PedsCases Podcast Scripts

This is a text version of a podcast from Pedscases.com on "**Sport Related Concussion.**" These podcasts are designed to give medical students an overview of key topics in pediatrics. The audio versions are accessible on iTunes or at www.pedcases.com/podcasts.

Sport Related Concussion

Developed by Adam Neufeld, Brendan Lee, and Dr. Ahmed Alterkait for PedsCases.com.
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Introduction:

"Hello and welcome to the first of two PedsCases podcasts on concussions. In part 2 of this series, we'll be covering post-concussive syndrome. My name is Brendan Lee and my colleague's is Adam Neufeld. Together, we would like to thank our supervisor for this podcast, Dr. Ahmed Alterkait -- a pediatric emergency physician at the University of Saskatchewan.

In this first podcast, we'll be addressing the most pertinent concepts surrounding pediatric concussions to help you learn this important topic, which you're likely to encounter in your practice. We will be focusing on sport related concussion. The objectives include:

Objectives:

1. Understand concussion epidemiology
2. Basic concussion pathophysiology
3. Recognize how concussion patients present clinically
4. How to diagnose a concussion
5. Evaluation and management of concussion
6. Key points

However, before we jump into the objectives, let's start with a case, first.

Case Study:

A 16-year-old male named Chris presents to the emergency department after a head to head hit in a high school football game. Immediately following the hit, he did not lose consciousness, but was disoriented, dizzy, and had loss of balance when he was brought to the sideline. When the trainer asked him several questions, he could answer correctly what day of the week it was and how many fingers they were holding up. He

was not able to answer how he got to the game. Chris was immediately brought to the emergency department. Once in the emergency department he is less dizzy and disoriented but is feeling "in a fog" and cannot recall what happened before he got hit. He is stable and no structural injury is suspected. Chris has not suffered any previous concussions. His general and neurological exam are both normal.

Now, with this case and presentation in mind, let's move into the objectives of the podcast, starting with the epidemiology.

1. Concussion Epidemiology:

There is increasing awareness amongst the scientific community and general public that sport related concussion is a serious health care issue with potentially devastating long term effects [1]. Concussion is a very common injury amongst children participating in sport and recreational activity [2]. A Canadian head injury study found that 53% of head injuries in children from the ages of 10-14 were sport-related [3]. In the United States, 175,000 children and adolescents are treated annually for sports related head injuries [2]. Concussions are most common amongst athletes participating in contact sports, such as football and hockey. Concussion is also common in non-sport related head trauma such as motor vehicle accidents. The signs and symptoms of concussion can often be subtle and go unnoticed by both athletes, coaches, trainers, and even healthcare professionals [2].

The next objective is the pathophysiology of concussion. There is still very little known about the pathophysiology of concussion and is a large area of research today. It is a very complex topic that we've tried to simplify for a good general understanding.

2. Concussion Pathophysiology:

The Concussion in Sport Group defines concussion as "a complex pathophysiological process affecting the brain, induced by biomechanical forces", resulting in "the rapid onset of short-lived impairment of neurological function that resolves spontaneously [4]." Concussions are also referred to as mild traumatic brain injury (MTBI), where all concussions are MTBI's but not all MTBI's are concussions.

Concussions occur due to a direct impact to the head, face, neck or other area of the body that transmits linear and/or rotational force to the brain [5]. There is no current known biochemical threshold for a clinical concussion [5]. The 'neuro metabolic cascade' underlying a concussive injury is a complex cascade of ionic, metabolic, and pathophysiological events that is accompanied by microscopic axonal injury [5]. Disruption of metabolism and ionic balance requires energy to re-establish homeostasis [5]. However, the increased energy requirement occurs in the presence of decreased cerebral blood flow and mitochondrial dysfunction, resulting in an imbalance between energy supply and demand [6]. If normal cellular brain function is not restored, a second injury before recovery results in worsening metabolic changes and more significant

cognitive deficits [6]. Excessive cognitive and/or physical activity can further cause prolonged dysfunction [5]. Concussion associated pathophysiological perturbations can be more pronounced in youth, causing concern that the immature brain may be more susceptible to repeat concussions before complete recovery [5].

Now, with an idea of the pathophysiology of concussion and mild traumatic brain injury, let's dive into how it presents clinically and how symptoms are assessed.

3. Concussion Presentation:

There are many different signs and symptoms that patients will present with following a concussion. Patients typically present following a direct hit to the head. Signs and symptoms can develop within minutes to hours or can present days following the injury [2]. A concussion patient may be fully conscious, aware, and initially asymptomatic, only to develop common symptoms such as headache, dizziness, and cognitive symptoms with the progression of time [1]. Symptoms typically resolve within seven-ten days, although in some individuals, symptoms can persist for weeks to months [1].

The Canadian Pediatrics Society breaks down symptoms into physical, behavioural, cognitive, and sleep disturbances:

Physical symptoms include: headache, vomiting, dizziness, visual disturbances, photophobia, phonophobia, loss of consciousness, amnesia, loss of balance or poor coordination, decreased playing ability.

Behavioural changes include: irritability, emotional lability, sadness, anxiety, and inappropriate emotions

Cognitive impairment includes: slow reaction times, difficulty concentration, difficulty remembering, confusion, feeling in a fog, feeling dazed.

Sleep disturbance includes: drowsiness, trouble falling asleep, sleeping more than normal, sleeping less than usual.

Each concussion may produce different signs and symptoms for different patients or even the same patient [1]. The variable combination of biomechanical forces, biochemical processes, and possibly psychosocial vulnerabilities of each individual contribute to different presentations and outcomes for each patient [1].

So... you've got a patient presenting with what you think might be a concussion. They've got some of the signs and symptoms discussed, and you want to make the diagnosis. How exactly is a diagnosis formed?

4. Diagnosis of Concussion:

Concussion is a syndromal diagnosis that does not have a reliable hallmark indicator [1]. Diagnosis is based on various somatic, psychological, and cognitive symptoms of significant clinical concern that usually involve head trauma - such as the common symptoms just discussed [1]. Making a diagnosis can be difficult due to a variety of reasons, including: there is no hard evidence of injury, the neurological examination is usually normal, and if selected MRI and CT are usually negative [1]. The diagnosis is therefore based on the clinical judgment of the physician in conjunction with the causative event and presenting symptoms.

Now that diagnosis is covered, consider a more acute or emergent situation, in which a patient presents to the ED. You don't have the luxury of knowing this patient and must rely on your evaluation and assessment ability to elicit all the information you need. Let's talk evaluation and management.

5. Evaluation and management of concussion:

According to current CPS guidelines, in any patient presenting to the emergency department with head trauma, the Glasgow Coma Scale (GCS) can be used to classify the severity [7]. General assessment and stabilization including airway, breathing, circulation, disability, and exposures should be conducted. Cervical spine injury should be considered and neutral neck position maintained [7]. Further, all patients presenting with moderate or severe head trauma should receive a cranial CT scan [7].

Until recently, the Canadian Assessment of Tomography for Childhood Head Injury (The Catch Rule) [8]would have been the go-to criteria for when to order a CT of the head for children with a minor head injury plus one of the following findings:

High Risk

1. GCS <15 at 2h after injury
2. Suspected open or depressed skull
3. History of worsening headache
4. Irritability on examination

Medium Risk

1. Any sign of basal skull fracture
2. Large boggy hematoma of the scalp
3. Dangerous mechanism of injury (e.g. MVA)

More recently, however, the CATCH rule has been re-validated and updated, based on the PECARN criteria [9] (Pediatric Emergency Care Applied Research Network). It has been validated and was done on a large sample. In this newly validated tool, they include the following criteria, based on children younger than 2 years, or older than 2 years:

The prediction rule for children younger than 2 years (normal mental status, no scalp haematoma except frontal, no loss of consciousness or loss of consciousness for less

than 5 sec, non-severe injury mechanism, no palpable skull fracture, and acting normally according to the parents) had a negative predictive value for ciTBI of 1176/1176 (100·0%, 95% CI 99·7–100·0) and sensitivity of 25/25 (100%, 86·3–100·0).

The prediction rule for children aged 2 years and older (normal mental status, no loss of consciousness, no vomiting, non-severe injury mechanism, no signs of basilar skull fracture, and no severe headache) had a negative predictive value of 3798/3800 (99·95%, 99·81–99·99) and sensitivity of 61/63 (96·8%, 89·0–99·6).

Once the patient is stabilized, vitals are taken, and all other serious injury associated with head trauma are ruled out, a thorough history, general exam, and neurological exam should be conducted. A detailed history should include: previous head and facial injuries, history of headaches or migraines in patient and family, mental health issues, sleeping problems, and learning disabilities [2]. The Sport Concussion Assessment Tool (SCAT) is a common tool used to evaluate concussion athletes [2]. The tool allows for brief neuropsychological assessment of attention, concentration and memory and can be performed on the field and in office. Concussion is a functional brain injury and is rare to result in structural changes on neuroimaging [2]. Therefore, routine structure neuroimaging is NOT recommended unless structural injury, in the form of focal neurological deficit, seizure activity, or prolonged unconsciousness is suspected [2].

Any individual that experiences a head injury during sport or recreational activity should be immediately removed from the game or practice. If in doubt, sit them out! If there is loss of consciousness during the injury, a cervical spine injury should be suspected and the appropriate precautions should be taken (i.e. collar and board, ambulance transfer), including airway, breathing, and circulation [2].

A conscious athlete should be closely observed following head trauma by a responsible adult for any signs of deterioration and should be evaluated medically as soon as possible in order to confirm a diagnosis of concussion [2]. Once evaluated by a physician, the patient should be closely monitored for 24 to 48 hours for any signs of deterioration (e.g. severe headache, persistent vomiting, seizure) [2]. Any signs of deterioration require immediate emergency department evaluation.

Cognitive and physical rest is the most important management of concussion [4]. Following a concussion, sports and recreational activities should be avoided. Cognitive rest includes limiting activities that cause mental exertion such a reading, texting, watching television, computer work, and school [2]. A specific plan should be discussed with the patient's family physician to take time away from such activities and re-evaluate regularly to initiate a return to play/return to learn plan. As symptoms begin to improve, individuals can gradually increase activity provided symptoms are not worsened [2].

Individuals should never return to sport or recreational activity until they are completely symptom free and have been medically cleared [4]. Return to play decisions for concussion patients can be difficult and controversial. Expert opinion is that return to

play should be conservative, cautious, and individualized [2]. A neuropsychological assessment can be helpful in developing individualized return to play/learn plans. Concussion education is important for everyone involved in childhood sport and recreational activities, including coaches, parents, trainers, officials, trainers, athletes, and health care professionals [2]. For a great resource for parents, teachers, and healthcare providers, visit www.parachutecanada.org, which includes a concussion section that provides PDF's detailing return to learn and return to sport instructions. They also designed an app "Concussion Ed" that contains all this info.

Although most patients recover within several weeks, some patients experience post-concussion symptoms for weeks, months, or even years following an injury. Once a patient has been experiencing symptoms for 3 months, they are diagnosed with post-concussion syndrome. To learn more about the topic of post-concussion syndrome, stay tuned for our next podcast on this two-part series on concussion!

Okay, so that's a lot of information to remember in one sweep. Let's put it all together and give you the big takeaway points.

6. Key Learning Points:

1. In terms of epidemiology, concussions in the pediatric population are very common, especially after sports injuries and MVA's. Signs & symptoms of MTBI can often be subtle and go unnoticed, so thorough assessment is warranted with any suspicion on the part of the athlete, coach, trainer, and healthcare practitioner. "When in doubt, sit them out!"
2. As for pathophysiology, concussions occur from direct impact not just to the head, but to the face, neck, or even other bodily areas, provided they transmit linear and/or rotational force to the brain.
3. Athletes are eager to get back to sport, but inadequate time off to recover can be detrimental, as premature return to sport has been associated with secondary brain injuries, and often progression of cognitive deficits, due to worsening metabolic supply and demand changes.
4. Most concussion patients recover within 7-10 days. In some patients, symptoms can persist for weeks to months. When symptoms last for 3 months a patient is diagnosed with post-concussion syndrome.
5. In terms of symptomology, the CPS breaks it down into 4 main categories: physical, behavioural, cognitive, and sleep disturbances.
    a. Physical signs/symptoms include HA, N/V, dizziness, visual disturbance, photo- and phonophobia, LOC, balance and coordination issues, and decreased playing ability.
    b. Behavioural signs/symptoms includes irritability, emotional disturbance, sadness, and/or anxiety.
    c. Cognitive signs/symptoms include slowed reaction time, trouble concentrating or remembering, confusion, brain fog, or feeling dazed.

   d. Lastly, sleep signs/symptoms include drowsiness, insomnia, and sleeping more/less, compared to usual.
6. The diagnosis of concussion can often be difficult, as a neurological exam and imaging results are often normal. It is therefore a clinical judgment, based on the history and presentation.
7. For evaluation & management of acute head injury, a primary & secondary survey including GCS should be done to assess the ABCDE's. This includes checking the C-spine, especially if LOC occurred.
8. General consensus for best concussion management practice is physical and cognitive rest. Therefore, return to sport and play should be conservative, cautious, and individualized. Medical clearance is required.

Conclusion:

Well, that's it for our PedsCases podcast on pediatric concussions. We hope that it benefits your learning! Stay tuned for the 2nd podcast in this two-part series, on post-concussive syndrome. Thanks for listening!"

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