



ON-SITE MANAGEMENT OF FROSTBITE IN THE HIMALAYAS

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INTRODUCTION: FROSTBITE

- Localized freezing injury - Common debilitating condition
- Soldiers, travelers, mountaineers, scientists, residents
- Prolonged morbidity, reduce performance, long-term sequelae can affect operational/mission targets
- Immediate evacuation to hospital recommended
- Established hospital protocols – ? Field conditions
- Delayed evacuation from high-altitude, remote mountain terrain – Limitations of weather, communication, aviation
- Mountain – Low resource facilities – Far and Few
- Paucity of evidence on emergent on-site management
- Study evaluated on-site management in Himalayas

MATERIALS AND METHODS

- Prospective, observational cohort of 172 patients of 1^o/2^o frostbite delayed for evacuation in four low-resource high-altitude field conditions of Himalayas – 2007-2016
- Karakoram, Kashmir, Garhwal and Nepal Himalayas
- Approvals from Nehru Institute of Mountaineering
- Blanket consent for training, treatment and evacuation
- Non-freezing cold injury excluded – No control group
- Pilot study - 08 frostbite patients – Favourable outcome
- On-site field management included cold protection and established hospital protocol of therapeutic rewarming
- Occupation, knowledge and pre-existing risks evaluated
- 1^o frostbite – pain, numbness, erythema, mild edema
- 2^o frostbite – pain, clear blisters, erythema, oedema
- 3^o frostbite - pain, haemorrhagic blisters
- 4^o frostbite – pain, necrosis of deeper tissues
- Intact blisters preserved, ruptured blisters debrided
- Protection – Refreezing, dry heat, excessive movement
- Both active and passive rewarming, pain relief, antibiotics
- Active moist rewarming- Chlorhexidine water bath 40-43°C (104-110°F) 15-45 min, 5-6 times a day- Recirculating water
- Passive rewarming - Sleeping bags, blankets
- No rewarming container- Bucket, mug, saucapan, messtin
- Aloe vera 10% over frostbitten areas and blisters
- Investigations, imaging and oxygen not available
- Primary outcome – Symptomatic relief, healing of injuries, return of function; Secondary outcome – No requirement of evacuation and return to operational/mission commitment

RESULTS

- All 172 were healthy, altitude-acclimatized, knowledgeable and prepared for cold weather – Age 16-37 yrs (Mean 27.8 yrs)
- 84% had cold weather experience, 58% previous cold injury
- 30% consumed tobacco and 7% consumed alcohol
- Frostbites sustained between 9000-24000 ft (Mean 14575 ft)
- Mean duration of injury at presentation 2.25 ± 1.85 days
- Poor judgement of injury due to numbness and hypoxia
- 53% frostbites on fingertips of gloved hands, 35% on toes with cold weather shoes, 20% on ungloved fingertips
- Primary outcome achieved – 83% patients
- Blistering, swelling, pain increased in 17% patients
- Secondary outcome achieved- 58% 1^o and 37% 2^o frostbite
- Outcome not quantifiable – Control arm would be unethical

Distribution of frostbite in Himalayan region and persona (N = 172)				
Males 158 Females 14	Karakoram	Kashmir	Garhwal	Nepal
Seasoned mountaineers	1	Nil	Nil	10
Porters	4	3	2	1
Amateur mountaineers	61	33	56	Nil
Mountain resident	Nil	1	Nil	Nil
Total	66	37	58	11
% age	38.37%	21.51%	33.72%	6.39%
95% confidence interval	31.1 – 45.64	15.37 – 27.65	26.65 – 40.79	2.73 – 10.05

	Presentation of frostbite (N=172)					
	First Degree		Second degree		Third degree	
	Frequency	% age	Frequency	% age	Frequency	% age
Fingertips	88	51.16	37	21.52	6	3.49
Toe tips	18	10.47	19	11.05	Nil	Nil
Nose	Nil	Nil	2	1.16	Nil	Nil
Ear	Nil	Nil	1	0.58	Nil	Nil
Cheek	1	0.58	Nil	Nil	Nil	Nil

Treatment/Evacuation of Frostbite (N = 172)	Treated on site		Evacuated	
	Frequency	% age	Frequency	% age
First degree (107)	62	57.94%	45	42.06%
Second degree (59)	22	37.29%	37	62.71%
Third degree (6)	Nil	Nil	6	100%
9000-11000 ft (42)	29	69.05%	13	30.95%
12000-14000 ft (59)	36	61.02%	23	38.98%
15000-17000 ft (21)	2	9.52%	19	90.48%
18000-20000 ft (37)	17	45.95%	20	54.05%
21000-23000 ft (11)	Nil	Nil	11	100%
24000 ft and beyond (2)	Nil	Nil	2	100%

DISCUSSION AND CONCLUSION

- Frostbite can occur in cold-experienced explorers
- Frostbite predilection in intense long duration missions
- False sense of bravado, fear of deinduction from mission
- Therapeutic rewarming can be attempted in controlled and protected conditions outside the hospital in field
- Emergent on-site management – Favourable outcome
- Aloe vera 10% over frostbitten areas and blisters
- Behavioural modification for exuberance of mountaineers
- Mountain risk modelling imperative in mission dynamics



REFERENCES

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