Turk J Intensive Care 2024;22:101-9
DOI: 10.4274/tybd.galenos.2023.05902

ORIGINAL RESEARCH / *ÖZGÜN ARAŞTIRMA*

Merve Sapmaz Tohumcuoğlu,
Merve Mısırlıoğlu,
Ahmet Yöntem,
Faruk Ekinci,
Dinçer Yıldızdaş,
Özden Özgür Horoz

Initial Vital Signs in Traumatized Children Determine the Length of Stay in Intensive Care Unit

Travma Geçirmiş Çocuklarda İlk Yaşamsal Belirtiler Yoğun Bakım Kalış Süresini Belirliyor

Received/Geliş Tarihi : 29.03.2023
Accepted/Kabul Tarihi : 05.06.2023

Merve Sapmaz Tohumcuoğlu
Çukurova University Faculty of Medicine, Department of Pediatrics, Adana, Turkey

Merve Mısırlıoğlu
Mersin University Faculty of Medicine, Department of Pediatric Intensive Care, Mersin, Turkey

Ahmet Yöntem, Faruk Ekinci, Dinçer Yıldızdaş, Özden Özgür Horoz
Çukurova University Faculty of Medicine, Department of Pediatric Intensive Care, Adana, Turkey

Merve Mısırlıoğlu MD (✉),
Mersin University Faculty of Medicine, Department of Pediatric Intensive Care, Mersin, Turkey

E-mail : mervemisirlioglu@gmail.com
Phone : +90 505 901 66 29
ORCID ID : orcid.org/0000-0002-9554-841X

Presented in: Our study was presented in the 1st International Rumi Pediatrics Congress, December 4-7, 2019, Konya.

ABSTRACT *Objective:* Vital signs and trauma scores of pediatric trauma patients affect morbidity and length of stay in the intensive care unit (ICU); treatment and follow-up of appropriate trauma patients in experienced centers is of great importance. This study aimed to determine the demographic data, clinical findings and scoring systems, and respiratory and circulatory support requirements of trauma patients during their follow-up in the pediatric ICU (PICU) and investigate the effects of these factors on the length of PICU and hospital stay and mortality.
Materials and Methods: Demographic and clinical findings of 49 pediatric patients who were hospitalized in the PICU because of trauma were prospectively recorded for 16 months. Data on the length of PICU and hospital stay, trauma mechanisms, and affected organ systems were collected.
Results: The most frequent etiology of trauma was falling from heights in 36.7% of the patients. Mechanical ventilation (MV) was necessary in 18.4% of the cases, and the mean duration for MV was 48 (12-306) hours. When MV need was evaluated concerning vital findings, the findings showed that patients with bradypnea needed MV more (p=0.004). MV was needed in 66.7% of hypotensive patients, and there was a statistically significant difference between blood pressure and MV requirement (p=0.005). Glasgow coma score and length of PICU stay were correlated (p=0.02). PICU (p=0.005, p=0.005, p=0.001) and hospital stay (p=0.02, p=0.01, p=0.04) were statistically significantly longer in patients who had blood products, inotropic agents and MV.
Conclusion: The effects of initial vital signs and trauma scores on morbidity and length of PICU stay of pediatric trauma patients, as well as the importance of treatment and follow-up of appropriate patients in experienced centers, have been shown in our study.
Keywords: Pediatric trauma, trauma scores, vital signs

ÖZ *Amaç:* Pediatrik travma hastalarının vital bulguları ve travma skorları, morbidite ve yoğun bakım ünitesinde (YBÜ) kalış süresine etkisi ile uygun travma hastalarının deneyimli merkezlerde tedavi ve takibi açısından büyük önem taşımaktadır. Bu çalışmada, travma hastalarının çocuk YBÜ'de (ÇYBÜ) izlemleri sırasındaki demografik verileri, klinik bulguları ve skorlama sistemleri, solunum ve dolaşım destek gereksinimlerinin belirlenmesi ve bu faktörlerin hastanede kalış, ÇYBÜ kalış süreleri ve mortalite üzerine etkisinin araştırılması amaçlanmıştır.
Gereç ve Yöntem: Bu çalışmada travma nedeniyle ÇYBÜ'de yatan 49 çocuk hastanın demografik ve klinik bulguları prospektif olarak 16 ay süreyle kaydedildi. ÇYBÜ ve hastanede kalış süreleri, travma mekanizmaları ve etkilenen organ sistemleri hakkında veriler toplandı.
Bulgular: Hastaların %36,7'sinde en sık travma nedeni yüksekten düşme idi. Olguların %18,4'ünde mekanik ventilasyon (MV) uygulanmıştı ve ortalama MV süresi 48 (12-306) saatti. Vital bulgular açısından MV ihtiyacı değerlendirildiğinde, bulgular bradipneli hastaların MV'ye daha fazla ihtiyaç duyduğunu gösterdi (p=0,004). Hipotansif hastaların %66,7'sinde MV ihtiyacı oldu ve kan basıncı ile MV ihtiyacı arasında istatistiksel olarak anlamlı fark vardı (p=0,005). Glasgow koma skoru ve ÇYBÜ kalış süresi arasında istatistiksel olarak anlamlı bir ilişki vardı (p=0,02). ÇYBÜ (p=0,005, p=0,005, p=0,001) ve hastanede kalış süresi (p=0,02, p=0,01, p=0,04) kan ürünleri, inotropik ajan ve MV bulunan hastalarda istatistiksel anlamlı olarak daha uzundu.
Sonuç: Çalışmamızda pediatrik travma hastalarında başlangıç vital bulguları ve travma skorlarının morbidite ve ÇYBÜ kalış süresine etkisi ile uygun hastaların deneyimli merkezlerde tedavi ve takibinin önemi gösterilmiştir.
Anahtar Kelimeler: Pediatrik travma, travma skorları, yaşamsal belirtiler

Introduction

Physical trauma is one of the most important causes of mortality and morbidity in childhood, especially in children older than one year of age (1,2). Trauma is a public health problem that needs to be solved, as trauma-related injuries and deaths in childhood outstrip other major diseases (2,3). According to the 2017-2018 data of the Turkish Statistics Institute, the death rates due to accidents, injuries and poisonings are in the first place for deaths between the ages of 0 and 14 years (4,5).

The most common causes of trauma-related death in children in all age groups are in-car or out-of-car motor vehicle accidents. Falling from heights, drowning, abuse, and fires are among the other causes of death. Adolescent deaths are mostly due to gunshot wounds (1-4). Risky trauma mechanisms may cause multiple trauma in children, paving the way for serious multi-systemic complications (6). Injuries due to trauma are the leading causes of emergency department and pediatric intensive care unit (PICU) admissions (7). The present study aimed to reveal the demographic data of trauma patients followed up in the PICU, evaluate the correlation of clinical findings with a length of PICU stay, respiratory and circulatory support requirements, and prognosis.

Materials and Methods

During the 16-month period between July 2018 and June 2019, 49 critically ill children were included in this study. The trauma mechanisms exposed, the organ systems affected by the trauma, demographic characteristics, clinical findings, vital signs, need for respiratory support, lengths of PICU, and hospital stays were prospectively recorded. Glasgow coma score (GCS) (mild head trauma was considered 15-14 points, moderate head trauma as 13-9 points, and severe head trauma as ≤8 points). Pediatric trauma score (PTS), the patient’s airway patency, state of consciousness, body weight, systolic blood pressure, presence of an open wound and roughly the presence of any skeletal system trauma are evaluated and scored. The total score ranges between -6 and +12, <8 points identifies a potential significant trauma and indicates that follow up in a trauma center would be appropriate. PTS is an important scoring system in predicting patient triage and mortality (6-12). Pediatric Risk of Mortality (PRISM III) and pediatric logistic organ dysfunction (PELOD) scores were calculated and recorded to determine the risk of morbidity and organ failure in trauma patients (13,14).

The use of inotropes and blood products and the type of hyperosmolar therapy administered to patients with head trauma were recorded. Serial intravesical pressure measurements were made in patients with risk factors for intra-abdominal hypertension (IAH). Intra-abdominal pressure (IAP) was measured through a Foley bladder catheter as defined in the final pediatric consensus definitions section of the 2013 updated The World Society of the Abdominal Compartment Syndrome (WSACS, www.wsacs.org) consensus (15). Briefly, in a complete supine position, 1 mL/kg of normal saline, with a minimal instillation volume of 3 mL and a maximum installation volume of 25 mL, was instilled in to the bladder through a Foley catheter. The end of the urinary catheter was connected to a transparent, open-ended plastic tube, which was then connected to a transducer set and monitoring lines. The IAP level was automatically measured by the monitor in mmHg units. The procedure was repeated every 6 hours (h), with four serial measurements per day.

In patients with head trauma, optic nerve sheath diameter (OSD) was measured with ultrasonography (USG), to detect and monitor the presence of high intracranial pressure. Mindray M7 ultrasound device and L14-6s linear probe were used for measurements. While the patients were in the supine position, ultrasound gel was applied over the closed eyelids, and they were examined with orbital USG, holding the probe in a straightforward position. OSD measurement was performed by obtaining images in the longitudinal and transverse axes from the area between the hyper echoic dural sheaths located at the edge of the hypo echoic subarachnoid area surrounding the optic nerve (16). In addition, cerebral monitoring was performed with near infrared spectroscopy (NIRS), a non-invasive method, to monitor regional tissue oxygenation (17). For cerebral measurement, self-adhesive pediatric probes were placed in the right and left frontal regions after skin cleansing. Cerebral oxygenation monitoring was performed with NIRS (INVOS somanetics, 5100C, Covidien, Mansfield, MA, USA) device. The patients who underwent electroencephalography (EEG) monitoring were recorded.

Ethical approval to conduct this study was obtained from the Non-Invasive Ethics Committee of the Faculty of Medicine of Çukurova University (decision no: 30, date: 07.12.2018). The data were recorded after obtaining written informed consent from the families of the patients included in the study.

Statistical Analysis

Statistical Package for Social Sciences (SPSS for Windows 20.0 version) was used for statistical analysis. Categorical variables are expressed as numbers and percentages. In numerical continuous data, it was stated that the mean ± standard deviation was given for those with normality distribution, and the median [minimum (min)-maximum (max)] value was given for those without normality distribution. Friedman's test was used to compare more than two dependent groups that did not show normal distribution. Kolmogorov-Smirnov test was used to test the normality of continuous data. The Mann-Whitney U test was used to compare two independent groups that did not show normal distribution. Conformity to the normal distribution was evaluated using the Shapiro-Wilk test. Fisher's Exact test was used to compare categorical variables according to groups. Linear regression analysis was used to analyze the independent variables affecting the duration of intensive care. The statistical significance level was p<0.05.

Results

We enrolled 49 pediatric patients (11 female), with a mean age of 90.78±59.70 months (min: 6 months, max: 17 years). Age group classification was made as follows: infant age group (younger than ≤24 months, 16.3%, n=8), toddlers (24-72 months, 28.5%, n=14) and school-age children (≥72 months, 55.2%, n=27). According to the age groups, the most common etiology of trauma was falling from heights (75%) in infants and out-of-car traffic accidents in toddlers (43%). In the group ≥72 months, which constituted the majority of the patients, falling from heights was the most common etiology. The classification of the patients according to their demographic and clinical characteristics is shown in Table 1.

Mortality did not develop in any of our cases during this study. The mean PRISM III score was 6.61±4.97 (min: 0, max: 21), while the mean PELOD score was 5.69±5.09 (min: 0, max: 22). When the need for mechanical ventilation (MV) was evaluated according to the vital findings, the need for MV was higher in patients with bradypnea (p=0.004). While 66.7% of hypotensive patients needed MV, this rate was 11.6% in non-hypotensive patients (p=0.001) (Table 2). Surgery was performed in 51% (n=25) of our trauma patients. When the relationship between vital signs and the need for surgery was examined, it was seen that there was no significant relationship between respiratory rate, blood pressure and

Table 1. Demographic and clinical characteristics of the pediatric trauma patients

Characteristics of the patients	% (n)
Mechanism of injury	
Falling from high	36.7% (n=18)
Non-vehicle traffic accident	34.7% (n=17)
In-vehicle traffic accident	8.2% (n=4)
Blunt trauma	6.2% (n=3)
Penetrating trauma	4.1% (n=2)
Firearm injury	4.1% (n=2)
Falling-crash on same ground	2% (n=1)
Hanging	2% (n=1)
Electric shock	2% (n=1)
Glasgow coma scores (GCS)	
GCS ≥12	73.5% (n=36)
GCS 9-11	10.2% (n=5)
GCS ≤8	16.3% (n=8)
Pediatric trauma scores (PTS)	
PTS >8	30.6% (n=15)
PTS ≤8	69.4% (n=34)
According to trauma mechanism need for mechanical ventilation	
Falling from high	22.2% (n=2)
Non-vehicle traffic accident	33.4% (n=3)
In-vehicle traffic accident	11.1% (n=1)
Firearm Injury	11.1% (n=1)
Others	22.2% (n=2)
Respiratory support	
No respiratory support	26.5% (n=14)
Oxygen support with reservoir mask	53.1% (n=26)
Need for mechanical ventilation	18.4% (n=9)
According to injured organ systems need for mechanical ventilation	
Head injury	53.4% (n=8)
Extremity injury	20% (n=3)
Thoracic injury	13.3% (n=2)
Abdominal injury	13.3% (n=2)
According to head trauma types need for mechanical ventilation	
Isolated skull fracture	25% (n=2)
Isolated parenchymal injury	50% (n=4)
Fracture and parenchyma injury	25% (n=2)
Mechanical ventilation indications	
Low Glasgow coma score	10.2% (n=5)
Hemorrhagic shock	4.1% (n=2)
Post-operation	4.1% (n=2)
Blood transfusions	
Transfused	36.7% (n=18)
Not transfused	64.3% (n=31)

body temperature values and surgery. However, patients with tachycardia needed surgery more (Table 2). Trauma etiologies and affected systems were evaluated according to the need for surgery, and no significant difference was found between them. A total of 18 patients (36.7%) were administered blood and blood products, and a massive blood transfusion was needed in one patient. After excluding the urethral and bladder injury, urinary catheters were placed in 33 (67.3%) patients to monitor urine output and/or monitor IAP. Intra-abdominal pressure measurement was performed in 15 patients (30.6%). The mean IAP was 9.0±2.4 (min: 5, max: 14) mmHg. IAH was detected in seven of 15 patients. Symptomatic treatment with nasogastric decompression and appropriate fluid management was applied to patients with IAH. Abdominal compartment syndrome and requirement of surgical decompression did not occur any of the patients with intraabdominal hypertension. There was no significant difference between the lengths of PICU and hospital stay between those with and without IAH. There was no statistically significant difference between the distributions of mechanical ventilator needs between those with and without IAH (p=1.000). MV was needed in 20% of those without IAH, and 10% of those with IAH.

The mean time between trauma and admission to the pediatric ICU was 31.6±98.7 h, with a median of six h. The mean hospital stay was eight (min: 2, max: 30) days, and the mean PICU stay was four (min: 1, max: 13) days. The median follow-up time on the mechanical ventilator was 48 (min: 12, max: 306) h. 18.4% (n=9) of the patients needed MV. There was no significant difference between trauma etiologies, affected organ systems and head trauma types in terms of MV (p=0.399). When the hospital and PICU stay of the patients who needed and did not need MV were compared, it was found that the need for MV had a statistically significant effect on the duration of PICU stay and hospitalization (p=0.01, p=0.04) (Table 3).

The critically ill children included in this study were grouped according to their PTS and GCS scores. Five patients with GCS below 8 had surgery, and all of them needed MV. When the lengths of PICU stay were compared between the patients with mild and moderate brain injury and no statistically significant difference was found (p=0.66). There was no difference between the cases with severe and moderate brain damage for the length of PICU stay (p=0.35). When the lengths of PICU stay were compared between the children with severe and mild brain injury, and the difference was statistically significant (p=0.02). According to the PTS, there was no correlation between the lengths of stay in hospital and PICU between the groups. The lengths of PICU stay were similar in patients who fell from heights and in

Table 2. Classification of patients according to their vital signs recorded within the first hour of admission to the pediatric intensive care unit; comparison in terms of mechanical ventilation and operation requirement

	Patients n (%)	Mechanical ventilation n (%)	p-value	Operation n (%)	p-value
Pulse					
Bradicardia	-	-	0.520	-	0.01
Normal	21 (42.9%)	3 (14.2%)		6 (28.6%)	
Tachycardia	28 (57.1%)	6 (21.4%)		19 (67.9%)	
Respiratory rate					
Bradypnea	3 (6.1%)	3 (100%)	0.004	2 (66.7%)	0.70
Normal	30 (61.2%)	5 (16.6%)		14 (46.7%)	
Tachypnea	16 (32.7%)	1 (6.2%)		9 (56.2%)	
Blood pressure					
Hypotension	6 (12.2%)	4 (66.6%)	0.005	6 (100%)	0.83
Normotension	32 (65.3%)	4 (12.5%)		14 (43.8%)	
Hypertension	11 (22.4%)	1 (9%)		5 (45.5%)	
Body temperature					
Hypothermia	2 (4.1%)	1 (50%)	0.346	1 (50.0%)	0.89
Normothermia	40 (81.8%)	6 (15%)		21 (52.5%)	
Hyperthermia	7 (14.6%)	2 (28.5%)		3 (42.9%)	

Table 3. Comparison of pediatric intensive care and hospital stays according to the clinical characteristics of the patients

	Length of hospital stay (days) Mean ± SD Median (min-max)	p-value	Length of pediatric intensive care (days) Mean ± SD Median (min-max)	p-value
PTS >8 (n=15)	10.73±7.13 9 (3-30)	0.77	3.80±2.78 3 (1-12)	0.26
PTS ≤8 (n=34)	12.26±8.80 8 (2-30)		4.71±2.96 4 (1-13)	
Falling from high (n=18)	8.56±6.00 7.5 (2-25)	0.01	15.41±9.26 12 (4-30)	0.08
Non-vehicle traffic accident (n=17)	15.41±9.26 12 (4-30)		5.35±3.23 4 (2-13)	
Need for MV (n=9)	18.11±10.26 16 (6-30)	0.04	7.11±3.75 7 (2-13)	0.01
No need for MV (n=40)	10.38±7.17 8 (2-30)		3.83±2.34 3.5 (1-12)	
Transfused (n=18)	16.78±9.69 13 (5-30)	0.02	6.00±3.25 6.5 (2-13)	0.005
Not transfused (n=31)	8.9±5.73 7 (2-30)		3.52±2.28 3 (1-12)	
Inotrope support (n=6)	22.00±9.52 25.50 (7-30)	0.01	7.17±2.04 7.50 (4-10)	0.005
Not receiving inotropic support (n=43)	10.37±7.11 8 (2-30)		4.05±2.82 3 (1-13)	

SD: Standard deviation, min-max: minimum-maximum, PTS: pediatric trauma score, MV: mechanical ventilation

those who had out-of-car traffic accidents, but the hospital stay was longer in the patients who had traffic accidents (p=0.01). The lengths of PICU stay (p=0.005, p=0.005, p=0.001) and hospitalization (p=0.02, p=0.01, p=0.04) were statistically significantly longer in patients who had blood products or inotropes and in the ones who needed MV support (Table 3).

The independent variables affecting the length of stay in the ICU were analyzed by linear regression analysis. The establish linear regression model was found to be statistically significant (F=7.554, p<0.001). In the established linear regression model, the independent variables and the dependent variable are explained at a rate of 48.9%. Those with blood products were 2,208 more times than those without PICU (p=0.005). The application period also has a positive effect on the duration of the application, and the duration of the application increases by 0.013 when the application period increases by one unit (p<0.001). There was no statistically significant effect of other variables (p>0.050) (Table 4).

Head trauma was present in 73.5% (n=36) of all cases, and all of these patients had hyperosmolar therapy for high intracranial pressure. Hypertonic saline was the agent chosen in the first step of hyperosmolar therapy. In addition, 10 (27.7%) patients had mannitol in addition to hypertonic saline. Barbiturates were administered to one (2%) patient due to a persistent high intracranial pressure. OSD was measured in those 36 (73.4%) patients with head trauma, 21 (42.9%) patients were followed up with NIRS, and 11 out of 14 (28.5%) patients who had EEG were treated with antiepileptic (all with levetiracetam and 3 with additional phenytoin).

Discussion

Trauma-related injuries are one of the most important causes of mortality, morbidity and health expenditures in childhood. While trauma takes the second place after infection among the causes of death between the ages of one and four in underdeveloped and developing countries, it takes

Table 4. Examination of the factors affecting the length of stay in the pediatric intensive care unit by linear regression analysis

	β_0 (95% CI)	SE	β_1	t	p	r^1	r^2	VIF
Static	3.461 (-0.37-7.292)	1.897	0.000	1.824	0.075	0.000	0.000	0.000
Transfused (reference: no)	2.208 (0.701-3.714)	0.746	0.370	2.960	**0.005**	0.416	0.420	1.465
Inotropic support (reference: no)	1.106 (-1.377-3.589)	1.230	0.126	0.899	0.374	0.355	0.139	1.841
MV (reference: no)	1.249 (-0.852-3.35)	1.040	0.168	1.201	0.237	0.442	0.184	1.838
BMI	-0.122 (-0.341-0.097)	0.108	-0.124	-1.127	0.266	-0.042	-0.173	1.144
Application deadline (h)	0.013 (0.007-0.02)	0.003	0.456	4.300	**<0.001**	0.458	0.557	1.057
Heart beat (reference: normokardi)	0.86 (-0.441-2.16)	0.644	0.148	1.335	0.189	0.301	0.204	1.150
Intracranial pressure treatment (reference: no)	1.345 (-0.098-2.788)	0.715	0.206	1.882	0.067	0.154	0.282	1.128

F=7.554. p<0.001. R^2=0.563. Corrected R^2=0.489. β_0: non-standardized beta coefficient, β_1: standardized beta coefficient, r^1: zero-order correlation, r^2: partial correlation, CI: confidence interval, BMI: body mass index, MV: mechanical ventilation, SE: standard error, VIF: variance inflation factor

the first place after the age of four in these countries and the period between 1-14 years in developed countries (2,3).

Wohlgemut et al. (18) examined the demographic and geographic characteristics of pediatric trauma patients, and the median age of the patients was 9.0 (4-12) years. In the İzmir region of our country, Öztan et al. (19) reported the median age as 16.0 (2-11) years. Yousefzadeh Chabok et al. (20) reported that the median age of the patients was 7.3 years (3 months-14 years). In our study, the youngest patient was six months old, the oldest was 17 years old, and the median age was 6.3 years.

When the etiologies of trauma were examined, falling from heights was the most common etiology (36.7%) in our study. This was followed by out-of-car traffic accidents with 34.7% and in-car traffic accidents with 8.2%. When the trauma etiologies in the pediatric age group are examined in the literature, it is evident that falling from heights and out-of-car traffic accidents are the most frequent etiologies for trauma, similar to our patient group (21). Yousefzadeh Chabok et al. (20) studied 588 patients aged 0-14 years in Iran, and the most common trauma etiologies were traffic accidents at a rate of 42.2% and falls at a rate of 39.8%. In the study conducted by Korkmaz et al. (22), it was determined that traffic accidents (50.4%) and falls (18.3%) were more frequent, followed by sharp object injuries (10.9%).

Tambay et al. (1) reported the mean hospital stay as 5.54±6.42 days and the longest hospital stay as 50 days. In another study, the length of PICU stay was 5.8±6.4 (1-34) days and the length of hospital stay was 5.8±7.2 (2-50) days (19). In our study, the mean length of hospital stay was 11.8±8.2 days, the longest length of hospital stay was 30 days, and the mean PICU stay was 4.4±2.9 days. Since ours is a tertiary healthcare institution, better intensive care services in our unit, early diagnosis and treatment of complications, such as possible organ failure and sepsis, increased survival and enable patients to receive longer treatment. The median length of stay in PICU was four (1-13) days, while the median length of hospital stay was eight (2-30) days in our study. Simon et al. (23) reported the length of hospitalization between one and 72 days, with a mean of 9.7±13.1 and a median of four days. In the study of Atike Ongun and Dursun (24), the median duration of PICU stay was four (1-22) days, and the median duration of hospitalization was 10.5 (1-96) days, similar to our study.

Thirty to fifty percent of trauma-related deaths occur at the accident site, and 30% occur within h or days after the accident, usually in the first h. Mortality rates can be reduced by rapid transport to a suitable hospital, rapid evaluation and resuscitation, and recognition of patients requiring surgical intervention. In addition, managing trauma patients in the emergency and PICU and a multidisciplinary approach are important to reduce mortality and morbidity (25,26). The fact that the 49 patients included in our study did not die is probably because the deaths occurred at the time of the accident while reaching the accident site or in the emergency room. In addition, eight patients with GCS scores below 8 were extubated during their follow-up in PICU and were transferred to the clinics where their follow-up will continue without any sequelae.

MV was needed in 18.4% of the patients we followed up in our PICU due to trauma. The indication for MV was a low GCS in five (10.2%) patients, hemorrhagic shock in two (4.1%) patients, and surgery in two (4.1%) patients. In a study involving a larger patient population, the MV rate of the patients was reported as 12.2%, with similar characteristics (27). The median follow-up period of our patients on the mechanical ventilator was 48 h. Atike Ongun and Dursun (24), on the other hand, found the median follow-up period on a mechanical ventilator as three days.

Surgical intervention was performed in 51% of our patients. Tambay et al. (1) reported that 43.3% of their patients had surgery. In our study, blood transfusion was administered to 18 (36.7%) patients. In their study, Anıl et al. (27) evaluated blunt high-energy trauma patients and reported a blood transfusion rate of 7%. The higher rate in our study may be explained by the inclusion of penetrating injuries and the need for blood transfusion more frequently in such injuries.

One of the best-known scoring systems is GCS. It has been widely used in triage scoring and for predicting mortality. Admission GCS has been found useful in predicting injury severity and the motor component is the most reliable and strongest predictor. In our country, Atike Ongun and Dursun (24) evaluated GCS in relation to traumatic brain injury, and 35.2% of the included patients had mild, 17.7% had moderate, and 47.7% had severe traumatic brain injury. In our study, 16.3% of patients had GCS <8 and had a severe traumatic brain injury. In the same study, when the lengths of PICU and hospital stays were compared according to the GCS of the patients, the mean PICU stay was 7.33±5.78 days in patients with severe traumatic brain injury, and the median length of hospital stay was 16.5 (1-96) days (24). On the other hand, we found the mean PICU stay as 7.00±4.00 days and the median length of hospital stay as 15 (6-30) days in patients with severe traumatic brain injury. In our study, when the lengths of PICU and hospital stays were compared between the patients with severe and mild traumatic brain injury, the mean PICU stay was 3.66±2.45 days in patients with mild traumatic brain injury, and a statistically significant difference was found between the lengths of PICU stay in these two groups.

Head trauma is the most common form of pediatric trauma and is the most common cause of trauma-related mortality and morbidity (28). Mayer et al. (25) reported head injuries as the most common (78.8%) type of injury in the pediatric population. In their study conducted in Tanzania in 2013, Simon et al. (23) found that head and neck injuries were the most common form of trauma in children. In a study conducted by Doğan et al. (29) in our country, in which 1293 pediatric trauma patients aged 0-16 years were examined, the most common injury sites were head and neck (41.9%) and extremities (33.4%). In our study, 73.5% of the patients had head trauma. Extremity (30.6%) and thoracic (26.5%) injuries were the second and third most common injuries. In our study, 73.5% of the patients had head trauma and intracranial pathologies detected on their cranial tomography were subdural hemorrhage in 22.4%, epidural hemorrhage in 16.3%, cerebral edema in 16.3%, and a parenchymal hemorrhage in 10.2% of the patients. In the study of Atike Ongun and Dursun (24), 28.4% of the patients had a subarachnoid hemorrhage, 14.8% had a subdural hemorrhage, 12.6% had an epidural hemorrhage, and 10.3% had a parenchymal hemorrhage. Unlike our study, Atike Ongun and Dursun (24) detected brain edema in 48.9% of their patients. All of the patients (73.5%) in our study, who were followed up for head trauma, had hyperosmolar therapy for high intracranial pressure. Hypertonic saline was the agent chosen in the first step of hyperosmolar treatment. Ten (27.7%) patients had mannitol in addition to hypertonic saline. In our study, none of the patients were administered mannitol alone. Atike Ongun and Dursun (24) reported that 67% of the patients followed in their pediatric ICU due to traumatic brain injury were treated for high intracranial pressure, 10.2% of them were treated with mannitol alone, 14.8% were treated with hypertonic saline alone, and the remaining patients were administered both hyperosmolar agents.

The pediatric trauma scores is used to assess the severity and extent of injury accurately (30). Using the pediatric trauma score, Simon et al. (23) determined the severity of the injury as 0-5 for severe injury, 6-8 for moderate injury, and 9-12 for mild injury. Most of the patients had a mild injury; 40% and 3.3% of the patients had moderate and severe injuries, respectively (23). In our study, 30.6% of the patients had PTS >8 and had trauma caused by minor injuries. The remaining 69.4% had PTS ≤8 and severe trauma. This score is a physiological scoring system developed especially for the triage of pediatric trauma patients, and we suppose that the high rate of severe trauma patients in our study is because our clinic is a tertiary center. Anıl et al. (27) reported that patients with PTS ≤8 had a longer hospital stay and longer follow-up in the emergency department. In our study, no significant difference was found between the lengths of hospital and PICU stay according to the PTS of our patients. We explain this with the small number of patients included in our study.

The limitations of our study are the lack of examining the factors affecting mortality in critically ill children followed up due to trauma, due to the small number of cases followed in the PICU due to trauma in the specified period and the absence of any mortality.

Conclusion

Pediatric patients are vulnerable to trauma due to their different anatomical and physiological characteristics than adults; therefore, the prevention of trauma should be aimed first. It is very important to identify critically ill children with appropriate triage and scoring systems in case of trauma and transport them to the centers that can provide appropriate treatment as soon as possible and monitor them by making the necessary interventions in a timely manner. As a result, the main goal is to reduce mortality and morbidity. In our study, the effects of vital signs and trauma scores on morbidity and length of stay in PICU are evident in pediatric trauma patients. The importance of treatment and follow-up of appropriate patients in experienced centers has been demonstrated.

Ethics

Ethics Committee Approval: Ethical approval to conduct this study was obtained from the Non-Invasive Ethics Committee of the Faculty of Medicine of Çukurova University (decision no: 30, date: 07.12.2018).

Informed Consent: The data were recorded after obtaining written informed consent from the families of the patients included in the study.

Authorship Contributions

Concept: M.S.T., M.M., A.Y., F.E., D.Y., Ö.Ö.H., Design: M.S.T., M.M., A.Y., F.E., D.Y., Ö.Ö.H., Data Collection and Process: M.S.T., M.M., Ö.Ö.H., Analysis or Interpretation: M.S.T., M.M., A.Y., F.E., D.Y., Ö.Ö.H., Literature Search: M.S.T., M.M., A.Y., F.E., D.Y., Ö.Ö.H., Writing: M.S.T., M.M., Ö.Ö.H.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Tambay G, Satar S, Kozacı N, Açıkalın A, Ay MO, Gülen M, et al. Retrospective analysis of pediatric trauma cases admitted to the emergency medicine department. JAEM 2013;12:8-12.
2. Grinkeviciūte DE, Kevalas R, Saferis V, Matukevicius A, Ragaisis V, Tamasauskas A. Predictive value of scoring system in severe pediatric head injury. Medicina (Kaunas) 2007;43:861-9.
3. Melek M, Çobanoğlu U, Bilici S, Ceylan A, Beğer B, Epçaçan S. General approach to the childhood trauma. Van Med J 2013;20:266-73.
4. Turan Y, Uysal C, Korkmaz M, Yılmaz T, Göçmez C, Özevren H, et al. Evaluation of patients who admitted to hospital due to accidentally falling objects on them. Dicle Med J 2015;42:51-4.
5. Cause of Death Statistics, 2018. Turkish Statistical Institute. https://data.tuik.gov.tr
6. Yılmaz G. Approach to multi-trauma in children and scoring systems. TOTBİD Dergisi 2019;18:313-9.
7. Osler TM, Vane DW, Tepas JJ, Rogers FB, Shackford SR, Badger GJ. Do pediatric trauma centers have better survival rates than adult trauma centers? An examination of the National Pediatric Trauma Registry. J Trauma 2001;50:96-101.
8. Marcin JP, Pollack MM. Triage scoring systems, severity of illness measures, and mortality prediction models in pediatric trauma. Crit Care Med 2002;30(11 Suppl):457-67.
9. Hannan EL, Farrell LS, Meaker PS, Cooper A. Predicting inpatient mortality for pediatric trauma patients with blunt injuries: a better alternative. J Pediatr Surg 2000;35:155-9.
10. Teasdale G, Maas A, Lecky F, Manley G, Stocchetti N, Murray G. The Glasgow Coma Scale at 40 years: standing the test of time. Lancet Neurol 2014;13:844-54.
11. Ramenofsky ML, Ramenofsky MB, Jurkovich GJ, Threadgill D, Dierking BH, Powell RW. The predictive validity of the Pediatric Trauma Score. J Trauma 1988;28:1038-42.
12. Lecuyer M. Calculated Decisions: Pediatric Trauma Score (PTS). Pediatr Emerg Med Pract 2019;16:3-4.
13. Pollack MM, Ruttimann UE, Getson PR. Pediatric risk of mortality (PRISM) score. Crit Care Med 1988;16:1110-6.
14. Leteurtre S, Martinot A, Duhamel A, Gauvin F, Grandbastien B, Nam TV, et al. Development of a pediatric multiple organ dysfunction score: use of two strategies. Med Decis Making 1999;19: 399-410.
15. Kirkpatrick AW, Roberts DJ, De Waele J, Jaeschke R, Malbrain ML, De Keulenaer B, et al. Intra-abdominal hypertension and the abdominal compartment syndrome: updated consensus definitions and clinical practice guidelines from the World Society of the Abdominal Compartment Syndrome. Intensive Care Med 2013;39:1190-206.
16. Rasulo FA, Bertuetti R. Transcranial Doppler and optic nerve sonography. J Cardiothorac Vasc Anesth 2019;33(Suppl 1):38-52.
17. Drayna PC, Abramo TJ, Estrada C. Near-infrared spectroscopy in the critical setting. Pediatr Emerg Care 2011;27:440-2.
18. Wohlgemut JM, Morrison JJ, Apodaca AN, Egan G, Sponseller PD, Driver CP, et al. Demographic and geographical characteristics of pediatric trauma in Scotland. J Pediatr Surg 2013;48:1593-7.
19. Öztan MO, Anıl M, Anıl AB, Yaldız D, Uz İ, Turgut A, et al. First step toward a better trauma management: Initial results of the Northern Izmir Trauma Registry System for children. Ulus Travma Acil Cerrahi Derg 2019;25:20-8.
20. Yousefzadeh Chabok S, Ranjbar Taklimie F, Malekpouri R, Razzaghi A. Predicting mortality, hospital length of stay and need for surgery in pediatric

trauma patients. Chin J Traumatol 2017;20:339-42.
21. Alonge O, Hyder AA. Reducing the global burden of childhood unintentional injuries. Arch Dis Child 2014;99:62-9.
22. Korkmaz T, Erkol Z, Kahramansoy N. Evaluation of Pediatric Forensic Cases in Emergency Department: A Retrospective Study. Med Bull Haseki 2014;52:271-7.
23. Simon R, Gilyoma JM, Dass RM, Mchembe MD, Chalya PL. Paediatric injuries at Bugando Medical Centre in Northwestern Tanzania: a prospective review of 150 cases. J Trauma Manag Outcomes 2013;7:10.
24. Atike Ongun E, Dursun O. Prediction of mortality in pediatric traumatic brain injury: Implementations from a tertiary pediatric intensive care facility. Ulus Travma Acil Cerrahi Derg 2018;24:199-206.
25. Mayer T, Walker ML, Johnson DG, Matlak ME. Causes of morbidity and mortality in severe pediatric trauma. JAMA 1981;245:719-21.
26. Serinken M, Ozen M. Pediyatrik yaş grubunda trafik kazası sonucu oluşan yaralanmalar ve özellikleri [Characteristics of injuries due to traffic accidents in the pediatric age group]. Ulus Travma Acil Cerrahi Derg 2011;17:243-7.
27. Anıl M, Saritas S, Bicilioglu Y, Gokalp G, Kamit Can F, Anıl AB. The Performance of the Pediatric Trauma Score in a Pediatric Emergency Department: A Prospective Study. J Pediatr Emerg Intensive Care Med 2017;4:1-7.
28. Melo JR, Di Rocco F, Lemos-Júnior LP, Roujeau T, Thélot B, Sainte-Rose C, et al. Defenestration in children younger than 6 years old: mortality predictors in severe head trauma. Childs Nerv Syst 2009;25:1077-83.
29. Doğan Z, Kukul Guven FM, Cankorkmaz L, Korkmaz I, Coşkun A, Döleş KA. Evaluation of pediatric cases presenting to the emergency department of our hospital because of trauma. Turk Arch Pediatr 2011;46:156-60.
30. Narci A, Solak O, Turhan-Haktanir N, Ayçiçek A, Demir Y, Ela Y, et al. The prognostic importance of trauma scoring systems in pediatric patients. Pediatr Surg Int 2009;25:25-30.