

# Altitude Illness

## Introduction

Altitude illness is divided into three syndromes, acute mountain sickness (AMS), high-altitude cerebral oedema (HACE) and high-altitude pulmonary oedema (HAPE). AMS is the most common, and usually occurs at altitudes of 2500-3500m (8,200-11,500ft) but can occur at lower altitudes between 1500 – 2500m (5,000- 8,200ft)<sup>2</sup>. Examples of commonly visited areas of high altitude include Cusco, Peru (3000m; 9840ft), La Paz, Bolivia (3,444m; 11,300ft) and Lhasa, Tibet (3,749m; 12,300ft)

## Risk for Travellers

It is not possible to predict the susceptibility of a traveller to AMS, and physically fit travellers are not necessarily at lower risk of developing AMS.

The best indicator of how altitude will affect a traveller is previous experience, but even this may be unreliable.

The most important risk factors are altitude gained, rate of ascent and level of exertion. Approximately 50% of trekkers in Nepal who walk to altitudes above 4000m for five or more days will develop AMS, whilst 84% of those who fly directly to 3860m are affected.<sup>3</sup> Thus, rapid ascent without a period of acclimatization puts a traveller at higher risk.

## Cause

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

One of the consequences of an increased breathing rate is the expiration of more carbon dioxide producing a respiratory alkalosis. Carbon dioxide in the blood controls 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 to balance.

## Signs and Symptoms

AMS may begin 6-12 hours after arrival at altitude, but can occasionally occur more than 24 hours after ascent.

The symptoms include headache, fatigue, loss of appetite and nausea.

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 will experience lethargy, confusion and ataxia in addition to the symptoms of AMS.

HAPE can occur by itself or in conjunction with HACE. Initial symptoms are shortness of breath with exertion, and a dry cough, progressing to shortness of breath at rest.

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 can be used for nausea. Acetazolamide (Diamox®) may also be used for treatment but the onset of its effect can 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 500-1000m 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 all travellers 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 may also be used by expeditions.

## **Prevention**

It is not always possible to prevent altitude illness, especially if an itinerary involves flying directly into 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. It is agreed that travel to altitudes above 3500m immediately from sea level should be avoided. Once acclimatised to 3000m further ascent should be gradual with no more than a 300m 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.

Diamox® has been extensively studied as prevention for AMS. Although it is unlicensed for treatment or prevention of AMS in the UK, the Drug and Therapeutics Bulletin accept its use in the prevention of high altitude illness. It should not be considered as an alternative to acclimatisation and gradual ascent, and its routine use before ascent should be avoided.

Diamox® 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 are to use Diamox®, trial doses 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 3000m 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. However, this dose has not been extensively studied in comparison with higher doses.

Diamox® can cause nausea and circum-oral and finger tingling. More unusual side effects include rashes, flushing and thirst. It is contraindicated in those with an allergy to sulphonamides.

## References

1. Dietz T, Hackett PH. Altitude, in Keystone J, Kozarsky P, Freedman D (eds.) et al Travel Medicine 2004 Elsevier Ltd
2. Pollard A, Murdoch D. Drugs for altitude sickness. Travel Medicine international. 1996, 14:211-5
3. Pollard A, Murdoch D. The High Altitude Medicine Handbook. 1997 Radcliffe Medical Press Ltd Oxon.

## Reading List

Clarke C. UIAA Mountain Medicine Centre Information Sheet 3. Mountain sickness, oedemas and travel to high altitudes. 1999 (BMC) [www.thebmc.co.uk/world/mm/mm3.htm](http://www.thebmc.co.uk/world/mm/mm3.htm)

Hackett PH, Roach RC. Current concepts: High Altitude Illness. N Engl J Med 2001; 345: 107-114

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