



PRACTICE

10-MINUTE CONSULTATION

Altitude sickness and acetazolamide

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What you need to know

- Help prevent mountain sickness by slow ascents ≤ 500 m/day, rest days every third day, and avoid over-exertion
- The most important treatment for altitude sickness is descent to a lower, more oxygen-rich environment
- Acetazolamide 125 mg twice daily can be prescribed as prophylaxis for those at risk of developing acute mountain sickness

A 25 year old man plans to trek to Everest Base Camp (5545 m) in Nepal for charity. He asks you for a prescription of acetazolamide to prevent mountain sickness.

For most people, mountain sickness is a self limiting illness, but it can become life threatening. It is estimated that more than 100 million people per year travel to the hypoxic environments found at altitudes above 2500 m,¹ and at least 10% to 20% of unacclimatised individuals develop acute mountain sickness at this height.² Acclimatisation to altitude involves multiple physiological changes, occurring over days to weeks, which enable individuals to function better in these hypoxic environments. If this natural adaptation is surpassed by the rate of exposure to altitude, acute mountain sickness can occur. Acetazolamide can help to prevent acute mountain sickness developing and has fewer side effects than alternative drugs such as dexamethasone, which can mask symptoms and therefore carries greater risks.²⁻⁵ Acetazolamide causes mild diuresis and increases renal excretion of bicarbonate, causing a mild metabolic acidosis which in turn increases respiratory rate (improving oxygenation).

In the UK, prescribing acetazolamide for travel is an optional service, not included in the general practitioner's contract. Some GPs may decide not to prescribe acetazolamide on this basis, or because they feel it is outside the scope of their practice.

This article is an approach to discussing travel and activity at high altitude, prevention of sickness, and acetazolamide prescription for non-specialists.

What you should cover**History***What does the person know about acute mountain sickness?*

Symptoms of acute mountain sickness commonly occur six to 12 hours after arrival at high altitude (>2500 m/8200 ft) and include headache with any of the following: nausea, dizziness, tiredness, loss of appetite, breathlessness, or insomnia.⁴ (The Lake Louise score can be used to diagnose and assess severity of acute mountain sickness—see resources.) Acute mountain sickness can progress to life threatening high altitude cerebral oedema, associated with severe headache and confusion, vomiting, or loss of balance and coordination.

Have they been diagnosed with altitude illness?

People with previous acute mountain sickness are at greater risk of developing subsequent episodes.⁶ Those with past complications of severe altitude illness such as cerebral or pulmonary oedema should exercise extreme caution returning to similar heights and are advised to seek specialist advice from a health practitioner with high altitude medicine experience (see resources).

Pre-existing health conditions which may worsen with altitude

Ask about high blood pressure, heart, kidney or lung problems, diabetes, anaemia, glaucoma, obstructive sleep apnoea, obesity, and any medications or allergies. Pre-existing health conditions can get worse at high altitude or increase the risk of acute mountain sickness. The Union Internationale des Associations d'Alpinisme provides some condition-specific advice (see resources).⁷ Depending on the medical condition, you might advise the person to undertake a more cautious ascent profile ("start low and go slow") or less strenuous activity. If in doubt, you could suggest the patient asks the specialist managing their condition, or seeks advice from a health practitioner with high

altitude medicine experience. Those wishing to undertake activities such as trekking must be able to complete such activities at low altitude where altitude sickness is not possible (<1500 m, eg, trekking in the Scottish Highlands).

Assess travel plans for risk (Box 1)

Box 1: Categorising risk of acute mountain sickness and suggested prophylactic approaches (based on Wilderness Medical Society guidelines (2014))⁵

Low risk

- People with no history of altitude illness who are ascending to less than 2800 m
- Those taking ≥ 2 days to arrive at 2500-3000 m with subsequent increases in sleeping height of <500 m/day and an extra day for acclimatisation every 1000 m

Suggested approach: prophylactic drugs are not usually necessary.

Moderate risk

- People with a history of altitude illness who are ascending to 2500-2800 m in one day
- Those with no history of acute mountain sickness but who are ascending above 2800 m in one day
- All people ascending >500 m/day (increase in sleeping height) at altitudes >3000 m but with an extra day for acclimatisation every 1000 m
- Suggested approach: consider acetazolamide 125 mg bd.

High risk

- People with a history of acute mountain sickness who are ascending to above 2800 m in one day
- Those with a history of high altitude cerebral oedema
- Climbers ascending to >3500 m in one day and those ascending >500 m/day (increase in sleeping height) above 3000 m without extra days for acclimatisation
- Very rapid ascents (eg, ascent of Mt Kilimanjaro in less than 7 days)
- Suggested approach: strongly consider acetazolamide 125 mg bd.

Being young and fit does not reduce the risk of developing mountain sickness,⁴ so travel plans are a more reliable indicator of risk or whether to prescribe prophylaxis.⁵ Rate of exposure to hypoxia dictates risk: the faster and more energetic the ascent (above 2500 m), the greater the likelihood of developing altitude illnesses. Guidelines suggest ascending no more than 500 m/day, with a rest day (no increase in altitude) every third day.^{4,5} Starting at a lower altitude allows more time to adapt to gradual changes in hypoxia.

By contrast, physical exertion directly after being transported to high altitude increases the risk of mountain sickness. Two common examples where there is a high risk of developing mountain sickness are flying to Cusco (Machu Picchu) in Peru at 3400 m and taking a bus to Lake Titicaca at 3812 m, or flying directly to Colorado ski resorts at over 3000 m.

What you should do

Offer advice about health at altitude

Websites such as NHS Choices give good advice on altitude illness and general health at altitude. Examples include advice to drink adequate fluids (>2L, dependent on activity levels) and to avoid alcohol. It might be helpful to print this out to help patients recognise the symptoms of acute mountain sickness and the need for rest and/or descent: just going as little as 300-500 m lower often makes a difference. Severe illness requires prompt descent and medical attention. Medex.org provides a greater depth of advice in a booklet that can be downloaded or printed (see link in resources).

Reiterate that although acetazolamide can be taken to help prevent acute mountain sickness, there is little evidence for its use as an acute treatment.

Who can take acetazolamide?

Box 1 outlines an approach to acetazolamide prescription dependent on risk. Acetazolamide should be avoided in people with glaucoma, hypokalaemia, hyponatraemia, renal or hepatic impairment, in pregnancy, and in those allergic to sulfonamides. Acetazolamide can interact with high dose aspirin (large doses of salicylates and oral carbonic anhydrase inhibitors can rarely result in severe metabolic acidosis and/or salicylate toxicity), cardiac glycosides, antihypertensive drugs, and lithium.

How effective is acetazolamide?

The recommended dose is 125 mg twice a day with a number needed to treat (NNT) of 6,^{2,3} based on one episode of acute mountain sickness, eg, a Lake Louise score of 3 or more. In those with higher risk ascent profiles (>500 m/day) the NNT is 4.²

What are the side effects of acetazolamide?

Common dose-dependent side effects include altered taste, paraesthesia, and polyuria. It is important to stay well hydrated. If these side effects are not tolerated, the dose can be reduced or discontinued. Parasthesia can be particularly uncomfortable at night. Symptoms may be improved by moving the evening dose to several hours before bed. If reducing the dose, we recommend 125 mg at night. This may also help altitude related sleep disturbance.

Less common side effects of nausea, headache, and dizziness have an overlap with symptoms of acute mountain sickness. Unless medical help is available, moderate to severe symptoms should be assumed to be due to mountain sickness, and anyone with these symptoms needs to act accordingly (see Lake Louise score and information in resources). Offer people written advice on taking the medication. Consider documenting that you discussed with the patient that it is their responsibility to: decide whether to take the risk of travelling to high altitude; be aware of the risks and symptoms of acute mountain sickness; and understand the risks/benefits of taking acetazolamide.

When should patients start and stop taking acetazolamide?

Most experts recommend starting acetazolamide 1-2 days before ascending above 3000 m and stopping on descent or below 2500 m.⁸ People staying at stable altitudes for >3 days who are asymptomatic can discontinue use. In practice, acetazolamide is rarely taken for more than a couple of weeks and the effects of taking it for a longer period have not been extensively researched.

Acetazolamide should be written on a private prescription, as it is for a condition which may develop outside the UK.

How this article was created

We used the Wilderness Medical Society's consensus guidelines backed by recent meta-analyses, and the Oxford Handbook of Expedition and Wilderness Medicine.

Resources for patients

http://medex.org.uk/medex_book/about_book.php
<http://www.nhs.uk/Conditions/Altitude-sickness/Pages/Introduction.aspx>
<http://www.altitude.org/ams.php>

Resources for clinicians

West, Schoene, Luks and Milledge. High Altitude Medicine and Physiology. 5th Edition, 2012.

Imray C, Booth A, Wright A, Bradwell A. Acute altitude illnesses. *BMJ* 2011; 43:d4943.

UIAA Library of recommendations. (for travel to high altitude) <http://www.theuiaa.org/mountain-medicine/medical-advice/>

UIAA pre-existing medical conditions advice. http://www.theuiaa.org/documents/mountainmedicine/UIAA_MedCom_Rec_No_13_Preexisting_Conditions_2008_V1-1.pdf

Advice for health professionals based in the UK regarding travel health, including travel to high altitude. [https://travelhealthpro.org.uk/contact +44 \(0\)845 602 6712](https://travelhealthpro.org.uk/contact+44(0)8456026712) (UK practitioners only)

Lake Louise scoring system for acute mountain sickness severity <http://thepeakinc.com/wp-content/uploads/2017/07/diagnosis-of-acute-mountain-sickness.pdf>

Education into practice

Have you discussed altitude illnesses with a patient? If so what did you say?

What symptoms of acute mountain sickness would you advise a patient to look out for?

Which other common travel illnesses might you discuss?

How might the information in this article be useful for the travel clinic at your practice?

Patient involvement: Patients were not involved in the creation of this article.

We have read and understood the BMJ policy on declaration of interests and declare no competing interests.

Provenance and peer review: not commissioned; externally peer reviewed.

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Accepted: 09 05 2018

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