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ORIGINAL WORK

Palliative Care Consultations in Patients with Severe Traumatic Brain Injury: Who Receives Palliative Care Consultations and What Does that Mean for Utilization?

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Abstract

Background: Palliative care has the potential to improve goal-concordant care in severe traumatic brain injury (sTBI). Our primary objective was to illuminate the demographic profiles of patients with sTBI who receive palliative care encounters (PCEs), with an emphasis on the role of race. Secondary objectives were to analyze PCE usage over time and compare health care resource utilization between patients with or without PCEs.

Methods: The National Inpatient Sample database was queried for patients age $\geq$ 18 who had a diagnosis of sTBI, defined by using International Classification of Diseases, 9th Revision codes. PCEs were defined by using International Classification of Diseases, 9th Revision code V66.7 and trended from 2001 to 2015. To assess factors associated with PCE in patients with sTBI, we performed unweighted generalized estimating equations regression. PCE association with decision making was modeled via its effect on rate of percutaneous endoscopic gastrostomy (PEG) tube placement. To quantify differences in PCE-related decisions by race, race was modeled as an effect modifier.

Results: From 2001 to 2015, the proportion of palliative care usage in patients with sTBI increased from 1.5 to 36.3%, with 41.6% White, 22.3% Black, and 25% Hispanic patients with sTBI having a palliative care consultation in 2015, respectively. From 2008 to 2015, we identified 17,673 sTBI admissions. White and affluent patients were more likely to have a PCE than Black, Hispanic, and low socioeconomic status patients. Across all races, patients receiving a PCE resulted in a lower rate of PEG tube placement; however, White patients exhibited a larger reduction of PEG tube placement than Black patients. Patients using palliative care had lower total hospital costs (median $16,368 vs. $26,442, respectively).

Conclusions: Palliative care usage for sTBI has increased dramatically this century and it reduces resource utilization. This is true across races, however, its usage rate and associated effect on decision making are race-dependent, with White patients receiving more PCE and being more likely to decline the use of a PEG tube if they have had a PCE.

Keywords: Traumatic brain injury, Palliative care, Racial disparity, Health care resource utilization

Introduction

Traumatic brain injury (TBI) is a major public health issue. In the United States, 2.5 million people suffer TBIs annually, leading to 2,30,000 hospitalizations,

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50,000 deaths, and $20.6 billion in work loss. Patients with severe TBI (sTBI) have a high mortality rate (31–49%), and many survivors have long-term neurological disability [1, 2]. TBI guideline-driven care is aimed at improving survival and decreasing disability [3]. It is important to balance interventions in sTBI aimed at improving survival with those geared toward patient quality of life and reducing caregiver burden. Palliative care consultation aids medical teams and families navigate between medical interventions focused on life extension and quality of life [4, 5].

Palliative care aims to prevent suffering and improve quality of life by optimizing symptom management and holistically supporting patients and families [6–8]. Over the past decade, hospital-based palliative care consultations have increased by 26% [9]. The increasing use of specialty palliative care has decreased hospital resource utilization [10]. Moreover, in elderly patients with trauma, palliative care consultation has been shown to improve satisfaction for caregivers and patients during goals of care discussions [11].

Beyond influences on utilization, quality of life, and caregiver well-being, palliative care consultation has the potential to help address racial disparities in resource utilization in sTBI. Black patients suffer a 35% higher incidence of TBI [12] and a higher likelihood of worse functional outcomes [13]. In sTBI, Black patients are less likely to choose withdrawal of life-sustaining treatment than their White counterparts [14]. Although there are real cultural and personal differences in opinion regarding goals of care after severe injury or at the end of life [15], studies have shown that Black patients are open to having discussions regarding end-of-life and palliative care if presented with the opportunity [16]. In light of the racial disparities in TBI incidence, prognosis, and treatment, understanding the relationship between these components becomes essential.

In this study of patients with sTBI, we aimed to (1) characterize trends in palliative care usage and its association with resource utilization, (2) identify characteristics associated with palliative care use, and (3) analyze potential racial disparities regarding the impact of palliative care on rates of aggressive treatment usage, particularly percutaneous endoscopic gastrostomy (PEG) tube usage. Based on prior work identifying differences in utilization of gastrostomy and tracheostomy by race in TBI, we decided to use gastrostomy as a proxy for the study of aggressive interventions [17]. Of note, in this article, we will use the term, palliative care encounter (PCE), to describe times when specialty consultation to a palliative care provider was involved.

Methods

Study Objective

We aimed to understand which patients with sTBI received PCEs. As part of this objective, a national trend in PCEs was assessed. The secondary objective of the study was to compare health care resource utilization between patients with and without PCEs and assess racial disparity in PCE use, primarily by describing differences in PEG utilization, although we also quantify other invasive procedure rates and clinical outcomes.

Inclusion and Exclusion Criteria

This study examined sTBI admissions using discharge data from the National Inpatient Sample (NIS), Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality [18]. Inclusion criteria were age $\geq$ 18 years and a diagnosis of sTBI using the comprehensive list of inpatient International Classification of Diseases, 9th Revision (ICD-9) codes chosen by the Defense and Veterans Brain Injury Center 2012 Criteria [19]. Severe (i.e., loss of consciousness > 24 h) and penetrating TBI were combined into one cohort. Patients whose TBI severity could not be classified were not included. Discharge records with invalid principal procedure code ($n = 2$), missing sex ($n = 28$), missing hospital information ($n = 304$), and extreme age values (age > 110 years) were excluded.

Because palliative care was formally recognized as a medical subspecialty in 2008 and coding/billing practices may have changed with this evolution (despite physicians practicing aspects of palliative care long before this century) [10], the inclusion of prior years could confound the analysis. Therefore, palliative care time trends were summarized across all years, but the analysis of association between prognostic factors and PCEs was only conducted for patients with admissions from 2008 to 2015.

Proxy Codes

Independent variables that are not readily available in NIS were derived using ICD diagnosis codes or procedure codes. Injury Severity Score (ISS) was derived by mapping ICD-9 diagnosis codes to the Abbreviated Injury Scale, using the ICD Programs for Injury Categorization [20]. Mechanism of injury (MOI) was defined by using NIS variable ECODE1–ECODE4 and was classified into four categories: unintentional MVT, unintentional fall, assault and self-harm (struck by or against an object), and other/unknown [21]. Frailty score was derived by using the 19-item Frailty Risk Scale system [22], in which the score was calculated

by the number of frailty items the patients had. Reoperation with craniotomy or craniectomy was defined as repeat surgery procedure codes within the same hospital admission.

Cost Analyses

Inpatient charges were converted to inpatient costs by using NIS cost-to-charge ratio files (ratio variable GAPICC before 2012, APICC after 2012). The top 1% and bottom 1% of the charges and costs were considered outliers and were removed to obtain the trimmed values. All charges and costs were adjusted for inflation using 2019 as the reference year using data provided by U.S. Department of Labor Bureau of Labor Statistic [23].

Palliative Care Trends Analyses

PCEs were identified using the ICD-9 code V66.7, as in previous studies [24–26]. To investigate the national trend of PCE for patients with admissions for sTBI from 2001 to 2015, weighted analysis was conducted accounting for clustering and stratification for the complex NIS survey design. NIS discharge weights were used to calculate weighted frequencies and percentages following the Healthcare Cost and Utilization Project Methods Series Report [27].

Factors Associated with Palliative Care

To assess factors associated with PCE, unweighted regression analysis was performed for patients with admission of sTBI between 2008 and 2015. The generalized estimating equations method was used to model palliative care use, with a logit link function to account for the clustering of patients admitted to the same hospitals in the same year. Covariates included age, admission day on weekend, frailty score, penetrating injury, late effects of cerebrovascular disease, renal failure, metastatic cancer, ISS, subdural/epidural hemorrhage, sex, insurance type, race, household income quartile (here treated as a reflection of socioeconomic status [SES]), hospital location and teaching status, hospital region, hospital control ownership, transfer in status, and primary MOI. All missing values were coded to an "unknown" classification. Descriptive statistics were used to summarize secondary outcomes.

Race as an Effect Modifier for Palliative Care

Descriptive analysis was conducted to compare PCE rate and patient outcomes among different racial groups. Asian/Pacific Islanders and American Indians were combined into the other/unknown group to be consistent with the study team's prior research [14] and maintain appropriate subgroup sample sizes. Per precedent, Hispanic patients were assigned to the Hispanic group regardless of their other races identified [28]. We chose to specifically analyze the association of PCE with the use of PEG because the timing of the decision is typically delayed and therefore less influenced by variable emergency care, and the decision regarding PEG is a common time point providers use to discuss goals of care and continuation of treatment with surrogate decision makers. We recognize that there are multiple procedures involved in the care of patients with sTBI, and not all are studied within this article. To examine if the association of PCE on reducing PEG tube use differed among racial groups, race was modeled as an effect modifier with PCE. Adjusted modified Poisson regression models were used to obtain estimates and 95% confidence intervals (CIs) for the following, according to Knol and VanderWeele's recommendations [29]: relative risks (RRs) for each stratum of race and PCE group with a single referent category; RR of PEG tube use between patients receiving PCE compared with no PCE within each racial group [30]; measures of effect modification on the additive scale, relative excess risks due to interaction between race, and PCE with their 95% CIs estimated by 1000 bootstrap samples [31]; and measures of effect modification on the multiplicative scale, ratio of RRs comparing use of PEG tube among different racial groups. The generalized estimating equations were used with a log link and a Poisson distribution to obtain the RRs and measures of interactions, controlled for the clustering of hospital center and covariates that were included in the model of PCE utilization.

Software

In all cases, statistical significance was assessed at level $\alpha = 0.05$. Analyses were conducted using SAS 9.4 (SAS Institute Inc, Cary, NC).

Results

Patient Inclusion and Demographics

A total of 8,59,220 patients were identified with TBI in the NIS database between 2001 and 2015, of whom 35,456 experienced sTBI. In 2008 or later, 17,705 patients had a sTBI. Following removal of excluded patients based on missing values, 17,369 patients remained in the analysis (eFigure 1).

A total of 17,369 patients with admissions after 2008 were included in the analysis of investigating potential factors associated with palliative care use. Patients who had PCEs were older (median age 71 vs. 48 years). There were also more female patients (37.6% vs. 27.7%), White patients (69.5% vs. 59.5%), and patients with renal failure (7.2% vs. 3.3%) and subdural/epidural hemorrhage (36.6% vs. 22.8%) in this group. However, the two groups were similar in overall ISS, head injury severity (Abbreviated Injury Scale), comorbidity condition before the injury

Table 1 Patient baseline characteristics

Parameters	Palliative care use		
	No (*n* = 13,279)	Yes (*n* = 4,090)	Total (*N* = 17,369)
Age at admission (yr)			
Mean (SD)	49.2 (22.0)	65.9 (20.2)	53.1 (22.8)
Median (Q1–Q3)	48.0 (29.0 to 67.0)	71.0 (52.0 to 83.0)	53.0 (32.0 to 73.0)
Range	18.0 to 111.0	18.0 to 101.0	18.0 to 111.0
Sex, n (%)			
Male	9,607 (72.3)	2,554 (62.4)	12,161 (70.0)
Female	3,672 (27.7)	1,536 (37.6)	5,208 (30.0)
Race, n (%)			
White	7,899 (59.5)	2,841 (69.5)	10,740 (61.8)
Black	1,299 (9.8)	239 (5.8)	1,538 (8.9)
Hispanic	1,421 (10.7)	256 (6.3)	1,677 (9.7)
Other/unknown	2,660 (20.0)	754 (18.4)	3,414 (19.7)
Subdural/epidural hemorrhage	3,021 (22.8)	1,495 (36.6)	4,516 (26.0)
ISS			
Mean (SD)	22.2 (9.7)	21.1 (8.8)	22.0 (9.5)
Median (Q1–Q3)	22.0 (16.0 to 26.0)	25.0 (16.0 to 25.0)	22.0 (16.0 to 26.0)
Range	4.0 to 75.0)	4.0 to 75.0)	4.0 to 75.0
AIS head score			
Mean (SD)	3.8 (0.9)	4.0 (0.9)	3.9 (0.9)
Median (Q1–Q3)	4.0 (3.0 to 5.0)	4.0 (3.0 to 5.0)	4.0 (3.0 to 5.0)
Range	2.0 to 6.0	2.0 to 6.0	2.0 to 6.0
Elixhauser comorbidity index			
Mean (SD)	6.7 (9.0)	6.6 (9.0)	6.6 (9.0)
Median (Q1–Q3)	4.0 (0.0 to 11.0)	4.0 (0.0 to 11.0)	4.0 (0.0 to 11.0)
Range	− 19.0 to 53.0)	− 18.0 to 47.0	− 19.0 to 53.0
Frailty score, n (%)			
0	8,788 (66.2)	2,367 (57.9)	11,155 (64.2)
1	3,393 (25.6)	1,213 (29.7)	4,606 (26.5)
2	872 (6.6)	400 (9.8)	1,272 (7.3)
3	191 (1.4)	91 (2.2)	282 (1.6)
4 +	35 (0.3)	19 (0.5)	54 (0.3)
Renal failure, *n* (%)	438 (3.3)	296 (7.2)	734 (4.2)
Metastatic cancer, *n* (%)	57 (0.4)	70 (1.7)	127 (0.7)
Median household income national quartile, n (%)			
First quartile(lowest)	4,110 (31.0)	1,044 (25.5)	5,154 (29.7)
Second quartile	3,255 (24.5)	1,080 (26.4)	4,335 (25.0)
Third quartile	2,910 (21.9)	986 (24.1)	3,896 (22.4)
Fourth quartile (highest)	2,423 (18.2)	852 (20.8)	3,275 (18.9)

AIS Abbreviated Injury Scale, *ISS* Injury severity score, *SD* standard deviation

(Elixhauser comorbidity index), frailty score, and household income (Table 1, 2).

Prevalence of PCE Increased Over Time

Weighted analysis was conducted to investigate the national time trend of having PCEs for patients with admissions for sTBI in NIS from 2001 to 2015. There were 35,346 discharges with sTBI, which represented a weighted estimate (per method of calculating trends in NIS) of 169,569 discharges nationwide. The trend was illustrated in eTable 1 and Fig. 1. From 2001 to 2007, the proportion of palliative care use in patients with sTBI increased slowly and was relatively stable at

Table 2 Patient discharge outcomes

Parameters	Palliative care use		
	No ($n = 13,279$)	Yes ($n = 4,090$)	Total ($N = 17,369$)
Trimmed costs[a] ($)			
Mean (SD)	45,647.9 (48,606.5)	27,772.2 (31,143.8)	41,437.5 (45,738.7)
Median	26,442.3	16,368.4	23,748.2
Q1–Q3	12,337.6–61,088.7	7,710.5–36,931.2	11,005.5–53,948.9
Range	1,561.7–285,790.6	1,552.3–256,605.4	1,552.3–285,790.6
Missing	816	250	1,066
Length of stay			
Mean (SD)	11.1 (20.6)	4.9 (8.4)	9.6 (18.7)
Median	3.0	2.0	3.0
Q1–Q3	1.0–14.0	1.0–6.0	1.0–11.0
Range	0.0–331.0	0.0–205.0	0.0–331.0
Missing	8	2	10
Died during hospitalization, n (%)			
Did not die in hospital	4,274 (32.2)	518 (12.7)	4,792 (27.6)
Died in hospital	8,989 (67.7)	3,572 (87.3)	12,561 (72.3)
Missing	16 (0.1)	0 (0.0)	16 (0.1)
Any complication, *n* (%)	10,712 (80.7)	3,070 (75.1)	13,782 (79.3)
Craniotomy, *n* (%)	1,348 (10.2)	256 (6.3)	1,604 (9.2)
Mechanical ventilation, *n* (%)	11,343 (85.4)	3,234 (79.1)	14,577 (83.9)
Any other invasive procedure, *n* (%)	5,605 (42.2)	1,381 (33.8)	6,986 (40.2)
Ventriculostomy, *n* (%)	1,718 (12.9)	449 (11.0)	2,167 (12.5)
Incision/excision of brain or meninges, *n* (%)	2,467 (18.6)	685 (16.7)	3,152 (18.1)
Invasive ICP monitoring, *n* (%)	2,219 (16.7)	510 (12.5)	2,729 (15.7)
Central line, *n* (%)	651 (4.9)	260 (6.4)	911 (5.2)
PEG tube, *n* (%)	1,813 (13.7)	117 (2.9)	1930 (11.1)

ICP, xxx, PEG, percutaneous endoscopic gastrostomy, SD, standard deviation

[a] Outliers (top 1% and bottom1%) were removed for trimmed values

1.5 to 5%. This percentage increased to 9% in 2008 and to 36.3% in 2015 (Fig. 1).

Black and Hispanic Patients are Less Likely to have PCE

Rate of palliative care in different race groups are reported in eTable 1. White patients and patients in the other/unknown category tended to use palliative care more than those who were Black or Hispanic.

Comparison of palliative care use between Black and White patients over the years was plotted in Fig. 2. The percentage of White patients with sTBI using palliative care reached 41.6% (weighted) in 2015, compared with 22.3% (weighted) of Black patients and 25.2% (weighted) of Hispanic patients in the same year.

Length of Stay, Procedural Utilization, and Costs were Less for Patients with PCE: Mortality was Higher

Patients who used palliative care had lower costs (median $16,368 vs. $26,442), shorter length of stay (median 2 vs. 3 days), fewer inpatient complications (75.1% vs. 80.7%), fewer craniotomies (6.3% vs. 10.2%), lower rates of mechanical ventilation during hospitalization (79.1% vs. 85.4%), and less usage of other aggressive procedures, such as invasive intracranial pressure monitoring and placement of central lines (33.8% vs. 42.2%; eTable 3). However, the in-hospital mortality rate of this group was also higher than that of patients who did not receive palliative care (87.3% vs. 67.7%, eTable 4).

Independent Variables Associated with Receiving Palliative Care: Regression Model

A 10-year increase in age was associated with a 34% increase in the odds of using palliative care (95% CI 1.30–1.38). In addition to age, factors that are associated with increased odds of receiving palliative care included renal failure, late effects of cerebrovascular disease, metastatic cancer, lower ISS, subdural/epidural hemorrhage, year of admission, being women, being White, higher SES, larger hospital bed number, hospitals in the West, private non-profit hospitals, being transferred in from another acute

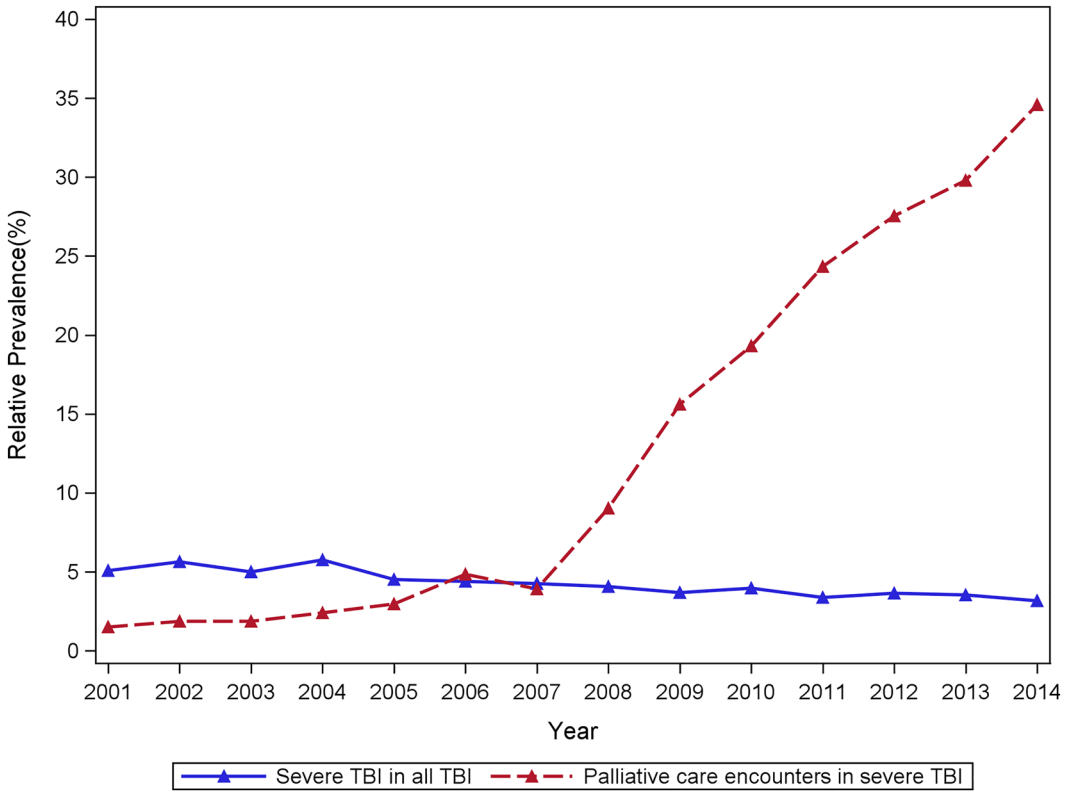

Fig. 1 Time trend of palliative care utilization, demonstrating a notable increase from 2001 to 2015. TBI, traumatic brain injury

care hospital, and primary MOI of unintentional fall (eTable 5).

Palliative Care Decreases Utilization of PEG Tube, But More so for White Patients

Table 3 provides the summary statistics of PEG tube utilization between patients with and without PCE in different racial groups. Across all races, patients receiving a PCE had a lower rate of PEG tube placement. Specifically, the proportion receiving a PEG tube dropped from 13 to 2.3% for White patients, from 16.8 to 5.9% for Black patients, and from 15.7 to 5.5% for Hispanic patients (Table 3).

The results after adjusting for covariates are also presented in Table 3. For White patients, PCE was associated with a 78% decrease in the rate of having a PEG tube placed (RR 0.22, 95% CI 0.17–0.28). On the other hand, for Black patients, PCE was associated with a 61% decrease in the rate of having a PEG tube placed (RR 0.39, 95% CI 0.23–0.67).

Table 3 presents the role of race as an effect modifier for PCE as it is associated with PEG tube placement, from both the additive and multiplicative perspectives. When controlling for covariates and comparing Black with White patients, the differences between the association of PCE on the PEG tube placement use were not statistically significant on the additive scale (relative excess risks due to interaction 0.07, 95% CI − 0.19 to 0.30). In other words, the absolute differences in risks of PEG tube placement between the PCE and No PCE groups were not statistically different when comparing Black with White patients. However, the differences were significant on the multiplicative scale, which is important because it compares RRs by race. The ratio of RRs across race stratum was 1.82 (95% CI 1.02–3.27), indicating that the estimated relative risk of PEG tube placement comparing PCE with no PCE was 82% higher for Black patients (adjusted RR 0.39) than that for White patients (adjusted RR 0.22).

Discussion

We analyzed database records of PCEs in sTBI. Patient and hospital factors were associated with increased odds of consulting palliative care. Patients who received palliative care consultation during the sTBI admission used less hospital resources. Compared with White patients, Black patients had higher inpatient costs and higher rates of invasive procedures such as craniotomy, mechanical

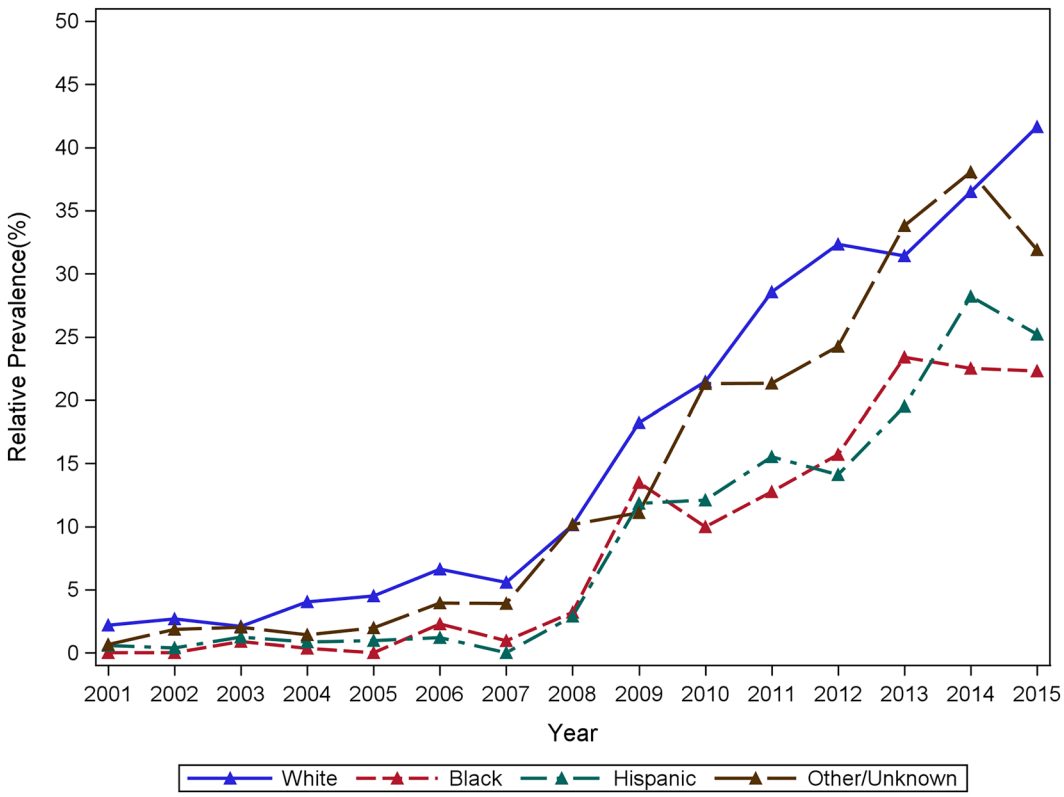

Fig. 2 Racial differences in time trend of palliative care utilization. Palliative care consultations were used almost twice as frequently for White patients compared with their Black and Hispanic counterparts

Table 3 Effect of PCE on PEG tube utilization by race

Race	PCE		No PCE		RR (95% CI); *P* for PCE versus no PCE within strata of race[a]
	PEG/no PEG tube	RR (95% CI); *P*	PEG/no PEG tube	RR (95% CI); *P*	
White	65/2776	1.0 (reference)	1030/6869	4.62 (3.57, 5.98); $P<.001$	0.22 (0.17, 0.28); $P<0.001$
Black	14/225	2.21 (1.24, 3.92); $P=0.007$	218/1081	5.59 (4.24, 7.38); $P<.001$	0.39 (0.23, 0.67); $P=0.001$
Hispanic	14/242	1.92 (1.11, 3.33); $P=0.020$	223/1198	5.20 (3.94, 6.87); $P<.001$	0.37 (0.22, 0.61); $P<.001$
Other	24/730	1.27 (0.81, 1.98); $P=0.295$	342/2318	4.40 (3.36, 5.78); $P<.001$	0.29 (0.19, 0.44); $P<.001$

Adjusted measure of effect modification on multiplicative scale (ratio of RRs) (White as reference): Black 1.82 (1.02, 3.27); Hispanic 1.71 (0.98, 2.98); 1.33 (0.84, 2.12)

RRs, RERIs, and ratio of RRs were adjusted for age, admission day on weekend, frailty score, penetrating injury, late effects of cerebrovascular disease, renal failure, metastatic cancer, ISS, subdural/epidural hemorrhage, sex, insurance type, race, household income quartile, hospital location and teaching status, hospital region, hospital control ownership, transfer in status, primary MOI, and calendar year, controlled for clustering effect of hospital center and calendar year

CI, confidence interval, ISS, Injury Severity Score, MOI, mechanism of injury, PCE, palliative care encounter, PEG, percutaneous endoscopic gastrostomy, RERI, relative excess risks due to interaction, RR, relative risks

[a] Adjusted measure of effect modification between races on additive scale (RERI) (White as reference): Black 0.07 (− 0.19, 0.30); Hispanic 0.09 (− 0.11, 0.29); Other 0.11 (− 0.02, 0.23). Confidence intervals of RERIs were obtained from 1000 bootstrap samples

ventilation, and PEG tube placement but also fewer PCEs. Hispanic patients also had less PCEs. PCE was associated with reduced utilization of PEG tubes for patients of all races with nuanced effects depending on race.

The rate of PCEs for patients with sTBI increased between 2001 and 2015. The upward trend of PCEs is particularly visible after 2008 when palliative care was more widely recognized as a distinct speciality, and it also mirrors trends for other disease processes associated with increases in PCEs following 2008 [32]. Considering the concentrated effort to increase the use of palliative care in sTBI, these trends in utilization are particularly relevant [7, 33].

PCEs have not risen as quickly for patients of color. Our study showed key demographic differences in utilization of PCE including patients of White race and wealthier patients being more likely to get PCEs than Black and Hispanic patients and, separately, patients with low SES. There are several possible explanations for this. Black patients suffer more TBI with worse functional outcomes; sicker patients may not be offered palliative care. There is evidence that Black patients may present to centers with less palliative care experience at the end of life. To avoid effects related to center, we controlled for both hospital type and teaching status. Additionally, Black patients are more likely to choose aggressive care and less likely to choose palliative approaches despite expressing quality of life-focused goals for their loved ones [14, 34, 35]. Differences in opinion among racial groups regarding goals of care after severe injury exist [15]. Prior research in palliative care has cited cultural backgrounds, religious beliefs, treatment preferences, knowledge inequities, and organizational barriers as reasons why Black and Hispanic patients are less likely to seek palliative care services [36]. The key is to align care with patient goals, allowing for cultural differences in decisions, and palliative care has the potential to do this.

PCEs were associated with decreased PEG tube utilization among Black and Hispanic patients. This association had a smaller effect size than that for White patients. This difference can be explained in a variety of ways; PCE may partially close a gap between Black patients and the medical system that has been widened by poor trust, cultural differences, communication and barriers to access [37]. This may represent a cultural inclination toward more aggressive care that is clarified rather than altered by a PCE.

We found that PCEs were associated with decreased utilization and inpatient cost for all patients. This may be mediated by shorter length of stay and less utilization of invasive procedures, as well. It is important to note that sicker patients did receive palliative care consultation and therefore these shorter lengths of stay and decisions not to pursue aggressive care (such as a PEG tube) likely related to severity of illness. Additionally, withdrawal of life-sustaining treatment decisions are associated with earlier mortality and therefore decreased utilization. This being said, the regression analysis did control for many clinical factors including age, ISS, frailty score, and multiple specific comorbidities. It did not control for decision to withdrawal life-sustaining treatment and this interaction should be explored in further studies. It is important to try to navigate the challenging decisions in sTBI in a way that is least burdensome to the patient, their family, and the health care system.

The United States dedicates significant resources to end-of-life surgery [38]. At times, these resources do not result in improved outcomes and rather prolong suffering for the patient and their family. This study shows that PCE can be effective in lowering the use of aggressive care. Many argue that early involvement of palliative care consultation in sTBI will improve goal-concordant care [33, 39]. Ensuring goal-concordant care can improve patient and caregiver outcomes, while decreasing unnecessary resource utilization. This data also shows that PCE can in part mitigate racial disparities in decision making after sTBI. Unfortunately, PCE is underutilized in patients of color and low SES patients. This is a place where the health care community can focus on improving goal-concordant care for all patients.

Limitations

This study has a number of limitations. This study is a retrospective cohort and therefore no causality or temporal relationship can be inferred. The coding differences in PCE and variable sensitivity of the V66.7 code [40, 41] are limitations to the study and many previous studies related to usage of palliative care consultation. Moreover, there are likely confounding variables that could not be measured in this database, for example, race of provider, details of palliative and decision-making conversations, and patient and family prior experience. Future studies could address these limitations by running prospective experiments based on the hypothesis-generating findings presented here.

Conclusions

PCE is associated with decreased utilization of aggressive interventions, particularly PEG tubes following sTBI. PCE rates are different between patients of color and White patients. Our model of PEG tube utilization shows that PCE decreases PEG use for patients of all races, though the effect is largest in White patients. An important area of further study is how PCE helps to align patient preferences with treatment options despite racial and cultural differences.

Supplementary Information
The online version contains supplementary material available at https://doi.org/10.1007/s12028-021-01366-2.

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This article complies with ethical approval and informed consent for human studies.

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