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Pediatric near-drowning events: do they warrant trauma team activation?



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ABSTRACT

Background: The purpose of this study was to determine the incidence of traumatic injuries, factors associated with mortality, and need for pediatric trauma surgery involvement for drowning and near-drowning events in children.

Materials and methods: An institutional review board–approved, retrospective chart review was performed at three American College of Surgeons–verified Pediatric Trauma Centers (2011–2014). Patients with International Classification of Diseases, Ninth Revision, codes or E-codes for fatal–nonfatal drowning, fall into water, accidental drowning, or submersion were included. Bivariate analysis using chi-square or Fisher exact test for nominal variables and Mann–Whitney U test for continuous variables was performed.

Results: A total of 363 patients (median 3.17 y [18 d–17 y]) met the inclusion criteria. Drowning sites included pool (81.5%), bathtub (12.9%), and natural water (5.2%). A witnessed fall or dive was reported in 34.9%, 57.9% did not fall or dive, and 7% had an unwitnessed event. Most patients did not undergo cervical spine (83%) or brain imaging (75.5%). Seven patients (1.92%) had associated soft tissue injuries. Two patients (0.006%) received surgical intervention (bronchoscopy and extracorporeal membrane oxygenation) within 24 h of presentation. Only 2.2% were admitted to the pediatric trauma service. The percentage of patients discharged home from the emergency department was 10.2%. Overall mortality was 12.4%. Factors associated with mortality included transfer from outside hospital ($P = 0.016$), presence of hypothermia on arrival ($P < 0.0001$), Glasgow Coma Scale of 3 on arrival ($P < 0.0001$), drowning in a pool ($P = 0.013$), or undergoing brain cooling at admission ($P = 0.011$).

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Conclusions: This is the largest reported series of pediatric near-drowning events. Only rarely did patients require immediate surgical attention and the majority were admitted to nonsurgical services. These data suggest that routine pediatric trauma surgery service involvement in patients with near-drowning events may be unnecessary.

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Introduction

In the United States, drowning is the leading cause of unintentional injury deaths in 1-4 y age group, and the second leading (following motor vehicle collision) cause of accidental deaths in 1-16 y age group and constitutes a serious public health problem globally.^{1,2} According to the Center for Disease Control and Prevention, there are approximately two drowning related deaths in children aged <14 y every day in the United States.² In addition, for each fatal drowning victim, five patients receive emergency department (ED) care for nonfatal drowning events. In the developed world, the mortality rate associated with submersion events is on a down-trend secondary to effective prevention as well as prehospital care including faster extraction and improved resuscitation at the site of drowning.¹⁻³

Many American College of Surgeons (ACS)-designated trauma centers routinely activate the trauma team on receipt of these patients. However, trauma activation for near-drowning is not an ACS-mandated criterion.⁴ Activation of trauma team is a high-resource utilizing event and involves mobilizing personnel from pediatric surgery, ED, intensive care unit (ICU), anesthesia, and allied health services (radiology, pharmacy, laboratory, respiratory care, operating room, and administrative staff).⁵ Utilization of this valuable resource should be optimal, matching the resources to patient need.

Currently, no evidence exists as to the necessity of trauma team activation and early involvement of trauma team in the ED management of drowning or near-drowning patients. The purpose of this study was to determine the incidence of traumatic injuries, identify factors associated with mortality, and need for pediatric trauma surgery involvement for children involved in drowning and near-drowning events.

Materials and methods

After institutional review board approval, a retrospective chart review was performed at three ACS-designated Pediatric Trauma Centers. Study sites included two urban, tertiary care pediatric facilities with ACS level 1 pediatric designation (Le Bonheur Children's Hospital, Memphis, TN, and American Family Children's Hospital, Madison, WI) and a suburban, tertiary care pediatric center with ACS level 2 pediatric designation (Cook Children's Medical Center, Fort Worth, TX). Data were extracted from trauma registries from each participating institute and primary chart review. Patients with fatal–nonfatal drowning ICD-9 codes or E-codes for fall into water, accidental drowning, or submersion (994.1, E883.0-9 and E910.0-9) managed at either of the institutes between January 1, 2011 and December 31, 2014, were included. Patients admitted to hospital as well as those who were

managed and discharged from ED, between the ages of 0-18 y were included in the study. Patients pronounced dead on arrival ($n = 1$) were excluded from the statistical analysis. Extracted variables included demographics, drowning circumstances, site of drowning, prehospital course, transfer from outside hospital, arrival Glasgow Coma Scale (GCS), arrival body temperature, airway status, intubation on arrival, death on arrival, cervical spine and head imaging, hospital admission, surgical versus nonsurgical admission, need for ICU admission, suspected or confirmed child abuse, need for operative intervention in first 24 h after admission, need for extracorporeal membrane oxygenation (ECMO), invasive rewarming, or brain cooling at or after admission, type of surgical intervention, associated injuries, and final discharge destination. Associated injuries were defined as traumatic injuries with a potential for considerable morbidity and mortality, including but not limited to brain, spine, and spinal cord, thoracic, intra-abdominal, and pelvic, as well as long-bone fractures, and major vascular injuries.

Bivariate analysis using chi-square or Fisher exact test (2×2 tables) for nominal variables and Mann–Whitney U test for continuous variables was performed using the SPSS software (IBM Corp Released 2013. IBM SPSS Statistics for Macintosh, Version 22.0. Armonk, NY). Statistical significance was set at $P < 0.05$.

Results

Three hundred sixty-four patients were identified at the three centers. Three hundred sixty-three patients with a median age of 3.17 y (range, 18 d-17 y) were included in the final analysis (one patient died before arrival). Demographic and clinical characteristics of study cohort are presented in [Table 1](#). Most patients were men (63.9%). Drowning sites included pool (81.5%), bathtub (12.9%), and natural water (5.2%). A witnessed fall or dive was reported in 34.9%, whereas 57.9% did not fall or dive and 7% had an unwitnessed event. Most patients did not undergo cervical spine imaging (83%) or brain imaging (75.5%). Seven patients (1.92%) had associated injuries; five had soft tissue contusions and two had neck sprains on cervical spine imaging. The percentage of patients discharged home from the ED was 10.2%. Of those who were admitted, most patients (97.8%) were admitted to nonsurgical services. Twenty-two patients (6%) underwent brain cooling after admission. One patient each received invasive rewarming, ECMO support, and bronchoscopy (in the operating room) within first 24 h of drowning or near-drowning accident.

Overall mortality was 12.4% ($n = 45$; [Table 2](#)). Patients who died were compared with the patients who survived after a drowning or near-drowning event. There was no

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