Traumatic Brain Injury in Combat and Assault Contexts

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Disclaimer

The views expressed in this presentation are those of the author and do not reflect the official policy of the Department of the Army, Department of Defense, or U.S. Government.
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Defense and Veterans Brain Injury Center  Washington, DC
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The United States launched air attacks against Iraq early Thursday, Saudia time, hurling its mighty air force into an Arab power that for five months has held Kuwait in defiance of the rest of the world.

"The liberation of Kuwait has begun," President Bush declared in Washington.

In an address to the nation this evening, Bush said the U.S. military forces would crush Iraq's chemical and nuclear weapons capability in the drive to liberate Kuwait.

He said the 28-nation coalition "exhausted all reasonable efforts" to reach a peaceful diplomatic solution to the Gulf crisis sparked by Iraq's August 2 invasion of Kuwait.

"Tonight the battle has been joined," Bush said in a nationally televised speech from the Oval Office.

"Our Secretary of State James Baker held an historic meeting in Geneva only to be totally rebuffed. In a last ditch effort the Secretary General of the United Nations Javier Perez de Cuellar were with us in Baghdad with no peace at all. Now 28 countries on five continents having exhausted all efforts found they had no choice but to drive Saddam Hussein out of Kuwait by force."

While the world waited, Saddam Hussein met every overture of peace with open contempt. While the world prayed for peace, Saddam prepared for war," Bush said.

He subjected the people of Kuwait to unspeakable atrocities. Among those harmed were innocent children."

Bush said U.S. air forces concentrated their attacks Thursday on military installations throughout Iraq.
Iraqis in full retreat

Allies enter Kuwait City; U.S. armor cuts off Guard

President Bush said Iraqi losses amounted to a rout, and allied generals predicted privately the war could end within a few days.

In a picture taken from television, soldiers unfurl the Kuwait flag in Kuwait City yesterday, marking freedom from Saddam Hussein's forces.

Stark reality, joy set tone in freed capital

KUWAIT CITY - There was joy amid the ruins. Residents who survived under the Iraqi juggernaut for nearly seven months raced into the streets of their once-prosperous city yesterday to embrace the first wave of allied forces.

U.S. aims at rout of Iraq

Only unconditional surrender acceptable.
THE “GOOD NEWS”

- Only 47 days – shortest war in U.S. history
- Fewer than 300 deaths and 400 wounded (only 147 combat deaths)
- Compared with estimated 100,000 Iraqi soldiers killed and 300,000 wounded
- Mass chemical and biological attacks did not occur
THE “BAD NEWS”

- Reports of frequent sounding of chemical alarms, dead animals
- Reports of strange, debilitating symptoms
- Beginning with reservists, then spreading to active duty, family members, then from Americans to other nationalities
WHY ARE WE SICK?
Persian Gulf war leaves legacy of illness and broken faith
Gulf War II -- “Shock & Awe”

- Focused on psychological destruction of the enemy's will to fight through rapid physical destruction of military forces
- More cruise missiles were launched in first day of War than in first 40 days of Gulf War I
- 80 percent precision-guided, as compared with 10% in Gulf War I
Gulf War II

- The “Bad News:”
  - As of this date,
    * Almost 2,300 troops killed in Iraq
    * Almost 300 troops killed in Afghanistan
    * Almost 18,000 wounded in action

- The “Good News:”
  ???
Health Screening of the Troops

- More pre- and post-screening than in previous wars
  - Health Risk Assessment (HRA)
  - Soldier Wellness Assessment Pilot Program (SWAPP)

- Both good and not-so-good news
  - Validity of self-report?
Challenges for the Current Force

- War is the norm, peace is the exception
- Our adversaries seek adaptive advantage through asymmetry
- We have near peer competitors in niche areas
- Conventional Force on Force conflicts are still possible
- There is an enormous pool of potential combatants armed with irreconcilable ideas
- Our homeland is part of the battlespace
- We are adapting to these challenges NOW
I will always place the mission first.
I will never accept defeat.
I will never quit.
I will never leave a fallen comrade.
## Traumatic Brain Injury Description

<table>
<thead>
<tr>
<th>Severity</th>
<th>GCS</th>
<th>LOC</th>
<th>PTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>13–15</td>
<td>&lt;20 min-1 hr</td>
<td>&lt;24 hr</td>
</tr>
<tr>
<td>Moderate</td>
<td>9–12</td>
<td>1 – 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>&gt;7 days</td>
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**GCS** = Glasgow Coma Scale  
**LOC** = Loss of consciousness  
**PTA** = Posttraumatic amnesia
Concussions

Grade 1

- Transient confusion
- No loss of consciousness
- Symptoms or mental status abnormalities resolve in 15 minutes or less

Grade 2

- Transient confusion
- No loss of consciousness
- Symptoms or mental status abnormalities last more than 15 minutes
- Anterograde amnesia 5 minutes or less
Concussions

Grade 3

- Any loss of consciousness, either brief (seconds) or prolonged (minutes)
- Symptoms or mental status abnormalities last more than 15 minutes
- Brief anterograde amnesia and retrograde amnesia

Grades 4 & 5

- Above symptoms plus unconsciousness between 5-10 minutes and longer than 10 minutes respectively
Immediate Signs of Concussion (may occur within seconds to minutes)

- Slurred or incoherent speech
- Gross incoordination
- Disorientation
- Impaired attention – vacant stare, delayed responses, inability to focus
- Impaired memory
- Emotional reactions out of proportion
Later Signs of Concussion (may occur within hours to days)

- Persistent headache
- Nausea or vomiting
- Difficulty concentrating
- Difficulty remembering
- Drowsiness or easily fatigued
- Irritability/easily angered
- Dizziness/vertigo
- Bothered by loud noise or bright lights
- Anxiety and/or depression
- Sleep disturbance
Post Concussive Syndrome

- Nearly 15% of patients with mild head injury continue to complain of symptoms 1 year or more after their injury.
- Lingering symptoms and continuing cognitive deficits may occur for weeks or months after injury.
- Associated with concussions of Grades 2-5.
Post Concussive Symptoms in Mild TBI

- Natural history is recovery within weeks/months
- A small percentage will have persistent symptoms
- Repeat concussions – more morbidity
Complications in Recovery (cf. Erin Bigler)

- Effects of CHI can be “silent”
- Day of injury scans often not reliable markers of what future holds in store
- F/U scans over 2-3 years often show brain deterioration, even for moderate CHI’s
- CHI represents a risk factor for later dementia
- Mental health problems are common following CHI (more severe CHI’s typically report fewer problems due to lack of awareness)
- Above effects are exacerbated with repeated CHI’s
Typical Geographic “Flow” for Injured Soldiers

U.S. Military Hospital in Balad, Iraq

Landstuhl Regional Medical Center, Germany

Walter Reed/ Bethesda, Wash. D.C.

Local MTF’s/Units
Defense and Veterans Brain Injury Center (DVBIC)

- DVBIC, founded in 1991 as Defense and Veterans Head Injury Program (DVHIP)
- The DVBIC mission:
  - conduct clinical research
  - ensure optimal clinical care
  - education for military, veterans, and their families.
- Military Sites: Walter Reed, San Diego Naval, Wilford Hall AirForce/Brooke Army Medical Center
- Richmond, Minneapolis, Palo Alto, Tampa
- 1 civilian community reentry program – Va NC
Blast Injuries

- 59-70% of blast-exposed patients from Iraq and Afghanistan admitted to Walter Reed had brain injury

- Concern that “silent” brain injuries potentially could represent another “Gulf War Syndrome”
Types of Blasts Common in Iraq & Afghanistan

- Mortars
- Land Mines
- Rocket-Propelled Grenades (RPG’s)
- Charges to open buildings
- Improvised Explosive Devices (IED’s)
Walter Reed Iraq/Afghanistan TBI Experience

Initial 433 patients with TBI seen at WRAMC from 1/03 to 4/05

- 68% of injuries were due to explosion/blast
- 88.5% were closed TBI
- 95.4% were male, with a modal age of 21 years
- Post Traumatic Amnesia (PTA) ≤ 24 hours: 43%
- Mortality after reaching Walter Reed was 0.9%

Warden et al., Journal of Neurotrauma 2005; 22:1178
Complications - 14% shock; 9.5% hypoxia; 25% skull fracture; 18.7% subdural hematoma; and 1.5% epidurals

6% had seizures

19% had limb amputations; lower extremity most common

91% reported post concussive symptoms:
  - headache (47%)
  - memory deficits (46%)
  - irritability/aggression (45%)
  - attention/concentration difficulties (41%)

Of 43% with a psychiatric symptoms noted, depression was the most common (27%).

Warden et al., Journal of Neurotrauma 2005; 22:1178
DVBIC TBI Screening, Evaluation – WRAMC

- Those at risk based on mechanism of injury
- Any LOC, impaired memory for or after the event
- Symptom Screen, Cognitive Screening (RBANS) and/or full neuropsychological evaluation
- Audiologic, neurologic, psychiatric psychosocial evaluation; EEG; MRI as clinically indicated
## Combat Experiences

<table>
<thead>
<tr>
<th>Experience</th>
<th>Army %</th>
<th>Marines %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saw dead bodies</td>
<td>93</td>
<td>94</td>
</tr>
<tr>
<td>Been shot at</td>
<td>93</td>
<td>97</td>
</tr>
<tr>
<td>Know someone wounded or killed</td>
<td>86</td>
<td>87</td>
</tr>
<tr>
<td>Saw injured or killed Americans</td>
<td>65</td>
<td>75</td>
</tr>
<tr>
<td>Responsible for enemy deaths</td>
<td>48</td>
<td>65</td>
</tr>
<tr>
<td>Engaged in hand-to-hand combat</td>
<td>22</td>
<td>9</td>
</tr>
<tr>
<td>Were wounded</td>
<td>14</td>
<td>9</td>
</tr>
</tbody>
</table>

Reasons for Not Seeking Help

- Would be seen as weak → 65%
- Unit leadership might treat them differently → 63%
- Members of unit might lose confidence in them → 59%
- Difficult to get time off for treatment → 55%
- Unit leaders would blame them for the problem → 51%
- It would harm their career → 50%
- Difficult to schedule an appointment → 45%
Kevlar Pro and Con

- Kevlar body armor and helmets – shield wearer from shrapnel and bullets

- However, not well-padded and provides little protection from concussion injuries

- Reduce penetrating injuries seen in previous wars but may actually increase concussion injuries
Blast Injuries

Multifactorial injury mechanisms:

1. **Primary**: Direct exposure to overpressurization wave – velocity \( \geq 300 \text{m/sec} \) (speed of sound in air)
2. **Secondary**: Impact from blast energized debris – penetrating and nonpenetrating
3. **Tertiary**: Displacement of the person by the blast and impact
4. **Quaternary**: Burns/Inhalation of gases

- May be combined with MVA in war theater
Shock Wave & Brain Injury
Potential Mechanisms

- **Biomechanical** – Coupled fluid-structures interaction during compression wave propagation in brain parenchyma, inertial shear/deformation of brain tissue, damage to axons, glia, and blood-brain barrier (BBB).

- **Hemodynamic** – Blood and pressure distribution in brain, local hemorrhage, edema, hematoma, increased ICP

- **Neurobiologic** – DAI, rise of intracellular Ca++, apoptosis

- **Metabolic** – inflammatory response, hypoxia, ischemia
Co-Morbid Conditions

- Sleep Disorders
- Hearing Loss
- Pain
- Emotional Disturbances
MAMC Patient Groups 2004-2005

- Blast Exposures/Injuries (N = 25)

- “Blast Plus” -- Multiple Blast Exposures and/or other neurologic/medical conditions (e.g., Hx. sleep apnea, prior TBI) (N = 20)

- Head Injuries due to other factors (e.g., MVA, falls) (N = 23)
MAMC Patient Groups 2004-2005

- Reported LOC ranged from “seconds” to “2 days”
- Reported PTA ranged from “less than 30 minutes” to “1-2 weeks”
- 52% undergoing Medical Evaluation Boards – received full HRB
- Almost all of remainder received ½ day battery
MAMC Iraq/ Afghanistan Returnees (Percentages)

- Blast (N=25)
- Blast+ (N=20)
- Other CHI (N=23)
MAMC Returnees – Degree of Npsych. Impairment (Percentages)

- Blast (N=25)
- Blast+ (N=20)
- Other CHI (N=23)
MAMC Returnees – Co-Morbidities (Percentages)

Emot. Dist. | Anx+Depr | Hear. Loss | Sleep D/O
--- | --- | --- | ---
Blast (N=25) | Blast+ (N=20) | Other CHI (N=23)
MAMC Summary

- Generally moderate concussions (Grades 3-4) – LOC’s but mostly brief
- Most soldiers returned to duty and completed deployment
- Generally little to mild impairment on formal neuropsychological evaluation
- Relatively high degree of co-morbid conditions, such as emotional disturbance
- “Blast Plus” group showed slightly more neuropsych. impairment and more co-morbid conditions
Developing the "Killer Instinct" in Your Soldiers

"This training is designed to be uncomfortable—physically first, then mentally—to take Soldiers to dark places, under control, so that if they are ever taken there by the enemy, it's not their first time."  

Company commander introducing that morning's combatives training to his Soldiers

One part of the warrior ethos is ferocity in combat, and the innate capability and powerful motivation to kill the enemy and to never give up—regardless of the circumstances. One question we have been wrestling with in the CC forum lately is, "How do we cultivate this killer instinct in our Soldiers?"

In this article, we will present some excerpts from the conversation that is still ongoing in the CC forum. Our desire is that the article sparks thinking and conversation about this critical subject, both in your unit and in the forum.

The Mindset

George Corbari
B/5-7th ADA (Patriot), 69th ADA BDE, V Corps

At the crux of this discussion is the "warrior mindset." It's not about being 6'2" and 240 pounds of anger—it's about making conscious choices about how you think. The killer instinct is a combination of confidence, concentration, and tenacity. Those qualities are next to worthless without the physical skill and ability to complete the task—but so, too, are the physical abilities without the proper mindset.

We train mental toughness not by throwing people who can't swim into the water, but by teaching people how to deal with extreme situations, by teaching people how to focus effectively, by teaching Soldiers the importance of confidence and how to build and maintain that personal confidence. Here's a mindset TTP that commanders can use before every mission:

When rehearsing actions on the objective, do more than just discuss the mechanics of the fight. Help Soldiers really visualize the battlefield by integrating all five senses. Talk about what they'll see, hear, smell, touch and even taste. For those who haven't been there, the details of combat won't be such a shock to them.

The Personal Nature of Killing

Clete Goetz
642nd EN CO, 548th CSB, 10th MTN DIV

Killing someone becomes more difficult as the means of their demise becomes more personal. For example, strangling or stabbing someone is more abhorrent psychologically to the average person than shooting someone through open sights. I recommend you read Dave Grossman's On Killing.

Incorporating combatives, knife-fighting techniques, take-downs, etc., will help to create killers. If you can train Soldiers to stab someone, you can expect them to shoot the enemy when required. You must create the mindset in them that killing the enemy is an acceptable action when given the permission to do so by legitimate authority.

Combatives as a Vehicle

Matt Michaelson
SS-21 OPFOR RS '95, B/4-5th ADA & D/4-5th ADA, 1st CAV DIV

Our Soldiers' ability to react—and even act—under duress, pain, and seemingly insurmountable odds remains the hallmark of the warrior ethos. Tenacity against the enemy must be trained, expected, and demanded—but
Killer Instinct

“Our biggest problem I see in developing the killer instinct is getting people to overcome some longstanding habits fairly quickly. Soldiers must acknowledge that as humans, they are predatory by nature. It’s only recently that our culture’s habits have been less aggressive, less predatory. We must put Soldiers back in touch with their nature as such...Once you have learned to kill mentally, The physical part is easy. The hard part is turning it off when necessary.”

Dr. Nate Zinsser, Center for Enhanced Performance, USMA
On Killing: The Psychological Cost of Learning to Kill in War and Society

Lt. Col. Dave Grossman
DoD/VA Guideline(s) for Management of Traumatic Stress

Primary Prevention
- Hardiness
- Resilience

Surveillance
- Force Health Protection
- Clinical Screening

Trauma Exposure

Acute Stress Reaction (ASP, CSR)

Acute Intervention
- Psychoeducation?
- Normalizing?
- Acute symptom management?
- Medications?
Acute PTSD

Early Intervention
- Formal assessment
  - diagnosis
  - specify target symptoms
- Treatment (outcomes goals)
  - ameliorate symptoms
  - reverse disorder
  - maintain functioning

Treat co-morbid disorders

Chronic PTSD
- Simple/ uncomplicated
- Complex/ complicated

Late Intervention
- Formal assessment (as above)
- Treatment (outcome goals)
  - ameliorate symptoms
  - mitigate impact of disorder
  - improve quality of life
  - restore/ improve functioning

Treat co-morbid disorders
Medical and Physical Evaluation Boards

- Medical Evaluation Board collects data relevant to soldier’s fitness for duty
- Physical Evaluation Board determines fitness and compensation (if appropriate)
- “Ratable” conditions
- Special case of PTSD
  - May require collateral information /sworn statements that alleged stressor occurred and that person really has sx.
  - Must be “severe” stressor
  - May be “combat stress reaction” instead
  - Traditional principles of combat psychiatry (e.g., Proximity, Immediacy, Expectancy → “PIE”)
Neurobiological Effects in Psychological Trauma

- Dysregulation of the norepinephrine, hypothalamic-pituitary-adrenocortical (HPA), thyroid, endogenous opioid, and serotonin systems
- Neurochemical correlates of chronic physiologic arousal lead to reduced regulation of autonomic reactions and reduced capacity to respond normally to both internal and external stressors.
- Glucocorticoids and hippocampal atrophy (Robert Sapolsky)
- Neurobiology of Childhood Abuse (Martin Teicher)
- “Vicious Circle” when TBI is added?
Summary

• TBI in the current combat environment is common, with multiple blast exposures for many soldiers
• Service members often returned to duty prematurely
• Service members typically show “warrior ethos”
• Our population showed mild formal neurocognitive impairment, but this was often in association with co-morbid conditions (e.g., sleep disorder, PTSD) that complicated symptom picture
Areas for Study

- Concussion Management in Theater
  - Assessment - cognitive – Standardized/Military Assessment of Concussion;
  - Other symptoms – instruments for Post Concussive Sx
    - Education for first providers re: management. In general, if symptomatic (and if possible) – rest; protect from new injury

- Pre-and post-deployment screening that uses more than self-report

- Relationship between TBI and co-morbid conditions such as sleep disorder and PTSD

- Factors of resilience