Recognizing and Managing Concussion and Sports Concussion in the Collegiate Setting

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NYSPHSAA Concussion Team & Safety Committee
NYS TBI Coordinating Council ⋅ Public Education Committee

NYSCHA 2008 Annual Meeting
Concussion

- Definitions and diagnostic criteria
- Epidemiology and pathophysiology
- Post-concussion symptoms
- Typical and complicated recovery
- Treatment and management
- Return to school and play
- Role of neuropsychological testing
- New developments
What is a concussion?

- Mild traumatic brain injury
- A disruption in normal brain function due to a blow or jolt to the head

_Centers for Disease Control_

- A trauma induced alteration in mental status that may or may not involve loss of consciousness

_American Academy of Neurology_
Definition of Concussion
American Congress of Rehabilitation Medicine

- Blow or jolt to the head AND
- Loss of consciousness (≤ 30 min) OR
- Post-traumatic amnesia (≤ 24 hrs) OR
- Focal neurological finding OR
  - Slurred speech, diplopia, etc.
- Alteration in mental state
  - Dazed or disoriented or confused
- After 30 minutes, an initial GCS of 13-15

Symptoms are non-specific so rule out other causes
## Glasgow Coma Scale (GCS)

<table>
<thead>
<tr>
<th>Eyes Open</th>
<th>Never</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To pain</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>To verbal stimuli</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Spontaneously</td>
<td>4</td>
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</table>

### Best Verbal Response

<table>
<thead>
<tr>
<th>Best Verbal Response</th>
<th>No response</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Incomprehensible sounds</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Inappropriate words</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Disoriented and converses</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Oriented and converses</td>
<td>5</td>
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</table>

### Best Motor Response

<table>
<thead>
<tr>
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<th>No response</th>
<th>1</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Extension</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Flexion abnormal</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Flexion Withdrawal</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Localizes pain</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Obeys</td>
<td>6</td>
</tr>
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</table>

*Scores of 13-15 indicate MTBI*
### TBI Classification

**NCIPC 2003 • ACRM 1993**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasgow Coma Scale</td>
<td>13-15</td>
<td>9-12</td>
<td>3-8</td>
</tr>
<tr>
<td>Loss of Consciousness</td>
<td>≤ 30 mins</td>
<td>&lt; 36 hours</td>
<td>&gt; 36 hours</td>
</tr>
<tr>
<td>Post-traumatic Amnesia</td>
<td>≤ 24 hours</td>
<td>1-7 days</td>
<td>&gt; 7 days</td>
</tr>
</tbody>
</table>

*mild does not refer to outcome*
It’s just a concussion.
Definition of Concussion
American Academy of Neurology

- Trauma-induced alteration in mental status

- Frequently *observed* features (signs):
  - Vacant stare (befuddled facial expression)
  - Slow or delayed verbal and motor responses
  - Confusion, disorientation, or inability to focus
  - Slurred or incoherent speech
  - Gross observable incoordination
  - Emotions out of proportion to circumstances
  - Memory deficits
  - Any period of loss of consciousness
Outdated AAN Criteria for Sports-related Concussion

Grade 1  Transient Confusion
Symptoms resolve in <15 minutes
No LOC

Grade 2  Transient Confusion
Symptoms last >15 minutes
No LOC

Grade 3  LOC: a) brief
b) prolonged
Prague Guidelines
(McCrory et al., 2004)

- **Simple concussion**
  - LOC < 1 minute
  - resolves in 7-10 days
  - first concussion

- **Complex concussion**
  - LOC > 1 minute
  - symptoms last longer than 7 – 10 days
  - history of multiple concussions
  - increasing “concussability”

**IOC • IIHF • FIFA**

No athlete returns in the current game or practice
Epidemiology of Concussion

- At least 1.5 million brain injuries per year in the United States
- 80% of all injuries are mild (MTBI)
- Up to 1 million additional injuries which are not recognized or reported
- Economic and societal costs of concussion are not well documented
Epidemiology of Concussion

- Falls, motor-vehicle accidents, and assaults are the most common causes.
- The risk of TBI is highest among those age 15-24.
- Risk of TBI is 4-6 times greater after one, and 8 times greater after two.
Mechanisms of Injury

- A complex physiological process induced by traumatic biomechanical forces
  - sudden chemical changes
  - stretching and tearing of brain cells
- Structural brain imaging (CT or MRI) is almost always normal
Neurometabolic Cascade
(Giza and Hovda 2001)

- Abrupt neuronal depolarization
- Release of excitatory neurotransmitters
- Changes in glucose metabolism
- Altered cerebral blood flow
- The brain goes into an \textit{ENERGY CRISIS} that typically lasts up to 7 – 10 days

\textit{symptoms often get worse before they get better}
Common Physical Symptoms

- Headache
- Dizziness and lightheadedness
- Clumsiness and poor balance
- Fatigue and lack of energy
- Sleep disturbance
- Blurred vision and light sensitivity
- Ringing in the ears
Common Emotional Symptoms

- Irritability
- Anxiety
- More extreme moods
- Easily overwhelmed
- Emotional and behavioral outbursts
- Lack of motivation
Common Cognitive Symptoms

- Feeling ‘dazed’ or ‘foggy’ or ‘fuzzy’
- Easily distracted and easily losing track of things
- Trouble doing more than one thing at a time
- Poor learning and memory
- Poor reading comprehension
Common Cognitive Symptoms

- Word-finding problems, and trouble putting thoughts into words
- Stuttering, slurred or scrambled speech
- Slowed processing
- Poor organization
- Easily confused
- Poor mental stamina
Exertion effects

- Symptoms are worsened by . . .
  - mental effort
  - environmental stimulation
  - emotional stress
  - physical activity
Functional MRI
Recovery from Concussion

- Full recovery in 7-10 days... *in most cases*
- About 95% recover in 3 months
- Symptoms generally thought to have a primarily neurological basis at first
- When symptoms persist, non-injury factors appear to play an increasingly significant role over time

a *miserable minority* experience complicated recovery
- Outcome after concussion is difficult to predict
- Early markers weakly related to recovery
  - LOC
  - GCS score
  - PTA

How to recognize the moods of an Irish setter
Post-Concussion Syndrome (PCS)

- Term used to describe the constellation of symptoms after concussion
- Originally used when symptoms lasted longer than 3 months
- Controversial
  - What are the causes of persistent symptoms?
  - Does such a ‘syndrome’ exist?
  - Overlap of symptoms with other conditions
  - Neurological vs. psychological?
Post-concussion syndrome

Risk factors for complicated recovery

- Re-injury before complete recovery
- Over-exertion, especially early after injury
- Significant stress
  - Unable to participate in sports or exercise
  - Medical uncertainty
  - Academic difficulties
- Prior illness or injury
  - TBI
  - Seizure
  - Migraine

Post-concussion syndrome
Post-concussion syndrome
Risk factors for complicated recovery

- Psychiatric history
  - Depression
  - Post-traumatic stress disorder

- Medical & psychological complications
  - Iatrogenesis & symptom expectancy
  - Pain & pain medication
  - Loss of self-confidence
  - Depression or anxiety

- Contextual variables
  - Litigation
  - Pressure to return to...
Secondary Problems in PCS

- Invisible Injury – person looks the same and no medical evidence of injury
- Poorly understood by doctors, employers, teachers, coaches, family and friends
- Expectation from self and others to ‘get over it’ and ‘get back in the game’

*most people think the symptoms of a concussion will only last a few days*
Don’t all kids have these problems?

“Mr. Osborne, may I be excused? My brain is full.”
Take two aspirin, then win the game

Notre Dame’s Chris Thomas suffers a concussion, but hits the late game-winner.

The Associated Press

A concussion couldn’t stop Chris Thomas. Neither could St. John’s.

Thomas, who missed the first eight minutes of the second half with a concussion, faked out St. John’s Daryll Hill and hit a 3-pointer with 6.5 seconds left to give Notre Dame a 67-66 victory over the Red Storm on Saturday at South Bend, Ind.

“It was a broken play. But that’s how it was going the whole game,” Thomas said. “I got up a good pass fake and Hill lost his footing.”

Notre Dame coach Mike Brey said he was surprised to see Thomas return to the bench in the second half, saying it looked as if there was no chance at half-

NOTRE DAME’S Colin Falls (15) hugs teammate Chris Thomas following the Irish’s 67-66 win over St. John’s Saturday. Thomas suffered a concussion, but returned to the game to make the winning basket.

Wildcats honored their 1985 title team.
Public misconceptions about TBI


60% agree . . . How quickly a person recovers from head injury depends mainly on how hard they work at recovering.

40% agree . . . Sometimes a second blow to the head can help a person remember things that were forgotten.

Willer et al. (1993) results are similar for WNY
“Concussion” refers to an immediate and transient loss of consciousness accompanied by a brief period of amnesia after a blow to the head.

Considerable confusion persists among physicians and the public regarding concussion and the post-concussion syndrome.
Secondary Problems in PCS

- Symptoms can disrupt vocational, academic, social, and recreational activities
- Changes in functioning can lead to changes in self-confidence and identity
- Risk of anxiety, depression and withdrawal

*many patients think they are just lazy or crazy*
Post-concussion syndrome

Neurological

Psychological

Contextual

symptoms
Principles of Concussion Treatment

- No cure, but treatment reduce symptoms and improve functioning
- Early recognition, education and reassurance is critical, and can improve outcome
- Avoid re-injury and over-exertion while symptomatic
- Monitor until recovered

*just knowing what’s going on is a big help*
Acute Management of Concussion

- Is it a concussion?
- Rule out more severe injury (head CT?)
- Monitor for deterioration in first 24h
- Screen for possible complicating factors
- Provide education and reassurance
- Prescribe rest and symptom relief
- Schedule follow-up
- Gradual return to activity as tolerated
Symptom Relief

- Rest
- Fluids
- Analgesia
  - Acetaminophen
  - Ibuprofen
  - Opioids
- Nausea and Vomiting
  - Insure hydration
  - Ondansetron
  - Avoid sedating antiemetics
When to go to the Emergency Department?

- Loss of consciousness (> 1 min)
- Severe headache
- Headache with nausea and vomiting
- Lethargy and difficult to arouse
- Significant vision problems
- Significant confusion or agitation
- Worsening symptoms
- “Something’s just not right”
Who Needs a CT? Adult Data

- 6 – 9% of patients with apparently minor HT will have positive CT scan
- < 1% require neurosurgical intervention
- Seven indicators (Hayel, et al. 2000)
  - Short–term memory
  - Intoxication
  - Trauma above clavicles
  - Age > 60
  - Headache
  - Vomiting
Who Needs a CT? Pediatric Data

- If none of the following present, then negative predictive value is essentially 100% (Palchak et al., 2003)
  - Clinical signs of skull fracture
  - Altered mental status
  - Headache
  - Vomiting
Acute Concussion Evaluation (ACE)

Available as part of Physicians Tool Kit on CDC website

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### Acute Concussion Evaluation (ACE)

**Physicians/Clincians Office Version**

**Patient Name:** 

**DOB** 

**Age:** 

**Date** 

**ID/MR#:** 

#### A. Injury Characteristics

- **Date/Time of Injury:**

- **Reported:** Patient, Parent, Spouse, Other

1. **Injury Description:**

   - 1a. Is there evidence of a contusion to the head (direct or indirect)?
   - 1b. Location of Impact: Parietal, Temporal, Occipital, Neck, Indirect Force

2. **History of Head Injury:**

   - 2a. History of Previous Concussion
   - 2b. History of Previous Head Injury

3. **Animal Bites:**

4. **Bite/Scratch:**

5. **Loss of Consciousness:**

6. **Faintly Sensed:**

7. **Impact:**

8. **SBM:**

9. **SBM:**

#### B. Symptoms Checklist

- **Date:**

- **Month:**

- **Day:**

- **Weeks:**

- **Years:**

- **Time:**

<table>
<thead>
<tr>
<th>PHYSICAL (10)</th>
<th>COGNITIVE (4)</th>
<th>SLEEP (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>0 1</td>
<td>Feeling mentally foggy</td>
</tr>
<tr>
<td>Nausea</td>
<td>0 1</td>
<td>Feeling general malaise</td>
</tr>
<tr>
<td>Vomiting</td>
<td>0 1</td>
<td>Difficulty concentrating</td>
</tr>
<tr>
<td>Sleep problems</td>
<td>0 1</td>
<td>Difficulty remembering</td>
</tr>
<tr>
<td>Cognitive</td>
<td>0 1</td>
<td>COGNITIVE Total (4-8)</td>
</tr>
<tr>
<td>Values</td>
<td>0 1</td>
<td>EMOTIONAL (4)</td>
</tr>
<tr>
<td>Fatigue</td>
<td>0 1</td>
<td>Stress</td>
</tr>
<tr>
<td>Anxiety</td>
<td>0 1</td>
<td>Speeds</td>
</tr>
<tr>
<td>Personality change</td>
<td>0 1</td>
<td>Nervousness</td>
</tr>
<tr>
<td>Balance</td>
<td>0 1</td>
<td>Nervousness</td>
</tr>
</tbody>
</table>

**C. Risk Factors for Protracted Recovery (check of last 60 days):**

- **Conscious History:**

- **History of Headache:**

- **Headache History:**

- **Developmental History:**

- **Psychiatric History:**

**E. DIOS:**

- **Acute:**

- **Delayed:**

**F. Follow-up Plan:**

- **Complete ACE Care Plan and provide copy to patient/family:**

- **Physicians/Clinicians Office Monitoring:** Date of next follow-up:

- **Referrals:**

- **NTS:**

- **Psychiatric:**

- **Emergency Department:**

ACE Complied by: 

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This form is part of the "Head-Up Your Injury in Your Practice" toolkit developed by the Centers for Disease Control and Prevention (CDC).
Management of Complex Concussion

- Consider referral to specialized provider or program if . . .
  - History of multiple concussions or other risk factors
  - Prolonged recovery (> 2 weeks)
  - Worsening symptoms
Treatment Strategies

- Education and psychotherapy
  - Help patient understand injury and symptoms
  - Prevent re-injury
  - Avoid overexertion
  - Reassurance about recovery

- EARLY
  - Educate family, employer, teacher, coach, etc.
  - Strategies to manage and cope with symptoms
  - Address psychological issues complicating recovery (depression, PTSD, somatization)
  - Identity, role, and meaning . . .
Treatment Strategies

- **Medications**
  - Sleep disturbance
  - Headache
  - Irritability or mood swings
  - Fatigue and poor concentration

- **Physical & Occupational Therapy**
  - Neck & back problems
  - Balance (fall prevention)
  - Vision and Cognition
Treatment Strategies

- Neuropsychological Testing
  - Clarify cognitive and emotional status
  - Monitor recovery and guide treatment
  - Screen for symptom exaggeration

- Refer for adjunctive treatments
  - Vision (dry eye, photophobia)
  - Vestibular (ENT)
  - Psychiatric disorders
  - Pain
Concussion on Campus

- Students may not seek medical attention when needed
- Faculty and staff may not know student well enough to notice subtle symptoms
- Alcohol and drug use can increase risk of concussion and complicate recovery
- Disability services office can coordinate and advocate on behalf of student
Guidelines for Return to Class after Concussion

- Out of classes at first if necessary (‘cognitive rest’), and then gradual re-entry as tolerated
- Focus on essential work that needs to be done (less mental energy available)
- Educate faculty and staff about injury and difficulties
- Provide academic accommodations
Academic Accommodations

- Reduced course and work load
- Extra time and a quiet location for tests
- Provide student with class notes or allow student to audiotape classes
- Preferential seating
- Rest breaks
- Minimize memorization
- Provide more structure and guidance on assignments
Return to Play

Prague 2004 guidelines recommend that when a player shows ANY symptoms or signs of a concussion:

- athlete should not return-to-play in the current game or practice
- return-to-play must follow a medically supervised stepwise process
- athlete must be symptom-free at rest and after exertion

*when in doubt – sit ‘em out!*
Multiple Concussions
What are the risks?

- **Second Impact Syndrome**
  - A second concussion within a week of first
  - Rare but almost always fatal
- **Increasing concussability**
- **Longer recovery**
- **Accumulating damage?**
- **Problems can be subtle and hard to detect**
- **Possible lifelong symptoms and problems**

*3 strikes and you’re out? Not necessarily...*
Neuropsychological Testing In Sports Concussion

- Computerized tests that measure attention, memory, and processing speed (reaction time)
- Sensitive to effects of concussion
- Tests can be repeated multiple times to monitor recovery
- Ideally, pre-injury baseline testing done for all athletes
- ImPACT, CogSport, HeadMinder
Unique Contribution of Neurocognitive Testing to Concussion Management

Testing reveals cognitive deficits in asymptomatic athletes within 4 days post-concussion

N=215, MANOVA p<.000000 (Lovell et al., 2004)
New Developments

- Advances in imaging (fMRI, DTI, etc.)
- Increased understanding of neurometabolic disruption
- Helmet sensors and improvements
- DOD and VA spending on research
- Education initiatives
  - CDC
  - NYSPHSAA
Summary

- Concussion is a brain injury
- Symptoms usually resolve in 1–2 weeks but can last longer
- Outcome complicated by pre- and post-injury factors (especially re-injury)
- Early recognition and education helps
- More research is needed to understand who is at risk for long-term problems and how to help them
Remember to wear your helmet!

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Concussion Management Program & CNY Sports Concussion Center
University Hospital

Clinical Evaluation and Treatment
Community Education
Research

upstate.edu/concussion