

# High Time

By Tom Welch, M.D.

*After twenty-three years* of writing this column, some overlap of subject matter is probably inevitable. I am going to discuss a topic I reviewed on these pages over two decades ago. Although there is very little new science about the subject, it will be a good reminder for the older reader and a good introduction for a new generation of trekkers.

Every now and then, I encounter a hiker huffing and puffing en route to an Adirondack summit and making a comment along the lines of "Air is pretty thin up here, eh?" While that's technically correct, the implication that the hiker's exhaustion is a function of altitude is not. This does not imply, however, that altitude is never a problem for the trekker—it most assuredly can be!

Every bodily function requires oxygen. Oxygen is delivered continuously to the muscles, brain, and other organs

by red blood cells. These cells pick up oxygen as they flow through the lungs and deliver it through the network of blood vessels. After offloading oxygen to tissues, the cells return to the lungs for a resupply.

The amount of oxygen that a red blood cell can take up from the lungs is a function of two things: the percent of oxygen in the air, and the air pressure. As one ascends, the percentage of oxygen in air is constant, but the air pressure decreases; this is why commercial aircraft, flying at very high

altitude, are pressurized.

Although air pressure decreases incrementally for every foot of elevation gain, the consequence for red blood cell oxygen delivery in healthy persons is inconsequential below about 8,000 feet. This is why folks climbing Mt. Marcy (or any peak east of the Mississippi) can't blame altitude for their fatigue. A ski vacation in the Rockies, or an alpine or Himalayan trek, is a very different story.

The medical effects of high altitude are all direct consequences of tissue oxygen deficiency. The earliest effect most folks notice is a lower threshold for exhaustion—becoming unusually fatigued by what seems like minimal effort. The body compensates for impaired oxygen delivery by increasing the respiratory rate and the heart rate (pulse). This is why one feels (and appears) much more "winded" by a jaunt in the Rockies than one of similar length and elevation change in the Adirondacks. There is no real "treatment" for this problem beyond factoring it into your trip planning.

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*As one ascends, the percentage of oxygen in air is constant, but the air pressure decreases.*

Acute mountain sickness (AMS) is the next step in altitude illness. It is marked by headache, occasionally very severe, accompanied by some systemic complaint such as nausea, extreme fatigue, or lightheadedness. Many New Yorkers who make quick trips for Colorado ski vacations experience AMS, which they may attribute to hangover! (Actually, alcohol can worsen AMS.)

More severe altitude complications generally start at or above 11,000 feet. High-altitude cerebral edema (HACE) refers to brain swelling, which results in deterioration in mental function,

delirium, and coma. Accumulation of fluid in the lungs, with cough, bloody sputum, and severe respiratory distress are the findings of high-altitude pulmonary edema (HAPE). Both of these conditions are life-threatening.

The most important preventive measure for altitude illness is allowing time for acclimatization. Once above about 11,000 feet, one should never sleep at a gain of more than 1,500 feet in a day. Extended climbs above this altitude should include a full rest day out of every three or four. Attention to hydration is important; one becomes dehydrated more easily at high altitude, and AMS, HACE, and HAPE are all worsened by dehydration.

Simple high-altitude headache typically responds to NSAIDs and fluids. There are additional prescription medications (acetazolamide and dexamethasone) useful for AMS and other complications. The only definitive therapy for severe altitude illness is descent; even seemingly severe symptoms seem to melt away upon a descent of a few thousand feet. Major

expeditions may carry supplemental oxygen, or even portable hyperbaric devices, but neither are substitutes for rapid descent.

I always recommend consultation with a wilderness or travel medicine specialist prior to undertaking an extended sojourn at very high altitude. Often, these physicians will provide prescriptions for possible use in the event of symptoms; they can also counsel folks with chronic conditions that could be worsened by high-altitude travel, or would make such treks unwise. ▲

*Tom Welch, MD, is a physician at Upstate Medical University in Syracuse and an active member of the Wilderness Medical Society. He is a licensed professional guide and a certifying instructor for the Wilderness Education Association, and has guided groups in the Adirondacks, Montana, and Alaska. More information is available at his website and blog, [adirondoc.com](http://adirondoc.com).*

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