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Minimal Head Trauma in Children Revisited: Is Routine Hospitalization Required?

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ABSTRACT. *Objective.* Children with a question of occult head injury are routinely hospitalized despite having both normal central nervous system (CNS) and computed tomographic (CT) scan examinations. We determined the incidence of significant CNS morbidity after occult head injury to determine whether or not hospital admission was necessary in children after minimal head trauma.

Methods. We reviewed the records of children admitted to a level I trauma center with a question of closed head injury, an initial Glasgow Coma Scale equal to 15, a normal neurologic exam, and a normal head CT scan. Children with associated injuries requiring admission were excluded. The endpoints were deterioration in CNS exam, new CT findings, and the need for a prolonged hospital stay.

Results. Sixty-two patients were studied with a mean age of 7 years (range, 1 month to 15 years), and 65% were male. The primary mechanisms of injury were fall (45%) and vehicular crash (23%). The mean injury severity score was 4 ± 2 . The mean length of stay was 1.2 days (range, 1 to 3 days). Prolonged hospitalization occurred in 9 patients (15%). No child developed significant CNS sequelae warranting hospital admission. Total charges for these hospitalizations were \$177 874.

Conclusions. Children undergoing emergency department work-up of occult head injury, who have a normal CNS exam and a normal head CT scan, do not seem to be at risk for significant CNS sequelae. These patients can be discharged home with parental supervision and avoid unnecessary and costly hospitalization. *Pediatrics* 1998;101:575-577; *trauma, brain injury, CT scan, pediatric injuries.*

ABBREVIATIONS. GCS, Glasgow Coma Scale; CT, computed tomography; ISS, injury severity score; CNS, central nervous system.

Treatment of minor head injuries has been debated for many years.¹ Teasdale and Jennett² designed the Glasgow Coma Scale (GCS) in 1974 to aid in the assessment of impaired consciousness. The current definition of a minor head injury includes patients with a GCS ≥ 13 and a history of loss of consciousness or amnesia for the event.³ It is estimated that more than 100 000 children per year sustain head injuries warranting hospital admission in the United States⁴ and 90% have a GCS ≥ 13 .⁵ Throughout the years, adjuncts such as noncontrast head computed tomography (CT) scanning have been introduced to better detect subtle intracranial pathology in patients after minor closed head trauma.^{6,7} CT scanning for minor head injuries has revealed an acute lesion in up to 20% of the adult population.⁸ In fact, Stein and Ross⁹ report that 2.6% of patients with a GCS of 15 will require a neurosurgical intervention. All of the patients in this subgroup, however, had obvious findings on admission head CT scan.

The early diagnosis of intracranial hemorrhage has been shown to result in an improved outcome.^{10,11} There have been numerous studies in the adult population demonstrating the efficacy and safety of utilizing a normal neurologic exam and negative CT scan in the emergency room as criteria for discharge.⁸ The controversy in this matter resides in the treatment of the pediatric patient. There are obvious social issues as well as communication barriers with this population. The clinical decision of when to admit children involved in accidents with head trauma may be influenced by associated injuries and by concern about neurologic observation and living environment.

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We reviewed all pediatric trauma admissions during a 3-year period who had a normal head CT scan, normal neurologic examination, and an admission GCS of 15 to evaluate if admission for isolated head trauma was truly obligatory. We hypothesized that the same criteria held true in both the adult and the pediatric population and that automatic admission in this situation was both unnecessary and costly.

MATERIALS AND METHODS

The records were reviewed of children less than 16 years of age admitted to the level I trauma center at Yale-New Haven Hospital between June 1992 and June 1995 with minimal head trauma (loss of consciousness or amnesia), normal neurologic examination, admission GCS equal to 15, and a normal noncontrast head CT scan. Children with associated injuries necessitating admission were excluded. The records were examined for worsening neurologic exam, new head CT scan findings, and the duration of hospitalization. Standard protocol at this institution requires neurosurgical consultation for all pediatric closed head trauma. The age, sex, revised trauma score, and injury severity score (ISS) of each child were recorded. The ISS includes the sum of the squares of the highest injury score from three of six body regions.¹² This is a standardized system of categorizing injury type and correlating it with mortality. The revised trauma score takes into account the GCS and the patient's initial vital signs and is also correlated with mortality.¹³ History of prior head trauma or seizures was noted. Admission and discharge GCS as well as neurologic complications were tabulated. The charges incurred for each admission were provided by the billing department at Yale-New Haven Hospital.

RESULTS

Two hundred seventy-seven pediatric patients were admitted to the trauma service during this 3-year period. There were 205 children with a GCS of 13 to 15 and 188 with a GCS of 15. Sixty-two patients met the study inclusion criteria for minimal head injury with a normal head CT scan. The mean age was 7 years with a range of 1 month to 15 years and the group was predominantly male (65%). The primary mechanisms of injury were fall (45%), vehicular crash (23%), pedestrian struck (13%), and bike-related accidents (8%). The mean ISS was 4 ± 2 with a range of 1 to 10. There was a loss of consciousness documented in 50% of the patients. Forty-two children were transported by ambulance, 1 child was brought in by helicopter, and 19 came to the hospital

by other means. No intensive care unit admissions were necessary and no changes were noted in the 2 children who had a repeat head CT scan the following day. The length of stay ranged from 1 to 3 days with a mean of 1.2 days. Prolonged hospitalization defined as greater than 24 hours of observation occurred in 9 patients (15%). Four patients stayed because of potential CNS problems: nausea in 3 and a delay in CT reading in 1 (Fig 1). There were no documented reasons accounting for prolonged hospitalizations in 3 patients, social service dispensation issues in 1, and a poor ambulatory status in 1. All patients continued to have a GCS of 15 from admission to discharge. The hospital charges incurred was \$2473 per day (including the charges for room, board, and level of care). The average patient charge, therefore, was \$2869 per hospital stay. The total hospital bill for these 62 patients was \$177 874. No neurologic complications resulted in this group.

DISCUSSION

The principal findings of this study were: 1) children admitted with minimal head trauma with a normal CNS exam and head CT scan did not develop significant CNS sequelae; and 2) the hospital charges for these patients were substantial.

Adults sustaining minimal head trauma with a GCS of 15 and a normal head CT scan may be safely discharged for home observation.¹¹ Evaluation of the trauma patient with appropriate imaging seems to be an effective method for assessing the need for in-hospital observation. Shackford et al⁸ reviewed 2766 patients at eight institutions with isolated minor head injuries. No patient of the 2103 patients with a normal head CT scan required craniotomy whereas 59 of the 2112 with a normal neurologic examination (and GCS of 15) required an operation. Safe discharge of these patients with a normal neurologic exam and normal head CT scan was estimated to save more than \$1.5 million in this study. Stein and Ross⁹ subsequently reviewed 1538 records of adults admitted with minor head injuries and none of the 1339 patients with a normal CT scan required intervention. There is a current propensity to admit children, however, for 24 hours of observation despite a negative work-up. This is both potentially stressful on the family and child, and generates substantial patient charges.

Several other studies have attempted to assess emergency room evaluation of children with isolated minor head trauma. Mitchell et al¹⁴ in a study of head trauma in 401 children with a GCS of >12 evaluated a subset of 51 patients who met our entrance criteria. These children had no neurologic sequelae from their head trauma. Ros and Ros¹⁵ similarly had 63 children who met our study criteria and had no neurologic sequelae in a retrospective analysis at Loyola University Medical Center. Kadish and Schunk¹⁶ reviewed 239 pediatric patients with basilar skull fractures and found 114 with a normal GCS, normal neurologic exam, and no intracranial pathology on head CT scan. This subgroup had only 1 individual who developed meningitis and 7 who developed emesis in their hospital stay. They postulated that

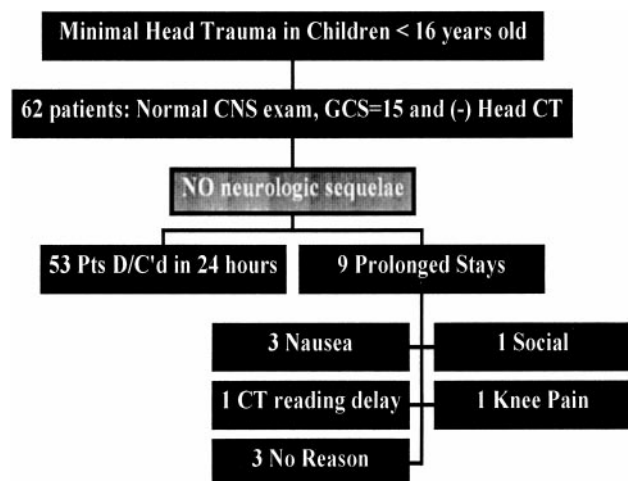


Fig 1. Experience with pediatric minimal head injury, Yale-New Haven Hospital, 1992 to 1995.

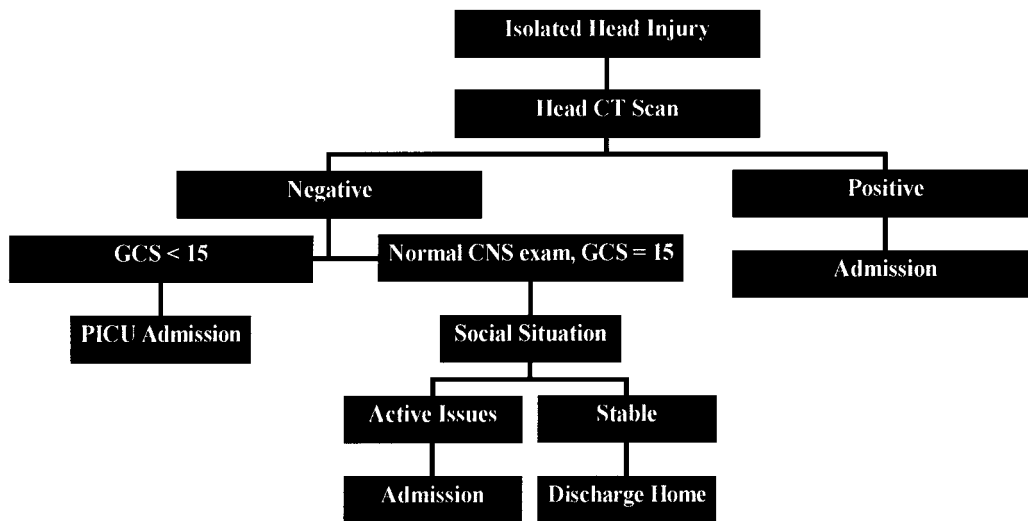


Fig 2. Evaluation of minimal head injury in children, proposed algorithm.

uniform in-hospital stay, even for pediatric patients sustaining basilar skull fractures, was not warranted. None of the children in this group had any clinical or radiographic signs of basilar skull fractures.

We have shown that children with a normal neurologic exam and a normal head CT scan sustaining minor head injury do not develop significant neurologic sequelae. We feel that these children can be safely discharged from the emergency department after their visit, provided parental anxiety regarding CNS sequelae is relieved. This obviously also assumes no neglect or abuse issues are in question at the time of the evaluation given that mortality among child abuse victims with closed head injury is exceedingly high.¹⁷ We should comment that we had very few infants in our series and that neurologic evaluation of these nonverbal children is difficult. Therefore, we do not recommend application of our proposed evaluation/admission algorithm to infants (Fig 2).

This study confirms that mandatory admission of head-injured children with no findings on exam or imaging studies is not warranted. The cost is prohibitive and the potential stress on the child and family is unnecessary. Adherence to these discharge criteria seems safe and cost-effective.

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