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Original Research Article

A prospective study of trauma patients at Gandhi Medical College and associated hospital emergency department, Bhopal, analysing anatomical and physiological scoring systems to predict mortality

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ABSTRACT

Background: Trauma, in a developing country like India, is a leader together with non-communicable diseases, when measured in terms of disability adjusted life years (DALYs) lost. Trauma scoring systems have been shown to decrease the number of preventable deaths caused by trauma. The aim of this study is to compare the various physiological and anatomical scoring systems.
Methods: Two hundred and sixty two cases of trauma of adult age group admitted in Gandhi Medical College and Hamidia Hospital, Bhopal, Madhya Pradesh, India from 1 July 2014 to 1 December 2014.
Results: Out of the 262 patients included in the study, 242 were discharged alive while 20 (7.6%) died. In our study, in of the patients who died it was observed that RTS was significantly low (<7) and ISS and TRISS were significantly high (>/=25 for ISS and >/=50 for TRISS).
Conclusions: Of all the scoring system TRISS has got the best sensitivity, specificity and positive predictive value of 83.3% and also miscalculation rate of 1.5 as per the MOTS norms as compared to RTS, which has sensitivity of 90% but low specificity, and ISS which has sensitivity and specificity comparable to TRISS but low positive predictive value.

Keywords: DALY, Glasgow Coma Scale, TRISS

INTRODUCTION

Trauma is a global phenomenon and a major cause of morbidity and mortality throughout the world.[1] Trauma is the study of medical problems associated with physical injury.[2] India has the 4th highest rate of road accidents in the world with a reported mortality rates of severely injured patients ranging from 7–45%.[3-5] This variant could reflect real differences in therapeutic results or rely on differences concerning injury severity or age. In view of differences in prognostic variables, an instrument is necessary that considers these differences.[6] Trauma score systems try to translate the severity of injury into a number. The scores enable physicians to translate different severity of injuries into a common language. Quantitative characterization of injury is essential for research and meaningful evaluation of patient outcome, quality improvement, and prevention programs.[7] The development of trauma severity indices has been foremost task of trauma investigators. There are around 50 scoring systems published for the classification of trauma patients. These large number of scoring systems indicate not only the need for such scoring systems but also their shortcomings to meet all requirements. The aim of this study is to compare the commonly used anatomical and physiological trauma scales.

METHODS

Two hundred and sixty two cases of trauma admitted in Gandhi Medical College and Associated Hospital emergency department, Bhopal, Madhya Pradesh, India in the year 2014.

Exclusion criteria

- Patients below the age of 15 years.
- Associated systemic diseases, e.g., congestive heart failure, chronic obstructive pulmonary disease etc.
- Burn patients

Patients were clinically assessed and managed as per the ABC protocol, detailed history was recorded and general physical/systemic examination was done. The following were determined

- RTS (Physiological score)
- ISS (Anatomical score)
- Age
- TRISS (includes RTS, ISS and age)

The revised trauma score (RTS) is made up of a combination of results from three categories; Glasgow coma scale, systolic blood pressure, and respiratory rate. The score ranges from 0-12.

Scoring

RTS variables used for scoring.[8]

Table 1: RTS variables.

Injury	AIS Score
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Unsurvivable

Weights for revised trauma score

GCS- 0.9368
Systolic B.P- 0.7326
Respiratory rate- 0.2908

The sum of these three products is the revised trauma score (RTS).

RTS = 0.9368 (GCSc) + 0.8326 (SBPc) + 0.2908 (RRc)

The injury severity score as calculated by abbreviated injury score (AIS) is a simple numerical method for grading and comparing injury by severity. The AIS is a consensus derived, anatomically based system of grading injuries on an ordinal scale ranging from 1 (minor injury) to 6 (Lethal injury).[9]

The ISS is defined as the sum of squares of the highest AIS grade in the 3 most severely injured body regions. Six body regions are defined, as follows: The thorax, abdomen and visceral pelvis, head and neck, face, bony pelvis and extremities, and external structures. Only one injury per body region is allowed. The ISS ranges from 1-75, and an ISS of 75 is assigned to anyone with AIS of 6.

The trauma score- injury severity score (TRISS) determines the probability of survival (Ps) of a patient from the ISS and RTS using the following formulae.[10, 11]

$$Ps = {}^{1}/_{(1+e^{-b})}$$

Where 'b' is calculated from:

$$b = b0 + b1(RTS) + b2(ISS) + b3(Age\ index)$$

The coefficients b0-b3 are derived from multiple regression analysis of the major trauma outcome study (MTOS) database. Age index is 0 if the patient is below 54 years of age or 1 if 55 years and over.

RESULTS

The performance of RTS, ISS and TRISS as predictors of survival was evaluated using the misclassification rate, the information gain and the relative information gain. This methodology is known as the PER method.[12] The second method is the definitive outcome based evaluation (DEF). In DEF, Flora's Z score quantifies the difference in the actual number of deaths (or survivors) in the test subset and the predicted number of deaths (or survivors) on the basis of the baseline population (MTOS norm). The formula for calculating Z is: Z ¼ D _ qi/piQi, where D is the actual number of deaths, Qi the predicted probability of death for a patient i, qi the predicted number of death and pi the predicted Ps for patient i. When mortality is studied, a negative value of Z is desired, since it implies that the number of deaths predicted from the baseline exceeds the number observed in the test. Therefore, a positive value of Z is desired in case survival is studied. Although the formula for calculation and the sign of Z changes, the absolute value does not. An absolute value of Z, which exceeds 1.96, is required for a significance level of 0.005. The injury severity match between the study and the baseline patient set can affect the Z score. The M score is a measure for that match. Values for M range from 0 to 1 and the closer the value is to 1, the better the match of injury severity. In present study, the value of Z was -3.95. These negative values are indicative of higher mortality observed in our

study than predicted according to the MTOS norm. The M statistic was 0.967 and it represents a good severity match of the patient with MTOS baseline subset.

Table 2: Mortality rate.

Deaths	No of patients	Percent
No	242	92.4
Yes	20	7.6
Total	262	100.0

Table 2 shows that out of 262 patients included in study 242 were discharged alive, while 20 patients expired. In Table 3 the mean RTS of the patient survived was 7.49+0.959 which was significantly higher than those who died (5.8+1.19) with p value <0.001.

Table 3: RTS according to mortality.

Mortality	Mean RTS	Std. Deviation	N
No	7.49	0.959	242
Yes	5.80	1.196	20

P<0.001, RTS was significantly low in died cases (student t test).

Table 4: ISS According to mortality.

Mortality	Mean ISS	Std. Deviation	No of patients
No	13.06	8.124	242
Yes	75.00	0.000	20

P<0.001, ISS was significantly high in died cases (student t test)

Table 5: Predictive/diagnostic indicators.

RTS	Died	Alive	Total
<7	18	68	86
	20.9%	79.1%	100.0%
>7	2	174	176
	1.1%	98.9%	100.0%
Total	20	242	262
	7.6%	92.4%	100.0%
True Positive		18	
True Negative		174	
False Positive		68	
False Negative		2	
Sensitivity		90.0	
Specificity		71.9	
Positive predictive value		20.9	
Negative predictive value		98.9	
Accuracy		73.3	
Miscalculation		26.7	

P<0.001, [chi square test], Mortality significantly high if RTS <7;

As the Table 4 suggests the mean ISS of patient who died was 75 suggesting than any organ injury with maximum AIS score 0/6 was not compatible with survival in our institution. p value <0.001 (significant).

Table 6: Predictive/diagnostic indicators ISS.

ISS	Died	Survived	Total
≥ 25	20	42	62
	32.3%	67.7%	100.0%
<25	0	200	200
	0.0%	100.0%	100.0%
Total	20	242	262
	7.6%	92.4%	100.0%
True positive			20
True negative			200
False positive			42
False negative			0
Sensitivity			100.0
Specificity			82.6
Positive predictive value			32.3
Negative predictive value			100.0
Accuracy			84.0
Miscalculation			16.0

P<0.001, [chi square test], Mortality significantly high if ISS ≥ 25.

Table 7: Predictive/diagnostic indicators TRISS.

TRISS	Died	Survived	Total
≥50	20	4	24
	83.3%	16.7%	100.0%
<50	0	238	238
	0.0%	100.0%	100.0%
Total	20	242	262
	7.6%	92.4%	100.0%
True Positive			20
True Negative			238
False Positive			4
False Negative			0
			TRISS
Sensitivity			100.0
Specificity			98.3
Positive predictive value			83.3
Negative predictive value			100.0
Accuracy			98.5
Miscalculation			1.5

P<0.001, (chi square test), Mortality significantly high when TRISS ≥50.

As per Table 5, taking the cut off RTS as 7, has a good sensitivity of 90% and a negative predictive value of 98.9 suggesting it to be good score for predicting outcome but the accuracy and specificity of the test is low. The ISS score has better sensitivity and negative predictive value of 100% compared to RTS but the positive predictive value is still low.

Of all the scoring system TRISS has got the best sensitivity, specificity and positive predictive value of 83.3% and also miscalculation rate of 1.5 as per the MOTS norms.

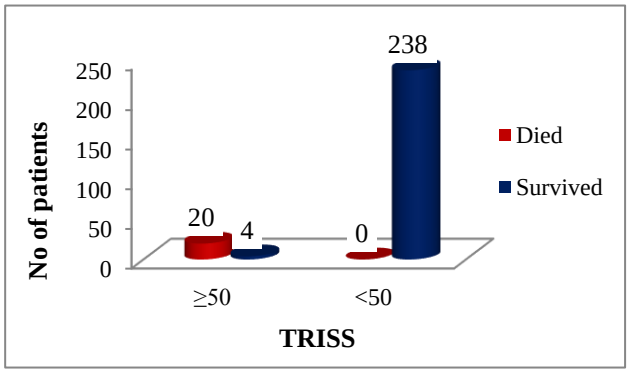

Figure 1: Correlation of TRISS and mortality.

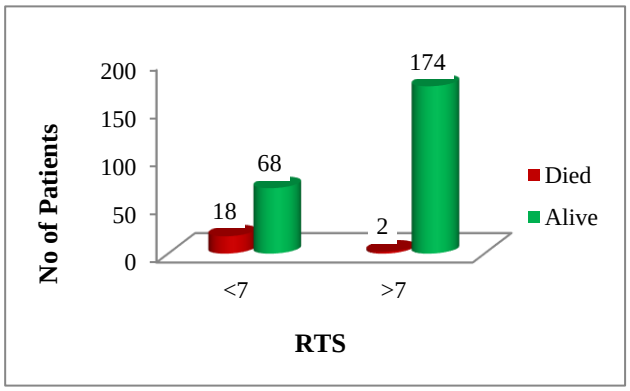

Figure 2: Correlation of RTS and mortality.

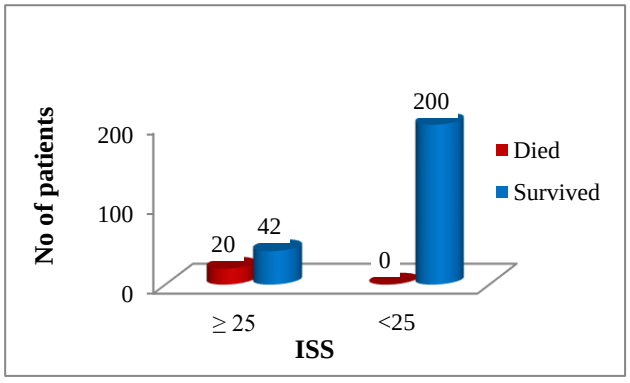

Figure 3: Correlation of ISS AND mortality.

DISCUSSION

Trauma and injury severity score (TRISS), introduced in 1981, is a combination index based on trauma score (RTS), injury severity score (ISS), and patient's age. Champion et al showed that the physiological index in combination with anatomic index and age is a powerful predictor of outcome in trauma patients.[12] Values for the RTS are in the range 0 to 7.8408. The RTS is heavily weighted towards the Glasgow coma scale to compensate for major head injury without multisystem injury or major physiological changes. A threshold of RTS<4 has been proposed to identify those patients who should be treated in a trauma center, although this value may be somewhat low.[10] The ISS score takes values from 0 to 75. If an injury is assigned an AIS of 6 (unsurvivable injury), the ISS score is automatically assigned to 75. The ISS score is virtually the only anatomical scoring system in use and correlates linearly with mortality, morbidity, hospital stay and other measures of severity. Its weaknesses are that any error in AIS scoring increases the ISS error. Many different injury patterns can yield the same ISS score and injuries to different body regions are not weighted. Also, as a full description of patient injuries is not known prior to full investigation & operation, the ISS (along with other anatomical scoring systems) is not useful as a triage tool.[13] The TRISS methodology offers a standard approach for tracking and evaluating outcome of trauma care. Anatomic, physiologic, and age characteristics are used to quantify probability of survival as it relates to severity of injury. %. Comparable performances of the RTS, ISS, and TRISS again showed RTS as the poorest index, while the results of ISS and TRISS were analogous TRISS has a better combination of low misclassification rate with high specificity and better sensitivity. With regards to comparison by PER method, RTS and TRISS performed better than ISS. With a better positive predictive value, TRISS as a combination of physiological and anatomical parameters is a better index to predict mortality and outcome of trauma patients.[14]

CONCLUSION

Numerous scoring systems are available, each having its own limitations. In present study RTS ranged from 2.746 to 7.8408. With mean of 7, RTS has a good sensitivity of 90% and negative predictive value of 98.9% signifying it is a good score to predict outcome, but low specificity of 71.9%. There was a graded increase in mortality with decreasing RTS score. The study of ISS score showed that it has a better sensitivity of 100%, specificity of 82.6% and negative predictive value of 100% than RTS but positive predictive value is still low (32%).There was a graded increase in mortality with increasing ISS scores. The mean ISS of patient who died was 75 suggesting than any organ injury with maximum AIS score 0/6 was not compatible with survival in our institution. TRISS also

revealed similar probability of survival as expected from above values. TRISS has sensitivity and specificity comparable to ISS of100% and 98.3% respectively, but a better positive predictive value of around 83.3.

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