

Incidence of High Altitude Illness among Low Landers in Northern India (Ladakh) and Its Association with Altitude Range and Acclimatization Schedule

A Bhattacharya, Kumari Nitu Roy*, Ravi Roy

*Corresponding Author: Dr (Maj) Kumari Nitu Roy

Abstract: High altitude and associated high altitude illnesses have always been an issue of concern especially in western Himalayan region and northern India. Ladakh has been stated to cause maximum number of cases of high altitude illness. This study was taken to assess the incidence of High altitude illness (HAI) among low landers adult males on rapid exposure to high altitude region and the association of altitude range and acclimatization schedule. An observational study was done prospectively in Ladakh region and all the reported cases of high altitude illness were assessed for two consecutive years. The overall incidence of high altitude illness were 7.6/1000 and 9.2/1000 in two consecutive years. Maximum number of acute mountain sickness (AMS) were reported between 0-2 days of acclimatization and 11500 to 13500 ft altitude range while the number of High altitude pulmonary edema (HAPO) cases reported between 3-5 days of acclimatization and at 11500 to 13500 ft altitude range. Rapid induction and gain in altitude of more than 13500 ft was found to have a direct association with high altitude illness.

Key words: High altitude illness, acute mountain sickness, acclimatization schedule, high altitude pulmonary edema, high altitude cerebral edema,

Date of Submission: 24-10-2019

Date of Acceptance: 09-11-2019

I. Introduction

Background

Terra Daily reports "Altitude sickness worst in northern India"(1). A region of northern India has been called the world's worst place for altitude sickness. In a large study of visitors to mountain regions around the world assessed for their vulnerability to altitude sickness, Ladakh was found to be the biggest threat (2). No clear explanation, linked to the climate or the difficulty of the terrain is available although many informal reports mention the higher risk of this location, Richalet said (1,2).

Ladakh is a very important part of India and many low landers stay there for many months in extreme hostile conditions as prevalent in higher regions of Ladakh. Exposure to high altitude is a physiological stress and human survival is possible only by physiological adaptations to the extremes of environmental conditions. Ladakh an arid desert between the Himalayas and the Kunlun Mountain ranges lying at 3000 to 4500 m altitude. It has been recognized that altitudes more than 1500m above sea level affect the health of human beings adversely (3). Staying at high altitude and exposure to low barometric pressure and partial pressure of oxygen cause hypoxaemia. Acute exposure to such hypoxic atmospheric conditions with inadequate acclimatization predisposes to severe high altitude illnesses like acute mountain sickness (AMS), high altitude pulmonary edema (HAPO) and high altitude cerebral edema (HACO) (4). In the background of above mentioned facts this study was taken up to assess the severity of High Altitude illnesses in low landers at various altitudes of Ladakh.

Aim: To study incidence of high altitude illness (HAI) and its association with altitude range and acclimatization among low unacclimatized males in high altitude region of north India (Ladakh).

Objective: 1. To predict the incidence of high altitude illnesses in low landers at high altitude.

2. To predict the effect of altitude range and acclimatization on high altitude illness

Study design: Prospective observational study

II. Material and methods

A prospective observational study was carried out for consecutive two years, Jan 2013 to Feb 2015 in a tertiary care hospital situated at the height of 11,500ft above sea level and in field hospitals at the height of 9500ft,13500ft 14500ft and 17500ft respectively. All the fresh low landers adult males inducted to high altitude areas undergo acclimatization varying from 7 to 10 days as per the assigned protocols (4, 10). All the participants were healthy males between 20 -50 years. All of them were given prophylactic tab acetazolamide prior to high altitude induction. They all were inducted to high altitude by rapid induction (by air). Inductees

with previous exposure to high altitude and with any co morbid conditions like high blood pressure and blood sugar were excluded. Those who came by road and those who had not taken prophylactic acetazolamide were also excluded. Informed consent was taken from all the participants.

They all were asked to follow acclimatization protocols (4, 10). Symptomatic score was prepared for headache, gastrointestinal symptoms, fatigue, weakness, dizziness, insomnia, mental status, ataxia, peripheral oedema, cough and breathlessness. Vital signs were recorded; laboratory and radiological investigations were done accordingly. Based on the symptomatic presentation and laboratory and radiological findings high altitude illness group was segregated and divided into three sub groups, acute mountain sickness, high altitude pulmonary oedema and high altitude cerebral oedema respectively. A diagnosis of AMS is based on Lake Louise scoring system. A score of 4 or more than 4 was taken as AMS (6, 8). High altitude pulmonary oedema was diagnosed based on symptom of cough, breathlessness, clinical signs of crackles, tachycardia, tachypnoea and features of pulmonary oedema on chest X-ray with absence of any respiratory infection and pulmonary thromboembolism (6,10). High altitude cerebral oedema was identified with onset of ataxia, altered consciousness or both in the absence of carbon monoxide poisoning, subdural haematoma and hypoglycaemia (9). To study the effect of altitude range four categories were prepared from 9500ft to 17500 ft and the inductees in these various altitude ranges were evaluated for high altitude illnesses. To study the effect of acclimatization on incidence of high altitude illnesses four groups were prepared varying from 0 to 8 day respectively and assessed accordingly.

III. Results

All the participants were evaluated for high altitude illnesses. For statistical analysis IBM SPSS Statistics 20 was used. The incidence rate for all the reported cases of high altitude illness was 7.6/1000 personnel in 2013-14 and 9.2/1000 in 2014-15. For both the years maximum numbers of cases were reported in the later half from July to December. In 2013-14 incidence rate for AMS was 4/1000, for HAPO 3.4/1000 and for HACO 0.2/1000. In 2014-15 incidence rate for AMS was 4.8/1000, for HAPO 4.1/1000 and for HACO 0.3/1000.

To study the effect of acclimatization on the incidence of high altitude illnesses four groups were prepared between 0-8 days of acclimatization. Maximum numbers of cases were reported between 0 -2 days followed by 3 -5 days of acclimatization. Minimum numbers were reported between 6-8 days and 8 days onwards no cases of AMS, HAPO and HACO were reported. No HACO was reported after 5 days of induction to high altitude.

For evaluating the effect of altitude range four groups were prepared between 9500 -17500 ft. Maximum number of cases of AMS and HAPO were reported between 11500 to 13500 ft, followed by 13500 to 15500ft. All the cases of HACO were reported between 13500 to 15500 ft. Minimum numbers of cases were found at 15500 – 17500 ft. At 15500 – 17500 mostly AMS cases were reported followed by HAPO cases.

At the altitude of 15500 – 17500ft all the reported cases of AMS and HAPO were between 0 to 1 day of induction to high altitude area. No cases of HACO were reported from 15500 – 17500 ft range.

IV. Discussion

Altitude related illnesses developing shortly after ascent to high altitude areas present either with cerebral or pulmonary syndromes. AMS and HACO refer to the cerebral abnormalities and HAPO to pulmonary abnormality. In this study incidence rate for high altitude illness was 7.6/1000 personnel in 2013-14 and 9.2/1000 in 2014-15. For both the years maximum numbers of cases were reported in the later half from July to December. In 2013-14 incidence rate for AMS was 4/1000, for HAPO 3.4/1000 and for HACO 0.2/1000. In 2014-15 incidence rate for AMS was 4.8/1000, for HAPO 4.1/1000 and for HACO 0.3/1000. In 2001 hospital admission rate for AMS in low landers was reported to be 0.13/1000 personnel while admission rate for HAPO was 0.15/1000 personnel (5). However the incidence of HACO has not been mentioned. This study shows a higher incidence rate for high altitude illnesses. Previous studies have also documented about the incidence rates of AMS and HAPO and are in accordance with this study. In this study incidence for HAI were assessed for consecutive two years on a large sized cohort. There is a difference in the incidence rates of HAI in 2013 -14 and 2014 -15. It shows incidence rate varies and depends on factors like body mass index, prophylactic use of acetazolamide, height attained, rate of ascent, preexposure, geographical location and hypoxic ventilation response (2, 12, 14). In this study all the participants were healthy adults with no co morbidity and all of them were given acetazolamide prophylactic dose and none of them had history of previous exposure. Occurrence of HAI even after with prophylactic doses of acetazolamide is in accordance with the fact that the frequency of various forms of high altitude illnesses was not different between acetazolamide users and nonusers (2, 13). Very high dose of acetazolamide probably could be of some help but it is also not free from side effects (13). In this study no one had previous exposure to high altitude and all of them had rapid induction to various altitudes. Rapid induction and absence of pre exposure are high risk factors for high altitude illness (4, 12, 14). In this

study most cases were reported in second half of the year from July to December. Chances of high altitude illness increases in later half because decreased partial pressure of oxygen decreases hypoxic response and oxygen extraction at tissue level which reveals the pressure – altitude relationship for the summit (15,16). Geographical locations do have an important role as a risk factor for HAI but exact cause is not Known. It has been reported that at higher altitudes of Ladakh above 14500 ft partial pressure of oxygen is even lower as compared to other geographical locations at same altitude. Ladakh being a barren mountain and arid desert could be a associated risk factor further decreasing the partial pressure of oxygen and altered pressure – altitude relationship, altered hypoxic response at tissue level (15, 16). Maximum number of AMS cases were reported within 0-2 days as per the other studies also. AMS occurs mostly within 48 hours of ascent to high altitude. It is seen mostly above the height of 10000ft. As the height increases, AMS can develop within 0-1 or even in 0 days also. So on rapid induction to heights above 14500ft like at 15500 and 17500 ft AMS developed in 0 and 0-1 days of induction to high altitude.

H ACO is considered as the progressive unattended form of AMS. At increased heights of 15500 – 17500 ft participants diagnosed with AMS were immediately sent back to lower altitude. This was probably the reason that HACO was rarely reported from that height.

Maximum number of cases were reported at 11500 to 13500 ft as maximum number of persons were posted to those areas and it is a fact that as altitude increases behavioural alterations also do occur. Inductees at lower altitudes of this range were slightly negligent of taking required amount of rest. Physical exertion being a precipitating factor can lead to increased incidence of AMS and HAPO at these altitudes.

V. Conclusion

This study shows that Ladakh is having higher incidence rate of high altitude illnesses. Rapid rate of induction and increased altitude increases the incidence rate of high altitude illnesses. Himalayan geography varies from east to west. Ladakh in western Himalayan range is more prone to suppress the physiological response to hypoxia by decreasing hypoxic ventilation response at altitudes above 14500ft. Pressure altitude response is found to be suppressed at high altitude region in Ladakh. Ladakh being a barren mountain region results into less partial pressure of oxygen so reduced oxygen delivery. However exact cause needs further exploration at cellular and molecular level.

References

- [1]. Terra Daily (News about planet earth), Altitude sickness worst in northern India by staff writers, New Delhi (UPI)Oct 31, 2011.to
- [2]. Jean Paul Richalet .Physiological Risk Factors For Severe High Altitude Illness, A Prospective Cohort Study; American Journal Of Respiratory And Critical Care Medicine. Vol 185, No 2, Jan 2012.
- [3]. Dash UK, Karamkar AA, Dangi MS. A Study of High-Altitude Associated Conditions in Soldiers less than 50 years of age admitted in the ICU of a tertiary care military hospital operating in a counter insurgency operation area. J Mar Med Soc 2017; 19: 138-41.
- [4]. PeterHH, Robert CR. High Altitude Illness. N Engl J Me. 2001; 345: 104-114.
- [5]. Manual of Health For The Armed Forces. Director General Armed Forces Medical Services. 2003;vol11:175-78.
- [6]. Basynet B, Murdoch DR. High Altitude illness. The Lancet 2003; 361: 1967-73.
- [7]. West JB. The physiologic Basis of High Altitude Disease. Ann Intern Med 2004; 141: 789-800.
- [8]. Roach RC, Bartsch P, HackettPH, Oelz O. The Lake Louise Acute Mountain Sickness Scoring System. In : Sutton JR, Houston CS, Coates G eds. Hypoxia and Molecular Medicine, Burlington Vt:Queen City Printers 1993:272-74.
- [9]. Hackett PH, Roach RC. High Altitude Cerebral Edema. High Alt Med Biol 2004; 5: 136-46.
- [10]. Rajan Kapoor, AS Narula, AC Anand,VSM. Treatment Of Acute Mountain Sickness an High Altitude Pulmonary Oedema. Med J Armed Forces India. 2004 oct; 60(4) : 384-87.
- [11]. Vardy J, Vardy J and Judge K. Acute mountain sickness and ascent rate in trekkers above 2500m in the Nepali Himalaya.Aviat Space Environment. 2006; 77: 742 – 744.
- [12]. Rathat C, Richalet JP, Henry JP, Larmignat P. Detection of high risk subjects for high altitude disease. Int J Sports Med 1992; 13 : S76 – S78.
- [13]. Grissom CK, Roach RC, Sarnquist FH, Hackett PH. Acetazolamide in the treatment of acute mountain sickness : clinical efficacy and effect on gas exchange. Ann Intern Med.1992; 116: 461 – 465.
- [14]. Schneider M, bernasch D, Weymann J, Holle R, Bartsch P. Acute mountain sickness : influence of susceptibility, pre exposure and ascent rate. Med Sci Sports Exerc 2002 ; 34 : 1886 – 91.
- [15]. Thomas F. Hornbein, Robert B. Schoene. High Altitude : An Exploration Of Human Adaptation. 2001; 161: 31 – 35.
- [16]. Annual report on HAPO. Department of preventive and social medicine, AFMC, Pune 2003.
- [17]. Virmani SK. High altitude pulmonary oedema : an experience in eastern Himalayas. MJAFI. 1997,July;53(3):163-168.

Dr (Maj) Kumari Nitu Roy. “Incidence of High Altitude Illness among Low Landers in Northern India (Ladakh) And Its Association With Altitude Range And Acclimatization Schedule.” IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 18, no. 11,