A Systematic Review and Meta-Analysis of the Management and Outcomes of Isolated Skull Fractures in Children

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Study objective: Most studies of children with isolated skull fractures have been relatively small, and rare adverse outcomes may have been missed. Our aim is to quantify the frequency of short-term adverse outcomes of children with isolated skull fractures.

Methods: PubMed, EMBASE, the Cochrane Library, Scopus, Web of Science, and gray literature were systematically searched to identify studies reporting on short-term adverse outcomes of children aged 18 years or younger with linear, nondisplaced, isolated skull fractures (ie, without traumatic intracranial injury on neuroimaging). Two investigators independently reviewed identified articles for inclusion, assessed quality, and extracted relevant data. Our primary outcome was emergency neurosurgery or death. Secondary outcomes were hospitalization and new intracranial hemorrhage on repeated neuroimaging. Meta-analyses of pooled estimate of each outcome were conducted with random-effects models, and heterogeneity across studies was assessed.

Results: Of the 587 studies screened, the 21 that met our inclusion criteria included 6,646 children with isolated skull fractures. One child needed emergency neurosurgery and no children died (pooled estimate 0.0%; 95% confidence interval [CI] 0.0% to 0.0%; I^2=0%). Of the 6,280 children with known emergency department disposition, 4,914 (83%; 95% CI 71% to 92%; I^2=99%) were hospitalized. Of the 569 children who underwent repeated neuroimaging, 6 had new evidence of intracranial hemorrhage (0.0%; 95% CI 0.0% to 9.0%; I^2=77%); none required operative intervention.

Conclusion: Children with isolated skull fractures were at extremely low risk for emergency neurosurgery or death, but were frequently hospitalized. Clinically stable children with an isolated skull fracture may be considered for outpatient management in the absence of other clinical concerns. [Ann Emerg Med. 2017;■:1-11.]

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INTRODUCTION

Background

Although minor blunt head trauma is a common reason for pediatric emergency department (ED) evaluation, few children have injuries that require acute intervention.[1] Among children who undergo neuroimaging, an isolated skull fracture is the most common traumatic finding, being identified in approximately 10% of patients.[2] In the United States, most children with isolated skull fractures (ie, skull fracture without intracranial injury) are hospitalized.[3] However, the clinical utility of inpatient care is increasingly being questioned.[4-6]

The hospitalization of a child with an isolated skull fracture could serve several purposes: evaluation for nonaccidental trauma,[7-10] treatment for persistent head injury symptoms (ie, concussion, including persistent vomiting or altered mental status, which may benefit from parenternal hydration or close observation[11]), or observation for clinical decompensation. Although most skull fractures in young children occur after accidental injuries and are without persistent symptoms, the potential risk of clinical decompensation and evolving intracranial hemorrhage must also be considered when the disposition of a child with an isolated skull fracture is determined.[4]

Importance

Previous studies of children with isolated skull fractures have included a relatively small number of patients, often from a single institution. Therefore, rare but important outcomes such as clinical decompensation, evolving intracranial hemorrhage, and the frequency of

Editor's Capsule Summary

What is already known on this topic

Most studies examining management of isolated skull fractures in children are small, without the power to detect relatively rare adverse outcomes.

What question this study addressed

In a large meta-analysis of more than 6,500 patients, what is the risk of emergency neurosurgery or death after an isolated skull fracture in children and how often are they hospitalized?

What this study adds to our knowledge

Adverse outcomes are rare in clinically stable children with isolated skull fractures, yet the majority are hospitalized.

How this is relevant to clinical practice

Isolated skull fractures in children are low risk.

emergency neurosurgery have been challenging to accurately quantify.

Goals of This Investigation

To this end, we performed a systematic review and meta-analysis of all reports on short-term adverse outcomes in children with isolated skull fractures.[12] The aim of our study was to determine the proportion of children who experience an acute clinical decompensation requiring neurosurgical intervention or resulting in death. We hypothesized that the risk of clinical decompensation requiring neurosurgical intervention or death in children with isolated skull fracture was extremely low (<0.1%).[5] The overall goal of this study was to inform clinical practice guidelines that can be used for children with an isolated skull fracture.

MATERIALS AND METHODS

Study Design

We conducted a systematic review and meta-analysis of all reports describing short-term adverse outcomes in children aged 18 years and younger with linear nondisplaced isolated skull fractures, defined as a fracture of the skull calvarium displaced less than the table width of the skull, without concurrent intracranial hemorrhage identified on neuroimaging. Our study conforms to the Meta-analysis of Observational Studies in Epidemiology guidelines for systematic reviews and meta-analysis of observational studies.[12] In conjunction with a medical librarian, we conducted a systematic search of PubMed, EMBASE, the Cochrane Library, Scopus, Web of Science, and ClinicalTrials.gov to include citations from January 1, 1974, to December 2016, without any limitations. We chose to begin our search in 1974 because computed tomography (CT) was not available for clinical use and we could not reliably exclude intracranial hemorrhage in children who did not have a CT performed before this time. Details of the search strategy are included (Appendix E1, available online at http://www.annemergmed.com). In addition, we manually reviewed the references of the selected studies to identify additional potential articles.

Selection of Participants

After the initial search, 2 investigators (S.B. and L.M.) independently manually screened study abstracts to remove the following: case reports (fewer than 3 patients), editorials or other narrative reports, and exclusively adult studies (all patients >18 years). We then reviewed the full text of the selected articles and excluded unavailable articles and abstracts without full articles because we could not determine important clinical outcomes.

The full text of each of the remaining articles was manually reviewed by 2 study investigators (S.B. and L.M.), who were unblinded to journal, institution, and author. We selected original research studies that included all of the following: patients younger than 18 years with an isolated linear nondisplaced skull fracture(s) after head injury; cross-sectional neuroimaging (eg, CT, magnetic resonance imaging) performed to exclude associated intracranial injury; and acute adverse clinical outcomes described. In studies including children with a Glasgow Coma Scale (GCS) score (≤15), we extracted patient data for children with an isolated skull fracture and a GCS score greater than or equal to 14 whenever possible. We excluded studies that included basilar or depressed skull fractures.[1] Studies that included both children and adults were included if pediatric data could be analyzed separately. We had potentially relevant non-English articles translated to determine final inclusion or exclusion. For studies published in the past 10 years, when the required data were not presented or were unclear, we attempted to contact the corresponding study author. If we were unable to clarify the needed data elements after this correspondence, we either excluded the article or used the data for clearly specified outcomes. Disagreements on study selection and study details were resolved by consensus methods.

We abstracted the following from each eligible study: setting and design, number of children with a linear