SPECIAL SECTION: ORIGINAL ARTICLE

Characteristics and Rehabilitation Outcomes Among Patients With Blast and Other Injuries Sustained During the Global War on Terror

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ABSTRACT. Sayer NA, Chiros CE, Sigford B, Scott S, Clothier B, Pickett T, Lew HL. Characteristics and rehabilitation outcomes among patients with blast and other injuries sustained during the Global War on Terror. Arch Phys Med Rehabil 2008;89:163-70.

Objective: To describe characteristics and rehabilitation outcomes among patients who received inpatient rehabilitation for blast and other injuries sustained in Iraq and Afghanistan during the Global War on Terror.

Design: Observational study based on chart review and Department of Veterans Affairs (VA) administrative data.

Setting: The 4 VA polytrauma rehabilitation centers (PRCs).

Participants: Service members (N=188) admitted to a PRC during the first 4 years of the Global War on Terror for injuries sustained during Operation Iraqi Freedom or Operation Enduring Freedom.

Intervention: Multidisciplinary comprehensive rehabilitation program.

Main Outcomes Measures: Cognitive and motor FIM instrument gain scores and length of stay (LOS).

Results: Most war-injured patients had traumatic brain injury, injuries to several other body systems and organs, and associated pain. Fifty-six percent had blast-related injuries, and the pattern of injuries was unique among those with injuries secondary to blasts. Soft tissue, eye, oral and maxillofacial, otologic, penetrating brain injuries, symptoms of post-traumatic stress disorder, and auditory impairments were more common in blast-injured patients than in those with war injuries of other etiologies. The mechanism of the injury did not predict functional outcomes. LOS was variable, particularly for those with blast injuries. Patients with low levels of independence at admissions made the most progress but remained more dependent at discharge compared with other PRC patients. The rate of gain was slower in this low-functioning group.

Conclusions: Blasts produce a unique constellation of injuries but do not make a unique contribution to functional gain scores. Findings underscore the need for assessment and treatment of pain and mental health problems among patients with polytrauma and blast-related injuries. Patients with polytrauma have lifelong needs, and future research should examine needs over time after community re-entry.

Key Words: Brain injuries; Length of stay; Outcome assessment (health care); Rehabilitation.

AMERICA'S ARMED FORCES are sustaining new and complex patterns of injuries during the Global War on Terror.[1-3] As of July 6, 2007, 27,919 service members had sustained nonmortal injuries during Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) (in and around Afghanistan), and 12,772 (46%) of these soldiers did not return to duty within 72 hours, presumably because of the severity of their injuries.[4] In this era of modern warfare, the majority of combat injuries are blast related.[5-7] In combat, sources of blast injury include artillery, rocket and mortar shells, mines, booby traps, aerial bombs, improvised explosive devices (IEDs), and rocket-propelled grenades (RPGs). The severity and pattern of blast injuries depends on the explosive composition and amount of material involved, surrounding environment, delivery method, distance between the victim and the blast, and presence of intervening protective barriers or environmental hazards.[8] More soldiers are surviving beyond the acute phase of blast injuries because of improvements in body armor and acute trauma care.[2,9] Consequently, the Department of Defense and Department of Veterans Affairs (VA) are providing medical care to soldiers with combat injuries who may have died in previous wars.

The 4 basic mechanisms of blast injury are termed primary, secondary, tertiary, and quaternary.[3] Primary injuries occur secondary to a high-order overpressurization shock wave moving through the body. This wave affects gas-filled organs such as the lungs, gastrointestinal tract, and middle ear. These injuries are not necessarily obvious. Secondary injuries are caused by bomb fragments and other objects propelled by the explosion. These result in penetrating injuries. Tertiary injuries result from the blast wind (not the overpressurization shock wave) throwing the victim and can include bone fractures and traumatic amputation. Quaternary injuries are those not included in the first 3 classes, such as burns, crushing injuries, and respiratory injuries. It is not surprising that blast injuries are often polytraumatic, meaning that they impact more than 1 body system or organ, given the various mechanisms of injury.[10]

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It has been estimated that over 60% of blast injuries result in traumatic brain injury (TBI),[1,11] and, for this reason, TBI is often referred to as the "signature injury" in the Global War on Terror.[12] Recognizing that new systems of care are needed to meet the rehabilitation needs and to optimize functional outcomes among service members with TBI in the context of polytraumatic injuries, the U.S. Congress passed public laws number 108-422 (§302) and 108-447 and the secretary of the VA designated 4 polytrauma rehabilitation centers (PRCs) (located in Minneapolis, MN; Palo Alto, CA; Richmond, VA; Tampa, FL) to provide specialized rehabilitation treatment and expand clinical expertise in polytrauma throughout the VA.[13,14] The majority of the war injured do not require the level of specialized inpatient treatment PRCs provide. However, to meet the needs of the war-injured patients who do present with polytrauma and TBI, clinicians and policy-makers within and outside the VA need evidence-based information about the PRC patient population.

There are no prior published studies that have examined health service use or needs of war-injured service members, let alone those whose injuries are severe enough to warrant intensive inpatient rehabilitation at a PRC. This study helps to fill this knowledge gap. Specifically, the purpose of this study was to describe the characteristics and rehabilitation outcomes of patients treated for TBI with polytrauma and other combat injuries in the VA's 4 PRCs. Prior research based on samples of people who endured TBI as part of civilian life have identified factors associated with favorable outcomes, including younger age,[15-18] higher functional status at admission,[18] higher preinjury education,[19,20] and a shorter injury to treatment interval.[18,21] In contrast, TBI of violent etiology,[22] nonwhite race,[23] preinjury substance use,[24] post-TBI mood disorders,[25] and the presence of comorbid conditions[26] are negatively associated with outcome. Many of these same factors have been associated with the length of stay (LOS) in prior studies, including functional status at admissions, age, days from injury to admissions,[18] and nonwhite race.[27] Additionally, it is well known that rehabilitation processes and outcomes vary by facility.[18] Two important questions are (1) whether these same factors are predictive of rehabilitation outcomes among OIF and OEF combat injured, and (2) whether those with blast-related combat injuries have similar or different outcomes compared with those with non–blast-related combat injuries. This retrospective observational study addresses the following specific questions: (1) What are the sociodemographic characteristics of PRC patients who sustained injures during the Global War on Terror? (2) Do blasts produce a unique constellation of injuries and impairments relative to other mechanisms of injury? (3) What are the levels of recovery in functioning among those injured during OIF or OEF? Do levels of recovery vary by mechanism of injury? (4) What is the average LOS among PRC patients injured during the Global War on Terror? Does LOS vary by mechanism of injury? and (5) What is the rate of mortality among PRC patients injured during the Global War on Terror? Does mortality vary by mechanism of injury?

METHODS

We obtained institutional review board (IRB) approval for this study from the VA and university IRBs associated with each PRC.

Sample

The sample consists of all service members injured as part of OEF or OIF who received VA inpatient rehabilitation services at a PRC during the first 4 years of the Global War on Terror (October 2001 through January 2006). The PRCs treated 566 post–Vietnam era patients during this time period, the vast majority of whom were active duty. Chart review of each of these cases revealed that 188 patients were injured in the Iraq or Afghanistan war zone and hence were included in this study. The other patients had sustained injuries after deployment in Iraq or Afghanistan or during other active duty assignments.

Measures

Trained master's and doctoral-level chart reviewers extracted from the VA electronic medical records patient sociodemographic characteristics, injury date, etiology and types, pre-VA hospitalization surgeries including craniotomies and craniectomies, and impairment and treatment information by using a structured chart extraction form. The chart reviewers read all notes for each case to obtain the required data elements. Impairments in body structures and organs were categorized according to the classifications used by the *International Classification of Functioning, Disability and Health* of the World Health Organization.[28] Accordingly, pain and psychiatric symptoms were classified as functional impairments. Psychiatric symptoms abstracted from the medical records included post-traumatic stress disorder (PTSD), anxiety disorders other than PTSD, depression, and psychosis. Patients with psychiatric symptoms were grouped together for the purpose of the analyses presented later. Because the study goals included comparing the effects of blast-related injuries to the effects of other mechanisms of injury, we created 2 groupings of injury etiology: blast and other. Blast-related injuries were those injuries related to explosions including IEDs, RPGs, hand grenades, mortar, and bombs. Other mechanisms of injury included vehicular, bullet, and falls (table 1).

Function was measured with the FIM instrument, which is to be completed within 72 hours of admissions and discharge.[29] FIM data are stored within the Functional Status Outcomes Database (FSOD) for all VA rehabilitation patients. All VA rehabilitation clinicians, including PRC providers, submitting data to the VA Uniform Data System are credentialed in the use of the FIM. The FIM is a 2-dimensional instrument consisting of 13 motor items and 5 cognitive items.[30] The LOS was identified through the FSOD and verified through chart review. Mortality during the inpatient stay and after discharge was obtained from a VA administrative database, and the cause of death was obtained by chart review.

Statistical Analyses

Pearson chi-square, Fisher exact, and Wilcoxon rank-sum tests were used to determine whether the injuries and impairments differed by mechanism of injury. To identify predictors of cognitive FIM gain, motor FIM gain, and LOS, we developed multiple regression models. First, based on our research goals and prior studies we identified predictors to force into the regression models. These variables were age, race (white, nonwhite), PRC site, and mechanism of injury (blast, other). Next, we conducted bivariate analyses to identify other potential predictors. Variables of interest for the cognitive and motor FIM gain models included the respective baseline FIM values, LOS, education (high school, some college, associate's degree, or greater), number of injuries, days between injury and acute rehabilitation, psychiatric symptoms (yes, no), marital status (married, not married), and history of craniotomy or craniectomy (yes, no). Variables of interest for the LOS model were the same, except that we used the total FIM score as a predictor rather than cognitive and motor FIM scores as 2 individual