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Necessity of repeat head computed tomography after isolated skull fracture in the pediatric population

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Abstract

BACKGROUND: Head injuries are common in the pediatric population, but when an isolated skull fracture is found, there are no guidelines for repeat imaging. This study evaluated the need for repeat head computed tomography (CT) for isolated skull fracture.

METHODS: A 10-year retrospective review was conducted of patients 17 years and younger with isolated skull fractures. Data included demographics, injury severity score (ISS), fracture location, clinical indicators of head trauma, intracranial hemorrhage, and mortality.

RESULTS: Of the 65 patients in this study, mean age was 4.2 years, ISS was 7.2, and head/neck abbreviated injury score was 2.3. Most injuries were from falls (69.2%) and motor vehicle collisions (23.1%). The most common clinical indicators associated with skull fractures were nonfrontal scalp hematoma (40.0%), severe mechanism (30.8%), and loss of consciousness (30.8%). One patient who developed intracranial hemorrhage after the initial head CT showed no bleed. There were no deaths.

CONCLUSION: Isolated skull fractures in the pediatric population do not necessitate a repeat head CT as long as they do not develop worsening clinical indicators of head injury.

Head trauma is common in children and intracranial hemorrhage (ICH) is one of the leading causes of traumatic death in this population.[1,2] The initial evaluation and management of head trauma is highly variable, although computed tomography (CT) is routinely used to assess injury extent and severity. Clinical indicators such as loss of consciousness and decreased Glasgow Coma Scale (GCS) score are unreliable in predicting ICH.[3,4] The only risk factor that has been identified as being predictive of ICH is skull fracture.[5]

CT of the head is indicated when a skull fracture is identified on plain radiographs or with a high index of suspicion of fracture on clinical evaluation.[6] When high-risk ICH such as epidural hematoma, subdural hematoma (SDH), or intraparenchymal hemorrhage is found, the

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common practice is to repeat the CT of the head after an interval of time to evaluate for progression of injury. In the case of low-risk injuries, there are mixed data for repeating a CT of the head when the child is without clinical change.[1,4,7] When the initial head CT shows no hemorrhage, and an isolated skull fracture (ISF) is the only radiologic pathology, recent trends have been to monitor clinically and not repeat imaging. However, there are no studies to date that have evaluated the safety of this treatment strategy.

Additionally, CT exposes the patient to ionizing radiation, which has been linked to increased risk of cancer. A recent study estimated that a year's worth of CT scans in the United States will result in almost 5,000 future cancers.[8] The pediatric population is at an especially high risk because of their sensitivity to this radiation.[8] This correlates with the National Institutes of Health study that estimated a 3-fold increase in the risk of brain tumors and leukemia in the pediatric population after 50 to 60 mGy of radiation.[9] Because of the increased utilization of imaging studies involving ionizing radiation and its associated risk of cancer, particularly in the pediatric population, several professional societies have published recommendations advocating minimization of radiation exposure in this population.[10] The purpose of this study was to evaluate the necessity of repeat CT of the head for ISFs in the pediatric population.

Methods

A retrospective study was conducted of all trauma patients 17 years of age or younger who sustained a skull fracture and were evaluated at an American College of Surgeons verified level I trauma center between January 1, 2001, and December 31, 2011. Study subjects were identified by searching the trauma registry for International Classification of Diseases, Ninth Revision codes for skull fractures. Eligible patients were those with ISFs identified without ICH on initial CT examination. Plain film radiography is not used to diagnose cranial injury in our center. Exclusion criteria included subjects greater than 17 years of age, multisystem trauma, and identification of ICH on initial imaging of the brain.

Each case was reviewed to ensure that the subjects met the inclusion/exclusion criteria for the study. Data collected included the following: demographics (age, sex, race), mechanism of injury, trauma level, initial vitals, Injury Severity Score (ISS), abbreviated injury score, GCS score, clinical indicators for CT examination, admission skull fracture details, presence of ICH on admission, presence of ICH on follow-up CT, intensive care unit (ICU) admission and length of stay, mechanical ventilation requirements, hospital length of stay, disposition, and mortality.

Clinical indicators of head injury prompting initial CT evaluation included the following: severe mechanism, nonfrontal scalp hematoma, loss of consciousness, GCS score less than 15, altered mental status, severe headache, amnesia, signs of a basilar skull fracture, irritability, lethargy, presence of a neurological deficit, seizures, behavioral changes, and nausea. Severe mechanism was defined as a fall from 3 times the patient height, high-speed motor vehicle collision, or direct blow to the skull.

Data were summarized and results reported as the mean and standard deviation for continuous variables, the median and 25th and 75th percentiles for ordinal data and frequencies for categorical variables using SPSS software, version 19.0 (IBM Corp., Somers, NY). This study was approved for implementation by the Institutional Review Board of Via Christi Hospitals Wichita, Inc.

Results

During the 11-year study period, a total of 298 pediatric patients were identified as having suffered a skull fracture. These patients' charts were reviewed and those with ICH or multisystem trauma were excluded. A total of 65 patients were identified with ISFs and were the focus of this investigation. The mean age was 4.2 years (range infant to 16 years), slightly more than one half of the children were male, and the majority were Caucasian (Table 1). There were several mechanisms of injury identified, but falls (69.2%) and motor vehicle collisions (23.1%) made up the majority of the injuries.

Admission vital signs and markers of injury severity are noted in Table 2. The majority of patients had stable vital signs on admission. Most were also minimally injured as evidenced by a mean ISS of 7.2 (median = 5) and mean

Table 1 Study patient demographics and mechanism of injury

Variable	Number	Percentage
Number of patients	65	100%
Age (years)*	65	4.2 ± 4.6
Male sex	35	53.8%
Race		
Caucasian	51	78.5%
African American	2	3.1%
American Indian or Alaskan native	1	1.5%
Asian	1	1.5%
Other	10	15.4%
Mechanism of injury		
Fall	45	69.2%
MVC/ATV	15	23.1%
Assault/abuse	2	3.1%
Kicked by a horse	2	3.1%
Unknown	1	1.5%

ATV = All-terrain vehicle; MVC = Motor vehicle collision.
*Data are expressed as mean ± standard deviation.