Medical Management & Imaging of Concussion
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Outline

1. Medical management of concussion: 10 minutes
   • All recent, EBM papers on medication management

2. Imaging of concussion: 10 minutes
   • What studies and why
   • Why these aren’t done routinely

3. Questions: 5-10 minutes
Sideline Management

- High index of suspicion
- Low threshold to remove athletes from play
- Monitor and serially examine players
- Determine disposition
  - “It's not a concussion until it’s definitely not a subdural”
- Educate parents and athlete
Keep your eyes open

- Retinal detachment
- Diabetes
- Leukemia
- Malignancy
- Intracranial masses
- Medication overuse headache
- Cervicogenic headache
- Transient quadriparesis
- Brachial plexopathy
- Drug and alcohol abuse
Medication Management

- No FDA approved drugs for concussion
- 85% of concussions are better in 7-10 days
- Many patients will be better before they are seen and "treated"
Medication overuse headache

• 70% of patients meet the criteria for medication overuse headache\(^1\) (\(>15\) days of OTC meds per month)
  
  • 69% of whom get better with discontinuation of the medication\(^1\)

\(^1\)Heyer GL
Medication usage by annual experience

- NSAIDs
- APAP
- TCA
- Melatonin
- Trazadone
- Methylphenidate
- Amantadine

Stache 2010
Tricyclic Antidepressants

- Amitriptyline, Nortriptyline, Desipramine, Doxepin
- No prospective studies
- Retrospective review showed 17% of kids were prescribed it
- **82% reported improvement in headache**
- 23% reported vivid dreams, oversedation, irritability, or heart palpitations

Halstead 2016
Bramley 2015
Post-Traumatic Headache Type at 3 months

- Migraine: 24%
- Probable migraine: 25%
- Tension-type: 37%
- Cervicogenic: 4%
- Unclassified: 10%

49% Migraine

Lucas, 2011
Triptans

- No prospective studies
- Superior to placebo for post-traumatic migraine
- 70% effective in a military population
- Increased risk of minor side effects in adolescents compared to children
- No more than 3 times per week, or 9 times per month (MOH)
- Theoretical risk of vasospasm in the hyperacute setting given decreased cerebral blood flow

Pinchefsky 2015
Erickson 2015
Choe 2015
Adverse Effects of Sumatriptan

**Common**
- **Cardiovascular:** Chest discomfort (1% to 5%)
- **Dermatologic:** Application site pain (26%), Flushing (7%), Injection site pain, Injection site reaction (59% to 63%)
- **Musculoskeletal:** Muscle weakness (5%), Neck pain (up to 5%)
- **Neurologic:** Abnormal sensation (oral, 5% to 6%; subQ, 7.8% to 42%), Burning sensation (1% to 7%), Dizziness (up to 12%), Numbness (1% to 5%), Paresthesia (0.1% to 5%), Pins and needles (14%), Sensation of hot and cold (oral, 2% to 3%; subQ, 11%), Vertigo (oral, up to 2%; subQ, 12%)
- **Respiratory:** Pain in throat (3%)
- **Other:** Heavy feeling (up to 7%), Malaise, Pressure (up to 7%), Tightness sensation (up to 5%)

**Serious**
- **Cardiovascular:** Cardiac arrest, Cardiac dysrhythmia, Coronary artery spasm, Hypertensive crisis, Myocardial infarction, Peripheral ischemia, Sudden cardiac death, Transient myocardial ischemia
- **Gastrointestinal:** Ischemic colitis
- **Hematologic:** Splenic infarction
- **Immunologic:** Anaphylactoid reaction, Anaphylaxis, Hypersensitivity reaction
- **Neurologic:** Cerebral hemorrhage, Cerebrovascular accident, Intracranial hemorrhage, Seizure, Subarachnoid hemorrhage
- **Ophthalmic:** Blindness AND/OR vision impairment level, Functional visual loss, Transient blindness
- **Other:** Serotonin syndrome
Amantadine

- Dopaminergic med, maybe NMDA agonist effects
- **3-4 weeks of 100mg BID***
- Improvement in symptoms and IMPACT scores
- Safe in pediatric and adult populations
- Mixed results in more severe TBI

Reddy 2013
Green 2004
Tenuovo 2006

*Why is this time frame an issue?
Methylphenidate

- Studied in more severe TBI for fatigue and improved cognitive function, attention, and speed of function
  - Mixed results
- No studies to date on its effectiveness on mild TBI
- No real role in acute concussion
- Maybe in prolonged recovery?

Meehan 2011
Diet and Supplements

• Melatonin
  • 0.5-10mg, 1-2 hours before bed
  • May need 1 month of treatment

• Omega-3 Fatty Acids
  • 2200 mg DHA x 30 days (study pending)

• Creatine*

• Reservatrol*

• Ketogenic diet

Ashbaugh 2016

*Animal studies only
The End of the Beginning...
Concussion is a “clinical diagnosis, you don’t need imaging!

Whew...this lecture is easy!
Imaging and Concussion
The Holy Grail

• Cheap
• Widely available
• Objective
• Determines severity
• Prognostic
• Surveillance
• Identifies safe return to play
• Identifies long-term prognosis
• Identifies long-term vulnerability
CT*

- Not sensitive for concussion
- Useful in acute and emergent situations.
- No real role in outpatient management
- “Overused” study
  - New Orleans Criteria
  - Canadian CT Head Rule

*Quick, cheap, available
MRI*

- Ideal outpatient study
- Sensitive to structural abnormalities
- Will show foramen magnum
- DWI and FLAIR sequences are sensitive for edema
- GRE and SWI are sensitive for hemorrhage

*Less quick, less cheap, less available
MRI with Diffusion Weighted Imaging (DWI)*

- More sensitive to diffuse axonal injury than standard MRI
- Most useful in acute cases *prior* to chronic changes occurring because the edema tends to leave

Less cheap, less quick, less available
MRI with Susceptibility-weighted imaging (SWI)

- High resolution gradient MRI technique
- Exquisitely sensitive to venous blood products

Less cheap, less quick, less available
Unpublished Data

- 110 outpatient MRIs ordered over 4 years
- 11 had “any abnormality”
- 0% of these caused a change in clinical management

Concussion is a CLINICAL diagnosis, not an imaging diagnosis

Laker, Rodriguez, Mcmahon, Unpublished
fMRI* (functional MRI)

- Non-invasive, MRI-based study
- Utilizes a neurocognitive task
- Blood-oxygen level dependent signal
- Conflicting results
  - Some report consistent changes at various time points
  - Others no significant differences

Hutchison 2014
Terry 2012
Dettwiler 2014
Keightley 2012
Churchill 2017

*Severity, prognosis, function
MRI Spectroscopy*

- Identifies cellular breakdown products
- N-acetylaspartate = axonal damage
- Choline = myelin damage
- May be able to predict outcomes
- May be correlated with neuropsychological abnormalities

*Return to play, severity, surveillance
Diffusion Tensor Imaging

- Identifies microstructural abnormalities using water flow properties
- Can identify diffuse axonal injury and white matter tract shearing
- Chronic (>3 months) injuries may not show up
- Though a few studies show abnormalities up to 5 years post-injury
- Some changes in findings based number of concussions

Breton 2017 *long-term prognosis determination?, vulnerability
Why don’t you see more of these imaging types in clinical practice?

or

?
Recommended reading

April Issue of BJSM
- SCAT5
- Berlin Consensus Statement
- Physiologic time to recover