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Traumatic skull fractures in children and adolescents: A retrospective observational study

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ABSTRACT

Objective: To investigate the epidemiological features of child and adolescent (≤18 years old) patients managed for traumatic skull fractures (TSKFs) and associated traumatic brain injury (TBI).
Design: 393 Patients who were children and adolescent who had TSKFs admitted to our university affiliated hospitals between January 2003 and December 2010. The incidence and patterns were summarized with respect to different age group, admission time and etiology.
Setting: Two university-affiliated hospitals from January 2003 to May 2010.
Results: The most common etiologies were motor vehicle collisions (MVCs) (166, 42.2%) and high fall (101, 25.7%). The most common skull fracture sites were parietal fractures (n = 111, 28.2%) and basilar skull fracture (n = 111, 28.2%). A total of 300 (76.3%) patients suffered TBI and 23 (5.9%) patients suffered OCI. The most common intracranial hemorrhage was epidural hemorrhage (n = 94, 23.9%). The frequencies of emergency admission, medical insurance and associated injuries were 56.2% (n = 221), 22.4% (n = 88) and 37.2% (n = 146). The frequencies of TBI and associated injuries were significantly increased from 53.45% to 76.3% and from 6.9% to 41.6% with age, respectively.
Conclusions: MVCs were the most common etiologies. Parietal and basilar skull fractures, epidural hemorrhages were the most common fracture sites and intracranial hemorrhage.

Introduction

Head injury is an important public health issue and a common cause of morbidity and mortality in the paediatric population [1,2]. Approximately two-thirds of traumatic skull fractures are accompanied by traumatic brain injury (TBI) [3–5]. TBI is the most common cause of acquired disability in the paediatric population. TBI may cause impairment of physical, cognitive, or psychosocial functions and may thereby influence key developmental processes, such as emotional awareness, learning, and social functioning [6–11]. TBI most commonly occurs in children and adolescents during falls, motor vehicle collisions (MVCs), or assault.

The type and site of skull fracture and the associated intracranial haemorrhage can affect the ultimate outcome of patients with TBI. The presentation of intracranial haemorrhage is very closely related to the skull fracture [12,13]. Although paediatric head trauma has been extensively studied, there are only a few reports from developing countries about the patterns of traumatic skull fracture (TSKF) [14,15]. The purpose of the present study was to describe traumatic skull fractures with respect to age group, admission time and aetiology. It is important to understand the clinical manifestations of TSKFs to allow early diagnosis of the injury and take appropriate therapeutic measures at an early stage. In the current study, we assessed the epidemiological features of patients treated for TSKFs and associated TBI at teaching hospitals in China from 2003 to 2010.

Materials and methods

Study population

Our study included 393 children and adolescents (≤18 years old) who had acute traumatic skull fractures between January 2003 and December 2010 who were admitted to our university-affiliated hospitals. Chongqing Municipality is a city located in

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southwest China. The data were collected from Third Military Medical University-affiliated hospitals, which are the two largest public tertiary hospitals located in the Shapingba District. The Shapingba District is a core district located in the northwest region of Chongqing. We made definitive diagnoses of traumatic skull fractures (TSKF) in all patients using X-rays and computed tomography (CT), MRI was performed if necessary. Sex ratio meant ratio of number of males to number of females. Mechanisms of trauma included high fall (height $\geq$2), low fall (height <2 m), motor vehicle collisions (MVCs), struck by object and hit by others. The TBIs were divided into closed craniocerebral injury (CCI) and open craniocerebral injury (OCI); CCI includes cerebral concussion, cerebral contusion and laceration, and brainstem injury. The skull fractures were divided into frontal, parietal, occipital, temporal and skull base fractures. The intracranial haemorrhages were divided into subarachnoid, epidural, subdural and intracerebral haemorrhage. Neurological injury (NI) included central nervous system injury (CNSI) and peripheral nerve injury (PNI). CNSI included traumatic brain injury (TBIs) and spinal cord injury (SCI). PNI included cranial nerve injury and spinal nerve injury. Emergency admission rate meant the frequency of patients who were admitted from the emergency department among all the included patients. The emergency admission means that the patients came to our hospitals from the emergency department. The patients who had an emergency admission typically were more serious than those who did not have an emergency admission. Associated injuries included only non-head injury in the current study. The study protocol and publication of the study were approved by the committee on ethics and the institutional review board of our institution.

Statistical analysis

We used SPSS version 22.0 (SPSS, Inc., Chicago, IL) to perform all statistical analyses. Pearson chi-square tests were conducted for assessing differences in age and sex distribution and other attribute data between groups. The continuous variables were expressed as the mean $\pm$ standard deviation (SD). Differences in the continuous variables between two groups were evaluated by the independent samples *t*-test.

Results

Demographic features and general characteristics

The study included 281 male and 112 female patients with a mean age of 9.3 $\pm$ 5.3 years and a sex ratio of 2.5. The emergency admission rates were 56.2% (n = 221). The frequency of NI and PNI was 76.3% (n = 300) and 5.9% (n = 23), respectively. A total of 88 (22.4%) patients presented with associated injuries. The most common associated injuries were upper limb injury (n = 44, 11.2%) and lower limb injury (n = 29, 7.4%). The mean ICU length of hospitalisation and total length of hospitalisation were (4.0 $\pm$ 7.3) days and (17.4 $\pm$ 19.0) days, respectively. The mean total cost of hospitalisation was (22.2 $\pm$ 33.0) $\times$ 10^3 CNY.

The most common skull fracture sites were basilar skull fractures (n = 111, 28.2%) and parietal fractures (n = 111, 28.2%), followed by temporal fracture (n = 104, 26.5%). The most common TBI were cerebral contusion and laceration (n = 145, 26.9%) and cerebral concussion (n = 102, 26.0%). OCI accounted for 10.9% (n = 43). The most common types of intracranial haemorrhage were epidural haemorrhage (n = 94, 23.9%) and subarachnoid haemorrhage (n = 46, 11.7%) (Fig. 1). Leakage of cerebrospinal fluid (LCS), pneumocephalus and cerebral hernia accounted for 3.6% (n = 14), 6.4% (n = 25) and 2.0% (n = 8), respectively. Surgical treatments were performed for head injuries in 139 patients (35.4%). The overall annual incidence of child and adolescent traumatic skull fractures was (455.2 $\pm$ 123.9) cases per 1,000,000 hospital admissions per 2-year period. Annual incidence rates increased from 333.9 cases to 590.0 cases and then decreased to 367.8 cases with year of admission per 1,000,000 hospital admissions per 2-year period. The rate of surgical treatment for head injury was significantly decreased from 42.9% to 29.6% ($P < 0.001$) with the year of admission.

The incidences had a little seasonal variation and an obvious time variation, with peaks in summer (34.6%) and 16–20 PM (30.0%). The seasonal distribution map showed that summer accounted for 34.6%, spring accounted for 26.2%, winter accounted for 21.1% and autumn accounted for 18.1%. The time distribution map showed that 16–20 accounted for 30.0%, 12–16 accounted for

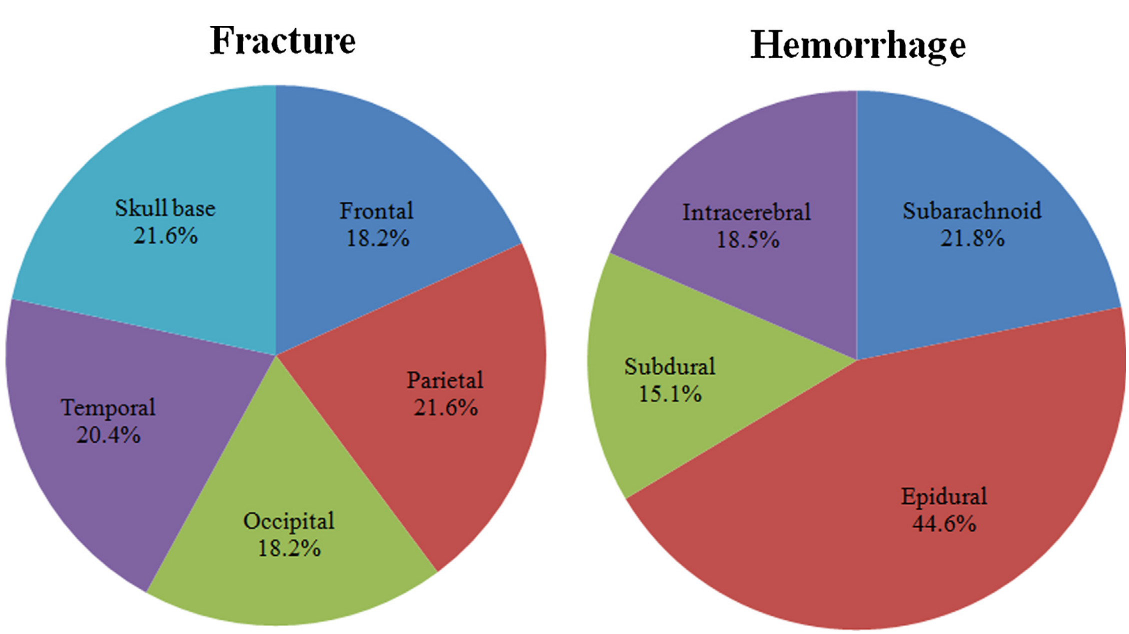

Fig. 1. Fracture and hemorrhage distributation.

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