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**Location, Location, Location**

The most common type of altitude sickness is acute mountain sickness, which can cause headaches, nausea, light-headedness, dizziness and difficulty sleeping. ACM can sharply decrease a warrior's effectiveness on a deployed operation.

By Kenya McCullum

All week, you've been looking forward to your weekend trip to the mountains. As you leave the hustle and bustle of the city and drive upward and onward, you enjoy the scenery and picture the wind rushing through your hair as you fly on your skis. But before you get there, you begin to have another strong feeling—one with which those who regularly ascend in altitude are quite familiar—altitude sickness.

"Altitude sickness is a conglomeration of symptoms brought about by going too high too quickly," said Larry Kutt, an avid climber and the CEO of Colorado Altitude Training (CAT), a Boulder-based company that manufactures equipment designed to reduce the effects of altitude sickness. "Your body has all these wonderful adaptive mechanisms that, if you give them time to work, you can adapt to really quite high altitudes."

The Lows of Going High

The most common type of altitude sickness is acute mountain sickness (ACM), which can cause headaches, nausea, light-headedness, dizziness and difficulty sleeping. In most cases, these

symptoms will be alleviated without any kind of treatment. However, in some cases, ACM can progress into more serious illnesses—high altitude pulmonary edema (HAPE) or high altitude cerebral edema (HACE)—that can be potentially fatal if left untreated.

HAPE is caused by an accumulation of fluid in the lungs, and its symptoms include shortness of breath and a severe cough. HACE is caused by an increased blood flow to the brain that results in swelling, and its symptoms include disorientation, confusion, hallucinations, fatigue and ataxia (the inability to walk in a straight line). When someone's ACM progresses into HAPE or HACE, it's imperative that they seek treatment immediately. The most common and easiest way to do this is simply to descend in altitude, which will usually improve the effects of HAPE and HACE right away.

Ideally, when people feel an initial bout of altitude sickness, they should descend immediately and continue their ascent at a slower pace—sometimes over the course of a few days, depending on how high they plan to ascend—to ensure the condition does not become life-threatening.

However, in the case of military personnel being transported to and stationed in high-altitude locations like Afghanistan and Iraq, the ideal strategy for handling altitude illness is a luxury they don't have time for.

"If you're in a helicopter and you leave a base that is 3,000 feet above sea level, which is not high altitude, and 45 minutes to an hour later, the helicopter is approximately at 8, 9 or 10,000 feet in the mountains of Afghanistan, that's a very rapid ascent. And you're very likely under those circumstances to develop altitude illness," said Dr. Stephen Muza, a research physiologist at the U.S. Army Research Institute of Environmental Medicine (USARIEM), an organization that studies the effects of environmental factors on the body.

"And if you're in a combat operation and you're running security or some type of mission where it's very high and there's a bad guy over at the next ridge, you can't wait two days to acclimatize and you can't get up there and say, 'Let's turn back because we've got a headache,'" Muza said. "That is what distinguishes the military from a recreational person. We have the choice to descend and wait it out, the military generally does not."

Though many soldiers may develop altitude sickness, they tend to ignore the warning signs in order to continue their work. "We know that a lot of troops just will simply suck it up, especially if it's a mild headache and nothing more than that," said Muza. While this may demonstrate a soldier's strength, will and dedication, it's not always wise, considering the potential of ACM progressing into HAPE or HACE.

But Muza knows it doesn't have to come to that, and his team of researchers at USARIEM is leading the charge to find more effective strategies for handling altitude sickness.

The Highs and Lows of Treatment

The military currently uses medications to treat and prevent altitude illnesses in soldiers. The most common among these is acetazolamide, the only FDA-approved medication for the treatment of the illness. In order to alleviate or prevent the effects of altitude illness, acetazolamide can be taken twice a day, beginning 24 hours prior to ascent and up to 48 hours after.

While acetazolamide is a useful treatment for about 75 percent of those who take it, the medication's side effects are less than ideal. It can cause diarrhea, a tingling sensation in the

fingers and toes, and—more importantly for soldiers on the battlefield—a decrease in endurance.

USARIEM is currently researching better solutions for dealing with altitude illness. Colorado Altitude Training's Kutt said he believes his company's altitude-training tents may be one practical and economical solution to the military's treatment of ACM.

"This came to our attention from folks in the military: They estimated the cost of altitude sickness in Afghanistan alone was \$120 million," Kutt said. "What was happening is that they were boarding the soldiers at low altitude and then bringing them up in helicopters to, for example, the Bora Bora mountains, where they would be fighting at 10, 11 and 12,000 feet, and when they got there, maybe they would bring 1,000 soldiers up. The next day you have 970 of them that were sick with acute mountain sickness."

Kutt said that if soldiers participate in altitude training, which involves exposing themselves to higher-altitude conditions before they actually ascend, the cases of altitude sickness will reduce dramatically.

Colorado Altitude Training manufactures altitude-training tents that help users acclimatize to higher altitudes as they sleep. The tents, which have been used by a who's who of professional athletes (including members of the Nike Running Team, French National Ski Team, United States Figure Skating Association and the Chicago Bears), help the body transport more oxygen by increasing the amount of red blood cells it produces. This is done by tricking the body into thinking it's at a higher altitude through the use of a molecular sieve, which increases the amount of oxygen in the air to mimic the amount one's body would receive at a higher altitude.

Kutt said that altitude training is becoming more and more popular among CAT's customers now that its benefits are becoming more widely known.

"It turns out that just time at altitude, whether you're just sitting and resting or sleeping, triggers the body's mechanisms and creates a whole physiological response that improves performance," said Kutt. "Our technology allows people to have that adaptive response in the comfort of their own home."

Kutt said that the same benefits that athletes receive from CAT's equipment can also be useful for soldiers deployed at high-altitude locations. "We look at our soldiers as elite athletes playing a very dangerous game, and we know the military spends a great deal of time and effort getting these guys into physical shape for whatever kind of mission they may be going on," he said.

The Highs of Altitude Training

Treatment and prevention of altitude sickness are not the only benefits that acclimatization produces. Muza said it's also important to note that acclimatization has a benefit that no drug will ever have—it can enhance both physical and cognitive performance, thus making soldiers more efficient on the battlefield, especially considering the decrease in stamina that occurs at higher altitudes. According to Muza, when people ascend 5,000 feet, their performance decreases to the point that a task that would normally take two hours to complete will take an extra one to one-and-a-half hours. After acclimatization, however, performance at high altitude can improve by 25 to 50 percent.

With these data in mind, USARIEM is currently testing equipment like Kutt's altitude-training tents to determine how long a soldier would need to acclimatize to altitude changes. Muza said it has already been proven that three to four hours per day for a week to 10 days can

significantly reduce the likelihood that one will develop altitude sickness. USARIEM is now studying how much that time can be reduced while still achieving a desired acclimatization outcome.

Muza said the military does not have many ways to help soldiers traveling at high altitudes outside of general education procedure. Service members about to be deployed to a high-altitude location are first given pamphlets describing environmental problems and infectious diseases specific to area. Troops are also taught about acclimatization and told not to ascend too rapidly, though oftentimes this is simply not possible.

"That's about all they have available to them. That's why we've been working on these alternative technologies, to find ways that we can prep them before they go," Muza said.

In addition to testing equipment, Muza also spends a lot of his time teaching military decision-makers about the effectiveness of other altitude-sickness "cures" and steers them away from snake oil products in panacea's clothing.

"There's not a week that goes by where we don't have a query or a question by the Army saying, 'Do you know about this product?' They're anxious for a solution and we try to filter those to see if it really has potential, and if it has potential, we do additional research. If it has no basis in science, we try to inform them of that, too," Muza said.

But unlike snake oil, exposure to high altitude has been scientifically proven to yield a multitude of benefits. "We know that we can take any individual and have them spend time in the altitude environment and we can improve their aerobic capacity and their anaerobic capacity. That's the key to someone's ability to perform physically," said Larry Kutt. "It has been shown very clearly that if you take people to higher altitudes slowly over a period of about a week, you can completely eliminate the symptoms of acute mountain sickness."

And from the athletic field to the battlefield, it's high time to eliminate altitude sickness.