

Acute Mountain Sickness Prophylaxis in the SOF Operator

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Special Operations Forces (SOF) may be required to conduct missions in mountainous terrain without prior acclimatization and while exceeding normally recommended ascent rates, making them more susceptible to high altitude illness. SOF medical personnel must be familiar with prophylactic measures against high altitude illness to reduce its potential detrimental impact on mission completion.

Brian Delmonaco, Jason Andrews, and Aaron May authored the article "Intermittent Hypoxic Exposure Protocols to Rapidly Induce Altitude Acclimatization in the SOF Operator" in this issue of *JSOM*. They utilized a Colorado Exercise Room to induce normobaric hypoxia through dilution of oxygen content, thereby achieving a specified PIO_2 to simulate a corresponding altitude. The authors hypothesize that this may provide sufficient hypoxic stimulus to rapidly achieve ventilatory and hematological adaptive responses in the unacclimatized Operator in order to decrease the incidence of acute mountain sickness (AMS) when exposed to the hypobaric hypoxic environment of altitude. Recent work by Dr. Stephen Muza noted that the literature on intermittent hypoxic exposure (IHE) for inducing altitude adaptation is still in the early phases with only five out of twenty-five available studies actually using normobaric hypoxia.¹ While he noted that adaptation (ventilatory and hematologic) is a function of PIO_2 and not absolute barometric pressure, several of the studies suggested higher rates of AMS in subjects exposed to hypobaric hypoxia (more accurately reflecting high altitude conditions) when compared to normobaric hypoxia. Also of note, there did not appear to be any correlation between IHE exposure and hematologic adaptation to altitude in any of the studies cited. While the authors should be commended for suggesting a potential alternative method of preparing Operators to rapidly ascend to high altitude, the use of chemoprophylaxis such as acetazolamide (Diamox) and dexamethasone (Decadron) currently offer far greater utility in the prevention of AMS and other high altitude illness.

The authors quote a study by Dr. Muza that demonstrated a 20% reduction in AMS and a 1 to 3% increase in resting SaO_2 through use of a week-long protocol of IHE for three hours daily. However, this reduction in AMS is significantly less than that seen with the use of prophylactic medications in other studies. Dr. Delmonaco and colleagues designed an alternate IHE protocol of 1.5 hours daily for five days with the desired goal of achieving a 1.5% increase in resting SaO_2 . This goal was only achieved for one of the three climbers in this article, which argues against the effectiveness of this protocol. While one of the three could statistically be expected to develop AMS on Mount Rainier, it is quite feasible that based on such a small study group, none would have developed AMS even without undergoing IHE. Although insufficient to meet a case definition of AMS, the reported insomnia and nausea/vomiting during the Rainier climb suggest that detrimental effects from high altitude may have occurred despite IHE.

We disagree with the authors' statement that acetazolamide must be taken "days in advance in order to be effective." A number of studies have demonstrated the efficacy of this drug to significantly reduce the incidence of AMS when initiated 24 hours in advance of arrival at high altitude.^{2,3} Since acetazolamide is an effective treatment of AMS, its use should offer at least some protection even if started on the day of the mission. While parasthesias are a known potential side-effect, this can be mitigated by using smaller doses of acetazolamide. One study demonstrated that acetazolamide 125mg PO BID is not significantly different in efficacy from 375mg PO BID.^{4,5} The primary drawback of acetazolamide is its contraindication in individuals with known sulfa allergies (or side-effects in persons with unknown sulfa allergies).

Dexamethasone is also highly effective in reducing the incidence of AMS.^{2,6-8} Care must be taken to ensure that dexamethasone is not discontinued while still at altitude due to the potential of rebound upon with-

drawal. The combination of acetazolamide and dexamethasone has been shown to be more effective than either alone.⁸ We recommend a dose of 4mg PO BID if dexamethasone is chosen as a prophylactic agent. Since mood disorders are a potential side-effect, SOF medical personnel may prefer to reserve the use of dexamethasone for situations when AMS symptoms are seen despite acetazolamide prophylaxis.

Some studies have suggested the use of ginkgo biloba as being effective in the prevention of AMS; however, other studies have found no demonstrable benefit.^{2,3,10-12} We cannot conclusively recommend ginkgo biloba as effective prophylaxis against AMS based on these conflicting scientific studies. However, since the prolonged routine use of ginkgo biloba has no appreciable side-effects, SOF personnel could consider this medication at a dose of 120mg PO BID when deployed to environments with potential high altitude missions.

The limited availability of IHE systems (e.g., Colorado Exercise Room) reduce their utility to SOF. Unless the system is deployable, SOF personnel can only undergo initial and maintenance IHE “dosing” in CONUS, which essentially negates the time benefit over chemoprophylaxis that Dr. Delmonaco and colleagues suggest. During the time frame required for deployment, AMS chemoprophylaxis could likely be effectively initiated. We encourage the authors to continue to attempt to develop an effective protocol that produces reproducible, significant reductions in AMS and can be validated using sufficiently large study groups. Such a protocol may yet prove to be of benefit in the future for select SOF elements that are on alert for high altitude missions. Until then, acetazolamide 125 to 250mg PO BID and/or dexamethasone 4mg PO BID remain the clear choices for the prevention of acute mountain sickness in SOF.

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