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CONCEPTS

Concussion Management in the Wilderness

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Head trauma accounts for a significant number of injuries in the wilderness setting. Concussions are possible sequelae of falls or encounters with unforeseen obstacles. Although not immediately life-threatening, concussions can be a source of significant short- and long-term morbidity. Diagnosis of a concussion in the wilderness may be challenging as symptoms can often be confused with other conditions, such as altitude illness and hyponatremia. Successful management depends on accurate diagnosis and determination of the severity of symptoms so that appropriate decisions regarding treatment and need for evacuation can be made.

Key words: concussion, head injury, wilderness

Introduction

On playing fields across the country, athletic trainers and team physicians treat athletes who have suffered concussions. It is an entity whose management has changed dramatically during the last decade. Even with the new changes in management and in the relatively controlled environment of the athletic arena, concussions present a significant challenge to healthcare providers as it is an entity that can be difficult to diagnose and challenging to treat in a patient population that is driven and goal-oriented. But what happens when a concussion is sustained in the wilderness? With the unforeseen obstacles and dangers present in the austere environment, the potential for one to suffer a concussion is high and the ability to manage a concussion is ever more challenging given limited resources and distance from definitive care.

A concussion is a brain injury, a disturbance in brain function induced by traumatic forces, either from a direct blow to the head or a transmitted force from a blow to the body.[1,2] Traumatic forces induce a neurometabolic cascade of events, starting with a disruption of neuronal cell membranes, efflux of potassium ions, and widespread neurotransmitter release, leading to more potassium efflux. To restore homeostasis, membrane ionic pumps are activated, consuming ATP and leading to hyperglycolysis to keep up with energy production. Energy depletion and resulting glucose hypometabolism follow within 6 hours of the injury. Concurrently, trauma-induced *N*-methyl-D-aspartate (NMDA) channel activation results in calcium ion accumulation in the mitochondria, causing glucose oxidative dysfunction. This combination of glucose hypometabolism and impaired oxidative metabolism contributes to the symptoms of concussion, and may last from 5 to 10 days.[3]

If properly managed, those who experience a concussion will recover completely without long-term sequelae. Improperly managed or unrecognized concussions may lead to prolonged physical and psychological symptoms. The wilderness setting is often remote, with limited supplies, weather and climate factors, and a potential lack of shelter, time to rescue or evacuation challenges, and innate topographical and geographical circumstances that are not necessarily stable and controllable as in an urban setting. Wilderness sport participation may take place as sanctioned wilderness races or sporting events with medical tents and trained personnel, or they may be individual recreational events or commercially guided trips or expeditions with little ability for intervention if an injury or emergency takes place. As such, wilderness practitioners must be prepared to recognize and manage concussion in a variety of settings. In an extensive review of the literature, we found few or no articles on concussion management for the wilderness environment. The aim of this review is to

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introduce the topic of concussion and discuss its management as it pertains to wilderness areas.

Epidemiology

Among the athletic population, the incidence of concussion is estimated to be 1.6 to 3.8 million annually.[1,4] In the wilderness setting, the incidence is not as clear. Overall occurrence of injury has been reported to be low.[5–13] In studies that examined injury and illness among national park visitors, head injury in the wilderness has been reported to comprise 3.3% to 34.8% of all injuries sustained.[5,6,10–13] Among students in the National Outdoor Leadership School (NOLS), head injuries are responsible for between 2.0% and 4.1% of all injuries.[7–9] Reports of injuries involving mountain and wilderness sports list an incidence of 6% to 29% of all injuries.[4,14,15] However, many of these studies grouped concussion with other types of head injuries, making it difficult to determine a true prevalence. Studies that looked at specific activities suggest that concussions account for 6.5% of injuries from outdoor activities presenting to emergency departments,[6] 1.2% of injuries occurring in mountain bike racers,[15] 9.6% of all injuries in skiers,[4] 14.7% of all injuries in snowboarders,[4] and 5.7% of all injuries in snowbladers.[4] It is difficult to obtain a true incidence of concussion in the wilderness because recognition can often be difficult and many do not seek medical attention until returning home. Previous outdated definitions and grading systems may have also led to inaccurate or absent reporting of concussions in previous injury incidence studies.

Evaluation

Whether in a controlled setting or a remote austere environment, the recognition and initial evaluation of concussion is the same. After head trauma, one must first evaluate for life-threatening injury. The ABCs (airway, breathing, circulation) should be assessed, and the patient should be evaluated for cervical spine injury and skull fracture and treated per ATLS (Advanced Trauma Life Support) guidelines. Complaints of neck pain, limited range of motion, significant spinal tenderness, or numbness or tingling in the extremities should prompt concern for a cervical spine injury. The unconscious patient should also arouse suspicion for a much more serious affliction. If a cervical spine injury or skull fracture is suspected, the patient should be stabilized and transported according to the Wilderness Medical Society guidelines for spine immobilization.[16] Once these conditions have been reasonably ruled out, the neurocognitive evaluation can proceed. Several concussion tools are available, including the SAC (Standardized Assessment of Concussion) and the SCAT-3 (Sideline Concussion Assessment Tool 3).[1,2] Although these tools are used frequently on the sidelines during athletic competition, their inclusion in preparations for wilderness excursions may not be practical.

SYMPTOMS

Initial steps in evaluating a concussion include recognition of and questioning about the presence of symptoms. Headache is the most common presenting symptom of a concussion.[1] The patient may also complain of dizziness, balance disturbance, or disorientation. Photophobia, phonophobia, amnesia, and nausea may be present as well. Loss of consciousness, once considered necessary for the diagnosis of concussion, occurs infrequently and, unless prolonged (>1 minute), is not indicative of the severity of the injury.[1,17] Many patients also report temperament changes or emotional lability or may complain of a feeling of fogginess and an inability to focus or concentrate. Family members, friends, and other associates may also note personality changes. Patients may have one or any number of the symptoms listed above, and the number or severity of symptoms may not correlate to injury severity or length of time to recovery[1,2]

ORIENTATION

It is well documented that the standard orientation questions of person, place, and time have been shown to be unreliable in an athletic situation when compared with other memory assessments.[2] Maddocks et al[18] developed a series of questions relevant to the sport that are more reliable in determining an athlete's orientation. These questions can be modified to reflect the wilderness setting (Table 1). Attention should also be paid to how quickly the patient responds. A failure to correctly answer these questions or taking longer to answer than expected may indicate that the patient has suffered a concussion.[17,18]

EXAMINATION

The examiner should perform a physical examination, focusing on the neurological examination and balance. Cranial nerves should be assessed, with any focal neurologic signs signaling a discrete intracranial lesion.[1] Pupils may be sluggish to react to light but should be equal bilaterally. Unequal pupils may also indicate a discrete lesion.[1] Attention should be paid to the individual with unequal pupil sizes at baseline. Balance may be assessed using the Romberg test or by observing