PEDIATRIC UROLOGY

Does the mechanism of injury in pediatric blunt trauma patients correlate with the severity of genitourinary organ injury? Bayo D. Tojuola, MD, Xiao Gu, MD, Nathan R. Littlejohn, MD,

John P. Sharpe, MD, Mark A. Williams, MD, Dana W. Giel, MD University of Tennessee Health Science Center and LeBonheur Children's Hospital. Memphis, Tennessee, USA

TOJUOLA BD, GU X, LITTLEJOHN NR, SHARPE JP, WILLIAMS MA, GIEL DW. Does the mechanism of injury in pediatric blunt trauma patients correlate with the severity of genitourinary organ injury? *Can J Urol* 2014;21(6):7570-7573.

Introduction: Blunt abdominal trauma can result in injury to genitourinary (GU) organs. Children may be more susceptible to some GU injuries due to anatomic differences compared to adults. Mechanism of injury (MOI) has been thought to relate to both the likelihood and severity of GU injury in children, although this has not definitively been proven. Our purpose was to determine if MOI has any correlation to the severity of GU injury in children treated at our institution.

Materials and methods: We reviewed records of all pediatric blunt trauma patients presenting to our institution from January 2005-December 2010 using the LeBonheur Children's Hospital Trauma Registry. All patients with GU injuries were included in this study. Data collected included demographic information, MOI, type and grade of GU injury, associated injuries, and clinical outcome. Continuous variables were tested with ANOVA and categorical variables were tested with chi-square test. *Results:* Records of 5151 children with blunt trauma were reviewed; 76 patients were found to have GU organ

Introduction

Blunt trauma in the pediatric population has been a common cause for genitourinary (GU) organ injury.

Accepted for publication September 2014

Address correspondence to Dr. Bayo D. Tojuola, University of Tennessee Health Science Center and LeBonheur Children's Hospital, 910 Madison Ave., Rm 409, Memphis, TN 38163 USA injury. There were 47 males (61.8%) and 29 females (38.2%). Categories of MOI included motor vehicle accident, sports injury, bicycle accident, all-terrain vehicle accident (ATV), pedestrian struck accident, falls, and animal injury. MOI did not have any statistically significant association with the severity of GU organ injury (p = 0.5159). In addition, there was no association between MOI and either gender or side of injury. There was a statistically significant association between MOI and either gender or side of injury. There more likely to experience GU injury due to sports injury and ATV accidents, where as younger patients were more likely to experience GU injury due to pedestrian struck, bicycle accidents or animal bite.

Conclusions: Although specific MOI would seem to relate to presence and severity of injury in children, MOI alone does not correlate with the severity of GU organ injury in our pediatric trauma population. Age of pediatric patients is associated with the type of MOI that results in GU organ injury. The possibility of GU injury should be considered in all symptomatic pediatric patients with clinically significant blunt trauma regardless of the exact MOI.

Key Words: mechanism of injury, pediatric blunt trauma, grade of injury, genitourinary trauma, urologic trauma

Children are more susceptible to major renal injury from blunt trauma in comparison to adults.¹ Burd et al demonstrated that children sustaining blunt injuries were more severely injured, required more acute care days, and were more likely to require rehabilitation after discharge in comparison to patients suffering injury from penetrating mechanism.² It has been postulated that children are more susceptible to GU organ injury from blunt trauma due to less protection from muscles of the flank and abdomen, less Does the mechanism of injury in pediatric blunt trauma patients correlate with the severity of genitourinary organ injury?

cushioning by perirenal fat, and underdeveloped rib cage. Congenital anomalies such as hydronephrosis due to ureteropelvic junction obstruction make some children more prone to GU organ injury even with minimal trauma.

Mechanism of injury (MOI) has been thought to relate to both the likelihood and severity of GU organ injury. A varying degree of force and energy transfer can be imparted depending on the mechanism of blunt trauma.³ Pediatric patients that suffer from higher force mechanism of blunt trauma should experience more severe GU organ injury. This is a prevailing thought but has not been proven.

MOI is an important factor in assessment of trauma patients and predicting several important variables throughout hospital course and at time of discharge. MOI has proven useful in field triage when used in combination with other trauma indices.² Haider et al found MOI to be an independent predictor of case fatality rates and functional outcomes after traumatic injury.⁴ Certain mechanisms of trauma have been associated with specific injuries which has lead to the belief that MOI is a useful variable to consider in trauma care.⁵⁻⁷

The purpose of this study is to evaluate the relationship between the MOI in pediatric blunt trauma patients and the severity of GU organ injury. We hypothesize that there will be a correlation between mechanism of blunt trauma with high degree of force and more severe GU organ injury.

Materials and methods

This study was a retrospective review of records of pediatric blunt trauma patients using the LeBonheur Children's Hospital Trauma Registry. The study has been approved by the Institutional Review Board at the University of Tennessee Health Science Center. Data (n= 5151) of all pediatric blunt trauma patients presenting to our institution from January 2005 to December 2010 were reviewed. Analysis was restricted to patients < 19 years old who were found to have a GU organ injury after blunt trauma.

Data collected from the trauma registry included demographic information (age and sex), MOI, type of injury, grade of GU injury, associated injuries, and clinical outcome. Type of injury included: renal, ureter, bladder, urethral, penile, testicular and scrotal injury. GU organ injuries were graded from computerized tomography (CT) results based on the injury scale of the American Association for the Surgery of Trauma. Seventy-six (76) patients were found to have GU organ injury. Patients with renal and bladder injuries (68) were included in the analysis of MOI in relation to severity of GU organ injury. Other GU organ injuries (penile, testicular, ureteral, urethral and scrotal) were not included in analysis of severity of GU organ injury versus MOI due to difficulty in determining grade of injury from chart review.

MOI included motor vehicle accident, sports injury, bicycle accident, all-terrain vehicle accident (ATV), pedestrian struck accident, falls, and miscellaneous. Bicycle accidents, animal accidents and pedestrian struck accidents were combined during data analysis in order to create an additional subgroup of similar mechanisms of injury with sufficient sample size. Primary data analysis was performed to determine if there was any correlation between the grade of GU organ injury and MOI. Continuous variables were tested with ANOVA and categorical variables were tested with chi-square test. Significance was defined as p < 0.05.

Results

In the study, 5151 pediatric patients with blunt trauma were reviewed. Seventy-six (76) patients were found to have GU organ injury. There was a 1.5% occurrence of GU organ injury in our pediatric blunt trauma population. There were 47 males (61.8%) and 29 females (38.2%). Mean age for patients with GU organ injury after blunt trauma was 10.5 years. The demographics and distribution of types of injury are shown in Table 1. The kidney was the most commonly injured GU organ. It was injured in 61 (80.3%) patients.

TABLE1. Demographics of children with genitourinary organ injury due to blunt trauma

Mean age (yrs, range)	10.5 (1-19)
No. males (%)	47 (61.8%)
No. females (%)	29 (38.2%)
No. injury side (%)	
Right	31 (48.4%)
Left	33 (51.6%)
No. type of injury (%)	
Renal	61 (80.3%)
Bladder	7 (9.2%)
Urethral	3 (3.9%)
Testicle	2 (2.6%)
Ureteral	1 (1.3%)
Scrotal	1 (1.3%)

Mechanism	No. (%)				
Motor vehicle	28 (36.8%)				
Fall	21 (27.6%)				
All-terrain vehicle	7 (9.2%)				
Pedestrian struck	8 (10.5%)				
Bicycle	4 (5.3%)				
Sports	6 (7.9%)				
Animal	2 (2.6%)				

TABLE 3.	Distribution of grade of injury				
Renal					

Grade 1-21 Grade 2-10 Grade 3-17 Grade 4-13 Grade 5-0

Grade 1-0 Grade 2-3 Grade 3-1 Grade 4-3 Grade 5-0

Motor vehicle collision was the most common cause of renal injury. The left kidney was involved in 32 (52.5%) cases and the right kidney was involved in 29 (47.5%). Table 2 shows the rate of each MOI. Motor vehicle accident was the most common mechanism for GU organ injury accounting for 28 cases (36.8%). Most renal injuries were grade 1 in nature. Bladder injuries ranged from grade 2 to grade 4. Table 3 shows the distribution of renal and bladder grade of injury. There were no grade 5 injuries in our entire patient population.

MOI did not have a statistically significant association with grade of injury of GU organs (p = 0.5159). In addition, there was no statistically significant correlation when comparing MOI to either patient age or side of injury, Table 4. A correlation between patient age and mechanism of injury was demonstrated in our patient population (p = 0.04). Older children were more likely to experience GU organ injury from a sporting injury or an ATV accident. Younger children were more likely to experience GU organ injury from a pedestrian struck accident, bicycle accident, or animal injury.

Discussion

Bladder

MOI with high degree of force and energy transfer are thought to be associated with more severe injuries. In a retrospective analysis of the National Pediatric Trauma Registry, certain mechanisms of injury were associated with high likelihood of severe injury.² In a separate study, MOI was found to be an independent predictor of mortality and functional impairment at the time of hospital discharge.⁵ These studies mainly looked at mortality as a primary outcome. Mortality in a trauma setting could be affected by a variety of other factors.

In this study, MOI was not associated with the severity of GU organ injury. The primary outcome of our study was the grade of GU organ injury. The grade of organ injury, graded according to the AAST scale, should be a direct result of the degree of force or energy transfer during trauma. Data revealed that patient age correlated with mechanism of injury that resulted in GU organ injury. Older patients were more

variables and chi square test for categorical variables)							
Mechanism	Motor vehicle	Pedestrian struck/bicvcle/	Sports iniury	Fall	All-terrain vehicle	p value	

TABLE 4. Statistical analysis of mechanism of injury versus various variables (ANOVA test for continuous

		animal				
Age (yrs)	10.3	8.3	13.3	10.2	13.7	0.04
Male (%)	67.8	57.1	100.0	57.1	28.5	0.1015
Left side (%)	45.4	50.0	50.0	55.6	66.7	0.9084
Grade (sd)	2.38 (1.02)	2.78 (1.12)	1.83 (1.33)	2.38 (1.28)	2.71 (1.38)	0.5159

Does the mechanism of injury in pediatric blunt trauma patients correlate with the severity of genitourinary organ injury?

likely to experience GU organ injury due to sporting injury or an ATV accident while younger children from a pedestrian struck accident, bicycle accident, or animal injury. Bicycle injuries are reported to be associated with high grade injuries.8 This did not hold true in our population. Of the four bicycle injuries in our population, there were two grade 1, one grade 3 and one grade 4 renal injuries. Our data may not be powered to adequately address bicycle injuries alone, however when analyzed with all other MOI no statically significant correlation is seen between MOI and grade of injury. Review of available literature reveals a predilection of certain MOIs depending on geography. Further investigation is needed with a larger population from a variety of centers across geographical regions.

Our study has limitations that are worth mentioning. The retrospective nature of analysis makes it subject to the accuracy and completeness of previously collected information. Our study population was drawn from a urban tertiary care center in the south which may provide a geographical bias. In addition, we did not take into consideration trauma injury assessment models such as injury severity score or trauma score, which are representative of global severity of injury in the trauma setting. Other studies have shown an association of MOI with global severity of injury from trauma when considering these factors.^{2,4,5} However, the goal of our study was to identify a specific correlation between MOI and severity of GU organ injury. The grade of injury, as graded per the AAST injury scale, provided a more accurate means of measuring severity of GU organ injury. It is reasonable for future studies to perform multivariate analysis taking into consideration trauma scores or injury severity scores.

Conclusion

Despite prevailing thought that a specific MOI would relate to presence and severity of injury in children, MOI alone does not correlate with the severity of GU organ injury in our pediatric blunt trauma population. Age of pediatric patients was correlated with the type of MOI that results in GU organ injury. The possibility of GU injury should be considered in all symptomatic pediatric patients with clinically significant blunt trauma regardless of the exact MOI.

References

- 1. Brown SL, Elder JS, Spirnak JP. Are pediatric patients more susceptible to major renal injury from blunt trauma? A comparative study. *J Urol* 1998;160(1):138-140.
- 2. Burd RS, Jang TS, Nair SS. Evaluation of the relationship between mechanism of injury and outcome in pediatric trauma. *J Trauma* 2007;62(4):1004-1014.
- Knopp R, Yanangi A, Kallsen G, Geide A, Doehring L. Mechanism of injury and anatomic injury as criteria for prehospital trauma triage. *Ann Emerg Med* 1988;17(9):895-902.
- 4. Haider AH, Crompton JG, Oyetunji T et al. Mechanism of injury predicts case fatality and function outcome in pediatric trauma patients: the case for its use in trauma outcomes studies. *J Pediatric Surg* 2011;46(8):1557-1563.
- 5. Haider AH, Chang DC, Haut ER, Cornwell EE 3rd, Efron DT. Mechanism of injury predicts patient mortality and impairment after blunt trauma. *J Surg Res* 2009;153(1):138-142.
- Ankarath S, Giannoudis PV, Barlow I, Bellamy MC, Matthews SJ, Smith RM. Injury patterns associated with mortality following motorcycle crashes. *Injury* 2002;33(6):473-477.
- Sullivan T, Haider A, DiRusso SM, Nealon P, Shaukat A, Slim M. Prediction of mortality in pediatric trauma patients: new injury severity score outperforms injury severity score in the severely injured. *J Trauma* 2003;55(6):1083-1087.
- 8. Gerstenbluth RE, Spirnak JP, Elder JS. Sports participation an high grade renal injuries in children. J Urol 2002;168(6):2575-2578.