SCIE DOI: 10.14744/scie.2024.16878
South. Clin. Ist. Euras. 2024;35(2):180-185

Original Article

Pediatric Trauma in a Tertiary Care Center: A Comprehensive Analysis Evaluation of Trauma Cases in Pediatric Intensive Care Unit

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Submitted: 17.02.2024
Revised: 20.05.2024
Accepted: 22.05.2024

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Keywords: Falls from a height; intracranial hemorrhage; mortality; pediatric trauma; prognosis.

ABSTRACT

Objective: In this study, the demographic characteristics, causes of trauma, prognosis, and types of trauma of pediatric trauma patients followed in a single center over a period of three years were retrospectively examined.

Methods: Data of pediatric patients admitted to our (single-center, 8-bed) pediatric intensive care unit due to trauma between January 2020 and January 2023 were retrospectively reviewed from computer records.

Results: This study includes 122 pediatric trauma cases (37 females and 85 males) with an average age of 75±59 months admitted to intensive care with a diagnosis of trauma. The most frequently observed type of trauma was falls from a height in 68 cases (55.7%), the most affected anatomical region was the head and neck region in 75 cases (61.5%), and the most common pathology was intracranial hemorrhage in 55 cases (45.1%). Surgery was necessary for 36% of the cases, and the predominant reason for surgical intervention was observed in 22 cases (18%), primarily attributed to falls from a height. During the course of their stay in the intensive care unit, 13 cases (10.6%) experienced mortality, indicating a mortality rate of 10.6%.

Conclusion: Traumas remain a significant cause of mortality and morbidity in the pediatric age group today.

INTRODUCTION

Despite significant advancements in the field of health over the years, trauma-related deaths in children remain a substantial health concern in both developed and developing countries.[1,2] In the United States, approximately 10 million children seek emergency care due to trauma each year, with over 10,000 children losing their lives due to severe trauma.[3] According to the Turkish Statistical Institute (TÜİK) data for the year 2018, the mortality rate in the 0-14 age group in Turkey, attributed to external injuries or poisoning, is 6.9%, ranking second among

the causes of child mortality.[4] The TÜİK reports for the years 2019,[5] and 2020,[6] further indicate that 1,326 and 1,348 children, respectively, died as a result of external injuries and poisonings. Despite preventive measures, injuries, which are preventable causes of death, have not significantly decreased.[7]

Injuries resulting from trauma are leading causes of emergency department visits and intensive care admissions.[3] Easy access of traumatically injured children to healthcare facilities and specialized trauma centers, coupled with improved therapeutic services, has contributed to reduced in-hospital survival rates and deaths.[8]

The aim of this study is to evaluate the demographic and epidemiological characteristics, as well as treatment outcomes, of pediatric trauma cases admitted to our pediatric intensive care unit. This research seeks to contribute to our national data on the subject.

MATERIALS AND METHODS

The data of pediatric patients monitored due to trauma in the Pediatric Intensive Care Clinic of Health Sciences University Bağcılar Training and Research Hospital were retrospectively examined from computer records between January 2020 and January 2023. The study included cases with a primary admission reason of trauma, specifically those related to motor vehicle accidents, falls from height, penetrating injuries, and drowning, all of which were followed in our Pediatric Intensive Care Unit (PICU). Patients with incomplete records and those with PICU stays of less than 24 hours were excluded from the study.

During the retrospective review of the files of identified trauma cases, demographic characteristics, etiology of trauma, duration of intensive care and hospital stay, clinical features, Pediatric Risk of Mortality (PRISM-3) and Glasgow Coma Scale (GCS) scores, laboratory values detected at the time of admission to the PICU, administered treatments, need for blood and blood product transfusion, requirement for invasive mechanical ventilation (IMV) support, need for inotropic infusion, continuous renal replacement therapy (CRRT) requirement, therapeutic plasma exchange (TPE) requirement, need for surgical operation, and discharge status were recorded by examining hospital information systems. Surgical interventions performed in the operating room conditions specifically targeting pathologies resulting from trauma were taken into account.

This study was evaluated and approved by the Bağcılar Training and Research Hospital Clinical Research Ethics Committee on May 10, 2023, with decision number 2023/05/07/026. Informed consent was obtained from the parents of the cases included in the study. It was conducted in accordance with the Declaration of Helsinki.

For statistical analyses, the SPSS software package version 28.0 (IBM SPSS, Armonk, NY, USA) was used. The data collected for the study were initially entered into the Microsoft Excel® database and then transferred to SPSS. Descriptive statistics were presented as mean ± standard deviation, median, frequency, percentage, minimum, and maximum values. The normal distribution of the data was examined with the Shapiro-Wilk and Kolmogorov-Smirnov tests. For continuous variables showing normal distribution, the Student t-test was used for comparisons between two groups, and one-way analysis of variance (ANOVA) was used for comparisons between more than two groups. The Mann-Whitney U test was employed for the analysis of continuous variables not showing normal distribution between two groups, and the Kruskal-Wallis test was used for comparisons between more than two groups. Pearson chi-square test and Fisher's exact test were used for the comparison of categorical variables.

RESULTS

A total of 122 patients (37 females and 85 males) were included in the study. The mean age of the cases was 75±59 months. By age groups, 0-4 years accounted for 52 cases (42.6%), 4-9 years for 38 cases (31.1%), 10-14 years for 18 cases (14.8%), and 15 years and above for 14 cases (11.5%).

The most common cause of trauma was falls from height, accounting for 55.7%. This was followed by motor vehicle accidents at 36.1%, penetrating injuries at 4.9%, and drowning at 3.3%. The distribution according to trauma types is shown in Figure 1 (Table 1).

Multisystemic trauma affecting more than one system was present in 87 cases (71.3%). Out of the total cases, 13 (10.6%) died, with 8 (61.5%) being male and 5 (38.5%) female. Looking at the etiology of trauma in the 13 lost children, 8 (61.5%) were due to falls from height, 4 cases (30.8%) were due to motor vehicle accidents, and one case (7.7%) was due to penetrating injury. However, no significant relationship was found between the type of trauma and mortality (p:0.891) (Table 1).

When comparing the treatment requirements of survivors and nonsurvivors, all nonsurvivors required blood transfusion, whereas only 45% of the survivors needed it, and

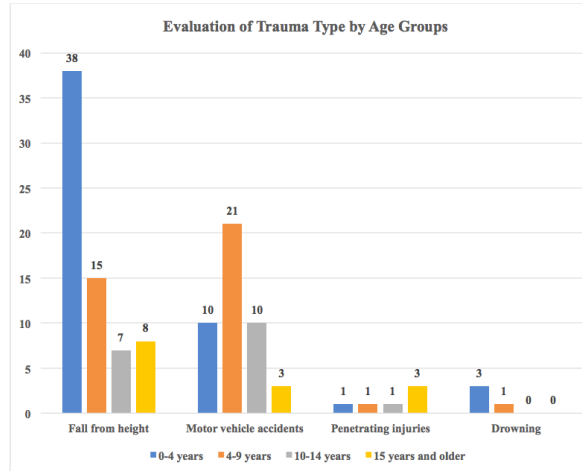

Figure 1. Evaluation of trauma by age groups.

Table 1. Evaluation of trauma etiology, clinical characteristics, and treatment needs in surviving and deceased trauma cases

	Survivors (n=109)	Nonsurvivors (n=13)	All patients (n=122)	P value
Age, years, mean ± SD	74.84±58.25	77±67.7	75.08±59.02	0.891[1]
Sex				
Male	77 (70.6%)	8 (61.5%)	85(69.7%)	0.500[2]
Female	32 (29.4%)	5 (38.5%)	37 (30.3%)	
Etiology of Trauma				
Fall from height	60 (54.1%)	8 (61.5%)	68 (55.7%)	0.891[2]
Motor vehicle accident	40 (33.9%)	4 (30.8%)	44 (36.1%)	
Penetrating injury	5 (3.7%)	1 (7.7%)	6 (4.9%)	
Drowning	4 (3.7%)	-	4 (3.3%)	
Need for transfusion	49 (45.0%)	13 (100%)	62 (50.8%)	[2]<0.001**
Need of Invasive Mechanical Ventilation	28 (25.7%)	13 (100%)	41 (33.6%)	[2]<0.001**
Need of Inotropic Agent Infusion	1 (0.9%)	10 (76.9%)	11 (9.0%)	[2]<0.001**
Need of TPE	1 (0.9%)	2 (15.4%)	3 (2.5%)	[2]0.001**
Need of CRRT	1 (0.9%)	4 (30.8%)	5 (4.1%)	[2]<0.001**
Need of Surgical Intervention	42 (38.5%)	2 (15.4%)	44 (36.1%)	0.100[2]

T-test1, Pearson chi-squres test2, significant p-values are highlighted in bold and indicated with the ** symbol. Abbreviations: SD: Standard deviation; CT: Computerized Tomography; MR: Magnetic Resonance; TPE: Therapeutic Plasma Exchange; CRRT: Continuous Renal Replacement Therapy.

Table 2. Evaluation of surgical need according to the type of trauma

Type of Trauma	No Need for Surgery (n=78)	Surgery Required (n=44)
Fall from height	46 (59%)	22 (50%)
Motor vehicle accident	28 (35.9%)	16 (36.4%)
Penetrating injury	-	6 (13.6%)
Drowning	4 (5.1%)	0 (0%)
P value	0.006**	

The Pearson chi-square test was utilized in the intergroup comparison, significant p-values are highlighted in bold and indicated with the **symbol.

this difference was statistically significant (p<0.001). Of the nonsurvivors, 84.6% required massive blood transfusion, while only 3.7% of the survivors needed it, and this difference was statistically significant (p<0.001). All nonsurvivors (100%) required invasive mechanical ventilation (IMV), while only 25.7% of the survivors received IMV support, and this difference was statistically significant (p<0.001). Inotropic infusion was required in 76.9% of nonsurvivors, whereas only 0.9% of the survivors needed it, and this difference was statistically significant (p<0.001). TPE was needed in 15.4% of nonsurvivors and 0.9% of survivors, while CRRT was required in 30.8% of nonsurvivors and 0.9% of survivors, and these differences were also statistically significant (p<0.001) (Table 1).

Among the 44 cases requiring surgical intervention, 50% were due to falls from height, and this trauma type was found to have a statistically significant higher need for surgical intervention compared to other trauma types, details are shown in Table 2.

The mean hemoglobin levels (8.3±2.9) and platelet levels (202.2±117.7) of nonsurvivors were significantly lower than survivors (p<0.001, p:0.001, respectively). The mean albumin level of survivors (3.95±0.6) was significantly higher than that of nonsurvivors (2.29±0.76) (p<0.001). The mean INR value of survivors (1.32±0.3) was significantly lower than that of nonsurvivors (3.81±2.95) (p<0.001) (Table 3).

The mean GCS score of nonsurvivors (4.2±1.96) and PRISM-3 score (40.8±16) were significantly lower than those of survivors (p<0.001) (Table 3).

Head trauma, thoracic trauma, intracranial bleeding, brain edema, lung contusion, and spleen laceration were significantly more common in nonsurvivors. A comparison of survivors and nonsurvivors based on the organ systems affected by trauma is shown in Table 4.

DISCUSSION

Trauma remains a significant public health concern worldwide across all age groups. Recent reports from the Turkish Statistical Institute (TÜİK) between 2018-2020 highlight childhood deaths due to trauma as a leading cause, emphasizing an age-specific distribution with increased mortality rates in the 15 and above age group. Our study,

Table 3. Comparison of laboratory values, GCS, PRISM scores, and duration of stay between survivors and non-survivors

	Survivors (n=109) Mean±SD	Nonsurvivors (n=13) Mean±SD	All patients (n=122) Mean±SD	P
Hemoglobin, g/dl	10.9±1.8	8.3±2.9	10.6±2.1	<0.001
Platelets, 10^3/ml	333±123.5	202.2±117.7	319.06±128.98	0.001
Albumin, g/dl	3.95±0.6	2.29±0.76	3.77±0.81	<0.001
Creatinine, mg/dl	0.43±0.25	0.65±0.25	0.45±0.26	<0.001
INR	1.32±0.3	3.81±2.95	1.59±1.24	<0.001
GCS	12.4±3.45	4.2±1.96	11.5 ± 4.17	<0.001**
PRISM-3	3.5±5.1	40.8±16	7.5±13.5	<0.001**
PICU Stay, days	7.51±8.19	4.46±4.79	7.19±7.94	0.048
Ward Stay, days	4.48±7.97	0	4±7.65	--

The independent t-test was utilized in the intergroup comparison, significant p-values are highlighted in bold and indicated with the **symbol. Abbreviations: SD: Standard deviation; INR: International Normalized Ratio; GCS: Glasgow Coma Scale; PRISM-3: Pediatric Risk of Mortality Score; PICU: Pediatric Intensive Care Unit.

Table 4. Comparison of anatomical regions and pathologies affected by trauma in survivors and non-survivors

	Survivors (n=109)	Nonsurvivors (n=13)	All patients (n=122)	P
Head	63 (57.8%)	12 (92.3%)	75 (61.5%)	0.016**
Brain Edema	12 (11.0%)	6 (46.2%)	18 (14.8%)	<0.001**
Intracranial Hemorrhage	44 (40.4%)	11 (84.6%)	55 (45.1%)	0.002**
Chest	60 (55.0%)	12 (92.3%)	72 (59.0%)	0.010**
Pneumothorax	39 (35.8%)	4 (30.8%)	43 (35.2%)	0.721
Hemothorax	12 (11.0%)	2 (15.4%)	14 (11.5%)	0.64
Lung Contusion	52 (47.7%)	10 (76.9%)	62 (50.8%)	0.046**
Abdomen	35 (321.%)	7 (53.8%)	42 (34.4%)	0.119
Liver Laceration	23 (21.1%)	1 (7.7%)	24 (19.7%)	0.25
Splenic Laceration	13 (11.9%)	6 (46.2%)	19 (15.6%)	0.001**
Extremities	47 (43.1%)	8 (61.5%)	55 (45.1%)	0.207
Closed Fracture	45 (41.3%)	8 (61.5%)	53 (43.4%)	0.164
Open Fracture	4 (3.7%)	0 (0%)	4 (3.3%)	0.482

The Pearson chi-square test was utilized in the intergroup comparison, significant p-values are highlighted in bold and indicated with the **symbol.

conducted in a tertiary care center, revealed an average age of 77±67.7 months for non-survivors, potentially linked to trauma-related deaths occurring on-site, during hospital transfers, or in emergency services, particularly in the adolescent age group.

In most studies in the literature, cases exposed to trauma are observed to be predominantly male.[8-11] Our study also revealed a similar predominance of males (69.7%), consistent with the literature. The higher incidence of trauma in male children compared to female children can be attributed to the fact that boys tend to be more active and engage in outdoor activities more frequently than girls.

Falls from height are the most common cause of childhood trauma and rank second among causes of death after motor vehicle accidents.[8,11-14] Our study results, similar to other studies, identified falls from height (55.7%) as the leading cause. Among our cases, 42.6% were in the 0-4 age group, with falls from height being the most frequent trauma type (72%). In the 4-9 age group, non-traffic accidents were most commonly observed. The prevalence of falls from height in the under-4 age group contributed to it being the most common trauma etiology in the overall distribution. As a tertiary care center receiving traumatic patients from the region, especially adolescent cases are managed in adult intensive care units in surrounding hospitals, while younger patients are referred to our center. This situation significantly contributes to the lower aver-

age age observed in our study. We believe that the high density of immigrant populations and crowded family structures in our region may hinder the implementation of sufficient preventive measures within households, leading to a higher incidence of fatal falls in the 0-4 age group.

The mortality rate of our study is 10.8%, and 8 out of the 13 cases (61.5%) that were nonsurvivors were those admitted to our unit due to falls from height. Interestingly, in contrast to the literature, the most common trauma etiology in the nonsurvivors was falls from height, followed by motor vehicle accidents as the second most common cause.[15] This discrepancy can be attributed to the fact that approximately half of our cases were under the age of 4, and deaths in this age group were frequently associated with falls from height.

The severe clinical conditions resulting from multiorgan failure in the nonsurvivors necessitated aggressive treatment. Treatments such as blood product transfusion (84.6%), endotracheal intubation (100%), inotropic infusion (76.9%), therapeutic plasma exchange (TPE) (15.4%), and continuous renal replacement therapy (CRRT) (30.8%) were more frequently applied in the nonsurvivors to halt the decompensation process.

Head injuries are the most commonly affected region in pediatric trauma, and trauma-related mortality and morbidity are primarily attributed to head injuries.[16] The higher incidence of head trauma in children following falls is due to their higher head-to-body ratio compared to adults, increasing the likelihood of head injuries.[17,18] In the United States, it is reported that 62% of childhood deaths are trauma-related, with head injuries constituting more than 50% of this proportion.[19] In a study by Doğan et al.[20] examining pediatric cases presenting to the emergency department due to trauma, the most frequently injured region was identified as the head (42%), followed by extremities at a rate of 33.4%. In another study conducted by Kıhtır and colleagues, evaluating children with trauma followed up and treated at PICU, the most commonly injured region was the head with 49.1%, and the abdomen region ranked second with 22.6%.[8] Our study aligns with the literature, with the head (61.5%) being the most frequently affected region, followed by the thoracic region (59%). Notably, in nonsurvivors, the head was the most commonly affected region (92.3%).

The necessity for surgical intervention following trauma in children has been reported at varying rates in different studies. In a study of 588 children by Chabok et al.[13] 46% of trauma-affected cases evaluated in the emergency department required surgical intervention.[13] Another study by McGaha et al.[21] involving 526 children exposed to trauma, reported a surgical intervention requirement of 13.6% in cases evaluated in the emergency department. In a study compiling trauma cases monitored in pediatric intensive care, the reported rate of necessity for surgical intervention was 28%.[22] In another study conducted in Antalya province, surgical intervention requirement was observed in 29.2% of 106 children exposed to trauma and followed up at the Pediatric Intensive Care Unit.[8] Our study reported a surgical intervention rate of 36%, considerably higher than the literature. The significant difference in our study may be attributed to our cases being critically managed in the pediatric intensive care unit. We believe that if all traumatic pediatric cases presenting to our emergency department were considered, this rate would be lower. Moreover, differences in trauma etiology and resulting pathologies may contribute to the higher surgical requirement observed in our study compared to other pediatric intensive care studies.

Our study has some limitations, including its retrospective design, single-center nature, and a limited number of cases.

Conclusion

Trauma remains a significant cause of mortality and morbidity today. Our study emphasizes that falls are the most common etiology for trauma admissions to our unit, and the head is the most commonly affected anatomical region. Both our study and literature findings suggest that a substantial portion of childhood traumas may be preventable. Simultaneously, we believe that a multidisciplinary approach involving medical and surgical treatment methods, implemented in specialized healthcare centers, could reduce mortality and morbidity associated with traumatic pediatric conditions.

Ethics Committee Approval

This study approved by the Bağcılar Training And Research Hospital Ethics Committee (Date: 10.05.2023, Decision No: 2023/05/07/026).

Informed Consent

Retrospective study.

Peer-review

Externally peer-reviewed.

Authorship Contributions

Concept: C.G., A.Ö., E.C.; Design: C.G., A.Ö., E.C., S.Y.; Supervision: M.E., A.Ö., E.C.; Fundings: A.Ö., S.Y., E.C.; Materials: C.G., A.Ö., S.Y.; Data: C.G., A.Ö.; Analysis: C.G., A.Ö., S.Y.; Literature search: C.G., A.Ö., M.E.; Writing: C.G., A.Ö., S.Y., E.C., M.E.; Critical revision: A.Ö., M.E., S.Y.

Conflict of Interest

None declared.

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Çocuk Yoğun Bakım Ünitesindeki Pediatrik Travma Vakalarının Kapsamlı Bir Analizi

Amaç: Bu çalışmada, tek merkezde üç yıl boyunca takip edilen çocuk travma hastalarının demografik özellikleri, travma nedenleri, prognozları ve travma tipleri retrospektif olarak incelenmiştir.

Gereç ve Yöntem: Ocak 2020 ve Ocak 2023 tarihleri arasında travma nedeniyle çocuk yoğun bakım ünitemize (tek merkezli, 8 yataklı) kabul edilen çocuk hastaların verileri bilgisayar kayıtlarından retrospektif olarak incelendi.

Bulgular: Bu çalışma, travma tanısı ile yoğun bakıma kabul edilen yaş ortalaması 75±59 ay olan 122 çocuk travma olgusunu (37 kız ve 85 erkek) içermektedir. En sık gözlenen travma tipi 68 olguda (%55.7) yüksekten düşme, en sık etkilenen anatomik bölge 75 olguda (%61.5) baş ve boyun bölgesi ve en sık görülen patoloji 55 olguda (%45.1) intrakraniyal hemorajiydi. Olguların %36'sında cerrahi müdahale gerekmiştir ve 22 olguda (%18) cerrahi müdahalenin en önemli nedeni yüksekten düşme olarak görülmüştür. Yoğun bakım ünitesinde 13 hasta (%10.6) exitus olmuştur, bu da %10.6'lık bir mortalite oranına işaret etmektedir.

Sonuç: Travmalar, günümüzde pediatrik yaş grubunda önemli bir mortalite ve morbidite nedeni olmaya devam etmektedir.

Anahtar Sözcükler: Mortalite; pediatrik travma; prognoz; yüksekten düşme.