Functional status, age, and long-term survival after trauma

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Background. *The association between functional status in trauma survivors and long-term outcomes is unknown.*

Methods. *We performed an observational cohort study on adult trauma patients (≥18 years), who required admission to the intensive care unit and who survived hospitalization between 1997 and 2011. The exposure of interest was a functional status defined as bed mobility, transfers, and gait level assessed at the time of hospital discharge. Adjusted odds ratios were estimated by multivariable logistic regression models. The primary outcome was all-cause, postdischarge mortality.*

Results. *We analyzed 3,565 patients with a mean (standard deviation) age of 55 (12.4) years; 60% were male, and 78% were white. The 720-day postdischarge mortality was 22.8%. In a logistic regression model, the lowest functional status category at hospital discharge was associated with 4-fold increased odds of 720-day postdischarge mortality (adjusted odds ratio 4.06 (95% confidence interval, 2.65–6.20,* $P < .001$*) compared with patients with independent functional status. We compared the odds of 720-day postdischarge mortality in patients with independent functional status and in patients in the lowest functional status category at hospital discharge. The odds of 720-day postdischarge mortality were stronger in older adults (≥65 years: adjusted odds ratio 3.34 [95% confidence interval, 1.72–6.50,* $P < .001$*]) than in younger adults (<65 years: adjusted odds ratio 2.53 [95% confidence interval, 1.39–4.60,* $P = .002$*]). Finally, improvement of functional status prior to discharge was associated with a 52% decrease in the odds of 720-day postdischarge mortality (adjusted odds ratio 0.48; 95% confidence interval, 0.30–0.75;* $P < .001$*) compared with patients without a change in functional status prior to discharge.*

Conclusion. *In trauma intensive care unit survivors, functional status at hospital discharge is predictive of long-term mortality. (Surgery 2016;160:762-70.)*

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As SURVIVAL AFTER A CRITICAL ILLNESS has improved during the past 30 years, attention has pivoted toward the importance of long-term outcomes. Survivorship in the critically ill is complicated by substantial long-term mortality and morbidity, such as long-term physical impairments, profound neuromuscular weakness, exercise limitation, and lower quality of life after hospital discharge,[1-6] but long-term outcomes among trauma intensive care unit (ICU) survivors have not been studied.

Physical therapy early in the ICU course has been shown to be safe.[7-9] Early physical therapy is associated with improved functional independence in mechanically ventilated patients.[7,8] Studies show that functional status may be modifiable in the ICU.[8-12] The combination of interrupted sedation with physical and occupational therapy early in the ICU course is related to functional status improvements at hospital discharge.[9] Although long-term functional independence is desirable among ICU patients, little information

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exists on critically ill trauma survivors' functional status at hospital discharge or on the adverse outcomes they face after hospital discharge.[13]

Because functional status may be an important driver of long-term outcomes in critically ill trauma patients, we performed this study to determine the relationship between critically ill trauma patients' functional status at hospital discharge and all-cause 2-year post-hospital discharge mortality. We hypothesized that a decrease in functional status at discharge would be associated with adverse outcomes among critically ill and injured patients.

METHODS

Source population and data sources. We abstracted patient-level administrative and laboratory data from the Brigham and Women's Hospital, a 793-bed urban level I trauma center. Data on all trauma patients ≥18 years old who were admitted to the intensive care unit between January 1, 1997, and December 31, 2011, and who survived to hospital discharge were obtained through the Research Patient Data Registry, a computerized registry that serves as a central data warehouse for all inpatient and outpatient records at Partners HealthCare sites.[14,15] Approval for the study was granted by the Partners Human Research Committee (Institutional Review Board) Protocol Number: 2010P000645. Requirement for consent was waived, as the data were analyzed anonymously.

Study population. During the study period, 7,450 unique patients met inclusion criteria. Exclusions included 3,885 patients who did not receive a formal structured evaluation from a physical therapist within 48 hours of hospital discharge. Thus, the analytic cohort comprised 3,565 patients.

Exposure of interest and covariates. The exposure of interest was functional status at hospital discharge defined as physical function assessed at the time of hospital discharge. Determination of physical function was made by a licensed physical therapist and rated based on qualitative categories adapted from the functional mobility subscales of the Functional Independence Measure.[16-18] The Functional Independence Measure mobility subscales incorporate transfers (including bed, chair, and wheelchair) as well as locomotion (including walking/wheelchair and stairs) and are scored on an ordinal scale based on percentage of active patient participation in the selected task.[16] The scale scoring system grades patients on a scale of function for motor tasks assessed (independent, standby assist/supervision, minimal assist, moderate assist, maximal assist, and total assist) with a determination of "not applicable" used when a patient was either incapable of progressing to the designated task or to indicate physical or medical limitations. Patients were assessed on bed mobility (roll side-to-side, supine-to-sit, sit-to-supine), transfers (sit-to-stand, stand-to-sit, bed-to-chair), and gait (level ambulation, stairs). A categorical risk prediction score was derived previously and validated based on a logistic regression model of the individual scale of function grades for each assessment.[19]

Definition and determination of the following covariates are outlined in the Supplementary Methods (online only version): Deyo-Charlson index,[20] intensive care unit admission,[21] race, sepsis,[22] exposure to inotropes and vasopressors,[23] acute kidney injury,[24] noncardiogenic acute respiratory failure,[25] emergency general surgery,[26] packed red blood cells transfused,[23] acute organ failure,[21,27] malnutrition,[28] and *International Classification of Diseases, Ninth Revision, Clinical Modification, Ninth Edition* (ICD-9-CM) derived injury severity score (ICISS).[29-33] Malignant neoplasm history is defined by the presence of any of the following *ICD-9-CM* codes prior to the hospital discharge date: 140-209.[34] For severity of illness risk adjustment, we used the acute organ failure score, an ICU risk-prediction score derived and validated from demographics (age, race), patient admission "type" as well as ICD-9-CM code based comorbidity, sepsis, and acute organ failure covariates, which has a similar discrimination for 30-day mortality as Acute Physiology and Chronic Health Evaluation (APACHE) II.[35] The trauma-related *ICD-9* diagnosis codes were grouped by body region of injury categories based on the Barell Injury Diagnosis Matrix.[36]

Endpoints. The primary endpoint was 720-day, all-cause mortality after hospital discharge. Secondary endpoints included 90- and 365-day all-cause mortality after hospital discharge.

Assessment of mortality. Vital status was obtained from the Death Master File of the Social Security Administration, which has high sensitivity and specificity for mortality[37]; we have validated the accuracy of this Death Master File for in-hospital and out-of-hospital mortality in the Research Patient Data Registry database.[21] In the study, 100% of the cohort had at least 720-day follow-up after hospital discharge. The censoring date was January 1, 2014.

Power calculations and statistical analysis. Previously in a cohort of critically ill patients (n = 43,212), we studied postdischarge mortality in ICU survivors.[23] From these data, we assumed that 720-day postdischarge mortality in ICU survivors was 18.8%. In our cohort of 1,224 patients