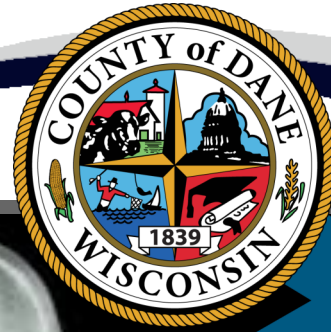


Dane County EMS

Monthly Newsletter

ISSUE 05 August 2018



Concussion In Children

Concussion is a traumatic brain injury after a mechanical force. Based on human studies and animal models, concussions are believed to be caused by a rapid rotational acceleration on the brain, typically triggered by a blow to the head. This rotational force is hypothesized to cause a shear strain on the underlying neural elements, causing inappropriate mass depolarization of neurons. In order to return to normal, these neurons use large amounts of ATP which causes the buildup lactic acid in the CSF. This is compounded by the decreased cerebral blood flow that follows for a period of days to weeks after concussion, leading to a supply-demand mismatch for glucose and ATP, the primary fuel for the brain. Although there is no structural damage to the brain, the accumulation of lactic acid with decreased ability to clear it and bring in more energy for neurons is believed to cause the cognitive dysfunction and symptoms of concussion.

Among surveyed United States middle school and high school children, the self-reported prevalence of concussion is approximately 20%¹. The CDC reports that as many as 3.8 million sport-related traumatic brain

injuries occur annually²; this accounts for approximately 4-10%³ of all sports related injuries from the middle school through college athlete. The risk of concussion is highest among boys who play collision sports such as rugby, American football, ice hockey and lacrosse. Among girls, the risk is highest in soccer, lacrosse and field hockey. Other recreational activities that commonly cause concussion in both genders are bicycle riding, skate boarding, ice skating and skiing.

Any potential sign of concussion soon after a rotational head trauma during a sporting event should lead to prompt removal of the child from competition and further sideline evaluation. Some of the clinical manifestations of concussion include:

- Headache
- Confusion or disorientation
- Difficulty with memory
- Blank stare or "stunned" appearance
- Inattentiveness
- Slow or incoherent speech
- Dizziness
- Gait abnormality or imbalance
- Vomiting
- Emotional Lability

As part of an effort to improve communications and keep everyone "in the loop" on current and trending topics in out-of-hospital care, we have decided to update and enhance the monthly Dane County EMS Newsletter. We hope to integrate topics from the Dane County EMS Commission, Medical Advisory Subcommittee along with current topics of interest, distill them down to a quick reference and then distribute to all County EMS Personnel. Please send us any feedback you may have, as we want this to be useful for you, and help make your job as efficient as possible.

With fall just around the corner and Packer season already upon us, this month we have decided to discuss concussion in adolescents and student athletes.

CONCUSSION IN CHILDREN - CONT.

There are several standardized assessment tools available, including the Standardized Assessment of Concussion (SAC), the Balance Error Scoring System (BESS) and the Sport Concussion Assessment Tool v. 5 (SCAT5). These tools are rarely performed in the Emergency Department and, even if performed, do not necessarily rule out intracranial injury even if results are normal. An example of the SCAT5 can be viewed here: <https://rothmanconcussion.com/files/docs/SCAT5.pdf>

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Patients who are being evaluated by EMS and in the Emergency Department after concussion are typically referred because of concern for conditions other than just concussion; primarily cervical spine injury, intracranial hemorrhage or skull fracture. In addition to assessing them for multiple injuries, it is important that the cervical spines of these athletes be immobilized until dedicated evaluation can be performed.

Clinical exam findings can help categorize children and adolescents into risk categories for intracranial injury, which help guide the decisions around emergent neuroimaging.

- High Risk – any of the following warrant Emergency Department transport and prompt imaging, even if well appearing:
 - Focal neurologic deficits
 - Skull fracture, especially basilar skull fracture (look for Battle Sign, Raccoon Eyes)
 - Seizure
 - Persistent altered mental status
 - Prolonged loss of consciousness (not strictly defined, but generally >5 minutes)
- Moderate Risk – Patients with headache, vomiting, questionable or brief LOC or injury caused by high-risk mechanism should be observed closely to monitor symptoms. This monitoring may occur in the Emergency Department or on the sidelines by Athletic Trainers familiar with concussion management. Any worsening should warrant neuroimaging
- Low Risk – Patients without LOC, normal mental status, no clinical signs of skull fracture, no vomiting, no concerning exam findings or headache that is improving (even if given Tylenol or ibuprofen) should be observed for changes in status, but generally do not warrant emergent imaging.

The manifestations of concussion can be obvious or they may be subtle. When subtle, the diagnosis can be very challenging. Many athletes may be unaware of the symptoms and potential seriousness of concussions, and may disguise or hide their symptoms from medical personnel. It is important to identify concussions in order to prevent serious brain injury and not allow patients, parents or coaches to minimize the diagnosis. Standardized assessments can often convince the parent, the player and the coaches that a concussion has occurred; these assessments should be followed closely and used to guide the decisions for emergency treatment, close follow up, return to school and return to sport recommendations.

The typical recovery time from a concussion is generally in the range of 14-21 days. A significant minority of athletes can have recoveries that exceed this typical time range; in those children and adolescents, lingering symptoms of concussion should warrant consideration of alternative diagnoses and potential comorbidities.

If you have any additional questions, please do not hesitate to contact me at mtlohmei@medicine.wisc.edu, or the Dane County EMS Office at 608-266-5374.

¹ Prevalence of Concussion Among US Adolescents and Correlated Factors. Veliz P, McCabe SE, Eckner JT, Schulenberg JE; JAMA. 2017;318(12):1180.

² Nonfatal traumatic brain injuries from sports and recreation activities--United States, 2001-2005. Centers for Disease Control and Prevention (CDC); MMWR Morb Mortal Wkly Rep. 2007 Jul;56(29):733-7.

³ Incidence of Concussion During Practice and Games in Youth, High School, and Collegiate American Football Players. Dompier TP, Kerr ZY, Marshall SW, Hainline B, Snook EM, Hayden R, Simon JE; JAMA Pediatr. 2015 Jul;169(7):659-65.

⁴ The Neurometabolic Cascade of Concussion. Giza CC, Hovda DA; J Athl Train. 2001;36(3):228.

⁵ www.uptodate.com "Concussion In Children and Adolescents: Clinical Manifestations and Diagnosis", "Sideline Evaluation of Concussion", "Concussion in Children and Adolescents: Management"