Mountain Medicine

Performance-enhancing drugs and climbing

GEOFF TABIN, MD, *and* SCOTT MCINTOSH, MS

In 1953, Hermann Buhl staggered off the summit of Nanga Parbat in the final stages of exhaustion. He was alone. Darkness was closing in. Clouds swirled ominously, and the wind howled. He had just completed the only solo first ascent of an 8000-meter peak. Now he had to survive. Fortunately, his expedition leader and doctor, Karl Herrligkoffer, had given him a packet of Pervitin. Buhl choked two of the amphetamine tablets past his parched lips and throat. A surge of energy from the drugs helped him get down alive.

In 1988, Stephen Venables, having completed a new route on Mt. Everest's Kangshung Face with his three teammates, broke trail without oxygen toward the summit. He had been out of food for two days, and had already spent two nights above 8000 meters. His partners were nowhere to be seen. Ahead of him lay the top, and, although he did not yet know it, an open bivouac at 8600 meters. He popped two prescription-strength caffeine pills into his mouth and swigged them down with Rehydrate juice. By the time he regained the South Col, he would be alone for 30 hours.

The ascents by Buhl and Venables are heralded in mountaineering lore for their difficulty, boldness, and style—but both athletes would be banned from Olympic competition for illegal drug use. Then again, without the drugs, they might be dead.

Would you take a magic pill that would allow you to climb faster above 8000 meters? What about one that improved your finger strength and endurance and allowed you to jump from being a 5.11 climber to cranking 5.14? How about a drug that keeps you awake, focused, and strong for 72 continuous hours on a superalpine ascent?

What if you knew that pill would shorten your life? Or end your sex life? Perhaps, for a cutting-edge climber, the improved performance would decrease the risk of an accident and actually increase life expectancy—but, if you need the drug to do it, perhaps the climb should not be done.

Performance-enhancing drugs have long been a source of controversy among athletic competitors. Ancient Greek Olympic athletes consumed herbs and mushrooms in an attempt to improve their performance. The modern Olympics have been embroiled with controversy over ergogenic aids. Sophisticated testing for a wide variety of medications and dietary supplements is routine in international and professional sports.

What about climbing? No governing body monitors climbers for drug use, though drugs certainly have been and are being used. Several famous sport climbers admit to using anabolic steroids or creatine to speed the healing of injuries. Certainly, some are also using steroids to improve performance. In Italy, controversy has recently centered on erythropoietin (EPO) use among alpinists and competitive skiers. Several guides on Mt. Everest have routinely given their clients "the three Ds" (dexamethasone, diamox, and dextroamphetamine) for summit day—and people who would not otherwise be capable have stood on top of the world.

This article will review several common medications and dietary supplements with regard to their efficacy and side effects. The broader ethical questions surrounding their use will be left for the individual to decide, for it is the individual who ultimately must decide what it is to "climb by fair means."

Caffeine

Want to set a speed record on a route on El Cap? How about if you are going to hike in, do a hard route on the Diamond, and hike out the same day (and your partner doesn't want you to fall asleep when you are belaying)? It might help to try a bit of caffeine.

Caffeine is the most widely consumed stimulant in the United States. It acts on the central nervous system to increase arousal, decrease motor reaction time, and decrease fatigue. Caffeine also stimulates the release of free fatty acids into the blood stream, allowing the body to spare glycogen and increase performance in endurance sports. One cup of coffee contains 100 milligrams of caffeine. Caffeine as a drug is banned by the IOC and NCAA at a dose of approximately 600 milligrams ingested over six hours (as measured by a urine level of 12mg/ml).

Side effects of caffeine include insomnia, nervous irritability, tremors, anxiety, and dehydration from a marked diuretic effect of the drug. Caffeine can increase the risk of frostbite and altitude illness secondary to dehydration and vasoconstriction, particularly at high altitude.

Amphetamines

Let's take it a bit further now. You are looking to climb from Base Camp to the summit of K2 in a single 72-hour push. You will need to remain alert, plus feel energized. What will help you in your effort?

Dr. Herrligkoffer had a good remedy. Amphetamines will keep you going longer than caffeine. Amphetamines are also central nervous system stimulants, activating the sympathetic nervous system and stimulating your ultimate survival physiology. (This is the "fight or flight response" that kicks in when a wild animal is cornered by a predator—the same system that gets triggered by a long leader fall.) Amphetamines increase attention, dilate the bronchi, and stimulate faster breathing, increased heart rate, and elevated blood pressure.

Side effects of amphetamines include psychological dependence and addiction, dangerous elevation of blood pressure (which could lead to a stroke), psychosis, anorexia, diarrhea, tremors, motor tics, dry mouth, loss of libido, and impotence. The NCAA and IOC ban dextroamphetamine at all doses. It is available by prescription only at dosages ranging from 5 to 30 milligrams.

Amphetamine use is widespread. A recent study in the Austrian Alps found amphetamines in the urine of 7.1 percent of climbers going above 3300 meters.

Dexamethasone

Let's say you are climbing a volcano in Ecuador. You are at the high hut and feel a bit lethargic. You have a mild headache. You know you should not go for the summit tomorrow, but you have to catch a plane and your partner is counting on you. If you take four milligrams of dexamethasone tonight, you will feel better in the morning. Pop another one when you wake, and chances are that you will make the summit.

Dexamethasone is a powerful glucocorticoid anti-inflammatory medication. It decreases cerebral swelling and has become a first-line drug for the treatment of High Altitude Cerebral Edema (HACE). It also alleviates the symptoms of severe Acute Mountain Sickness (AMS). It can be effective in preventing the symptoms of altitude illness during rapid ascent.

Dexamethasone can improve performance on alpine and Himalayan climbs. However, it has serious side effects and is very dangerous with prolonged use. Common side effects with short-term use include mood changes, insomnia, susceptibility to infection, gastritis, and bleeding peptic ulcers. Prolonged use can lead to suppression of the entire endocrine system and a myriad of serious side effects including aseptic necrosis of the heads of the long bones in the arm and leg, muscle weakness, glaucoma, and bone loss.

Diamox

You have been at your 16,000-foot base camp for a week. Each morning you feel worse than you did the night before. Your tentmate tells you that you gasp for breath and then stop breathing during the night—and that one of you is going to have to move out. You are wondering if you can climb any higher.

Perhaps if you take diamox, your climb can be saved. Diamox is acetazolamide, a carbonic anhydrase inhibitor that acts on the kidneys to help combat the respiratory alkalosis that often accompanies high-altitude climbing. It can help prevent altitude illness and the hypoxia caused by irregular breathing during the night.

Diamox does not improve athletic performance. The only significant side effect is that, like supplemental oxygen, once it is initiated at a certain altitude, it must be continued until the climber has returned to that altitude, or there is a risk of more serious mountain sickness. Other side effects of diamox include dehydration from its diuretic action and peripheral nerve tingling. It also makes carbonated and alcoholic beverages taste terrible.

Erythropoietin

What if you want to do the same climb from the 16,000-foot base camp, but you don't have the luxury of spending a week acclimating? You might try a trick that top international bicyclists have been using for a decade: get a doctor to inject you with erythropoietin (EPO).

Erythropoietin is a natural chemical that is released from the kidney when oxygen levels in the blood are low. Erythropoietin stimulates the bone marrow to make more red blood cells, enabling the blood to carry more oxygen. All states of low oxygen, including the hypoxia of high altitude, cause EPO release. With your blood having more oxygen-carrying capacity, muscle and brain cells receive an increased supply of oxygen. Athletic performance, particularly in endurance events, can be dramatically improved.

In the late 1980s, an injectable form of EPO was developed to treat the anemia of renal disease. In healthy athletes, it stimulates natural red blood cell production and an increase in measured hematocrit. Maximal aerobic power correlates with red blood cell mass. Many studies have shown increased athletic performance with blood doping. Injectable recombinant DNA EPO is currently the most effective and controlled method of blood doping. It clearly does increase aerobic capacity and performance in endurance sports, including mountaineering, and helps speed acclimatization.

EPO is banned by the IOC and in professional cycling. The major danger with EPO is

that its results are unpredictable. It can lead to too much red blood cell production and blood that is too thick, leading to high blood pressure, strokes, and heart failure. EPO is the suspected cause of the deaths of several top European cyclists. The risk of these serious consequences increases with dehydration. When the blood loses water volume, it becomes even thicker and sludges.

Currently, EPO is only available for injection. It is very expensive and requires careful monitoring of the blood hematocrit level for both desired performance enhancement and safety.

Above 10,000 feet, exercise performance is limited not only by red blood cells but also by the respiratory rate and the speed at which oxygen passes from the lungs into the blood. Studies in hypobaric chambers show that raising one's hematocrit by blood doping may result in little improvement in athletic performance. Combining the unpredictable effect of EPO injection on each climber's individual physiology with the inherently unpredictable nature of mountaineering and the possibility of dehydration, malnourishment, and sickness makes EPO use risky for high-altitude mountaineering.

Creatine

Beyond his fabled strength at altitude and amazing endurance, the late great Alex Lowe had crazy power. He trained harder than most climbers I know, and had the ability to train several days in a row without resting. He also took creatine.

Creatine is an amino acid available from dietary sources as an oral supplement. It is naturally synthesized in the body. Once in the body, it is transported to skeletal muscle and changed to creatine-phosphate to provide a source for replenishing ATP, the high-power molecule that energizes muscle contraction.

Creatine-phosphate is the only fuel available that rapidly regenerates ATP during episodes of brief high-power exercise. By taking the oral supplement creatine monohydrate, athletes can maintain stores approximately 20 percent higher than normal. This has been shown in multiple studies to enhance both power and endurance in sports that require maximal output for short periods of time (i.e., sport climbing) and to increase lean muscle mass. Taking creatine with fruit juice or other high sugar drinks significantly increases absorption, while caffeine proportionately negates the positive effects of creatine supplementation (it is thus not recommended for Seattle climbers).

Creatine's side effects include muscle cramping, dehydration, gastro-intestinal distress, and nausea. In high doses, creatine can lead to kidney failure.

Anabolic Steroids

Do you want to get stronger quickly? What about being able to recover faster from big days of training or a full day of climbing? Anabolic steroids could be the answer to your quest to be the best sport climber. Anabolic steroids are a variation of the male hormone, testosterone. They are very effective at improving muscle-building capacity. Anabolic steroids bind to muscle cells, where they intensify the muscle's ability to absorb protein. They also help prevent muscle breakdown. Overall, anabolic steroids lead to a bigger and stronger muscle.

The positive effects are increased power and endurance in short-burst activities and faster muscle healing. They may improve sport climbing performance dramatically.

Anabolic steroid use is endemic among football players, weight lifters, sprinters, and professional wrestlers. It is banned by virtually every sporting organization, including the

NCAA, NFL, and IOC. Steroids are available both in oral and injectable forms. Several famous rock climbers admit to using steroids to speed their recovery from injury. None admitted to using them to improve performance, but they are definitely being used.

Anabolic steroids do have serious side effects. First, they are a male hormone and produce androgenic (masculinizing) effects including acne, facial hair, male pattern baldness, a deepening of the voice and aggressive, violent, or irrational behavior. These problems may be permanent and can be distressing to some women. They also inhibit natural testosterone production, which leads to a decreased libido in men, low sperm count, impotence and testicular atrophy (which is medically termed "chemical castration"). Steroid use can lead to infertility in women and men. Anabolic steroids also affect lipid profiles with an increase in cholesterol levels and a decrease in HDL levels. This can lead to heart disease, stroke, and death. Finally, steroid use has been linked to cancer and the early death of several athletes.

As we learn more about human physiology, we are able to improve athletic performance through pharmacology. Supplemental oxygen is already in common and accepted use for climbing Mt. Everest. It delivers oxygen in higher concentrations to the lungs and effectively lowers the physiologic altitude, allowing increased performance. Currently, supplemental oxygen use is reported in the style of an ascent. Perhaps we should declare all of our aids and routinely report on drug use as well.

Bibliography

Blue, J.G., and Lombardo, J.A. "Steroids and Steroid-Like Compounds." In *Clinics in Sports Medicine*. 18 (3): 667-689. 1999.

Knopp, W.D. et al. "Ergogenic Drugs in Sports." In *Clinics in Sports Medicine*. 16 (3): 375-393. 1997.

Kraemer, W.J., and Volek, J.S. "Creatine Supplementation: Its Role in Human Performance." In *Clinics in Sports Medicine*. 18 (3): 651-666. 1999.

Roeggla, G. et al. *Schweiz. Ztschr. Sportmed.* 41: 103-105. 1993.

Thein, L.A. et al. "Ergogenic Aids." In *Physical Therapy*. 75 (5): 95-108. 1995.

Young, A.J. et al. "Effects of Erythrocyte Infusion on VO2 Max at High Altitude." In *Journal of Applied Physiology*. 81 (1): 252-259. 1996.

Zafren, K., and Honigman, B. "High Altitude Medicine." In *Emergency Medicine Clinics of North America*. 15 (1): 191-222. 1997.