MINISTRY OF HEALTHCARE OF UKRAINE
DANYLO HALYTSKY LVIV NATIONAL MEDICAL UNIVERSITY

SURGICAL DEPARTMENT #1

FROSTBITE

Guidelines for Dentistry Students

LVIV – 2019
Approved at the meeting of the surgical methodological commission of Danylo Halytsky Lviv National Medical University (Meeting report № ___ of ____________ ___ 2019)

Guidelines prepared:

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Referees:

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I. **Background**

Frostbite is the freezing of tissue and may involve only superficial tissues or may extend to the bone. The onset and severity of frostbite may be affected by air temperature, wind speed, duration of exposure, amount of exposed area, and predisposing conditions such as:

- Poor or inadequate insulation from the cold or wind;
- Immersion;
- Altitude;
- Impaired circulation from tight clothing or shoes;
- Fatigue;
- Injuries;
- Circulatory disease;
- Poor nutrition;
- Dehydration;
- Hypothermia;
- Alcohol or drug use; and
- Use of tobacco products.

Damage to the frostbitten tissues is caused by crystallization of water within the tissues, typically between the cells, and by resulting changes in electrolyte concentration within the cells. Damage occurs during the freezing process. Further damage occurs during reperfusion of frostbitten tissue. Frostbite is frequently seen in Alaska, although, in most circumstances, the frostbite is superficial and treated by the patient at home. Occasionally, it is severe enough to warrant transport to a medical facility for evaluation and treatment. Seldom will it be necessary for emergency medical personnel to perform in-field rewarming for deep frostbite. It may, however, be necessary to treat patients with superficial frostbite who have sustained other injuries, (e.g. a motor vehicle crash patient who has been exposed to sub-zero temperatures while awaiting the arrival of rescue and medical personnel).

II. **Learning Objectives**

1. To study the etiological factors of cold injury and frostbite, classification, clinical signs, diagnostic methods, treatment and complications ($\alpha = I$).
2. To know the main causes of the cold injury and frostbite, typical clinical course and complications, diagnostic value of laboratory and instrumental methods of examination and the principles of the modern conservative and surgical treatment ($\alpha = II$).
3. To be able to collect and analyze the complaints and disease history, thoroughly perform physical examination, determine the order of the most informative examination methods and perform their interpretation, establish clinical diagnosis, justify the indications for surgery, choose adequate method of surgical intervention ($\alpha = III$).
4. To develop creativity in solving complicated clinical tasks in patients with atypical clinical course or complications of cold injury and frostbite ($\alpha = IV$).
III. Purpose of personality development

Development of professional skills of the future specialist, study of ethical and deontological aspects of physicians job, regarding communication with patients and colleagues, development of a sense of responsibility for independent decision making. To know modern methods of treatment of patients with cold injury and frostbite and its complications.

IV. Interdisciplinary integration

<table>
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<th>To know</th>
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<td>Determine the topographic location and degree of the frostbite</td>
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<td>Describe macroscopic changes of inflamed skin and identify morphological forms</td>
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<td>3. Propedeutics of internal diseases</td>
<td>Sequence of patient’s survey and physical examination of the injured patients</td>
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<td>Groups and representatives of antibiotics, analgesics, antiinflammatory drugs, colloid and crystalloid solutions</td>
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<td>Efficiency of radiological investigation in patients with cold injury and frostbite</td>
<td>Indications and description of x-ray, ultrasound, computed tomography examination</td>
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</tbody>
</table>

Future subjects

| Anesthesiology and Critical Care Medicine | Clinical signs urgent conditions that occur in patients with complications of cold injury and frostbite, methods of diagnosis and pharmacotherapy | Determine the symptoms of urgent conditions, differential diagnosis and treatment |
V. Content of the topic and its structuring

General Points

A. Hypothermia and other life threatening conditions may be present in the patient with frostbite and must be evaluated and treated immediately.

B. When caring for a patient in extremely cold temperatures, take great care to prevent hypothermia. Protect tissues from becoming frostbitten, and already frostbitten tissues from worsening.

C. If the decision has been made not to rewarm frostbitten tissue in the field, it should be protected, during transport, from additional injury and temperature changes.

D. **Superficial frostbite** affects the dermis and shallow subcutaneous layers of the part exposed, and is recognized by white or gray colored patches. The affected skin feels firm, but not hard. The skin initially turns red and, once frostbitten, is not painful. No deep tissue loss will occur when treated with rapid rewarming.

E. **Deep frostbite** affects the dermal and subdermal layers and may involve an entire digit or body part. The skin feels hard and cold and the affected tissue is white or gray. A pulse cannot be felt in the deeply frostbitten tissue and skin will not rebound when pressed.

F. Large blisters on the frostbitten area indicate that deep frostbite has partially or totally thawed.

G. Treatment of deep frostbite may be painful and is best accomplished in a medical facility. Before electing to rewarm frostbitten tissue in the field, advice should be sought by radio or telephone, if possible, from a physician who is knowledgeable about field treatment of frostbite.

If transport time will be short (1-2 hours at most), the risks posed by improper rewarming or refreezing outweigh the risks of delaying treatment for deep frostbite.

If transport will be prolonged (more than 1-2 hours), frostbite will often thaw spontaneously. It is more important to prevent hypothermia than to rewarm frostbite rapidly in warm water. This does not mean that a frostbitten extremity should be kept in the cold to prevent spontaneous rewarming. Anticipate that frostbitten areas will rewarm as a consequence of keeping the patient warm and protect them from refreezing at all costs.

H. Tissue which is thawed and then refrozen almost always dies. Consequently, the decision to thaw the frostbitten tissue in the field commits the provider to a course of action which may involve pain control, maintaining warm water baths at a constant temperature, and protecting the tissue from further injury during rewarming and eventual transport. Once an extremity is rewarmed in the field, it should not be used for ambulation.

I. In most cases, the patient should be transported as promptly as circumstances allow. When frostbite is mild and is not complicated by other injuries, and there are resources available to care for the patient without transport, it may be appropriate not to transport the patient to a medical facility. This should only be done in consultation with a physician who is knowledgeable about the treatment of frostbite. The decision not to transport should be carefully documented by the prehospital provider, as with any such decision.
J. Cautions:
1. do not rub the frozen part;
2. do not allow the patient to have alcohol or tobacco;
3. do not apply ice or snow;
4. do not attempt to thaw the frostbitten part in cold water;
5. do not attempt to thaw the frostbitten part with high temperatures such as those generated by stoves, exhaust, etc.;
6. do not break blisters which may form.
K. Frostbitten tissues should be handled extremely gently before, during, and after rewarming.
L. When moving patients with frostbite by helicopter, care must be taken to protect the patient from additional exposure to cold due to the increased windchill caused by rotorwash. Rotorwash can be minimized if the helicopter shuts down while loading and unloading. If this is unsafe from an aviation standpoint, the patient must be packaged carefully to avoid any additional loss of heat or skin exposure that can cause or worsen frostbite and hypothermia.

**FROSTBITE**

Frostbite is injury due to freezing of tissue. Initial manifestations may be deceptively benign. Skin may appear white or blistered and is numb; rewarming causes substantial pain. Gangrene may develop. Severely damaged tissue may autoamputate. Treatment is rewarming in warm (40 to 42° C) water and local care. Surgical amputation is occasionally necessary, but a decision, often guided by imaging results, should usually be delayed until after definitive demarcation of necrotic tissue.

Frostbite usually occurs in extreme cold, especially at high altitude, and is aggravated by hypothermia. Distal extremities and exposed skin are affected most often.

Ice crystals form within or between tissue cells, essentially freezing the tissue and causing cell death. Adjacent unfrozen areas are at risk because local vasoconstriction and thrombosis can cause endothelial and ischemic damage. With reperfusion during rewarming, inflammatory cytokines (eg, thromboxanes, prostaglandins) are released, exacerbating tissue injury.

**Classification**

<table>
<thead>
<tr>
<th>Injury severity</th>
<th>Description</th>
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<tr>
<td>First degree</td>
<td>Hyperemia, edema</td>
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<tr>
<td>Second degree</td>
<td>Hyperemia, edema, blistering</td>
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<tr>
<td>Third degree</td>
<td>Necrosis of skin and subcutaneous tissues</td>
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<td>Fourth degree</td>
<td>Full thickness tissue necrosis, gangrene</td>
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**Symptoms and Signs**

The affected area is cold, hard, white, and numb. When warmed, the area becomes blotchy red, swollen, and painful. Blisters form within 4 to 6 h, but the full
extent of injury may not be apparent for several days. Blisters filled with clear serum indicate superficial damage; blood-filled, proximal blisters indicate deep damage and likely tissue loss. Superficial damage heals without residual tissue loss. Freezing of deep tissue causes dry gangrene with a hard black carapace over healthy tissue. Wet gangrene, which is gray, edematous, and soft, is less common. Wet gangrene is characterized by infection, but dry gangrene is less likely to become infected. Depth of tissue loss depends on duration and depth of freezing. Severely damaged tissue may autoamputate. Compartment syndrome may develop. All degrees of frostbite may cause long-term neuropathic symptoms: sensitivity to cold, excessive sweating, faulty nail growth, and numbness (symptoms resembling those of complex regional pain syndrome, although any relationship is speculative).

**Diagnosis**

**Clinical evaluation**

Diagnosis is based on clinical findings. However, because many of the early characteristics of frostbite (eg, coldness, numbness, white or red color, blisters) are also characteristic of nonfreezing cold injuries, differentiation of frostbite may require repeated observation until more specific characteristics (eg, black carapace, gangrene) develop.

**Treatment**

- Rewarming in warm (40 to 42°C) water
- Supportive measures
- Local wound care
- Sometimes delayed surgery

**Prehospital care:**

In the field, frostbitten extremities should be rewarmed rapidly by totally immersing the affected area in water that is tolerably warm to the touch (40 to 42°C, ideally about 40.5°C). Because the area is numb, rewarming with an uncontrolled dry heat source (eg, fire, heating pad) risks burns. Rubbing may further damage tissue and is avoided. The longer an area remains frozen, the greater the ultimate damage may be. However, thawing the feet is inadvisable if a patient must walk any distance to receive care because thawed tissue is particularly sensitive to the trauma of walking and, if refrozen, will be more severely damaged than if left frozen. If thawing must be delayed, the frozen area is gently cleaned, dried, and protected in sterile compresses. Patients are given analgesics, if available, and the whole body is kept warm.

**Acute care:**

Once the patient is in the hospital, core temperature is stabilized and extremities are rapidly rewarmed in large containers of circulating water kept at about 40.5°C; 15 to 30 min is usually adequate. Thawing is often mistakenly ended prematurely because pain may be severe during rewarining. Parenteral analgesics, including opioids, may be used. Patients are encouraged to move the affected part gently during thawing. Large, clear blisters are left intact or aspirated using sterile technique. Hemorrhagic blisters are left intact to avoid secondary desiccation of deep dermal
layers. Broken vesicles are debrided. If there is no perfusion after thawing, the administration of papaverine (a vasodilator) followed by intra-arterial thrombolytic (fibrinolytic) therapy may be considered.

Anti-inflammatory measures (eg, topical aloe vera q 6 h, ibuprofen 400 mg po q 8 h, ketorolac 30 to 60 mg IV) probably help. Affected areas are left open to warm air, and extremities are elevated to decrease edema. Anticoagulants, IV low molecular weight dextran, and intra-arterial vasodilators (eg, reserpine, tolazoline) have no proven clinical benefit. Phenoxybenzamine, a long-acting α-blocker, at a dosage of 10 to 60 mg po once/day may theoretically decrease vasospasm and improve blood flow.

Preventing infection is fundamental; streptococcal prophylaxis (eg, with penicillin) is sometimes provided. If wet gangrene is present, broad-spectrum antibiotics are used. Tetanus toxoid is given if vaccination is not up to date. If tissue damage is severe, tissue pressure is monitored.

Ongoing care:
Adequate nutrition is important to sustain metabolic heat production. Imaging tests (eg, radionuclide scanning, MRI, microwave thermography, laser-Doppler flowmetry) can help assess circulation, determine tissue viability, and thus guide treatment. MRI and particularly magnetic resonance angiography may establish the line of demarcation before clinical demarcation and thus make earlier surgical debridement or amputation possible. However, whether earlier surgery improves long-term outcome is unclear. Usually, surgery is delayed as long as possible because the black carapace is often shed, leaving viable tissue. Patients with severe frostbite are warned that many weeks of observation may be required before demarcation and the extent of tissue loss become apparent.

Whirlpool baths at 37° C 3 times/day followed by gentle drying, rest, and time are the best long-term management. No totally effective treatment for the long-lasting symptoms of frostbite (eg, numbness, hypersensitivity to cold) is known, although chemical or surgical sympathectomy may be useful for late neuropathic symptoms.

COLD INJURY
Cold injury is classified in a variety of ways, including acute and chronic pernio (chilblains), trench foot (immersion foot), and frostbite. Many of the descriptive terms are derived from military experience.

Pernio, also known as chilblains, occurs in acute and chronic forms and is described as mild injury to the skin and subcutaneous tissues. The classic appearance is red or purple pruritic skin lesions along with edema or blistering. Repeated exposure to cold but not freezing temperatures results in chronic vasculitis. Injuries are generally confined to the anterior tibial surfaces, the face, and the dorsum of the hands and feet. Prolonged exposure causes scarring, ulceration, hemorrhage, fibrosis, and atrophy. Treatment involves removing the patient from the cold environment, elevating the affected body part, and gradually rewarming it to room temperature. Massaging the affected body part should be avoided because it can cause secondary mechanical damage.
Trench foot, also known as immersion foot, is an injury commonly seen in military personnel because of exposure to cold, damp conditions for a prolonged time. Temperatures are typically above freezing, but injury is augmented by the moist environment (i.e., water, mud). The pathophysiology involves alternating vasoconstriction and vasodilation of the extremity. In the beginning, the affected limb is cold and numb. This eventually progresses to hyperemia and intense pain within 24 to 48 hours. The physical characteristics consist of edema, erythema, ecchymosis, and blistering. Injuries can be complicated with infection, lymphangitis, and gangrene. The posthyperemic phase initiates within 2 to 6 weeks and is hallmarked by cyanosis and cold insensitivity. Treatment starts with removal from the hostile environment, elevation of the limb, and exposure to warm, dry air. Again, massage, rapid rewarming, and immersion in warm liquid are not recommended.

Frostbite is the most common type of cold injury affecting the civilian population. It is caused by prolonged exposure to below-freezing temperatures. Exposure to temperatures ranging from −7°C to 7°C for 18 hours or longer is generally sufficient to cause frostbite injury. The pathophysiology of frostbite involves cold injury directly to the tissues and to the vasculature. Patients typically present with pain, pruritus, edema, and limited range of motion. Symptoms progress to numbness and eventually to loss of sensation. The affected area may appear pale, cold, and hard.

Vasoconstriction and arteriovenous shunting with intermittent vasodilation are the initial responses to cold temperatures. This response fades with prolonged exposure to cold temperatures. Cold injury begins at 10°C and becomes irreversible at −5°C. At −2°C extracellular ice crystals begin to form, causing the osmotic movement of fluid into the interstitial spaces and edema. Cells shrivel, become hyperosmolar, and alter enzymatic function. Rapid chilling (>10°C/min) causes intracellular ice crystal formation and cell death.

Vascular damage begins with low-grade vasculitis that proceeds to intimal inflammation, endothelial damage, capillary leak, and extravasation of intravascular fluid into the interstitium, causing edema. Tissue rewarming can induce injury through thrombosis of the microvasculature and release of free radical species.

Treatment involves removal from the causative environment, rapid rewarming in warm water (40° to 44°C for 30 to 45 minutes), and elevation to prevent further edema. Analgesics are given because rewarming can cause significant pain. Blisters can be debrided, and antibiotics are given for infection. The injured tissue is dressed in sterile bandages with sterile cotton placed between digits to prevent additional mechanical injury. Adjuncts to therapy include whirlpool baths daily to twice daily, topical aloe vera (inhibits thromboxane), and nonsteroidal anti-inflammatory drugs. Sympathectomy has been used with mixed results to limit vasospasm and to prevent the late complications of chronic pain, hyperhidrosis, and cold sensitivity. Tissue damage can initially appear more severe than it actually is. Surgical intervention should be delayed until the devitalized tissue becomes demarcated (this usually requires several days).
HYPOTHERMIA

Hypothermia is a core body temperature < 35° C. Symptoms progress from shivering and lethargy to confusion, coma, and death. Mild hypothermia requires a warm environment and insulating blankets (passive rewarming). Severe hypothermia requires active rewarming of the body surface (eg, with forced-air warming systems, radiant sources) and core (eg, inhalation, heated infusion and lavage, extracorporeal blood rewarming).

Primary hypothermia causes about 600 deaths each year in the US. Hypothermia also has a significant and underrecognized effect on mortality risk in cardiovascular and neurologic disorders.

Etiology

Hypothermia results when body heat loss exceeds body heat production. Hypothermia is most common during cold weather or immersion in cold water, but it may occur in warm climates when people lie immobile on a cool surface (eg, when they are intoxicated) or after very prolonged immersion in swimming-temperature water (eg, 20 to 24° C). Wet clothing and wind increase risk of hypothermia.

Conditions that cause loss of consciousness, immobility, or both (eg, trauma, hypoglycemia, seizure disorders, stroke, drug or alcohol intoxication) are common predisposing factors. The elderly and the very young also are at high risk. The elderly often have diminished temperature sensation and impaired mobility and communication, resulting in a tendency to remain in an overly cool environment. These impairments, combined with diminished subcutaneous fat, contribute to hypothermia in the elderly—sometimes even indoors in cool rooms. The very young have similarly diminished mobility and communication and have an increased surface area/mass ratio, which enhances heat loss. Intoxicated people who lose consciousness in a cold environment are likely to become hypothermic.

Pathophysiology

Hypothermia slows all physiologic functions, including cardiovascular and respiratory systems, nerve conduction, mental acuity, neuromuscular reaction time, and metabolic rate. Thermoregulation ceases below about 30° C; the body must then depend on an external heat source for rewarming. Renal cell dysfunction and decreased levels of vasopressin (ADH) lead to production of a large volume of dilute urine (cold diuresis). Diuresis plus fluid leakage into the interstitial tissues causes hypovolemia. Vasoconstriction, which occurs with hypothermia, may mask hypovolemia, which then manifests as sudden shock or cardiac arrest during rewarming (rewarming collapse) when peripheral vasculature dilates.

Immersion in cold water can trigger the diving reflex, which involves reflex vasoconstriction in visceral muscles; blood is shunted to essential organs (eg, heart, brain). The reflex is most pronounced in small children and may help protect them. Also, hypothermia due to total immersion in near-freezing water may protect the brain from hypoxia by decreasing metabolic demands. The decreased demand probably accounts for the occasional survival after prolonged cardiac arrest due to extreme hypothermia.
**Symptoms and Signs**

Intense shivering occurs initially, but it ceases below about 31°C, allowing body temperature to drop more precipitously. CNS dysfunction progresses as body temperature decreases; people do not sense the cold. Lethargy and clumsiness are followed by confusion, irritability, sometimes hallucinations, and eventually coma. Pupils may become unreactive. Respirations and heartbeat slow and ultimately cease. Initially, sinus bradycardia is followed by slow atrial fibrillation; the terminal rhythm is ventricular fibrillation or asystole.

**Diagnosis**
- Core temperature measurement
- Consideration of intoxication, myxedema, sepsis, hypoglycemia, and trauma

Diagnosis is by core temperature, not oral temperature. Electronic thermometers are preferred; many standard mercury thermometers have a lower limit of 34°C. Rectal and esophageal probes are most accurate.

Laboratory tests include CBC, glucose (including bedside measurement), electrolytes, BUN, creatinine, and ABGs. ABGs are not corrected for low temperature.

ECG may show J (Osborn) waves (Fig. 1: Abnormal ECG showing J (Osborn) waves (V4) and interval prolongation (PR, QRS, QT). Causes are sought. If the cause is unclear, alcohol level is measured, and drug screening and thyroid function tests are done. Sepsis and occult head or skeletal trauma must be considered.

![Fig. 1. Abnormal ECG showing J (Osborn) waves (V4).](image)

**Prognosis**

Patients who have been immersed in icy water for 1 h or (rarely) longer have sometimes been successfully rewarmed without permanent brain damage, even when core temperatures were very low or when pupils were unreactive. Outcome is difficult to predict and cannot be based on the Glasgow Coma Scale. Grave prognostic markers include evidence of cell lysis (hyperkalemia > 10 mEq/L), intravascular thrombosis (fibrinogen < 50 mg/dL), and presence of a nonperfusing cardiac rhythm (ventricular fibrillation or asystole). For a given degree and duration of hypothermia, children are more likely to recover than adults.

**Treatment**
- Drying and insulation
- Fluid resuscitation
- Active rewarming unless hypothermia is mild, accidental, and uncomplicated
The first priority is to prevent further heat loss by removing wet clothing and insulating the patient. Subsequent measures depend on how severe hypothermia is and whether cardiovascular instability or cardiac arrest is present. Returning patients to a normal temperature is less urgent in hypothermia than in severe hyperthermia. For stable patients, elevation of core temperature by 1 °C/h is acceptable.

If hypothermia is mild and thermoregulation is present (indicated by shivering and temperature typically 31 to 35 °C), insulation with heated blankets and warm fluids to drink are adequate.

Fluid resuscitation is essential for hypovolemia. Patients are given 1 to 2 L of 0.9% saline solution (20 mL/kg for children) IV; if possible, the solution is heated to 40 to 42 °C. More fluid is given as needed to maintain perfusion.

**Active rewarming:**
Active rewarming is required if patients have cardiovascular instability, temperature < 32.2 °C, hormone insufficiency (such as hypoadrenalism or hypothyroidism), or hypothermia secondary to trauma, toxins, or predisposing disorders. If body temperature is at the warmer end of the range, external rewarming with forced hot air enclosures may be used. External heat is best applied to the thorax because warming the extremities may increase metabolic demands on a depressed cardiovascular system. Patients with lower temperatures, particularly those with low BP or cardiac arrest, require core rewarming.

**Core rewarming options include**
- Inhalation
- IV infusion
- Lavage
- Extracorporeal core rewarming (ECR)
  - Inhalation of heated (40 to 45 °C), humidified O₂ via mask or endotracheal tube eliminates respiratory heat loss and can add 1 to 2 °C/h to the rewarming rate.
  - IV crystalloids or blood should be heated to 40 to 42 °C, especially with massive volume resuscitations.

Heated lavage of the bladder or GI tract transfers minimal heat, although closed thoracic lavage through 2 thoracostomy tubes see procedure is very efficient in severe cases. Peritoneal lavage with dialysate heated to 40 to 45 °C requires 2 catheters with outflow suction and is especially useful for severely hypothermic patients who have rhabdomyolysis, toxin ingestions, or electrolyte abnormalities.

There are 4 types of ECR: hemodialysis, venovenous, continuous arteriovenous, and cardiopulmonary bypass. ECR measures require a prearranged protocol with appropriate specialists. Although they are intuitively attractive and heroic, these measures are not routinely available, and they are not commonly used in most hospitals.
## VI. Plan and structure of class

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<th>Methods of teaching and control</th>
<th>Guidelines</th>
<th>Time distribution</th>
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<td>2.</td>
<td>Determining the relevance, educational objectives and motivation</td>
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<td>5 min.</td>
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<td>3.</td>
<td>Control of the input level of knowledge, skills and abilities:</td>
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<td>45 min.</td>
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<tr>
<td>1.</td>
<td>Etiology and pathogenesis</td>
<td>I</td>
<td>Survey</td>
<td>Questions</td>
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<tr>
<td>2.</td>
<td>Clinical signs</td>
<td>II</td>
<td>Survey, tests</td>
<td>Questions, II level MCQs</td>
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<td>3.</td>
<td>Diagnosis</td>
<td>II</td>
<td>Clinical cases, MCQs</td>
<td>Typical clinical cases, II level MCQ</td>
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<td>4.</td>
<td>Treatment</td>
<td>II</td>
<td>Clinical cases, MCQs</td>
<td>Typical clinical cases, II level MCQ</td>
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<td>4. Main stage</td>
<td>Formation of students professional skills:</td>
<td>III</td>
<td>Practical training</td>
<td>5. Patients with frostbite</td>
<td>95 min.</td>
</tr>
<tr>
<td>1.</td>
<td>Master the skills of the physical examination</td>
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<td>Practical training</td>
<td>6. Patients with frostbite</td>
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<td>2.</td>
<td>Perform physical examination of the patient with frostbite. Plan the patients laboratory and instrumental examinations</td>
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<td>Practical training</td>
<td>Clinical cases, III level MCQs</td>
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<td>3.</td>
<td>Differential diagnosis</td>
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<td>Practical training</td>
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<td>4. Treatment schemes</td>
<td>training</td>
<td>algorithms, atypical clinical cases</td>
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<td></td>
<td>Practical training</td>
<td>Typical and atypical clinical cases</td>
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<td>5. <strong>Final stage</strong></td>
<td>Personal skills control, analysis and evaluation of the results of clinical work, clinical cases, level III MCQs</td>
<td>Clinical cases and III level MCQs</td>
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<td></td>
<td>III</td>
<td>30 min.</td>
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<td>6. Summarizing class</td>
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<td>Results of patients examination, MCQs and clinical cases solutions</td>
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<td>7. Homework (recommendation of basic and additional literature)</td>
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<td>Oriented card for independent work with literature</td>
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I. **Materials for classes**

**Questions** $(\alpha = I, \alpha = II)$

1. Etiology and pathogenesis of frostbite.
2. Classification of frostbite.
3. Clinical signs of frostbite.
4. Laboratory diagnosis of frostbite.
5. Role of localization procedures in diagnosing of frostbite.
7. Treatment of frostbite.

**MCQs** $(\alpha = II)$

1. Define hypothermia (3 parts): *Lower body core temperature 2 degrees C; body cannot retain NOR generate heat on its own.*
2. Most likely conditions for hypothermia are ___wet___ and ___cold____.
3. Best clothing options to prevent hypothermia: ___layers, wool clothing____
4. Body core is made of ___brain___, ___heart___, and ___lungs____.
5. Best places to put warming packs: ___neck___, ___armpits___, and ___groin____.
6. Negative cold factors are ___wet___, ___cold___, and ___wind______.
7. Best way to PREVENT hypothermia: ___be prepared!_____
8. Best method of TREATMENT for hypothermia: ___warm, dry cloths, heat, warm liquids (if not in shock)___
9. Best way to treat frostbite: ______rapid rewarming in 100-105 water (if there is NO danger of re-freezing the injury____
10. Areas most likely to get frostbite: ___hands and feet (fingers and toes)_____.

**Typical clinical cases (α =II)**

1. A 43-years man admitted to the emergency department in severe general conditions, arterial pressure < 80 mm of Mercury, pulse rate − 56 per minute. The areas of necrosis of skin and subcutaneous tissues on both legs. What degree of the frostbite?
   Answer: III.

2. A young man was found outside in the cold weather without a consciousness. Blood pressure − 90/60 mmHg, pulse rate − 60 per minute, lower limbs are swollen, hyperemia of feet. What first help?
   Answer: Treatment involves removal from the causative environment, rapid rewarming in warm water (40° to 44°C for 30 to 45 minutes).

**Atypical clinical case (α =III)**

3. In winter time a man has sat down to rest and has fallen asleep. A general condition is heavy, he is without a consciousness, pale, cold; pulse is threadylike, arterial pressure < 70 mm of Mercury. Formulate the preliminary diagnosis. What stages of the first help?
   Answer: General hypothermia. Termoisolative coverage (blanket) to avoid further loss of the heat, warm fluid per os if patient able to eat, evacuation to more warm environment, intravenous warm fluid replacement, resuscitation if necessary.

**VIII. Literature**


