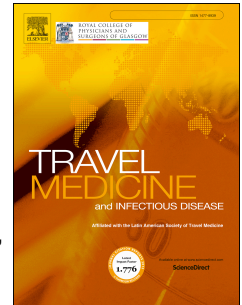


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HIGH ALTITUDE ILLNESS IN PILGRIMS AFTER RAPID ASCENT TO 4380 M

Running title: High altitude illness in pilgrims

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KZ, MP and BB conceived and designed the study. All authors except BB were involved in data acquisition. KZ drafted the article. KZ, MP and BB revised the article critically for important intellectual information. All authors approved the version to be submitted.

We have no conflict of interest to declare.

Key words: altitude sickness; acute mountain sickness; high altitude cerebral edema; high altitude pulmonary edema; hypoxia; pilgrims

ABSTRACT

Background

The goal of the study was to characterize high altitude illness in Nepali pilgrims.

Methods

We kept standardized records at the Himalayan Rescue Association (HRA) Temporary Health Camp at Gosainkund Lake (4380 m) in the Nepal Himalaya during the annual Janai Purnima Festival in 2014. Records included rate of ascent and Lake Louise Score (LLS). We defined High Altitude Headache (HAH) as headache alone or LLS=2. Acute Mountain Sickness (AMS) was $LLS \geq 3$. High Altitude Cerebral Edema (HACE) was AMS with ataxia or altered mental status.

Results

An estimated 10,000 pilgrims ascended rapidly, most in 1-2 days, from Dhunche (1960 m) to Gosainkund Lake (4380 m). We saw 769 patients, of whom 86 had HAH. There were 226 patients with AMS, including 11 patients with HACE. We treated patients with HACE using dexamethasone and supplemental oxygen prior to rapid descent. Each patient with HACE descended carried by a porter. There were no fatalities due to HACE. There were no cases of High Altitude Pulmonary Edema (HAPE).

Conclusions

HAH and AMS were common in pilgrims ascending rapidly to 4380 m. There were 11 cases of HACE, treated with dexamethasone, supplemental oxygen and descent. There were no fatalities.

1.1 INTRODUCTION

Millions of people ascend annually to high altitude pilgrimage sites.[1] Compared to trekkers and climbers, far more pilgrims are at risk for high altitude illness. However, there are fewer studies of high altitude illness in pilgrims than in trekkers and climbers.

Pilgrims are not immune to altitude illness. Multiple studies have demonstrated high rates of Acute Mountain Sickness (AMS), High Altitude Cerebral Edema (HACE) and High Altitude Pulmonary Edema (HAPE) in pilgrims after rapid ascent to high altitude.[2-5]

Thousands of Nepali pilgrims ascend every year to Gosainkund Lake (4380 m), the site of our study, during the Janai Purnima Festival. Two cross-sectional studies found vastly different rates of AMS in pilgrims at Gosainkund Lake. The first study looking only at pilgrims who were visibly ill found a 4.4% incidence of AMS and a 1% incidence of HACE.[2] The second study reported that 68% of randomly chosen pilgrims had AMS, 31% had HACE and 5% had HAPE.[3] A cohort study, found an overall incidence of AMS of 34% with higher rates in women and in subjects over 35 years old as well as in subjects who used garlic for prevention of AMS. Other studies at Gosainkund Lake have looked at the incidence of AMS in children[6] and at the roles of dehydration [7, 8] and serum bicarbonate [7-9] in the pathophysiology of AMS.

The Himalayan Rescue Association, a non-profit, Nepalese non-governmental organization has run a clinic for pilgrims at Gosainkund Lake during the Janai Purnima

festival every year for over 20 years. The goal of our study was to characterize high altitude illness in pilgrims who ascended rapidly to 4380 m who presented to the HRA Temporary Health Camp clinic. The primary goal of data collection was to assess the needs of the clinic. We studied High Altitude Headache (HAH) as well as AMS, HAPE and HACE.

2.1 MATERIAL AND METHODS

We kept standardized records for patients seen at the Himalayan Rescue Association (HRA) Temporary Health Camp at Gosainkund Lake (4380 m) in the Nepal Himalaya during the annual Janai Purnima Festival in 2014. Records included age, sex, place of residence, rate of ascent, vital signs, including oxygen saturation, diagnosis and treatment. We also documented each element of the Lake Louise Acute Score (LLS) for AMS.

We defined HAH as headache alone or headache with $LLS \leq 2$. AMS was $LLS \geq 3$. HACE was AMS with ataxia or altered mental status. The number of pilgrims was based on the official estimate of the Gosainkunda Area Development Committee. We report descriptive statistics.

3.1 RESULTS

An estimated 10,000 pilgrims ascended rapidly, most in 1-2 days, from Dhunche (1960 m) to Gosainkund Lake (4380 m). We saw 769 patients, of whom 86 (11%) had HAH. There were 226 (29%) patients with AMS, including 11 patients who had HACE.

At least 302 (39%) of the 769 patients lived in the Kathmandu Valley at about 1400m. In addition, 39 (5%) of the patients lived in the local area, some as low as 1460m. The majority of patients from other areas lived at or below 1400m. Some of the places of residence were not well-enough defined to determine altitude of residence. Place of residence was missing from the data for 40 (5%) of the patients. Only a few patients with a known altitude of residence above 2000m were diagnosed with AMS. No patient from above 2000m was diagnosed with HACE.

Except for one patient from India, all of the patients were from Nepal. The only Western visitors at Gosainkund Lake during the Janai Purnima Festival were the lead author from the USA and a group of about 12 trekkers from Europe.

Almost all patients with AMS or HAH descended soon after they were seen in the clinic. We treated most patients who had HAH with paracetamol (called acetaminophen in North America) 500 mg orally. Most patients who had AMS received acetazolamide 250 mg orally, with or without paracetamol.

We treated patients with HACE using dexamethasone and supplemental oxygen while we arranged rapid descent. Dexamethasone 8 mg was given orally in 10 patients and by

intramuscular injection in one patient who was unconscious at presentation. We discontinued supplemental oxygen at the start of descent. Each patient with HACE descended carried by a porter. The use of helicopters for descent was not an option due to weather conditions during the monsoon season. Even if the weather had been suitable, the cost of helicopter evacuation is prohibitive for the vast majority of Nepalis. There were no fatalities due to HACE. There were no cases of High Altitude Pulmonary Edema (HAPE).

4.1 DISCUSSION

The largest proportion of pilgrims at Gosainkund Lake live in the Kathmandu Valley. The HRA has an ongoing program of educational efforts to prevent high altitude illness by encouraging slow ascent, recognition of altitude illness and treatment by descent of severe altitude illness. These efforts include lectures in the Kathmandu area, brochures at the main checkpoint near Dhunche, the starting point of the trek and many signs along the way. In spite of these efforts, most pilgrims make the one-day trip to Dhunche (1960 m) then ascend in 1-2 days to Gosainkund Lake (4380 m). This itinerary carries a very high risk for high altitude illness.[10]

Fortunately, most pilgrims spend only one night at Gosainkund Lake. In the morning they participate in a ceremony near the lake and then take a quick “dip” in the lake. They then immediately start descending, often reaching Dhunche the same day. Because AMS typically takes 6-10 hours to develop,[11] most pilgrims with AMS descend soon after the onset of symptoms.

As far as we are aware there have been no previous studies of HAH among pilgrims at Gosainkund Lake. In previous studies, patients with HAH would have been characterized only as not having AMS.

We are not aware of previous reports in which HACE was treated with the use of supplemental oxygen and dexamethasone prior to descent. Although we were unable to obtain formal follow-up of the 11 patients with HACE, we are confident that there were no deaths. Had any of our patients died, we would have heard about it from the many people we met on the trail during our descent.

In contrast to our study, previous studies at Gosainkund Lake reported patients with HAPE. HAPE is likely to be uncommon because it usually develops after 2 nights at a given altitude.[11] Most pilgrims descend after only one night.

5.1 CONCLUSIONS

HAH and AMS were common in pilgrims ascending rapidly to 4380 m. There were 11 cases of HACE, treated with dexamethasone, supplemental oxygen and descent. There were no fatalities. There were no cases of HAPE.

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