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Management of traumatic subarachnoid hemorrhage by the trauma service: is repeat CT scanning and routine neurosurgical consultation necessary?

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SUMMARY

Subarachnoid hemorrhage (SAH) results frequently from traumatic brain injury (TBI). The standard management for these patients includes brief admission by the acute care surgery (trauma) service with neurological checks, neurosurgical consultation and repeat head CT within 24 hours to identify any progression or resolution. Recent studies have questioned the need for repeat CT imaging and specialty consultation in mild TBI. We reviewed patients with mild TBI specifically with isolated SAH to determine progression of the pathology and need for neurosurgical involvement. All patients with SAH secondary to mild TBI (Glasgow Coma Score (GCS) of 13–15) who presented over a 5-year period (January 2010 to December 2014) to a level I trauma center were identified from the trauma registry. Demographic data, initial CT findings, neurosurgical consultation, follow-up CT findings, Injury Severity Score (ISS), admission GCS and length of stay (LOS) were all obtained from the patient's charts. Patients with other traumatic brain lesions on the initial CT were excluded. There were 299 patients (male, 48.5%), mean age 60.9 and mean ISS 8. Average time between the first and second CT was 11.3 hours. In all, 267 (89.2%) patients had either no change or an improvement/resolution on follow-up CT scan. Only 26 patients (8.7%) had either worsening or new findings on CT. Eight patients did not have a second scan completed (2.6%). All patients had neurosurgical consultation. Patients with mild TBI with isolated SAH generally have low morbidity, short LOS and negligible mortality. Less than 10% of this population had worsening of their head injury on repeat CT scanning. Given the low acuity of these patients with SAH and tendency towards resolution without intervention, acute care surgeons can manage this specific group of patients with TBI without routine neurosurgical consultation. Repeat CT scanning continues to have utility as it may identify new lesions, deterioration or need for further management.

INTRODUCTION

Traumatic brain injuries (TBI) are common and have continued to be increasingly diagnosed over the last several years.[1] TBIs vary in range, anatomical location and severity and can result in significant short-term and long-term disability. Emergency department physicians and acute care surgery (trauma) services typically are the first points of hospital contact for this population who typically receive at a minimum initial head CT scan to establish the diagnosis. The standard management of patients with TBI with evidence of intracranial hemorrhage includes admission to the hospital, neurosurgical consultation and evaluation with a repeat head CT scan 6–24 hours after the initial study to evaluate for progression.[2 3]

Recent studies have challenged the traditional practice of routine repeat CT scans in patients with TBI. A more selective approach has been proposed, with repeat studies in patients with deterioration in their Glasgow Coma Score (GCS).[4 5] The need for a mandatory neurosurgery consultation has also been questioned.[6 7]

Patients with traumatic (non-aneurysmal) subarachnoid hemorrhage (tSAH) with a normal or near normal GCS (13–15) are recognized to be a population at low risk for progression and intervention among patients with head injury. A recent study looking specifically at patients with tSAH showed that <1% of this population required any form of intervention, neurosurgical or otherwise.[8]

We sought to investigate the clinical progression and management of this specific subset of patients with TBI with the goal of assessing the utility of our current practice of a routine repeat head CT and mandatory neurosurgical consultation prior to discharge. Our working hypothesis is that a repeat head CT scan and neurosurgery consultation is not necessary in patients with mild TBI (GCS≥0.13) and a diagnosis of tSAH.

METHODS

All patients admitted to Miami Valley Hospital, Dayton, Ohio, an American College of Surgeons (ACS) verified level 1 trauma center between January 2010 and December 2014, with isolated tSAH and a GCS of 13–15, were identified from the Trauma Registry. Patients with other traumatic brain lesions on the initial CT were excluded. Demographic data, Injury Severity Score (ISS), initial admission GCS, 24 hours GCS, initial CT findings, progression of CT findings, neurosurgical consultation, total length of stay (LOS) and intensive care unit LOS were obtained. Additionally, anticoagulation medication status, international normalized ratio (INR) and platelet count were also obtained from the patients' hospital records. Findings on third or fourth CT scans, even if performed on outpatient basis were also noted to assess for further progression of any findings.

Table 1 Demographics of patients with tSAH and mild TBI

Characteristic	Mean or total (n=299)
Male	145 (48.5%)
Mean age	60.8±20.12
Mean ISS	8
GCS at 24 hours (mean±SD)	14±3
INR (mean±SD)	1.18±0.71
Platelet count (mean±SD)	209.7±81.7
Hours between CT 1 and 2 (mean±SD)	11.4±7.7
Days between CT 2 and 3 (mean±SD)	10.7±17.9
Length of stay in days (mean±SD)	3.59±3.52
ICU days (mean±SD)	1.00±1.98

GCS, Glasgow Coma Score; ICU, intensive care unit; INR, international normalised ratio; ISS, Injury Severity Score; TBI, traumatic brain injury; tSAH, traumatic subarachnoid hemorrhage.

Table 2 CT 2 results between those aged 65 years and over and under 65 years

Characteristic	≥65 (n=143)	≤65 (n=156)	P value
ED GCS (mean±SD)	14.81±0.43	14.83±0.44	0.648
GCS at 24 hours (mean±SD)	**14±3**	**14±4**	**0.007**
INR (mean±SD)	**1.18±0.71**	**0.93±0.39**	**0.007**
Platelet count (mean±SD)	209.7±81.7	229.8±86.7	0.681
Hours between CT 1 and 2 (mean±SD)	11.4±7.7	11.3±8.8	0.192
Days between CT 2 and 3 (mean±SD)	10.7±17.9	8.41±15.1	0.144
Injury Severity Score (mean±SD)	**7±3**	**10±6**	**0.000***
Length of stay in days (mean±SD)	**3.59±3.52**	**3.71±6.80**	**0.044***
ICU days (mean±SD)	1.00±1.98	0.99±3.81	0.089

Bold values significance p<.05
ED, emergency department; GCS, Glasgow Coma Score; ICU, intensive care unit; INR, international normalised ratio.

Statistical analysis was performed using χ^2 test for parametric variables and Mann-Whitney U test specifically for non-parametric variables was performed as secondary analysis to compare patients above and below 65 years of age.

RESULTS

In the studied period, there were 299 patients identified with isolated tSAH from the trauma registry (male, 48.5%). Mean age was 60.8±20.12 years and mean ISS was 8. Other demographic features of the cohort are mentioned in table 1. Most patients—177 (59.2%) had other injuries, while the rest (40.8%) were identified with isolated tSAH. In all, 275 patients (88.6%) had either no change or an improvement/resolution on follow-up CT scan. Only 26 patients (8.7%) had either worsening or new findings on CT. Eight patients did not have a repeat CT scan. All patients received neurosurgery consultation. The average GCS on arrival was 14 and at 24 hours was 14.03. None of the patients had deterioration in their GCS to <13. The average time between the first and second CT scans was 11.33±8.2 hours. There were 49.8% of patients that had a third CT scan (table 1) and 10.4% of patients that had a fourth CT scan. There was no worsening on any of the subsequent scans.

Of the 299 patients, 37 patients (12.4%) had complete resolution seen on the second CT scan, 169 patients (56.5%) had no significant change and 59 patients (19.7%) had a decreasing tSAH. As stated above, none of these patients had a significant deterioration in their GCS out of the mild TBI range or the need for any neurosurgical intervention. Seventy-seven patients (25.8 %) were receiving some sort of antiplatelet medication preinjury (eg, aspirin or clopidogrel) and 12 patients (4.0%) were on warfarin. Ten patients (3.3%) were on both warfarin and antiplatelet agents.

In comparing the elderly population (>65) with the rest of the population (table 2), the geriatric group appeared to have a higher GCS score at 24 hours (p=0.007) as well as a higher INR (p=0.007)—likely representing the greater tendency for this population to be on anticoagulant medication. Additionally, the older patients had a statistically significantly higher ISS as well as LOS.

DISCUSSION

A few recent studies have questioned the utility of repeat brain imaging and neurosurgical consultation in patients with TBI. Joseph *et al* in a prospective study of all patients with TBI concluded that without deterioration of the clinical neurological exam, a repeat CT scan is not warranted.[4] Abdel-Fattah *et al* examined patients with mild TBI and GCS scores 13–15 and found that selective, as opposed to routine, repeat head CT scans led to decreased hospital LOS without impacting GCS.[9] Borczuk *et al* examined all patients with traumatic intracranial hemorrhage at their center and concluded that patients with isolated tSAH are at low risk for deterioration. These individuals may not need neurosurgical consultation or transfer to a trauma center where neurosurgical backup is available. This contrasted with patients with other injuries such as subdural hematomas that had a higher risk of deterioration.[10]

Other studies have examined the cost-effectiveness of routine CT scans following mild TBI. Stein *et al* described that routine CT scans for patients aged in their 20s were more cost-effective than repeat CTs following clinical change. However, with increasing age, the relative cost-effectiveness for routine CT scans declines.[11]

Besides the issue of routine CT utilization, the need for mandatory neurosurgical consultation in patients with TBIs, specifically tSAH, has been challenged. A recent study of 500 patients with mild TBI demonstrated only 10% of the cohort required any neurosurgical intervention. The authors advocated for a more selective approach in obtaining neurosurgical consultation.[11] Other groups have taken steps of only selectively using neurosurgical consultations based on their findings. Joseph *et al* concluded, based on their data that ACS services can independently care for patients with mild TBI without obtaining a formal neurosurgical consultation given the rarity of neurosurgical consultation in this group.[12] A recent study from Alabama concluded patients with mild TBI with isolated tSAH or intraparenchymal hemorrhage should not require a neurosurgical consultation or even transfer to a major center.[7] In a retrospective study specifically looking at isolated tSAH, Phelan *et al* concluded that these injuries are less severe brain injuries than other TBI and those with GCS scores of 13–15 demonstrate low rates of clinical progression. When progression occurred, there was resolution without intervention and there was no benefit to ICU admission.[13]

In our study, we focused specifically on patients with mild TBI with tSAH and not the general population of TBI, which includes a wide myriad of brain injuries with varying modes of clinical progression. The fact that patients with tSAH generally have good outcomes with minimal complications as seen in this study, and typically have no need for any interventions supports

the recommendation that acute care surgeons can manage those patients without the need for neurosurgical consultation. This point is particularly of importance given the national shortage of neurosurgeons in the USA. This is further accentuated at trauma centers that have no neurosurgical residency programme—further complicating the manpower issues and work burden for neurosurgeons.[14–16]

Our study adds to the growing body of literature attempting to define the optimal use of resources in the mild TBI population. This may translate into cost savings, improved LOS and eliminate redundancy in patient care. Adoption of the findings from these studies, most of which are retrospective, should be done with caution. Prospective studies to validate guidelines for managing mild TBI are being discussed.[17]

In our series, patients with isolated tSAH and a GCS of 13–15 had worsening of CT findings <10% of the time. There was no significant deterioration in clinical status or need for neurosurgical intervention. Given the low acuity of this population and the tendency towards resolution without intervention, we recommend that acute care surgeons can manage this specific group of patients with TBI with only selective neurosurgical consultation. This may be of relevance in level 3 trauma centers where protocols could potentially be developed to avoid transfers in patients with normal or near-normal GCS and isolated tSAH without clinical deterioration.

There are some recognized limitations of this study. Data regarding specific mechanism of injury were not collected. Such information may sometimes indicate the severity of the overall injury burden to a patient. Additionally, the role of anticoagulant/antiplatelet agents in patients who received them was not explored for their potential contribution (or lack thereof) in the patients that had worsening CT scans. Given the ubiquitous presence of these agents in contemporary clinical practice, this would have been relevant information.

Based on our data, we recommend the continuing practice of repeat CT scanning for tSAH as this may identify new lesions, worsening or the need for further management in up to 10% of this population.

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