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Altitude Illness

Introduction

Altitude illness is a term used to describe a spectrum of illness associated with ascent to altitudes usually higher than 2,500 metres. It can be divided into three syndromes, acute mountain sickness (AMS), which is the most common, high-altitude cerebral oedema (HACE) and high-altitude pulmonary oedema (HAPE) [1].

Risk for Travellers

It is difficult to predict the susceptibility of a traveller to AMS, and physically fit travellers are not necessarily at lower risk. The best indicator of how altitude will affect a traveller is previous experience at altitude, but even this may be unreliable.

Important risk factors are altitude gained, rate of ascent, altitude achieved, altitude at which a traveller sleeps, and level of exertion. Approximately 50% of trekkers in Nepal who walked to altitudes of between 4,500 and 5,000m developed AMS [2]. In another study 84% of trekkers who flew directly to 3,860m were affected by AMS [3]. Thus, rapid ascent without a period of acclimatisation puts a traveller at higher risk.

Cause

There are several physiologic contributions to the development of AMS. Hypoxia is one of the main alterations during ascent to high altitude. The percentage of oxygen in the air remains the same at different altitudes; however, the partial pressure drops [1]. It is this pressure that drives oxygen into the bloodstream, therefore a decrease results in lower oxygen levels in the blood. The body's response to lower oxygen levels is to increase the breathing rate.

One of the consequences of an increased breathing rate is the expiration of more carbon dioxide leading to a respiratory alkalosis. Carbon dioxide in the blood helps to control the rate of breathing, and a low level slows the breathing again, leading to further hypoxia. Over several days the kidneys will increase excretion of bicarbonate bringing the system back in balance.

Signs and Symptoms

AMS is the most common syndrome, and usually occurs at altitudes of 2,500-3,500m (8,200-11,500ft) but can occur at lower altitudes between 1,500–2,500m (5,000-8,200ft) [1]. Symptoms of AMS typically occur 6-12 hours after arrival at altitude [4], but can begin more than 24 hours after ascent.

Initial symptoms include headache, fatigue, loss of appetite, nausea and sleep disturbance. These symptoms usually resolve within one to two days if further ascent does not occur.

AMS progresses in less than 10% of cases to the more severe HACE where travellers experience lethargy, confusion and ataxia in addition to the symptoms of AMS.

HAPE typically occurs in the first two to four days after arrival at altitudes higher than 2,500m [4]. HAPE is not necessarily preceded by AMS. Initial symptoms of HAPE include shortness of breath with exertion, and a dry cough, progressing to shortness of breath at rest. The cough may become productive with blood-stained sputum. HAPE is frequently accompanied by symptoms of HACE.

Anyone with symptoms of HAPE or HACE should descend immediately. Both HACE and HAPE can progress rapidly and death is the likely consequence if a descent is not made as soon as the symptoms are recognised.

Treatment

Although mild AMS is unpleasant, it is usually self-limiting, resolving spontaneously over several hours or days if no further ascent is made. Acclimatisation may take from one to four days. Paracetamol, aspirin or ibuprofen can be used to relieve headache, and anti-emetics may be used for nausea. Acetazolamide (Diamox®) can be used for treatment but the onset of its effect may be delayed. A person with AMS should never be left unattended in case symptoms worsen.

If no improvement occurs, or symptoms worsen, an immediate descent by at least 500-1,000m should be made.

The main principle of treatment of severe AMS, HACE or HAPE is immediate descent. Oxygen by face mask can help to relieve symptoms. Nifedipine and dexamethasone can be useful in the treatment of HAPE, and dexamethasone can relieve symptoms of HACE. These drugs are not routinely recommended for travellers to carry to altitude, but are usually reserved for climbing expeditions to extreme altitudes and administered by persons with extensive experience in the management of high altitude illness. Portable hyperbaric chambers can also be used during expeditions.

Prevention

It is not always possible to prevent altitude illness, especially if an itinerary involves flying directly to a high altitude destination. Nevertheless, severe consequences of altitude should be avoidable.

The most important prevention of AMS is adequate acclimatisation and regular rest days. Travel to altitudes above 3,500m immediately from sea level should be avoided whenever possible. Following a short period of acclimatisation at 3,000m further ascent should be gradual with no more than a 300-500m increase in sleeping altitude per day, with a rest day every three days. If symptoms of AMS develop, no further ascent should be made until recovered, and a rapid descent should be made if signs of severe AMS occur.

Acetazolmide (Diamox®) has been extensively studied as prevention for AMS, although it is unlicensed for treatment or prevention of AMS in the UK. Acetazolamide should not be considered as an alternative to adequate acclimatisation and gradual ascent, and its routine use before ascent should be avoided. Acetazolamide will hasten acclimatisation, and may help to relieve the symptoms of AMS but has a delayed onset of 12-24 hours when used in treatment.

If travellers use acetazolamide, trial doses of 125mg twice daily for two days should be taken prior to travel. Assuming there are no adverse events it should then be

commenced one to two days prior to ascent to 3,500m and then continued for at least two more days after reaching the highest altitude. A dose of 125mg twice daily is likely to be effective and to be associated with fewer adverse events than higher doses [5, 6]. However, this dose has not been extensively studied in comparison with higher doses.

Acetazolamide can cause nausea, a mild diuresis, and circumoral and finger tingling. More unusual side effects include rashes, flushing and thirst. It is contraindicated in those with hypersensitivity to sulphonamides.

Specific considerations for travellers with special health needs

- **Pulmonary problems**

Persons with chronic pulmonary disease who experience dyspnoea during mild exercise at sea level are likely to experience more severe symptoms at altitude [7]. Therefore such travellers should avoid high-altitude destinations. Those with mild or moderate pulmonary disease may be able to tolerate trips to altitude, but should be evaluated by their respiratory consultant. All travellers with pulmonary disease intending to travel to high altitude should ensure that they are in optimum health. The '50 meter walk' test has traditionally been used to assess persons with pulmonary illness. The ability to walk 50 meters without distress is a crude indicator of an individual's ability to tolerate the relative hypoxia experienced during air travel [8].

Although there is the suggestion that persons with asthma have improvement at altitude, only long-term, high-altitude residents have been studied [9,10]. Travellers with severe asthma should be advised against travel to altitude [11]. Travellers with mild and well controlled asthma should continue their usual medication even if their symptoms improve. Brochospasm can be triggered by cold air, therefore covering the mouth and nose with a scarf or balaclava to warm and humidify the air may reduce this risk.

- **Cardiovascular problems**

Persons with mild angina or those who have had successful bypass surgery have travelled to altitude without ill effects. However, those with a history of cardiac failure are likely to experience problems above 3,000m [12]. Travellers with cardiac disease should discuss their plans with their cardiologist. They should limit their activities during the first days of acclimatisation and allow extra time to acclimatise. Adequate supplies of cardiac medication should be carried and the need for any dosage adjustments discussed.

Studies of the effect of high altitude on blood pressure have had conflicting results. There is little evidence of adverse events associated with hypertension at altitude, and well controlled hypertension is not a contraindication to high altitude areas [13]. It is not necessary to change the dosages of anti-hypertensive medication.

- **Pregnancy**

There is a lack of data on the effects of exposures to high altitude during pregnancy. However, short exposures appear to be tolerated well by healthy pregnant women [7]. Changes in air cabin pressure can have a transient effect on the foetus but air travel is safe for most pregnant women [14].

It is prudent to avoid travel to high altitude during the first trimester. Pregnant women who are anaemic, carrying more than one baby, or who have been diagnosed with a condition that reduces the oxygen supply to the foetus, are advised to avoid high altitude travel. Another consideration is that travel to altitude is often remote and access to medical facilities in the event of an obstetric emergency will be difficult. Trekking and skiing increase the risk of accidents which can be harmful to the foetus. Pregnant women travelling to high altitude areas should discuss their travel plans with their obstetrician or midwife.

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Reading List

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