

Sports-Related Concussion

See also Concussion

See also Injury Grading Scales

See also Blunt Head Trauma: Minor

Background

1. Definition

- Guidelines revised in 2004 at Second International Symposium on Concussion in Sport, Prague Czech Republic
- "Concussion is defined as a complex pathophysiological process affecting brain, induced by traumatic biomechanical forces."
 - Caused either by direct blow to head, face, neck, or elsewhere on body w/an "impulsive" force transmitted to head
 - Typically results in rapid onset of short-lived neurologic impairment (see below) that resolves spontaneously
 - May result in neuropathological changes, but defined by functional disturbance rather than a structural injury
 - May or may not involve LOC
 - Resolution typically follows a sequential course

2. General information

- American Medical Society for Sports Medicine
 - <http://www.newamssm.org/Public.html>
- CDC Heads Up Concussion in High School Sports
 - http://www.cdc.gov/ncipc/tbi/Coaches_Tool_Kit.htm
- ThinkFirst Canada Concussion Education
 - www.thinkfirst.ca

Pathophysiology

1. Pathology of dz

- Definitive pathophysiological responses not well understood
- In experimental models
 - After impact a complex biochemical and metabolic response occurs
 - May last up to 2-4 wks
- This prolonged recovery leaves athlete particularly vulnerable to further brain injury
- Cognitive deficiencies can be monitored via neuropsychological testing

2. Incidence/ prevalence

- Approximately 1.4 million traumatic brain injuries annually in U.S.
 - Most are mild
- Reportedly 300,000 sports-related concussions annually in U.S.
 - 62,816 in high school athletes
 - Two-thirds of all sports-related concussions occur in football
 - Collision sports have higher incidence
- M:F ratio of 2.8:1

3. Risk factors

- High school football players most at risk d/t large numbers that participate annually
- Unclear whether a hx of concussions predisposes to future concussions

- During recovery, a sports-related concussion may occur w/less impact force required
- 4. Morbidity/ mortality
 - Long-term complications incl
 - Post-concussion syndrome
 - Prolonged neurocognitive symptoms incl HA, dizziness, affective symptoms, and cognitive impairment
 - Symptoms generally improve within few months, may last indefinitely
 - Second impact syndrome
 - Rare but potentially fatal complication of sports-related concussion
 - Defined as death from herniation after sustaining a second concussion within a short time from first injury
 - New thinking places this at extreme end of post-concussion syndrome
 - To date, there are only 17 reported cases of death from second impact syndrome
 - Post-traumatic epilepsy
 - Rare complication
 - Post-traumatic vertigo
 - Thought to result from vestibulocochlear injury or trauma induced benign paroxysmal positional vertigo
 - Cranial nerve injuries
 - Cumulative neuropsychological impairment
 - Also called dementia pugilistica in boxing, is defined as chronic neuropsychological impairments experienced after repeated concussions
 - Not well understood

Diagnosics

1. History

- Symptoms most common immediately after injury
 - May not develop until several hrs later
 - If any symptoms are experienced after impact, head injury should be suspected and eval should be completed immediately and before athlete returns to game or practice
- Symptoms
 - Cognitive
 - Unaware of game details, confusion, amnesia, possibly LOC
 - Typical symptoms
 - HA or head pressure (86% of athletes)
 - Balance difficulty or dizziness
 - Nausea
 - "Dinged", "stunned", "foggy" or "dazed"
 - Visual problems
 - Tinnitus
 - Irritable or other emotional changes
 - Feeling of slowness or fatigue

- Atypical symptoms
 - Neck pain or cervical spine tenderness should raise suspicion of a spinal injury and mandates immobilization and eval w/X-rays or other Dxs
 - Global amnesia and cortical blindness
 - May be caused by trauma-induced vascular hyper-reactivity

2. Physical exam

- Signs
 - LOC or impaired conscious state
 - Poor coordination or balance
 - Concussive convulsion/ impact seizure
 - <5% of mild head injuries
 - 50% occur in first 24 hrs
 - Earlier onset more often generalized seizure
 - Benign and not representative of severe injury if occur at time of impact
 - Gait unsteadiness/ loss of balance
 - Slow to answer questions or follow directions
 - Easily distracted, poor concentration
 - Displaying inappropriate emotions
 - Vomiting
 - Vacant stare/ glassy eyed
 - Slurred speech
 - Personality changes
 - Inappropriate playing behavior
 - Heading to wrong sideline or huddle
 - Running in wrong direction
 - Significantly decr playing ability
- Athlete should be monitored after injury for
 - Decline in mental status
 - Development of delayed symptoms
 - Focal neurologic deficits
- Pt should return for
 - Decr arousal or inability to awaken
 - Worsening symptoms
 - Confusion or altered mental status
 - Seizures
 - Vomiting, stiff neck, neck pain
 - Incontinence
 - Weakness or numbness

3. Diagnostic testing

- Sport Concussion Assessment Tool (SCAT)
 - http://www.newamssm.org/SCAT_v13_-_Side_1.doc
 - http://www.newamssm.org/SCAT_v13_-_Side_2.doc
- SCAT standardized tool combines:
 - (See also Concussion: Injury Grading Scales)
 - Guidelines for the Management of Concussion in Sports: Colorado Medical Society

- Management of Concussion Sports Palm Card: American Academy of Neurology & Brain Injury Association
- Standardized Assessment of Concussion (SAC)
- Sideline Concussion Check: University of Pittsburgh Medical Center, Thinksafe, Sports Medicine New Zealand Inc, and the Brain Injury Association
- McGill Abbreviated Concussion Evaluation (ACE)
- National Hockey League Physician Evaluation Form
- The UK Jockey Club Assessment of Concussion
- Maddocks questions
- Imaging
 - Neuroimaging usually normal
 - Imaging indicated if structural lesion suspected
 - CT or MRI (preferable)
 - Prolonged loss of consciousness
 - Altered level of consciousness
 - Focal neurological deficit
 - Worsening symptoms
 - Decline after a lucid interval
- 4. Grading
 - Vienna 2001 Committee agreed not to classify concussions according to grade
 - Monitor recovery from symptoms and return to baseline
 - Clinical symptoms resolved
 - Neuropsychological testing
 - Postural stability testing
 - Once asymptomatic, classify as
 - Simple concussion
 - Uncomplicated recovery 7-10 days after injury
 - Complex concussion
 - Prolonged symptoms
 - Cognitive impairment
 - Symptoms w/exertion
 - Prolonged loss of consciousness >1 min
 - Subsequent or multiple concussions classified as complex

Differential Diagnosis

1. Simple Concussion
2. Complex Concussion
3. Epidural Hematoma
4. Subdural Hematoma
5. Subarachnoid Hemorrhage
6. Migraine
7. Skull Fracture
8. Facial Fracture
9. Cervical Spine injury

Therapeutics

1. If athlete displays S/S of concussion

- Disqualify athlete from current event
- Complete sideline medical eval
- Monitor for deterioration of neurologic status
- 2. Activity
 - Limit physical activity to activities that do not cause symptoms
 - No contact activities for a minimum of 7 days, athletes must be asymptomatic and their coordination and neuropsychological tests should have returned to pre-injury baseline
 - High-risk athletes (those with Hx of previous concussion, high-school age or younger, or female) may need to avoid contact even after all these criteria are met
 - Resume normal activities when asymptomatic
 - Cognitive rest when symptomatic
- 3. Medications
 - Not recommended d/t masking symptoms or incr complications
 - Incr bleeding w/NSAIDs
 - Complex concussions may require tx for prolonged symptoms
 - Acetaminophen 500mg QID may be used for headaches

Follow-Up

1. Return-to-play guidelines
 - Step-wise incr in activity until no symptoms at any level of activity
 - No activity and cognitive rest
 - Light aerobic exercise, no resistance training
 - Sport specific exercise, progressive introduction of resistance training, no contact
 - Non-contact training
 - Full contact training
 - Return to play w/o restrictions when symptom free
 - If symptoms occur at any step, fall back one step until asymptomatic
 - Try to progress again after 24 hrs
 - Neuropsychological testing
 - Return to baseline on neuropsychological testing usually takes 7-10 days
 - Areas examined: attention, concentration, learning and memory, working memory, and verbal fluency
 - Attention, concentration, and memory most sensitive to concussions
 - Test athlete when asymptomatic
 - Compare results to baseline test done before season
 - Test results should not be only guide for return to play decision
 - Computerized testing can be done online
 - Uses different tests to decr practice effects
 - Can be admin w/o neuropsychologist
2. Postural stability testing
 - Balance testing used to monitor recovery and guide return to play decisions
 - **The Balance Error Scoring System (BESS):**
 - Can be used on sideline for eval
 - Three stance positions on two surfaces are scored

- Compare to previous and future testing
 - Stances 20 seconds each on hard floor
 - Repeat on foam surface (46 x 43 x 13 cm³)
 - Hands on iliac crests, heads up
 - Single leg
 - Double leg
 - Tandem (Heel-to-Toe)
 - Score 1 point for each mistake
 - Add scores, compare w/previous tests
 - Scored mistakes
 - Open eyes
 - Steps, stumbles, falls
 - Moves hands
 - Moves hips >30°
 - Lifts toes or heels
 - Remains out of position for >5 sec

3. Disqualification

- For Game or Practice: any S/S of concussion
- For Season: 3 concussions w/in same season
 - Established in 1945
 - Still followed but not supported by scientific data

4. Return-to-play guidelines for children

- More conservative
- Prolonged asymptomatic period before return to play

5. Refer to specialist

- If initial eval by athletic trainer, should see MD for
 - LOC
 - Amnesia >15 min
 - Incr in blood pressure
 - Vomiting
 - New onset motor, sensory, balance, or cranial nerve deficits
 - Worsening or new post-concussion symptoms compared to initial symptoms
 - Continued symptoms after game
- Refer to sports medicine physician for continued post-concussion symptoms
- Immediate transfer to ED for
 - Deterioration in neurologic status
 - Decr LOC
 - Bradypnea or irregular respirations
 - Bradycardia or irregular pulse
 - Unequal, unreactive, or dilated pupils
 - S/S of axial skeletal injury
 - S/S of intracranial bleeding or focal lesion
 - Mental status changes incl: lethargy, difficulty maintaining arousal, confusion, agitation
 - Seizures
- Sports psychologist
 - Concussed athletes at risk for
 - Depression

- Anxiety, especially if complex concussion
- Long recovery
- Possibility of permanent disqualification
- Admit to hospital
 - Glasgow coma score <15
 - Abnormal CT scan or MRI
 - Seizures
 - Hx of bleeding diathesis or on medication that prolongs coagulation

Prognosis

1. Complications

- Postconcussion syndrome
- Second impact syndrome
- Post-traumatic epilepsy
- Post-traumatic vertigo
- Cranial nerve injuries
- Cumulative neuropsychological impairment

2. Cumulative effects of concussions

- Not well understood
- 3 or more concussions are associated with:
 - LOC
 - Amnesia
 - Confusion
 - Abnormal mental status

Prevention/ Screening

1. Detailed Hx of head/ neck injuries prior to participation

- Establish baseline for athlete
- Prior concussion put athletes in "complex" category
- Opportunity for a close observation of athletes at risk
- Consensus panel recommends baseline symptom scale before season
- Computerized or SCAT paper-based tool
 - Computerized neuropsychological testing is reliable, efficient way to establish a baseline and follow post-concussion
 - Drawback is cost
 - ImPACT
 - The Automated Neuropsychological Assessment Metrics (ANAM)
 - CogSport
 - HeadMinder
 - Prague Sport Concussion Assessment Tool (SCAT) paper based tool
 - http://www.newamssm.org/SCAT_v13_-_Side_1.doc
 - http://www.newamssm.org/SCAT_v13_-_Side_2.doc

2. Apolipoprotein E4 linked to more severe, prolonged course after head injury

- Routine screening not recommended

Evidence-Based Inquiry

1. How should we follow athletes after a concussion?

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