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Original Research—CME

Early Predictors of Functional Outcome After Trauma

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Abstract

Background: Despite the availability of routinely collected trauma data, researchers who investigate rehabilitation outcomes, functional evaluation, and comparative effectiveness have not incorporated this potentially clinically meaningful information in their modeling as predictors or adjustors.
Objective: The purpose of this study was to identify variables from the scene of a traumatic accident and from the emergency department that can be used in assessing functional outcomes of persons who survive trauma.
Design: Prospective study.
Setting: Level I academic trauma center.
Patients: Persons who sustained and survived a spinal cord injury, a traumatic brain injury, or polytrauma.
Methods: Trauma and rehabilitation registries were merged by matching the 2 data files for each patient by medical record number, and the files were verified by gender and date of birth. Analysis consisted of standard descriptive statistics (frequencies and averages). A 2-staged linear regression was used to investigate the relationship between the demographic, scene, and ED data elements and discharge functional outcome.
Main Outcome Measure: Discharge Functional Independence Measure (FIM).
Results: Older patients with government insurance had poorer discharge FIM scores compared with patients who had commercial insurance. The Injury Severity Score (ISS) and Glasgow Coma Scale score from the scene of the accident were significantly associated with the discharge FIM. Persons with a lower ISS had significantly higher discharge FIM scores than did persons with a higher ISS ($P < .001$). For every unit change in Glasgow Coma Scale score, FIM scores increased by 0.488 points ($P = .030$).
Conclusion: The use of routinely collected trauma data elements can be useful in assessing the continuum of patient care. Incorporating trauma data into research has the potential to improve our models of functional outcomes and provide meaningful risk adjustors when comparing and evaluating rehabilitation care systems and treatments.

Introduction

The National Trauma Data Bank (NTDB) is the principal U.S. national repository for trauma center registry data to inform the medical community, the public, and decision makers about a wide variety of issues that characterize the current state of care for injured persons [1]. It has implications in many areas, including epidemiology, injury control, research, education, acute care, and resource allocation. The 2014 NTDB annual report contained 814,663 records with valid trauma diagnoses [1]. The overall mortality rate was 4.47. The most deaths were caused by fall-related injuries (33.59%) and motor vehicle—related injuries (26.17%). The highest case fatality rates were seen in suffocation (30.15), drowning/submersion injuries (19.62), and firearm injuries (15.71). Case fatality rates were highest for patients aged 75 years or older (7.82). The fatality rate was 4.81 for males and 3.93 for females. The case fatality rate with an Injury Severity Score (ISS) >24 was 28.18; this rate dropped to 5.43 with an ISS of 16-24, 2.81 with an ISS of 9-15, and 1.33 with an ISS of 1-9. The case fatality rate with an Abbreviated Injury Scale (AIS) score ≥3 by AIS body region is most common at the head (17.95); however, the mortality rate was highest for the neck (20.01). The case fatality rate was 4.65 for urban incidents, 4.0 for rural incidents, 5.13 for suburban incidents, and 3.83 for wilderness incidents. Of the 778,256 persons in the NTDB who initially survived, 54.18% were discharged home

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with no home services, 11.37% were discharged to a skilled nursing facility, 8.72% were discharged to another type of rehabilitation or long-term care facility, 5.02% were discharged to home with home care services, and 2.69% died before discharge.

The existence of integrated trauma systems and trauma registries has proved to be essential in improving survival rates, with an overall reduction in risk of death of 10%-25% when care was provided at a trauma center [2-6]. The reduction in mortality is attributed to improved and effective triage in the field and highly specialized regional trauma centers that can provide skilled care in a timely manner. However, trauma system effectiveness must rely on more than mortality statistics to assess the overall effectiveness of the system of care and the ultimate burden of injury on society [4-9]. The recognition of the trauma system's role in reducing mortality and the successful integration of trauma survivors back into society through rehabilitation was highlighted in the Model Trauma System Planning and Evaluation document, which was released by the Health Resources and Service Administration in 2006 [10]. This document promotes database linkage between trauma registry, emergency department (ED), prehospital, and rehabilitation to create an all-inclusive trauma system registry. Trauma registries have the capacity to improve patient care by rapidly identifying factors that may alter morbidity and mortality, including diagnostic evaluations and therapeutics, risk assessment, staffing needs, and cost [10]. The linkage of trauma registries and rehabilitation outcome data has the potential to further enhance outcome, comparative effectiveness, and cost-effectiveness research by identifying trauma factors that may play a role in functional outcome.

Studies have identified a number of demographic, physiologic, and anatomic data elements from trauma registries that have been used successfully to develop and improve trauma care protocols. For example, older persons are more likely to have higher morbidity and mortality than are younger persons [11-13]. Physiologic indicators such as systolic blood pressure (SBP), respiratory rate, and Glasgow Coma Scale (GCS) scores have been shown to be associated with poor trauma outcomes [14-18]. Penetrating injuries result in significantly higher mortality [19]. It has been shown that time of injury affects trauma outcome, with the survival rate increasing when trauma survivors are brought to the appropriate trauma center within the "golden hour" or 1 hour since injury [20]. Prehospital intubation has been associated with a decrease in survival among trauma victims [21-23]. However, failed prehospital intubations were also associated with increased mortality [23]. Mortality after trauma is also associated with positive toxicology screenings for alcohol and use of illicit drugs [24-26].

Trauma outcomes based on mortality have altered triage applications [27,28], modified treatment algorithms [29-31], and identified patients who will need long-term care [32,33]. The value of reducing morbidity and mortality in survivors has been essential for the growth of the trauma system. However, with the decline in the rate of preventable mortality at mature trauma centers, its usefulness as an indicator of performance is becoming limited [34]. The addition of functional outcome data to the trauma registry may provide Emergency Medical Services (EMS), emergency medicine physicians, and trauma surgeons with additional information on the quality of survival. This information may be used to alter triage protocols and treatment based not only on patients who survive, but with additional information regarding their functional capabilities.

Delivering care for an individual based on mortality statistics is critical. However, to improve the delivery of care for patients who survive, data elements beyond mortality are required, and the relationship between assessments made at the scene and in the ED and functional outcomes during rehabilitation needs to be evaluated. The purpose of this study was to identify data elements from the scene of a traumatic accident and from the ED that are associated with functional outcomes and to describe the nature of that association for persons who sustained and survived a spinal cord injury (SCI), traumatic brain injury (TBI), or polytrauma (Poly-T).

Methods

We merged a level I trauma center's registry of patients aged 18 years and older who were admitted between January 1, 2005, and December 31, 2010, with their individual data located in the center's rehabilitation registry using medical record numbers. Matches were verified using the patients' date of birth and gender. Discrepancies were resolved by direct review of the patients' electronic medical records. The merged dataset provided an account of trauma victims' clinical records from time of injury (scene) through the ED and discharge from the inpatient rehabilitation facility (IRF). From the merged dataset, we further refined the study sample to include all trauma patients who were admitted to the hospital system's acute rehabilitation

Table 1
International Classification of Disease, 9th Revision diagnosis codes

Type of Injury	ICD-9 Codes
Spinal cord injury	952.00-952.9, 806.00-806.9, 344.0, 344.9
Traumatic brain injury	800.00-801.99, 803.00-804.99, 850.0-854.1
Polytrauma	800-959.9

ICD-9 = International Classification of Disease, 9th Revision.

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