The Egyptian Journal of Hospital Medicine (October 2024) Vol. 97, Page 3510-3514

Pediatric BIG Score versus Pediatric Trauma Score in Prediction of Mortality in Pediatric Polytrauma

Gehad Abdullah Mohamed[1], Amr Samir ElSaid[2], Mohamed El-Said Ahmed[1], Samir Mohammed Attia[3]
Departments of [1]Emergency Medicine, [2]General Surgery and
[3]Vascular Surgery, Faculty of Medicine, Mansoura University, Egypt
***Corresponding author:** Gehad Abdullah Mohamed, **Mobile:** (+20) 01005990100, **E-mail:** gehadnour7322@gmail.com

ABSTRACT
Background: Traumatic injury remains a main cause of death in the pediatric population. The pediatric trauma score (PTS) was designed to reflect the children's liability for traumas. The pediatric BIG score could be conducted immediately on admission to assess the degree of injury and to predict mortality in traumatized children.
Objective: This study aimed to compare pediatric BIG score with PTS in predicting mortality in pediatric polytrauma.
Patients and methods: This was a prospective comparative study conducted on 50 polytrauma pediatric cases that were admitted to the pediatric emergency department (ED). Entire cases were subjected to primary and secondary surveys. In addition, laboratory and radiological investigations were conducted. Both the pediatric BIG score and the PTS were calculated. The primary outcome was evaluated by the thirty-day mortality.
Results: There was a statistically significant difference between mortality and PTS. There was a statistically significant difference between mortality and mechanical ventilation, Glasgow Coma Score (GCS) and BIG score of the studied cases. BIG score of the studied cases is statistically significant predictors of mortality. BIG score could differentiate between mortality and morbidities among the studied cases with higher sensitivity, specificity and accuracy.
Conclusion: BIG score is a strong predictor of morbimortality in high-energy trauma (HET) among pediatrics. While the PTS score is also a good predictor of morbidity in pediatric HET. The BIG score presents itself as a more helpful and strong predictor because of its early and simpler calculation assets.
Keywords: Pediatric polytrauma, BIG score, Pediatric trauma score.

INTRODUCTION

Trauma is the most critical public health problem in developing nations. Rapid prediction of mortality in trauma cases is very difficult but has essential possible advantages [(1)].

Precise rapid prediction of the mortality risk may have the likelihood to notify triage decisions, or stratify cases for additional care. Particularly, as a prerequisite for clinical studies, it might be attractive to match an interference to a suitable group at risk. In recent years, numerous trauma scores are validated for prediction of patient survival [(2)].

The PTS has emerged as a method of rapid, precise evaluation of the injuries. It is composed of six determinants of the child's state. A grade of +2 (little or no injuries), +1 (mild or potentially serious injuries), or -1 (major or imminent fatal injury) is given to each of the determinants [(3)].

The BIG score [Admission BD (B), INR (I), and GCS (G)] is a scoring system used to predict mortality precisely on admission in the context of children with trauma. It carried out better than different scoring systems in the context of injuries to the pediatric population with higher degrees of sensitivity, specificity, and accuracy [(4)]. Twenty-six points of the BIG score indicate mortality of more than fifty percent. Despite the promising efficacy of the BIG score, the requirement of laboratory analysis for its calculation has been considered the main limitation [(5)].

Of note, the BIG score doesn't require the assessment of blood pressure, pulse, and respiratory rate. The GCS is an easy clinical tool, in contrast, both BE and INR could simply and rapidly be acquired in the ED context [(6)].

This work aimed to compare between the pediatric BIG score and PTS in the context of prediction of mortality in pediatric polytrauma.

PATIENTS AND METHODS

This prospective comparative study was conducted over a period of one year and included 50 polytrauma pediatric cases admitted to The Pediatric ED.

All cases were subjected to primary survey (ABCDE approach), which included airway, breathing, circulation, disability [Random blood sugar (RBG), GCS, signs of lateralization, & pupil] and Exposure. Also, secondary survey from head to toe. In addition, laboratory tests were conducted which included complete blood count (CBC), Arterial blood gas (ABG), prothrombin time, partial thromboplastin time, INR, serum creatinine and liver function tests.

Radiological investigations included Chest X-ray (pelvis, cervical spine), CT of the cervical spine, and focus assisted sonography for trauma (FAST) or extended-FAST. The PTS was measured by using these variables [Table 1] [(5)].

Received: 05/05/2024
Accepted: 03/07/2024

Table (1): Parameters for PTS measurement [5]

Variables	+2	+1	−1
Weight (kg)	>20	12-20	<10
Systolic blood pressure (mmHg)	>90	50-90	<50
Mental status	Awake	LOC	Unresponsive
Airway	Patent	Maintainable	Unmaintainable
Skeletal fracture	None	Closed or suspected	Multiple closed or open
Open wounds	None	Minor	Major or penetrating

Pediatric trauma BIG score was measured by the next formula: (Admission BD) + (2.5×INR) + (15-GCS). The previous equation could after that be applied into a mortality prediction formula: Predicted mortality = 1/ (1 + e−x), in which x=0.2 × (BIG score) − 5.208. The primary outcome was evaluated by the thirty-day mortality.

Inclusion criteria: All pediatric polytraumatized cases between 1 and 18 years old and within one day following trauma were enrolled in the current study.

Exclusion criteria: Cases with age < 1 year old or > 18 years old, cases coming to the hospital following one day 24 h of occurrence of traumas, burns, and electrical shock. Cases with chronic diseases, which include renal dysfunction and hepatic, haematological and neurological diseases.

Ethical approval: The Ethics Committee of Mansoura Faculty of Medicine has authorized this study. Parents provided signed informed permission for their involvement in the study. The study adhered to the Helsinki Declaration throughout its execution.

Statistical analysis

All data were analyzed using SPSS version 20.0. The qualitative data were reported as frequencies and relative percentages. The quantitative data was presented as mean ± SD. Two separate sets of parametric data were compared using the Student t-test, and two independent groups of non-parametric data were tested using the Mann Whitney-U test. To compare categorical data, either the X^2-test or Fisher's exact test was employed, depending on the specifications.

In order to forecast mortality, we employed ROC curve analysis. The Younden index was used to determine the cut-off points for the measured variables, and the computed area under the ROC curve (AUC). A quantitative indicator of the ability of markers to discriminate between two groups, was added. Significance was considered when $P \leq 0.05$.

RESULTS

Table (1) displayed a significant difference between mortality (alive or dead) and pediatric trauma scores of the studied cases (P=0.001 and <0.001 respectively), where dead cases had higher scores.

Table (1): Relation between mortality and pediatric trauma score of the studied cases

	Total N=72	Alive N=67(%)	Dead N=5(%)	Test of significance
Pediatric trauma Score	8 (7-10)	9 (7-10)	-1 (-1, 2)	Z=3.75 P=0.001*
Pediatric risk of mortality score	8 (6-10)	8(6-9)	37 (28.5-42)	Z=3.74 P<0.001*

Z: Mann Whitney U test, *statistically significant.

Table (2) displayed statistically significant difference between mortality (alive or dead) and (mechanical ventilation, GCS and BIG score) of the studied cases (P<0.05). While, there was non-statistically significant relation between mortality (alive or dead) and length of ICU stay (days) (P=0.72).

Table (2): Relation between mortality and mechanical ventilation, length of ICU stay, GCS and BIG score of the studied cases

	Total N=72	Alive N=67(%)	Dead N=5(%)	Test of significance
MV				
-VE	43	43(64.2)	0	FET=7.97
+VE	29	24(35.8)	5(100)	P=0.005*
Length of ICU stay (days)	10.96±4.37	11.01±4.42	10.20±3.83	Z=0.334 P=0.728
GCS	10.94±2.64	11.52±1.61 12(10-13)	3.20±0.45 3(3-4)	t=11.47 p=0.001*
Big score	8.68±6.29	7.12±2.54 6.5 (5.2-8.7)	29.60±3.05 30 (26.5-32.5)	t=18.84 p=0.001*

FET: Fisher exact test, t: Student t test, Z: Mann Whitney U test, *statistically significant.

Table (3) showed that INR and BIG score of the studied cases were statistically significant predictors of mortality (alive or dead) (P=0.005, 0.001 and 0.001, respectively). While, PTS, pediatric risk of mortality score, WBCS, CK, D-Dimer, platelet, base deficit and GCS were non- significant predictors of mortality (P > 0.05).

Table (3): Binary logistic regression for predictors of mortality

	β	P value	AOR (95%CI)
Pediatric trauma Score	11.42	0.993	0.002 (UNDEFINED)
Pediatric Risk of Mortality Score	3.44	0.995	31.27 (UNDEFINED)
WBCS	-0.03	1.0	0.970 (0.004-53.4)
Creatinine kinase (U/L)	0.130	0.994	1.14 (0.002-76.35)
D-Dimer	0.006	0.994	1.01 (0.213-4.75)
Platelet	0.076	0.998	0.98 (0.08-2.58)
Base deficit	8.68	0.996	58.6 (0.002-68.5)
INR	6.27	0.004*	53.2 (7.25-68.25)
GCS	-7.07	0.995	0.001 (UNDEFINED
Big score	3.18	0.01*	24.09 (18.15-30.5)

AOR: adjusted odds ratio

Table (4) displayed statistically significant relation between morbidity and pediatric trauma scores [PTS and pediatric risk of mortality (PRISM) score] of the studied cases (P=0.001), where cases with morbidity had higher scores.

Table (4): Relation between morbidity and pediatric trauma score of the studied cases

	Total N=72	No morbidity N=45(%)	Morbidity N=27(%)	Test of significance
Pediatric trauma Score	8 (7-10)	8.0 (8.0-9.0)	8.0 (5.0-12.0)	z=3.75 p=0.001*
Pediatric Risk of Mortality Score	8 (6-10)	8.0 (6.0-10.0)	8.0 (6.0-12.0)	z=3.74 p=0.001*

Z: Mann Whitney U test, *statistically significant

Table (5) displayed statistically significant relation between morbidity and GCS and BIG score of the studied cases (P<0.001).

While there was non-statistically significant relation between mortality (alive or dead) and mechanical ventilation and length of ICU stay (days)) (P=0.57 and 0.18).

Table (5): Relation between morbidity and mechanical ventilation, length of ICU stay, GCS and BIG score of the studied cases

	Total N=72	No morbidity N=45(%)	Morbidity N=27(%)	Test of significance
MV				
-VE	43	28 (62.2)	15 (55.6)	FET=0.312
+VE	29	17 (37.8)	12 (44.4)	P=0.577
Length of ICU stay	10.96 ± 4.37	11.49 ± 4.04	10.07 ± 4.82	z=1.34 p=0.186
GCS	10.94 ± 2.64	11.80 ± 1.55 12(10-13)	9.52 ± 3.40 10(9-12)	t=3.89 p<0.001*
Big score	8.68 ± 6.29	5.66 ± 1.20 5.7 (5.0-6.6)	13.71 ± 7.98 10.2 (8.9-12.5)	t=6.67 p<0.001*

FET: Fisher exact test, t: Student t test, Z: Mann Whitney U medical test, *statistically significant

Table (6) showed that ischemic heart disease, pediatric risk of mortality score, GCS and BIG score of the studied cases were statistically significant predictors of morbidity (P=0.043. 0.034, 0.005 and 0.02 respectively). While, Pediatric trauma score, CK, D-Dimer and Base deficit were non-statistically significant predictors of mortality (P > 0.05).

Table (6): Binary logistic regression for predictors of morbidity

	β	P value	AOR (95%CI)
Ischemic heart disease			1
-VE (R)	1.16	0.043*	3.19(1.04-9.81)
+VE			
Pediatric trauma Score	0.107	0.329	1.11(0.898-1.38)
Pediatric Risk of Mortality Score	0.156	0.034*	1.17(1.01-1.35)
UREA	-0.05	0.079	0.951(0.899-1.01)
Creatinine kinase (U/L)	0.003	0.391	1.00(0.997-1.01)
D-Dimer	0.001	0.794	1.0(1.0-1.5)
Base deficit	-0.100	0.590	0.905(0.628-1.30)
GCS	-0.467	0.005*	0.627(0.44-0.866)
Big score	20.87	0.02*	2.56(1.2-4.56)

Table (7) showed that BIG score of the studied cases was statistically significant in differentiating mortality and morbidities (P=0.001) at cut off point ≥ 20.90 and ≥ 8.0 respectively) and AUC of the ROC curve for both mortality and morbidity was calculated as 1.0.

Table (7): Validity for BIG score in differentiating outcomes

BIG score	AUC (95%CI)	P value	Cut off point	Sensitivity %	Specificity %	PPV%	NPV%	Accuracy%
In differentiating mortality	1.0 (1.0-1.0)	0.001*	≥20.90	100.0	100.0	100.0	100.0	100.0
In differentiating morbidities	1.0 (1.0-1.0)	0.001*	≥8.0	100.0	100.0	100.0	100.0	100.0

DISCUSSION

The current study aimed to compare pediatric BIG score with PTS in predicting mortality in pediatric polytrauma. The current study included 72 multiple trauma pediatric patients (67 stilled alive and 5 died).

The current study evaluated the mortality and morbidity and their predictors among the included traumatized pediatrics. Regarding mortality, the current study showed statistically significant difference between mortality (alive or dead) and PTS of the studied cases (P=0.001 and < 0.001 respectively), where died cases had lower scores.

Interestingly, the current study found statistically significant relation between mortality (alive or dead) and mechanical ventilation, GCS and BIG score of the studied cases. In contrast, there was non-significant association between mortality (alive or dead) and length of ICU stay (days) (P=0.72). In agreement with our findings, **Kıhtır and Ongun** [7] study evaluated pediatric patients with HET and found non-statistically significant difference between mortality (survivors or non-survivors) and clinical presentation of the studied cases (intra-abdominal hge or intracranial hge) (P=0.6). In contrast, they found a statistically significant difference between mortality (survivors or non-survivors) and BIG score, PTS, GCS and PRISM score of the studied cases (P <0.001), where non-survivors had greater BIG and PRISM scores [7].

The PTS was first conducted by **Tepas *et al.*** [8]. The total PTS ranges between six and twelve and the PTS ≤ eight is regarded as extensive trauma [9]. In disagreement with our findings **Yousefzadeh-Chabok *et al.*** [10] recorded that PTS isn't a significant predictor for the mortality in terms of pediatric traumas. On the other hand, they conducted a ROC analysis and revealed that PTS had good performance (AUC=0.94) for prediction of mortality as recorded in the current study (AUC=0.96).

In harmony, **Kıhtır *et al.*** [7] reported statistically significant difference between mortality (survivors and non-survivors) and laboratory findings (albumin, platelets, D- dimer, base deficit and INR) of the studied cases (P <0.05). In contrast, there was non-significant difference between mortality (survivors and non-survivors) and laboratory findings (CRP, LDH, procalcitonin, creatinine kinase and Lactate dehydrogenase).

Consequently, the current study found that INR and BIG score of the studied cases were statistically significant predictors of mortality (alive or dead) (P < 0.05). In contrast, PTS, PRISM Score, WBCS, CK, D-Dimer, platelets, base deficit, and GCS were non-significant predictors of mortality (P > 0.05). **Hess *et al.*** [11] demonstrated that abnormalities in coagulation profile were significantly elevated with increasing injury severity. **Verma *et al.*** [12] revealed that INR is in fact a good mortality predictor with regard to trauma cases.

The current study is in the same line with a preceding study that confirmed the BIG score as a valid mortality predictor in terms of blunt traumas among the pediatric population [13]. In addition, **El-Gamasy *et al.*** [5] demonstrated that there was a significant elevation in INR of non-survivor cases in comparison with survivor ones, which raises the specificity and accuracy of the BIG score with regard to the mortality prediction.

Likewise, in the context of traumatized adult subjects, **Brockamp *et al.*** [6] displayed that the BIG score is a good predictor of mortality in both blunt and penetrating traumas compared to the different trauma scores, while the penetrating trauma is better.

The current study showed statistically significant relation between morbidity and pediatric trauma scores (PTS and PRISM score) of the studied cases (P=0.001), where cases with morbidity had lower scores. The current study found statistically significant relation between morbidity and GCS and BIG score of the studied cases (P<0.001). Therefore, the current study illustrated that PRISM score, GCS and BIG score of the studied cases were statistically significant predictors of morbidity (P=0.043. 0.034, 0.005 and 0.02 respectively). While, PTS, CK, D-Dimer and base deficit were non-statistically significant predictors of morbidity (P > 0.05).

Finally, the current study showed that BIG score of the studied cases was statistically significant in differentiating mortality and morbidities (P=0.001) at cut off point ≥ 20.90 and ≥ 8.0 respectively with sensitivity, specificity, PPV, NPV and accuracy of 100% for all and AUC of the ROC curve for both mortality and morbidity was calculated as one.

The role of BIG score in ROC curve to predict mortality was evaluated in various research. **Kıhtır and Ongun** [7] found that the AUC of the ROC curve for

mortality was measured as 0.89 and it was recorded that it was better compared to the remaining studied trauma scores. Recently, evidence regarding the role of the BIG score concerning the mortality prediction in pediatric populations with traumas has emerged. **Davis *et al.* [13]** recorded that BIG score could precisely predict mortality in blunt traumas among children. In addition, they displayed that the BIG score was associated with an excellent predictive performance in terms of ICU admitted cases. In the same line, **Muisyo *et al.* [14]** displayed that BIG score had an excellent and similar performance to PRISM-III (0.96), and PIM-II (AUC=0.97). **El-Gamasy *et al.* [5]** reported that BIG score had a significant positive relationship with mortality rate.

CONCLUSION

BIG score is a strong predictor of morbimortality in HET among pediatrics. While the PTS score is also a good predictor of morbidity in pediatric HET, the BIG score presents itself as a more helpful and strong predictor because of its early and simpler calculation assets.

RECOMMENDATIONS

BIG score could be used as an easy strong predictor of morbimortality in the context of high-energy pediatric traumas.

Fund: None.
Conflict of interest: None.

REFERENCES

1. **Maas A, Menon D, Adelson P *et al.* (2017):** Traumatic brain injury: integrated approaches to improve prevention, clinical care, and research. The Lancet Neurology, 16 (12): 987-1048.
2. **Fonarow G (2012):** Clinical risk prediction tools in patients hospitalized with heart failure. Reviews in Cardiovascular Medicine, 13 (1): 14-23.
3. **St-Louis E, Séguin J, Roizblatt D *et al.* (2017):** Systematic review and need assessment of pediatric trauma outcome benchmarking tools for low-resource settings. Pediatric Surgery International, 33: 299-309.
4. **Yoon T, Ko Y, Lee J *et al.* (2021):** Performance of the BIG score in predicting mortality in normotensive children with trauma. Pediatric Emergency Care, 37 (12): 1582-88.
5. **El-Gamasy M, Elezz A, Basuni A *et al.* (2016):** Pediatric trauma BIG score: Predicting mortality in polytraumatized pediatric patients. Indian Journal of Critical Care Medicine, 20 (11): 640-45.
6. **Brockamp T, Maegele M, Gaarder C *et al.* (2013):** Comparison of the predictive performance of the BIG, TRISS, and PS09 score in anadult trauma population derived from multiple international trauma registries. Critical Care, 17: 1-9.
7. **Kıhtır H, Ongun E (2022):** BIG score is a strong predictor of mortality and morbidity for high-energy traumas in pediatric intensive care unit. Turkish Journal of Trauma & Emergency Surgery, 28 (9): 1297. doi: 10.14744/tjtes.2022.42347.
8. **Tepas J, Mollitt D, Talbert J *et al.* (1987):** The pediatric trauma score as a predictor of injury severity in the injured child. Journal of Pediatric Surgery, 22 (1): 14-18.
9. **Kaufmann C, Maier R, Rivara F *et al.* (1990):** Evaluation of the pediatric trauma score. JAMA., 263 (1): 69-72.
10. **Yousefzadeh-Chabok S, Kazemnejad-Leili E, Kouchakinejad-Eramsadati L *et al.* (2016):** Comparing Pediatric Trauma, Glasgow Coma Scale and Injury Severity scores for mortality prediction in traumatic children. Turkish Journal of Trauma and Emergency Surgery, 22 (4): 328-32.
11. **Hess J, Lindell A, Stansbury L *et al.* (2009):** The prevalence of abnormal results of conventional coagulation tests on admission to a trauma center. Transfusion, 49 (1): 34-39.
12. **Verma A, Kole T (2014):** International normalized ratio as a predictor of mortality in trauma patients in India. World Journal of Emergency Medicine, 5 (3): 192.
13. **Davis A, Wales P, Malik T *et al.* (2015):** The BIG score and prediction of mortality in pediatric blunt trauma. The Journal of Pediatrics, 167 (3): 593-98.
14. **Muisyo T, Bernardo E, Camazine M *et al.* (2019):** Mortality prediction in pediatric trauma. Journal of Pediatric Surgery, 54 (8): 1613-16.