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Original Article

Frostbite injuries and our experience treatment in the Samarkand area Uzbekistan

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Abstract: Cold injury remains one of the most complex and actual problems of emergency medicine. Frosting injuries are also observed in the regions with warm climate particularly in Uzbekistan able - bodies men suffer most often, 85-90% of them are admitted in the condition of alcohol intoxication. A retrospective review was performed of patients admitted to the Burn Department of the Centre of Emergency Medical Care with frostbite injury 92 individuals of 19 to 63 years of age. The data on each patient were collected including age, sex, period of injury, injuries of extremities, bacteriological investigations, along with general warming of victims, all patients were given intravenous injection of infusion spasm and to improve microcircula determination of the injury area and different general and local treatment. Treatment of these patients is very prolonged, expensive, frequently requiring crippling operations, resulting in disability.

Keywords: Frostbite injury, wounds, treatments

Introduction

Cold injury remains one of the most complex and actual problems of emergency medicine. Among hospitalized patients at the department of thermic injury specific gravity of patients with cold injury varies from 3 to 30% and duration of treatment in frostbite injuries makes 34-78 days in III-IV degrees [1-4].

Frequency of frostbite injuries increases in War time, when factors contributing to cold injury are evident. According to T. Aryeva [5] frosting injuries loss in German Army during the Second World War was significant and achieved 25% of the number of sanitary casualties.

According to M. Edwards and A. Burton [6] frosting injuries loss in American troops during military operations in Korea (1950-1951) made about one forth off all sanitary casualties.

Under peace-time condition frostbite injuries are more often observed in northern subarctic regions making 0.8-1.2% of all injuries [7, 8]. Surgical patients treated in Russian stationaries make 0.07%, 4.5-7.0% of all admitted patients are treated in burn departments. Cold injuries lethal outcome makes 3.6-5%, disability in deep frosting injuries makes 15-80% [9-11].

However frosting injuries are also observed in the regions with warm climate particularly in Central Asia, sometimes in winter months when the air temperature is 10-15 degrees below zero and humidity is increased. The persons of asocial type without definite place of residence and having a heavy background status most often suffer from frostbite injuries [12].

In Uzbekistan able-bodied men suffer most often, 85-90% of them are admitted in the condition of alcohol intoxication. In alcohol consumption inhibition of the body protective reactions occur, decrease of sensitivity may achieve complete anesthesia and as a result the victims do not feel frostbite injuries of extremities.

In this study we aimed to investigate the efficacy of medical therapy and topical treatment carried out in patients in preoperative period was evaluated. Additionally bacteriological investigation was performed in order to deter-

Table 1. -Sex/age distribution

№	Age	Males	Females	%
1.	Under 20	4	-	4.3
2.	21-30	9	-	9.8
3.	31-40	24	2	28.3
4.	41-50	29	4	35.9
5	Over 50	17	3	21.7
Total	92	83	9	100

Figure 1. Frostbite of both hands II-III degree.

Figure 2. Frostbite of both foot III-IV degree.

mine qualitative and quantitative contents of the wound microflora and its sensitivity to antibiotics.

Materials

Population

The Burn Department of the Centre of Emergency Medical Care (RCSUMA) serves a population of 2.5 in Samarkand Region with a mixture of urban and rural area. 1000-1200 patients are treated each year.

Data collection

During a 9 years period, 92 individuals of 19 to 63 years of age were included in this report. The data on each patient were collected including < age, sex, period of injury, bacteriological investigations and treatment.

Patients overview

83 patients were male and 9 were female. Age and sex distribution of individuals suffered from frostbite is shown in **Table 1**.

Periods of hospitalization

In prereactive period 23 (25%) patients were admitted, 41 (44.6%) patients had been hospitalized in early reactive period (**Figure 1**) and 28 (30.4%) - in late period, more than 5 days after getting cold injury (**Figure 2**).

Injury of extremities

Injuries of both upper extremities were noted in 14 (15.2%) patients, both lower extremities in - y 48 (52.2%), both upper and lower extremities in - y 16 (17.4%) patients. Isolated injuries of only upper or lower extremity had 14 (15.2%) victims.

Bacteriological investigation

All patients underwent bacteriological investigation in order to determine qualitative and quantitative contents of the wound microflora and its sensitivity to antibiotics.

Methods

At the reception ward

The character and volume of initially performed therapeutic measures depending on the results of primary examination, clarification of anamnesis, circumstances of getting trauma were of particular specific nature. Thus, all patients admitted from frosty outside, with the signs of clearly marked tissue cooling (loss of all kinds of sensitivity; white or with light cyanotic shade skin covering colour) were immediately applied multilayer thermolytic cotton-gauze bandages on the injured segments of extremities for the time of no less than 24 hours without performing any traditional measures for their warming (massage, warm bath,

etc.), i.e. well know and entirely proved principle of warming of injured tissues from inner to outer layer was followed. There was performed immobilization of extremity by plaster splints, seroprevention of tetanus and the patients were hospitalized into in-patient department.

At the inpatient department

Along with general warming of victims, all patients were given intravenous injection of infusion spasm and to improve microcircula determination of the injury area. The alcohol intoxication, physiological needs loss during 24 hours. The volume according to the formula: V = (FSC × S) + (AC × CVIT) + Ph.R + PL: V - is the volume of infusion the rapy in ml. FSC-frostbite severity coefficient: 1.0 in frostbite of degrees I-II; 2.0 in frostbites of degrees III and IV; S-square of the injured surface in cm^2; AC-alcohol intoxication severity coefficient: 0.5 in mild degree, 0.75 in moderate degree; 1.0 in severety degree; 1.5 in alcohol coma; SVIT-standardized volume of infusion therapy in alcohol intoxication, equal to 2,500 ml. for 24 hours; PhR-physiological requirement of the body for 24 hours in ml; PL-pathological loss during 24 hours in ml.

Simultaneously anticoagulant therapy was carried out: 1,500 units of heparin in 20 ml of 0.25% Novocain solution was infused 4-6 times during 24 hours under the control of coagulating blood system. In essential cases heparin therapy was carried out in combination with intravenous infusion of fibrinolysin in 20,000-40,000-unit dose.

In patients admitted in later terms, in early or late reacture periods the volume and character of therapeutic measures were determined according to the degree of frostbite and peculiarities of the injury process course.

The study was approved by an ethics committee of the Centre of Emergency Medical Care, Samarkand, Uzbekistan. The Ethics Committee of the Centre waived the need to obtain consent for the collection, analysis and publication of the retrospectively obtained and anonymized data for this non-interventional study.

Local treatment

In victim admitted in late reactive period with obvious frostbite sighs of III-IV degree, the primary tactics of local treatment depended on the condition of necrotized tissues. The preserved cysts with hemorrhagic contents were removed. In absence of cysts with but in tendency of injurious process to form humid gangrene, injury toilet was carried out and frequently changed (2-3 times during 24 hours) moist - drying not multilayer bandages with antiseptic solutions (betadin, furacilin, dioxidin) and warm physical methods to dry necrotic tissues (blowing of the affected extremities segments by warm air of hair dryer and heat ventilator) were used. In hospitalization of patients with already drying or completely mummificated crust dry sterilized bandage was applied and the same methods of warm physical therapy were used.

The patients who failed to prevent necrosis of one or another layer of tissues as well as patients admitted to the in-patient department with formed necrosis underwent surgical treatment to fight against intoxication and infections and also to prepare injuries to skin plastic operations. The most typical operations in patients with frostbites of III-IV degree were necrotomy, necrectomy, autodermoplasty and amputation of the injured segments of extremities. The indication for necrotomy, performed in 4-6 days after getting trauma was moist necrosis, marked edema and signs of purulent-ichorous infection of the affected tissues, severe general intoxication, absence of clear line of demarcation between viable and necrotic tissues. On the lower extremities the process in these cases usually spreads behind the area of the ankle joint and on the upper ones the area of the wrist joint. The operations consisted of making a large number of longitudinal to extremity axis incisions of all unviable tissues up to appearance of capillary (as dewdrops) bleeding. Application of moist-drying bandages with antiseptic solutions and warm physical therapy in the postoperative period contributed to intensive drying and mummification of necrotic tissues, relieved the fight against wound infection and general intoxication.

Necrectomy with excision of necrotic layers or the whole thickness of the skin was performed on frostbites of II-III degree after complete formation of dry necrosis, revealing a clear line of demarcation and remission of infections process in the wound. The operations as a rule were performed 12-15 days after getting trauma. The main purpose of these protecting operative interferences was maximum

Table 2. The results of treatment of hospitalized patients in prereactive period

Number of patients	Types of frostbites revealed in reactive period			
	I-II degree	II-III degree	III-IV degree	Average bed day
23 patients	11 patients	7 patients	5 patients	26.0±3.0

Table 3. Frostbite types in patients hospitalized in early reactive period in primary examination and final result

The number of patients	Degree of frostbite before treatment	Final result	Average bed-day
8	I-II degree	I-II degree	11.0
19	II-III degree	II-III degree	27.0±3.0
14	III-IV degree	III-IV degree	48.0±4.0

restriction of the zone with excision of tissues and signs of doubtful viability. For the same purpose excision of necrotized layers of tissues was performed on 1-2 cm more distally to the line of demarcation. I revealing residual or newly formed areas of necrotic tissues necrotomy was repeated. The final autodermoplasty was performed not earlier than 3 weeks after the last necrectomy on well granulating wound surface.

74 microbiological investigations of wound secretions in 48 patients with severe cold injury were carried out. The investigation was carried out in patients with deep frostbite injuries of extremities of III-IV degree, with development of soft tissue necrosis; and necrectomy was performed on extremities on different levels.

Elimination of cultures was performed according to general rules, identification-according to classical methods (Bergy 1994).

91 strains of infections agents were eliminated from the wounds. Monoculture was eliminated in 31 (47.4%) microbiological investigations, microbe association in 43 (52.6%) ones. Various microorganism combination occurred more often in patients with duration of more than 10-14 days.

The study of infections agents structure show ed that in 44 (49.5%) investigations gram-negative microorganism and in 47 (50.5%) gram-positive ones were revealed. The most often infections agent among gram-negative flora was the agent of hospital infection Pseudomonas aeruginosa -21.2% of the studied biological material. Specific gravity of the other gram-negative microorganism-Acinetobacter baumannii was 10.5%. Among gram-positive flora Staphylococcus spp.-predominated 25 (26.3%) samples. Antibiotics were prescribed after evaluation of mi-croorganisms sensitivity to preparations.

Results

Efficacy of infusion medical therapy and topical treatment carried out in patients in preoperative period was evaluated according to the type and severity of necrobiotic involvement of tissue on the one hand and it was impossible to prevent it in the reactive period and on the other hand according to duration of stationary treatment of patients (**Table 2**).

As it can been seen from the presented Tables of data in 18 of 23 patients the development of deep frostbites of III-IV degree was prevented due to timely undertaking proper and pathogenetically based therapeutic measures.

The results of similar treatment of 27 patients hospitalized in early reactive period were significantly worse (**Table 3**).

As it can be seen from the presented data in the table the development of deep frostbites of III-IV degree was not prevented in the majority of patients. Nevertheless, the treatment was justified that had been proved by the fact that of 9 patients with primary frostbite diagnosis of III-IV degree it was confirmed in 7 patients and in 2 patients the depth of injury was restricted by one's own skin.

In II-III frostbite degree autodermoplasty was considered to be of minimum interferences volume as well as the operations performed owing to the development of local infectious complications (section of abscesses, phlegmons, purulent edemas, etc.). Amputation of the affected segments of extremities, fingers and toes were considered to be of maximum volume. It is clear that operative activity and the number of amputations were most numerous in treatment of patients with frostbites of III-Iv

degree, although they were hospitalized in early reactive period.

Treatment of 28 patients with frostbite extremities, admitted in late reactive period also had its peculiarities. Thus, in 19 of them with frostbites of III-IV-degree mummification process of necrotized tissue had been completed by the moment of their admission to the inpatient department. Absence of obvious intoxication signs, local and generalized infectious complications in 9 of these patients made in possible to limit the volume of intensive infusion transfusion therapy of desintoxication character. Along with this late hospitalization of patients with deep irreversible injuries of tissues made the majority of them to undergo operative treatment in maximum volume (exarticulations, amputations). Their average bedday was 42.0±5.0.

Conclusions

Frostbite is a form of cold injury in which tissue fluids crystallise after exposure to freezing temperatures. Its health effects are associated with the immediate functional disadvantages that it causes and its various sequelae [13-15].

Frostbites are most often typical for asocial type of people without definite place of residence, having heavy background status. Most patients injuries of tissues occur as a result of ischemia, circulatory necrosis and reactive inflammation. In frostbite pathogenesis vascular disturbances which occur as a result of stable and prolonged vascular spasm as well as microvascular thrombosis are of essential significance. In its turn these changes results in microcirculatory disturbance in the tissues injured by cold and their necrosis [16, 17]. In employment of traditional methods of treatment 30-60% of victims become disabled persons and this is extremely high disability level among the patients, which confirms the problem urgency [18, 19].

Treatment of these patients is very prolonged, expensive, frequently requiring crippling operations, resulting in disability. These patients frequently stay at the department, with need of somebody's care and it is impossible to discharge them because of absence of place of residence. Official registration into the home for invalids is delayed for many months sometimes up to a year. The attending physician has to deal with registration of documents, examination in MSE, negotiations which social service employee to solve the problems of further residence. Treatment and further more a common stay of these patients on the hospital bed is impermissible extravagance.

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Disclosure of conflict of interest

None.

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