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Trench foot and other non-freezing cold injuries (literature review)

Abstract. *Non-freezing cold injury is a general term that includes trench foot and immersion foot and is characterized by damage to the soft tissues, nerves, and vessels of the distal extremities as a result of long stay (usually two to three days or longer) in wet, cold (but not freezing: typically 0 to 15 °C) conditions. Trench foot syndrome primarily affects military personnel, fishermen, agricultural workers, travelers, and other segments of the population. In wartime, the number of such local cold injuries increases several times. Unfortunately, in domestic medical developments, this problem is practically not given due attention. Based on data from foreign literary sources and their own clinical experience, the authors were able to highlight the main patterns of pathogenesis and clinical picture of this pathological condition with justification of treatment tactic and preventive measures.*
Keywords: *local cold injury; trench foot; immersion foot; pathogenesis; treatment*

The soles of his feet were purple-black, cold.
The surgeon's diagnosis of trench foot indicated that amputation was inevitable if he remained alive.

Lesnyak B.M. I came to you! (1998)

Cold injuries and their consequences have been and remain an actual problem and occupational risk in the military for decades. These consequences can worsen the combat capability of the military in the near and distant future [1]. In wartime, the danger of general and local cold injury increases several times. In recent years, a clear trend towards an increase in the number of victims of cold injury in regions with a temperate climate has been noted [2]. Local cold injury is mainly seasonal, in peacetime its frequency is much lower than that of burns [3].

Non-freezing cold injury is a general term that includes trench foot (TF) and immersion foot (IF) and is characterized by damage to the soft tissues, nerves and vessels of the distal extremities due to long stay (usually two to three days or longer) in wet, cold (but not freezing: usually from 0 to 15 °C) conditions [4]. Unfortunately, this serious problem has not received enough attention in domestic literature. Based on data from foreign literary sources and their own clinical experience, the authors were able to highlight the problems of epidemiology, pathogenesis and treatment of this serious pathological condition in the military and civilian population.

Trench foot syndrome was described by the French army surgeon Dr. Dominique Jean Larrey during the Patriotic War of 1812 [5, 6], but the name of the syndrome appeared more than 100 years later during World War I [7]. Starting in 1914, trench warfare was a common battle strategy on the European front. During this time, the soldiers stood for a long time in swampy trenches and were in damp, cold and dirty conditions. In the winter between 1914 and 1915, more than 20,000 British soldiers were treated for trench foot. Additionally, in retrospect estimates, trench foot resulted in the deaths of 2,000 American and approximately 75,000 British soldiers. Most cases of TF are observed in military conditions both during hostilities and exercises. The US military reported 11,000 cases of trench foot in November 1944 during World War II [4, 8]. In the French army, trench foot affected more than 3 % of soldiers. Excessive sweating of the feet (hyperhidrosis) can also cause trench foot. The cornerstone of this type of injury was rubberized boots that were too tight; sweat accumulated in them and kept the feet moist [5–7, 9–11]. During this period, it was observed that trench foot mostly affected the toes, but sometimes also the legs,

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which swelled up to the knees. 115,000 English and 80,000 French soldiers suffered from frostbite or trench foot [12, 13]. This led to the creation of the term "trench foot" or "immersion foot" [11, 14]. Trench foot and frostbite developed in over a million US soldiers in World War I, World War II, and the Korean War [2, 13, 15]. During the conflict in the Falklands (Malvinas Islands) in 1982, infantry units of one of the brigades of the United Kingdom reported an incidence of 76 % [4, 8]. A retrospective survey of a battalion of 400 US infantry soldiers training in the rainy mountains of Hawaii in 1994 found 149 cases of trench foot among 176 soldiers who responded to the questionnaire [4].

Blunt trauma or marching can lead to more severe injuries. Mechanical and cold injuries can occur simultaneously. These combined injuries are more difficult to treat than common injuries, and the end result is often unfavorable. Consequences: pain, numbness, loss of deep sensation and coldness of the foot. Hyperhidrosis often develops with fungal paronychia [12, 13]. Another example is "shelter limb" that affected civilians who were forced to hide from bombings in the deep tunnels of the London Underground during World War II [15]. The most severe cases were when the lesion was localized in the popliteal fossa or near it, which suggests that these injuries were peripheral neuropathies [16]. Homeless people, alcoholics and the elderly are most prone to trench foot. Travelers and other individuals who spend several days in cold and wet conditions without removing wet shoes and socks are also at risk of developing TF [4]. Trench foot develops in patients over the age of 15 [6]. Although historical reports describe certain segments of the population as more susceptible to TF, the validity of such reports is questionable. There is no clear evidence that certain groups are at increased or decreased risk [4].

Trench foot occurs as a result of exposure to cold and humidity and is characterized by swelling, pain and sensory disturbances in the area of the foot. The syndrome develops in conditions of low temperature (from 1 to 10 °C) with rewarming to normal [17]. Unlike frostbite, trench foot can occur without sub-zero temperatures. At temperatures of up to 16 °C, the disease can develop in only 10–14 hours [9].

Very high humidity can cause mummification of the feet already at a temperature of 2.5 °C.

Provocative factors are dehydration, insufficient or substandard nutrition, mental stress in military personnel during combat operations, overfatigue, weakening of the body due to a concomitant disease or combat injury. The action of these factors causes the destruction of capillaries, which leads to tissue necrosis. Cold temperatures constrict blood vessels to prevent heat loss, so wet feet lose heat 25 times faster than dry feet. As a result of a lack of oxygen supply, skin tissues are damaged [6, 18, 19]. Microvascular spasm with tissue ischemia is an obvious etiological factor. Nerves, muscles and endothelial cells are most sensitive to prolonged cooling. It is noted that the development of the disease can occur despite periodic warming of the limb [9, 11]. Based on observations during World War II, this condition was described as vasoneuropathy [20]. Maximum vasoconstriction occurs when the arm or leg is cooled to approximately 15 °C. Further cooling causes an increase in blood flow, known as cold-induced vasodilation or the scavenging response, occurring in cycles of 5 to 10 minutes. Prolonged and repeated exposure to cold increases the amplitude and frequency of the reaction. Inuit, Sami and Nordic fishermen have a strong response with rapid cycling. A strong vascular response is thought to reduce susceptibility to TF, but scientific evidence is insufficient. A study of 206 Dutch marines showed that a weak response correlated with increased susceptibility to such a lesion [4].

The latent period lasts 4–5 days, the severity of the injury also depends on the loss of sensitivity, which prevents timely seeking medical help. Tight shoes increase the risk of developing TF. It includes degenerative changes in nerve, muscle tissues and vessel walls. The severity of the damage depends on the temperature of the environment and the duration of exposure. A characteristic feature is water infiltration of the horny epithelial layer, especially in the skin of the feet. In severe cases, superficial nerves, as well as muscles and blood vessels may be damaged [12]. Often, the first symptoms are a feeling of coldness in the feet with slight pain and numbness, or a feeling of "walking on wood", pain in the joints of the feet, paresthesias, pronounced impairment of all types of sensitivity and functions of the limb. When walking, the patient steps on the heels. The skin of the feet is pale, waxy. When the condition worsens, blisters appear, filled with a clear liquid with an unpleasant odor, as in gangrene. The foot may swell with bruising, redness, or blackening of the skin. The limb is hot to the touch and often swollen. Local ecchymoses and ulcers appear. Later, swelling develops, covering the leg up to the knee joint, blisters with hemorrhagic contents are formed. When heated, the pain is very strong and is not relieved by the administration of painkillers (including morphine). Over time, colliquative necrosis develops in the distal parts of the limb, but even proximal tissues can be affected. There is no clear line of demarcation between dead and healthy areas. In more severe cases, wet gangrene of the foot develops [11, 17].

Three forms of TF are defined.

The mild form is the most common, occurs in 80–90 % of cases, is characterized by loss of tactile and pain sensitivity, numbness of the legs, increased spontaneous pain that prevents independent walking and deprives the patient of normal sleep. In this case, the front part of the foot and fingers are most affected, which forces the patient to lean on the heel when walking, and there is a burning and tingling sensation in the legs. Normalization of the condition of the feet begins on day 8–9 after the cessation of the effect of cold with the occurrence of intense paresthesia. For 3–4 weeks, stabbing or shooting pain and almost continuous tingling is felt.

The medium-severe form is characterized by the appearance of blisters in the areas of edema of the legs, fingers and plantar folds, which are filled with a gel-like substance of lemon or blood color.

The severe form is characterized by deep trophic tissue disorders, including necrosis, with the development of putrefactive or anaerobic infection.

In the course of the pathological condition, certain stages are observed.

The first stage: under the influence of cold. The key feature of the first stage is loss of sensitivity. This usually takes

the form of general anesthesia. Patients complain of numbness, sometimes describing that the legs or arms feel like a wooden block. Because of this loss of sensation and proprioception, patients may become clumsy and experience difficulty walking. The extremities may be bright red at first, but then become pale or completely white due to severe vasoconstriction. The extremity is usually painless until an attempt is made to warm it.

Second stage: after exposure to cold. The second stage begins as soon as the patient is removed from the cold environment, and continues during and after rewarming. This stage usually lasts only a few hours, but can last for several days. The extremities acquire a mottled pale blue color, which reflects a slight increase in blood flow. It is difficult to see a change in the color of pigmented dark skin. The peripheral pulse is initially filiform. Over time, it becomes jerky, but capillary filling is delayed. The extremity continues to be cold and numb. Some swelling may occur. The patient may have problems with walking.

Third stage: hyperemia. The third stage usually begins suddenly and lasts from several days to several weeks, in severe cases — from 6 to 10 weeks. The affected limb becomes bright red and swollen with an increased pulse, but with delayed capillary refill, which characterizes microcirculatory damage. Anesthesia is replaced by intense pain with hyperalgesia. However, the distal parts of the affected limbs may remain insensitive. Tissue damage is usually imperceptible, but severely damaged areas may blister. Nonviable areas of tissue are rare, but blistering or skin discoloration may occur before stage four of necrosis develops.

The fourth stage: after hyperemia. The last stage can end in a few weeks, persist for years, or be permanent. The affected limb usually appears normal, except for cases of tissue necrosis, which is rare. Affected limbs are cold and very sensitive to cold. Vasoconstriction in response to cold is common. Extremities may remain cold for several hours after short exposure to cold. Most patients have chronic pain, usually in response to cold. Small areas may remain insensitive. Hyperhidrosis is common. Some patients develop symptoms similar to complex regional pain syndrome. In severe cases, tissue gangrene may occur, requiring amputation [4, 6].

The diagnosis of trench foot is completely clinical. First, it is necessary to determine the situation in which it happened, and a high-quality medical examination is of primary importance. Underlying infections should be ruled out, so a white blood cell count may be indicated. Inflammatory markers such as C-reactive protein or erythrocyte sedimentation rate may be helpful, as well as radiographs or bone scans when osteomyelitis is suspected [9].

The specific features of the water environment (the thermal conductivity of water is 25 times higher, and the heat capacity is 4 times higher than the corresponding indicators for atmospheric air) cause the rapid exhaustion of possible thermoregulation mechanisms: tissues in water lose heat approximately 11 times faster than in an air environment of the same temperature, and rapid immersion in cold water increases heat loss by 32 times [21, 22].

Immersion foot (submerged foot syndrome, sea boot foot, Irish foot or bridge foot) is an identical injury that was first described during World War II in shipwrecked sailors, on the lifeboats. When they were forced to kneel or sit on the wet bottom of the boats, it was mostly the knees or buttocks that suffered. The main civilian groups affected by IF are shipwrecked crews in cold waters and wilderness survivors of plane crashes and overturned boats, who have to walk in cold and wet environments in wet shoes and clothing. Travelers and homeless people are also significantly at risk of IF [23].

IF develops as a result of immersion of the feet in a liquid environment (water, mud) at a temperature of up to 17 °C for > 12 hours. The term "miner's foot" was defined separately: an occupational disease that develops as a result of a long forced stay in a position with bent legs, often in water, which leads to a violation of blood circulation and trophism of the tissues of the feet. An injury to the hand of a diver who stayed in a cold (6 °C) water is described [24].

Immersion foot in warm water is a transient syndrome first described in soldiers in Vietnam. It manifests itself in the form of painful, white, wrinkled soles of the feet due to immersion in warm water (from 15 to 32 °C) for up to 72 hours [4]. It is also called rice foot and, incorrectly and erroneously, tropical immersion foot, which is a more serious condition. Most IF patients recover completely within one to three days with drying and elevating the feet. *Meliorator's foot* or *rice foot* occurs at a higher temperature (up to 29 °C all day) in agricultural workers when growing crops that require significant humidity. Therefore, the term "cold injury" may not be appropriate for some of these syndromes [25]. In warm water, IF usually develops more slowly, taking about 48 hours, than in cold water (according to early estimates — up to 12 hours) [26].

Tropical immersion foot has been described in soldiers in Vietnam and is a more severe condition than trench foot because it causes the inability to walk due to painful, swollen feet after immersion in warm water (22 to 32 °C) for more than 72 hours, characterized by symmetrical redness, swelling and soreness of the skin of the ankles and the back surface of the feet. The plantar surfaces are hyperhydrated and wrinkled, and patients with severe cases have fever and inguinal lymphadenopathy. Treatment includes drying the feet, followed by bed rest and leg elevation. Full recovery usually takes four to five days, although severely affected patients sometimes require 10 to 12 days. There are no known consequences.

Jungle foot, sometimes called *tropical jungle sole, tropical swamp foot,* or *jungle rot,* is a dangerous condition seen during the Vietnam wars [4]. Symptoms usually develop after a period of more than 48 hours of water exposure in tropical climates with temperatures of 22–32 °C. This pathology often occurs in peacetime in fishermen and hunters, as they are prone to wet feet for a long time, in tourists and in case of concomitant alcohol or drug intoxication. A shorter duration of contact at a temperature of 0 °C leads to a similar lesion [13, 27–30].

Cyanotic, swollen, with increased sweating, feet and toes resemble trench foot. According to the degree of warming, it is noticeable how the legs change their color from white to red, become dry and painful. Blisters may form, leading to gangrene and amputation. In peacetime, it is observed

during long concerts in rainy weather: at the music festival in Glastonbury (Great Britain) in 1998, doctors consulted ninety victims with immersion foot daily.

Pathophysiology

Tissue damage develops against the background of venous stasis with interstitial edema in progressive trophic disorders [17]. The pathophysiology of trench foot is difficult to explain. Since this syndrome refers to non-freezing cold injuries, the formation of ice crystals does not occur. Researchers demonstrate a damage to all tissues after cold-wet exposure, but primarily muscles and nerves. Degenerative changes in nerve and muscle tissues and walls of blood vessels are of great importance. Cold moisture causes heat loss, and swelling and narrowing of blood vessels causes tissue ischemia [5].

Pathophysiology involves alternating narrowing and widening of the vessels of the limb. At first, the affected limb is cold and numb. This eventually progresses to hyperemia and severe pain within 24 to 48 hours. Physical features include swelling, erythema, ecchymoses, and blistering. Injuries can be aggravated by infection, lymphangitis and gangrene [31].

The severity of the damage depends on the temperature of the environment and the duration of exposure. Characteristic findings are fluid-filled stratum corneum, especially on the soles of the feet. In mild cases, superficial nerves are damaged, in severe cases, damage to muscles and blood vessels is added. Such damage to the skin (water filling) can occur after a long stay in relatively warm water [12].

Stages of trench (immersion) foot

Stage 1 — trauma phase

This stage involves the restriction of blood flow due to the cold effect on the tissues, symptoms may include numbness and redness of the skin, but no pain is felt yet.

Stage 2 — pre-hyperemic phase

This stage lasts from 6 to 24 hours. Feet are pale, white, cold with paresthesias (tingling sensation). The feet and toes are stiff, which makes it difficult to walk. During the examination, the doctor is sometimes unable to palpate (feel) a normal pulse on the legs (which indicates a violation of normal blood flow).

Stage 3 — hyperemic phase

Lasts up to two months. The legs are painful, hot to the touch. Swelling is observed, which increases with heating, movement and standing. In severe cases, small blisters can be visualized. There may be hemorrhages, as well as petechiae (rash on the skin). With a mild course, the condition disappears with treatment at this stage. In severe cases, trench foot symptoms progress.

Stage 4 — the post-hyperemic phase

It begins within 2–6 weeks and is characterized by cyanosis and insensitivity to cold [31] and can last throughout a person's life. This is a prolonged vasospastic (narrowing of blood vessels) phase, characterized by increased pain when warmed up, hyperhidrosis (excessive sweating of the feet) and paresthesias (tingling sensation). The affected foot/feet may develop a persistent feeling of coldness. Secondary Raynaud's syndrome (a condition accompanied by increased sensitivity to cold in which the toes turn blue and/or white when exposed to cold and then bright red when warm) develops as a result of long-term narrowing of small blood vessels [5, 12].

The pre- and hyperemic stages of the disease usually escape the attention of the doctor, who most often meets the patient in the post-hyperemic phase of the disease [32]. In the first minutes of the limbs being in the water, there is a feeling of numbness, difficulty and pain when trying to move the fingers, fasciculations, tremors and cramps in the calf muscles, swelling in the distal parts, blisters with transparent contents may form. Common signs of hypothermia often appear very quickly: chills, depression, general weakness, drowsiness, sometimes increased excitability. The patient cannot walk because he "doesn't feel the floor", 2–5 hours after removal from the liquid medium, the reactive phase begins. The border of the hyperemia zone corresponds to the level of limb immersion into the water, increasing pain appears in the limb. With a lesion of the I–II degree, there is hyperemia of the skin, pronounced edema, multiple blisters are formed — the so-called cold neurovasculatures, which last 2–3 months. There is pain, impaired sensitivity of soft tissues, muscle strength decreases. With a lesion of the III–IV degree, hyperemia of the skin and blisters appear much later, a wet scab is formed. There is always a pronounced purulent-resorptive fever, lymphangitis, lymphadenitis, thrombophlebitis are frequent. Obliterating endarteritis is observed in later periods [5, 11].

There are individual differences in susceptibility to cold injuries, which are related to each other by the intensity of the reaction of human vessels to a cold, moist environment. Individuals who can maintain higher local blood flow and skin temperature are less susceptible to trench foot than those with lower peripheral blood flow and skin temperature. Individuals with previous cold injuries face an increased risk of re-exposure, especially if there is evidence that they suffer from residual cold sensitization [15].

During World War I, as understanding of the disease progressed, so did treatments for trench foot. At first, bed rest was recommended, and many different remedies were tried at one time or another. Among them, a mixture of lead and opium, alcohol of various kinds, mercuric chloride in alcohol, tincture of iodine, pear oil, picric acid, and chloral hydrate mixed with camphor. Some powders have also been used, including boric acid, starch, zinc, and salicylic acid. Radiant heat, complex massage techniques, and even different types of electrical stimulation have been tried in the treatment of trench foot when initial treatments have failed. However, as soon as the disease turned into a severe form, the main method of treatment became surgical, similar to the treatment of gangrene. Often, it ended up with an amputation of extremity [9].

Trench foot is a clinical diagnosis. The patient's condition and the development of complications determine the need for diagnostic studies. If a traumatic injury is suspected, X-ray of the affected arms or legs should be taken. If infection is suspected, a computed tomography or magnetic resonance imaging scan should be performed to look for free air, abscess, or other signs that require surgical intervention. Early surgical consultation is recommended for suspected soft tissue infection. Unlike frostbite, the informativeness of

angiography, CT angiography, magnetic resonance angiography, or radioisotope scanning is unknown in the evaluation of TF. Infrared thermography was once used in the United Kingdom to assess the severity of injuries and extent of recovery, but has been abandoned, since its feasibility was not confirmed in controlled studies [4]. Today, trench foot is usually detected at an early stage and the treatment is quite simple, the main thing is to keep the feet dry and warm.

Treatment

— It is better to evacuate the victims at the first signs.

— Get rid of wet clothes and replace them with dry and warm ones.

— Avoid moving on affected limbs.

— Bed rest and injury avoidance.

— ***Immersion of the foot in warm or hot water is contraindicated!***

— ***Massage is contraindicated!***

— Elevated position of the affected foot as this will help prevent new sores and blisters.

— The leg is kept dry with the help of a fan heater.

— Warm slowly at room temperature. The affected area will likely be swollen, red, and hot to the touch after it is warmed. Blisters may form.

— Prophylactic antibiotics are not indicated.

— Systemic antibiotics are indicated when non-viable tissue is present, as with any contaminated wound or when signs of infection appear.

— Co-infections can be treated with topical antifungals for dermatophytes or systemic antibiotics for bacterial cellulitis or deep infection.

— Prevention of tetanus and gas gangrene.

— Analgesia: the only effective drug is amitriptyline at a dose of 50–150 mg at bedtime. Other analgesics and vasodilators, such as nifedipine, are either completely ineffective or (like narcotics) do not relieve pain; acetaminophen or aspirin will help with pain but may not help with swelling.

— Lumbar sympathectomy (regional anesthesia) is outdated and should not be performed, although it sometimes reduces sensitivity to cold for several months, but symptoms return after treatment to be at least as severe as before treatment (and sometimes worse).

— Epidural sympathetic opioid blockade may be valuable for early pain relief.

— The patient may require medicated sleep.

— Administration of disaggregants, anticoagulants, low molecular weight dextran.

— Optimize nutrition with a high-protein, high-calorie diet.

— Avoid early surgery, but if C-reactive protein is elevated and hyperthermia or other signs of sepsis occur, early amputation should be considered.

— Macerated or damaged skin needs topical antiseptic measures.

— First of all, do not puncture the blisters as this can lead to infection of the area. The bottom of self-opening blisters requires thorough antiseptic treatment, excision of necrotic tissues is indicated.

— Early mobilization is very important to prevent prolonged immobility (risk of ankylosis).

— UVR, UHF therapy.

— Delayed surgical intervention — amputation.

— The soldier will be an ambulatory patient for several weeks [4, 9, 12, 13, 29, 31, 33].

Combined injuries

Trench foot and frostbite can occur at the same time. Combinations of cold injury, fractures, and lacerations are also not uncommon (for example, in an avalanche accident). Finally, there are also frostbite injuries, spontaneous thawing with refreezing. Combined injuries are more difficult to treat than isolated and combined injuries, and the final outcome is worse [12].

Complications

— Soft tissue infections (cellulitis or gangrene).

— Subacute (moderate) or long-lasting neuropathic pain (nerve pain).

— Improper treatment of trench foot can lead to irreversible sensory changes.

— Cellulitis (infection in the deeper layers of the skin).

— Thrombophlebitis (inflammation of the blood vessel wall).

— Muscle atrophy (loss/reduction of muscle mass).

— Osteoporosis (softening of bones).

— Damage to muscles, skin tissues, blood vessels or peripheral nerves [5].

Prevention of trench foot is not difficult and has been known since 1982. During World War I, the introduction of regular foot examinations was found to reduce morbidity. The soldiers were divided into pairs and instructed to watch their partner's legs. It was found that a soldier was more likely to remove his boots and wipe his feet and change his socks if reminded to do so by a fellow soldier. After thousands of such cases were recorded, soldiers were ordered to always carry 3 pairs of socks and change them at least twice a day. Soldiers were also given whale oil to rub on their feet after they were dry to prevent trench foot. Historically, a battalion (up to 1,000 men) on the front of World War I could use up to 10 gallons of whale oil daily. Draining trenches is an ancient military art. To prevent trench foot, wooden planks known as "ducks" were used to cover the wet, dirty, cold ground in the trenches [9]. Trench foot was virtually eliminated among Allied troops on the Western Front during World War I, when rations were increased and waterproof sacks of clean, dry socks were sent to the trenches nightly with food. Prohibiting foot cloths (a wrap around the lower leg over boots that caused compression) and encouraging soldiers to move as much as possible contributed to lower morbidity rates, as did the use of foot powder rather than grease [4].

According to the results of a modern survey conducted in Ukraine, 74 % of soldiers are not informed about such a disease as trench foot. At the same time, 95 % of them were often in conditions of high humidity and simultaneously exposed to low temperatures, in wet shoes and socks, that is, they had a high risk of disease. It was found that only 53 % of servicemen change their shoes in a timely manner if possible, and 40 % walk in wet shoes for a certain time, regardless of the possibility of changing them. According to the results of the survey, more than 85 % of the soldiers noticed

the first signs of this disease (feeling of weakness in the toes, decreased sensitivity, pallor, spontaneous pain and tingling in the feet). Part of the military already noted more serious manifestations of local hypothermia (cyanosis, edema that did not disappear after warming up, and blisters), which indicates more pronounced symptoms of the disease and possible risks of gangrenous changes [34].

Prevention

— *Feet should be clean and dry:* dirty and wet foot cloths and socks lose their thermal properties.

— Dry, wash, change foot cloths and socks.

— If possible, use copper-infused socks.

— Apply silica gel, antiseptic and antifungal powders.

— It is useful to dry your feet in the air, moist them with a special cream.

— Check the condition of the feet regularly (most often in the morning and in the evening).

— Mild foot massage improves blood circulation.

— Sleep in arctic mittens on your feet.

— Avoid smoking and using other products that contain nicotine, which can impair blood flow to the legs.

— Follow a high protein diet.

— Remember that the duty of the commander is to maintain the unit's combat effectiveness.

— Strict compliance with the recommendations is absolutely mandatory.

N.B.! ***Soldiers apathetic to the situation usually neglect to take care of their feet. Check back regularly! [4, 7, 9, 13, 34, 35].***

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Траншейна стопа та інші незамерзаючі холодові травми (огляд літератури)

Резюме. Незамерзаюча холодова травма — це загальний термін, що включає траншейну й імерсійну стопу та характеризується пошкодженням м'яких тканин, нервів і судин дистальних відділів кінцівок внаслідок тривалого перебування (зазвичай два-три дні або довше) у вологих, холодних (але не заморожуючих: зазвичай від 0 до 15 °С) умовах. Синдром траншейної стопи вражає насамперед військових, рибалок, сільськогосподарських працівників, мандрівників та інші верстви населення. У воєнний час кількість таких локальних холодових травм збільшується в декілька разів. На жаль, у вітчизняних медичних розробках цій проблемі практично не приділено належної уваги. На основі даних зарубіжних літературних джерел та власного клінічного досвіду автори спромоглися висвітлити основні закономірності патогенезу й клініки цього патологічного стану з обґрунтуванням лікувальної тактики та профілактичних заходів.

Ключові слова: локальна холодова травма; траншейна стопа; імерсійна стопа; патогенез; лікування