Evidence-Based Management of Sport-Related Concussion

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Agenda

1. Definition, Diagnosis and Acute Assessment (Dr. McCrea)
2. The Role of Neuropsychological Assessment (Dr. Bobholz)
3. Clinical Management and Return to Play (Dr. Walter)
4. Panel Discussion
Old Problem

New Awareness

What’s All The Fuss About?

- Up to 3.8 million concussions due to sport and recreation per year
- Among most frequent injuries in contact and collision sports
- More than just “bell rung”
- Serious acute effects that effect function
- Urgency to “get back out there”
- Concern about lasting effects
- Not just the pros…
Not Just on Sundays!

Seen any High School Ball Lately?
ED visits for SRC (1997-2007)

- 100% increase for 8-13 yo’s
- >200% increase for 14-19 yo’s

**TABLE 1 Concussion Rates in High School Sports**

<table>
<thead>
<tr>
<th>Sport</th>
<th>Injury Rate, per 1000 Athlete Exposures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Football</td>
<td>0.47–1.03(^{a,b})</td>
</tr>
<tr>
<td>Girls' soccer</td>
<td>0.36(^{a})</td>
</tr>
<tr>
<td>Boys' lacrosse</td>
<td>0.28–0.34(^{c,d})</td>
</tr>
<tr>
<td>Boys' soccer</td>
<td>0.22(^{a})</td>
</tr>
<tr>
<td>Girls' basketball</td>
<td>0.21(^{a})</td>
</tr>
<tr>
<td>Wrestling</td>
<td>0.18(^{a})</td>
</tr>
<tr>
<td>Girls' lacrosse</td>
<td>0.10–0.21(^{c,d})</td>
</tr>
<tr>
<td>Softball</td>
<td>0.07(^{a})</td>
</tr>
<tr>
<td>Boys' basketball</td>
<td>0.07(^{a})</td>
</tr>
<tr>
<td>Boys’ and girls’ volleyball</td>
<td>0.05(^{a})</td>
</tr>
<tr>
<td>Baseball</td>
<td>0.05(^{a})</td>
</tr>
</tbody>
</table>
Sometimes It’s Obvious…

53% of athletes did NOT report their concussion
Of those who reported: 77% reported to ATC, 39% report to coach, 36% to parent, 27% to teammate

Why not report?
66% “not serious enough”
41% “didn’t want to leave game”
36% “didn’t know it was a concussion”

...but usually it’s not!
Sport Concussion: Clinician Challenges


- **Monitoring Recovery**: Level of recovery? Residual symptoms, deficits? Need for restrictions, accommodations?

- **Return to Play**: OK to resume participations? Tolerance for activity/exertion? Risks?

- **Extended Observation**: Preventing cumulative impairment after re-injury? Future RTP? Permanent DQ?

*All hampered by a lack of research and clinical tools*

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Advances in Concussion Management

1. **Standardization Movement**: Tools to quantify the acute clinical effects of concussion

2. **Scientific Age**: Methods inform science on the true natural history of clinical and physiological recovery after concussion

3. **Evidence-based Management**: More informed decisions on return to play based on objective assessment, demonstrated recovery

4. **Prevention Initiatives**: Reducing the ill effects of repetitive concussion, particularly during a “window of vulnerability”

Balanced by What is Practical for the Competitive Sporting Environment
Defining Sport-Related Concussion

• Concussion is defined as a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces.
• May be caused by direct blow to head, neck, face (or the body with force transmitted to the head)
• May or may not involve LOC, PTA
• Typically results in a rapid onset of brief impairment of neurologic function that spontaneously resolves
• Typically a functional disturbance, not structural injury
• Graded set of clinical symptoms that resolve over a sequential course in most cases (small % prolonged sx’s)

- Zurich Statement, 2008
Concussion Signs/Symptoms

- Subjective Symptoms:
  - Somatic: headache, nausea, dizziness, etc.
  - Cognitive: poor concentration, feeling in a fog, etc.
- Physical Signs/Acute Injury Characteristics:
  - LOC, PTA
- Neurobehavioral Changes:
  - Irritability, mood lability, etc.
- Cognitive Impairment
  - Memory, attention, reaction time, processing speed
- Sleep Disturbance
  - Drowsiness, insomnia, hypersomnia

RED FLAGS!

**Signs to watch for**

Problems could arise over the first 24-48 hours. You should not be left alone and must go to a hospital at once if you:

- Have a headache that gets worse
- Are very drowsy or can’t be awakened (woken up)
- Can’t recognize people or places
- Have repeated vomiting
- Behave unusually or seem confused; are very irritable
- Have seizures (arms and legs jerk uncontrollably)
- Have weak or numb arms or legs
- Are unsteady on your feet; have slurred speech

**Remember, it is better to be safe.**

Consult your doctor after a suspected concussion.
Practical, Evidence-Based Concussion Assessment

After an apparent second concussion this season, Drew Bledsoe refused to describe his symptoms as concussion related. “I’m saying it’s a hit to the head that knocked me out a little bit,” Bledsoe said, when asked about the second hit. “I feel a little fuzzy, but I’m going to go and play,” Bledsoe said. “This is football, man, you play.”

Associated Press, November 29, 2003
**Orientation:** Day, Month, Date, Year, Time

**Immediate Memory:** Repeated List Learning Paradigm

**Exertional Maneuvers:** Provocative conditions

**Neurologic Exam:**
- Strength
- Sensation
- Coordination
- Record LOC, PTA

**Concentration:**
- Digits Backward
- Months Backward

**Delayed Recall:** Word List Recall

**Total Score (30):**
- Orientation /5
- Im. Memory /15
- Concentration /5
- Delayed Recall /5
Measuring Postural Stability

Balance Error Scoring System – Types of Errors

1. Hands lifted off iliac crest
2. Opening eyes
3. Step, stumble, or fall
4. Moving hip into > 30 degrees abduction
5. Lifting forefoot or heel
6. Remaining out of testing position > 5 seconds

The BESS is calculated by adding one error point for each error during the six 20 second tests.

<table>
<thead>
<tr>
<th>SCORE CARD: ( # errors )</th>
<th>FIRM Surface</th>
<th>FOAM Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Leg Stance (narrow stance – feet together)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Leg Stance (non-dominant foot)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tandem Stance (non-dominant foot in back)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Scores:</td>
<td>Total Score:</td>
<td></td>
</tr>
</tbody>
</table>

Source: Guskiewicz, 1999

Can we measure the acute effects of...

...What does early recovery look like?

Evidence-based clinical management to reduce risk
Acute Effects and Recovery Time Following Concussion in Collegiate Football Players
The NCAA Concussion Study

JAMA 2003; 290:2556-2563

**Research Supported by:** NCAA, NOCSAE, NAN, NFL Charities, NFHS, Green Bay Packers Foundation, WMH Foundation, MCW Functional Imaging Research Center

Investigators hold no relevant financial interest or conflict in the research methods, materials, or findings

**CRC: Sport Concussion Database**

<table>
<thead>
<tr>
<th></th>
<th>NCAA</th>
<th>Project SL</th>
<th>CDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teams</td>
<td>25</td>
<td>30</td>
<td>124</td>
</tr>
<tr>
<td>Athlete Seasons</td>
<td>4,251</td>
<td>6,779</td>
<td>9,094</td>
</tr>
<tr>
<td>Concussions</td>
<td>196</td>
<td>215</td>
<td>375</td>
</tr>
<tr>
<td>AAN Grade 1-2</td>
<td>93.2%</td>
<td>82.1%</td>
<td>80.7%</td>
</tr>
<tr>
<td>AAN Grade 3</td>
<td>6.8%</td>
<td>17.9%</td>
<td>9.3%</td>
</tr>
<tr>
<td>LOC</td>
<td>6.8%</td>
<td>17.9%</td>
<td>9.3%</td>
</tr>
<tr>
<td>PTA</td>
<td>19.1%</td>
<td>37.3%</td>
<td>21.9%</td>
</tr>
<tr>
<td>RGA</td>
<td>7.4%</td>
<td>29.9%</td>
<td>17.3%</td>
</tr>
<tr>
<td>No LOC/PTA</td>
<td>77.8%</td>
<td>49.1%</td>
<td>64.5%</td>
</tr>
<tr>
<td>% Complete Protocol</td>
<td>84%</td>
<td>98%</td>
<td>80%</td>
</tr>
</tbody>
</table>

20,124 Athlete Seasons, 786 Concussions Studied (3.9% IR)
Measuring and **Quantifying** Recovery

| Day | Baseline | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|-----|----------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|
| Symptom Recovery | 30 | 25 | 20 | 15 | 10 | 5 | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 |
| Cognitive Recovery | 30 | 25 | 20 | 15 | 10 | 5 | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 |
| Postural Stability Recovery | 30 | 25 | 20 | 15 | 10 | 5 | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 |

**Risk of Repeat Concussion:**
- 75% of repeat concussions within first 7 days
- 92% of repeat concussions within first 10 days

**Summary: Acute Effects & Recovery**
- **Big Numbers:** 5-10% in contact/collision sports
- **Below the Knock Out:** LOC < 10%
- **Serious Effects:** Significant symptoms, cognitive & functional impairments first several days
- **Favorable Course:** 80-90% fully recover 7-10 days
- **More than Symptoms:** Performance-based, multi-dimensional assessment to measure recovery
- **Window of Cerebral Vulnerability:** early risks, when is the brain recovered?
Future Directions:
Window of Cerebral Vulnerability?

When is the Brain Recovered?

Longitudinal Perspective on MTBI: Future Directions

ACUTE INJURY

REPETITIVE MTBI

LONG-RANGE OUTCOME

Cumulative Effects:
How many is too many
(or, how much is too much)?

Neurodegeneration:
What are the long-term
or late life risks?