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Pediatric vascular injury: experience of a level 1 trauma center

Casey J. Allen, MD,[a] Richard J. Straker, BS,[a] Jun Tashiro, MD, MPH,[b] Laura F. Teisch, BS,[a] Jonathan P. Meizoso, MD,[a] Juliet J. Ray, MD,[a] Nicholas Namias, MD,[a] and Juan E. Sola, MD[b,*]

[a] Division of Trauma Surgery, DeWitt Daughtry Family Department of Surgery, University of Miami Miller School of Medicine, Miami, Florida

[b] Division of Pediatric Surgery, DeWitt Daughtry Family Department of Surgery, University of Miami Miller School of Medicine, Miami, Florida

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ABSTRACT

Background: Our purpose was to analyze modern major vascular injury (MVI) patterns in pediatric trauma, interventions performed, and outcomes at a level 1 trauma center.

Materials and methods: From January 2000–December 2012, all pediatric admissions (≤17 y) were reviewed.

Results: Of 1928 pediatric admissions, 103 (5.3%) sustained MVI. This cohort was 85% male, age 15 ± 3 y, 55% black, 58% penetrating, injury severity score of 23 ± 15, with a length of stay of 8 (5) days. Firearm-related injury (47%) was the most common mechanism. Location of injuries included the extremities (50.5%), abdomen/pelvis (29.1%), and chest/neck (20.4%). Operative procedures included repair/bypass (71.4%), ligation (12.4%), amputation (10.5%), or temporary shunt (2.9%). Only three injuries (2.9%) were treated endovascularly. MVI patients had a mortality rate of 19.4%, higher than the overall pediatric trauma population of 3.5% ($P < 0.001$). After logistic regression, independent risk factors of mortality were vascular injury to the neck (odds ratio [OR]: 6.5; confidence interval (CI): 1.1–39.3), abdomen/pelvis (OR: 16.3; CI: 3.13–80.2), and chest (OR: 49.0; CI: 3.0–794.5).

Conclusions: MVI in children more commonly results from firearm-related injury. The mortality rate associated with MVI is profoundly higher than that of the overall pediatric trauma population. These findings underscore the major public health concern of firearm-related injury in children.

1. Introduction

Trauma remains the leading cause of death and morbidity in children after the age of 1 [1]. Vascular injury, although rare, contributes significantly to morbidity and mortality in children [2–4]. Exsanguination from such injuries is the most common cause of early mortality in trauma across all age groups [5]. Because vascular disease is so rare in children, one

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* *Corresponding author*. Division of Pediatric Surgery, DeWitt-Daughtry Family Department of Surgery, University of Miami Miller School of Medicine, 1120 NW 14th Street, Suite 450K, Miami, FL 33136. Tel.: +1 305 243 5072; fax: +1 305 243 5731.
E-mail address: jsola@med.miami.edu (J.E. Sola).

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of the most common indications for vascular surgery in this population is traumatic injury [6–8].

Because of the infrequency of these cases, intervention in pediatric vascular injury has traditionally been extrapolated from the experience with adult trauma patients. However, pediatric vascular injury varies significantly in certain aspects from that of adults. The rarity of these injuries in children has resulted in imprecise and ambiguous management strategies [9].

Currently only a few series exist describing the occurrence, injury patterns, initial management, and outcomes associated with pediatric trauma vascular injuries. The purpose of this study was to analyze modern vascular injury patterns in pediatric trauma, the interventions performed, and subsequent outcomes at a high-volume level 1 trauma center.

2. Materials and methods

Data for this analysis were gathered from the trauma registry of a level I trauma center serving a large urban population of 2.6 million and the surrounding metropolitan area. Cases were identified in the period between January 2000 and December 2012 and limited to patients aged <18 y. All patients were treated and admitted to the trauma center by either the trauma service or pediatric surgery service for management of their injuries. Demographics, mechanisms of injury (MOI), and clinical measures, such as initial vital signs, initial laboratory values, injury severity score (ISS), vascular injury (including major arteries/veins of the chest, abdomen, pelvis, neck, and extremities), operative intervention (mode of repair, ligation, shunt, amputation, and endovascular), length of stay (LOS), and survival were gathered.

Major vascular injury (MVI) was defined as any injury to a named vessel. Patients were identified with the use of International Classification of Diseases, Ninth Revision coding. Injuries were confirmed on thorough review of patient records.

Parametric data are reported as mean ± standard deviation, and nonparametric are reported as median (interquartile range). 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. The results of the univariate analyses were used to identify variables for inclusion in a binary logistic regression model to determine which injury locations were significant independent predictors of mortality. Statistical significance was determined at alpha level 0.05. Statistical analyses were performed using SPSS version 21 (IBM Corporation, Armonk, NY).

The Institutional Review Board of the University of Miami Miller School of Medicine (Miami, FL) approved this retrospective analysis.

3. Results

Overall, 1928 patients were identified within the study period. The cohort was 70% male, with the age of admission of 11 ± 6 y. Blunt injuries constituted 76% of trauma presentations with an ISS of 13 ± 12. Patients were discharged from the resuscitation area to the trauma floor (45%), intensive care unit (ICU) (31%), or required emergent surgery (24%). LOS was 3 (7) days and overall mortality was 3.5%. See Table 1 for demographic characteristics of all pediatric trauma admissions.

Table 1 – Demographic characteristics of entire pediatric trauma cohort.

Characteristics	Values
Sex	
Male	1350 (70%)
Female	578 (30%)
Age, y	11 ± 6
Blunt/penetrating	1465 (76%)/463 (24%)
ISS	13 ± 12
Operative intervention	463 (24%)
LOS, d	3 (7)
Mortality	67 (3.5%)

Total cases in cohort = 1928. Parametric values are shown as mean ± standard deviation, nonparametric as median (interquartile range).

A total of 103 (5.3%) patients sustained a MVI. This population was 85% male, age of 15 ± 3 y, 55% black, 58% penetrating, with an ISS of 23 ± 15. The most common MOI associated with vascular injury was gunshot wound (GSW) (47%), followed by motor vehicle collision (17%). To note, 44% required a blood transfusion during initial resuscitation, significantly higher than for all other pediatric trauma patients at 8% ($P < 0.001$). In those with an MVI, GSW patients had a transfusion rate similar to those of other MOI, 50% *versus* 38%, respectively ($P = 0.240$). However, when a transfusion was required, patients of GSW required significantly more units of packed red blood cells than those of other MOI, 7 (17) units *versus* 2 (3) units, respectively ($P < 0.001$). Overall LOS was 8 (5) days with an overall mortality rate of 19.4%. See Table 2 for demographic characteristics of MVI cohort. This

Table 2 – Demographic characteristics of MVI cohort.

Characteristics	Values
Sex	
Male	88 (85%)
Female	15 (15%)
Race	
Black	57 (55%)
White	26 (23%)
Hispanic	23 (22%)
Age, y	15 ± 3
Blunt/penetrating	43 (42%)/60 (58%)
MOI	
GSW	48 (47%)
MVC	18 (17%)
PHBC	11 (11%)
ISS	23 ± 15
Operative intervention	82 (80%)
Transfusion	45 (44%)
LOS, d	8 (5)
Mortality	20 (19.4%)

MVC = motor vehicle collision; PHBC = pedestrian hit by car. Parametric values are shown as mean ± standard deviation, nonparametric as median (interquartile range). Total cases in cohort = 103.