

Review of our 10 years experience in cold burns at the burn center in the Southeast Anatolia region of Turkey

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ABSTRACT

BACKGROUND: Frostbite injuries remain to be one of the most complex and current problems of emergency medicine. Although cold burns are less frequent in hot climatic regions, it is a trauma, especially for men in our region. Also, most of the patients have difficulties in gaining early access to health and burn centers.

METHODS: We performed a retrospective analysis on sixteen patients aged between 13 and 82, who were presented to Gazi Yaşargil Training and Research Hospital Burn Center due to frostbite injuries. Data of each patient, including age, gender, injury time, extremity injuries, bacteriological observations, and general warming, were obtained from patients' files and computer records.

RESULTS: After providing the first intervention to all the patients with trauma, a circulatory disorder of the injury area was determined, and the treatment was provided accordingly. The treatment of these patients required very long and expensive operations, which often resulted in making them disabled.

CONCLUSION: Deep frostbites in the cold winter months are frequently observed due to the unconscious use of ice and illegal crossings from the mountains at the Turkey border.

Keywords: Demographic characteristics; frostbite injury; prevention; treatment.

INTRODUCTION

Frostbite traumas remain to be one of the most complex and current problems of emergency medicine. The rate of frostbite injuries varies between 3% and 30% among the patients hospitalized in the burn trauma clinic. For the third-degree and fourth-degree frostbite injuries, the length of the treatment varied between 34 and 78 days.^[1-4]

The frequency of frostbite injuries increases during the war. For example, during the Second World War, 25% of all casualties in the German army happened due to icing of the injuries.^[5] A similar result was also seen in the American troops (25%) during their military operations in Korea (1950–1951).^[6]

In the periods of no war, frostbite injuries were mostly seen in northern Antarctica, which constituted 0.8–1.2% of all injuries.^[7,8] The mortality rate in frostbite injuries was found to be 3, 6–5%, while the morbidity rate in deep frostbite injuries was 15–80%.^[9-11]

However, especially in the hot climatic regions such as ours, icing injuries were seen in the winter months. For example, frostbites were observed when the air temperature was below zero, but the humidity was at increased levels. Moreover, 13–14% of healthy individuals in our country do not have safe working opportunities and health insurance,^[12] and most frequently, it is the asocial people with no place for residence or a residential status who suffer from frostbite injuries due

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to the lack of health insurance and insufficiency of the health centers.^[13]

In this study, we aimed to retrospectively investigate the effectiveness of medical and surgical treatments provided to patients with frostbites.

MATERIALS AND METHODS

Our study included sixteen patients over the past 10 years, who were aged between 13 and 82 years. The data, including their age, gender, the period of injury, bacteriological studies, and treatment, were retrospectively analyzed. The study was conducted as per the principles of the 2008 Helsinki Declaration, and before the study, approval was obtained from the ethics committee of the Gazi Yasargil Training and Research Hospital.

RESULTS

Of the sixteen patients, eleven were men, and five were women. The age range was between 13 and 82 years, and the average age was 31, 25 years. The age and gender distribution of the patients are shown in Table I. Frostbite injuries occurred mostly in the months of December and January, accounting for 62.5% of the total cases. The most frequent reason for frostbite was environmental factors, especially the illegal border crossings routes from the mountains (43, 75%), which resulted in deep and infectious wound sites in three of our patients (18, 75%).

In terms of frost localization, one patient showed injuries in the hands, feet, and fingers (6.25%), while five patients showed injuries in both upper extremities (31.25%). In four patients, injuries were seen in both the lower extremities (25%) whereas, isolated upper and lower extremity frostbite injuries were observed in six (37.5%) patients. Also, nine patients had second-degree cold burns while five patients had third-degree, and two patients had fourth-degree cold burns (Figs. 1 and 2).

Our treatment approach was determined by the time of occurrence and the environment in which the event occurred, along with the anamnesis at the time of the presentation. Firstly, to warm the patients presented to the hospital within the first 24 h, fluids at a temperature of 40–45°C were administered. Then, the affected areas were washed at room temperature for 20–30 min using 40–42°C warm water containing povidone-iodine. After warming up all the patients at our center, the first interventions were carried out, and then the circulatory disorders of the injury areas were determined. Next, according to the patient's weight, subcutaneous clexane and 0.5–2.0 ng of iloprost/kg body weight/minute intravenous (IV) were simultaneously administered as an anticoagulant treatment. After which, multilayer cotton-gauze bandages were applied to the injured areas of the patients

Table I. Patients and clinical characteristics

Patient	Arriving at the hospital	Number of patients	%
Male		11	68.75
Female		5	31.25
Age range	13–82 ages		
Age average	31.25 year		
Age table			
Under 20		3	18.75
Between 21 and 30		7	43.75
Between 31 and 40		3	18.75
Above 40		3	18.75
Frostbite time			
December		7	43.75
January		3	18.75
February		2	12.5
April		1	6.25
May		3	18.75
Frostbite reason			
Cold ice application		6	37.5
Environmental factors		9	56.25
cryotherapy		1	6.25
Arrival time at the hospital			
Within the first 24 h		5	31.25
Within more than 24 h		11	68.75
Smoke		3	18.75
Alzheimer		1	8.33
Illegal crossing from the border		7	43.75
Frostbite area			
Both feet, hands and their fingers		1	6.25
Both feet and their toes		5	31.25
Both hands and fingers		4	25
Right hand and fingers		1	6.25
Right thigh		2	12.5
Left thigh		1	6.25
Right forearm		2	12.5
Burn degree			
2 nd -degree		8	50.0
3 rd -degree		5	31.25
4 rd -degree		3	18.75

that showed white or light cyanotic skin color with loss of sensitivity in the extremities. Later, air splint and extremity immobilization were also provided, followed by a shot of tetanus vaccine regarding patient's previous immunization, and



Figure 1. (a, b) Frostbite of hands IV degree

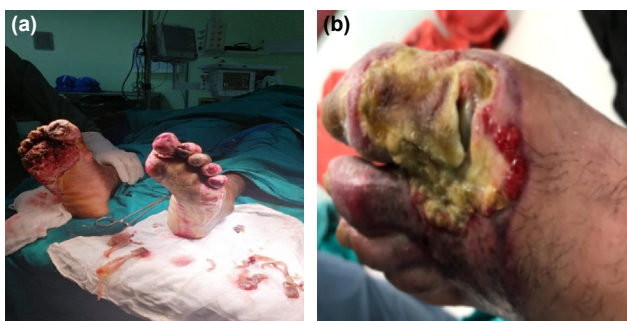


Figure 2. (a, b) Frostbite of feet IV degree.

the patients were then hospitalized for the treatment. Bacterial culture was collected from all the patients for bacteriological examinations to determine the infection at the wound site and also to assess their sensitivity to antibiotics. There was no growth found in the wound site cultures of any of our patients presented within the first 24 h.

For the patients presented at the hospital later than 24 h, the treatment method was determined according to the frostbite degree and injury process. Especially for the patients displaying third and fourth-degree apparent symptoms, the local treatment method depended on the conditions of the necrotic tissues. The cysts with preserved hemorrhagic content were unroofed. For the wound sites that showed a tendency to create moist gangrene, multilayered bandages were applied with a moist-antiseptic solution (Povidone-iodine, Nitrofurazon, and dioxidine), which were changed frequently (2–3 times within 24 h). Also, mild physical methods (blowing hot air into the parts of the affected extremities using a hairdryer) were applied. A dry sterilized bandage was applied to the dried scab. In three of the late presented patients, *Staphylococcus aureus* infection isolated in the culture of the wound site. Thus, antibiotic treatment was started accordingly. All these three patients with growth in the wound site cultures were the ones who stayed in the mountains for a long time (3–5 days). Here, one of the patients showed third-degree and fourth-degree frostbite injuries along with cyanosis in

Table 2. The degree of burn and length of stay in the hospital

Burn degree	II-degree	III-degree	IV-degree
Number of patients	8 patients	5 patients	3 patients
Average hospitalization period	10.6 days	19.4 days	34.0 days
Treatment conservative	2 patients	2 patients	
Treatment surgical	6 patients	3 patients	3 patients

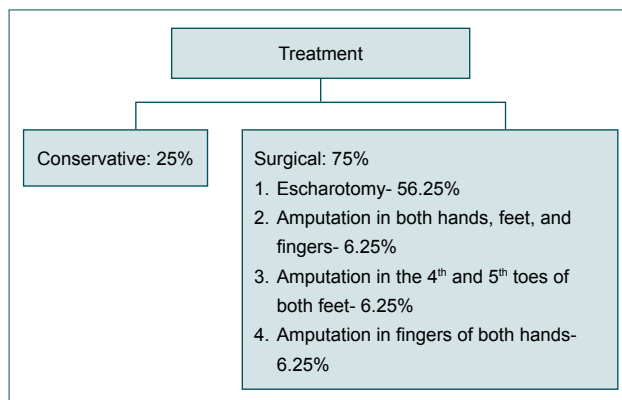


Figure 3. Treatment of patients.

both upper and lower extremities whereas, the other two patients showed cyanosis in the upper extremities only. All three patients were treated as inpatients.

Out of sixteen, nine patients had second-degree cold burns, of which three of them were treated conservatively while six of them were treated surgically by performing escharotomy, and later the wound was dressed with silver-containing products (Table 2). Other seven patients displayed third and fourth-degree deep cold burns upon arrival to the hospital. In one patient, amputations were performed in both the hands, feet, and fingers (6.25%) while in another patient, 4th and 5th toes of both feet were amputated (6.25%) whereas, in the other patient, the fingers of both hands were amputated (6.25%). For four patients, treatment was done by grafting (Fig. 3).

The duration of hospitalization for nine patients with second-degree frostbite was 10.6 days, while for five patients with third-degree frostbite, it was 19.4 days, and for two patients with fourth-degree frostbite, hospitalization was for 34 days. The average hospitalization stays for all the patients was 15.6 days (Table 2).

DISCUSSION

In our study, most of the patients who were presented to the emergency department were without health insurance, with 43.75% of them being homeless. This finding also showed similarity with many of the previous studies, where frostbite

was related to poverty. According to Pinzur and Weaver,^[14] the frostbite occurrence in the urban areas of the United States was typically observed among the poor and homeless without health insurance.

Previous literature reported that deep frostbite injuries were more common in patients who were smoking, male, old, and consumed alcohol.^[15] However, in our study, none of our patients consumed alcohol, but the smoking rate was 18.75%. We defined smoking as a risk factor for the emergence of deep frostbite. In previous studies, smoking was found to be a predisposing factor for frostbite, also “prohibit smoking” was included in the McCauley protocol.^[16–20]

Recent epidemiological studies have classified the age group with a high risk of frostbite as 30–49 years.^[19,21] In our study, the age range was between 13 and 82 years, and the average was 31.25 years. Moreover, previous studies indicated that males were the ones affected more frequently,^[15] and even in our study, men were the most affected with a rate of 68.75%.

The reasons for frostbite injuries were environmental factors, which were primarily the route of illegal crossing on the border from the mountains (43.75%) and also the unplanned use of medical ice (37.5%). The refugees, who want to cross the border of Turkey to reach Europe, know well that when they apply to any government agency such as a hospital, they will be caught by the security forces and sent back to their countries of origin. So patients who illegally crossed the border from the mountains with a fear of being caught by the forces were associated with a significantly higher rate of operative intervening because of their late arrival to the healthcare facilities. Cold applications should usually take 15–30 min to reduce swelling and pain in the trauma region. Longer application time leads to frostbite burns. Our patients used ice packs for 30 min longer. In our study, all the patients had frostbite in their feet or hands, which was similar to the studies investigating the most affected anatomical regions.^[22–24]

The tissue damage that occurs due to frostbite injuries is associated with ischemia, which happens partly due to the insufficient vascular supply. This suggests that early treatment of a frostbite injury more likely results in the preservation of more tissues. In our study, five patients presented themselves within 24 h of injury, while eleven patients came in after 24 h. We believe that instead of using 24 h as an indicator of early and late presentation, using the initiation time of the treatments may serve as a more useful indicator.^[17,18]

It is generally accepted that hypothermia in the patients with frostbite injuries should be set right, and their wounds should be rewarmed in a 40–42°C water bath for 15–30 min or until it gets thawed.^[25–30] However, as per the previous studies, it was not common to set hypothermia right and use quick rewarming methods.^[16] The reason behind this was the late presentation of the patients after their first frostbite injury,

which constituted 68.75% of the patients being presented after 24 h of their first injury. Moreover, hypothermia was not a common finding, and cold burns were irreversible.

Since the tissues with frostbite injuries are fragile, immobilization can prevent further tissue damage, although there is no evidence to support it.^[25] Nevertheless, air splints were applied to the frostbite trauma areas of all the inpatients.

Frostbite injuries should be considered as open injuries carrying the risk of exposure to infection, which should receive tetanus toxoid. There are tetanus case reports of frostbite patients, and hence, most of the studies support the use of tetanus toxoid prophylaxis.^[3] In our study, since the event of frostbite, was defined as an open injury, tetanus vaccines were given to all the patients regarding the protocols.

Antibiotics (oral, IV, or topical) were one of the most commonly given treatments, for, which the underlying reason could be the resemblance of frostbite event to cellulite, and it might have been believed that any injury could carry the risk of developing inflammation.^[15,21] Although previous studies have observed the tendency of developing inflammation in frostbite cases, there is no evidence on antibiotic prophylaxis effect on the patient's outcome in such cases. In our study, once the microbial culture result turned out positive in three patients, antibiotic treatment was applied accordingly.

Regular hydrotherapy aids the injury debridement of dead tissues and also helps in the preservation of function by promoting a range of motions.^[3] In our study, only five patients (31.25%) received hydrotherapy, and we anticipated that this might have been due to the developments in wound care. However, no studies specifically examined frostbite care with respect to dressings or hydrotherapy.^[25]

When we classified frostbite injuries into superficial frostbite and deep frostbite, it was observed that superficial frostbites were seen more frequently (56.25%) and were less subjected to surgical interventions. However, the number of surgical interventions was higher in the case of deep frostbite injuries. As seen from the data presented in Table 3, the third and fourth-degree frostbite development could not be prevented in most of the patients. Also, four out of seven patients diagnosed with third and fourth-degree primary frostbites were amputated due to the advanced depth of the injury. Especially for the treatment of patients with fourth-degree frostbite who were presented to the hospital later, a higher number of surgical treatments and amputations were observed, which could be attributed to the fact that more serious injuries need more aggressive treatments.

Deep frostbite trauma was seen in six male patients (37.5%) and one female (6.25%) patient who illegally crossed our country border. These patients also presented themselves to a health institution late due to the fear of being caught by the

security forces. Amputation was performed for four of these patients, who crossed the border illegally, presenting a rate of 25%. In the study conducted by Miller et al.,^[20] the amputation rate was 28.6%, which was similar to our amputation rate as well.

Conclusions

Turkey's location and particularities of its borders seriously affect the rate of migrant smuggling. Especially, the borders of the eastern and southeastern regions are very active in all types of smuggling. Deep frostbites in the cold winter months are frequently observed due to the unplanned use of ice and smoke by the patients and also illegal crossings from the mountains at the Turkey border. Hence, more surveillance should be conducted to keep these people and borders safe, especially during the colder months. Furthermore, there is a need to raise awareness about reporting to a health institution as early as possible to improve the diagnosis and treatment of deep frostbite injury.

Study Limitations

The most important factors limiting our study are the retrospective nature of our study and the limited number of patients. The fact that statistical analysis cannot be performed due to the insufficient number of cases is another limitation of our study.

Ethics Committee Approval: This study was approved by the Gazu Yasargil Training and Research Hospital Ethics Committee (Date: 29.01.2021, Decision No: 654).

Peer-review: Internally peer-reviewed.

Authorship Contributions: Concept: E.Y.; Design: E.Y.; Supervision: E.Y.; Resource: E.Y.; Materials: E.Y.; Data: E.Y.; Analysis: A.Ç.Y.; Literature search: A.Ç.Y.; Writing: E.Y., A.Ç.Y.; Critical revision: A.Ç.Y.

Conflict of Interest: None declared.

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ORJİNAL ÇALIŞMA - ÖZ

Türkiye Güneydoğu Anadolu Bölgesi'ndeki yanık merkezinde donmaya bağlı yanıklarda 10 yıllık deneyimimiz

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AMAÇ: Donmaya bağlı yaralanmalar, acil tıbbın en karmaşık ve güncel sorunlarından biri olmaya devam etmektedir. Sıcak iklime sahip bölgelerde, donmaya bağlı yanıkları daha az sıklıkta olup, özellikle bölgemizde daha çok erkeklerin karşılaştığı bir travmadır. Hastaların çoğu sağlık merkezlerine ve yanık merkezlerine erken dönemde ulaşımında sorun yaşamaktadır.

GEREÇ VE YÖNTEM: Gazi Yaşargil Eğitim ve Araştırma Hastanesi Yanık Merkezi'ne donmaya bağlı yaralanmalar nedeniyle başvuran yaşları 13 ila 82 arasında değişen 16 kişi geriye dönük olarak incelendi. Yaş, cinsiyet, yaralanma süresi, ekstremitte yaralanmaları, bakteriyolojik incelemeler ve hastaların genel ısınması dahil olmak üzere her hastaya ait veriler hastaların dosyalarından ve bilgisayar kayıtlarından elde edildi.

BULGULAR: Travmalı tüm hastalara ilk müdahale yapıldıktan sonra yaralanan bölgede dolaşım bozukluğu belirlendi ve buna göre tedavi sağlandı. Bu hastaların tedavisi çok uzun ve pahalı operasyonlar gerektirdi ve bu da çoğu kez engelli olmalarına neden oldu.

TARTIŞMA: Soğuk kış aylarında, bilinçsiz buz kullanımı ve Türkiye sınırındaki dağlardan kaçak geçişler nedeniyle sıklıkla derin donma yanıkları görülmektedir.

Anahtar sözcükler: Demografik özellikler; donma yaralanması; korunma; tedavi.

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