Youth Sports Concussion Training

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What I was asked to do...

- What risk factors make contact sports too risky?
- Are girls at higher risk of prolonged symptoms than boys? If yes, are there policy implications?
- What should be done about families who shop for a physician who will say “yes”?
- Should there be a certification process for professionals making return to play decisions?
- How would law makers know if the RTP law was having a positive effect?
What else I would like to talk about briefly...

- Epidemiology
- Evaluation & Management
- Recovery
- Retirement (How many is too many?)
- Prevention (lack thereof)
- What’s on the horizon?
- Questions

One Reason Why Concussion Laws are Important

- Study of 118 HS fb players’ knowledge of & attitude towards concussion
  - 25% prior concussion
  - 70% had concussion education
  - 91% recognized risk of serious injury from returning to play too quickly after concussion
  - 91% felt it was ok to play with concussion
  - 41% would tell their coach immediately if they had concussion symptoms

Anderson et al, PAS 2013
How would law makers know if the RTP law was having a positive effect?

- ↑↑↑ concussion visits
- From 1997-2007 ED visits for SRC*
  - Doubled in 8-13yo
  - ↑ 200% in 14-19yo
- NCH Sports Medicine head injury visits
  - 162 in 2009
  - 2889 in 2012

Bakhos et al, Pediatrics 2010

Effects of Lystedt Law in Seattle

<table>
<thead>
<tr>
<th>Year</th>
<th>Concussion Rate/1000 AE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008-09</td>
<td>0.16</td>
</tr>
<tr>
<td>Law Passed</td>
<td></td>
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<tr>
<td>2009-10</td>
<td>0.34</td>
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<tr>
<td>2010-11</td>
<td>0.36</td>
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</tbody>
</table>

Jingugi et al. In Press
How would law makers know if the RTP law was having a positive effect?

- Ultimately change in behavior/attitude among athletes as well
  - More difficult to achieve and measure
- Studies showing shorter duration of concussion sx in young athletes
  - Could imply earlier recognition/treatment

**Epidemiology**

**Concussion Incidence**

- Concussion in U.S. athletes (Gessel et al, 2007)
  - 8.9% of all high school injuries
  - 5.8% of all college injuries
    - Higher rate in college but proportion of injury not as great
- 9 sports studied
  - Football (41%)
  - Girls’ soccer (22%)
  - Boys’ soccer (15%)
  - Girls’ basketball (10%)
Concussion Risk Factors

- **Sport/position**
  - **Contact sports**
    - Football, hockey, rugby, wrestling (men)
    - Soccer, basketball (women)
  - Football LB, DB, QB, RB
  - Soccer goalies, defenders
  - Rugby midfield back
- **Games > practice**
  - Limits effectiveness of rule changes to decrease practice time/contact in practice
Concussion Risk Factors

Age

- Weak evidence that younger age assoc with:
  - ↑ risk of concussion
  - Prolonged recovery
- HS athletes take longer to resolve sxs and recover neurocognitive deficits more slowly than college athletes
- Age < 13 may have faster recovery???

*Eisenberg et al, 2013

Concussion Risk Factors-

Gender

- In sports played by both genders with same rules & same equipment, girls have:
  - Higher rates of concussion
  - Greater proportion of total injuries
- Females report more symptoms & show more cognitive deficits (visual memory)
- Higher % of female soccer players report prolonged sxs
Concussion Risk Factors - Gender

- Why?
- Hormonal?
  - Women injured during luteal phase of menstrual cycle (high progesterone) reported more sxs and lower QOL 1 mon post-concussion vs those injured in follicular phase or on OCPs
  - Injury may → ↓ progesterone levels
- Neck muscle strength?
- Reporting?

Concussion Risk Factors - Previous Concussion/Timing

- H/o prior concussion is risk factor for future injury
  - > 2-fold ↑ in HS athletes w/ prior concussion
  - 3x ↑ risk in college FB w/ ≥ 3 concussions
- Also risk for prolonged sxs (< 22yo) ↑ with:
  - Multiple concussions
  - Concussion w/in last year
Concussion Risk Factors - Mixed Evidence

- Genetics
  - APOE e4, APOE G-219T, tau exon 6
- ADHD/learning disability
- Mood disorders
- Migraine history
- Signs/Sxs
  - LOC, amnesia probably not good predictors

Concussion Risk Factors

<table>
<thead>
<tr>
<th>Clinical Recommendation*</th>
<th>SORT Evidence Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk factors for concussion:</td>
<td>A A</td>
</tr>
<tr>
<td>Prior concussion</td>
<td>B</td>
</tr>
<tr>
<td>Collision sports for men</td>
<td>C</td>
</tr>
<tr>
<td>Soccer for women</td>
<td>C</td>
</tr>
<tr>
<td>Female sex</td>
<td>C</td>
</tr>
<tr>
<td>Age</td>
<td>B</td>
</tr>
<tr>
<td>Migraine</td>
<td>C</td>
</tr>
<tr>
<td>Risk factors for prolonged recovery:</td>
<td>B</td>
</tr>
<tr>
<td>Multiple symptoms at presentation</td>
<td>B</td>
</tr>
<tr>
<td>Memory dysfunction</td>
<td>B</td>
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<tr>
<td>Migraine symptoms</td>
<td>B</td>
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<tr>
<td>Longer duration of headache</td>
<td>B</td>
</tr>
<tr>
<td>Age</td>
<td>B</td>
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</table>

*Insufficient evidence exists to make clinical recommendations on genetics and sport positions for concussion risk and on sex, prior concussion, mood disorders, attention deficit/hyperactivity disorder and learning disability, and premorbid migraine on prolonged recovery.

Scopaz & Hatzenbuehler, 2013
Concussion Signs & Symptoms

<table>
<thead>
<tr>
<th>Physical</th>
<th>Cognitive</th>
<th>Emotional</th>
<th>Sleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>Feeling mentally “foggy”</td>
<td>Irritability</td>
<td>Drowsiness</td>
</tr>
<tr>
<td>Nausea</td>
<td>Feeling slowed down</td>
<td>Sadness</td>
<td>Sleeping more than usual</td>
</tr>
<tr>
<td>Vomiting</td>
<td>Difficulty concentrating</td>
<td>More emotional</td>
<td>Sleeping less than usual</td>
</tr>
<tr>
<td>Balance problems</td>
<td>Difficulty remembering</td>
<td>Nervousness</td>
<td>Difficulty falling asleep</td>
</tr>
<tr>
<td>Visual problems</td>
<td>Forgetful of recent information</td>
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<tr>
<td>Fatigue</td>
<td>Confused about recent events</td>
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<tr>
<td>Sensitivity to light</td>
<td>Answers questions slowly</td>
<td></td>
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<tr>
<td>Sensitivity to noise</td>
<td>Repeats questions</td>
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<td></td>
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<tr>
<td>Dazed</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Stunned</td>
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Halstead & Walter, Pediatrics 2010

Concussion Evaluation

Physical Exam

- Vision screen
- Neck
  - TTP
  - ROM
  - Strength
  - Spurling’s
- Fundoscopic
- Cranial Nerves
  - Nystagmus
- HEENT
- Motor

- Sensation
- Reflexes
- **Cerebellar tests**
  - Finger to nose
  - RAM
  - Rhomberg/Pronator Drift
  - Tandem Gait
Concussion Evaluation
BESS Test

- Balance
- Error
- Scoring
- System

Computerized Neurocognitive Testing

- Multiple programs
  - Axon Sports
  - ImPACT
  - HeadMinder
  - Automated Neuropsychological Assessment Metrics (ANAM)
  - Concussion Vital Signs
- All have been shown to demonstrate deficits in concussed athletes vs baseline states
- Published Data on test-retest reliability
- **Does not independently establish concussion dx**
- Has not been shown to change outcomes
BESS & Neurocognitive Testing

- Compare to baseline
- Compare to normative values
  - If no baseline
  - Less helpful
- Monitor over time

Concussion Management

- EDUCATION
  - Consider further imaging (rare) if worsening sx
    - r/o bleed or axonal injury
- Physical Rest
- Mental Rest
- Pharmacologic treatment
- Vestibular rehabilitation
- Neuropsychology referral
- Gradual RTP once asymptomatic
Concussion Management Education

- Clinical diagnosis
- Symptoms vary
- Recovery unpredictable
- Second Impact Syndrome (SIS)
- Physical & mental rest
- No driving
  - Delayed reaction time
  - Trouble concentrating
  - Slowing on neurological exam
- RTP protocol

Recovery From Concussion: How Long Does it Take?

N=134 High School athletes

Collins et al., 2006, Neurosurgery
Concussion Recovery in Children/Adolescents

- Eisenberg et al, 2013
- 207 athletes
- 29% with previous concussion
- Age 11-22 (mean 14)
- Recovery after
  - 7 days = 23%
  - 28 days = 68%
  - 90 days = 85%

Concussion Recovery in Children/Adolescents

- Brown et al, 2014
- 335 athletes
- 39% with previous concussion
- Age 8-23 (mean 15)
- Mean duration of symptoms = 43 days
- No difference b/w school age (42), junior high/high school (43) and adult (39)
Concussion Management
Who Can Return to Play?

- No symptoms (at least 24 hrs)
  - Off medication
  - Full days of school
- Normal physical exam
- “Normal” balance testing if done
- “Normal” neurocognitive tests if done
- Asymptomatic at rest
- Asymptomatic with exertion

Multiple Concussions – How Many is Too Many?

- No magic #
- 3 concerning features
  - ↑ Frequency of concussions
  - ↑ Intensity and duration of sx/s
  - ↓ in trauma assoc w/ subsequent concussions
- Retirement or prolonged (>1 year) break from contact sport
Prevention

- Helmets
  - No consistent/compelling evidence of superior helmet
  - Skull fracture vs concussion
- Headgear
  - May attenuate force from head-head collisions but not from heading ball in soccer
  - No good clinical studies showing ↓ risk of concussion w/ headgear
  - ? ↑ Aggression w/ headgear
- Mouthguards
  - Protect from dental/facial trauma but not concussion
  - Neck strengthening?

What’s Next?

- Rule changes
  - Less contact
    - NFL, Ivy League, Pop Warner
    - No head shots (NHL)
      - No effect*
  - Delay contact sports until certain age?
- Laboratory testing
  - Apoe E4
  - S-100 calcium-binding protein
  - Neuron-specific enolase
- Functional imaging
- Risk of repeated subclinical impacts?

*Donaldson et al, 2013
What should be done about families who shop for a physician who will say “yes”? 
- Better education of physicians?
- Should there be a certification process for professionals making RTP decisions? 
  - Ideally yes, but logistically difficult
  - Access to care, funding
  - Advocate for athletic trainers in all districts

Questions?
Helpful links

- http://www.healthyohioprogram.org/concussion
- http://www.cdc.gov/concussion/sports/
- http://www.nationwidechildrens.org/concussions

References

- Collins MW et al. Relationship between concussion and neuropsychological performance in college football players. JAMA 1999;282:964-70
- Giza CC, Hovda DA. The Neurometabolic cascade of concussion. JATA 2001;36(3):228-235
References

- Halstead ME & Walter KD. Clinical report - Sport-related concussion in children and adolescents. *Pediatrics* 2010;126(3):597-611