

Concussion in a Football Player

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Disclosure of Conflict of Interest

I do not have any significant or other financial relationships with industry or commercial supporters to disclose.

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Presentation- Day #0

- This is a 18 year old male college freshman football running back who presented for evaluation of headache after a helmet-to-helmet collision during football practice

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### Presentation of Injury

- No loss of consciousness
- He was removed from practice by his athletic trainer directly after the hit, and did not return to practice
- Reported mild headache that started immediately after the hit, which improved some with Tylenol
- Denied sensitivity to light, blurred vision, nausea or vomiting

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### Past Medical History

- No history of concussion
- No history of migraine
- No history of ADHD
- Denies any significant family history

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### Physical Exam

- General: Appears uncomfortable, but no acute distress.
- HEENT: Normocephalic/atraumatic. PERRLA. Fundi appear normal without evidence of papilledema. TMs clear.
- Neck: Mild cervical paraspinal muscle tenderness bilaterally. No midline vertebral tenderness.
- Neuro: CN II- XII intact. Strength 5/5 bilaterally throughout. DTRs 2/2 bilaterally throughout. Normal finger-nose-finger test. Normal gait. Mental status clear.
- Balance: Modified BESS (Balance Error Scoring System) barefoot on flat surface < 3 errors for double-leg stance, single-leg stance, and tandem stance.

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## Diagnosis

- Concussion

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## Plan

- Complete rest- cognitive and physical
- Follow up daily with athletic training staff, and in a few days with the team physician

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## Day #10 Post-Injury

- He followed up regularly over the past week without significant improvement in his symptoms.
- Continues physical rest, although has resumed attending some classes.
- Symptoms persist:
  - Headache 5/10
  - Pressure behind both eyes and temples
  - Headaches worsened by loud music, TV, and computer work
  - Also getting nauseated with car rides, although is not usually prone to motion sickness
- Exam: Appears uncomfortable. Affect flat. Cervical paraspinal muscle tenderness resolved.
- Plan:
  - Ongoing physical rest
  - May attend class as able
  - Neuropsychological testing
  - F/u tomorrow

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### Day #17 Post-Injury

- Presented to training room complaining of 10/10 headache
- States he was unable to sleep the night before due to the pain, and he reports it was so bad it brought him to tears
- Exam: Appears uncomfortable. AOx4. No focal neurologic signs.
- Due to recent concussion, and worsening of symptoms, he was transported to the ED

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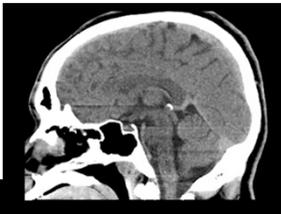
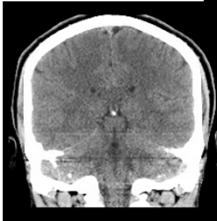
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### Day #17 Post-Injury

Head CT without contrast was negative



In the ER, he revealed that his headache was worsened by going to a football game over the weekend, exacerbated by the noise and lights. He had to leave the game early due to his symptoms.

He was prescribed Hydrocodone-Acetaminophen to take as needed for his headaches

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### Week #3 Post-Injury

- Continues to have daily headaches
- Trial of Amantidine 100 mg BID
- Discussions with Academics and Athletics
- Neurology consult

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### Week #4 Post-Injury

- ◉ Doing better on Amantadine
- ◉ Continues to have headache, but less
- ◉ Exam: First time since his initial presentation that he looks comfortable. Smiling.
- ◉ Plan:
  - Continue Amantadine
  - Rest
  - F/u next week

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### Week #5 Post-Injury

- ◉ Seen by neurology
- ◉ Revealed that mother has history of migraines
- ◉ Assessment: Migraine headaches
- ◉ Plan:
  - No further diagnostic testing recommended
  - Encouraged to continue resting
  - F/u in 2 weeks

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### 4 1/2 months Post- Injury

- ◉ Reports being asymptomatic
- ◉ No longer taking any medications
- ◉ Resuming classes for spring semester
- ◉ Exam: Unremarkable
- ◉ Plan:
  - F/u with neurology
  - He is now cleared for non-contact exercise as tolerated with close follow up

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### 9 months Post- Injury

- He had been doing cardio training over the past few months, which had gone well. However, he did not participate in spring ball, and has not participated in any contact sport since the initial event.
- Yesterday, he was rearended.
- Described as a minor accident, although he thinks he hit his head on the steering wheel at the time of injury.
- Notes mild left-sided neck pain, headache, and amnesia around the event.
- Exam shows a small erythematous swollen area in the middle of his forehead slightly tender to palpation, and mild tenderness of bilateral neck muscles. Appears uncomfortable. Flat affect.
- Diagnosis: Concussion, MVA
- Plan:
  - Rest
  - Neurology appointment
  - Ibuprofen prn
  - F/u in 1 day

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### 9 Months and 1 Week Post- Injury

- One week after the his MVA, on the way to his neurology appointment, he was again rearended. It was a worse accident, and his car was "totaled".
- He made it to neurology, but was clinically looking very poorly, and neurology ordered a head CT that day, which was read as normal.
- His headache was significantly worse after this second accident.
- Neurology expressed concern that he was not returning to baseline after each head injury, and that further head injuries could increase his risk of impaired function and memory in the future.
- Consideration of medical retirement is recommended

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### 9 Months and 2 Weeks Post- Injury

- After discussion with family, neurology, coaching staff, and the NCAA compliance officer, he has decided to retire from football.
  - Medical retirement/disqualification letter signed
  - Continue physical rest for now
  - Limited school as tolerated
  - Close follow up
- Final Assessment:
  - Migraines
  - Recurrent concussions
    - Concern for decreased concussion threshold

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### Pathophysiology

- Trauma-induced neurometabolic cascade
- Changes include abrupt neuronal depolarization, release of excitatory neurotransmitters, ionic shifts, altered glucose metabolism and cerebral blood flow, and impaired axonal function. Michael W. Kirkwood et al. *Pediatrics*. 2006.

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### Epidemiology

- 1.6-3.8 million sports-related concussive injuries occur annually in the USA Langlois JA et al. *J Head Trauma Rehabil*. 2006.

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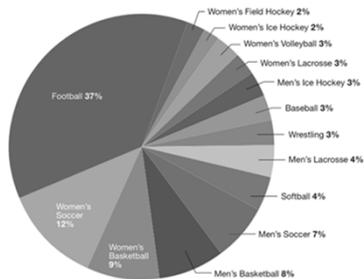
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### Epidemiology

Figure 2: National annual estimate of concussions for practice and competition in 14 NCAA sports



NCAA.org

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### Neuropsychological Testing

- 81.9% sensitivity and 89.4% specificity in diagnosis of concussions. Lau, BC. *The American Journal of Sports Medicine*. 2011.
- Began in athletes in the 1980's
- Considered a tool to use as an adjunct to clinical assessment regarding diagnosis and return-to-play in athletes with suspected concussion
- ImPACT consists of seven individual test modules used to measure aspects of cognitive functioning

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### Neuropsychological Testing

- No universally agreed upon recommendations for the use of NP testing
- Existing recommendations based on expert opinion
- Debate exists regarding the utility of NP testing while a patient is still symptomatic
- Data suggest that cognitive impairment after concussion may last longer than subjective symptoms

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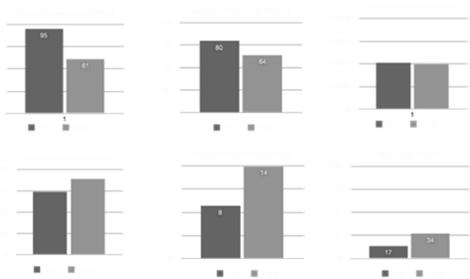
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### ImPACT Clinical Report



Cognitive Efficiency Index: -0.17 (Pre-concussion) -0.03 (Post-concussion)

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### Imaging

- Brain CT or MRI contribute little to concussion evaluation and management
- Obtained to rule out more serious, life-threatening etiologies
  - CT: used acutely to evaluate for bone fracture, intracranial bleeding, contusion, mass effects, and/or brain stem herniation
  - MRI: more sensitive for evaluating persistent or worsening symptoms or concern for underlying pathology Harmon KG. Br J Sports Med. 2013.

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### Imaging

- Signs/symptoms to consider imaging:
  - Prolonged loss of consciousness (> 1 minute)
  - Focal neurological deficit
  - Deterioration or worsening symptoms
  - Mental status changes
  - Repeated vomiting
- Other imaging modalities are still in developmental stages at this time
  - Functional MRI (fMRI)
  - Positron emission tomography (PET)
  - Single-photon emission CT (SPECT)
  - Diffusion tensor imaging (DTI)
  - Magnetic resonance spectroscopy (MRS)
  - Functional connectivityMcCorry et al. Br J Sports Med. 2013.

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### Prolonged Concussive Symptoms

- Majority of concussions (80-90%) resolve within 7-10 days
- Signs/symptoms persisting weeks to months often described as a postconcussive syndrome
- Management is ideally done by a team of providers
- Cognitive therapy, integrated neurorehabilitation programs, and supervised progressive exercise programs may help improve recovery Harmon KG. Br J Sports Med. 2013.

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**Migraine Headaches**

- Headache is the most common symptom reported after concussion Mihalik JP. J Neurosurg. 2005.
- Head trauma, even mild, may result in migraine-like symptoms
- Symptoms of posttraumatic migraine are a complication of sports-related concussion that is poorly understood

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**Migraine Headaches**

- Athletes suffering from posttraumatic migraine (PTM) characteristics shown to experience greater deficits in neurocognitive testing and symptom evaluation
- Symptoms consistent with posttraumatic migraine may serve prognostic purpose in identifying athletes likely to experience protracted symptom recovery after concussion Mihalik JP. J Neurosurg. 2005.

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**Disqualification from Sports**

- No evidence-based guidelines for disqualifying or retiring an athlete from their sport after concussion
- Proposed reasons for consideration of disqualifying an athlete:
  - Structural abnormality on neuroimaging
  - Multiple lifetime concussions (no agreed upon number)
  - Persistent diminished academic or workplace performance
  - Persistent postconcussive symptoms
  - Prolonged recovery course
  - Perceived reduced threshold of sustaining recurrent concussions
- An individualized approach is essential

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Thank You!




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### Amantadine

- Dopaminergic agent that facilitates the release of dopamine and inhibits reuptake, thereby increasing the concentration of dopamine
- Several case studies and retrospective reviews have reported improved cognitive function with use of Amantadine after TBI
- A recent retrospective study evaluating the use of Amantadine in athletes after concussion demonstrated statistically significant improvement in symptoms, verbal memory, and reaction time as compared to the control group  
Cara Camliolo Reddy et al. J Head Trauma Rehabil. 2013.

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