American Journal of Emergency Medicine xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Opportunity to reduce transfer of patients with mild traumatic brain injury and intracranial hemorrhage to a Level 1 trauma center

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ARTICLE INFO

Article history:
Received 10 March 2017
Received in revised form 24 March 2017
Accepted 28 March 2017
Available online xxxx

Keywords:
Intracranial hemorrhages
Traumatic brain hemorrhage
Traumatic subdural hematoma
Traumatic brain injuries
Traumatic subarachnoid hemorrhage
Brain concussion
Traumatic cerebral hemorrhage
Neurosurgery
Patient transfer

ABSTRACT

Objective: Current guidelines do not address the disposition of patients with mild traumatic brain injury (TBI) and resultant intracranial hemorrhage (ICH). Emergency medicine clinicians working in hospitals without neurosurgery coverage typically transfer patients with both to a trauma center with neurosurgery capability. Evidence is accruing which demonstrates that the risk of neurologic decompensation depends on the type of ICH and as a result, not every patient may need to be transferred. The purpose of this study was to identify risk factors for admission among patients with mild TBI and ICH who were transferred from a community hospital to the emergency department (ED) of a Level 1 trauma center.

Methods: Study subjects were patients ≥18 years of age who were transferred from a community hospital to the ED of an urban, academic Level 1 trauma center between April 1, 2015 and March 31, 2016, and with an isolated traumatic ICH. Patients who had an epidural hematoma, were deemed to require a trauma center's level of service, were found to have non-traumatic ICHs, or had a Glasgow Coma Scale of <13 were excluded. Using a multivariable logistic regression model, we sought to determine patient factors and Computed Tomography (CT) findings which were associated with admission (to the floor, intensive care unit, or operating room with neurosurgery) of the Level 1 trauma center.

Results: 644 transferred patients were identified; 205 remained eligible after exclusion criteria. Presence of warfarin (odds ratio [OR] 4.09, 95% Confidence Interval [CI] 1.64, 10.25, p = 0.0026) and a subdural hematoma (SDH) ≥1 cm (OR 6.28, 95% CI 1.24, 31.71, p = 0.0263) were independently statistically significant factors predicting admission. Age, sex, GCS, presence of neurologic deficit, aspirin use, clopidogrel use, SDH <1 cm, IPH, and SAH were each independently not significant predictive factors of an admission.

Conclusions: After controlling for factors, transferred patients with mild TBI with a SDH ≥ 1 cm or on warfarin have a higher odds ratio of requiring inpatient admission to a Level 1 trauma center. While these patients may require admission, there may be opportunities to develop and study a low risk traumatic intracranial hemorrhage protocol, which keeps a subgroup of patients with a mild TBI and resultant ICH at community hospitals with access to a nearby Level 1 trauma center.

1. Introduction

Annually, an estimated 1.5 million people in the United States (U.S.) sustain a non-fatal head injury, 80% of which are considered mild traumatic brain injuries (TBI) [1,2]. About 10% of those with TBI are found to have an intracranial hemorrhage (ICH) [3]. While American College of Emergency Physicians guidelines exist for managing patients with mild TBI without ICH, no current U.S. guidelines address what to do with patients who have mild TBI, defined as Glasgow Coma Scale (GCS) 13–15 [1], with ICH [4]. As a result, there is wide variation in care of patients who suffered a mild TBI with CT evidence of ICH [5,6], and clinicians have little data to assist in determining the most appropriate disposition.

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http://dx.doi.org/10.1016/j.ajem.2017.03.071
0735-6757/

Due to the potential for poor outcomes in this patient population [3], emergency department (ED) clinicians working in hospitals without neurosurgery access typically transfer such patients to a hospital with neurosurgery availability [7]. However, mounting evidence shows that intracranial hemorrhage in mild TBI is not a homogeneous disease. Compared to patients with mild TBI and subdural hemorrhages, patients with mild TBI with isolated subarachnoid hemorrhages and cerebral contusions are less likely to need neurosurgical intervention [6,8,9]. As a result, it is unlikely that every patient with mild TBI and evidence of ICH requires transfer to a tertiary care center.

Therefore, the purpose of this study was to identify factors predicting admission (to the floor, the intensive care unit, or operating room with neurosurgery) among patients with mild TBI and ICH who were transferred from a community hospital to the ED of a Level 1 trauma center.

2. Methods

2.1. Study design

This was a Health Insurance Portability and Accountability Act-compliant, retrospective cohort study, approved by the study site's Institutional Review Board.

2.2. Study setting and population

The study was performed at an urban, 999-bed quaternary care academic center with an ED hosting an ACGME-accredited emergency medicine residency, carrying both a Level 1 Adult and Pediatric Trauma Center designation, and conducting approximately 109,000 annual visits. The ED also has observation unit (EDOU) capability, composed of 32 beds staffed by both nurse practitioners and physician assistants with emergency medicine physician oversight. At our institution, all patients with a traumatic ICH receive a neurosurgical consultation. For patients with non-operative traumatic ICH, emergency medicine physicians decide the disposition in consultation with neurosurgeons, which may include discharge, placement in EDOU, admission to the floor, or admission to the intensive care unit (ICU). For patients with an isolated non-operative ICH who require an admission to the floor, the neurosurgery, trauma surgery, and neurology services admit patients on a scheduled rotation.

Using our ED reporting system, we searched for patients ≥18 years old who were transferred to our ED from surrounding community hospitals between April 1, 2015 and March 31, 2016 with a chief complaint of traumatic ICH, ICH, subdural hematoma (SDH), or subarachnoid hemorrhage (SAH). We sought to include patients with an isolated traumatic ICH. Patients who had a traumatic ICH with a minor orthopedic injury not requiring surgery were included. We excluded epidural hematoma as it is associated with high mortality [10]. Additional exclusion criteria were patients deemed to require a trauma center's level of service (patient required additional surgical subspecialty services, such as oral maxillofacial surgery, plastic surgery, ophthalmology, or operative orthopedic services), were intubated at the community hospital, were found to have non-traumatic ICHs, or had a GCS of <13.

2.3. Data collection

For each patient, we reviewed their electronic medical record and collected age, sex, initial ED GCS, presence of neurologic deficit (motor or sensory), anticoagulation use, anti-platelet therapy, Computed Tomography (CT) head findings, and disposition from the ED. We recorded CT findings based on the final neuroradiologist report. Imaging findings included SDH (<1 cm or ≥1 cm), SAH, or intraparenchymal hemorrhage (IPH). We also recorded the subsequent disposition after placement in the EDOU (discharge, floor, ICU, OR).

2.4. Outcome measure

Our composite endpoint was admission to the floor, ICU, or operating room (OR) for a neurosurgical operation from the ED.

2.5. Data analysis

Baseline characteristics were summarized using descriptive statistical methods. We identified factors potentially predicting admission (floor, ICU or OR), our primary outcome measure, based on our prior knowledge and prior mild TBI studies [6,8], and used them to create a logistic regression model. We identified the following factors: age, sex, initial GCS, presence of neurologic deficit, warfarin use, clopidogrel use, aspirin use, and presence of SDH (<1 cm or ≥1 cm), SAH, or IPH. We chose an alpha of 0.05 as the cutoff for significance. We used SAS 9.4 (SAS Institute Inc., Cary, North Carolina) for the statistical analysis [11].

3. Results

3.1. Study population

A total of 644 patients were identified during the study period; 2 were excluded as they had an epidural hematoma and 174 were excluded as they suffered multiple traumatic injuries requiring additional surgical subspecialty services, had a GCS <13, or arrived intubated from the community hospital. A further 263 were excluded as they were found to have non-traumatic ICHs. Baseline characteristics of the 205 patients who remained eligible and comprise the study population are presented in Table 1.

3.2. Patient disposition

98 (48%) patients ultimately required admission, including 12 who were admitted to the floor after a stay in the EDOU. All 8 of the patients who went to the operating room had a SDH ≥1 cm. Additional patient dispositions are presented in Fig. 1.

3.3. Predictors for admission

In multivariable regression modeling, warfarin use (odds ratio [OR] 4.09, 95% confidence interval [CI] 1.64, 10.25, p = 0.0026) and a SDH ≥1 cm (OR 6.28, 95% CI 1.24, 31.71, p = 0.0263) were independently

Table 1
Baseline characteristics.

Variable	Value (n = 205)
Mean age (standard deviation)	71 years [17]
Male (%)	95 (46%)
GCS (%)	
13	2 (1%)
14	13 (7%)
15	190 (92%)
Neuro deficit	18 (9%)
ASA use	77 (38%)
Clopidogrel use	9 (4%)
Warfarin use	33 (16%)
Novel oral anticoagulation use	0 (0%)
CT findings[a]	
Subdural	
<1 cm	97
≥1 cm	23
Subarachnoid	83
Intraparenchymal	18

[a] As patients can have more than one CT finding, total is >205.

Please cite this article as: Yun BJ, et al, Opportunity to reduce transfer of patients with mild traumatic brain injury and intracranial hemorrhage to a Level 1 trauma center, American Journal of Emergency Medicine (2017), http://dx.doi.org/10.1016/j.ajem.2017.03.071