Journal of Pediatric Surgery (2013) **48**, 1357–1362

ELSEVIER

Journal of Pediatric Surgery

www.elsevier.com/locate/jpedsurg

The importance of surgeon involvement in the evaluation of non-accidental trauma patients

Emily L. Larimer, Sara C. Fallon, Jaimee Westfall, Mary Frost, David E. Wesson, Bindi J. Naik-Mathuria*

Texas Children's Hospital Trauma Program, Division of Pediatric Surgery, Michael E. DeBakey Department of Surgery, Baylor College of Medicine, Houston, TX 77030, USA

Received 24 February 2013; accepted 8 March 2013

Key words:
Pediatrics;
Child Abuse;
Non-accidental Trauma

Abstract

Introduction: Non-Accidental Trauma (NAT) is a significant cause of childhood morbidity and mortality, causing 50% of trauma-related deaths at our institution. Our purpose was to evaluate the necessity of primary surgical evaluation and admission to the trauma service for children presenting with NAT.

Methods: We reviewed all NAT patients from 2007–2011. Injury types, demographic data, and hospitalization information were collected. Comparisons to accidental trauma (AT) patients were made using Wilcoxon rank sum and Student's t tests.

Results: We identified 267 NAT patients presenting with 473 acute injuries. Injuries in NAT patients were more severe than in AT patients, and Injury Severity Scores, ICU admission rates, and mortality were all significantly ($p < 0.001$) higher. The majority suffered from polytrauma. Multiple areas of injury were seen in patients with closed head injuries (72%), extremity fractures (51%), rib fractures (82%), and abdominal/thoracic trauma (80%). Despite these complex injury patterns, only 56% received surgical consults, resulting in potential delays in diagnosis, as 24% of abdominal CT scans were obtained >12 hours after hospitalization.

Conclusion: Given the high incidence of polytrauma in NAT patients, prompt surgical evaluation is necessary to determine the scope of injury. Admission to the trauma service and a thorough tertiary survey should be considered for all patients.

Non-accidental trauma (NAT) is a significantly underappreciated cause of childhood morbidity and mortality. A recent study found an estimated incidence of severe physical abuse of 6.2 per 100,000 children [1]. This rate is 9 times higher in children less than one year of age, and 21 times higher in children on Medicaid [1]. Compared to children with accidental trauma (AT), those who suffer from NAT tend to be younger with more severe injuries and longer hospitalizations. At discharge, NAT patients have significantly higher rates of severe functional limitations, including cerebral palsy and developmental delay, than those with AT [2–6]. Finally, reported mortality rates are 3–5 times higher in children suffering from NAT [2,4,5].

At our institution, NAT accounts for the majority of trauma-related deaths. Although our hospital was designated

* Corresponding author. Tel.: +1 832 822 3135; fax: +1 832 825 3141.
E-mail address: bnaik@texaschildrens.org (B.J. Naik-Mathuria).

0022-3468/$ – see front matter © 2013 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jpedsurg.2013.03.035

as a level I pediatric trauma center only recently, we have been caring for children with NAT for many years since we are the largest children's hospital in the region. These patients were traditionally considered as "medical" and "social" and were admitted to either pediatric critical care or the general pediatric service, with surgery service consultation only when deemed necessary. Since becoming a level I trauma center, the importance of treating these patients as "trauma" patients, including primary evaluation by a trauma surgeon and admission to the trauma service, has been emphasized. The key reason for this culture change is the belief that most of these patients do not have an isolated acute injury and need to be evaluated for polytrauma. The objective of this study was to review our experience at a large, tertiary care children's hospital to determine the incidence of multiple acute injuries within the NAT population.

1. Methods

This was a retrospective review of the records of NAT patients from 2007 to 2011. After Institutional Review Board approval from Baylor College of Medicine (H-29543), patients were identified using the Texas Children's Hospital trauma registry. Data concerning patient demographics, mechanism and circumstances of the acute injuries, injury severity, operative interventions, radiological findings, hospital course, and outcomes were collected. We identified eight categories of acute injury to define the incidence of polytrauma: closed head injury, skull fracture, extremity fracture, abdominal injury, acute rib fracture, diffuse soft tissue injury, intra-thoracic injury and spine injury. Each patient was assigned to a primary area of acute injury (e.g., skull fracture) and was then evaluated for additional concomitant injuries (closed head, abdominal, extremity etc.). This process was repeated with each category designated as the primary injury to determine rates of polytrauma per injury type. Non-acute healing injuries discovered on radiographs or skeletal surveys were not included in our polytrauma evaluation. Statistical comparisons were made using Wilcoxon rank sum tests for non-parametric data, and Student's t tests or chi-square tests for normally distributed data.

2. Results

2.1. Patient population

From 2007 to 2011, 5048 trauma patients were evaluated at the Texas Children's Hospital Emergency Center. Of those, 267 patients (5.3%) were coded by a dedicated trauma registry nurse as having NAT as the mechanism of injury. All other patients were considered to be injured accidentally. A comparison of the NAT and AT groups is shown in Table 1. NAT patients were younger, with a median age of 7 months compared to the AT median of 72 months ($p = 0.001$), and had a lower rate of private insurance coverage (19% vs. 40%, $p = 0.001$). The racial distribution of the two groups also differed. While no difference was noted in the Hispanic population (35% vs. 34%), there was a significantly higher percentage of African Americans (34% vs. 15%, $p = 0.001$) and lower percentage of Whites (26% vs. 36%, $p = 0.001$) in the NAT group. NAT patients had a significantly higher median Injury Severity Score (ISS) (13 vs. 9, $p = 0.001$), admittance rates to the ICU (34% vs. 9%, $p = 0.001$), and longer hospital stays (3 days vs. 1 day, $p = 0.001$) than AT patients (Table 1). The NAT patients had a higher mortality rate than the AT patients (7% vs. 0.3%, $p = 0.001$; OR 26.5, 95% CI 12.8–54.7) and were younger (median age 1.2 vs. 4.2, $p < 0.001$). All of the 18 NAT deaths during this time period were a result of severe traumatic brain injury.

2.2. Incidence of injury

The incidence of NAT was noted to increase at our hospital in 2009, with a concomitant increase in the number of deaths from NAT in our county (Harris), and state (Texas) during the same year (Fig. 1). We identified 472 discrete acute injuries in 267 NAT cases. NAT patient injury patterns ranged from diffuse bruising to severe intracranial bleeding with concomitant abdominal trauma. The most common injuries were head trauma (64%) and extremity fractures (38%). Table 2 describes the frequency of presenting injuries. The majority of patients did not present with isolated injury. Patients with intra-thoracic injury (100%) and spine injuries (100%) had the highest incidence of multiple injuries. Abdominal trauma and acute rib fractures were associated with additional injuries 81% of the time. While it seems likely that these types of high-impact injuries involve multiple affected areas, it is notable that the majority of children who presented with a closed head injury, skull

Table 1 Comparison of the demographics of non-accidental trauma (NAT) to accidental trauma (AT) patients from 2007–2011.

Patient Demographics	NAT (n = 267) Median (range)	AT (n = 4781) Median (range)	P-value
Age in months	7 (0.4 - 122)	72 (0.03 - 228)	<0.001
Male, sex	61%	64%	0.327
Private Insurance	19%	40%	<0.001
Race			
Hispanic	36.0%	34%	0.507
African American	34%	15%	<0.001
White	25.8%	36.3%	<0.001
ISS	13 (1–50)	9 (1–59)	<0.001
Length of stay, days	3, (1–63)	1 (1–106)	<0.001
% pt admitted to the ICU	34%	9%*	<0.001
Mortality	7%	0.3%	<0.001