SPECTRUM OF PRESENTATION OF ACUTE MOUNTAIN SICKNESS AT DIFFERENT ALTITUDES

Jamal Azfar Khan, Mohsin Qayyum*, Hanif Khan Safdar*, Muhammad Rizwan Bashir Kiani, Syed Saddam Hussain***, Kamran Memon*****

Prince Sultan Military College of Medical Sciences Dhahran Kingdom of Saudi Arabia, *Military Hospital/National University of Medical Sciences (NUMS) Rawalpindi Pakistan, **Army Medical College/National University of Medical Sciences (NUMS) Rawalpindi Pakistan, ***Goma Hospital Gilgit Baltistan Pakistan

ABSTRACT

Objective: To determine the frequency of Acute Mountain Sickness (AMS) and the spectrum of clinical presentations in the troops/mountaineers who ascend to different altitudes.

Study Design: Prospective case series.

Place and Duration of Study: Study was conducted at Field Hospital Goma, from April to May 2012.

Material and Methods: The study was carried out on 582 soldiers at 3330 meters (m), which were subsequently followed up on 4496 m and 5700 m. All participants were given Lake Louise Questionnaire to report symptoms. They were examined and any signs of AMS were registered. The frequency of AMS, spectrum of presentation and severity were noted.

Results: Frequencies of development of AMS symptoms were 2.75% (3330 m), 7.4% (4496 m) and 16.7% (5700 m). The most common symptoms were headache, insomnia, fatigue, dizziness and gastrointestinal symptoms including nausea and vomiting.

Conclusion: Overall, 8% people developed AMS. The severity of signs and symptoms increased with altitude.

Keywords: Acclimatization, Acute mountain sickness, High altitude, Lake Louise questionnaire.

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INTRODUCTON

Going to the mountains has its fair share of thrill as well as perils. A number of changes are experienced by the individual as he/she ascends the mountains. The temperature cools down, the atmospheric pressure gets low, and all this is usually accompanied by higher physical exertion. So, the oxygen demand usually increases whereas, owing to the low atmospheric pressure, the oxygen supply is decreased. This may lead to a decrease in perfusion, cerebral perfusion in particular[1]. As a consequence, the mountaineer can suffer from a variety of symptoms, including headache, nausea, vomiting, loss of appetite, dizziness etc[2]. This symptom complex is collectively known as Acute Mountain Sickness (AMS)[3]. AMS is usually experienced at heights above 2000 m[4]. It has a considerable impact on climbing expeditions and can hamper their progress. It usually occurs in people who have not acclimatized adequately to the changes of high altitude or those who attempt scaling the heights too quickly[5]. If left untreated, AMS has the potential to worsen and get complicated with life threatening conditions like High Altitude Cerebral Edema (HACE)[6].

Baltistan is a mountainous region in the north of Pakistan. It comprises of the world famous mountain range; Karakoram. It has some of the world's highest and most majestic peaks[7]. The average height of the mountains in the Karakoram is 20000 feet (ft) or 6100 m[8]. Pakistan army is deployed over a large area of these mountain ranges and maintains its presence all year round. The soldiers, like all mountaineers, are subjected to the hazards of high altitude. They suffer from high altitude-related illnesses, including AMS.

It is difficult for the soldiers to perform their designated duties at high altitude, owing to the

Correspondence: Dr Jamal Azfar Khan, Department of Medicine, Goma Hospital Giligit Baltistan Pakistan
Email: jamalazfar@yahoo.com
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harsh climate. These difficulties get compounded if high altitude diseases also start to take their toll. AMS has, thus, been known to impede army's performance at high altitude[9]. If left unchecked, it can pose a lot of problems by stretching human and material resources. In this context, it becomes all the more important to study these diseases, so that preventive measures are adopted in time. However, studies related to high altitude problems have scarcely been conducted conclusively in this area. There has been a need to conduct a study that highlights the most frequent height related issues, especially AMS, encountered over there. This study was thus conducted with the objective of determining the frequency of AMS and the spectrum of clinical presentations in the troops/mountaineers that ascend to different altitudes.

MATERIAL AND METHODS

This prospective case series was conducted at three different heights: 3330 m,4496 m and 5700m. The sampling technique used was purposive sampling (total population sampling) with a sample size of 582. Informed consent was taken from all troops who ascended to these heights. All the soldiers were examined initially and a complete history of any illness was taken. Those who were residents of areas above 2000 m above sea level were excluded. Those with pre-existing heart or lung diseases, and those who had been pre-exposed to high altitude (above 2000 m) were also excluded. It was asked if anyone had been pre-medicating for prevention of high altitude illness or taking any medicines beforehand. None was found to be doing so. The soldiers were given lectures on high altitude diseases.

Base camps with medical inspection rooms have been established at locations on above mentioned heights. All the troops who ascended to these heights were given Lake Louise Questionnaire (LLQ)12 hours after the climb to fill in any symptoms.

They were also examined to assess whether the subjects had any signs of change in mental status, ataxia or peripheral edema. The signs and symptoms were marked on the LLQ worksheet, along with their severity. AMS was defined as per The Lake Louis Consensus on the Definition of Altitude Illness[10] as development of headache plus at least one of: gastrointestinal symptoms (nausea, vomiting or anorexia), insomnia, dizziness and fatigue/ weakness, in the setting of recent climb. Soldiers who fulfilled this criterion and scored 3 or more on the LLQ work sheet were declared as cases of AMS. The scoring system of LLQ has been studied and validated against the U.S. Army Environmental Symptoms Questionnaire and has demonstrated similar sensitivity and specificity[11] .

All the troops ascended according to standing operating procedures of climbing not more than 300 mper day, allowing proper acclimatization. The frequency of AMS was determined at the three altitudes by noting the number of individuals who developed AMS against total number of individuals who ascended these three different heights. Then we calculated the percentage of people suffering from AMS at these heights. The severity of symptoms was noted by scoring each symptom according to its severity mentioned in LLQ. Column charts were constructed to illustrate the severity of signs and symptoms of AMS with respect to different heights.

RESULTS

Five hundred and eighty two soldiers participated in the study, filled the LLQ worksheet and were subjected to clinical examination at 3330m. They reported their symptoms by filling out the LLQ worksheet and underwent a clinical examination. All of them were male. They ranged in age from 22 to 35 years, mean being 27 years. The height varied from 1.60 m to 1.92 m, mean height being 1.70 m. The average BMI was 22, range being 20 to 27. Out of them, 16 developed AMS (2.7%). From 3330 m onwards, their ascent was on foot. They carried their weapon (rifle) and some provisions with them, the combined weight of which was less than 10 kg. Some of the participants had to stay back at

3330 m for their military duties at their respective stations, so 570 soldiers participated in the study at 4496 m and 400 participated at 5700 m. At 4496 m, 42 out of 570 soldiers (7.4%) had AMS as per the laid down criteria whereas 67 out of 400 soldiers (16.7%) developed AMS at 5700 m. The soldiers who developed AMS were monitored and treated by the doctor for symptomatic relief and with Acetazolamide. Their symptoms improved as they acclimatized to high altitude. Lowering of altitude was not required for any of the participants. They were allowed to proceed further only after their AMS symptoms abated.

Headache was the most common symptom, affecting 125 soldiers, followed by difficulty in sleeping (98), gastrointestinal symptoms includeing nausea, loss of appetite and vomiting (94), fatigue/ weakness (56) and dizziness/ lightheadedness (40). The frequency of clinical signs and symptoms at different altitudes is listed in table.

The severity of symptoms varied with altitude. At 3330 m and 4496 m, the participants reported only mild to moderate headache whereas 18 cases of severe headache were reported at 5700 m. A moderate degree of nausea, loss of appetite and vomiting were experienced up to 4496 m but nine cases of severe nausea and incapacitating vomiting were there at 5700 m. Similarly, three cases of severe weakness and one of incapacitating dizziness and lightheadedness were reported at 5700 m and none at lower altitudes. Twenty-five soldiers experienced difficulty in sleeping at 3330 m, thirty two at 4496 m and fifty two at 5700 m but severe insomnia (complete loss of sleep) was reported only at 5700 m. No change in mental status was observed in any of the mountaineers at 3330 and 4496 m whereas two cases each of lassitude and confusion were present at 5700 m. One soldier experienced mild ataxia at 3330 m, five reported experiencing ataxia at 4496 m and nine cases of mild to moderate ataxia were reported at 5700 m. However, no report of falling down as a consequence of ataxia was made. No case of peripheral edema was seen at any of the locations. The distribution of symptoms and signs as per their severity at different altitudes is shown in fig-1 & 2 respectively.

Table: Frequency and percentage of signs and symptoms of AMS at different altitudes.

Symptoms	**3330 m (N=582)**	**4496 m (N=570)**	**5700 m (N=400)**
Headache	16 (2.7%)	42 (7.4%)	67 (16.8%)
GI	14 (2.4%)	34 (6%)	46 (11.5%)
Fatigue/Weak	8 (1.4%)	20 (3.5%)	28 (7%)
Dizzy/Lightheaded	5 (0.9%)	13 (2.3%)	22 (5.5%)
Difficulty sleeping	14 (2.4%)	32 (5.6%)	52 (13%)
Signs			
Change in mental status	0 (0%)	0 (0%)	4 (1%)
Ataxia	1 (0.02%)	5 (0.9%)	9 (2.3%)
Peripheral edema	0 (0%)	0 (0%)	0 (0%)

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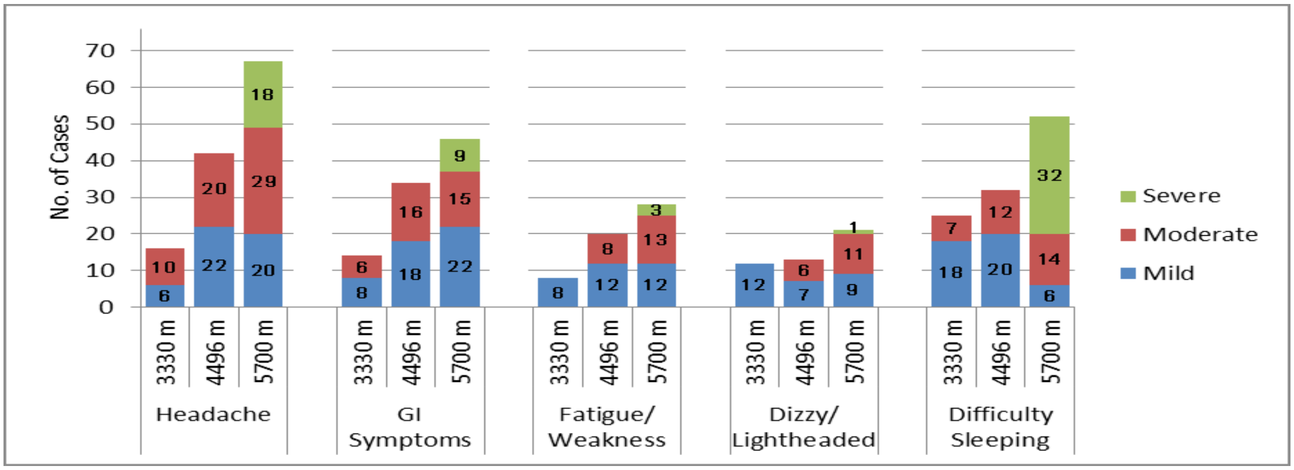

Figure-1: Severity of AMS symptoms at different altitudes.

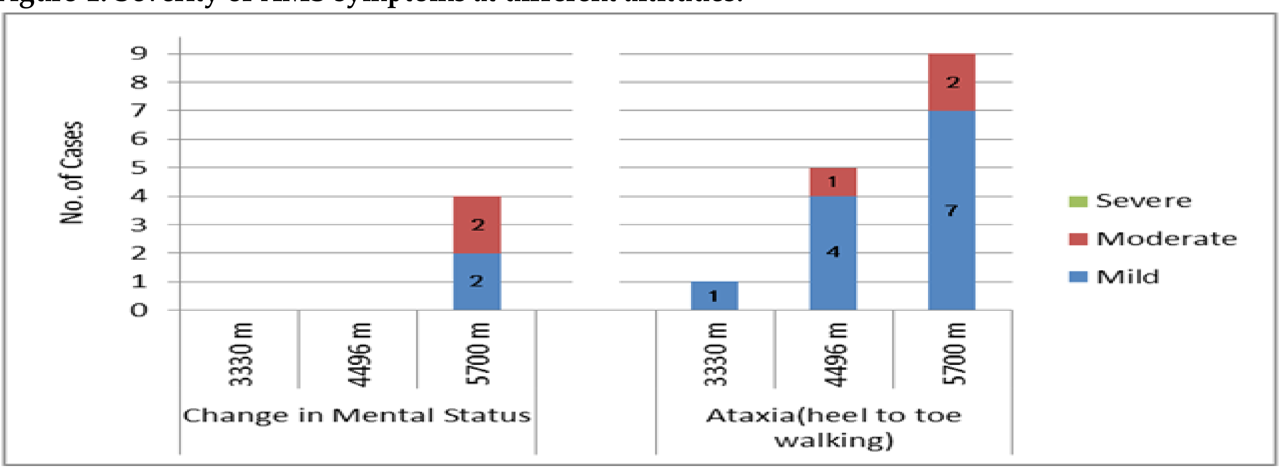

Figure-2: Severity of clinical signs of AMS on various altitudes.

DISCUSSION

The frequency of AMS was considerably lower in our cohort when compared with other studies at high altitude around the world. In a study carried out in the Annapurnas in Nepal at 17820 ft (5400 m) on 500 trekkers, 29% developed AMS[12]. In another study carried out at 4419 m at Mount Whitney, 43% trekkers developed AMS[13]. The frequency of AMS has been recorded up to 77% in climbers of Mount Kilimanjaro (5895 m)[14]. What we recorded was only a fraction of the frequency of AMS recorded in these studies.

There can be many factors responsible for the relatively small number of AMS cases in our participants. The most striking feature which stands out when we compare our study with the others is the methodology of ascent, that is, the rate of ascent. Most of the studies carried out worldwide at high altitude involve mountaineers who to maintain a time schedule. The commercial ventures like on Mount Kilimanjaro have a tough schedule to keep and therefore, the mountaineers are not adequately acclimatized, resulting in a very high incidence of AMS there[15]. We carried out the study on soldiers who did not have such restraints. They were a disciplined group and had been instructed to follow the recommendations of climbing not more than 300 m per day[16]. Rapid ascent to high altitude has been mentioned as a risk factor for developing AMS[3]. Schneider *et al* defined rapid ascent as an independent risk factor for AMS[17]. Hooper *et al*, in a study with a small sample size, reported that a conservative approach to ascent lowers the incidence of AMS[18]. Beidleman *et al* also stated that the safest and surest way to prevent AMS was slow ascent[19]. Our results second their claim.

It has been postulated that obesity is a risk factor for developing AMS[20]. Age is also a risk factor; AMS being more common in older individuals[21]. The participants in our study were young and fit soldiers, with average body mass index being 22 and average age 27. These attributes may have resulted in fewer cases of AMS.

In addition, the participant soldiers in our study had been educated about high altitude illnesses, including AMS through lectures. These awareness lectures are part of the soldiers' preparation before being assigned to high altitude posts. Gaillard *et al* studied the effect of awareness of high altitude diseases on its prevalence in trekkers in Nepal. The results showed the effects in the form of decrease in AMS prevalence[12]. We can also postulate that awareness of high altitude illness could be a contributing factor towards good symptom profile amongst our participants.

We observed that the frequency of AMS increases with the absolute altitude reached by the trekkers. It was only 2.7% at 3330 m but increased to 7.4% at 4496 m and then had a sharp climb to 16.8% at 5700 m. A study carried out in the Eastern Alps on 431 recreational climbers also noted that the prevalence of AMS increased significantly with altitude, being 6.9% at 2200 m, 9.1% at 2500 m, 17.4% at 2800 m and 38% at 3500 m[22]. Another study conducted by Maggiorini *et al* in the Swiss Alps noted that the prevalence of AMS increased with the increase in altitude, being 9% at 2850 m, 13% at 3050 m, 34% at 3650 m, and 53% at 4559 m[23].

The most common symptom reported by the participants of our study was headache. All the cases of AMS at different altitudes complained of it. Headache has been described as the most common symptom at high altitude in other studies too. Queiroz *et al* stated that millions of visitors to high altitude suffer from significant headache each year[24]. Fiore *et al* studied that headache was the most common presentation of AMS and occurred 6-12 hours after the climb. They also noted that it was frequently associated with malaise. Headache has been said to be the defining component of AMS due to its prevalence at high altitude[25].

Headache at high altitude has been known to be associated with other symptoms like nausea, vomiting and insomnia[26]. Wang *et al* studied AMS on Jade Mountain, Taiwan. The prevalence of AMS was 36%. The most common symptoms were headache, followed by insomnia, fatigue or weakness, gastrointestinal symptoms, and dizziness[27]. Our study revealed difficulty in sleeping to be most common after headache, followed by gastrointestinal symptoms including nausea and vomiting.

Mild degree of pure hypoxia has been known to cause neurological features like impair-ment of judgment and ataxia[28]. We encountered a few cases of ataxia and confusion only at 5700 m. This low frequency may be attributed to compliance with the schedule of acclimatization.

Maggiorini *et al* described peripheral edema as a common sign of AMS[23]. However, we did not encounter even a single case with peripheral edema in this study.

CONCLUSION

The overall frequency of AMS in our study was 8%. The frequency correlated with the increase in altitude. Headache, insomnia and gastrointestinal symptoms including nausea and vomiting were the most common presentations of AMS.

LIMITATIONS OF STUDY

The participants could have under-or over-reported their symptoms. Secondly, the study was carried out over a period of two months, whereas the soldiers' movement goes on throughout the year. We may get different results at different times. Further studies are needed to answer these questions.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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