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Increased hospice enrollment and decreased neurosurgical interventions without changes in mortality for older Medicare patients with moderate to severe traumatic brain injury

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ABSTRACT

Background: Hospice improves quality and value of end of life care (EOLC), and enrollment has increased for older patients dying from chronic medical conditions. It remains unknown if the same is true for older patients who die after moderate to severe traumatic brain injury (msTBI).
Methods: Subjects included Medicare beneficiaries (≥65 years) who were hospitalized for msTBI from 2005 to 2011. Outcomes included intensity and quality of EOLC for decedents within 30 days of admission, and 30-day mortality for the entire cohort. Logistic regression was used to analyze the association between year of admission, mortality, and EOLC.
Results: Among 50,342 older adults, 30-day mortality was 61.2%. Mortality was unchanged over the study period (aOR 0.93 [0.87−1.00], p = 0.06). Additionally, 30-day non-survivors had greater odds of hospice enrollment, lower odds of undergoing neurosurgery, but greater odds of gastrostomy.
Conclusion: Between 2005 and 2011, hospice enrollment increased, but there was no change in 30-day mortality.

1. Introduction

Trauma continues to rise as a cause of death in the geriatric population within the United States,[1] and the increasing frequency of hospital admissions for, and deaths related to, geriatric trauma underscores the importance of delivering quality end-of-life care (EOLC) to these patients.[2] Traumatic brain injury (TBI) in older patients is also on the rise,[3] and compared to their younger counterparts, older adults have higher healthcare utilization, worse functional outcomes, and higher mortality after TBI.[4] In-hospital mortality for older patients admitted with a Glasgow Coma Score less than 8 is 53%,[5] one year mortality is estimated at 50−70%, and in one series 86% of live discharges were functionally dependent.[5] Non-beneficial, high-intensity treatments are not appropriate if these efforts do not result in an outcome that is acceptable to the patient or if treatments are discordant with patient preferences.[6] Moreover, high mortality among older patients with severe TBI denotes the importance of end-of life care in measuring the quality and value of the care they receive.

Hospice enrollment has well-established benefits for EOLC for patients with chronic serious illness, including lower rates of hospitalization, fewer invasive procedures, and better physical and psychological outcomes for patients and bereaved survivors.[7–10] In recent years, hospice utilization has increased for non-trauma patients.[11] Despite the demonstrated benefits of hospice for other terminally ill patients and support from national organizations including the Eastern Association for the Surgery of Trauma (EAST), it is not known whether trends of increased hospice enrollment are also seen among trauma decedents. Given the increasing size of the geriatric population and the high likelihood of mortality for older patients with moderate to severe traumatic brain injury (msTBI), it is important to better understand EOLC for non-survivors.

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However, the type of EOLC patients receive after trauma remains poorly understood.

Current quality metrics in trauma focus on mortality and complications, yet less is known about intensity of treatment and hospice enrollment for those who die. We sought to describe annual trends in intensity of treatment and hospice enrollment among older patients who died after msTBI between 2005 and 2011, and compare these trends to 30-day mortality rates.

2. Methods

2.1. Data source and cohort selection

This retrospective cohort study used national Medicare billing claims data from 2005 to 2011. The *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis codes were used to identify Medicare beneficiaries, ≥ 65 years, who were hospitalized for traumatic brain injury (TBI) (800–801, 803–804, 850–854, or 959.01). The International Classification of Diseases Program for Injury Categorization (ICDPIC) tool, version 3.0[12] was used to classify msTBI based on head Abbreviated Injury Scores (AIS) ≥ 3. Additionally, mechanical ventilation and intensive care unit (ICU) stay were used as inclusion criteria to further restrict our population to persons whose injuries required a high level of care. We excluded patients with head AIS of 6, as these injuries are generally not survivable, and patients who died on the date of admission, as these patients may have met brain death criteria at admission.[13]

2.2. Variables

In order to study trends in care, year of msTBI admission was the primary independent variable. Patient covariates included age (years), sex (male or female), race (White, Black, Hispanic, Asian, or Other/Unknown), comorbidity, and injury severity. Comorbidity was measured by the Deyo modification of the Charlson comorbidity index (CCI),[14] which uses ICD-9-CM codes for 17 disease conditions to generate a score scaled from 0 to 2, with 2 indicating the highest degree of comorbidity.[15] The Injury Severity Score (ISS) is an anatomically based scoring system that provides prognostic information about patients suffering from multiple injuries.[16] We computed ISS from ICD-9-CM codes using the ICDPIC tool and categorized injury severity as moderate (ISS 9–15), severe (ISS 16–24), or critical (ISS ≥25).[17]

2.2.1. Outcomes

Outcomes of interest included mortality and EOLC. Mortality was defined as the percentage of patients who died ≤30 days after the date of admission and included in-hospital deaths as well as those who died after hospital discharge. Among patients who died during the 30-day timeframe, the type of care they received at the end of life was examined in two domains: hospice enrollment and treatment intensity. Hospice enrollment was defined as the percentage of patients with any hospice claim prior to death or discharge to inpatient or outpatient hospice. Treatment intensity included the percentage of patients who underwent neurosurgical interventions (craniotomy, craniectomy, or invasive intracranial pressure monitor) and life-sustaining interventions (gastrostomy, tracheostomy, and cardiopulmonary resuscitation) during the msTBI admission.[21] All variables were defined based on ICD-9 CM procedure codes.

Standardized quality outcome measures for end-of-life care for older trauma patients do not exist. Previous quality studies of seriously ill older adults describe utilization of intense treatments (e.g. feeding tube placement, chemotherapy in the last two weeks of life) as a marker of poor quality end-of-life care.[18–20] Given that seriously ill traumatic brain injury patients often have a high mortality rate and significant cognitive impairment, we extrapolated from these diverse populations that have established quality end-of-life care indicators to support the idea that increased hospice enrollment and decreased treatment intensity are markers of better quality end-of-life care in geriatric trauma.

2.3. Analyses

Patient characteristics and outcome variables were presented as medians or percentages. Logistic regression was used to analyze the association between year of admission, mortality, and EOLC, adjusting for age, sex, race, CCI, and ISS. Given that at the extremes of age patients and families may opt for less intervention, age-stratified analyses were performed. Analyses were performed using Stata, version 14.0 (StataCorp, College Station, TX). This study was approved by the Partners Human Research Committee.

4. Results

There were 50,342 older adults who were hospitalized with msTBI and were eligible for inclusion. Cohort characteristic are represented in Table 1. Overall, 61% of patients died ≤30 days after admission. From 2005 to 2011, the number of patients with msTBI increased from 6881 to 7,572, but there was no significant difference in 30-day mortality (59–63%, aOR 0.93 [0.87–1.00], p = 0.06). Among patients who died ≤30 days after admission (n = 30,829), enrollment in hospice ranged from 10% in 2005 to 16% in 2011, neurosurgical intervention ranged from 37% to 33%, and gastrostomy placement from 14% to 17% (Fig. 1). Tracheostomy and CPR were unchanged from 2005 as compared to 2011.

Compared with 2005, 30-day non-survivors admitted in 2011 had greater odds of hospice enrollment (aOR 1.60 [1.41–1.81], $p < 0.001$) and lower odds of undergoing neurosurgery (aOR 0.81 [0.74–0.88], $p < 0.001$) (Fig. 1), but greater odds of gastrostomy (aOR 1.32 [1.13–1.54], $p < 0.001$). After stratifying by age, the oldest patients (≥85 years) had similar results with the exception that the odds of receiving a gastrostomy were not significantly different between 2005 and 2011 (Table 2).

Table 1
Characteristics and Demographics of All Older Patients Hospitalized with moderate to severe traumatic brain injury from 2005 to 2011 (N = 50,342).

Variable	N (%)
Age	
65-74	15,830 (31.4)
75-84	21,695 (43.1)
85+	12,817 (25.5)
Sex	
Female	20,924 (41.6)
Male	29,418 (58.4)
Race	
White	43,963 (87.3)
Black	3172 (6.3)
Asian	1076 (2.1)
Hispanic	987 (2.0)
Other/Unknown	1144 (2.3)
Charlson Comorbidity Index	
0	22,126 (44.0)
1	14,755 (29.3)
2	13,461 (26.7)
Injury Severity Score	
9-15	14,042 (27.9)
16-24	27,504 (54.6)
25+	8796 (15.5)

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