Overview of Traumatic Brain Injury (TBI) in the Military

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Disclaimer

The views expressed are those of the presenters and do not necessarily reflect the opinions of the Uniformed Services University of the Health Sciences, the Department of Defense, or the U.S. Government.

Acknowledgements

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Learning Objectives

1. Define and differentiate between different types of traumatic brain injuries.
2. Identify the mechanisms of brain injury common in a military population.
3. Discuss traumatic brain injury resources for military clients, families, and providers.

Definition of TBI

Any injury to the head that results in:
- Loss of consciousness for any period of time
- Loss of memory immediately before or after injury
- Alteration of mental state
- Focal neurological deficits transient or non-transient in nature

American Congress of Rehabilitation Medicine, (1993).

What is Traumatic Brain Injury (TBI)?

Neurocognitive Disorder: DSM-5

A: Decline in one or more cognitive domains:
- Complex attention
- Executive functioning
- Learning and memory
- Perceptual-motor
- Social cognition
Neurocognitive Disorder: DSM-5

- Major Neurocognitive Disorder, Criteria A
  - Concern of the individual, a knowledgeable informant, or the clinician that there has been a significant decline in cognitive functioning
  - A substantial impairment in cognitive performance, preferably documented by standardized neuropsychological testing

B: Capacity for independence in everyday activities
- The degree to which the neurocognitive deficits affect the individual’s capacity for independent activities differentiates between Major and Mild Neurocognitive Disorder

- Mild Neurocognitive Disorder, Criteria A
  - Concern of the individual, a knowledgeable informant, or the clinician that there has been a mild decline in cognitive functioning
  - A moderate impairment in cognitive performance, preferably documented by standardized neuropsychological testing

- Major Neurocognitive Disorder, Criteria B
  - Interferes with independence
  - Requiring assistance with complex instrumental activities (paying bills or managing medications)

- Mild Neurocognitive Disorder, Criteria B
  - Does not interfere with independence
  - Greater effort, compensatory strategies or accommodation may be required
Neurocognitive Disorder: DSM-5

C: Deficits do not occur exclusively in the context of delirium
D: Not better explained by another mental disorder

Neurocognitive Disorder due to TBI

A: Criteria met for Neurocognitive Disorder
B: Evidence of a TBI with one or more of the following:
   1. Loss of consciousness
   2. Posttraumatic amnesia
   3. Disorientation and confusion
   4. Neurological signs

C: The neurocognitive disorder presents immediately after the occurrence of the TBI or immediately after recovery of consciousness, and persists past the acute post-injury period.

Emergency Department Visits, Hospitalizations and Deaths Related to TBI 2001-2010 (per 100,000)

Centers for Disease Control and Prevention (2014)
All Armed Forces – TBI
2000 – 2014 Q2

DoD Numbers for Traumatic Brain Injury
Worldwide – Totals

- Penetrating: 4,538
- Severe: 3,088
- Moderate: 25,370
- Mild: 253,350
- Not Classifiable: 20,937

Total - All Severities: 307,283

2000-2014 Q2, as of Aug 19, 2014

Mechanisms of Injury

- Traumatic Brain Injury
  - Closed
    - Explosion, Blast
    - Motor Vehicle Accident
    - Falls
  - Penetrating
    - Stabbing
    - Gunshot Wound
    - Fragment

TBI Incidents by Branch of Service
2000 – 2010

Closed Brain Injury

- Diffuse Axonal Injury
- Contra Coup
Diffuse Axonal Injury (DAI)

Penetrating Brain Injury

Mechanisms of Blast Injuries

Primary
Secondary
Tertiary
Quaternary

Blast Mechanism Overview

Invisible Wounds

Shock waves from an explosive blast can cause injuries as the invisible pressure variations pass through brain tissue. Shock waves can also cause brain trauma by compressing the chest and abdomen, which transfer the wave's kinetic energy through large blood vessels into the brain.

Shrapnel, by fragmenting the blast wave and penetrate the skull or hit the head with conductive force.

Acceleration of the body can cause trauma. Rapid head movement can cause the brain to strike the inside of the skull, and hitting the ground or a wall can lead to bruising on the opposite side of the brain.

Source: Jody Crenn, Johns Hopkins Applied Physics Laboratory
Primary Blast

- Enormous Over-Pressurization Wave:
  - Axonal Damage
  - Changes in Cell Metabolism
- Primary Blast Injuries Examples:
  - Ear/Auditory/Vestibular
  - Lung
  - Abdomen

Secondary Blast Injury: Flying Debris

Objects propelled by blast wind
- Small missiles accelerated to 50 ft/sec cause skin laceration
- Speeds of 400 ft/sec associated with body cavity penetration

Secondary Blast Injury: Fragment and Shrapnel Wounds

Image: Al Granberg/ProPublica
**Tertiary Blast Injuries**

- Body Displacement by:
  - Overpressure
  - Shockwave
- Close to explosion
- Multiple Fractures
- Head Injuries
- Amputations

**Quaternary or Miscellaneous Blast Injuries**

- Collapsed Structures
- Displaced Heavy Objects
- Smoke Inhalation
- Burn Injuries
- Complications from Existing Conditions

**Concussion/mTBI Assessment: Principle Goals**

- **Identify** patients who have experienced risk for mTBI
- **Minimize** impact of secondary effects
- **Improve** treatment outcome
- **Optimize** mTBI care
- **Reduce** disability

**Predisposing TBI Risk Factors**

- Psychiatric Conditions
- Personality Traits
- Medical Conditions
- Intelligence Level
- Demographic Characteristics
- Coping Abilities
Concussion Screening

- Military Acute Concussion Evaluation (MACE)
- Screening Protocols in Theater, Landstuhl, MTFs
- PDHA, PDHRA
- VA 4 Questions

Pre-Deployment Testing: ANAM

- Automated Neuropsychological Assessment Metrics (ANAM)
- Establishes an accurate baseline of cognitive performance

Accurate Diagnostic Factors

- Screening Checklists
- Records Review
- COC Input
- Family/Patient Interview
- Concussion History
- Potential Missed & Misdiagnoses Issues

TBI Assessment Domains

<table>
<thead>
<tr>
<th>Severity</th>
<th>Glasgow Coma Score (GCS)</th>
<th>Alteration in consciousness (AOC)</th>
<th>Loss of consciousness (LOC)</th>
<th>Post traumatic amnesia (PTA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>13 – 15</td>
<td>≤ 24 hrs</td>
<td>0 – 30 min</td>
<td>≤ 24 hrs</td>
</tr>
<tr>
<td>Moderate</td>
<td>9 – 12</td>
<td>&gt; 24 hrs</td>
<td>&gt; 30 min, &lt; 24 hrs</td>
<td>&gt; 24 hrs, &lt; 7 days</td>
</tr>
<tr>
<td>Severe</td>
<td>3 – 8</td>
<td>&gt; 24 hrs</td>
<td>≥ 24 hrs</td>
<td>≤ 7 days</td>
</tr>
</tbody>
</table>

- Consider imaging results when determining level of severity
- Positive Imaging = at least a moderate TBI rating
- GCS not as useful given complications of theater setting
- Use of AOC in DoD severity rating

Fallen Heroes Fund
**TBI “Red Flags”**

- a) Altered consciousness
- b) Progressively declining neurological exam
- c) Pupillary asymmetry
- d) Seizures
- e) Repeated vomiting
- f) Double vision
- g) Worsening headache
- h) Cannot recognize people or is disoriented to place
- i) Behaves unusually or seems confused and irritable
- j) Slurred speech
- k) Unsteady on feet
- l) Weakness or numbness in arms/legs

**Identified as Positive for Concussion**

- Evaluate and treat symptoms
- Assess for non-TBI factors contributing to presentation
- Assess cognitive complaints through formal testing, if appropriate
- Educate about recovery appropriately depending on severity of injury and time since injury

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**Concussion Education**

- Early intervention with TBI education and positive expectations have a direct effect on recovery
  - Patients, families, providers, military command, employers
  - Reduces patient and family anxiety
- Prevent re-injury while recovering
- Address specific symptoms (e.g., headaches, sleep problems) with strategies or referrals

**Concussion Brain Injury Clinical Course**

**Expected Outcomes**

- Full recovery (vast majority)
  - Rapid recovery (days to weeks) with minimal intervention
  - Longer recovery (3 months – 12 months)
- Persisting symptoms (minority; years)
  - Sometimes referred to as post-concussive syndrome (PCS) but controversial and not in DSM-5
Concussion Brain Injury Clinical Course

- Second impact syndrome (repeated mild concussion before full recovery) -> possible [rare] fatality (synergistic effects)
- Multiple concussions (>2) over time – more morbidity/slower recovery
- “Invisible Injury”
  - Can adversely impact interpersonal relationships
  - Symptoms can be missed due to more apparent physical injuries
  - Co-morbid emotional distress

What are common changes following a concussion?

Thinking Changes in “Executive Functioning”

- Planning/goal setting
- Organization
- Flexibility
- Problem solving
- Prioritizing
- Decreased awareness of thinking changes in self

Thinking Changes

- Learning & Memory
- Attention
- Processing Speed
- Communication
Emotional, Behavioral, and Social Changes

- Depression
- Rebellious
- Difficulty with self initiation
- Impatience
- Inability to get along with others
- Increased risk taking
- Anxiety
- Increased impulsivity
- Irritability/agitation
- Socially inappropriate behavior
- Intolerant
- Before-after contrasts
- Increased self focus
- Rapid loss of emotional control (short fuse) and poor self-monitoring

Long Term Challenges Post TBI

- Vocational and/or school failure
- Family life/social relationships collapse
- Increased financial burden on families and social service systems
- Alcohol and drug abuse
- Chronic depression/anxiety

TBI and DoD

Some controversies include:

- Diagnosis of mTBI
- Effectiveness of cognitive rehabilitation
- Utility of ANAM

Comorbid Conditions & TBI Overview

- Risk of psychiatric conditions increase with TBI
- Assessment difficulties due to similar symptoms
- Psychiatric conditions and cognitive compromise

Post-Deployment Disorders

Sample = 340 OEF/OIF outpatients at Boston VA

- TBI: 5.3%
- PTSD: 2.9%
- Pain: 10.3%
- TBI/Pain: 6.8%
- Pain/PTSD: 46.5%
- Post-deployment Multi-symptom Disorder: 42.1%

Clark (2009)

Concussion and PTSD Overlap

- Headache
- Sensitivity – light or noise*
- Fatigue
- Insomnia
- Cognitive Deficits
- Irritability
- Nausea
- Avoidance
- Flashbacks
- Hypervigilance
- Nightmares
- Tension

* Some PTSD patients startle to noises; sensitivity to noises could also be either PTSD as well.

Concussion and Depression Overlap

- Headache
- Sensitivity – light or noise
- Fatigue
- Insomnia
- Cognitive Deficits
- Irritability
- Appetite
- Sadness
- Lack of interest
- Guilt/Worthless
- Psychomotor Issues
- Suicidal Ideation

Factors Affecting Outcome after Concussion

- Physical injury in theater
- Pre-injury and demographic variables
- Family/social/unit/command support
- Compensation/secondary gain
- Additional behavioral health conditions
- Course of medical care
TBI Resources for Patients, Families & Providers

Products & Tools Available From DVBIC

- mTBI Pocket Guide
- Clinician Resources & Tools Binder
- DoD ICD-9 Coding Guidance

Mild TBI Pocket Guide

Contents Include
- Summary of VA/DoD Clinical Practice Guideline (2009) and DoD mTBI Updated Clinical Guidance (2008)
- Assessment, referral and treatment for common symptoms associated with mTBI
- ICD-9 coding guidance
- Summary of cognitive rehabilitation clinical recommendations
- Clinical recommendations on driving after mTBI
- Patient education materials
- Clinical tools and resources

Purpose: Quick reference, all encompassing resource on the treatment and management of patients with mTBI and related symptoms

Resources

Concussion Symptom Management Patient Handouts
- Improving Memory
- Healthy Sleep
- Mood Changes
- Headache Management
- Head Injury and Dizziness

To request copies, please contact info@dvbic.org or call 1-800-870-9244
Web Based TBI Education & Resources

- www.dvbic.org
- www.dcoe.health.mil
- www.traumaticbraininjuryatoz.org
- www.brainline.org

TBI Clinical Practice Guidelines

- Acute/Subacute
  - Evaluation & Management of Concussion in Deployed Setting (DVBIC, 2008)
  - Evaluation & Management of Concussion in CONUS (DVBIC, 2008)
- Chronic
  - VA/DoD Evidence Based Guideline for Management of Concussion / mTBI (DVA/DoD, 2009)

Rapid TBI Consultation

Providers, SMs & Families
- DVBIC
  - Info@DVBIC.org
  - 1-800-870-9244
- DCoE 24/7 Outreach Center
  - 1-866-966-1020
  - resources@dcoeoutreach.org
  - Live Chat
- Military One Source
  - 1-800-342-9647
  - wwrcc@militaryonesource.com

Providers Only
- TBI.consult
  - For Deployed Providers
  - Feedback Within 12 Hours
  - 38 TBI Specialists
  - 14 Clinical Disciplines
- ANAM Baselines
  - anam.baselines@amedd.army.mil

Traumatic Brain Injury:

A Guide for Caregivers of Service Members and Veterans
DVBIC

The following online courses are located on the CDP’s website at: Deploymentpsych.org/training/online-courses

NOTE: All of these courses can be taken for free or for CE Credits for a fee

- Cognitive Processing Therapy (CPT) for PTSD in Veterans and Military Personnel (1.25 CE Credits)
- Prolonged Exposure Therapy for PTSD in Veterans and Military Personnel (1.25 CE Credits)
- Epidemiology of PTSD in Veterans: Working with Service Members and Veterans with PTSD (1.5 CE Credits)
- Provider Resiliency and Self-Care: An Ethical Issue (1 CE Credit)
- Military Cultural Competence (1.25 CE Credits)
- The Impact of Deployment and Combat Stress on Families and Children, Part 1 (2.25 CE Credits)
- The Impact of Deployment and Combat Stress on Families and Children, Part 2 (1.75 CE Credits)
- The Fundamentals of Traumatic Brain Injury (TBI) (1.5 CE Credits)
- Identification, Prevention, & Treatment of Suicidal Behavior in Service Members & Veterans (2.25 CE Credits)
- Depression in Service Members and Veterans (1.25 CE Credits)

All of these courses and several others are contained in the Serving Our Veterans Behavioral Health Certificate program, which also includes 20+ hours of Continuing Education Credits for $350.