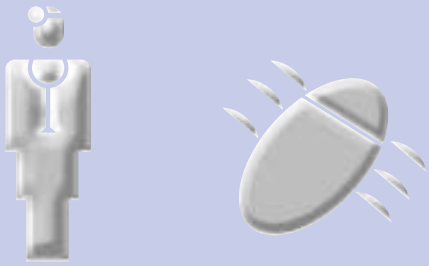

BLOCK 3

BI-3/A MEDICAL ASPECTS OF DISASTERS AND EMERGENCY FIRST-AID PROVISION

BI-3/B EPIDEMIOLOGY AND SANITARY ACTION

ACCORD RISQUES MAJEURS • MAJOR HAZARDS AGREEMENT
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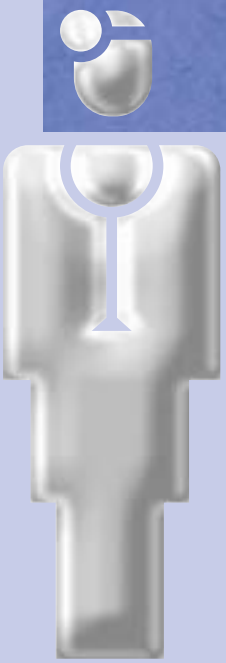
SCHOOL OF CIVIL PROTECTION

MODULE BI-3/A

MEDICAL ASPECTS OF DISASTERS AND EMERGENCY FIRST-AID PROVISION



HANDBOOK

ACCORD RISQUES MAJEURS • MAJOR HAZARDS AGREEMENT
EUR-OPA
Conseil de l'Europe · Council of Europe

IOM - OIM

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MEDICAL ASPECTS OF DISASTERS AND EMERGENCY FIRST-AID PROVISION

Table of contents

1. The human body

1.1 The skeleton

Biologically speaking, humans are vertebrates and, as such, have an internal skeleton forming the framework of the body.

Although surrounded by muscles which in turn are covered by skin, the human skeleton gives the body not only its general shape, but also numerous individual features (shape of the nose, chin, feet). These features are of particular interest to the field of physical anthropology and can be used to identify race, sex, etc. Morphometry is the precise measurement of the characteristics of the skeleton.

The parts of the skeleton are made up primarily of bone tissue, the matrix of which is formed by the deposit of tricalcium phosphate. This gives the bones their rigidity and almost mineral hardness. Because of their composition, bones are conserved for a very long time after death and in a dry environment there is virtually no decomposition.

The parts of the skeleton are joined together sometimes by sutures, but most often by moveable or semi-moveable joints, which enable the skeletal system to act in conjunction with the muscles to make movement possible.

Together, all the bones form the solid framework of the human body.

The skeleton (Fig. 1) is made up of:

- a central column,
- the vertebral or spinal column, composed of vertebrae
- the ribs, joined at the back to the spinal column and at the front to the sternum

All together they form the thorax, and the skull (cranium), which joins onto the upper end of the vertebral column.

The skeleton has around 200 bones and comprises two main parts:

- the axial, consisting of the skull, vertebral column, ribs and sternum, and
- the appendicular, comprising the upper and lower limbs and their anchoring points (the shoulder and hip girdles).

The bones of the skeleton play an essential role in movement, forming a solid and stable framework, attached to which the muscles can act effectively and in co-ordination. They also serve as a calcium store for the body. Lastly, the skeleton protects the viscera, primarily the brain, the bone marrow (located in the skull and the vertebral column respectively), the heart and the lungs (protected by the ribs).

1.2 Muscles

Muscular system (Fig. 2) is an organ which is able to contract and relax.

Muscle tissue is comprised of muscle fibres which in turn are composed of cells called myocytes. The latter's cytoplasm contains numerous elongated filaments (myofibrils) parallel to the major axis of the cell. These filaments are of two types:

- thin filaments, made of actin
- thick filaments made of myosine

Muscle contraction is the result of interaction between the two.

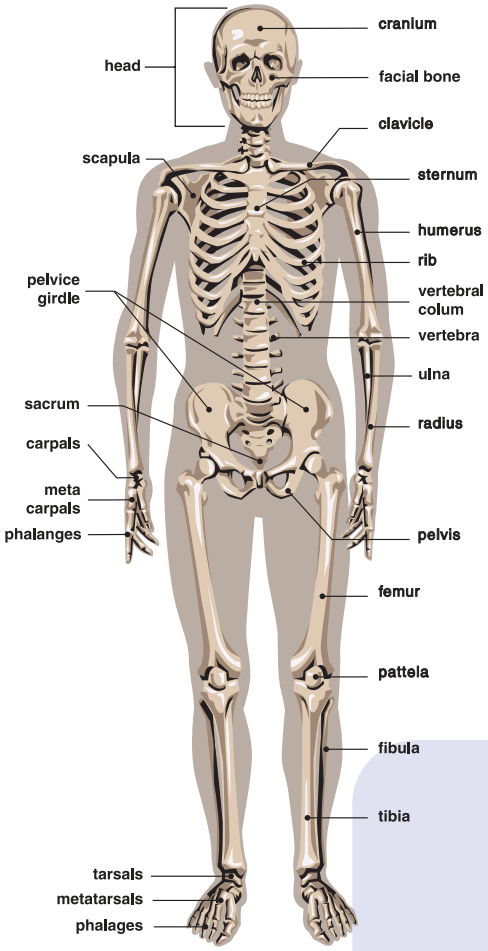


Fig. 1 **The skeleton system**

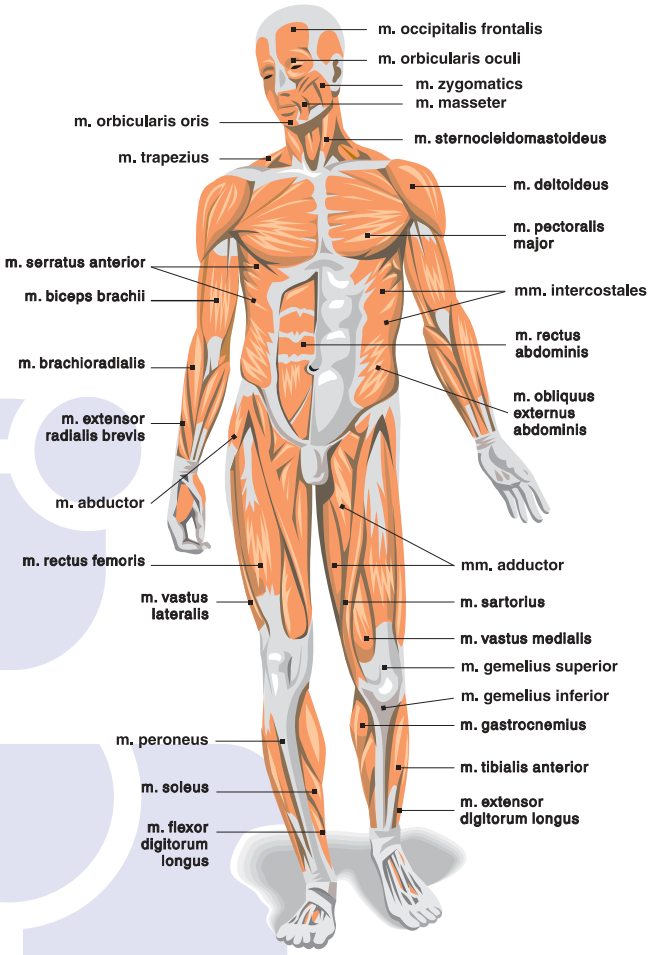


Fig. 2 **The muscular system**

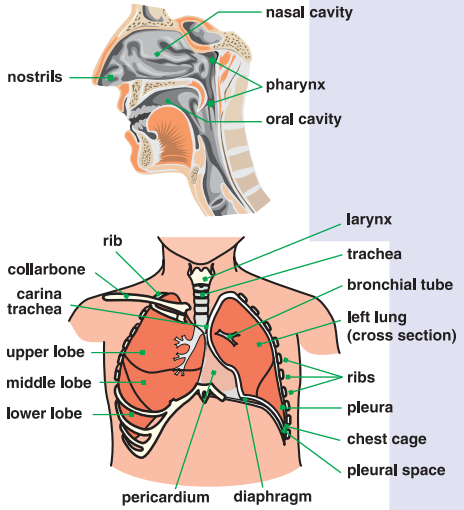


Fig. 3 **The respiratory system**

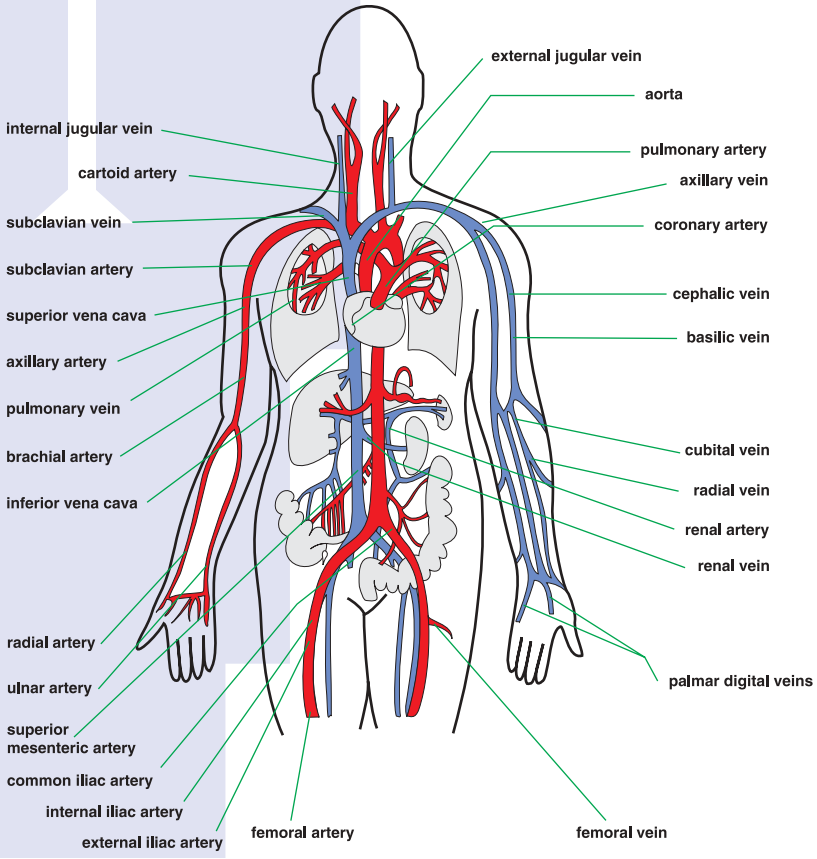


Fig. 4 **The cardiovascular system**

1.2.1 Cardiac muscle

The cardiac muscle is also called the myocardium. It is similar in structure to striated muscles, but its contractions are rhythmical and involuntary. These contractions pump the blood through the cardiovascular system.

1.2.2 Smooth muscles

Smooth muscles are present in the walls of many organs (the uterus, intestines, the bronchial tubes, gall bladder, blood vessels, etc). Although similar to those of striated muscles, their contractions are involuntary, being triggered by the self-stimulating nervous system which is not under direct conscious control.

1.2.3 Disorders

Certain smooth muscles can have spasms (sudden involuntary contractions). These are the muscles of the digestive tube (oesophagus, pylorus, colon), the urinary tracts, the upper respiratory tracts (glottis, larynx), and especially the sphincters: anal sphincter, the biliary tract sphincter (spasms in which lead to biliary colic) and the vesical sphincter (spasms in which result in urine retention).

1.2.4 Striated muscles

Also striped or skeletal muscles, striated muscles join the bones together and make motion possible. They contract voluntarily, under the control of the brain. Each muscle fibre is connected to a nerve ending which receives signals from the brain. This signal stimulates the muscle by releasing acetylcholine, a chemical neurotransmitter (substance secreted by certain neurons to transmit the nerve impulse to other cells), which via a chain of chemical reactions, acts upon the end-plate (the area of the muscle cell with which the nerve fibre which commands it comes into contact) and produces motion. These muscles are maintained in a constant state of moderate contraction: muscular tone. Hypotonia (pathological reduction of muscular tone) can result following a fall in level of potassium in the blood. Hypertonia (pathological increase in the muscular tonus) can be a result of a fall in the level of calcium in the blood; when it is very severe, it is referred to as spasticity.

Skeletal muscles are classified in accordance with how they work. A muscle is termed agonist if it is a prime mover, antagonist if it opposes agonist movement. An extensor muscle “opens” a joint, a flexor muscle “closes” it; adductor muscles move a limb or appendage towards the mid-line of the body, abductors move it away from the mid-line. Muscles which enable a part of the body (e.g. hand, foot) to move are called intrinsic muscles when situated in that part of the body and extrinsic muscles when they are located in another part of the body (forearm, leg).

1.3 The respiratory system

The respiratory system (Fig. 3) is a system of organs involved in the initial stages of respiration, i.e. breathing (movement of air in the lungs) and haematosis (turning carbon dioxide-laden venous blood into oxygen-bearing arterial blood) whereby cells are provided with the energy they require.

The respiratory system comprises the respiratory tracts (i.e. the upper air passages - the nasal cavity, the mouth, pharynx and larynx), the windpipe (trachea), the bronchial tubes and the lungs, enveloped in pleura. The thorax, with its rib cage and muscles, also plays a part in the functioning of the respiratory system.

1.4 Circulatory systems

The concept of "circulatory system" is a relatively recent acquisition since the term "artery" still perpetuates the mistake made by the authors of the ancient world who, along with Hippocrates, believed that the air from the lungs was conveyed throughout the body by the vessels. Galen was the first to recognise the presence of blood there, but it was only in 1553 that Servetus described the independent right and left compartments of the heart. Finally in 1628, William Harvery discovered blood circulation.

The names of Bartholin, for the lymphatic system, Malpighi (1661) and Magendie for capillaries, Claude Bernard and René Leriche for vasomotricity (the ability to produce change in the diameter of blood vessels), André Thomas and C. Lillehei for the artificial heart-lung machine, W.B. Kouwenhoven for external cardiac massage (cardiopulmonary resuscitation CPR), Shumway and Barnard for heart transplants, and many others are key figures in the progress made in studying the cardiovascular system. Research in this field is clearly of prime importance as the circulatory system is the key to life in the higher animals.

1.4.1 The cardiovascular system

The role of blood circulation is to provide tissue with the oxygen and nutrients it requires and evacuate the waste products produced. The cardiac arrest of 3 minutes is enough to shut down the brain, producing the straight line on the brain monitor (EEG), the irreversible sign that the individual has died.

The heart

As in all higher vertebrates, birds and mammals, the human heart is divided, from birth, into two halves by a partition, which subdivides the circulation of blood into two totally independent sectors.

The right-hand side or half of the heart contains only the deep-red, almost black venous blood, poor in oxygen and rich in carbon dioxide. This right-hand side is oriented towards the lungs, the organs responsible for respiration and exhalation, and is the dynamic keystone to pulmonary circulation, which is wholly encased in the thorax.

The left-hand side or half of the heart contains the bright-red arterial blood, rich in oxygen, purified of carbon dioxide, which it pumps to all tissues along the blood vessels which reach the whole body (systemic circulation).

Each of these two compartments is subdivided into the atrium and the ventricle, separated by a valve which channels the blood from the atrium into the ventricle.

The atria receive the blood arriving into the heart via the veins, large thin-walled vessels. The upper and lower venae cavae lead into the right atrium bringing the oxygen-depleted blood from all organs except for the lungs.

The left atrium receives the four pulmonary veins, two on the right and two on the left, which bring oxygenated blood from the lungs.

Leading from each ventricle is a large vessel or artery with a thick but elastic wall. The right ventricle is the chamber from which the pulmonary artery carries blood to the lungs; it is divided into two branches, left and right, which then further branch out into the corresponding lung. The blood it transports is poor in oxygen. The left ventricle leads into the aorta, the common trunk of all the body's arteries, with the exception of the pulmonary artery; the blood it transports is rich in oxygen.

Vessels

From the artery to the pulmonary veins, the blood completes the small or pulmonary circulation, whereas the aorta and the venae cavae are the vehicles for the greater or sys-

temic circulation. Blood is passed between the arteries and the corresponding veins at tissue level via a vast network of small canals, the capillaries, with the result that the blood is completely contained: the circulatory system is “closed’.

In describing the vasculation of an organ, we shall look at the muscular wall of the heart, or the myocardium. Two coronary arteries, the left and the right, which originate in the aorta and are about 5mm in diameter, enter the heart. Each of these arteries has its own dedicated territory and if there is any obstruction in either one, the circulation cannot generally be re-established by anastomoses (bypass surgery).

A sudden blockage in one branch of the left coronary artery, for example, stops the flow of blood to a whole section of the left ventricle wall and this section, having lost all blood supply, dies. This is what happens in a heart attack (myocardial infarction).

Each coronary artery is subdivided into ever finer branches; the wall of the artery gradually becomes thinner. The final branches of the arteries become the capillaries, characterised by a stratified layer of flattened cells, the endothelium. The extreme thinness of the capillary walls (1 micrometer thick) is conducive to the diffusion of gases and the transfer of dissolved substances between the blood and the vascularised area.

Capillaries are approximately 7-8 micrometers in diameter, i.e. roughly the same as the diameter of a red blood corpuscle. The transition from capillaries to venules takes place almost imperceptibly. These venules continue from the network of capillaries and gradually form larger branches. Lastly, circulation back to the myocardium passes through a single venous trunk, the coronary sinus, which leads into the right atrium.

1.4.2 The lymphatic system

The lymphatic system plays a very important role, draining the interstitial, extra-cellular spaces which contain lymphatic fluid. This fluid penetrates a system of small, irregular, multi-valved vessels, the lymphatic canals. They are interspersed by nodes, the lymphatic nodes. The lymphatic collectors come together in larger ducts. The most important, the thoracic duct, originates in the abdomen, crosses the thorax and empties into the left subclavical vein at the base of the neck. The lymphatic system drains digested fat from the small intestine. Lymphatic fluid is whitish, rich in white blood corpuscles, has no red blood corpuscles and is drained by the system of veins.

1.5 Physiology

Physiology is the study of the functions and normal functioning of living organisms. It is concerned with the physical and chemical processes at work in cells, tissues, organs and the various systems of healthy living beings.

1.6 Effects of emergencies and disasters on health

1.6.1 Types of emergencies and disasters

A long technical study should be made of each of the bellow listed emergencies and/or disasters, with operational plans being elaborated for intervention by specialised teams and equipment.

Detail approaches to be adopted, the precautions to be undertaken during rescue operations, and a number of prevention guidelines will be detailed and presented in other modules.

In the following observed are only a few of the basic principles pertinent to different natural and man-made emergencies and/or disasters.

Earthquakes

The buildings' destruction in earthquakes may cause many deaths (over 10% of the population) and injure large numbers of people. The toll depends mostly on three factors:

- the buildings' typology
- the time of day at which the earthquake occurs, and
- the population density.

Little information is available about the kinds of injuries (or injury epidemiology) resulting from earthquakes, but regardless of the number of casualties, the broad pattern of injury is likely to be a mass of injured with minor cuts and bruises, a smaller group suffering from simple fractures, and a minority with serious multiple fractures or internal injuries requiring surgery and other intensive treatment. Patients may appear in two waves, the first consisting of casualties from the immediate area around the medical facility, and the second of referrals as humanitarian operations in more distant areas become organised.

Destructive winds

Unless they are complicated by secondary emergencies and/or disasters such as the floods or sea surges often associated with them, destructive winds cause relatively few deaths and injuries.

Effective warning before such windstorms will limit morbidity and mortality, and most injuries will be relatively minor.

Flash floods and tidal waves

Flash floods and tidal waves may cause many deaths but leave relatively few severely injured in their wake. Deaths result mainly from drowning and are most common among the weakest members of the population.

Floods

Slow-onset flooding causes limited immediate morbidity and mortality. A slight increase in deaths from venomous snake bites has been reported, but not fully substantiated. Traumatic injuries caused by flooding are few and require only limited medical attention.

Fires

Every year about 100 severe burn disasters occur, each with more than 20 deaths at the scene. These are classified as severe fires and explosions due to airplane accidents, mine explosions, industrial and factory explosions, traffic accidents (bus, tanker truck, train), hotel and discotheque fires, fires collateral to natural disasters (earthquakes, volcano eruptions), etc.

The heat aggression can be associated with a toxic threat such as inhalation of combustion products or caustic gases, with a mechanical aggression such explosion and collapse and with radiation and contamination threat.

Road accidents

In many serious accidents, the effectiveness of relief depends upon the behaviour of the first witnesses in the minutes immediately following the disaster.

The fate of the casualties and the action taken by relief personnel will depend to a large extent on:

- the speed with which the warning has been given
- whether the warning is addressed to the appropriate headquarters
- the accuracy of the information provided

- victim-preservation measures taken
- the initial steps taken

Unless the accident is of catastrophic proportions, it is possible to be either witness or victim.

1.6.2 Principal effects on human health

In the past, sudden-impact disasters were believed to cause not only widespread death, but also massive social disruption and outbreaks of epidemic disease and famine, leaving survivors entirely dependent on outside relief. Systematic observation of the effects of natural disasters health has led to different conclusions, both about their effects on human health and about the most effective ways of providing humanitarian assistance. Though all disasters are unique in the way they affect areas with different levels of vulnerability and with distinct social, health and economic conditions, there are still similarities between different emergencies and disasters. If recognised, these common factors can be used to optimise the management of health humanitarian assistance and use of resources. The following key issues should be noted:

- There is a relationship between the type of disaster and its effects on health. This is particularly true of the immediate impact in causing injuries. For example, earthquakes cause many injuries requiring medical care, while floods and tidal waves cause relatively few.
- Some effects are a potential, rather than an inevitable threat to health. For example, population movement and other environmental changes may lead to increased risk of disease transmission, although epidemics do not generally result from natural disasters.
- The actual and potential health risks after a disaster do not all occur at the same time. Instead, they tend to arise at different times and to vary in importance within a disaster-affected area. Thus casualties occur mainly at the time and place of impact and require immediate medical care, while the risks of increased disease transmission take longer to develop and are greatest where there is overcrowding and standards of sanitation have declined.
- Disaster-created needs for food, shelter and primary health care are usually not total. Even displaced people often salvage some of the basic necessities of life. Furthermore, people generally recover quickly from their immediate shock and spontaneously engage in search and rescue, transport of the injured and other private relief activities.
- Effective management of health humanitarian aid depends on anticipating and identifying problems as they arise, and delivering specific materials at the precise times and points where they are needed. The logistical ability to transport maximum numbers of supplies and personnel to disaster areas is less essential.

1.6.3 Common health problems

Social reactions

After a major natural emergency or disaster, human behaviour only rarely reaches generalised panic or stunned waiting. Spontaneous yet highly organised individual action increases as survivors rapidly recover from their initial shock and set about purposefully to achieve clear personal ends. Earthquake survivors often begin search and rescue activities minutes after an impact and within hours may have organised themselves into groups to transport the injured to medical posts.

Additional resources should, therefore, be directed towards meeting the needs that survivors themselves cannot meet on their own.

Diseases

The most frequently observed increases in disease incidence are caused by faecal contamination of water and food; hence such diseases are mainly enteric.

The risk of epidemics is proportional to population density and displacement. These factors increase the pressure on water and food supplies and the risk of contamination (as in refugee camps), the disruption of pre-existing sanitation services such as piped water and sewage, and the failure to maintain or restore normal public health programmes in the immediate post-disaster period.

Population displacements

When large, spontaneous or organised population movements occur, an urgent need to provide humanitarian assistance is created. People may move to urban areas where public services cannot cope, and the result may be an increase in morbidity and mortality.

Climatic exposure

The health hazards of exposure to the elements are not great, even after major emergencies or disasters in temperate climates. As long as the population is dry, reasonably well clothed, and able to find windbreaks, death from exposure does not appear to be a major risk. The need to provide emergency shelter therefore varies greatly with local conditions. It may be necessary to provide shelter for reasons other than protection against the elements.

Food and nutrition

Food shortages in the immediate aftermath may arise in two ways. Food stock destruction within the disaster area may reduce the absolute amount of food available, or disruption of distribution systems may curtail access to food.

Mental health

Anxiety, neuroses and depression are not major, acute public health problems immediately following disasters, and family and neighbours in rural or traditional societies can deal with them temporarily. Wherever possible, efforts should be made to preserve the family and community social structures. The indiscriminate use of sedatives and tranquillisers during the emergency relief phase is strongly discouraged.

2. The general principles of first AID

2.1 Examining a casualty

The first-aider to approach a casualty has an enormous responsibility. Not only in view of the steps that must be immediately taken, but also those that must be avoided. He or she must also prevent any harmful intervention by bystanders who may or may not have any medical knowledge.

In the time of just a few seconds, the first-aider should be able to assess the vital functions of the casualty by looking, listening and asking questions. He or she will be looking for whether:

- the casualty is conscious or not
- the casualty suffers from any breathing difficulties
- the casualty's' circulation is functioning normally

2.1.1 The initial assessment

Except in dangerous situations (fire, risk of further accidents), a few words, a careful and quick examination and listening should provide answers to four fundamental questions concerning the state of the casualty:

- is he or she conscious ?
- does he or she have breathing difficulties ?
- is there any loss of blood ?
- is he or she in a state of severe shock ?

Consciousness

When approaching a casualty, the first-aider should speak to him or her. An examination carried out in total silence yields few results.

It is only by asking questions (e.g. "What happened?", "Where does it hurt?", "Are you alone?", "Where are you going?") that the injured person will be able to respond, either verbally or visually; an eyelid opening or a hand moving are signs of consciousness which should be looked for.

If there is no response, the first-aider may legitimately assume that the casualty is unconscious. However, it is possible that he or she can still hear everything. Accordingly, care should be taken to avoid pointless comments which could be misunderstood, or indeed understood only too well, by an apparently unconscious casualty.

Examination of the two pupils, by raising the eyelids, takes only a few tenths of a second. The pupils should be round, symmetrical and regular. Normally, they are more dilated in darkness and should contract when a light is shone on them or when the eyelids are opened. This response is called the "pupil reflex".

The pupils may be:

- contracted, which is usual
- dilated, without any response to light. This generally indicates a lack of oxygen to the brain caused by either an airway obstruction (asphyxia) or a circulatory problem (state of shock, cardiac arrest)
- irregular or asymmetrical (one contracted, the other dilated), generally indicative of damage to the nervous system

These aspects are all part and parcel of the initial assessment and should be noted down. If there is a blood clot on the eye or eyes, or if there is severe damage to the eyes, it is not possible to examine the pupils. In such cases, the first-aider should not attempt to open the eyelids, should assume a fractured skull, and keep a very careful watch

Unconsciousness may be assumed from the casualty's physical state (motionless, head bent, eyes closed, etc); however, despite the urgent action this requires, the first-aider should still carry out a rapid examination:

- is the casualty breathing normally ?
- is there a loss of blood ?
- is he or she in a visible state of shock ?

The same examination should also be carried out on a casualty who is conscious. A number of clear and concise questions should also be asked. The casualty may lose consciousness at any moment and the information required will be all the more difficult, if not impossible, to obtain at a later stage.

Questions to be asked as soon as possible

- Where does it hurt?
- Do you have any problems breathing? Take a deep breath, breathe out hard!
- Are you taking any medication for your heart? For your nerves? For diabetes?
- Are you under any medication?
  - Are you taking anticoagulants?
  - Are you taking corticosteroids?
- Are you carrying any medical card showing:
  - You are suffering from haemophilia?
  - You are suffering from diabetes?
  - You are being treated with anticoagulants?
- Do you have any allergies to particular medicines?
- Do you have any other allergies?

The answers to these questions could save the casualty's life if he or she subsequently loses consciousness. They should be noted on an evacuation sheet following this initial examination.

Breathing

Look and listen for signs of breathing. That may be:

- hard or impossible to see or hear
- gasping
- noisy
- wheezing
- rapid and superficial

Chest and abdomen movements may be:

- non-existent, this is respiratory arrest
- irregular or erratic, preceding respiratory arrest
- too fast or too slow, a sign of breathing deficiency

The consequences of breathing difficulties are:

- the neck muscles tighten or a hollow forms just above or just below the sternum, indicating major effort required to breathe
- fluttering of the nose, indicating advanced breathing difficulties
- a bluish hue to the lips, ears or nails (cyanosis) indicating a lack of oxygen in the body
- sweating is often a sign of a build-up of carbon dioxide in the body, a consequence of breathing difficulties

It is essential to listen to the casualty speak (if he or she is conscious) or breathe (if unconscious). A casualty who complains of choking should be believed (and the causes of this have to be identified).

With unconscious casualties, make sure you listen out for gurglings caused by a build-up of mucus, blood or vomit which can obstruct the upper air passages. One out of 7 casualties die from this.

A gasping sound is often caused by the tongue falling backwards when the head is bent.

Bleeding

It is usually quite clear when there is considerable external bleeding. The position of the casualty and the path followed by the blood flowing beneath the clothes can mislead, and first-aider should be alert to this. Bleeding from the thigh, whether arterial or venous, is often seen only once it reaches the foot, having travelled down the leg underneath the trousers. The same can be true of bleeding from the arm or the armpit, which runs down under the sleeve and drips off the hand onto the car seat (in a road accident for example). However, as a general rule, bloodstained clothing should immediately be visible.

State of shock

Commonly the only indication of internal bleeding is a state of shock. It is therefore essential that the initial examination should check for this, since in such cases the measures to be taken are somewhat different. Indications of a state of shock in a conscious casualty are anxiety, shivering trembling and thirst.

With unconscious casualties, first-aiders have to assess the situation themselves. Indications are paleness of the lips, ears and the face. Cold sweats, rapid and superficial breathing and, especially, a very weak but racing pulse (over 110/min) taken at the neck or the groin, are signs that the casualty should not be left in a sitting position.

Lastly, with an unconscious casualty, if there is no pulse, or if it cannot be detected, and the person concerned is no longer breathing or is gasping, there has been cardiac arrest and the appropriate steps must be taken immediately.

2.1.2 First steps

If the victim is conscious, has no breathing difficulties, is not bleeding and is not in a state of severe shock, the examination should be continued and the casualty monitored pending, during and after evacuation.

If the victim is unconscious, is not bleeding, is not in a state of severe shock, is not breathing or not breathing properly, the first-aider should:

- make sure the upper air passages are unobstructed
- if the victim is in a vehicle (road accident), as carefully as possible tilt the head well back so that the head, neck and trunk are all aligned. As soon as is practicable, unfasten clothes, remove any dentures, insert a Guedel-type airway (or tilt the head to the side in the recovery position) and, where appropriate, arrange for oxygen to be administered (provided there is no risk of fire)
- No matters what the location (except where the air is toxic) carry out artificial resuscitation (such as mouth-to-nose) before and during removal. This task should be taken over by a qualified first-aider as soon as possible, using manual insufflators.

If the victim is in a severe state of shock indicating major internal bleeding, it is essential for him or her to be placed in a lying position (with the head, neck and body aligned) before being extricated, to allow circulation to the brain. If there is no serious injury, raise his or her legs slightly.

If the victim appears to be dead, a qualified first-aider should apply external cardiac massage and resuscitation, once any obstruction to the air passages have been removed and once steps have been taken to ensure no further accidents could occur.

2.2 Handling techniques

2.2.1 General principles

The first aid personnel must be given training in the correct use of handling techniques. If this is not done, injuries – pain, lumbago, sciatica, back strain, torn muscles, sprains, etc – will be inevitable.

This general advice should be followed in all cases of handling, e.g. in lifting and carrying casualties on stretchers (this, however, involves team work).

The position to be adopted

The centres of gravity of both the bearer and the load should be as close together as possible. The lever arm, i.e. the distance between the load and the fulcrum, should be as short as practicable. A crane, for example, can bear 1 tonne when the trolley is 3 metres from the tower, and 500 kg when it is 6 metres away.

Reducing the length of the lever arm also reduces the pressure on the vertebrae. However, this can only be done by adopting a particular position, with the feet as close to the load as possible. To do that, the knees and hips should be bent.

Balance is essential to avoid any involuntary movement. A person's balance is linked to the position of and distance between the feet, which should never be parallel; one should be in front of the other. In this way, the surface area between the external sides of the feet is larger and the centre of gravity is generally perpendicular to this. If the centre of gravity moves outside this base surface area, a fall is inevitable.

The individual's centre of gravity is located more or less at the pubis.

The carrier should therefore be close to the object, with one foot in front of the other, either side of the item to be carried, and should bend his or her hips and knees.

Lastly, the back should be kept straight, with the chin tucked in, shoulders back and elbows as close as possible to the body. It is the power of the leg muscles which is used to perform the lift. To use this power to its best advantage, the back should be straight, the knees bent and the pelvis tilted forward. Do not bend too much, however, as it would then be difficult to straighten up. When bending and straightening up, move slowly and smoothly.

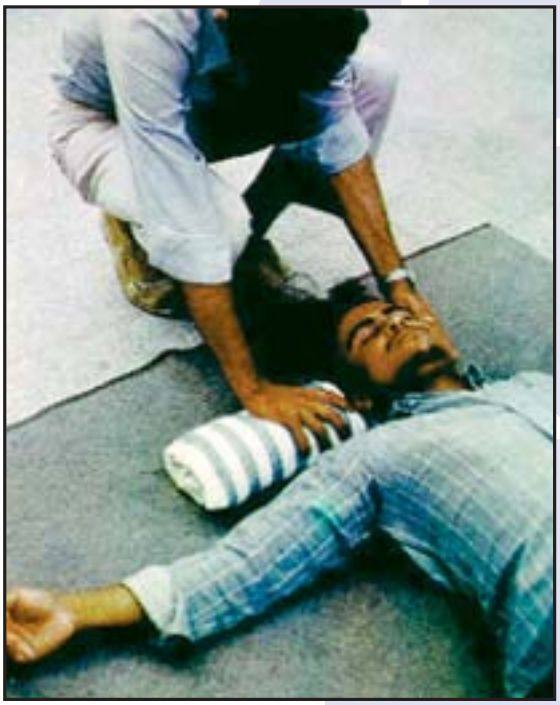


Fig. 5 **Examination of conscious victims**

Fig. 6 **Examination of unconscious victims**

Fig. 7 **Handling techniques (A-turinig a victim/patient ; B-Lifting a victim/patient)**

Mistakes to be avoided

Pay attention to the following:

- make sure your feet are not too close together or too far apart; this will upset your balance and could cause spinal injury or hernias
- be as close as possible to the load to be lifted
- do not arch your back or curve the spinal column as this could damage the inter-vertebral disks; damage can also be caused by twisting the spine, to be avoided at all times
- do not forget to bend your legs; keeping them straight will make you arch your back
- do not bend your legs too much otherwise you will have difficulty straightening up

Examples/Exercises on movements

These are a few exercises for providing a better understanding of movements. These techniques can help avoid injuries. This is possibly one of the most important things to retain.

Carrying an object with handles

Position the load between your feet, with one handle facing forwards, your arms outstretched and legs bent. Lift the object by straightening your legs, using your thigh to support the load.

Carrying a box without handles

The box should be placed at an angle and gripped by opposite corners and then lifted by straightening your legs. If you wish to place it on a table, or if it is resting on your thigh, take it in your forearms, keeping your legs bent. Then place it against your chest and, by straightening your legs, lift it to onto the table.

Carrying a stretcher

You should bend down, keep your back straight and have your feet slightly apart. To lift, straighten your legs, keeping your arms straight all the time.

Lifting a bucket

Place your feet either side of the bucket, bend your legs and keep your shoulders straight. Bend slightly forward. Lift the bucket by straightening your legs.

Lifting a wheelbarrow

The technique is very similar to carrying a stretcher. Your feet should be slightly apart, body bent forward, arms as far back as possible. Lift the wheelbarrow by straightening your legs.

2.2.2 Application of handling principles to casualties / patients

There are many patients or others who are unable to move by themselves. Family members are often required to pull them back up to the top of the bed, sit them down on a bed, lift them, help them walk, turn them over, wash them etc. A person is very heavy and much more difficult to manoeuvre than crates or buckets. This is why it is first of all essential to understand the general principles before they can be applied to specific cases.

Related movements

Once you are in a position where your back is straight, feet apart and knees bent, there are a number of other movements to help reduce fatigue.

Your arms should remain straight when lifting. In fact, the arms and hands merely serve as a "claw" but the arm muscles are not actually used for lifting, even though these muscles react quickly and precisely and provide considerable power when lifting. You should take hold of the load with the palms of your hand and not the end of your fingers, so that it does not slip and oblige you to make extra effort to keep hold.

Pressure on the spinal column should be distributed by trying to create "shock absorbers", formed by air in the organs.

When exerting effort, hold your breath after breathing in (when the diaphragm is raised), not after breathing out.

A crane with its weights and counterweights gives a good illustration of how to avoid becoming unbalanced. This will help you limit excessive contraction of the paravertebral muscles. The counterweight could be, for example, a straightened leg.

The object may be moved more easily as a result of the speed it acquires as these movements flow on from each other (but this speed should not be reduced midway through the process). To this end, do not keep your feet in one place, but move them appropriately. Moving in this way also helps avoid sprains to the spinal column.

The direction of movement can also be utilised. Lastly, movement increases kinetic energy, i.e. to a certain extent, your own body weight can also on occasion be turned to advantage.

First of all, the room should be tidied. If the floor is littered with various objects, or if the furniture is positioned too closely together, it is not at all easy to move about. Your feet could slip or your knees knock into something. In short, it is very likely that you could fall.

Access to the bed should be as convenient as possible. If access from three sides (the bed head and the two sides) is impossible, access from a single direction should be unobstructed, with plenty of room.

Principles to be borne in mind

Always stand close to the load, feet apart, the two centres of gravity as close as possible, back straight and legs bent

Use your leg muscles to lift the load and be careful not to twist the spine

To reduce the effort required, use the weight of the body and the speed acquired in the movement, for example when breaking the fall of an object

Never arch your back to lift anything, never carry anything in a crouched position or twist your body

Examples/Exercises

Turning a patient over in bed

To turn a patient over in bed, you should, if possible, stand on the side of the bed opposite to the one towards which he or she will be pivoted. With your knees bent, feet apart, place one of your arms under the patient's shoulder and the other hand around the crotch area. By straightening your legs, you should be able to turn the patient without much effort. Occasionally, patients lying on their stomach have to be turned onto their back. To do this, place one hand around the patient's thighs or pelvis and the other under the thorax. Pull the hand around the thorax upwards. This makes it easy to turn the patient round.

Seating a patient on the bed side

It is relatively easy to seat a patient on the side of the bed.

The principle involved is to pivot the patient once he or she is in a semi-seated position. Place your arm around patients back of the neck and the other around the opposite thigh. The patient can then be turned round without having to be lifted.

Complete the manoeuvre by bending your knees.

Getting a patient seated on the edge of the bed into a standing position

To get a patient seated on the edge of the bed into a standing position, it is useful to put a draw sheet or a belt around his or her waist. Keeping your back straight, your knees bent and one foot in front of the other, take hold of the belt or sheet and steady the patient's legs. By leaning backwards you will create a counterweight and be able to lift the patient.

Pulling a patient back up to the top of the bed

It is often quite difficult to pull a patient back up to the top of the bed. It is much easier if there are two of you. Stand either side of the patient, place your forearm and hand under him or her, bend one leg and keep the other straight in the waiting position. Then bend your straight leg. Here, you are shifting the weight of the body from one leg to the other.

It is much harder to do this task on your own, especially if you cannot stand at the head of the bed. Where this is possible, stand behind the patient, take hold of his or her wrists and place your arms underneath his or her armpits.

These movements should not be undertaken without careful preparation. They do illustrate, however, that applying good handling principles can ease everyone's task and prevent injury.

It is often more difficult to arrange for the right number of carriers, and frequently just one person has to do the lifting. Clearly, it is much better if there are two people to perform this task.

It is essential to ensure that patients are aware of what is going to happen. They must be told what movements will be made so that they do not do anything out of fear which could lead to a fall. Lastly, while beds which are too high are difficult to access, beds at floor level can often be raised, making it much easier to provide care to a patient or elderly person.

2.3 Organisation of medical care

First aid is generally given at the disaster site itself in order to provide casualties with the urgent care they need. When disasters occur in urban areas, first aid is generally administered by ambulance staff, fire fighters, the police, the Red Cross, or other health care organisations. If the disaster occurs in a rural area, away from a town or city, dispensary and health centre staff are responsible for emergency assistance.

Whatever the type of disaster, a number of basic principles have to be observed to avoid inefficiency and chaos.

The following must be carried out:

- a command post must be set up to co-ordinate relief, monitor the use of resources and prevent conflicts of responsibility
- an assessment must be made of the scale of the disaster, the number of casualties, where they are located and their immediate needs
- an appropriate location has to be found for the initial triage of casualties, before they are evacuated to medical centres
- casualties should be given first aid (including maintenance of vital functions, stopping bleeding, clearing air passages and, where required, transfusions and IV drips)
- contact should be made with regional hospitals and their outposts so that they can implement their emergency plans to take in the casualties

2.3.1 Mobile hospitals

The use of mobile hospitals as observation, treatment or first-aid centres is justifiable when existing hospitals have been damaged or cannot function.

Before they are set up, it is essential to ensure that there is adequate staff, in terms of qualifications (medical, auxiliary, administrative and technical) and numbers, and that there are the appropriate medical and surgical facilities, supplies of medicines and emergency equipment. It is also necessary to ensure that there are adequate supplies of drinking water, food and other daily necessities for both casualties and staff, so that these hospitals do not have to depend on the already stretched resources of the community. The local authorities should be given responsibility for co-ordinating the tasks assigned to the mobile hospitals. These local authorities should be able to incorporate the activities of the mobile units into the general framework laid down by the national plan.

2.3.2 First-aid mobile hospitals

A first-aid mobile hospital is a day centre providing first-aid care (treating bruises, cuts, sprains etc) and ambulatory treatment for the non-serious casualties and inhabitants of the disaster area.

2.3.3 Observation mobile hospitals

These are units with limited medical and paramedical staff resources, possibly reinforced by volunteers. They will take in patients who have already been treated and who require simply medical surveillance or nursing care.

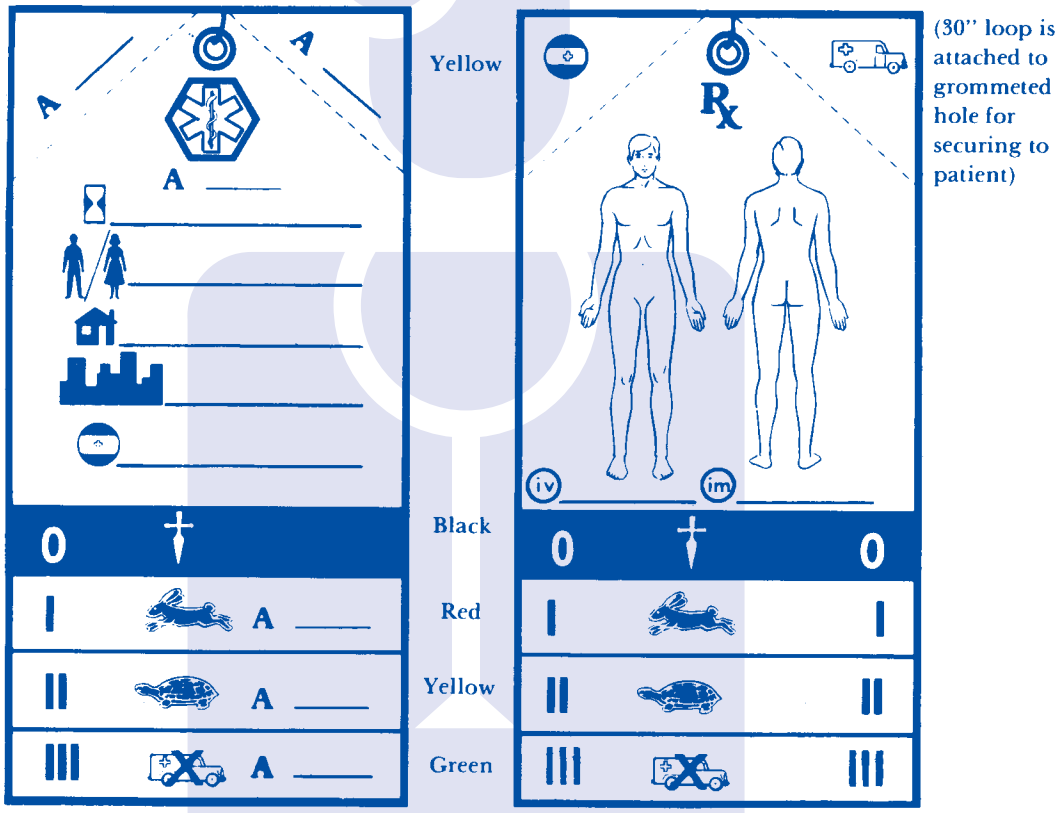
2.3.4 Search and rescue units

If they are to be effective, rescue units should have teams who have been trained in first aid. They should, in addition, be able to travel immediately to the scene of the disaster.

2.3.5 Triage, identification and classification of casualties

When there are a large number of casualties and medical resources are limited, the injured have to be classified on the basis of the likelihood of their survival. This procedure is called triage.

Triage is a continual process. Initial priorities are determined at the disaster site (first-level triage). A second order of priority (second-level triage) is decided upon outside the disaster area or upon admission to hospital. A third order of priority (third-level triage) is carried out in the hospital and it is at this point that decisions are taken on transfer to the health-care services.



In June 1977 the Emergency Medical Services Commission of Metropolitan Chicago endorsed METTAG (Medical Emergency Triage Tag) as the standardized field triage disaster tag. *Source:* METTAG, *Journal of Civil Defense*, P.O. Box 910, Starke, Florida, 32091.

/sorce: PAHO, Scientific publication N° 443, 1983/

Fig. 8 **Model triage tag**

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2.3.6 Triage at the disaster site

Ideally, a doctor should be dispatched to the disaster area to examine all casualties whatever the severity of their injuries. This doctor should take care of the triage operations.

All deaths should be certified so that medical staff do not waste any time having to carry out examinations to confirm death.

2.3.7 Identification and classification

Wherever possible, casualties should be identified during the triage process. This involves putting a colour-coded tag on the casualty (Table 1) that indicates the injury severity and the evacuation priority.

Table 1 **Tagging of casualties**

Colour of the tag	Evacuation priority	Casualty description
Red	Highest	Used only for casualties requiring immediate care.
Yellow	Second	Casualties falling into this category must receive care but they are not in a life-threatening situation.
Green	Third	Used for casualties who have minor injuries or who are likely to die very shortly.
Black		Placed on the dead, only. Casualties are considered to be dead if they are no longer breathing, if there has been no pulse for 20 minutes, or if their situation is such that it is impossible to apply the necessary techniques to maintain their vital functions.

2.3.8 Evacuation priorities

Evacuation priorities (Table 2) are made in accordance with the injury status of the casualty.

Table 2 **Evacuation priority according to injury status of the casualty**

Injury status of the casualty	Evacuation order
Casualties who are neither trapped nor buried	red tags yellow tags green tags
Casualties who have been trapped or buried	red tags yellow tags green tags
The dead • casualties with black tags, neither trapped nor buried • casualties with black tags who are trapped	to be evacuated after other casualties

3. Treatment of casualties

3.1 Haemorrhages

Haemorrhage means bleeding, a discharge of blood from the vessels when an artery, vein or capillary vessel is ruptured. The bleeding may be internal (inside the body tissues) or external, where there is an open wound.

3.1.1 Types of haemorrhage

Haemorrhages are traditionally broken down into three types:

- external haemorrhage, generally linked to an accident and the casualty loses blood from an open wound
- internal haemorrhage, where the blood escapes from the normal circulatory channels, but remains inside the body and cannot be seen from the outside; the fact that an accident has taken place and the appearance of certain symptoms should alert the rescuer to the possibility of serious haemorrhage; ecchymosis or bruising are visible signs of less serious haemorrhage
- internal haemorrhage with bleeding from body openings, where the blood flows from the body without there being any open wounds; the bleeding occurs inside body cavities connected to the outside: the casualty may bleed from the head or face orifices (ears, nose, mouth) or from the genito-urinary tract and anus

External haemorrhages

Three categories of external haemorrhage:

- arterial
- venous
- capillary

are usually distinguished, depending on the type of blood vessel involved (artery, vein, capillary).

Arterial haemorrhages

As artery walls are thick, the cut remains wide open and bright red blood gushes out in rhythmic spurts, corresponding to each beat of the heart (left ventricle).

Venous haemorrhages

As veins have thinner, softer walls, the severed edges tend to collapse and close, reducing the bleeding. The wound bleeds in a steady stream of dark red blood, much darker than arterial blood, as it is poor in oxygen and much richer in carbon dioxide. Rupture of a varicose vein is one example of venous haemorrhage.

Capillary haemorrhage

Capillary haemorrhage affects the minute blood vessels we call “capillaries” because they are as fine as hair. Here blood oozes in droplets. Most external haemorrhages are capillary haemorrhages, i.e. most of the haemorrhages that occur as a result of everyday accidents, in the family environment, during leisure activities and at work.

For a very long time these different types of haemorrhage were dealt with in different ways.

Nowadays it is the amount of bleeding, rather than this textbook pattern, that determines the course of action.

Accidents are usually complex events that rarely affect only one vein, one artery or one group of capillaries. It is often difficult, if not impossible (even for a doctor) to determine the exact type of haemorrhage at the scene of the accident.

Bleeding wounds (which are often covered by clothing) are more often than not a sign of ruptured veins or arteries. Some deep wounds (bullet or knife wounds or injuries caused by pitchforks, agricultural equipment and so on) often bleed in a steady flow, which can be misleading, for even if a major artery has been severed deep inside the body, the mass of muscle has a regulating effect on the external bleeding.

Internal haemorrhages

These are haemorrhages with no open wound. Although blood escapes from the blood vessels, it cannot be seen from the outside. It remains inside the body.

The term “internal haemorrhage” covers a variety of accidents, from the most harmless (bruising) to the most serious (rupture of the liver or spleen, ectopic pregnancy).

The course of action varies according to the gravity of the injury.

Internal haemorrhages may be caused by:

- a simple knock, blow or everyday accident
- contusion injury following an accident to the chest, abdomen (rupture of the liver or spleen), back, skull, etc.
- rupture or tear of one or more blood vessels by broken bone fragments
- injury by firearm or foreign body; here there is an open wound but often only a small one, obstructed by a foreign body; the bleeding remains inside the body
- ectopic pregnancy; rupture of the fallopian tube produces internal bleeding that requires urgent surgery

Serious internal haemorrhages

There is always a possibility of serious internal haemorrhage in the event of an accident.

Warning signs exist on three levels:

- the accident itself, where the victim received a violent blow to the abdomen, back, skull, etc.
- the general appearance of the casualty, where the previously discussed signs of a state of shock are apparent
- the victim looks pale and drawn, is weak and faint, is cold and shivering (cold hands or feet); the pulse is barely perceptible, weak, tenuous, irregular. If still conscious, the casualty complains of breathing difficulties (suffocation), intense thirst, buzzing in the ears, blurred vision and, above all fear, the feeling that he or she is dying

Some internal haemorrhages, large or small, very local or more widespread, are signs of diseases of the blood and must be treated accordingly.

Ecchymosis, or bruising

Bruising is an accumulation of varying amounts of blood under the skin following the rupture of capillary vessels; it may also occur under a mucus membrane (conjunctivitis) or around an open wound.

The first sign of ecchymosis or bruising is a reddish or blackish discolouration of the skin that changes colour as the days go by, turning blue, greenish then yellowish before eventually disappearing. When bruising following a violent blow or sprain is accompanied by a

very sharp pain and functional disability, it is a sign of a more serious injury - a fractured or broken bone. If bruising appears spontaneously, without any physical trauma, it is a sign of a blood disorder that falls outside the scope of first aid.

Haematoma

The difference between an ecchymosis and a haematoma is that with haematoma there is more blood and it forms a clot or cyst in the body tissue (subcutaneous haematoma, for example) or inside an organ.

Amongst the more serious haematoma are those formed inside the skull following a blow or an accident. For example, extradural (epidural) haematoma is a haematoma where haemorrhage occurs between the outer membrane covering the brain (the dura mater) and the skull. Haematomas may also be subdural (when they form between the dura mater and the brain) or intracerebral (inside the brain itself).

Ectopic (or extrauterine) pregnancy

In normal pregnancy the ovum, fertilised by a sperm in the outer third of the fallopian tube, implants itself in the uterus. Sometimes, for some obscure reason, the fertilised egg implants itself in the fallopian tube. The tube is not elastic enough for it to develop to maturity, so two types of accident are to be feared:

- tubal abortion, where the ovum is ejected into the peritoneal cavity
- tubal rupture, where the fallopian tube breaks, causing heavy bleeding in the peritoneal cavity

Tubal rupture is a terrible and brutal accident. The victim feels a sudden stabbing pain in the lower abdomen. She is pale and faint, with signs of internal haemorrhage.

This is a case of bleeding in a body cavity being evacuated through a natural orifice.

Otorrhagia

This means bleeding from the ear. The origin may be accidental (fall on the head, road accident), or a burst eardrum sustained in a diving accident. Bleeding from the ear may also occur in connection with certain ear disorders, such as otitis.

Blood or a clearer fluid may be secreted from the ear. As burst eardrums are dealt with in the section on diving and leisure accidents, suffice it to say here that bleeding from the ear may be a sign of a fractured skull, and in particular fracture of the petrosal bone, when the origin of the haemorrhage is a trauma.

Epistaxis

This is the scientific name for nosebleed. The cause is often simple and local, in which case only a simple treatment is required.

Sometimes it is a sign of a blood disease or of high blood pressure.

In the event of an accident, however, sometimes but not necessarily in conjunction with otorrhagia, it can point to fracture of the skull.

Haematemesis

Blood leaks or is vomited from the mouth. The victim vomits varying quantities of very dark blood, which should be conserved for subsequent analysis in order to evaluate the amount of blood lost and the real extent of the haematemesis.

There are various possible causes: ruptured varices, veins or oesophageal lining, gastric or duodenal ulcer, haemorrhagic gastritis, etc.

Haemoptysis

Haemoptysis is the spitting of blood, generally accompanied by coughing. It may be of cardiovascular or broncho-pulmonary origin. More often than not the origin of these broncho-pulmonary accidents is disease: bronchiectasis (brochial dilatation), pneumonia, lung abscess, tuberculosis, etc. Cardiovascular origins include the mitral stenosis that characterises many heart diseases.

Haematuria

Haematuria is the presence of blood in the urine. The colour of the urine depends on how much blood it contains.

Following a blow or shock it can be a sign of a fractured pelvis, but in general it is merely a symptom of a disease of the urinary tract.

Some of the most frequent causes of renal haematuria are acute inflammation of the kidneys, kidney stones, kidney cancer, renal tuberculosis.

Menorrhagia

Menorrhagia is abnormal vaginal bleeding during menstruation. Any change in the amount of bleeding or the duration of the period should be reported to a doctor. If the bleeding is profuse and gives cause for concern, the patient must be taken to hospital, as a blood transfusion may be necessary. Menorrhagia may be caused by cysts, tumours, fibromas, genital infections, etc.

Metrorrhagia

This is also vaginal blood loss, but outside the normal menstruation period. It may be a sign of a tumour, an ectopic pregnancy, inflammatory lesions of the genital apparatus (ovaries, fallopian tubes, uterus).

Like all menstrual anomalies, metrorrhagia can be a sign of a disease that should be treated without delay. A doctor or gynaecologist should therefore be consulted at the earliest opportunity.

3.1.2 What to do in the event of external haemorrhage

The most important sign for the rescuer is the amount of blood being lost. The section of an artery in the thigh or the arm requires immediate action, a reflex which is nothing new but, on the contrary, a spontaneous, subconsciously remembered reaction. Someone who instinctively presses a cloth to a bleeding forehead, a child who presses a handkerchief against a grazed knee or winds it round a bleeding finger, is doing the right thing.

Immediate actions

In just about every case the first things to do are:

- press your hand directly on the wound
- if necessary, lay the casualty down in a horizontal position to prevent the onset of shock

Pressing down on the wound

First aid is often administered by a bystander who has no special equipment. This first step must be taken very quickly, possibly with the aid of any available piece of cloth (handkerchief, towel, folded scarf, etc.) held down firmly on the wound. Done properly, this is sufficient to stop the bleeding. It is important to stop the bleeding as soon as possible, as blood loss can be dangerous for the casualty. The most urgent thing for the first-aid provider is the haemorrhage, not the wound, which will be attended to later in hospital. It is vital not to waste time looking for a sterile bandage or a clean cloth to place between the hand and

the bleeding wound. If there is nothing at all to hand, which is often the case, and however unpleasant it may be, the rescuer must press his or her hand directly on the wound to stop the bleeding.

Laying the casualty down

The casualty may already be lying down. In the event of wounds to the upper limbs, thorax or head, however, the casualty may still be in a standing or sitting position; in this case it is important to make him or her lie down.

This serves two purposes:

- it makes it easier to apply compression to a wound to the lower limbs, thorax or head
- it helps prevent the shock that often accompanies cases of severe haemorrhage

The casualty must be made to lie down with great care. The easiest way is to ask the casualty to kneel and then, still supported by the rescuer (who constantly maintains manual compression of the wound), to sit on one side and finally to lie down.

Too much haste may cause the casualty to fall over, making the rescuer release the pressure on the wound; this must be avoided.

So, when faced with a haemorrhage, press down on the wound with the hand (protected by a cloth when one is available) and only release the pressure when you have made an improvised bandage to stop the bleeding (using a scarf, for example).

What to do next

After a short time (a few minutes) the rescuer should check on the casualty's condition by carefully releasing the pressure of the hand on the wound. The rescuer will observe one of two situations:

- the bleeding will have stopped or decreased considerably
- the bleeding will resume as badly as before

Make a bandage

Having to press on the wound immobilises the rescuer, so he/she must try to make a tight bandage with whatever material is available, in order to be free to do other things.

Sterile compresses

When first-aid equipment is available, sterile compresses should be placed on the wound and held in place with strips of gauze, canvas or elastic bandage.

Sticking plaster

These are easy to use and should always be kept in the home, in the car and at the workplace. Separately wrapped and sterile, they protect the wound and effectively stop ordinary cuts from bleeding.

Emergency haemostatic pad dressing

This material is more sophisticated and very effective.

Supplied in a plastic sachet that protects it from the light, the ready-to-use dressing is in three parts: a compress, a foam pad and an elastic bandage. The sterile compress, wrapped separately, is placed over the wound. The latex foam pad is airtight and acts as a sponge. When placed over the wound and compressed, it absorbs some of the blood, depending on how serious the haemorrhage is and how tightly it is compressed (with about

40% pressure it absorbs 50 ml of blood). This absorption of blood is quite normal. If blood continues to seep through the bandage, however, it should be tied tighter. As it fills with blood, the foam expands and a balance is achieved between the pressure inside the vein or artery and the pressure of the pad. It is held in place with a sliding strap under which the bandage passes and under which one can slip one's hand.

The elastic bandage is between 0.9 and 1.3 metres long, with a grip on one end and a fastening device using hooks which attach to the final layers of the bandage. It is highly elastic, so rescuer must be careful not to pull it too tight as each extra turn adds to the pressure already exerted by the previous layers.

Improvising a bandage with whatever is available

When there is no domestic, car or factory first-aid kit to hand, which is usually the case, the cloth used initially should be left in place and held there by a bandage, which replaces the pressure previously exerted by the rescuer. The bandage may be made with a scarf, a tie or a twisted strip of cloth.

The bandage should be moderately tight, but not as tight as a tourniquet, which is always dangerous, often serves no useful purpose and sometimes makes things worse. If the bleeding continues, the bandage is not tight enough. It should be tightened by tying another strip of whatever cloth is available around it.

The emergency haemostatic pad should be applied as follows:

- place the sterile compress on the wound
- slip the hand between the pad and the reverse side of the bandage, underneath the sliding strap
- apply the pad and start winding the bandage (the side facing inwards is the side with the green dotted line). Although this type of bandage can stop all sorts of haemorrhages, both those which decrease considerably after local manual compression and those which resume bleeding as badly as before, care must be taken to avoid certain mistakes.
- The rescuer should not release pressure on the wound in order to go and fetch the haemostatic pad from the first-aid cabinet or kit.
- The rescuer should not release pressure on the wound while preparing the pad (opening the wrapper and taking out the compress).
- The transition from manual pressure to application of the haemostatic pad should take no more than a split second. If necessary the cloth already covering the wound may be left in place instead of the sterile compress. As soon as the pad is held in place by the first loop of bandage, the rest of the bandage should be applied in the recommended manner, winding inwards from the extremity towards the root of the member.

The emergency haemostatic pad stops blood circulation locally, in the injured vessels, but without the disadvantages of the tourniquet. Its wide distribution and use should be encouraged.

In all cases the following precautions should be taken:

- the bandage should not turn red or leak blood - if it does it has not been applied tightly enough
- blood should continue to circulate lower down the limb from the bandage; the extremity of the limb should not turn cold or blue; the pulse must remain perceptible; the compress bandage is not a tourniquet

The haemostatic pad can be used more than once. Just roll up the bandage with the hooks facing outwards and apply a new sterile compress. If the latex foam pad is bloodstained, it should be washed like a woollen garment and left to dry away from the light.

Horizontally lying casualty

With the casualty lying horizontally, raise the injured limb above the level of the heart to decrease the pressure in the veins and arteries.

Applying non-local pressure

While the above measures will stop most haemorrhages, there are some rare cases where a more delicate approach is needed:

- when the material available for making a compress bandage is insufficient and the bleeding continues
- when the rescuer cannot press directly on the wound because a foreign body is in the way (for example, a knife or broken glass)

In such cases the rescuer must stop the circulation between the heart and the wound, as close to the wound as possible.

This is done by exerting pressure on the main arterial trunk, pressing the artery against a bone with the thumb or fist. The pressure should be maintained at all times, even during pick-up and transportation to hospital, until trained emergency staff takes over.

In order to apply pressure on the artery correctly, the rescuer or first-aid provider must be familiar with the paths followed by the main arteries and the points on the body where they are most accessible. 6 precise pressure points should be remembered:

- 3 points on each upper limb (behind the clavicle or collar bone, under the armpit and on the inside of the arm between elbow and armpit
- 2 points on the lower limbs (in the middle of the groin and on the inside of the thigh, between the knee and the groin)
- 1 point on each carotid (on either side of the Adam's apple)

In all cases the pressure should be exerted as close as possible to the wound.

In practice 2 key points can be used to stop almost all haemorrhages thus:

- the sub-clavian pressure point (under the collar bone, by pressing the artery against the first rib) for all haemorrhages of the upper body
- the pressure point in the hollow of the groin, i.e. where the leg meets the trunk, for all haemorrhages of the lower limbs

Statistically the carotid pressure points are seldom used. Bleeding from severed carotids is so profuse that pressure on the artery is only effective if exerted within seconds of the wound being inflicted. In first aid and occupational safety training only the 2 pressure points located at the roots of the limbs are taught.

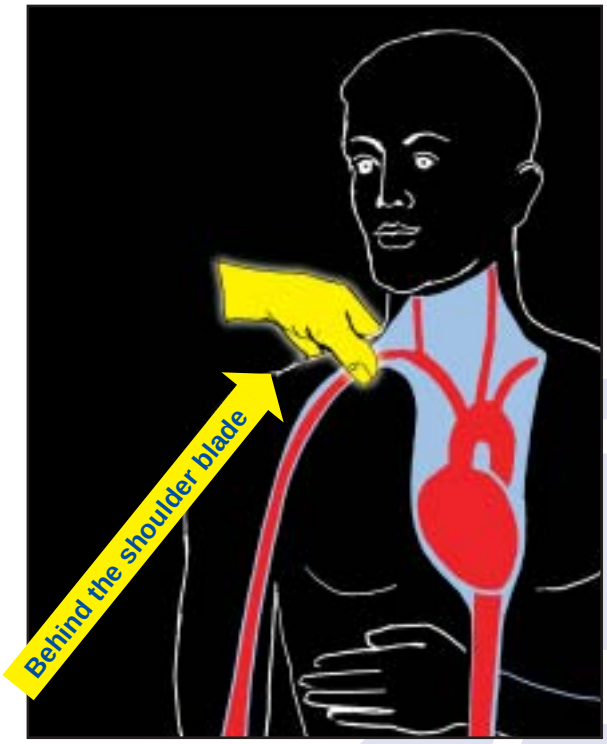

Fig. 9 **Pressure point on the subclavian artery behind the shoulder blade**

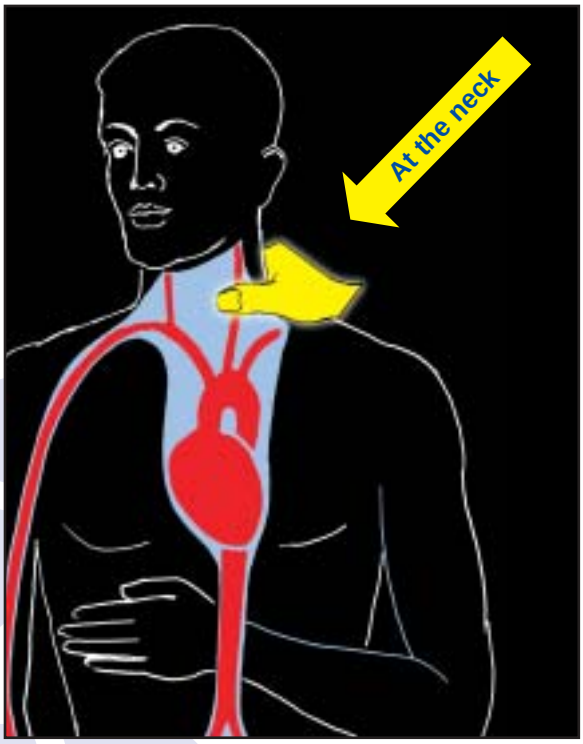

Fig. 10 **Pressure point on the carotid artery at the base of the neck**

Fig. 11 **Pressure point on the inguinal-femoral artery in the middle of the groin**

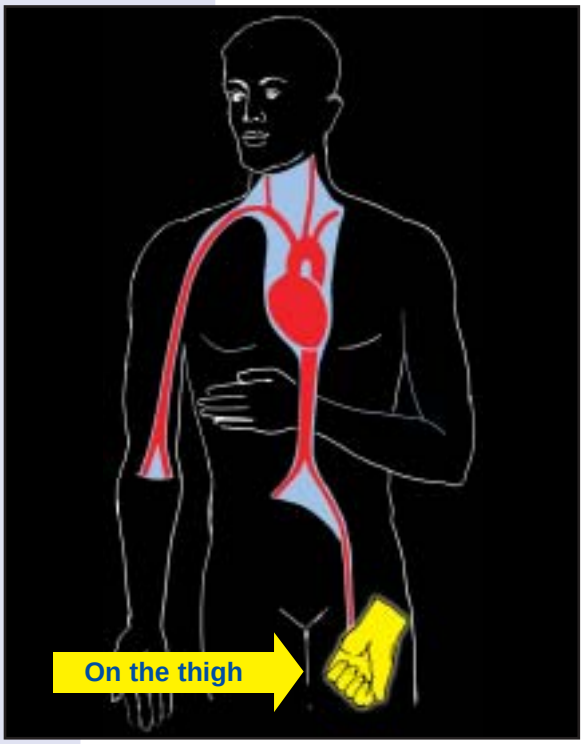

Fig. 12 **Pressure point on the femoral artery on the thigh**

The upper limbs

The sub-clavian artery

From the aortic arch, a major artery reaches out of the thorax between the collar bone and the first rib to irrigate the upper limbs.

This is the artery to compress (Fig. 9) in the event of serious haemorrhage of the shoulder or the armpit, or when a whole limb is torn off, in a road accident, for example (arm out of window when overtaking or passing too close to a vehicle coming the other way).

The sub-clavian artery is accessible behind the collar bone, at the base of the neck (Fig. 9). Press the thumb downwards into the hollow.

If the haemorrhage is on the left side, use the right thumb; if it is on the right side use the left thumb. The other fingers use the upper back muscles for leverage.

When this is done properly the bleeding should stop.

The axillary artery

This leaves the trunk and is accessible in the hollow of the armpit.

Pressure is exerted here when the haemorrhage is located in the upper arm. The rescuer must use both hands, wrapping them round the shoulder muscles and pressing into the armpit with both thumbs placed side by side, flattening the artery against the bone.

The position of the thumbs is important. They must be side by side, not tip to tip or one on top of the other.

As previously, the pressure must be maintained until the casualty can be got to a hospital.

In practice, although it is mentioned in the main first-aid manuals, this pressure point is seldom used because it “neutralises” the rescuer.

The humeral artery

The humeral artery irrigates the upper limbs and is accessible inside the biceps on the upper arm. It forks in the forearm below the elbow.

This pressure point is used for all major haemorrhages of the upper limbs when no material is available or when pressure cannot be exerted locally. It is in fact a “pressure line” along the artery. If the wound is on the right side, the right thumb is used, and if it is on the left side, the left thumb. The rescuer grasps the arm from behind, slips the thumb round the biceps and presses it against the humerus (the arm bone).

The other fingers grip the outer arm for pressure.

Another technique is to apply the pressure with the fingers, seizing the arm from the front and applying counter pressure with the thumb on the outside of the arm. It is more tiring to keep up the pressure in this position, so the other, more accurate method, using the thumb, is recommended.

There are countless possible pressure points, even on the forearm. All that is needed is an accessible artery and a bone against which to press it. But the branching of the humeral artery into the radial and ulnar arteries can lead to mistakes that waste precious time to the detriment of the casualty. For practical purposes, therefore, there is generally considered to be no emergency pressure point below the elbow.

The lower limbs

The groin

The aorta branches into the two iliac arteries, which then become the femoral arteries at the level of the groin.

The femoral artery in the groin is the pressure point in the event of haemorrhage in the upper third of the thigh.

The artery is accessible (Fig. 11) in the middle of the groin (the mid-inguinal point). It is essential for this operation that the casualty should be lying down. The rescuer, beside the casualty, watching his or her face, presses down with closed fist and outstretched arm vertically on the middle of the groin. Difficult as this may be, this pressure must be applied firmly even while the casualty is picked up and transported to hospital.

Effective pressure can only be applied with the fist, especially when the subject is overweight, in which case it is virtually impossible to depress the artery using one or both thumbs.

The femoral artery

This artery spirals down the inside of the thigh from the middle of the groin to the popliteal fossa at the back of the knee.

It is used as a pressure point (Fig. 12) for all haemorrhages of the lower limbs that cannot be stopped using a bandage compress.

Like the humeral artery, it is accessible on the inside of the limb. The rescuer, positioned beside the casualty where he or she can watch the casualty's face, presses vertically down on the artery with the fist, the arm outstretched, always between the wound and the heart. To make it easier, the casualty's leg is slightly bent and placed sideways against the ground. Once again, a constant pressure must be kept up until the casualty is hospitalised.

The carotid

Severed carotid arteries are a rare occurrence, generally caused by a road accident or an accident at work. They are usually accompanied by other damage, such as a severed trachea, and sometimes lead to instant death.

The rescuer may be tempted to use this pressure point in the event of profuse bleeding from facial wounds, nosebleeds or the vomiting or spitting of blood. This is not only ineffective but it can be dangerous for the casualty as it deprives the brain of necessary blood.

Bleeding from open wounds to the head or face should be stopped by manual pressure followed by a compress bandage.

Bleeding from the orifices is a sign of internal haemorrhage. So the only time the carotid should be used as a pressure point to stop bleeding is when a single carotid is severed (by a knife or broken glass, for example). As usual, the pressure should be exerted between the wound and the heart. The carotid arteries run along both sides of the Adam's apple. It is important not to obstruct breathing. Pressure should be applied using the right thumb (Fig. 10) if the left carotid is severed and with the left thumb if the right carotid is severed. The other fingers press against the back of the neck. The carotid should be pressed backwards against the vertebrae. Again, the pressure must be maintained throughout pick-up and transportation to hospital.

The tourniquet

This was long considered as the easiest, most effective means of stopping an external haemorrhage, so it is found in most manuals and school textbooks. Before considering how to use it properly, therefore, let us consider its disadvantages, for the tourniquet can be a dangerous weapon.

It stops all irrigation of the limb downstream of the application point, crushing and injuring body tissue and complicating any surgery the injury may require. It should be used only in exceptional circumstances and in certain specific cases when:

- the rescuer is alone and has to leave the scene to fetch help
- the rescuer is alone and there are other casualties in need of urgent attention and first aid
- the rescuer cannot continue to apply manual pressure (for example while the casualty is disengaged from a vehicle following a road accident)
- a whole limb has been severed (hand or arm sawn off by a circular saw or chopped off by a guillotine or other cutting machine, leg severed by falling sheet metal or the wheel of a railway truck or carriage)

Even then, the rescuer should check that the following four conditions are fulfilled:

- is the tourniquet really necessary ?
- has a major artery in the arm or leg been severed ?
- is it not possible to use a compress bandage ?
- is there enough room for the tourniquet between the heart and the wound, i.e. between the wound and the root of the limb (armpit or groin) ?

In such cases, when all these conditions are fulfilled, a tourniquet can be improvised.

The word tourniquet means different things to different people:

- for a nurse it is a venous tourniquet made with a rubber strap and used to facilitate the taking of blood samples or the administration of intravenous injections; it is therefore a means of stopping venous (or return) circulation and is of no concern to the rescuer at an accident scene
- the tourniquet has traumatised generations of accident casualties, not only because of the equipment needed (a strap or cuff, a stick, sometimes a second strap) but because it is often a source of skin and tissue lesions
- finally, there is the improvised tourniquet, the weapon of last resort for the modern-day first-aid provider

Applying an improvised tourniquet

This is never the first course of action. It should only be done when other methods fail or cannot be used in the circumstances.

The first-aid provider should already be exerting pressure (haemostasis) on or near the wound, and should continue to do so while applying the tourniquet.

Taking the available material in the free hand, proceed as follows:

- fold the material double to make a loop
- wrap it round the limb, with the loop towards you
- slip the hand through the loop, grab the two loose ends and pull them through the loop
- tighten the tourniquet by pulling the two ends apart - this can be done by holding one end between the teeth
- now stop applying pressure with the other hand and use both hands to tie a tight flat knot on the side of the limb opposite the loop
- check that the tourniquet is sufficiently tight, i.e. that the bleeding has stopped

Material used

A tourniquet can be improvised using various materials: a tie, a canvas belt, a scarf folded diagonally, a strip of cloth, a stocking, etc. can all give excellent results.

Narrower materials, like string, wire, shoe laces cut into the skin and should be avoided at all costs.

Elastic tourniquets (made of flat rubber bands) are not improvised and are used in other circumstances.

Special cases

The improvised tourniquet is usually applied to the thigh, and the available material may be too short to make a tourniquet as described above. In this case, just pass one end of the material through the loop, pull it tight and tie it to the other end.

What to do next

After applying the tourniquet, the rescuer must:

- prevent the casualty from going into shock
- carefully note the time at which the tourniquet was applied
- alert the emergency services
- keep a constant watch on the casualty while awaiting the ambulance and during transport

Preventing shock

Blood loss (sometimes substantial) and pain can trigger severe shock.

To prevent this the first-aid provider should lay the casualty down in a horizontal position, cover him or her for warmth, and comfort him/her.

The dressed wound and tourniquet should be kept visible.

Write a note for the emergency services

The first-aid provider should note the time at which the tourniquet was applied, either on his/her own watch or on that of the casualty, or preferably both; then, as soon as the essential steps have been taken (dressing the wound, warming and comforting the casualty), the first-aid provider should prepare a note for the doctor or surgeon who will be receiving the casualty in hospital. The doctor needs to know how long the circulation has been stopped in the injured limb.

Also, in major disasters, the arrival of large numbers of casualties can cause delays in the handling of emergency cases. So the note should provide the following information if possible:

- the casualty's name
- the word "tourniquet" in a highly visible position
- the time at which the tourniquet was applied (24-hour system, i.e. 17.15, not 5.15)

If there is no paper, pen or pencil to hand, the most important piece of information (the word "tourniquet" or a large "T" and the time of application) can be written on the casualty's forehead with lipstick or whatever else is available.

Alerting the emergency services

The evacuation of a casualty wearing a tourniquet is an emergency. The requisite preparations must be made with minimum delay. The emergency services should therefore be alerted swiftly, clearly and accurately, so that the ambulance can arrive at the scene in the shortest possible time and surgery can be performed without unnecessary delay.

Constant supervision

- The first-aid provider must check the casualty's general condition, especially the following:
- breathing (apply mouth-to-mouth artificial respiration if breathing stops)
- state of consciousness (place the casualty on his or her side in the recovery position if unconscious)
- circulation (check pulse regularly)
- this observation must be kept up during transport, either by the ambulance crew or by the first-aid provider where a less appropriate vehicle has to be used. In any event the casualty must be transported lying down, preferably on a stretcher

Important warning

Once a tourniquet has been applied it must never be removed or loosened except by a doctor!

Doctors alone are aware of the risks involved in removing tourniquets and able to take preventive action or corrective measures if anything goes wrong. In addition to blood loss, removing a tourniquet can result in sudden respiratory and circulatory arrest. The first-aid provider cannot take that risk, no matter how long it takes to evacuate the casualty. The careful loosening of the tourniquet every 20 minutes still recommended in some manuals is an obsolete and dangerous practice that must be proscribed.

3.1.3 What to do in the event of internal haemorrhage

Serious internal haemorrhages

As no local action is possible, the first-aid provider's role is limited to preventing the situation from deteriorating:

- a conscious casualty should be laid down flat, with the legs slightly elevated
- an unconscious casualty should be laid on his/her side in the recovery position

In both cases, try to keep the casualty warm.

If the casualty is conscious and asks for something to drink, do not give any liquid at all, and certainly not anything like alcohol, tea or coffee, which stimulate the heartbeat, thereby increasing the haemorrhage.

Ecchymosis

Ordinary ecchymosis or bruising is treated by applying a compress bandage soaked in alcohol. If in doubt, or in the event of extensive bruising, leave it to a doctor to decide what treatment to administer.

Bruising in the presence of an open wound can foster the development of microbes and infection, hence the importance of immediate first aid, to disinfect the wound and place the casualty in a clean environment.

Haematomas

In simple cases, following a not-too-severe blow, haematomas can be held in check with warm, salty compresses. Certain anticoagulant ointments also help: arnica is one example, often used on bumps.

However, bumps on the head and serious haematomas can be external signs of more serious damage and a doctor should be consulted.

Ectopic (or extrauterine) pregnancy

Where profuse intraperitoneal bleeding occurs, only an emergency surgical operation can save the casualty. There is nothing the rescuer can do except call an ambulance as quickly as possible. Failing this, he/she should transport the casualty to the nearest hospital by car, in the same position as for ordinary internal haemorrhage (recovery position).

This type of accident can occur during the first 6 weeks of pregnancy and is sometimes preceded by loss of very dark blood, severe abdominal pain and fainting.

Internal haemorrhages that bleed through body orifices

Otorrhagia

The casualty should be placed in the recovery position (on his/her side) and picked up and transported in that position, under observation. Which side up is of no consequence and will neither help nor harm the casualty.

Epistaxis

- The simple nosebleed is a frequent accident in childhood (falls, rough games). Numerous traditional remedies exist, but the procedure to follow is straightforward:
- keep the subject's head up and slightly tilted forward; sitting subjects may support their head on their hand, with their elbow on the table
- press against the bleeding nostril with a finger
- prevent the subject from coughing or blowing his/her nose for a few minutes after the bleeding stops

Tilting the head backwards does stop the bleeding, it is true, but blood runs down the throat and some people react badly to this.

Important warning

The drug ***antipyrine*** is frequently confused with ***aspirin***. Aspirin is not haemostatic. On the contrary, it increases bleeding and should therefore not be used. Women who lose a lot of blood during menstruation are advised to avoid this simple "miracle" drug.

If the bleeding persists, the nostril can easily be plugged:

- roll a small piece of gauze into a cylindrical plug
- imbibe it with oxygenated water or a special haemostatic substance
- insert it into the nostril, leaving one end protruding

If plugging the nostril fails to stop the bleeding, the subject should be seen by a doctor, who may cauterise the nostril.

Recurrent nosebleeds should be reported to a doctor as they may be a sign of a more serious problem. When a nosebleed occurs following a blow to the skull or a fall, the accident (violent blow to the nose, road accident, fall, etc.) should alert the rescuer to possible complications; even if there is no simultaneous bleeding from the ear, a nosebleed is a possible external sign of a fractured skull.

In all cases caution is required and the casualty should be evacuated in the recovery position to a hospital and placed under observation.

Haematemesis

If the bleeding is not too serious, call a doctor and make the subject stay in bed in a semi-reclining position or lying on the side so that the airways are unobstructed. The subject must not eat or drink anything. To avoid masking the symptoms and making the bleeding worse, refrain from giving the subject ice to suck or a hot water bottle to hug.

In the event of profuse bleeding, immediate hospitalisation is necessary, to replace the lost blood by transfusion and/or perform surgery.

Haemoptysis

The bright red frothy blood ejected should be kept for analysis. The subject should remain in bed, in a semi-reclining position, the airways unobstructed. The subject should not talk or cough or drink anything.

Haemoptysis can be caused by thoracic trauma.

Whatever the cause, a doctor should be called, and in particularly alarming cases the subject should be taken to hospital with the utmost urgency.

Special cases

Non-bleeding open wounds

When a member is severed, crushed or seriously damaged, it is possible that a major blood vessel has been severed but is temporarily crushed or obstructed by a foreign body, such as a piece of bone or muscle.

There is no haemorrhage as such, although the wound is bloody.

When the subject is moved, however, during pick-up or transportation to hospital, a sudden life-threatening haemorrhage may be triggered, so extreme vigilance is called for. Delayed external haemorrhage can cause death within seconds. Preventive action must be taken. There are two possibilities.

If the whole member has been severed, a tourniquet may be applied. It should be placed just above the wound, tightened, even if there is no haemorrhage, and a note left in evidence as explained earlier, stating the time of application.

If the wound is deep and likely to have severed a major blood vessel, haemorrhage may occur at any time. The first-aid provider or ambulance crew must remain vigilant and keep a compress bandage or, better still, an emergency haemostatic pad at the ready. The application of a tourniquet (loosely at first) should be envisaged only in the event of extensive damage, a fracture or when it is impossible to apply a haemostatic pad properly.

Compound (open) fracture of the femur or thigh bone

Fracture of the femur is one of the most serious fractures of all as the femur is one of the largest bones in the human body. It is always accompanied by profuse bleeding, bruising and swelling, so it is only natural to mention it in this section on haemorrhages. It is a "shock-inducing" fracture, so it is important to prevent the casualty from going into shock. It should be remembered that the broken bones might still move even after the accident. Even after immobilisation of the limb, contraction of the large muscular masses of the thigh can move the splintered bone, causing it to perforate the femoral artery and trigger profuse arterial haemorrhage.

If the fracture is closed, there is likely to be internal haemorrhage, with a large bruise and signs of shock. If the fracture is open, blood will spurt from the wound. The presence of a splint or other apparatus may make it difficult or impossible to press on or near the wound to stop the bleeding.

A tourniquet may be set in position between the wound and the heart (and left loose if there is no heavy bleeding) before the fracture is splinted.

The wound must then be kept under careful observation during transport. If the wound suddenly starts to bleed profusely, the bleeding can be stopped by pulling the two ends of the tourniquet to tighten it.

Crushed limbs

Where a limb has been crushed or compressed for a long time under a heavy load (beam, tree trunk, car chassis, etc.) it should not be freed without due reflection and precaution.

Could the load be acting as a tourniquet? If so, lifting it off suddenly could trigger a haemorrhage or worse, so this must be avoided.

One means of doing so in such exceptional circumstances is to apply a tight tourniquet further up the limb before removing the load.

A note should be made of the existence of the tourniquet, as usual, but in this case the time of application noted should be the (approximate) time of the accident, when the circulation was first cut off.

Conclusion

In spite of the wide variety of haemorrhages, the rescuer's response is generally very much the same:

- avoid aggravating the situation
- evacuate the casualty while keeping him/her under constant observation

As a rule one simple step is enough to stop an external haemorrhage: press directly on the wound with the hand, then, after a few minutes, replace this measure with a bandage tightened until the bleeding stops. If pressure cannot be applied directly to the wound, compress a pressure point on an artery between the wound and the heart.

Only in exceptional circumstances and as a last resort should a tourniquet be used, but tourniquets can be dangerous and should be avoided if possible.

3.2 Fractures

The skeleton, joints and muscles together form what we call the musculoskeletal system.

The skeleton, composed of 208 bones, forms the supporting framework for the body. Bones are living tissue which grows and needs irrigation. They provide anchorage for the muscles, which impart motion, and they protect the vital organs (the rib cage protects the heart and lungs, the skull protects the brain, and so on).

Composed of proteins and minerals, including calcium and phosphorus, the bones can be grouped into three main categories:

- long bones, like those of the limbs and the ribs
- flat bones, like the skull and the shoulder blades
- short bones, like the vertebrae, the tarsi and the carpi

Add the fact that red blood corpuscles are generated by the red marrow of the long bones and we have summarised the main functions performed by the skeleton in the human body.

The names of all the bones in the body are of little interest to providers of first aid, but two parts of the skeleton deserve special attention:

- the spine
- the skull

The spine, made up of 32 or 33 vertebrae, depending on whether one counts 3 or 4 coccygeal vertebrae, is the “backbone” of the human body. The column of vertebrae forms a protective canal for the spinal cord. The intervertebral discs, whose purpose is to cushion shocks, connect the adjacent vertebrae, with the exception of the first cervical vertebrae.

Each disc is composed of a fibrocartilagenous ring (annulus fibrosus) around a softer nucleus called the nucleus pulposus. The discs are the first to suffer when the spine is placed under excess pressure or undergoes undue torsion. The disc is crushed, or slips out of place and can even crack in older subjects.

The head is made up of 14 facial bones and 8 skull bones. It rests on and is attached to the spinal column. The skull, or cranium, forms the protective envelope of the noble control organs (brain, cerebellum, medulla oblongata).

A fracture occurs when a bone is partially or completely broken. There are a number of possible causes:

- **direct blows:** a blow or shock to the bone (occupational accident), an object falling on the unprotected head, a leg hit by a car bumper in a road accident, a blow from the boom when sailing, etc.
- **indirect blows:** these fractures are the effect of countercoup or muscular contraction (fracture of the spine following a fall on the heels, fracture of the arm or forearm caused by a fall from a bicycle, even when only the hand strikes the ground)
- **spontaneous fracture:** through decalcification, for example.

3.2.1 Types of fracture

The signs of a fracture differ depending on its location. Traditionally a distinction is made between three types of fracture:

- simple non-displaced fractures
- simple displaced fractures
- open or compound fractures

The last type is compound because as well as the fracture there is an open wound, and therefore a risk of infection in addition to the general dangers of fractures. The open wound may be caused by the causal agent (and is therefore an inward-facing wound) or it may be caused by the broken bone, in which case it is outward-facing.

If the casualty is moved there is added risk of tearing muscles or perforating or severing blood vessels and nerves.

The bones most frequently fractured are the long bones, sometimes with no displacement. Only an X-ray can confirm the diagnosis. In other cases the broken bone may have been displaced in various ways and to varying degrees, and the rescuer should be able to recognise signs of overlapping, bent or twisted fractures.

To simplify matters, fractures of the long bones are often compared with a branch breaking.

The short bones (vertebrae, carpi, tarsi, metatarsi, metacarpi) are often crushed and “cracked like nuts”.

Flat bones, on the other hand, are often broken without being deformed (the skull, for example). They crack like a car windscreen, but their shape remains the same after the impact.

There are five main pointers to a possible fracture:

- highly localised pain that intensifies at the slightest movement
- inability to use the injured limb which is not due to paralysis or a nerve problem
- deformity caused by bone displacement (limb at abnormal angle at the fracture point; limb shortened where two bone parts have overlapped or compacted; “ski-type” rotation of the leg, where the foot is not at the proper angle with the knee; transversal displacement)
- sooner or later other signs appear - swelling, oedema, ecchymosis, haematoma, signs of bleeding from ruptured blood vessels
- sometimes the casualty will have heard the bone crack; under no circumstances should the rescuer expect to hear any cracking or attempt to move the bones to listen for a cracking sound

It is rare to come across all these signs at once, but one is enough. The rescuer should always bear in mind that when an accident occurs there is the possibility of a fracture.

3.2.2 How fractures heal

A pocket of blood forms round the fracture point and phosphocalcic changes occur as calcium is supplied. Bone tissue is generated. A callus forms and hardens until the bone mends.

Sometimes the callus is too large, causing discomfort, unsightly deformity or functional problems.

If the new bone tissue does not harden enough, the bone will set abnormally. This problem seems to arise several months after the fracture, when the person starts to move or put pressure on the injured limb again prematurely.

3.2.3 What to do in the event of fracture

A number of principles guide the rescuer, who should, when examining the casualty, seek to establish the exact circumstances of the accident and ascertain exactly what happened, in order to be able to:

- preserve the vital functions, which are an absolute priority, without aggravating obvious or suspected fractures
- identify related lesions, particularly in road accidents
- avoid making matters worse by any inappropriate manipulation
- avoid all movement before the fracture has been properly immobilised
- alleviate pain, thereby reducing the risk of shock
- in the event of a compound fracture, cover the wound carefully
- immobilise the fractured limb or, where spinal injury is suspected, the head/neck/trunk system
- arrange for proper transport under observation

Fractured limbs

To avoid pain and displacement, block the joints above and below the fracture.

Always use a fast and simple splint requiring minimum material. It is not difficult to immobilise a fractured limb.

Fractures of the forearm

If the fracture is a simple, single fracture, the injured person will often naturally do the right thing by holding the fractured forearm with the other forearm. The wrist and elbow joints should be immobilised with whatever material is available; this can usually be done, at least temporarily, using the casualty's own clothes. If the casualty is wearing a pullover or a cardigan, the bottom of the garment should be rolled upwards until the fractured limb can rest in it. This is then held in place by a sling, one end of which is passed under the item of clothing in which the arm is resting, then back up the front and round the neck to be tied to the other end.

Temporary immobilisation also be achieved by turning up the flap of a jacket and pinning it with the arm cradled inside, or supporting it in a sling tied round the neck.

Where a triangle of cloth is available it can be used to make an even better sling that blocks the elbow. The triangle has a long base ending in two corners, and a summit or apex. One corner of the triangle is passed under the injured forearm and up over the chest to the shoulder on the same side, with the apex towards the elbow; the other corner is folded up over the injured arm and the two ends are tied together round the neck. The forearm should preferably be maintained in a horizontal position or tilted slightly towards the opposite shoulder. The fingers should be left protruding from the edge of the sling and the wrist should be well supported.

To block the elbow properly, take the overlapping apex of the sling and secure it with a pin or twist and tuck the end in between the sling and the elbow.

Sometimes the broken bone is displaced and the temporary immobilisation described above is insufficient, as the thorax, against which the fractured forearm rests, is not flat. In such cases the fractured arm and the nearest joints may be immobilised using a magazine curled into a U-shaped tube or a malleable metal splint that will accommodate any deformity of the fractured arm. The magazine technique requires a magazine, three thongs and some padding. Proceed as follows:

- slip the three thongs crosswise under the magazine at equal distances
- place the forearm along the middle of the magazine or ask the casualty to do so
- form a cradle for the forearm by loosely tying the two ends of the middle thong together
- place the padding between the magazine and the fractured limb, filling in the

area around the deformed fracture point and making a sort of cushion soft enough to accommodate any subsequent swelling

Having padded the arm to immobilise the fracture, the rescuer should then:

- tie up the two end thongs: the one by the thumb should be folded double and one end passed above the thumb, leaving the thumb free, while the other is passed across the palm of the hand (taking care not to make a noose around the thumb that could cause a constriction)
- tighten the middle thong
- check that the magazine causes no discomfort to the elbow

Prior to all this, the rescuer should take off any watch or bracelet the casualty is wearing on the forearm that could cause a constriction in the event of tightening or swelling. The procedure is now half complete as only the wrist has been immobilised. The elbow can now be immobilised very easily by placing the splinted forearm in a triangular sling as described above.

Fractures of the upper arm

The principle is the same as before - immobilise the joints on either side of the fracture, i.e. the elbow and shoulder. Once again, the casualty's clothing may provide the necessary material.

Two triangular slings are used. First, an ordinary sling is applied (as for fractures of the forearm) to block the elbow. Next, to immobilise the shoulder and the fractured bones, a second sling is applied as follows:

- with the apex of the triangle facing downwards towards the elbow
- place the middle of the sling against the top of the shoulder
- tie the ends together under the opposite armpit, if possible without covering the hand

As with a normal sling, the apex of the triangle (at the elbow) should once again be twisted and tucked in. Both the elbow and the shoulder are now immobilised.

Fractures of the lower limbs

Broken legs require more equipment. Chance first-aid providers will use whatever means are available:

- use the uninjured limb as a splint
- improvise a lateral splint out of wood (a stick or slat of wood)
- make a U-splint using a blanket and two pieces of wood

Professional emergency services will use:

- a malleable metal side splint (wire mesh splint, Kramer splint)
- a ready-made metal tube splint or a malleable metal wire or aluminium splint (SAM splint)
- a Thomas splint
- a reduced air pressure or vacuum splint

For the casual first-aid provider the rule is once again to immobilise the broken limb in the position it is in, no matter how badly misshapen it may be.

Qualified first-aiders will generally carefully exert gentle traction on the limb, along its axis, with one hand under the heel and the other over the instep.

Using the uninjured leg as a splint

Padding is placed between the legs and the feet are maintained perpendicular to the legs with the aid of a figure-of-8-shaped bandage. The fractured limb is then bound to the uninjured limb by wrapping several wide bandages around both legs, taking care that no bandage covers the site of the fracture.

Side splints

Improvised splints can be made using any strong, narrow stick, strip of wood, broom handle etc., and cut to suit the size of the injured person and the location of the fracture.

Fracture of the thigh

One splint is placed along the outside of the body, from the bottom of the foot to under the armpit. The other is placed along the inside leg, from foot to groin. Both are padded, especially around the groin and armpit. They will be held in place with straps or thongs (in principle three straps per limb segment and three round the trunk). It is easier to position the straps first and to lay the splints on top of them. The “end” straps (ankle, top of thigh and top of trunk) should be wound once round the splints to hold them in place while padding is positioned. The three straps are then tied to position the splints, and padding is added to the gaps and the hollows left by the deformed limb. The remaining straps are then tied tight and the foot is blocked perpendicular to the leg using a figure-of-8 bandage.

Wherever the fracture is located, the shoe should first be unlaced but not removed. The knee should be immobilised with a wide bandage. The splint is then finished.

Fracture of the lower leg

The outside splint stops at mid-thigh. Only the knee and ankle joints need to be immobilised. There is no need for straps around the chest, waist and hip. The knee must be immobilised by a wide strap, however, and the foot held perpendicular to the leg. Gaps between the splint and the leg should be padded, and padding should be positioned around the knee and ankle and wherever contact with the wood could cause discomfort or injury.

Place an improvised “stretcher” or U-splint under the fractured leg: take a blanket and roll each edge of it round a stick. Carefully raise the leg just high enough to slide the splint into position. This is the most delicate part of the operation. It should be done either while pulling gently on the foot and raising the leg or by making a “cushion of hands” under the fractured limb if there are enough helpers. The improvised splint is then held tight by straps or a spiral bandage. The foot is maintained perpendicular to the leg.

Specialized equipment

Malleable metal splints

These are side splints made of wire mesh and known as Kramer splints, which can be cut to size and adjusted to the deformation. They fit snugly round the angle of the broken limb and protect it during pick-up and transportation. Like wooden side splints, they are held in place with 3 straps per limb segment, with extra immobilisation around the joints.

Malleable metal U-splints

These are like mesh casts padded and wrapped in cotton, on which the fractured leg is placed rather like on an improvised splint. Here too the splint is held in place with straps or a spiral bandage around leg and splint.

Pneumatic or inflatable splints

Although these are supposedly for use in the event of fracture of the upper or the lower limbs, they should really be used only for fractures of the ankle or lower leg. In thigh frac-

tures they do not immobilise the hip, and this is unacceptable. There are several models of pneumatic splints (the most frequently used are made of long tubular compartments and can be folded into a tube shape). Buttons are easier to close than zip fasteners. Like "stretcher-type" U-splints, the uninflated splint is placed under the injured limb, which should be raised very carefully, exerting a slight traction on the foot. It is then fastened and inflated by mouth. It should not be blown up too hard as the resulting pressure could hinder the circulation. This is less of a problem when the splint is made up of parallel tubular compartments with spaces between them.

Inflatable splints can be left on the casualty while X-rays are taken.

The Thomas splint

This is a complex piece of equipment comprising the following:

- an elongated U-shaped metal frame with a dent in the curved part for fastening a thong to immobilise the instep
- a bandage forming several figures-of-8, forming a trough or bed
- two articulated hoops at the upper end of the inside branch, which wrap around the thigh and clip into the upper end of the outside branch
- two rings on the side, for use in raising the limb off the ground

It takes two people to apply this splint - one to raise the limb off the ground while pulling gently on the foot along the line of the leg, while the other first ties a canvas ring loosely round the ankle, with strong bonds on each side, then places thick padding where the inside leg joins the trunk and finally applies the splint without the traction on the leg being released.

The limb is immobilised using a bandage or straps. If possible, the foot is held perpendicular to the leg with a bandage tied to the side rings.

The traction exerted by the first rescuer is maintained by the canvas ring round the ankle, which is attached to the dent in the frame at the level of the instep.

Another version – the ATLAIR IT 10 – exists, with a frame that is permeable to X-rays, and long inflatable cushions replacing the bandages and straps to hold the limb still.

Vacuum splints and mattresses

Vacuum mattresses are useful for immobilising the spine. The casualty is placed on the mattress and the air is emptied from the envelope, which contains small polystyrene balls that espouse the shape of the body and immobilise it. The mattress becomes a rigid, easy-to-transport stretcher.

Chest injuries

Almost 25% of the injuries sustained in road accidents are chest injuries sustained by drivers thrown against the steering wheel.

There are several types of chest injury:

- visible injuries with an open wound
- injuries where the casualty has difficulty breathing because several ribs are broken
- a simple fracture of the rib is usually no problem and the injury heals well
- in the case of a blowing wound it is essential to close the wound immediately. This is done by pressing a piece of cloth onto the wound with the hand. This emergency step can subsequently be replaced by a triangular bandage or strips of overlapping adhesive cloth, to facilitate evacuation.

When there is no open wound the casualty's pain should alert the rescuer. The pain is sharper when the casualty coughs or breathes deeply. The casualty barely dares to breathe, which can result in real suffocation, with the casualty turning blue, sweating, etc. If the wound is slight, the casualty is placed in a semi-sitting position, but this position must not be used if there is any suspicion of spinal injury, which there usually is in road accidents. In general, therefore, the casualty is transported in the recovery position (on the side which gives least discomfort), making sure that the airways are completely unobstructed. No body bandage should be used.

The casualty must be evacuated as a matter of urgency, without any shaking, bumping or sudden acceleration or deceleration that might aggravate his or her condition. The following should be kept under close observation:

- breathing (frequency should remain almost normal, between 12 and 20 breaths per minute)
- colouring of lips and nails
- pulse (the normal rate is between 60 and 80 beats per minute)
- state of consciousness

If necessary, artificial respiration should be administered. Care should be taken with oxygen - sweating is a sign of carbon dioxide poisoning. An adverse effect is possible.

In conclusion, road accident casualties should always be examined for chest injuries, which may be easy to detect, for example when the casualty has difficulty breathing properly or coughing up the mucus obstructing the lungs (which can accelerate suffocation). If no injury is obvious at first glance, pain may be revealed by asking the casualty to cough or take a deep breath.

Fractures of the jaw

These may occur as a result of a blow to the chin or the whole face. Simple fractures of the lower jaw should be held in place by a sling, the main purpose of which is to maintain the lower jaw against the upper jaw (the (remaining) lower teeth against the upper teeth). If the whole face is injured, this takes priority and the airways must be cleared of any obstructions (clotted blood, foreign bodies such as teeth, dentures, glass, etc.). The casualty should be placed in the recovery position, the mouth open and the tongue protruding.

Injuries to the joints

These are strain injuries. The ligaments may simply be stretched, as in the case of a simple sprain, or torn, resulting in a more serious injury. When the two parts of the joint are actually pulled apart or out of joint, we call it dislocation or luxation.

Sprains

The ligaments are pulled or torn. Sprains generally affect the ankle or knee but can also affect the wrist and elbow. They may be caused by a fall, by tripping or by a sporting accident. The subject immediately feels a searing pain and cannot move for a few minutes, then the pain subsides and movement becomes possible. Swelling occurs. Any sprained or twisted joint should be X-rayed to make sure there is no more serious injury (dislocation or even a fracture). Local application of a soothing ointment twice a day for several days usually helps. It is advisable to bandage the ankle with a medium-tight bandage over a strip of cotton soaked in alcohol.

Remember that one of the purposes of the bandage is to hold the foot perpendicular to the leg.

Where ligaments have been torn the joint must be immobilised in a plaster cast. This is followed by massage treatment when the cast is removed.

Dislocations

Dislocation occurs when the two bones of the joint are separated. The person is unable to use the injured limb or even to move it, as the joint is blocked in an abnormal position. first-aid providers must leave the joint as they find it and not try to put it back in place. In the event of a dislocated shoulder (the most frequent case), place a cushion, made of clothing, for example, between the arm and the thorax to hold the arm away from the body. Fold the arm on the injured side across the chest and support it with the aid of a sling.

The sling should be placed with the apex of the triangle on the elbow side, with one end round the front of the arm and over the neck on the uninjured side and the other end passing behind the back, the two ends being tied together on the healthy shoulder. The fingers should protrude from the edge of the sling so that the circulation can be observed. The elbow is blocked in place by securing the apex of the sling with a (safety) pin or by twisting it and tucking it in beside the elbow. The patient should then be taken to hospital for an X-ray before the joint is put back in place.

3.3 Wounds

3.3.1 Types of wound

Minor wounds

These are superficial grazes, scratches and clean-edged cuts or incisions, which generally heal normally. In such cases bleeding is minimal, there is little or no risk of infection, and the casualty is, in principle, properly vaccinated against tetanus (i.e. had a booster injection less than five years ago).

Severe wounds

It is solely for a doctor to decide what treatment should be given.

Severe wounds may:

- be large (possibly requiring stitches or a skin graft)
- go deep
- be very dirty/highly contaminated
- have a large foreign object lodged in them or one that is difficult to spot and remove
- be contused, in which case the crushed tissue is conducive to infection
- be complicated by a fracture, a haemorrhage, etc.

Specific wounds

Certain wounds can be life-threatening; these include wounds to the thorax, abdomen, face and eyes

Wounds to the thorax

Depending on their seriousness, these wounds can affect a casualty's breathing to a greater or lesser extent. A perforating wound, or a wound combined with a fractured rib, may lead to asphyxia, especially if the casualty is lying down with the head in a low position.

Wounds to the abdomen

Apart from obviously superficial grazing, any wound to the abdomen, even a small puncture wound, entails a risk of damage to an intra-abdominal organ.

The hollow organs (stomach, intestines), covered by the peritoneum (the membrane which

also forms the lining of the abdominal cavity), may be perforated, resulting in a peritonitis-related shock.

The solid organs (liver, spleen, etc.) may rupture, causing an internal haemorrhage. Rupturing may be either immediate or delayed, as is frequently the case with road accident casualties. Following an impact, the external membrane remains intact but there is bleeding inside the organ. As the blood builds up, the fairly inflexible outer membrane ruptures under the pressure and the casualty suffers a violent internal haemorrhage, with all the symptoms of shock.

Wounds to the face and eyes

Facial wounds usually bleed heavily. Wounds to the eyes often cause shock, because they are very painful.

3.3.2 How to deal with a wound

Minor wounds

Debriding (cleaning) the wound

A wound is often contaminated through contact with the ground and may contain dirt, dust or various kinds of debris, and sometimes oil or grease. It must therefore be cleaned rapidly, but without using substances which may cause tissue necrosis. Use of ether is not recommended for reasons already explained; alcohol is an irritant and causes stinging; hydrogen peroxide and soap give good results.

Handling a compress

Without the right equipment, i.e. tweezers, a compress should be removed from its packaging by holding one corner. If it is in an individual wrapper, tear one edge of the wrapper and remove the compress, holding it by one corner. A compress removed from a metal box should be handled in the same way.

Actual cleaning of the wound

The compress is used to clean the wound, moving outwards from the centre of the wound onto the surrounding healthy skin. Never go over the same area twice to avoid transferring debris back onto the part of the wound which has already been cleaned.

Protecting the wound

Wherever possible, a minor wound should not be dressed but be left uncovered. If the wound is oozing fluid or there is a risk of dirt getting into it, it must be covered. The dressing will consist of one or two compresses of sterile gauze, which form a dust barrier but allow the wound to breathe. The dressing should be kept in place with strips of, preferably non-allergic, adhesive plaster, attaching the edges of the compress to the surrounding skin.

Severe wounds

Three rules must be followed:

- protect the wound
- prevent deterioration of the situation
- evacuate the casualty under supervision

The golden rule: Do not touch the wound!

Protecting the wound

A rescuer does not have appropriate means of cleaning and disinfecting a wound properly. Antiseptics and other products should not be used. The wound should be left as it is until the casualty is taken in charge by the emergency services.

Preventing deterioration of the situation

- Deterioration of the situation may concern:
- the wound itself, which may become infected
- the casualty, who may show symptoms of shock

Depending on its size, the wound should be covered with a sterile dressing (compresses) or a clean piece of cloth (a handkerchief, napkin, towel, etc.).

Some particularly severe, large, deep wounds have a traumatising effect. The casualty should therefore always be kept lying down and warm and should be comforted.

Evacuation

The casualty should be evacuated to a hospital, which is better equipped to treat serious injuries than a mere local medical practice. A severely wounded person must be transported lying down.

It is advisable to prepare an information sheet, giving the casualty's name, the time and circumstances of the injury and any other potentially useful information.

Specific wounds

With a wound to the thorax (chest or upper back), the presence of air "bubbles" must immediately be checked, i.e. whether air is leaking out from the lungs via the wound ("blowing wound"). Where this is the case, the wound must be "sealed" as quickly as possible with an airtight dressing.

Several techniques are possible, depending on the equipment available:

- in a real emergency, the rescuer should press either a hand or a clean, thick pad of cloth directly onto the wound
- a pad of cloth may be kept in place with an improvised triangular bandage, tied around the thorax, with the upper corner of the bandage passing over the person's shoulder and secured with a strip of cloth
- if a little equipment is available, the wound should be covered with several layers of gauze compresses and kept airtight with a patchwork of pieces of adhesive plaster, arranged so that each piece of plaster overlaps the edge of the compresses and half covers the previous piece of plaster

Positioning the casualty while waiting for evacuation and during transport

Wounds to the thorax necessitate emergency evacuation. If the person is conscious, he or she should be kept in a half-sitting position, sometimes leaning over slightly onto the injured side. The casualty will in fact automatically adopt the position which causes least discomfort.

An unconscious person should be transported lying on one side, with the head propped up and tilted back to facilitate breathing. The casualty must be kept under close surveillance throughout transport, and, if available, oxygen should be administered to a person experiencing breathing difficulties.

3.4 Breathing difficulties

3.4.1 General observations

Oxygen is absolutely vital to human life. A cell receiving insufficient oxygen and too much carbon dioxide will first cease functioning and then die.

Death of an organ deprived of oxygen occurs after a variable period of time, depending on the type of organ concerned. The most vulnerable organ is the nervous system. The brain cannot go short of oxygen for more than three minutes, beyond which time the consequences may be irreversible and any effort to resuscitate the casualty may be irrevocably doomed. This shows how important it is for a rescuer to take rapid action when faced with a person experiencing breathing difficulties.

Respiration

Respiration consists of all the phenomena linked to the absorption, circulation and cellular use of oxygen present in the air (which is made up of 20.93% oxygen, 79.03% nitrogen, very small quantities of rare gases and traces of carbon monoxide).

Ventilation

This is the movement of air in and out of the lungs, measured in litres per minute. In the mechanics of breathing, ventilation ensures the intake of oxygen into the lungs and the release of carbon dioxide into the atmosphere.

If oxygen is to reach the cells, the two fundamental body systems must be functioning properly:

- the respiratory system, which brings in air
- the circulatory system, which carries blood around the body

Role of the respiratory system

The respiratory system is the mechanism which brings large quantities of blood into contact with air. It is an air-pump which carries air through the airways to the pulmonary alveoli. The respiratory system has two separate parts:

- a system of airways in which virtually no exchange of gases takes place
- the alveoli where oxygen is exchanged for carbon dioxide at high speed

Role of the circulatory system

The circulatory system takes up oxygen from the alveoli, releasing carbon dioxide in exchange, and transports all essential substances to and from the cells by means of a remarkable chemical, haemoglobin, which can carry large quantities of oxygen and carbon dioxide. This circulatory system acts as a pump which evacuates blood from the heart along the arteries to fine tubes (capillaries) surrounding the alveoli. The capillary network has a surface area of about 70 m^2, which explains the speed of gaseous exchanges at this level. The blood is evacuated by a pump (the right ventricle) along a transport system (the pulmonary arteries) to an exchange system (the capillaries); it then flows through a gathering system (the pulmonary veins) to a second pump (the left ventricle), which delivers it to all the cells in the body.

Blood serves as a vehicle for oxygen. Oxygen is transported in two ways:

- dissolved in the plasma
- combined with the haemoglobin contained in the red blood cells

3.4.2 Asphyxia

The term asphyxia was originally applied to a person with no detectable pulse, but it gradually came to mean lack of ventilation. Then, anyone whose condition necessitated artificial resuscitation of the respiratory function was considered to be suffering from asphyxia, i.e. anyone experiencing respiratory difficulties even if ventilation had not ceased entirely. Lack of oxygen or excess carbon dioxide in the cells, tissues and organs, whatever the cause, is what really defines respiratory failure. A deficiency of oxygen is known as "hypoxia", and its complete lack "anoxia" (which is exceptional).

An increase in carbon dioxide is known as "hypercapnia". Hypercapnia and hypoxia are often combined in persons experiencing breathing difficulties and result in cell death.

Signs of respiratory difficulties

Asphyxia always involves:

- the symptoms of the causal illness or accident
- the symptoms of hypoxia and hypercapnia themselves, whether separate or combined
- the symptoms due to the various (arterial and bulbar) nerve receptors' reaction to the hypoxia or hypercapnia

In a medical environment, measurement of the partial pressures in oxygen and carbon dioxide, and of the pH of the blood, makes it possible to determine the seriousness of a patient's condition.

Most of the symptoms observed are respiratory, circulatory or cerebral. A number of stages can be distinguished, depending on whether hypoxia or hypercapnia predominates.

Hypercapnia

Hypercapnia develops more slowly than hypoxia, and the four stages traditionally described (Table 3) may last several hours or days.

Table 3 **Three stages of hypercapnia**

Stage	Description
One	Difficulty in breathing
Two	Sweating Partial airway obstruction Rapid pulse High blood pressure Slight cyanosis
Three	Deep coma with total loss of reflexes
Four	Cardiac arrest Cessation of breathing

Hypoxia

Irrespective of its cause, hypoxia is a deficiency of oxygen reaching the lungs. It involves four stages (Table 4), each lasting a few minutes.

Table 4 **Four stages of hypoxia**

Stage	Description
One	The person takes stronger, quicker and quicker breaths, straining the rib cage to absorb as much air as possible - this is known as polypnoea.The pulse, whether taken at the wrist or the carotid, is fast, often more than 100 beats per minute; it may reach and exceed 150 per minute; at this initial stage, blood pressure is not high.
Two	The person falls unconscious, often suddenly, but with no loss of reflexes. This state is brief, and there is little time to act. Breathing is always strong and fast. The heartbeat speeds up considerably; cyanosis is particularly evident at this stage; the pupils are often already dilated. Attempts at resuscitation are always successful.
Three	Only a few minutes later the person falls into coma, with a total loss of reflexes and, above all, cessation of breathing (apnoea). Blood pressure falls, convulsions are frequent, and the pupils are usually dilated.
Four	Circulation stops due to cardiac arrest. The person is no longer breathing, and his or her pupils show excessive dilation (mydriasis).At this stage artificial ventilation alone does not always suffice to resuscitate the casualty, and cardiopulmonary resuscitation, combining artificial ventilation and heart massage, may be the only means of restarting breathing and heart movement.

The signs of asphyxia

The symptoms are usually a combination of the symptoms of hypercapnia and hypoxia, varying according to the cause. It is important to be aware that a person suffering from asphyxia does not always cease breathing. As we have just seen, during the first two stages of hypoxia and the first three stages of hypercapnia ventilation continues, although the speed, strength and regularity of breathing may vary. It is therefore no longer possible to consider that a casualty is suffering from asphyxia only once the chest and abdomen have stopped moving and breathing has ceased, at which point effective artificial ventilation, commenced within the next few seconds, is clearly the sole means of resuscitating the casualty. To recognise a case of asphyxia before this stage is reached, it is necessary to know how to look and listen for the symptoms.

Cyanosis of the fingernails, lips and ear lobes is a sign of hypoxia or of the second and third stages of hypercapnia. A pulse which is fast and too marked may indicate the beginning of hypercapnia.

It is above all the rhythm and quality of breathing that symptomatize the onset of asphyxia and make it necessary to start resuscitation:

- breathing which is too fast - beyond forty breaths per minute - but weak, scarcely causing any movement of the ribs
- breathing which is too slow - five or six breaths per minute - shortly before respiratory arrest
- troubled, noisy (gurgling) breathing, showing an obstruction of the airways due to an accumulation of secretions in the throat, trachea and bronchi; this is a sign of excess carbon dioxide (hypercapnia) at all stages

Resuscitation is possible only through artificial ventilation and opening of the airways.

When a person is inhaling harshly, or gasping for air, it should not be assumed that ventilation is continuing. On the contrary, artificial ventilation should be commenced immediately.

When a person is pale, unconscious, has dilated pupils, is no longer breathing or is gasping for air, and has no discernible pulse, artificial ventilation sometimes suffices to restart all the vital functions. However, in most cases it must be combined with heart massage.

The causes of asphyxia

The causes of asphyxia include:

- A change in the mix of gases breathed in
- A fall in partial pressure in oxygen, alone
- Decreased oxygen combined with a non-toxic gas
- Stale air
- A lack of breathable oxygen in the atmosphere

The presence of toxic gases in the air breathed in, preventing haematosis

Partial or complete obstruction of the airways:

- the mouth and nose
- the front and back of the throat
- obstruction with the tongue - when a person is unconscious and lying on his or her back the tongue falls down the back of the throat.
- obstruction with blood - blood in the nose or mouth of a person lying on his or her back will flow down into the throat, where it coagulates
- swelling of the mucous membranes of the throat
- presence of mucus
- spasms of the glottis - these occur in the event of sudden stimulation of the entrance to the trachea. They may be triggered by cold water swallowed by a diver or a person who is drowning or by a violent blow to the throat.
- strangulation
- hanging
- obstruction of the trachea and bronchi: Small foreign bodies (peas, parts of toys, peanuts) which are swallowed, particularly by children, may get past the epiglottis and enter the trachea. They never cause a complete obstruction to begin with, and artificial ventilation (mouth-to-mouth) remains perfectly effective until specialist medical help is available. However, no time must be lost in getting to a hospital, as the mucous membrane of the trachea swells up in reaction to the irritation, and the resulting oedema may completely obstruct the windpipe in a matter of hours. It is necessary to be aware that, although the breathing difficulties may cease, this does not always mean that the foreign body is no longer causing an obstruction. It may in fact obstruct only one of the bronchi, in which case the child will be breathing normally. However, specialist medical help must be obtained as a matter of urgency, in order to remove the foreign body using bronchoscopy.
- Drowning - in the last stages of drowning, flooding of the bronchopulmonary system with water prevents oxygen from reaching the alveoli and passing into the blood.

3.4.2 Carbon monoxide poisoning

Carbon monoxide poisoning is a frequent phenomenon, especially in towns and cities. Poisoning may be due to a suicide attempt or may be caused accidentally by a fuel-burning appliance.

Symptoms of carbon monoxide poisoning

Acute poisoning

The initial symptoms of acute poisoning are not well known, as casualties are often intoxicated while asleep. However, it would seem that the first signs are headache, abdominal pain, dizziness, loss of hearing, confusion, somnolence and, above all, a general impression of unease, followed by gradual paralysis, beginning with the extremities. Casualties usually attempt to stand up in order to open a window and take a few steps before collapsing. Loss of consciousness is sometimes preceded by a period of mental confusion and agitation, which may give the impression that the person is drunk.

What is carbon monoxide?

Carbon monoxide is a colourless, odourless, tasteless gas. It is lighter than and easily mixes with air. On burning, carbon monoxide emits intense heat and is transformed into carbon dioxide. In certain conditions (presence of oxygen), its combustion causes a violent explosion. It is sufficiently toxic to harm the organism. Carbon monoxide is considered dangerous from a concentration of 1/10,000 (i.e. one litre of carbon monoxide for ten cubic metres of air). Once the concentration reaches 1/500 (one litre of carbon monoxide for 500 litres of air), there is a danger not only of chronic poisoning, but also of acute poisoning with coma. Concentrations of 1/200 or more (one litre for 200 litres of air) result in rapid death.

All town and city dwellers have small quantities of carbon monoxide in their blood. In a non-smoker arterial blood contains 2.2% carbon monoxide, and in a smoker 3%. In a country dweller the quantity is tiny.

How does carbon monoxide affect the organism?

It does not have a direct toxic effect. The damage which it causes is due to its affinity with all molecular structures that usually fix oxygen.

The effects vary depending on the quantity of carbon monoxide absorbed and how quickly it builds up in the organism. Symptoms depend on carbon monoxide concentration in the air inhaled, duration of exposure and the casualty's prior state of health. Poisoning may be **acute**, **non-acute** or **chronic**.

Subsequent effects

The subsequent effects of carbon monoxide poisoning are variable. If left untreated, acute poisoning is always fatal. Despite treatment, various complications may be observed:

- pulmonary (lung infections)
- cardiac (irregular heartbeat, pseudo-infarction)
- vascular (state of shock)
- renal (renal insufficiency, uraemia)

The long-term effects are mainly neurological and mental. Even after recovery, casualties may be subject to stuporous states or pseudo-dementia, convulsions, pseudo-Parkinsonism, fits of dizziness or paralysis.

How to deal with carbon monoxide poisoning

A rescuer must take extreme care when attempting to save a casualty. There are two main risks:

- the gas is highly toxic, and the rescuer may be poisoned in turn
- the slightest spark or flame may trigger an explosion

Before doing anything, it is essential to seek help.

The treatment to be given is the same as for any person suffering from asphyxia.

First, ensure that the airways are unobstructed by loosening clothing and clearing the person's mouth and throat with two fingers wrapped in a piece of cloth.

Examine the casualty

Different solutions can be envisaged depending on the casualty's state (Table 5).

Table 5 **Three states of carbon monoxide casualty**

State	Description
One	The casualty is unconscious but still breathing and has a detectable pulse. **Lay the casualty on his/her side, and monitor pulse and breathing!**
Two	The casualty is no longer breathing or breathing too slowly and irregularly; a pulse can be felt. **Immediately start artificial ventilation!**
Three	The casualty is no longer breathing, and a pulse cannot be felt. **Immediately start artificial ventilation! After breathing into the person's mouth or nose three times, take the pulse again. If there is no pulse, begin heart massage combined with artificial ventilation.**

Conclusion

Carbon monoxide poisoning is a frequent occurrence, which anyone who understands the causes can avoid by taking simple preventive measures.

Rescuers must be aware of the risk and approach any casualty with care, as their own life is in danger. Carbon monoxide poisoning must be suspected where anyone is found asphyxiated in a kitchen or bathroom. It must be borne in mind that this form of poisoning is all the more insidious since carbon monoxide is odourless. Casualties show an abnormal rosy colouring. Before taking any further steps, rescuers must contact the fire department because of the risk to themselves and sometimes to all other people present in the building. An asphyxiated casualty must be dealt with as follows:

- ensure that the airways are kept unobstructed by tilting back the person's head and, if he/she is breathing, placing him/her on his/her side
- if breathing has stopped begin artificial ventilation (mouth-to-mouth) immediately
- never cause a spark and open all windows to air the premises and reduce the risk of explosion
- before going to the casualty's assistance rescuers must protect themselves and others

3.4.3 Carbon dioxide poisoning

Carbon dioxide poisoning (hypercapnia) may be caused either by breathing air with an excess concentration in carbon dioxide (external cause) or by problems in eliminating carbon dioxide produced by the organism (internal cause), which arise in all cases of respiratory failure.

What is carbon dioxide ?

Carbon dioxide (CO_2) is an odourless, colourless gas, with a faint acid taste (soda water). It is heavier than air and initially builds up at ground level. It will put out a flame and prevents combustion.

The usual sources of carbon dioxide are combustion (fires, ovens), fermentation (wine and cider fermentation tanks) and human and animal respiration (on breathing out, carbon dioxide is emitted along with water vapour and nitrogen).

How does carbon dioxide affect the organism ?

Experiments have been conducted in which a person was administered a mix of gases containing a known percentage of carbon dioxide. When the carbon dioxide concentration in alveolar air is increased by 0.2%, ventilation per minute doubles. A 4% concentration in alveolar air produces a state of polypnoea (deep, rapid breathing) in a person at rest. 10% is the tolerance limit in a conscious person. Beyond 10%, a decrease in breathing capacity (oligopnoea) is noted, followed by respiratory arrest (apnoea).

Symptoms of hypercapnia

Initial symptoms of hypercapnia are a fast pulse, slight reddening of the complexion and sweating with no physical effort. Blood pressure also rises at this stage.

Obstruction of the airways is frequent and often discernible through gurgling or snorting noises when breathing. At the same time, ventilation speeds up, and the person may experience all the usual forms of breathing difficulties.

Casualties are often agitated, lack coordination, and their speech becomes incoherent or aggressive.

Subsequently, at the second stage, breathing is fast and weak (oligopnoea). Casualties are often agitated but may already show signs of unusual torpor or somnolence. Heavy sweating can be observed at the level of the forehead, armpits and chest, and the casualty shows obvious signs of obstruction of the airways. Slight cyanosis of the base of the fingernails, the ear lobes or the lips may be noted. At stage three, the casualty falls into a deep coma. Breathing is weak and sometimes irregular, with interruptions. The pulse is fast and sometimes irregular. There are clear signs of cyanosis, particularly of the fingernails. The airways are severely obstructed, and breathing is noisy.

How to deal with carbon dioxide poisoning

Where the person is breathing, the vicious circle of reciprocal cause and effect must be broken. To do this:

- the casualty should be brought out of the state of torpor by being shaken or pinched, and must be made to breathe heavily and cough
- secretions should be removed with a mucosity aspirator, if available
- the airways should be opened up by loosening any clothing or other object that may hamper breathing
- the casualty should be made to lie down with the upper half of the body propped up and the head tilted back; an unconscious casualty should be positioned on his/her side (in the recovery position)
- take care to prevent a too sudden intake of oxygen, which may, paradoxically, cause respiratory arrest

Where the person is no longer breathing, after rapidly loosening clothing and clearing the mouth and throat with two fingers wrapped in a piece of cloth, mouth-to-nose resuscitation should be commenced immediately.

Conclusion

Carbon dioxide poisoning is mostly caused by inhaling stale air, by a build-up of the gas in a confined area or by an inability to eliminate the carbon dioxide produced by the body.

Hypercapnia should be suspected when the person is sweating, experiences difficulty breathing, shows signs of cyanosis or is in a coma. It may lead to respiratory and cardiac arrest.

It is important to clear the airways, to stimulate the person so that he/she begins to breathe normally and, in the event of coma, to position the person on his/her side in the recovery position.

Respiratory arrest necessitates immediate artificial ventilation.

3.4.4 Electrocution

Electrocution causes over 200 deaths per year in France, for example. A casualty who has been resuscitated, or who showed no signs of asphyxia, may develop after-effects, such as renal failure, which may prove fatal in the long run. Casualties may also suffer cosmetic damage through burning. This type of accident is, above all, due to carelessness on the part of the casualty or his or her entourage. Electrical accidents are a consequence of the nature of electricity itself – electricity is not visible on the surface of a conductor, and this can be conducive to negligence (imprudence, poor maintenance of electrical wiring and appliances) – but can be avoided through a minimum of care and attention.

The main risks and lesions caused

Electric shock

Electric shock can be observed in cases where there is neither cardiac arrest nor asphyxia. It is generally due to a strong flow of current of several amperes.

Casualties are projected over a distance of several metres as soon as they come into contact with the conductor. For a number of seconds or minutes they remain immobile, haggard and dazed, with bulging, wild eyes. The complexion is pale and blue-grey in colour. Breathing is rapid, sometimes panting or weak. The pulse rate exceeds 120 beats per minute and may reach 180 to 200 per minute in cases, in which case the casualty's life is threatened. The person feels numb.

After a number of minutes or hours numbness gives way to muscle ache, breathing returns to normal, and the person feels calmer and recovers some colour. The pulse often takes time to stop racing (several hours). Serious injuries may have been caused when the person was propelled through the air (broken limbs, severe wounding, cranial traumatism). Others may be the result of the electrical current itself (torn muscles, serious burns).

After an accident of this type the casualty must therefore undergo a full examination. The state of shock must be monitored and treated as such.

Asphyxia

Depending on the strength of the current, this may take the form of respiratory arrest alone, due to muscle contraction (detectable carotid pulse), or circulatory arrest, due to ventricular fibrillation (no carotid pulse).

Respiratory arrest: This occurs with a current of between 20 and 80 mA. It is a result of constant contraction of the diaphragm and intercostal muscles for as long as the current passes. Chest movement is paralysed, and the person can neither exhale nor inhale.

Circulatory arrest: This occurs with a current of between 80 mA and several amperes (a figure of 100 mA is usually given). The current produce genuine short-circuits inside the body, resulting in contraction of the ventricles and of all the fibres of the myocardium.

The heart no longer functions as a pump; under the hand it feels like a mass of earthworms (ventricular fibrillation). Blood is no longer evacuated into the circulatory system; the heart no longer fills and empties; circulation ceases.

Burns

These may be caused by an electrical arc (spark) between two live conductors, by particles of molten metal (jewellery), or by the current itself passing through the body. Burns vary in seriousness, but are always more severe than is apparent to the naked eye, as a mere visual examination reveals only the entry and exit points of the current, not the extent of internal lesions.

Visible burns exist only where the current entered and left the body. They are distinctive in appearance. Their shape varies: round, linear, or map-like. They may be very small, sometimes even a mere pinpoint, or large. However, they are always deep, reaching the underlying muscles and bones. The area may be completely charred. These burns have smooth edges, which are greyish or purplish in colour; their surface is hard, tough and flexible. They do not bleed when probed with an instrument, even at some depth. All circulation has ceased in the burnt area, which is truly necrotised, consisting of dead, eroded tissue. Healing is extremely slow because of the vascular changes, and surgery is often necessary.

How to deal with electrocution

The approach varies depending on whether the casualty is still in contact with the conductor and whether the accident occurs indoors or outdoors.

The casualty is not in contact with the conductor

The person has been projected some distance away from the conductor and usually shows the effects of electric shock. A brief examination should be made to verify breathing and pulse. The casualty must be treated for shock and left lying down, if unconscious on his or her side (in the recovery position), after the airways have been cleared. Prevent the person from standing up, talk to and reassure him/her. Keep him/her warm, by covering, and arrange for transfer to a hospital for surveillance, administration of an alkaline drip and any necessary treatment.

Serious burns are particularly subject to infection. They must be isolated from the surrounding air with a temporary, sterile dressing. Lastly, the rescuer must bear in mind that if one accident has occurred, there may be a risk of others. The electricity supply must be turned off until the cause of the accident has been established and any necessary repairs have been made.

The casualty is still in contact with the conductor

The current may be conducted by a pool of water, in which case the electricity supply must be turned off (at the master switch) before touching the casualty. If need be, the defective appliance (an electric razor, for example) may simply be unplugged. Remove any wire touching the person, because the power can always be switched on again accidentally by someone else. If it is difficult to switch off the electricity supply, or that would take too long, the wire or other electrical source can be pulled away from the casualty. To do this, rescuers should protect themselves by standing on insulating material (a wooden chair, stool or stepladder, possibly placed on glass) and using a dry piece of wood, e.g. a broom-handle, or a dry bottle to touch the electrical source. These measures, which should be applied only when dealing with a household electricity supply, are merely fall-back solutions and do not remove all risk. After removing the casualty from the electrical source, the rescuer must ensure that his or her airways are kept clear by loosening clothing at the neck and waist, clearing the mouth and throat, removing any dentures and tilting the head back. If the person has stopped breathing but has a detectable carotid pulse, mouth-to-mouth or mouth-to-nose resuscitation must be administered immediately, until the person begins to breathe again on their own and regains consciousness. If these measures are taken without delay, they are usually successful. The casualty should then be evacuated to a hospital.

If the person is in a death-like state, i.e. has no carotid pulse, has stopped breathing, is unconscious, shows a blue-grey colouring and has both pupils dilated, after clearing the airways and tilting the head back, the rescuer should breathe into the mouth or nose three times, then check the carotid pulse. If a pulse can now be felt, the rescuer should continue artificial ventilation. If there is still no pulse, heart massage must be commenced, beginning with 5 or 10 chest compressions, given by pressing on the lower sternum with both arms straight, so that it is compressed by about 4 cm. The rescuer should then alternate five chest compressions with one breath (insufflation) until a pulse is detected, from which point artificial ventilation alone is necessary.

Always ensure that help is being sought and that the emergency services have been called so they can take charge of the casualty and transfer him or her to hospital.

Electrocution outdoors

In this case the type of current is unknown, and rescuers can take action only if they have themselves ensured that the power supply is off or if they have special insulating equipment (an electrical emergencies kit), including rubber boots and gloves, wire cutters, a pole with an insulated handle and a special stool. Each of these pieces of equipment must have been tested to guarantee that it protects the user up to a given voltage noted on the equipment itself.

A high-voltage power line brought down by a storm and lying on the ground is a case apart. Despite the considerable safety systems incorporated in power grids, such a line poses a very high risk, and may be dangerous even at some distance because of residual current travelling through the ground. The only solution is to call the electricity company and seal off the area, preventing people from approaching the power line, even if someone near it has been electrocuted and needs help. No attempt should be made to cut off the power by breaking the circuit, as the device used to do so may not be sufficiently insulated.

Conclusion

Electrocution can always be avoided, and such accidents should therefore never occur. They cause many different kinds of lesion.

Immediate injuries consist of burns and a state of shock. The greatest risk is of respiratory or circulatory failure, necessitating artificial resuscitation, possibly including external heart massage.

Long-term damage mainly results from the internal effects of electrocution, above all on the kidneys.

When coming to the assistance of a person who has been electrocuted, the rescuer must think fast and exercise the greatest possible caution. In all cases, rescuers must always call for help first, then ensure that they themselves will not be exposed to danger, by turning off (or having someone else turn off) the power supply, before removing the casualty from the power source and administering first aid.

3.4.5 How to deal with breathing difficulties

It always falls to a chance rescuer to administer first aid, but specialist medical assistance, according to the nature of the problem, must be obtained very rapidly. This shows how important it is to call the emergency services.

Each step taken by a rescuer, whether amateur or professional, must obey one obvious, basic rule: "every second counts"!

Success or failure often depends on speed of action. A rescuer must not need to think about what to do or dig in his or her memory. There are only a few seconds in which to take action, and time lost may prove fatal.

First steps

Eliminate the cause of asphyxia

Without risking his or her own life, a rescuer must first move the casualty away from or eliminate the cause of asphyxia. The earlier this measure is taken, the more effective it will be. It may entail:

- a simple action, such as turning off the electricity supply at the master switch then removing any wire still in contact with the casualty
- complex action, involving more or less sophisticated techniques, the basic principles of which should be familiar to everyone, if only to avoid unnecessary exposure to danger

Although there is a need for speed, the measures taken by any rescuer must be well thought-out. Ensuring one's own safety is a basic rule, with direct consequences for the casualty's chances of survival and for subsequent rescue action.

Alert the public emergency services

Medical reanimation techniques are often very complex and cannot be taught to amateur rescuers. However, the latter should be familiar with effective methods of providing basic life support while waiting for specialist assistance.

Examination and initial action

The rescuer must quickly examine the casualty to assess his or her condition, which decides the first steps to be taken. There are four possibilities (Table 6), according to a casualty's state of consciousness and whether he or she is still breathing and has a pulse.

In any case, the first steps taken by an amateur rescuer are aimed at providing effective basic life support but will be limited in scope, and the chances of success therefore depend entirely on the rapid arrival of medical assistance. This shows the vital importance of seeking help promptly and providing precise information to the emergency services.

Preventing asphyxia

The recovery position

At present, an incalculable number of unconscious casualties die of asphyxia each day. The way accident casualties or persons who fall into a coma die often has nothing to do with the cause. Death is simply due to gradual asphyxia, caused by the tongue obstructing the back of the throat, or sudden asphyxia, caused by inhalation of gastric secretions.

The recovery position keeps the upper airways of an unconscious person clear, by facilitating the evacuation of mucus, vomit or blood and preventing the tongue from blocking the throat. This position must be used whenever breathing may be hampered by obstruction of the upper airways, particularly in the event of aggravating circumstances, such as unconsciousness, loss of normal coughing or swallowing reflexes, vomiting, blood running through the nose or mouth or facial injury.

Placing the person in this position is simple, but must be done with care in the case of accident casualties. If the rescuer is alone, he or she should kneel beside the casualty at chest level. With one hand, grasp the lower part of the person's farther thigh (just above the knee) and, with the other hand, the lower half of the farther upper arm (near the elbow).

The person is rolled towards the rescuer in a single movement. The upper leg is bent at the knee, to serve as a prop. The head is tilted back and the mouth opened and turned towards the ground or bed-surface.

Where two rescuers are present (which is desirable after any accident which may have caused a spinal fracture), the second places his or her hands on the casualty's cheeks, keeps the head extended and follows the rotating movement. In this way it is possible to avoid any bending or rotation of the neck and to keep the spinal column aligned. To maintain head, neck and thorax alignment, it is preferable to have first placed an improvised cushion (a folded pullover or jacket), of a thickness equivalent to half the width of the shoulder, against the person's check. The casualty should then be wedged in position using blankets or items of clothing placed between the knees and behind his or her back.

Clearing the airways

This entails ensuring unhampered respiratory movement and a good airway from the mouth to the lungs. A partial obstruction worsens respiratory problems, hastens asphyxia and makes any resuscitation attempt ineffective.

After loosening tight clothing (collar, tie, belt), a number of actions should be taken.

Table 6 **Possibilities according to a casualty's state of consciousness, breathing and a pulse conditions**

Casualty's state	First steps to be taken
First possibility The casualty is unconscious and is still breathing, but with difficulty. A pulse can be felt.	open the airways by loosening any clothing which may hamper breathing (collar, tie, belt), removing dentures, tilting the head back and clearing the mouth and throat with two fingers, using a hooking motion. Remove secretions with a mucosity aspirator, if available insert a Guedel-type artificial airway, if available prevent the asphyxia from worsening (for instance, due to obstruction of the airways with vomit) by lying the casualty on his/her side in the recovery position administer oxygen, carefully to begin with (a rush of oxygen may cause respiratory arrest in a person suffering from hypercapnia) do not leave the person alone but stay near and monitor skin colour (disappearance of cyanosis, integuments turning pink again), breathing (rhythm, strength, respiratory failure), circulation (the rescuer should keep one hand on the carotid pulse), recovery of consciousness (keep talking to the casualty)
Second possibility The casualty is conscious but breathing is laboured, too fast, too slow or hampered.	reassure and calm the casualty, who experiences a suffocating feeling leave the casualty in the position where breathing is easiest, often half sitting-up loosen any clothing which may hamper breathing (collar, tie, belt) encourage the casualty to cough and to breathe slowly remove dentures place the head in the correct position, slightly tilted back administer oxygen with care
Third possibility The casualty is unconscious; breathing has stopped or is ineffective (too slow, too fast, weak); a pulse can be detected at the throat or groin.	loosen the clothing clear the mouth and throat remove dentures and immediately begin a method of oral (mouth-to-mouth, mouth-to-nose) or manual (Silvester or Nielsen) resuscitation *The speed with which the method can be implemented is a key success factor. Only mouth-to-mouth and mouth-to-nose resuscitation in fact make it possible to commence artificial ventilation immediately.*
Fourth possibility The casualty is unconscious; breathing has stopped, no pulse can be detected at the throat or groin; pupils are often dilated. This is sometimes referred to as a death-like state. It corresponds to circulatory arrest, or deficiency, combined with respiratory arrest.	clear the airways begin mouth-to-mouth or mouth-to-nose resuscitation immediately If, after three insufflations, there is still no detectable pulse, begin artificial circulation by means of external cardiac massage, alternating with artificial ventilation

Tilt the head back

Whatever the casualty's position, this action tips the tongue forward, away from the back of the throat, and thus opens the upper airways. It can be done as follows: the rescuer's hands are placed on the person's cheeks, with the fingers hooked round the lower jaw, which is gently tilted up.

Artificial ventilation

There are two main types of artificial ventilation. A number of methods not requiring apparatus can be used for first-aid purposes; their means of action, and therefore effectiveness, differ according to the technique used. The two main categories to be distinguished are:

- expired air resuscitation methods, which entail breathing air into the asphyxiated person's airways; these are the oral methods (mouth-to-mouth; mouth-to-nose)
- closed-chest manual methods, which entail causing movements of the rib cage so that the air contained in the lungs is expelled, and then allowing the lungs to refill with air passively, by widening the rib cage to facilitate inhaling

There are many closed-chest manual methods, the most well known being the Schafer, Nielsen and Silvester methods. Only the last two are described here. Other known methods (Hederer, Chauveau, Binet) are more complex to implement or require a significant amount of equipment (the Eve method).

Relay methods, using apparatus, make it possible to maintain artificial ventilation for a lengthy period. No matter how simple the apparatus used, these methods are always intended as a follow-up measure to oral or manual resuscitation begun immediately on the spot. Typical apparatus consists of a manual ventilator, of bellows or bag-valve type, connected to a face-mask. This type of equipment is fast and easy to use and effective, but is always a follow-up solution to mouth-to-mouth.

In a medical environment mechanical artificial ventilators, of varying degrees of complexity, are used as a follow-up measure to emergency resuscitation.

Oral methods

Their unquestionable effectiveness is due to the fact that the air supplied by the rescuer has high oxygen content.

The air reaching the alveoli of the asphyxiated person is in fact that contained in the rescuer's mouth, throat, bronchi and trachea. The alveolar air exhaled by the rescuer, which has a high carbon dioxide content, in fact serves to push properly oxygenated air towards the casualty's alveoli.

The oral methods, which can be implemented rapidly in any location, constitute the basic artificial ventilation technique. The only circumstances in which they cannot be used are where there is extensive facial injury and the mouth and nose are no longer recognisable, or where the casualty has undergone a tracheotomy or has a tracheal wound. Amateur rescuers should be aware of the slight, but real, risk that exists when oral ventilation is given to a casualty intoxicated with certain poisonous substances that are eliminated via the lungs (trichlorethylene, carbon tetrachloride, methyl bromide). In such cases, the rescuer must be careful to remove his lips completely from the casualty's face when the latter exhales so as not to breathe in the toxic air released.

Mouth-to-mouth

More often than not, the casualty will be lying on the ground, but this method can be carried out anywhere: in a bed, a boat, a car, on rocks or even in water.

With a casualty lying on his or her back, the rescuer takes up position alongside him or her

and, after opening the airways (loosening clothing, clearing the mouth), tilts the head back, placing one hand or forearm under the back of the casualty's neck and the other on the casualty's forehead. Other techniques are possible, such as lifting the casualty's chin or placing a support under the casualty's shoulders.

The nose, though which a significant amount of the air insufflated would otherwise escape, is closed by pinching it with the index finger and thumb of the hand resting on the casualty's forehead. It is also possible for the rescuer to use his or her own cheek, which fills with air on insufflation, to close the casualty's nose. After taking a slightly deeper breath than normal, the rescuer places his or her lips around the casualty's mouth, ensuring a good seal. Then, without completely emptying his or her lungs, the rescuer blows into the casualty's mouth quite fast. The rescuer than removes his or her mouth and watches for the casualty's chest to fall, while taking another breathes. The sign that this method is effective is chest movement in the casualty as air enters and leaves the lungs.

The volume of air insufflated should be neither too much not too little. Optimal frequency in an adult is 15 to 20 breaths per minute. The rescuer should not breathe too fast, so as to avoid hyperventilating, which would make him or her dizzy and thus less efficient.

Mouth-to-nose

This method can be easier in certain situations. The positions of the casualty and the rescuer are the same as for mouth-to-mouth resuscitation. The rescuer tilts the casualty's head back, by lifting the chin with the palm of his or her hand, and closes the casualty's mouth to prevent the insufflated air from escaping. The other hand presses down gently on the casualty's forehead. The rescuer seals his or her mouth around the casualty's nose and blows into it quite fast, before removing his or her mouth and watching for the casualty's chest to fall. The insufflation rate should be about 15 to 20 breaths per minute.

Mouth-to-mouth-and-nose

This technique is applied to infants or small children. The rescuer places his or her lips around the casualty's mouth and nose. The rescuer should give weaker breaths than for an adult and more frequently, about 25 to 30 per minute. The volume of air needed is that sufficient to raise the casualty's chest. This shows how important it is for the rescuer to monitor the child's chest movement. Giving too much air inflates the child's stomach, which may with time hamper ventilation. Moreover, the rescuer should press gently on the child's stomach one or two times per minute, to evacuate any air that has entered the stomach despite the rescuer's precautions.

Manual methods

There are many manual methods, which are always a fall-back solution and must only be used when the oral methods (mouth-to-mouth, mouth-to-nose) prove impossible. The precautions are the same as for any artificial ventilation method.

Immediate action is essential. Time lost placing the casualty in the right position may have serious consequences.

As with any other artificial ventilation method, the airways must be opened by loosening the casualty's collar and belt, then opening and clearing the mouth and throat.

To ensure maximum effectiveness, it is essential that the casualty should be lying on a firm surface, so as to permit proper compression of the rib cage. These methods are based on the principle of chest compression using the rescuer's own weight, but, as the chest is quite resistant to pressure, the surface on which the casualty is placed to be pressed down at the same time should be firm and not sink or compress when the rescuer applies pressure.

All of these methods begin with a movement to expel air from the casualty's lungs (expiration).

Heart massage

When the casualty is no longer breathing but a pulse can be felt, administering artificial ventilation, so that the blood in circulation is oxygenated, is enough. It is a quite different matter when the heart is no longer beating or is beating ineffectively.

During evaluation of an asphyxiated casualty, the sign of cardiac failure is absence of a (properly checked) pulse in the throat or groin.

The casualty is usually pale and has ceased breathing. There is no detectable pulse. The pupils are usually dilated (mydriasis). The casualty is in a death-like state. It is first necessary to administer effective artificial ventilation, as a result of which the pulse will often become detectable. If, after three properly administered rescue breaths (mouth-to-mouth or mouth-to-nose), the pulse is still absent, artificial circulation by external heart massage must be commenced, combined with artificial ventilation. If either artificial circulation or artificial ventilation is not properly provided, it will be impossible to resuscitate the casualty.

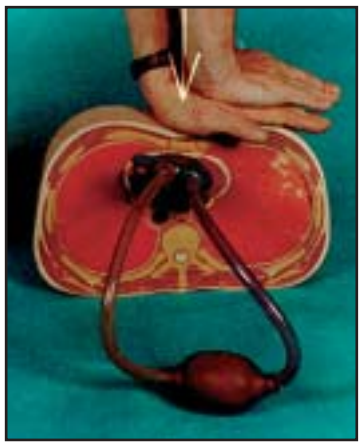

Fig. 13
Cardio-pulmonary massage (reanimation)

However, attention must be drawn to the fact that, although there is absolutely no risk with artificial ventilation, external heart massage does entail a risk of fracturing the ribs or the sternum, with damage to the underlying viscera (liver, spleen, stomach, heart). This means that someone who does not have adequate training must be absolutely certain that the casualty is in a death-like state, before commencing such a dangerous procedure. The pulse must be checked several times, after administering several rescue breaths, before beginning heart massage. Nothing could be worse than administering chest compressions to a person who has merely fainted. Before taking this action, a rescuer must be convinced that, if nothing is done, the casualty will die. It is only in these circumstances that an amateur rescuer should, as a last resort, take this initiative which may have very serious consequences.

The principle of external heart massage is based on the fact that the heart is a hollow muscle, which can be compared to the pear-shaped bulb of a spray. It is located in the middle of the thorax between two bone surfaces, the sternum in front and the spine behind, with the lungs on either side. Blood arrives at the heart via the pulmonary and major circulatory veins, and is evacuated via the pulmonary arteries to the lungs, where it is oxygenated, and then passes via the aorta to the organs and tissue. When the heart has stopped it is flaccid like the bulb of a spray. By pressing on the sternum it is possible to squeeze the heart against the spine, causing the blood contained in it to flow out into the arteries.

When pressure on the sternum is released, the heart fills spontaneously, like the bulb of a spray resuming its initial shape after being compressed. The normal rate of massage to be administered by the rescuer is compression and release five times in about three seconds, or ten times in six seconds, alternating with one inflation of the lungs (insufflation) in the first case and two in the second.

In the course of about one minute of this compressions-breathing cycle, 60 chest compressions and twelve breaths (insufflations) should be administered.

Before commencing cardio-pulmonary resuscitation ensure:

- that the casualty shows all the signs of a death-like state (unconsciousness, blue or grey colouring, respiratory failure, absence of a carotid or femoral pulse, mydriasis of the pupils, which no longer react to light)
- that the person is lying on his or her back on a firm surface (e.g. the ground)

The rescuer should begin by administering three effective rescue breaths and then check the pulse again.

It is then necessary to alternate five external cardiac compressions with one insufflation administered by the mouth-to-mouth or mouth-to-nose method, or ten cardiac compressions with two insufflations.

To do this, the rescuer should kneel down beside the casualty's shoulder with his or her knees touching the casualty's arm. After the first three breaths, if there is still no pulse, the rescuer locates the lower third of the sternum, which is the flat bone in the middle of the chest. The rescuer then places the heel of his or her hand (fingers lifted off the casualty's chest) on this part of the sternum, with the axis of the hand perpendicular to the axis of the

Conclusion

Respiratory failure is frequent and causes many deaths if the right action is not taken immediately.

From a moral standpoint, no one should let another person die simply because they do not know the basic steps to be taken, as described in many manuals and taught by national and international relief organisations, such as the Red Cross. It is important to know how to avoid respiratory failure in a person who is unconscious or experiencing breathing difficulties by opening the upper airways. This entails rapidly:

- loosening clothing
- laying a person who is vomiting, bleeding from the mouth or unconscious on his/her side
- prudently tilting back the person's head
- clearing the mouth and throat

These are essential steps, which often suffice to avoid asphyxia.

It is important to know how to recognise respiratory failure. An asphyxiating person often ceases ventilating (lack of movement of the chest and abdomen), but someone who is breathing too fast or too slowly, struggling to breathe or gasping for air must also be given effective artificial ventilation without delay.

It is important to react fast and give mouth-to-mouth or mouth-to-nose resuscitation, no matter where the person is located (bed, roadside, rocks, boat, water, car, etc).

It is important for a rescuer to be familiar with artificial ventilation methods, which he or she can put into practice without having to think first.

It is important to be aware that if circulatory arrest (no carotid pulse) continues after the commencement of effective artificial ventilation, a rescuer may need to associate artificial ventilation with external heart massage. This technique can be dangerous and allows of no error. It can have tragic consequences and should be used only in cases where a death-like state persists. In such cases an inability to carry out the proper measures will result in death.

sternum. This hand is for positioning purposes and most remain in place for five compressions. The other hand is placed on top of the first; it is this hand which is mainly used to exert pressure. With elbows locked and arms straight, the rescuer uses the weight of his or her body to press down, with a smooth, sharp movement, on the sternum. Pressure is then suddenly released, again with a smooth, sharp movement. For the massage to be effective, the chest must be compressed by 3 to 5 centimetres. This involves little risk, provided that the hands are positioned correctly. If they are placed too high or to the side, there is a risk of fracturing the ribs. If they are placed too low, the massage will be ineffective.

The rhythm is slightly less than one compression every half-second (five movements in three seconds or ten in six).

Although dangerous if performed improperly, this technique can save lives, even when carried out by an amateur. However, it is vital to seek help promptly, giving information that is as precise as possible, and to obey all the rules necessary to ensure effective artificial ventilation (removal of the cause of the breathing problem, if accidental, opening of the airways, head tilted back, etc.).

The effectiveness of artificial ventilation can be verified by watching for the casualty's chest to rise on inflation of the lungs.

The effectiveness of heart massage can be seen from the return of normal colour to the face, a reduction in dilation of the pupils, and the resumption of a pulse in the groin (to be checked by another rescuer).

Resuscitation should continue until spontaneous circulation resumes (in this case the pulse, which should be checked between chest compressions, restarts), the casualty begins to breathe again spontaneously and regains consciousness.

3.5 Burns

A burn is damage to the skin or mucous membranes caused by heat, fire, electricity or caustic chemicals.

3.5.1 Classification of burns

Burns are classified according to their:

- extent
- depth
- location
- cause

Extent. The extent of a burn determines whether it is life threatening. It can be calculated using Wallace's "rule of nines", which divides the body into percentages. The head, each lower leg, each thigh, each arm, the chest, the back, the stomach and the buttocks all count for 9%, and 1% is added for the genitals.

Depth. The depth of a burn determines the duration of the healing process. A first-degree burn merely reddens the skin; a second-degree burn involves blistering; a third-degree burn affects sub-cutaneous tissue, muscles or even bones.

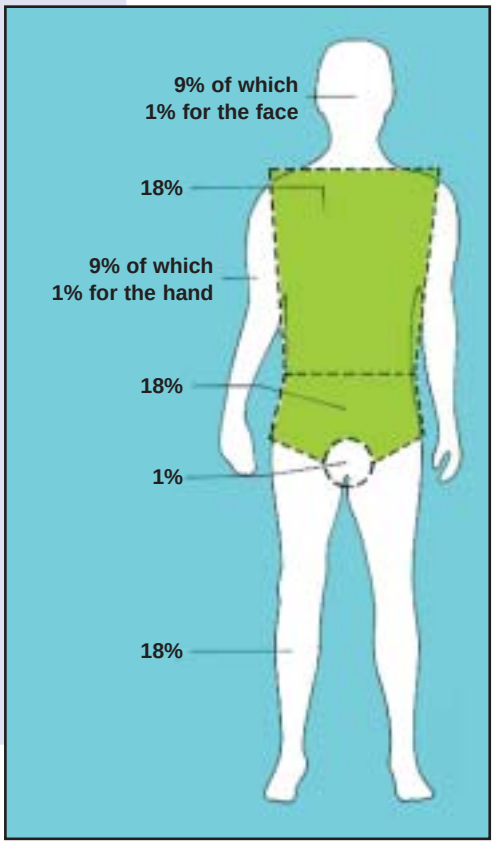

Fig. 14 **Calculation of burns extent**

Location. Burns to the genitals, trunk, bodily orifices, joints and extremities are the most serious. Burns to the face entail a risk of damage to the mucous membranes and airways.

Cause. Fire causes burns which do not continue to develop. Steam penetrates clothing and the respiratory system. Electricity causes serious internal injuries. Chemicals cause burns which grow worse if the area is not immediately rinsed with water.

3.5.2 The main types of burns and related risks

Depending on the cause, location, extent, depth or possible complications, a burn may be (Table 7):

- minor, not requiring medical attention
- severe, necessitating medical assistance
- very severe, necessitating emergency admission to hospital without waiting for a medical opinion

Table 7 **The main types of burns and related risks**

Burn	Description	Risks
Minor	First or second degree burns, which are small in size (no more than a few square centimetres) and are not located on a joint, bodily orifice or the face.	heatstroke, in the event of redness of the skin infection, in the event of blistering
Severe	First, second or third degree burns of the following three types: extensive, but covering less than 20% of the body in an adult, less than 10% in a child and less than 8% in an infant suffered by a person with diabetes or a heart condition or who is elderly affecting a joint or bodily orifice	shock, in all cases heatstroke, in the event of extensive redness of the skin infection, in the event of blistering or necrosis
Very severe	First, second or third degree burns of the following four types: covering more than 20% of the body in an adult, 10% in a child and 8% in an infant suffered by a person with diabetes or a heart condition or who is elderly affecting bodily apertures or joints caused by chemicals or electrocution	Shock Infection Asphyxia

Chemical burns are always serious. They take place in ten to fifteen seconds, following which pain is felt. They must always be rinsed with large quantities of water.

In the case of a burn by electrocution the visible damage is no guide to the extent of internal injuries (haemolysis, renal insufficiency, etc.).

3.5.3 How to deal with a burns

General precautions

Should the casualty's clothing be removed? The answer is yes, if the burn is caused by steam or a caustic liquid or if clothing is still burning; no, if clothing is no longer burning and the burn was caused by a flame. Should water be poured over the casualty? Yes, if clothing is still burning or if the burn is due to a caustic chemical (acid or alkaline); no, if the burn is due to a flame and clothing is no longer burning. Should the casualty be given something to drink? Yes, if the burn is severe; no, if the casualty is unconscious or there is burning of the mouth or throat.

Minor burns

The following steps should be taken:

- someone who is suffering from sunburn should be kept in the shade
- blisters should never be broken; apply an antiseptic and carefully cover the area with a sterile dressing
- chemical burns should be rinsed with large quantities of water

Severe burns

The following steps should be taken:

- treat casualties for shock, by making them lie down, reassuring them and covering them if they feel cold
- give bicarbonated water to drink
- cover the burn with a sterile dressing or clean cloth
- seek medical assistance

Very severe burns

Treat the casualty for shock, by:

- lying him/her down, on his/her side if unconscious
- giving reassurance
- covering him/her
- giving bicarbonated water to drink if he or she is conscious and feels thirsty
- wrap the casualty in a clean sheet
- lift both of the casualty's legs

The casualty must then be evacuated to the nearest hospital, where a drip can be administered.

4. Bandages

For treating minor wounds or burns and certain joint injuries, bandages are a necessary addition to the usual equipment, as a means either for keeping a sterile dressing in place when adhesive plaster or tape is unavailable or for immobilising a joint.

Moreover, a wound which is fairly extensive, even if only superficial (scratches or grazing after falling off a bicycle, for instance), or which is located on a joint, particularly the inner side, may often be untreatable with the limited equipment available in a home, car or camper's first-aid kit. A sore eye that needs covering, a boil in the armpit, a sprained ankle, a minor wound to the palm of the hand … all may find you unequipped and obliged to seek help from the nearest chemist, nurse or even doctor. Yet it is easy to save time and avoid expense and trouble by using bandaging techniques.

Depending on the bandage's shape, it is referred to as a triangular, tailed or roller bandage. These different types of bandage are most often used on the same parts of the body (joints, limbs, etc.) as an improvised means of keeping a sterile dressing, or failing that a clean piece of cloth, in place on an injury (wound or burn), when an adhesive plaster or tape is not available.

4.1 Triangular bandages

4.1.1 General observations

An improvised triangular bandage consists of a large piece of cloth (handkerchief, napkin, towel or any square piece of fabric) folded into a triangle. Examples are:

- household linen, preferably freshly laundered
- pieces of fabric found in a traveller's luggage
- bandages produced by relief organisations from pieces of woven or unwoven fabric, which are increasingly to be found in members' first-aid kits; these triangles of fabric are folded so as to take up as little space as possible, sterilised and individually wrapped. Frequently their size is determined by the initial piece of fabric, but the ideal bandage is an isosceles triangle, in which the two equal sides are between 90 cm and 1 m long. To facilitate manipulation, the long side is referred to as the base, the vertex as the tip or point, and the two base angles as the corners.

Triangular bandages have many advantages:

- they can be used on any part of the body
- they can be applied very rapidly
- they are an easy means of keeping in place a dressing, or clean piece of cloth, positioned directly on a wound, without causing pain either when the bandage is tied or when it is removed
- they stay in place well, without hampering movement; a properly positioned bandage does not slip or move out of place
- they are extremely easy to improvise

A few simple rules should be followed by rescuers to ensure correct use of triangular bandages:

- when bandaging limbs (the most common use) the tip is always placed towards the shoulder or hip
- the knot is, in principle, positioned on the opposite side to the injury; the two corners are tied together and the tip is then folded down. A reef knot is then used to hold the bandage in place

4.1.2 Placing triangular bandages

Head

Depending on the location of the wound - the back of the neck or, conversely, the forehead or scalp - the bandage must be turned round.

For example, when bandaging a boil on the back of the neck proceed as follows:

- a sterile dressing or clean piece of cloth is placed on the boil itself
- the base of the triangle is positioned on the back of the neck, holding the dressing in place
- the tip is placed on the forehead
- the two corners are wrapped around the head, preferably without covering the ears too much, and are then knotted in the middle of the forehead, securing the tip, which is itself then folded back and held in place with a reef knot

With a wound to the hairline or scalp, use of a traditional adhesive plaster makes it necessary to shave the area surrounding the wound. Children will accept this without problems, but adults are sometimes more reticent, in which case use of a bandage is a good solution.

Since the knot cannot be tied on the wound, the bandage must be turned round, as follows:

- the base of the triangle is positioned on the forehead, and it is the tip which is placed at the back of the neck
- the two corners are wrapped around the head, without covering the ears (which support the bandage) and tied in a simple knot; the bandage is then secured with a reef knot

The appearance of these two types of bandage, which can be compared to the scarf a woman ties around her head to protect her hair when doing the housework, can be improved by folding the base of the triangle up over a few centimetres and concealing the knot with the resulting roll of cloth.

Thorax

The technique is the same whether the chest or the upper back is being bandaged.

The base of the triangle is tied around the thorax parallel to the waist. The tip is passed over one shoulder. A strip of material, such as a cloth belt, is then knotted to the tip and to the two corners (already tied together) or to the casualty's belt. A sterile dressing or clean piece of cloth must naturally be positioned between the casualty's chest (or back) and the middle of the bandage before it is tightened.

A triangular bandage can be used in this way to keep in place a thick pad of material sealing a wound to the thorax through which air is leaking (a "blowing" wound).

Abdomen

The principle is the same, but instead of passing over a shoulder, the tip is secured after passing it between the legs.

Elbow or knee

Wounds are most often located on the outer surface of the joint (the kneecap or the tip of the elbow), in which movement must be maintained. The bandage should be applied with the elbow or knee half bent. The triangle is positioned on the outer surface of the joint with the tip lying on the upper arm or the thigh pointing towards the shoulder or the hip. The corners are crossed over at the back of the knee or in the hollow of the elbow, then knotted above the joint so as to secure the tip, which is folded back.

Shoulder or hip

As for the thorax or abdomen, the tip is kept in place with a strip of bandage or cloth.

Shoulder

The tip is rolled around a strip of bandage or cloth, which is then positioned so that it passes over the shoulder, with the base of the triangle facing out. The strip securing the tip of the triangle is then passed under the opposite armpit and tied there, or preferably slightly in front on the chest, so as not to hamper arm movement (if it was tied in the back it would cause discomfort when the casualty was seated).

Hip

The principle is the same as for the shoulder. Depending on the location of the wound, it is possible to cover either the hip itself or the front or back of the pelvis.

The tip of the triangle is rolled around the strip of bandage or cloth or around the casualty's belt, and the corners are tied horizontally around the thigh, with the knot on the outside of the leg.

Parts of limbs

The rule that the tip should always point towards the shoulder or hip is followed, but the bandage is turned in such a way that one of the equal sides lies along the axis of the limb.

The bandage should stop at the joints (on either side of the wound), which should not be covered.

Lower leg

The tip is positioned under the knee, and one of the equal sides is placed along the axis of the leg; this leaves the other side positioned horizontally parallel to the ground. This second side is wound around the leg to secure the tip of the bandage. The first side, positioned above the ankle, is wound in the opposite direction, moving up the leg.

Depending on the circumstances:

- either the two corners are knotted together half way up the leg, using a reef knot on the opposite side to the wound
- each corner is slipped separately under one side of the bandage, already wound around the leg

The second technique, which makes it possible to use a smaller size of bandage, is less satisfactory, as the bandage may become loose more easily and slip out of place when the person moves.

Forearm, upper arm and thigh

The principle is the same. One of the equal sides is left parallel to the axis of the limb, and the tip is placed under the upper joint. The bandage maintains the dressing or piece of material in place, and the two corners are wound around the limb, in opposite directions, before being knotted on the opposite side to the wound.

Foot

The foot may either be placed flat on the triangular bandage (resting on a chair, for example) or the bandage may be placed on top of the foot. In the latter case, the tip points towards the ankle, and the base is wrapped around the foot, covering the heel. The two corners are crossed over at the front of the ankle, holding the tip in place, then knotted as described above.

The foot may also be placed on top of the bandage. Position the foot in the middle of the triangle with the toes towards the tip. The tip is then immediately folded back, to point towards the ankle.

The base is wrapped around the heel, and the two corners are crossed over on top of the foot, securing the base in place, then wrapped around the ankle and knotted at the front.

Hand

A wound may be located in the palm or on the back of the hand. In some cases, wounds or burns may also be positioned between the fingers. As a precautionary measure, the fingers should be separated from each other with sterile dressings, or an accordion-folded piece of fabric. The hand is positioned in the middle of the triangle, with the tip towards the wrist. The base is folded over the fingers, then the corners are crossed over and wrapped around the wrist; they are secured first with a simple knot, then with a reef knot, holding the tip in place after it has been folded back.

Face

Less frequently, a triangular bandage can be used to cover a casualty's face, in the event of severe burns or damage to the bones of the face. In this case, holes should be made in the bandage to allow the casualty to breathe, and possibly also to see, or to permit subsequent medical examination. The resulting mask is a good example of the primary use of bandages, as a protection against dirt and infection.

4.2 Tailed bandages

4.2.1 General observations

These are also an improvised means of holding in place a sterile dressing or clean piece of cloth on a wound, when an adhesive plaster or strip is unavailable.

Their name comes from their shape.

As with triangular bandages, pre-cut tailed bandages are produced for inclusion in first-aid kits, sometimes made out of elasticised material and individually wrapped. Where more suitable equipment (a haemostatic pad or individual dressing) is not available, they can be very useful for stopping haemorrhages, which require compression bandaging.

A tailed bandage is made out of a piece of cloth (towel, serviette, old shirt, piece of sheet, etc), from which a strip should be torn. This strip of cloth will be about 1 m long and of variable width, depending on the intended use, although three widths are generally encountered in practice:

- 8 to 12 cm for the nose, chin, eye or ear
- 15 to18 cm for the forehead, back of the neck or armpit
- 20 to 30 cm for the thorax or abdomen

The principle is that the central portion of the strip of fabric is left intact, to be used to maintain a protective dressing or clean piece of cloth in place on a wound or burn. Then, the ends of the strip of cloth are torn to form two or three straps, known as the "tails", which can be tied together on either side of the area covered by the bandage.

4.2.2 Placing tailed bandages

Knee

Depending on the position of the central piece of material (on the kneecap, or conversely at the back of the knee), the bandage is tied somewhat differently.

Kneecap

This is a bump-shaped part of the body. As with a triangular bandage, the tailed bandage is always tied with the joint in a bent position. The centre keeps the dressing in place. The upper tails, at thigh level, are crossed around the back of the knee then tied around the lower leg (with the knot to the front or the outside). The lower tails are also crossed around the back of the knee and tied around the thigh.

Back of the knee

The centre is positioned in the hollow of the half-bent joint. The upper tails are tied around the thigh, and the lower tails around the lower leg.

Elbow

The technique is the same as for the knee. The bandage should be applied with the fore-arm bent horizontal, and movement of the joint must not be hampered when the bandage is in place.

Head

Back of the neck

This type of bandage is often used to hold a dressing in place or cover a boil. The back of the neck is a flat part of the body. The centre secures the dressing. The upper tails are passed around the head over the ears (which serve as a support), then tied across the forehead. The lower tails are tied around the neck, but not too tightly.

Forehead

The forehead is regarded as a bump-shaped part of the body. The two sets of tails should therefore be crossed over each other.

This is one of the most difficult bandages to tie because of the hair. It is advisable to use a fairly wide bandage (about 15 cm). The bandage is placed on the forehead. The upper tails (those nearest the ears) are tied under the chin. The lower tails, positioned above the eyes, are passed over the upper ones, thus securing the bandage at the temples. They are then knotted at the back of the head.

Nose

A thin strip of material should be prepared, so that the bandage covers neither the eyes nor the mouth. The centre of the bandage keeps the dressing in place on the nose. The upper tails are passed around the head, under the ears, then tied at the back of the neck. The lower tails, sometimes folded slightly to form a pocket of material, are folded back and pass over the ears, before also being tied behind the head.

Chin

This bandage is frequently used for either chin wounds or fractures of the lower jaw.

Although an improperly tied bandage entails little risk when it is a matter of keeping a dressing in place on the chin, the same does not apply in the event of a fractured jaw.

In the latter case, the sequence of actions in applying the bandage is important and must be studied with care. If capable, the casualty should himself hold the broken jaw in place. The first step is therefore to press the lower jaw against the upper jaw, which serves as a splint. The bandage's role is that of a support wrapped around the head (under the chin and over the scalp), as follows:

- holding the bandage with the tips of the fingers, place the centre under the casualty's chin
- the two upper tails are passed over the temples and tied on top of the head

- the two lower tails are folded back, crossed over at the back of the neck and then tied on the casualty's forehead, after passing over the ear

By folding back the lower tails, a small pocket of fabric is formed with the centre, intended to hold the dressing in place on the chin.

The bandage is sometimes not long enough for the lower tails to be tied directly on the forehead. In that case a strip of material should be attached to one of the tails, so that it is long enough for the bandage to be secured. The tails put in place first are supported by the top of the head, in as vertical a position as possible, but tend to slip because of the hair. The extra turn around the head is therefore intended to secure them at the temples.

Care should be taken, as in the event of a bilateral fracture of the lower jaw, it is dangerous to tie the lower tails too tightly at the back of the neck.

Eye

The difficulty here lies in the need to cover only one eye, without hampering vision from the other eye. The eye to be protected is covered with a dressing. The centre of the bandage is placed above the ear and tied behind the head. The lower tail is passed under the ear on the side of the injured eye, twisted on itself (diagonally) to keep the uninjured eye free, then, after being pressed against the head, tied with the other tail behind the head.

Ear

It is first necessary to form a small pocket of material, to be positioned over the ear and the dressing. This is the most difficult part of this bandaging technique. The simplest method is to place the bandage flat in front of you, pick up the furthest tail on either side and turn it towards you, perpendicular to the nearer tail.

Then, pass the end of the tail under and through the "buttonhole" created on either side of the centre. For the pocket to be properly formed, the knot must in fact be tied in the same direction, on either side of the centre. The pocket of fabric, containing the dressing, is placed against the ear and the upper tails are tied above the opposite ear. The lower tails are then tied around the neck, not too tightly.

Thorax

A tailed bandage can be applied to the thorax to keep in place a dressing used to seal a "blowing" wound. It may have two or three tails.

With two tails, the centre keeps in place the dressing or piece of cloth, and the tails are tied on the opposite side of the thorax to the wound.

With three tails, it is the central tail that keeps the dressing in place. It is therefore tied first, especially with a "blowing" wound. The upper tails are passed over a shoulder, to prevent the bandage from slipping down, and then tied around the thorax.

Armpit

This is one of the most frequently used forms of tailed bandage, since keeping a dressing in place with adhesive plaster or tape is very difficult on this part of the body, which is particularly mobile, with a fair amount of hair and, often, a tendency to perspire.

Boils in the armpit are frequent, and this type of bandage is virtually the only means of keeping a moist dressing in place.

The sterile dressing or pad of material is positioned directly on the centre of the bandage, then the whole thing is placed in the armpit, and the middle tails are crossed over on top of the shoulder on the injured side, then tied under the opposite armpit.

The other tails are tied two around the arm, but not too tightly, and two around the thorax.

To keep a dressing moist, it is advisable to position a waterproof barrier (plastic, for example) between the centre of the tailed bandage and the gauze or cotton of the dressing. This is a more sophisticated technique, and the equipment used is less improvised.

4.3 Roller bandages

4.3.1 General observations

Like triangular or tailed bandages, roller bandages can be used to hold in place a sterile dressing or clean piece of cloth on a wound or burn, but these bandages are also used to immobilise joints, especially a sprained ankle.

Equipment used

There are several types of roller bandage:

- single-use gauze roller bandages, which are thrown away each time the dressing is changed
- cloth roller bandages, which can be washed and ironed like ordinary linen. Despite their ease of use, they are not very common, except among professional relief workers. Such bandages can be improvised by cutting up sheets or other large pieces of cloth, but this remains exceptional
- elasticised crepe bandages, which are multi-use if properly looked after

Washing

The technique varies according to the material used:

- cloth roller bandages can be boiled, to ensure that they are properly sterilised; they are then ironed like ordinary linen but with a very hot iron.
- elasticised bandages should be treated like wool; boiling and a hot iron are therefore to be avoided. After being washed in a suitable detergent and carefully rinsed, they should be dried flat between two towels.

After washing, the bandage should be rolled up again. Fold one end over on itself four or five times to start off the roll of bandage, which is referred to as the head. Then hold the roll between your hands from underneath, with the end secured between the thumb and the forefinger on either side. The forefingers support the bandage, and the roll is moved with the thumbs towards the person rolling the bandage.

Rules of use

Apart from the three usual types of roller bandage (cloth, gauze, elasticised), there are certain bandages, usually available in widths of 5, 7 and 10 cm, with an average length of between 5 and 8 metres, which is often not enough to allow proper tying with traditional bandaging techniques.

A roller bandage has two parts: the ends and the roll itself, known as the head.

The roll should preferably be oriented uppermost, that is to say pointing towards the rescuer. The bandage is held between the thumb and the forefinger.

A bandage is always begun with two turns, the first slightly slanting so as to leave a corner, which is then tucked in and held in place with the second turn. The tucked-in end prevents the bandage from rolling on itself and slipping.

When bandaging a limb, start from the lowest point and move up towards the elbow or shoulder, for an arm, or the knee or hip, for a leg.

All bandages are finished by making two turns. Depending on the equipment available, a bandage can be secured in three ways:

- with a safety-pin, inserted from top to bottom, securing the end to the previous turn
- by tucking the end in under the previous turn
- by tearing the last strip of bandage in half lengthways; the two cut ends can be tied in a simple knot to prevent the fabric from fraying or tearing further. The two resulting ends are then tied together to secure the bandage, as with a tailed bandage.

After applying a bandage, the rescuer should always check that the bandage is not too tight, hampering or blocking circulation. With a bandaged limb, it is recommended to check the casualty's pulse at the wrist or the ankle. A bandage which is too lose will tend to slip and will not serve its purpose.

Techniques

There are three bandaging techniques:

- spiral bandages, which are the easiest to apply. These are used for parts of limbs or when a joint (elbow or knee) has to be immobilised completely in the extended position. Begin bandaging below the wound or joint and move up the limb in a spiral. Each new turn of the bandage covers part (1/2 to 2/3) of the previous turn
- the herringbone bandage is more effective, particularly for the lower leg or thigh, but more difficult to apply. After two turns the bandage is folded over on itself at each turn, to form a V-shape. This is done either by pressing the thumb on the point where the bandage is folded over, while changing the direction of the roll, or by guiding the movement of the bandage with a finger
- a crossed or figure-of-eight bandage is used for joints (elbow or knee); the turns form the shape of a figure 8 or a letter X

4.3.2 Placing roller bandages

Elbow

An elbow bandage must allow movement and leave the joint as flexible as possible.

As with a triangular or a tailed bandage, the arm is bent. The first two turns (securing the end) start at the elbow itself, then alternate turns are made around the forearm and the upper arm, each time overlapping the edge of the previous turn by 1 or 2 cm. The bandage is crossed over in the hollow of the elbow and forms a figure eight.

Lastly, the bandage is finished off with two turns around the upper arm, moving towards the shoulder.

Knee

The technique is the same. A figure-of-eight bandage is applied, crossing over at the back of the knee, and finished off with two turns around the thigh.

If the first two turns are numbered 1 and 2, it can be said that the uneven-numbered turns are always made around the lower leg or forearm, and the even-numbered turns always around the thigh or upper arm.

This figure-of-eight bandage stays in place well and allows freedom of movement, even when taking part in certain sports, for example.

A roller bandage 5 to 8 cm wide is best suited for use on the elbow or knee.

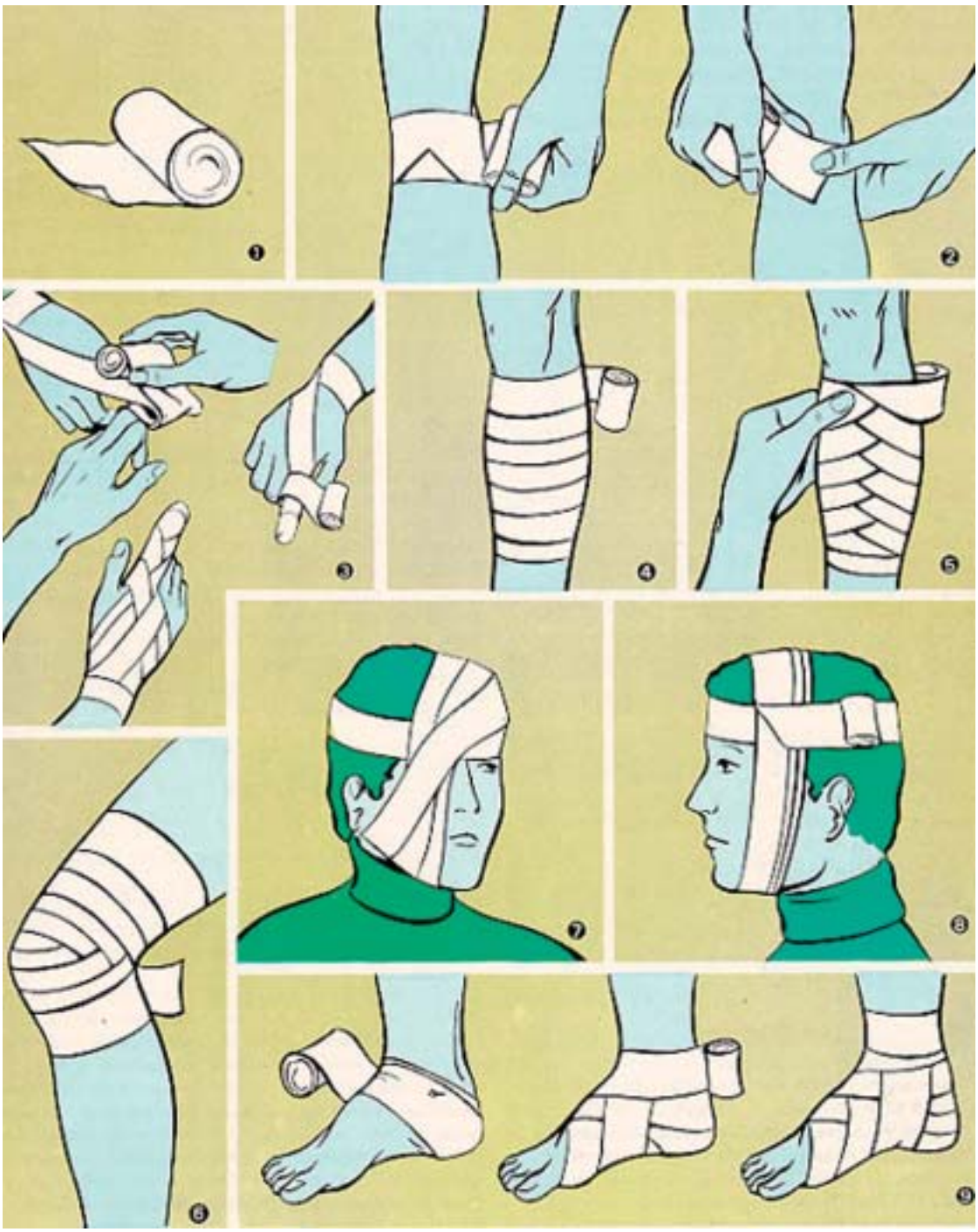

Fig. 15 **Placing roller bandages**

Finger

A narrow (3 to 5 cm) bandage should preferably be used. It should be applied as follows:

- begin with two turns around the wrist, to provide a stable base for the bandage
- pass the bandage diagonally across the back of the hand and right up to the end of the finger to be covered (a sterile dressing should already have been positioned on the wound to protect it)

- pass the bandage under the finger and hold it in place with the middle finger of the other hand
- take the bandage to the base of the finger, pass it back on top and hold it in place with your forefinger; the bandage is then held in place with one or two turns at the tip of the finger
- return to the wrist and continue applying the bandage in a figure-of-eight shape, moving from the tip of the finger to the wrist, successively overlapping the edges of the previous turns by about 1/3 of the bandage's width
- finish off the bandage with two turns around the wrist

Before starting to apply the bandage, the rescuer should ensure that the finger is slightly bent and not pulled too far back, which would rapidly cause discomfort or even pain.

Hand

The wound is covered and protected with a sterile dressing or clean piece of cloth. If necessary the fingers are separated, for example with an accordion-folded dressing.

The bandage is begun in the same way, starting at the wrist, and wrapping it several times around the fingers, so they are fully covered. The thumb is usually left free, but can also be protected with the bandage.

It is rarely possible to complete a proper hand bandage with a bandage of the usual length. It is therefore necessary to use a second bandage of the same kind and width (preferably 5 to 8 cm).

Eye

The eye sometimes has to be held firmly closed, in which case a tailed bandage will not do.

A tailed bandage is, on the other hand, preferable where the aim is merely to prevent blinking and limit movement or to avoid anything pressing on the eye when a foreign object is lodged in it, piercing the pupil.

An eye bandage is applied using a 5 cm wide roller bandage. Two turns are wrapped around the forehead, above the ears, then the bandage is folded over towards the back of the neck and passed vertically across the middle of the head. The bandage covers the injured eye then passes down to the corner of the lower jaw. It is wound around the head diagonally, each turn partly overlapping the previous one (on the side opposite the injured eye). The bandage is finished by winding twice around the forehead.

Temple

To hold a compression pad in place and stop a haemorrhage at the temple, a 5 cm wide bandage should be used. This technique can also be applied to fractures of the lower jaw. The bandage is begun with two turns around the forehead, above the ears. Start applying the bandage from left to right, beginning on the temple opposite the dressing. Hold the bandage in place with a finger, positioned on a slant, and fold it over on one of the temples, then pass it under the chin and over the top of the head twice. Depending on the type of injury, the fold is positioned on the wound itself or on the opposite temple. As is the case with the hand, a second bandage is often required. Continue with two further turns around the head and under the chin and finish with two turns around the forehead.

Thorax

The thorax is rarely bandaged with a traditional roller bandage in an emergency.

Use of such a bandage is dangerous if the casualty has a broken rib or internal contusions. More often than not, a bandage is improvised out of large pieces of cloth, held in place with safety-pins and supported with straps over the shoulders, to avoid slippage.

To keep in place a dressing used to seal a “blowing” wound of the thorax, it is preferable to use a triangular or tailed bandage (2 or 3 tails) rather than a roller bandage.

Ankle

As for the elbow or knee, the aim here is to immobilise the joint. A cloth bandage is preferable, but an elasticised or semi-stretch one is often used in practice.

The main purpose of immobilising the joint is to keep the foot at a right angle to the leg. In an emergency a simple figure-of-eight, or double loop, can be used to hold the foot in this position.

Various techniques are possible. The bandage can either be supported by the malleolus, on each side of the ankle, or, as for a bandage of the knee or elbow, it is possible to begin with two diagonal turns around the heel and the instep. This is an easier method of keeping in place a dressing moistened with surgical spirit, often recommended as a treatment for a slight sprain.

The bandage is then wrapped around the end of the foot at the base of the toes, brought back to the lower leg, and then wrapped in a figure-8 pattern several times around the foot and the ankle. Each figure-of-eight overlaps the edge of the previous one by 1 or 2 cm, thus forming a regular herringbone pattern on the top of the foot. The bandage is finished off by winding the end around the ankle twice and is held in place, preferably with two strips of adhesive tape or a safety-pin, inserted from top to bottom.

4.3.3 Removing a bandage

Once the adhesive tape or safety-pin securing the bandage has been removed, do not attempt to roll up the bandage directly while unwinding it. The ball of bandage should be passed from one hand to the other, unwinding it in the opposite direction from that in which it was applied. The bandage is then washed, dried and rolled up.

Conclusion

Application of a triangular, tailed or roller bandage is, above all, a matter of careful thinking and common sense. Bandaging techniques can prove very useful in a wide variety of fields.

Depending on the circumstances, they can be used to prevent a casualty’s condition from deteriorating, protect a large wound or immobilise a joint. In the event of a minor injury, they allow a casualty to continue with his or her usual occupations, without experiencing discomfort.

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Annex 1: Classification card

Classification card

Attach to patient's wrist
Code:
Minor: (yellow)
Major: (red)
Dead: (white)
Name: _____
Address: _____
Telephone: _____
Religion: _____
Diagnosis: _____
Category:
Minimum treatment: ☐
Immediate treatment: ☐
Delayed treatment: ☐
Expectant treatment: ☐
Room: _____

Date: _____ _____ a.m.
_____ p.m.
Card No. _____

Age: _____ Sex: M ☐ F ☐

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Annex 2: Management of health relief supplies

During the first week, health relief supplies will consist mainly of drugs and medical equipment for treating casualties and preventing communicable disease. Later supplies will include sanitary engineering equipment, vehicles, food, construction materials, and the like.

Emergency supplies that must come from abroad are often limited to few essential items of relatively small bulk.

In general, the main problem is not acquiring large amounts of new supplies but redistributing those on hand.

Use of Local Stocks

The effective mobilization of all local sources of medicine and medical supplies will require that the Health Relief Coordinator update or establish a rough inventory of the types of supplies available and their location and condition following the impact, have the authority to purchase or requisition them from private suppliers, and reallocate budgeted funds to meet immediate needs.

National List of Essential Drugs

Every disaster-prone country should prepare in advance its own list of basic medical supplies to be made available immediately through local stockpiling, increases in inventory in pharmaceutical stores or government hospitals, or donation following a major catastrophe.

Submitting Requests for International Assistance

To maximize the benefit of scarce international assistance to the country, the following guidelines should be followed:

- A single government official should be made responsible for channelling emergency international requests, for otherwise duplication, confusion, and shortcomings will result.
- Potential donors should be asked to provide large amounts of a few items since this simplifies and expedites procurement and shipping.
- The request should clearly indicate the order of priority, amounts, and formulation (e.g. tablets or syrup). Vague requests for “antidiarrheal drugs,” “antibiotics,” or “vaccines” must be avoided. The amounts requested should be compatible with the size of the affected population and the anticipated occurrence of trauma and disease.
- Requests should be limited to drugs of proven therapeutic value and reasonable cost.
- Perishable products and vaccines should not be requested unless refrigeration facilities are available and special handling arrangements can be made at the airport.
- Supplies will be duplicated if the same list is sent to several donors.

Procedures for Labelling and Marking Consignments

Long experience in different international relief operations has shown that all agencies need to use a uniform system for marking or labelling relief consignments. Recipient governments and donors should adopt the procedures the League of Red Cross Societies has developed in coordination with United Nations agencies.

- *Colour code*. The colours used for the relief supplies most often required after disasters are:
  - red for foodstuffs
  - blue for clothing and household equipment
  - green for medical supplies and equipment.
- *Labelling*. The label should provide essential information on:
  - expiration date of the product
  - temperature controls
  - English should be used on all labels (stencilled markings)
- *Size and weight*. Containers should be of a size and weight that one man can handle (ideally, 25 kg; up to a maximum of 50 kg) since mechanical loading and unloading devices are rarely available at the receiving end.
- *Contents*. Relief supplies should always be packed by type in separate containers.
- *Advance notice to the consignee and Health Relief Coordinator*. To cover in one document all the details necessary for safe transport and ease of handling at the

receiving end, the following information is essential:

- name of sender
- name of consignee
- method of transport, including (where applicable) the name of the vessel or flight number and its date and port or airport of departure
- a detailed list of contents, including weight, dimensions, and number and type of packages
- value in the currency of the sending country
- type of insurance, name of company, etc.
- the carrier's agent, including the name of the person to be contacted in the receiving country
- estimated time of arrival (ETA)
- instructions or special requirements for handling and storing the supplies; in most instances a *pro forma* invoice is required by the authorities in the sending or receiving country or both

➠ Acknowledgement by the receiving country. It is important that an acknowledgement be sent to donors as quickly as possible after consignments are received.

Inventory and Distribution of Incoming Supplies

Unsolicited drug supplies are often a major problem in large relief operations. The receiving government should adopt a firm policy about accepting unsolicited, unannounced supplies. This policy statement should in general suggest that international assistance not be sent except in response to a specific request from or after negotiation with the national government. National representatives abroad and local diplomatic missions and aid agencies should be informed of the policy.

When possible, professional inspection of medical supplies collected from the private sector abroad should be arranged before shipment.

Despite any such policy, the arrival of unsolicited supplies should be anticipated and procedures devised to handle them.

Expired Drugs, Perishable Products

Some drugs close to or past their stated expiration dates are often donated or offered. Expiration dates are very conservatively set for some drugs, and with suitable storage the drugs remain safe and potent for much longer. When consignments are large and the drug is of particular value, reference laboratory testing and recertification should be arranged. Assistance may be requested from the United Nations or bilateral sources.

Annex 3: Medical care survey form

Medical care survey form

The purpose of this survey is to solicit information on health care centers at the national level and the availability of their human and material resources, in order to organize plans and programs for medical care in the event of public disasters. It is important to obtain detailed information in order to create a regionally-organized file of resources that makes possible the quick deployment of those resources to meet requirements in the country's various regions.

Medical Care Survey Form

1. General Data

1.1 Name of medical care center _____

_____

1.2 Address _____

_____

1.3 Telephone(s) _____

_____

1.4 If the center has radio equipment: _____

_____

i) Call letters _____

_____

ii) Operating frequency _____

_____

1.5 Area served (geographic) _____

_____

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1.6 Comments: _____

_____

_____

_____

i) Type of center:

Hospital _____

Health center _____

Dispensary _____

Health unit _____

Clinic _____

Service module _____

2. Environmental Structures

2.1 *Hospital capacity*

Indicate the total available number of:

i) Beds: _____

ii) Intensive therapy beds: _____

iii) Infectious-case beds: _____

iv) Beds for burn victims: _____

v) Intermediate therapy beds: _____

vi) Specialty beds (specify): _____

	Specialty	Number
a.		
b.		
c.		
d.		
e.		

vii) Operating rooms:

viii) Morgue:

ix) Others (specify):

	Name	Number
a.		
b.		
c.		
d.		
e.		
f.		

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Describe the characteristics of convertible areas and spaces that might be utilized to increase hospital capacity in the event of an emergency or disaster. Specify the size (in square meters) of each area or space, the services available in it (water, light, telephone, others), and provide any other information that may be useful for assessing the suitability of each area for medical care in the event of an emergency or disaster.

Area 1

Surface area _____ m²
Water Yes ☐ No ☐
Light Yes ☐ No ☐
Telephone Yes ☐ No ☐

Area 2

Surface area _____ m²
Water Yes ☐ No ☐
Light Yes ☐ No ☐
Telephone Yes ☐ No ☐

Area 3

Surface area _____ m²
Water Yes ☐ No ☐
Light Yes ☐ No ☐
Telephone Yes ☐ No ☐

Area 4

Surface area _____ m²
Water Yes ☐ No ☐
Light Yes ☐ No ☐
Telephone Yes ☐ No ☐

Area 5

Surface area _____ m²
Water Yes ☐ No ☐
Light Yes ☐ No ☐
Telephone Yes ☐ No ☐

Area 6

Surface area _____ m²
Water Yes ☐ No ☐
Light Yes ☐ No ☐
Telephone Yes ☐ No ☐

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d. Fuel storage capacity: _____

e. Autonomy _____ hours.

f. Indicate whether the feeding of the plants by the electric company is by means of an independent circuit or a circuit serving various users.

☐ Independent ☐ Various users

g. Indicate the supply voltage (number of volts): _____

h. Identify the power substation supplying the hospital and give its location: _____

i. Indicate the electric company's three substations which are closest to the hospital and may be usable as sources of supply by direct special line in the event of an emergency.

1) Substation _____ Address _____
2) Substation _____ Address _____
3) Substation _____ Address _____

j. Average daily use of electricity in 24 hours _____ kv/24.

k. Is the hospital's physical structure such that certain areas can be supplied with electricity independently?

Yes ☐ No ☐

l. If yes, explain whether the normal power system has special feeder circuits for:

Emergency units	Yes ☐	No ☐
Operating rooms	Yes ☐	No ☐
Intensive care units	Yes ☐	No ☐
Intermediate care units	Yes ☐	No ☐
Laboratory	Yes ☐	No ☐
Sterilization center	Yes ☐	No ☐
X-rays	Yes ☐	No ☐
Elevators	Yes ☐	No ☐
Kitchen (cold storage rooms)	Yes ☐	No ☐
Water pumping systems	Yes ☐	No ☐

m. Is there any emergency lighting system (batteries or stationary lights, etc.)?

1) Area _____ Type of lighting _____ No. _____
2) Area _____ Type of lighting _____ No. _____
3) Area _____ Type of lighting _____ No. _____
4) Area _____ Type of lighting _____ No. _____
5) Area _____ Type of lighting _____ No. _____

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2.2 *Autonomy*

The following information will make it possible to determine the length of time over which the facilities can continue to be operated autonomously in the event of a disruption of basic services or a supply crisis.

i) *Plant*

List of buildings making up the hospital's plant
(including maintenance areas)

Building (Name/ Identification No.)	Number of floors	Number of entrances/ exits	Year of construction	Type of construction	Number of beds in the building	Medical services in the building
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Others (attach additional sheet(s))

Does the hospital have extensive and unobstructed grounds nearby where field hospitals and/or emergency services can be located? Include parking areas, green areas, and others. For each area include dimensions in meters.

1. Area _____ Location _____ Surface area _____ m²
2. Area _____ Location _____ Surface area _____ m²
3. Area _____ Location _____ Surface area _____ m²
4. Area _____ Location _____ Surface area _____ m²

ii) *Electricity*

If the facility has a power generator, indicate:

a. Type of plant: _____
b. Capacity (kw): _____
c. Fuel used: _____

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iii) *Water supply*

a. Source: _____

_____

b. Capacity of tanks: _____ liters.

c. _____ cubic meters.

d. Reserves estimated for _____ hours.

e. Hospital's monthly water use: _____ m^3

f. Diameter of supply pipe(s):

1) _____

2) _____

3) _____

g. Does the hospital have a water pumping system?

Yes ☐ No ☐

h. If yes, indicate:

Number of pumps _____ Capacity of each _____

_____

_____

i. What would be the best way of supplying water to the hospital in an emergency? _____

iv) *Sewage*

Type of disposal: _____

_____

v) *Food*

a. Freezers and refrigerators

Indicate the characteristics and capacity (cubic feet or cubic meters) of each:

_____

_____

_____

_____

b. Reserve supply of food estimated to last:

- Nonperishable food: _____ days.
- Perishable food: _____ days.

vi) *Drugs*

Reserve supply of drugs estimated to last: _____ days.

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3. Technical resources

Indicate the characteristics, quantity, and capacity of available technical resources.

3.1 *Surgical instruments*

Indicate specialty, characteristics, and quantity of available surgical instruments:

i) General surgery boxes _____
ii) Trauma boxes _____
iii) Neurosurgery boxes _____
iv) Laparotomy boxes _____
v) Thoracotomy boxes _____
vi) Boxes for _____
vii) Boxes for _____
viii) Boxes for _____
ix) Boxes for _____
x) Boxes for _____

3.2 *Sterilization systems*

Indicate with respect to each system:

i) Type: _____
ii) Capacity: _____
iii) Energy sources: _____
a. _____
Type: _____
Capacity: _____
Energy sources: _____
b. _____
Type: _____
Capacity: _____
Energy sources: _____
iv) Total number of sterilization systems: _____
v) Total capacity: _____

3.3 *X-ray equipment*

Indicate with respect to each set of x-ray equipment:

☐ Stationary ☐ Portable

Type: _____

Characteristics: _____

_____

_____

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☐ Stationary ☐ Portable
Type: _____
Characteristics: _____
_____
_____

☐ Stationary ☐ Portable
Total number of sets of x-ray equipment: _____
☐ Stationary ☐ Portable

3.4 *Other equipment*

Indicate with respect to any other available equipment:

Name: _____
Type: _____
Characteristics: _____
_____
_____

Name: _____
Type: _____
Characteristics: _____
_____
_____

Name: _____
Type: _____
Characteristics: _____
_____
_____

3.5 *Blood bank*

If the facility has a blood bank, indicate:

i) Capacity: _____ liters _____
ii) Average reserve: _____ liters _____
iii) Number of associated donors: _____

4. Human resources

4.1 *Physicians*

Specialty:	*Number:*
_____	_____
_____	_____
_____	_____
_____	_____

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Specialty:	*Number:*

4.2 *Nonmedical personnel*

Specialty:	*Number:*
Dentists	
Bioanalysts	
Psychologists	
Sociologists	
Anthropologists	
Social workers	
Nursing professionals	
Medical technicians	
Social auxiliaries	
Nursing auxiliaries	

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4.3 *Employees and workers*

i) Number of employees _____

ii) Number of workers _____

5. Transportation and mobilization resources

5.1 *Number of ambulances:* _____

5.2 *Other transportation vehicles (specify):*

Type: _____

Characteristics: _____

_____

Type: _____

Characteristics: _____

_____

Type: _____

Characteristics: _____

_____

5.3 *Access and transportation facilities*

i) If there is a heliport near the facility, indicate:

a. Geographic location: _____

_____

b. Distance between the heliport and the facility: _____

_____

ii) If there is an airport or landing strip near the facility, indicate:

a. Geographic location: _____

_____

b. Characteristics: _____

_____

iii) If there is a port near the facility, indicate:

a. Geographic location: _____

_____

b. Distance between the port and the facility: _____

_____

c. Characteristics: _____

_____

_____

_____

_____

_____

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iv) Indicate the name and best means of access to the facility: _____

_____
_____
_____
_____
_____
_____
_____

6. Emergency plans

6.1 If there is an emergency plan, indicate the following (attach a copy of the plan):

i) Has the plan been put into practice?

Yes ☐ Dates: _____

_____

No ☐

ii) Have emergency or disaster simulation exercises been carried out?

Once ☐ Date: _____

Several times (how many?) _____

Periodically (how often?)

_____

Never ☐

iii) If simulation exercises have been held, what have been the results?

_____
_____
_____
_____

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