

Select Isolated Pediatric Closed Head Injuries can be safely managed on a Nonsurgical Service

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ABSTRACT

Introduction: Annually in the United States, there are an estimated 474,000 traumatic brain injury (TBI) related Emergency Department (ED) visits in children under age 15 years. While their evaluation and management are not standardized, guidelines generally include a neurological examination and head computed tomography (CT) with neurosurgical and/or pediatric surgical consultation, and admission generally based on imaging as well as persistent neurological symptoms. The primary purpose of this study was to review our experience with admitted isolated closed head injuries in children. We evaluated the safety of their management on a nonsurgical service after ED pediatric neurosurgical consultation deemed the injuries nonoperative.

Study design: A retrospective review was conducted of pediatric patients with closed head injuries between 2008 and 2013 (n=837). Inclusion criteria were isolated closed head injury, discharged within 48 hours of admission, Glasgow Coma Scale (GCS) score greater than 13, and admission to a nonsurgical service. A total 272 patients met the inclusion criteria. These patients were divided into two groups based on whether or not they received a neurosurgical consult.

Results: Of the 272 patients, 221 received a pediatric neurosurgery consult while 51 did not. Those that received a neurosurgical consult had a higher Injury Severity Score (ISS) (7.5 vs 3.6), younger age (4.4 vs 6.9), longer length of stay, higher admission acuity, and were more likely to receive a repeat head CT. There was no difference in GCS score (14.9 vs 15), and the most common discharge symptom was a headache. With admission to nonsurgical services, no complications, readmissions, or missed injuries occurred.

Conclusion: As pediatric neurosurgery is a limited resource, we evaluated the safety of admitting patients deemed nonsurgical to a medical service for management and follow-up of the TBI, as well as the social issues which are often present. The practice resulted in no morbidity or mortality with efficient management of ancillary consult services.

Keywords: Brain injuries, Head injury, Pediatric trauma.

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INTRODUCTION

Annually, there are an estimated 474,000 traumatic brain injury (TBI) related Emergency Department (ED) visits in children under age 15 years.¹ While their evaluation and management are not standardized, guidelines generally include a neurological examination and head computed tomography (CT) with neurosurgical and/or pediatric surgical consultation, and admission generally based on the CT scan findings as well as persistent neurological symptoms.²⁻⁷

While it has been reported that select adults with mild TBI can be managed without neurosurgical consultation or subsequent management after admission, there is no literature guiding such practices in children.⁸ With an estimated 110 pediatric neurosurgeons and 760 pediatric general surgeons currently practicing in the United States, a limited resource exists.⁹ Therefore, it would be useful to know if a select group of children admitted with TBI either did not need ED neurosurgical consultation or alternately could be managed on a nonsurgical service after initial ED neurosurgical consultation. Both approaches would help address the limited provider resource.

The primary purpose of this study was to review our experience with admitted isolated closed head injuries in children. We evaluated the safety of their management on a nonsurgical service after ED pediatric neurosurgical consultation deemed the injuries nonoperative. Furthermore, we sought to evaluate whether neurosurgical consultation in this select group of patients altered their management in a meaningful way. Finally, we evaluated whether there was a subgroup of these admitted patients that may not need ED pediatric neurosurgical consultation.

MATERIALS AND METHODS

Study Population

After institutional review board approval, a retrospective review was undertaken of all children under age 15 years admitted with isolated TBI to our level 1 urban pediatric trauma center between 2008 and 2013. Further inclusion

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criteria were an isolated TBI, admission to a nonsurgical service, Glasgow Coma Scale (GCS) at admission greater than 13, and discharge within 48 hours. A total 272 patients met the final criteria and were included in the study.

Traumatic brain injury patients were evaluated in our pediatric ED with physical examination, and head CT was performed for suspicion of injury in infants, loss of consciousness, and/or persistent neurologic symptoms. Pediatric neurosurgical consultation was requested for any radiographic intracranial abnormality and/or severe neurologic symptoms; a negative head CT was almost always unassociated with a neurosurgery consult. If the neurosurgical consultation deemed the TBI nonoperative but admission was necessary for observation, patients were admitted to either a general pediatric service or a pediatric specialty service, such as neurology. Patients were typically discharged after 24 to 48 hours of observation with management of ancillary consults as needed.

Endpoints

As the primary purpose of the study was to evaluate the management of these patients on a nonsurgical service, the cohort was divided into two groups: Those patients admitted who received a neurosurgical consult (n=221) and those admitted without such consultation (n=51). Primary endpoints were length of stay, admission acuity as defined by admission to Intensive Care Unit (ICU) or step-down vs floor observation, and receipt of a repeat head CT after initial CT in the ED.

Statistical Analysis

Statistical analysis was performed with Student’s t-tests and Wilcoxon two-sample tests. A stepwise multiple linear regression analysis was performed on hospital length of stay to determine which variables were most responsible.

RESULTS

A total 272 pediatric patients with isolated TBI were admitted to nonsurgical services over the time studied. All patients received a head CT in our ED or at an outside hospital prior to transfer for further evaluation. Injuries were categorized as nondepressed fractures (n=128) or intracranial hemorrhage to include subdural, epidural, subarachnoid, and intraparenchymal hemorrhages (n=90). Neurosurgical consultation was obtained on all patients with intracranial hemorrhage and 125/128 of patients with a nondepressed skull fracture. Of the 51 patients who did not receive a neurosurgical consultation, all had negative head CTs; 19 of these had associated loss of consciousness.

Table 1: Comparison of patients with and without neurosurgical consultation

	Neurosurgical consultation		p-value
	Yes	No	
Number	221	51	–
ISS	7.5	3.6	0.0001
GCS	14.9	15.0	0.5832
Age (years)	4.4	6.9	<0.0001
Positive head CT*	215	3	<0.001
High admission acuity	173	6	<0.0001
Length of stay (hr)	35	27.6	0.0082
Repeat head CT	34	0	<0.0001

*Positive head CT = skull fracture or intracranial hemorrhage

Patients who received a neurosurgical consultation were more likely to be younger than those who did not and have a higher Injury Severity Score (ISS), but there was no significant difference in GCS (Table 1). Neurosurgical consultation was also associated with longer length of stay, higher admission acuity, and a higher likelihood of receiving a repeat head CT.

Of the 34 patients who received repeat head CTs, no physical or neurologic exam changes were noted and the scans ordered at attending preference. Twenty-four of the repeat scans showed persistent or decreased intracranial hemorrhage, but no change in plan of care was made subsequent to the scans. The remaining ten head CTs showed an increase in intracranial hemorrhage, but the patient exhibited no change in physical exam findings.

Of the patients who did not receive neurosurgical consultation (n=51), no missed injuries, complications, or readmissions at 30 days were observed. Although neurosurgical consultation was associated with a longer length of stay, multivariate analysis revealed only ISS and higher admission acuity were statistically significant. The most common complaint upon discharge among all patients was headache.

DISCUSSION

Although isolated TBI is relatively common among injuries to children, evaluation and management is not generally standardized and often left to local guidelines or, appropriately, the judgment of the treating physician. A general approach includes a thorough history and physical examination as well as imaging when indicated. As part of this management process in the acute phase, pediatric neurosurgical consultation can be of enormous importance. Like many pediatric subspecialists, this is a limited resource, even in areas where it is supported by population demand, as in major urban areas.⁹ As such, it is important to be able to triage the need for these resources effectively so that children in need receive appropriate



care, while areas of questionable need are defined to refine clinical management.

To help further define the management of these milder injuries in the acute care setting, we looked at our experience with mild TBI admissions in children with regard to pediatric neurosurgical consultation as well as safety of admitting TBI deemed nonsurgical at admission to a nonsurgical service for management and follow-up.

Joseph et al⁸ demonstrated the safe management of admitted adult trauma patients with mild TBI and intracranial hemorrhage without the need for neurosurgical consultation. Kaye et al¹⁰ reported on pediatricians being comfortable managing the follow-up care for mild TBI and consulting neurologists if they felt they were not the appropriate care provider for these patients.

In the present study, we selected patients with mild TBI who were admitted to the hospital after pediatric neurosurgical consultation for observation and discharged within 48 hours. As it has been the practice to admit such patients to a nonsurgical service as a resource-preserving measure, we looked specifically at safety of this process and any differences between those children receiving neurosurgical consultation and those who did not.

All children admitted had received a head CT scan. A negative head CT generally precluded the request for neurosurgical consultation, and children were admitted for neurologic symptoms or, in the case of infants, further workup of nonaccidental trauma concerns. This appears to be a safe practice as one would expect in the absence of a radiographic finding. Certainly, these children are well served by dedicated pediatric medical support during their admission.

The children with a positive finding on CT scan all received neurosurgical consultation for either intracranial blood or fracture. If deemed nonoperative by neurosurgery, these children were also admitted to a medical service for management and follow-up. As well, this appears to be an appropriate practice as evidenced by data showing no morbidity, mortality, or readmissions within 30 days.

The admission of these children to a medical service has distinct advantages in addition to neurosurgical resource preservation. It is an unfortunate fact that many of these infants and toddlers, as a result of their TBI, will now undergo a complete evaluation for nonaccidental trauma. This can involve an inpatient skeletal survey and ophthalmologic evaluation, as well as social work, child protective services, and child protective team consults. In our system, these events are efficiently handled by medical services such that these evaluations are completed within 24 to 48 hours, permitting discharge

and increased throughput. Additionally, all children are scheduled in follow-up with our TBI clinic.

A secondary finding was the number of repeat CT scans performed within the neurosurgical consultation group which were not indicated by any documented change in physical or neurologic exam recorded, nor did they seem to dictate a change in patient care. Repeat scans were not mandated by any guideline but were left to individual attending preference. Aziz et al¹¹ reported on the use of neurological examination in lieu of repeat head CT in pediatric patients with blunt brain injuries and an initial abnormal CT. They showed a reliable neurologic examination can be followed as a guide to determine the need for a repeat head CT that would be useful in further decision making. Additionally, the issue of radiation induced CNS malignancy in the young child has received significant attention recently. Minimal pediatric radiation protocols should be used and avoiding unnecessary scanning altogether should be the goal if clinically prudent.¹²⁻¹⁵

CONCLUSION

Pediatric mild TBI is a frequent presentation to the pediatric ED and is commonly evaluated with physical examination and CT scans; depending on those results, pediatric neurosurgical consultation may be useful. In this study and as pediatric neurosurgery is a limited resource, we evaluated the safety of admitting patients deemed nonsurgical to a medical service for management and follow-up of the TBI, as well as social issues often present. The practice resulted in no morbidity or mortality with efficient management of ancillary consult services. As all children in this study received a head CT, yet injuries found were deemed nonsurgical, and further stratification of specific CT injuries may further decrease the need for neurosurgical consultation in cases where the outcome is well defined.

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INVITED COMMENTARY

Select Isolated Pediatric Closed Head Injuries can be safely managed on a Nonsurgical Service

Traumatic brain injury (TBI) remains a major cause of death and disability. Our understanding of the pathophysiology of TBI has improved recently. Improvement in survival, however, has not been realized, because of failure of improved therapeutic interventions. The difficulty in classifying the various clinical varieties of TBI and applying specific interventions are considered some of the most significant challenges. The current inclusion criterion in a TBI clinical trial is the Glasgow Coma Scale (GCS). Patients are typically divided into broad categories of mild, moderate, and severe injury based on the GCS. Although this is a great and easy way to stratify patients with TBI, it has its own limitations. Unfortunately, there is no correlation between GCS number and intrinsic pathological brain tissue injury.

These facts are illustrated in the current study. Six patients are classified as having a severe TBI. Computed tomography (CT) scans of these six different patients with severe TBI, defined as a GCS score of <8, document widely different pathological findings: Epidural hematomas, contusions and parenchymal hematomas (contusion/hematoma), diffuse axonal injury, subdural hematoma, subarachnoid hemorrhage and intraventricular hemorrhage, and diffuse brain swelling (diffuse swelling). Given the heterogeneity of the pathoanatomic features depicted in these CT scans, it is difficult to see how a therapy targeted simply for severe TBI could effectively treat all of these different types of injury.

For this group of patients, the benefit of having neurosurgery consultation is of the essence. I concur with the author's work for pediatric patients with mild TBI and no signs of intracranial brain injury. For this special subgroup of patients, there is no need for pediatric neurosurgery consultation since this group of patients can be safely observed in a pediatric ward and discharged home within a 48-hour period. For the subset of patients with intrinsic brain injury, regardless of their initial GCS (mild, moderate, or severe) neurosurgery involvement is appropriate. I congratulate the authors in helping elucidate better this subset of patients that can be safely observed by trauma team without pediatric neurosurgery consultation.

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