Concussion

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Objectives

• Define and discuss various types of head injuries in sport
• Review initial evaluation of an athlete with a head injury
• Review concussion evaluation and treatment
• Discuss return to play guidelines for an athlete with a head injury
Head Injuries in Sport

- Actual number of injuries unknown because many are not reported by the athlete
- Most head injuries in sport are minor:
  - Sports are third behind MVA and falls as cause of minor head injuries
  - Most common head injury in sports is a concussion

Concussion

- Definition:
  - Concussion is defined as a complex physiological process affecting the brain, induced by traumatic biomechanical forces.
  - Caused by a direct blow to the head, face, neck, or elsewhere on the body with an impulsive force transmitted to the head
Concussion

- Typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously
- May result in neuropathological changes reflecting a functional disturbance rather than a structural injury
- Graded set of clinical syndromes that may or may not involve LOC
- Associated with grossly normal neuroimaging studies

Concussion

Anatomy of a head injury

There are two types of concussions, defined by the impact forces that create them: linear and rotational. In both kinds, the neurons, brain and central nervous system cells can be stretched and torn.

**Linear**
1. Direct impact stops the head's forward motion.
2. The brain keeps moving, colliding with the inside of the skull and injuring the frontal lobe.
3. The brain recoils, crashing into the back of the skull and injuring the occipital lobe.

**Rotational**
A lateral impact, like a cross-punch in boxing, spins the brain on its axis, stretching or tearing neurons.

Source: Centers for Disease Control and Prevention
Concussion

Sideline Assessment of Concussion

Table 1  Selected acute and delayed signs and symptoms suggestive of concussion

<table>
<thead>
<tr>
<th>Cognitive</th>
<th>Somatic</th>
<th>Affective</th>
<th>Sleep disturbances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confusion</td>
<td>Headache</td>
<td>Emotional liability</td>
<td>Trouble falling asleep</td>
</tr>
<tr>
<td>Anterograde amnesia</td>
<td>Dizziness</td>
<td>Instability</td>
<td>Sleeping more than usual</td>
</tr>
<tr>
<td>Retrograde amnesia</td>
<td>Balance disruption</td>
<td>Fatigue</td>
<td>Sleeping less than usual</td>
</tr>
<tr>
<td>Loss of consciousness</td>
<td>Nausea/vomiting</td>
<td>Anxiety</td>
<td></td>
</tr>
<tr>
<td>Disorientation</td>
<td>Visual disturbances (photophobia, blurry/double vision)</td>
<td>Sadness</td>
<td></td>
</tr>
<tr>
<td>Feeling “a fog,” “zoned out”</td>
<td>Photophobia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual acuity inability to focus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delayed verbal and motor responses Slurred/incoherent speech</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excessive dizziness</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sideline Assessment of Concussion

When to transport to an emergency facility:

- Worsening headache
- Very drowsy or cannot be easily awakened
- Cannot recognise people or places
- Develops significant nausea or vomiting
- Behaves unusually, more confused or irritable
- Develops seizures
- Weakness or numbness in the arms or legs
- Slurred speech or unsteadiness of gait


Sideline Assessment of Concussion

- Working within a medical team for evaluation
  - Athletic trainers, team physicians, specialists
- Do you know the athlete?
  - Personality
  - Normal vs abnormal
  - Clinical judgment
- Standardized assessment
  - Symptom scale
  - Cognitive evaluation
  - Balance evaluation
Sideline Assessment of Concussion

STEP 2: OBSERVABLE SIGNS

Witnessed □ Observed on Video □
- Lying motionless on the playing surface: Y N
- Balance / gait difficulties / motor incoordination: swaying / slow / laboured movements: Y N
- Disorientation or confusion, or an inability to respond appropriately to questions: Y N
- Blank or vacant look: Y N
- Facial injury after head trauma: Y N

STEP 3: MEMORY ASSESSMENT
MADDOCKS QUESTIONS

I am going to ask you a few questions, please listen carefully and give your best effort. First, tell me what happened?

Mark Y for correct answer / N for incorrect
- What venue are we at today? Y N
- Which half is it now? Y N
- Who scored last in this match? Y N
- What team did you play last week / game? Y N
- Did your team win the last game? Y N

Sideline Assessment of Concussion

STEP 4: EXAMINATION
GLASGOW COMA SCALE (GCS)

<table>
<thead>
<tr>
<th>Item</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of assessment</td>
<td></td>
</tr>
<tr>
<td>Date of assessment</td>
<td></td>
</tr>
<tr>
<td>Best eye response (E)</td>
<td></td>
</tr>
<tr>
<td>No eye opening</td>
<td>1</td>
</tr>
<tr>
<td>Eye opening in response to pain</td>
<td>2</td>
</tr>
<tr>
<td>Eye opening spontaneously</td>
<td>4</td>
</tr>
<tr>
<td>Best verbal response (V)</td>
<td></td>
</tr>
<tr>
<td>No verbal response</td>
<td>1</td>
</tr>
<tr>
<td>Incomprehensible sounds</td>
<td>2</td>
</tr>
<tr>
<td>Inappropriate words</td>
<td>3</td>
</tr>
<tr>
<td>Confused</td>
<td>4</td>
</tr>
<tr>
<td>Oriented</td>
<td>5</td>
</tr>
<tr>
<td>Best motor response (M)</td>
<td></td>
</tr>
<tr>
<td>No motor response</td>
<td>1</td>
</tr>
<tr>
<td>Extension to pain</td>
<td>2</td>
</tr>
<tr>
<td>Abnormal flexion to pain</td>
<td>3</td>
</tr>
<tr>
<td>Flaccid / Withdrawn to pain</td>
<td>4</td>
</tr>
<tr>
<td>Limpless to pain</td>
<td>5</td>
</tr>
<tr>
<td>clergy instructions</td>
<td>6</td>
</tr>
<tr>
<td>Glasgow Coma score (E + V + M)</td>
<td></td>
</tr>
</tbody>
</table>

CERVICAL SPINE ASSESSMENT

Does the athlete report that their neck is pain free at rest? Y N

If there is NO neck pain at rest, does the athlete have a full range of ACTIVE pain-free movement? Y N

Is the limb strength and sensation normal? Y N
Sideline Assessment of Concussion

**STEP 2: SYMPTOM EVALUATION**

ORIENTATION

- What month is it? 0 1
- What is the date today? 0 1
- What is the day of the week? 0 1
- What year is it? 0 1
- What time is it (right now? (within 1 hour) 0 1

Orientation score: 4/10

**IMMEDIATE MEMORY**

<table>
<thead>
<tr>
<th>List</th>
<th>Alternatives (5 words)</th>
<th>Score (of 5)</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Page, Penny, Station, Lemon, Bees</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Frog, Paper, Sugar, Sandhill, Wings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Kelly, Window, Perfume, Sunset, Toy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Moon, Apples, Pear, Saddle, Rabbit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Jacket, Arrow, Pepper, Cotton, Wane</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Dollar, Honey, Mirror, Saddle, Anchor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Immediate Memory Score: 4/5

**DIGITS BACKWARDS**

<table>
<thead>
<tr>
<th>List</th>
<th>Alternatives (5 words)</th>
<th>Score (of 5)</th>
<th>Trial 1</th>
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<tr>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>F</td>
<td>Dollar, Honey, Mirror, Saddle, Anchor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Immediate Memory Score: 4/5
Sideline Assessment of Concussion

MONTHS IN REVERSE ORDER

M 0 1 2 3 4 5 6 7 8 9 10 11 12
J 1 2 3 4 5 6 7 8 9 10 11 12 S
D 1 2 3 4 5 6 7 8 9 10 11 12
F 1 2 3 4 5 6 7 8 9 10 11 12
E 1 2 3 4 5 6 7 8 9 10 11 12
R 1 2 3 4 5 6 7 8 9 10 11 12
S 1 2 3 4 5 6 7 8 9 10 11 12
O 1 2 3 4 5 6 7 8 9 10 11 12
C 1 2 3 4 5 6 7 8 9 10 11 12
M 1 2 3 4 5 6 7 8 9 10 11 12

Sideline Assessment of Concussion

STEP 4: NEUROLOGICAL SCREEN

See the instruction sheet (page 7) for details of test administration and scoring of the tests.

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can the patient name the month in reverse order?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Can the patient perform the finger move correctly?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Can the patient perform tandem gait normally?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Does the patient have a full range of pain?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Has the patient been aware of any abnormality?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Can the patient look in the mirror and hold up and gaze without double vision?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Can the patient perform the finger move coordination test normally?</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>

Sideline Assessment of Concussion

BALANCE EXAMINATION

Modified Balance Error Scoring System (mBESS) testing

- Testing surface (hard floor, soft, etc.)
- Condition (heels, hands, knees, eyes open, etc.)
- Error (left, right)
- Balance error score
  - Six uneven steps
  - Six-step sequence
  - Eyes closed
  - Eyes open

Sideline Assessment of Concussion

STEP 5: DELAYED RECALL:

The delayed recall should be performed after 5 minutes have elapsed since the end of the Immediate Recall section. Score 1 pt. for each correct response.

Time Started

Please record each word correctly recalled. Total score equals number of words recalled.

Total number of words recalled accurately

Sideline Assessment of Concussion

STEP 6: DECISION

Date & time of assessment

- If the athlete is known to you prior to their injury, are they different from their usual self?
  - Yes
  - No
  - Unsure
  - Not applicable

Concussion Diagnosed?
  - Yes
  - No
  - Unsure
  - Not applicable

If re-evaluating, has the athlete improved?
  - Yes
  - No
  - Unsure
  - Not applicable

I am a physician or licensed healthcare professional and I have personally administered or supervised the administration of this SCATS.

Signature:

Name:

Title:

Registration number (if applicable):

Date:
## Sideline Assessment of Concussion

<table>
<thead>
<tr>
<th>Test</th>
<th>Time to administer</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>False positives</th>
<th>False negatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptom scores</td>
<td>2–3 min</td>
<td>68%</td>
<td>68%</td>
<td>0%</td>
<td>32%</td>
</tr>
<tr>
<td>Bragaño (2007) 9 item</td>
<td></td>
<td>89%</td>
<td>100%</td>
<td>0%</td>
<td>11%</td>
</tr>
<tr>
<td>Maddocks (GCM 1999)</td>
<td>&lt;1 min</td>
<td>32–75%</td>
<td>86–100%</td>
<td>29–68%</td>
<td>0–11%</td>
</tr>
<tr>
<td>SAC</td>
<td>5 min</td>
<td>94%</td>
<td>76%</td>
<td>24%</td>
<td>6%</td>
</tr>
<tr>
<td>Barr (2001)</td>
<td></td>
<td>80%</td>
<td>91%</td>
<td>9%</td>
<td>20%</td>
</tr>
<tr>
<td>McCrea (2005)</td>
<td>5 min</td>
<td>34%</td>
<td>91%</td>
<td>64%</td>
<td>9%</td>
</tr>
<tr>
<td>BESS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modified BESS</td>
<td>2–3 min</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>SAC + BESS</td>
<td>10 min</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>NFL Sideline Concussion Assessment Tool (SAC+modified BESS+Symptoms score)</td>
<td>8–10 min</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>SCAT2 (SAC+modified BESS+Glasgow coma scale+physical signs score+Maddock’s score+coordination exam)</td>
<td>8–10 min</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
</tbody>
</table>


## Sideline Assessment of Concussion

- **SAC**
  - Sensitive for 48 hours following SRC
- **Maddock’s**
  - Useful for acute evaluation only
- **Symptoms**
  - Sensitive initially; approaching 0 at day 7
- **Balance**
  - Lower sensitivity (confounding variables)
  - Good specificity to day 7
### Sideline Assessment of Concussion

- **Combination evaluations**
  - Include validated sub sections but are not validated in the evaluation of SRC
- **Gold standard**
  - *Clinical impression*
    - A clinician’s diagnostic impression should override a negative sideline assessment

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### Sideline Assessment of Concussion

- **King-Devick**
  - Saccadic eye movements
- “**Concussion bin**”
  - Rest period for evaluation (15 min)
  - Move to a quiet environment for testing
- **Serial evaluations**
  - Monitor for neurologic deterioration
  - Clinical determination if a concussion occurred

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Return to Play Following Concussion

- No return to play on same day of concussion
  - US Team Physician Consensus Statement
  - NCAA (2010)
  - Legislation – “Lysert law”
- Duration of symptoms: 7-10 days
  - Multimodal assessment
  - Cognitive deficits


Return to Play Following Concussion

- Normal testing (“at baseline”) and clinical impression determine beginning of return to play progression
- No set time period for completion

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Graduated return-to-play protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rehabilitation stage</strong></td>
<td><strong>Objective of stage</strong></td>
</tr>
<tr>
<td>No activity</td>
<td>Recovery</td>
</tr>
<tr>
<td>Light aerobic exercise</td>
<td>Increase heart rate</td>
</tr>
<tr>
<td>Sport-specific exercise</td>
<td>Add movement</td>
</tr>
<tr>
<td>Non-contact training drills</td>
<td>Exercise, coordination and cognitive load</td>
</tr>
<tr>
<td>Full-contact practise</td>
<td>Restore athlete’s confidence; coaching staff assesses functional skills</td>
</tr>
<tr>
<td>Return to play</td>
<td></td>
</tr>
</tbody>
</table>

**Concussion Grading**

- No consensus exists regarding the grading of concussions
- There is very little evidence to support any specific grading scheme
- Most have been based on expert opinion and limited data
- Glasgow Coma Scale is the only validated scale for use in head injury

**Concussion Evaluation**

- Neuropsychological testing has been shown to be of value when evaluating concussion
  - Baseline testing is needed for accurate results and periodic baseline updates are recommended
  - Players may return to baseline testing while still symptomatic
  - Aid to clinical decision making
Concussion Evaluation

- Neuroimaging is not usually necessary and is usually normal with a concussion injury
  - CT scan initial study of choice if concurrent focal injury is present
  - MRI better for anatomy and if imaging is needed 48 hours or more post injury
- Newer modalities (PET scan, functional MR modalities) promising but not established for use in concussion

Concussion evaluation myths
Making return to play after concussion objective

Recovery After Sports Concussion

Kevin Weber, M.D., M.H.A.  
Assistant Professor of Neurology  
Neurological Institute  
Department of Neurology  
The Ohio State University Wexner Medical Center
Disclosures

• None

Objectives

• Learn the latest recommendations from the International Berlin Conference on Sports Concussion?
• What is post-traumatic headache? What are the different populations that get them?
• What types of pharmacologic treatments are there for abortive treatment?
• What types of pharmacologic treatments are there for preventative treatment?
• How can you tell the difference between post-traumatic headache and migraine or other primary headache syndrome?
Berlin Guidelines

Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016


Symptoms after concussion

- Headaches, fogginess, emotional lability
- Amnesia, focal deficits
- Unsteady gait
- Irritability or other behavior changes
- Cognitive changes (concentration deficit, slowed reaction times)
- Sleep/wake disturbance (trouble sleeping, drowsiness)
- Ocular symptoms (convergence insufficiency, trouble with saccades)
Rest

Rest and treatment/rehabilitation following sport-related concussion: a systematic review

Kathryn J Schneider,1 John J Leddy,2 Kevin M Guskiewicz,1 Tad Seifert,4 Michael McCrea,3 Noah D Silverberg,6 Nina Feddermann-Demont,18 Grant L Iverson,9 Alix Hayden,16 Michael Makiussi11,2

Rest

• 24-48 hours of cognitive and physical rest
• After that, a gradual return to activities is recommended
• No evidence that keeping an athlete in a dark room and out of school and all exercise until symptoms completely resolve is beneficial
• Many athletes recover within 10-14 days (adults) and 30 days (children)
Return to School

• Most important!

<table>
<thead>
<tr>
<th>Stage</th>
<th>Aim</th>
<th>Activity</th>
<th>Goal of each step</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Daily activities at home that do not give the child symptoms</td>
<td>Typical activities of the child during the day as long as they do not increase symptoms (e.g., reading, texting; screen time). Start with 5–15 min at a time and gradually build up.</td>
<td>Gradual return to typical activities</td>
</tr>
<tr>
<td>2</td>
<td>School activities</td>
<td>Homework, reading, or other cognitive activities outside of the classroom</td>
<td>Increase tolerance to cognitive work</td>
</tr>
<tr>
<td>3</td>
<td>Return to school part-time</td>
<td>Gradual introduction of schoolwork. May need to start with a partial school day or with increased breaks during the day</td>
<td>Increase academic activities</td>
</tr>
<tr>
<td>4</td>
<td>Return to school full time</td>
<td>Gradually progress school activities until a full day can be tolerated</td>
<td>Return to full academic activities and catch up on missed work</td>
</tr>
</tbody>
</table>


Return to School

• In Ohio, schools without a designated case manager were smaller and less likely to have an athletic trainer
• Only 32% of respondents provided students with a written academic plan after a concussion.
Return to Play

- Once symptoms have completely resolved at rest, and the athlete is back to work/school, return to play progression may begin under the supervision of a health professional (preferably one with training in concussion).

<table>
<thead>
<tr>
<th>Stage</th>
<th>Aim</th>
<th>Activity</th>
<th>Goal of each step</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Symptom-limited activity</td>
<td>Daily activities that do not provoke symptoms</td>
<td>Gradual reintroduction of work/school activities</td>
</tr>
<tr>
<td>2</td>
<td>Light aerobic exercise</td>
<td>Walking or stationary cycling at slow to medium pace. No resistance training</td>
<td>Increase heart rate</td>
</tr>
<tr>
<td>3</td>
<td>Sport-specific exercise</td>
<td>Running or skating drills, no head impact activities</td>
<td>Add movement</td>
</tr>
<tr>
<td>4</td>
<td>Non-contact training drills</td>
<td>Harder training drills, eg, passing drills. May start progressive resistance training</td>
<td>Exercises, coordination and increased thinking</td>
</tr>
<tr>
<td>5</td>
<td>Full contact practice</td>
<td>Following medical clearance, participate in normal training activities</td>
<td>Restore confidence and assess functional skills by coaching staff</td>
</tr>
</tbody>
</table>

6 Return to sport Normal game play

NOTE: An initial period of 14-48 hours of both relative physical rest and cognitive rest is recommended before beginning the RTS progression. There should be at least 24 hours (or longer) for each step of the progression. If any symptoms worsen during exercise, the athlete should go back to the previous step. Resistance training should be added only in the later stages (stage 3 or 4 at the earliest). If symptoms are persistent (e.g., more than 10-14 days in adults or more than 1 month in children), the athlete should be referred to a healthcare professional who is an expert in the management of concussion.


Rehabilitation

- I use a multidisciplinary approach with our therapists at Ohio State for patients with prolonged symptoms
- Speech/cognitive therapy for cognitive symptoms
- Physical therapy for “symptom-limited” aerobic exercise program, cervical and vestibular therapy
- Ocular rehabilitation for athletes with difficulty with convergence or saccades
- Psychological therapy for persistent mood symptoms
- Pharmacologic therapy (usually for headaches or mood)
Long-Term Effects

- There is no absolute number of concussion threshold where retirement is recommended. This is a decision involving athlete, parents (if under 18), and their physicians.
- There has not yet been a cause and effect relationship established between concussions and chronic traumatic encephalopathy (CTE).
- Do a certain number of concussions cause CTE? Or many sub-concussive repetitive blows?

Source: Concussion Legacy Foundation
Concussion and Migraine

- Personal or family history of migraine observed in 80+% of symptomatic mild TBI
- Why is there so much comorbidity?
  - Thought that hyperexcitability of the brain in migraineurs can lead to increased risk of sustaining concussion
  - We know a pre-existing headache disorder like migraine is associated with an increased risk of worsened and prolonged symptoms after a concussion.
  - Peripheral activation of the trigeminocervical complex?


Acute Post-traumatic headache

- Most common symptom after minor head injury
- 94% of athletes with sports-related concussion have headache

Acute Post-traumatic headache

- A. Any headache fulfilling criteria C and D
- B. Traumatic injury to the head has occurred
- C. Headache is reported to have developed within 7 days of one of the following:
  1. the injury to the head
  2. regaining consciousness following injury to the head
  3. Discontinuation of medication (s) that impair the ability to sense or report headache following the injury to the head
- D. Either of the following:
  1. headache has resolved within 3 months after the injury to the head
  2. headache has not yet resolved but 3 months have not yet passed since the injury to the head

- Persistent post-traumatic headache = the above criteria but greater than 3 months.
- Similar criteria for “whiplash” headaches

Source: ichd-3.org

Populations

- Secondary gain is an important factor to account for when evaluating concussion patients
- Some VERY different populations:
  - Military
  - Athletes
  - Accident victims
  - Assault victims
  - Workplace injury
- Ask about pending litigation, worker’s compensation claims, and of course future plans in sport with athletes.
# Taking a Headache History

- Family history of migraine?
- Personal history of migraine?
- Detailed previous concussion history. Did they have headaches afterwards? How long? Were they like these?
- Location, length, character (Dull? Throbbing?), radiation, severity, time to build up, time of day when pain is worst or when headache starts, onset
- Associated symptoms: dizzy, nausea, vomiting, aura, photophobia, phonophobia, neck pain
- What is the patient taking for the pain?
- Triggers?
- Missing school/work due to headaches?
- Worsening with activity?

# How to treat?

- No randomized controlled clinical trials in PTH treatment
- Standard of care is treating the headache like the primary headache type it most resembles (usually migraine)
IV Abortive Treatment

- Retrospective study by Chan et al showed that among patients with mild TBI treated with combinations of prochlorperazine, ketorolac, ondansetron, or metoclopramide, patients treated with highest rate of treatment success received either prochlorperazine or metoclopramide alone.
- An earlier 1994 study showed evidence for dihydroergotamine (DHE) and metoclopramide for headache after concussion.
- In our neurology infusion center we will use various combinations of ketorolac, prochlorperazine, IV fluids, DHE, metoclopramide, dexamethasone, valproic acid, magnesium, and diphenhydramine to break severe migraine attacks and cycles, including post-traumatic headache.


Options for Home Abortive Therapy

- Acetaminophen
- NSAIDs, including prescription indomethacin, diclofenac, etodolac, etc.
- Combination analgesics (acetaminophen/caffeine/aspirin). Midrin (isometheptene/dichloralphenazone/acetaminophen). AVOID butalbital-containing compounds due to risk of medication overuse headaches
- Triptans
  - Longer-acting: frovatriptan, zolmitriptan (pill and nasal spray), naratriptan
  - Shorter-acting: sumatriptan (pill, nasal powder, injectable, nasal spray), almotriptan, rizatriptan, eletriptan
- Ergots
  - DHE (subcutaneous or nasal spray)
- Anti-emetics
  - Prochlorperazine (rectal, oral, injectable), metoclopramide (oral or injectable), promethazine (rectal, oral, injectable)

Clinical Pearls for Abortive Treatment

- Avoid triptans, ergots, acetaminophen/dichloralphenazone/isometheptene in patients with coronary artery disease, peripheral vascular disease, hemiplegic migraine, or stroke.
- These are technically contraindicated in migraine with brainstem aura as well.
- Avoid medication overuse headaches. Limit all abortive use to 10 days/month or less. Exception is muscle relaxants and anti-emetics.
- Oral steroid tapers can break bad headache cycles. I usually use a three day course of dexamethasone (4 mg TID day 1, 4 mg BID day 2, 4 mg once day 3) or prednisone (60 mg daily for 5 days and then taper by 10 mg per day until off). Add PPI/H2 blocker if not already on one, and avoid this in patients with poorly controlled diabetes.
- Another option is chlorzoxazone 500 mg every 6 hours for 5 days.
- Sometimes infusion therapy is warranted.

Preventative Treatments

- What evidence is there for treatments in post-traumatic headache?
- For now, we use migraine or tension-type headache treatments
**Amitriptyline**

- Weiss et al (propranolol and/or amitriptyline) and Tyler showed benefit of amitriptyline in post-traumatic headache.
- Saran found in 1988 that amitriptyline was ineffective.
- Retrospective studies!
- Side effects: weight gain, dry mouth, constipation. Avoid in those with arrhythmias. Often will check EKG in children and younger adults before initiating this medication.

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**Valproic Acid**

- Packard found that in 100 patients with chronic post-traumatic headache, 60% had mild to moderate improvement in headaches after one month
- Side effects: very toxic to fetus (generally don’t have to child-bearing age females), blood count derangements, tremor, weight gain, alopecia. Contraindicated in liver failure.
- Retrospective!
Topiramate

- Erickson in 2011 found that there was a significant decline in headaches after TBI in soldiers when using topiramate.
- Side effects: nephrolithiasis, paresthesias, weight loss, cognitive dysfunction, word-finding difficulty, acute angle-closure glaucoma
- Retrospective! Look at the population as well.

Interventional Treatment in PTH

- Several retrospective studies show benefit for occipital nerve blocks
- A few small studies and lots of anecdotal evidence are promising for physical therapy of the neck in PTH
- Others: SPG block, transcranial magnetic stimulation have case reports in PTH

Onabotulinumtoxin A

- 64 (63 of them men) active duty military members underwent injections after mild TBI.
- Most received PREEMPT protocol
- 64% felt better
- Retrospective!

Opportunities for research in treatments for PTH?

- More studies on medications in athletes
- Particularly onabotulinumtoxin A
- Venlafaxine/desvenlafaxine
- Gabapentin
- Memantine
- Physical therapy of the neck
- Melatonin
- Alternative treatments
Alternative treatments in PTH?

- CBT = mixed results
- Biofeedback studies in PTH promising, however many trials were combined with some other modalities. Also small N of patients
- One positive study in servicepeople for acupuncture

The real reason you came...

- How to tell the difference between post-traumatic headache and migraine?
- In a patient with a previous history of migraine or a young patient with a family history of migraine but no personal migraines, how in the world can you tell?
- Signs the post-traumatic headache may have reverted back to migraine:
  - All other concussion symptoms resolved
  - The headaches do not worsen with exercise
  - The headaches are random and do not correlate with increased mental or physical activity
  - The frequency and character are now similar to what they were prior to the injury
- What if the patient is on migraine/posttraumatic headache prophylaxis?
  - Controversial
  - Exercise caution
  - There is always concern that medications mask symptoms. That said, an underlying migraine disorder could worsen off the medication even though the concussion recovery itself has completed.
General Pearls

• Headache lifestyle is very important: keep caffeine intake steady, hydration, exercise, sleep, regular meals, mood.
• Avoid analgesic medication overuse
• Encourage a multidisciplinary approach with psychology, physical therapy (and occupational and/or speech therapy for other concussion symptoms).
• Refer if necessary. We have a Comprehensive Sports Concussion Clinic at Ohio State.