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Characteristics and outcomes of acute pediatric blunt torso trauma based on injury intent☆

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ABSTRACT

Introduction: Blunt trauma is a leading cause of pediatric morbidity. We compared injuries, interventions and outcomes of acute pediatric blunt torso trauma based on intent.
Methods: We analyzed de-identified data from a prospective, multi-center emergency department (ED)-based observational cohort of children under age eighteen. Injuries were classified based on intent (unintentional/inflicted). We compared demographic, physical and laboratory findings, ED disposition, hospitalization, need for surgery, 30-day mortality, and cause of death between groups using Chi-squared or Fisher's test for categorical variables, and Mann-Whitney test for non-normal continuous factors comparing median values and interquartile ranges (IQR).
Results: There were 12,044 children who sustained blunt torso trauma: Inflicted = 720 (6%); Unintentional = 9563 (79.4%); Indeterminate = 148 (1.2%); Missing = 1613 (13.4%). Patients with unintentional torso injuries significantly differed from those with inflicted injuries in median age in years (IQR) [10 (5, 15) vs. 14 (8, 16); p-value < 0.001], race, presence of pelvic fractures, hospitalization and need for non-abdominal surgery. Mortality rates did not differ based on intent. Further adjustment using binary, logistic regression revealed that the risk of pelvic fractures in the inflicted group was 96% less than the unintentional group (OR: 0.04; 95%CI: 0.01–0.26; p-value = 0.001).
Conclusions: Children who sustain acute blunt torso trauma due to unintentional causes have a significantly higher risk of pelvic fractures and are more likely to be hospitalized compared to those with inflicted injuries.

1. Introduction

Injuries are a leading cause of morbidity and mortality in US children aged 1–18 years [1]. Most of these injuries are due to blunt trauma. Non-fatal unintentional injuries are almost 39 times higher than injuries sustained due to assaults among US children aged 18 years and under [2]. Motor vehicle crashes (MVCs) account for a majority of unintentional injury death in children [3] whereas non-self-inflicted injuries occur as a result of child maltreatment in infants and young children [4] or due to peer-violence in adolescents [5,6].

The mechanism of injury and the anatomy of the child determine their type of injuries [7]. An important pitfall in diagnosing injuries to the chest and abdomen in children is the relative lack of external signs of trauma. The flexibility and resilience of the pediatric skeleton and surrounding structures allows external forces to be transmitted to the deeper structures in the body [7]. Additionally, in young children the horizontal insertion of the diaphragm permits the abdominal organs to be more exposed and less protected by the ribs and muscle further increasing the risk for injury. In victims of inflicted injuries, diagnostic challenges may occur because of a delay in presentation or the absence of a reported mechanism [8-10]. Clinical prediction rules [11] and certain patterns of recognizable injury such as the Waddell's triad in pedestrian-motor vehicle crashes or the seat-belt sign [7,12] in inappropriately restrained child passengers are helpful in diagnosing and managing children with certain types of blunt traumatic injuries. However, an accurate description of the mechanism of injury and being aware of the different injuries based on intent is also important in diagnosing and treating injuries in children who sustain blunt torso trauma.

Lane et al. described abusive abdominal trauma leads to more severe injuries, longer hospitalizations, higher charges, and higher mortality rates compared to those suffering accidental trauma injuries in a cohort of children less than nine years of age but called for studies to explain these differences [13]. Further, the authors were unable to describe the mechanisms of injuries in their cohort. The types of injuries to the chest, abdomen and pelvis and clinical outcomes of children who present to the ED with blunt torso trauma based on the mechanisms

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of injury and intent have not been described. We hypothesize that in pediatric blunt torso trauma that is severe enough to require treatment in the ED, children who sustain unintentional injuries have worse clinical outcomes than those with inflicted injuries. This is because children with unintentional injuries may be exposed to higher energy mechanisms such as motor vehicle crashes and falls than children with inflicted injuries. The aim of the study was to compare injuries, interventions and clinical outcomes based on injury intent among children who present to the pediatric emergency department with blunt torso trauma.

2. Methods

We undertook a secondary analysis of de-identified data obtained from a prospective, multi-center observational cohort of children younger than 18 years old, presenting within 24 h of blunt torso trauma to 20 participating EDs of the Pediatric Emergency Care Applied Research Network (PECARN) from 2007 to 2010 [11]. The full inclusion criteria are described in the study [11]. The exclusion criteria, based on the primary study, were children in whose injury occurred >24 h before presentation, penetrating trauma, preexisting neurologic disorders precluding reliable examination, known pregnancy, transfer from another hospital with previous abdominal computed tomogram (CT) or diagnostic peritoneal lavage.

The treating physician collected the patient history, physical examination and injury variables on a structured data collection form. Imaging, including radiography and computerized tomography (CT) and laboratory investigations were performed at the discretion of the treating physician. Data collection included demographic information, mechanism of injury, symptoms and physical examination (including abdominal and thoracic examination), laboratory and imaging information and outcomes (ED disposition, need for hospitalization, need and anatomic location for surgery, 30-day mortality, and cause of death). Thoracic injury was diagnosed based on the chest radiograph. Abdominal and pelvic injuries were diagnosed based on CT. The decision to hospitalize the child was made by the treating physician. Subjects were classified based on injury intent (unintentional, inflicted or indeterminate) using the mechanism of injury and additional narrative information obtained from the electronic case report form (ECRF4) [14]. The injury intent was indeterminate when the mechanism was unknown and the narrative on the ECRF4 did not specify an intent. Intentional injury was coded as inflicted injury. The method of data collection of subjects, the investigations performed and the follow up procedures have been described elsewhere [11]. The study was granted exempt status by the Baylor College of Medicine Institutional Review Board (IRB).

3. Outcome measures and definitions

We defined torso injuries to those that included the chest, abdomen and pelvis. The outcomes investigated included ED disposition, need for hospitalization, need and anatomic location for surgery, 30-day mortality, and cause of death. Intra-abdominal injury (IAI) was defined as any radiographically or surgically apparent injury to the following structures: spleen, liver, urinary tract (from the kidney to the urinary bladder), gastrointestinal tract (including the bowel or associated mesentery from the stomach to the sigmoid colon), pancreas, gallbladder, adrenal gland, intraabdominal vascular structure, or traumatic fascial defect (traumatic abdominal wall hernia). Thoracic injuries consisted of pneumothorax, hemothorax, rib fracture, pulmonary contusion, pneumomediastinum, pneumopericardium and diaphragmatic injury. Additionally, pelvic injuries consisted of fractures to the pubis, ilium, sacrum, ischium, acetabulum and arterial bleeding from a pelvic fracture. Cases where the site investigator could not make a definitive determination were adjudicated by a 5-member study panel for final determination [11].

3.1. Primary data analysis

We compared demographic, physical examination, laboratory and clinical outcomes between inflicted and unintentional injuries. Descriptive comparisons were made using the Pearson Chi-Square test for categorical variables or Fisher's Exact test for variables with a cell value less than five. The Mann-Whitney test was utilized for non-normally continuous cofactors.

Unadjusted odds ratios were calculated for statistically significant variables between patients with inflicted and unintentional injuries. Binary logistic regression modeling, using a backward-step approach was utilized to further adjust clinical associations. Factors that had a p-value < 0.20 were included in the regression model. The highest p-values were removed one-by-one until only variables with p-value(s) < 0.05 remained. Statistical significance was defined as a p-value < 0.05. All statistics were computed using the Statistical Package for the Social Sciences (SPSS) version 23 software (IBM Corp., Armonk, NY).

4. Results

The initial study cohort with a history blunt torso trauma included 12,044 subjects with the following injuries by intent: unintentional: 9563 (79.4%); inflicted: 720 (6%), indeterminate: 148 (1.2%) and missing intent: 1613 (13.4%) (Fig. 1). The differences between children who had a recorded intent of injury and those with a missing intent of injury are shown in Table 2S in the Supplement. Patients with a known injury mechanism were twice as likely to be African-American

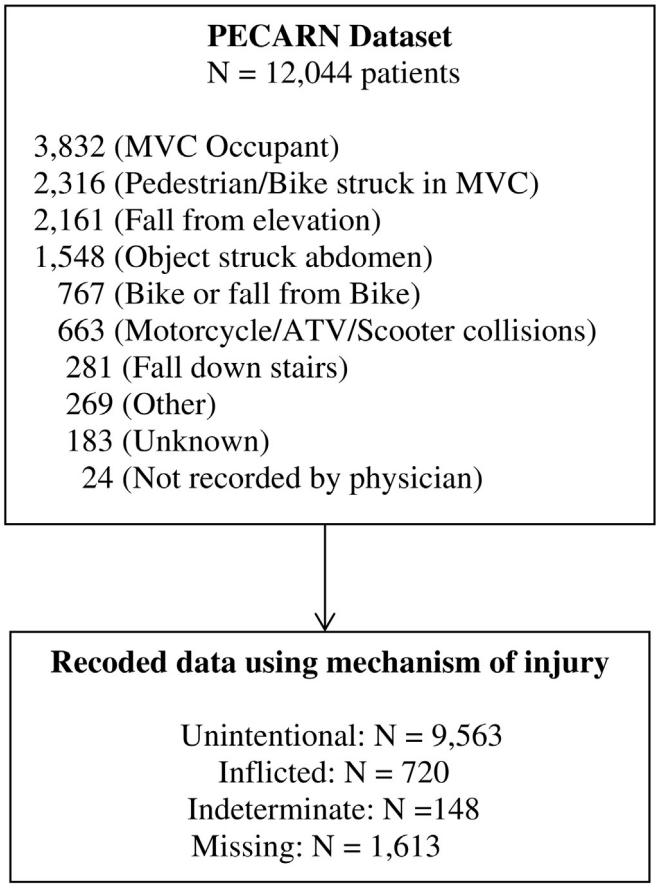

Fig. 1. Consort diagram of PECARN data showing victims of blunt torso injury by intent in analysis dataset. ATV: all-terrain vehicle; MVC: motor vehicle collision PECARN: Pediatric Emergency Care Applied Research Network.

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