Original Research Article

Evaluation of Revised Trauma Score in Polytrauma.

ABSTRACT

Objectives: This study aims to improve the management processes of polytrauma patients by evaluating the Revised Trauma Score (RTS) in predicting trauma outcomes by studying the incidence of mortality, intensive care unit (ICU) need and duration of hospital stay.

Methods: Our study had carried out fifty patients with polytrauma examined at Emergency and Traumatology Department, Tanta University Hospital in the period between beginning of December 2020 to beginning of December 2021. Including all polytraumatized patients with age ≥18 years and excluding patients who arrived dead or who had significant co-morbidity.

Results: The mean RTS value for survival was 7.05 (min-max=5.67-7.84), and was 4.73 (min-max=1.96-6.9) in non-survivals. Mean GCS for survival was 13.1 (min-max=8-15), and was 7.13 (min-max=3-13) in non-survivals.

The mortality prediction of the GCS, RR and SBP were also compared using univariate logistic regression. The OR of the actual GCS score was 0.492 (p <0.001; 95% CI, 0.338 – 0.714). While was 0.940 (p =0.005; 95% CI, 0.910-0.983) for SBP and 0.892 (p =0.023; 95% CI, 0.809 – 0.985) for RR.

When the performances of the RTS in predicting in-hospital mortality was evaluated through ROC analysis, the AUC was 0.919 (95% CI 0.806 to 0.977) (p<0.001)

Conclusion: RTS is a good predictor of prognosis among trauma patients. The lower the RTS is significantly associated with a higher mortality and long hospital stay. Early evaluation of the injury level can be effective in patients' management. The revised trauma score is a reliable indicator of prognosis of polytraumatized patients. Therefore, it can be used for field and emergency room triage.

Keywords: polytrauma score, Revised Trauma Score, polytrauma mortality.

1. INTRODUCTION

Trauma is the commonest cause of death in the first four decades of life, and still, it's a major health problem in all countries, while damage in Egypt is several times higher due to under-reporting and misclassification[1].

Classically, mortality secondary to trauma is described as having a trimodal distribution. The first peak occurs in the first seconds to minutes following trauma due to fatal injuries. The second one occurs minutes to several hours after, resulting in serious, potentially fatal injuries if there is no intensive care. Finally, the third peak occurs several days to weeks after trauma, due to complications such as sepsis and multiple organ failure [2].

There are several trauma scores, with different levels of complexity for practical implementation. The Revised Trauma Score (RTS) is widely used by emergency services around the world. It is classified as physiological, since it takes into

account parameters of the patient's vital functions. This is an improvement of Trauma Score (TS), created in 1981, but without the assessment of capillary refill and respiratory effort [3].

2. PATIENTS AND METHODS

2.1 Study Design

This is a prospective study that conducted at Emergency medicine and Traumatology Department-Tanta University Hospitals. All patients underwent the standard procedures of the protocol.

Our study had carried out fifty patients with polytrauma examined at Emergency and Traumatology Department, Tanta University Hospital.

2.2 Inclusion criteria

All polytraumatized Patients with age ≥18 years are included.

2.3 Exclusion criteria

Patients with pre-existing significant comorbidity: previous stroke, decompensated liver failure, interstitial lung fibrosis,…..

We excluded also those pronounced dead on arrival and patients referred from other hospitals.

2.4 Duration of the study

This study was done in a period of one year from beginning of December 2020 to beginning of December 2021.

2.5 Statistical analysis

Data were collected, coded, revised and entered to the Statistical Package for Social Science (IBM SPSS) version 20. The data presented as numbers and percentages for the qualitative data, mean, standard deviations and ranges for the quantitative data with parametric distribution and median with inter quartile range (IQR) for the quantitative data with non-parametric distribution.

Comparing different methods done by the chi-square test for categorical variables and students test for continuous variables. Variables presenting significant differences between methods in univariate comparison will be entered in step wise Logistics regression analysis. A two-side P-value of less than 0.05 considered statistically significant.

3. RESULTS

3.1 Patient demographics

Fifty Patients were included in the study; 35 of them (70%) were males and 15 (30%) were females with mean age of the whole study population was (33.38) years old. The mean age of males was (33.03) years old with minimum age 18 years old and maximum age 60 years old compared to mean age in females (34.20) years old with minimum age 18 years old and maximum age 66 years old.

3.2 Distribution of patients according to medical and surgical history

When the patients were evaluated by ED physician, 9 patients (18%) have history of cardiovascular diseases, 5 patients (10%) have history of respiratory system diseases and 4 patients (8%) have endocrinal diseases. Surgical history includes: appendectomy in 2 patients (4%), cholecystectomy in 1 patient (2%) and hysterectomy in 1 patient (2%). 27 patients (54%) have no past medical or surgical history.

3.3 Time interval between trauma and hospital arrival

The time interval between trauma and hospital arrival was from 30 minutes up to 4 hours with mean 1.63 ±0.84 hours.

3.4 Different Ways of arrival among study patients

While 35 patients (70%) were transmitted to the hospital by the ambulance,13 patients (26%) were transmitted by a private vehicle and 2 patients (4%) came on foot.

3.5 Mechanism of trauma between study patients

Forty-eight patients (96%) had blunt trauma including 25 patients (50%) with road traffic accident (RTA), 15 patients (30%) falling from height (FFH) and 8 patients (16%) with run over. Penetrating trauma (stab chest) was found in 2 patients (4%).

3.6 Physiological parameters

At the patients' arrivals Glasgow Coma Score (GCS) was ranged from (3 to 15). GCS of 27 patients (54%) was ranged from (13 to 15), 11 patients (22%) was ranged from (9 to 12), 7 patients (14%) was ranged from (6 to 8), 4 patients (8%) was ranged from (4 to 5), 1 patient (2%) was 3.

At the patients' arrivals Systolic Blood Pressure was ranged from (40 to 114) mm Hg. SBP of 24 patients (48%) was more than 89 mm Hg, 13 patients (26%) was ranged from (76 to 89) mm Hg, 9 patients (18%) was ranged from (50 to 75), 4 patients (8%) was ranged from 40-49 mm Hg, no patients (0%) have undetected SBP.

At the patients' arrivals, respiratory rate was ranged from (5 to 38) b/m. Respiratory rate was ranged from (10 to 29) b/m in 32 patients (64%), more than 29 b/m in 15 patients (30%), and was ranged from (6 to 9) b/m in 2 patients (4%), 1 patient (2%) has respiratory rate of 5 b/m, no patients (0%) were apneic.

3.7 Revised Trauma Score calculation

Revised Trauma Score (RTS) is calculated for each patient according to previous physiological parameters by using the formula:

RTS = 0.7326 **SBPv +**0.2908 **RRv +**0.9368 **GCSv**

(v) is the value (0-4) corresponding to the variables of patient physiological parameters.

Table 1: Revised Trauma Score calculation.

Physiological parameter	Value	Coded value	Patients' no	% of patients
GCS	13-15	4	27	54%
	9-12	3	11	22%
	6-8	2	7	14%
	4-5	1	4	8%
	3	0	1	2%
SBP	>89	4	24	48%
	76-89	3	13	26%
	50-75	2	9	18%
	1-49	1	4	8%
	0	0	0	0%
	10-29	4	32	64%

RR	>29	3	15	30%
	6-9	2	2	4%
	1-5	1	1	2%
	0	0	0	0%

GCS: Glasgow coma scale SBP: Systolic Blood Pressure RR: Respiratory Rate

Revised Trauma Score (RTS) was found to be more than 6 in 37 (74%) of patients, less than 6 in 13(26%) of patients (figure 1).

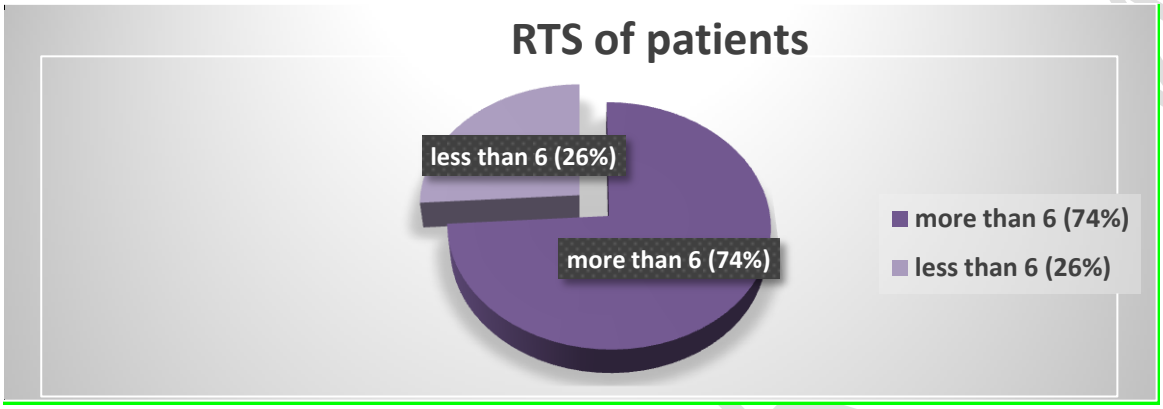


Figure 1: Revised Trauma score of patients

3.8 Radiological findings of studied patients

Table 2: radiological findings of studied patients

4 Radiological modality	Findings	N	%
Ct brain and skull bones	**Normal**	**23**	**46**
	Positive findings	**27**	**54**
Ct chest	**Normal**	**24**	**48**
	Positive findings	**26**	**52**
FAST scan of abdomen and pelvis	**Normal**	**25**	**50**
	Positive findings	**25**	**50**
Pelvis and extremities radiology	**Normal**	**32**	**64**
	Positive findings	**18**	**36**

Ct brain and skull bones radiological findings include:

Extradural hemorrhage (EDH) in 4 patients (8%), subdural hemorrhage (SDH) in 6 patients (12%), subarachnoid hemorrhage (SAH) in 9 patients (18%), fracture skull bones in 13 patients (26%), thalamic contusion in 2 patients (4%), other brain contusions in 5 patients (10%), intracerebral hemorrhage in 3 patients (6%), interventricular hemorrhage in 1 patient (2%), pneumocephalus in 2 patients (4%), brain edema in 2 patients (4%).

Ct chest findings include:

Fracture ribs, lung contusion, hemothorax, pneumothorax, hemopneumothorax, pneumomediastinum.
Twelve patients (24%) had lung contusion, 11 patients (22%) had fracture ribs, 7 patients (14%) had pneumothorax, 5 patients (10%) had hemothorax and the same percentage (10%) had hemopneumothorax, lastly 1patient (2%) had pneumomediastinum.

Ultrasound FAST scan of abdomen findings:

Turbid intraperitoneal free fluid (IPFF) (bloody) ranging from rim to marked, hepatic, renal and splenic injury and pelvic hematoma.

Twenty-five patients (50%) had turbid IPFF, 5 patients (10%) had hepatic injury, 3 patients (6%) had splenic injury, 3 patients (6%) had renal injury and 7 patients (14%) had pelvic hematoma.

Pelvis and extremities radiology findings:

Fracture pelvis in 6 patients (12%), fracture femur in 5 patients (10%). Other bony fractures include fracture humerus, radius, ulna, clavicle, tibia and fibula.

3.9 Surgical interventions

Nine patients (18%) underwent neurosurgical intervention, 5 patients (10%) underwent orthopaedic surgery, 4 patients (8%) underwent abdominal surgery, 2 patients (4%) underwent plastic and vascular surgery and 1 patient (2%) underwent urological surgery. 29 patients (58%) were not operated.

3.10 General characteristics of the patients (table 3)

Characteristics	All (N=50)	Male (N=35)	Female (N=15)
Age*	33.38± 12.83	33.03 ± 12.68	34.20± 13.58
Way of arrival†			
Ambulance	35(70%)	25 (50%)	10(20%)
Private vehicle	13(26%)	9(18%)	4 (8%)
On foot	2(4%)	1 (2%)	1 (2%)
Trauma Type			
Blunt Trauma			
-RTA	25(50%)	17(34%)	8(16%)
-FFH	15(30%)	11(22%)	4(8%)
-Runover	8(16%)	5(10%)	3(6%)
Penetrating Trauma	2 (4%)	2 (4%)	0 (0%)
Physiological parameters			
GCS‡	11.22 (3-15)	11.8 (4-15)	9.8 (3-15)
Respiratory rate*	26.2±7.01	27.63±6.6	22.87±6.98
SBP*	83.84±18.77	83.9±20.52	83.7±14.49
RTS Score ‡	6.30 (1.96-7.84)	6.41(1.96-7.84)	6.06 (2.04-7.84)
Fate			
In-hospital mortality†	16 (32%)	11 (22%)	5 (10%)
ICU admitted†	29(58%)	18(36%)	11(22%)
Ward admitted†	21 (42%)	17 (34%)	4 (8%)
Length of stay (days) *****			
Ward stay†	11.95±6.45	11.0 ± 6.4	17.67 ± .05
ICU stay†	11.55±4.46	12.76±4.62	9.83±3.76
Ward stay after ICU	5.07±1.44	5.0±1.6	5.20±1.3
Mortality			
lived	34 (68%)	24 (48%)	10 (20%)
Died	16 (32%)	11 (22%)	5(10%)

*Presented as mean±SD. †Presented as n (%)., ‡Presented as mean (minimum–maximum).
GCS; Glasgow Coma Scale, RTS; Revised Trauma Score, FFH: Falling From Height,
RTA: Road Traffic Accidents, SBP: Systolic Blood Pressure, ICU: Intensive Care Unit.

3.11 Revised Trauma Score

Depending on the previous results, we analyzed the whole data and make this comparison between survivors who were discharged after their hospital stay and non-survived patients who passed away after they were admitted to ICU (table 4).
There were 34 survived patients (68%) with male percentage of 70.58% and 16 non-survived patients (32%) with male percentage 68.75%.
According to mechanism of trauma; there were 16 survivors and 9 non-survivors in RTA. Whereas there were 10 survivors and 5 non-survivors in FFH, 6 survivors and 2 non-survivors in runover patients. Two patients who had penetrating trauma were all survived.

Comparing all vitals at time of hospital arrival between survivors and non survivors, we found differences in SBP, GCS, heart rate, respiratory rate, temperature, O2 saturation, length of hospital stay and RTS, moreover differences in GCS and RTS between survivors and non-survivors were statically significant (**p-value <0.001**).
The mean RTS value for survival was 7.05 (min-max=5.67-7.84), and was 4.73 (min-max=1.96-6.9) in non-survivals. Mean GCS for survival was 13.1 (min-max=8-15), and was 7.13 (min-max=3-13) in non-survivals (figure 10, 11).
The other two components (SBP, RR) affecting RTS value were non statically significant. The mean SBP in survivors was 89.4 mmhg and 71.9 mmhg in non-survivors, while the mean respiratory rate for survivors was 27.88 and was 22.63 for non-survivors with p-value 0.012 and 0.052 respectively (table 4).

Table 4: Characteristics of survivors versus non-survivors.

Characteristic	Survivors (n=34)	Non-Survivors (n=16)	p-Value
Gender			
Male	24(70.58%)	11(68.75%)	
Female	10(29.42%)	5(31.25%)	**1.000**
Age (years)	33.15 (18-66)	30 (18-60)	**0.762**
Systolic Blood pressure	89.4(95-114)	71.9 (40-112)	**0.012**
Pulse rate	93 (75-109)	102 (80-131)	**0.331**
Respiratory rate	27.88(17-37)	22.63(5-38)	**0.052**
Temperature	36.80 (36.5-37.2)	36.65 (36.4-36.9)	**0.187**
O2 saturation	92 (89-98)	82 (73-95)	**0.778**
GCS	13.1 (8-15)	7.13 (3-13)	**<0.001**
RTS	7.05 (5.67-7.84)	4.73 (1.96-6.9)	**<0.001**
Length of stay (days)	12.76 (4-24)	9.5(5-16)	**0.196**
Trauma Type			
RTA	16 (47.05%)	9(56.25%)	**0.725**
FFH	10(29.41%)	5(31.25%)	
Runover	6(17.64%)	2(12.50%)	
Penetrating	2 (5.88%)	0(0%)	

Data presented as n (%) or mean (minimum–maximum).
GCS; Glasgow Coma Scale, RTS; Revised Trauma Score, FFH: Falling From Height, RTA: Road Traffic Accidents.
[a] Levene's test is significant (p < .05), suggesting a violation of the assumption of equal variances

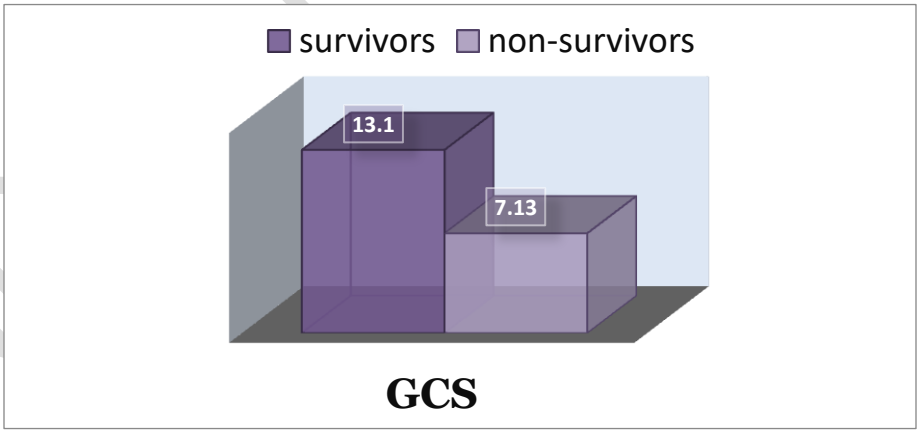


Figure 2: mean Glasgow Coma Score in survivors versus non-survivors.

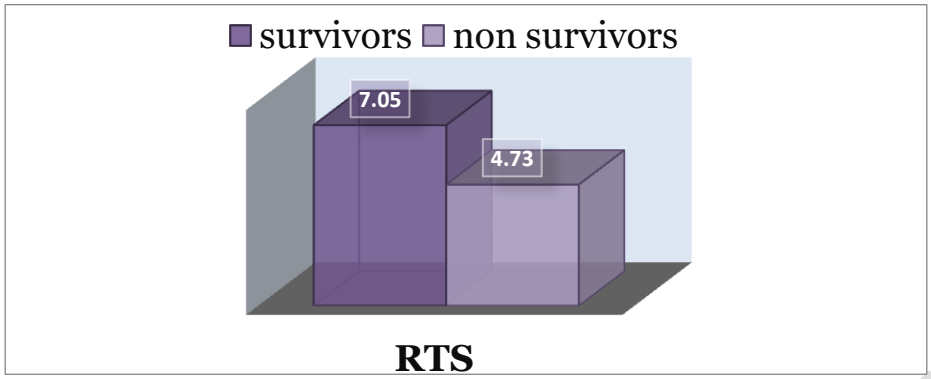


Figure 3: mean Revised Trauma Score in survivors versus non-survivors.

3.12 Univariate and multivariate analysis of Glasgow Coma Score, Systolic Blood Pressure and Respiratory Rate.

The mortality prediction of the GCS, RR and SBP were also compared using univariate logistic regression. The OR of the actual GCS score was 0.492 (p <0.001; 95% CI, 0.338 – 0.714). While was 0.940 (p =0.005; 95% CI, 0.910-0.983) for SBP and 0.892 (p =0.023; 95% CI, 0.809 – 0.985) for RR.

Table 5: Results of Univariate analysis of Glasgow Coma Score, Systolic Blood Pressure and Respiratory Rate.

	OR	P-value	% CI
GCS	0.492	<0.001	**0.338 – 0.714**
SBP	0.940	0.005	**0.910 – 0.983**
RR	0.892	0.023	**0.809 – 0.985**

GCS: Glasgow coma scale SBP: Systolic Blood Pressure RR: Respiratory Rate OR: Odds Ratio
CI: Confidence Interval P-value: Probability Value

Moreover, we made a multivariate logistic regression model in order to predict the in-hospital mortality. The GCS, SBP and RR were entered and only GCS showed significance (p <0.001; 95% CI, 0.289 – 0.717).

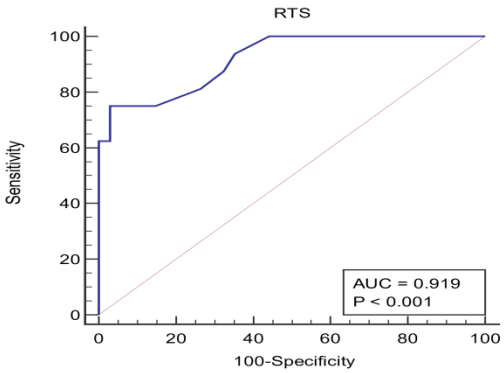
Table 6: Results of multivariate logistic regression analysis of Glasgow Coma Score, Systolic Blood Pressure and Respiratory Rate.

RTS	p-Value	OR	95% CI for OR
GCS	<0.001	0.455	0.289 – 0.717
SBP	-	-	-
RR	-	-	-

RTS: Revised Trauma Score

3.13 ROC analysis of RTS performance

When the performances of the RTS in predicting in-hospital mortality was evaluated through ROC analysis, the AUC was 0.919 (95% CI 0.806 to 0.977) (p<0.001) (Figure 4).



AUC: Area Under Curve

Figure 4: Receiver operating characteristics (ROC) curves for discriminating non-survivors and survivors

In distinguishing the patients who were admitted to ward or ICU, ROC analyses were performed to evaluate the performances of RTS. The AUC was 0.838 (95% CI 0.707 to 0.927) (p<0.001) for the RTS (Figure 5).

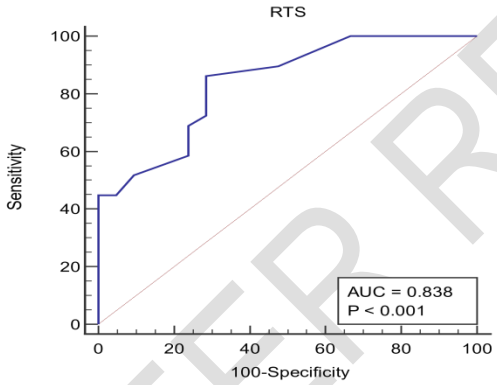


Figure 5: Receiver operating characteristics (ROC) curves for discriminating ward admitted and Intensive Care Unit admitted patients.

4. DISCUSSION

We aimed to improve the management processes of polytrauma patients by evaluating the Revised Trauma Score (RTS) in predicting trauma outcomes by studying the incidence of mortality, intensive care unit (ICU) need and duration of hospital stay.

Our study had carried out fifty patients with polytrauma examined at Emergency and Traumatology Department, Tanta University Hospital in the period between beginning of December 2020 to beginning of December 2021. Including all polytraumatized patients with age ≥18 years and excluding patients who arrived dead or who had significant co-morbidity.

In our study, we found that the mean SBP in survivors was 89.4 mmhg and 71.9 mmhg in non-survivors. Lip, H. et al found the mean SBP for survivors was 126.29 mmhg and 121.9 mmhg for non-survivors[4]. In contrast, other study showed the median SBP in survivors was 133 and 78 mmhg in non-survivors [5].

In our study, the mean respiratory rate for survivors was 27.88 and was 22.63 for non-survivors. Lip, H. et al found the mean respiratory rate for survivors was 20.16 and 21.6 for non-survivors[4]. In contrast, other study showed that the mean respiratory rate for survivors was 19.06 and was 18.16 for non-survivors [6]. Yu, Z, et al found the median respiratory rate was 20 in survivors and was 14 in non-survivors[5]. Different results in mortality according to respiratory rate may be due to different cardiothoracic injuries between study patients and neurosurgical injuries that may centrally affect the respiratory rate even with no cardiothoracic injury.

As regards GCS, we found the mean GCS for survivors was 13.1 and 7.13 for non survivors. In contrast, Attia et al found the mean GCS for survivors was 13.07 and was 12.54 for non-survivors [7]. Lip, H. et al found the mean GCS for survivors was 13.31 and 10.36 for non-survivors[4]. Unlike our study another study showed that GCS in survivors was 9.01, while in non-survivors' group was 4.88, there was a significant increase in GCS in good prognosis patients than the poor prognosis patients (p<0.01)[8]. The significant difference in GCS may be due to different neurosurgical injuries and temporary altered mental status as in post-ictal state.

Regarding mortality, 16 patients (32%) died. This result is in contrast to Singh, A et al who found mortality only 16%cases[9]. Also, Attia, et al found mortality in 25% [7]. This may be due to more neurological and FAST scan positive

findings in percentage of patients that is more than other studies. And this makes significant difference separately in vital signs and in RTS overall.
We found the mean RTS in survivors 7.05 and in non-survivors was 4.73. Singh, A et al found close results that are mean RTS in survivors was 7.24 and 5.14 in non-survivors [9]. Also, Norouzi, et al who found that the mean RTS score in survivors was 7.62 and 5.29 in dead cases [10]. Soni, K. et al reported that the mean RTS in survivors was 7.13 and 4.39 for non-survivors[11]. Javali et al found that the mean RTS in survivors was 7.60 and 5.43 in non-survivors [12]. All mentioned results are close, however small differences are multifactorial including different ages of patients, delay of arrival, different mechanisms of injuries, different systems involved and availability of ICU admission after resuscitation or surgery.

5. CONCLUSION

RTS is a good predictor of prognosis among trauma patients. The lower the RTS is significantly associated with a higher mortality and long hospital stay. Early evaluation of the injury level can be effective in patients' management. The revised trauma score is a reliable indicator of prognosis of polytraumatized patients. Therefore, it can be used for field and emergency room triage.

STUDY LIMITATION

This was a single-center experience and represents a limited number of patients. There was only in-hospital follow-up and longer follow-up periods may show different results.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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