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Identifying patients with mild traumatic intracranial hemorrhage at low risk of decompensation who are safe for ED observation☆

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ABSTRACT

Background: Patients with traumatic intracranial hemorrhage and mild traumatic brain injury (mTIH) receive broadly variable care which often includes transfer to a trauma center, neurosurgery consultation and ICU admission. However, there may be a low risk cohort of patients who can be managed without utilizing such significant resources.
Objective: Describe mTIH patients who are at low risk of clinical or radiographic decompensation and can be safely managed in an ED observation unit (EDOU).
Methods: Retrospective evaluation of patients age ≥ 16, GCS ≥ 13 with ICH on CT. Primary outcomes included clinical/neurologic deterioration, CT worsening or need for neurosurgery.
Results: 1185 consecutive patients were studied. 814 were admitted and 371 observed patients (OP) were monitored in the EDOU or discharged from the ED after a period of observation. None of the OP deteriorated clinically. 299 OP (81%) had a single lesion on CT; 72 had mixed lesions. 120 patients had isolated subarachnoid hemorrhage (iSAH) and they did uniformly well. Of the 119 OP who had subdural hematoma (SDH), 6 had worsening CT scans and 3 underwent burr hole drainage procedures as inpatients due to persistent SDH without new deficit. Of the 39 OP who had cerebral contusions, 3 had worsening CT scans and one required NSG admission. No patient returned to the ED with a complication. Follow-up was obtained on 81% of OP. 2 patients with SDH required burr hole procedure >2 weeks after discharge.
Conclusions: Patients with mTIH, particularly those with iSAH, have very low rates of clinical or radiographic deterioration and may be safe for monitoring in an emergency department observation unit.

1. Introduction

Patients with minor head injury make up about 6–7% of emergency department visits in the United States. The vast majority of these patients have minimal injury and are discharged home without sequelae. However, the overall in-hospital mortality of traumatic brain injury (TBI) is 8% and increases to greater than 40% in patients with severe TBI, emphasizing the broad spectrum of disease severity [1,2]. The decision to image a patient with head trauma has been extensively studied and evidence-based rules are available to guide this decision [3,4]. However, support for the emergency physician's disposition decision is lacking, particularly in patients with traumatic intracranial hemorrhage (TIH) and a relatively intact mental status. Historically, most patients with intracranial hemorrhage have been admitted to a trauma center and frequently to the ICU, regardless of the severity or type of hemorrhage [5]. However, the clinical status of these patients and their underlying pathology varies widely. There may be some subgroups which will have excellent outcomes without the resource expenditure and risks of intensive monitoring.

When Emergency Department Observation Units (EDOU) were first developed, they specialized in the evaluation of chest pain syndromes in patients at low risk for coronary ischemia [6]. The use of EDOUs has subsequently expanded to include patients with asthma, CHF, TIA and even minor traumatic injuries [7]. In these units, emergency providers facilitate focused, expedited evaluations in a setting that requires less time and incurs less cost than a regular inpatient admission [8]. In the past, the use of EDOUs has been described for monitoring of patients with traumatic brain injuries, especially patients who are on anticoagulation and have had head injury without evidence of intracranial hemorrhage

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[9]. To our knowledge, there is no existing literature about the safety of monitoring of patients with intracranial hemorrhage in observation.

We defined mild traumatic intracranial hemorrhage (mTIH) as patients with radiographic hemorrhage and a preserved GCS (≥13). We hypothesized that these patients can be safely managed in an EDOU. To evaluate the safety of this approach, we reviewed consecutive patients with mTIH who were treated in our institution's EDOU.

2. Methods

2.1. Study-design

This retrospective chart review was performed at an urban academic Level I trauma center with a volume of over 100 000 annual visits. Patients were identified by running a query of our proprietary Emergency Department Information System (EDIS) using the International Statistical Classification of Diseases and Related Health Problems (ninth edition) codes for TIH (852.00–853.10, 851.00–851.90, 800.00–801.9, 803.00–804.9). All patients with a traumatic intracranial hemorrhage or skull fracture who were age 16 years or older and had a GCS of 13 or higher on admission (adults with mild TIH), presenting between January 1, 2009 and June 30, 2013, were included in this study. As is routine at our institution, all patients who presented with intracranial injury received a neurosurgical consultation. The hospital's institutional review board approved the study.

2.2. Study protocol

All data were collected using Microsoft Access (Microsoft Corporation, Redmond, WA). After the initial query of the medical records was conducted and ineligible patients were excluded, the study team abstracted data from physician notes, radiology reports, laboratory data, and discharge summaries into a standardized form. Two investigators who were unblinded to the study hypothesis abstracted the data. Clinical and radiographic scoring criteria were standardized between the reviewers a priori via the creation of a scoring protocol. Data were collected on a standardized data collection form.

Variables collected included age, gender, method of arrival (walk-in, ground ambulance, air ambulance), direct from scene versus interfacility transfer, disposition from ED (home, floor admission, ICU admission, ED observation unit), admitting service, medical history including hypertension and anticoagulant use, mechanism of injury, initial GCS, initial mental status, cranial nerve exam, motor exam, sensory exam, alcohol intoxication, initial platelet count and international normalized ratio level (INR), initial cranial computed tomography (CT) results, follow-up CT results, and neurosurgical consultant recommendations. Cranial CT data were collected from attending radiologist reports noting the presence of subdural hematoma (location, size, presence of shift), intracranial contusion (number of contusions, location, size), subarachnoid hemorrhage (location, size), epidural hematoma (location, size), and skull fracture (location, type). CT results were abstracted by a separate reviewer who was blinded to the patient and clinical information while reviewing the CT scan.

Observation status was defined as continued monitoring and evaluation for a period of greater than 6 h per neurosurgery recommendations or ED attending discretion. Neurosurgical consult recommendations were followed, and, if a bed became available, patients were moved to the EDOU. Exclusion criteria for transfer to the observation unit or discharge home were limited to polytrauma, spontaneous (non-traumatic) hemorrhage, GCS < 13, active treatment with intravenous antihypertensive medications or ongoing correction of a coagulopathy (with either fresh frozen plasma or platelets). Patients with coagulopathy (including warfarin, novel oral anticoagulant or aspirin use) were transferred to the observation unit once any neurosurgery treatment recommendations regarding reversal had been implemented. The observation unit was able to provide oral and single dose intravenous antihypertensive and antiepileptic medications. We used an intention to treat approach such that if the patient completed the recommended period of observation in the ED and was discharged without being physically transferred to the observation unit, they were included in our study population. The final decision to admit was made by the neurosurgery and ED teams.

The electronic health record was used to determine if the patient had any follow up visits, and if, on follow-up, they noted persistent or new neurologic complaints. This review included records from our institution as well as many of the other hospitals within our healthcare system, including several other tertiary care centers and most of the region's head injury referral centers.

2.3. Outcome measures

The primary outcomes were clinical deterioration (defined as decrease in mental status, worsening neurologic exam or death) or the need for neurosurgery during admission. These endpoints was designed to reflect conditions that would trigger a transfer for neurosurgical consultation during an observation admission at a community hospital. In order to focus on patient-centered outcomes, radiographic worsening was considered as a secondary outcome separate from clinical deterioration. Patients who required burr-hole drainage for sub-acute and chronic subdural hematomas were classified as having a neurosurgical intervention.

2.4. Data analysis

Continuous variables were summarized by mean and standard deviation (SD) and categorical variables were summarized by count and percentage. The risk of deterioration was compared using chi-squared tests and summarized using odds ratios with 95% confidence intervals (CIs) in the univariate analysis. A difference was considered statistically significant at a p value < 0.05. Inter-rater reliability was assessed on the first 100 charts, with kappa being 0.95 for the 3 outcome variables and 0.91 for the remainder of the clinical variables.

3. Results

1185 patients met our initial inclusion criteria. 814 were admitted to the hospital directly from the ED and were therefore excluded from our analysis. This group consisted of patients with multisystem trauma who were admitted to the trauma service per our hospital protocol or patients with more severe head injuries who were admitted to the neurosurgical service at the discretion of the neurosurgery team. The remaining 371 observed patients (OP) had isolated head trauma. Of these, 239 were transferred to the EDOU while 132 were discharged directly from the ED after a period of observation without being moved to the EDOU. Patient demographics are summarized in Table 1. A breakdown of the different types of lesion and their frequency is summarized in Table 2. Compared to the OPs, the admitted patients tended to have lower GCS and an increased rate of anticoagulant/antiplatelet drug use. OPs were more likely to have a single type of intracranial lesion (74.3% vs. 24%, p < 0.0001). For patients who were transferred to the observation unit, there was a subsequent admission rate of 2.9% if patients with epidural hematoma were excluded, or a rate of 5% if EDH patients were included. Outpatient follow-up was obtained via medical record review in 81% of OP.

299 (81%) of OP had a single type of lesion on CT, while the remaining 72 had multiple types of lesion. The 120 patients with isolated subarachnoid hemorrhage (iSAH), comprising 32% of the study population, did uniformly well. No patient with iSAH had clinical or radiographic deterioration throughout their period of observation. Two patients with iSAH required admission to the hospital, however both admissions were unrelated to head trauma: one patient was admitted for operative management of a radius fracture, the other was admitted to treat atrial

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