FIELD MEDICINE

FROSTBITE: SEVERITY AND PREDISPOSING FACTORS AMONGST PAKISTANI TROOPS IN SIACHEN

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ABSTRACT

Objectives: To know the severity and find out the exact causes and predisposing factors of frost bite, so that certain guidelines can be formulated for the troops and the people in command channel in order to minimize significantly the frequency and severity of this disability.

Design: Descriptive, questionnaire-based study

Place and duration of study: Study was done in field hospitals of Siachen sector from May 2002 to April 2003.

Patients and Methods: A total of 130 patients who suffered from frostbite in this duration were included, excluding injuries due to other causes. Proforma with questionnaire was completed by the doctor him self.

Results: The cumulative incidence was 29/1000 in one year. Maximum injuries were 1st degree (37.7 %) and 2nd degree (33.1%). Feet (56.9%) and hand's (26.9%) involvement was most common. There was a significant relation between lack of proper equipment or lack of knowledge and the injury. Maximum cold injuries (52.3%) were due to ill fitted, defective and soaked boots, socks and gloves. Majority of troops (47.6%) did not have basic knowledge to protect themselves from cold injuries. Maximum cases (about 84%) were seen in peak cold weather i.e. November – February.

Conclusions: High altitude serving troops should wear appropriate clothing, properly fitted quality boots, socks and gloves. They should have proper education and training regarding how to deal with cold weather. They should also avoid wet clothing, movement in blizzard, prolonged exposure to severely cold wind, and should be replaced after short intervals from their posts.

Keywords: Frostbite, northern area, siachen, cold injuries, predisposing factors, high altitude (HA)

INTRODUCTION

Siachen is the highest battlefield of the world. Pakistani troops are offering their services at an altitude of 12000 to 22000 feet above sea level. Frostbite is the most common cold injury causing major health problem in the troops deployed in Northern area. It can involve any exposed part of the body including hands / feet / nose / and ears. Despite adopting many preventive measures, there are a significant number of soldiers who suffer from frostbite, which is a matter of great concern.

Frostbite is a disability, which starts initially with arteriolar spasm after exposure to intense cold. There is stasis of blood in the damaged capillaries resulting in occlusion of the distal micro vascular system. It proceeds proximally, involving small and medium sized vessels, leading to death of tissues due to anoxia as well as ice crystal formation of the protoplasmic material of the cells. Cell damage due to freezing starts from the periphery towards the center of the exposed organs [1]. Clinically; it is classified into four degrees. First-degree injury is characterized by epidermal involvement, which causes erythema and mild oedema. Second-degree

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Received 26 Aug 2006, Accepted 28 May 2007

injury is full thickness skin freezing with substantial oedema and formation of clear blisters, which contract and dry within two to three weeks, forming a dark eschar. Formation of hemorrhagic blisters, blue-grey discoloration of the skin, thick gangrenous eschar formation, sequelae of trophic ulceration and severe cold sensitivity characterize third degree injury. In fourth degree injury, muscle, bone, and tendons are involved [2, 3].

Our troops face extreme weather during their tenure of duty in Northern area. Most of them are at risk of frostbite and get affected in cold seasons particularly when deployed at posts at high altitudes. Little work has been carried out, to study the magnitude of the problem in this group, and medical literature is lacking in studies on the epidemiology of frostbite amongst soldiers. This study was planned in order to gather information to allow implementation of the best possible preventive measures.

PATIENTS AND METHODS

This descriptive study was carried out in field hospitals of Siachen sector from May 2002 to April 2003. Data regarding the exact number of soldiers present in the area during the study period was correctly known from head quarter and medical records (each soldier undergoes medical examination before entering and leaving the operational area). All persons suffering from cold injuries were directed to report in the field hospitals. Soldiers having considerable medical problem i.e. Ischemic heart disease (IHD), Diabetes Mellitus (DM), chronic chest disease, Hypertension (HTN), and other vascular and cardiac problems were not allowed to serve in the area. During this period total number of troops at risk present in the area was 4482 who were deployed at an altitude of 12000 to 22000. Among them 130 personals suffered from frost bite during this particular time. This helped to find out the exact incidence of frostbite during this specific period. Data gathered through a questionnaire filled out by of 130 patients who encountered this problem during this period. All patients were male (18-42 years, mean; 29.06) and serving army personals.

This study included all the patients who were diagnosed by the surgeons as having frostbite (1st, 2nd, 3rd and 4th degree). Friction injuries sunburn and injuries due to UV rays were not included in this study.

Causes and predisposing factors were determined by the following means;

Detailed history by the patient

Consultation with the Medical Officers of the units

A consultation with the nursing assistants appointed at respective posts/ sectors.

Consultations with the Officers & and junior commissioned officers of the units.

After confirmation of diagnosis by the surgeon, each patient was given a questionnaire. On this basis, a Proforma was completed by the doctor, which contained detailed description of symptoms and signs of various degrees of frostbite. The soldiers were asked to define the body part affected (by choosing from a list of six locations- hands, feet, both {hands and feet}, nose, and ears), height of post, duration of stay, the season in which the injury occurred, the appropriateness of the equipment being used (checked against a list of indispensables consisting of proper boots, socks, gloves with cover, and windbreaker), whether they were properly trained or educated by someone, and what they believed was the main cause of the injury.

RESULTS

Total number of troops at risk present in the area was 4482 among them 130 soldiers reported with different degrees of frostbite during the period of one year in two field hospitals of this sector. Cumulative incidence of frost bite in this study group was 29/1000 in one year. The mean age of the affected soldiers was 29.06 + 5.44 years; the youngest was 18 and the oldest 42 years old.

Frequency of Disabilities

First-degree frostbite was the most frequent (37.7%) in all body parts. While

33.1% cases suffered from second-degree frostbite. Third degree was 19.2%, and 4th degree injured cases were 10.3% (fig.1).

Areas Regions Involved

The feet were the most affected part, with 56.9% of all cases. Followed by hand with 26.9% of those affected, while 5.4% cases presented with involvement of both the areas i.e. feet and hands. 5.4% cases reported with involvement of nose while almost the same number (5.4%) suffered from frostbite of the ear (table-1).

Seasonsonal Distribution of Frost Bite

The injury occurred mostly during ascent to high altitude posts (ranging from 18000 to 22000 feet above sea level) as well as during stay at such posts. The seasonal distribution of frostbite shows the highest occurrence from November to February (table-2).

Etiological Factors Causing Frost Bite

Predisposing (etiological) factors causing frostbite found in these cases were following:

- Ill fitted boots and socks were responsible for. 28.5% injuries, which got damage before time.
- Defective snow gloves and clothing in 23.8% soldiers frostbite was due to having defective snow gloves and HA clothing probably due to use of second hand items.
- Remaining factors related to lack of education and training to cope with severe cold weather and proper use of High Altitude (HA) equipment.
- Soakage of inner gloves and shoes in 19.2% cases occurred because soaked snow gloves/ socks and shoes were not replaced in time.
- Prolonged exposure time. About 13.8% soldiers suffered from this injury when they were asked to perform guard duties for a prolonged period of time and moreover due to delayed evacuation to the base hospitals in extreme cold environment after getting initial damage.
- Removal of snow gloves in cold during fine hand movements. Ten percent cases were not educated how to perform manual work in cold. Initial burning sensations due to exposure in severe cold led untrained soldiers to seek relief by burying their fingers/ hands and feet in the snow which caused further damage.
- Movement about during blizzard and extreme cold winds. About 4.6% planned their move in blizzard and extreme cold winds which resulted in cold injuries and then due to feeling of excessive cold some soldiers immersed the hands / feet in severe hot water or put the hands on hot stoves or fire, which further damaged the skin/ tissues (Figure-2).

DISCUSSION

The data was gathered in a reasonably reliable method and therefore led to drawing of these deductions.

The cumulative frequency of frostbite in this study with one-year experience was 29 per 1000 troops, which is only 2.9%. Cumulative lifetime incidences have been stated to be as high as 44–68% for all types of frostbite among a civilian northern population in a Finnish study [4]. while in another study the incidence of frostbite was 2.5 per 100,000 inhabitants in Finland who were residing in temperature from –15 to –20 degree C. [5] A retrospective study performed on medical records of the British Antarctic Survey between 1986 and 1995 determined 61 new consultations for cold injury, with an incidence of 65.6/1000 per year [6] although they worked in excellent research centers, received adequate training about managing cold conditions and necessary precautions were undertaken well in advance to prevent cold injury. It was therefore predictable that the incidence among the troops deployed in Siachen would be higher than among regular mountaineers, who are very well prepared and much more highly equipped. Furthermore, the study group was relatively

Table-1: Parts of body involved.

	Frequency	Percent	Valid Percent	Cumulative Percent
Feet	74	56.9	56.9	56.9
Hands	35	26.9	26.9	83.8
Both (feet and hands)	7	5.4	5.4	89.2
Nose	7	5.4	5.4	94.6
Ears	7	5.4	5.4	100.0
Total	130	100.0	100.0	

Table-2: Seasonal distribution of frost bite injuries.

	Frequency	Percent	Valid Percent	Cumulative Percent
January	29	22.3	22.3	22.3
February	28	21.5	21.5	43.8
March	10	7.7	7.7	51.5
April	1	.8	.8	52.3
August	3	2.3	2.3	54.6
September	3	2.3	2.3	56.9
October	4	3.1	3.1	60.0
November	27	20.8	20.8	80.8
December	25	19.2	19.2	100.0
Total	130	100.0	100.0	

young, and younger people might be more adventurous and had less knowledge about dealing with problems of wilderness conditions. According to the above figures, the incidence reported in our study seems very reasonable although unexpected. This result may not be comparable to the other studies in other countries. Despite the low economic status of Pakistan, all effort has been made to provide the troops with proper clothing, equipment, and training for minimizing the incidence of frostbite. Still the incidence is higher than expected by the authorities.

The self claimed reasons for the injury (inappropriate clothing, lack or incorrect use of equipment, and lack of knowledge of dealing with cold) emphasize the necessity of paying more attention to training. There is also need to educate them not to take measures that aggravate the initial injury. There should be minimum exposure to cold and early evacuation to field hospitals. The most important cause of frostbite according to our figures is inappropriate footwear and snow gloves, accounting for 52% of cases with frostbite. That is true because if we see the pattern of injuries, about 89% cases presented with involvement of toes and fingers. So, it is highly recommended that all troops should be provided with properly fitted boots, socks

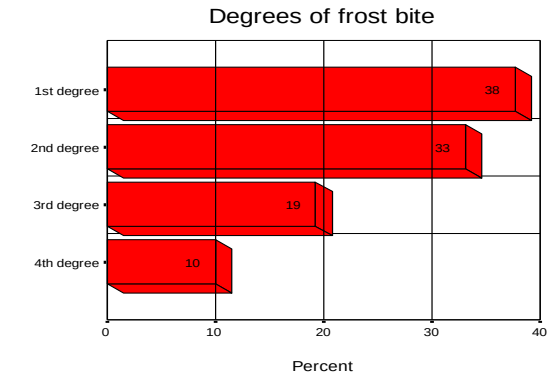

Fig. 1: Degrees of frost bite

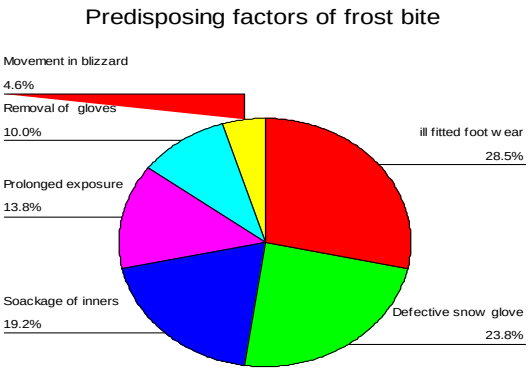

Fig. 2: Predisposing factors of frost bite.

and gloves. These should not be defective one and be replaced well in time after getting damage. They should be provided with special fitted gloves, which can help in fine manual work. In a study done in Tehran hands were primarily involved (26.4%) followed by feet (24.1%) in frostbite [7]. In a

retrospective study [8] on frostbite referrals to a tertiary care center that deals with accidents in the Karakoram mountains in Pakistan, feet were most often involved (64%), followed by hands (32%). Figures in our study regarding involvement of body parts are almost the same but the difference is that the former study was done in a tertiary care hospital which has less access to lower degree injuries, with up to 92% of their patients having second or third degree frostbite, necessitating definitive surgical intervention. In our study 71% cases with initial injury (1st and 2nd degree) were successfully managed conservatively in Field hospitals. This study led to the conclusion that first and second-degree injuries (71%) affected hands and feet primarily, and higher degree injuries were more prevalent in feet. As maximum cases (57%) presented with frostbite of feet with higher degree of injuries so more attention should be paid to protect the feet from cold, with use of specially designed, two layered plastic boots.

On the other hand, First and second-degree frostbite accounted for only 99.3% in U.S army soldiers from Sep 90 to May 95 in Alaska [9]. However, other body parts were the primary sites of involvement in other studies—for example, ears were the most affected part in Finnish conscripts, [5,10] even frozen cornea has been seen in a study done in USA [11].

Other studies indicate that the risk of cold injury is increased by alcohol consumption, [12] sedative drugs, opioid medicines. Patients with medical conditions such as peripheral vascular diseases, diabetes mellitus, hypothyroidism, and adrenal insufficiency should be advised to avoid winter expeditions because their risk of frostbite is high. [13] In our study such conditions are not possible because all troops have to get their medical fitness before entering in operations area and the persons getting above-mentioned medicines or suffering from any of such problem are not allowed to serve in the area. However other 48% cases were found having frostbite due to lack of training and education to cope with extreme cold weather.

Winter ascenders had the highest risk of cold injuries; maximum injuries occurred during November, December, January and February. Siachen and surrounding regions have the highest snowfall and the lowest temperatures (up to –60 degree) in these four months, which may account for the peak in frostbite incidence. These findings support the generally accepted advice that any troop should limit its movement as much as possible during this period.

Finally, it should be mandatory to adopt measures to minimize such injuries, like the US army that has reduced its incidence of cold injuries from 38.2/100,000 in 1985 to 0.2/100,000 in 1999 [14]. We can also reduce the risk of cold injuries, if we try to focus on the following

RECOMMENDATIONS:

Troops should be properly dressed during movement.

Boots and socks should be properly fitting and without defect.

They should take necessary extra equipment such as well-fabricated boots and mittens for replacement in time.

Having a knowledgeable guide.

Regarding Proper training and education on how to manage cold, they must emphasize on following:

Avoidance of wet clothing, windy terrains, and remaining in the same position for long periods

Avoidance of exposure of the affected body part to flame or hot water.

Proper Sheltering from wind and cold

Move during extreme weather and blizzard should be restricted.

Personal carelessness regarding touching bear metals i.e. Field telephone, torch, gun with bare hands should be avoided.

There should not be prolonged exposure in cold environment i.e. Sentry duties should be cycled in minimum intervals.

Over exhaustion and fatigue at posts should be avoided.

CONCLUSION

Although cumulative incidence of frostbite is low in our troops but still significantly high as compared to US and other European armies. It can be further reduced by wearing appropriate clothing, properly fitted quality boots, socks and gloves and having proper education and training on how to deal with cold weather. Troops should also avoid wet clothing, movement in blizzard and prolonged exposure to severely cold wind, and should be replaced after short intervals from posts, as forewarned is always forearmed.

REFERENCES

1. J.B. Walter, IC Talbot. Ischaemia and infarction. In: Walter & Israel General pathology, 7th Edition. Churchill livingstone, USA 1996; 711.
2. Reamy BV. Frostbite: Review and current concepts. J Am Board Fam Pract 1998; 11:34–40.
3. Cheng D. Frostbite. http://master.emedicine.com/ped/topic803.htm (accessed 16 Jul 2004).
4. Hassi J, Makinen TM. Frostbite: Occurrence, risk factors and consequences. Int J Circumpolar Health 2000; 59:92–8.
5. Juopperi K, Hassi J, Ervasti O, Drebs A, Nayha S. Incidence of frostbite and ambient temperature in Finland, 1986-1995. A national study based on hospital admissions. 2002; 61; 4: 352-62.
6. Cattermole TJ. The epidemiology of cold injury in Antarctica. Aviat Space Environ Med 1999; 70:135–40.
7. Harirchi I, Arvin A, Zafarmand V. Frostbite: incidence and predisposing factors in mountaineers. 2005; 39; 12: 898-901.
8. Hashmi MA, Rashid M, Haleem A, et al. Frostbite: epidemiology at high altitude in the Karakoram Mountains. Ann R Coll Surg Engl 1998; 80:91–5.
9. Candler WH, Ivey H. Cold weather injuries among U.S. soldiers in Alaska: a five-year review: 1997; 162; 12: 788-91.
10. Lehmuskallio E, Lindholm H, Koskenvuo K, et al. Frostbite of the face and ears: epidemiological study of risk factors in Finnish conscripts. BMJ 1995; 311:1661–3.
11. Long WB, Edlich RF, Winters KL, Britt LD. Cold injuries. 2005; 15; 1: 67-78.
12. Freund BJ, O'Brien C, Young AJ. Alcohol ingestion and temperature regulation during cold exposure. J Wilderness Med 1994; 5:88–98.
13. Scott AR, Bennett T, Macdonald IA. Diabetes mellitus and thermoregulation. Can J Physiol Pharmacol 1987; 65:1365–76.
14. DeGroot DW, Castellani JW, Williams JO, Amoroso PJ. Epidemiology of U.S. Army cold weather injuries, 1980-1999. 2003; 74; 5: 564-70