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The Performance of the Pediatric Trauma Score in a Pediatric Emergency Department: A Prospective Study

Pediyatrik Travma Skorunun Çocuk Acil Servisindeki Performansı: İleriye Yönelik Bir Çalışma

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Abstract

Introduction: The aim of this study was to assess the efficacy of the Pediatric Trauma Score (PTS) in predicting significant trauma in patients presenting with blunt trauma to a high-level pediatric emergency department.
Methods: Patients younger than 15 years of age presenting to the pediatric emergency department of the Tepecik Training and Research Hospital with acute high-energy blunt trauma were analyzed prospectively. The PTS was calculated on arrival at the pediatric emergency department. The patients were classified into two groups as follows: patients with a PTS of ≤8 comprised the significant trauma group, while patients with a PTS of >8 made up the non- significant trauma group.
Results: Two-hundred-thirteen children with a mean age of 6.1±3.9 years (range: 10 days-15 years) were included in the study. The frequency of coagulation testing and thorax computed tomography in the pediatric emergency department, need for critical interventions and therapies in the pediatric emergency department, rate of hospitalization, need for transfer to the pediatric intensive care unit, mechanical ventilation, operation, blood transfusion, and mortality rate were statistically higher in the significant trauma group (p<0.05). PTS ≤8 exhibited a sensitivity of 56.2% and a specificity of 90.8% for hospitalization (AUROC: 0.682; 95% confidence interval: 0.610-0.755). The PTS was significantly correlated with length of hospital stay (r=-0.493; p<0.001) and length of observation in the pediatric emergency department (r=-0.442; p<0.01).
Conclusion: PTS on arrival at a high-level pediatric emergency department is a good predictor of the need for critical interventions/therapies and mortality in children with high-energy blunt trauma. However, its accuracy is moderate for the prediction of hospitalization.
Keywords: Pediatric Trauma Score, high-energy trauma, mortality, hospitalization

Öz

Amaç: Çalışmanın amacı, üst düzey bir çocuk acil servisine künt yüksek enerjili travma nedeniyle başvuran çocuklardaki ciddi travmayı öngörmede, Pediyatrik Travma Skoru'nun (PTS) etkin olup olmadığının araştırılmasıdır.
Yöntemler: Akut künt yüksek enerjili travma nedeniyle Tepecik Eğitim ve Araştırma Hastanesi'ne başvuran 15 yaşından küçük çocuklar ileriye yönelik olarak incelendi. PTS yaralı acil servise geldiği anda hesaplandı. Hastalar iki gruba ayrıldı: PTS ≤8 (ciddi travma) ve PTS >8 (ciddi olmayan travma).
Bulgular: İki yüz on üç çocuk (ortalama yaş: 6,1±3,9 yıl; en küçük: 10 gün - en büyük: 15 yıl) çalışmaya alındı. Acil serviste koagülasyon testi ve toraks tomografisi sıklığı, acil serviste kritik girişim ve tedavi gereksinimi, hastaneye yatış oranı, yoğun bakım gereksinimi, mekanik ventilatör gereksinimi, ameliyat, kan transfüzyonu, ölüm sıklığı PTS ≤8 grubunda daha fazlaydı (p<0,05). PTS ≤8'in duyarlılığı %56,2; özgüllüğü %90,8 (AUROC: 0,682; %95 CI: 0,610-0,755) olarak hesaplandı. PTS hastanede yatış süresi (r=-0,493; p<0,001) ve acil serviste izlenme süresi (r=-0,442; p<0,01) ile anlamlı korelasyon göstermekteydi.
Sonuç: Künt yüksek enerjili travmadan etkilenmiş çocuklarda, üst düzey bir acil servise başvuru sırasında ölçülen PTS, kritik girişim ve tedavi ihtiyacını ve mortaliteyi öngörmede iyi bir belirteçtir. Fakat hastaneye yatışı öngörmedeki etkinliği orta düzeydedir.
Anahtar Kelimeler: Pediyatrik Travma Skoru; künt yüksek enerjili travma, mortalite, hastaneye yatış

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Introduction

Trauma is the leading cause of death in developed countries. Over 17.000 children and adolescents die annually of unintentional and intentional injuries in the United States.[1] Trauma also comprises up to one-third of all emergency department visits for children under 15 years of age.[2]

Various scoring systems have been developed to predict the severity of trauma and to organize the medical resources. Basically, a trauma patient can be scored in three different ways: the body regions affected by trauma, the mechanism of trauma, and the severity of the trauma. Other classification systems are based on physiology, anatomy, or a combination of the two. There are two primary objectives for trauma classification: namely triage decision support and severity of illness or mortality prediction.[3,4] The scoring systems are often used retrospectively to collect scientific data and to compare institutions with each other or with the same institution over time. Rarely, scoring systems can be used to predict the prognosis in some patients. However, these systems are never a guide to starting critical interventions. The trauma triage systems based on post-accident vital findings, physical examination findings and trauma mechanism are used to identify the hospital where the injured patient is to be transported.[5] An ideal trauma scoring system should be easy to use and should have high predictive power for severe trauma. The validity of the pediatric Glasgow Coma Score (GDC), Trauma Score, Revised Trauma Score, and the Pediatric Trauma Score (PTS) has been proven.[6-8]

Developed in 1987 by Tepas et al.[9] the PTS is patterned after the evaluation process of the Advanced Trauma Life Support (ATLS), and it is specifically designed for the triage of children with traumatic injury.[5] It is the sum of six parameters incorporating size as a surrogate for age and vital signs plus organ-specific injury data.[5] According to the ATLS manual, the PTS correlates well with injury severity. It is useful for paramedics in the field, as well as for doctors in facilities other than pediatric trauma centers.[10] However, it can be a poor predictor of intra-abdominal organ injury for children with isolated blunt abdominal trauma.[11] In addition, in a cost analysis from Turkey, the PTS had no effect on the burden of pediatric trauma in emergency care.[12]

The aim of this study was to assess whether the PTS can predict significant trauma in a pediatric blunt-trauma population in a high-level pediatric emergency department (PED). We also sought to test the triage success of the PTS in PED.

Materials and Methods

This study was conducted prospectively between 07.01.2014 and 06.31.2015 in the PED of the Tepecik Training and Research Hospital in İzmir, Turkey. Our hospital is one of the referral centers in İzmir which is Turkey's third largest city (population: 3.950.000). Furthermore, it is accepted as a pediatric trauma center in İzmir by the Ministry of Health. More than 160.000 children (younger than 15 years of age) visit the PED every year; approximately, 25.000 of them are pediatric trauma patients. Our PED is a pediatric emergency subspecialty training center. All other departments, such as radiology, pediatric surgery, orthopedics, and neurosurgery, are also training clinics and are open 24 h.

Patients younger than 15 years of age presenting to the PED of the Tepecik Training and Research Hospital with acute trauma (within the first 24 h) were evaluated. We assessed the patients in terms of the mechanism of injury and evidence of high-energy impact according to the US 2011 Trauma Field Triage Algorithm[13], the Pediatric Emergency Care Applied Research Network Trial[14], and the Canadian Assessment of Tomography for Childhood Head injury rules[15] (Table 1). Patients with acute high-energy blunt trauma were included in the study. We obtained information about the mechanism of trauma through the medical history of the patients, witnesses of the event, parents or caregivers, the ambulance crew, and police reports. All cases with a high-energy trauma mechanism during the study period were included in the study. A pediatric emergency fellow, who works in the trauma observation unit in the department, filled out the PTS

Table 1. The high-energy impact trauma mechanisms (including criteria) according to the USA 2011 Trauma Field Triage Algorithm(13) and Pediatric Emergency Care Applied Research Network (PECARN) Trial (14), and Canadian Assessment of Tomography for Childhood Head injury (CATCH) rules(15)

Fall[13,14]	<2 years of age: >1 m* ≥2 years of age: >1.5 m or two or three times the height of the child
High-risk auto crash[13]	• Intrusion (interior compartment intrusion, as opposed to deformation which refers to exterior damage) including roof >30 cm**; 45 cm*** at any site • Ejection (partial or complete) from automobile • Death in the same passenger compartment • Vehicle telemetry data consisted with high risk of injury
Auto vs. pedestrian/bicyclist thrown, run over, or significant (>30 km/h†) impact	
Motorcycle crush >30 km/h†	
Head struck by high-impact-object[14]	
Fall from ≥5 stairs[15]	

*: In original guideline, the value is 0.9 m; we adopted the value to the study as 1 m.
**: In original guideline, the value is 30.48 cm (12 inches); we adopted the value to the study as 30 cm.
***: In original guideline, the value is 45.72 cm (18 inches); we adopted the value to the study as 45 cm.
†: In original guideline, the value is >32.2 km/h (20 mph); we adopted the value to the study as >30 km/h

forms. Patients with penetrating injuries, patients with burns, patients who were referred to another hospital, and patients with insufficient medical history concerning the trauma were excluded from the study.

Patient demographic findings (age, sex), clinical characteristics (trauma mechanism, body weight, vital signs, symptoms, physical examination findings), laboratory and radiological results, length of observation in the PED, disposition [admitting details: hospitalization in the ward or the pediatric intensive care unit (PICU), discharge from the PED], interventions/therapies [operation, mechanical ventilation (MV) support, blood or blood product transfusion], length of stay (LOS) in the hospital, and outcome (death or discharge from the hospital) were recorded. The PTS was calculated using the first clinical findings on arrival at our PED for all patients after the disposition from the PED. A PTS of ≤8 was considered severe trauma according to the literature (Table 2)[9,10]. Based on this cutoff point, patients were classified into two groups as follows: patients with a PTS of ≤8 comprised the significant trauma group (STG), while patients with a PTS of >8 made up the non-significant trauma group (NSTG).

The primary outcome measure was the association between in-hospital mortality/hospitalization and the PTS calculated on arrival at our PED. Secondary outcomes included the following: the association between the PTS and the rate of hospitalization in the PICU, the association between the PTS and the rate of MV support, the association between the PTS and the rate of operation, the association between the PTS and the rate of blood/blood product transfusion (Tx), the correlation between the PTS and length of observation in our PED, and the correlation between the PTS and LOS. All work was conducted in accordance with the principles of the Declaration of Helsinki and was approved by Tepecik Training and Research Hospital (19.06.2013/51/8) institutional review board.

Study databases were evaluated using SPSS 20.0 (SPSS Inc., Chicago, IL). Categorical variables were expressed as numbers (*n*) with percentages (%); these were compared using the chi-squared or Fisher's exact tests, as appropriate.

Table 2. The Pediatric Trauma Score

Clinical Parameter	Score -2	+1	+2
Weight (kg)	<10	10-20	≥20
Airway	Unmaintainable	Maintainable	Normal
Systolic blood pressure (mmHg)	<50	50-90	≥90
Central nervous system	Coma or decerebrate	Obtunded/Loss of consciousness	Awake
Open wound	Major/penetrating	Minor	None
Skeletal	Open/multiple fractures	Closed fracture	None

Correlations were sought using Spearman's rank test. The receiver operating characteristic (ROC) curve of the PTS was constructed to identify predictor of hospitalization and/or mortality in the PED. The area under the ROC curve (AUROC) was determined for PTS ≤8. A p value of less than 0.05 was considered statistically significant.

Results

Between 07.01.2014 and 31.06.2015, 213 children with high-energy impact trauma mechanisms who presented to the PED were included in the study. The mean age was 6.1±3.9 years (range: 10 days-15 years); 143 (67.1%) of the patients were male. The etiologies of the high-energy trauma were high-risk auto crash (93 patients, 43.7%), falling from a height (74 patients, 34.7%), auto vs. pedestrian impact (21 patients, 9.9%), auto vs. cyclist impact (11 patients, 5.2%), motorcycle crash (five patients, 2.3%), falling down stairs (five patients, 2.3%), and head struck by high-impact object (four patients, 1.8%). 168 patients (78.9%) arrived at our PED by ambulance.

According the radiological examination in the PED, 108 patients (50.7%) had abnormal findings, and 31 of them (14.6%) had multiple trauma. The findings were as follows: traumatic brain injury (72 patients, 33.8%), extremity fracture (38 patients, 17.8%), intra-abdominal injury (13 patients, 6.1%), intrathoracic/chest wall injury (12 patients, 5.6%), genitourinary injury (four patients, 1.9%), and spinal cord injury (two patients, 0.9%). Hundred and five patients (49.3%) were hospitalized. According to the disposition type from the PED, 73 (34.3) were hospitalized in the ward and 25 (11.7%) were hospitalized in the PICU. Seven patients (3.3%) were admitted to the operating room directly from

Table 3. The comparison of the rates of laboratory tests, radiological tests, and the number of consultation between significant trauma group (Pediatric Trauma Score ≤8) and non-significant trauma group (Pediatric Trauma Score >8)

Parameter, n (%)	Total	STG n=69	NSTG n=144	p
CBC (+),	206 (96.7)	67 (97.1)	139 (96.5)	>0.999
Basic biochemistry tests (+)	207 (97.2)	67 (97.1)	140 (97.2)	>0.999
Coagulation tests (+)	177 (83.1)	65 (94.2)	112 (77.8)	0.003
Blood gas analysis	171 (80.3)	54 (78.3)	117 (81.2)	0.608
X-ray (+)	207 (97.2)	142 (98.6)	65 (94.2)	0.088
Ultrasound (+)	206 (96.7)	64 (92.8)	142 (98.6)	0.038
Cranial CT (+)	208 (98.7)	69 (100)	139 (96.5)	<0.177
Abdominal CT (+)	32 (15)	14 (20.3)	18 (12.5)	0.136
Thorax CT (+)	21 (9.9)	13 (18.8)	8 (5.6)	0.002
Number of consultation, median (IQR)	2 (1-3)	2 (1-3)	3 (2-4)	<0.000

STG: Significant trauma group, NSTG: Non-significant trauma group, CBC: Complete blood count, CT: Computerized tomography, IQR: Interquartile range the PED. In total, 32 (15%) patients required care in the PICU (seven patients were transferred to the PICU from the operating room). Twenty-six patients (12.2%) were intubated and mechanically ventilated. In the study group, 35 patients (16.4%) underwent operations. Blood transfusion was performed in 15 patients (7%; 9 in the PED).

The mean length of observation in the PED was 6.5±0.2 h (3-16); PICU LOS was 5.8±6.4 days (1-34); total LOS was 5.8±7.2 days (2-50). Four patients (1.8%) died in the hospital. Two of them died in the PED (1 h and 30 min after admission to the PED; trauma etiology was auto vs. pedestrian impact in both cases). One patient died in the PICU 12 h after admission (trauma etiology was high-risk auto crash). Another patient died in the operation room four hours after admission (trauma etiology was auto vs. pedestrian impact). All mortalities were related to trauma. The PTS scores for the patients who died were 0, 0, 3, and 4, respectively.

The STG was consisted of 69 patients (32.3%). The rates of coagulation testing and thoracic computed tomography (CT) were higher in the STG ($p<0.05$) in the PED. In contrast, the ultrasound examination rate and the number of consultations were higher in the NSTG ($p<0.05$) (Table 3).

We compared the rates of critical interventions and therapies performed in the PED between the STG and NSTG. In the PED, the rates of bolus fluid therapy, transfusion, cardiopulmonary resuscitation, endotracheal intubation, and hyperosmolar therapy were higher in the STG ($p<0.05$) (Table 4). The rates of disposition types from the PED; need for PICU admission; need for MV, operation, Tx in hospital; mortality; and discharge type (with disability and without disability) were statistically different between the STG and NSTG ($p<0.05$) (Table 5).

The ROC analysis was performed to identify the PTS's prediction of hospitalization. When the cutoff point was ≤8, the PTS exhibited a sensitivity of 56.2% and a specificity of 90.8%. The AUROC for the PTS was 0.682 (95% confidence interval: 0.610-0.755); the p-value was significantly different from the AUROC, at 0.500 (p<0.001) (Figure 1).

We analyzed the correlations between the PTS on arrival and the length of observation in the PED, as well as between the PTS on arrival and the LOS. The calculated PTS on arrival at the PED was significantly correlated with LOS (r=-0.493); (p<0.001) and the length of observation in the PED (r=-0.442; p<0.01).

Table 4. The comparison of the rates of interventions and therapies in emergency department between significant trauma group (Pediatric Trauma Score ≤8) and non-significant trauma group (Pediatric Trauma Score >8)

Parameter, n (%)	Total	STG n=69	NSTG n=144	p
Bolus fluid therapy (+),	7 (3.3)	7 (10.1)	0	<0.001
Tx (+)	9 (4.2)	9 (13)	0	<0.001
CPR (+)	12 (5.6)	12 (17.4)	0	<0.001
Endotracheal intubation (+)	26 (12.2)	24 (34.8)	2 (1.4)	<0.001
Hyperosmolar therapy for intracranial hypertension	36 (16.9)	30 (43.5)	6 (4.2)	<0.001

STG: Significant trauma group, NSTG: Non-significant trauma group, CPR: Cardiopulmonary resuscitation, Tx: Blood/blood product transfusion

Discussion

We explored the accuracy of the PTS for the prediction of significant trauma among children with high-energy impact trauma mechanisms in a pediatric trauma center in Turkey. In the study, we used a specific cutoff value of 8, as in the original study performed by Tepas et al.[7] Since we did not aim to look for a new specific cutoff value for PTS, we performed the analysis using the original cutoff value. The rates of coagulation test and thoracic CT in the PED, interventions and therapies in the PED, hospitalization, need for the PICU, MV, operation, Tx, and mortality were higher in patients with a PTS of ≤8 than in patients with a PTS >8. Furthermore, the PTS was significantly correlated with length of observation in the PED and LOS. However, the prediction power of PTS for hospitalization was moderate. A sensitivity of 56.2% and a specificity of 90.8% were determined for hospitalization.

In the first study on the PTS, Tepas et al.[7,9] determined a statistically significant linear relationship between the PTS and the Injury Severity Score. Following this, its validity was confirmed for predicting mortality, with a sensitivity of 95.8% and a specificity of 98.6% for the PTS.[16] Specifically, a PTS of <3-4 was a significant risk factor for death in children with severe trauma.[17,18] However, its accuracy for the prediction of mortality is still debated.[19-21] In our study, the mortality rate was very low (1.8%), and all deaths occurred in patients in the STG (PTS ≤8). Their PTS scores were four or lower. Despite

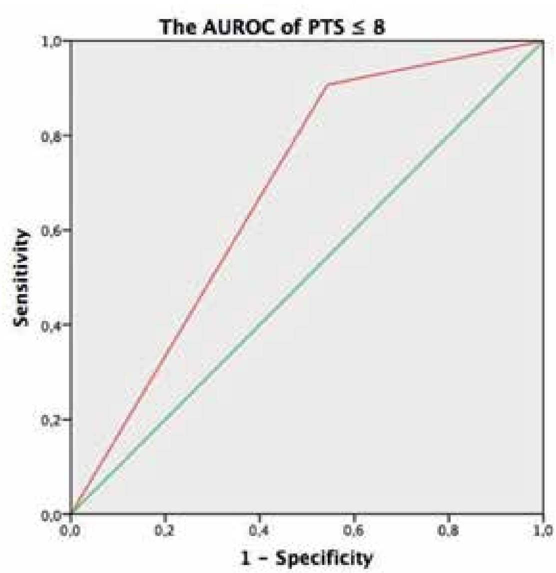

Figure 1. The ROC analysis of Pediatric Trauma Scoring for predicting hospitalization in children with high-energy trauma
PTS: Pediatric Trauma Scoring

studies reporting low PTS as a significant predictor of death. In our view, the low mortality rate may be associated with deaths in the field or in the first admitted hospital (lower level hospital). In Turkey, ambulances usually transfer patients to the nearest hospital. Moreover, the number of air ambulances and heliports are insufficient. There is no heliport at our hospital; the nearest one is 3 km away from the hospital.

The sensitivity and specificity of PTS ≤8 for predicting major trauma have been reported to be 61.5% and 77.3%, respectively.[22] In that study, the authors concluded that the PTS parameters need to be further refined to improve its accuracy. The PTS was determined as an independent predictor of morbidity and PICU need in a study from Turkey. When the authors compared the PTS with other trauma scoring systems, the PTS was not found to be an independent predictor for LOS.[23] In another study from Turkey, the authors investigated the relationship between radiological cost and the PTS. They found that the total cost of radiological imaging was not correlated with the PTS.[24] In our analysis, we investigated the relationships between the PTS and radiological/laboratory investigation rates in the PED. The rates of coagulation testing and thoracic CT were more common in the group with a PTS of ≤8. These results were related to the severity of the injury. Despite this, the rate of ultrasound examination and the number of consultations were higher in the NSTG. We assume that noninvasive ultrasound examination in the observation unit was used more liberally. In addition, some of the noncritical consultations in the NSTG may have been carried out in the observation unit of the PED. More importantly, critical interventions and therapies were more common in patients with a PTS of ≤8 in the PED. As expected, the rates of hospitalization, need for PICU, MV, and Tx need, and operation were more common when the was PTS ≤8.

LOS in hospital increased as the injury severity score increased.[25] In our study, the sensitivity of the PTS for hospitalization was low (56.2%), but the specificity was high

Table 5. The comparison of the rates of hospitalization, pediatric intensive care unit need, mechanical ventilation, operation, blood transfusion, and in-hospital mortality between significant trauma group (Pediatric Trauma Score ≤8) and non-significant trauma group (Pediatric Trauma Score >8)

Parameter, n (%)	Total	STG n=69	NSTG n=144	p
Hospitalization	105	59 (85.5)	46 (31.9)	<0.001
PICU	32	28 (41.2)	4 (2.8)	<0.001
MV	26	24 (34.8)	2 (1.4)	0.001
Operation	35	20 (29.4)	15 (10.6)	0.001
Tx	15	15 (21.7)	0	<0.001
In-hospital mortality	4	4 (1.8)	0	0.010

STG: Significant trauma group, NSTG: Non-significant trauma group, PICU: Pediatric intensive care unit, MV: Mechanical ventilation, Tx: Blood/blood product transfusion

(90.8%). Thus, the accuracy of the PTS for prediction of hospitalization was moderate (AUROC: 0.682). Following the original study on this topic, we used a specific cutoff value of 8 in our analysis.[7] If we were to use a lower score, such as 3 or 4, we would expect better accuracy for hospitalization. Furthermore, the longer observation periods (range: 3-16 h) in our PED may have affected the results for hospitalization rates. These periods were related to the capacity of our department. This study was conducted in a high-capacity PED; if the study was performed in a lower capacity emergency department, a larger group of patients observed in the PED would need hospitalization. Thus, the accuracy of the PTS for hospitalization would be higher.

Length of observation in the PED and LOS are important multifactorial parameters. Confounders, such as waiting for consultants or waiting for test results, can affect the length of observation in the PED. Although our study was not well controlled, we examined the correlations between length of observation in the PED and LOS. In our department, the consultation and test result times are stable. Based on our experiences, we spend a lot of time trying to stabilize the more severe trauma patients. The finding that length of observation in the PED and LOS increased when the PTS decreased was compatible with our experiences. Generally, our results were in agreement with the literature.

The PTS was developed to reflect children's vulnerability to traumatic injury.[7] In our view, the state of PTS ≤8 was more common in patients who needed critical interventions and/or therapies in the PED or hospital. However, some of the children with high-energy trauma needed only observation on the ward for more than 24 h. Due to its characteristics, the PTS could not identify these patients. In addition, the PTS has several deficiencies. First, the systolic blood pressure must be ≥90 mmHg for a full score to be obtained. However, the lower limit of systolic blood pressure is <90 mmHg for children under 10 years of age. Second, open fracture is the lowest score among the skeletal parameters, but this does not include the place of the fracture. For example, an open metacarpal fracture is given the same weight as an open fracture of the femur. Third, blunt trauma is the most common type of injury in children, and most pediatric trauma patients are stable on arrival to the PED. Some of the critical signs such as hemorrhagic shock findings or elevated intracranial pressure signs appear over time. The measured PTS on arrival does not identify children who will develop these signs. Fourth, in childhood, blunt head trauma is common. Most children with blunt head trauma have low GCS scores. The other parameters of the PTS can be within normal limits; thus, the PTS cannot identify these patients. When we evaluate from another perspective, the PTS is a sufficient pediatric triage tool, as its main purpose is to detect only the severe pediatric trauma victims who need the capacity of a pediatric trauma center. Ultimately, perhaps we should not expect anything more from the PTS.

Our study had both strengths and weaknesses. The size of the study group and the prospective character are the strengths of our study. Nevertheless, we could not extrapolate information concerning the success of the PTS in mortality because of the low mortality rate. In our analysis, we did not compare the PTS to other scoring systems. Furthermore, we evaluated only total score of PTS. We did not assess the success of each parameter in a deeper analysis. The correlation between the PTS on arrival at the PED and the Glasgow Outcome Scale score at discharge was not evaluated. Perhaps such an analysis could more accurately depict the relationship between the PTS and trauma morbidity in children. Finally, we excluded patients with penetrating or burn injuries from our analysis. Thus, our results on the PTS cannot be generalized for this patient group.

Conclusion

In conclusion, the PTS on arrival at a high-level PED is a good predictor for the need of critical interventions/therapies and mortality. However, its accuracy is moderate for the prediction of hospitalization in children with high-energy trauma in a high-capacity PED. This result may be related to the nature of the PTS and the capacity of the ED. It was developed with the purpose of detecting the most severe pediatric trauma cases.

This manuscript was reviewed for grammar and style by a native English speaker from Scribendi (online editing and proofreading company).

The access code is: vFNmwRgBmBFt.

Ethics

Ethics Committee Approval: All work was conducted in accordance with the principles of the Declaration of Helsinki and was approved by Tepecik Training and Research Hospital (19.06.2013/51/8) institutional review board.

Peer-review: Internally peer-reviewed.

Authorship Contributions

Medical Practices: M.A., Y.B., G.G., F.K.C., A.B.A., Concept: M.A., Design: M.A., S.S., Y.B., A.B.A., Data Collection or Processing: S.S., Y.B., G.G., F.K.C., Analysis or Interpretation: M.A., S.S., Y.B., A.B.A. Literature Search: M.A., S.S., G.G., F.K.C., Writing: M.A.

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