Military Blast Injury In Iraq and Afghanistan: The Veterans Health Administration's Polytrauma System of Care

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The proportion of veterans cared for by the **Veterans Health Administration** (VHA) is rapidly shifting to those deriving from the Gulf War, which began in 1990 and the Global War on Terror, which began in 2001.[1] The conflicts in Afghanistan (Operation Enduring Freedom, OEF) and Iraq (Operation Iraqi Freedom, OIF), have produced 1,016,213 veterans; and 454,121 of them have received care through the VHA as of the second quarter of 2009.[2]

As of July 31, 2009, 3980 US service members have been killed and almost 35,000 have been wounded in action in OEF/OIF.[3] Explosive blasts have accounted for about 60% of these injuries.[4,5] Other mechanisms of injury include projectiles (bullets, shrapnel), motor vehicle collisions, falls, and non-combat-related assaults. Service members are surviving combat injuries at much higher rates than in past conflicts[5] and a high percentage of these individuals have **traumatic brain injury** (**TBI**), which has led to TBI's label as the "signature injury" of OEF/OIF.[6] Estimated rates of TBI in OEF/OIF reported in the media vary widely with some being alarmingly high. However, empirical support for these estimates is limited due to the small sample size, reliance on self-report data, use of data derived from a single center, and restrictive inclusion criteria.[5] Epidemiological data for injuries in these conflicts continues to develop but a rigorous scientific study of the prevalence of TBI has not been done.[5]

Blasts, TBI, and PTSD in the Military Population

Blasts are by far the most common cause of wounded-in-action injuries and death in OEF/OIF.[5,6] The majority of blasts are from improvised explosive devices. The most commonly involved organ systems include skin and muscle, skeletal, pulmonary, gastrointestinal, cardiovascular, vestibular, and neurological including brain, spinal cord, and peripheral nerves.

The mechanisms by which blasts cause TBI are unclear but likely arise from a combination of primary and secondary effects. The primary effect derives from the blast pressure wave. Evidence that these pressure waves can cause brain injury derives from animal studies.[7,8] Secondary effects contributing to blast-related TBI include impact from projectiles launched by the blast or from the victim striking his or her head against the ground or other stationary objects as a result of the blast.

The definition of **mild TBI** (**mTBI**) adopted by the VHA and **Department of Defense** (**DOD**) is based on the 1993 American Congress of Rehabilitation Medicine criteria:

> Mild traumatic brain injury is a traumatically-induced structural injury or physiological disruption of brain function resulting in one of the following: brief alteration in consciousness (dazed, disoriented, or confused), or **loss of consciousness** (**LOC**) of 30 minutes or less, or 24 hours or less of **posttraumatic amnesia** (**PTA**, i.e., a loss of memory for the period surrounding the event that may occur with or without LOC).

It is unknown whether the nature or prognosis of blast-related mTBI differs from other causes of mTBI. Recent data suggest that the cognitive profiles of patients with blast-related vs. impact-related mTBI are similar.[9] Blast-related mTBI may have a stronger association with PTSD than other causes of mTBI.[5] Recent studies have demonstrated a high rate of comorbidity with **post traumatic stress disorder** (**PTSD**).[10-12] As of the first quarter of 2009 approximately 102,000 of OEF/OIF veterans have been diagnosed with PTSD.[2]

Postconcussive and PTSD symptoms overlap considerably but not completely.[13] Shared symptoms include depression/anxiety, insomnia, appetite changes, irritability/anger, concentration difficulty, fatigue, hyperarousal, and avoidance. Symptoms more uniquely associated with persistent postconcussive syndrome include headache, heightened sensitivity to light and sound, dizziness and disequilibrium, and memory impairment. Symptoms that are more unique to PTSD include re-experiencing, shame, and guilt. Nonetheless, accurately parsing the extent to which an individual's symptoms are attributed to PTSD vs. TBI is difficult, especially when relying on retrospective self-report of a temporally remote event. Many believe that it is more parsimonious and clinically useful to conceptualize these symptoms as a single syndrome rather than two distinct entities. One term that has been proposed is Combat-Related Brain Injury and Stress Syndrome (David X. Cifu, personal communication, October 2007). One of the authors (S.M.) has used the term "Deployment-Related Cognitive Impairment" to refer to the frequent cognitive complaints of inattention and forgetfulness. This term aligns well with previous findings of deployment-related neuropsychological deficits in army personnel deployed in the Iraq war.[14]

Polytrauma System of Care

The rate of survival of combat injuries in OEF/OIF, including TBI, is approximately 90%[15]—considerably higher than in previous conflicts. The high survival rate is due mainly to improvements in helmet and body armor and to improved delivery of medical care including battlefield and in-theater hospital innovations.[5] This has led to a high number of veterans with re-

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habilitative needs. In response, the VHA established the Polytrauma Sytem of Care in 2004 with a mission "To ensure that the needs of injured service members and Veterans are met."[16] The VHA defines polytrauma as follows:

> "...two or more injuries sustained in the same incident that affect multiple body parts or organ systems and result in physical, cognitive, psychological, or psychosocial impairments and functional disabilities. TBI frequently occurs as part of the polytrauma spectrum in combination with other disabling conditions, such as amputations, burns, pain, fractures, auditory and visual impairments, PTSD, and other mental health conditions. When present, injury to the brain is often the impairment that dictates the course of rehabilitation due to the nature of the cognitive, emotional, and behavioral deficits related to TBI."[16]

The system is a hierarchy of facilities with particular roles:

Polytrauma Rehabilitation Centers (PRC) provide acute high-intensity rehabilitative and medical care for the seriously injured. There are four PRCs, located at VA Medical Centers in Tampa, FL; Richmond, VA; Minneapolis, MN; and Palo Alto, CA. A fifth center is under construction at San Antonio, TX.

Polytrauma Network Sites (PNS) provide post-acute inpatient and outpatient interdisciplinary rehabilitative care of moderate intensity for medically stable patients. Each of VHA's 22 **Veterans Integrated Service Networks (VISNs)** has one PNS. The PNS for the New England region (VISN-1) is the Boston VA Health Care System.

Polytrauma Support Clinic Teams (PSCT) are interdisciplinary teams that manage medically stable outpatients with an interdisciplinary treatment plan. Patients are monitored for progress and the team identifies unresolved problems and implements solutions. Eighty one PSCTs have been established nationally.

Polytrauma Points of Contact (PPOC) are staff members at all remaining VA facilities who assist veterans in accessing the Polytrauma system.

Patients can be referred up or down the hierarchy in accordance with their medical needs and the services provided at the various facilities.

Polytrauma System: Screening for TBI

VHA Directive 2007-13 established screening of all service members returning from deployment in OEF/OIF to determine if they had possibly sustained a deployment-related traumatic brain injury that had not already been diagnosed. In response, the VA Polytrauma Program developed a standard, two-tier screening process implemented nationally. The data collected is entered into the VA's electronic medical record system and is tracked nationally.

The initial screen, called the "TBI Clinical Reminder," is required for all OEF/OIF veterans who enter the VA health care system. The Reminder consists of a set of yes-no questions organized into four sections that determine whether or not the veteran experienced the following: exposure to a deployment-related event with risk for TBI; acute alteration of consciousness; postconcussive symptoms during the immediate post-acute phase; persistence of such symptoms currently. A positive screen is defined as an affirmative response to all four sections; a negative response to any section results in a negative screen. The reliability and validity of the screen have not been established, and is under research investigation.

Veterans who screen positive are referred for a "Comprehensive Second-Level Evaluation" which consists of a standard, more detailed assessment of TBI. It is intended to determine more accurately the likelihood that a veteran sustained a TBI and to estimate the severity of the injury. It also assesses symptoms, elicits clinicians' opinions about the likelihood that the symptoms reflect the effects of TBI and/or other factors (e.g., psychiatric disorder), and establishes a treatment plan. At most VA facilities, the "Second-Level Evaluation" is performed by a "TBI specialist," typically a physiatrist or neurologist, who leads the polytrauma team at that facility.

Except in relatively rare cases in which documentation is available, the initial screen and the Second-Level Evaluation typically rely on patients' recall of their injuries. This is an important limitation to the system because retrospective self-report of an event or events that occurred many months or years earlier may be unreliable. Moreover, the intense emotional reaction to the chaotic event of a blast may well acutely and transiently alter cognitive function which could masquerade as TBI or enhance its effects and it can be very difficult teasing these factors apart. At the PVAMC, we have adopted a fairly parsimonious clinical guideline for determining the presence of absence of TBI: a patient who can relate a continuous narrative before/during/after an event seems unlikely to have suffered a physiologic disruption of brain function. We have found this guideline to be quite helpful in ambiguous cases but its reliability and validity have not been determined.

Diagnosis of TBI in the Polytrauma System

National Experience (data rounded off to nearest 1000):

The TBI Clinical Reminder was implemented in April 2007. Through May 31, 2009, 316,000 veterans have completed the Clinical Reminder; 63,000 (20%) screened "positive" for possible TBI. Of these, 41,000 completed the Comprehensive Second-Level Evaluation which confirmed the mTBI diagnosis in 20,000 (49%). This estimate does not include an additional 9440 veterans who self-reported having been previously diagnosed with TBI during their deployment.

There is considerable variability across VA Medical Centers in the rate at which mTBI is diagnosed by this process. Potential reasons include variability in the combat roles of military units based in different geographical regions of the U.S. (some combat roles carry

greater risk for TBI than others), variability in TBI experience of clinicians performing the evaluations, and the institutional learning curve given the fact that the process was introduced relatively recently.

Providence VAMC Experience:

Through May 31, 2009, the PVAMC has screened 1672 veterans with the Clinical Reminder; of these, 262 (15.7%) have screened "positive." Of these positive screens, 184 have completed the Comprehensive Second-Level Evaluation, which confirmed the mTBI diagnosis in 120 (65%).

Our Polytrauma Team functions as a PSCT (official designation by VHA is pending). The team is led by a neurologist specializing in neurorehabilitation/TBI and includes a social worker/case manager, neuropsychologist, primary care physician, and a psychologist specializing in PTSD, as well as a physical therapist, occupational therapist, speech therapist, ENT nurse practitioner, and hearing and vision specialists. Other disciplines are consulted as needed. The team meets weekly to review veterans new to the Polytrauma Team and to provide periodic review of established patients.

A weekly Polytrauma intake clinic (neurologist, neuropsychologist, social worker/case manager) screens newly referred veterans to identify ongoing problems and develop a treatment plan. In addition, the neurologist and case manager have a weekly Polytrauma/TBI follow-up clinic in which veterans with ongoing medical and psychosocial problems are seen as needed. The majority of patients seen by our team likely sustained mTBI during their OEF/OIF deployment without concomitant severe somatic injuries.

Symptom Management

The most common complaints of patients in the Polytrauma Clinic include pain (mostly headaches and back pain), dizziness, hearing loss/tinnitus, sleep difficulty, anxiety and symptoms of PTSD, and cognitive complaints such as forgetfulness and diminished concentration.

As there is no "specific" treatment for cognitive complaints in mTBI, emphasis is placed on identifying and treating modifiable factors such as PTSD, depression, substance abuse, sleep deprivation, pain, and other factors such as loss of employment and marital distress, that might be contributing to veterans' symptoms and which, if adequately treated or addressed, could have a positive impact on their quality of life. The Polytrauma Team makes referrals to specialists and VA programs as needed and promotes veterans' compliance with treatment plans. The most common referrals are to the PVAMC Mental Health and Behavioral Science Service, particularly to the PTSD Clinic, the Returning Veterans Program, the Substance Abuse Treatment Program, and to the Neuropsychology Clinic. Referrals to Physical Therapy and Speech and Language Pathology services (the latter for cognitive retraining) are also common. The Polytrauma Team emphasizes educating patients and their families about the expected trajectory of recovery from mTBI and the possible treatable factors. Such interventions have been shown to reduce the likelihood of patients with mTBI developing persistent postconcussion syndrome.[17,18]

As of the first quarter of 2009 approximately 102,000 of OEF/OIF veterans have been diagnosed with PTSD.

Mild TBI: Controversies

Hoge et al[19] raise several concerns about the DOD/VA process for diagnosis and management of mTBI. First, they postulate that the screening process risks incorrect attribution of nonspecific symptoms to mTBI. Second, they suggest that disability may be overly attributed to mTBI, and they raise the possibility that "post-deployment screening is...likely to promote negative expectations for recovery." They also assert that misattribution of symptoms to mTBI potentially places veterans at risk of negative consequences, including medication adverse effects, failure to adequately address concurrent conditions (e.g., depression, PTSD, substance abuse, etc.), and inappropriate use of rehabilitation procedures. They suggest development of improved definitions and diagnostic criteria and processes.

The VHA's standardized team approach aims to minimize over-diagnosis and misattribution errors via thorough Second-Level Evaluations that assess for co-existing conditions that may be contributing to symptoms and addressing them appropriately. Many believe that the benefit derived from the thoroughness of this process in identifying and addressing previously untreated symptoms outweighs the risk of over- diagnosis, and that when managed by trained physicians and ancillary providers, the risk of negative consequences is minimal, if present at all. Finally, the data to design improved diagnostic criteria are not yet available.

Conclusions

Veterans of conflicts occurring over the last nineteen years often have complex, multisystem injuries, and a large number are being diagnosed with mild TBI with significant comorbidities including PTSD and somatic injuries, particularly auditory/vestibular injuries. The Polytrauma System of Care is designed to standardize the diagnosis and management of these conditions nationwide. Although making the diagnosis of mTBI requires ongoing assessment, our experience at PVAMC has been that the Polytrauma Team has been effective in bringing veterans with multiple injuries and/or medical conditions into the health care system, helping them access the care they need, and monitoring their progress.

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