A REVIEW OF CONCUSSION RECOGNITION, ASSESSMENT AND MANAGEMENT FOR PARAMEDICS

Authors

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Introduction

A concussion (orig. Latin: concutere, "to shake violently") is a clinical diagnosis of a biomechanically-induced alteration in brain function. This impairment is usually reversible and often affects memory, orientation, and attention. It may or may not cause a loss of consciousness and does not show evidence of brain damage on computed tomography (CT) or magnetic resonance imaging (MRI) scans.(1,2)

The internationally accepted consensus definition of concussion incorporates several criteria.(3)

1. Concussion may be caused by a direct blow to the head, face, neck, or elsewhere on the body with an "impulsive" force transmitted to the head.
2. Concussion typically results in the rapid onset of short-lived impairment of neurologic function that resolves spontaneously. However, in some cases, symptoms and signs may evolve over a number of minutes to hours.
3. Concussion may result in neuro-pathological changes, but the acute clinical symptoms largely reflect a functional disturbance rather than a structural injury, and as such, no abnormality is seen on standard structural neuroimaging studies.
4. Concussion results in a graded set of clinical symptoms that may or may not involve loss of consciousness. Resolution of the clinical and cognitive symptoms typically follows a sequential course. However, it is important to note that in some cases symptoms may be prolonged.

Although paramedics are trained in the recognition and management of traumatic brain injuries, the management of the patient with a concussion is a clinical presentation that may not be addressed in sufficient detail within paramedic education, and paramedics may be unaware of the latest evidence-based concussion treatment guidelines and recommendations. While life-support measures are rarely required in concussion injuries, it would be prudent for paramedics to familiarise themselves with this evolving area of concern in medicine. This brief overview aims to address these potential issues.

Epidemiology

The incidence and prevalence of concussions is felt to be largely underreported with some estimates in the United States quoting up to 3.8 million per year. Even more difficult to quantify is the number of individuals suffering long-term sequelae of concussion, with up to 36% of patients reporting repeat concussions thereby placing them at higher risk for permanent injury.(4)

High-risk activities

Concussions are most often associated with sports and most research has investigated the concussion risk associated with individual sports. Risk differs depending on the sex of the

athlete, with the highest risk sports for males being football, rugby, ice hockey, and wrestling and the highest risk for females being soccer and basketball. Unfortunately, sports which intuitively run a high risk of concussion such as boxing and mixed martial arts do not have sufficient available data but are generally felt to be within the high risk category.(4)

Outside of the sports arena, most concussions are recognized through motor vehicle collisions (MVC), pedestrian struck, or major trauma due to the direct force mechanism of injury (MOI); however, impulsive forces and coup-contrecoup injuries should also be considered. MVCs, pedestrians struck and many sports carry the potential for individuals to experience injuries that may not present as head trauma but run the risk of causing concussion due to transfer forces throughout the body. A hard hit to the body during a football game, running into a hard screen during basketball practice, taking a tumble over the handlebars of a bike, or landing hard on the floor after slipping in the shower all pose risk for concussion but often go unrecognized due to the lack of direct trauma to the head.

Considering the MOI and identifying any potential impulsive forces should be a top priority for paramedics when assessing for potential brain injuries and concussion.

Pathophysiology

As noted, the clinical features of a concussion syndrome imply a biomechanically-induced alteration in brain function. There are multiple ways in which this alteration occurs, involving direct mechanical forces as well as ionic changes and distortions in cerebral blood flow. Ionic changes occur after mechanical forces alter cellular membranes, ultimately leading to release of excitatory neurotransmitter and depletion of energy stores. At the same time, blood flow in the area decreases, thereby worsening the poor metabolic state of the affected neurons.(4)

Recognition

Any new neurological symptom following a head trauma should be considered a concussion until proven otherwise, including headache, dizziness, confusion, incoordination and nausea.(4) It is important to note that symptoms may arise minutes to hours after the trauma has occurred so a high level of suspicion should be maintained and reassessment should be regularly performed.(1) Concussion should be seen as an evolving injury in the acute stage. A post-concussion syndrome is also recognized where patients can have similar symptoms lasting for weeks to months.

In March 2013, the American Academy of Neurology (AAN) issued an updated guideline on concussion evaluation and management, based on current evidence. Within this guideline, the AAN provided several Level B recommendations. These include using standardized assessment tools as an adjunct to evaluation of suspected concussion, in combination with history and physical assessment. Additionally, team personnel (such as coaches or trainers) should immediately remove any player suspected of having a concussion from play and should not permit return to play until a full assessment has been made. Finally, the athlete with a concussion diagnosis should be prohibited from returning to play or practice until a physician has judged the concussion to have resolved and the player is asymptomatic and off medications.(5)

Further Assessment

The authors of the AAN Guidelines also evaluated multiple studies on various concussion assessment tools. The Post-concussion Symptom Scale (graded symptom checklist) had a sensitivity of 64-89% and specificity of 91-100% in identifying a concussion in athletes, following an injury.(5)

The Standardized Assessment of Concussion (SAC) test (which comprises an assessment of orientation, memory, concentration and delayed recall) had a sensitivity of 80-94% and a specificity of 76-91% in identifying a concussion. Neuropsychological testing had a sensitivity of 71-88% in identifying a concussion in adolescents to adults, with insufficient evidence to support use in pre-adolescent age groups.(5)

The Balance Error Scoring System (BESS), which measures postural stability, when used alone, had a sensitivity of 34-64% and a specificity of 91% in identifying a concussion, while the Sensory Organization Test (SOT), used alone, had a sensitivity of 48-61% and specificity of 85-90%. Although in practice these tools are often used in combination, there was insufficient evidence found to determine which combinations are most effective.(5)

The Sport Concussion Assessment Tool, 3rd edition (SCAT-3) combines many aspects of these assessment tools (SAC, BESS), along with the Glasgow Coma Scale, key features of the history, and physical exam findings. The SCAT-3 is commonly used in side-line assessment and is often the first set of baseline information obtained. It is generally accepted that no single tool used alone will be sufficient, and combinations of the above screening and assessment tools are commonly used. (5) It is important to note that although these tests provide information post trauma, they should be compared to a pre-trauma baseline to identify any areas of discrepancy especially during recovery.

A note on sensitivity and specificity

Sensitivity, also known as the "true positive rate", in this case measures the percentage of 'sick' people who are correctly identified as having a concussion. Specificity, also known as the "true negative rate" measures the percentage of 'healthy' people who are correctly identified as not having a concussion.

Ideally, a test will be both highly sensitive and highly specific to ensure there are minimal false positives (someone without a concussion incorrectly identified as having one) and minimal false negatives (someone with a concussion incorrectly identified as not having one).

Emergency Management

Red flag symptoms listed below suggest injury which may be more than a concussion. (1) In these circumstances, paramedics should ensure immediate management of airway, breathing and circulation, and expedite transport to the nearest neurosurgical capable facility if possible.

- Prolonged loss of consciousness (generally defined as > 1 minute)
- Clinical concern of c-spine injury (based on history and/or physical exam)
- High risk for intracranial bleeding (based on history of high velocity injury or fall from height)
- Concern for skull fracture
- Post-trauma seizure
- Significant worsening of symptoms, with special emphasis on persistent nausea & vomiting, focal neurologic deficits, somnolence, slurred speech, difficulty walking, and worsening mental status.

Post-concussion management

The single most important management step, as reflected in the AAN guidelines, is removing a player with a suspected concussion from activity immediately. A second injury can cause more severe neurological deficits which may result in lasting injury.(1,2) Neurocognitive rest is usually recommended for the first 24-72 hours following injury, to allow the brain's metabolic processes to return to normal function (although those with only mild symptoms may potentially return to school after 24 hours).

Despite a lack of studies comparing different methods of neurocognitive rest, a conservative approach is generally adopted, advising no school or work, television, music, computer, phone, or physical activity.(1) The majority (80%

to 90%) of concussions resolve in a short (7–10 day) period, although the recovery timeframe may be longer in children and adolescents.(6)

Long-term consequences

The concern surrounding repeated concussions has been elevated in recent years with increasing recognition of the long-term sequelae of concussion, from chronic post-concussive symptoms to a neurodegenerative dementia, referred to as chronic traumatic encephalopathy (CTE). Although the majority of patients find their symptoms resolve within weeks to months, it is concerning to note that up to 15% of the general population (i.e. non-athletes) may continue to have symptoms longer than one year after a single concussion.

After repeated concussions, CTE can occur, with the insidious onset of behavioural and cognitive dysfunction as well as various effects on motor function and coordination. Similar to other types of dementia, CTE is not reversible and there are no effective treatments.(7) As a result, prevention of CTE is of primary concern when managing a concussion patient - prevention of return to play, and appropriate rest as described above are key in the prevention of long-term sequelae. cP

- For a free online education resource on concussion management in rugby, visit http://www.irbplayerwelfare.com/concussion
- A copy of the SCAT-3 can be found here: http://bjsm.bmj.com/content/47/5/259.full.pdf

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