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Prehospital care and transportation of pediatric trauma patients

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ABSTRACT

Background: Despite advances in prehospital emergency medical services (EMS), most advocate "scoop-and-run" over "stay-and-play." However, there are almost no studies in children. We hypothesize that the transportation of mortally injured children is delayed and that the performance of prehospital interventions (PHIs) themselves delay transportation and worsen outcomes in pediatric trauma patients.

Materials and methods: A total of 1884 admissions (≤17-y-old) transported via EMS to a level 1 trauma center from January 2000–December 2012 were reviewed. Propensity scores were assigned based on the need for a PHI (intubation and resuscitation). PHI and non-PHI cohorts were matched 1:1 to compare outcomes. Data are expressed as mean ± standard deviation or median (interquartile range).

Results: The population was 11 ± 6 y, 70% male, 50% black, 76% blunt injury, injury severity score 13 ± 12, length of stay 3 (7) d, and mortality 3.6%. Incident to EMS arrival was 38 (20) min, EMS on-scene time was 14 (12) min, and overall time of arrival to hospital was 27 (15) min. Patients that were mortally wounded, despite having significantly higher rates of PHI, still had similar transportation times to those who survived. Mostly every measure of injury severity was worse in those who required PHI. When these factors were corrected, EMS on-scene time was 18 (13) *versus* 14 (13) min ($P = 0.551$), EMS arrival at the hospital was 31 (16) *versus* 28 (12) min ($P = 0.292$), length of stay was 5 (15) *versus* 4 (12) d ($P = 0.368$), and mortality was 31.7% *versus* 28.3% ($P = 0.842$) for PHI and non-PHI matched cohorts.

Conclusions: PHIs did not delay transportation times or worsen outcomes in pediatric trauma patients. Although mortally injured children more often required PHIs, this did not delay transportation to the trauma center.

Portions of these data were presented at the 10th Annual Academic Surgical Congress, Las Vegas, Nevada, February 2–4, 2015.

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1. Background

In the United States, trauma is the leading cause of morbidity and mortality among the pediatric population. Over 9 million children annually visit an emergency department because of an unintentional injury with over 12,000 deaths [1].

Aggressive efforts to improve emergency transportation of injured children to major trauma centers [2–4] save over 2,000 lives annually [5]. Regionalization of trauma care and implementation of helicopter emergency medical services (EMS) have also improved outcomes [6,7]. Furthermore, EMS often provides advanced care at the scene of trauma, which should theoretically improve outcome. However, most current data do not support this practice, at least in the adult population. Indeed, although some prehospital interventions (PHIs) can be lifesaving, those beyond basic life support are generally ineffective. In a surprising number of cases, PHI may be futile, unnecessary, or even harmful [8,9]. Thus, in an urban environment with short transport times to trauma centers, outcomes mostly depend on the mechanism and severity of injury and the distance from the trauma center, rather than PHI performed by skilled EMS [10]. Regardless, in many trauma systems the policy is "scoop-and-run" not "stay-and-play" [8,9]. However, this idea has never been rigorously examined in the pediatric population. We hypothesize that the transportation of mortally injured children is delayed and that the performance of PHIs themselves delay transportation and worsen outcomes in pediatric trauma patients.

2. Materials and methods

After approval from the University of Miami Miller School of Medicine Institutional Review Board, consecutive pediatric admissions (≤17 -y-old) from January 2000–December 2012 at the Ryder Trauma Center in Miami, Florida, were retrospectively reviewed. Those pregnant, incarcerated, or not admitted to either the trauma or pediatric surgery services were excluded from analysis. Demographics, mechanisms of injury, mode of transportation, EMS transportation times, PHIs, injuries sustained, length of stay (LOS), and survival were reviewed. Hypotension and tachycardia were defined as any value outside of the normal age-specific range.

On-scene shock was defined by EMS, based on hemodynamics (systolic blood pressure, heart rate, and altered mental status, etc.) and/or signs of external blood loss [11]. In south Florida, children with on-scene shock are considered to be hypovolemic from hemorrhage; the EMS protocol is to gain intravenous (IV) or intraosseous access for fluid resuscitation and/or place an extremity tourniquet for hemorrhage control [11]. Therefore, in south Florida, on-scene shock is synonymous with prehospital IV fluid resuscitation and/or extremity tourniquet placement for hemorrhage control. Accordingly, PHI was defined as either endotracheal tube intubation, cardiopulmonary resuscitation (CPR), and/or on-scene shock.

Propensity scores were based on a logistic regression model for predicting the need to undergo a PHI using patient and injury characteristics (i.e., age, scene Glasgow Coma Scale [GCS], injury severity score [ISS], traumatic brain injury [TBI], and subsequent blood transfusion requirement or operative intervention on arrival). A 1:1 fixed ratio nearest-neighbor matching was performed to compare transportation times and outcomes of the PHI and non-PHI cohorts to minimize bias without sacrificing power [12]. Also, each independent PHI was separately assigned a propensity score, matched and compared as aforementioned.

Statistical analyses were performed using SPSS version 21 (IBM Corporation, Armonk, NY). Parametric data are reported as mean ± standard deviation, and nonparametric data are reported as median (interquartile range). Continuous data were compared using a *t*-test or Mann–Whitney *U*-test, as appropriate. Categorical variables were compared using a chi-square or Fisher exact test, as appropriate. For comparison of propensity-matched cohorts, Wilcoxon signed-rank tests for continuous variables and McNemar chi-square test for categorical variables were performed [13]. Statistical significance was determined at alpha level 0.05.

3. Results

Table 1 shows that 1884 pediatric trauma patients were transported via EMS to this trauma center over the study period. Characteristics included age 11 ± 6 y, 70% male, 50%

Table 1 – Patient demographics (n = 1884).

Characteristics	
Age, y	11 ± 6
Sex, %	
Male	69.5
Female	30.5
Race, %	
Black	49.6
Hispanic	27.2
White	22.9
Other	0.3
Mechanism of injury, %	
Blunt	76.3
Penetrating	23.7
Transportation modality, %	
Ground	60.1
Air	39.9
Incident to EMS arrival time, min	38 (20)
EMS time spent at scene, min	14 (12)
Time from scene arrival to hospital arrival, min	27 (15)
Scene shock, %	5.9
Scene CPR, %	1.8
GCS	15 (1)
Hypotension, %	6.0
Tachycardia, %	31.9
BE, mEq/L	−3±5
Hematocrit, %	37 ± 6
TBI, %	4.4
ISS	13 ± 12
LOS, d	3 (7)
Mortality, %	3.6

Data are expressed as mean ± standard deviation or median (interquartile range).