ALTITUDE MEDICINE: A COMPREHENSIVE GUIDE



WORLD EXTREME MEDICINE
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WELCOME

Welcome to "Altitude Medicine: A Comprehensive Guide," an eBook designed to provide valuable insights into the world of altitude medicine and its significance for safe and successful high-altitude adventures.

Understanding altitude medicine is crucial for anyone venturing into high-altitude and remote environments. Whether you are an avid mountaineer, an adventure seeker, or a medical professional, having a solid grasp of the unique challenges and considerations at altitude can make all the difference in ensuring your wellbeing and that of others.

In this eBook, we delve into the fundamental aspects of altitude medicine, including the physiological effects of high altitudes, common symptoms and conditions associated with altitude sickness, and essential acclimatisation techniques.

While this guide provides valuable information, it is through our Mountain Medicine Courses that you can truly enhance your understanding and practical skills. Led by expert instructors with extensive experience in alpine medicine, these courses offer a comprehensive curriculum.

Join us on this journey to develop the knowledge and skills necessary for safe and successful ventures into high-altitude environments.

IMPACT OF ALTITUDE

Altitude is not merely a measure of elevation; it exerts profound physiological effects on the human body.

As we ascend vertically from sea level, atmospheric pressure progressively decreases. While the proportion of oxygen in the air remains constant at 21%, the reduced atmospheric pressure results in a decline in the partial pressure of oxygen that drives gas exchange in the lungs.

Remarkably, at the summit of Everest, the inspired oxygen pressure plummets to a mere 30% of the sea level value [1]. Nonetheless, the human body possesses an extraordinary capacity for acclimatization, enabling rapid adaptation to the resulting state of tissue hypoxia.

However, in certain individuals, this adaptation process may give rise to acute altitude illness [2][3].

Understanding these dynamics is crucial for safely navigating high-altitude environments and managing the associated risks.

ACUTE ALTITUDE ILLNESS

It is rare for illness related to altitude to occur below 2500 metres'. Acute Altitude illness consists of 3 recognised (and overlapping) disease entities:

1. Acute Mountain Sickness (AMS)
2. High Altitude Cerebral Oedema (HACE)
3. High-Altitude Pulmonary Oedema (HAPE)

Factors increasing risk of Acute Altitude Illness include: [4][5]

- Rapid ascent
- Strenuous physical exertion
- Low degree of acclimatisation
- Younger age
- A previous history of altitude illness
- Cigarette smoking [6]

Some individuals adapt quickly to altitude (fast acclimatisers) whilst others adapt slowly (slow acclimatisers). It is worth noting, there are no definitive indicators (e.g. fitness level, body mass index, gender) for individual acclimatisation ability. As such, no assumptions of participants coping mechanisms should be made. The only true test of acclimatization ability is actually going to altitude.

INTERESTING FACT

Polar explorers may also experience hypoxia, even if they are on a lower elevation ice sheet and not high on a mountain. This is because barometric pressure falls the further you travel from the equator.[7]

Whilst you will only discover your acclimatization ability once in altitude, there are a number of strategies and practical measures you need to know in order to safeguard yourself the best you can from acute altitude illness.

Let's dive into our top tips and discover the key to a successful high-altitude adventure...



PREVENTION OF ACUTE ALTITUDE ILLNESS

SIGNS & SYMPTOMS	Educate all participants on AMS signs and symptoms so they know what to look out for. This is best done during a pre-expedition briefing
ASCENDING LIMITS	Avoid ascending more than 300-500 metres per day
SLEEP	Climb high & sleep low
ACCLIMATISATION	Allow an extra day for acclimatisation every 1000m (staged ascent)
EXERCISE LEVELS	Mild exercise for the first 48 hours is preferable over strenuous activity
CAFFEINE INTAKE	Normal caffeine intake should be continued to reduce the likelihood of withdrawal headaches which could be mistaken for AMS
ACETAZOLAMIDE	Consider Prophylactic Acetazolamide 125mg PO 12 hourly for known slow acclimatisers

A planned and structured ascent facilitates acclimatisation and reduces the possibility of altitude illness, poor sleep and impaired cognitive function. [8]

Having explored our top tips for preventing altitude illness, let's now delve in further to the various signs and symptoms associated with altitude that can lead to other issues.

By familiarizing yourself with these signs and symptoms, you will gain valuable insights into identifying and managing altitude-related conditions effectively.

ACUTE MOUNTAIN SICKNESS (AMS)

This describes a small constellation of non-specific symptoms which present in unacclimatised individuals typically 4 – 12h after arrival at a new altitude >2500. They are usually most pronounced the first night at altitude. The symptoms are:

- Headache
- Gastrointestinal upset/nausea
- Fatigue/weakness,
- Dizziness/light-headedness

The above symptomatology forms the basis for the Lake Louise Score (LLS) [2] (see section below) which is a useful clinical tool for recognition and grading severity of AMS.

Sleep disturbance, previously thought to be a symptom of AMS is also highly prevalent in healthy individuals at altitude and is more a symptom of hypoxia per-se. It is normal for individuals to experience ‘periodic breathing’ at altitude (fast/slow breathing rates, sometimes with breath holding and gasping). As such, a revision of LLS took place in 2018 removing the sleep component.

AMS TREATMENT

- **The single most important intervention is limiting further ascent or descent. In most cases this will herald resolution of all symptoms.[2]**
- **Acetazolamide (diamox) 250mg PO 12 hourly**

LAKE LOUISE SCORE [2]

A comprehensive tool for diagnosing AMS is the Lake Louise Score (LLS). Rated on a severity scale of 1 – 3 the score for AMS consisted of five symptoms (headache, gastrointestinal upset, fatigue/weakness, dizziness/lightheadedness, and sleep disturbance).

In the context of high altitude exposure, a total score >3 in the presence of headache is deemed diagnostic of AMS.

In 2018 a revision of the LLS took place, removing the sleep component.

Scoring:

3-5
POINTS
MILD AMS

6-9
POINTS
MODERATE AMS

10-12
POINTS
SEVERE AMS



HIGH ALTITUDE CEREBRAL OEDEMA (HACE)

There is thought to be pathophysiological and clinical overlap between severe AMS and the onset of HACE. Both may involve a degree of brain swelling (cerebral oedema). The key differentiator is rate of onset (HACE usually presents abruptly within 1-2 hours) and the presence of neurological and behavioural features – namely incoordination, ataxia, confusion and impaired consciousness. HACE is a medical emergency and can progress to coma and death without appropriate action.

Beware: the absence of headache does not rule out a diagnosis of HACE. Signs of pulmonary oedema (HAPE, see below) may present as HACE worsens. Avoiding progression of AMS is the best way to mitigate against HACE, although this condition rarely occurs at <4000m. The estimated prevalence between 4500 – 5500m is 0.5 - 1% Immediate descent is required. [2]



DIFFERENTIAL DIAGNOSES FOR AMS AND HACE

Beware of premature diagnostic funnelling. When at altitude, it's easy to fall into the trap of misattributing all symptoms to the altitude and forgetting a full range of alternative pathologies still exist including:

- Dehydration
- Carbon monoxide poisoning
- Migraine
- Exhaustion
- Hypothermia
- Hyponatremia
- Infection
- Alcohol and drugs
- Hypoglycaemia
- Stroke and TIA
- Acute psychosis

This highlights the importance of taking a good history and making a thorough clinical assessment.

HACE TREATMENT [4]

- **A,B,C's and supportive care**
- **Immediate descent! If not feasible or safe consider the use of a portable hyperbaric chamber (discussed in the course)**
- **High flow bottled oxygen (lower if supply limited)**
- **Acetazolamide (Diamox)**
- **Dexamethasone 8mg (PO/IM/IV) as a stat dose then 4mg 6 hourly**

HIGH-ALTITUDE PULMONARY OEDEMA (HAPE)

In HAPE, fluid gathers in the lungs (pulmonary oedema) which may lead to respiratory failure. Unlike HACE, which normally evolves out of AMS, around 50% of cases of HAPE occurs in isolation, often out of the blue. Like HACE, it can develop rapidly and should be considered a medical emergency.

Early warning signs include dyspnoea, mild cough, tight chest, and reduced physical performance. In more advanced cases patients develop cyanosis, tachypnoea, increased work of breathing, chest gurgling and pink frothy sputum. [2] Aside from rapid ascent by unacclimatised individuals, also susceptible may be acclimatised individuals returning rapidly from lowlands (re-entry HAPE).

HAPE TREATMENT [4]

- **Descent**
- **Oxygen**
- **Consider portable PEEP valve**
- **Dexamethasone 8mg (PO/IM/IV) as a stat dose then 4mg 6 hourly**
- **Slow release nifedipine 20-30mg PO 8-12 hourly (avoid immediate release which can drop blood pressure).**
- **There is no role for diuretics (i.e. furosemide)**
- **Portable hyperbaric chamber.**

Now that we have provided a concise overview of the signs and symptoms associated with Altitude Medicine, it's time for you to delve into the practical learning opportunities that will empower medical professionals and aspiring adventurers to excel in such challenging environments.

THANK YOU FOR READING

Now that we have provided a concise overview of the signs, symptoms, and treatments associated with altitude medicine, it's time for you to delve into the practical learning opportunities that will empower medical professionals and aspiring adventurers to excel in such challenging environments.

You can join us for practical mountain medicine learning at the following courses:



ALPINE MEDICINE, CHAMONIX

FULL DETAILS



ALPINE MEDICINE, SLOVENIA

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MOUNTAIN MEDICINE, NEPAL

FULL DETAILS

QUESTIONS?
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