



EXTREME ALTITUDE PULMONARY EDEMA IN ACCLIMATIZED SOLDIERS

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INTRODUCTION: EXTREME ALTITUDE

- High Altitude >2700m/9000 ft, Extreme altitude >5500m/18000 feet
- Extremely low oxygen (<40%)
- Extreme cold (-30°C to -70°C)
- Terrain hazards (ice sheets, loose snow)
- Mountain hazards (avalanches, crevasses)
- Weather hazards (snow storms, lightning)
- Health Hazards- Extremely tough living conditions
- Low resource healthcare setups are far and few
- Difficult evacuation (Weather, communication and enemy action)
- Limited research and experience
- Pulmonary Oedema- Most common cause of hypoxic death
- Rapid ascent, improper acclimation, undue exertion, cold exposure
- Young adults, males, lowlanders, obese
- Early symptoms masked by Acute Mountain Sickness

MATERIALS AND METHODS

- 31 soldiers presented with EAPE at worlds highest medical set up
- Lake Louis Consensus Criteria
- Ascent to altitude
- Cough, SOB, chest pain, cyanosis, lung crackles
- Crepitations in ≥ one lung field/ Central cyanosis/Tachycardia/pnoea
- Descent – Gold standard and Evacuation
- HAPO Bag nursing – No oxygen available (8-10 litres/min)
- Acetazolamide 250 mg TDS
- Dexamethasone 4 mg stat, 2 mg BD
- Response monitored clinically

RESULTS

- EAPE seen in fully acclimatized mountain trained soldiers
- EAPE also seen in native highlanders
- 20 (64.52%) regular smokers, 11 (35.48%) occasional smokers
- HAPE Bag ensued dramatic improvement in absence of oxygen
- 30% consumed tobacco and 7% consumed alcohol

Table 3 Clinical features of HAPO/AMS (Including Lake Louis criteria for HAPO)

Sign/symptom	No. of cases	% age
Symptoms		
History of exertion	10	32.26%
Dyspnoea/Orthopnoea	30	96.77%
Cough	20	64.52%
Haemoptysis	3	9.68%
Chest pain/tightness	20	64.52%
Headache	14	45.16%
Nausea	6	19.35%
Vomiting	3	9.67%
Weakness	15	48.39%
Dizziness	5	16.12%
Sleeping problems	7	22.58%
Decreased Appetite	15	48.39%
Signs		
Tachypnoea	31	100%
Tachycardia	30	96.77%
Altered Blood Pressure	31	100%
Central Cyanosis	6	19.35%
Reduced SpO ₂ (<75%)	31	100%
Lung crepitations	31	100%

All patients fulfilled Lake Louis criteria for HAPO. Fever was not presented.

DISCUSSION AND CONCLUSION

- EAPE despite strict staged-graded acclimatization schedule customized for extreme altitude
- Prolonged stay at extreme altitude not protective
- Prior knowledge and experience not protective
- Every day is a new day beyond 5500 metre or 18000 ft
- Due care needs to be taken in judging summit ascents, reconnaissance treks, military operations and troop deployment at extreme altitude

Table 6 Comparison with various research studies

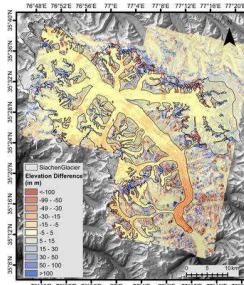
Parameter	Present study	Lugman et al ¹⁶	Gabry et al ¹⁸	Hultgren et al ¹⁹
Lead Diagnosis	Extreme Alt HAPO	Severe Acute AMS	Moderate Alt HAPO	High Alt HAPO
Study altitude	>19000 ft	>16000 ft	<7870 ft	9600 ft
Patient age 21-30 years	70.97%	88.37%	Mean age 37±14	Mean age 34.3±15.5
Highlanders	70.97%	50% approximately	Not described	Not described
Acclimatization status	Acclimatized cases	Acclimatized cases	Not described	Not described
Post acclimatization stay	Mean 39 days	30-60 days	Not described	Not described
Regular smokers	64.52%	20.93%	Not described	Not described
History of exertion	32.26%	30.23%	Not described	Not described
Dyspnoea/Orthopnoea	96.77%	95.35%	96%	77%
Cough	64.52%	81.39%	72%	69%
Haemoptysis	9.68%	48.84%	Not described	6%
Chest pain/tightness	64.52%	74.42%	17%	41%
Headache	45.16%	72.09%	53%	53%
Nausea	19.35%	Not described	Not described	35%
Vomiting	9.67%	Not described	Not described	16%
Weakness	48.39%	Not described	Not described	25%
Dizziness	16.12%	Not described	Not described	17%
Sleeping problems	22.58%	27.9%	62%	21%
Decreased Appetite	48.39%	Not described	28%	Not described
Tachypnoea	100%	79.07%	100%	26%
Tachycardia	96.77%	60.47%	100%	90%
Altered Blood Pressure	100%	Not described	100%	Not described
Central Cyanosis	19.35%	Not described	59%	Not described
Reduced SpO ₂ (<75%)	100%	Not described	Not described	Mean SpO ₂ -74.4%
Lung crepitations	100%	81.39%	77%	85%

Age profile		
Age/Residence	No. of cases	% age
21-30 years	22	70.97%
31-40 years	7	22.58%
>41 years	2	6.45%



Day/Night presentation and evacuation of EAPE cases

Day/Night	Presented		Evacuated	
	No. of cases	% age	No. of cases	% age
Day time	25	80.64%	10	32.26%
Night time	6	19.35%	4	12.9%



REFERENCES

- (1) International Society for Mountain Medicine. Lake Louise Consensus on the Definition of Altitude Illness. ISMM, 2001.
- (2) Headquarters, Dept of the Army. In: Field Manual 3-97.6: Acclimatization 1-41. Mountain Operations 2000.; 1-11-3.