The Journal of Emergency Medicine, Vol. 45, No. 3, pp. 332–337, 2013

0736-4679/$ - see front matter

ELSEVIER

http://dx.doi.org/10.1016/j.jemermed.2013.03.020

Original Contributions

CHILDHOOD DEATH ATTRIBUTABLE TO TRAUMA: IS THERE A DIFFERENCE BETWEEN ACCIDENTAL AND ABUSIVE FATAL INJURIES?

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□ **Abstract—Background: Trauma is a leading cause of death among children worldwide. Detailed knowledge of the epidemiology of childhood fatal injuries is necessary for preventing injuries. Objective: To determine clinical differences between children who were treated in an emergency department for accidental or abusive injuries. Methods: A retrospective review of all deceased patients who were treated in two urban pediatric emergency departments between 1998 and 2010 was performed. Patients were categorized into two groups, accidental and abusive, for comparison. Results: A total of 1498 patients died during the study period, with 124 deaths being attributable to injury for a rate of 9.5 injury-related deaths per year. Most fatal injuries were accidental. Children with abusive fatal injuries were younger and more likely to have been seen for an injury in a clinic or emergency department within 2 months of their death. Eighty-two percent of abusive fatal injuries had documented subdural hematomas, whereas only 7.2% of accidental fatal injuries had a subdural hematoma documented. Nearly 50% of abusive fatal injuries had retinal hemorrhages reported, although no child with an accidental fatal injury had this type of injury documented. Conclusion: Younger children, especially those previously seen in an emergency department or clinic for injury, are more likely to sustain an abusive fatal injury. Sentinel physical findings associated with abusive fatal injuries include subdural hematomas and retinal hemorrhages, and the presence of these findings should prompt an investigation into the circumstances of injury.** © **2013 Elsevier Inc.**

□ **Keywords—child abuse; pediatric fatal injury; death; accident**

INTRODUCTION

Traumatic injuries are a major public health problem in the United States (US), with an estimated 20 million children sustaining injuries that require emergency treatment every year (1,2). Trauma is also the leading cause of death among children and adolescents, accounting for approximately 15,000 deaths each year and >50% of pediatric deaths in the US (3).

Although the death of a child is a difficult to experience at any level, it is important to understand the circumstance surrounding a child's death. Although the recognition of an abusive cause of injury has improved since the report by Caffey in 1946, detailed knowledge of the epidemiology of childhood fatal injuries is necessary for allocating available treatment resources and for preventing injuries at a community level, as well for developing health policy at a regional level (4,5).

Clinical characteristics of the abused child have been well described, yet it is still often difficult to accurately determine an abusive injury in the emergency department (ED) (6–9). Although previous studies have reported various risk factors associated with abused children with nonfatal injuries treated in the ED, to our

RECEIVED: 4 May 2012; FINAL SUBMISSION RECEIVED: 28 November 2012;
ACCEPTED: 15 March 2013

knowledge there has been no report comparing accidental to abusive or nonaccidental pediatric fatal injuries (10–14).

The objective of this study was to determine differences between children who were treated in the ED for accidental or abusive fatal injuries. This knowledge should help distinguish the mechanisms and types of injuries associated with accidental and abusive deaths. By understanding any differences in accidental and abusive fatal injuries, providers could target at-risk populations of children who may benefit from a more focused injury prevention anticipatory guidance. This information may also be used to help health care providers build a rational and systematic approach to the prevention of traumatic injuries in children at both the community and individual provider levels.

METHODS

Study Design and Patient Selection

Our institution maintains two EDs in free-standing, urban, university-affiliated children's hospitals that have a combined annual census of over 80,000 visits per year. Our institution has a team of abuse specialists who are available to provide consultation in cases of suspected abuse.

This retrospective review was approved by our institutional review board. The study sample consisted of patients <19 years of age who received emergency treatment for a fatal injury at one of our EDs between January 1, 1990 and December 31, 2010. We included all patients who either died in the ED or were admitted to the hospital for treatment of an injury and died as a result of their injury during the initial hospitalization. Patients who were discharged from the hospital after their initial injury were excluded from this study because we defined a fatal injury as an injury resulting in death before the patient left the hospital. Patients who died as a result of a noninjury event or medically complex patients with unexplained deaths were excluded from this study. Patients were determined to be medically complex if they were technology dependent or had a chromosomal disorder that resulted in severe developmental delays. An unexplained death was defined as a death without injury or suspicion of abuse, such as sudden infant death syndrome. Data were extracted by a single researcher from our electronic medical records system data warehouse (Cerner Corporation, Kansas City, MO), which included autopsy reports when available.

We collected demographic data, including age, race, and sex, directly from the electronic database. Clinical data, such as mechanism of injury, radiographic findings, and location of injury were extracted from the medical record by the study investigator. A board certified pediatric radiologist read all radiology studies reported in the medical records.

Patients were categorized into two groups during analyses for comparison in this study: (1) accidental trauma and (2) abusive or nonaccidental trauma (NAT). A death was considered accidental if there were no suspicions regarding the injury documented in the medical record or autopsy report, or it was specifically stated in the medical record that there were no suspicions of nonaccidental trauma, regardless of the physical findings documented. A death was considered nonaccidental if there were any suspicions, confessions, or a clear consensus among medical professionals documented in the medical record or autopsy report. Police reports were used (if available) in addition to the medical record. To minimize subjectivity in data collection, only statements or data directly documented in the medical records were included in this study.

Statistics

We calculated means and standard deviations as well as medians (with ranges) for age and other continuous variables and frequency distributions for categorical variables for all subjects by category of death (accidental vs. abusive/nonaccidental). We used *t* test or nonparametric Mann-Whitney test to compare means or medians on the continuous variables and χ^2 or Fisher exact test on categorical variables as appropriate. Computation of relative risk (RR) with 95% confidence intervals (CIs) was performed for assessing the risk of abuse associated with subdural hematoma and retinal hemorrhages in each injury group. We used SPSS version 17.0 (SPSS Inc., Chicago, IL) to perform all statistical analyses.

RESULTS

A total of 1498 patients died at our institution during the study period, with 124 deaths being attributable to an injury (8.3% of total deaths), for a rate of 9.5 injury-related deaths per study period year.

Table 1 shows the demographic and basic clinical characteristics of the study population. Of the 124 total injury-attributable deaths, 55 (44.4%) were determined to be abusive. Patients with abusive fatal injuries were younger ($p < 0.001$), more likely to be seen by an abuse specialist as part of their ED or hospital treatment ($p < 0.001$), and more likely to have been seen for an injury in a clinic or ED within 2 months of their death ($p < 0.001$).

Table 2 describes the mechanisms of injury found in our population. Overall, submersion injuries (26.6% [33/124]) were the most common type of fatal injury.