Preparation and Medical Management of Events in Mountain and High-altitude Environments

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Introduction
Athletic pursuits in the mountain environment continue to increase in popularity for the recreational as well as professional athletes pushing the limits of human performance [1,2]. Accordingly, the sports medicine physician will have increasing opportunity and responsibility to serve the unique needs of the mountain sport athlete. Sports medicine practitioners can expect mountain sport patient-athletes to participate in traditional activities such as downhill skiing and expedition mountain climbing, to increasingly popular activities such as backcountry ski racing and adventure racing in the alpine environment [2]. The scope of practice ranges from pre-event prevention of common medical conditions unique to the mountain environment to on-site event coverage requiring additional skills in wilderness medicine. Postactivity care of injuries and medical conditions allows the athlete to return to participation as soon as possible.

General Considerations
Initial background information should include the role the physician will play in the medical care for these athletes, which can range from pre-event planning to full medical care, including event planning, on-site event coverage, and postevent medical care [3•,4,5••]. In this scope the physician is essentially taking on a group of athletes as regular patients. Many medical conditions encountered by the athlete will be familiar to the sports medicine physician in a standard practice setting, such as musculoskeletal injuries and common upper respiratory and gastrointestinal illnesses. Others conditions, such as altitude illness occurring at extreme altitudes and infectious diseases common in third-world countries, will be unique and not commonly experienced by most Western practitioners. In addition to unique medical conditions, the practitioner needs to factor in the location of the event, as many mountain ranges are considerably remote from definitive medical care, whereas others have local infrastructure with rescue teams, allowing relatively easier access to medical care [3•]. The unique demands of elite-level extreme athletes willing to take educated risks is also a factor that can add interesting variety to the standard medical care of athletes and should be taken into consideration. There is a real, definite level of risk undertaken by all athletes participating in athletics in the alpine environment, and this undeniable risk should be taken into consideration on an individual basis. For example, an elite mountain climber establishing a first ascent on a remote Himalayan peak might request medical advice and possibly treatment and management for a recently reduced shoulder dislocation with the intent to continue climbing at a strenuous level. The treatment plan for this athlete could be much different than that of a rock climber who suffers a similar injury on a popular route in the Mont Blanc range in France. This athlete would possibly prefer to seek a helicopter evacuation to medical care to allow the quickest return to her sport as possible, and would not risk any further injury brought on by continued activity. The individual needs and objectives of both athletes, as with all sports medicine patients, require individual consideration and bring about the challenges of practicing sports medicine in the alpine environment.

Event Background
In providing event coverage or assisting in the medical preparation for athletic events occurring in the mountain environment, the initial process requires a detailed history. The history should include the location of the event, the duration
and timing of the event, the number of members, and a detailed medical history for each member under the care of the physician. As telemedicine and communications are advancing, there is a role for the physician providing remote medical care through the means of providing advice and recommendations to team members [6]. In this regard, it is essential for the physician to be aware of the medical training and equipment available to the athletes. The Mt. Everest base camp was recently staffed by a volunteer physician of the Himalayan Rescue Association to provide medical care for the expeditions and accordingly, detailed knowledge of the location of the event and the available medical resources can assist in making advance trip plans for medical care [7]. Some remote trips away from medical care could be best served with the on-site presence of a health care provider with a comprehensive medical kit, and could be a recommendation given to a group planning such an adventure. The medical expertise of the members should be taken into account, as well as (and especially) the members’ willingness to assist others in the group. An expedition with a physician member does not necessarily signify that the physician will be interested in providing routine or nonurgent medical care to other group members should the need arise, and accordingly the goals and duties of each member should be established [3•,4]. For example, an event planner for an organized ultramarathon taking place in the Andes should not assume that a participant physician will be interested or adequately trained to manage the medical situations that may arise in a high-altitude endurance event. Also, a nurse practitioner climbing as a team member on an expedition on Denali in the Alaskan Range might be interested in primarily being a climber on the expedition. The climber nurse practitioner might not willingly forgo a chance to continue climbing by staying at camp managing high-altitude illness and travelers diarrhea occurring to members of the team.

History and Physical Examination
A physical examination and personal medical history of the participants is paramount and should include previous experience in similar events and any medical conditions that have occurred on previous trips. Particular emphasis should be placed on any pre-existing medical conditions, focusing on those that can be exacerbated by events occurring in the environment of the event. In addition, the goals and level of risk assessment should be addressed by the physician in order to establish groundwork for further medical management. For example, a climber who has suffered from high-altitude cerebral edema at 7500 M with a fractured talus that required evacuation on a recent climbing expedition might seek pre-event medical advice on returning to climb the same peak. The challenge of providing care to such an athlete entails a discussion of the risks of returning to altitude and also a careful discussion about the risks the athlete is willing to take in the unforgiving mountain environment. Many athletes are placed at further risk through traveling to an event taking place in a location with endemic infectious diseases, and accordingly pre-event advice on prophylaxis and appropriate immunizations should take place. Resources available to the practitioner on travel to third-world countries and appropriate pre-trip prophylaxis are available and are best utilized with a detailed itinerary of the exact geographic location in which the event will take place. The Centers for Disease Control and Prevention website (http://www.cdc.gov/travel/) is an excellent resource for evaluation of predeparture immunizations recommendations.

Medical Supplies
Providing medical kits to athletes or packing a kit for on-site event coverage requires knowledge of the limitations in available space and weight for the group, the potential medical needs of the participants, and the local medical care available. Some patient-athletes will seek out medical care with the intention of having a proper medical kit and medications supplied for the trip, and will plan on participants administering medical care within the group. For remote trips away from local medical care, more extensive medical supplies could be required, yet must be weighed with the difficulties of transporting the medical supplies and the experience of medical providers who will be responsible for the utilization of the medical supplies. Specific recommendations for supplies can be found in the literature [3••,5••,8]. Remote trips will always require a level of proficiency with wilderness medicine and especially with improvisation of available medical supplies. This is an essential skill and can be further investigated through wilderness medical organizations such as the Wilderness Medical Society [3•,9]. Of special importance is transporting and providing controlled substances and potentially dangerous pharmaceuticals for the medical kit. The level of medical expertise of the party should be considered in providing medications and the potential for improper diagnosis and improper dispensing of medications should be taken into consideration. More practically, the physician should be aware of the legal implications enforced by local state boards for the improper dispensing of controlled substances [10].

Event Preparation
In addition to providing for the essential medical needs of alpine athletes, the sports medicine practitioner can assist the athlete in preparing physically and mentally for the future event. For the recreational athlete or novice to the mountain environment, the physician can play a role in implementing a well-rounded training program, which should include mastering the technical skills required for the event. For example, a triathlete with ambitions to participate in a high-altitude adventure race in mountainous terrain should be encouraged