Neuropsychology of TBI & PTSD

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TBI: The Signature Injury of the Iraq/Afghanistan War Veteran?

- 19% - 30% of OEF/OIF veterans reported some level of TBI (Blast Wave Exposure)

- Although less than half report seeking help.

(DOD/Veterans Brain Injury Center Estimates; U.S. Dept. of Health & Human Services Estimates)
In 2005, virtually 100% deaths and 80% of casualties of U.S. forces were from roadside bombs or improvised explosive devices (IEDs).

More recent estimates by the DOD: 63% of all injuries

- Vast majority classified as mild

(Glasser, 2006)
TBI: The Signature Injury of the Iraq/Afghanistan War Veteran?

- This has lead some in the military to speculate that TBI is the “Signature Injury” of these wars.

(Military TBI Task Force Position Paper, 2008)
Persistence of Cognitive Deficits Secondary to MTBI
Persistence of Cognitive Deficits
Reitan & Wolfson (2001)

• Research on persistent cognitive deficits from MTBI (based upon LOC < 20-30 minutes) revealed the following:

  • *Does not* result in severe or permanent disability and *self-reported complaints* of such problems do not reflect brain damage” (Greiffenstein, Gola & Baker, 1995)
Research on persistent cognitive deficits from MTBI (based upon LOC < 20-30 minutes) revealed the following:

- Any immediate deficits are subtle and usually resolve by 3 months to 1 year following the injury.

(Dikman et al., 1995; Levin et al., 1987; Belanger, et al., 2005; Binder et al, 1997)
Research on persistent cognitive deficits from MTBI (based upon LOC < 20-30 minutes) revealed the following:

- Effect size for 8 years following mild head injury is trivially small (- 0.03) (Vanderploeg et al., 2005)
The literature clearly demonstrates that a single uncomplicated concussion is a transient neurologic event characterized by gradual resolution of cognitive dysfunction and complete recovery within days to weeks of injury for the majority of mTBI patients.

McCrea (2008)
An understanding of the effect of blast injury effects on brain functioning is in its infancy (Military TBI Task Force Position Paper, 2008)

Due to the “fog of war”, there is minimal good documentation regarding the injury

- Distance from and strength of the blast
- Ratings of Glasgow Coma Scale (GCS) or Posttraumatic Amnesia (PTA), etc.
- These are typically fully documented in civilian-related TBI (police, EMS, ER reports, etc.)
State of Knowledge of Blast Injury

- An understanding of the effect of blast injury effects on brain functioning is in its infancy (Military TBI Task Force Position Paper, 2008)

- Assessment of cognitive difficulties are typically based solely upon retrospective self-report
  
  - Significant limitations when using self-report of cognitive impairment – found to be a very poor indicia of actual brain dysfunction
State of Knowledge of Blast Injury

- Blast injuries to air filled organs (e.g., ear, lungs, gastrointestinal tract) is well described in the literature although effect on brain in survivors is lacking

- Commonly believed that the high pressure blast wave is sufficient to cause brain injury in human beings

(Warden, 2006)
There are very few published, peer reviewed, prospective research studies with human subjects that have demonstrated this to be the case.

The evidence is based on a few old single case studies, military documents that were not scientific research studies, and data from animal research.

(Carone, 2009)
Quantitative studies that have been conducted in OIF-OEF veterans with mild blast injury have largely shown mean group scores well above the established cutoff as indicative of brain damage.
Exploring the Link Between Self-Reported MTBI Complaints and PTSD

- Hoge et al. (2008) studied self-reported Mild TBI in 2,525 returning Iraq war veterans
  - 3-4 months post deployment:
    - 44% of those who reported a brief loss of consciousness, and 27% who reported some altered mental state, also met diagnostic criteria for PTSD.
    - If there is a clear link between self-reported mTBI complaints and PTSD, then what is the nature of that link?
Mild TBI In Returning Iraq War Veterans
(Hoge et al, 2008)

- Effect of Statistically Adjusting for PTSD and Depression on Cognitive & Physical Complaints
  - All complaints, except headache, were non-significant in terms of post-concussion symptoms (i.e., likelihood of experiencing symptoms)
  - Not surprisingly, PTSD and depression were strongly associated with physical and cognitive complaints
Extensive symptom overlap between PCS and PTSD

Hoge et al. found there was little PCS variance that is unique to mTBI after symptoms of PTSD and depression were accounted for in the statistical analysis.
Considerable Symptom Overlap Between PCS and PTSD

<table>
<thead>
<tr>
<th>Postconcussion Syndrome (PCS)</th>
<th>Posttraumatic Stress Disorder (PTSD)</th>
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<tbody>
<tr>
<td>• Insomnia</td>
<td>• Insomnia</td>
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<tr>
<td>• Impaired memory</td>
<td>• Memory problems</td>
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<tr>
<td>• Poor concentration</td>
<td>• Poor concentration</td>
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<tr>
<td>• Depression</td>
<td>• Depression</td>
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<td>• Anxiety</td>
<td>• Anxiety</td>
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<td>• Irritability</td>
<td>• Irritability</td>
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<tr>
<td>• Apathy/Flat Affect</td>
<td>• Emotional Numbing</td>
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<td>• Noise/light intolerance</td>
<td>• Noise intolerance</td>
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<tr>
<td>• Fatigue</td>
<td>• Sleep Problems</td>
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<tr>
<td>• Headache</td>
<td>• Re-experiencing</td>
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<tr>
<td>• Dizziness</td>
<td>• Avoidance</td>
</tr>
</tbody>
</table>
Considerable Symptom Overlap Between PCS and PTSD

- PCS symptoms are also highly elevated in:
  - Depression (Iverson, 2006)
  - Chronic pain (Iverson & McCracken, 1997)
  - Orthopedic Injuries (Mickeviciene, et al, 2002)
  - Litigation Status (Carrol et al, 2004)

- PCS symptoms occur at a fairly high base rate in the normal population (Iverson & Lang, 2003; Wang et al, 2006)
Caveats Regarding Recovery of Neurocognitive Function Following Mild TBI
Bigler (2001)

• Studies assessing the cognitive effects of mTBI rely upon group effects or meta analyses of group effects
  - Individual effects showing impaired performance may be obscured
  - This doesn’t necessarily rule out the MTBI-related cognitive deficits in some veterans
  - Hoge et al. acknowledged this in his study
What do we know about the Polytrauma and/or OIF/OEF veterans referred to the Cleveland VAMC for neuropsychological since the inception of the Polytrauma Program?

- The modal diagnoses are Mild TBI (mTBI) and PTSD.
Preliminary Findings on Polytrauma Veterans at the Cleveland VAMC

• Before analyzing the data, those malingering either memory impairment (22%) or psychopathology (4%) were excluded from the sample

• Mean scores revealed no impairment across all domains of cognition:
  • Long-term Memory, Problem-solving, Planning/Organization, Language, Visuospatial, Working Memory/Attention, Speed-of-Processing
Preliminary Findings on Polytrauma Veterans at the Cleveland VAMC

HOWEVER

- 27% of the sample had some level of significant cognitive impairment:
  - Speed-of-Processing (31%) and Working Memory (27%)
  - Impairment tended to be mild across nearly all domains except Visuospatial & Planning/Organization, which were unimpaired *
Preliminary Findings on Polytrauma Veterans at the Cleveland VAMC

- Nearly all veterans carried an anxiety spectrum disorder (i.e., PTSD)
- ~60% of ALL veterans had significant moderate-severe elevations in scales measuring anxiety, demoralization/depression
- Self-report of cognitive complaints in this population clearly outweigh actual findings
Mixed results regarding the relationship between PTSD and neurocognitive dysfunction

- Ranges from no relationship to very small effect sizes
Increased PET activation of amygdala and decreased frontal activation in response to symptom provocation and cognitive challenge such as when performing a vigilance task (CPT)

Cognitive dysfunction may be secondary to increased emotional stress

This pattern is not unique to PTSD, as it also occurs in patients with anxiety disorders.
Brain Mechanisms Involved in Mood and Cognitive Disturbances in Head Injury and PTSD

In PTSD and depression, the frontal brain is “hijacked” by the limbic brain
During emotionally acute episodes:

- Hypermetabolism in the amygdala and orbitofrontal cortex
- Resting State hypometabolism in the dorsolateral prefrontal cortex (DLPFC)
- Impaired working memory
• MTBI cases largely return to baseline cognitive functioning with time

• Persistent cognitive deficits, if any, are mild

• PTSD/Anxiety is extremely prevalent in veterans exposed to blast wave/IEDs

• PTSD/Anxiety effects on Neurocognitive deficits are none to mild and may vary depend on severity/acuteness
Summary

• Regardless...veterans over-estimate severity of their cognitive deficits and underestimate the impact of emotional dysfunction

• Probability for error is higher when diagnosing brain damage than diagnosing PTSD
Is TBI Really The "Signature Injury"
or Is It PTSD?