudden illness apply for help (the chemist's shop, laboratory, stomatological polyclinic, epidemiological station), there must be the instruments and medicaments for rendering first aid. The pharmaceutical kit should have hydrogen peroxide solution, alcohol iodine solution, ammonium hydroxide, analgetics (analgin, amidopyrine), cardiovascular agents (valerian tincture, caffeine, validol, nitroglycerin, cordiamin, papasol), antipyretics (aspirin, phenacetin), anti-inflammatory agents (sulphonamides and antibiotics), and purgatives as well as a haemostatic tourniquet, thermometer, individual first-aid dressing pack, sterile bandages, cotton wool and splints.

All pharmacists must know how to render first aid and what medicaments are needed in case of a sudden illness or an accident. The chemist's shop must also have additional stretchers, crutches, sterile instruments (clamps, syringes, scissors), oxygen cushions, certain drugs in ampoules (caffeine, cordiamin, lobelin, adrenaline, atropine, glucose, corglycon, promedol, analgin, amidopyrine). The narcotics and strong medicaments must be registered in a special book whenever they are used.

Chapter 1
Essentials of Antisepsis and Asepsis

More than one hundred years ago the eminent French scientist Louis Pasteur proved that putrefaction and fermentation are caused by micro-organisms. Proceeding from Pasteur's works the English surgeon Joseph Lister concluded that wounds are infected by the micro-organisms getting into them. The Russian scientist Nikolai Pirogov was the first to suggest that it was a "hospital miasma" which infects wounds. He employed alcohol, silver nitrate, and iodine to disinfect wounds long before Lister.

Man constantly comes in contact with a huge number of micro-organisms contained in the air and on surrounding objects, and various micro-organisms are found on the skin and mucous membranes of a healthy person. They only enter the body, however, when the skin or mucous membranes are disrupted by wounds, abrasions, punctures, burns or when the body's defence forces are weakened by circulatory disorders, cooling, exhaustion, or a general ailment. Micro-organisms cause purulent-inflammatory foci where they enter the tissue (suppuration, abscesses, phlegmons); in more severe cases they enter the blood stream and cause general toxaemia or sepsis.

Most surgical interventions (operations, blockades, intravenous or subcutaneous injections) are attended by the disruption of the continuity of the skin, thus enabling the infection to penetrate the body. Preventing the infec-

tion of wounds is known as antisepsis, while maintaining them in an antiseptic state is known as asepsis.

Antisepsis

Antisepsis is a combination of measures aimed at killing micro-organisms in the wound and preventing them from getting deep into the tissues. It is accomplished by mechanical, physical, chemical and biological means. *Mechanical antisepsis* is the removal of dead and crushed tissue, blood clots, and foreign bodies from the wound, with the debridement of a wound by a physician in hospital being an example. *Physical antisepsis* includes the exposure of the wound to infrared radiation, introduction into the wounds of drains, tampons and turundae impregnated with hypertensive sodium chloride solution to induce the outflow of pus and fluid thus hindering the development of wound infection. This method of antisepsis is mainly employed when first aid is rendered by medical personnel. *Chemical and biological antisepsis*, which is most essential, includes the application of bactericidal agents to kill wound microbes or delay their reproduction.

Chemical Antisepsis

Many antiseptics or disinfectants can harm somewhat the tissues of the wound. For this reason they should be used very carefully and strictly according to indications.

Hydrogen peroxide solution (Sol. Hydrogenii peroxidati) is a colourless liquid, a weak disinfectant, and a good deodorant. As a 3 per cent solution it is used as a mild antiseptic for skin and mucous membranes. When it comes into contact with a dirty wound it gives off a considerable amount of oxygen producing foam which helps

to cleanse the wound of pus and remnants of dead tissue. It is widely employed for softening dried bandages and dressings.

Potassium permanganate (Kalii permanganas) occurs as dark-violet crystals readily soluble in water. It is weak disinfectant and is used in a 0.1-0.5 per cent solution to disinfect purulent wounds and as a tanning agent in burns, ulcers, and bedsores.

Boric acid (Acidum boricum) is a white crystalline powder soluble in water. Used as a 2 per cent solution to wash mucous membranes, wounds, and body cavities.

Tincture of iodine (Tinctura jodi) is employed to disinfect the operative field and the hands of surgical personnel, and to treat contaminated wounds, lacerations, and scratches.

Iodonate (Iodonatum) is a dark brown liquid with a slight iodine odour readily soluble in water. Used as a 1 per cent solution for disinfecting the operative field and, in cases of emergency, the hands.

Iodoform (Tri-iodomethane) is manufactured in the form of powder and is employed in ointments and emulsions to disinfect purulent wounds.

Chloramine B (Chloraminum B) is a white or slightly yellowish crystalline powder with the typical odour of chlorine. It is readily soluble in water and acts as an antiseptic and deodorant. As a 1 or 2 per cent solution is used to irrigate putrefactive wounds; a 0.25-0.5 per cent solution is employed for disinfecting hands, gloves, and instruments. Chloramine when used in solution decomposes in several days and loses its antiseptic properties, which is why it should be stored in dark vials.

Mercuric chloride (perchloride) (Hydrargyri dichloridum) is a heavy white powder readily soluble in water. Solutions of mercuric chloride are used in a 1:1000 dilution. Mercuric chloride is a powerful poison and is easily

absorbed even through intact skin. For this reason it should be stored in locked cases in vials bearing label "strong poison". It is used primarily for disinfecting contaminated articles and soiled gloves.

Diocide (Diocidum) is a compound antiseptic (ethanol mercuric chloride + cetylpyridinum chloride) from which a highly bactericidal solution is prepared according to special techniques. Used for treating hands in a 1 : 5000 dilution. Diocide is most commonly employed for sterilizing plastic objects and instruments in a 1 : 1000 dilution.

Collargol (Collargolum) is colloidal silver soluble in water. Dark brown or red brown collargol possesses bactericidal, astringent, and cauterizing effects. As a 0.2-1 per cent solution it is used for douching, enemas, and for washing the eyes and nose and as a 5-10 per cent solution for cauterization.

Silver nitrate (Argentum nitricum) is a powerful antiseptic with a cauterizing and anti-inflammatory action. Weak solutions of silver nitrate (1 : 3000) are used for douching the urinary bladder; wound granulations are cauterized with a 10-30 per cent solution.

Ethyl alcohol, ethanol (Spiritus aethylicus) is a colourless liquid with a characteristic smell. As 70 and 96 per cent solutions it is used for disinfecting cutting instruments (scalpels, scissors), suturing material (silk), and the operative field, for preparing and tanning the surgeon's hands and the skin around the wound. It is possible to enhance the bactericidity of ethyl alcohol by adding thymol or aniline dyes. An alcohol thymol solution in a 1 : 1000 dilution is highly effective and 30 times stronger than a 3 per cent solution of carbolic acid. Moreover, it has none of the unfavourable properties of carbolic acid (pungent odour, irritating action, and so on).

Brilliant green solution (Viride nitens). A 1 per cent

solution is used for sterilizing instruments, and for painting the skin in suppurative lesions, lacerations and scratches. Brilliant green is a component of *Novikov's liquid*, which also includes tannin, ethyl alcohol, castor oil, and collodion. The collodion mass quickly dries to form a dense elastic film on the skin. Used as an antiseptic for the treatment of minor skin lesions.

Methylene blue solution (Methylenum coeruleum). As a 2 per cent alcohol solution it is used for the treatment of burns, as a 0.02 per cent aqueous solution to wash cavities.

Degmin (Degminum) is a derivative of high-molecular alcohols and hexamethylene amine. It is readily soluble in water and has a marked bactericidal action. A 1 per cent solution is employed for disinfecting the hands and operative field.

Ethacridine lactate (Aethacridini lactas) or **Rivanol** is a fine yellow crystalline powder, poorly soluble in cold water though readily soluble in hot water. A 0.05 per cent solution is used for irrigating cavities and purulent wounds.

Furacilin (Furacilinum), a yellow crystalline powder, is hardly soluble in water; it is a potent antiseptic that affects most pyogenic microbes. In a 1 :5000 dilution it is used for washing purulent wounds, cavities, burns and bedsores.

Ammonium hydroxide solution (Sol. Ammonii caustici), a colourless liquid with a pungent smell. It is readily soluble in water. A 0.5 per cent solution is employed for disinfecting hands, contaminated wounds, and operative field.

Pure phenol (Phenolum purum) or **carbolic acid** (Ac. carbolicum crystallisatum) occurs in the form of colourless crystals. They have pungent smell and are soluble in water, alcohol, and ether. Solutions of phenol have powerful bactericidal actions. Articles used by patients, bed-

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ding, discharges, etc. are disinfected with 3-5 per cent solutions. Soap phenol solutions are employed for disinfecting premises. Phenol is easily absorbed through the skin and therefore may cause poisoning.

Formaldehyde solution (Sol. Formaldehydi), a transparent liquid with a peculiar odour, is toxic. Used as a disinfectant for treating the hands and instruments (a 0.5 per cent solution), disinfecting gloves, and for drainage.

Sulphonamides. Compounds of this series are important antiseptics. Their good bacteriostatic action, inhibiting the growth of microbes, and the relatively little harm they do to the organism enable us to use them widely to control infection. Streptocid (sulphanilamide), norsulphazol (sulphathiazole), aethazol (sulphaethiodole), sulphadimezine (sulphadimidine), sulgin (sulphaquanidine), phthalasol (phthalylsulphathiazole) and sulphadimethoxine are most commonly used. To prevent wound infection sulphonamides are taken orally; in special cases local application is possible by powdering the wound. Some preparations in the series have been produced for intravenous administration (e. g. sulphathiazole). In suppurative wounds sulphonamides are employed locally in ointments and emulsions, which provide reliable disinfection without disrupting the healing of the wound.

Biological Antisepsis

Biological antisepsis is effected by various biological agents, which kill micro-organisms in the wound or in the body. These include the antibiotics, i. e. substances produced by micro-organisms themselves or those reproduced synthetically, and compounds that heighten the organism's own defence forces (vaccines, sera, gammaglobulins, etc.).

Antibiotics were introduced into clinical practice in the 1940's. Credit is given to Z. V. Ermolyeva who was the

first to study and obtain antibiotics in the Soviet Union. Antibiotics affect the growth and reproduction of micro-organisms in the body. Most only affect certain species of bacteria but there are a great number of antibiotics that are effective against several species simultaneously. The most commonly used are penicillin, streptomycin, chloramphenicol (Chloromycetin), tetracycline (Achromycin), neomycin sulphate (Colimycin), monomycin, erythromycin (Lincocin), sigmamycin, morphocycline, gentamycin sulphate (Garamycin), kanamycin (Kantrex), laevomycetin, piopen, and methacycline (Rondomycin). Semi-synthetic preparations (ceporin, ampicillin [Omnipen]) are also produced.

Antibiotics are used locally (in solutions to wash and irrigate the wounds) or in ointments and emulsions (for dressing) and orally, subcutaneously, intramuscularly, and intravenously. Bacteria rapidly adapt to antibiotics and become resistant to them so antibiotic therapy is conducted under the control of bacterial sensitivity to the antibiotic used.

Antibiotic therapy is sometimes followed by complications such as allergic oedema, urticaria, and even shock. Therefore it must be preceded by an antibiotic sensitivity test.

Sterilization of instruments, apparatus, and suturing material with solutions of antibiotics most commonly supplements chemical sterilization and is conducted prior to surgery. Antibiotics are usually combined, e. g. penicillin + streptomycin + neomycin sulphate in a dose of 1 000 000-2 000 000 U per 150-200 ml of distilled water.

Asepsis

The term *asepsis* is used to describe a process by which micro-organisms are prevented from entering objects and wounds. It is maintained by disinfecting everything

that comes into contact with the wound. *Sterilization* is the complete destruction of bacteria and their spores on operation linen, and instruments, suturing material, and surgeons' robes, gloves, and hands. It may be done in many ways: by steam under pressure (autoclaving), dry heat, calcination, boiling, burning and by keeping the contaminated articles in solutions of antiseptics and antibiotics. Sterilization by radiation (gamma rays), ultraviolet radiation (mercury quartz lamps), gases and other means is also widely employed.

An object is considered sterile when its surface and interior are free of microbes capable of reproducing. Article sterilization is checked by inoculation of bacteria into a special nutritive media.

Sterilization of the Dressing Material

A material that is used during operations to dry wounds and the operative field and to apply tampons, and various bandages with medication is called dressing. Dressing material should be absorbent, dry quickly, be pliable and be easy to sterilize.

The most commonly used dressing material are gauze, cotton wool, and lignin. *Gauze* is a cotton that quickly absorbs blood, pus, and other liquid discharges. It is pliable, soft, does not contaminate the wound. It is employed in roller bandages, napkins, swabs, and turundae. *Cotton wool* is a downy material made from the fibre of cotton seeds. Medicine makes use of the hygroscopic cotton wool which is a good absorbent. A pad of cotton wool with a gauze backing is applied to a wound thus improving the absorbing capacity of the dressing and protects the wound from external effects. *Lignin* (corrugated sheets of the fine paper) is used instead of hygroscopic cotton wool.

Dressing material is manufactured either non-sterile in

large rolls and packs in which case it must be prepared and sterilized on the spot, or sterile in small hermetically sealed packs made of wax paper. Sterile packs are most convenient when first aid is rendered at work, in the field or at home. The Soviet pharmaceutical industry manufactures sterile dressing material in the form of bandages and cloth and in individual packs containing special bandages and packs impregnated with antiseptics such as iodoform, brilliant green, and synthomycin, which promote blood coagulation (e. g. haemostatic gauze).

First aid at industrial enterprises and establishments is rendered by the medical staff of a health centre or a medical post, or by workers trained in first aid. They have at their disposal first aid kits, stretches, splints and so on. Public health centres and medical posts must have a supply of sterile dressing material. Standard packs with sterile roller bandages, napkins and cotton wool can be most easily stored and applied. It is obligatory to have individual dressing packs which allow rapid and reliable protection of the wound from contamination.

When sterile dressing material is not available it can be made from the non-sterile large bands of gauze (Fig. 1). Napkins and tampons (10 in a package) are put into steam sterilizers and autoclaved. The sterile dressing material must then be stored in closed containers. In the absence of a standard individual pack dressing made of a piece of gauze (6 × 9 cm) with an even layer of cotton wool in the centre can be improvized. It is then rolled in half with the gauze on the outside and wrapped in wax paper 16 × 16 cm in size. Individual dressings made in this manner are put into drums and sterilized.

Linen and dressing material are most commonly sterilized by high-pressure steam in autoclaves, hence the other name for this process is autoclaving. Linen and dressing material are usually sterilized and kept in metal containers (drums). The walls of the containers have orifices

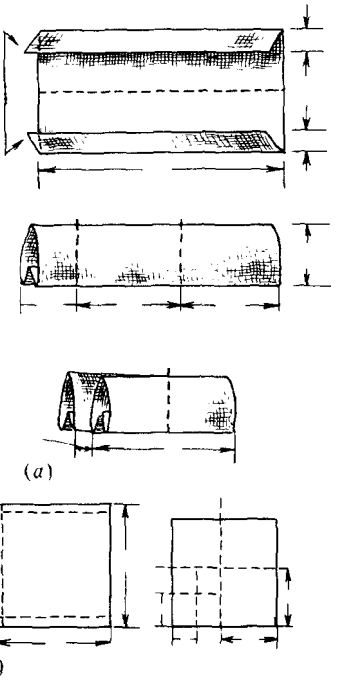


Fig. 1.
Preparing dressing material
a, large napkin; *b*, medium-size napkin

through which steam passes inside. When the sterilization is over, the orifices are closed using a metal ring. If the orifices are open the material is considered to be non-sterile. Dressings can be sterilized in bags made of closely woven cloth.

The sterility of the autoclaved material is checked by putting test tubes containing either sulphur powder, antipyrin, amidopyrin or other substances, whose melting point is about 120°C, with a dressing material in the sterilizer. At high temperatures (120-134°C) the substance melts. If the substance has not melted the contents of the

sterilizer cannot be considered sterile. Sometimes Miculicz's method is used for testing the sterility of dressings. The word "sterile" is written in pencil on strips of filter paper, the strips are smeared with starch glue and immersed in aqueous iodine solution. The strips turn bright blue and the inscriptions disappear. The strips are then put in the sterilizers with the dressing material. At high temperatures (above 110°C) the starch is transformed into dextrin, the blue colour disappears, and the inscription "sterile" becomes visible.

Sometimes sterility is checked biologically. A piece of a silk thread impregnated with a solution that contains certain amount of sporogeneous bacteria is packed into a sterile paper. After autoclaving the silk thread is put into a nutrient media and if the bacteria do not grow the sterilization was effective.

Sterilized linen must be dry, otherwise its sterility is doubtful.

In emergencies, when there is no sterile gauze or roller bandages, any clean piece of cloth can be used for dressings. Clean gauze must be well pressed with a hot iron before being applied to a wound.

When sterilization cannot be performed a non-sterile gauze or other hygroscopic material (linen) should be soaked in a rivanol solution (ethacridine lactate), or potassium permanganate, or Burov's liquid (liquor alumini acetates in a dose of 2 teaspoonfuls per glass of boiled water), or in solution of boric acid (1/3 teaspoonful per glass of boiled water).

Sterilization of Surgical Instruments

Surgery requires many different instruments to dissect tissues (knives, scalpels, scissors), to arrest haemorrhages (haemostatic clamps), to grasp and hold tissues in position during an operation (different types of hooks), and

to suture dissected tissues (needles and clamps).

The following instruments are used for dressings: forceps (anatomical and surgical), scissors, probes (grooved and bulbous-end), hooks (to dilate wounds), and haemostatic clamps. When sterile instruments are employed to apply a dressing it is called *instrumental*. This protects the wound from possible infection, on the one hand, and the hands of the person applying the dressing from contamination, if the wound is purulent, on the other. A dressing should only be applied with sterile instruments whether the wound is clean or purulent. After each dressing the instruments are washed and sterilized. When a wound is purulent the instruments should be sterilized singly.

Metal instruments are sterilized by *calcination* and by *dry heat* in desiccators. Desiccators with electric heating, which can bring the temperature to 140-180°C in 10-15 minutes are most common. At this temperature instruments are sterilized in 20-30 minutes.

Boiling is the simplest method of sterilization and can be accomplished in any sort of vessel and using any source of heat. There are special sterilizing boilers ranging in size from small pocket ones to stationary units. Metal instruments, syringes, and other glassware, gloves, rubber catheters and tubes, plastic instruments and, in special cases, the dressing material can be sterilized by boiling in sterile water. Water is easily sterilized by boiling it twice for 30 minutes with a 6-hour interval in between. This fractional boiling kills off even the most stable microbial spores. Sodium hydrocarbonate is added to the water to obtain a 2 per cent solution. The alkaline water promotes sterilization, and prevents any oxidation or corrosion of the instruments. Nickel-plated instruments can be immersed in boiling water and cooled on a table covered with a sterile oil-cloth. To avoid damage, glassware (syringes, flasks, jars, and glasses)

should not be put directly into boiling water.

In emergencies metal instruments can be disinfected quickly by burning them in spirit. The instruments are put into a basin covered with spirit, which is then ignited. The flames provide reasonable disinfection but do not reliably sterilize the instruments.

Sterilization and Application of Syringes

Parenteral (subcutaneous, intramuscular, intravenous, etc.) administration of drugs is accomplished using various syringes. A syringe is made up of a cylinder with a cone on one end, onto which a needle can be fitted, and a plunger inserted into a cylinder. Syringes differ in capacity (1 to 250-500 ml), material (glass, metal, plastic, combination of glass and metal) and in the thickness of the tip. Luer type needles do not fit Record type syringes.

Each injection must be made with a sterile syringe. Sterilization is most commonly accomplished by boiling in distilled water. The syringe is disassembled and each part is wrapped in a gauze napkin and put into a sterilizer filled with cold water to prevent cracking. Special care must be taken when sterilizing syringes made of metal and glass which expand to different degrees on heating. The procedure lasts for 30 minutes from the moment boiling begins. The syringe is then removed with a sterile forceps or dressing forceps. Luer type glass syringes and heat-resistant combined syringes (bearing the mark "200°C") can be sterilized in autoclaves or dessicators.

Injection techniques. Injection includes the following steps: (1) the hands are thoroughly washed with soap, dried with a sterile napkin and treated with surgical spirit; (2) the syringe is cooled, assembled and the appropriate needle is chosen (a short one for hypodermic injections, and a long needle 40 mm in size for intramuscular

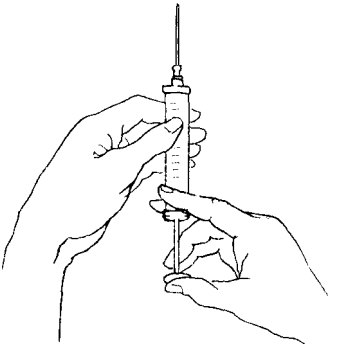


Fig. 2.
Removing air from the syringe and needle

injections); (3) the syringe is filled with the medicine through the needle, which is then pointed upward and the excess air expressed from the syringe and needle (Fig. 2); (4) the skin at the site of the injections is treated with surgical spirit or iodine tincture, the skin is collected into a fold with a left hand and rapidly pierced with the

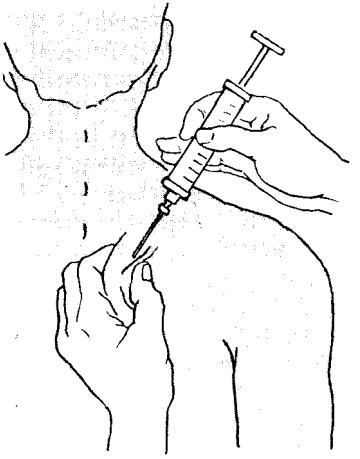


Fig. 3.
S bcutaneo s inje tion

syringe held in the right hand, the needle being perpendicular for an intramuscular injection and at an angle for a subcutaneous one (Fig. 3); (5) the syringe is held stably and the medicine is injected smoothly and slowly, after which the needle is removed and the site of the injection massaged for some time with a piece of cotton wool impregnated with spirit.

After being used syringes are disassembled and rinsed in running water. The syringes are immersed (for 15 minutes) in a hot (50°C) solution of 0.5 per cent hydrogen peroxide and washing powder. One litre of the solution is prepared from 975 ml of boiling water, 20 ml of a 33 per cent perhydrol solution, and 5 g of washing powder. The syringes are taken out of the solution, washed with cotton wool and gauze tampons for 25-30 seconds, rinsed first with tap water and then distilled water, and sterilized by one of the methods described above. This treatment of syringes and needles is essential because dangerous virus diseases, in particular Botkin's disease or infectious jaundice, are often transmitted through syringes and needles.

Sterilization of solutions. Solutions for parenteral injections are sterilized by autoclaving or boiling in the vessels in which they are stored. The unstoppered bottles and vials containing the solutions together with their stoppers are put into an autoclave and sterilized for 30 minutes at 2 atm pressure. After that the bottles and vials are stoppered, and the necks wrapped additionally with cellophane and tied with thread.

Sterilization by boiling involves a fractional method. The solutions are just boiled for 30 minutes in the vessels in which they are stored. Six hours later they are boiled again for 30 minutes, then the vial is stoppered. The solutions should only be stored for 1 or 2 days.

Sterilization of the Hands and Disinfection of the Gloves

The hands, even when clean, the cuticles and the skin underneath the nails contain germs which can penetrate quite deeply into the pores and the sebaceous and sweat glands of the skin. To prevent infection from getting into a wound the hands of anyone carrying out a surgical procedure must be thoroughly washed and the nails cut short. Washing the hands involves careful mechanical cleaning of the skin, rinsing them in an antiseptic solution and tanning the skin with spirit, which hardens the skin, promotes the pores to close and prevents the hands themselves from becoming infected. Hands can be washed using the following methods.

The Spasokukotsky-Kochergin method. The hands and forearms are thoroughly washed under running water with soap to remove house-hold dirt. If the hands are clean they need not be washed beforehand. For the main treatment of the hands two enameled basins are filled with a warm 0.5 per cent ammonium hydroxide solution (Sol. Ammonii caustici), 10 ml of ammonium hydroxide being added per 2 litres of boiled water to each basin. The hands are energetically scrubbed with sterile gauze napkins keeping them mostly in the solution. The forearms, nailbeds and palms are especially thoroughly washed in the first basin, and the hands and wrists in the second basin, three minutes in each basin. The hands are then carefully dried up with a sterile towel or a napkin after which the hands and wrists are treated twice with 96 per cent ethyl alcohol for 2.5 minutes. This method is reliable, preserves the skin, and makes it possible to achieve sufficient cleanliness for most situations.

Furbringer's method. The hands are scrubbed with soap with two sterile bristle brushes for 10 minutes under a stream of warm running water, dried with a sterile napkin and then treated with 70 per cent ethyl alcohol for 3

minutes and a 1 : 1000 solution of mercuric chloride. The cuticles are smeared with an alcohol iodine solution.

Disinfection of the hands with performic acid. The hands are washed with soap in running water, dried with a sterile napkin, and washed again in a performic acid solution for one minute and dried with a sterile napkin. The disinfectant solution should be prepared 1-1.5 hours before the use. A 2.4 per cent solution is used. One litre of solution is prepared from 17 ml of 33 per cent hydrogen peroxide and 7 ml of 100 per cent formic acid, which are mixed and kept in a refrigerator for 1 hour. Then the solution is made up to 1 litre with distilled or boiled water.

Disinfecting hands with cerygel. Cerygel is a colourless viscous liquid that possesses marked bactericidal action, and rapidly hardens in the air. Having been applied over the hands it forms a film and the hands become covered with sterile "gloves". Method of preparation: 5 ml of cerygel is poured onto the dry palms, which are energetically rubbed for 8-10 seconds so that the solution covers the whole surface of the fingers, hands, and around the wrists. The hands are dried for 2-3 minutes with the fingers spread apart. The film or "glove" can be easily washed off with spirit.

Surgical gloves markedly improve the reliability of disinfection but the hands must still be washed properly. Non-disposable gloves require great care: following the operation, they must be washed thoroughly taking care to preserve their wholeness, dried, and covered with talcum. The *gloves are sterilized* by autoclaving and boiling. Before autoclaving, the outer and inner surfaces of each glove are covered with talcum, and the glove is wrapped in a gauze napkin, which is then put into the steam sterilizer. So that the gloves do not touch the walls of either the steam sterilizers or one another a towel or a layer of napkin is put on the bottom and between them. After

autoclaving, the gloves are kept in the same steam sterilizer. The gloves can be sterilized by boiling in water (without sodium carbonate) for 15-20 minutes after which they are carefully dried with a sterile towel and covered with a layer of sterile talcum. Cold sterilization of the gloves is also possible. The gloves are immersed in a 2 per cent chloramine B solution for 15-30 minutes or an 0.2 per cent mercuric chloride solution for 1-1.5 hours, then washed in an isotonic sodium chloride solution, dried, treated with talcum, and stored in sterile steam sterilizers.

Rapid disinfection of the hands in emergencies. Before rendering first aid the hands must be disinfected as far as possible by one of the methods described above, especially when the victim has wounds or damage to the skin or mucosa (lacerations, burns, or frostbite). In emergencies the hands can be disinfected in a simpler manner by washing them with soap in running water and drying with a clean towel. Then 5-7 ml of a tanning or disinfectant solution is poured on a small ball of cotton wool or gauze, and the hands and fingers are rubbed with it for 1-2 minutes. The skin can be tanned with ethyl alcohol, 5 per cent iodine alcohol solution or 5 per cent tannin; the hands can also be disinfected with a 5 per cent phenol solution (or carbolic acid), a solution of mercuric chloride (1 : 1000), diocide solution (1 : 5000 ethanol mercuric chloride), 0.5 per cent chloramine B solution, or 1 per cent degmine solution. If sterile gloves are available they can be put onto non-sterile hands. In rendering help the hands become contaminated so they must be continually rubbed with the same disinfectant solution.

Chapter 2

Techniques for Applying Bandages (Desmurgia)

A bandage is a dressing fastened on the body according to the special rules. Bandages are most commonly applied to cover the wounds, to protect wounds from infection, and to arrest bleeding.

Desmurgia is a section of medicine that studies the types of bandages, the methods for their application, and the purposes for which they are applied.

Bandages can be classified according to their purpose as follows: *common (protective) bandages* that protect the wound from the harmful external effects and retain dressing and medicinal agents in position; *pressure bandages* that exert continuous pressure on a part of the body (commonly to arrest bleeding); *immobilizing bandages* that ensure needed immobility of the injured part of the body; *bandages with traction* that continuously extend a part of the body; *occlusion bandages* that cover a body cavity hermetically; *correction (fixing) bandages* that correct an improper position of a limb.

Bandages may be either soft or hard, depending on the dressing material used. Soft bandages include gauze roller bandages, elastic bandages, elastic wide mesh tubular bandages, and cotton bandages. Hard bandages may either include a hard material (wood, or metal) or involve a hardening material such as plaster of Paris, special plastics, starch, or glue.

In first aid every type of soft bandage is used, while of the hard bandages, splints are common.

Soft Bandages

There are many types of soft bandages. The bandages are usually applied to retain the dressing (gauze or cotton

wool) and the medicament on the wound or in a disease focus. Bandages are classified according to the manner of fixation of the dressing on the body as glue, triangular, sling, contour, or roller bandages.

Glue bandages are mainly applied to protect the wound from external effects. The dressing material is fastened to the skin around the wound with a glue: e.g. cleol, collodion, and adhesive plaster. The application of a *cleol bandage* is very simple. Several layers of gauze are applied on the wound and the skin around the wound is smeared with a narrow band of cleol. A stretched gauze napkin is applied to the layer of cleol and kept there until the napkin firmly adheres to the skin (Fig. 4*a*).

Collodion bandage. The glue is applied with a spatula over a stretched fixating napkin. The dressing is retained by strips of *adhesive plaster* (Fig. 4*b*). Adhesive plaster bandages of the spica type are used to apply occlusive bandages over wounds that penetrate the chest.

Wounds can be covered by a bactericidal adhesive plaster whose adhesive layer contains antiseptics. This

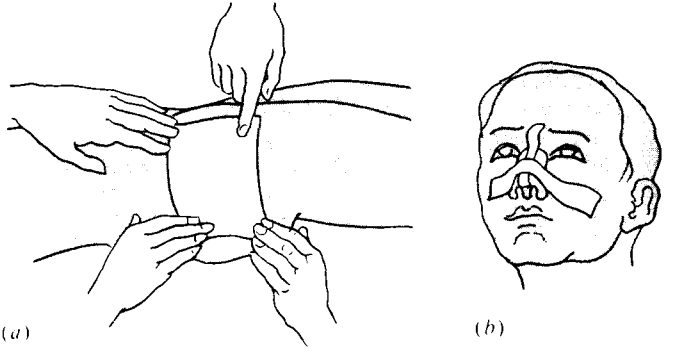


Fig. 4.
Glue bandages
a, cleol bandage; *b*, adhesive plaster bandage

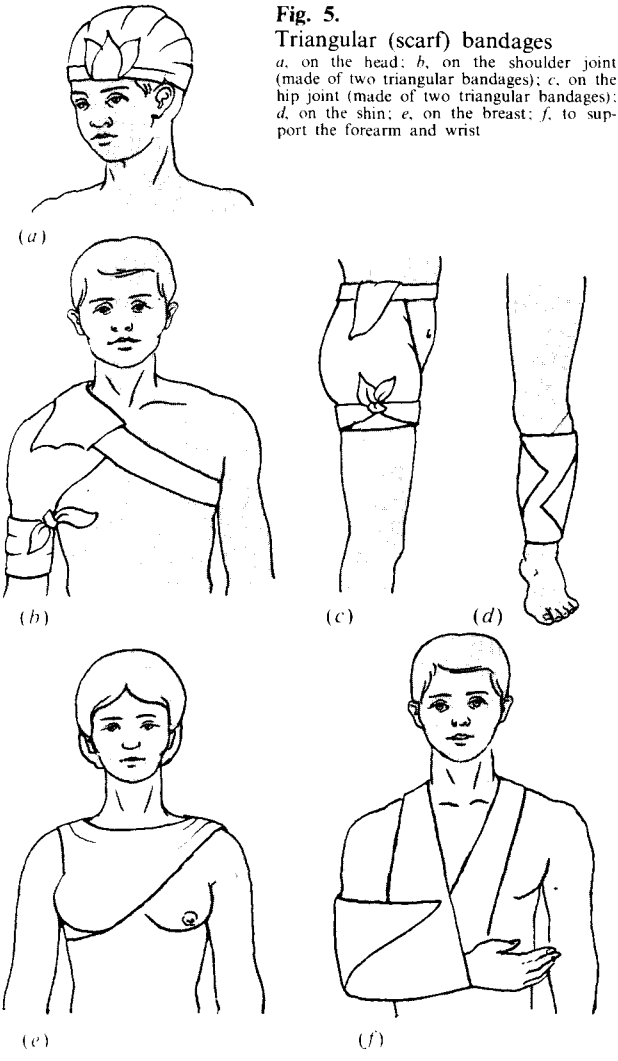


Fig. 5.
Triangular (scarf) bandages
a, on the head; *b*, on the shoulder joint (made of two triangular bandages); *c*, on the hip joint (made of two triangular bandages); *d*, on the shin; *e*, on the breast; *f*, to support the forearm and wrist

plaster has very fine pores which prevent skin maceration and do not hamper the wound from healing.

Triangular bandages are made from a square of material that is cut or folded diagonally. Triangular bandages are fastened with a pin or their ends are tied. The Soviet pharmaceutical industry produces standard triangular bandages 135 × 100 × 100 cm in size. They are produced in a compressed form for medical bags and first aid kits and have the appearance of a little brick 5 × 3 × 3 cm in size. Triangular bandages can be used on any part of the body. Typical triangular bandages are demonstrated in Fig. 5.

A **four-tail or sling bandage** can be made from a wide roller bandage or a piece of cloth 75-80 cm in length. It is split down both ends, but leaving the middle part 15-20 cm in length intact. The unsplit part of the bandage is applied across the requisite part of the body. The split ends on each side are crossed so that the lower band becomes the upper and vice versa and they are tied with the corresponding band from the other side. When the bandage is applied to a nose or upper lip two ends are passed above the ears and tied on the back of the head and the other two ends below the ears and tied on the neck (Fig. 6*a*). When a bandage is applied to a chin, the lower ends are passed in front of the ears and tied in the parietal region, while the upper ends are passed below the ears, over the back of the head, crossed and passed along the forehead across the temples where they are tied (Fig. 6*b*). The application of a sling bandage to the vault of the skull is shown in Fig. 6*c* and *d*.

Bandages with special shapes can be cut from any piece of material according to the shape of the part that is to be bandaged (Fig. 7*a* and *b*). These include bandages for the lower abdomen and suspensories and bandages that are cut individually according to the size of the body part (Fig. 7*c*). These bandages are fixed by strips or hooks

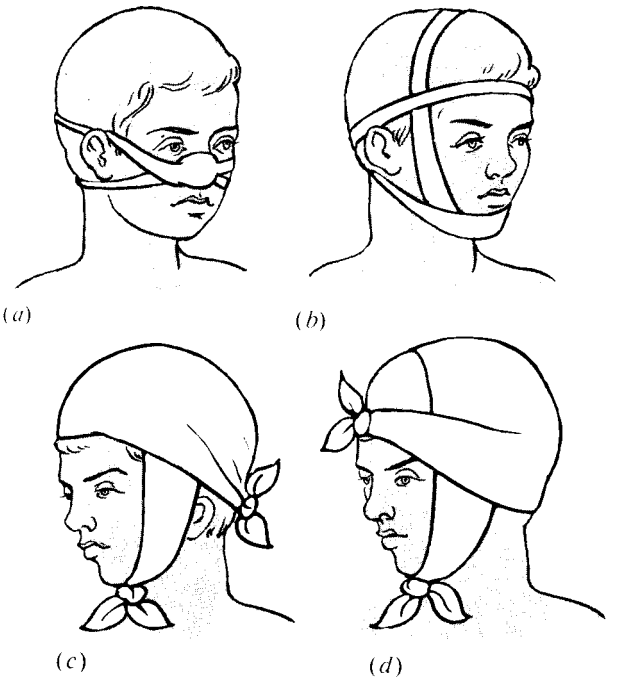
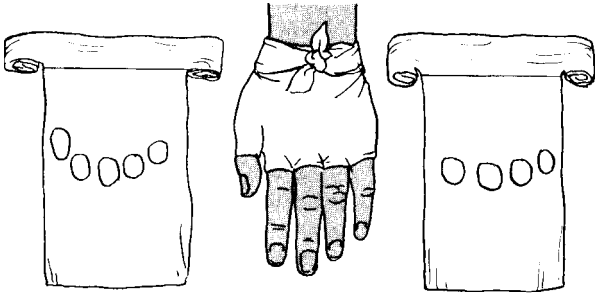


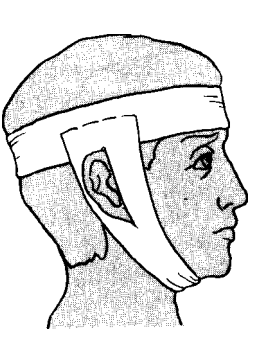
Fig. 6.
Four-tail or sling bandages
a. on the nose; *b*. on the chin; *c*. on the occiput; *d*. on the vertex

and are most commonly used for strengthening the anterior abdominal wall.

Roller bandages vary in size from the narrow ones up to 5 cm for the application to smaller parts of the body (e. g. fingers), to medium size ones (7-10 cm) used on the forearm, leg, neck, and head, and wide bandages (up to 20 cm) that are applied to the chest, abdomen, and hip.



(*a*)



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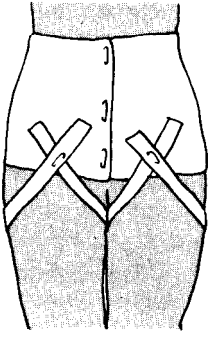


(*c*)

Fig. 7.
Bandages with special shapes
a, on the wrist; *b*, on the chick and lower jaw; *c*, bandage

A gauze roller bandage is very pliable and easily takes the shape of the part being bandaged. Ready-made standard roller bandages are the most convenient, though it is possible to make them from a piece of gauze by cutting it into long bands which are stitched together and rolled up tightly. The bands become more uniform if the whole

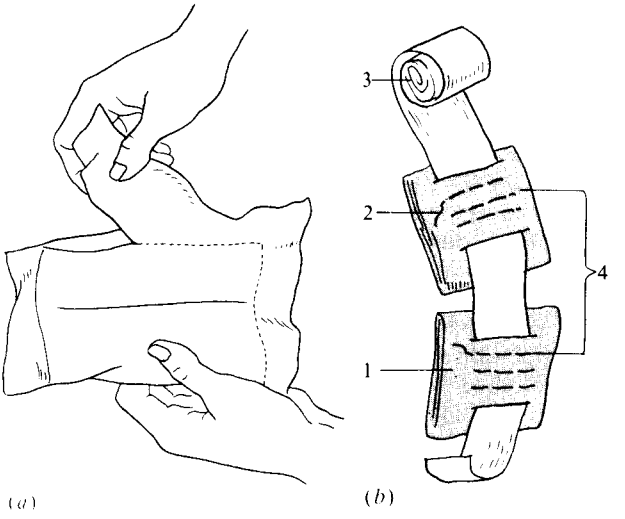


Fig. 8.
Individual first-aid dressing pack
a, the pack is open; *b*, the dressing pack is unwrapped; *1*, fastened cotton-wool pad; *2*, movable cottonwool pad; *3*, gauze bandage; *4*, thread; the interrupted line shows where the pack should be torn

piece of material is tightly rolled around a metal core. When the core is removed the rolls can be cut off with a sharp knife obtaining bands of the needed width.

Individual first-aid dressing pack. Ready-made dressings, the so-called individual dressing packs, are very convenient for first aid (Fig. 8). These packs are sterile and they can therefore be applied to the wound in any condition. An individual dressing pack consists of a roller bandage and a pad of cotton wool and gauze stitched onto the free end of the bandage (compress). There is a second pad of cotton wool and gauze between the roller and the first pad which can be moved as

needed. The pack also contains a pin and an ampoule with an alcohol iodine solution. The dressing is wrapped in waxed paper and packed in a rubberized envelope which keeps the pack sterile for a long time. The main rule in using the pack is to avoid contact with the side of the pad which will be applied to the wound. The pack is taken in the left hand and the perforated edge of the rubberized envelope torn off with a sharp movement of the right hand after which the contents wrapped in the waxed paper can be removed. The paper is carefully unwrapped and the end of the bandage with the cotton wool and gauze pad stitched to it is taken with the left hand (the side of the pad that can be handled is marked by a coloured thread), while the roller bandage is taken in the right hand. The hands are moved apart and the piece of the bandage with the pads on it stretched tightly. The pads are applied to the wound and fixed in place by wrapping the bandage round them. With a perforating wound, one pad is placed over the entry of the wound and the other over the exit. The end of the bandage is pinned.

Rules of bandaging. At the moment the dressing is applied the patient should be in a comfortable position causing the least pain. The dressing is most easily applied if the part being bandaged is on a level with the chest of the person who is rendering help. The part of the body to be bandaged, particularly a limb, should be in the position it will be in after the bandaging. If this rule is not observed and the limb (e.g. an elbow joint) is bandaged when straight, the dressing will slip off if the limb is then held in a bent position after bandaging. Conversely, if a bandage is applied to a bent knee joint, it will slip off as soon as the patient straightens it to walk.

A bandage that is applied for a long period of time fixes the joint and causes it to stiffen, and sometimes can make it completely immobile (ankylosis). That is why

bandages are applied when the limb is in the most comfortable physiological position, thus when the bandage is removed any stiffness can easily be relieved and a satisfactory limb function restored. A knee is bandaged slightly flexed and a foot is bent at a right angle. An elbow is bandaged flexed at a right angle and a wrist somewhat extended. Fingers are slightly flexed so that the thumb can be moved easily.

When applying a bandage, it is necessary to watch the face of the patient and try not to cause him any additional pain with one's movements. When the bandage is uncomfortable, it should be loosened or the direction of the turns of the bandage changed. A bandage is usually applied clockwise using both hands to take the bandage round the part being bandaged. The bandage roll is unravelled so that each turn overlaps half to two-thirds of the preceding turn (Fig. 9). The whole bandage should be applied according to a plan that depends on

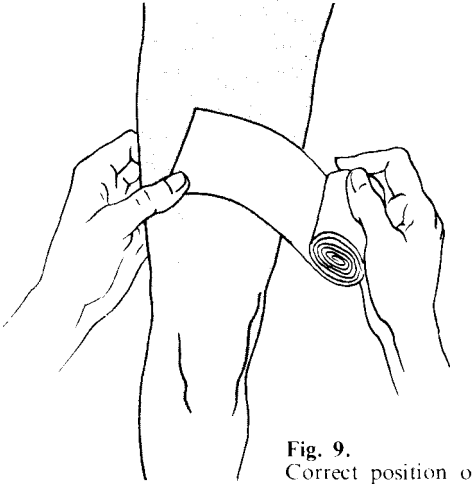


Fig. 9.
Correct position of the bandage

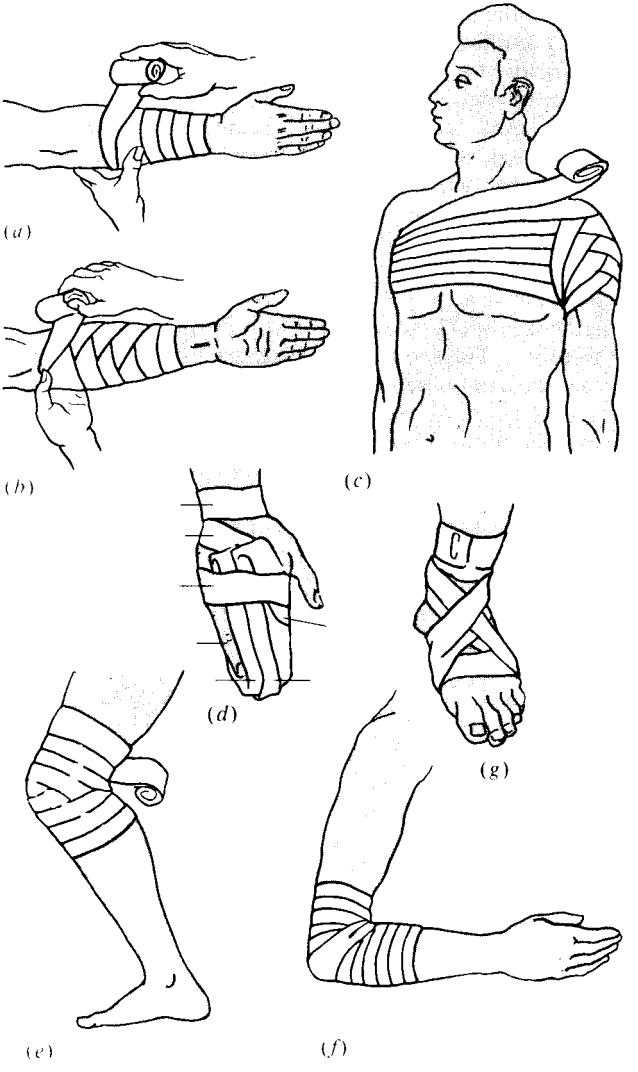
where the wound is so as to make it possible to cover the wound properly and to fix the bandage firmly using the bandaging material economically. The bandage should not cause any circulatory disorders, e.g. paleness of the limb below the bandage, cyanosis, numbness or pulsating pain. An improperly applied bandage should be corrected or a new bandage applied. The end of the bandage should be tied or pinned above a healthy part of the body.

Basic types of bandages. *Circular bandages*: all the turns of the bandage are applied on the same place and they completely overlap each other. Circular bandages are most commonly applied on the wrist, the lower third of the leg, and on the abdomen, neck, and forehead.

A *spiral bandage* is applied when a considerable area of the body should be bandaged. The turns of the bandage are passed somewhat obliquely from bottom to top and each turn overlaps two-thirds of the preceding one. Bandaging is usually started with several circular fixing turns. A spiral bandage is easily applied on parts of the limbs of uniform thickness, but when it is applied on a forearm, for instance, the bandage turns cannot fit smoothly over each other and the bandage wrinkles. In such cases *spirals with reverses* are made (Fig. 10*a* and *b*). The lower edge of the last turn is held with the thumb of the free hand where the wider part of the limb begins and the bandage is turned sharply onto itself at each turn so that its upper edge becomes the lower one. Reverses are made several times and they are more acute the

Fig. 10.
Different types of bandages

a, spiral bandage with reverses; *b*, spiral bandage with reverses applied to the forearm; *c*, spica bandage for the shoulder joint; *d*, convergent bandage on the wrist joint; *e*, divergent bandage on the knee joint; *f*, convergent bandage on the elbow joint; *g*, figure-of-eight bandage on the ankle joint. Figures show in what order the bandage turns are applied


(a)
(b)
(c)
(d)
(e)
(f)
(g)

greater the difference between the diameters of the parts being bandaged.

Figure-of-eight bandage: the turns cross one another in figure of eight. It is a convenient dressing for parts of the body that have complex shapes such as ankles (Fig. 10*g*), shoulder joints, wrists, the back of the head or the perineum. Spica bandages and convergent and divergent bandages are varieties of the figure-of-eight bandage. *Spica bandage*: the place where the turns cross is gradually displaced (Fig. 10*c*). *Convergent and divergent bandages:* the turns forming the figure of eight either approach one another or diverge (Fig. 10*e* and *f*). *Returning bandages* make it possible to fix dressings on the head, limb stumps, or fingers. The turns are applied gradually in the perpendicular planes which is achieved by bending the bandage at right angles. The bend is made in different places to prevent excessive pressure on one place (Fig. 10*d*).

Tubular-net bandages. Elasticized tubular-net medical bandages for fixing dressing on any part of the body are now available. An elastic bandage is a net tube (sleeve) made from elastic, synthetic, and cotton threads. The bandage is very stretchable and can fit over any part of the body, even one with a complex shape. When applied it does not cause circulatory disorders and allows joints to move freely. The bandage does not run when cut or partly incised. The elastic properties of the bandage remain even after laundry and autoclaving at 1.2 atm for 30 minutes. Tubular-net bandages take less time to apply which is done as follows: the fingers of both hands are inserted into the bandage, the bandage is expanded and is put over the body part. When the hands are taken out the bandage contracts, closely fitting and fixing the dressing reliably.

Tubular-net bandages are produced in the Soviet Union in seven sizes to match the sizes of different parts of

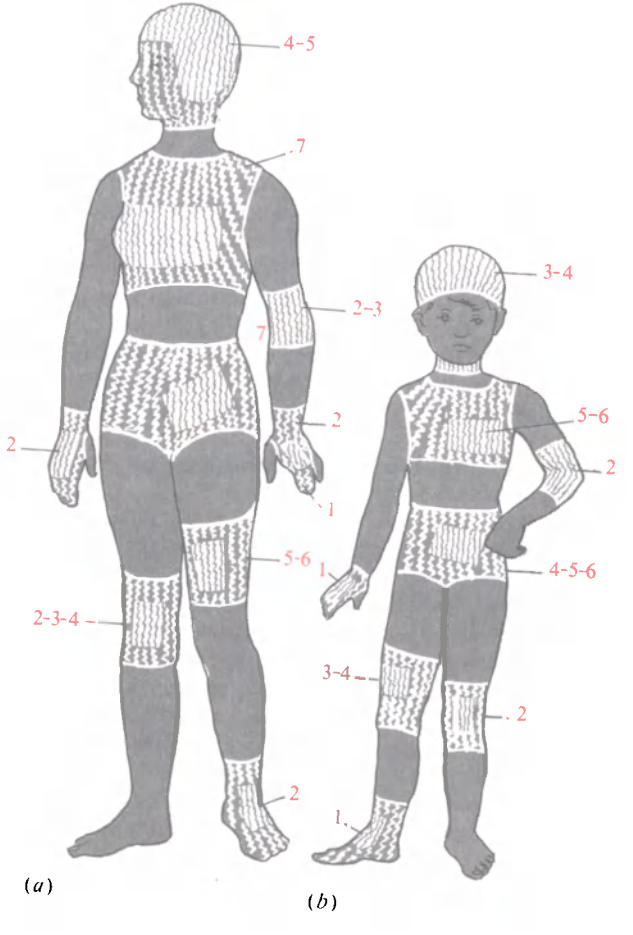


Fig. 11.
Possible variants of applying tubular-net bandages and the numbers of bandages used for adults (*a*) and children (*b*)

the body (Fig. 11). No. 1 bandage (its diameter in its free state is 10 mm) is applied to fingers of adults, to the wrists and feet of children; No. 2 (17 mm) to the wrists, forearms, feet, elbows, radiocarpal joint and ankles of adults, and to the arms, shins and knees of children; No. 3 and No. 4 (25 and 30 mm, respectively) are for the forearms, arms, shins, and knees of adults, and the thighs and heads of children; No. 5 and No. 6 (35 and 40 mm, respectively) are for the heads and thighs of adults, and the chests, abdomen, pelvis and perineum of children; No. 7 (50 mm) is for the chest, abdomen and perineum of adults.

The bandages are destroyed by acids, alkalies, and oils, so they should be washed in soap and not synthetic washing powders. They should not be squeezed dry.

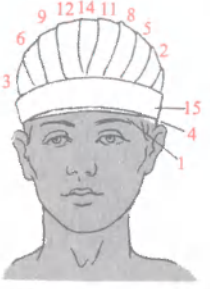
Rules for Applying Soft Bandages on Individual Body Parts

Bandages for the head. A *capeline bandage* (Fig. 12*a*) is commonly applied to cover the hairy part of the head. It is simple and reliable. A piece of a narrow roller bandage (up to 1 m long) is put over the crown of the head so that it hangs down equally on either side in front of the ears. These are held taut either by the patient or an assistant and after the dressing has been applied this roller bandage is used as a fixing tape. Two circular turns of another roller bandage are passed over the forehead and occipital area. The third turn is brought to the fixing tape, the main roller bandage is passed under it after

Fig. 12.
Bandages for the head

a, capeline bandage; *b*, returning capeline bandage; *c*, bandage for one eye; *d*, bandage for both eyes; *e*, bandage for the ear and occiput; *f*, bandage for the occiput and neck; *g*, bandage for the chin and lower jaw; *h*, tubular-net bandage for scalp and neck. Figures show the order in which the bandage's turns are applied

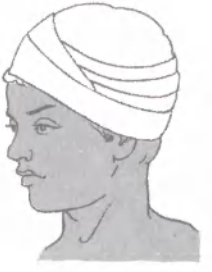
(a)



(b)

(c)

(d)



(e)

(f)

(g)

(h)

which the bandage is passed over the occipital region to the other end of the tape. Here the roller bandage is again passed around the tape and is applied to the frontoparietal area so as to cover the roller bandage by two-thirds. By spanning every time the roller bandage over the tape toward the crown of the head the whole vault of the skull is gradually covered. The end of the roller bandage is tied to one of the tapes after which the ends of the vertically applied tapes are tied up under the chin.

A *returning capeline bandage* is less reliable (Fig. 12*b*). The roller bandage is fixed by two circular turns passed over the forehead and the occiput, the reverse is made in front and the bandage is passed on the lateral surface of the head. In the back the bandage is reversed and is applied on the opposite side of the head. During bandaging the reverses are held by an assistant. After the bandaging is completed they are fixed by a circular turn. The procedure is repeated, each turn being closer to the centre. The bandaging is completed with circular turns. A returning capeline bandage is easily applied by using two bandages: one for fixing the dressing by circular turns and the second one for covering the vault of the skull.

Bandages for the eye. A circular turn is passed around the head. The next turn across the occiput is passed closer to the neck and brought under the ear to the front and up over the eye to the forehead. The third turn is circular and fixing. The next turn is passed obliquely from the occipital area, above the ear and eye to the forehead, and so on. Each oblique turn is displaced to top, finally covering the eye. The bandaging is completed with a circular turn (Fig. 12*c*). The applications for the right and left eyes differ. For the right eye the bandage is applied from left to right, while for the left eye from right to left. When *two eyes are bandaged* the first three turns are applied in the same manner as in bandaging the right eye.

i. e. an oblique turn runs from below under the ear, over the eye to the forehead. The next two turns cover the left eye. The bandage is passed from top to bottom, i.e. from the right parietal area, over the forehead above the eye and under the left ear, and then to the occiput changing to a circular turn. The next turns run above the right eye, and so on (Fig. 12*d*).

The *Neapolitan bandage* (Fig. 12*e*) is most convenient for the ear. The first turn is circular and is passed across the head (over the occiput and the forehead). The next turns on the affected side are gradually lowered. When the ear and the area around the mastoid process have been covered the bandage is fixed with several circular turns.

The *occiput and the neck* can be covered by a figure-of-eight bandage (Fig. 12*f*). Two circular turns are passed round the head. Next the bandage is passed above the left ear to the occiput and is brought out to the anterior surface of the neck under the right of the lower jaw. From below the left of the lower jaw it is passed up over the occiput, above the right ear, to the forehead, and so on. By gradually displacing the place where the oblique turns intersect the whole occiput is covered. When it is necessary to cover the neck, the figure-of-eight turns are supplemented by several circular turns around the neck.

The *lower jaw* can be covered reliably by a trefoil bandage (Fig. 12*g*). The bandage is started by a fixing circular turn around the head (over the forehead and the occiput). The next turn is passed over the occiput and then down the far side to run under the lower jaw. Then several vertical spirals are applied in front of the ears to cover the temporal, parietal and mental areas. When the lower jaw has been supported, the next turn is passed from under the lower jaw up and over the occiput. Next come horizontal turns that are passed across the forehead and the occiput. In order to cover the lower jaw

fully, the bandage is passed obliquely over the occiput and then down the far side of the neck. It is then wound round the lower jaw and neck. After several horizontal spirals have been applied, the bandage is passed down to the chin and several vertical turns are applied over the chin and crown of the head. The bandaging is completed by bringing it up over the occiput and spiralled around the head. A dressing can be reliably secured to any part of the head by a tubular-net elastic bandage (Fig. 12*h*).

Scarf, sling, and contour bandages are convenient and easily applied to the nose, upper lip, chin, and vault of the skull (Figs. 5, 6, and 7).

Bandages for the upper and lower limbs. A figure-of-eight bandage is usually applied to the hand and the wrist (Fig. 13*a*). A returning bandage (see Fig. 10*d*) is used for extensive wounds of the hand and fingers. The bandage is fixed with several spirals at the wrist. Then it is passed over the back of the hand to the index finger, across the palm of the hand, wrapped round the four fingers, then being taken from the base of the index finger back to the wrist. The hand and four fingers are covered by several returning turns, these are then fixed with horizontal spirals beginning from the tips of the fingers and finishing on the wrist. When one finger is bandaged the roller bandage is fixed by several spirals at the wrist. Then it is passed over the back of the hand to the tip of the finger, which is covered by spiralling the bandage from tip to base. When the finger has been covered the bandage is brought out to the back of the hand and is fixed there by several turns above the wrist joint (Fig. 13*b*). A spiral bandage is suitable for the forearm (see Fig. 10*b*) and elbow joint. The forearm is slightly flexed at the elbow. The bandage is fixed by several circular turns just below the joint. Then the bandage is gradually wound round the elbow and the bandaging is completed with several spirals above the joint.

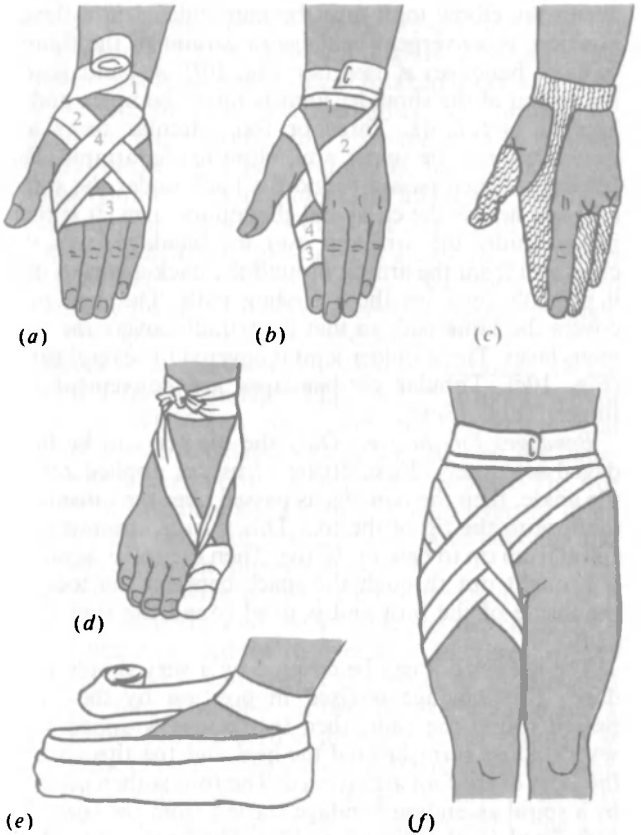


Fig. 13.
Bandages for the upper and lower limbs

a, for the hand and wrist joint; *b*, for the index finger; *c*, tubular-net bandages for the fingers; *d*, for the big toe; *e*, for the foot; *f*, combined bandage for the hip joint, buttock and abdomen. Figures show the order in which the bandage's turns are applied

When the elbow joint must be immobilized in a flexed position, a convergent bandage (a variant of the figure-of-eight bandage) is used (see Fig. 10*f*). A bandage on the region of the shoulder joint is rather complex and is applied as follows. Three or four circular turns are passed around the upper arm, close to the armpit. The bandage is then passed round the back under the other arm and across the chest and the injured arm. It is then passed under the arm and over the bandage from the chest and from the armpit around the back again so that it partially overlaps the preceding path. The next turn covers the same path so that it partially covers the previous layer. The shoulder joint is covered by several turns (Fig. 10*c*). Tubular net-bandages are convenient for fingers (Fig. 13*c*).

Bandages for the feet. Only the big toe can be bandaged separately. First, fixing turns are applied round the ankle, then the bandage is passed over the outside of the foot to the tip of the toe. This turn is covered by a spiral from tip to base of the toe. Then the roller bandage is brought out through the space between the toes on the inside of the foot and is fixed round the shin (Fig. 13*d*).

The whole foot can be covered by a very simple bandage. The bandage is fixed in position by the turns passed round the shin; then the foot is wrapped with several loose turns around the heel and toe tips so that the sides of the foot are covered. The foot is then covered by a spiral ascending bandage started from the toes and completed on the shin (Fig. 13*e*). The knee joint is best covered by a diverging bandage (see Fig. 10*e*).

Bandages for the lower abdomen and the upper third of the thigh do not hold well and may slip off. In such a case, a combined bandage is applied. It covers the abdomen, buttocks and thigh. The bandage is fixed in position round the abdomen by spirals. When the right

thigh is to be bandaged the spirals are directed from left to right and vice versa if the left thigh is to be bandaged. After the last spiral the bandage is taken downward over the sacrum, buttock, and trochanter, and around the back of the thigh. Then it goes up to the front and medial surfaces of the thigh, passes along the back of the thigh, obliquely upward to the pubis, and above the iliac bone round the waist. The next turns are applied in the same manner as the first oblique turn but are displaced slightly upwards. The spiral and spica bandages applied alternately make it possible to cover reliably the thigh, buttocks, groin, and lower abdomen (Fig. 13*f*).

Bandages for the chest. The simplest bandage for the chest is a spiral bandage (Fig. 14*a*). A bandage about 1.5 m long is laid over the shoulder to hang free. Several turns of a roller bandage are then wound over the hanging bandage from bottom to top to the armpits. The free ends of the first bandage are then brought over the other shoulder and tied, fixing reliably the spiral bandage and preventing it from slipping down.

Desault's bandage is most commonly used to fasten the shoulder girdle and the shoulder to the chest. It is used when first aid is rendered in fractures of the shoulder, clavicle and after a reduction of a dislocated shoulder joint. The elbow is bent at a right angle and a cotton wool pad is placed in the armpit. The shoulder is fixed to the chest by several circular turns, directing them from the healthy side to the affected shoulder. The next turn goes from under the armpit of the healthy side and across the chest over the affected shoulder. Then it is taken down the back under the elbow over the forearm to the armpit of the healthy side. The roller bandage is then passed round the back over the affected shoulder, down the front of the shoulder. Then it is passed under the elbow and then brought out across the back to under the armpit thence to the front and across the chest

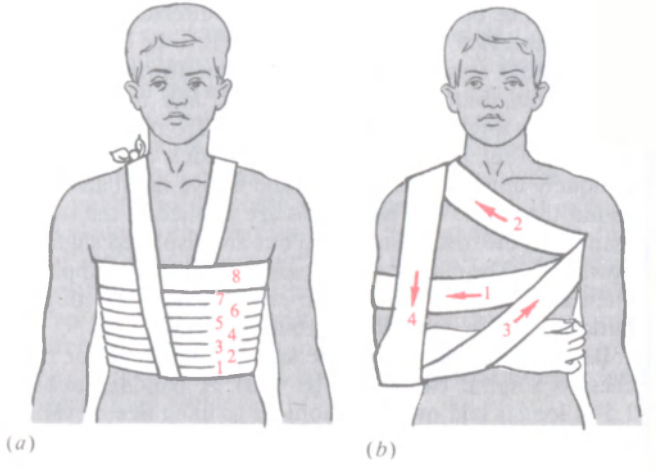


Fig. 14.
Bandages for the chest
a, spiral bandage; *b*, Desault's bandage. Figures show the order in which the bandage's turns are applied

(Fig. 14*b*). The turns marked 2, 3, and 4 in the diagram are repeated several times to fix completely the shoulder girdle. It should be stressed that a Desault bandage never goes over the healthy shoulder while the oblique turns form regular triangles on the anterior and posterior surfaces of the chest.

Tubular-net bandages are easily applied to the chest. Due to their elastic properties they hold any dressing material reliably in place and do not hamper breathing.

Hard Bandages

Plaster of Paris bandages are the best among the hard bandages. They were introduced into surgical practice by Pirogov in 1854. They are made of cotton impregnated

with plaster and are widely used in traumatology and orthopaedics for treating fractures and certain bone diseases. The high plasticity of the plaster when wet enables a firm bandage to be applied to any part of the body.

Plaster bandages are usually left on for long periods of time (until the fracture heals completely) and are changed only when the bandage crumbles or a new one is needed.

Special conditions are required to apply them, while the plaster takes several hours to dry completely. That is why they are not used in rendering first aid. But there are cases when a patient to whom a circular plaster bandage has been applied in an out-patient department may need help. This occurs when the bandage is too tight or when a trauma has caused swelling of the limb and there is a danger that nerves or vessels may be compressed. The last condition is particularly dangerous as it may lead to gangrene of the limb. The condition is attended by growing pain and a cooling of the limb below the plaster bandage. In this case the patient must be immediately taken to a medical establishment. If this is not possible or it would take more than an hour or two to transport the patient then the plaster bandage must be cut off and refixed on the limb with a spiral bandage.

Hard bandages made with a glue, gelatin or dextrin base are even more rarely used for first aid. Recently, specialized first aid ambulances have been supplied with quick-action plastics. Splints modelled from these plastics are hard, comfortable, and immobilize the limbs.

Hard bandages also include *transportation splints* made of wood, wire, or pneumatic splints, or any materials available at the site of an accident. Transportation splints are discussed in more detail in Chapter 3.

Chapter 3

General Principles for Rendering First Aid

An accident or sudden illness often occurs when the necessary medicaments and dressing material are unavailable, and when there are neither assistants nor transportation facilities, and the site of the accident is poorly illuminated. In such cases the composure and activity of the person rendering the first aid acquire particular importance. The life of the victim or the person who has suddenly fallen ill will fully depend on how promptly and skilfully the first aid is rendered. That is why it is essential to know the signs of injury or an illness, and the principles of rendering first aid can be reduced to the following:

1. The actions of the person rendering the first aid have to be expedient, carefully thought out, decisive, rapid, and calm.

2. The situation must be appraised and the necessary measures taken for removing the victim from the hazardous environment (e. g. from the water, burning premises, or premises filled with poisonous gas; burning clothes must be extinguished and the electricity switched off in case of electrocution).

3. The victim's condition has to be established rapidly and correctly. It is necessary to find out when, where, and in what circumstances the trauma or sudden illness occurred. This is particularly significant if the patient is unconscious. Examination of the victim will help reveal his or her condition (whether he is dead or alive), and the type and severity of the injury. Special attention should be paid to any haemorrhaging: whether it has stopped or is still continuing.

4. The method and sequence of measures for render-

ing first aid are established on the basis of the inspection of the victim.

5. It is necessary to find out what means are needed for rendering first aid given the conditions and facilities.

6. The next step is to render the first aid and to prepare the victim for transportation.

7. The helper should keep an eye on the victim until taken to a medical institution.

8. Arrange for transportation of the victim to a medical institution.

9. First aid should be rendered both at the spot of the accident and en route to a medical institution.

Identification of signs of life and signs of death. Severe trauma, electrical injuries, drowning, suffocation, poisoning, and certain diseases may cause a loss of consciousness, i. e. a state when the victim lies motionless, does not answer questions and does not respond to the surroundings. The condition is due to a disturbance in the activity of the central nervous system, mainly the brain, which is the centre of consciousness.

Cerebral activity is deranged when:

(1) there is a direct injury to the brain (contusion, concussion or crushing of the brain, cerebral haemorrhage, or electrical injury) or poisoning, including that caused by alcohol;

(2) the blood supply to the brain has been disrupted (loss of blood, fainting, heart arrest, or severe disturbance of heart activity);

(3) the blood contains too little oxygen (hypoxaemia) or the oxygen supply to the body has ceased (suffocation, drowning, compression of the chest by a load);

(4) the blood is incapable of being saturated with oxygen (poisoning, metabolic disorders such as diabetes or fever);

(5) there is overcooling or overheating of the brain (frostbite, heat stroke, hyperthermia, and in certain illnesses).

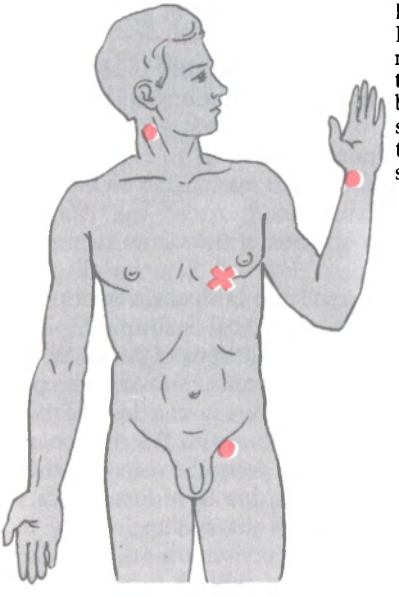


Fig. 15.
Main points of measuring pulse in the arteries shown by dots; heart sounds are auscultated on the body site shown by cross

The person rendering help must rapidly and clearly distinguish between loss of consciousness and death. First aid, and primarily resuscitation, must be resorted to immediately if minor signs of life are found.

Signs of life: (1) cardiac contractions, which are detected by the hand or by listening to the victim's heart by putting an ear on his or her chest around the left nipple;

(2) pulsation of the arteries, which can be felt on the neck (carotid artery), on the wrist (radial artery), or in the groin (femoral artery) (Fig. 15);

(3) breathing which can be seen from excursions of the chest and abdomen or by fogging of the mirror applied to the victim's mouth and nose, or movement of a piece

of cotton wool or gauze applied to the victim's nostrils (Fig. 16);

(4) reaction of pupils to light (direct light reflex). If a flashlamp is shone on the eyes the pupils will contract, i. e. a positive pupil reaction is produced. In the daytime this reaction can be checked by covering the victim's eyes by hand and then quickly withdrawing it. Pupil contraction due to light shows that the person is alive (Fig. 17).

The presence of *signs of life* calls for immediate resuscitation measures.

It should be kept in mind that the *absence of heartbeat, pulse, breathing, or a negative reaction of pupils to light are not evidence of the victim's death.*

The same complex of symptoms may also be observed in clinical death (discussed below) nevertheless aid must be rendered to the victim in full scope.

Application of first aid measures is obviously hopeless when there are apparent *signs of death* which are as follows:

Fig. 16.
Determining signs of life with the help of a mirrow and a piece of cotton wool (explained in the text)

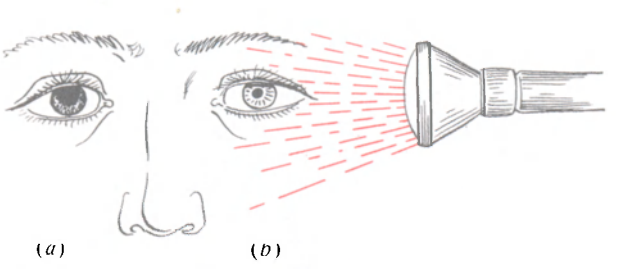


Fig. 17.
Determining reaction of pupils to light (explained in the text)

(1) a cloudy, dry cornea;

(2) cat's eye symptom, i. e. when the sides of an eye can be pressed in by fingers deforming the pupil so that it resembles a cat's eye (Fig. 18);

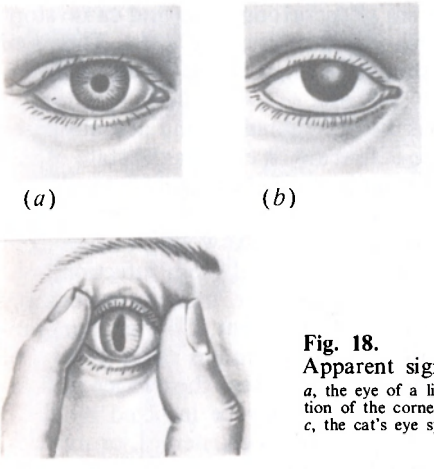
(3) cooling of the body and blue-violet cadaver spots appearing on the skin. In a dead person lying on his back these form around the shoulder blades, loins, and buttocks, and when the corpse is lying on its belly the spots form on the face, neck, chest and belly;

(4) stiffening of the corpse (rigor mortis). This obvious sign of death appears 2 to 4 hours after death.

When the victim's state has been appraised, first aid measures are applied according to the type and severity of the injury and the victim's state. The sequence of actions in various traumas and diseases is discussed in the appropriate chapters.

Anyone rendering first aid must be familiar with its rules and know how to handle the victim so as not to cause him additional harm.

Clothes should be removed in a proper way when the bandage is to be applied to a wound, especially in fractures and haemorrhages and when the victim has thermal or chemical burns or when his clothing is burning. In the presence of injury to the upper limbs, the clothing is first



(*a*) (*b*)

(*c*)

Fig. 18.
Apparent signs of death
a, the eye of a live person; *b*, opacification of the cornea in a dead person; *c*, the cat's eye symptom

removed from the sound arm and then from the injured one supporting it from below and pulling at the sleeve at the same time. If the victim lies on his back and cannot be moved into a sitting position clothing from the chest and the arm is removed in the following order. The shirt (dress or coat) is pulled from the back upwards to the neck and brought to the chest over the head. After that the sleeve is removed from the healthy arm. The next step is to release the injured arm which is done by pulling at the sleeve without turning it inside out. Clothes from the lower part of the trunk are removed in the same manner. When there are severe haemorrhages and burns the clothing must be cut away.

It should be kept in mind that in the presence of wounds, fractures, or burns any awkward movement makes the pain worse when the victim is turned over or shifted. It is still worse when the helper touches the injured area or fractured or dislocated limb. This may

deteriorate the victim's general condition and cause stoppage of the heart, shock, or respiratory arrest. Therefore the injured limb should be lifted very carefully supporting it from below.

Immobilization is the most common and in many cases the main technique of first aid. It ensures the state of rest in the zone of the trauma and lessens pain. Immobilization is an anti-shock measure, especially in fractures of the bones and joints; it prevents the wound's edges from moving apart, protects the wound from infection, and retains bone fragments in contact, which considerably facilitates further surgical treatment. Correct immobilization during transportation promotes rapid healing of the fractures. Immobilization lessens the danger of complications, i. e. damage that may be inflicted by sharp bone fragments on the blood vessels, nerves, or muscles.

Transportation splints. Immobilization is accomplished by fastening stiffeners to the injured body part with roller bandages, belts, or straps.

There are various ready-made splints made of wood, wire, net or plastic. Recently pneumatic (inflatable) splints made of rubber and plastic have been introduced. All ambulances are provided with standard transportation splints. These splints are also available in the first-aid kits in medico-sanitary units, polyclinics, and chemist's shops.

If standard splints are unavailable they may be easily improvized from any hard material at hand – planks, skis, cane, umbrella, and so on.

Diedrich's transportation splint is best used in fractures of the thigh bone and it immobilizes the ankle, knee, and hip joints. The splint consists of two adjustable wooden planks and a wood footing with a twist (Fig. 19). The splint is applied over the clothing and the wooden footing is bandaged to the injured leg (shoes are not removed). The length of the splint is adjusted accord-

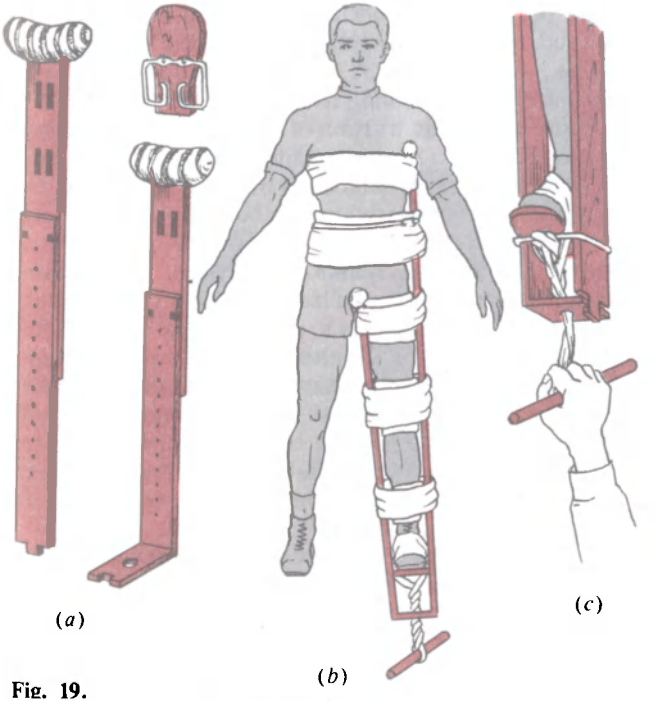


Fig. 19.
Diedrich's transportation splint
a, parts of the splint; *b*, general appearance of the splint; *c*, traction of the limb by means of a twist

ing to the victim's height: the outer part of the splint (the long one) has a little crutch (pad) and push gently into the armpit; the opposite end should be 12-15 cm below the foot; the inner part (the short one) should push into the perineum and be 12-15 cm below the foot. The two side splints are first pushed through the holes in the wooden footing and then adjusted in the armpit and groin. The splints are connected by a hinged transverse

plate beyond the wooden footing. The whole splint is secured to the chest, belly, hip and leg by the belts, straps, and bandages. A strong doubled string is taken from the wooden footing to the connective plate and by twisting it a certain traction of the limb is accomplished.

Another common ready-made transportation splint is Cramer's wire splint, which resembles a ladder. It is 1 m long and 10-15 cm wide and can be easily moulded to fit the part to be splinted (Fig. 20). When a larger splint is needed two or three splints can be used. The forearm, wrist and foot are immobilized by a mesh splint made of soft fine wire which is easy to mould to any shape. A netted splint is used in addition to other splints. Ready-made splints made of plastics, plywood, and cardboard are also available. They are less convenient than wire splints but nevertheless can be used to immobilize the forearm and wrist. It is advisable to pad the wire splints with cotton wool before immobilization to protect the parts that come into contact with them.

Pneumatic (inflatable) splints are very convenient. The inner wall is made of rubber and easily takes the shape of a limb to be splinted and the outer wall is made of hard plastic. The limb is easily immobilized by inflating it (Fig. 21).

Transportation of victims. The prompt and correct transportation of a victim or a patient to a medical institution is the most essential task set before first aid. It must be done safely and carefully, keeping in mind that any pain caused during the transportation will cause complications such as heart and lung disorders and shock. The choice of the transportation method is determined by the victim's condition, the character of the injury or illness, and the available facilities.

In cities and large population centres, victims are best transported by summoning the first aid of a first-aid station. The station sends out a specially equipped car or

Fig. 20.
Wire transportation splints
a, Cramer's splint; *b*, mesh splint

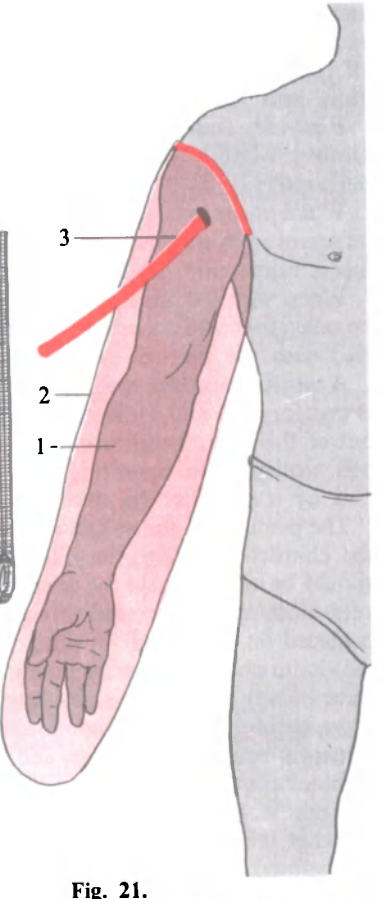


Fig. 21.
Pneumatic (inflatable) splint for immobilization of the upper limb
1, inner wall of the splint; *2*, outer wall of the splint; *3*, nipple through which air is inflated

minibus with places for sitting and for stretchers. The stretchers are easily pushed through the door in the back of the car, and put on a trolley with rollers, directing rails, and special springs to lessen jolting.

First-aid stations may also have air transport to remove victims from remote regions on airplanes or helicopters.

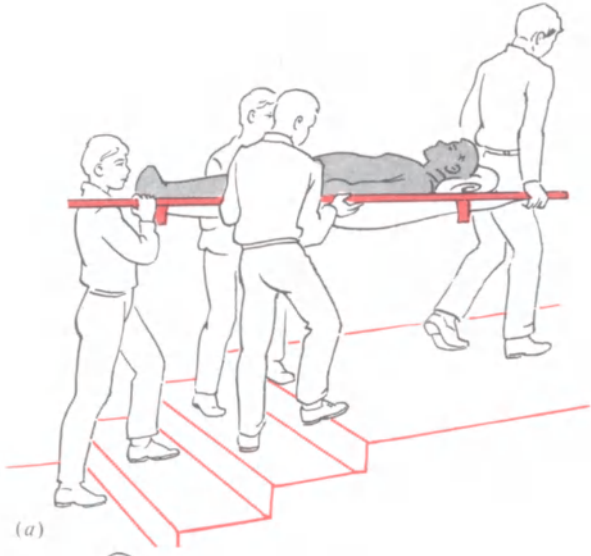
When an ambulance cannot be called the victim has to be removed by any transportation means available be it a lorry, horse cart, sledge or barge.

When wheeled transport is unavailable a victim may be taken to a medical establishment by a stretcher or carried with the help of straps or in the arms.

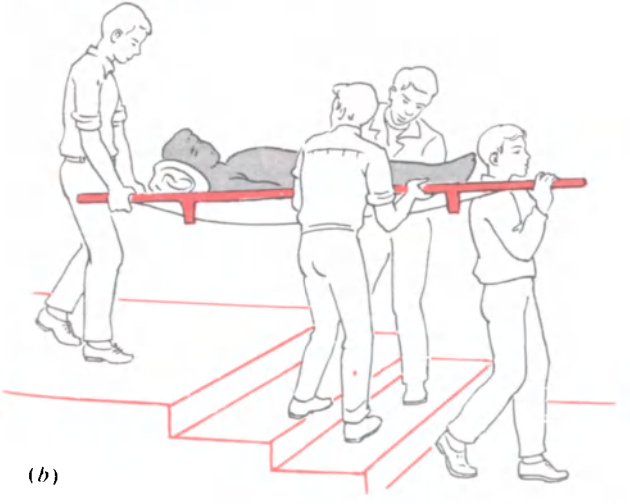
A **medical stretcher** ensures the victim a position which is comfortable and makes it easier to move him in and out of the transportation means or to shift him onto a bed, trolley or the operating table. A victim may be carried by a stretcher by two or four people.

The position of the victim on the stretcher depends on the character of his injury or illness. First of all, he should be comfortable for which purpose pillaws, blankets, clothing or other soft things may be used. A victim is placed on a stretcher by placing the stretcher next to the victim on the side of the injury (given an injury to the spine on any convenient side). Two or three people kneel down beside the victim's sound side, carefully pass their forearms beneath the victim and then lift him. At this moment another person slides the prepared stretcher under the victim, who is then gently lowered onto a stretcher taking particular care of the injured body part. In confined areas (e. g. tunnel, or narrow passage), the stretcher can be set down at the head or foot of the vic-

Fig. 22.
Position of a stretcher when going uphill (*a*) and when descending (*b*)



(*a*)



(*b*)

tim. If the weather is cold he should be warmly covered.

There are certain rules which must be observed when *carrying a victim on a stretcher*. On an even surface he should be carried feet first. If the patient is in a grave condition (e. g. unconscious or bleeding heavily) he should be carried head first so that the end bearer can watch the patient's face in order to be able to help him immediately or stop transportation in case the patient's condition deteriorates. The bearers should not march in step (if there are two bearers they start with opposite feet) and walk unhurriedly, taking short paces and avoiding rough surfaces. The taller bearer should carry the foot end of the stretcher.

When going uphill or upstairs the victim is carried head first and when descending feet first. Victims with fractures of the lower limbs should better be carried feet first when going uphill and head first when descending. The stretcher should be kept horizontally all the time, whether going uphill or downhill. This is done by using the following simple maneuvres. When going uphill the bearer at the foot end of the stretcher lifts it on the level with his shoulders; when going downhill this maneuvre is repeated by the bearer who goes at the head end of the stretcher (Fig. 22).

When carrying patients on long distances the bearer's effort can be made easier by using straps to reduce the load exerted on their hands. A *stretcher strap* is 3.5 m long and 6.5 cm wide made of canvas with a metal clasp on one end for connecting it with another end. A figure-of-eight loop is made of the strap which is adjusted to the bearer's height. The length of the loop should be equal to the span of the arms when spread sideways. The loop is put on the shoulders so that it crosses on the back while the loops hanging on the sides are at the level with the lowered hands (Fig. 23*a* and *b*). The handles of the stretcher are inserted in the loops. The bearer at the head

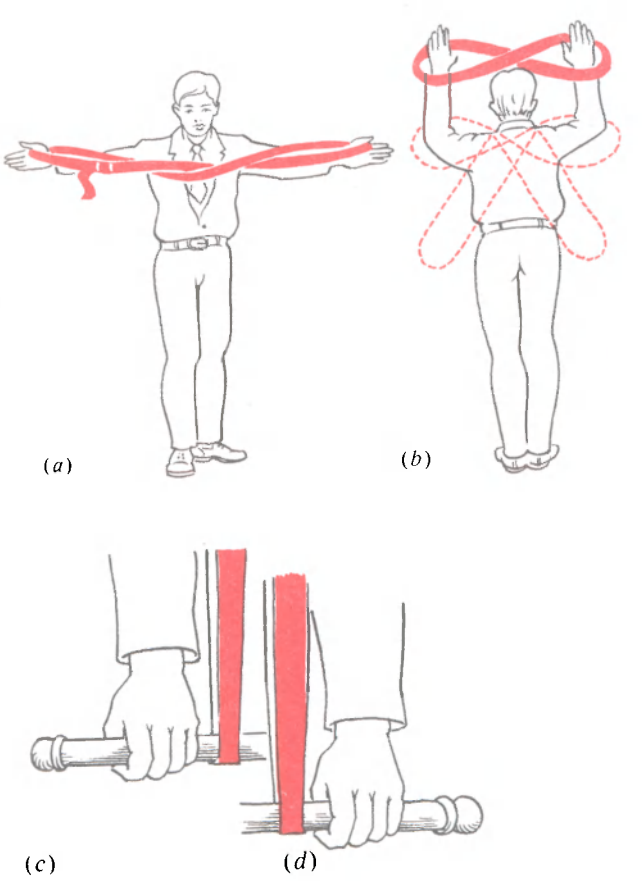


Fig. 23.
Straps for carrying stretcher

a, straps are adjusted according to a bearer's height; *b*, straps are put on; *c*, position of a strap on a stretcher's handles and the hands of the head-end bearer; *d*, position of a strap and the hands of the foot-end bearer

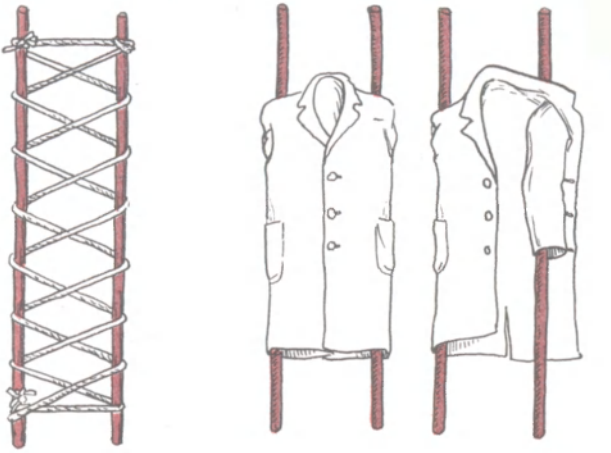


Fig. 24.
Improvized stretchers

end of the stretcher should grasp the stretcher handles in front of the strap while the bearer at the foot end of a stretcher should grasp the handles behind the strap (Figs. 23*c* and *d*).

When a medical stretcher is not available, it can be improvized using a branch, pole, or plank, and a coat, blanket, or sack. The stretcher must be strong enough to withstand the victim's weight (Fig. 24). When a stretcher is improvized from something hard, something soft (hey, grass, clothing) should be put under the victim's back. A strap for the stretcher can be made, for example, of two or three belts, a piece of canvas, sheet, toweling, or a thick rope.

There are cases when the first aid has to be rendered in conditions where no stretcher is available and there is no time to improvize one. The victim has to be carried *in the arms*. A patient can be carried in one's arms, on the back

(piggy-back), or across the shoulder (Fig. 25). When the patient is too weak or unconscious he can be carried in the "arms in front" or "across the shoulders" (fireman's lift). An ordinary piggy-back technique can be used if the patient is conscious and able to hold on. All these methods require great physical strength and are used when the victim is to be carried a short distance. A patient is more easily being carried in the arms when there are two bearers. Unconscious patients are best carried by the "one after another" technique. If the patient is conscious and can hold on he can be carried by the three- or four-handed seat (Fig. 26).

Carrying in the arms is considerably facilitated by the strap (Fig. 27). Sometimes a patient can walk a short distance himself with assistance. The victim's arm goes round the helper's neck while the helper supports the

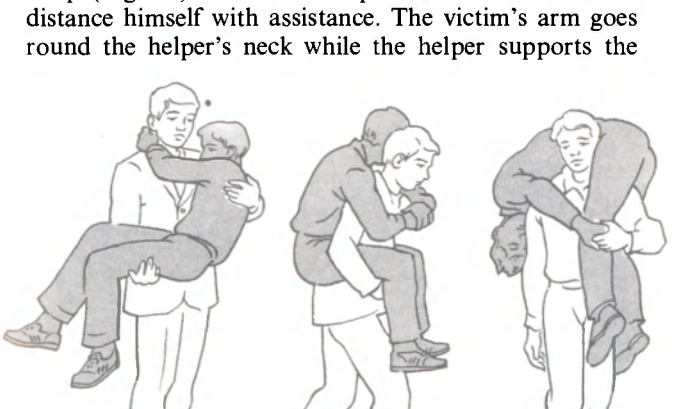
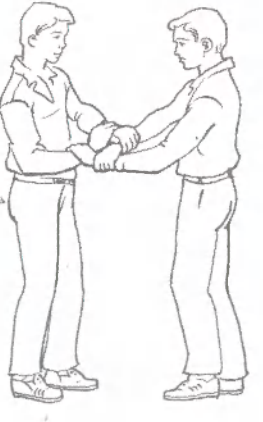


Fig. 25.
A patient is carried by one person
a, in the arms; *b*, on the back; *c*, across the shoulder

(*a*)

(*b*)



(*c*)

Fig. 26.
Methods of carrying victims

a, "one after another"; *b*, a three-handed seat; *c*, a four-handed seat

patient with one arm and holds the patient around the waist or chest with the other (Fig. 28). The victim can gain additional help by supporting himself with a walking stick.

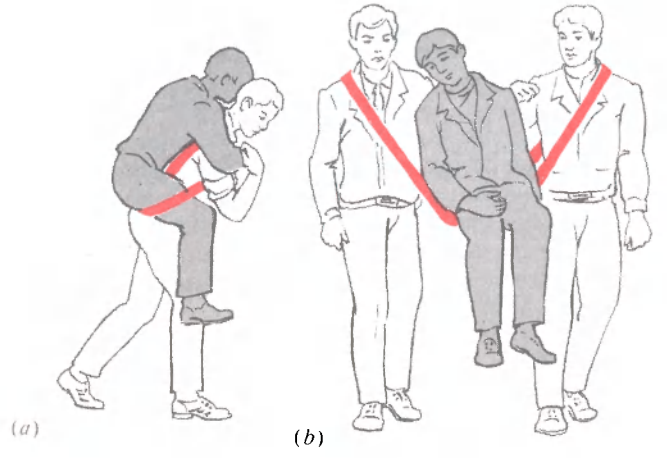


Fig. 27.
A victim is carried using the straps by one bearer (*a*) and by two bearers (*b*)

Fig. 28.
A victim walking with the assistance of one person

When there is only one person to help and the victim cannot walk, he can be transported by means of an improvized sledge, on a piece of canvas or poncho (Fig. 29).

Thus a helper can transport a victim in various conditions using various techniques. The type and localization of the injury or the nature of the illness will determine the type of transportation means and the position in which the patient should be transported or carried.

Position of a victim (patient) during transportation. A victim should be transported in a certain position according to the injury to prevent complications en route. The correct position often saves the victim's life and, as a rule, facilitates more rapid healing. Consequently the *correct placing of a victim during transportation is an essential factor of first aid.*

When the patient is transported lying down the type of the injury or illness determines whether he or she lies on the back, on the back with knees bent, on the back with head lowered and lower limbs raised, on the belly, on the side in a fixed position (Figs. 30*a*, *b*, *c*, *d*, and *e*). Victims with wounds to the head, craniocerebral injuries, damage

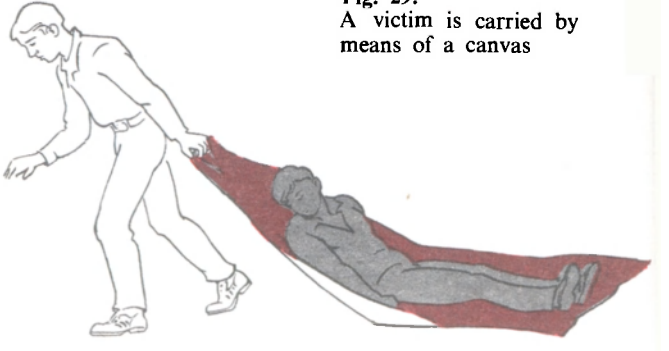


Fig. 29.
A victim is carried by means of a canvas

to the spine, or spinal medulla, or fractures of the pelvic bones or lower limbs should be transported lying down. All patients whose trauma is attended by shock, heavy blood loss, or loss of consciousness (however, short-lived), patients with surgical diseases and injuries to abdominal organs (appendicitis, strangulation of hernia, perforated ulcers) should also be transported lying down.

To prevent asphyxia victims and patients who have lost consciousness are transported lying face down with their foreheads and chests supported by rollers. Many patients may be transported sitting or semi-recumbent (see Figs. 30*f* and *g*).

In cold weather patients should be kept warm since overcooling sharply aggravates their condition and facilitates complications in almost all types of injuries, accidents or sudden illness. Special care should be taken of patients to whom arterial tourniquets have been applied, those who have lost consciousness, or are in a state of shock, and those with frostbite.

Throughout transport a careful watch must be kept on the general condition of the patient, his breathing, and pulse. It is necessary to prevent aspiration of the vomitus into the respiratory tract.

It is essential that the helper should comfort the patient psychologically by his actions, behaviour, and talk, trying to convince him of the favourable outcome.

Sequence of transportation measures in mass accidents. Mass injuries occur in earthquakes, road and railway accidents, fires, and explosions. Successful first aid in these situations depends on entire discipline and order. The emergency cases should be identified first and first aid rendered in the following order: (1) suffocating people; (2) victims with perforating wounds of the chest or abdomen; (3) patients with heavily bleeding wounds; (4) people who have lost consciousness or are in a state of shock; (5) victims with extensive fractures, and finally (6)

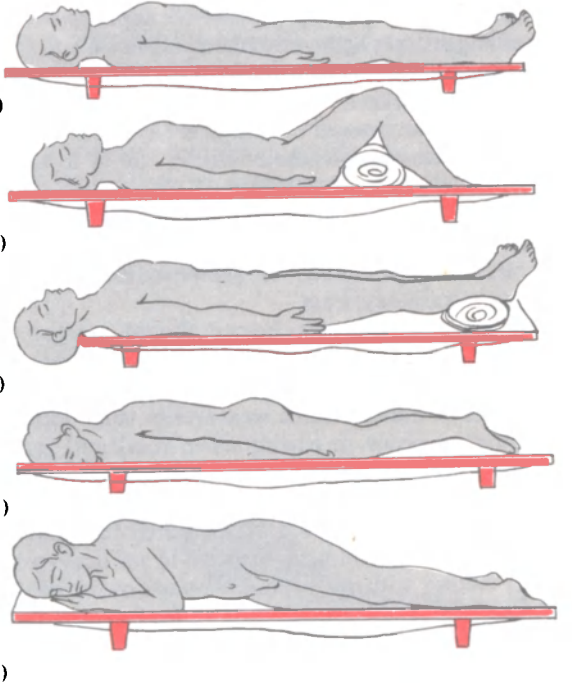
victims with minor wounds or fractures.

The victims should be divided in groups according to the sequence of transportation and severity of the injury.

Group I: victims with perforating wounds of the chest or abdomen, those who have lost consciousness or are in a state of shock, and victims with cranial wounds, internal haemorrhages, amputated limbs, open fractures, or burns.

Group II: victims with closed fractures of the limbs, copious but arrested bleeding.

Group III: victims with minor haemorrhages, small-bone fractures, or contusions.



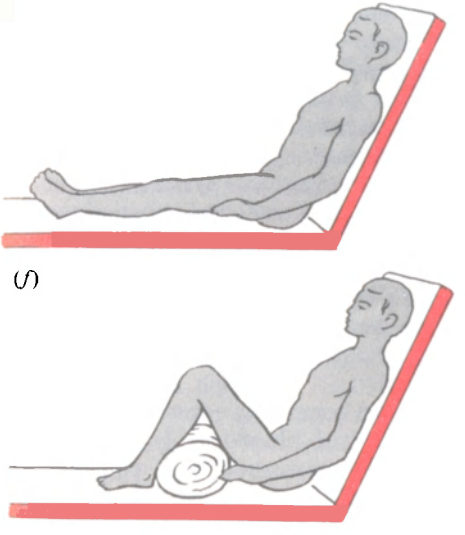


Fig. 30.
The patient's position during transportation
a, lying down on the back; *b*, on the back with knees bent; *c*, on the back with the head lowered and the lower limbs raised; *d*, on the belly; *e*, on the side in a fixed position; *f*, in a sitting position; *g*, in a semi-recumbent position with the knees bent

Young children in each of these groups must be evacuated first and, if possible, with their parents.

Chapter 4
Shock

Extensive wounds, burns, grave injury or illnesses give rise to many factors such as pain, blood loss, or the formation of toxic poisonous substances in the injured tissue which negatively affect the body's vital activity.

These factors *considerably damage the brain and endocrine glands, the organs that control the activity of the whole body. The ensuing disorders are manifested by a very intricate reaction that is known as shock.*

In shock all the vital functions of the body are gradually and drastically inhibited. The activity of the central and vegetative (autonomic) nervous system, circulation, respiration, metabolism, and renal and hepatic function is disturbed. Shock is a condition on the border between life and death, hence only correct and prompt treatment can save the patient's life. According to the cause, shock is classified as traumatic, burn, anaphylactic (due to intolerance of drugs), cardiogenic (in myocardial infarction), septic (in sepsis), etc.

Traumatic shock most commonly occurs in grave traumatic injuries attended with blood loss. It develops due to nervous or physical overexertion, fear, chilling or a chronic disease (tuberculosis, heart and metabolic diseases). Shock is a frequent occurrence among children, who poorly tolerate blood loss, and among old people who are very sensitive to pain stimuli. Traumatic shock may also develop in injuries that are not attended with heavy blood loss, especially in injury to the most sensitive areas known as the reflexogenic zones (thoracic cavity, skull, abdominal cavity, perineum).

Shock may arise immediately after the trauma but late shock is also possible and develops 2 to 4 hours after the trauma if the anti-shock measures were inadequate. The first classical description of the clinical picture of traumatic shock was given by the famous Russian surgeon N. I. Pirogov.

Two phases are distinguished in the course of traumatic shock. The first, **erectile** phase, develops at the moment of the injury. Pain impulses coming from the zone of injury sharply stimulate the nervous system, intensifying metabolism, increasing the blood content of adrenaline,

accelerating breathing, and vascular spasm, and raising the activity of the endocrine glands (pituitary and adrenal). This phase is short-lived and manifested by marked psycho-motor excitement. The organism's defensive forces become rapidly exhausted, with the compensatory mechanisms diminishing. The second, **torpid** phase (inhibition) of shock then sets in. The activities of the nervous system, heart, lungs, liver, and kidneys are typically inhibited. Toxic substances accumulate in the blood and cause vascular and capillary paralysis. The blood pressure drops, and the inflow of blood to organs sharply decreases resulting in oxygen hunger. All these factors may lead to the rapid destruction of nerve cells and the victim's death.

The torpid phase of shock is subdivided into four degrees of severity. *First degree shock (mild)*. This is accompanied by pallor, sometimes mild inhibition, diminished reflexes, and dyspnoea. The patient is usually conscious, though pulse is accelerated to 90-100 per minute, and the blood pressure is about 100 mm Hg.

During *second degree shock (moderate severity)* there is a marked inhibition, weakness, the skin and mucous membranes are pale, and there is acrocyanosis. The skin is covered by a sticky sweat, breathing is accelerated and shallow. The pupils are dilated, pulse is 120-140, and blood pressure 80-70 mm Hg.

Third degree shock (severe). The condition of the patient is grave, consciousness is preserved but he does not respond to the surroundings or to pain stimuli. The skin is covered with a cold sticky sweat, the face is ashen-grey, and the lips, nose, and finger tips are cyanotic. The pulse is thready (140-160), and blood pressure is up to 70 mm Hg. Breathing is shallow, accelerated, though sometimes slow. The patient vomits and may urinate and defaecate uncontrollably.

Fourth degree shock (pre-agonal or agonal state). The

patient is unconscious. The pulse and arterial pressure are not countable. Heart sounds are hardly auscultated. The respiration is agonal, by the air swallowing type.

First aid. Promptly applied first aid in severe trauma or injury may prevent the development of shock. **It is more effective the earlier it is started.** First, the causes of shock should be removed (alleviation or diminution of pain, arrest of haemorrhage, application of measures to improve respiration and cardiac activity and to prevent general chilling). Pain can be alleviated by placing the patient or the injured limb in a most comfortable position or by immobilizing the injured part of the body. If possible, the pain should be lessened by the administration of analgesics, soporifics, tranquilizers and sedatives: analgin, amidopyrine, diazepam (seduxen), trioxazin. If analgesics are unavailable the victim may be given a sip of alcohol, vodka, or wine. The doctor in the ambulance or at the hospital where the victim is admitted should be notified of this fact.

Shock cannot be controlled whilst a patient is still haemorrhaging. The haemorrhage should be rapidly arrested by applying a tourniquet, pressing bandage, or by some other means. In heavy blood loss the patient must be placed in the position that is conducive to the improvement of blood supply to the brain (see Chapter 6).

In order to improve breathing one should remove any clothing that is hampering respiration, make sure (if necessary) that there is fresh air, and put the victim in a position that makes breathing easier. Administration of cardiac stimulants is expedient: 20-30 drops of lantoside, 1-2 tablespoonfuls of Bekhterev's mixture, 15-20 drops (or 1 tablet) of adonizid, 15-20 drops of convalariae tincture, or convalariae + valerianae tincture.

A victim in a state of shock should be warmed and if no internal organs are damaged be given plenty to drink: hot tea, coffee, or water.

Prompt transportation of victims to a hospital is the next essential step of first aid. A patient in a state of shock should be transported to a hospital, taking special care of his condition so as neither to cause him additional pain nor to aggravate the severity of the shock. It is best to use for this purpose a specially equipped reanimation ambulance where facilities are available for controlling disorders of the nervous system and alleviating the pain by administering morphine, omnopon, promedole, nitrous oxide anaesthesia, or a procaine blockade.

Compensation for the lost blood volume is the main measure when shock is a result of blood loss. It is made up by administering blood substitutes (polyglucin, haemodes, gelatinol), or transfusing blood, glucose solution, or isotonic sodium chloride solution. All these measures have to be started in the reanimation ambulance. The administration of adrenaline, noradrenaline, or phenylephrine hydrochloride in shock is not advisable and even dangerous since these drugs constrict the blood vessels and if the blood volume has not been compensated deteriorate the blood supply to the brain, heart, kidneys, and liver. Reanimation ambulances have facilities for controlling respiratory disorders and, in grave cases, for beginning artificial ventilation of the lungs.

Resuscitation measures (heart massage and artificial respiration) may be needed in the terminal stages of shock (see Chapter 5).

One should keep in mind that **it is easier to prevent shock than to treat it.** That is why five principles of prophylaxis should be observed in rendering first aid: alleviate pains; administer liquids; warm the victim; create conditions for rest and calm; and carefully transport.

Chapter 5

Principles and Methods of Resuscitation

Attempts to bring a dying man to life have been known since the dawn of civilization. Early writers have described the revival of people apparently dead from drowning by using artificial respiration.

Vesalius and Harvey, the Renaissance physicians, studied the problems related to the mechanisms of death and strived to prolong the life of a dying man by using artificial techniques. However, only the scientific and technical progress of the last decades have enabled the emergence of the new science, **reanimatology** (L *re* again, *animus* mind). Soviet scientists, in particular Prof. V. A. Negovsky and his school, have greatly contributed to the development of reanimatology which became one of the leading clinical disciplines. Methods of reanimatology are now widely used in medical practice. Clinical reanimatology is closely related to physiology, pathological anatomy, surgery, therapy and other medical specialities. Reanimatology is the study of the mechanisms and processes that set in in dying and the development of a terminal state, and the elaboration and introduction into clinical practice methods for combating death.

It has been established that the human body continues to live even after respiration and cardiac activity have ceased, although cells are in fact no longer supplied with oxygen and without it the living organism cannot function. The tissues differently respond to the lack of blood and oxygen and die at different time. Consequently, *the timely restoration of blood circulation and respiration by using the combination of measures which are known as*

resuscitation can bring a patient to life from a terminal state.

Terminal states may be due to various factors, e. g. shock, myocardial infarction, massive blood loss, obstruction of the airways or asphyxia, electrocution, drowning, falling debris, and so on. Three phases are distinguished in the **terminal state**: (1) the pre-agonal state, (2) agony, and (3) clinical death.

In the *pre-agonal state*, consciousness is still retained but it is clouded. Blood pressure drops to zero, pulse is drastically accelerated and thready, respiration is shallow and difficult, the skin is pale.

Throughout the *agony* the blood pressure and pulse are uncountable, eye reflexes (corneal, and the pupil's reaction to light) disappear, and respiration is of the air swallowing type.

Clinical death is a short-term (3-6 minutes) transitory stage between life and death. Respiration and cardiac activity cease, the pupils are dilated, the skin is cold, and the reflexes are absent. The vital functions can still be restored during this period by resuscitation techniques. Later, irreversible changes in the tissues set in and **clinical death** transforms into **true biological death**.

Disturbances in the Organism in Terminal States

A terminal state, whatever its cause, gives rise to general changes in the organism. An understanding of their effect on the body helps explain the essence and expediency of resuscitation methods. The organs and systems of the body (brain, heart, metabolism) are changed and the different organs are altered at different periods of time. Since the organs still continue to function after respiration and cardiac activity have ceased it is possible to revive a patient using current methods of resuscitation.

The cerebral cortex is the most sensitive to hypoxia or hypoxaemia, i.e. a low oxygen content in the tissues and blood, therefore in terminal state the first functions to be switched off are those of the higher part of the central nervous system, i. e. cerebral cortex. With the cessation of the oxygen supply to the brain, consciousness is lost. If the oxygen hunger lasts longer than 3 or 4 minutes, cerebral activity cannot be restored, and is also lost. Next come changes in the subcortex. The last to die is the medulla oblongata where the automated respiratory and circulatory centres are located. Irreversible death of the brain sets in.

Growing hypoxaemia and the functional disorders of the brain give rise to cardiovascular disturbances. The pumping function of the heart in the pre-agonal state is sharply diminished, and the amount of blood ejected by the heart, i. e. the cardiac output, is also decreased. The diminished blood supply to the organs, and especially to the brain, is responsible for the development of the irreversible changes. Since the heart possesses its own automaticity cardiac contractions may continue for some time. They are inadequate, however, and their effect is small as a result of which the pulse filling decreases and it becomes thready, blood pressure sharply diminishes and soon becomes uncountable. Later the rhythm of the cardiac contractions becomes markedly impaired and cardiac activity finally ceases.

Throughout the pre-agonal state (initial phase of the terminal state) the respiration accelerates and becomes deeper. During the period of agony the blood pressure drops, and the respiration becomes irregular and shallow and finally ceases, which is followed by a terminal state.

The liver and kidneys also respond to hypoxia: long-term oxygen hunger causes irreversible changes in them.

Drastic metabolic changes are typical in all the terminal states. They are displayed by reduced oxidative

processes and the accumulation in the body of organic acids (lactic and pyruvic) and carbon dioxide. As a result the acid-alkaline equilibrium is impaired. In normal conditions the blood and tissues have a neutral pH. The fading oxidative processes throughout the terminal state are responsible for a shift of the reaction into the acid side and acidosis sets in. The more prolonged the period of dying the more pronounced is this shift.

When the organism is brought out of the state of clinical death, the first to be restored is cardiac activity, then natural respiration, and only when the drastic changes in the metabolism and the acid-alkaline state disappear may the cerebral function be restored. The period during which the cerebral cortex is functionally restored is most protracted. Consciousness may not be regained for a long time even after short-term hypoxia and clinical death.

Essentials of Resuscitation

The control of hypoxia and the stimulation of the organism's fading functions are the main tasks in the resuscitation of a patient who is in a state of clinical death. Depending on how quickly they are started, resuscitation measures may be classified into two groups: (1) the maintenance of artificial respiration and artificial blood circulation, and (2) intensive therapy to restore independent circulation and respiration and central nervous, liver, kidney and metabolic functions.

Resuscitation in Respiratory Arrest

The need for artificial respiration or, to be more correct, the *artificial ventilation of the lungs*, arises during asphyxia due to the obstruction of the airways by foreign bodies, or after drowning, electrocution, drug or toxic

poisoning, cerebral haemorrhages, or traumatic shock. *Artificial respiration is the sole method for treating all states when the patient's independent respiration is unable to provide adequate saturation of the blood with oxygen.*

Acute respiratory insufficiency may develop indirectly as a consequence of circulatory disorders, a heart stoppage, for example.

Acute respiratory insufficiency and its extreme degree, respiratory arrest, whatever the cause, are responsible for a decrease in the oxygen content in the body (hypoxia) and the undue accumulation of carbon dioxide in the blood and tissues (hypercapnia). Hypoxia and hypercapnia give rise to grave functional disorders of all the organs, which can be relieved by timely resuscitation, i. e. artificial ventilation of the lungs.

There are many methods for artificial ventilation of the lungs. Recently the Silvester and Schaefer methods have come to be used only in rare cases. They are less effective than artificial respiration based on the principle of blowing air into the lungs (the expired air method). The two methods are used in injuries to the face and must not be used in injuries to the chest. The Silvester method is not used if the airways are obstructed after drowning.

Artificial respiration by the expired air method can be accomplished by several techniques. The simplest are the mouth-to-mouth or mouth-to-nose methods. Recently a manual device for artificial respiration has been developed. It consists of a resilient rubber bag and a mask (Fig. 31). This respirator should be available in any medical establishment and medical and obstetric units. Special complex respirators are used in hospitals for artificial ventilation and ambulances and first-aid stations on beaches have portable respirators.

The mouth-to-mouth or mouth-to-nose technique for the artificial ventilation of the lungs. The patient is laid flat on

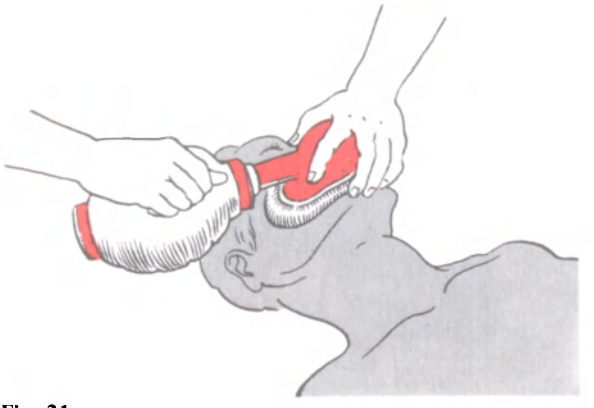


Fig. 31.
Artificial ventilation of the lungs by means of a respirator

his back, tight clothing on the chest is loosened. The next step is to remove quickly anything from the mouth or throat using fingers, or a napkin or kerchief, or an aspirator (Fig. 32). A rubber syringe with a thin cut tip can be used for the purpose. In order to free the airways the

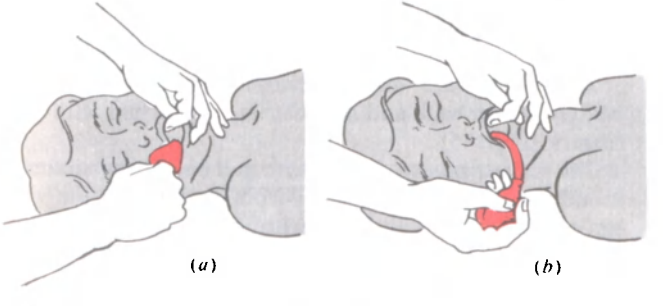


Fig. 32.
Foreign bodies, mucus or vomit are removed by fingers (*a*) and by aspirator (*b*)

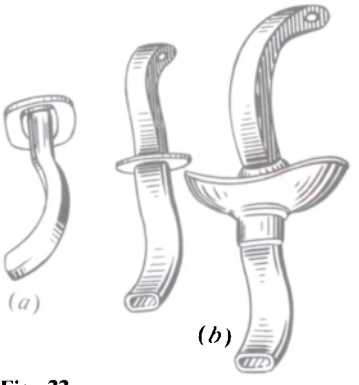


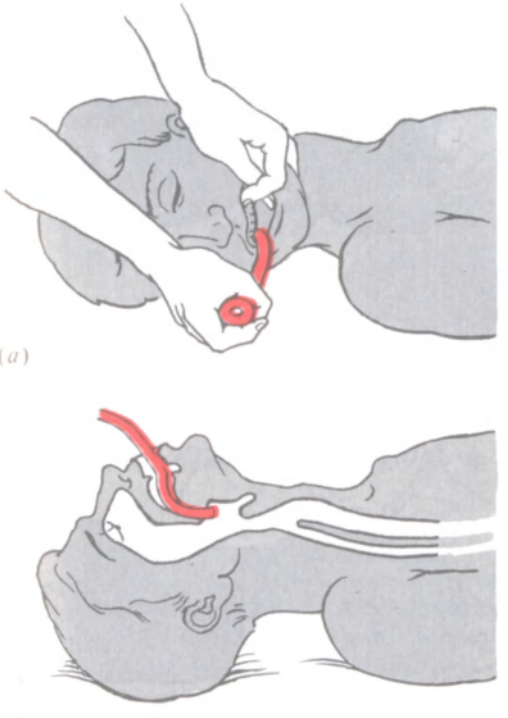
Fig. 33.
Airways used in artificial ventilation of the lungs
a, common airway; *b*, double airways for mouth-to-mouth artificial respiration

victim's head must be tilted backwards. One must bear in mind that undue tilting of the head may constrict the air passages. Then the victim's lower jaw is advanced forward to aid the passage of air into the respiratory tract. If there is some appliance (airway) (Fig. 33) it should be introduced into the throat to prevent the tongue from retracting (Fig. 34), otherwise the victim's head should be held tilted, the lower jaw being advanced forward.

Mouth-to-mouth artificial respiration. The victim's head is drawn back and his nostrils are pinched with the fingers (Fig. 35).

The rescuer takes a deep breath and covers the victim's mouth with his own, blows air from his lungs in the victim's. The victim will expire without aid because of the elasticity of his chest. The number of breaths per minute should be around 16-20. The air must be blown quickly and energetically (less so in children) so that the duration of each inhalation is twice that of each expiration.

Certain rules have to be observed so that the inhaled



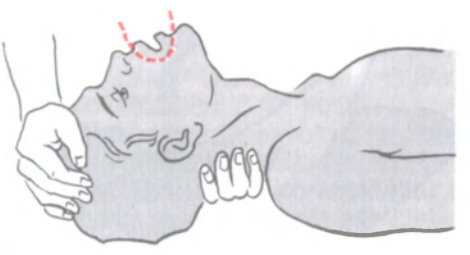
(*a*)

(*b*)

Fig. 34.
An airway introduced correctly into the mouth and throat (*a*) and schematical representation of the position of an airway in the mouth and throat (*b*)

air does not inflate the stomach too much, as there is a danger of food masses getting into the bronchi.

The mouth-to-mouth method has some disadvantages because it is unhygienic. In order to avoid direct contact with the mouth of the victim the air may be blown



(*a*)

(*b*)

Fig. 35.
Artificial ventilation of the lungs using the mouth-to-mouth technique
a, position of the victim's head; *b*, blowing air through the mouth

through a gauze napkin, or kerchief, or some other piece of cloth. Airways can be used for the purpose (Fig. 36).

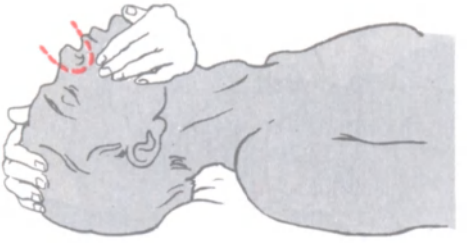
Mouth-to-nose technique. The air is blown through the nose, the victim's mouth being closed with the rescuer's hand, which is simultaneously shifting the lower jaw upwards to prevent the tongue from retracting (Fig. 37).

Fig. 36.
Artificial ventilation of the lungs through an airway

Artificial ventilation of the lungs using portable (manual) respirators. Patency of the respiratory tract is first provided (as described above) and the airway is introduced into the mouth. The mask is snugly fitted to the victim's nose and mouth (see Fig. 31), expiration is accomplished through a valve in the bag so that the duration of the exhalation is twice that of inhalation.

The effectiveness of the artificial ventilation of the lungs, using any of the techniques, can be assessed by the excursions of the chest. *Artificial respiration is started only after the respiratory tract has been freed of foreign bodies or food.*

Ventilating the lungs using one of the techniques described should not be carried out for a long period of time and should be used as a first aid measure during transportation, so resuscitation (heart massage and artificial respiration) needs to be continued. It is necessary to



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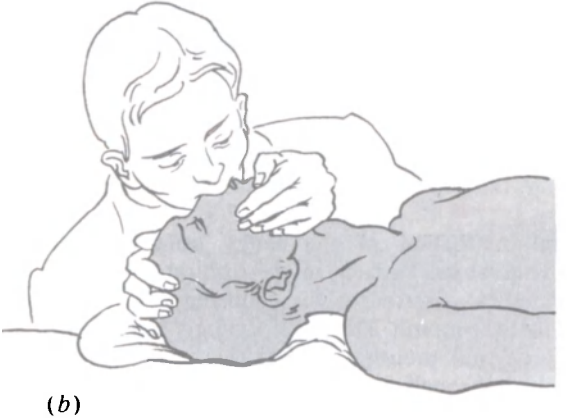


(*b*)

Fig. 37.
Artificial ventilation of the lungs by the mouth-to-nose technique
a, position of the victim's head; *b*, blowing air through the nose

summon an ambulance and take the victim into a medical institution where he will be given skilled aid.

Ambulances are supplied with all necessary facilities for conducting tracheal intubation and artificial machine respiration.

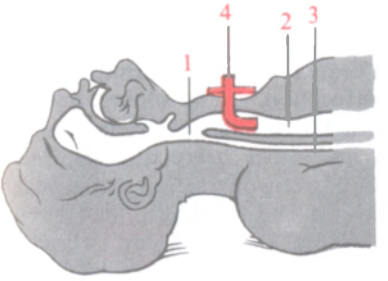


Fig. 38.
Tracheostomy
1, larynx; *2*, trachea; *3*, oesophagus; *4*, a tracheostomy tube

Intubation of the trachea is obligatory when the artificial ventilation of the lungs must continue for a long time. An endotracheal tube is introduced into the trachea by a laryngoscope. Tracheal intubation is the best technique for maintaining free patency of the respiratory tract. It prevents the tongue from blocking the back of the throat and vomit from getting into the lungs. An endotracheal tube makes it possible to conduct mouth-to-tube artificial respiration and to ventilate the lungs with a respirator. These machines can ventilate the lungs for days and even months. Tracheostomy is resorted to when the artificial respiration must be maintained for 3 or 4 days.

Tracheostomy is an emergency operation to introduce into the trachea a tube through an incision made in the anterior surface of the neck. It may also be used in cases of asphyxia due to diphtheria or false croup, or when it is caused by foreign bodies clogging the throat or when the throat is injured (Fig. 38).

Any tube can be used (the neck of the teapot, a roll or a metal tube) when a special tracheotomy tube is unavailable. The wound rapidly heals after the tube has been removed.

Resuscitation in a Circulatory arrest

Cardiac activity can cease for various reasons among which are drowning, suffocation, gas poisoning, injuries due to electric shock or lightning, cerebral haemorrhage, myocardial infarction and other heart diseases, heat stroke, loss of the blood, a strong direct blow to the heart area, burns, and frostbite. The condition may occur anywhere: in a hospital, dental ward, at home, or during work. In any cases the rescuer has only 3 or 4 minutes during which he has to establish the diagnosis and restore the blood supply to the brain. There are two types of heart stoppage: (1) *asystole* (a true stoppage of the heart), and (2) *ventricular fibrillation* when certain cardiac muscles contract in a chaotic uncoordinated manner. In both cases the heart stops pumping blood and the blood flow in the vessels ceases.

The *main symptoms of stoppage of the heart* that allow prompt diagnosis are as follows: (1) loss of consciousness; (2) absence of pulse in the carotid and femoral arteries; (3) absence of heart sounds; (4) respiratory arrest; (5) pallor or cyanosis of the skin and mucous membranes; (6) dilation of the pupils; and (7) convulsions which may appear at the moment consciousness is lost and be the first symptoms of heart arrest.

These symptoms clearly testify to circulatory arrest and leave no time for any additional inspection of the victim (measurement of blood pressure or pulse rate) or for searching for a doctor. Urgent resuscitation (heart massage and artificial respiration) is obligatory in such cases. It should be kept in mind that *heart massage must be done at the same time as artificial respiration* due to which the circulating blood is saturated with oxygen. Otherwise, the resuscitation becomes useless.

Two types of heart massage are now used: open or direct, which is performed only during operations on the

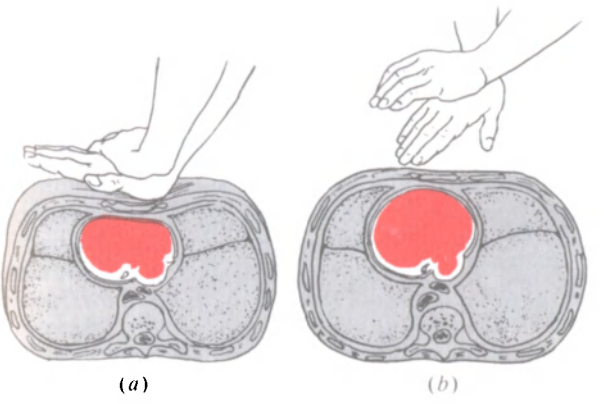
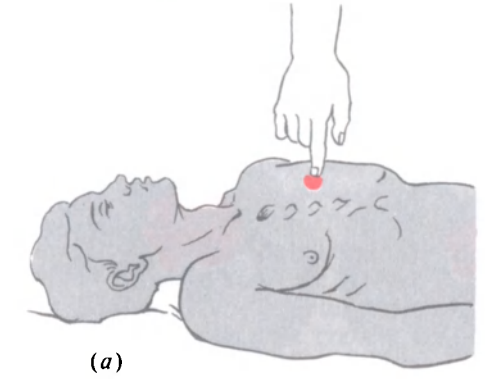


Fig. 39.
Mechanism of external heart massage
a, artificial systole (heart contraction); *b*, diastole (relaxation and blood filling of the ventricles)

thoracic cavity, and closed, external, which is done through the intact thoracic cage.

External heart massage techniques. External heart massage is essentially a rhythmical compression of the heart between the sternum and the spine. Blood is expelled (squeezed out) from the left ventricle into the aorta and flows from it throughout the body and enters different organs, and in particular the brain. Blood from the right ventricle simultaneously passes into the lungs where it is saturated with oxygen. When the pressure on the sternum is released the heart cavities are filled again with blood (Fig. 39). In order to apply external heart massage the patient is laid flat on his back on a hard base (floor, ground) and not on a mat or something soft. The helper kneels beside the patient and places his hands on the lower third of the sternum, i. e. two fingers' width above the xyphoid process (Fig. 40). He presses down on the lower sternum with the palms of his hands placed one



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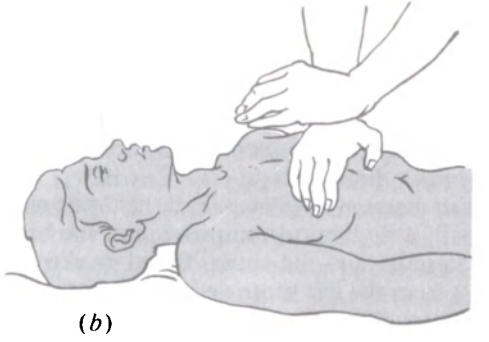

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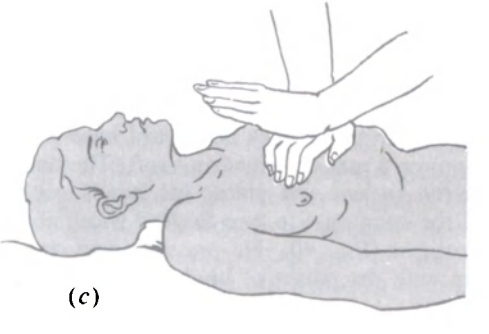


(*c*)

Fig. 40.
Techniques of external heart massage
a, position of the hands; *b*, *c*, correct position of the hands during heart massage

over another. Sufficient pressure is applied to push the sternum 4 or 5 cm down towards the spine. The rate of compressions should be at least 50 to 70 per minute. When resuscitating children the massage is performed with one hand while for the newborn and infants only the tips of two fingers placed on the lower end of the sternum are needed. The rate of compressions should be 100 to 120 per minute. The strength of the arms and trunk must be used when massaging adults. It requires considerable physical endurance and is tiresome. The following sequence of actions can be used when the resuscitation is done by one person (I) or by two (II). I. The sternum is compressed 15 times with 1-second intervals; the mas-

Fig. 41.
Artificial respiration and external heart massage conducted at the same time

sage is stopped; two forceful inhalations are done by the mouth-to-mouth or mouth-to-nose techniques or with a respirator; or II, one inhalation is done for every 5 compressions of the sternum (Fig. 41).

If the massage is effective the following signs appear: (1) a pulse is distinct in the carotid and femoral arteries; (2) the blood pressure rises to 60-80 mm Hg; (3) the pupils contract and the light reflex appears; (4) cyanosis and "mortal" pallor fade away; (5) natural respiration is subsequently restored.

It should be kept in mind that uncontrolled external heart massage may cause grave complications such as fracture of the ribs with damage to the lungs and heart. Forceful pressure on the xyphoid process may rupture the stomach or liver. Special care must be taken when heart massage is performed on children and middle-aged people.

The resuscitation may be considered inexpedient and stopped if irreversible changes in the body or brain death have occurred. This is shown by the following signs: heart massage, artificial respiration, and drug therapy performed for 30-40 minutes have produced no results; cardiac activity remains unrestored; the pupils remain dilated, and there is no reflex to light. When there are true signs of death (see Chapter 3) resuscitation may be stopped earlier.

Resuscitation is useless and should not even be begun in certain grave diseases and traumatic injuries (malignant tumour with metastasis, serious cranial injury with crushing of the brain).

In other cases of sudden death there is always the hope of bringing the patient to life, and every possible measure should be taken. Patients with respiratory or cardiac arrest may be removed to a hospital only after their cardiac activity and respiration have been restored. They

must be transported in a special first-aid ambulance where the resuscitation can be continued en route.

Intensive Therapy

Artificial ventilation of the lungs and heart massage are only the initial stages in the complex of measures designed to restore independent circulation, respiration, and the function of the brain and other organs. The effectiveness of resuscitation is determined by many factors: timely application of emergency measures, correct diagnosis of the terminal state, and application of the relevant drug and infusion therapy. Electrocardiographic examination will help identify the cause of circulatory arrest. The ECG patterns in asystole and ventricular fibrillation are quite different and every medical worker should be familiar with their specific features (Fig. 42).

Fibrillation may be treated by special defibrillators. This is an electric condenser that can create an electric discharge of several thousand volts. Safety rules must be observed in handling defibrillator. A 3000-7000 V discharge can relieve cardiac fibrillation through an unopened thoracic cage. Recently specialized reanimatological vans have been supplied with defibrillators.

Drug therapy for terminal states and clinical death is usually started by the medical team that arrives in the reanimatological van to the scene of the accident. The medicaments are aimed at restoring the metabolism of the heart, increasing its contractile capacity, alleviating the disturbances in the acid-base equilibrium (acidosis) that are attendant to circulatory arrest, preventing the complications inherent in the post-reanimation period, brain oedema in particular.

In order to restore cardiac activity, adrenaline is administered. It produces a strong action on the heart muscle and should be given together with cardiac massage. Adrenaline is injected directly into the heart or in-

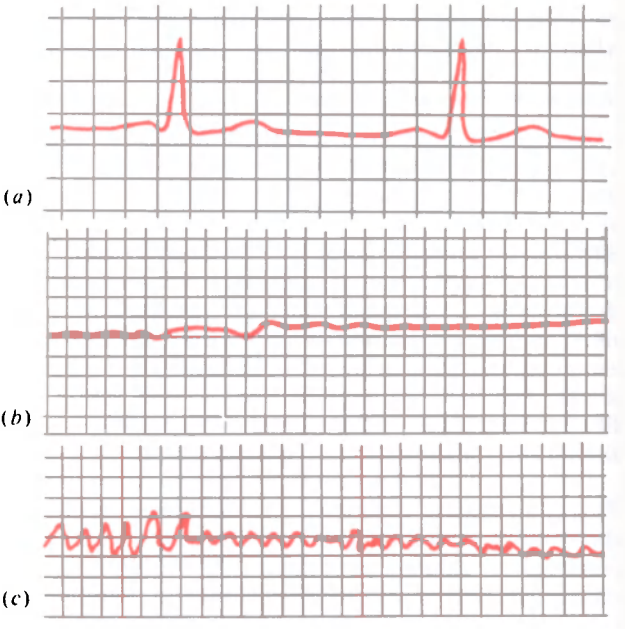


Fig. 42.
Electrocardiogram
a, normal: *b*, asystole; *c*, ventricular fibrillation

travenously in a dose of 0.5 ml of a 0.1 per cent solution diluted in 5 ml of isotonic sodium chloride or glucose solution. Ephedrine hydrochloride, phenylephrine hydrochloride, and noradrenaline are also used. Calcium chloride and calcium gluconate also produce a good effect. They intensify the cardiac contractions and are effective in cardiac arrest: 5-10 ml of 10 per cent calcium chloride is sometimes administered to the heart together with adrenaline. Procainamide hydrochloride is also used in resuscitation, especially in cases of ventricular

fibrillation and prior to defibrillation; sometimes it even relieves the cardiac fibrillation.

It should be kept in mind that resuscitation and drug therapy are ineffective when there is acidosis. A 4-8 per cent sodium hydrocarbonate solution should be administered as soon as possible to reduce acidosis. Injection of B complex vitamins, ascorbic acid, cocarboxylase hydrochloride, and prednisolone is essential since these drugs affect the metabolism, correct acidosis, and restore cardiac activity. *Preparations that stimulate respiration and the central nervous system (cordiamin, lobelin, cytiton, strychnin) should not be used* because they enhance metabolism of the cells and increase their demand in oxygen, thus weakening their resistance to hypoxia. *During resuscitation all drugs are administered either intravenously or directly into the heart.* Since subcutaneous fat and the muscles have no blood flow, injections under the skin or into the muscles are ineffective and if the drugs are then absorbed after the normal circulation has been restored grave consequences may ensue. That is why venipuncture or catheterization of the vein is performed. Recently the major vessels that are located near the heart (subclavian or jugular veins) have been catheterized. In order to administer drugs during resuscitation heart massage and artificial respiration should be stopped for no more than 10-15 seconds.

Massive infusion therapy is the basic measure used in the intensive therapy in the postreanimation period. It includes the transfusion of blood or blood substitutes, solutions of electrolytes and energy substances (glucose, or alcohol), and drug solutions that regulate different aspects of homeostasis and eliminate endogenic or exogenic toxicosis.

Organization of Resuscitation

The need in reanimatological aid may arise anywhere and in any situation. The victim's life will fully depend on the rescuer's skill in the resuscitation techniques (external heart massage and artificial respiration). It is quite clear that only medical personnel can provide adequate resuscitation measures. A special ward in polyclinics, chemist's shops or medical points supplied with a *reanimatological kit* is thus important. This kit should have:

(1) sterile roller bandage and napkins;

(2) syringes in special containers;

(3) tourniquets;

(4) an airway for mouth-to-mouth artificial respiration;

(5) portable respirator;

(6) drugs: 0.1per cent adrenaline solution, 10 per cent calcium chloride solution in ampoules; caffeine, ephedrine, strophantine, promedole or morphine, prednisolone for internal administration, novocaine (procaine) hydrochloride; papaverin; nitroglycerin in tablets; solutions for intravenous injection – polyglucine, haemodes and gelatinol;

(7) needles for venipuncture;

(8) a sterile system for intravenous infusion.

The reanimatological service created within the first-aid emergency service is essential so that the reanimatological aid can be timely. Special ambulances are supplied with the necessary facilities for resuscitation and even minor operations (e. g. tracheostomy, catheterization of the veins, arteries and the heart, and direct heart massage).

All large hospitals have specialized intensive therapy units with their own staff of reanimatologists and highly skilled nurses, equipment for cardiac and respiratory

reanimation, and diagnostic machines. The reanimatological units admit severely ill patients from other departments (e. g. after the operation), and victims and patients brought by ambulances. There are specialized reanimatological departments such as therapeutic ones for treating patients with myocardial infarction, acute heart failure, and grave respiratory conditions; surgical departments for the postoperative management of patients; toxicological centres for treating poisoning; and traumatological departments for patients with grave injuries and traumatic shock.

Chapter 6
First Aid for Haemorrhages

The blood is carried through the human body by the blood vessels – arteries, veins and capillaries, which permeate every organ and tissue. When an organ or tissue in the human body is damaged the blood vessels are also injured.

When the blood escapes from a blood vessel the condition is known as haemorrhage. The causes of haemorrhages are quite varied, the most common being a direct trauma (puncture, incision, blow, stretching, crushing, etc.). The strength of a haemorrhage is determined by the number of the injured vessels, their diameter, the nature of the injury (full interruption of the vessel, parietal injury, crushing, etc.), the type of the injured vessel (artery, vein, capillary), blood pressure, and the state of the coagulation blood system. The place where the blood escapes is also important: that is whether the blood flows from the surface, into a large- or small-volume cavity (pleural, abdominal or knee joint cavity), or into soft tissues (subcutaneous cellular

tissue, muscles and intermuscular spaces).

Vessels affected by atherosclerosis may be destroyed by an elevation in the blood pressure or under the effect of essential hypertension. Ruptures of arterial aneurysms are particularly dangerous because the circulating blood may escape in several minutes. Copious bleeding may occur in varicosity of the veins. The most dangerous situation is bleeding from varicose veins of the oesophagus in portal hypertension (cirrhosis of the liver). The vascular wall may be destroyed by an inflammatory process, ulcer, or malignant tumour.

Sometimes bleeding may occur due to a change in the composition of the blood, in which case the blood may escape even through the wall of an intact vessel. This condition is encountered, for example, in jaundice, sepsis, and blood diseases.

Types of Bleeding

Bleeding can vary in strength and depends on the type of injury to the blood vessel. Arterial, venous, capillary, and parenchymatous bleedings are distinguished.

In *arterial bleeding* the blood escapes from the injured arteries. It is bright red and flows in a tense pulsating stream. Arterial bleeding is most dangerous, usually very strong, and causes a heavy blood loss. When the major arteries, or the aorta, are damaged the blood loss is so copious that it becomes incompatible with life and has fatal outcome.

Venous bleeding occurs in wounds of the veins. The blood pressure in veins is much lower than in arteries so that the blood flows more slowly, in an even stream, and is dark-cherry in colour. Venous bleeding is less strong than arterial bleeding and therefore rarely threatens the patient's life. Wounds of the neck and

chest are frought with another fatal danger, however. At the moment of inhalation a negative pressure develops in veins of the neck and chest so that if there is a gaping wound in a major vein air may be sucked into the blood stream. Air bubbles getting into the blood stream can plug the heart and blood vessels, thus causing *air embolism*. This is a grave, often fatal complication, leading to fulminant death.

Capillary bleeding is caused by damage to the smallest blood vessels (capillaries), for example, by superficial cuts or scratches of the skin. When clotting is normal the bleeding stops spontaneously.

Parenchymatous bleeding. The liver, spleen, kidneys, and the other parenchymatous organs have a well-developed network of arteries, veins and capillaries. Wounds of these organs cause damage to the blood vessels and profuse bleeding, known as parenchymatous, occurs. Since the vessels permeate the organ they never collapse and the bleeding never stops by itself.

Haemorrhages are also classified as external and internal depending on where the blood escapes to from the injured vessel.

In **external haemorrhage** the blood escapes to the outside through the wound of the skin. Haemorrhages into the lumen of a hollow organ (stomach, intestine, urinary bladder, trachea) that has a contact with the environment are known as *external latent*. When blood escapes into interstitial spaces (muscles, subcutaneous fat) *haematomas* or *bruises* form.

Internal haemorrhages occur in perforating wounds, closed injuries (e. g. the rupture of an internal organ without skin breakage due to a strong blow, a fall from a height, compression) and diseases of internal organs (ulcer, cancer, tuberculosis, aneurysms of the blood vessels). In this type of haemorrhage the blood escapes into a closed cavity. Internal haemorrhages into closed cavi-

ties (pleural, abdominal, pericardial sac, cranial cavity) are the most dangerous. They take a latent course and are extremely difficult to diagnose and may remain unrecognized if the care of patients is insufficient.

The pleural or abdominal cavities are large enough to accumulate the whole volume of the blood circulating in the body, so that haemorrhages into these cavities are often fatal.

There are cases when the haemorrhage is dangerous not because it is heavy, but because the extravasated blood may compress vital organs. For example, blood within the pericardial sac may cause compression of the heart (tamponade) and its stoppage; when blood accumulates in the skull the brain is compressed and death may ensue.

Haemorrhages are dangerous because copious loss of blood sharply deteriorates cardiac activity and the supply of oxygen to vital organs (brain, liver, kidneys), as a result of which the metabolic processes are impaired and death sets in.

First Aid in External Haemorrhages

When rendering first aid, bleeding can be arrested only for the short period of time that is necessary to remove the victim to a medical institution.

The techniques for the temporary arrest of bleeding are as follows: (1) raising the injured body part (in relation to the trunk); (2) compressing the bleeding vessel at the site of injury with a pressure bandage; (3) directly pressing the artery with the fingers; (4) securing the limb so that the joint is stretched or bent to a maximum; (5) compressing the circumference of the limb by a tourniquet; (6) clamping of the bleeding vessel in the wound, a procedure that requires special attention.

Capillary bleeding is easily arrested by applying a com-

mon bandage on the wound. In order to lessen the bleeding for the period of time needed to prepare a dressing, the injured limb should be raised as much as possible. The inflow of blood to the limb is sharply lowered, the pressure in the vessels drops, there is rapid formation of a blood clot over the wound, the closure of the vessel, and the arrest of the bleeding.

Venous bleeding can be temporarily arrested by applying a compression bandage. Several layers of gauze and a tight cotton wool pad are applied to the wound and tightly bandaged. Blood vessels compressed by a bandage become quickly thrombosed, so this method of bleeding arrest may be a last step. In order to gain time needed to prepare a pressure bandage when there is profuse venous bleeding, the wound can be compressed with the fingers. When the wound is on the upper limb the bleeding can be lessened considerably by raising the arm.

Arterial bleeding from a small artery can be easily stopped by a pressure bandage. When a major artery is injured the bleeding can be stopped immediately by finger pressure in the wound. A more reliable method of arresting the bleeding has to be prepared in the meantime. This method has some variants, for example, a haemostatic clamp can be applied on a gaping blood vessel and tight tamponade of the wound done by a sterile napkin or bandage. The clamp should be firmly secured to make it immobile during transportation.

Compression on an artery along its course is widely used for urgent arrest of bleeding. This method is based on the fact that certain arteries can easily be palpated and completely closed by compressing them against the underlying bones. The finger compression of an artery can only be used for a brief period, and besides it requires physical exertion, and is tiresome for the rescuer. It cannot be used during transportation. With this

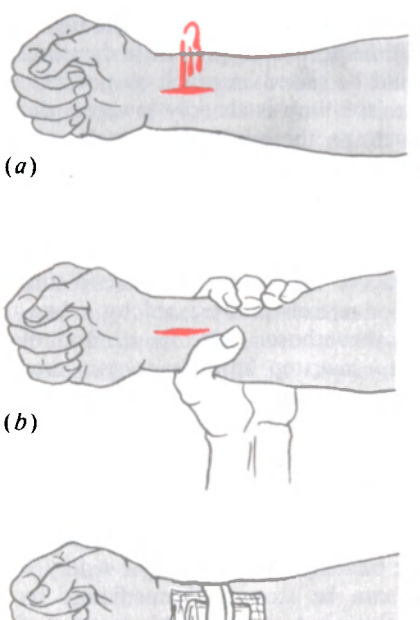


Fig. 43.
Pressure bandage used for arresting arterial bleeding
a, arterial bleeding; *b*, temporary arrest of bleeding by compessing the artery along its course; *c*, pressure bandage

method the bleeding is arrested, the wound is not contaminated, and time is saved for preparing a more convenient method of arresting the haemorrhage, such as a pressure bandage (Fig. 43), twist, or tourniquet. The artery can be pressed with a thumb, palm of the hand, or fist. It is very easy to compress the femoral and bra-

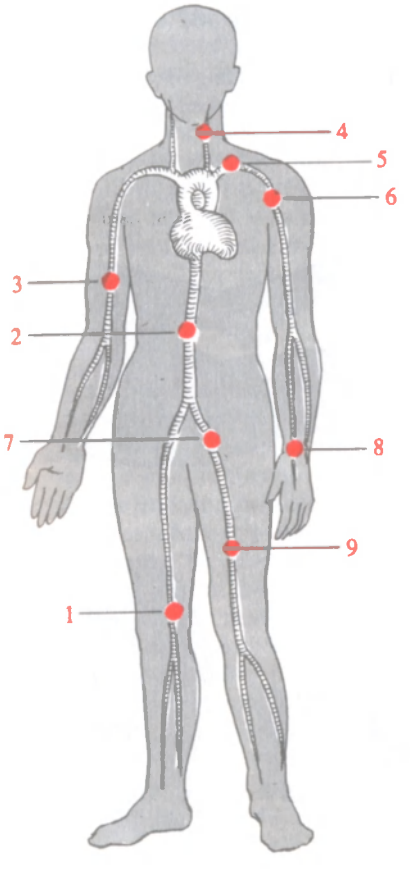


Fig. **44.**
Most typical points of compressing the arteries along their course

1, popliteal; *2*, abdominal; *3*, brachial; *4*, carotid; *5*, subclavian; *6*, axillary; *7*, femoral; *8*, radial; *9*, tibial

chial arteries, and less so the carotid and subclavian arteries (Fig. 44).

Compressing an artery by bending or stretching the limb is used when the patient is taken to the hospital.

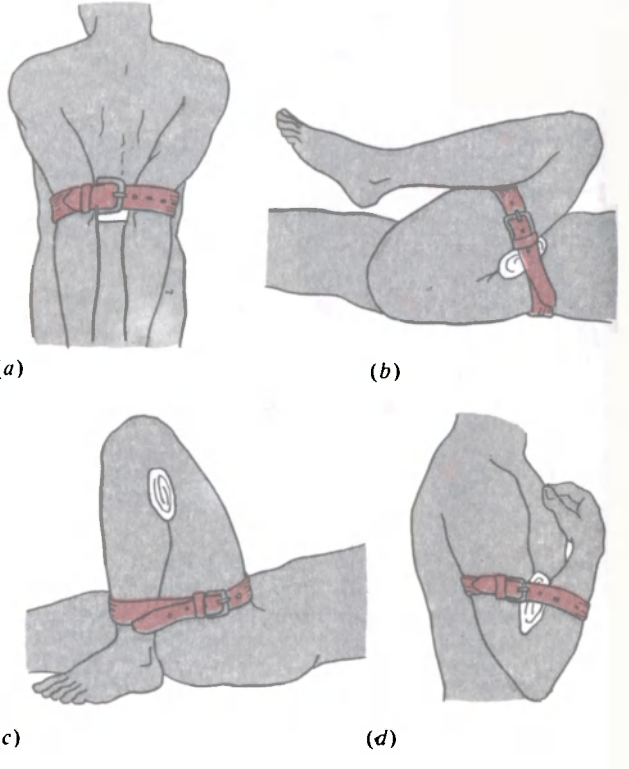


Fig. 45.
Temporary arrest of bleeding by fixing the limb in a certain position
a, subclavian artery; *b*, femoral artery; *c*, popliteal artery; *d*, brachial and ulnar arteries

When the subclavian artery is wounded the bleeding can be arrested by bending the arms at the elbows and drawing the elbows back as far as possible and fastening the arms securely at the elbow joint. The popliteal artery can be compressed by bending the leg at the knee joint as fully as possible. The femoral artery is compressed by bringing the thigh as close to the belly as possible. The brachial artery at the elbow joint can be compressed by maximal bending the arm at the elbow joint (Fig. 45). This technique is more effective if a roller made of gauze or cotton wool is put in the joint being bent.

Arterial bleeding can be arrested by *compressing tightly* the limb vessels above the wound which can be easily done by a rubber tourniquet.

Techniques of tourniquet application. A tourniquet may be an elastic rubber tube, or a band with a metal chain at one end and a hook at the other for fastening the tourniquet. Any strong rubber tube with a diameter of 1-1.5 cm can be used.

The upper third of the shoulder and the middle third of the thigh are the most convenient places for tourniquet application. *A tourniquet should only be applied in cases of profuse bleeding from a limb artery,* in all other cases it is not recommended.

A tourniquet is applied over a soft pad or a towel or the victim's clothing to prevent the skin from being pinched. The wounded limb is slightly raised, the tourniquet is placed under the limb, stretched and wrapped several times around the limb until the bleeding has stopped. The tourniquet is applied so that each turn lies close to the other without pinching the skin. The first turn is the most tight, the second one less so, and the other turns are applied loosely only lightly stretching the rubber. The ends of the tourniquet are fastened by the chain and the hook over all the turns (Fig. 46). The

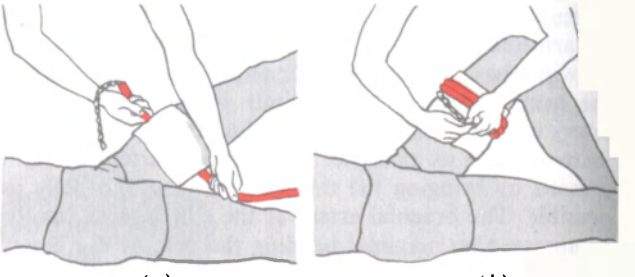


Fig. 46.
Techniques of the application of a rubber tourniquet
a, stretching a tourniquet; *b*, fastening the tourniquet by the chain and hook

tissues should be compressed until the bleeding has stopped. **When a tourniquet is applied correctly arterial bleeding stops immediately, the limb turns pale and pulsation below the tourniquet ceases.** Too tight a tourniquet can crush the soft tissues, muscles, nerves, or vessels and paralyse the limbs. If it is not tight enough it fails to arrest the bleeding and promotes venous stasis (the limb does not pale but turns bluish) and makes venous bleeding more copious. The limb is immobilized after a tourniquet has been applied.

Errors in tourniquet application: the absence of indications, i. e. applying a tourniquet to venous or capillary bleeding, applying one without soft padding and too far from the wound; too loose or too tight application, and inadequate fastening of the tourniquet's ends. If there is inflammation where the tourniquet has been applied it should be taken off.

A tourniquet should not be left in position more than 1.5-2 hours, otherwise a long-term compression of the vessels will cause necrosis of the whole limb. In view of this fact, it is fully forbidden to apply dressings or ker-

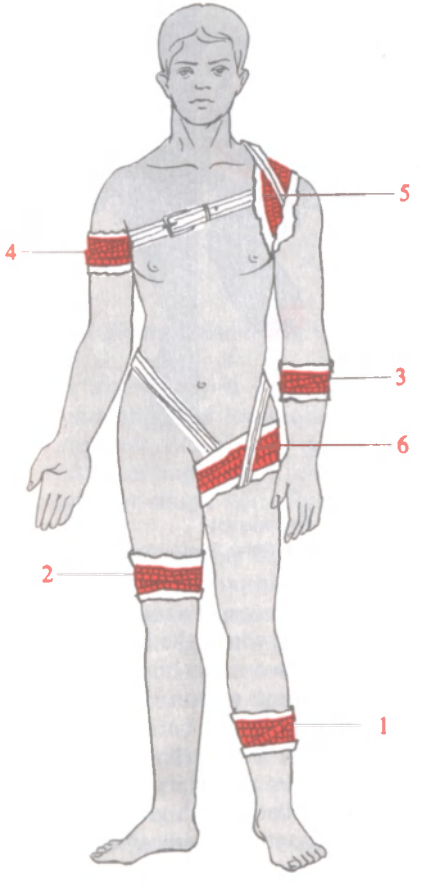


Fig. 47.
Main points for the application of a haemostatic tourniquet in arterial bleeding

1, foot; *2*, the shin and knee joint; *3*, wrist; *4*, forearm and elbow joints; *5*, shoulder; *6*, thigh

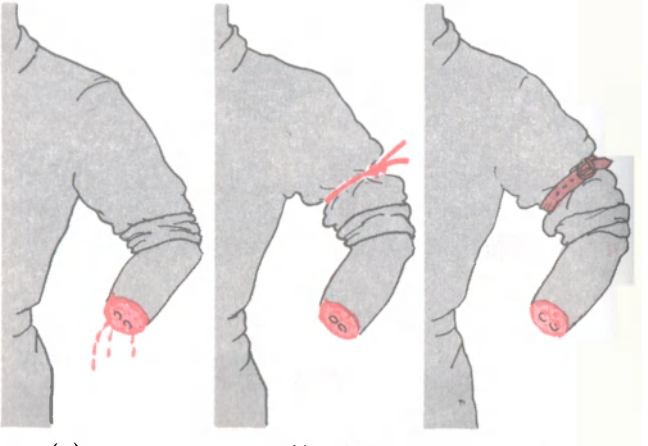


Fig. 48.
Application of an improvized tourniquet
a, arterial bleeding; *b*, tourniquet made of a rubber tube; *c*, tourniquet made of belt

chiefs over a tourniquet. Every measure should be taken to admit the victim in a hospital where the bleeding will be arrested completely within two hours since the tourniquet was applied. If, for some reason, the bleeding still continues, the tourniquet should be loosened for 10-15 minutes (during this time the arterial bleeding is stopped by finger compression of the artery) after which the tourniquet should be reapplied a bit higher or lower. Sometimes the procedure has to be repeated several times (every half hour in winter and every hour in summer). In order to know exactly the time when the tourniquet was applied, the date and time should be noted on a piece of paper and fastened in a conspicuous place on the outer clothing of the victim. Typical sites for tourniquet application in bleedings from various

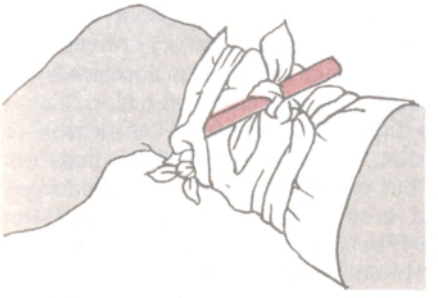


Fig. 49.
Arrest of arterial bleeding by a twist

arteries are shown in Fig. 47.

When a standard tourniquet is unavailable, any rubber tube, belt, kerchief, or piece of cloth (Fig. 48) can be used as an improvized tourniquet. It should be kept in mind that rough tourniquets may easily damage the nerves.

Twists for tightening the limbs. An improvised tourniquet made of any material available at the moment of an accident is wrapped round the limb at the correct level. A stick or rod is inserted into a loop formed from the material and twisted until the bleeding ceases. Then the stick is fastened to the limb (Fig. 49). The twists can be rather painful, so a soft pad must be put under the twist. All the rules, errors and complications arising for applying tourniquets apply to twists.

First Aid in Certain External and Internal Haemorrhages

Bleeding can also result from disease or blunt injuries.

A **nosebleed** is sometimes so profuse that emergency aid may be needed. It may be due to local morbid pro-

cesses such as injuries, scratches, an ulcer of the nasal septum, due to forced blowing of the nose, or from fractures of the skull. There are cases when nosebleeds are due to various illnesses, e. g. diseases of the blood, heart defects, infectious diseases (scarlet fever, influenza), or essential hypertension. Sometimes the blood does not escape externally, but passes through the nasal passages to the throat and mouth causing coughing and frequently vomiting. The patient then becomes restless, which makes the bleeding more profuse.

The person rendering the first aid must first of all identify and remove the factors promoting nosebleed. It is necessary to calm the patient down and warn him that any sharp movement, cough, talk, blowing of the nose, or strain will make the bleeding worse. The patient should be supported in a comfortable sitting position that will prevent blood escaping into the throat. An ice bag or a ball of snow wrapped in a kerchief, or a piece of any soft material, or cotton wool soaked in cold water is applied to the bridge of the nose. In addition, the patient should have a supply of fresh air. If the bleeding occurred because the patient was too hot he or she should be put into the shade and cold compresses applied to his head and chest.

If the bleeding continues the patient should be asked to pinch the soft parts of his nose and press them firmly against the nasal septum, and to bend his head slightly forward. The nose should be kept compressed for 3 to 5 minutes. The patient should be instructed to breathe through the mouth and to spit out any blood that escaped into the mouth.

Putting a tamponade made from dry sterile cotton wool plug or a cotton wool soaked in a hydrogen peroxide solution into the nasal passages is another method for arresting a nosebleed. The patient's head is bent slightly forward and balls of the cotton wool are introduced into

the nasal passages. A blood clot rapidly forms on the cotton wool and the bleeding ceases. These measures usually arrest the bleeding; otherwise the patient must be promptly removed to hospital.

Bleeding following the extraction of teeth may be very strong. To stop it, a cotton wool pad is placed over the socket. The patient is asked to bite on the pad for several minutes.

Bleeding due to damage to the acoustic meatus and the internal structures of the ear (blow, scratches, fracture of the cranial bones). The bleeding is stopped by introducing a gauze plug folded into a funnel into the external ear canal and held in position by a gauze dressing placed over the ear.

Lung haemorrhage may develop due to damage to the lungs (a heavy blow on the chest or a fracture of the ribs) or due to a lung or heart disease (e. g. pulmonary tuberculosis, carcinoma of the lung, pulmonary abscess, and mitral cardiac defect). While coughing the patient spits out a sputum of scarlet frothy blood which is known as *haemoptysis*. Lung haemorrhages are sometimes quite copious.

When blood admixture is found in the sputum, the patient must be placed in a semi-recumbent position and his clothing that makes the breathing difficult loosened immediately. The patient should be reassured and told that complete rest is essential for successful treatment. Plenty of fresh (better cold) air should be supplied to the premises where the patient lies. The patient is asked to breathe deeply and to keep from coughing, if possible, and not to move or talk. An ice bag is applied to the chest and the patient is given tablets to relieve cough.

Any lung haemorrhage is a menacing symptom of a grave illness and therefore the main task of the first aid is prompt admission of the patient to a medical institution.

Patients with lung haemorrhage are extremely vulner-

able to movement so they must be transported by special ambulance in a semi-recumbent position in as quiet and gentle manner as possible, avoiding sharp movement and jolting, which make the cough and haemorrhage worse.

Haemorrhage into the thoracic cavity. Blow in the chest, fractures of the ribs, and certain lung diseases may damage blood vessels. The escaping blood fills one or both pleural cavities and compresses the lung thus causing respiratory disorders. The loss of blood and switching off the lung from respiration contribute to a rapid deterioration of the patient's condition: breathing sharply accelerates, and the skin turns pale and acquires a bluish tinge.

The patient must be immediately taken to a medical institution. He is supported in a semi-recumbent position and an ice bag is applied to his chest.

Gastro-intestinal haemorrhage occurs either as a complication of a certain disease (peptic ulcer, gastric carcinoma, varicosity of the oesophageal veins) or as a result of trauma (foreign body, burn, etc.). It may be profuse and fatal. In addition to the symptoms of acute anaemia (pallor, sweating, malaise), gastro-intestinal haemorrhage is attended by vomiting of blood or something resembling coffee grounds, and by frequent loose stool with tar-like faeces.

In order to improve the patient's condition and relieve the haemorrhage, the patient is placed in a horizontal position and an ice bag applied to his belly. He is put in conditions of rest and is not permitted food or drink.

The main task of the first aid is urgent admission of the patient to a hospital. During the transportation the patient should remain in a horizontal position, with the foot end of the stretcher being raised to prevent anaemia of the brain.

Abdominal haemorrhage occurs due to a blunt injury to the abdomen and is caused by rupture of the liver or

spleen. Intra-abdominal haemorrhage may be due to certain diseases of the liver or spleen; in women it occurs as a result of rupture of the uterine tube in an extrauterine pregnancy.

Abdominal haemorrhage is manifested by strong pain in the belly, pallor of the skin, and accelerated pulse. Profuse haemorrhage may be attended by a loss of consciousness. The patient is placed in a horizontal position, an ice bag is applied to his belly, and he is not permitted food or drink. Patients with abdominal haemorrhage must be urgently taken to hospital in a supine position.

Acute anaemia develops when a considerable amount of blood is lost. Every patient tolerates blood loss differently with children and middle-aged people being the most sensitive. The most vulnerable are those people who have sustained a protracted illness, and those who are hungry, tired, or frightened.

An adult who has lost 300-400 ml of blood may not feel anything abnormal but for children this blood loss is fatal. An adult will die when 2 to 2.5 l of blood is lost.

Loss of 1-1.5 l of blood is very dangerous and is manifested by acute anaemia, drastic circulatory disorders and oxygen hunger. The rate of blood loss is also of importance: a small amount of blood lost in a short period of time may induce the same condition. The severity of the patient's condition may be judged both by the amount of extravasated blood and by the level of the blood pressure.

The symptoms of acute anaemia are very typical and are not dependent on whether there is external or internal haemorrhage. The patient complains of a growing malaise, dizziness, noise in the ears, darkening in the eyes, thirst, nausea, and vomiting. The skin and visible mucous membranes turn pale and the features of the face sharpen. The patient is sometimes inhibited and sometimes excited; his breathing quickens, the pulse is weak

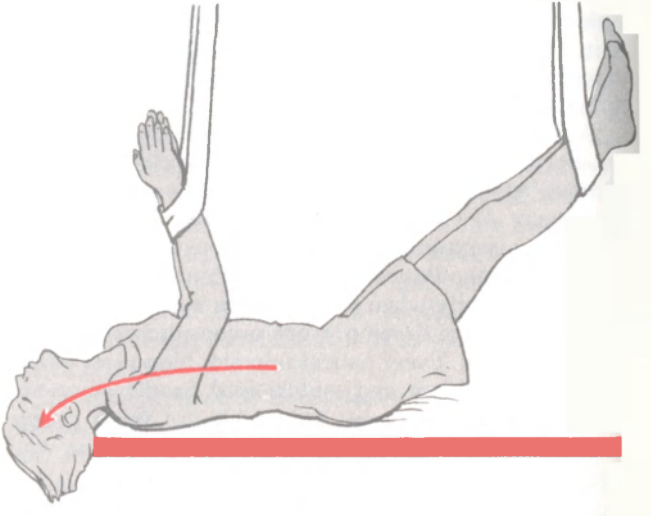


Fig. 50.
The patient's position in acute anaemia: "selftransfusion"

or barely countable, and the blood pressure is low. This is followed by a loss of consciousness due to cerebral anaemia; the pulse and blood pressure are not countable, convulsions, and involuntary urination and defaecation may occur. The patient may die if the aid is not prompt.

The haemorrhage may cease from the heavy loss of blood and low blood pressure. Nevertheless, when rendering first aid a pressure bandage must be applied to the wound and anti-shock measures begun. The patient is laid down on an even surface to prevent cerebral anaemia. When the blood loss is heavy and has caused fainting or shock the patient is placed so that his head is lower than his trunk so as to increase the flow of blood to the head. In individual cases a "self-transfusion" of blood is expedient: the patient's limbs are raised (Fig. 50) which

promotes the temporary blood flow to the lungs, brain, kidneys, and other vital organs. When consciousness is preserved and no abdominal organs are damaged, the patient may be given hot tea, mineral or natural water. Terminal states and heart arrest call for resuscitation measures. An urgent transfusion of the donor's blood is the main method for treating acute anaemia, which is why patients must be promptly removed to a medical institution. Blood may be transfused en route if the patient is transported in an ambulance which has a store of donor's blood.

Blood Transfusion

The transfer of blood from one person (donor) to another (recipient) is known as a transfusion of blood. The development of the science of the transfusion of blood and blood substitutes is linked with the Soviet scientists S. I. Spasokukotsky, V. N. Shamov, and A. N. Filatov. Blood transfusion became possible when it was discovered that people possess four blood groups. Numerous investigations have shown that a transfusion of blood is quite safe if the donor and recipient have the same blood group. Blood groups are conventionally designated O(I), A(II), B(III) and AB(IV). *In exceptional cases it is possible, however, when blood of the same group is not available, to transfuse blood of a different group.* For example, O(I) group blood can be transfused into people with any blood group, although AB(IV) group blood can only be transfused into people with blood of the same group. At the same time, persons with O(I) group blood can only receive blood from people with the same group, while those with AB(IV) blood can receive the blood of any group.

Transfusion of blood with group incompatibility leads to grave complications and death. That is why transfusion of

blood must be preceded by the establishment of blood groups of the donor and recipient.

Standard sera of the O(I), A(II) and B(III) groups are specially prepared in the laboratories of blood transfusion stations, for determining the blood group. The numbers I, II, III that designate standard sera are applied on a white plate every 3-4 cm from left to right in sequence. A drop of a standard serum of each group is applied by a different pipette under the numbers that designate the relevant blood groups.

A finger of the person being examined is pricked and a drop of blood is applied to a drop of a serum using a clean spatula for each serum. It is then mixed to obtain regular staining. The blood group is established by examining the changes in the serum exactly 5 minutes after the moment of staining. The well visible red granules and lumps appear in the serum as a result of the blood's red cells agglutination; in the non-agglutinating serum the drop of blood remains homogeneous and has a regular pink colour. Agglutination occurs in certain tests, according to the blood group of a person being examined. If it is O(I) group blood the red cells will not agglutinate in any of the sera. If it is A(II) group blood there will be no agglutination with only the serum of the A(II) group, and if he has the B(III) group agglutination will not occur with the B(III) serum. Agglutination takes place in all sera if the blood under study is AB(IV) (Fig. 51).

Sometimes a transfusion of blood between people with the same blood group can give rise to severe reactions. Studies have shown that the blood of about 15 per cent of people does not have a special protein known as the **rhesus factor**. The repeated transfusion of blood containing this factor to a rhesus-negative person (someone who does not have the factor in his blood) causes a severe complication known as rhesus conflict, and shock may

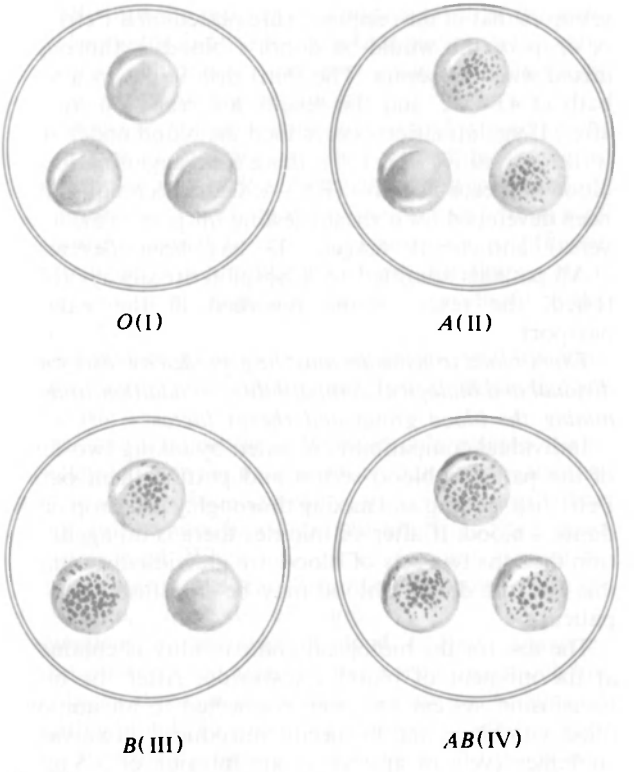


Fig. 51.
Determining blood groups by means of standard sera

develop. That is why blood transfusion is now preceded by the establishment of the rhesus factor, and rhesus-negative blood may only be transfused to rhesus-negative recipients.

Techniques for quickly determining the rhesus factor. Five drops of the rhesus-negative serum of the same

group as that of the recipient's are placed on a Petri dish. A drop of the would-be donor's blood is thoroughly mixed with the serum. The Petri dish is put in a water bath at 43-45°C and the results are ready 10 minutes after. If agglutination occurs then the blood under study is rhesus-positive (Rh +); if there is no agglutination the blood is rhesus-negative (Rh −). Other techniques have been developed for a rhesus testing, in particular, a universal anti-rhesus reagent D has been developed.

All patients admitted to a hospital are always rhesus tested, the results being recorded in the patient's passport.

Every blood transfusion must be preceded by tests for individual and biological compatibility, in addition to determining the blood group and rhesus factor.

Individual compatibility is tested by taking two drops of the patient's blood serum and putting them onto a Petri dish, adding and mixing thoroughly in a drop of the donor's blood. If after 10 minutes there is no agglutination then the two sets of blood are individually compatible and the donor's blood may be transfused into the patient.

The test for the biological compatibility is conducted at the moment of blood transfusion. After the blood transfusion system has been connected to an ampoule filled with blood and the needle introduced into a vascular lumen (vein or artery) stream infusion of 3-5 ml of blood is begun. The patient's condition should be watched for several minutes. If there is no untoward reaction (headache or pain in the lumbar region, asphyxia, heart pain, hyperaemia of the skin, chills, etc.) the blood is biologically compatible and the transfusion may be continued. The transfusion must be immediately discontinued the moment any reaction appears.

Blood may be transfused by a direct technique by taking the unchanged donor's blood into a syringe and injecting

it directly into the recipient's blood stream. In the *indirect technique* the donor's blood is first put into a test tube filled with a solution that prevents coagulation and then later transfused to the recipient.

The direct technique is complicated and is used rarely and on special indications. The indirect technique is much simpler and makes it possible to store blood in large amounts, to regulate easily the rate and volume of the transfused blood, to carry out transfusion in different conditions (e. g. in ambulances, during air flights, etc.), and to avoid many of the complications produced by the direct technique.

Blood may be transfused into an artery, vein, or bone marrow. Drip and stream transfusion methods are distinguished.

Intra-arterial injection of blood is only resorted to in resuscitation when the need arises to make up for the lost blood, to increase blood pressure, or to stimulate cardiac activity. Intravenous blood transfusion (Fig. 52) is most commonly used. When the course of a vein cannot be outlined intraosseous transfusion is performed through the sternum, calcaneus, or ilium.

Indications to transfusion of blood. 1. *Acute anaemia*: the transfused blood restores the normal haemoglobin level, the erythrocyte count, and the normal volume of circulating blood. Two to three litres of blood are sometimes transfused when the loss of blood is heavy.

2. *Shock*: blood transfusion improves cardiac activity, increases vascular tone and the blood pressure, and prevents the development of traumatic shock during serious operations.

3. *Chronic exhaustive diseases, toxicosis, and diseases of the blood*: a blood transfusion stimulates the haemopoietic organs, increases the organism's defence forces, and lessens toxicosis.

4. *Acute poisoning* (poisons and gases): blood has good

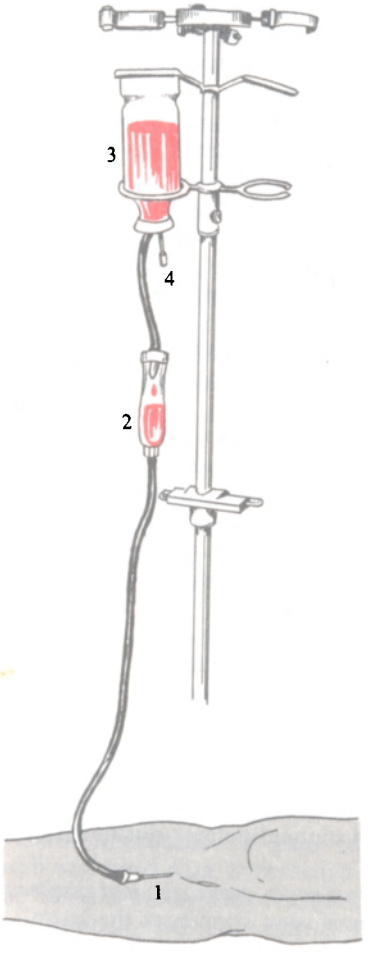


Fig. 52.
Intravenous drip transfusion

1, needle in the venous lumen; *2*, plastic system with dropper; *3*, vessel with blood; *4*, needle and filter for letting air into the vessel

detoxicating properties and sharply decreases the harmful effect of poisons.

5. *Disorders of coagulation capacity*: transfusion of small doses of blood (100-150 ml) increases its coagulative properties.

Transfusion of blood is contraindicated in cases of severe inflammatory diseases of the kidney and liver, decompensating heart defects, cerebral haemorrhages, and the infiltrative form of lung tuberculosis.

Donors in the Soviet Union. Any healthy individual between the ages of 18 and 55 can donate blood. Most donors give their blood for treating patients without compensation and many thousands do so. A repeated donor is awarded the title "Donor of the Soviet Union".

Blood is stored at blood transfusion stations, in blood transfusion departments at large hospitals, and in specialized research institutes. Donation campaigns are undertaken in many industrial, governmental, and educational establishments, and so special mobile stations are affiliated to where donors work or study.

Chapter 7
First Aid in Wounds

Wounds

A wound or open injury is an abnormal break of the continuity of the skin, mucous membranes, deeply lying tissues, or surface of an internal organ as the result of a mechanical or some other action. A cavity formed between the tissues due to the penetration of a wounding object is known as a wound canal.

Wounds are classified as superficial and deep. In

superficial wounds, the skin and mucous membranes are damaged. Deep wounds may be attended by damage to blood vessels, nerves, bones, tendons, and the internal organs. *Deep wounds with damage to the internal membranes of the closed cavities* (e. g. the abdomen, chest, skull, joints) are known as *perforating*.

Every wound, except for cuts made by sterile instruments during an operation, should be considered contaminated. *Wounds that were subjected to the action of some other physical or biological factors (such as poison, or radiation) are called complicated.*

According to the wounding object wounds can also be classified as abrasions, punctures (stabs), incisions (cuts), chopped wounds, contusions (bruises), lacerations or torn wounds, gunshot wounds, and bites.

The edges of a wound are less ragged when the wound was made quickly by a sharp instrument. Wounds made by a blunt object usually have heavily broken edges. They are attended by strong pain, which not infrequently gives rise to shock.

Types of wounds. A *punctured wound* or *stab* is caused by a sharp pointed instrument such as a knife, bayonet, awl, or needle. The superficial openings are small, but usually very deep. The wound canal is narrow and, as a rule, disrupted and becomes zigzag-like because the tissues pull apart (due to muscular contraction or skin movements). This makes punctured wounds especially dangerous since it is difficult to determine the depth of the injury or whether the internal organs are wounded. Latent damage to the internal organs may give rise to internal haemorrhages, peritonitis (inflammation of the peritoneum), or pneumothorax (a condition when air penetrates the pleural cavity).

An *incised wound* may be caused by a sharp cutting instrument, such as a knife, razor, glass, or scalpel. The edges of these wounds are usually straight

Chopped wounds occur when the injury is caused by a sharp and heavy instrument (axe or sword). Externally they may resemble incised wounds but in fact they are more extensive and often attended by damage to the bones. The edges of the wounds are crushed rather than cut.

Contused or bruised wounds are caused by a blunt instrument (hammer, stone, etc.). These wounds have crushed and uneven edges impregnated with blood. Because of the damage to the blood vessels and their thrombosis, nutrition of the wound edges is impaired and necrosis develops. Crushed tissues are a very favourable medium for microbe reproduction and are easily infected.

Gunshot wounds are classified as bullet wounds, wounds caused by small shot, and splinter wounds. A wound may be *perforating*, when the bullet goes straight through the body forming two orifices, the inlet and the outlet, *blind* when the bullet remains in the body, or *tangential*, when the bullet grazes the body and causes only superficial injury. The inlet to a perforating wound is smaller than the outlet. In a blind wound the bullet gets stuck in the tissues of the wound canal and becomes a foreign body which causes suppuration. Sometimes bits of clothing may also get into the wound canal.

Splinter gunshot wounds are often numerous and always damage a large area of tissue because the splinters have uneven edges and are sometimes large. The rough edges of the splinters can carry with them various bits and pieces (clothing, earth, or skin) that penetrate the wound and make any infection of the tissues worse. The large amount of blood accumulated in the wound canal promotes rapid infection and the development of purulent inflammation.

Gunshot wounds may often be numerous and combined. *In combined wounds a bullet penetrates several*

organs and cavities (e. g. the abdominal cavity, diaphragm, pleural cavity) *and can disrupt the function of several organs.*

Each wound is attended by pain, gaping and bleeding.

The *pain* is especially strong at the moment of the injury although the severity will depend on the sensitivity of the wounded zone, the fingers, teeth, tongue, genitals, and anus being the most sensitive. As a wound heals the pain gradually subsides. A sharp intensification of a pain and change in its character are evidence of the onset of complications (e. g. suppuration, or anaerobic infection).

Gaping or separation of the wound's edges depends on the resilience of the soft tissues and their ability to contract. The larger and deeper the wound, the more it gapes.

Bleeding from a wound is determined by the type of the damaged vessels, i. e. whether it is artery, vein, or capillary, the blood pressure, and the character of the wound. Incised and chopped wounds bleed most profusely. In crushed tissues the vessels are crushed and thrombosed, and so contused wounds do not bleed very much. Wounds to the head and face are exceptions. The soft tissues of the head are permeated by numerous blood vessels which do not collapse when injured. This results in profuse haemorrhage attendant to any wound to the head. The other feature of wounds to the head is that the skin and underlying soft tissues move very easily with the result that the wound gapes widely, and its edges are frequently formed by exfoliated skin flaps (called *scalped wounds*).

The severity of a wound (mild, moderate, or grave) depends on its size and depth, the injury done to the internal organs, and the ensuing complications (haemorrhage, functional disorders of a wounded organ, peritonitis, pneumothorax, etc.).

A dangerous condition threatening a patient's life can develop from any wound. Wounds, like all other injuries, may trigger the organism's general reaction, i. e. fainting, while shock and terminal states more often develop due to haemorrhage and blood loss than due to pain. Haemorrhage is therefore the most dangerous complication though infection entering the wound later and through it into the body is also dangerous.

Wound Infection

The objects that caused a wound and the skin contain a multitude of various bacteria on their surface which can get inside the body. The most common are pyogenic bacteria which are responsible for purulent inflammation. They sharply deteriorate healing process and create conditions favourable for the development of sepsis. *An infection that got in the wound with the object that caused the wound is known as a primary infection. Secondary infection develops later in a person suffering from an infection of another nature.*

Secondary infection occurs in cases when the wound is handled by dirty hands, or when a non-sterile dressing is applied, or when the dressing is improperly applied during bandaging. The infection may get into the wound along the course of a blood vessel from a purulent focus located in another part of the body (e. g. chronic tonsilitis, purulent inflammation of the soft tissues, furunculosis, or highmorrhitis).

A purulent inflammatory process in a large and deep wound may take such a rapid and turbulent course that the body is unable to create a defence barrier around the abscess. In these cases the *infection may break out into the blood stream and involve all the organs and tissues into a process followed by general infection or sepsis.* This com-

plication is very dangerous and can lead to death despite intensive therapy.

Sepsis is a general infectious condition caused by various micro-organisms (e. g. staphylococcus or streptococcus) and their toxins. Its clinical manifestations vary widely, the most typical being high fever (up to 40°C) attended by shivering and profuse perspiration, a drastic aggravation of the patient's general condition with the onset of delirium, hallucinations, and loss of consciousness. A marked shortage of breath, tachycardia, or decrease in the blood pressure are also typical symptoms. Later the patient rapidly looses weight and becomes exhausted, the skin turns yellow and the features of the face sharpen. This condition is very dangerous and often fatal. Prompt aid can prevent the development of this menacing complication.

In addition to pyogenic bacteria, the wound may be infected by the more dangerous micro-organisms which cause tetanus and gas gangrene.

Tetanus (or lockjaw) often develops when the wound is contaminated by earth, dust, or manure. It may arise in gunshot wounds or from injuries sustained during agricultural work, or in road accidents.

The early symptoms of tetanus are high body temperature (40-42°C) on the 4-10th day after the injury, involuntary muscular twitching around the wound, pain in the stomach and abdominal muscles, difficulty in swallowing, contractions of facial muscles, and spasms of jaw muscles (trismus), during which the mouth cannot be opened. Later generalized tormenting convulsions develop, a condition known as opisthotonos (Fig. 53), which may be triggered by any slight stimulation. These are followed by spasms of the respiratory muscles and asphyxia. Tetanus is very difficult to treat though it is possible in medical institutions to alleviate the condition. There are no specific measures to control tetanus once

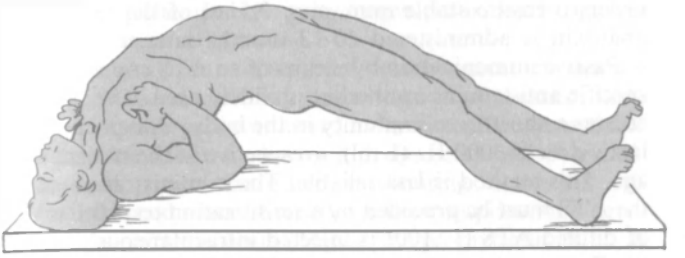


Fig. 53.
Opisthotonos in tetanus

developed, while symptomatic therapy often requires special equipment and skilled personnel.

Tetanus can be prevented by a specific anti-tetanus immunization. This is accomplished by the parenteral administration of the tetanus adsorbent anatoxin, which ensures the organism's resistance to tetanus for many years provided the vaccination is repeated every 5-10 years.

Urgent specific tetanus prophylaxis must be applied without fail in any trauma attended by impaired continuity of the skin or mucous membranes, burns and I-III degree frostbite, wounds caused by the animal bites, extrahospital abortions, and in labour that occurred at home without qualified medical aid.

An immunized person is given 0.5 ml of the purified adsorbent anatoxin (active immunization), regardless of the severity of the injury. The anti-tetanus serum (ATS) is not used in these cases. An unvaccinated person or someone improperly vaccinated is immunized by the active-passive method (1 ml of the adsorbent tetanus anatoxin and 3000 IU of the anti-tetanus serum) as a measure of urgent specific tetanus prophylaxis. This method should be supplemented by repeated vaccination (0.5 ml of the anatoxin) carried out 30-40 days later. In

order to ensure stable immunity, 0.5 ml of the tetanus anatoxin is administered 10-12 months later.

Passive immunization by means of an ATS containing specific anti-tetanus antibodies is widely used. The ATS creates a short-term immunity in the body. One prophylactic dose is 3000 IU (1 ml), irrespective of the patient's age. This method is less reliable. The administration of the ATS must be preceded by a sensitization test: 0.1 ml of diluted ATS (1 : 100) is injected intracutaneously on the flexor surface of the forearm. The test is considered negative if a red papule of up to 9 mm in diameter forms at the site of the inoculation 20 minutes later. In this case another 0.1 ml of the undiluted ATS is introduced and if there is no further reaction the whole dose is administered 30-60 minutes later. If the intracutaneous test is positive, ATS is not given.

Tetanus anatoxin should not be prescribed if the term after the first revaccination is no longer than 6 months and no longer than 12 months after the second revaccination.

Gas gangrene. A severe inflammatory process may develop in the wound and the surrounding tissues when bacteria capable of reproducing in the absence of oxygen (anaerobic bacteria) get into the wound. The earliest symptoms of the developing complication are a feeling of bulging out of the wound and excruciating pain that appears 24-48 hours after the injury. The tissues around the wound rapidly swell, the skin turns cold and is covered by dark spots and the pulse in the vessels disappears. There is crepitation when the surrounding tissues are compressed due to gas liberated from the tissues. The general body temperature rapidly increases to 39-41 C. Treatment of gas gangrene includes the following steps: (1) administration of antitoxic sera; (2) an extensive surgical excision of the tissues in the affected organ or its amputation; (3) local treatment of the area with oxygen-

...ating chemicals (e. g. hydrogen peroxide). Prognosis ...erious in all cases.

...as gangrene, sepsis, and tetanus most commonly ...elop in extensive injuries when bits of crushed, non-...ble tissues get into the wound and create a favourable ...ment medium for bacteria. Exhaustion and overcool-...g in a patient are other contributing factors for mi-...be reproduction. Sometimes the complications deve-...p in a matter of hours. Hence, the prompt admission of ...se patients to a hospital so they can be given timely ...dical aid and be administered specific antitoxic sera ...quires special importance.

Debridement of the wound (primary surgical treat-...nt) which must be performed within 6 hours of the ...ury is the main means for preventing wound infec-...n.

Debridement. The only wounds that heal by first inten-...n (without suppuration) are those that are made either ...y a sharp instrument or during operation made in asep-...c conditions. Every wound sustained during an accident ...infected and if there is no surgical intervention they ...al by second intention, i. e. with suppuration, slow ...ejection of the dead tissues and gradual filling of the ...ound with granulations and subsequent scarring. *A sur-...al intervention that involves incision of the wound's ...dges along the whole canal is known as debridement.* The ...ontaminated and crushed tissues are incised and the for-...gn bodies removed, the bleeding is arrested, and the ...ound is sutured layer by layer. A debridement carried ...ut within a few hours of the injury enables, in most ...ases, the wound to heal by first intention. This is the ...est preventive measure for controlling sepsis, gas gan-...rene, and tetanus.

Haemorrhage from the first moment of the injury is ...ry dangerous. **An acute blood loss has fatal outcomes ...er the injury and therefore arresting the blood flow is an**

essential measure. Any method, such as compression of a vessel, application of a pressure bandage to the wound (see above), should be used to stop the flow.

Protection of the wound from contamination and infection is no less essential task of the first aid. Properly treating the wound prevents complications and can reduce the period of healing by almost three times. The wound should be treated with clean, disinfected hands. An aseptic bandage should be applied so that the fingers do not touch the part of the dressing which will be in contact with the wound. When antiseptics are unavailable the wound should be protected by a common aseptic dressing (a bandage, individual first-aid pack or a scarf bandage). If there are antiseptics (hydrogen peroxide, furacillin, iodine tincture, benzene, etc.) the skin around the wound should be first cleaned with gauze or a cotton wool pad impregnated with the antiseptic solution trying to remove away from the wound surface any dirt, bits of clothing, or earth, and only after that apply a bandage. This prevents any infection from spreading into the wound.

A wound must never be washed with water, which promotes infection. Care should be taken to prevent cauterizing antiseptic substances from getting into the wound surface. Alcohol, iodine tincture and benzene can destroy cells thus promoting suppuration and intensifying the pain. Foreign bodies and dirt lying deep inside the wound should be left in place, otherwise the wound will be infected still more and complications develop (e. g. bleeding or damage to organs).

Small foreign bodies that have got stuck under the skin (splinters, bits of glass or metal) can cause pain, infect wound, and can give rise to severe inflammatory processes (phlegmon, panaritium). Therefore in rendering aid they should be removed. Dirt, sand, or earth are easily removed from excoriations by wiping them with

ydrogen peroxide. Splinters, thorns, or other small foreign bodies should be removed using a needle, a pair of forceps, or sometimes finger nails, after which the wound should be treated with any antiseptic solution available at the moment. Only a surgeon can remove foreign bodies from large wounds during debridement.

Powders and ointments must never be applied to a wound neither should cotton wool be put directly onto a wound's surface as it promotes infection.

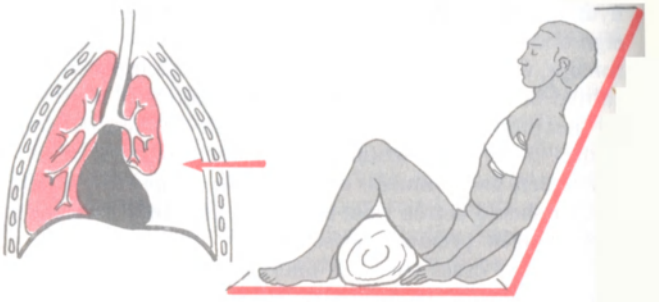
There are cases when an internal organ (brain, intestine, or tendons) protrudes through the wound. In such cases, the protruded organs should be left in place and covered with a dressing.

In large injuries to the limbs they should be immobilized.

Urgent transportation of a victim to any medical establishment is one of the main tasks of first aid. The earlier the victim receives skilled medical aid the more effective the treatment will be. It should be kept in mind, however, that in no case should someone be transported so quickly that the rules we laid down are broken. Victims should be transported in the most comfortable position according to the type and localization of the injury and severity of blood loss, avoiding jerking and bumping en route. If the injury is attended by shock and copious bleeding a victim is transported lying on his back.

Features of the First Aid in Injuries to the Head, Chest, and Abdomen

First aid in *wounds to the soft tissues of the head* is aimed at arresting haemorrhage. Due to the fact that the soft tissues cover the cranial bones a tight compression bandage is the best way to stop bleeding. In certain cases a haemorrhage is arrested by finger compression of an artery (the external temporal artery is compressed in



(*a*) (*b*)

Fig. 54.
Perforating wound of the thoracic cage
a, open pneumothorax (schematical representation); *b*, position of the victim during transportation after the chest wound has been closed

front of the ear, the external mandibular artery in the lower edge of the lower jaw, 1-2 cm from its angle). Wounds to the head are extremely dangerous since they can be attended by a simultaneous injury to the brain (concussion, contusion, compression). First aid in such cases is reduced to the following measures: the victim is placed in a horizontal position, cold is applied to his head, and he is immediately removed to a hospital.

Perforating wounds of the chest are very dangerous because the heart, aorta, lungs or other vital organs might be damaged with consequent profuse haemorrhage and rapid death. When the internal organs remain intact, another danger arises, namely, air penetrating into the pleural cavity, which causes open pneumothorax (Fig. 54). As a result, one lung collapses, the heart becomes displaced, and the sound lung compressed, followed by a general grave condition known as pleuropulmonary shock. A person who is rendering first aid must

know that if the wound is closed hermetically this menacing complication may be prevented or lessened considerably. A wound can be reliably covered by an adhesive plaster that should be applied by the spica type. When a plaster is unavailable the wound may be covered by the rubberized wrapping from an individual first-aid pack and tightly bandaged. An occlusive bandage covered with a gauze thickly smeared with vaselin, or oil-cloth, or airtight film, etc., is applied with a compression bandage. Anti-shock measures are started and the patient is transported in a semi-recumbent position (Fig. 54).

Injuries to the abdomen (abdominal wall) are extremely dangerous because even a small wound might be perforating and damage the abdominal organs. These may be followed by dangerous complications that require emergency operation, for example, internal haemorrhage and discharge of the gastro-intestinal contents into the abdominal cavity with the subsequent development of a purulent (faecal) inflammation of the peritoneum (peritonitis).

First aid consists in treating the wound of the anterior abdominal wall according to the common rules. In extensive wounds the abdominal organs, sometimes injured, may protrude through the opening in the abdominal wall (eventration). Such a wound should be covered by an aseptic bandage. *In no case must the protruded organs be pushed back into the abdominal cavity since this will lead to peritonitis.* After the skin around the wound has been treated the protruding organs should be covered with sterile gauze or a towel, or a hemmed sheet. A thick pad of cotton wool is applied over and around the organs, and covered by a circular bandage. Shock rapidly develops in patients with eventration, which is why antishock measures should be begun. Drink, food, or the oral administration of drugs are not permitted because of the danger of peritonitis.

A patient with an abdominal wound should be transported lying down with a raised upper part of the trunk and with his legs being bent at the knees to prevent spreading of the inflammatory process to all parts of the abdomen (see Fig. 30*b*).

Chapter 8

First Aid in Injuries to the Soft Tissues, Joints and Bones

Essentials of trauma. Anatomical or functional damage to tissues and organs by the environment is known as a trauma or injury. The cause may be mechanical (a blow, compression, strain), physical (heat, cold, electricity, radiation), chemical (acids, alkalis, poisons), or psychological (fright, fear). The severity of the trauma is determined by the strength and the duration of the cause.

An injury is most commonly the direct result of a mechanical force (a blow, compression, strain). Mechanical injuries may be closed or open. In closed injuries the continuity of the skin or mucous membranes is preserved. They include contusions, sprains, subcutaneous rupture of the organs and soft tissues (muscles, tendons, vessels, or nerves). In open injuries the organs and tissues are damaged and the continuity of the skin or mucous membranes is disrupted (wounds, open bone fractures).

An *acute trauma* is an injury caused by a single sudden and strong action on the body's tissues. Traumas that develop due to repeated constant actions of a small force are known as *chronic traumas*. These include most occupational diseases (flatfoot in people engaged in hard

physical labour, tendovaginitis in typists, eczemas and ulcers on the hands of X-ray technicians, etc.). In addition to local damage to the tissues, any trauma produces general changes in the body such as cardiovascular, respiratory, or metabolic disorders (see Chapters 4 and 5).

Traumatism is the set of traumas that occurs in a population group in a period of time (calculated by the number of traumas per 100 or 1000 of the population per month or year). Traumatism is classified as occupational (industrial, agricultural, house-hold, sport, transport, or military), and non-occupational. Control of traumatism is one of the main tasks of the public health and labour protection organizations.

First Aid in Contusions, Sprains, Ruptures, Compression, or Dislocations

In many cases the skin remains intact after an injury, while the soft tissues and bones beneath are damaged.

Contusion is the most common injury to the soft tissues and is caused by a blow from a blunt instrument. It is attended by swelling and not infrequently by a bruise because blood may accumulate under the skin (haematoma) when the large vessels are broken. A contusion can cause a functional disorder in an injured organ. When the soft tissues are contused only pain and a moderate limitation of movement result but if an internal organ (brain, liver, lungs, or kidneys) is contused, grave disturbances in the whole body and even death may ensue.

First aid in contusion. The injured organ is placed at rest and raised to arrest haemorrhage into the soft tissues. A compression bandage and an ice bag are applied to the contused area to lessen the pain and inflammation.

Sprains and ruptures of the ligaments occur when a joint is moved outside its physiological limits. A sprain is attended by a sharp pain, rapidly developing swelling

near the injury, and a marked functional disorder in the joint.

First aid. When the tendons are ruptured a bandage is applied to secure a joint. The patient is placed at complete rest, and a tight bandage is applied to the injured joint to secure it firmly in position. To lessen the pain 0.25-0.5 g of analgin or amidopyrine is given and an ice bag applied to the injured site.

A patient with a sprain must consult a doctor since the symptoms typical of sprains may resemble those found in cracks of the bone.

Compression is a very serious injury to the limbs in which the muscles, subcutaneous fat, vessels, and nerves are crushed. These injuries occur from pressure, for example, heavy loads falling down (bricks from a collapsed wall, logs, earth) or earthquakes. Compression is attended by shock and later by intoxication of the body by the products of the disintegration of the soft tissues.

First aid. A victim should be immediately released from the collapsed debris, and a tourniquet applied as close as possible to the base of the limb to prevent discharge of toxic substances into the body from the crushed tissues of the limb (the techniques are the same as those for arresting arterial haemorrhage). The injured limb should be splinted and covered with an ice bag or a cloth soaked in cold water. Patients with this type of injury often develop shock at the moment of the injury. In order to control or prevent it they should be made warm and given hot tea or coffee, or a sip of vodka or wine. If possible omnopon, morphine (1 ml of a 1 per cent solution) and cardiac stimulants should be administered. The victim must be immediately taken to a hospital lying down.

Dislocation *is an injury when a bone in a joint has been pulled from its socket and protrudes through the ruptured capsule into the surrounding tissues.* A complete disloca-

is when the articular surfaces are no longer in contact, while an incomplete dislocation is when there is partial contact between them.

A dislocation is named according to the more peripheral bone in the injured joint, for example, a dislocation of the foot is when the ankle bones are dislocated while a dislocation of the upper arm is when the bones in the humerus are displaced. The main cause of a dislocation is an indirect trauma, e. g. a dislocation of the hip may occur by falling onto a bent leg with a simultaneous turn of the leg inward, while a dislocated humerus can be caused by falling onto an extended arm.

A dislocation can be recognized by the following symptoms: pain in the limb and the contours of the joint are distorted (deformation, sinking of the joint). Active movements in the joint are absent and the passive ones are impossible, the limb is fixed in an awkward position which cannot be corrected, the limb seems to have been changed, often shortened.

First aid. The pain should be alleviated, cold applied to the injured joint, the limb immobilized in the position it acquired after the injury, and anaesthetics administered (analgin, amidopyrin, promedol). An upper limb can be supported by a triangular or roller bandage, a lower limb immobilized by means of a splint or other means available. It is much easier to reduce fresh dislocations than neglected ones. The tissues swell and blood accumulates in the injured joint 3 or 4 hours after the accident, and this makes reduction difficult. *A dislocation should only be reduced by a doctor*, which is why a victim must be promptly taken to a hospital. When an upper limb is dislocated the victim is able to see a doctor without assistance or can be taken sitting down by any available transport. A patient with a dislocated lower limb should be taken to hospital lying down.

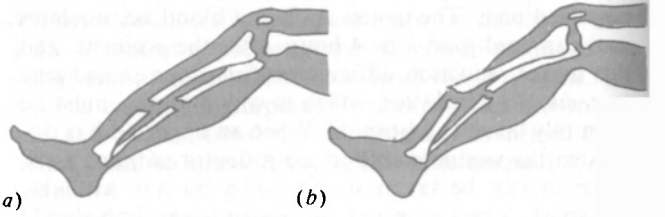
You should never attempt to reduce a dislocation yourself because it is sometimes difficult to distinguish between a dislocation and a fracture. Moreover, dislocations are often attended by cracks and fractures in the bones.

First Aid in Fractures

A **fracture** is a break in the continuity of the bone. Fractures are classified as traumatic and pathological. *Traumatic* fractures may be closed (the skin remains intact) or open (the skin is damaged) (Fig. 55). Open fractures are the more dangerous because the fragments can be contaminated and osteomyelitis can develop. These make the reunion of the bone fragments more difficult. *Pathological* fractures are induced by diseases (tuberculosis, osteomyelitis, tumours) which develop in the bone and lead to its gradual destruction. At some stage of the disease an ordinary load exerted on the limb will cause it to fracture.

There are complete and incomplete fractures, the latter being distinguished by the disruption of some part of the bone diameter, most commonly in the form of a longitudinal fissure.

Fractures vary widely in shape, being transverse,



(*a*) (*b*)

Fig. 55.
Types of fractures
a, open; *b*, closed

oblique, spiral, or longitudinal. Splinter fractures, in which the bone is broken into separate fragments, are not uncommon. They often occur in gunshot wounds. A fracture that has resulted from compression or flattening is known as a *compression fracture*.

In most cases the fracture fragments are moved apart. Which way the fragment moves depends, on the one hand, on the direction of the mechanical force that caused the fracture, and, on the other, on the pull of the muscles attached to the bone and on the way they contract after the fracture. The bone fragments may be displaced along the limb, across it, or at an angle to each other, depending on what and where the injury is, and the strength of the muscles attached to the bone. Wedged fractures, in which one of the fragments is driven into the other, are not uncommon.

The symptoms of a fracture include: sharp pain at the site of the injury which increases given any movement or when a load is put on a limb; a distorted position and shape of the limb; functional disorders (inability to use the injured limb); swelling or bruising at the site of an injury; a shortening of the limb; and abnormal mobility where there should be none. Palpating the fracture site causes sharp pain and makes it possible to determine the uneven surface of the bone, the sharp edges of the fragments and crepitation on a mild pressure. Any examination of a limb, especially when it moves abnormally, must be done very carefully, using both hands so as not to cause additional pain and complications (damage by the bone fragments of the blood vessels, nerves, muscles, skin, or mucous membranes).

A bone fragment projecting through the wound is an obvious sign of an open fracture and makes palpation unnecessary.

Timely and correct aid is the essential component of the treatment of fractures. Healing and the prevention of

complications such as haemorrhage, displacement of fragments, or shock, and other morbid conditions depend on how promptly the aid has been rendered.

First aid includes the following steps: (1) immobilization of bones at the site of the fracture; (2) the control and prevention of shock; (3) prompt removal of a victim to a medical establishment. *Rapidly immobilizing the fractured bones lessens the pain and is the main factor in preventing shock.*

Fractures of the limbs are the most common. Correct immobilization of the limb prevents the fragments from being displaced and decreases the danger of the major blood vessels, nerves, or muscles being injured or the skin being broken by the sharp edges of the bone, as the patient is moved. A limb is immobilized with splints which may be made of any material at hand.

A splint should be applied at the scene of the accident and only after that should the patient be taken to hospital. The splints should be applied very carefully so as not to displace the fragments and cause pain. One should never attempt to correct the position of or reduce the fragments, unless a broken bone with a sharp edge is threatening to break the skin. The victim should be carried very carefully, lifting and supporting both the limb and trunk, and keeping them at the same level.

In the case of an *open fracture* the skin around the wound should first be treated by iodine tincture or other antiseptic, an aseptic bandage applied, and the limb immobilized. If sterile material is unavailable the wound should be covered with any clean cotton cloth. In open fracture, as was the case with closed fractures, never attempt to remove or reduce the bone fragments projecting into the wound, which may cause bleeding and additional contamination of the bone and soft tissues. Any bleeding should be arrested by applying a temporary compression bandage or tourniquet, or a twist.

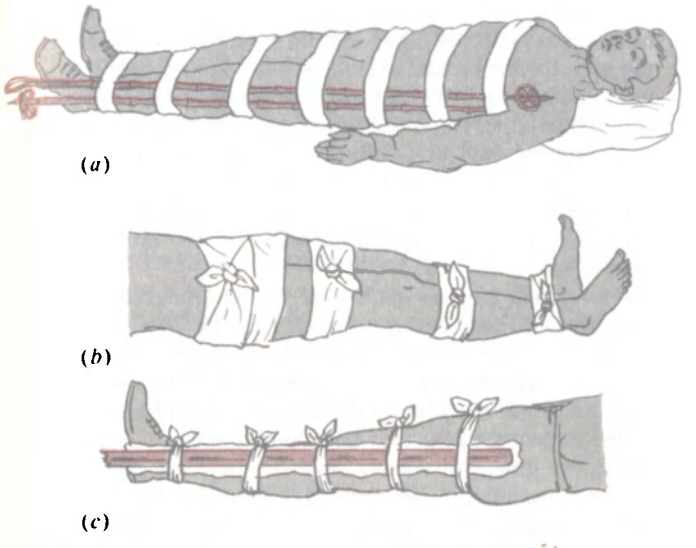


Fig. 56.
Immobilization of the limbs in fractures using any means available at the moment of a fracture

a, in fracture of the thigh bone with the help of two planks; *b*, in fracture of the thigh bone and shin with fixation of the injured leg to the sound leg; *c*, in fracture of the leg bones

The lower limbs are best immobilized by Diedrich's transportation splint, while the upper limbs are best dealt with using Cramer's ladder splint or a pneumatic splint (see Chapter 3). When standard splints are unavailable splints can be improvized from any material (planks, skis, guns, branches, reeds, or strips of cardboard). To immobilize the bones of the limb firmly, at least two hard objects are needed, which are applied to opposite sides of the limb. When nothing else is available, an arm can be tied to the trunk with a scarf or roller bandage and a broken leg to the sound one (Fig. 56).

To move someone the following rules should be observed: (1) the splints should be secured so as to fasten the area of the fracture; (2) the splints should be padded with cotton wool or other soft material; (3) in order to immobilize the fractured area, the joints above and below the fracture should be fastened (e. g. for a leg fracture the ankle and knee joints should be fixed in a comfortable position; (4) in fracture of the thigh bone it is necessary to immobilize all the joints of the lower limb (knee, ankle, and hip).

Prevention of shock and other general disorders. If the fracture is properly immobilized, i. e. the position that causes least pain is chosen, shock and other complications are usually avoided. Unnecessary fussiness, and loud and shrill chatter about the injury and the condition of the patient are also very unfavourable. Cold promotes the development of shock, therefore patients should be covered warmly. A sip of something alcoholic (e. g. vodka, brandy, or wine), hot coffee, or tea is also beneficial. Pain can be relieved by administering 0.5-1 g of amidopyrine or analgin, or anaesthetics (1-2 ml of a 1 per cent solution of morphine, omnopon, or promedol).

It is best to take a patient to a medical establishment in an ambulance or by any transportation means available at the moment. Patients with fractures of the arms are transported sitting, something soft being put under the arm which is raised a little; those with fractures of the legs should be moved lying down on a stretcher. Special care should be taken when moving a patient because the slightest displacement of bone fragments will cause sharp pain. Moreover, a bone fragment may break through soft tissues and produce new grave complications.

Injuries to the skull and brain. Injuries to the brain which result from a blow on a head are extremely dangerous, even when the cranial bones remain intact. Damage to the brain is classified as follows: concussion

"shaking of the brain"), contusion, and compression. The symptoms of concussion are oedema and swelling of the brain, while in contusion or compression of the brain some of the brain tissue is also destroyed.

A brain injury can be recognized by the following general cerebral symptoms: dizziness, headache, nausea and vomiting, and a slowing pulse. The severity of the symptoms depends on the degree and extent of the damage to the brain. *Concussion of the brain* is the most common condition and is marked by the following basic symptoms: consciousness may be lost for either a brief period of up to a few minutes or for several hours (24 and longer) or retrograde amnesia may develop, i. e. loss of memory of the events preceding the accident. *Contusion* and *compression* of the brain are attended by the symptoms of the local damage to the brain; *speech, sensitivity, movement of the limbs, facial expression are deranged.*

In more serious traumas fractures of the cranial bones are encountered. The brain may be considerably damaged by the blow itself, by haemorrhage (compression haematoma), and by bone fragments imploded into the skull cavity. Open fractures of the cranial bones are particularly dangerous, being attended by a loss of brain matter, or by an infection of the brain.

It is very difficult to establish to what degree the brain has been damaged. That is why any patient having the symptoms of concussion, contusion, or compression of the brain must be urgently admitted to hospital. First aid consists in placing the patient at rest. He should be put in a horizontal position and given an infusion of valeriana (15-20 drops), Zelenin drops, and an ice bag or cold compress should be applied to his head. If the patient is unconscious his mouth should be cleaned by removing mucus and vomit. He should then be placed in a stabile position taking every measure to improve respiration and cardiac activity (see Chapter 3).

In open fractures of the cranial vault, care should be taken to protect the wound from infection by covering it with an aseptic dressing.

During transportation the patient must be watched constantly to prevent possible repeated vomiting and aspiration of the vomit, retraction of the tongue, or asphyxia.

Patients with wounds to the head or damage to the cranial bones or brain should be transported in stretchers lying down. To prevent additional injuries and jolting of the head, it is immobilized by means of a cotton wool and gauze ring-shaped roll, a rubber bed-pan, or some other means at hand (e. g. blanket, clothing, hay, sand-bags) that can be rolled around the head. The head may be immobilized by a sling bandage that is passed under the chin and fastened to the stretcher (Fig. 57). In case of fractures of the occiput the patient should be laid on his side and taken carefully to hospital.

Vomiting is often observed in patients with this type of injuries, therefore they should be watched carefully to prevent asphyxia by the vomit.

Fractures of the bones of the nose are often attended by nosebleed, in which case the patient should be transported in a stretcher in a semi-recumbent position, with the head and shoulders raised and supported.

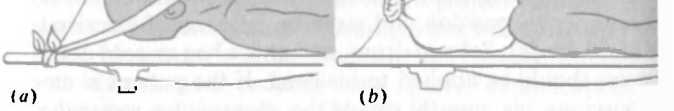


Fig. 57.
Immobilization of the head
a, fixation by a sling bandage to stretcher; *b*, fixation with the help of sacks of sand

A victim with injuries to the jaws should be transported sitting, their head being slightly bent forward. An unconscious patient should be placed on his belly during transportation to prevent asphyxia from accumulating blood, saliva, or a retracted tongue. A roll made of clothing, a blanket, or such like should be put under his forehead and chest. Prior to the transportation the lower jaw should be immobilized by a sling bandage; the upper jaw is immobilized by inserting a ruler or a piece of plywood and securing it to the head.

Fractures of the spine most commonly result from falling from a height, a heavy weight falling on the back, or from a direct and strong blow on the back in a road accident. Fractures of the neck vertebrae often occur if the head strikes the ground in diving.

Fractures of the spine are very dangerous and manifested by excruciating pain on a slightest movement. The spinal cord may be ruptured or compressed which will lead to paralysis of the limbs (loss of movement and sensitivity). It may also be ruptured if the vertebrae are slightly displaced, therefore no attempt should be made to sit or stand the victim up with a suspected fracture of the spine. Conditions of complete rest should be provided. The patient should be laid down on a rigid even surface using a wooden board which is also used to immobilize him when he is moved (Fig. 58). Should these be unavailable or the patient unconscious, he may be transported in a stretcher lying flat on his belly, with pillows put under his shoulders and head, which makes the transportation less dangerous. With fracture of the cervical spine the victim should be transported lying on his back, his head being immobilized as for a fracture of the skull. He must be transported very carefully. Three or four persons should handle the victim, supporting his trunk and keeping it on the same level and preventing his spine from sagging when he is shifted or lifted. It is better

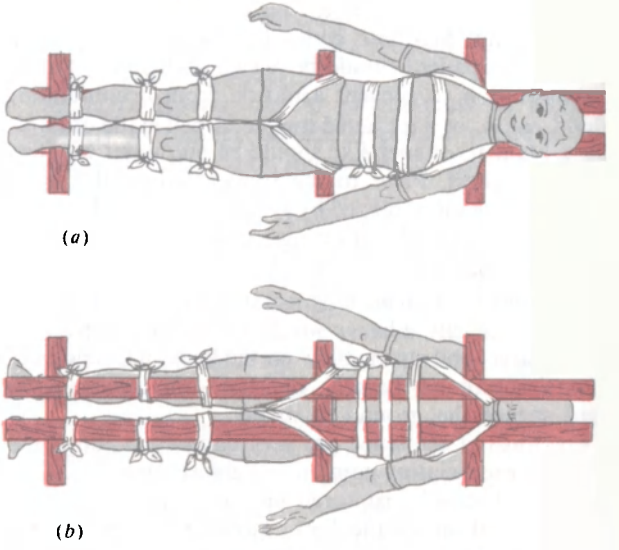


Fig. 58.
Immobilization in fracture of the spine
a, front view; *b*, back view

to shift a patient together with the board on which he lies.

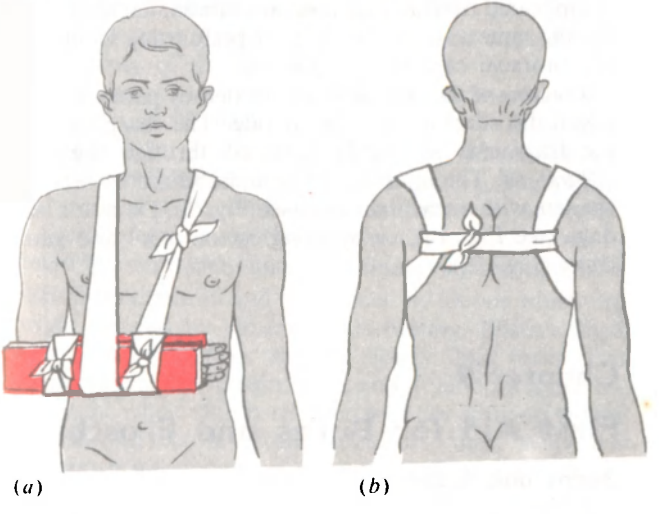
Fracture of the pelvic bones is one of the gravest injuries. It occurs when the victim falls from a height, is compressed, or has suffered direct strong impacts. The injury is attended by damage to the internal organs and severe shock. The main symptom is the sharpest pain in the pelvic area arising whenever the limbs are slightly moved or the patient's position is changed.

The pelvic bones cannot be splinted therefore the patient should be placed in the most comfortable position in which the pain is less frequent and less strong, making it possible to prevent the internal organs from

being damaged by the bone fragments. The patient should be placed on his back on a rigid even surface, with his knees bent and parted a little (the "frog" position). A tight bolster (a cushion, folded blanket, coat, or hay) 25-30 cm high is placed under the knees. Anti-shock measures are essential.

The patient is transported in a stretcher or on a rigid wooden board lying down (see Fig. 30*b*). The bolster is tied in position to the patient's hips with a soft material (a towel or a bandage).

Fractures of the ribs are usually caused by a direct strong blow to, or compression of, the chest, or by falling from a height. Cases have been known when the fracture has occurred during forced coughing or sneezing. The symptoms of the fracture are sharp pain that becomes



(*a*) (*b*)

Fig. 59.
Immobilization in fracture of the forearm (*a*) and clavicle (*b*)

stronger during breathing, coughing, or when the body's position is changed. Multiple rib fracture is dangerous due to growing respiratory insufficiency. The sharp edges of the fragments can damage the lungs as a result of which pneumothorax or intrapleural haemorrhage would develop.

First aid: the ribs are immobilized by a tight circular bandage applied to the chest or using a towel, sheet, or a piece of cloth when bandage is unavailable. Analgin, codein, or amidopyrine (one tablet) may be given to relieve the pain and cough. The patient should be transported sitting to lessen the pain. When the patient is in a grave condition and cannot sit he should be transported in a stretcher semi-recumbent.

The first aid and transportation methods in cases of complicated rib fractures (pneumothorax, haemothorax) are the same as those for cases of perforating wounds of the thoracic cage (see Chapter 7).

Fracture of the clavicle is manifested by pain and functional disorders at the injured side. The sharp edges of the fragments are easily palpated through the skin.

First aid. The injured area is immobilized by securing the arm with a scarf bandage (see Fig. 5), Desault's bandage (see Fig. 14), or by using cotton wool and gauze rings (Fig. 59).

Chapter 9

First Aid for Burns and Frostbite

Burns and Scalds

Burns and scalds are injuries caused by high temperatures, chemicals, X-rays, sunlight, or ionizing radiation.

Thermal Burns

Thermal burns are caused by high temperatures (flames, boiling water, burning or hot liquids or gases, red-hot objects, molten metal). The severity of the damage depends on the temperature, exposure, and the extent and locality of the burn. Particularly severe burns are caused by flames and steam under pressure, in which case the mouth and nose, the trachea, and the other organs directly in contact with the atmosphere are damaged.

Burns on the limbs and eyes are more common than those of the trunk and head. The larger the extent and depth of the burn, the more dangerous it is to the patient's life. Burns covering one third or more of the body often terminate in death.

Four degrees of burns are distinguished according to the severity of the damage.

First degree burns (erythema) are when the skin turns red, swells, and is tender to the touch. This is the mildest degree of burn and is characterized by skin inflammation, which disappears in 3-6 days. Later pigmentation and peeling of the skin remain at the site of affection.

Second degree burns (formation of blisters) are manifested by more pronounced inflammatory reaction. The burn is very painful and is attended by lesions which are bright red and by the epidermis peeling. Blisters filled with a transparent or slightly cloudy fluid form. The deeper skin layers remain intact and if the burn is not infected the whole skin is restored without scarring within a week. Full recovery occurs after 10-15 days. When the blisters are infected the regenerative processes are drastically deranged and the wound heals by second intention much later.

Third degree burns are when all the skin layers are necrosed. The cell proteins and blood coagulate to form a

dense scab that covers the injured and necrosed tissues. The wound heals by second intention. Granulation tissue forms at the site of affection which is replaced by connective tissue and a coarse, star-like scar.

A *fourth degree burn* (charring) is due to very high temperatures (electrical arcs or molten metal) and is the gravest form of burn. It is attended by damage to the skin, muscles, tendons, and bones. Third and fourth degree burns heal very slowly and often need skin grafting to cover the burnt surface.

Burns give rise to severe general symptoms due, on the one hand, to disorders of the central nervous system (pain, shock) and, on the other, to changes in the blood and the activity of the internal organs (toxicosis). The greater the area of the burn the worse is the damage to the nerve endings, and the more traumatic is the shock. The function of the internal organs is deranged because of the copious discharge of the fluid portion of blood (plasma) through the burnt surface. The body becomes intoxicated by the products of the necrosed tissues which are absorbed from the lesion. The condition is attended by headaches, general malaise, nausea, and vomiting.

First aid: the high temperature source must be removed as soon as possible. Flames on the clothing must be beaten out, the victim taken from the high temperature zone, and glowing or hot clothing removed. All the measures should be done as gently as possible so as not to impair intact skin with awkward actions. Bits of clothing, especially where it adheres to the burnt skin, should be cut around and never torn off. An aseptic bandage is then applied over the remaining clothes. The patient should not be undressed, especially in cold weather, because cooling aggravates the trauma and may be conducive to shock.

The next step is promptly to apply a dry aseptic bandage to prevent the burnt surface from becoming in-

fected. A sterile bandage or individual first-aid pack should be used. In the absence of a sterile dressing the lesion may be covered by a clean cotton cloth pressed with a hot iron or soaked in ethyl alcohol, vodka, ethacridine lactate (rivanol), or potassium permanganate solution. The dressing somewhat relieves pain.

The person rendering the first aid must know that additional damage to, and infection of, the lesion is dangerous, which is why the burnt area should never be washed or touched. It is absolutely forbidden to puncture blisters, to tear bits of clothing adhering to the lesion, to smear a burn with fat (vaseline, butter, or oil), or to powder it. Oil (or powder) applied to a wound will not promote healing or lessen the pain, but it will make it easier for infection to penetrate the lesion and, what is more dangerous, will hinder medical aid and debridement of the burn.

General symptoms of shock rapidly develop in extensive second, third, or fourth degree burns. In order to lessen pain, the victim should be placed in a comfortable position, covered warmly and given plenty to drink. Anti-shock measures must be started at once. If possible, narcotics (omnopon, morphine, or promedole – 1 ml of a 1 per cent solution) should be administered to relieve pain, and hot strong coffee, tea, wine, or a sip of vodka may be given.

A victim with extensive burns is simply wrapped in a clean ironed sheet and promptly taken to hospital. Before transportation he should be immobilized so that the burnt skin is stretched. For example, if the burn is on the inner surface of the elbow the limb should be extended; if the posterior surface of the elbow is burnt the arm should be secured with the elbow bent; if the palm of the hand is injured the hand should be fixed with the hand and fingers fully extended.

The victim must be taken to a hospital by ambulance

but any transport may be used. The patient is placed at rest in the most comfortable position. It should be remembered that cooling may deteriorate his condition and cause shock. Hence it is necessary to keep a careful watch on the patient, covering him warmly and giving him plenty of hot drinks.

Transportation of a patient with extensive burns needs special care. He is placed on his intact surface (e. g. his side or belly). He should be put on a tarpaulin, or blanket, to move him more easily on a stretcher without causing him additional harm.

Patients with lesser burns (first or second degree, or sometimes third degree burns) may come to hospital without assistance where they receive out-patient medical aid (except for patients with burns to the eyes, genitals, or perineum).

During transportation measures should be taken to prevent shock and if it has already developed anti-shock therapy should be resumed (see Chapter 6).

Chemical Burns

Chemical burns may be caused by a concentrated acid (e. g. hydrochloric, sulphuric, nitric, acetic, or carbolic) or alkali (e. g. potassium hydroxide, sodium hydroxide, ammonium hydroxide, or calcium oxide), phosphorus or certain heavy metal salts (e. g. silver nitrate or zinc chloride).

The severity and depth of the damage depend on the chemical and its concentration and how long the skin was exposed to it. The mucous membranes and the skin on the neck and perineum are more sensitive while the soles and palms are more resistant.

A dark brown or black scab with well defined borders rapidly forms on the skin and mucous membranes when exposed to a concentrated acid, while a moist dirty gray

blurred scab forms after exposure to concentrated alkalis.

First aid in chemical burns is determined by the chemical substance. A burn caused by a concentrated acid (except sulphuric) should be washed with current of cold water for 15-20 minutes. Sulphuric acid liberates heat when it reacts with water and thus may aggravate the burn. Washing the burn with an alkaline solution is best: soapy water, 3 per cent sodium bicarbonate solution (1 teaspoonful per glass of water). Burns caused by alkalis should also be thoroughly washed with strong current of water and treated with a 2 per cent acetic or citric acid solution (lemon juice). An aseptic bandage or a dressing impregnated with the solutions for treating the burn should be applied.

There is a difference between burns caused by phosphorus and those caused by acids and alkalis. Phosphorus ignites on contact with air and the burn is then both thermal and chemical (acidic). The burnt body part should be best immersed in water and the remaining bits of phosphorus removed under the water with a needle, cotton wool, or washed away by strong current of water. The lesion then should be treated with a 5 per cent copper sulphate solution and covered with a dry sterile dressing. Oil and ointments are contraindicated because the phosphorus can then be absorbed.

Burns caused by lime (calcium oxide) should never be washed with water. The lesion is smeared with butter or oil, the bits of lime removed, and the wound covered with a gauze dressing.

The action of acids and alkalis on the mucous membranes including that in internal administration is described later under the heading "First Aid for Poisoning by Concentrated Acids or Alkalis".

Frostbite

Damage to tissues due to their exposure to extreme cold is known as **frostbite**. The causes of frostbite are quite varied (long exposure to cold, wind, high humidity, too tight or wet footwear, immobility, various ailments, exhaustion, alcoholic intoxication, or blood loss) and in certain conditions it may occur even at 3-7°C. The distal parts of the limbs, the ears, and nose are more susceptible to frostbite. The first symptom is a feeling of cold, followed by numbness and pain, and finally all sensitivity is lost. The ensuing anaesthesia makes continuing exposure to cold unnoticeable and results in severe irreversible changes.

Four degrees of a frostbite are distinguished, depending on the severity and depth of the changes. The degree of a frostbite can be established only after the patient has been warmed up, sometimes only in a few days.

First degree frostbite is when the skin is damaged with ensuing reversible circulatory disorders. The skin is pale and mildly swollen, and its sensitivity is sharply reduced or lost completely. If warmed it acquires a bluish-red tinge, the swelling increases, and dull pain occurs. The inflammation (swelling, redness, and pain) persists for several days and then gradually disappears. Peeling and itching of the skin ensue later. A frostbitten part of the body is very sensitive to cold for a long time after.

In *second degree frostbite* the superficial skin layers are necrosed. When warmed up the pale skin becomes reddish-blue, the tissues rapidly swell and the inflammation spreads beyond the frostbitten lesion. Blisters filled with a transparent or white fluid form in the affected area. Blood circulation is restored slowly. Insensitivity of the skin persists nevertheless it remains rather painful.

This type of a frostbite is characterized by elevated body temperature, chills, poor appetite and sleep. In the

absence of a secondary infection, the skin layers gradually detach without granulation and scarring (15-30 days). The skin in the affected area remains bluish for a long time and its sensitivity is reduced.

Third degree frostbite is when the circulatory disorders (vascular thrombosis) lead to necrosis of the whole thickness of the skin and soft tissues. The depth of the lesion is only gradually revealed. Skin necrosis occurs in the first days with blisters filled with a dark red or dark brown fluid. An inflammatory ridge (a bordering line) develops around the necrosed area. Damage to the deeply lying tissues is revealed after 3-5 days as developing moist gangrene. The tissues are completely insensitive but patients suffer from excruciating pain.

The general symptoms of this type of the frostbite are more pronounced. The toxicosis is manifested by severe shivering, profuse perspiration, a marked deterioration of the patient's general condition, and apathy to the surroundings.

Fourth degree frostbite is when the whole thickness of the skin and the bones are necrosed. The affected body part cannot be warmed up and remains cold and absolutely insensitive. Blisters filled with a dark fluid rapidly cover the skin. The border of the affection appears slowly, a clear demarcation line being visible only 10-17 days later. The affected area rapidly turns dark and begins to dry (mummification). The process of detachment of the necrosed limb takes 1.5-2 months, and the wound heals very slowly and sluggishly.

The general condition of the patient in this period is severely impaired. Dystrophic changes, continuous pain, and toxicosis cause exhaustion, while the blood's composition is changed, and patients become easily susceptible to other ailments.

First aid. The patient should be taken into warm premises and warmed immediately, paying particular

attention to the frostbitten part of the body and trying to restore circulation in it. A warm bath is the most effective and safe method. The water temperature should be gradually raised from 20 to 40° C over 20-30 minutes. The affected limb should be thoroughly washed with soap.

After the bath the affected area should be wiped dry, covered with a sterile dressing and protected from the cold. It should not be smeared with fat or ointment since these make any subsequent debridement more difficult. The frostbitten area should not be rubbed with snow because this makes cooling worse and bits of ice may wound the skin and promote infection.

In a case of first degree frostbite the individual body part (nose or ear) may be warmed either by the hands of the person rendering help or by hot-water bottles.

It is necessary to restrain from vigorously rubbing or massaging a frostbitten lesion because this may injure the blood vessels, increase the danger of vascular thrombosis, and cause deeper affection of the tissues. General measures to warm the victim are applied. He is given hot coffee, tea, or milk and promptly transported to a hospital, taking care to prevent further cooling en route, and rendering aid if it has not been given before the ambulance arrived.

General Freezing

General freezing occurs when the whole body has been cooled after a person has lost his way, is all tired out, exhausted or has been weakened by illness. Those in a state of alcoholic intoxication are most susceptible to freezing.

A person freezing first feels tired, strain, irresistible drowsiness, and apathy. He may faint when the body's temperature falls several degrees. Continued exposure to cold rapidly causes respiratory and circulatory arrest.

A freezing person has to be taken into warm premises

and then warmed slowly, better in a bath with room-temperature water. Then every part of the body has to be cautiously massaged while gradually rising the water temperature to 36°C. Once the body becomes pink and the signs of freezing of the limbs have subsided, artificial respiration and heart massage should be started immediately. As soon as the natural breathing appears the patient is put into a bed, wrapped warmly and given hot coffee, tea, or milk. If the signs of freezing of the limbs still persist, medical aid should be rendered. The patient has to be taken to a medical establishment without fail.

Chapter 10
First Aid in Accidents and Sudden Illness

Accidents and acute illnesses not infrequently give rise to pathological changes in the body, quickly leading to death. The outcomes of these conditions depend, to a great measure, on how promptly and adequately first aid is rendered at the spot of the accident.

Injuries Caused by Electric Shock and Lightning

Injuries caused by electricity or a discharge of atmospheric electricity (lightning) are known as electric injuries. The electricity produces local and general disorders in the body. The local disorders are burns of the tissues at the entrance and exit of the current. Depending on the victim's condition (moist skin, fatigue, exhaustion) and the size and voltage of the current, various local disorders may occur, ranging from loss of sensitivity to deep crater-like burns. Skin lesions in these cases resemble third or fourth degree burn. A crater-like wound with callous grey-yellowish edges can sometimes

reach the bone. The flesh may sometimes be torn to shreds or a limb turn off by a very high tension discharge.

Local disorders caused by lightning are similar to those due to an electric current used in engineering. Dark-blue spots due to vascular paralysis often appear on the skin and resemble the branches of a tree.

The general disorders resulting from the electric current affecting the nervous system are more dangerous with the victim instantaneously losing consciousness, as a rule. It is sometimes difficult to release someone from a source of electricity because of tonic muscular contractions and respiratory paralysis often occurs with subsequent respiratory arrest.

Damage to the nerve cells cause grave disorders: consciousness is lost, body temperature decreased, there are respiratory arrest, deep inhibition of cardiac activity, and paralysis. The general disturbances are more pronounced after a lightning strike, e. g. paralysis, deafness, dumbness and respiratory paralysis. The condition of a victim immediately after an electric shock may be so grave that it is difficult to determine from his appearance whether he is alive or dead. His skin is pale, his pupils wide, nor do they respond to light, respiration and pulse are absent, i. e. he is comatose (supposed death). Signs of life can be revealed only by thoroughly auscultating his heart or by electrocardiography.

In milder injuries, the general disorders may be manifested by fainting, severe nervous shock, dizziness, and general weakness.

First aid. The current must be immediately switched off by throwing off the knife switch, unscrewing the fuse, or breaking the wires and lifting them from the victim's body with a stick or by grounding the current or shunting it (connecting the two wires). *Touching the victim with unprotected hands while current is still on is dangerous.* As soon as the injured person has been freed from the cur-

rent, he should be thoroughly examined, local injuries treated and bandaged as is done in burns.

In the presence of injuries attended with mild general disorders (fainting, short-term loss of consciousness, dizziness, headache, pain in the heart) the first aid is to put the victim at rest and take him to hospital. It should be kept in mind that the patient's general condition may sharply and suddenly deteriorate in the nearest hours after the injury. The blood supply to the heart muscle may be deranged (angina pectoris, myocardial infarction) or secondary shock develop. These conditions are sometimes encountered in patients who may only have very mild general symptoms (headache, general weakness). **Therefore every victim who has had an electric shock must be hospitalized.**

Analgesics (0.25 g of amidopyrine, 0.25 g of analgin), sedatives (Bechterev mixture [1], 0.2-0.4 g of meprotan), and cardiac drugs (Zelenin drops [2], valerian tincture) are given to relieve the pain. The patient is warmly covered and transported lying down. A careful watch should be kept on these patients when moved because respiratory or cardiac arrest may occur at any moment. Therefore one should be ready to render prompt and effective help en route.

Artificial respiration is the only effective first-aid measure for managing general disorders (e. g. respiratory arrest or coma). It must be started immediately and sometimes continued for many hours. If the heart beat is preserved artificial respiration rapidly improves the

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[1] Inf. herbae Adonidis vernalis 6.0 : 180 ml
Natrii bromidi 6.0
Codeini phosphatis 0.2

[2] Tincturae Convalariae
Tincturae Valerianae āā 10.0
Tincturae Belladonae 2.5
Mentholi 0.1

patient's condition so that the skin regains its normal colour, the pulse appears, and the blood pressure becomes countable. The mouth-to-mouth technique (12-16 inhalations per minute) is the most effective and should be done using a tube or airway. The Silvester or Schaefer methods may be used but they are less effective (see Chapter 5).

If possible, the artificial respiration should be combined with the administration of cardiac stimulants (2-4 ml of cordiamine intramuscularly or intravenously, 1 ml of a 10 per cent caffeine solution, or 1 ml of a 5 per cent ephedrine solution). When the patient has come to he should be given plenty of drink (water, tea, or stewed fruit); neither alcohol nor coffee are permitted. The patient should be warmly covered.

When transporting an unconscious patient or one whose breathing has not been completely restored, artificial respiration may have to be continued persistently for many hours.

First aid for cardiac arrest should be started as soon as possible, i. e. within the first five minutes when the cells of the brain and spinal cord are still alive. Artificial respiration is combined with external heart massage at a rate of 50-60 compressions a minute. The effectiveness of the massage is shown by the appearance of a distinctive pulse in the carotid arteries. When artificial respiration is combined with heart massage the air should be blown once every 5-6 presses on the chest, mainly during exhalation. The heart massage and artificial respiration should be continued until the natural function is completely restored or definite signs of death have appeared. If possible, the heart massage should be combined with the administration of cardiac stimulants (1-2 ml of cordiamine, ephedrine or adrenaline, 1-3 ml of caffeine or corazol).

In some countries a folk remedy for those struck by

lightning is to lie the victim on the ground and cover him with earth.

In no case should a person who has been struck by lightning be covered with earth! This deteriorates the breathing (if any), cool the body, causes disorders of the circulation and, what is more important, delays the start of effective help.

Drowning, Asphyxia and Accidents in Falling Earth

Asphyxia or **suffocation** is the complete cessation of the oxygen supply to the lungs. Terminal states caused by asphyxia develop within 2 or 3 minutes. As a result of the cessation of gas exchange in the lungs, the brain cells are no longer supplied with oxygen, oxygen hunger develops and consciousness is lost. Somewhat later, the heart stops, all oxygen supply to cells of the brain ceases, the cells die of oxygen hunger and the patient's death ensues. Asphyxia occurs when the airways, most commonly the throat or trachea, are compressed by hands or a loop (strangulation), are filled with water (in drowning), mucus, vomitus, or earth, or are obstructed by a foreign body or the patient's tongue falling to the back of the throat (during anaesthesia, or when consciousness is lost). Asphyxia may also occur if the respiratory centre is paralysed by a toxic substance (poison, ether, carbon monoxide, soporific), or if the brain is injured (electric shock, lightning, wounds, etc.). Asphyxia often develops in children who have an oedema of the larynx due to an infectious disease (diphtheria, influenza, or tonsillitis).

Care should be taken when removing a drowning person from water. He should be approached from behind. The rescuer should grasp the victim by his hair or under the armpits, then turn him so that his face is up and swim to the shore, preventing any attempt by the victim to grasp the rescuer.

First aid should be rendered immediately the victim has been removed from the water. The victim should be laid with his belly across the rescuer's bent knee so that his head is lower than his chest and the upper part of his body angled down. Then any water, vomitus, or seaweed should be removed from the mouth and throat using a piece of cloth. The next step is to remove water from the trachea and bronchi which the rescuer does by energetically pressing the chest with his hands (Fig. 60). It should be stressed that when a person has drown, his respiratory centre becomes paralysed after 4 or 5 minutes, while his cardiac activity is maintained for up to 15 minutes. After the airways have been freed from water, the victim is laid on an even surface, and, if he is not breathing, artificial respiration must be started by one of the methods blowing air 16-18 times a minute. External heart massage should be carried out if cardiac activity has ceased.

To make the artificial respiration more effective tight clothing should be removed. Artificial respiration and heart massage should be continued for several hours until natural respiration and adequate heart activity have been restored or true signs of biological death appeared. Measures should be taken to transport the victim to a medical establishment and continue heart massage and artificial respiration en route. First aid for **asphyxia** is rendered in the same manner. The cause of the compression of the airways is first eliminated, any foreign body removed from the mouth and throat, and artificial respiration started.

An oedema of the larynx may be recognized by noisy difficult breathing, the patient suffocates, and the skin and mucous membranes turn blue.

First aid: a cold compress is applied to the neck and the limbs are immersed in a hot bath. If possible, 1 ml of a 1 per cent diphenhydramine hydrochloride solution or

Fig. 60.
Removal of water from the airways

1 ml of a 2 per cent promethasine hydrochloride solution is injected subcutaneously. The patient should be hospitalized as soon as possible.

An urgent tracheostomy should be conducted if the larynx is clogged completely and a terminal state develops. The trachea should be excised and a tube introduced into its lumen (see Fig. 38).

Accidents caused by **falling earth** may cause severe damage. Because the thoracic cage is heavily compressed the flow of blood in the vena cava superior will be hampered, as a result of which the small veins of the face and neck may rupture. Respiration is drastically disturbed. In addition, when the patient has been released from the earth, the traumatic crushing syndrome may develop (see Chapter 8). Toxic substances and myoglobin accumulate in the soft tissues, especially in the skeletal muscles, when

they are compressed for a long time. When the compression is eliminated they enter the general blood flow and cause severe toxicosis, acidosis, and grave heart, renal and liver disorders, which may cause death.

The *first aid* depends on the severity of the damage. If the patient is in a terminal state, the first measure must be to restore patency of the respiratory tract, cleanse the mouth and throat from earth, and begin resuscitation (artificial respiration and heart massage). When the patient has been brought out from clinical death, his injuries should be examined, and tourniquets applied if the limbs are injured or there is the syndrome of traumatic crushing. Analgesics (trimeperidine hydrochloride or omnopon) are administered. The patient should be promptly taken to hospital.

Whenever first aid is rendered to a victim removed from water or fallen earth, care should be taken to prevent him from cooling albeit for a short time. Dry rubbing or rubbing in stimulating substance (e. g. spirit of camphor, vinegar, or vodka, ammonium hydroxide) is a good remedy. Warming with hot-water bottles is not recommended because in a terminal state it may cause undesirable effects such as the redistribution of the blood or burns.

Carbon Monoxide Poisoning

Carbon monoxide poisoning may occur in the chemical industry where it is used for synthesizing certain organic compounds (aceton, methyl alcohol, phenol), in poorly ventilated garages, or in stuffy, freshly painted premises. It may also happen in households when the stove shutters are closed too early in premises with stove heating.

The early symptoms are headache, heaviness in the head, nausea, dizziness, noise in the ears, and palpi-

tation. Later muscular weakness and vomiting occur. If the victim remains in the poisonous atmosphere, the weakness intensifies, somnolence, clouding of consciousness, and dyspnoea develop. The skin turns pale and sometimes bright red spots appear on the body. In further exposure to carbon monoxide the patient's respiration becomes shallow, convulsions develop, and paralysis of the respiratory centre terminates in death.

First aid. The victim must be immediately removed from the poisonous surroundings, better into the open air in warm weather. If his breathing is weak and shallow or arrested, artificial respiration should be continued until adequate natural breathing or the true signs of biological death appear. Rubbing should be carried out and hot-water bottles applied to the legs. A brief whiff of ammonium hydroxide is beneficial. A patient with severe carbon monoxide poisoning must be immediately hospitalized in order to prevent possible grave complications in the lungs and nervous system which may develop later.

Food Poisoning

Food poisoning or **food toxinfection** occurs when spoiled (infected) food of animal origin (meat, fish, sausage, canned meat or fish, or milk, or milk products such as cream, or icecream) is consumed. The disease is caused by bacteria and their toxins (i. e. products of their life activity). Meat and fish may be infected when the animals are alive but most commonly food poisoning occurs by undercooking or improperly storaging. Minced meat (paté, meat jelly, sausage meat) is infected particularly easily. The first symptoms of the disease appear 2 to 4 hours after eating the infected food. In certain cases the disease may develop 20-26 hours later.

The onset of the disease is sudden and is manifested by sharp general malaise, nausea, repeated vomiting, colicky

pain in the stomach, and frequent and thin stool, sometimes with mucus and blood streaks. The toxicosis rapidly develops: the blood pressure drops, pulse quickens and weakens, and the patient turns pale, is thirsty, and his body temperature rises (to 38-40°C). If left unaided, cardiovascular failure develops with a fulgurant speed, muscular convulsions appear followed by collapse and death.

First aid. The stomach must be immediately washed with tepid water through a stomach tube. Forced vomiting should be stimulated by making the patient drink 1.5 to 2 litres of warm water and then irritating the root of his tongue. The washing should be continued until "clean water" appears. Copious drink should also be given to the patient if he is vomiting naturally. In order to remove the infected products quickly from the intestine, activated carbon and purgatives (25 g of saline purgative per half glass of water, or 30 ml of castor oil) should be given. Food is not permitted for 1 or 2 days but copious drink is recommended. Hot tea or coffee should be given in the acute period after the gastric lavage. The patient should be warmed by putting hot-water bottles around his arms and legs. Sulphonamides (0.5 g of sulphaguanidine or phthalylsulphathiazole 4-6 times a day) or antibiotics (0.5 g of laevomycetin 4-6 times a day or 300 000 IU of chlortetracycline hydrochloride 4 times a day for 2-3 days) produce good results. The patient's faeces and vomit must be disinfected in a bed-pan by mixing them with calcium chlorite. An ambulance should be summoned for rendering aid or the patient taken to a medical institution.

Anyone who might have eaten the poisonous products should be kept under observation 1 or 2 days and, if similar symptoms appear, hospitalized.

Mushroom poisoning may occur either if poisonous mushrooms (e. g. crimson or gray fly agaric, false ined-

ible honey fungus, death cup) are eaten or if edible mushrooms but spoiled by long storage (so they are musty or covered by mucus) are eaten. Death cup is the most poisonous mushroom and death may occur if only one mushroom has been eaten. It should be kept in mind that the toxic substances contained in the mushroom are not destroyed by boiling.

The first symptoms of poisoning become apparent in 1.5 to 3 hours. Salivation, nausea, repeated tormented vomiting, strong colicky pain in the stomach, headache, and dizziness develop together with growing weakness. Diarrhoea, often with blood, and symptoms of the affection of the nervous system rapidly appear such as vision disturbance, delirium, hallucinations, motor excitement, and convulsions.

When the poisoning is grave, especially that caused by the death cup, the excitation grows rather quickly (in 6-10 hours). This is followed by somnolence and apathy. The heart activity in this period weakens, the blood pressure drops, the body temperature markedly decreases, and jaundice appears. If the patient is left unaided, he will collapse and die rapidly.

First aid for mushroom poisoning is often decisive in saving the patient's life. The stomach should be washed immediately with water, better using a weak potassium permanganate solution (ink in colour) and a stomach tube introduced or artificial vomiting induced. Activated carbon (carbolen) may be added to the solution. Then castor oil or saline purgative should be administered and cleansing enemas given several times. The patient should be covered warmly, hot-water bottles applied, and hot sweet tea or coffee given. He must be rapidly taken to hospital for skilled help.

Botulism is an acute infectious disease in which the central nervous system is affected by the toxins formed by anaerobic spore-forming bacillus (sausage toxin).

Botulism is a food toxinfection, in which the patient is poisoned by ingesting the infected food.

Products which were prepared without being sufficiently heated are the most susceptible to infection with botulism. These include dried, salted, and smoked meat and fish, sausage and old canned meat, fish, and vegetables. The period between the intake of food and the onset of the disease is from 12 to 24 hours; in some cases it may be up to several days.

The early symptoms of the disease are headache, general indisposition, and dizziness. Bowel movements are absent, the belly distends but body temperature is normal. The patient's condition gradually worsens and symptoms of severe brain disturbances appear on the day after the onset of the disease. Double vision, squinting, ptosis of the upper eyelid, and paralysis of the soft palate develop. The voice becomes indistinct, and the act of swallowing disturbed. Distension of the belly increases and the urine is retained. The disease is rapid and death ensues within five days due to paralysis of the respiratory centre and cardiac weakness.

The *first aid* is the same as that in other food poisonings: the stomach is lavaged with a weak soda or potassium permanganate solution to which adsorbents (e. g. activated carbon) may be added. Purgatives, cleansing enemas, and plenty of hot drink (tea or milk) are prescribed.

It is essential to know that the main treatment is the administration of specific antibotulinum serum, therefore a patient must be immediately admitted to hospital.

Poisoning with Toxic Chemicals

Toxic chemicals are now widely used in agriculture for controlling weeds, diseases, and pests. Standard rules for the application of toxic chemicals for crops and animal

husbandry are laid down by statute both in the USSR and elsewhere and they should be strictly adhered to so that the application of strong toxic chemicals prevents possible poisoning of the population. Poisoning will only occur when the rules are crudely breached.

Organophosphorus compounds (e. g. thiophos, trichlorfon or dipterex) are those most commonly responsible for poisoning. They enter the body by inhalation, or eaten if food is contaminated. The chemicals burn on contact with mucous membranes.

The latent course of the disease is 15-60 minutes, after which the symptoms of the affection of the nervous system appear (e. g. enhanced salivation, discharge of sputum, and perspiration). Breathing accelerates and becomes noisy, with rales heard at a distance. The patient becomes restless and excited. Cramp appears in the legs and the intestine undergoes increased peristalsis which is followed by muscular paralysis and paralysis of the respiratory muscles. The respiratory arrest that follows causes asphyxia and death.

In accidents connected with the inhalation of the toxic chemicals the victim must be immediately hospitalized. If possible, he should be given 6-8 drops of a 0.1 per cent atropine solution or 1-2 tablets of belladonna. When respiration is arrested, artificial respiration should be carried out. When the poisoning is caused by toxins getting into the gastro-intestinal tract, the stomach should be washed with water mixed with suspension of activated carbon. Saline purgatives should also be prescribed.

The toxic substances should be removed from the skin and mucous membranes with running water.

Poisoning with Concentrated Acids and Alkalis

In poisoning with concentrated acids and alkalis, a grave condition rapidly develops due, in the first place,

to extensive burns in the mouth, throat, oesophagus, stomach, and often the larynx. Later, the absorbed toxins affect the vital organs (e. g. liver, kidneys, lungs, or heart). Concentrated acids and alkalis are able to destroy tissues. The mucous membranes, being less resistant than the skin, are destroyed and necrosis occurs more rapidly involving deeper layers.

Burns and scabs form on the mucous membrane of the mouth and lips. When a burn is due to sulphuric acid the scabs are black, in a burn due to nitric acid they are greyish-yellow, in one due to hydrochloric acid they are yellowish-green, and in one due to acetic acid greyish-white.

Alkalis more easily penetrate the skin and affect deeper layers. The burnt surface is loose, decomposed, and whitish in colour.

As soon as an acid or alkali is swallowed the patient feels strong pain in the mouth, behind the breast bone and in the epigastrium. When laid down he tosses in bed from unbearable pain. There is almost always tormenting vomiting often with admixtures of blood. Pain shock rapidly develops. The larynx may swell and asphyxia develop. When an acid or alkali is taken in great amount cardiac weakness and collapse rapidly develop.

Poisoning with ammonium hydroxide takes a grave course. The pain syndrome is attended by asphyxia because the airways are also affected.

The person who is rendering first aid must find out at once which chemical caused the poisoning because the treatment varies according to the type of poison.

If the poisoning was caused by *concentrated acids* and the symptoms of oesophageal or gastric perforation are absent, the stomach should be lavaged through a thick stomach tube using for it 6-10 litres of warm water mixed with magnesium oxide (20 g per litre of liquid), or lime water. Sodium carbonate is contraindicated for a gastric

lavage. "Minor lavage", i. e. drinking 4-5 glasses of water and then inducing vomiting, will not alleviate the patient's condition and sometimes may even promote absorption of the poison.

If a stomach tube is unavailable, the patient may be given milk, oil, egg white, mucilaginous decoctions, or soothing substances. In poisoning with carbolic acid (phenol, lysol) milk, oil or fat should not be taken. Magnesium oxide mixed with water or lime water should be given in this case, as in poisoning by all other acids. Cold compresses or ice should be put on the epigastric region to lessen pain.

When the poisoning is due to *concentrated alkalis*, the stomach should be immediately lavaged with 6-10 litres of tepid water or a 1 per cent citric or acetic acid solution within four hours of the poisoning. When a stomach tube is unavailable and the patient's grave condition (swelling of the larynx) prevents a stomach lavage, mucilaginous solutions are given, 2-3 per cent citric or acetic acid solution (1 tablespoonful every 5 minutes), or lemon juice. Rinsing of the mouth or administration of sodium hydrochloride solution is contraindicated.

First aid. The patient should be immediately admitted to a medical institution where he will be given the necessary urgent medical help.

It should be kept in mind that when a perforation of the oesophagus or stomach is suspected, they being manifested by severe pain in the stomach and unbearable pain behind the breast bone, drinking and, moreover, lavage of the stomach are not permitted.

Alcohol and Drug Poisoning

Drug poisoning most commonly occurs in children especially in the families where the drugs are stored in places easily accessible to children. Drug poisoning in

adults is due to overdosage, suicide attempts, or drug addiction. The symptoms in this condition are quite different and depend on the drug taken.

Overdosage of pain-relieving (analgesic) or antipyretic drugs (phenylbutazone, analgin, aspirin, trimeperidine hydrochloride). In these cases the central nervous system is disturbed, capillary paresis sets in and the body loses heat badly. As a result, profuse perspiration, weakness, and drowsiness, which may change to deep sleep and even unconscious state, sometimes with respiratory disorders, develop.

The victim must be immediately hospitalized. If he has respiratory or cardiac disorders, resuscitation should be begun (see above).

Poisoning is often caused by an *overdosage of soporifics* (amytal sodium, glutethimide, or pentobarbital sodium). The central nervous system is deeply inhibited, sleep transforms into unconscious state with subsequent respiratory paralysis. The patient becomes pale, and his respiration shallow, slow, and irregular, often with rattling and bubbling.

If the consciousness is preserved, the stomach should be washed and active vomiting induced. In respiratory disorders artificial respiration should be carried out.

Poisoning with narcotics (morphine, opium, codein) is manifested by dizziness, nausea, vomiting, weakness, and somnolence. In great overdosage, deep sleep and unconscious state develop, which terminate in paralysis of the respiratory and circulatory centres. The patient becomes pale, his lips cyanotic, his breathing irregular, and the pupils of his eyes very narrow.

First aid. The victim must be taken immediately to hospital. Resuscitation is carried out in cases of respiratory and circulatory arrest.

Alcohol taken in considerable (toxic) quantities may cause fatal poisoning. A fatal dose of ethyl alcohol is 8 g

per 1 kg body weight. Alcohol affects the heart, blood vessels, gastro-intestinal tract, liver, kidneys, and mainly the brain. In a case of severe intoxication, sleep is followed by unconscious state. Vomiting and involuntary urination are frequent symptoms. The respiratory centre is drastically inhibited, which is manifested by irregular breathing. Death ensues when the respiratory centre becomes paralysed.

First aid. Fresh air should be provided (a window open or the victim taken outside), vomiting induced by "minor lavages". If the patient is still conscious, he should be given hot strong coffee. A respiratory arrest is managed by artificial respiration.

Heat-stroke and Sun-stroke

Heat-stroke is an acute abnormal condition due to the body overheating as a result of long exposure to high ambient temperatures. It may be caused by either insufficient heat loss from the body surface (e. g. in high temperatures, very humid atmosphere or in the absence of wind), or too high generation of heat (e. g. due to physical exertion or thermoregulation disorders). The direct effect on the head of sun light in hot weather may severely overheat the brain, a condition known as *sun-stroke.*

The symptoms of these conditions are similar. The patient feels malaise, headache, dizziness, weakness, and pain in the legs or in the back. Vomiting sometimes occurs. Later noise in the ears, darkness in the eyes, shortness of breath and palpitation appear. If measures are taken in time the disease ceases. But if the patient remains exposed to the sun, his condition will rapidly deteriorate due to the affection of the central nervous system. Cyanosis of the face and severe dyspnoea (up to 70 respiratory movements per minute) develop; the pulse accelerates and weakens and the patient loses conscious-

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ness. Muscular contractions, delirium and hallucinations are observed. The body temperature rises to 41 °C and higher. The patient's condition rapidly worsens, breathing becomes irregular and the pulse uncountable, which may lead to death within hours due to respiratory paralysis and cardiac arrest.

First aid. The patient should be moved to a cool place, in the shade, he should then be laid down, his clothing removed, and his head raised a little. Rest should be provided and cold applied to the head. The heart area should be sprinkled with cold water or a cold compress applied. The cooling should be gradual. The patient should be given plenty of cold water to drink. Smelling ammonium hydroxide or administration of Zelenin drops, convalaria tincture stimulates breathing and is beneficial. Any method of artificial respiration should be carried out immediately if respiration is disturbed. The patient should be transported lying down.

Bites by Rabid Animals, Poisonous Snakes, or Insects

Bites by rabid animals. Rabies is an extremely dangerous disease in which the virus affects the cells of the brain and spinal cord. Infection is contracted by being bitten by a rabid animal. The virus is discharged with the saliva of the dog or cat and is transmitted to the brain through the wound in the skin or mucous membrane. The incubation period is 12-60 days, the disease lasts 3-5 days and usually terminates in death. The animal although already rabid may look quite normal when it bites therefore most animal bites in countries where rabies is prevalent should be considered dangerous as regards rabies.

Every bite victim should be taken to a Pasteur Station for an antirabies vaccination beginning from the day of the accident.

First aid. The bleeding should not be stopped at once because the animal's saliva may be removed from the wound with the escaping blood. The skin around the wound should be treated several times with a disinfectant such as potassium permanganate solution, iodine tincture, or ethyl alcohol and covered with an aseptic bandage. The victim should be taken to hospital for debridement of the wound and antitetanus prophylaxis.

Snakebites (cobra, rattle snake, adder) severely endanger life. A sharp burning pain, reddening of the skin and ecchymosis appear immediately around the bite. Swelling (oedema) rapidly develops and red streaks appear along the lymphatic vessels, a condition known as lymphangitis. General symptoms of intoxication develop simultaneously: dryness in the mouth, thirst, drowsiness, vomiting, diarrhoea, convulsions, speech and swallowing disorders, sometimes motor paralysis (in cobra bites). Death ensues due to respiratory arrest.

First aid. A haemostatic tourniquet or a twist should be applied immediately, within two minutes of the bite, considerably higher than the site of the bite. The skin should be cut across the bite until blood appears (the knife should be sterilized by fire) and a medical cup applied to the lesion to suck the blood. If a special cupping glass is unavailable an ordinary thick glass tumbler may be used. A piece of cotton wool is wrapped round a stick, a few drops of spirit or ether poured on it and ignited. The cotton wool, still burning, is introduced into the cup and left for 1 or 2 seconds. Then the cup is quickly applied to the bite. A breast pump or rubber bulb may be used instead. After the poison has been sucked out the wound should be wiped with a potassium permanganate or sodium hydrocarbonate solution and an aseptic bandage applied.

If the bitten area is already swollen or the victim been given antivenom serum, aspiration of a poison or appli-

cation of the tourniquet is useless. An aseptic bandage should be applied to the wound, the limb immobilized and put at rest, and cold-water bottles applied around the limb (other methods of cooling can also be used). In order to relieve the pain, analgesics should be administered: aspirin, amidopyrin or analgin. Copious beverages are recommended (milk, water, or tea). Alcohol is categorically forbidden. The larynx may swell later and breathing disturbed, until there is respiratory and cardiac arrest. In this case artificial respiration and external heart massage are recommended. Emergency tracheostomy is the sole method that can save the victim's life in a case of oedema of the larynx.

The victim must be immediately taken to hospital to receive medical help. He should be transported lying down on a stretcher. Any active movements may promote the absorption of the poison.

The earliest possible administration of antivenom (antiadder) polyvalent serum is the most effective method of treating snake-bite poisoning. The sera are stored in 2-ml ampoules and introduced according to the Bezredka method to prevent anaphylactic shock. The serum is administered in fractional doses: first 0.5 ml is injected. If there is no reaction half of the remaining dose is introduced 30 minutes later, and the remainder is injected after another 30 minutes.

Bites by poisonous insects. *Bee* and *wasp* stings are quite common. At the moment of a sting a sharp burning pain occurs and the bitten area soon swells. Single bee stings are not usually serious but multiple stings may be fatal.

It is first of all necessary to remove a sting from the skin and to treat the wound with an antiseptic solution. Hydrocortisone ointment mitigates the pain and swelling. When multiply stung, the victim should be given first aid and taken to hospital.

Scorpions can inflict a very painful sting which is followed by a rapidly developing swelling and reddening of the skin.

First aid. The wound should be treated with an antiseptic solution, an aseptic bandage and cold compress applied to the bitten area. Analgesics (amidopyrine or analgin) should be administered to relieve pain. When the pain is strong, administration of narcotics is recommended.

Spider poison causes the severest pain and spasms in the muscles, especially those of the abdominal wall.

First aid. The wound should be dabbed with potassium permanganate solution and analgesics and calcium gluconate administered. If there is a severe reaction, the victim should be taken to hospital for vaccination with a special antiserum.

Foreign Bodies of the Ear, Nose, Eye, Respiratory, and Gastro-intestinal Tract

Foreign bodies in the ear. There are two kinds of foreign body which can get into the external ear canal: (1) insects (bedbugs, cockroaches, midgets, and flies) and (2) inanimate small objects (buttons, beads, peas, fruit stones, sunflower seeds, pieces of cotton wool, etc.).

Accidents due to foreign bodies are most common among children. The small objects that get into the ear canal usually do not cause pain and their presence in the ear is not very dangerous, so emergency first aid in such cases is not needed. It should be emphasized that any attempt by the victim or those around him to remove the foreign body may only aggravate the condition and will push it deeper into the ear canal. Therefore, in no case should a foreign body be removed by a layman, otherwise grave complications may develop, such as perforation of the ear drum or infection of the middle ear.

Insects getting into the ear may cause unpleasant subjective sensations, e. g. a feeling of piercing, burning or pain.

First aid. The ear canal should be flooded with oil, spirit, or tepid water, with the victim lying on his sound side. As soon as the insect dies and the subjective disorders subside, the victim should be asked to turn on his affected side. Very often the foreign body will float out with the fluid. If it is still in the ear, the victim should be taken to a doctor.

Foreign bodies in the nose are usually encountered in children who push small balls, beads, balls of paper or cotton wool, or berries, or buttons in their nose.

First aid. It is recommended that the victim should forcefully blow his nose with one nostril closed. No attempt should be made to remove the foreign body. Only a doctor can do it. It is recommended to take the victim to hospital in the first days of an accident because if the foreign body is left unremoved it may cause inflammation, swelling, and sometimes even ulceration and bleeding in the nose.

Foreign bodies in the eye. Small objects such as dust or sand particles, or midgets getting in the conjunctiva (mucous membrane) or the eye cause lacrimation and a sharp burning sensation increasing in blinking. If the foreign body remains in the eye, the conjunctiva swells and reddens and the vision becomes impaired. The foreign body usually lodges under the upper or lower eyelid.

The earlier the foreign body is removed the sooner the disorder it caused disappears. The victim should be prevented from rubbing his eye because this irritates the conjunctiva even more. The eye should be examined and the foreign body removed. The conjunctiva of the lower eyelid is first inspected: the patient is asked to look up, and the lower eyelid is pulled downwards, and the lower part of the conjunctiva is exposed for inspection

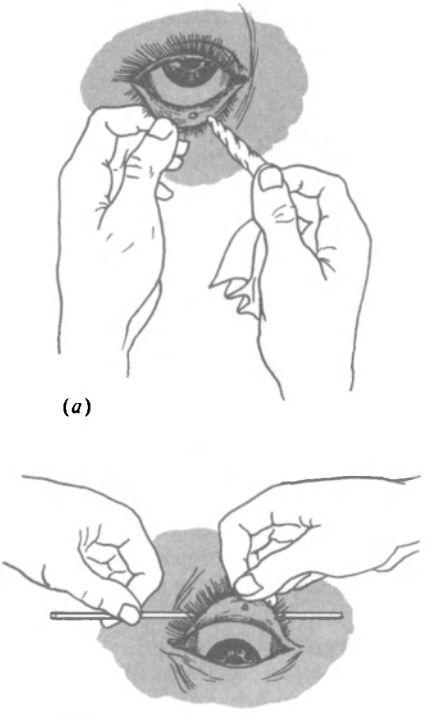

Fig. 61.
Foreign body removed from the eye
a, from the lower eyelid; *b*, from the upper eyelid

(Fig. 61*a*). The foreign body is then removed with a wisp of cotton wool either dry or soaked in a boric acid solution. Removing a foreign body from the upper eyelid is more difficult because the whole conjunctiva should be everted outside. The patient is asked to look downwards, the upper eyelid is grasped with two fingers of the right

hand, pulled forwards and downwards, and then inverted by using the index finger of the left hand to push the eyelid down (Fig. 61*b*). After the foreign body has been removed, the victim is asked to look upwards and the everted eyelid returns by itself to its usual place. In order to prevent infection, 2 or 3 drops of a 3 per cent sulphacil natrium (sulphacetamide natrium) solution is administered to the eye. It is categorically forbidden to remove foreign bodies embedded in the cornea. Only a doctor can do this.

Foreign bodies in the respiratory tract. A foreign body in the airways may fully obstruct them and cause asphyxia. Accidents of this type most commonly occur in children. An adult often chokes with the food when he eats and talks at the same time, or if he has a disease of the epiglottis, which unfully closes the entrance to the larynx when swallowing. An object in the mouth may get into the larynx or trachea together with air during a deep inhalation (Fig. 62). They cause fits of severe coughing in which the foreign body may be coughed out. A large foreign body may cause spasm of the vocal cords and get stuck there, while the lumen of the rima glottidis become fully closed, thus causing suffocation.

If the foreign body cannot be coughed out in forceful coughing then an attempt should be made to remove it. The victim should be placed with his belly over the rescuer's knee, with his head downwards as far as possible, and sharply striked between his shoulders. If no effect is produced, the victim should be laid down on the table, nodding his head as far back as possible. The throat is inspected through the open mouth (Fig. 63). If the foreign body can be seen it can be grasped with a forceps, fingers, or a dressing forceps and removed. The victim should be hospitalized. When the airways are fully obstructed, asphyxia develops, and the foreign body cannot be removed, emergency tracheostomy is the only

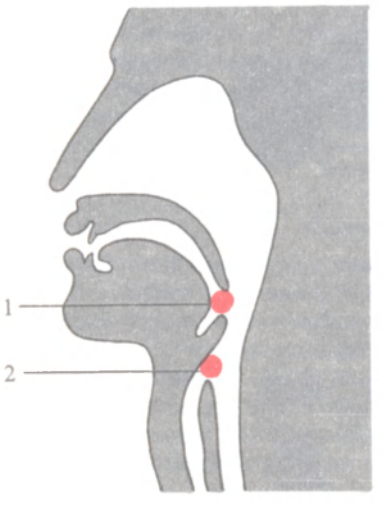

Fig. 62.
Foreign bodies in the respiratory tract
1, at the entrance in the larynx; *2*, in the larynx

method for saving the victim's life (see Fig. 38).

Foreign bodies of the gastro-intestinal tract. Foreign bodies get into the gastro-intestinal tract most often by chance and mainly among people who have a bad habit of holding small objects in their teeth during work (e. g. nails, pins, neddles, or knobs) and those who eat hurriedly. Cases are known when foreign bodies were swallowed by small children, or mental patients trying to commit suicide. Small round objects, passing through the whole gastro-intestinal tract, are often evacuated with the faeces. Sharp and large objects may injure the intestinal organs or get stuck in some part of the gastro-intestinal tract causing severe complications (e. g. bleeding, perforation, or intestinal obstruction).

Fig. 63.
Techniques of removal of a foreign body from the airways
a, passive removal; *b*, active removal, (position of the victim)

First aid. When small round objects have been swallowed measures should be taken to make their passage through the gastro-intestinal tract quicker. It is recommended that the patient should be given food rich in protein, e. g. bread, potato, cabbage, carrots, or beetroot.

Purgatives should not be prescribed. For further treatment a doctor should be consulted. When the foreign bodies are large and have sharp edges or if a pain appears behind the breast bone or in the stomach, food and drink are not permitted. The patient must be rapidly admitted to hospital.

Acute Diseases of the Abdominal Organs

Complications that require emergency surgery often occur in a sudden and rapidly developing illness of the abdominal organs. These include inflammation of the peritoneum and intra-abdominal haemorrhages which inevitably terminate in death, if surgical aid is delayed.

The clinical picture of the inflammation of the peritoneum or that of the intra-abdominal haemorrhage (i. e. symptoms indicating serious abdominal disorder) is known as **acute abdomen.** Any medical worker who recognizes the first symptoms of an abdominal emergency must send the patient to hospital with the diagnosis "acute abdomen". This signifies that the patient is in a grave condition.

The most common conditions of the abdominal cavity which produce the symptoms of the acute abdomen include *acute appendicitis, perforated gastric* or *duodenal ulcer, acute cholecystitis, strangulated hernia, acute intestinal obstruction, closed injuries to the abdominal organs, acute pancreatitis, rupture of the uterine tube in extrauterine pregnancy or torsion of the ovarian cyst.* Typically the longer it takes for skilled aid to be rendered after the onset of the disease the worse the patient's condition will deteriorate and the number of the unfavourable outcomes increases.

The general symptoms of most of the illnesses of the abdominal organs are *acute pains in the belly*, which may differ in intensity, localization, extent, and character

(continuous, colicky, etc.). The pain may occur suddenly, in full health, or it may begin gradually and only some time later become acute. The next symptoms are *nausea* and *vomiting*, which are sometimes very persistent and uncontrollable. Most patients with the acute abdomen have delayed stool and meteorism.

The inflammatory process in the abdominal cavity is characterized by *drastic tension of the anterior abdominal wall around the tender organ.* The *Shchetkin-Blumberg (release) sign* is revealed, as a rule, being the clearest and constant symptom of peritonitis. It is checked as follows. If the hand is pressed gently and slowly over the anterior abdominal wall and there is a sharp pain as the hand is released, the sign is considered positive.

In *intra-abdominal haemorrhage*, the abdominal muscles are tense, tender to palpation, and the Shchetkin-Blumberg sign is positive, in addition to *acute anaemia* (paleness, weakness, dizziness, cold perspiration, weak and accelerated pulse, drop in arterial pressure and reduced haemoglobin count).

Peritonitis, irrespective of its cause, has grave consequences if the first aid is delayed in one of the acute diseases of the abdominal organs.

Intra-abdominal haemorrhage may cause acute anaemia and death within a short period of time.

It is very difficult to save a patient's life after he has succumbed to generalized peritonitis; to prevent peritonitis by removing its cause is much easier.

Thus, the conditions grouped under the general name "acute abdomen" should be considered emergency surgical diseases.

First aid. Immediate hospitalization of a patient who has inflammation in the abdominal cavity is the main task of first aid. The patient should be put at rest, and ice or a cold-water bottle applied to his belly. Food, drink, a cleansing enema, washing of the stomach and adminis-

tration of purgatives are not permitted, otherwise the inflammation may spread.

Narcotics, analgesics, antibiotics, and other drugs are categorically forbidden because they may smooth out the clinical picture of the disease and make the diagnosis and treatment incorrect and late.

Renal Colic and Acute Ischuria

Renal colic. A sudden attack of lumbar pain radiating to the groin, genitals, and hips may be caused by a variety of diseases of the kidneys and ureters (e. g. tuberculosis, pyelonephritis, tumour, and most often nephrolithiasis) and is known as renal colic. Typically renal colic is attended by localized spreading pain, burning sensations in urination, pollakiuria, and changes in the colour of the urine.

The pain is very severe and depends on the position of the body. The pain occurs due to overextension of the renal pelvis and muscular spasm of the ureter when it is obstructed by a calculus or pus.

In order to relieve the pain, patients are given several drops of a 0.1 per cent atropine solution, tablets of belladonna, or 2-3 drops of cystenal on sugar under the tongue; hot-water bottles on the lumbar region and general warm baths are beneficial.

It should be remembered that such attacks of pain may occur in acute inflammatory illnesses of the abdominal organs, the condition known as acute abdomen. In this case all the above measures are categorically forbidden. Only a doctor can choose the best method of treatment for renal colic. Hospitalization of such patients is obligatory.

Acute ischuria. A grave condition may arise quite unexpectedly by the acute retention of urine. A patient may be unable to urinate due to tumours of the prostate, urinary calculi, or diseases of the spinal medulla. The accu-

mulated urine distends the urinary bladder and causes severe pain in the abdomen which may impair by reflex the functioning of other organs, e. g. intestine, heart or lungs.

First aid. Several measures can be taken to relieve the spasm thus enabling natural urination. The patient should be given a glass of cold water to drink, a hot-water bottle applied to the perineum, the sound of dropping water imitated; then a small-volume cleansing enema should be given and suppositories containing belladonna applied. If all these measures proved ineffective, the patient should be promptly taken to hospital where the urine will be drained by a catheter (a special hollow tube made of rubber or metal which is passed through the urethra into the bladder).

Insult (Cerebral Haemorrhage), Epileptic and Hysterical Fits

A **cerebral haemorrhage** may be a complication of essential hypertension or cerebrovascular sclerosis. The onset is sudden often without any precursors, and may occur when the patient is either awake or asleep. The patient loses consciousness, and vomiting and involuntarily defaecation and urination may occur. The face becomes hyperaemic, and the nose and ears cyanotic. Respiratory disorders are typical: sharp dyspnoea with noisy hoarse breathing is followed by respiratory arrest or rare single inhalations. The pulse slows to 40-50 beats per minute. Paralysis of the limbs is often revealed at once; there may be face asymmetry (muscles on one side of the face may be paralysed), and anisocoria (a condition in which both pupils are not of equal size). Sometimes the insult may take a milder course but paralysis of the limbs and some degree of speech impairment are constant signs.

The patient should be laid down in a comfortable position, his clothing restricting breathing loosened, and fresh air provided. Ice or a cloth soaked with cold water should be put around the patient's head and hot-water bottles around his legs. Absolute rest should be provided. If the patient is able to swallow he should be given sedatives (valerian tincture or bromides), and drugs to reduce blood pressure (bendazole hydrochloride or papaverine hydrochloride). A watch should be kept of his breathing and measures taken to prevent his tongue from retracting; mucus and vomit should be removed from his mouth. The patient may be moved and transported only on a doctor's permission.

An **epileptic fit** is one of the manifestations of a severe mental disease known as epilepsy. The patient suddenly loses consciousness after which tonic and then clonic convulsions develop. The head turns abruptly to one side and there is foaming at the mouth. The moment a fit begins, the patient falls down, and often sustains injuries. His face is cyanotic, and the pupils do not respond to light.

A fit lasts 1-3 minutes, after which the patient falls asleep and does not remember what has happened to him. There may be involuntary urination and defaecation during a fit.

A *patient needs help during the fit.* He should not be held or moved anywhere during the convulsions. Something soft should be put under his head, any clothing restricting breathing loosened, and a knotted handkerchief, or similar soft material, put between his teeth to prevent his tongue from being bitten. When the convulsions have ceased, the patient should be taken home or to a medical establishment, if the fit happened in the street.

An epileptic fit and loss of consciousness in insult should be differentiated from a hysterical fit.

A **hysterical fit** usually occurs during the day, and is

preceded by a dramatic unpleasant emotional upset. A hysterical patient usually falls down in a convenient place gradually rather than suddenly and takes care not to be hurt. The convulsions are usually chaotic, theatrically expressive, or in the form of trembling. There is no foaming at the mouth, consciousness is preserved, breathing is normal, and the pupils respond to light. The patient may continue the fit for an indefinite time in order to attract the attention of the people around him. Involuntary urination is absent, as a rule.

When a fit has ceased there is neither sleep nor stupor and the patient may calmly proceed with his work.

A patient with a hysterical fit also needs help. He should not be restrained but should be put at rest and left alone, avoiding any fuss about his condition; he may be given ammonium hydrochloride to smell. In such conditions the patient soon calms down and the fit ceases.

Acute Cardiovascular Failure

Acute cardiovascular failure is one of the severest circulatory disorders. It may develop as a result of prolonged oxygen hunger (hypoxia) due to a loss of blood, or a respiratory disorder, traumatic shock, a heart defect (mitral stenosis), essential hypertension, myocardial infarction or poisoning with toxic chemicals.

In a case of acute heart failure, the myocardium loses its contractile capacity and the heart fails to pump the inflowing blood, as a result cardiac output is sharply reduced. Stasis of the blood occurs. If left-ventricular failure prevails, the blood stasis occurs mainly in the lungs. This is manifested by shortness of breath, tachycardia, marked hypoxia, acidosis, and functional disturbances of the other vital organs, especially the kidneys. Pulmonary oedema may develop in pronounced left-ventricular failure.

If right-ventricular failure predominates, the vessels of the major circle are congested with blood, oedema appears, the liver is enlarged, the rate of blood flow decreases, and different tissues and organs are poorly supplied with oxygen.

The *first aid* for an acute heart failure should be first of all directed at strengthening the heart contractions, using strophanthin, corglycon, or digitoxin. Strophanthin is used as a 0.05 per cent solution: 0.5 ml of the drug is diluted in 20 ml of a 40 per cent or 5 per cent glucose solution, which is slowly injected into the vein. If the acute heart failure is associated with angina pectoris, the patient should be given a 1-g tablet of nitroglycerin under the tongue. Aminophyllin (euphyllin) produces a good effect when the pulmonary vessels are congested. It is used intravenously as a 2.4 per cent solution or intramuscularly as a 24 per cent solution and should be injected very slowly. The patient should be given a diuretic, either furosemid (lasix) or novurit. Humidified oxygen should be given to lessen the hypoxia.

A patient with acute heart failure should be transported very carefully. If the arterial pressure is slightly decreased, the patient should be raised a little. In order to reduce blood flow to the heart, tourniquets should be applied to the limbs to compress the veins though not the arteries. It should be borne in mind that acute heart failure can only be managed effectively under hospital conditions, so every measure should be taken to transport the patient promptly.

Acute vascular insufficiency develops because the vascular tonus drastically reduces. The volume of the vascular channel becomes larger than the amount of the blood in it, therefore the vital organs, including the brain, are insufficiently supplied with oxygen carried with the blood and their function is either impaired or switched off completely.

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Fainting is one of the manifestations of acute vascular insufficiency. *This is a sudden short-term loss of consciousness due to a sharply decreased flow of blood to the brain.* Fainting often occurs in attendance to psychic trauma or nervous breakdown and is promoted by exhaustion, anaemia, or physical fatigue or conditions such as pregnancy or essential hypertension. It is sometimes preceded by nausea, lack of air, dizziness, darkening in the eyes, weakness, etc. The skin and mucous membranes turn pale, the blood pressure drops to 70-60 mm Hg, and breathing slows. Fainting usually lasts several seconds but sometimes may go on for several minutes.

First aid. The patient should be laid down, with his head lower than his trunk to increase the flow of blood to the brain and to restore quickly his respiration. Tight clothing should be loosened. In order to stimulate the respiratory and vaso-motor centres, the patient may be given a whiff of ammonium hydroxide, or his face wiped or sprinkled with cold water. Fresh air should be provided. All these measures will help the patient to come to in most cases. In more severe cases, cordiamine, caffeine, or strychnine should be administered. The patient should only be moved when consciousness and respiration have been restored.

Collapse. A more severe degree of vascular insufficiency is known as collapse. The vascular tonus is so grossly impaired that the blood pressure suddenly drops and heart activity diminishes. Collapse frequently develops as a complication of typhoid fever, cholera, pneumonia, food toxinfection, acute pancreatitis, or peritonitis, and is attended by pain and toxicosis. It may also occur in cases of severe shock, massive blood loss, during anaesthesia, or under the effect of strong pain, e. g. due to a blow to the solar plexus or perineum.

The patient turns pale, his skin is covered by cold

sweat and has a bluish tinge. His consciousness is sometimes clouded, his respiration accelerated and shallow, while his pulse becomes thready and his blood pressure drops below 60 mm Hg. If appropriate measures are not taken, the patient may die.

First aid. The cause of the collapse should be removed, and the vascular and heart failure controlled. In order to increase the blood flow to the brain, the patient's legs should be raised and tight bandages applied to them, which also increases the blood flow to the heart and brain.

The patient should be instantly taken to a medical establishment for necessary treatment. The symptoms of vascular insufficiency are mostly pronounced in shock (see Chapter 4).

The heart failure that occurs during cardiac diseases is usually accompanied by vascular insufficiency. In such cases, drugs affecting the contractile myocardial capacity should be combined with vasoconstrictive preparations such as noradrenaline, mesathon, ephedrin, prednisolon, or by hydrocortisone, vitamins or carboxylase.

Pulmonary Oedema

Pulmonary oedema is a grave complication of certain diseases and may occur for various reasons. In myocardial infarction it is caused by heart failure in which blood outflow from the pulmonary vessels is subsequently impaired. Pulmonary oedema in cases of essential hypertension or anaemia occurs because the vegetative nervous system is stimulated, vascular spasm develops and as a result the blood in the body is redistributed and accumulates in the lungs. The same condition develops in cerebral injuries and illnesses. The increased permeability of the pulmonary capillary walls is responsible for the development of oedema of the lungs in uraemia or poi-

soning with toxic chemicals such as chlorine or phosgene. Whatever the cause of the pulmonary oedema, respiration is always impaired and hypoxia develops. Difficult rapid respiration (shortness of breath), anxiety and quickened pulse are the earliest symptoms of pulmonary oedema. Later, the breathing becomes hoarse and even bubbling, coughing appears attended by a white or pinkish foamy sputum. The foam prevents the air from entering the pulmonary alveoli and oxygen hunger develops due to which the skin and mucous membranes turn blue (cyanosis).

The oxygen hunger aggravates blood circulation disorders, and metabolic acidosis develops.

First aid in pulmonary oedema should be aimed at removing the hypoxia. The patency of the airways should be restored by removing or aspirating the foamy sputum or by giving the patient oxygen with alcohol vapour to inhale. The alcohol vapour is a most effective antifoaming agent. Tourniquets should be applied to the limbs in order to lessen the blood filling of the pulmonary vessels. Only the veins should be compressed and the normal arterial blood flow preserved. As soon as the tourniquet has been applied, the pulse in the artery below the tourniquet should be checked. In addition, different remedies should be administered, e. g. diuretics (mercurophylline, furosemid or lasix) and antihypertensive drugs to lessen the blood filling of the pulmonary vessels. These preparations should be used with great care in cases of low blood pressure. When rendering help in cases with pulmonary oedema, various causes and mechanisms of its development should be kept in mind. For example, morphine administered to a patient with a heart defect to reduce shortness of breath in pulmonary oedema produces good effect, while in pulmonary oedema due to injury to or diseases of the brain this drug should not be used. Therefore, while rendering first aid, which includes

anti-foam therapy, oxygen inhalation, or application of a tourniquet, a doctor should be called who will find out the cause of the pulmonary oedema and prescribe the adequate intensive therapy.

Myocardial Infarction

Myocardial infarction, or necrosis (death) of a portion of the myocardium, is a major cause of death. It occurs due to a sharp disorder in the blood supply to the heart as the result of atherosclerosis or a spasm of the coronary vessel or its thrombosis by a blood clot (Fig. 64). Disturbances of blood circulation in the myocardium are manifested by an attack of angina pectoris in the form of sharp retrosternal pain. Treatment applied in time by administering vasodilating preparations (e. g. nitroglycerin or papaverin) may prevent subsequent myocardial infarction.

Cardiovascular failure is the most common and the gravest manifestation of myocardial infarction. This condition is extremely dangerous and is now considered as grave as a cardiogenic shock. Pulmonary oedema and ventricular fibrillation are among the complications of myocardial infarction.

The *first aid* should follow the same principles as that used for managing acute cardiovascular failure, shock, or pulmonary oedema (see the relevant sections). The first measure should be aimed at relieving the pain by administering morphine, promedole, or another analgesic. In addition, vasodilating drugs should be used, such as nitroglycerin, validol, or amyl nitrite. Complete rest should be provided and active movement forbidden. In case myocardial infarction has been suspected, the patient, whatever his condition, must be taken immediately to hospital. Transportation should be accomplished by a reanimatological ambulance, in which the necessary resuscitation measures can be carried out en route.

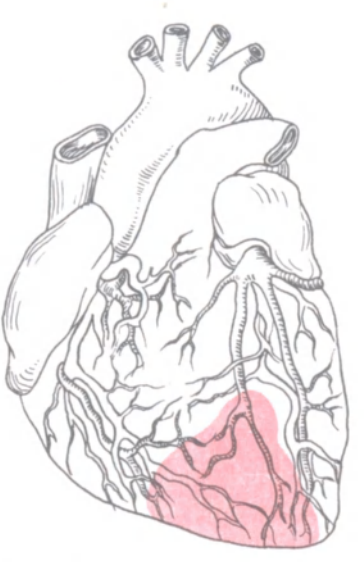

Fig. 64.
Myocardial infarction. Thrombosis of arteries (shown in black) and zone of necrosis (hatched area)

Emergency Labour

Although there is a large network of maternity homes, and pregnant women are kept under thorough constant surveillance, there are cases, however, when the delivery takes place at home, or in a train or airplane. The person rendering the first aid must first of all provide aseptic conditions. The hands should be thoroughly washed, and a pair of scissors or a knife disinfected, bandages prepared, and a string for tying the umbilical cord immersed in a spirit or iodine tincture. If the baby was born in asphyxia, the amniotic fluid must be aspirated by a rubber bulb.

The newborn baby should be put on a clean sheet

(diaper) ironed with a hot iron. After the umbilical cord has stopped pulsating, it is tied very firmly with a string or a piece of a bandage in two places: one 5 cm and one 10 cm from the baby's navel. After that the cord should be cut between two ties (Fig. 65). The end of the cord should be treated with an antiseptic solution and secured with a sterile dressing which is fastened to the cord by a thread.

Should the baby not show signs of breathing, mouth-to-mouth artificial respiration should be started, drawing out all the amniotic fluid from the baby's nose and mouth with a rubber bulb.

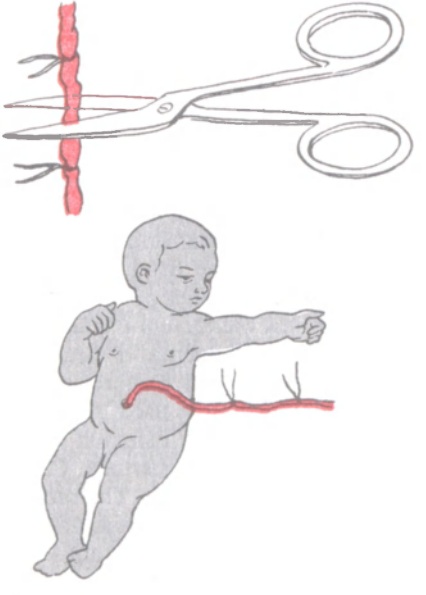

Fig. 65.
Tying (*a*) and cutting (*b*) the umbilical cord

The mother and the newborn baby should be admitted to a maternity home as quickly as possible.

The afterbirth (placenta) has to be delivered from the birth canal within an hour of the labour together with the remnants of the cord. It should be kept and showed to the doctor who will see whether it is complete. An afterbirth which has not been delivered in time may cause serious complications. After the delivery, the perineum should be covered with a clean diaper or a piece of cloth.

Chapter 11

Care of Patients: Elements of Rendering First Aid

Every medical worker must know the elements of rendering first aid, which is essentially the care of patients. Among other things these include giving water or other liquids, covering the patient, giving cleansing enemas, or putting cold compresses or ice to the head, belly, etc.

Enemas. *Evacuation of the large intestine by introducing a liquid into the intestine through the rectum is known as enema.* There are various types of enema, a cleansing enema being most commonly used. An Esmarch vessel (an India-rubber bag) or a funnel may be used. A rubber tube up to 1.5 m in length is fitted to an Esmarch vessel and a nozzle is fitted to the other end of the tube. Clean tepid water (20-30°C) is used for the enema. The tube is shut with a clamp and one litre of water poured into the vessel. Before introducing the nozzle into the anus the tube should be filled with water. The clamp should be opened and the water filling the tube will force the air out. The patient is laid on his left side on an oil-cloth (in

case he cannot retain the water), and the vessel is hung on the wall. The nozzle is oiled, the buttocks are separated with the thumb and the index finger of the left hand, and using the right hand the nozzle is introduced into the rectum very gently, pushing it forwards and upwards with a screwing motion. When the nozzle is in the right position, the clamp is removed and the water from the vessel flows into the intestine. The water must be made to flow gently, otherwise pain may occur. When all the water has been used, the tube is clamped again and the nozzle gently removed. The patient should be asked to retain the water for several minutes to make his faeces loose. When the stool is hard, the water cannot always enter the intestine. In such a case, the vessel should be raised higher and the position of the nozzle changed pushing it deeper, or it should be removed and washed. If the nozzle is repeatedly obstructed with faecal matter, a finger should be introduced into the rectum to remove the faecal matter (finger enema) after which the cleansing enema should be given.

If the patient cannot be moved to his side, the enema may be given with the patient lying on his back. Oil (e. g. castor oil, vaseline, or sun-flower oil) is sometimes added to the water to make the evacuation of the faeces easier; a small amount of a neutral soap may be added (1 tablespoon of soapsuds per litre of water).

In individual cases (e. g. essential hypertension, cardiovascular failure, oedema) an ordinary enema is contraindicated due to a partial absorption of the water by the intestine. The intestine in this case should be emptied by means of a hypertonic enema: 50-100 ml of a 10 per cent sodium chloride solution (table salt) is introduced using a rubber bulb. The patient should retain the solution for 20-30 minutes, which intensifies intestinal peristalsis and causes copious transudation of the fluid from the intestinal wall into the lumen.

The intestine may be evacuated more actively by using a siphon enema for repeatedly washing the intestine with water. A siphon enema consists of a 50-ml funnel, a rubber tube, a long rubber nozzle, and a connecting glass tube between them for checking the washing water. The system should be filled with water, clamped, the oiled nozzle introduced into the rectum for 20-25 cm, then the system should be unclamped letting water fill the intestine. When the level of the water has reached the narrow part of the funnel, the funnel is lowered to below the patient's body and water returns to the funnel. The funnel should then be raised again. The dirty water is removed, and the funnel filled with clean water. The procedure should be repeated until clean water appears from the intestine.

Watch should be kept that not all the water enters the intestine, otherwise the siphon will not work, and it will be difficult to return the water to the vessel. Care should also be taken to ensure that air is not sucked into the intestine. When water is introduced too quickly, a vortex forms and air enters the intestine. This can be easily avoided if the funnel is slightly inclined. The enema should be terminated the moment the whole amount of water is evacuated from the intestine. The water for both the cleansing and siphon enemas should be at room temperature.

Warming procedures may be either general, i. e. acting over the whole body surface, or local, in which case they act on an individual body part. Local warming is used more frequently, in the form of compresses or hot-water bottles.

A *warming compress* or fomentation causes a flow of blood and contributes to the resolution of various inflammatory processes. A compress should not be applied to skin damaged by wounds, excoriations, or a purulent inflammation, e. g. a boil or carbuncle.

A warming compress is prepared by folding a clean piece of cloth into several layers, dipping it in cold (10-15°C) water, squeezing it out, and applying to the part. It is then covered with a piece of wax paper or oil cloth, which is larger than the piece of cloth. A thick layer of cotton wool is then laid over the wax paper and loosely bandaged with a roller bandage to keep it in place and to prevent circulatory disturbances.

The compress should be kept on for 6-8 hours. In order to prevent rapid cooling of the skin after the compress has been removed, a dry gauze bandage should be applied to the site. The cloth may be soacked in 50 per cent spirit which makes the warming more effective and lessens possible maceration (swelling and loosening) of the skin.

A hot-water bottle produces dry heat and is used both for local and general warming. A hot-water bottle should be a half to two thirds filled with hot water of any temperature. By gently compressing the walls of the hot-water bottle the air should be forced out and the stopper tightly screwed on. Then it is turned upside down to check whether it leaks; the stopper is dried and the hot-water bottle covered with a towel to avoid burning of the skin. If the hot-water bottle is kept too long on the same place the skin may be burnt. Burns easily occur in unconscious patients or when the skin's sensitivity is reduced due to swelling or when the nerves are damaged. A hot-water bottle may be kept on several hours but it should be remembered that it warms the patient generally.

Cooling procedures. Cooling is applied locally in case of inflammatory diseases of the abdominal organs or diseased veins of the limbs, in general heating, brain oedema, and other conditions. Cold lessens inflammation, tissue swelling and pain. A hot-water bottle filled with ice or cold water is used for cooling. The air is

Fig. 66.
Washing out the stomach

a, water introduced into the stomach; *b*, water removed from the stomach

(*a*)

(*b*)

forced out of the hot-water bottle and the stopper is screwed on firmly. In order to prevent the skin from being overcooled the bottle should be wrapped in a towel.

A hot-water bottle filled with ice may be used for several days, but it should not be permanently left on the skin. It should be applied for 10-15 minute intervals every 30 minutes. Overcooling may be prevented if the cold-bottle is moved elsewhere.

Gastric lavage. It is more convenient to wash out the stomach when the patient is sitting but the procedure may be carried out with the patient lying down (Fig. 66).

A special India-rubber stomach tube should be moistened and introduced into the patient's mouth. The patient is then asked to make a swallowing movement and at this moment the tube should be introduced first into the oesophagus and then into the stomach. Since the tube is marked in cm it is easy to determine its position in the body. If there is any fluid in the stomach it will pass through the tube to the outside. A funnel fitted to the free end of the stomach tube should be filled with water which is used for washing out the stomach. The procedure should be repeated until the whole contents are drawn off. In case of a poisoning, the appropriate antidote or activated carbon should be added to water. The stomach tube should be removed after the fluid has been fully drawn off from the stomach.

Supplement 1
Table of Common Poisons and Their Antidotes

Poison	First aid
Acacia, yellow, willow thicket	Gastric lavage with water, adding activated carbon. Saline purgative. Rest. Warming of the body
Ammonium hydroxide	Gastric lavage with copious amount of water, adding citric or acetic acid. Orally: 1 per cent solution of either of these acids
Aniline (aniline dyes, nitrobenzene, toluidine)	In natural breathing fresh air and inhalation of oxygen. In respiratory arrest: artificial respiration. In internal poisoning: gastric lavage adding activated carbon, administration of saline purgative (30 g) and vaseline oil (150 ml); emetics (apomorphene). Milk, oils and spirit are forbidden
Arsenic and its compounds	Copious gastric lavage with water adding either activated carbon or magnesia solution (20 g per one litre of water), or arsenic antidote solution (100 ml per 2-4 litres of water). Internally repeatedly every 5 minutes 1 tablespoonful of arsenic antidote or metal antidote, magnesia. Saline purgative, milk, oil. Warming of the body, hot-water bottle on the belly.

Poison	First aid
Atropine (beladonna, henbane, thorn apple)	Gastric lavage with water, adding either activated carbon or potassium permanganate solution (1 : 1000); introduction of saline purgative through a stomach tube. Bed-rest; cold to the head. In weakness: caffeine tablets; in respiratory disorders: artificial respiration and oxygen inhalation
Benzene, kerosene, acetylene	In poisoning with vapours: inhalation of oxygen, fresh air, artificial respiration, warming of the body; internally: cafeine, ascorbic acid (vitamin C). In internal poisoning: the same treatment and gastric lavage with water and activated carbon; purgative: castor oil, and black coffee and hot milk to drink
Boric acid	Gastric lavage adding activated carbon. Orally: 20 g of magnesia per glass of water; lime water: 1 tablespoonful every 5-10 minutes, milk; saline purgative
Calcium oxide	Gastric lavage adding acetic acid. Orally: 1 per cent solution of citric or acetic acid; milk, egg white
Chlorine, chlorine water, lime chlorine, hydrogen chloride, perchloric acid	In poisoning through inhalation: immediate removal from the poisonous atmosphere, fresh air, warming procedures, inhalation of oxygen and warm water vapours with an admixture of ammonium hydroxide. In internal poisoning: immediate washing out of the stomach using potassium permanganate solution adding activated

Poison	First aid
	carbon, or 1-3 per cent hydrogen peroxide, or 5 per cent sodium thiosulphate solution. Inhalation of oxygen, artificial respiration when needed
Cocaine, dicaine, procaine	Gastric lavage adding activated carbon or 0.1 per cent potassium permanganate solution; orally: 2-3 drops of nitroglycerin, warming procedures, hot coffee, wine, inhalation of oxygen. In respiratory disorders and heart arrest: external heart massage
Cyanogen compounds (potassium cyanamide, sodium cyanamide, hydrogen cyanide)	See: Hydrocyanic acid
Digitalis, adonis convalaria, adoniside	Gastric lavage adding activated carbon, bed-rest, inhalation of oxygen, saline purgative. Orally: 6-8 drops of 0.1 per cent atropine sulphate solution. Emetics are contraindicated
Hydrocyanic acid (bitter almond, cherry lourel water, potassium cyanide, cyanic gas)	In poisoning by inhalation: removal of the patient from poisonous surroundings. Fresh air, inhalation of amylnitrate or oxygen. In internal poisoning: immediate gastric lavage using potassium permanganate solution and activated carbon, or 1-3 per cent peroxide hydrogen solutions, or 5 per cent sodium thiosulphate solution. Inhalation of oxygen, artificial respiration when needed

Poison	First aid
Iodine, Lugol's solution, iodoform	In internal poisoning: gastric lavage with 0.5 per cent sodium thiosulphate solution or drinking of 2-3 glasses of 5 per cent sodium thiosulphate solution, thin starch, milk, mucilaginous decoction, 20 g of magnesia in 1-2 glasses of water or in aqueous carbon suspension, alkaline mineral water. In vapour poisoning: fresh air, inhalation of vapours of 2 per cent sodium hydrocarbon or 5 per cent sodium sulphate solution
Lead, lead dioxide, lead acetate	Internally: emetics (apomorphine) and sodium or magnesium sulphate solution, metal antidotes. Gastric lavage with sodium sulphate solution or aqueous carbon suspension or solution of metal antidote; saline purgative; in colicky pain: atropine, nospani hydrochloride (drotaverine), warm baths
Methyl alcohol (methanol)	Copious drinking of alkaline water, sodium hydrocarbonate; gastric lavage using the same solutions; saline purgative. Internally: 30 per cent ethyl alcohol solution (100 ml), then 50 ml every 2 hours
Mercuric chloride, calomel, mercury and its salts	Acid drinks or vinegar are contraindicated. Immediate oral administration of metal antidotes. Gastric lavage with an aqueous solution of the same antidote. Internally: activated carbon, magne-

Poison	First aid
	sia, milk, egg white, mucilaginous decoctions. Rinsing of the mouth with hydrogen peroxide or potassium permanganate solution every hour. Warming, warm baths
Morphine, codeine, dionine, opium, omnopon	Repeated gastric lavage adding activated carbon or 0.1 per cent potassium permanganate solution, saline purgative. Inhalation of oxygen. Internally: 6-8 drops of atropine sulphate solution. In respiratory disorders: prolonged artificial respiration. Rest, ice to the head; emetics are contraindicated
Organophosphorous compounds (tetraethyl monothiopyrophosphate, thiophos, phosphonium, trichlorphon, malathion, insecticide, trichlormethaphos)	On contact with the skin: washing of the skin with 10 per cent ammonium hydroxide or 5 per cent sodium hydrocarbonate solution. In internal poisoning: gastric lavage with an aqueous carbon suspension and 2 per cent sodium hydrocarbonate solution. Copious drinking of 2 per cent sodium hydrocarbonate solution. Saline purgative. In respiratory disorders: inhalation of oxygen, artificial respiration
Strychnine (nux vomica, seeds of various species of *Strychnos*)	Instantaneous gastric lavage with an aqueous carbon suspension and 0.1 per cent potassium permanganate solution; vomiting must be induced. Internally: activated carbon, saline purgative. Rest

Supplement 2

Specific (Antidote) Treatment of Acute Poisoning

Poison	Antidote
Acids	Sodium hydrocarbonate (4 per cent solution)
Aniline, potassium permanganate	Methylene blue (1 per cent solution), ascorbic acid (5 per cent solution)
Anticoagulants: heparin and other agents	Protamine sulphate (1 per cent solution), vitamin K (1 per cent solution)
Atropine	Pilocarpine (1 per cent solution), proserine (neostigmine methylsulphate) (0.05 per cent solution)
Barbiturates	Bemegride (0.5 per cent solution)
Barium and its salts	Magnesium sulphate (100 ml of 30 per cent solution)
Cardiac glucosides	Tetacin calcium (sodium calcium edetate) (10 per cent solution), potassium chloride (0.5 per cent solution), atropine sulphate (0.1 per cent solution)
Carbon monoxide, hydrogen sulphide, carbon disulphide	Inhalation of oxygen
Formalin	Ammonium chloride (3 per cent solution) or ammonium carbonate (3 per cent solution)

Poison	Antidote
Hydrocyanic (prussic) acid	Sodium nitrite (1 per cent solution), sodium thiosulphate (30 per cent solution), chromosmon (1 per cent methylene blue in 25 per cent glucose solution)
Hydrogen arsenide (arsine)	Mercaptide (40 per cent solution)
Isoniazid (hydraside of isonicotinic acid), ftivazid	Vitamin B_6 (5 per cent solution)
Metals, heavy (mercury, arsenic, lead, copper)	Unithol (BAL, dimercaprolum) (5 per cent solution), tetacin calcium (sodium calcium edetate) (10 per cent solution)
Methyl alcohol (methanol), ethylene glycol	Ethyl alcohol: 30 per cent solution internally; 5 per cent solution intravenously
Non-specific sorbent of drugs (alkaloids, soporifics), compounds of heavy metals, etc.	Activated carbon (carbolene)
Organophosphorous (morphine, promedol, codeine, etc.)	Atropine sulphate (0.1 per cent solution). Nalorphine hydrochloride (0.5 per cent solution)
Organophosphorous compounds	Cholinesterase reactivating substances: dipiroxim (trimedoxime bromide, TMB 4) (1 ml of 15 per cent solution), isonitrosin (3 ml of 40 per cent solution), atropine (0.1 per cent solution)

Poison	Antidote
Pachycarpine	Proserine (neostigmine methylsulphate) (0.05 per cent solution), ATP (1 per cent solution), vitamin B_1 (5 per cent solution)
Silver nitrate	Sodium chloride (10 per cent solution)
Snakebites	Specific antisnakebite serum (antivenene)

Supplement 3

Hypothetical Situations for Studying the Principles of First Aid: *Tasks for Self-control*

1. A piece of glass has fallen onto someone causing an incised wound to the anterior surface of the arm from which dark venous blood is flowing. Neither special instruments for stopping bleeding nor sterile bandages are available. However, the person rendering the first aid does have a handkerchief, ethacrydine lactate (rivanol) solution, an electric iron, and a kettle for boiling water.

What should the person rendering the first aid do, and in what order?

The relevant sections are "Sterilization of the Dressing Material" in Chapter 1 and in Chapter 2 (bandages for the upper and lower limbs).

2. A boiling liquid has caused a II-III degree burn of the thigh and leg. The person rendering the first aid has neither water nor sterile bandages, his hands are dirty. He has, however, a vial of cerigel and vial of potassium permanganate solution and handkerchiefs.

What is the order of the first-aid measures?

The relevant sections are "Chemical Antisepsis and "Sterilization of the Hands and Disinfection of the Gloves" in Chapter 1; Chapter 2 (bandages for the upper and lower limbs); Chapter 3 (immobilization), "Burns and Scalds" in Chapter 9.

3. A blow by a blunt instrument has caused a profuse nosebleed. Only cotton wool and a band of cloth (5 cm wide and 50 cm long) are available.

What is the order of the first aid?

The relevant information is in section "First Aid in Certain External and Internal Haemorrhages" in Chapter 6 and in Chapter 2 (sling bandages).

4. A young man has an incised wound under his right clavicle

3 × 1.5 cm in size. Foamy blood is flowing from the wound. The person rendering the first aid has a vial with iodine tincture, non-sterile cellophane bag, and a non-sterile roller bandages.

What should be the first aid?

The relevant information is in Chapter 2 (bandages for the chest), and in "Features of the First Aid in Injuries to the Head, Chest, and Abdomen" in Chapter 7.

5. A knife wound has caused profuse arterial haemorrhage from the popliteal artery. Neither instruments nor bandages are available, except for the rescuer's clothing.

What is the order of rendering the first aid?

The relevant information is in Chapter 7, p. 135 and in Chapter 3 (transportation of victims).

6. You see a man lying in the street without any sign of life: he is unconscious, respiratory movements are absent, and his pulse is uncountable.

How do you determine whether the man is alive or dead?

The relevant information is in Chapter 3, p. 54.

7. A man walking in front of you shrieks and falls down; convulsive twitchings in his limbs subside the moment you approached him. Examination shows that an electric wire hanging from the electric pole is in the victim's hand.

What is the order of the first-aid measures?

The relevant information is in section "Injuries Caused by Electric Shock and Lightning" in Chapter 10; in Chapter 3, p. 59; "Resuscitation in Respiratory Arrest" in Chapter 5.

8. A lifeless man has been removed from water, he is not breathing, there is no pulse, no heart sounds can be heard.

In what order should the first aid be rendered?

The relevant sections are "Drowning, Asphyxia and Accidents in Falling Earth" in Chapter 10; "Resuscitation in Circulatory Arrest" in Chapter 5.

9. A man skiing downhill has fallen and feels a sharp pain in his leg. He is unable to stand up, and the pain worsens in movement, his foot is unnaturally turned outside. His skin is intact.

What kind of injury does he have? What help is needed?

The relevant section is "First Aid in Fractures" in Chapter 8.

10. Two people have been involved in a car accident. The clothing and face of one of the victims are covered with blood, and there is a bleeding wound (3 cm in size) on his forehead. He

is conscious, excited, and his pulse and respiration are normal. The second victim has no visible injury but complains of headache and nausea; he has no memory for the events preceding the accident.

How serious are the injuries? Which of the two victims needs help first? Who should be taken to hospital first?

The relevant information is in Chapter 8, pp. 141 and 148.

11. A victim has swallowed an unknown liquid after which he felt a sharp pain in the mouth, behind the breast bone and in the stomach. He is restless, tosses from pain, repeatedly vomits with an admixture of blood. His lips, tongue, and the mouth cavity are covered with films and yellow-green scabs. His breathing is difficult.

What sort of poisoning is it? What should be the first aid?

The relevant section is "Poisoning with Concentrated Acids and Alkalis" in Chapter 10.

12. A man staying on a beach on a hot sunny day suddenly developed a headache, dizziness, vomiting, shortness of breath and noise in the ears. His pulse is 120 beats per minute and weak; his respiration is shallow, 40 breaths per minute, and he finds it difficult to speak.

What is the cause of such a state? What should the first aid be?

The relevant section is "Heat-stroke and Sunstroke" in Chapter 10.

13. A feeling of drilling, a pain and sensation of scraping suddenly start in someone's ear. On inspection an insect is seen deep in the ear canal.

What is the first aid?

The relevant section is "Foreign Bodies of the Ear, Nose, Eye, Respiratory, and Gastro-intestinal Tract" in Chapter 10.

14. Having gone to a toilet a person suddenly felt dizzy and then lost consciousness. On inspection, the patient is pale and his pulse is weak, 130 beats per minute. The toilet bowel has a large amount of black liquid resembling tar, with a sharp offensive odour.

What caused a fainting and the serious condition of the patient? What first-aid measures should be applied?

The relevant section is "Acute Diseases of the Abdominal Organs" in Chapter 10.

15. You have been asked to see a sick child. He is lying in the bed. All the child's muscles convulse at the slightest stimulation. A sharp spasm of the facial muscles and an inability to open the child's mouth are the signs that attract attention. A small wound covered by a scab is seen on the leg.

What has caused the child's grave condition? What should be the first aid?

The relevant information is in Chapter 7 (tetanus).

16. A traveller in an electric train suddenly felt ill. He feels a strong retrosternal pain radiating to the left arm and neck, a lack of air, dizziness, and weakness. He turned pale, his face becomes frightened, and his pulse weak, 50 beats per minute, and his breathing rapid.

What has caused this condition? What is the first aid?

The relevant section is "Myocardial Infarction" in Chapter 10.

17. As the result of a car accident the legs of one of the victims have been squeezed by the overturned car. He could not be released for two hours.

What should the first aid be when the victim's legs are released from the weight?

The relevant information is in Chapter 8, p. 141.

18. A child has swallowed many tablets of aminophenazone.

What is the first aid?

The relevant information is in Chapter 10, p. 178.

19. A man has stayed out in the cold (– 10-– 15°C) for too long without actively moving. He had tight cold boots on. Later at home his body temperature rose, he felt chilly and pain occurred in his feet which turned purple-bluish and got swallen, the swelling spreading to his shins. Blisters filled with a whitish fluid appeared on his heels. He lost sensitivity in his toes and his feet were very tender on palpation.

What is the type of injury? What is the first aid?

The relevant section is "Frostbite" in Chapter 9.

20. A worker has breached the safety rules, as the result of which his forearm has been injured by a circular saw. There is a gaping wound on the anterior surface in the middle third of his forearm. Bright-red blood flows from time to time in a stream from the wound. The victim is pale, and covered by sticky sweat.

Which factor determines the sequence of the first-aid measures? What is the type of haemorrhage and how it can be stopped? What will your further actions be?

The relevant information is in Chapters 2, 6, and 7; in Chapter 3 (transportation of victims; position of a victim during transportation).

21. An unconscious man has been found in an unventilated garage lying near a running engine. Bright-red spots are seen on his pale skin, respiration is absent, the pulse is uncountable, the pupils are dilated, and his heart sounds are rare and dull.

What has happened? What is the victim's condition? What measures should be taken immediately, and what is the order of the first aid?

The relevant sections are "Carbon Monoxide Poisoning" in Chapter 10; "Resuscitation in Respiratory Arrest" in Chapter 5.

22. A varicose node has suddenly ruptured in a middle-aged woman with a long-standing varicosity of the veins of her legs. A profuse bleeding developed on a lateral surface of the skin. The dark blood is flowing from the wound in a stream. The blood loss is considerable because everything around the woman is flooded with blood. Her pulse is 100 per minute, and her skin is pale.

What is the type of haemorrhage? What are the principles and the order of the first-aid measures?

The relevant information is in Chapter 6 (acute anaemia); in section "Types of Bleeding" in Chapter 2 (basic types of bandages).

23. A man walking in front of you suddenly falls down. On approaching him you find that his respiration is spasmodic, his face bluish, pupils dilated, pulse uncountable, and heart sounds cannot be heard, i. e. there are signs of circulatory arrest.

Which first-aid measures should be taken and in what order? How should the patient be transported to a medical establishment?

The relevant section is "Resuscitation in Circulatory Arrest" in Chapter 5.

24. A stout woman has slipped and fallen onto her bottom. When she landed she felt a sharp lumbar pain that made any further movement impossible. Soon she felt that her legs had

become numb. She feels sharp pain at the slightest attempt to move. On palpation, a sharp pain develops in her back.

What is the type of the injury? Is transportation immobilization needed? How to take the victim to hospital?

The relevant information is in section "First Aid in Fractures" (fractures of the spine) in Chapter 8.

25. A middle-aged man has stumbled and fallen onto his hands. A sharp pain appeared in his wrists which worsens in any movement. The shape of his joint and of the radius is grossly distorted.

What is the injury? What are the principles and measures of the first aid?

The relevant information is in section "First Aid in Fractures" in Chapter 8.

26. A log has fallen down and squeezed a man who was unloading a lorry. He complains of a strong pain in the pelvis and loss of movement in the legs. The victim is pale, his skin is covered with cold sticky sweat and his pulse is rapid and weak.

What is the type of the injury? How do you explain the victim's serious condition? What is the order of the first-aid measures?

The relevant information is in section "First Aid in Fractures" in Chapter 8.

27. A motorcyclist has collided and sustained a trauma of both shins. The shape of his leg bones is distorted, they are abnormally mobile, though any movement causes an excruciating pain. A wound is visible on the right leg through which a sharp fragment of the tibia protrudes.

What is the trauma? What is the order of the first-aid measures? How should you handle the wound and how should the legs be immobilized if special splints are unavailable?

The relevant information is in section "First Aid in Fractures" in Chapter 8.

28. A man has been knocked off by a car. He fell and hit his head against the pavement. He does not remember what has happened to him and complains of a headache, dizziness, nausea, and vomiting. He has a contused wound in the back of the head; there is sanguineous discharge from the ear canals. No clear signs of bone injury are seen.

What is the cause of the victim's severe condition? What first-

aid measures are needed? What are the basic rules for transporting a patient with such a type of injury?

The relevant information is in Chapter 8 (injuries to the skull and brain).

29. A child has fallen from a tree and hit his chest against something hard. He moans with pain, and his respiration is shallow and rapid. The pain worsens during coughing or when his position is changed. On palpation, the chest is sharply tender, there is crepitation under the skin, a sound resembling snow crunching.

What organ has been injured? How can the victim be helped?

The relevant information is in section "Features of the First Aid in Injuries to the Head, Chest, and Abdomen" in Chapter 7; in Chapter 8 (fractures of the ribs).

30. A neighbour has asked you to help him. He complains of many hours pain in the belly. He has been vomiting repeatedly, and his body temperature has risen to 37.5°C. The pain is localized in the right iliac region, and there have been no bowel movements. The abdomen is very tense and is tender on palpation.

What illness can be suspected? What is the first aid? Should the patient be immediately taken to hospital?

The relevant section is "Acute Diseases of the Abdominal Organs" in Chapter 10.

31. While eating in a hurry, a man has swallowed his denture. He feels that it has got stuck in his oesophagus. He complains of retrosternal pain; his breathing is normal and his voice is clear, however.

Is it possible that the foreign body has been retained in the oesophagus? Should he apply immediately to a doctor? What is the first aid?

The relevant section is "Foreign Bodies of the Ear, Nose, Eye, Respiratory, and Gastro-intestinal Tract" in Chapter 10.

32. A child has behaved carelessly near beehive and has been stung by several bees in various parts of his body and face.

What is the first aid? Is there need to take the child to hospital if many stings have been found?

The relevant section is "Bites by Rabid Animals, Poisonous Snakes, or Insects" in Chapter 10.

33. A young woman has asked you for help. She complains of sharp weakness, dizziness, nausea, and moderate abdominal pain. She is very pale, and her pulse is over 120 beats per minute and weak. Her abdomen is moderately distended, tender on palpation in all parts, and the pain intensifies if you take your hand suddenly from her belly.

What illness should be thought of? Is it dangerous? Is it necessary to render the first aid and take the patient immediately to hospital?

The relevant information is in sections "Acute Diseases of the Abdominal Organs" in Chapter 10; "First Aid in Certain External and Internal Haemorrhages" in Chapter 6.

34. Your neighbour has come home from work one evening to find her husband lying on the sofa unconscious. His breathing is noisy with rales heard at a distance, and his pulse is rapid and weak. The windows in the room are closed, and there is a vial with trichlorfon (insecticide) aerosol on the window-sill.

What is the cause of the patient's severe condition? What are the principles of the first aid and the way he should be transported?

The relevant section is "Poisoning with Toxic Chemicals" in Chapter 10.

35. A man standing in a bus suddenly fell down. The muscles of his legs and arms, neck and face began contracting in a random fashion. The convulsions were attended by him turning his head from side to side. A foamy fluid was discharged from his mouth. His face turned bluish and bloated, and his breathing became noise and forced. The convulsions ceased 2-3 minutes later, after which his breathing became regular, like that of a sleeping man.

What illness does the man suffer from? Why is the attack dangerous? What is the first aid?

The relevant information is in Chapter 10 (epileptic fits).

36. A man applied for help to a chemist's shop. His wife is in labour. The waters have already broken.

What should be taken from the first-aid kit? How should the newborn baby be handled and how should the cord be treated? Is it necessary to take the mother and baby to a maternity home?

The relevant section is "Emergency Labour" in Chapter 10.

37. A child has drunk an unknown liquid from a bottle. Sharp pain developed in the mouth and belly. The lips and oral mucosa are inflamed and covered with yellow-greenish films. He is vomiting repeatedly with an admixture of blood, his breathing is difficult.

What was the substance the child swallowed? What is the first aid?

The relevant section is "Poisoning with Concentrated Acids and Alkalis" in Chapter 10.

38. The condition of a patient who has a long-standing heart defect drastically deteriorated. He suddenly had a sensation of lack of air and shortness of breathing that increased rapidly. His respiration became hoarse, coughing developed with a large amount of whitish foamy sputum. His skin and mucous membranes turned blue. The signs of heart disorder appeared: intermittent beat, irregular pulse.

What complication developed? What is the first aid? In what position should the patient be transported to hospital?

The relevant section is "Pulmonary Oedema" in Chapter 10.

39. A child is excited, his movements are abrupt and chaotic. His skin is pale, pulse is very rapid, his pupils are widely dilated, he is vomiting repeatedly. According to other children, he ate some berries.

What is the cause of the poisoning? What is the first aid? Is a doctor's help needed?

The relevant sections are "Alcohol and Drug Poisoning" in Chapter 10. "Table of Common Poisons and Their Antidotes" in Supplement 1 (henbane).

40. A man has got an incised wound in the abdomen. On inspection there is a wound to the interior abdominal wall 5 cm in length with moderate bleeding. An intestinal loop protrudes through the wound.

What is the order of the first-aid measures? What should be used for covering the wound in the absence of sterile bandages? How should the victim be transported?

The relevant section is "Features of the First Aid in Injuries to the Head, Chest, and Abdomen" in Chapter 7.

41. A woman has been bitten by a stray dog and has many lacerated, moderately bleeding wounds on her legs. Should she

be given antirabies vaccination and in what terms?

The relevant section is "Bites by Rabid Animals, Poisonous Snakes and Insects" in Chapter 10.

42. A family has eaten wild mushrooms for their mid-day meal. Several hours later abdominal pain, salivation, vomiting, headache, loose stool, and elevated body temperature appeared in all members of the family. Children were excited and became delirious.

What was the cause of the poisoning? What is the first aid? Is hospital treatment necessary?

The relevant section is "Food Poisoning" in Chapter 10.

43. The worker's clothing has ignited due to the explosion of a vessel of kerosene. The flames were extinguished with the help of a tarpaulin and the glowing clothing was drenched with water. There are burns on the victim's face, his condition is deteriorating. He is inhibited, apathetic, his pulse is quick, and his respiration is shallow.

How to explain the victim's serious condition? What are the first-aid measures? How to transport the victim?

The relevant information is in Chapter 4; in the section "Thermal Burns" in Chapter 9.

44. A sharp pain in the shoulder joint developed after someone fell onto his stretched arm. The joint is distorted. Movements in the joint are lost, the arm is in an unnatural position and shorter than normal.

What is the type of injury? What is the first aid? Is a doctor's help needed?

The relevant information is in section "First Aid in Contusions, Sprains, Ruptures, Compression, or Dislocations" in Chapter 8, and in Chapter 2 (bandages for the chest).

Subject Index

TO THE READER

Mir Publishers would be grateful for your comments on the content, translation and design of this book.

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The textbook deals with general concepts and essentials of First Aid in various accidents and sudden illnesses. General problems discussed in the book include the concepts of asepsis and antisepsis, the principles of applying bandages and basic aspects and methods of resuscitation. First Aid in haemorrhages, wounds, injuries to the soft tissues and bones, electric shock, heat- and sunstroke, poisoning, acute surgical and non-surgical diseases, and emergency labour are dealt with in detail.

The textbook is written in accordance with the programme adopted by the USSR Ministry of Health and is intended for students of the medical schools, training feldschers, laboratory technicians and pharmacists.

V. M. Buyanov • First Aid