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Trauma Scoring in a Developing Country

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ABSTRACT

Aim of Study: The aim of the study was to evaluate the efficacy of trauma scoring systems in a developing country.

Method: Trauma Score (TS) and Trauma and Injury Severity Score (TRISS) were used to predict the survival of 462 trauma patients during the period January 1996 to July 1996.

Results: TS had a sensitivity of 53.9% and a specificity of 98.8% whereas TRISS had a sensitivity of 46% and a specificity of 98.7%. Significant differences in mortality were observed compared with the baseline Major Trauma Outcome Study (MTOS) norms ($Z = 4.17$, $p < 0.001$).

Conclusion: Present injury severity instruments using MTOS coefficients do not accurately predict survival of trauma patients in a developing country, thus highlighting the need for developing new coefficients for trauma scoring in these countries.

Keywords: trauma, severity indices

INTRODUCTION

Trauma is an ever increasing problem. In India every year, approximately 3.2 million people are injured in road traffic accidents and out of these, 48,000 die[1]. This manifold increase in the quantum of trauma has necessitated the use of various modalities for its categorisation and quantification. The statistical data obtained can be utilised for institutional auditing of patient care and management and also for comparing the efficacy of various treatment modalities.

Considerable research has been conducted in an attempt to predict the probability of survival of trauma patients using the Major Trauma Outcome Study (MTOS) data base. Champion et al[2-4] developed the Trauma and Injury Severity Score (TRISS), which combined patient age, Injury Severity Score (ISS), and Revised Trauma Score (RTS) into a formula that predicts a trauma patient's probability of being discharged alive from hospital subsequently after a traumatic event.

Although the scoring systems have been studied extensively in the developed world, there is still a lack of a large study to judge its applicability in the developing world. The aim of this study was therefore to study the efficacy of such scoring systems in predicting survival outcome in trauma patients in a developing country; to compare the results obtained with the expected outcomes and to propose changes, if any in the existing scoring systems.

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PATIENTS AND METHODS

Setting

Between January 1996 and July 1996, 462 patients with multiple blunt injuries were admitted to the emergency room of JLN Hospital, Ajmer. Ours is a tertiary level trauma care centre and the facilities available here are a reflection of the facilities of trauma evaluation and care at similar hospitals in developing countries. Emergency radiographs are available, but facilities for emergency ultrasonography and CT scan are only available at some distance from the hospital. Facilities for emergency resuscitation and operation are also available.

Estimation of the probability of survival (Ps)

This was done by using the formula

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

where $b = b_0 + b_1$ (RTS) $+ b_2$ (ISS) $+ b_3$ (A). The constant e is equal to 2.718282. b_0, b_1, b_2, b_3 are coefficients derived from Walker-Duncan regression analysis applied to data from thousands of patients analysed in the Major Trauma Outcome Study (MTOS) and are -1.2470, 0.9544, - 0.0768 and -1.9052 respectively. RTS (Revised Trauma Score), the physiologic component of TRISS is :

RTS = 0.9368 (G) + 0.7326 (S) + 0.2908 (R)

G, S, and R are coded values for the Glasgow Coma Scale, systolic blood pressure and respiratory rate respectively[5]. ISS (Injury Severity Score) is the anatomic component of TRISS and is based on the Abbreviated Injury Scale (AIS), 1985[6].

Each of the six body regions was scored with the highest AIS values given to any injury in that area. The AIS values for the three highest scoring body regions were squared and summed to form the ISS. "A" (age) is coded as 1 if the patient is at least 55 years old and 0, if otherwise.

Trauma score (TS) was calculated by using the method described by Champion et al, utilising the systolic blood pressure, capillary refill, respiratory rate and respiratory expansion combined with the Glasgow Coma Scale[2].

Statistical analysis

The number of deaths and survivals was noted. The sensitivity and specificity of the methods was estimated by using a decision criterion that predicts survival for all patients calculated to have a Ps of $\geqslant 50\%$ and predicts death for all those with a Ps of $< 50\%$[4].

The Flora Z statistic[7] was used to quantitate the difference in the actual number of deaths in our institution and the predicted number of deaths based on the baseline MTOS norm. When considering mortality, the formula for calculating Z is :

$$Z = \frac{D - EQ_i}{\sqrt{EP_i Q_i}}$$

D = Actual number of deaths

$Q_i = (1 - P_i)$ Predicted probability of death for patient i.

EQ_i = Predicted number of deaths

P_i = Predicted P_s for patient i (from baseline norm)

An absolute value of Z exceeding 1.96 was required for a significance level of 0.05. Finally, M statistic was calculated to evaluate the degree of match between the test and baseline patient sets, the fraction of patients (f_1 .... f_6) falling into each of six increments of P_s for the baseline group (MTOS) was compared with the corresponding fraction for the study sample (g_1 .... g_6). If S_i is the smaller of the two values f_i and g_i, then S_1 .... 6 were summed to arrive at M, A value of $M > 0.88$ indicated a good match between the test and baseline groups[4].

Table I – Patient distribution and trauma score

Trauma score	Expected survival (%)	Survived (%)	Died (%)	Total
16	99	95 (100.0)	-	95
15	98	146 (96.7)	5 (3.3)	151
14	95	49 (94.2)	3 (5.8)	52
13	91	67 (90.5)	7 (9.5)	74
12	83	21 (80.8)	5 (19.2)	26
11	71	5 (62.5)	3 (37.5)	8
10	55	8 (57.1)	6 (42.9)	14
9	37	4 (36.4)	7 (63.6)	11
8	22	3 (23.1)	10 (76.9)	13
7	12	1 (10.0)	9 (90.0)	10
6	7	-	4 (100.0)	4
5	4	-	-	0
4	2	-	4 (100.0)	4
Total		399	63	462

Table II – Injury severity score (ISS) and patient outcome

ISS	Survived (%)	Died (%)	Total
0 – 10	252 (97.7)	6 (2.3)	258
11 – 20	98 (90.7)	10 (9.3)	108
21 – 30	35 (57.4)	26 (46.6)	61
31 – 40	14 (60.9)	9 (39.1)	23
41 – 50	-	9 (100.0)	9
51 – 60	-	3 (100.0)	3
Total	399	63	462

RESULTS

Out of 462 patients, 369 (79.9%) were males and 93 (20.1%) were females. Median age was 42.2 years (range 13 to 72 years). Table I shows the distribution of patients according to trauma score (TS) along with the observed and expected deaths. As against 42 deaths predicted by TS, 63 deaths were observed, thus giving a sensitivity of 53.9% and a specificity of 98.8%. Table II shows the ISS value versus patient outcome. There was a steep rise in mortality with ISS above 20. Table III shows the RTS value versus patient outcome. There was a steep rise in mortality with decreasing RTS, with P_s dropping sharply from the RTS value of 6.6132 and reaching very low levels as RTS approached 5.0304. Table IV shows the distribution of patients according to P_s using the TRISS method. The overall mortality was 13.6% as against a predicted mortality of 7.35% ($Z = 4.17$, $p < 0.001$), thus giving a sensitivity of 46% and a specificity of 98.7%.

Table V shows the comparison of the distribution of patients with the baseline MTOS norm, giving a M statistic of 0.956, thus representing an excellent match.

DISCUSSION

Although injury severity instruments are important, it is difficult to compare their merits[5]. Proponents of specific injury severity instruments claim that their instruments are effective and recommend general adoption[5,9], whereas some regard them as[10-12] ineffective . TRISS has been demonstrated to be an improvement on previous methods for predicting survival in trauma patients but it has been said to suffer from limitations like poor ordinality ie. the patient's injury may not always be ranked correctly[13].

Moreover, the baseline norms have been framed in the United States and Canada and their applicability to other setups, particularly in developing countries is doubtful because of less efficient emergency care. Our study reveals a Z statistic of 4.17. This is a statistic of outcome comparison between two subsets of a population and a negative value is desirable while studying mortality as compared to the baseline MTOS norm. Since Z value can be affected by injury severity mismatch between the study and baseline sets, we calculated the M statistic which was found to be 0.956. Since this is an excellent match with the baseline MTOS norm (minimum being 0.88) the mortality in our study is significantly higher. This has two possible reasons: (i) the trauma scoring was improper or (ii) emergency care was not as efficient. The first reason is easier to explain.

In the absence of facilities such as emergency ultrasonography and CT scan, the correct value of ISS may not always be calculated. TRISS in such circumstances may predict false high survival. In our study, although the specificity of TRISS in predicting deaths was 98.7%, the sensitivity was only 46%.

In contrast to this, trauma score which utilised only the physiologic status of the individual, had higher sensitivity and specificity. The ordinality in our study was maintained, thus ranking the patients according to the severity of injury.

Table III – Revised trauma score (RTS) and patient outcome

RTS	Survived (%)	Died (%)	Total
1 – 2	-	6 (100.0)	6
2 – 3	-	10 (100.0)	10
3 – 4	-	5 (100.0)	5
4 – 5	1 (6.3)	15 (93.7)	16
5 – 6	37 (71.2)	15 (28.8)	52
6 – 7	77 (89.5)	9 (10.5)	86
> 7	284 (99.0)	3 (1.0)	287
Total	399	63	462

Table IV – Probability of survival (Ps) versus patient outcome

Ps (%)	Total	Survived (%)	Died (%)
96 – 100	364	347 (95.3)	17 (4.7)
91 – 95	22	19 (86.4)	3 (13.6)
81 – 90	27	21 (77.8)	6 (22.2)
71 – 80	5	3 (60.0)	2 (40.0)
61 – 70	5	2 (40.0)	3 (60.0)
51 – 60	5	2 (40.0)	3 (60.0)
41 – 50	7	2 (28.6)	5 (71.4)
31 – 40	5	1 (20.0)	4 (80.0)
21 – 30	15	2 (13.3)	13 (86.7)
11 – 20	3	0	3 (100.0)
1 – 10	4	0	4 (100.0)
	462	399	63

Table V – Patient distribution compared with baseline MTOS norm

Probability of survival	Fraction of total in test group (g)	Fraction of total in MTOS group (f)
0.96 – 1.00	0.7879	0.828
0.91 – 0.95	0.0476	0.045
0.76 – 0.90	0.6449	0.044
0.51 – 0.75	0.0259	0.029
0.26 – 0.50	0.0692	0.017
0.00 – 0.25	0.3030	0.036

M = 0.9560

The higher mortality rates in our patients may be due to the non-applicability of these baseline norms in developing countries like India, where emergency care is not as efficient as compared to developed countries, thus the expected outcome differ widely from the predicted ones.

We conclude that the present injury severity instruments using MTOS coefficients do not accurately correlate with observed survival rates in a developing country.

Keeping these facts in mind, we feel that for purposes of predicting survival of patients with blunt injuries in developing countries, it is wise to build new TRISS coefficients using Walker Duncan regression analysis based on a new data base utilising a large number of patients. This should be done keeping in mind the facilities for emergency diagnosis and management in these countries.

REFERENCES

1. Agarwal ND. National policy on accidents. Ind J Orthop 1985; 19:107-8.
2. Champion HR, Sacco WJ, Carnazoo AJ, Coper WJ, Fouty WJ. The trauma score. Crit Care Med 1981; 9:672-6.
3. Champion HR, Sacco WJ, Hunt TK, et al. Trauma severity scoring to predict mortality. World J Surg 1983; 7:4.
4. Boyd CR, Tolson MA, Copes WS. Evaluating trauma care: The TRISS method. J Trauma 1987; 27:370-8.
5. Champion HR, Sacco WJ, Copes WS, et al. A revision of the trauma score. J Trauma 1989; 29:623.
6. American Association for Automotive Medicine: Abbreviated injury scale, 1985 Revision: Des Plaines, III, AAAM, 1985.
7. Flora JD. A method for comparing survival of burn patients to a standard survival curve. J Trauma 1978; 18:701-5.
8. Lett RR, Hanley JA, Smith JS. The comparison of injury severity instrument performance using likelihood ratios and ROC Curve analysis. J Trauma 1995; 38:142-8.
9. Smith JS, Bartholomew MJ. Trauma index revisited: A better triage tool. Crit Care Med 1990; 18:174.
10. Baxt WG, Bany CC, Epperson MD, et al. The failure of prehospital trauma prediction rules to classify trauma patients accurately. Ann Emerg Med 1989; 18:21.
11. Markle K, Cyten CG, Byrne DW, et al. Comparison between TRISS and ASCOT methods in controlling for injury severity. J Trauma 1992; 33:326.
12. Hannan EL, Modeloff J, Fassel LS, Cayten CG, Murphy JG. Validation of TRISS and ASCOT using a Non-MTOS trauma registry. J Trauma 1995; 38:83-8.
13. Copes WS, Champion HR, Sacco WJ, et al. The Injury Severity Score revisited. J Trauma 1988; 28:69-77.