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ORIGINAL ARTICLE

Analysis of Trauma Outcome Using the TRISS Method at a Tertiary Care Centre in Pune

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Abstract Out of the various systems used to assess the outcome of polytrauma patients, trauma and injury severity score (TRISS) is considered as the standard tool for evaluating the performance of trauma centres. The present study was carried out to evaluate the outcome of severely injured patients using the TRISS method in a developing country like India and to compare it with the major trauma outcome study (MTOS). A prospective study of 300 patients of trauma was done. Outcome assessment was done for the severely injured patients using the TRISS method. Road traffic accidents (213 cases) were the most common cause of injury. Fifty-seven (19%) cases were severely injured defined as having an injury severity score ≥16. Outcome assessment was done for these patients using the TRISS method. The predicted mortality was 15.7%, while the observed mortality was 33.3%. The mean revised trauma score was 6.63±1.79 and the mean injury severity score (ISS) was 23.7±8.17. Compared to the MTOS, the patients in the present study had more severe injuries with higher mortality. The present method of comparison of trauma care, i.e. TRISS which uses the MTOS coefficients, does not accurately predict survival of trauma patients in the developing countries as indicated by the present and other studies. There is a need for developing a national trauma registry to derive new coefficients for trauma scoring for the Indian subcontinent so that the quality of trauma care can be compared with that in the developed countries.

Keywords Trauma · Injury · Outcome

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Introduction

Trauma is a leading cause of death globally and in India. In India, it is the second most common cause of death after the age of 5 years [1]. Trauma care systems in India are at a nascent stage of development and there is an almost complete lack of organized trauma care [2].

A central problem in trauma research is the prediction of survival after injury. If accurate, such predictions allow meaningful comparisons of results between alternative treatments, institutions, and trauma systems [3]. Currently, the most commonly used approach to outcome prediction is Trauma and Injury Severity Score (TRISS) [4].

The present study was conducted to evaluate the outcome of severely injured patients using the TRISS method in an Indian setup and to compare it with the data from the major trauma outcome study (MTOS) [5].

Material and Methods

This study was conducted at Bharati Vidyapeeth University (BVU) Hospital, Pune, which is a tertiary care teaching hospital. The duration of the study was 1 year from January

2007 to January 2008. The study had the approval of the ethical committee of Bharati Vidyapeeth University. In this study, 300 patients of trauma admitted to BVU Hospital were prospectively studied. All patients of trauma above 1 year of age and brought within 24 h of trauma were included. Patients having minor injuries and managed on OPD basis were not included. The patients who were brought in dead and who did not complete their treatment were also not included.

Methodology

The details of each patient, from the time of arrival in the emergency department until the time of discharge from hospital or death, were recorded. The data collected included demographics, details of trauma (mode, place, day, time, etc.) and physiologic status of the patient (revised trauma score [RTS]) at admission. For calculation of the RTS, coefficients from the MTOS were used. After stabilization of the patient, the injury severity score (ISS) was obtained from the trauma chart, imaging studies and intraoperative findings. The 2005 version of abbreviated injury scale (AIS) dictionary was used to derive the AIS for particular injuries. Outcome assessment was done for the severely injured patients (i.e. with ISS ≥16) using the TRISS methodology [6, 7].

The origin of TRISS can be traced to the MTOS, which was conducted in the United States in 1980s, and provides a database for audit in the individual patient and allows for comparison of performance over time and between hospitals. TRISS combines anatomic and physiologic measures of injury severity (ISS and RTS, respectively) and age of the patient to provide a measure of the probability of survival [4]. This is done by two methods, i.e. preliminary outcome-based evaluation (PRE chart) and definitive outcome-based evaluation (DEF).

Preliminary outcome-based evaluation is used to evaluate the quality of trauma care by identifying patients suitable for audit analysis. For this a PRE chart is made which is a scatter diagram of RTS versus ISS in the patient set (Fig. 1). Patients with ISS-RTS coordinates on the diagonal line, i.e. isobar (determined by setting $b=0$ in the norm equation) are estimated to have a 0.50 survival probability. Coordinates above this line have estimated survival probabilities less than 0.50, and coordinates below this line have estimated survival probabilities greater than 0.50. Survivors above the line and non-survivors below it represent patients with mathematically 'unexpected' outcomes, and such cases are suitable for focused audit [4].

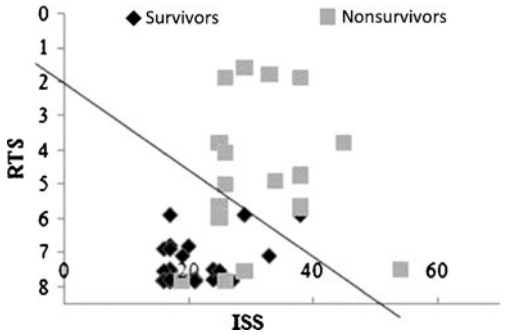

Fig. 1 PRE chart

DEF is a statistical method for comparing the outcomes of two patient groups, in this case the severely injured patients of this study and the patients in the MTOS. In DEF *Z-statistic* identifies if study group outcomes are significantly different from expected outcomes as predicted from MTOS. Absolute values of Z >1.96 or <−0.96 are statistically significant ($p<0.05$). For institutions with significant Z scores, the statistic W is intended to describe the clinical or practical significance of differences between the actual survivors and the expected survivors. The *W-statistic* calculates the actual number of survivors greater (or fewer) than predicted by MTOS, per 100 patients treated in the institution under study compared to the baseline institution. The *M-statistic* is an injury severity match, allowing comparison of the range of injury severity in the sample population with that of the main database. The nearer M is to 1 the better the fit [5].

Results and Analysis

Out of the 300 patients studied, 207 (69%) patients were in the age group of 15–44 years. A total of 237 (79%) patients were males, while 63 (21%) patients were females. A total of 297 patients (99%) sustained blunt injuries, with road traffic accidents being the most common cause (Table 1). A total of 132 (61.9%) cases of the road accidents involved two-wheeler riders and bicyclists, with 106 (50%) victims of road accidents being drivers of the two wheelers or bicycles.

The majority of the patients, i.e. 238 (79.3%) cases, did not receive any pre-hospital care. The average time taken for the patients to reach the hospital was 2.3 hrs. Head injury was present in 149 (49.6%) cases (Table 2). Polytrauma was seen in 49 (16.3%) cases.

Table 1 Distribution of cases according to the mode of injury

Mode of injury	Number of cases	Percentage
Road traffic accidents	213	71%
Fall from height	33	11%
Assault	21	7%
Fall—low level	18	6%
Other	12	4%
Penetrating injury	3	1%
Total	300	100%

Table 2 Division according to body region involved

Body region involved	No. of cases	Percentage
Head and neck	149	49.6%
Face	44	14.6%
Chest	21	7%
Abdomen	17	5.6%
Extremities	136	45.3%
External (wounds)	255	85%

Out of a total of 300 cases studied, 57 (19%) cases were severely injured, defined as having an ISS ≥16 [6, 7]. The outcome analysis was done only for these patients to make the data comparable with the MTOS. However out of 243 (81%) cases, which were less severely injured and thus not included in the outcome analysis, there was no mortality. The observations and results that follow are only for the severely injured patients. The average time for the patient to reach the hospital was 2.9 hrs for the survivors and 2.1 hrs for non-survivors. This difference in the time delay for definitive care was statistically not significant.

In the severely injured group, head and neck region was the most commonly injured region (48 cases, i.e. 84.2%) while severe head injury (AIS ≥4) was present in 42 (73.6%) cases. The severe thoracic and abdominal injuries (AIS ≥4) were seen in 7 (12%) cases and 2 (3.5%) cases, respectively.

The mean ISS was 23.7±8.17 and the mean RTS was 6.63±1.79. The average probability of survival was 0.85. The overall mortality was 33.3% (i.e. 19 cases), whereas the expected mortality by the TRISS method was 15.7%.

The mean RTS of survivors was 7.49±0.57, while that of non-survivors was 4.9±2.16. Using the unpaired *t* test, this difference in the RTS between the two groups was found to be highly significant ($p<0.001$). The mean ISS of survivors was 20±5, while that of non-survivors was 30.9±8.48. Using the unpaired *t* test, this difference in the ISS between the two groups was found to be highly significant ($p<0.001$).

The PRE chart of the severely injured patients is shown in Fig. 1. *Z statistic* was −5.376. This suggests that there are statistically significant differences between the actual and predicted numbers of deaths (*Z* value greater than 1.96%). *W statistic* was 18.5. This indicates that there was an increase of 18 deaths per 100 patients treated compared with the norm expectations. *M statistic* was 0.82, indicating a poor match of severity with the MTOS.

Discussion

This study was carried out to evaluate the outcome of severely injured patients using the TRISS method and to compare it with the data from the MTOS.

In comparison with the MTOS (Table 3), the incidence of blunt trauma was more in the present study while that of penetrating injuries was very low. This is related to the high incidence of road accidents in Pune leading to more blunt injuries. Penetrating injuries are commonly due to firearms or weapons. The low incidence of penetrating injuries is possibly due to the low incidence of assault cases and also because blunt weapons of offence like lathies are more commonly used in assault than the sharp weapons and firearms as they are easily available and do not usually cause life-threatening injuries.

It was also observed that compared to the MTOS, the incidence of fall from heights in the present study was high. This is explained by the fact that majority of these patients are construction workers. In developed countries, the use of personal protective equipment is strictly enforced while the same is not implemented in India.

The overall mortality in the severely injured patients of this study was fairly high at 33.33% compared to 9% in the MTOS. However, this is in line with other reported studies in developing countries [8–10]. Also, it is an established fact that the mortality in serious injuries is six times worse in a developing country such as India compared to a developed country [11]. There are several explanations for the higher than expected mortality of the group under study. The first is that the average patient in the present study was found to be more severely injured (ISS) and more physiologically deranged (RTS).

Pre-hospital care is virtually non-existent in India, and implementation of the 'golden hour' concept is still an unachieved goal [7]. The time lag for definitive care for the severely injured patients in this study averages over and above the 'golden hour' period and 50% of the non-survivors; i.e. 10

Table 3 Comparison of present study with MTOS

Variable	MTOS (n=80,544)	Present study (n=57)
Type of injury		
Blunt (%)	79	98.25
Penetrating (%)	21	1.75
Outcome		
Live (%)	91	66.67
Dead (%)	9	33.33
Cause of injury		
Road accidents (%)	50	56
Fall from height (%)	17	31
Gender		
Male patients (%)	71	80.7
Female patients (%)	28	19.3
Trauma scoring		
RTS (Mean ± S.D.)	1.1±1.7	6.63±1.79
ISS (Mean ± S.D.)	12.8±11.3	23.7±8.17

RTS Revised Trauma Score; *ISS* Injury Severity Score

cases were received in the hospital after the critical 'golden hour'. Seventeen (89.4%) of the non-survivors had head injury, majority of them of a severe nature which could have been salvaged. Nine (47.3%) of the non-survivors were in shock at the time of admission. These patients could have been salvaged as early management of shock is known to improve survival [12].

In the present study, 17 (89%) of the non-survivors had head injury; however, presence of head injury did not affect the outcome significantly. Although this was true, the incidence of head injury >5 on the AIS scale was more in the non-survivors. The statistical significance of this finding could not be found out due to the small number of cases. However, the AIS scoring may be a more valid predictor of the outcome than the probability of survival (p) calculated using the TRISS method [13].

The low mean RTS of the non-survivors, as compared to the survivors, shows that the former were physiologically more deranged. The reason for this can be the delay in transporting a patient to the hospital. A majority of bystanders at a site of an RTA hesitate to transport a victim due to a fear of legal hassles. The emergency medical services (EMS) in Pune are limited and are provided by a few private corporate hospitals, and majority of the patients are transported to the hospitals by private vehicles or by autorickshaws. Thus, due to lack of pre-hospital care and an effective transport system, the average patient has a more deranged physiology when first seen in the hospital as compared to the developed world where the EMS is highly responsive.

The high mean ISS of the non-survivors, as compared to the survivors, shows that the former had more severe injuries. This highlights the need for using safety measures such as wearing seatbelts/helmets and airbags to reduce the impact of the accident and thus prevent serious injuries.

The M statistic for the present study group was 0.82, indicating a disparity in injury severity between the two study populations under comparison.

The above differences in the outcome of trauma in the present study highlight the many inadequacies of trauma care in India. Lack of adequate resources for trauma care including adequate manpower and equipment for patient monitoring is also important reasons for suboptimal care and a higher mortality of trauma patients in developing countries [13]. There is a need for organized efforts for trauma system development which should include an improvement in the pre-hospital trauma care, an integrated transportation system and establishment of regional trauma care centres. Presence of a dedicated trauma care team in all tertiary care centres would certainly improve the outcome of trauma. There is also an urgent need to adopt preventive measures to address common causes of trauma. Also, the coefficients for the TRISS method have been derived from the MTOS which was conducted in the United States. It is likely that these coefficients may not apply to populations and conditions that differ markedly from the MTOS database as indicated by this and other studies [8, 14, 15]. Thus, modified TRISS coefficients should be used for outcome assessment based on the location of the injured population [16]. There is a need for developing a national trauma registry and better documentation to derive new coefficients for trauma scoring for the Indian subcontinent so that the quality of trauma care can be compared with that in the developed countries. A population-based national trauma registry would also constitute a major source for research on injury (primary) prevention, epidemiology of severe injury, and aid in the development of trauma systems as well as secondary prevention (better quality of care) of severe injuries.

Conclusion

The outcome of major trauma in this study was far below the expectations as compared to the MTOS. The present method of comparison of trauma care, i.e. TRISS which uses the MTOS coefficients, does not accurately predict survival of trauma patients in the developing countries as indicated by the present and other studies. There is a need for developing a national trauma registry to derive new coefficients for trauma scoring for the Indian subcontinent so that the quality of trauma care can be compared with that in developed countries.

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Conflict of interest None.

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