Letter to the Editor

Airway Obstruction and Acute Mountain Sickness

To the Editor:

There is a huge population of underserved travelers to high altitude conditions who have acute mountain sickness (AMS). A greater awareness and more preventative measures for AMS could keep the visitors returning to ski resorts and other mountain destinations. Identifying persons who could be susceptible to AMS could be very beneficial.

Oxygen desaturation during sleep has been shown to cause AMS in high altitude conditions.¹ In addition to the reduced atmospheric pressure at altitude, it would be expected that anything else that causes desaturation during sleep could also lead to the onset of AMS. Airway obstruction is the cause of obstructive sleep apnea (OSA), which is characterized by desaturation events. Airway obstruction is also seen with snoring. Sleep apnea at moderate to high altitude has been associated with hypoxemia, increased sleep breathing disturbances, and low nighttime oxygen saturation.² Obstructive sleep apnea and obesity are associated with worse AMS scores and exacerbate hypoxemia and increase a person's risk for high altitude pulmonary edema.³ Problems with airway obstructive conditions cause low nighttime oxygen saturation and are related to the onset of AMS.

At altitude, as compared to sea level, there is reduced atmospheric pressure with reduced arterial oxygen saturation. There could be AMS-contributing subclinical factors existing at sea level that only become pathological when higher altitudes (with reduced arterial oxygen saturation) are reached. The upper airway is a collapsible structure and is influenced by gravity, and in the supine position during sleep, the tongue and soft palate move posteriorly, obstructing the oropharyngeal space.⁴ In healthy persons during sleep the airway is reduced in both the anteroposterior and lateral dimensions, and there is an increase in resistance and narrowing of the airway, which is not usually a problem at sea level.⁴ However, this normal physiology might contribute to the onset of AMS as this obstruction could lead to an increase in desaturation events commonly seen in OSA pathology.

Other upper airway obstructive conditions may exist in ways not previously considered. Other than the respiratory depressing effects of alcohol and sedatives, excessive alcohol can also cause nasal inflammation and obstruction and prevent optimal oxygen saturation during sleep. Although sildenafil is purported to improve AMS,

it could have the opposite effect since for some there is the side effect of nasal stuffiness, which further obstructs the airway.

Obstruction of the airway by the tongue appears to be a cause of OSA. Because OSA is a predictor of AMS, removal of the obstruction by moving the tongue forward during sleep should assist in treating AMS. A recent pilot study, presented at the Hypoxia Symposium in Lake Louise in February 2011, showed an improvement in AMS symptoms and a reduction in oxygen desaturation events while using a mandibular advancement device to hold the tongue forward.⁵ In a paper recently published in *High Altitude Medicine and Biology*,⁶ the mandibular advancement device was suggested as being beneficial, if used alone or in combination with continuous positive airway pressure and altitude medications when treating persons with OSA.

Some people may be genetically predisposed to AMS whereas others may be affected owing to airway obstruction, or possibly a combination of factors may be involved. Even airway obstruction during the day could contribute to AMS, as altitude arrival exercise seems to be associated with the AMS. Airway obstruction can also make exercise more difficult. Even extremely fit and world class athletes get AMS—perhaps there is an obstructive component to the athlete's susceptibility.

I suggest that AMS is more likely to develop in persons having upper airway obstruction problems at sea level, and there may be subclinical populations who have predisposing factors at sea level that only become meaningful at altitude. There are many forms of treatment for sleeping airway obstruction at sea level that may also be beneficial in the treatment of AMS. It appears that any anatomical abnormality or physiological factor that potentially compromises the airway (resulting in lower arterial oxygen pressure) could increase the risk for AMS, and all persons with known airway obstruction should be vigilant.

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References

1. Burgess KR, Johnson P, Edwards N, Cooper J. Acute mountain sickness is associated with sleep desaturation at high altitude. *Respirology*. 2004;9:485–492.
2. Nussbaumer-Ochsner Y, Schuepfer N, Ulrich S, Bloch KE. Exacerbation of sleep apnoea by frequent central events in

- patients with the obstructive sleep apnoea syndrome at altitude: a randomised trial. *Thorax*. 2010;65:429–435.
3. Mieske K, Flaherty G, O'Brien T. Journeys to high altitude—risks and recommendations for travelers with preexisting medical conditions. *J Travel Med*. 2010;17:48–62.
 4. Ayappa I, Rapoport DM. The upper airway in sleep: physiology of the pharynx. *Sleep Med Rev*. 2003;7:9–33.
 5. Williams M. Acute mountain sickness prevention with a mouthpiece. International Hypoxia Symposium; 2011; abstract no. 3. Available at: http://hypoxia.net/2011_meeting/program/index.htm. Final program, page 18, March 6, 2012.
 6. Latshang TD, Bloch KE. How to treat patients with obstructive sleep apnea syndrome during an altitude sojourn. *High Altitude Med Biol*. 2011;12:303–307.