

**FEDERAL STATE BUDGETARY EDUCATIONAL INSTITUTION OF  
HIGHER EDUCATION  
“NORTH-OSSETIA STATE MEDICAL ACADEMY”  
OF THE MINISTRY OF HEALTHCARE OF THE RUSSIAN FEDERATION**

Department of traumatology and orthopedics

**FIRST AID FOR FROZEN AND COLD INJURIES.**

Methodical recommendations for practical classes for 2nd year students of MD-  
program (III semester)

Vladikavkaz. 2020

## **FIRST AID FOR FROZEN AND COLD INJURIES.**

### **TRAINING QUESTIONS**

1. Introduction.
2. The structure of the skin.
3. Frostbite (causes, classification, first aid for frostbite).
4. Hypothermia (classification, symptoms, first aid for hypothermia).
5. Freezing. First aid for freezing.
6. Bandages on possible sites of injury at frostbite.
7. External heart massage. Artificial ventilation of the lungs.

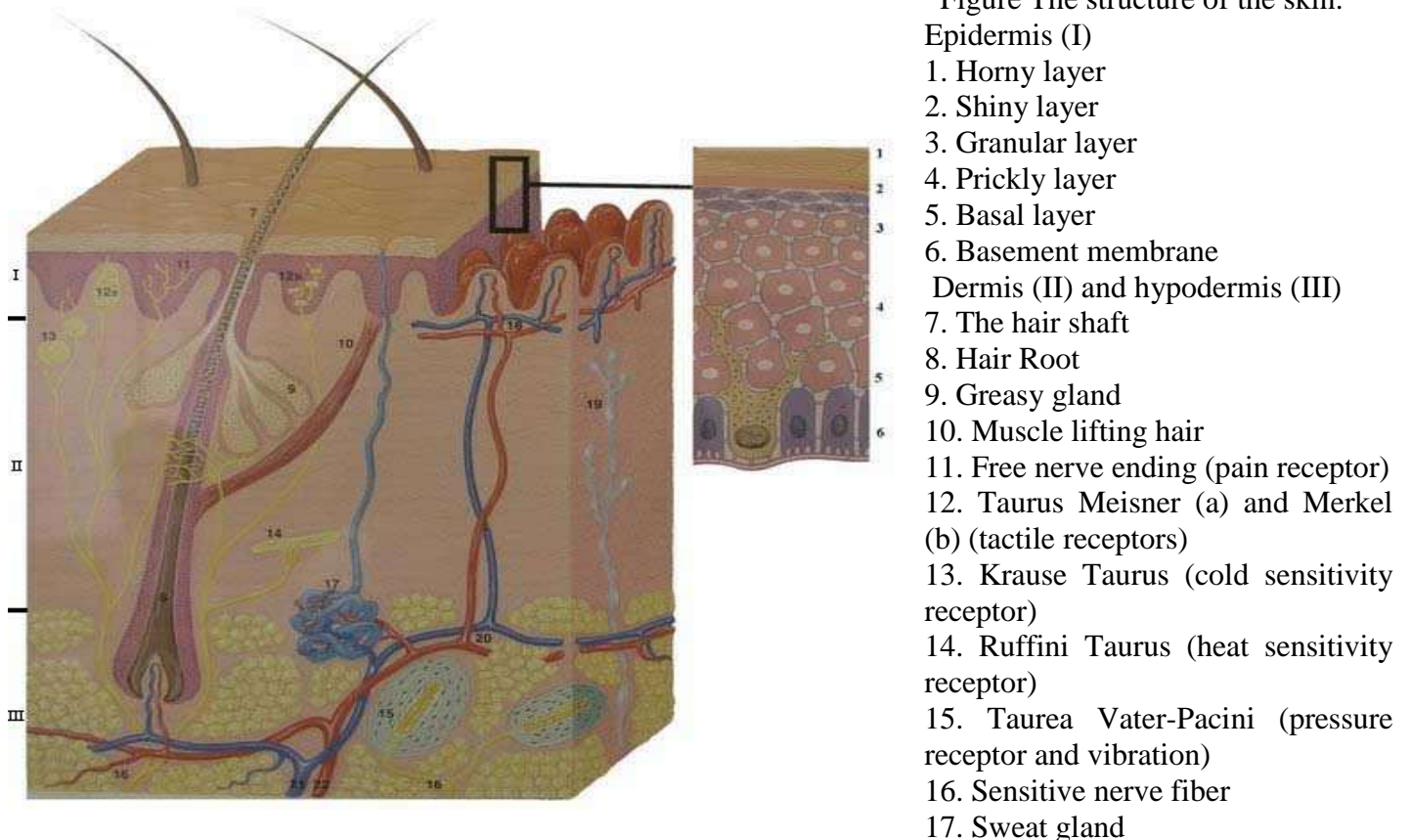
### **1. Introduction.**

The human body functions best at a body temperature of 36-37 ° C, which is kept within these limits due to the work of a special thermoregulation center located in the brain. Warming the body is achieved through the conversion of food into heat energy, as well as due to the heat generated during muscle activity. Therefore, external influence on the system, which is responsible for the body thermoregulation, can lead to certain changes not only in itself, but even threaten life. Lesions that result from exposure to a thermal factor (high or low temperature) are called thermal. Thermal factors primarily act on human skin, and then on the internal organs.

### **2. The structure of the skin.**

Human skin has an area of 1.5-2 m<sup>2</sup>. The mass of human skin is about 5% of body weight. Every day, about 600 ml of water is removed through the skin through sweat, as well as mineral salts, aromatics, proteins and fats. Vitamin D synthesis occurs in the cells of the skin under the action of ultraviolet rays. Sweat is due to the smell of indole derivatives secreted by apocrine sweat glands, which are located in the armpits and perineum. Skin pH - 3.8-5.6.

Figure The structure of the skin.



18. Superficial vascular network of the dermis

19. Lymphatic vessels

20. Deep vascular network of the dermis

21. Veins

22. Arteries

**Epidermis.** Upper, thinnest layer of skin. It is a stratified squamous keratinizing epithelium. Consists of five layers of cells that differ in the degree of differentiation. The lower (basal) layer of the epidermis is bordered by the vessels of the dermis. It is the most active processes of division and metabolism. Moving upward the cells of the epidermis (keratinocytes) flatten and lose the nucleus, as well as the organelles. The water content in them decreases. Thus, the upper (horny) layer consists of "dead" cells in which there is no metabolism. Normally, the process of moving takes about a month. In addition to representing the vast majority of keratinocytes in the epidermis in a smaller number, there are other types of cells: melanocytes that perform the pigment-forming function, Langerhans cells are cells of the immune system, lymphocytes.

**Dermis.** Includes papillary and reticular (reticular) layers. Located in the dermis fibers of collagen and elastin are the support frame of the skin and, together with the interstitial substance, give it elasticity. Here you can find smooth muscle fibers. So the muscle, lifting the hair, contracting, causes the effect of "goose skin". Here are the sebaceous and sweat glands, hair roots, blood vessels, tactile cells of Merkel and Meisner, free nerve endings.

**Subcutaneous fatty tissue (hypodermis).** Bundles of the continuing fibers of the reticular layer of the dermis and the fat cells located between them form subcutaneous fatty tissue. Due to subcutaneous fatty tissue, the body is protected from sudden temperature changes. There is a depreciation of mechanical shocks and shocks. During a long period of nutritional deficiencies, the body receives energy through the breakdown of fat cells.

### **3. Frostbite (causes, classification, first aid for frostbite).**

Any person in the winter season is exposed to varying degrees of exposure to cold. In cold weather, body heat is maintained by means of a reflex mechanism, due to which the blood vessels in the skin are closed. Involuntary muscular activity in the form of trembling and the "goose skin" effect also contributes to warming.

Prolonged loss of heat by the body, especially with continuous cooling, can lead to serious health problems and danger to life.

Cold exposure can be distinguished:

- frostbite (local process);
- hypothermia, freezing (general process).

Frostbite, or frostbite (Latin congelatio) - damage to body tissues under the influence of cold. Often accompanied by general hypothermia of the body and especially often affects such parts of the body as auricles, nose, insufficiently protected limbs, especially the fingers and toes. It differs from "cold burns" resulting from direct contact with extremely cold substances, such as dry ice or liquid nitrogen. Most often frostbite occurs in cold wintertime at an ambient temperature below  $-20-10^{\circ}\text{C}$ . With a long stay outdoors, especially with high humidity and strong wind, frostbite can be obtained in the fall and spring when the air temperature is above zero. The direct cause of frostbite is the effect of low temperature on the human body. The human body has a thermal control system that prevents thermal damage to tissues, but under the action of a number of external factors, the effectiveness of thermoregulation decreases, and frostbite occurs. These factors can be divided into the following main groups:

**1. Weather conditions.** Humidity and wind contribute to frostbite. Often the occurrence of such injuries is possible with positive air temperature, with strong wind and high humidity. Wind and high humidity increase heat transfer, reduce the insulating properties of clothing and footwear.

**2. State of thermal insulation limbs.** Tight shoes, prolonged immobility, the need for constant retention in the hands of any object, reduce the effectiveness of microcirculation, and as a result contribute to the occurrence of cold lesions.

**3. The general condition of the body.** A weakened body produces less heat and, as a result, is more susceptible to cold injury. The reasons leading to a person's increased vulnerability to cold are the most diverse. The most common are injuries, blood loss, lack of food, fatigue and stress.

**4. Various blood supply disorders.** The development of frostbite is largely promoted by obliterating diseases of the extremities, various systemic diseases affecting capillaries, and larger vessels. Similarly, to frostbite, more prone tissues with low vascularization, such as scar tissue.

It is conditionally possible to distinguish 2 large groups of causes of the formation of necrosis during frostbite. These are local and systemic factors.

**Local factors.** There are two causes of cell death in the frostbite. The first reason is the direct traumatic effect of the cold. The second reason is a violation of metabolic processes in tissues and organs due to a decrease in their temperature. Direct cold lesion of tissues is relatively rare with contact frostbite. Most often, metabolic changes lead to cell death. For example, at a temperature of  $+ 8^{\circ}\text{C}$ , hemoglobin ceases to give oxygen to organs and tissues. As a result, ischemia begins to grow in the chilled areas of the body (blood flow stop). In the pathogenesis of local lesions, microcirculation disorders play a leading role. Tissues remain without adequate supply of oxygen and nutrients, as a result of which massive cell death develops, which leads to the appearance of foci of necrosis.

**Systemic factors.** Systemic damaging factors can be divided into 2 groups.

The first is the absorption into the blood of products of autolysis of cells during necrosis of frostbite foci.

The second group includes the overall cooling of the body. This factor begins to operate at body temperature below  $+ 34^{\circ}\text{C}$ . All metabolic processes are slowed down, metabolism is disturbed.

Due to hypothermia, the process of dying with general supercooling has a number of characteristic features.

1. The tissue needs for oxygen is reduced, and therefore, the process of dying is significantly extended in time.

2. When warming, a pronounced "oxygen indebtedness of tissues" is detected, and therefore, a sharp increase in hypoxia and deterioration of the patient's condition is possible.

3. The transition to the state of clinical death is observed at a temperature of  $+ 24^{\circ}\text{C}$  due to the disruption of the work of the respiratory center in the medulla.

4. The duration of clinical death, at which successful resuscitation of the patient is possible, exceeds the usual 5-6 minutes.

**There are several classifications of frostbite on various principles.**

**General classification of damage by low temperatures:**

1. Acute cold lesion.

2. Freezing (damage to internal organs and body systems).

3. Frostbite (development of local necrosis with extensive secondary changes).

4. Chronic cold damage.

5. Cold neuroscience.

6. Foreheading.



According to the mechanism of the development of

#### **frostbite:**

From exposure to cold air.

Contact frostbite.

#### **According to the depth of tissue damage:**

**Frostbite I degree** (easiest) usually occurs with a brief exposure to cold. The affected area of the skin is pale, reddened after warming, in some cases has a purple-red hue, edema develops. Skin death does not occur. By the end of the week after frostbite, there is sometimes a slight peeling of the skin. Full recovery occurs by 5 - 7 days after frostbite. The first signs of such frostbite are a burning sensation, tingling, followed by numbness of the affected area. Then there is itching and pain, which may be minor and pronounced.

**Frostbite II degree** occurs with longer exposure to cold. In the initial period there is blanching, cooling, loss of sensitivity, but these phenomena are observed at all degrees of frostbite. Therefore, the most characteristic feature is the formation of bubbles in the first days after injury filled with transparent contents. Full restoration of the integrity of the skin occurs within 1 to 2 weeks, granulation and scars are not formed. When frostbite of the II degree after warming the pain is more intense and longer than with frostbite of the I degree, itching and burning are concerned.

**Frostbite III degree.** The duration of the period of cold exposure and decrease in temperature in the tissues increases. The bubbles formed in the initial period are filled with bloody contents, the bottom of them is blue-purple, insensitive to irritations. The death of all elements of the skin occurs with the development in the outcome of frostbite granulations and scars. Descended nails again do not grow or grow deformed. Rejection of dead tissues ends on the 2nd - 3rd week, after which scarring occurs, which lasts up to 1 month. The intensity and duration of pain is more pronounced than with frostbite II degree.

**Frostbite IV degree** occurs with prolonged exposure to cold, a decrease in temperature in the tissues with him the greatest. It is often combined with frostbite III and even II degree. All layers of soft tissues are dead, bones and joints are often affected. The damaged area of the limb is sharply bluish, sometimes with a marble color. Edema develops immediately after warming and increases rapidly. The skin temperature is much lower than on the surrounding tissue frostbite.

Bubbles develop in less frostbitten areas where there is frostbite of III — II degree. The absence of blisters with significant edema, the loss of sensitivity indicates frostbite IV degree.

In conditions of prolonged stay at low air temperature, not only local lesions are possible, but also the general cooling of the body. Under the general cooling of the body should be understood as a condition that occurs when the body temperature drops below 34 ° C.

The onset of general cooling is facilitated by the same factors as during frostbite: high humidity, damp clothing, strong wind, physical fatigue, mental trauma, past illnesses and injuries.

**Separately isolated immersion frostbite** (trench foot): the defeat of the feet with prolonged exposure to cold and damp. Occurs at temperatures above 0 ° C. For the first time described in the period of the 1st World War, 1914-1918 in the soldiers during their long stay in the raw trenches. In mild cases, painful numbness, swelling, redness of the skin of the feet appear; in cases of moderate severity - serous-bloody bubbles; in severe form - the death of deep tissues with the addition of infection, the development of wet gangrene is possible.

**"Iron" frostbite.** In practice, there are also cold injuries that occur when warm skin comes into contact with a cold metal object. For example, a curious baby grabs such an object with his bare hand or, even worse, lick it with his tongue, as a result he will stick, and after the adhered area will be poured with warm water and the baby will be released, a contact will appear in the place of contact. In this case, the wound must be urgently disinfected. First rinse with warm water and then with hydrogen peroxide. The escaping bubbles of oxygen will remove the dirt that has got inside. After that, try to stop the bleeding by pressing, tamponade or a tight bandage. If the bleeding is not stopped, immediately call an ambulance.

**First aid for frostbite.** Actions in the provision of first aid vary depending on the degree of frostbite, the presence of general cooling of the body, age and associated diseases.

When frostbite usually used old methods that sometimes even more harm the body - rubbing with woolen cloth, snow. This is by no means to do. It is impossible to rub deeply frozen tissue with a cloth or snow, the integrity of the cells of the frozen areas of the skin will be broken, which leads to irritation, abrasions, bruising, weeping wounds and boils. In addition, you can not immerse frostbitten limb in warm water - even at room temperature. This is due to the fact that the frozen layer quickly thaws, it will resume blood supply and other biological processes, but in the deeper layers of the frozen skin longer minus temperatures persist, and this area will "cut off" the thawed upper layer from the whole organism. Death of the upper portion or the entire limb may occur.

**First aid is to stop cooling,** warming the limb, restore blood circulation in the affected tissues and prevent infection. The first thing to do with signs of frostbite is to deliver the victim to the nearest warm room, remove frozen shoes, socks, and gloves. Gradually warm dry heat (heat radiators). Apply a special thermoinsulating bandage to the affected surface - first, the affected area is bandaged, then wrapped with a thick layer of cotton, over which it is necessary to apply a layer of polyethylene, oilcloth; after which the affected area with a bandage is wrapped in a woolen cloth (scarf, shawl, blanket). The victim should be offered to drink coffee or tea. Simultaneously with the conduct of first aid activities, it is necessary to urgently call an ambulance.

**When frostbite I degree** chilled areas should be warmed to redness with warm hands, light massage, breathing, and then put a cotton-gauze bandage.

**When frostbite II — IV degree** fast warming, massage or rubbing should not be done. Apply a heat-insulating bandage to the affected surface (a layer of gauze, a thick layer of cotton wool, again a layer of gauze, and on top of an oilcloth or rubberized fabric). The affected limbs are fixed with the help of available tools (a plank, a piece of plywood, thick cardboard), imposing and pinning them over the bandage. Outerwear and so on can be used as a heat insulating material. Victims are given hot drinks, hot food, on an aspirin tablet, and Analgin.

**4. Hypothermia** (classification, symptoms, first aid for hypothermia).

More serious in terms of consequences and danger to life is the general overcooling of the body, when a person for one reason or another is exposed to prolonged exposure to dry frost or cold water. The mechanism for the development of hypothermia due to the specificity of the effects of cold on the whole body is similar to that in shock: bleeding the peripheral organs will lead to centralization of blood circulation and depletion of the energy capabilities of the body's defense mechanisms.

**There are mild, moderate and severe degrees of general hypothermia.**

**Mild:** body temperature 32-34 ° C. The skin is pale or moderately bluish, appear "goose bumps", chills, difficulty speaking. Pulse slows to 60-66 beats per minute. Blood pressure is normal or slightly elevated. Breathing is not disturbed. Possible frostbite I-II degree.

**Average degree:** body temperature 29-32 ° C, characterized by severe drowsiness, depression of consciousness, meaningless look. Pale skin, bluish, sometimes with marble color, cold to the touch. Pulse slows down to 50-60 beats per minute, weak filling. Blood pressure is reduced slightly. Breathing is rare - up to 8-12 per minute, superficial. Frostbite of the face and extremities of the I — IV degree are possible.

**Severe:** body temperature below 31 ° C. Consciousness is absent, there are convulsions, vomiting. The skin is pale, bluish, cold to the touch. Pulse slows to 36 beats per minute, weak filling, there is a pronounced decrease in blood pressure. Breathing is rare, superficial - up to 3-4 per minute. There are severe and widespread frostbite until glaciation.

**Signs of hypothermia.** Prolonged exposure of dry frost to the entire human body is less dangerous to life than exposure to cold water. Therefore, the time of development of complications and, accordingly, a threat to the life of a person who has fallen into the water will be different.

Water temperature	Possible duration of survival
Below 2 ° C	Less than 45 minutes
2-4 ° C	Less than 1.5 hours
4-10° C	Less than 3 hours
10-15° C	Less than 6 hours
15-20° C	Less than 12 hours
Above 20 ° C	Time indefinite, depends on fatigue

However, the external signs and subjective feelings of the victim will be the same:

- shivering or chills;
- loss of sensitivity of the limbs (numbness);
- lethargy;
- loss of movement coordination;
- unusual behavior;
- body temperature 35 ° C and below;
- at later stages loss of consciousness may occur;
- the characteristic appearance of the victim - he "shrinks", as it were, trying to group.

**First aid for hypothermia.** If the victim has signs of frostbite and hypothermia at the same time, then first of all it is necessary to proceed to general warming of the victim, eliminating signs of hypothermia, and then carry out measures for local impact on the affected areas.

The following measures should be taken:

1. remove the victim from the prevailing hypothermia, quickly release from wet clothes;
2. call an ambulance;
3. slowly, gradually warm the affected person with dry heat.

4. put warm warmers on the back of the head and the liver area;
5. give the victim warm sweet tea, some carbohydrate food (cookies, white bread);
6. If the victim is unconscious, but with preserved cardiac activity and breathing, he should be put in a "safe position", covered up warmly and waiting for the arrival of the doctors to constantly monitor the condition and the flow of his airways;
7. If a respiratory arrest or pulse occurs, it is necessary to urgently fulfill the requirements of the preparatory stage of resuscitation and proceed to perform the CPR complex, following the ABC rule.

#### **5. Freezing. First aid for freezing.**

Freezing occurs as a result of depletion of the adaptation mechanisms of thermoregulation, when the body temperature under the influence of external cooling decreases progressively, and all vital functions are inhibited until their complete extinction.

With the development of the freezing process, two periods are distinguished - latent and reactive. Hidden period: drowsiness, lethargy, slowness of reactions, speech, movements, general trembling of the body prevail.

With continued exposure to low temperature, three freezing phases occur successively.

**Adynamic phase.** In the initial period of decreasing temperature, all vital functions of the body are amplified and, above all, the excitability of the nervous system increases; the frequency and depth of respiration increase, pulse increases and blood pressure increases, blood flow speeds up, metabolism and oxygen consumption of the body increase. Due to this, for some time the normal level of body temperature is maintained due to the maximum tension of all body forces and increased heat production. Then comes a decrease in body temperature, followed by a drop in the main indicators of vital functions. Respiration rate, heartbeat decreases, consciousness is inhibited, reactions slow down, speech stiffness, drowsiness, etc. appear.

**Stuporous phase.** It should be considered as a protective inhibition of the cerebral cortex with spread to the lower parts of the central nervous system. The frequency of respiration and pulse slows down, the strength of heart contractions weakens, hypoxia and hypoxia increase, the trembling stops. Developed severe muscle rigidity, incontinence of urine and feces. Mental activity is completely suppressed, the excitability of the subcortical centers decreases, reactions and reflexes weaken.

**Convulsive phase.** The metabolism is sharply reduced and the supply of tissues with oxygen is disturbed. Cardiac activity weakens, blood pressure disappears. The breathing rhythm is disturbed and it stops. Muscle tone and muscle rigidity disappear. In the final phase of the development of transboundary inhibition, parabiosis, and paralysis of the central nervous system, all vital functions die down, and clinical death occurs.

Reactive period: comes after warming the body as a whole. During this period, various pathological processes in the internal organs (pneumonia, nephritis, etc.) and disorders of the nervous system (neuritis, paralysis, trophic lesions, mental and nervous diseases, etc.) can develop.

The main task of first aid in case of pronounced freezing is the rapid active warming, aimed at the early restoration of the normal level of the human body temperature. Passive warming (wrapping in a warm room, etc.) such victims should be considered fruitless loss of time. It is dangerous only to overheat, which can cause serious consequences even with a small excess of body temperature. Therefore, rational measures of active warming should ensure the fastest return of body temperature to a normal level and at the same time prevent the danger of overheating.

The following measures should be taken:

1. remove the victim from the prevailing hypothermia, quickly release from wet clothes;
2. call an ambulance;

3. warming the victim in the bathroom with a water temperature of 21-24 ° C, with a gradual increase in water temperature every 30 minutes at 2 -3 ° C;
4. put warm warmers on the back of the head and the liver area;
5. give the victim warm sweet tea, some carbohydrate food (cookies, white bread);
6. If the victim is unconscious, but with preserved cardiac activity and breathing, he should be put in a "safe position", covered up warmly and waiting for the arrival of the doctors to constantly monitor the condition and the flow of his airways;
7. If a respiratory arrest or pulse occurs, it is necessary to urgently fulfill the requirements of the preparatory stage of resuscitation and proceed to perform the CPR complex, following the ABC rule.

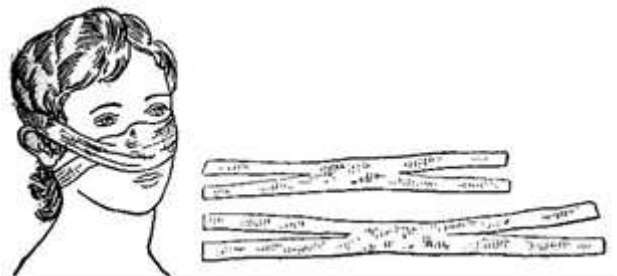
#### 6. Bandages on possible sites of injury at frostbite.

One of the first aid measures for frostbite is bandages, let's look at the most common bandages for this type of lesion.

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1. **Thorough dressings.** When wounds of the protruding parts of the face - the nose and lower jaw - apply torsion bandages (Fig. 1). They are applied with a bandage, the ends of which are cut lengthwise. When applying a sling on the jaw, the upper ends of the sling are tied around the neck, and the lower ends on the crown.



**Figure 1. Nose bandage**



2. **Neapolitan dressing on the ear.** Initially, horizontal anchoring rounds are applied around the head. Then, in the nape area, the bandage is led down to the injured ear and slanting upward above the eye. The third move (fixative) is made around the head. The fourth and subsequent moves alternate in such a way that one move of the bandage goes into the ear, and the next is fixing. Bandaging is completed in circular motions on the head (Fig. 2).

3. **Spiral bandage on the finger (Fig. 3).** Most of the wrist bandages begin with circular bandaging moves in the lower third of the forearm directly above the wrist. The bandage is held obliquely along the rear of the hand to the end of the finger and, leaving the fingertip open, spiral the bandage to the base with spiral passages. Then again through the rear of the brush return bandage on the forearm. Bandaging is completed in circular tours in the lower third of the forearm.

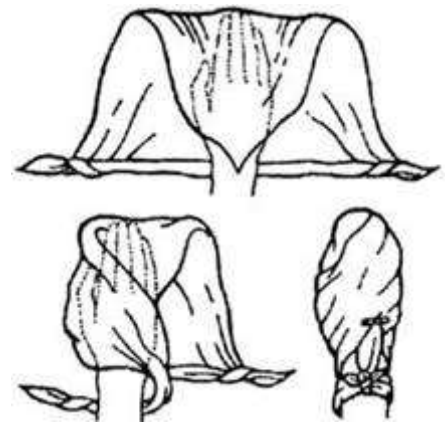


4. **Cruciform bandage on the brush (Fig. 4).** Closes the back and palmar surface of the hand, except for the fingers, fixes the wrist joint, limiting the range of movements. The width of the bandage is 10 cm. Bandaging begins with reinforcing rounds on the forearm. Then the bandage is guided through the rear of the hand to the palm, around the hand to the base of the second finger. From here on the rear of the brush bandage obliquely return to the forearm. For a more reliable retention of the dressing material on the wrist, the cruciform



passages supplement the circular passages of the bandage on the wrist. Rounding out the bandage in circular tours over the wrist.

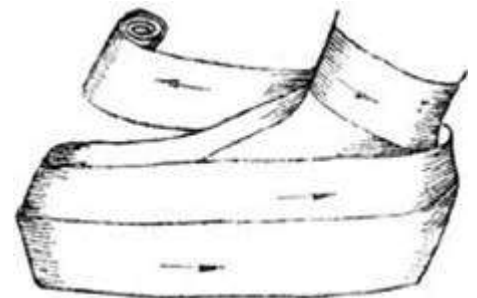
**5. Cruciform bandage on the brush** (Fig. 4). Closes the back and palmar surface of the hand, except for the fingers, fixes the wrist joint, limiting the range of movements. The width of the bandage is 10 cm. Bandaging begins with reinforcing rounds on the forearm. Then the bandage is guided through the rear of the hand to the palm, around the hand to the base of the second finger. From here on the rear of the brush bandage obliquely return to the forearm. For a more reliable retention of the dressing material on the wrist, the cruciform passages supplement the circular passages of the bandage on the wrist. Rounding out the bandage in circular tours over the wrist. .



**6. Spiral bandage on the first toe** (Fig. 1). The width of the bandage is 3-5 cm. Usually, only one thumb is usually bandaged. Bandaging is recommended to start with strengthening circular tours in the lower third of the leg over the ankles. Then, through the back surface of the foot, the bandage is led to the nail phalanx of 1 finger. From here, spiral tours cover the entire finger to the base and again, through the rear of the foot, return the bandage to the shin, where the dressing is completed with fixing circular tours.

**7. Spike bandage on the first toe of the foot** (Fig. 7). The width of the bandage is 3-5 cm. Like all spica-shaped bandages, the spica bandage on the first toe is bandaged in the direction of the damage. On the left foot, bandage is conducted from left to right, on the right foot - from right to left.

Bandaging begins by strengthening circular rounds in the lower third of the leg over the ankles. Then the bandage is led from the inner ankle to the back side of the foot to its outer surface and along the plantar surface to the inner edge of the nail phalanx of the first finger. After the circular turn on the first finger, the stroke of the bandage is transferred along the back surface of the foot to the outer edge and a circular turn through the plantar surface to move the bandage to the external ankle. Each subsequent round of the bandage on the first finger is shifted upwards relative to the previous one, thus forming an ascending spica bandage. Retractable bandage on peripheral parts of the foot. Applied with diseases and injuries of the peripheral parts of the foot and toes. The width of the bandage is 10 cm. Each finger is covered with a dressing material separately, or all of the fingers, along with gauze pads between them. Then proceed to the bandaging of the foot. Circular strengthening tours impose in the middle sections of the foot. After that, the longitudinal returning rounds from the plantar surface of the foot through the tips of the fingers to the dorsal surface and back, close the foot across the entire width. By the creeping motion the bandage is led to the tips of the fingers, from where the spiral tours bandage the foot to the middle. The bandage on the foot is usually poorly held, therefore it is recommended to finish the bandage with strengthening eight-shaped tours around the ankle joint with fixing circular tours over the ankles.



**8. Returning bandage on the entire foot** (Fig. 8). It is used for damage to the foot, when you want to close the entire foot, including the fingers. The width of the bandage is 10 cm.

Bandaging begins with circular fixing tours in the lower third of the leg over the ankles. Then the bandage move is transferred to the foot, from the side of the inner ankle on the right foot and from the side of the outer ankle on the left, and impose several roundabouts along the side surface of the foot to the first finger, from it back on the opposite side surface of the foot to the heel. From the heel creeping lead bandage to the fingertips and bandage the foot with spiral strokes in the direction of the lower third of the leg. In the area of the ankle joint, a technique of applying a bandage on the heel area is used (Fig. 5). Finish the bandage in circular tours over the ankles.

**9. Cravat on the whole foot (Figure 9 a, b).** The plantar area is closed with the middle of the kerchief, the top of the kerchief is wrapped, covering the fingers and the rear of the foot. The ends are slung over the back of the foot, crossed, and then twisted around the lower leg over the ankles and knotted on the front surface.



**A blanket bandage on the heel region and the ankle joint (Fig. 9c).** The kerchief is placed on the plantar surface of the foot. The base of the scarf is located across the foot. The tip is located on the back surface of the ankle joint. The ends of the kerchief are crossed first on the back of the foot, and then above the tip of the ankle and the lower third of the tibia, which is wound up on the back surface. Tie ends on the front surface of the tibia above the ankles.

## **7. External heart massage. Artificial ventilation of the lungs.**

When a person is found as a result of freezing in an unconscious position, a formidable complication is possible - dropping the root of the tongue. Sinking down the tongue root is a fairly frequent and ridiculous reason for the unreasonable death of the victim, who is unconscious in a supine position.

In this case, the root of the tongue, due to gravity and due to the lack of control from the cerebral cortex, sinks and blocks the flow of air through the oropharynx into the trachea. To restore the airway patency, as was discussed above, the following can be done: it is necessary to tilt the victim's head back, creating the so-called over-bending of the head (Fig. 17).

Tilting of the head is achieved in various ways: the resuscitator is located either at the head of the victim, or facing him and, holding the fingers of both hands at

the back of the neck, produces a neat tipping back of the victim's head, simultaneously fixing the cervical spine; head tilting can also be done by over-bending the head, when one arm of the resuscitator is placed



Рис. 19. Осуществление пробного (диагностического) выдоха в дыхательные пути пострадавшего с целью определения их проходимости (одновременно производится визуальный контроль поднимания грудной клетки во время выполнения ИВЛ)

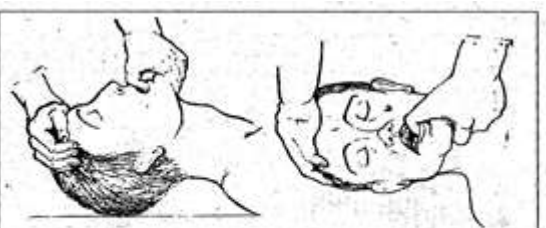


Рис. 20. Модификация «тройного приема» — метод «крючка» (за нижнюю челюсть)

on the victim's forehead, and the other is placed under the neck from the inside (or holding the lower jaw) and hand movements are carried out in mutually opposite directions.

You can also use a roller from improvised means (a scarf, a muffler, a hat, etc.), which is enclosed either under the victim's neck or under his shoulder blades. This technique in most cases allows to achieve the discharge of the root of the tongue of the victim from the back wall of the larynx (Fig. 18).

In order to find out whether the victim's airways are permeable or not, it is necessary to carry out a so-called test diagnostic breath (PDV) —that is, following the technique of mechanical ventilation, try to inhale the victim 2-3 times in the respiratory tract, feeling airway patency for a stream of air (no resistance during inhalation) and visually checking the rise of the chest (Fig. 19).

However, in almost 20% of people, due to the individual anatomical features of the neck, the maximum extension of the head does not provide a sufficient degree of permeability of the upper respiratory tract. And therefore, if the PDV did not succeed, it is guaranteed to eliminate the dropping of the root of the tongue if you carry out the so-called triple reception of Safar (by the name of the American resuscitator who developed this method), which includes the following three actions

- drooping of the head;
- extension of the lower jaw;
- mouth opening. In this case, the resuscitator can be located both at the head of the victim, and facing him.

To extend the lower jaw forward, it is necessary to place four fingers of each hand behind the corners of the lower jaw and, resting your fingers on its edge, push it forward so that the lower teeth are ahead of the upper ones.

Extending the mandible forward creates conditions for the guaranteed separation of the root of the tongue from the back wall of the larynx, thereby eliminating one of the most common causes of airway obstruction.

If in a real situation for any reason it is impossible to perform the "triple reception" in the classical way, then you can eliminate the sticking of the language using any of its varieties or modifications: using the hook method, in which the resuscitator's thumb pushes the victim's front lower teeth (second the hand fixes the head behind the forehead) and pulls the lower jaw forward (Fig. 20).

Also, the extension of the lower jaw forward can be provided with the victim's head thrown back and fixed backward, holding his lip and pulling it anteriorly.

It would be more convenient and more reliable to eliminate a fallen root of the tongue by using a duct, a special device that follows the contour of the human oropharynx for artificial respiration. In the car first aid kits, as well as in rescue packings, there should be three types of air ducts for the main age categories: children, adolescents and adults.

The duct insertion technique is as follows: the victim is lying on his back, turn his head to the side and clean the mouth; then the victim's head returns to its original position, the mouth opens and the duct is inserted with a cut (concavity) to the victim's sky; after which the air duct is screwed into the oropharynx of the victim and already turns out to be its concavity to his tongue, thereby moving away the root of the tongue.

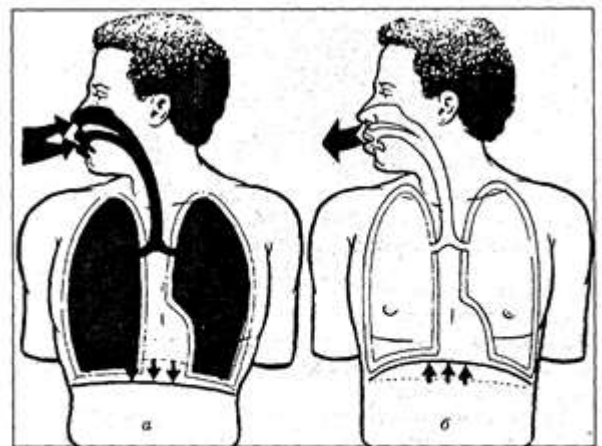


Рис. 23. Механизм дыхания:  
а — акт вдоха (диафрагма опускается вниз, воздух активно засасывается в дыхательные пути); б — акт выдоха (диафрагма возвращается в исходное положение, воздух пассивно выходит из дыхательных путей)

Next, the lower jaw is pressed against the upper part of the duct, while its bezel should be above the victim's lips, after which the head returns to its original position.

With a correctly inserted duct, the dropping of the tongue root is guaranteed to be eliminated and, moreover, the duct bezel ensures a certain safety of the resuscitator, eliminating contact with the victim's lips.

Thus, to eliminate the most common cause of airway obstruction in an injured person, who is unconscious in a supine position, is the dropping of the tongue root in the following ways:

- 1) dropping the victim's head back;
- 2) conducting a "triple taking Safar" in the classical way or applying its variants (modifications);
- 3) the introduction of the duct.

Artificial ventilation of the lungs - is used for various violations of the respiratory function, as well as in a state of clinical death, regardless of the cause that caused it. Exhaled air, containing 16-18% oxygen, is an adequate resuscitation gas, provided that the victim's lungs are normal and the resuscitator performing the ventilator uses 2 times more breathing volume than normal.

At the same time, arterial blood oxygen saturation can reach about 80–90% of the norm, which will create conditions for maintaining the brain in a viable state. Therefore, you should never postpone the implementation of urgent artificial respiration. IVL is carried out in several ways:

- using an ADR (respiratory hand-held device), which is located in rescue packings, and against the background of an already introduced ventilation duct, ventilation can be very successful; in addition, the apparatus itself is equipped with a non-reversible valve, which allows only ambient air to be sucked in (where the percentage of oxygen, as



Рис. 36. Проведение ИВЛ ребенку (воздух одновременно посылается и в рот, и в нос маленькому пострадавшему)

- in young children, mechanical ventilation is performed using both of the above methods, i.e. injection is carried out simultaneously in the mouth and in the nose of the small victim (Fig. 36).

**Conducting IVL method "mouth-to-mouth."** In order to perform IVL in this way, it is necessary to sit slightly to the

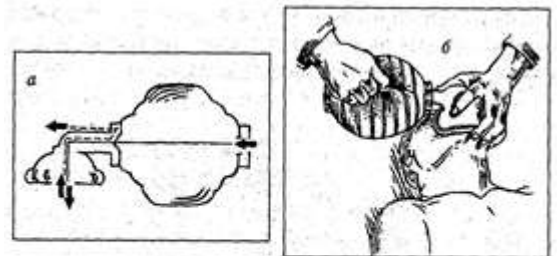


Рис. 34. Использование АДР (аппарата дыхательного ручного): а — устройство аппарата (схема); б — проведение искусственной вентиляции легких при помощи АДР

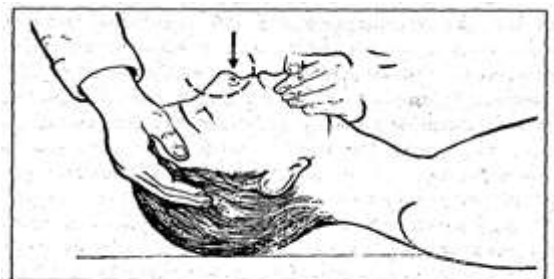


Рис. 35. Проведение ИВЛ методом «изо рта в нос»

as noted above, is much higher than in the exhaled air), as well as an oxygen supply to the ADRs, which increases many times the efficiency of this method (Fig. 34);

- using the "mouth-to-mouth" ("mouth-to-mouth") method — the most commonly used method of ventilating ventilators in real situations;

- "from mouth to nose" method - if for some reason the previous method turns out to be ineffective or is impossible (for example, the victim's jaws are tightly compressed), this method can be used (Fig. 35), although this method can prevent, for example, a banal runny nose;

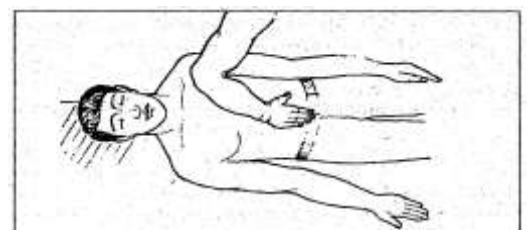


Рис. 37. Удаление воздуха из желудка при ошибочном его нагнетании

side of the victim's head, tilt his head back with one of the above methods, clamp the nose wings (to create tightness), inhale deeper than usual and tightly press your mouth to the victim's half-open mouth respiratory tract, while controlling the rise of the chest.

Then you need to slightly pull back, holding your head in the upturned position, and give the opportunity to passive exhalation, the duration of which should be about twice as long as the breath. As soon as the rib cage descends and assumes its original position, the cycle should be repeated.

As with every action, a ventilator has its own parameters (technical conditions), which must be followed in order for artificial lung ventilation to be as effective as possible. They, of course, depend on the age and age characteristics of the victim, but the main criterion of a properly performed mechanical ventilation will be the rise of the chest when performing a "breath".

If excessive (erroneous) air is forced into the lungs, as well as insufficient head drooping, it is possible that it enters the stomach, which can cause the acidic contents of the stomach to enter the victim's airways and lungs (and this can lead to destruction of the lung tissue).

Therefore, if during the IVL procedure, instead of raising the chest, the victim's abdomen swells (stomach, in particular), you need to do the following: turn the victim on his side, face the resuscitator, and press his stomach with his fist or palm base several times to remove air from stomach (Fig. 37), while you need to get ready to clean the oral cavity, then immediately continue the IVL (Fig. 38).

**External heart massage** - was developed in 1960, when Covenhoken described and scientifically proved the high efficiency of this method of recovery (more than 40% of the norm). Moreover, any deviations caused by the technically incorrect application of the Method significantly reduce the effectiveness of the entire resuscitation, lead to an unfavorable outcome and, ultimately, the death of the victim. Proper NMS equipment is a prerequisite for resuscitation success. The purpose of the NMS is to squeeze the victim's sternum in such a way that the following two mechanisms "work"

- direct pressure on the heart muscle; change (increase) in the total intrathoracic pressure, the so-called "thoracic pump" (Fig. 39).

Therefore, for the successful implementation of the NMS, the victim must be laid on a hard, flat surface and, despite the season and his gender, the head-neck-chest block should be removed from the clothing items, and the waist belt or trouser belt should be undone. The pressure at the NMS is carried out with the base of the palm (fig. 40) in a strictly defined place (fig. 41, 43). The

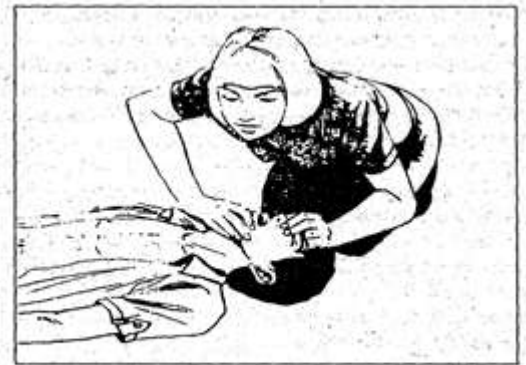


Рис. 38. Правильное проведение ИВЛ (выполнен тройной прием)

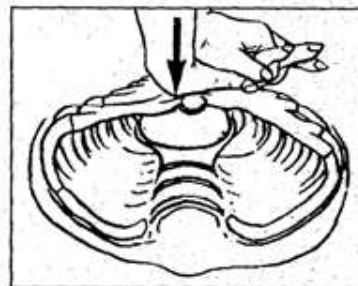


Рис. 39. Схематичное изображение наружного (непрямого) массажа сердца — НМС

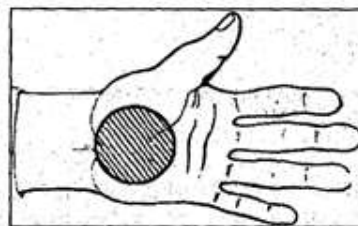


Рис. 40. Основание ладони для проведения НМС



Рис. 41. Правильное место для проведения НМС

base of the palm is set perpendicular to the axis of the sternum in a strictly defined place, which in real conditions can be found in the following ways:

- on the edge of the second finger above the xiphoid process (lower part of the sternum) (Fig. 42); to clasp the chest with the palm of your hand (if the injured man or young woman) and “expose” the arm, i.e. lift the brush, with the base of the palm will be located in the right place (Fig. 44).

The second hand is located on top of the first one, either parallel to it, or perpendicularly (Fig. 45), or the fingers of both hands intertwine and pull away from the difficult cell (Fig. 45).

It is necessary to press with the weight of your body, slightly leaning over the injured, arms straightened in the elbow joints, while the fingers of the lower arm of the chest cell do not touch in any way (Fig. 46).

NMS begins with a press-like squeezing of the sternum and its displacement towards the spine (lasting about 0.5 seconds) and a quick relaxation of the arms, while the arms do not come off the sternum (Fig. 39, 44, 45). If it is necessary to carry out NMS for adolescents, pressure is applied with one hand, which, however, is set in the same way as for an adult victim (Fig. 47).

An external heart massage to young children is performed with two fingers of the resuscitator, which are located on the victim’s sternum as follows: place three fingers along the imaginary line connecting the nipples, then lift the finger along this line, and the other two appear in the exact location of the NMS (Figure 48).

There are parameters for NMS, presented in the form of table 1.

It should be noted that the force of pressing for adequate compression of the heart muscle with NMS can be measured in real conditions only by the depth of displacement (“squeezing”) of the



Рис. 42. Один из способов определения правильного места для проведения НМС

Рис. 43. Точка на грудине, где должно располагаться основание ладони при проведении НМС



Рис. 44. Один из вариантов расположения рук реаниматора для выполнения НМС («европейский способ»)

Рис. 45. Один из вариантов постановки рук реаниматора для проведения НМС («российский способ»)



Параметры НМС

Параметры	Возрастные категории		
	Дети	Подростки	Взрослые
Частота нажатий (в мин)	120	100	90
Сила нажатий (в см)	1–2	3–4	4–5

sternum. The use of excessive force can lead to multiple fractures of the ribs and (or) the sternum with damage to the chest organs.

## TEST CONTROL.

### 1. Human skin has an area of:

- 0.5-1 m<sup>2</sup>.
- 1.5-2 m<sup>2</sup>.
- 2.5-3 m<sup>2</sup>.

### 2. The mass of human skin is about:

- 1% of body weight.
- 5% of body weight.
- 10% of body weight.

### 3. In the cells of the skin under the action of ultraviolet rays occurs the synthesis

1. Vitamin A.

2. Vitamin B.

3. Vitamin D.

4. pH of human skin is normal:

1. 3.8-5.6.

2. 5.8-6.6.

3. 7.0-7.6.

5. Cells of the immune system of the skin are cells:

1. Langerhans.

2. Merkel.

3. Meisner.

6. With general hypothermia characteristic:

1. the process of dying is significantly reduced in time.

2. the process of dying is not changed in time.

3. the process of dying is significantly extended in time.

7. Tactile cells of the skin are cells:

1. Langerhans.

2. Merkel.

3. Lymphocytes.

8. The transition to the state of clinical death is observed at a temperature of:

1. + 21C °.

2. + 24C °.

3. + 26C °.

9. During hypothermia, the duration of clinical death, at which successful resuscitation of the patient is possible:

1. exceeds the usual 5-6 minutes;

2. exceeds the usual 8-10 minutes;

3. exceeds the usual 12-15 minutes.

10. When frostbite I degree:

1. on the affected area formed in the first days after injury bubbles filled with transparent contents;

2. pale skin affected area, reddened after warming, skin necrosis does not occur;

3. in the affected area are formed in the first days after injury blisters filled with bloody contents.

11. Frostbite II degree:

1. on the affected area formed in the first days after injury bubbles filled with transparent contents;

2. pale skin affected area, reddened after warming, skin necrosis does not occur;

3. in the affected area are formed in the first days after injury blisters filled with bloody contents.

12. Frostbite III degree:

1. on the affected area formed in the first days after injury bubbles filled with transparent contents;

2. pale skin affected area, reddened after warming, skin necrosis does not occur;

3. in the affected area are formed in the first days after injury blisters filled with bloody contents.

13. Frostbite IV degree:

1. on the affected area formed in the first days after injury bubbles filled with transparent contents;

2. on the affected area formed in the first days after injury bubbles filled with bloody contents;

3. The damaged part of the limb is sharply bluish, sometimes with a marble color, edema develops immediately after warming and rapidly increases, there are no blisters.

14. With a slight degree of hypothermia:

1. body temperature 29-32 ° C;
2. body temperature 32-34 ° C;
3. body temperature below 31 ° C.

15. With a moderate degree of hypothermia:

1. body temperature 29-32 ° C;
2. body temperature 32-34 ° C;
3. body temperature below 31 ° C.

16. With a severe degree of hypothermia:

1. body temperature 29-32 ° C;
2. body temperature 32-34 ° C;
3. body temperature below 31 ° C.