Predictive Power Of Pediatric Trauma Score (PTS) In Predicting Of Child's Mortality

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Abstract

Introduction: Trauma is a serious global health issue, and children are among the world's most vulnerable victims. Pediatric Trauma Score (PTS) is a rating for the prediction of death in pediatric with trauma. This study aimed to evaluate

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the predictive power of PTS in predicting death in children with trauma.

Materials and Methods: This prospective study was part of a national study to develop a primary model for estimating mortality by adjusting the severity of injury in Iran, which was performed on 92 pediatric trauma participants. To predict the predictive power of PTS, the Area under the Curve (AUC), 95 % confidence interval (95 % CI), sensitivity, specificity, coefficient of determination and, odds ratio was utilized. All tests were carried out with a significance level of 0.05.

Results: The mean age of patients participating in this study was 11.86 ± 4.94 years and 68 (73.91%) of them were male. The most common injury type was trauma to the head and face (53.26%) and the most common cause of trauma was motorcycle accidents (27.17%), respectively. The AUC value for PTS score was 0.911 and its coefficient of determination (R2) was 38%.

Conclusion: PTS is a good score for predicting trauma death in children in Iran. PTS can be used especially for triage of children with trauma in hospitals.

Keywords

- PTS
- Pediatric
- Traffic Accident
- Wounds and Injury
- Prognostic

Introduction

Trauma is a major public health problem worldwide. Trauma is one of the most common causes of death and disability in the under 60 age group.[1-2] According to the Global Disease Load Model, in 2025 (compared to 1990) traffic accidents, which is one of the leading causes of trauma, will be the sixth leading cause of death in the world. On the other hand, traffic accidents become the third cause of years of life lost and years spent with disability.[3] Trauma is the most common cause of death at the age of 1-44 years and the third most common cause of death regardless of age.[4] Children are one of the most important trauma victims in the world. Items such as children's physiological conditions have put children at higher risk for trauma

complications.[1] Trauma is the cause of about half of all deaths in children.[5] The problem of trauma in children is growing like trauma in other age groups.[4] About 5 to 8 million children die each year from trauma. Approximately 20 % of trauma cases occur in children.[6-7] Trauma is also one of the causes of disability among children.[8-10] A significant proportion of trauma deaths and disabilities occur in developing countries, and children and young people make up a significant proportion of patients.[11] Early identification of children at risk of trauma and emergency treatment for these patients can greatly increase the likelihood of survival rates.[8] Trauma scoring indicators have been used for investigation and improvement of patients trauma care.[12] Accurate prediction of trauma outcomes can identify high risk patients need for emergency clinical services, and improvement of survival by reducing decision time.[13] So far, many indicators and scoring models have been developed for triage of trauma patients.[14] In general, three predictive indicators of trauma such as:

1) physiological indicators
2) anatomical indicators and
3) combined indicators were identified

These indicators are used in pre-hospital and hospital stages and for triage of patients at high risk of death. Many of these indicators are applied to different types of trauma and to all age groups, and some others are specifically tailored to age groups or type of trauma.[15] Pediatric Trauma Score (PTS) has been developed according to the specific physiological conditions of children. PTS consists of the airway status, systolic blood pressure (SBP), central nervous system (CNS), weight, skeletal trauma status and wound status. The index is between 6 and 12: the high-risk group includes people with a PTS score of ≤ 8 and the low-risk group includes people with a PTS score between 9 and 12.[16-17] The PTS index has not been developed based on the information and facilities available in hospitals of Iran and similar countries. Like any other trauma scoring index, the predictive power of the PTS index could be assessed based on the trauma distribution status, patient conditions, and availability of facilities in hospitals.[17] To the best of our knowledge, so far there haven't been any investigations on the predictive power of the PTS in Iran. The major objective of this study was to investigate predictive power of PTS index

in anticipating children's death due to trauma.

Materials and Methods

This study was a prospective study conducted in Haft Tir and Sina hospitals of Tehran and Imam Reza of Tabriz, Iran by census method. This study was part of a national study to design a prototype model for estimating injury-adjusted mortality. Participants of this study included 92 children with trauma who were referred to the mentioned hospitals during the study period (2020-2021).

The participants meeting the inclusion criteria were identified: 1) trauma Patients with age <18 years at time of injury, 2) referred within 24 hours to the emergency department of hospitals and 3) had informed consent to participate in the national study. Participants exclusion criteria were: 1) Patients with >18 years old, 2) late trauma complications and referral 24 hours after the trauma 3) Patients who escaped from the emergency room.

Age was measured based on the chronological time interval based on the patient's birth date information to the time of examination in the emergency department.

Data were collected through a six-part researcher-made checklist including:

1) demographic information
2) underlying diseases
3) type of patient transfer to hospital
4) pre-hospital procedures
5) physiological characteristics
6) anatomical variables

We assessed the validity of the tool by content validity ratios (CVR), average scale-level content validity (S-CVI), item-level content validity index (I-CVI). To evaluate the reliability of the checklist, 45 patients (in all age groups) from the three studied hospitals were evaluated in equal proportions. Content validity for all items of the questionnaire (S-CVI) was equal to 0.93. Spearman correlation was higher than 0.70 for all sections of the checklist.

Statistical analysis Mean, standard deviation, absolute frequency and absolute frequency percentage were used to report descriptive results. Logistic regression, Odds Ratio (OR), Area under ROC curve (AUC) and 95% confidence interval (95% CI) were used to evaluate the predictive power of PTS score. The PTS index was categorized based on a study by Aprahamian et al. Components of the PTS index include: 1) weight kilograms like (> 20 = 2, 10-20 = 1 and <10 = -1), 2)

respiratory status and airway (normal = 2, cannot be opened and maintained = 1 and the airway cannot be opened and maintained = -1), 3) systolic blood pressure SBP (> 90 mm Hg = 2, 90-50 mm = 1 and <50 mm Hg= -1), 4) Central nervous system(CNS) (awake = 2, Obtunded and stunned = 1 and coma = -1), 5) skeletal trauma status (no skeletal trauma =2, suspected or closed Skeletal trauma = 1 and open or multiple Skeletal trauma = -1) and 6) wound condition (no sores = 2, small wounds = 1 and large wounds - penetrating or burns = -1).[16]

The final PTS score was calculated by summing the scores of all its components using the formula (PTS score= weight + airway status + SBP + CNS + wound status +skeletal trauma status). The PTS score is between -6 and 12. Patients with a score between 9-12 are in the mild trauma group (at low risk of death) and patients with a score of ≤ 8 are in the severe trauma group (at high risk of death).[16] Follow-up of patients up to 30 days after the first examination of patients in the emergency department was performed. All analyzes were performed using STATA version 14 software at a significance level of 0.05.

Results

This study investigates 92 children with trauma. The mean age of patients was 11.86 ± 4.94 years. The most common injuries were in the head and face (49 cases (53.26%)). The most common cause of trauma was motorcycle accident 25 (27.17%). Mean and standard deviation of systolic and diastolic blood pressure in patients was 111.5 ± 16.92 and 71.1 ± 13.15, respectively. By the end of the 30th day of follow-up, 5 patients (5.43 %) died. Two of the deceased patients (40.00 %) were in the age group of 0-7 years and 3 (60.00%) were in the age group of 13-18 years. four of them (80.00 %) were male and one (20.00 %) was female. In terms of anatomical location of the injury among them: all patients (100.00%) had head and face, 2 patients (40.00%) neck, 2 patients (40.00%) thoracic and 4 Patients (80.00%) had abdominal or pelvic or spinal injuries **Table 1.**

Table 1: Distribution of contextual variables and factors related to trauma among patients

Background Variables					
Variable	category	Absolute frequency (%)	Variable	category	Absolute frequency (%)
Age	0-7	21 (22.83)	Trauma outcome	survivor	87 (94.57)
	8-12	18 (19.57)		Death	5 (5.43)
	13-18	53 (57.61)			
Gender	Male	68 (73.91)	Previous medical history	Yes	2 (2.17)
	female	24 (26.09)		No	90 (97.83)
Prehospital measures and variables related to the occurrence of trauma					
Variable	category	Absolute frequency (%)	Variable	category	Absolute frequency (%)
Status of the day of the accident	Holiday	17 (18.48)	Type of patient referral to the studied hospitals	Direct from the scene of the trauma	73 (79.53)
	Work day	75 (81.52)		Transfer from other medical centers	19 (20.65)
Neck protection (hard Clare)	Yes	38 (41.30)	Perform infusion protection	Yes	56 (60.87)
	No	54 (58.70)		No	36 (39.13)
Pelvic protection	Yes	1 (1.09)	Limb protection	Yes	21 (22.83)
	No	91 (98.91)		No	71 (77.17)
Perform respiratory protection	No protection	73 (79.35)			
	face mask	7 (7.61)			
	Bag Mask	0 (0.00)			
	Nasal protection	3 (3.26)			
	Bag tube	8 (8.69)			
	Ventilator	1 (1.09)			
The site of injury					
Location of injury	Status of injury	Absolute frequency (%)	Location of injury	Status of injury	Absolute frequency (%)
	Yes	49 (53.26)		Yes	11 (11.95)

Head and face injury	No	43 (46.38)	Elbow and forearm injuries	No	81 (88.05)
Neck injury	Yes	8 (8.69)	Wrist injury	Yes	8 (8.69)
	No	84 (91.31)		No	84 (91.31)
Thoracic and thoracic injury	Yes	12 (13.04)	Thigh and hip joint injury	Yes	4 (4.35)
	No	80 (86.96)		No	88 (95.65)
Injury to the abdomen, pelvis and spine	Yes	8 (8.69)	Knee and leg injuries	Yes	21 (22.82)
	No	84 (91.31)		No	71 (77.18)
Shoulder and arm injuries	Yes	5 (5.43)	Ankle injury	Yes	5 (5.43)
	No	87 (94.57)		No	87 (94.57)
Section 4: Mechanism and cause of trauma					
Variable	category	Absolute frequency (%)	Variable	category	Absolute frequency (%)
	Passenger accident	19 (20.65)	Mechanism of trauma	Blunt	80 (86.96)
	Bicycle accident	4 (4.35)			
	Motorcycle accident	25 (27.17)			
	Light passenger car accident	13 (14.13)			
	Fall or slip	16 (17.39)			
	Exposure to mechanical force	3 (3.26)		Unblunt	12 (13.04)
	Intentional self-harm or suicide	3 (3.26)			
	Injury from rape or assault	6 (6.52)			
	Unintentional accidents	2 (2.17)			
	Other factors	1 (1.09)			
Total		92 (100)	Total		92 (100)

There was a significant relationship between of head and face injury (p-value <0.000), thorax or chest injury (p-value = 0.008) and neck injury (p-value = 0.036) with trauma death in children. PTS index predicts trauma mortality significantly (p-value <0.000). This index predicts 38% (R2 = 0.3855) of changes in the dependent variable, i.e. death due to trauma in children. The AUC value for the PTS index was 0.911 (95% confidence interval AUC = 0.99 - 0.81) **Figure 1.**

This study did not detect any evidence for relationship between the variables of age, gender (p-value = 0.710), cause of trauma (p-value = 0.223), mechanism of trauma (p-value = 0.617), injuries of abdomen or pelvis or spine (p-value = 0.433), shoulder and arm (p-value = 0.617), wrist (p-value = 0.434), Hip joint or thigh (p-value = 0.127), knee or leg (p-value = 0.939), ankle (p-value = 0.247) and injury to various parts of the body with mortality.

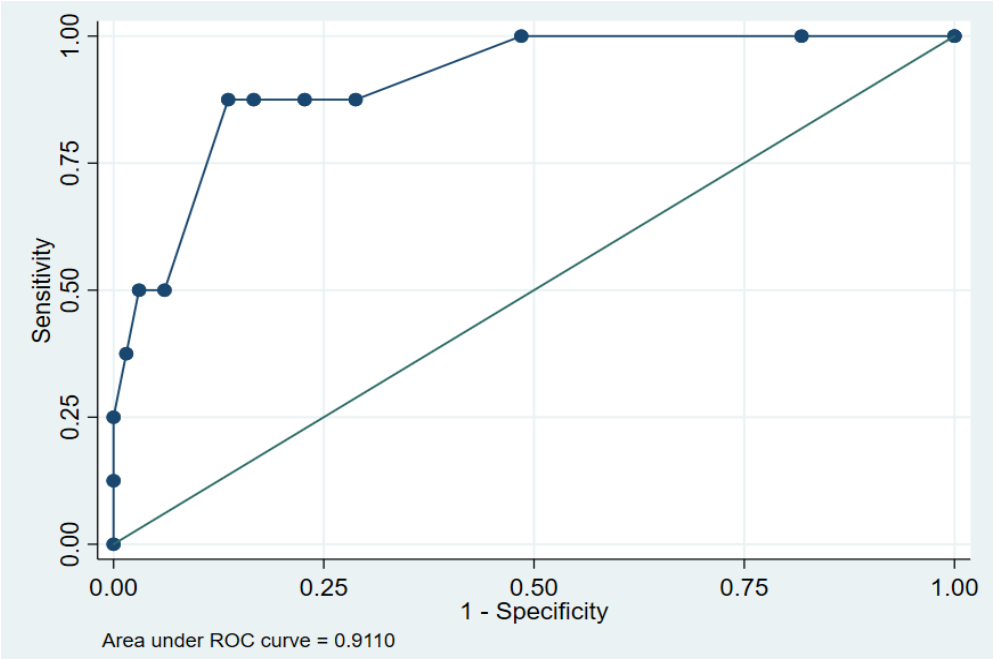

Figure 1: PTS index rock curve

for PTS index, it was found that at the cut point of PTS 0.05, sensitivity and specificity is equal to 87.50% and 86.36%, respectively **Table 2.**

Table 2: Evaluation of PTS diagnostic indices at the cut-off point of 0.0

Index name	Index value%
Sensitivity (Sen)	87.50
Specificity (Spe)	86.36
Predictive Value Positive (PPV)	43.75
Negative Value Positive (NPV)	98.28
Classification accuracy	86.49

Discussion

The mean age of patients participating in this study was 11.86 ± 4.94 years and 73.91% of patients were male. In other studies, respectively, the mean age of patients was 6.62 ± 4.16 years and 62.10% of patients were male and there was a significant relationship between age and trauma mortality (p-value = 0.04), but there was no significant relationship between gender and trauma outcome (p-value = 0.915).[4] In another study they reported that 66.70% of these patients were male.[18] Panahi et al. reported that in their study the age of patients were 11.30 ± 3.60 years.[19] In a study of children with trauma, Sharma and colleagues reported that the ratio of boys to girls was 9.1.[20] In a study by Karbakhsh et al., it was reported that 69.10% of children with trauma were male.[21] In the study of Vijay Kumar Kundal et al., 69.86% of trauma cases occurred in trauma was 9.50 years and 67.20% of patients were male.[11] In a study of children with trauma in Afghanistan and Iraq, it was reported that most cases were in the age group of 5-9 years and 77.10% were male.[22] In the study of Jalalvandi et al., it was reported that there was no significant relationship between gender and trauma injury of children (p-value = 0.122).[23] Similar results to our study were obtained in other studies.[6-11-20-23] These studies are all consistent with our study and may indicate that male children, like adults, are more at risk of trauma than females. This higher risk of trauma in male children may be due to the greater independence of male children. Considering that gender was not significantly associated with trauma mortality in our study, and above-mentioned studies, about 70.00% of trauma cases occur in male children, it can be

trauma. Therefore, the gender variable cannot be used to predict the death due to trauma in children.

The most common causes of trauma in our study were motorcycle accidents (27.17%), pedestrian accidents (20.65%) and falls (17.39%), respectively. In the study of Asadi et al., The most common cause of trauma in the children under study was a fall with 259 cases (40.40%).[4] In a study by Memarzadeh et al., it was reported that the most common causes of trauma among children with trauma examined by him were falls 736 (32.00), car accident 713 (31.10%) and motorcycle accidents 358 (15.60%).[18] Sharma et al. Reported that the most common cause of trauma in the children studied was falls (39.40%) and traffic accidents (27.80%).[20] In the study of Vijay Kumar Kundal et al., It was reported that the most common cause of trauma in male children was road accidents (59.47%) and in female children falls (29.42%).[6] Jalalvandi et al. Also reported that the most important cause of trauma in the children studied was falls (65.50%) and traffic accidents (16.40%).[23] These studies were almost consistent with our study and show that the most important cause of trauma in children is falls and traffic accidents, but since our study found that there is no significant relationship between death from trauma and the cause of trauma in children. Therefore, the cause of trauma does not seem to be a good variable to predict death due to trauma.

The most common injured anatomical organ among the patients evaluated in our study was head and face injury and there was a significant relationship between head and face, thoracic or chest and neck injuries with trauma mortality in children. In the study of Asadi et al., It was reported that the most common anatomical site of injury among trauma children was head injury (71.20%).[4] In the study of Memarzadeh and her colleagues, it was reported that the most common anatomical organ of injury for patients was head and neck injury (886 cases (38.52%)).[18] In the study of Jalalvandi et al., the most common anatomical sites of injury were upper limbs (36.80%), head and neck (31.20 %) and lower limbs (16.80 %), respectively.[23] In the study of Solari et al., It was reported that the most common anatomical location of trauma in children is head and face injuries (35.60 % in pre-school age, 43.00% in school age) and neck injury (33.40 % in pre-school age and 66.60 % school age) .[1]

The injured anatomical location was not significantly associated with trauma mortality in our study. However, in the study of Asadi et al., it was reported that there was a significant relationship between the anatomical location and trauma mortality in children (between chest injury (p-value = 0.014)) and injury to other organs (0.032 p-value) with death from trauma.[4] The results of the studies were consistent with our study and showed that children with injuries to the head, face, neck, thorax or chest are at higher risk of death, so treatment staff should pay more attention to these patients. In our study, 62.5% of children with trauma eventually died within a month of follow-up. In the study of Asadi et al., 11 children with trauma (1.70%) had died.[4] In the study of Memarzadeh et al., It was reported that 4.10% of children with trauma had died.[18] Vijay Kumar Kundal et al. Reported that 57.5% of children with trauma had died.[6] These studies were almost in line with our study. Given that the results of previous studies on the distribution of age, gender, cause of trauma and other variables were almost close to our study, it can be said that the patients evaluated in our study can be a good representative of the community of children with trauma and results of our study can be generalized to the community of children with trauma. However, since the percentage of deaths due to trauma in children in different societies is slightly different, it seems that a study with a larger sample size should be done in the country to achieve more accurate results. In our study, the AUC for PTS was 0.911 and its sensitivity and specificity were 87.50% and 86.36%. In a study conducted by Sultanoğlu et al. (2018), it was reported that the AUC for PTS was 0.957 and its sensitivity and specificity were 90.70% and 90.40%, respectively.[24] In a 2014 study by Fieber, the AUC for the PTS index for predicting death from trauma was reported to be 0.996.[25] A study conducted by Ziaee and Mirafzal in 2016 found that the PTS index significantly predicted death from trauma.[26] A study by Cantais et al. found that the PTS index significantly predicted death from trauma.[27] In a study conducted by Abdelhady Essa et al, the AUC, sensitivity and specificity for the PTS index were reported to be 0.940, 95.80% and 98.60%, respectively. They also find that the PTS index significantly predicts death due to trauma.[28]

Conclusion

Based on the results of this study and the reviewed studies, it can be concluded that PTS has a good predictive power for predicting mortality due to trauma in Iranian children. We recommend that PTS can be used to evaluate children with trauma in Iranian hospitals. The PTS index is more applicable to the initial triage of pediatrics' trauma. In order to a more detailed investigation of quality of service and death audits, using more accurate combined indicators such as the TRISS index which don't have weight limitation, can be used. Since the sample size in our study was small, a study with a larger sample size should be conducted to investigate the use of PTS in Iran in order to draw more decisive conclusions about the use of PTS for Iranian children.

Ethical Consideration

This study was approved by Institutional Ethics Committee of Tabriz University of Medical Sciences with code number IR.TBZMED.REC.1396.999 and the project of the master's thesis in the field of epidemiology was with the project number 61281.

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Conflict of interests

We declare that this study was not in conflict of interest with any organization or individual or legal entity.

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