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Incidence of Cold Injury and Effects of Reduced Air Pressure in High Altitude Areas of the Himalayas

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Abstract. Data covering the three-year period, 1981-1984, from the forward area hospitals, receiving patients from units operating in high altitude areas of the Himalaya reveal an average admission of 247 and 171 cases of cold injury and effects of reduced air pressure respectively. Chillblain was the commonest (85.8%) form of cold injury and high altitude pulmonary oedema the commonest (76.2%) clinical syndrome in the hopoxia group. In both groups, the disease was mild in 61 per cent cases and severe in about 36 per cent.

1. Introduction

The border of India in the north is formed by Himalaya mountains, sometimes called the roof of the world. They extend over 2,400 km eastwards across the northern frontier of the sub-continent from Afghanistan to China through Kashmir, Tibet, Nepal, Bhutan and Sikkim. The Himalayas along with their western bastion, the Karakoram mountains, contain more than 90 peaks over 7,310 meters high and probably 40 peaks higher than any in the rest of the world. On the southern faces of the Himalayan peaks above the level of 4,870 meters, the snow remains throughout the year. In winter it creeps down to 1,830 meters or even below. Between May and October the temperature at 3,660 meters is usually above the freezing point, but at 4,570 meters it is seldom higher than freezing point, even in summer. Most of the mountain passes are blocked from September to May or even early June[1].

The term high altitude has no precise definition[2]. For the purpose of this paper high altitude is taken to mean an elevation of 2,700 meters or more[3].

Considerations of national security and sovereignty entail the deployment of a large number of military and para-military forces in high altitude areas. These persons are exposed to the physical factors, namely, hypoxia, cold, humidity etc., operating

in these areas. The aim of this paper is to present the incidence of cold injury and effects of reduced air pressure among these personnel.

2. Material and Methods

Extracts from the admission registers of all forward hospitals receiving patients from high altitude areas, pertaining to direct admissions due to cold injury[4] and the effects of reduced air pressure[4], for the three-year period from 1981 to 1983, were obtained and analysed. It contained complete information regarding the number of individuals so admitted, their ages, diagnoses, number of days spent in hospital and disposal on discharge from hospital.

Only actual numbers have been presented and no rates calculated. Reasons for this are two. Firstly, the patients belonged to several diverse organisations mentioned earlier. Secondly, it is almost impossible to ascertain with any degree of accuracy, the precise number of persons actually at risk, because usually batches of persons from various units are engaged in duties at different locations situated at different altitudes.

3. Results and Discussion

Various aspects of cold injury are presented in Tables 1-5 and of effects of reduced air pressure in Tables 6-12.

3.1 *Cold Injury*

The admission of 741 cases of cold injury over a period of three years gives an yearly average of 247 cases. Of these 85.5 per cent had chillblain, 13.9 per cent frost bite and 0.3 per cent trench foot (Table 1). Out of 636 cases of chillblain 573 (90.1%) affected the feet and only 63 (9.9%) involved the hands. Out of 103 cases of frost bite 55 (53.4%) involved the feet and the rest 48 (46.4%) affected the hands. No other part of the body was affected. 93 per cent of patients were between 20 and 39 years of age (Table 2).

Table 1. Number and types of cold injury hospitalised during 1981-83

Srl No	ICD No	Diagnosis	No of cases	% of total cases
1	N-991 (c)	Chillblain	636	85.8
2	N-991 (a)	Frost bite	103	13.9
3	N-9991 (b)	Trench foot	2	0.3
	Total		741	100.0

Table 2. Frequency distribution by age of 741 cases of cold injury hospitalised during 1981-83

Age in years	Chillblain	Frost bite	Trench foot	Total
< 20	17	–	–	17 (2.3)
20–	454	62	2	518 (69.9)
30–	140	31	–	171 (23.1)
40–	25	10	–	35 (4.7)
50–	–	–	–	–
Total	636	103	2	741 (100.0)

Note : Figures in parenthesis denote percentage of total cases.

Table 3. Frequency distribution of 741 cases of cold injury hospitalised during 1981-83 according to the month of admission

Month of admission	Chillblain	Frost bite	Trench foot	Total
Jan-Mar	246	48	1	295 (39.8)
Apr-Jun	30	7	–	37 (5.0)
Jul-Sep	11	–	–	11 (1.5)
Oct-Dec	349	48	1	398 (53.7)
Total	636	103	2	741 (100.0)

Note : Figures in parenthesis denote percentage of total cases.

Table 3 shows that 93.5 per cent cases were admitted during the winter months October to March and 6.5 per cent during the remaining six months of the year. This is as would be expected.

More than 63 percent cases were mild and were discharged to their units to resume active duties in their units (Table 4). The disease was severe in nearly 36 per cent cases who had either to be sent on sick leave (9.3% of total cases) or evacuated to hospitals in the rear (26.6% of total cases). 73 per cent of the mild cases had been discharged from the hospital within 15 days (Table 5).

Table 4. Frequency distribution showing the disposal of 741 cases of cold injury hospitalised during 1981-83 on discharge

Disposal	Chillblain	Frost bite	Trench foot	Total
Discharged fit to resume active duties	438	29	1	468
	(68.9)	(28.2)		(63.2)
Discharged in low medical category	6	1	–	7
	(0.9)	(1.0)		(0.9)
Sent on sick leave	39	30	–	69
	(6.1)	(29.1)		(9.3)
Transferred to another hospital	153	43	1	197
	(24.1)	(41.7)		(26.6)
Total	635	103	2	741
	(100.0)	(100.0)		(100.0)

Note : Figures in parenthesis denote percentage of total cases of each disease.

Table 5. Frequency distribution showing number of days spent in hospital by 475 cases of cold injury who were discharged to active or sheltered duty

No of days spent in hospital	No of patients	% of total 475
< 5	13	2.7
5–	159	33.5
10–	175	36.8
15–	77	16.2
20–	22	4 6
25–	9	1.9
30–	8	1.7
35–	7	1.5
40–49	5	1.0
Total	475	100.0

Table 6. Number and types of cases of reduced air pressure hospitalised during 1981-83

Srl No	ICD No	Diagnosis	No of cases			% of total cases
			Kashmir sector	All other sectors	Total	
1	N–993 (a)	High altitude pulmonary oedema (HAPO)	265	126	391	76.2
2	N–993 (b)	Acute mountain sickness	32	32	64	12.5
3	N–993 (g)	Transient effects of high altitude	42	2	44	8.6
4	N–993 (c)	Chronic mountain sickness	9	3	12	2.3
5	N–993 (d)	High altitude pulmonary	2	0	2	0.4
	Total	hypertension	350	163	513	100.0

3.2 *Effects of Reduced Air Pressure*

With 513 cases of effects of reduced air pressure admitted over three years, the average yearly admissions comes to 171. High altitude pulmonary oedema (HAPO) was the commonest diagnosis (76.2% of total cases) and pulmonary hypertension the rarest (Table 6). The number of cases reported from Kashmir sector have been shown separately because in this sector routine use is made of air transportation especially during winter when mountain passes are closed. More than 89 per cent patients were in 20-39 years age group (Table 7); however, this is also the age group of the bulk of the persons serving there.

The distribution of HAPO cases according to the time-period of their occurrence is depicted in Table 8. In Kashmir sector the maximum number of cases (40.4%)

Table 7. Frequency distribution by age of 513 cases of reduced air pressure hospitalised during 1981-83

Age in years	HAPO	Ac. mtn. sickness	Transient effects of HA	Ch. mtn. sickness	HA pulm. hypertension	Total
<20	4	2	2	–	–	8 (1.6)
20–	251	41	24	2	–	318 (62.0)
30–	103	19	11	6	1	140 (27.3)
40–	31	2	6	4	1	44 (8.5)
50–	2	–	1	–	–	3 (0.6)
Total	391	64	44	12	2	513 (100.0)

Note : Figures in parenthesis indicate percentage of total cases.

Table 8. Frequency distribution of 391 cases of HAPO according to the month of admission

Sector	Number of admissions			Total
	Jan-Sep	Oct-Jan	Feb-May	
Kashmir	78	80	107	265
	(29.4)	(30.2)	(40.4)	(100.0)
All others	35	52	39	126
	(27.8)	(41.3)	(30.9)	(100.0)

Note : Figures in parenthesis denote percentage of total cases.

occurred during February to May i.e. when road transportation is at a standstill due to closure of the mountain passes. The temporal variations were just short of statistical significance ($\chi^2 = 5.51$; $d.f. = 2$; $0.1 > p > 0.05$). In other sectors the period October to January witnessed the maximum cases (41.3%) : here the temporal variations were much below the level of statistical significance ($\chi^2 = 3.76$; $d.f. = 2$; $0.2 > p > 0.1$). The preponderance of HAPO cases during February to May in Kashmir sector is largely linked with induction of persons by air since it is known that HAPO results from rapid exposure to high altitude[5].

Temporal distribution of cases of acute mountain sickness in Kashmir and other sectors is shown in Table 9. The maximum number of cases were seen during the months of June to September and the minimum during February to May. These variations were highly significant ($P < 0.01$) for Kashmir sector but far from significant for other sectors ($\chi^2 = 2.44$; $d.f. = 2$; $0.3 > p > 0.2$). Corresponding data for the transient effect of high altitude are presented in Table 10. These show that in Kashmir sector maximum and significantly ($p < 0.05$) higher number of cases were witnessed during June to September as compared to the other months. The symptoms of these two syndromes are in reality the symptoms of rapid acclimation[5], and their high preponderance during summer months in Kashmir is most likely associated with the higher quantum of movement of personnel which takes place during these months in this sector.

Table 9. Frequency distribution of 64 cases of acute mountain sickness by months of admission

Sector	Number of admissions			Total
	Jun-Sep	Oct-Jan	Feb-May	
Kashmir	23	7	2	32
	(71.9)	(21.9)	(6.2)	(100.0)
All others	15	10	7	32
	(46.9)	(31.2)	(21.9)	(100.0)

Note : Figures in parenthesis denote percentage of total cases.

Table 10. Frequency distribution of 44 cases of transient effects of hige altitude by month of admission

Sector	Number of admissions			Total
	Jun-Sep	Oct-Jan	Feb-May	
Kashmir	23	8	11	42
	(54.8)	(19.0)	(26.2)	(100.0)
All others	1	—	1	2

Note : Figures in parenthesis denote percentage of total cases.

Table 11. Frequency distribution showing the disposal of 513 cases of reduced air pressure hospitalised during 1981-83 on discharge from the forward hospital

Disposal	HAPO	Ac. mtn. sickness	Transient effects of HA	Ch. mtn. sickness	HA pulm. hyper-tension	Total
Discharged fit to resume active duties	239 (61.1)	34 (53.1)	37 (84.1)	3 (25.0)	—	313 (61.0)
Discharged in low medical category	16 (4.1)	—	—	—	—	16 (3.1)
Sent on sick leave	48 (12.3)	3 (4.7)	1 (2.3)	1 (8.3)	2	55 (10.7)
Transferred to another hospital	86 (22.0)	27 (42.2)	6 (13.6)	8 (66.7)	—	127 (24.8)
Died	2 (0.5)	—	—	—	—	2 (0.4)
Total	391 (100.0)	64 (100.0)	44 (100.0)	12 (100.0)	2	513 (100.0)

Note : Figures in parenthesis denote percentage of total cases of each disease.

Table 12. Frequency distribution showing number of days spent in hospital by 329 cases of reduced air pressure who were discharged to active or sheltered duty

No of days spent in hospital	No of patients	% of total 329
<5	19	5.8
5—	115	34.9
10—	119	36.2
15—	50	15.2
20—	15	4.6
25—	7	2.1
30—49	4	1.2
Total	329	100.0

Though HAPO and acute mountain sickness including the transient effects of high altitude are considered to be clinical variants of the same disorder[5], the dissociation between the periods of maximal occurrence of cases of HAPO and acute effects of high altitude has been clearly revealed.

The data in Table 11 reflect the severity of disease. 61 per cent cases were mild and discharged to their units to resume active duty. The disease was severe in about 36 per cent cases who had either to be sent on sick leave (10.7% of the total cases) or evacuated to hospitals in the rear (24.8% of total cases). In this series the immediate fatality rate of HAPO was 0.5 per cent. Table 12 shows that more than 76 per cent of mild cases had spent less than 15 days in hospital.

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