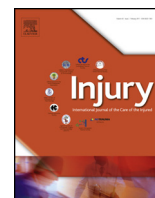




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Early traumatic brain injury screen in 6594 inpatient combat casualties

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ABSTRACT

Introduction: The purpose of this study was to review the inpatient traumatic brain injury (TBI) screening program at a Role IV regional resource trauma center. TBI has been coined the “signature wound” during current U.S. combat operations. All patients injured in Iraq or Afghanistan who transit through Landstuhl Regional Medical Center (LRMC) undergo an initial TBI screen regardless of anatomic injury. The incidence and factors associated with positive screening for concussion (physical event + alteration of consciousness (AOC)) and TBI diagnoses were examined.

Methods: A retrospective review of consecutively admitted patients to LRMC who underwent a TBI screen from 5/06 to 7/11 was performed. Patient characteristics, self-reported symptoms, and TBI diagnoses were analyzed.

Findings: Among 43,852 patients screened during the 5-year period, 6594 were admitted, of whom, 6590 received a complete TBI screen. Predominantly male (97.1%), the mean age was 26.7 ± 7.4 yrs. The average GCS and ISS at admission were 13.9 ± 2.8 and 10.1 ± 8.6 , respectively. Positively screened patients averaged 1.8 deployments, 69.5% experienced one or more blasts, 16.1% experienced one or more vehicular crashes, with 18.0% reporting a prior head injury. Of the 2805 (42.6%) who screened positive for possible concussion, 2393 (85.3%) were diagnosed with a concussion/TBI during their inpatient stay; the remaining 412 (14.7%) were identified by screening only. Of the screened positive patients, 1953 (69.6%) reported 1 or more current concussion/TBI-related symptoms; of those with symptom(s), 532 (27.2%) reported 5 or more.

Conclusions: Early screening based on self-report identified a large number of patients admitted directly from the combat zone with possible deployment-related concussion and TBI symptoms. Such screening provides valuable information to guide decisions about early management and return to duty.

Level of evidence: Level III, Therapeutic.

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Background

Traumatic brain injury (TBI) has been coined “the signature wound” of operations in Iraq and Afghanistan [1]. It has been estimated that 320,000 U.S. service members have suffered a TBI since combat operations began in 2001 [2]. Although the exact proportion is unknown, it is believed that the majority of these patients have sustained “mild” or “concussive” TBI. Long-term

adverse health outcomes have been associated with mild TBI (mTBI) and early identification with treatment has been shown to decrease persistent symptoms [2–6]. As a result, an increase in the need for screening was identified and the Department of Veterans Affairs has published directives to increase TBI screening [7].

In 2006, a comprehensive screening program was implemented at Landstuhl Regional Medical Center (LRMC) [8]. LRMC is located in Landstuhl, Germany and serves as the only role IV military treatment facility (MTF) in the Department of Defense (DOD). As such, all service members injured in Iraq or Afghanistan travel through LRMC en-route back to the continental United States (CONUS). The purpose of this study was to review the in-patient screening for mild to moderate TBI at a role IV MTF. We sought to better define the incidence and factors associated with a positive screening for concussion and mTBI.

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Methods

A retrospective review of consecutively admitted patients who underwent a TBI screen at the Landstuhl Regional Medical Center (LRMC) was performed between May 2006 and July 2011. Inclusion criteria were U.S. Military, U.S. civilian or foreign national >18 year of age who completed the LRMC TBI screening and were admitted as an in-patient to be included in the LRMC Trauma Registry.

The TBI database contains data on TBI screening and Military Acute Concussion Evaluation (MACE) scores for all U.S. military personnel who have been evacuated from Iraq and Afghanistan. The MACE score is a well-established, rapid screening tool that is designed for use immediately after traumatic injury in patients suspected of having a concussion, to screen for the cognitive, neurologic, and symptomatic effects of TBI [9]. It was derived from the validated *Standardized Assessment of Concussion* used in sports medicine [10]. A MACE score below 25 (maximum score 30) may indicate clinically relevant neurocognitive impairment mandating further evaluation (MACE scorecard available at the Defense and Veterans Brain Injury Center, DVVIC.org).

The first part of the comprehensive screening tool at LRMC is the self-reported LRMC mTBI Screening Questionnaire evaluating for; (1) exposure to a TBI mechanism of injury, (2) immediate symptoms following the event, and (3) symptoms experienced since the event [8]. The second portion of the tool examines cognitive deficits (e.g., orientation and immediate memory recall) using the MACE screening protocol. The screening algorithm used can be viewed in Fig. 1.

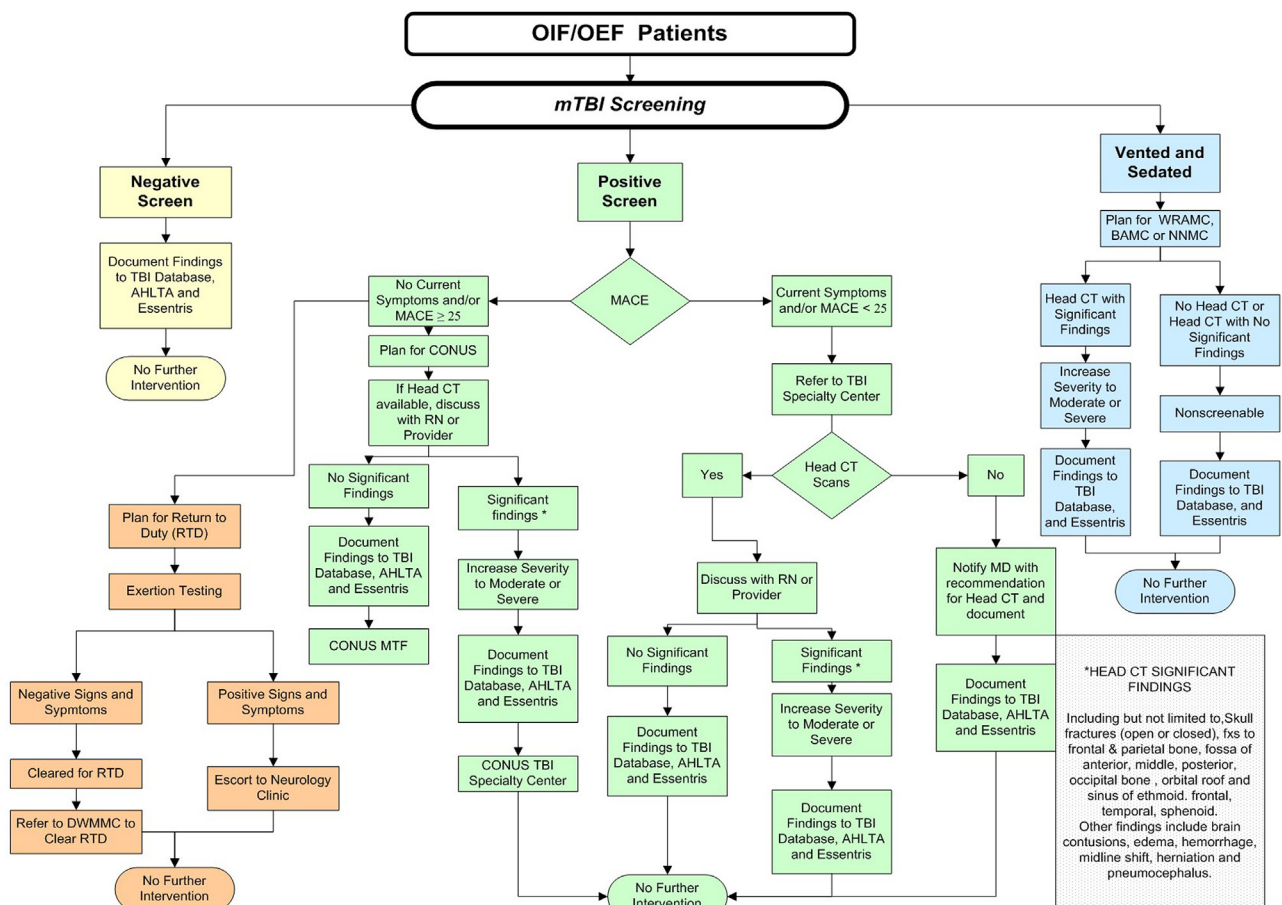
Unique patient identifiers from this screening tool were linked to the Landstuhl trauma registry (TR). The LRMC TR includes

detailed injury data on the subset of service members admitted for care. Further data was incorporated from the Department of Defense Trauma Registry (DoDTR), formerly known as the Joint Theater Trauma System (JTTR). Baseline patient characteristics recorded included service status, mechanism of injury, number of deployments, exposure event (e.g., blast, fall, gunshot, motor vehicle crash), injury severity score (ISS), military injury severity score (mISS), and Glasgow Comas Score (GCS). The full screening protocol can be viewed in Fig. 2.

TBI diagnosis was defined as having at least one TBI ICD-9-CM diagnosis code according to the Armed Forces Health surveillance Center DOD TBI surveillance case definition (ICD-9 codes 850.0–859.9). Possible concussion/mTBI was defined as positive screening plus current symptoms of mTBI and/or a MACE score less than 25. Patients designated as special interest or detainee were excluded. Descriptive statistical analyses were performed on this cohort of patients. Continuous variables were reported as means or medians with standard deviation. These variables were compared via Wilcoxon Test for nonparametric data and *t*-test for parametric data. Dichotomous variables were compared using the chi-square test. All tests for significance were reported as 2-tailed, with level of $\alpha = 0.05$. This protocol was approved for study by the Brooke Army Medical Center Institutional Review Board (H-08-027).

Results

Between May 2006 and July 2011, 43,852 patients underwent mTBI screening at Landstuhl (Fig. 3). Those treated as outpatients could not be linked to the JTTR and were excluded from further analyses. Among the study population of 6594 screened in-



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