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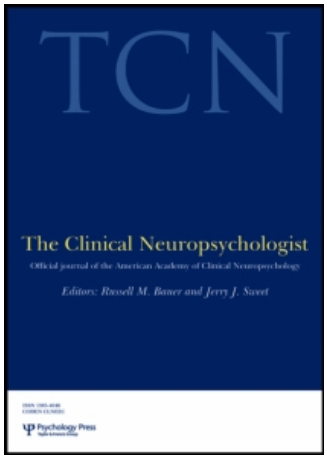

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Official Position of the Military TBI Task Force on the Role of Neuropsychology and Rehabilitation Psychology in the Evaluation, Management, and Research of Military Veterans with Traumatic Brain Injury

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OFFICIAL POSITION OF THE MILITARY TBI TASK FORCE ON THE ROLE OF NEUROPSYCHOLOGY AND REHABILITATION PSYCHOLOGY IN THE EVALUATION, MANAGEMENT, AND RESEARCH OF MILITARY VETERANS WITH TRAUMATIC BRAIN INJURY[1]

APPROVED by:
American Academy of Clinical Neuropsychology (AACN)
American Psychological Association Division 40 (Neuropsychology)
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This Position Statement is a summary of the literature and learning regarding current issues raised by the occurrence, treatment, and study of traumatic brain injury in military service members and veterans. The Report has been approved by the American Academy of Clinical Neuropsychology (AACN), Divisions 40 (Neuropsychology) and 22 (Rehabilitation Psychology) of the American Psychological Association (APA), and the National Academy of Neuropsychology (NAN), with the goal of providing information of relevance on an important public policy matter within their respective areas of expertise. The Report is not intended to establish guidelines or standards for the professional practice of psychology, nor has it been adopted as official policy by the American Psychological Association or any other division or subunit of APA.

[1]While this document mainly focuses on the role of neuropsychologists and rehabilitation psychologists in the assessment, management and research of traumatic brain injury, the Military TBI Task Force also recognizes the vital role of psychologists from many other speciality areas (e.g., clinical, counseling, health) in providing care to military veterans with TBI, PTSD, and other mental health issues.

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INTRODUCTION

Traumatic brain injury (TBI) has been widely considered the ''signature injury'' among United States military personnel involved in combat in Iraq and Afghanistan. In previous wars such as Desert Storm, approximately 20% of military personnel treated for wounds had primary or concurrent head injuries (Carey, 1991, 1996; Leadham, Newland, & Blood, 1993). Due to several factors, however, the rate of traumatic brain injury in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) is thought to be significantly higher than any previous war (Warden, 2006). In brief, advances in protective armor (e.g., helmets and Kevlar vests) and medical triage have saved lives of military personnel that likely would have died from the same serious injuries in previous wars. Additionally, the frequency of explosive or blast attacks in Iraq and Afghanistan is significantly higher than in past military conflicts, creating a new set of concerns about the risks and dynamics of closed head injury (Scott, Belanger, Vanderploeg, Massengale, & Scholten, 2006; Taber, Warden, & Hurley, 2006).

Data from the Defense and Veterans Brain Injury Center (DVBIC) at Walter Reed show that, among OIF and OEF veterans, 30% had traumatic brain injury, with an even greater percentage meeting TBI criteria when their mechanism of injury was blast related. Of those TBI patients sufficiently injured to warrant this transfer stateside, 56% have moderate to severe TBI and 44% have mild TBI (MTBI) (Warden et al., 2005). As in the civilian setting, the overwhelming majority of TBIs in the current military conflict are categorized as MTBI based on acute injury characteristics and accepted injury definition criteria. The prevalence of MTBI in the austere environment is considered very high, a precise estimate being difficult to establish due to the fact that milder injuries may go untreated or unreported, just as in the civilian sector. Additionally, an estimated 10–20% of combat veterans meet the criteria for MTBI on post-deployment screening (Zoroya, 2006).

The prevalence of MTBI, as well as the deployment-related circumstances of trauma, also raises concerns about resulting Postconcussion Syndrome (PCS) and Post-traumatic Stress Disorder (PTSD) negatively impacting post-deployment outcome among injured military personnel. Previous studies have shown high rates of PTSD and other psychological disorders following Iraq deployment, significantly higher than other theaters (Hoge, Auchterlonie, & Milliken, 2006; Hoge et al., 2004).

As a result, assessment, management, and rehabilitation of deployment-related TBI has garnered increasing attention from the medical community (both military and civilian), multiple government agencies, patient advocacy groups, and the media. The Department of Defense (DoD) assembled the Defense and Veterans Brain Injury Center (DVBIC) Working Group on the Acute Management of Mild Traumatic Brain Injury (MTBI) in Military Operational Settings, which included representation from neuropsychology, and generated the first Clinical Practice Guideline (CPG) in December 2006 (DVBIC, 2006). The Working Group's CPG focused primarily on standardized algorithms for the operational assessment and management of MTBI *in-theater*, but also generated recommendations

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for pre-deployment baseline cognitive testing and military educational initiatives around MTBI.

More recently, the DoD organized the Department of Defense/Department of Veterans Affairs (DVA) Traumatic Brain Injury (TBI) Planning Conference where military, DVA, and civilian experts formed consensus around refined protocols for clinical management of TBI and identified key areas in need of further research. Additionally, the DVA has implemented the TBI Clinical Reminder protocol to help identify potentially undiagnosed deployment-related TBI and ensure that veterans affected by TBI are offered appropriate post-deployment clinical follow-up.

Specialists from neuropsychology and rehabilitation psychology, including several members of the Military TBI Task Force, have been centrally involved in the progress made to date by the DVBIC Working Group, DoD/DVA Planning Conference, and DVA TBI Clinical Reminder system. Neuropsychologists and rehabilitation psychologists are uniquely trained specialists who play a vital role in evaluation and treatment of patients with all forms of TBI, as well as PCS and PTSD. These specialty-trained psychologists within the Department of Veterans Affairs, United States Military, Defense Veterans Brain Injury Center, and various civilian settings have cared for injured veterans affected by TBI and PTSD from several military conflicts over the past century.

Recognizing the important role that neuropsychologists and rehabilitation psychologists will play in caring for the large number of our veterans affected by traumatic brain injury, an inter-organizational Military TBI Task Force of experts representing the American Psychological Association (APA) Division 40 (Neuropsychology) and Division 22 (Rehabilitation Psychology), American Academy of Clinical Neuropsychology (AACN), and the National Academy of Neuropsychology (NAN) was recently assembled.

Given that other organized efforts such as the DVBIC Clinical Practice Guideline and DoD/DVA proceedings have developed thorough protocols and recommendations for in-theater management of TBI in Iraq and Afghanistan, the Military TBI Task Force focused more on the role of neuropsychologists and rehabilitation psychologists in the post-deployment care for veterans with TBI, PCS, and PTSD in federal and civilian care systems. Additionally, based on the injury epidemiology and relative role of psychologists, the Military TBI Task Force focused primarily on the evaluation, treatment, and study of deployment-related MTBI rather than on moderate and severe TBI.

The specific objectives of the Military TBI Task Force were:

1. to identify, based on a review of current literature, issues important to delivering effective neuropsychological and psychological care for TBI patients across the DoD and Veterans Health Administration (VHA) care continuum;
2. to review and summarize the existing evidence-based literature regarding the evaluation, management, and rehabilitation of veterans with MTBI, PCS, and PTSD;
3. to outline key research initiatives that both advance our scientific understanding of deployment-related TBI and create a platform of translational research that informs the clinical science of TBI in the general population.

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In keeping with its main objectives, the Military TBI Task Force offers the following information regarding the evaluation, treatment, and study of deployment-related MTBI.

SECTION 1: EVALUATION AND DIAGNOSIS OF MILD TRAUMATIC BRAIN INJURY

Defining Mild Traumatic Brain Injury

Several definitions of MTBI exist in the literature, most notably those from the American Congress of Rehabilitation Medicine (ACRM) (Kay et al., 1993), Centers for Disease Control (CDC) (*Report to Congress on Mild Traumatic Brain Injury in the United States: Steps to Prevent a Serious Public Health Problem*, 2003), and World Health Organization (WHO) (Holm, Cassidy, Carroll, & Borg, 2005) (see Tables 1–3). Closer review of these definitions reveals considerable overlap in their core injury criteria and characteristics. All systems identify minimum parameters required for the diagnosis of MTBI, but also establish an upper limit to MTBI characteristics—e.g., Glasgow Coma Scale (Jennett & Teasdale, 1981), duration of unconsciousness, retrograde and post-traumatic amnesia—beyond which would reflect moderate or severe TBI. The more recent Clinical Practice Guideline (CPG) published by DVBIC specifically developed an operational definition of MTBI intended for use in military combat settings (see Table 4).

Inherent to the DVBIC criteria and any definition of TBI is the prerequisite of biomechanical force sufficient to cause brain injury, which unfortunately is difficult to precisely determine in the current military setting. In traditional animal research models and human experimental paradigms, recent prospective studies suggest that there must be a minimum biomechanical linear translational force or acceleration sufficient to cause MTBI, which is augmented by the influence of accompanying rotational force (Brolinson et al., 2006; Zhang, Yang, & King, 2004). In the current military theater, however, blast injuries resulting from improvised explosive devices (IEDs) are extremely prevalent but their influence on traditional biomechanical dynamics of brain injury remains unclear (Taber et al., 2006). Therefore, an absolute threshold for injury in translational force units likely cannot be applied unilaterally in this context.

Table 1 American congress of rehabilitation medicine (ACRM) mild traumatic brain injury committee of the head injury interdisciplinary special interest group of mild traumatic brain injury

The ACRM states that a patient with mild traumatic brain injury is a person who has had a traumatically induced physiological disruption of brain function, as manifested by at least one of the following:

1. Any period of loss of consciousness.
2. Any loss of memory for events immediately before or after the accident.
3. Any alteration in mental state at the time of the accident (e.g., feeling dazed, disoriented, confused).
4. Focal neurological deficit(s) that may or may not be transient.

But where the severity of the injury does not exceed the following:

1 Loss of consciousness (LOC) of 30 minutes.
2. After 30 minutes, an initial Glasgow Coma Scale (GCS) score of 13–15.
3. Post-traumatic amnesia (PTA) not greater than 24 hours.

Reference: Kay et al., 1993.

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Table 2 Centers for disease control conceptual definition of MTBI

A case of MTBI is an occurrence of injury to the head resulting from blunt trauma or acceleration or deceleration forces with one or more of the following conditions attributable to the head injury during the surveillance period:

- Any period of observed or self-reported transient confusion, disorientation, or impaired consciousness.
- Any period of observed or self-reported dysfunction of memory (amnesia) around the time of injury.
- Observed signs of other neurological or neuropsychological dysfunction, such as:
  - –Seizures acutely following head injury;
  - –Among infants and very young children: irritability, lethargy, or vomiting following head injury;
  - –Symptoms among older children and adults such as headache, dizziness, irritability, fatigue, or poor concentration, when identified soon after injury, can be used to support the diagnosis of mild TBI, but cannot be used to make the diagnosis in the absence of loss of consciousness or altered consciousness. Further research may provide additional guidance in this area.
- Any period of observed or self-reported loss of consciousness lasting 30 minutes or less.

More severe brain injuries were excluded from the definition of MTBI and include one or more of the following conditions attributable to the injury:

- Loss of consciousness lasting longer than 30 minutes.
- Post-traumatic amnesia lasting longer than 24 hours.
- Penetrating craniocerebral injury.

Reference: Report to Congress on Mild Traumatic Brain Injury in the United States: Steps to Prevent a Serious Public Health Problem, 2003.

Once biomechanically induced trauma is considered present and sufficient to cause brain injury, MTBI should be diagnosed on the basis of acute injury characteristics, not retrospectively on the basis of symptoms alone. Classic indicators include loss or alteration of consciousness, post-traumatic amnesia, some alteration in mental or neurologic status, and other acute symptoms representative of traumatic brain injury, as reflected in the DVBIC and other formal MTBI definitions. Explicit in the WHO definition and implicit in the other definitions is that this loss or alteration of consciousness is due to the biomechanical force to the brain, not to other

Table 3 World Health Organization (WHO) collaborating centre task force on mild traumatic brain injury operational definition of MTBI

MTBI is an acute brain injury resulting from mechanical energy to the head from external forces.

Operational criteria for clinical identification include:

A) One or more of the following:
- Confusion or disorientation.
- Loss of consciousness for 30 minutes or less.
- Post-traumatic amnesia for less than 24 hours.
- Other transient neurological abnormalities such as focal signs, seizure, intracranial lesion not requiring surgery.

B) Glasgow Coma Scale score of 13–15 after 30 minutes post-injury or later upon presentation for healthcare.

C) These manifestations of MTBI must not be:
- Due to drugs, alcohol, medication.
- Caused by other injuries or treatment for other injuries (e.g., systemic injuries, facial injuries, or intubation).
- Caused by other problems (e.g., psychological trauma, language barrier, or coexisting medical conditions).
- Caused by penetrating craniocerebral injury.

Reference: Holm et al., 2005.

Table 4 Defense and Veterans Brain Injury Center (DVBIC) working group on the acute management of mild TBI in military operational setting: screening and operational definition of MTBI

Screening for MTBI
Anyone exposed to or involved in a blast, fall, vehicle crash, or direct impact who becomes dazed or confused, even momentarily, should be further evaluated for a brain injury.
Operational Definition of MTBI
Mild TBI in military operational settings is defined as an injury to the brain resulting from an external force and/or acceleration/deceleration mechanism from an event such as a blast, fall, direct impact, or motor vehicle accident which causes an alteration in mental status typically resulting in the temporally related onset of symptoms such as: headache, nausea, vomiting, dizziness/balance problems, fatigue, trouble sleeping/sleep disturbances, drowsiness, sensitivity to light/noise, blurred vision, difficulty remembering, and/or difficulty concentrating.

Reference: DVBIC, 2006.

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injury-related factors such as systemic injuries, psychological trauma, or medication. In the context of war this is extremely difficult to determine because many of these factors may occur concomitantly.

Systematic Approach to Standardized Evaluation

In settings with a known high incidence of traumatic brain injury (i.e., current military conflict, collision sports), a systematic approach is essential for injury surveillance, evaluation, and management. The DoD has established elaborate, stepwise protocols for in-theater management of TBI at all severity levels, and the DVBIC Clinical Practice Guideline included a protocol specific to the management of MTBI from in-theater to post-deployment.

During the acute phase, use of standardized methods provides objective data on injury severity and recovery to guide operational decisions regarding an injured military personnel's fitness to return to combat or active duty. Additionally, standardized protocols help determine those injured military personnel who may be in need of further evaluation (e.g., more thorough neuropsychological testing) and management at a higher echelon of care in the current military theater. Finally, use of standardized methods also facilitates communication on a military personnel's injury status between providers across the care continuum, and allows comparative clinical analysis across time and across patients.

Domains considered to be relevant to evaluating the effects of traumatic brain injury include:

1. *Acute injury characteristics*: assessment and documentation of mechanism of injury, presence and duration of unconsciousness, presence and duration of post-traumatic amnesia, acute alterations in mental status, and associated neurologic abnormalities.
2. *Cognitive functioning*: standardized, objective evaluation of cognitive functions most susceptible to deficit after TBI (attention/concentration, memory, working memory, reaction time, cognitive processing speed, executive functioning).

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3. *Postconcussive symptoms*: standardized assessment of specific symptoms and severity (e.g., MTBI symptom checklist).
4. *Postural stability and agility*: evaluation of physical impairments that negatively impact the military personnel's ability to function in full military capacity.
5. *Psychological risk factors for adverse outcome*: evaluation of potential obstacles to psychological adjustment (e.g., event-associated injuries independent of MTBI, developmental history suggestive of disorder of attention or impulsivity, history of drug abuse, poor social adjustment in military).

In the current military operational setting, the evaluation of TBI frequently involves a tiered approach stratified by (a) the purpose and complexity of evaluation required, (b) the time required to complete the evaluation, (c) the feasibility of completing the evaluation in a given location, and (d) the training requirements of the evaluator.

Considering these constraints, the DVBIC Working Group and DoD/DVA Planning Conference offered recommendations on standardized protocols for evaluation of TBI at each echelon of care across the DoD/DVA continuum. While there is some variability between the DVBIC and DoD/DVA systems, both call for the aforementioned tiered approach with brief, intermediate, and comprehensive methods for TBI evaluation depending on the required purpose and setting.

With respect to brief assessment methods for acute TBI evaluation, DVBIC has developed the Military Acute Concussion Evaluation (MACE) that combines a system for documenting acute injury characteristics with the Standardized Assessment of Concussion (SAC), a brief cognitive screening tool previously validated for evaluation of MTBI (DVBIC, 2006; McCrea et al., 2003; McCrea, Kelly, Randolph, Cisler, & Berger, 2002). The MACE has been deployed to active military personnel and is currently being used to evaluate TBI in theater.

Beyond the constraints of acute TBI assessment on the frontline, more sophisticated means of evaluating physical, cognitive, and neurobehavioral TBI sequelae are available. It is at this point that brief neuropsychological testing becomes a valuable tool to evaluate the more subtle, persistent cognitive effects of TBI perhaps no longer detectable on brief screening tools such as the MACE and SAC. At this intermediate assessment point, a more thorough survey of symptoms is also indicated and feasible.

Finally, a comprehensive approach to evaluation may be indicated at higher echelons of care for military personnel with an atypical recovery after mild TBI. Post-deployment, comprehensive evaluation methods may be useful to guide treatment planning and assess claims of service-connected disability resulting from deployment-related TBI at all severity levels, including MTBI.

Given several factors (e.g., volume of injured patients to be evaluated, need for serial testing across several levels of the care continuum, importance of rapid data accessibility and transfer), it is likely that computerized cognitive testing will emerge as an important tool in this venue. Consideration should be given to an electronic platform of both brief assessment methods (e.g., handheld screening instruments) and more extensive neuropsychological testing. Selection of a specific computerized test battery by the military or VA will require a critical review of currently available or innovative new modules in terms of their feasibility and appropriateness in

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the evaluation of deployment-related TBI. The current setting perhaps creates a unique environment for a head-to-head comparison to determine the most effective evaluation methods for this purpose.

Most importantly, any measure purporting to objectively measure the effects of MTBI and subsequent recovery should meet basic psychometric rigors related to reliability and validity (Randolph, McCrea, & Barr, 2005). Additionally, demonstration of sensitivity, specificity, and relative predictive power specific to MTBI must be established. Regardless of the tool(s) selected, professional interpretation of neuropsychological findings in the context of history and other medical and psychosocial findings will be essential. Ideally, neuropsychologists also will aspire to demonstrate the incremental value of neuropsychological testing in detecting clinically meaningful abnormalities in the otherwise asymptomatic patient. In other words, what is the likelihood that a test will detect significant cognitive abnormalities in the TBI patient who would otherwise be given ''the green light'' to return to active duty on the basis of symptom report alone? Assessment methods utilized beyond the acute injury phase could also include symptom validity or response bias measures, given the potential for motivational factors to sometimes confound the clinical picture of recovery after MTBI.

Other factors in the selection of neuropsychological measures include:

- Time to administer
- Ease of administration and training required by the examiner
- Ease of interpretation
- Availability of alternate forms to reduce possible practice effects from serial testing
- Adaptability of measure to computerized testing methods
- Portability of the measure
- Ease of electronic data transfer across the care continuum
- Direct and indirect costs of the measure.

Pre-Deployment Baseline Testing

Borrowing from the sport concussion research model, military protocols are evaluating the feasibility and potential benefit of pre-deployment baseline testing to establish a benchmark against which to compare post-injury results to detect impairments and track recovery after MTBI. Relative to traditional methods that compare an individual's postinjury performance to normative data on a given instrument, the baseline testing model theoretically improves the sensitivity and specificity of any instrument in detecting abnormality at the individual case level.

Aside from the potential advantages, the baseline testing model creates significant methodological complexities relevant to the psychometric properties of various assessment instruments, the confounding effects of serial testing, and evidence-based approaches to distinguishing between a clinically meaningful change in test performance from error variance (Barr, 2001; McCrea et al., 2005).

These complex issues indicate the need for experienced neuropsychologists to be integrally involved in this movement toward implementation of baseline testing, independent of any commercial or financial conflicts of interest with various cognitive

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testing products. Most apparent is the need to critically evaluate existing test batteries to determine standards of reliability, validity, sensitivity and specificity acceptable for clinical use, as well as their practicality and user-friendliness.

Screening for Unreported or Unrecognized MTBI

Given the difficulties in sometimes recognizing the subtle signs of MTBI, the complexities of a chaotic combat setting, and perhaps a tendency for these injuries to go unreported as in a sports setting, there exists the possibility that cases of chronic MTBI may first surface post-deployment.

The Department of Veterans Affairs has proactively implemented a TBI Screening Clinical Reminder throughout the VA system to prompt care providers to survey veterans on (a) whether the veteran served in OIF or OEF, (b) if they had been already diagnosed as having TBI during OIF/OEF, (c) the veteran's exposure to blast or explosion, vehicular crash or other incidents with biomechanical force sufficient for MTBI, (d) whether there were any alterations in consciousness, amnesia, or postconcussive symptoms after the event, and (e) whether the veteran is experiencing any persistent symptoms and difficulties at the time of the screening. Further consultation within the four-tiered VA Polytrauma System of Care is triggered by a positive response to the Clinical Reminder. This consultation includes an interdisciplinary team of professionals employing a standardized screening instrument and applying results to an algorithm-derived care approach.

In addition to the VA's approach to this issue, the Military TBI Task Force offers the following points of emphasis on the retrospective diagnosis of MTBI:

- Retrospective diagnosis based on chronic subjective symptoms can be inadequate in the case of MTBI. Although it may present challenges in the military operational setting, establishing the biomechanical parameters of the injury-causing event and relevant acute injury characteristics is an important aspect for diagnosing MTBI, in conjunction with a standardized operational definition of MTBI that goes beyond symptom reporting. The same approach to diagnosis applies in the post-acute setting.
- Early, accurate in-theater identification and documentation of event and symptom parameters could ultimately negate the need to screen for undetected MTBI.
- The postinjury course is critical. The true natural history of MTBI is commonly characterized by the most pronounced symptoms and abnormalities immediately after injury, followed by a gradual improvement in symptoms, cognitive functioning, and other abnormalities to complete recovery within days to weeks in the overwhelming majority of cases (Iverson, 2005). Note that immediately following the trauma, most individuals focus on physical symptoms and may be less aware of cognitive and emotional symptoms because these may not manifest themselves in a clinical setting but may emerge in normal activities of daily living. However, new symptoms rarely manifest weeks after injury. DoD and VHA should assure that their respective medical personnel receive education on the expected recovery course, which is critical for early detection and for sorting out later cases that might exhibit catastrophic reactions or signs not specific to MTBI.

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- As has been previously established in the sports setting, it is possible that military personnel may not be inclined to report MTBI because of several factors, including (a) failure to recognize the signs of injury; (b) unawareness or underestimation of the potential seriousness of concussion or MTBI; or (c) fear that reporting their injury may result in being pulled from active duty and letting down their comrades on the front line. (McCrea, Hammeke, Olsen, Leo, & Guskiewicz, 2004) Additionally, it is very reasonable to assume that the military personnel or military medical personnel may not recognize MTBI when it occurs in the context of more critical injuries (e.g., abdominal wound, orthopedic injury, spinal cord injury, etc.) that take a higher priority during acute triage.
- The terms postconcussion syndrome (PCS) and MTBI are not synonymous. MTBI is a criteria-based diagnosis based primarily on parameters of the injury-causing event and acute injury characteristic. PCS is diagnosed when a patient presents with ongoing complaints 3 months post-accident. A differential diagnosis is called for to separate between PCS and other disorders with nonspecific symptoms not associated with the MTBI (Belanger, Curtiss, Demery, Lebowitz, & Vanderploeg, 2005; Luis, Vanderploeg, & Curtiss, 2003).
- False positives in the retrospective diagnosis of MTBI and especially PCS can occur, which may lead to potential iatrogenic influences on recovery and outcome.

Education and Training

Ideally, DoD and VHA will provide their medical professionals with training by MTBI experts on (a) mechanisms, signs, and symptoms of TBI, (b) criteria for differentiating mild, moderate, and severe TBI, (c) challenges unique to the diagnosis of MTBI, (d) evidence-based methods for MTBI evaluation and management, and (e) expected recovery course and factors that complicate recovery after MTBI.

SECTION 2: TREATMENT AND REHABILITATION OF MTBI

Acute Injury Management

Ideally, and if operationally feasible, military personnel should not return to full duty or be exposed to risks of repeated head injury until completely symptom free and normal for several days at rest and under exertion. Protecting military personnel during a period of cerebral vulnerability during which the brain is susceptible to the effects of additional trauma is vital to preventing rare catastrophic outcome after MTBI and reducing the potential long-term effects of recurrent MTBI. In addition, prematurely returning to duty before full recovery after MTBI may jeopardize the military mission and expose comrades to risk of harm.

Borrowing from the sports concussion injury management model, it has been suggested that acute injury evaluation incorporate provocative exertional maneuvers (e.g., sit-ups, push-ups, etc.) to create conditions of increased intracranial pressure most likely to elicit any latent postconcussive abnormalities in the head-injured patient who is otherwise appearing normal at rest (Guskiewicz et al., 2004). A graduated protocol for return to duty has also been suggested, starting with complete rest while the military personnel remains symptomatic, followed by gradually increasing exertion and returning to normal activity once the injured

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military personnel is completely symptom free for several days, even under maximum exertion.

Acute Psycho-Educational Intervention

Several studies have demonstrated that supportive psychological and educational interventions can effectively reduce the incidence of postconcussion syndrome (PCS), which in turn enhances functional outcome and alleviates the burden of disability associated with MTBI (Borg et al., 2004; Kashluba et al., 2004; Mittenberg, Tremont, Zielinski, Fichera, & Rayls, 1996; Ponsford et al., 2001). These interventions need not be intensive and are most effective when introduced early during the acute or subacute recovery phase after MTBI (Borg et al., 2004).

DoD psychologists and neuropsychologists should be integrally involved in devising evidence-based interventions for MTBI patients that are feasible for implementation by non-psychologists on the front line. To that end, it will be imperative to educate DoD, VHA, and civilian care providers in evidence-based treatment of MTBI and PCS. One suggested method is to provide patients with standardized informational resources that positively and appropriately present the expected recovery post MTBI, which reduces the injured military personnel's anxiety about their MTBI symptoms (Mittenberg et al., 1996).

Postconcussion Syndrome (PCS)

Diagnostic criteria for PCS have been formalized by both the World Health Organization (WHO) (see Table 5) (WHO, 1992) and American Psychiatric Association (see Table 6) (American Psychiatric Association, 1994). While data on PCS from the current military conflict are not available, the true incidence of persistent PCS after MTBI may be lower than the incidence rate that has been estimated in the literature for the general population (Iverson, Zasler, & Lange, 2006). Furthermore, there is now a substantial empirical literature base showing that PCS symptoms are typically influenced by factors other than head injury, such as

Table 5 ICD-10 diagnostic criteria for post-concussional syndrome

A. History of head trauma with loss of consciousness precedes symptoms onset by maximum of 4 weeks
B. Symptoms in three or more of the following symptom categories:
- Headache, dizziness, malaise, fatigue, noise tolerance.
- Irritability, depression, anxiety, emotional lability.
- Subjective concentration, memory, or intellectual difficulties without neuropsychological evidence of marked impairment.
- Insomnia.
- Reduced alcohol tolerance.
- Preoccupation with above symptoms and fear of brain damage with hypochondriacal concern and adoption of sick role.

Reference: WHO, 1992.

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Table 6 DSM-IV research criteria for post-concussional disorder

A. A history of head trauma that has caused significant cerebral concussion.
   Note: The manifestations of concussion include loss of consciousness, post-traumatic amnesia, and, less commonly, post-traumatic onset of seizures. The specific method of defining this criterion needs to be established by further research.
B. Evidence from neuropsychological testing or quantified cognitive assessment of difficulty in attention or memory (learning or recall of information).
C. Three (or more) of the following occur shortly after the trauma and last at least 3 months:
   1. becoming fatigued easily;
   2. disordered sleep;
   3. headache;
   4. vertigo or dizziness;
   5. irritability or aggression on little or no provocation;
   6. anxiety, depression, or affective instability;
   7. changes in personality (e.g., social or sexual inappropriateness);
   8. apathy or lack of spontaneity.
D. The symptoms in Criteria B and C have their onset following head trauma or else represent a substantial worsening of pre-existing symptoms.
E. The disturbance causes significant impairment in social or occupational functioning and represents a significant decline from a previous level of functioning. In school-aged children, the impairment may be manifested by a significant worsening in school or academic performance dating from the trauma.
F. The symptoms do not meet criteria for Dementia Due to Head Trauma and are not better accounted for by another mental disorder (e.g., Amnestic Disorder Due to Head Trauma, Personality Change Due to Head Trauma).

Reference: American Psychiatric Association, 1994.

premorbid/comorbid factors and litigation, which are not specifically caused by head injury (Iverson et al., 2006).

A biopsychosocial approach can be employed to conceptualize, diagnose, and manage PCS, with equal emphasis on the somatic, cognitive, and neurobehavioral symptoms. A comprehensive examination of PCS is beyond the scope of this article. It is important to note, however, that PCS is considered to be influenced by somatic, psychological, social, and motivational factors. Accordingly, it has been suggested that evaluation of those factors be part of a comprehensive neuropsychological evaluation. The degree to which cognitive and psychological functioning is compromised by MTBI versus other factors can be quantified in the neuropsychological evaluation. PCS symptoms are understood to be quite common among individuals with various medical (e.g., polytrauma, chronic pain, etc.) or psychological disorders, including those likely to be quite prevalent in combat settings (e.g., depression, anxiety, etc.) (Iverson et al., 2006; McCrea, 2007). Theory, research, and clinical practice all converge on the concept of PCS as a neuropsychological disorder associated with the acute, transient neurologic effects of MTBI, but PCS is frequently accompanied or maintained by a host of non-injury-related factors (McCrea, 2007).

Fortunately, PCS is amenable to treatments that include supportive patient education and cognitive-behavioral therapy (Borg et al., 2004; Kashluba et al., 2004; Mittenberg et al., 1996; Ponsford et al., 2001). Neuropsychologists and rehabilitation psychologists are uniquely trained to recognize the diagnostic complexities of PCS and to design effective interventions. In a clinical setting, an

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interdisciplinary approach is preferable to a non-integrated approach to care. An interdisciplinary approach is appropriate for treating PCS and can improve functional outcome for MTBI patients, which significantly reduces the overall public health burden associated with MTBI.

Recognizing the Influence of Post-Traumatic Stress Disorder (PTSD) and Other Psychological Effects of War

Awareness of the more global issues that military veterans with MTBI face in their return to civilian life is important, particularly given the known effect that psychological stress can have on outcome after MTBI (Hoge et al., 2006; Hoge et al., 2004). To this end, evaluating healthcare professionals will want to be aware of the possibility of unique or comorbid influences of deployment and post-deployment stresses and psychological reactions, including but not exclusive to PTSD, on persistent symptoms and functional deficits after possible MTBI.

In some instances it is also possible that MTBI could be retrospectively diagnosed in error on the basis of nonspecific symptoms of PCS that are more accurately attributable to PTSD. As in the case of MTBI and PCS, established diagnostic criteria have been adopted to assist in formal diagnosis of PTSD. The American Psychiatric Association (APA) defines PTSD as a disorder characterized by the re-experiencing of an extremely traumatic event accompanied by symptoms of increased arousal and by avoidance of stimuli associated with the trauma. Acute Stress Disorder is characterized by symptoms similar to those of PTSD that occur immediately in the aftermath of an extremely traumatic event and may or may not eventuate into more persistent PTSD (APA, 1994).

Whether PTSD is the sole source of persistent symptoms or co-existing with MTBI and PCS, the existing evidence base for treatment of combat-related PTSD, much of which has been delivered by psychologists and neuropsychologists, provides an important reference point for diagnosis and treatment. Recognizing potential comorbidity of MTBI, PCS, and PTSD, psychologists can design effective evidence-based individualized treatment.

SECTION 3: KEY RESEARCH INITIATIVES ON DEPLOYMENT-RELATED TBI, PCS, AND PTSD

Certainly, there remain many unknowns about the effects of deployment-related MTBI. As was initially recognized more than 20 years ago with respect to the sports concussion research model, the current setting of high TBI prevalence in OEF and OIF personnel may create a unique, controlled environment for epidemiological and clinical research that advances the basic and clinical science of brain injury in general. To that end, the Military TBI Task Force recommends the following areas of focus for prospective study designed to:

- characterize the acute effects and natural course of recovery after deployment-related MTBI;
- identify factors that best predict a military personnel's readiness for return to active duty *and* modulate risk of reinjury;

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- conduct comparative analysis of blast-related MTBI and other biomechanical causes;
- determine which evaluation methods are most clinically effective and feasible for evaluation of deployment-related TBI, perhaps through head-to-head, controlled comparisons;
- elucidate injury and non-injury-related factors that best predict favorable vs poor outcome in symptoms, cognitive recovery, and psychosocial functioning after deployment-related MTBI; special consideration should be given to studying longitudinal outcomes in this population, particularly those individuals with exposure to multiple deployment-related TBI;
- establish the true incidence of PCS and PTSD in this combat veteran population;
- evaluate the interactive effects of MTBI, PCS, and PTSD;
- explore interventional strategies that prevent the occurrence of PCS and PTSD;
- determine the efficacy of various medical and psychological methods for the treatment of patients with poor outcome related to PCS and PTSD;
- assist in the development of pre-deployment education about MTBI and development of in-theater brief, standardized MTBI screening methods.

Given the increased incidence of deployment-related TBI, strong consideration should be given to establishment of a DoD/DVA TBI patient registry as a centralized database to track clinical outcomes and drive these vital research initiatives. The centralized registry ideally would integrate objective documentation on acute injury characteristics, assessment data, treatment records, and outcome measures.

SUMMARY AND CONCLUSIONS

In summary, the increased prevalence and complexity of TBI in the current military combat setting creates a unique set of immediate challenges that require experts to develop new, innovative methods for injury evaluation and treatment. Beyond the front lines, similar challenges will be encountered in the post-deployment evaluation of veterans with documented or suspected MTBI.

The work of the Military TBI Task Force highlights the critical issues relevant to deployment-related TBI and provides information about evidence-based approaches to TBI from the perspective of neuropsychology and rehabilitation psychology. As research-oriented experts in evidence-based specialties, neuropsychologists and rehabilitation psychologists should and will be vital contributors to the process of developing effective military medical operations for the management of TBI across the care continuum, and to addressing the needs of the military veteran affected by TBI.

The challenge of providing appropriate assessment and treatment of MTBI to the potentially high numbers of solders who may benefit reflects a significant opportunity for collaboration between military and civilian healthcare providers, perhaps more so than ever previously encountered. Although many military personnel are being cared for within the DoD and DVA systems, community-based partnerships are being formed both nationally and locally. This consensus statement helps pave the road for collaboration in providing evidence-based practice and promoting joint research endeavors.

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DISCLOSURE

Michael McCrea is one of the principal authors of the Standardized Assessment of Concussion (SAC); Dr. McCrea holds no financial interest in either the SAC or the Military Acute Concussion Evaluation (MACE).

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