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Original Research Article

Evaluation of trauma outcomes using the trauma and injury severity score at a tertiary care centre: a prospective observational study

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ABSTRACT

Background: Trauma is a leading cause of death among young, economically active people. The trauma and injury severity score (TRISS) combines anatomical injury, physiological status and age to estimate probability of survival (Ps). We assessed its ability to predict in-hospital mortality at a tertiary care centre.
Methods: In this prospective study, 180 adults (≥18 years) with trauma admitted and treated for at least 24 hours over 18 months were evaluated. Glasgow coma scale (GCS), revised trauma score (RTS), injury severity score (ISS) and TRISS Ps were calculated using standard Boyd coefficients and compared with observed outcomes. Discrimination was assessed using the area under the receiver-operating-characteristic curve (AUROC).
Results: The cohort was predominantly young and male (85.6%), with road traffic accidents (60.5%) and blunt trauma (88.9%) predominating. Overall survival was 91.1% and mortality 8.9%. Non-survivors had lower GCS (7.88±3.28 versus 14.52±0.76), higher ISS (35.19±13.24 versus 12.98±7.61), lower RTS (4.60±1.40 versus 7.64±0.46) and lower TRISS Ps (48.1±28.9% versus 98.0±4.0%; all p<0.001). TRISS showed excellent discrimination (AUROC 0.994), with 56.3% sensitivity, 100% specificity, 100% positive predictive value, 95.9% negative predictive value and 96.1% accuracy.
Conclusions: TRISS demonstrated excellent discrimination for in-hospital mortality and may be useful for trauma outcome assessment and audit. Its modest sensitivity suggests potential limitations in identifying some patients at risk of death and supports local validation and recalibration.

Keywords: Trauma, TRISS, Injury severity score, Revised trauma score, Probability of survival, Trauma audit

INTRODUCTION

Injury is among the most pressing public-health problems worldwide and falls most heavily on young, economically active people. Knowing whether a trauma service is performing well requires more than counting deaths; it requires a way to judge outcomes against the severity of the injuries treated. The trauma and injury severity score (TRISS) was designed for exactly this purpose, converting a patient's injuries and physiology into an estimated probability of survival.[1]

TRISS brings three things together: the anatomical burden of injury, captured by the injury severity score (ISS); the physiological state on arrival, captured by the revised trauma score (RTS); and the patient's age, with a separate set of weightings for blunt and penetrating mechanisms.[1-3] The weightings were derived from the major trauma outcome study (MTOS), which set reference norms from a large trauma population and made it possible for a single centre to compare its results with an established benchmark.[1,4]

Because of this, TRISS has been used across both high- and low-resource settings to measure the quality of trauma care and to expose where systems fail.[5,6] It is not without weakness: predictive accuracy shifts from one population to another, and several groups have argued for adjusted models or local validation before the score is relied upon.[6,7] The present study therefore aimed to evaluate trauma outcomes using the TRISS methodology at a tertiary care centre. The specific objectives were to grade injury severity using the RTS and ISS; to estimate the probability of survival and compare it with observed in-hospital mortality; and to assess the value of TRISS for trauma audit and benchmarking of trauma-care performance.

METHODS

Design and setting

This was a prospective observational study run in the department of general surgery of a tertiary care centre over 18 months, enrolling patients referred from the emergency department.

Participants

Adults (≥18 years) of either sex admitted with traumatic injury of any mechanism and treated for at least 24 hours were eligible. Patients treated for under 24 hours, those under 18 years, those brought in dead, and those declining participation were excluded. Written informed consent was obtained from every patient or their legally authorised representative, and the protocol was approved by the institutional ethics committee in keeping with the declaration of Helsinki.[8]

Assessment and management

Each patient underwent primary resuscitation and a standardised evaluation recorded on a structured proforma. Laboratory tests, plain radiography and ultrasonography were performed as indicated, with computed tomography reserved for haemodynamically stable patients; imaging was interpreted alongside the clinical findings. Treatment followed institutional trauma protocols, with specialty input and an individualised choice between conservative and operative care.

Scoring

Consciousness at arrival was graded on the glasgow coma scale (GCS, 3-15).[9] The RTS was computed from the first recorded coded values of GCS, systolic blood pressure (SBP) and respiratory rate (RR).

$$RTS = 0.93(GCS) + 0.73(SBP) + 0.29\,(RR)$$

Injuries were coded on the abbreviated injury scale, and the ISS taken as the sum of squares of the three highest regional AIS scores (0-75).[10,11]

TRISS probability of survival was calculated as follows.

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

Where for blunt injury b=-1.2470+0.9544 (RTS)-0.0768 (ISS)-1.9052 (AgeIndex), and for penetrating injury b=-0.6029+1.1430 (RTS)-0.1516 (ISS)-2.6676 (AgeIndex). AgeIndex was set to 0 for ages ≤54 years and 1 for ages ≥55 years.[1]

Outcomes and analysis

The primary outcome was in-hospital death. Complications, need for operation, length of stay and organ-system involvement were also recorded. Data were entered on a spreadsheet and analysed with standard statistical software. Continuous variables are reported as mean±standard deviation and compared using the independent-samples t-test; proportions were compared using the Chi-square test. Discrimination was quantified by the area under the receiver-operating-characteristic curve (AUROC), and sensitivity, specificity, predictive values and accuracy were calculated at the conventional TRISS cut-off (Ps≥0.50 predicted survival; Ps<0.50 predicted death). A p value below 0.05 was treated as significant.

RESULTS

Who was injured

Of 180 patients, most were young adults aged 21-40 years (55.5%), and the mean age was 35.1±14.4 years. Men greatly outnumbered women (154 versus 26; 85.6%; ratio 5.9:1). Road traffic accidents were the commonest cause (60.5%) and blunt trauma the dominant mechanism (88.9%) (Table 1).

Table 1: Demographic and injury characteristics (n=180).

Characteristics	Category	N	%
Age group (years)	≤20	28	15.5
	21-40	100	55.5
	41-60	39	21.6
	61-80	12	6.6
	>80	1	0.5
Sex	Male	154	85.6
	Female	26	14.4
Mode of injury	Road traffic accident	109	60.5
	Assault	41	22.7
	Stab	16	8.9
	Self-fall	10	5.6
	Bull-horn injury	4	2.2
Mechanism	Blunt	160	88.9
	Penetrating	20	11.1

Outcome and severity

In all, 164 patients (91.1%) survived and 16 (8.9%) died. Those who died arrived older and more severely compromised: their GCS and RTS were markedly lower, their ISS considerably higher, and their TRISS Ps far lower than survivors (Table 2). Mean SBP and RR were lower in non-survivors but did not differ significantly as continuous measures, although the underlying derangement fed into their low RTS.

Table 2: Admission severity in survivors versus non-survivors.

Parameters	Survived (n=164)	Died (n=16)	P value
Age, years	34.03±14.02	44.75±16.86	0.025
GCS	14.52±0.76	7.88±3.28	<0.001
SBP, mmHg	110.89±24.26	89.00±48.41	0.093
Respiratory rate, /min	23.83±2.83	18.44±12.13	0.096
RTS	7.64±0.46	4.60±1.40	<0.001
ISS	12.98±7.61	35.19±13.24	<0.001
TRISS Ps, %	98.0±4.0	48.1±28.9	<0.001

*Values are mean±SD; GCS: Glasgow coma scale; SBP: systolic blood pressure; RTS: revised trauma score; ISS: injury severity score; Ps: probability of survival

Mortality climbed steadily with age, from 3.6% in those aged ≤20 years to 23.1% in those over 60, though the overall association across age bands fell short of significance (χ^2, p=0.092) (Table 3). Blunt and penetrating mechanisms carried similar mortality (χ^2, p=0.286), suggesting that how badly a patient was hurt, rather than how, drove the outcome.

Table 3: Mortality by age group.

Age group (years)	Survived	Died	Total	Mortality (%)
≤20	27	1	28	3.6
21-30	55	3	58	5.2
31-40	39	3	42	7.1
41-50	23	4	27	14.8
51-60	10	2	12	16.7
>60	10	3	13	23.1
Total	164	16	180	8.9

How well TRISS predicted death

Discrimination was near-perfect, with an AUROC of 0.994 (Figure 1). At the Ps=0.50 cut-off, no survivor was wrongly labelled high-risk and every patient labelled high-risk did die (specificity and PPV 100%), while sensitivity was 56.3%, NPV 95.9% and accuracy 96.1% (Table 4). Predicted and observed outcomes were strongly associated (χ^2, p<0.001).

Table 4: Diagnostic performance of TRISS for in-hospital death.

Metrics	Value	Meaning
Sensitivity	56.3%	9 of 16 deaths flagged as high risk
Specificity	100%	No survivor flagged as high risk
Positive predictive value	100%	Every high-risk patient died
Negative predictive value	95.9%	Most low-risk patients survived
Accuracy	96.1%	High overall agreement with outcome
AUROC	0.994	Excellent discrimination

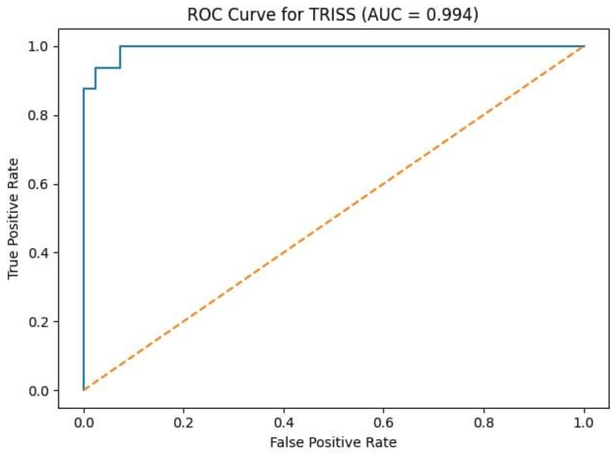

Figure 1: ROC curve of TRISS probability of survival for predicting in-hospital mortality (AUC=0.994).

DISCUSSION

Across 180 patients, TRISS distinguished those who lived from those who died with striking accuracy. The people injured were, for the most part, young men hurt on the roads by blunt force - a picture that recurs throughout Indian and other developing-country trauma series. Death tracked closely with a depressed conscious level, a heavy anatomical injury load and a low predicted survival, confirming that neurological state and injury burden are the levers of outcome.

The value of TRISS lay in combining physiology and anatomy into one figure that outperformed either ISS or RTS used alone, reflected in an AUROC of 0.994. Its behaviour at the decision threshold is worth reading carefully: perfect specificity and positive predictive value meant that a high-risk label was never wrong, yet a sensitivity of only 56.3% meant the score missed nearly half of the deaths. That combination - confident about survival, less reliable about death - is the pattern typically seen when coefficients built on the MTOS population are transplanted elsewhere.

Our demographic findings sit comfortably beside the recent literature. The mean age near 35 years and the concentration in the 21-40 band echo Indurkar and Besra and colleagues, and the heavy male preponderance (85.6%; 5.9:1) is almost identical to several Indian series and registry datasets reporting male shares of roughly 80–87%.[12-15] International cohorts tend to show a gentler male skew of around 68-80%, hinting that hospital trauma in India is even more male-dominated.[16] Road traffic accidents as the leading cause, and the 88.9% blunt share, likewise align with Rajappan and Besra and colleagues and are close to the distributions reported by Domingues and colleagues.[13,16,17]

Where the score is weaker is at the extremes of age and in isolated severe head injury. Mortality rose with each successive age band in our data, and the modest sensitivity is consistent with reports that TRISS underestimates death in older patients and in those whose injury is chiefly neurological - groups in whom physiological reserve and brain injury are poorly captured by the equation.[6,7] These are the same observations that have driven calls for locally recalibrated coefficients and for adjusted-misclassification and W-statistic methods, which strip out preventable, care-related deaths before a service is judged.[7,18] Embedding TRISS in a national trauma registry would allow that kind of fair, like-for-like comparison between hospitals, while directed investment in neurotrauma capacity would address the head-injury deaths this study highlights.[19]

Several limitations temper these findings. The work was confined to a single centre, so the results may not generalise; comorbidity, which shapes survival, was not recorded; follow-up ended at discharge; and TRISS cannot handle multiple injuries within one body region or estimate respiratory rate in intubated patients. With only 16 deaths, the sensitivity estimates and the age-band comparisons are also imprecise. Its strengths are a prospective design, complete scoring of every patient, and use of the standard coefficients.

CONCLUSION

In this cohort, TRISS predicted in-hospital survival with excellent discrimination and proved a dependable instrument for outcome prediction, audit, quality assessment and comparison between centres. Its lower sensitivity, and the steady rise in mortality with age, expose weaker calibration in older patients and in severe head injury. Larger, multicentre studies that add comorbidity data and recalibrate the coefficients to local conditions would sharpen the score for Indian trauma practice.

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