Combat-Related mTBI: Patient Subtypes, Empirical Evidence, and Treatment Implications

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Disclosures

The views, opinions and findings contained in this report are those of the author(s) and should not be construed as an official Department of Defense position, policy or decision unless so designated by other documentation.

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In the Military, mild Traumatic Brain Injury (mTBI) is common....

- 15-30% of troops engaged in active combat in Afghanistan and Iraq sustained a mTBI
Military and mTBI

- Commanders required to ensure mandatory evaluation for any Service Member (SM) in a “mandatory event”:
  - Any SM in a vehicle associated with a blast event, collision, or rollover
  - Any SM within a specified distance of a blast (inside or outside)
  - A direct blow to the head or witnessed loss of consciousness
  - Command-directed, especially in a case with exposure to multiple blast events.

- Advanced Treatment of Concussion in Combat Arenas
  - i.e., Concussion Restoration Care Center (CRCC) in Afghanistan
Traumatic Brain Injury (TBI)

- A traumatically induced structural injury and/or physiological disruption of brain injury following an external force
  - With at least one of the following immediately after:
    - Loss or decreased level of consciousness
    - Any loss of memory of events surrounding the injury
    - Alteration in mental status (e.g., confusion)
    - Neurological deficits (weakness, loss of balance, dizziness, praxis, paresis/plegia, sensory loss, aphasia)
    - Intracranial lesion

(DOD/VA 2009 Clinical Practice Guideline)
Traumatic Brain Injury (TBI)

- Mild Traumatic Brain Injury (mTBI)
  - Loss of consciousness (LOC) less than 30 minutes
  - Alteration of consciousness (AOC) for less than 24 hours
  and/or
  - Post-traumatic amnesia (PTA) less than 24 hours
Mild TBI: Subtype Classification

- Symptoms of Mild TBI vary widely across patients:
  - forgetfulness, poor attention, slow processing speed, impaired problem-solving, poor concentration, fatigue, abnormal sleep, hearing loss, dizziness, balance problems, visual changes, headaches, fatigue, depression, irritability, anxiety....
Mild TBI: Subtype Classification

- Are there sub-types of combat-related Mild TBI
  - Miserable Minority versus Good Recovery?
  - Psychiatric Subtype?
    - Emotional symptoms following mTBI are similar to post-traumatic stress (PTS)
    - Emotional disorders have a large impact on post-concussive symptoms
    - Depression (Lange et al., 2011)
    - PTSD (Belanger et al., 2010)
Identification of Subtypes

- **Participants**
  - $n = 1,341$
  - Recruited from 6 MTFs
  - Combat-Related Mild TBI
    - 73.7% OIF, 26.3% OEF
    - 54.0% within 3 months of injury
    - 83.8% blast related injury

- **Measures**
  - Neurobehavioral Symptom Inventory (NSI)
    - 22 items
    - Post-Concussive Symptoms
      - affective, vestibular, cognitive, physical, sensory
  - PTSD Checklist (PCL-C)
    - 17 items
    - Post-traumatic stress
      - Hyperarousal, re-experiencing, avoidance
Identification of Subtypes

- **Data Reduction**
  - 39 Self Reported Symptoms
  - **Exploratory Factor Analysis**
    - Hyperarousal
      - 1 NSI, 10 PCL items
    - Dissociation/Depression
      - 4 NSI, 6 PCL items
    - Cognitive/Headaches
      - 8 NSI, 1 PCL items
    - Neurological
      - 9 NSI, 0 PCL items

- **Symptom Profile Analysis**
  - **Internal Validation**
    - 2-Step Cluster Analysis Procedure
      - Replication across methods
        » hierarchical
  - **External Validation**
    - Resulting Profiles compared on demographic and injury related variables.
Results

Combat Mild TBI: Symptom Profiles

Error bars represent 2 SEM
Results

Combat Mild TBI: Symptom Profiles

Total Score (Max 50)

- Hyperarousal
- Depression
- Cognitive
- Neurological

Error bars represent 2 SEM

Legend:
- Purple: Good Recovery (n=508)
- Light gray: Primary Cognition (n=289)
- Medium gray: Primary Psychiatric (n=294)
- Dark gray: Mixed Presentation (n=250)
Good Recovery Group

- Frequently Experienced **Severe** Symptoms
  - Poor Sleep (22%-28%)

- 65% of this group had normal rates of post-concussive symptoms
Results

Combat Mild TBI: Symptom Profiles

Symptom Summary Scores

- Hyperarousal
- Depression
- Cognitive
- Neurological

Error bars represent 2 SEM

Total Score (Max 50)

- Good Recovery (n=508)
- Primary Cognition (n=289)
- Primary Psychiatric (n=294)
- Mixed Presentation (n=250)
Primary Cognition/Headaches

- Frequently Experienced **Severe** Symptoms
  - Headaches (52.2%)
  - Forgetfulness (46%)
  - Poor Sleep (39%-42%)
  - Poor Concentration (36%)
  - Slowed Thinking (26%)
Results

Combat Mild TBI: Symptom Profiles

- Good Recovery (n=508)
- Primary Cognition (n=289)
- Primary Psychiatric (n=294)
- Mixed Presentation (n=250)

Symptom Summary Scores

- Hyperarousal
- Depression
- Cognitive
- Neurological

Total Score (Max 50)

Error bars represent 2 SEM
Primary Psychiatric

- Frequently Experienced **Severe** Symptoms
  - Poor Sleep (68%-85%)
  - Repeated Memories of Event (72%)
  - Repeated Dreams of Event (68%)
  - Easily Startled (61%)
  - Feeling On Guard (59%)
  - Avoiding Thinking of Event (58%)
  - Feeling Upset when Reminded (55%)
Results

Combat Mild TBI: Symptom Profiles

- Good Recovery (n=508)
- Primary Cognition (n=289)
- Primary Psychiatric (n=294)
- Mixed Presentation (n=250)

Error bars represent 2 SEM

Symptom Summary Scores
- Hyperarousal
- Depression
- Cognitive
- Neurological

Total Score (Max 50)
Mixed Psychiatric/Cognitive

- Frequently Experienced **Severe** Symptoms
  - Poor Sleep (57%-68%)
  - Poor Concentration (63%)
  - Irritability (57%-63%)
  - Forgetfulness (55%)
  - Feeling Distant/Cut-Off (53%)
  - Feeling On Guard (54%)
  - Easily Startled (50%)
Cluster Subtype Validation

- **Internal Validation:**
  - Multi-profile multi-method correlation matrix

- **External Validation:**
  - Differences between groups on key variables
    - Demographic Information
    - TBI Characteristics (e.g., duration PTA)
    - Associated Medical Information (e.g., other non-TBI physical injuries)
Key Mild TBI Subtype Characteristics

- “Good Recovery” Type (37.9%)
  - Lowest symptom profile
  - More likely sub-acute phase (< 3 months)
  - Injured later in conflicts (2008-2011)
  - More physical injuries and higher rates of pain medication use
Key Mild TBI Subtype Characteristics

- “Primary Cognition/Headache” Type (21.5%)
  - Complaints of poor attention, forgetfulness, headaches and light sensitivity
  - Second highest return to duty rate
  - Lowest anti-depressant use
  - Highest rate of central nervous system (CNS) abnormality (e.g., subdural hematoma)
“Primary Psychiatric” Type (21.9%)

- Prominent symptoms of hyperarousal and dissociation/depression
- High rate of antidepressant usage
- Typically injured earlier in conflicts (2004-2007)
“Mixed Presentation” Type (18.6%)

- Notable complaints of hyperarousal, depression, as well as cognitive complaints and headaches
- Lowest rates of CNS abnormality (similar to Primary Psychiatric type)
- High rate of antidepressant use and low rate of pain medication use
- Delayed engagement in treatment
- Highest return-to-duty percentage
Conclusions

- Four distinct subtypes of combat-related Mild TBI
  - Unique symptoms profiles that were validated by external variables (demographic and injury characteristics)

- Majority of patients had a relatively low symptom profile

- Psychiatric symptoms, typically associated with PTSD, were notable features of two identified sub-types

- Neurological symptoms (e.g., sensory changes) had a minimal effect ($\eta_p^2 =0.02$) on subtype identification
Treatment Implications
Treatment Implications

- One size fits all?
  - Comprehensive pathways involving multi-disciplinary treatment team (i.e., every patient sees every provider):
    - Vestibular Therapy
    - Physical Therapy
    - Occupational Therapy
    - Speech Therapy
    - Psychology (e.g., Neuropsychology, Health Psychology)
    - Psychiatry
    - Medical (e.g., Neurology, Physiatry, Sports Medicine)
  - Cost? Time? Iatrogenic Effects?
Individualized Symptom Based Treatment Programs:

- Decisions of rehabilitation based specifically on symptom presentation
- Comprehensiveness of treatment plan development may be sacrificed
- Reliant on the patient’s ability/willingness to report symptoms
  - Insight into the relationship between symptom and mTBI
Treatment Implications

- Development of Treatment Tracks
  - Not every patient needs every specialty service, but most patients require similar services
  - Based on symptomatology at intake, it may be possible to develop broad treatment tracts that meet the needs of most patients while maintain efficient use of resources
Treatment Pathways

Track 1: Intake/Evaluation
- TBI Education
- Sleep Hygiene
- Headache Mgmt
- Cognitive Assessment/Tx

Track 2: Cognitive/HA
- TBI Education
- Sleep Hygiene
- Mental Health Tx (PTS)*

Track 3: Primary Psychiatric
- TBI Education
- Sleep Hygiene
- Cognitive Assessment/Tx
- Mental Health Tx*

Track 4: Cog/MH
- TBI Education
- Sleep Hygiene
- Cognitive Assessment/Tx
- Mental Health Tx*

*Consider referral to primary mental health services
Treatment Implications

- Continue identification of subtypes
  - Treatment Outcome? Prognosis?
    - Early evidence suggests the Primary Cognitive Group and Mixed Presentation Group have statistically better response to multi-disciplinary TBI treatment.
  - Return to duty rates? Disability?
  - Biomarker differentiation?

- Would empirically based Treatment Tracks improve treatment efficiency and outcome?
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