Mild Traumatic Brain Injury and Post-Concussion Syndrome: Diagnosis, Treatment and Controversy

Joel J. Silverman, MD
Virginia Commonwealth University
Joel J. Silverman, MD

Disclosures

- **Research/Grants:** None
- **Speakers Bureau:** None
- **Consultant:** None
- **Stockholder:** None
- **Other Financial Interest:** None
- **Advisory Board:** None
Learning Objective

Identify 4 treatment principles for mild traumatic brain injury
The Brain Is Our Organ

- More cells than stars
- It gets injured
  - Sports (3%)
  - Vehicular accidents (50%)
  - Falls (21%)
  - Violence (20%)
  - War

Epidemiology

- Men ages 15-24\(^1\) (15-20% combat troops in current wars)
- Children—accidents & abuse\(^1\)
- 1.4 million per year in USA\(^2\)
- 75% MTBI\(^3\)
- TBI—most common neurologic disorder after HA/herpes\(^4\)

HA = headache; MTBI = mild traumatic brain injury; TBI = traumatic brain injury

Huge Costs

- Financial
- Psychosocial
- Functional
- Psychiatric
- Interpersonal
- Physical
Our Role as Psychiatrists

- Do No Harm
- Diagnose
- Treat (early)
- Forensic evaluations
A person who has had a traumatically induced physiological disruption of brain function as manifested by at least one of the following:

- Any LOC < 20 minutes, but...
- Any amnesia < 24 hours—best indicator, but...
- Any alteration in mental state at the time of the accident (i.e., feeling dazed, disoriented, confused) but...
- 24 hours—best indicator, but...
- GCS 13–15
- Neurological exam (initial seizures, lesions, aphasias, gait disorders, anosmia)
- Imaging (MRI, CT)

CT = computed tomography; GCS = Glasgow Coma Scale; LOC = loss of consciousness; MRI = magnetic resonance imaging

Controversy

- So, it is often really hard to diagnose
- Diagnosis really matters
- Diagnosis impacts expectation for doctor and patient

Pre-eminent questions:
- What are clinically useful diagnostic criteria?
- Who had a physiological disruption of brain function?
Differential Diagnosis

- PTSD
- Depression
- Substance abuse
- Anxiety disorder
- ADHD
- Malingering
- Iatrogenic

ADHD = attention deficit hyperactivity disorder;
PTSD = post traumatic stress disorder
<table>
<thead>
<tr>
<th></th>
<th>PCS</th>
<th>PTSD</th>
<th>MAD</th>
<th>Chronic HA</th>
<th>Malingering</th>
<th>Substance Abuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatigue</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Sleep D/O</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Headache</td>
<td>X</td>
<td>?</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Dizziness</td>
<td>X</td>
<td>X</td>
<td>?</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Irritability</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Anxiety</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Depression</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Personality D/O</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>?</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Apathy</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>?</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Concentration</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Memory</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>?</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

D/O = disorder; MAD = major affective disorder; PCS = post-concussion syndrome
Mechanisms of Injury

- Contusions
  - Contrecoup 2°
    - Sudden deceleration
    - Impact not required, but...

- Traumatic Axonal Injury (DAI)
  - Injury proportional to force—Controversial
  - No Shearing—Controversial
  - Mechanical—Stretched neurons
  - Chemical

DAI = diffuse axonal injury
Neurotransmitter Changes

- Glutamine
- Catecholamines
- Serotonin
- Acetylcholine
- Norepinephrine
- Others
Short-Term Effects of MTBI

- Headache, fatigue, dizziness, photophobia, sleep, hyperacusis
- Attention
- Concentration
- Memory
- Irritability
- Depression
- Anxiety
- Relationships
- Work
Clinical Evaluation

- History—patient and others
  - Accident
  - Pre-accident and post-accident
- Standardized questionnaires (GOAT)
- Neurologic exam
- Neuroimaging
- Psychiatric exam
- Neuropsychological assessment
- Standardized academic testing and grades

GOAT = Galveston Orientation and Amnesia Test
The Galveston Orientation and Amnesia Test

Harvey S. Levin, Ph.D., Vincent M. O’Donnell, M.A., & Robert G. Grossman, M.D.

Instructions: Can be administered daily. Score of 78 or more on three consecutive occasions is considered to indicate that patient is out of post-traumatic amnesia (PTA).

<table>
<thead>
<tr>
<th>Question</th>
<th>Error Score</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is your name?</td>
<td>-2</td>
<td>Must give both first name and surname.</td>
</tr>
<tr>
<td>When were you born?</td>
<td>-4</td>
<td>Must give day, month, and year.</td>
</tr>
<tr>
<td>Where do you live?</td>
<td>-4</td>
<td>Town is sufficient.</td>
</tr>
<tr>
<td>Where are you now:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) City</td>
<td>-5</td>
<td>Must give actual town.</td>
</tr>
<tr>
<td>(b) Building</td>
<td>-5</td>
<td>Usually in hospital or rehab center. Actual name necessary.</td>
</tr>
<tr>
<td>When were you admitted to this hospital?</td>
<td>-5</td>
<td>Date.</td>
</tr>
<tr>
<td>How did you get here?</td>
<td>-5</td>
<td>Mode of transport.</td>
</tr>
<tr>
<td>What is the first event you can remember after the injury?</td>
<td>-5</td>
<td>Any plausible event is sufficient (record answer).</td>
</tr>
<tr>
<td>Can you give some detail?</td>
<td>-5</td>
<td>Must give relevant detail.</td>
</tr>
<tr>
<td>Can you describe the last event you can recall before the accident?</td>
<td>-5</td>
<td>Any plausible event is sufficient (record answer).</td>
</tr>
<tr>
<td>What time is it now?</td>
<td>-5</td>
<td>-1 for each half-hour error.</td>
</tr>
<tr>
<td>What day of the week is it?</td>
<td>-5</td>
<td>-1 for each day error.</td>
</tr>
<tr>
<td>What day of the month is it? (i.e. the date)</td>
<td>-5</td>
<td>-1 for each day error.</td>
</tr>
<tr>
<td>What is the month?</td>
<td>-15</td>
<td>-5 for each month error.</td>
</tr>
<tr>
<td>What is the year?</td>
<td>-30</td>
<td>-10 for each year error.</td>
</tr>
</tbody>
</table>

**Total Error**

Total Actual Score = (100 - total score) = 100 - Total Error

- 76-100 = Normal
- 75-70 = Borderline
- <65 = Impaired

Developed by Harvey Levin, Ph.D., Vincent M. O’Donnell, M.A., & Robert G. Grossman, M.D.

Research Tools

- SPECT
- Computerized EEG
- Auditory evoked potentials
- Diffusion tensor imaging (DTI)
- S-100B, a neuroprotein

EEG = electroencephalogram;
SPECT = single photon emission computed tomography
Risk Factors

- Stress at time of accident
- Post-accident depression/anxiety
- Social support
- Headache and dizziness

Course of MTBI

- Athletes—baseline in 2–21 days
- MVA—recovered in 3 months
- “Worst is first”

MVA = motor vehicle accident
Athletic Injuries

- NFL—650 players with 887 concussions
  - No one failed to return to play
  - 56% in 1–6 days
  - 36% in 7–14 days
  - 6.5% in more than 14 days
  - No measurable effect on cognitive function after acute recovery

NFL = National Football League
Military Injuries

- TBI—a common injury
- 15–20% MTBI in Iraq and Afghanistan
- Compared with soldiers with other injuries, MTBI with LOC had more
  - Poor health
  - Missed work
  - Medical visits
  - PPCS symptoms
- However, after adjusting for depression and PTSD
  - No association between MTBI and physical health outcomes/symptoms except HA

PPCS = persistent post-concussion syndrome
Treatment Principles

- Do No Harm
- Realistic reassurance = evidence-based optimism
- Education
- Diagnose and treat early

Treatment Considerations

- Evaluate life stressors
- Pain
- Psychiatric disorders: Pre-existing and post
- Occupational intervention: Back on the horse
- Family involvement
- CBT

- Great care with meds that impact and may worsen CNS function
  - Polypharmacology - +’s and –’s
  - Start low—go slow
  - Avoid narcotics
  - Side effect sensitivity

CBT = cognitive-behavioral therapy; CNS = central nervous system
Treatment Options

- Depression
  - Sertraline
  - Citalopram
  - Concern: bupropion and seizures

- Cognitive
  - Speed of information

- Memory
  - Donepezil

Persistent Post-Concussion Syndrome
What Is Post-Concussion Syndrome?

- Must have had:
  - A “significant cerebral concussion”

- Three other symptoms X 3 months
  - Loss of consciousness
  - Amnesia
  - Seizures

- Or is it a psychological-psychosomatic extension of a previous brain injury?

- Or is it expectation plus?

Prevalence of PPCS

- 40% at 3 months\(^1\)
- 16–50% at 6 months\(^2\)
- < 6% at 1 year\(^3\)

PPCS Predictive Factors

- Anxiety
- Chronic pain
- Depression
- Female
- Headache
- Litigation
- Lower SES
- Prior TBI
- Serious injury
- Social problems
- Substance abuse

SES = socioeconomic status
Test for Malingering

Amsterdam Short-Term Memory Test

MTBI Litigant  61%

MTBI Non-Litigant  29%

MTBI with Orthopedic Controls

- Sample > 200
- Lithuania—Litigation rare

<table>
<thead>
<tr>
<th></th>
<th>3 Months MBTI (n = 200)</th>
<th>12 Months MBTI (n = 192)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control (n = 210)</td>
<td>Control (n = 215)</td>
</tr>
<tr>
<td>6 Core PCS Symptoms</td>
<td>MTBI Controls</td>
<td>2 (1%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 (1.5%)</td>
</tr>
<tr>
<td>3 Core PCS Symptoms</td>
<td>MTBI Controls</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PPCS Following MTBI

- Rare in prospective studies
- Seen equally in post-MTBI and non-brain injury trauma
- Usually no neuropsychological test evidence of organic brain disorder
- Not predicted by original peritraumatic amnesia
25% of patients with concussion have some symptoms (but not necessarily from a concussion) persist at least a year.

“It is getting increasingly difficult…to find good scientific evidence that MTBIs are associated with demonstrable cognitive deficits where symptoms are due to the biologic effects of the injury in more than a small minority of patients who are more than 3 months post-injury.”

– Grant Iverson

“Post-concussion-like symptoms are common in healthy subjects and patients with no history of brain injury, outpatients seen for minor medical problems, in personal injury claimants, patients with PTSD, patients with orthopedic injuries, individuals with prior pain, and patients with whiplash.”

“The effects of MTBI on neuropsychological functioning after the acute recovery period are considerably less than the effects of litigation, depression, or ADHD.”

– Grant Iverson

People never head-injured reported the usual, expected symptoms of MTBI correctly
- Early and late experience reinforces expectation
- Prior symptom levels underestimated

Effect Sizes on Neuropsychological Functioning

Effect Sizes on Memory Functioning

Conclusions

Presence of Cognitive Deficits

- HI = Cognitive Deficits
- Cognitive Deficits $\neq$ HI
- Must make sense
- Severity defined by injury characteristics
  - When they don’t, think psychiatry etiology
- Symptoms improve

HI = head injury
Conclusions

- MTBIs and PPCSs exist
- Real MTBIs have short-term impacts on cognition, emotions, neurologic function
- They are under-diagnosed and they are over-diagnosed
- Very heterogeneous
- They are very hard to accurately diagnose
- Need more than dazed and symptoms
- Need real traumatic insult to the brain
Conclusions (cont.)

- Most MTBIs heal during first week to 3 months
- Primary injury does not get worse over months
- First is worse!
- Head injury causes the presence of cognitive deficits, but the presence of cognitive deficits does not necessarily mean head injury
- PPCS: Think “expectations”
  - Think rehabilitation
  - Think biopsychosocial

The field badly needs better diagnostic tools
Summary
This CME/CE activity is co-sponsored by

Southwestern Medical Center

CME Outfitters
Mild Traumatic Brain Injury and Post Concussion Syndrome: Diagnosis, Treatment and Controversy
Joel J. Silverman, MD


