ORIGINAL ARTICLE

Registry based trauma outcome: perspective of a developing country

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Objective: To report trauma outcome from a developing country based on the Trauma and Injury Severity Scoring (TRISS) method and compare the outcome with the registry data from Major Trauma Outcome Study (MTOS).
Design: Registry based audit of all trauma patients over two years.
Setting: Emergency room of a teaching university hospital.
Subjects: 279 injured patients meeting trauma team activation criteria including all deaths in the emergency room.
Outcome measures: TRISS methodology to compare expected and observed outcome.
Statistical analysis: W, M, and Z statistics and comparison with MTOS data.
Results: 279 patients meeting the trauma triage criteria presented to the emergency room, 235 (84.2%) were men and 44 (15.8%) women. Blunt injury accounted for 204 (73.1%) and penetrating for 75 (26.9%) patients. Seventy two patients had injury severity score of more than 15. Only 18 (6.4%) patients were transported in an ambulance. A total of 142 (50.9%) patients were transferred from other hospitals with a mean prehospital delay of 7.1 hours. M statistic of our study subset was 0.97, indicating a good match between our patients and MTOS cohort. There were 18 deaths with only one unexpected survivor. The expected number of deaths based on MTOS dataset should have been 12.
Conclusions: Present injury severity instruments using MTOS coefficients do not accurately correlate with observed survival rates in a developing country.

In South Asia trauma related mortality is increasing and the World Health Organisation predicts that by year 2020, trauma will be the leading cause of years of life lost for both developed and the developing nations.[1 2] Trauma is a significant national health problem and death after potentially salvageable injuries has been reported from Pakistan.[3] It is attributed to inadequate prehospital care, resuscitation, and definitive care. However, very few objective data on injury severity, outcome, and process of trauma care have been published from Pakistan. The lack of trauma related data is a major impediment in recognition of deficiencies in care.[4] Trauma database in the form of a registry can provide necessary information for monitoring and modifying trauma care. These databases in the developed countries are used for objective comparison based on Trauma and Injury Severity Scoring (TRISS) method.[5] We report the outcome of managing trauma based on registry data over a two year period between January 1998 to December 1999. The outcomes were compared with norms established in North America based on data from Major Trauma Outcome Study (MTOS).[6]

METHODS

All trauma patients admitted between 1 January 1998 to 30 December 1999 meeting trauma team activation criteria (table 1) including patients transferred from another hospital, patients admitted to an intensive care unit, and all patient dying in the emergency room were included in the study.[7] Patients presenting after definitive procedure in another hospital were excluded. A daily log of all trauma admissions, transfers, or deaths within the emergency department was maintained.

Setting

The Aga Khan University Hospital is a private teaching hospital with a trauma resuscitation room, diagnostic radiology including computed tomography, 24 hour availability of operating room, and multidisciplinary trauma team. Karachi has a population of about 12 million; the incidence of trauma related mortality is not known but is considered significant.[8] The prehospital care is either non-existent or of poor quality.[3] There is no pre-arrival notification or interhospital communication in case of trauma transfers.[9]

Table 1 Trauma team activation criteria

Patient assessment on admission to ED
- 1 Physiological
  - (a) Pulse <60 or >100 per minute
  - (b) Respiratory rate <10 or >29 per minute
  - (c) Systolic blood pressure <90 mm Hg
  - (d) Glasgow Coma Score <14
- 2 Anatomical
  - (a) Penetrating injury to head, neck, torso, or extremities proximal to elbow or knee
  - (b) Flail chest
  - (c) Two or more proximal bone fractures
  - (d) Pelvic fractures
  - (e) Extremity amputation
- 3 Mechanism of injury
  - 1 Ejection from automobile
  - 2 Death of victim in the same passenger compartment
  - 3 Fall >20 feet
  - 4 High speed vehicle crash
  - 5 Auto versus pedestrian >5 miles per hour
  - 6 Motorcycle crash >20 miles per hour or separation of rider from bike

Data collection and analysis

Data acquisition was a three step process. All patients had their initial assessment and treatment based on Advanced

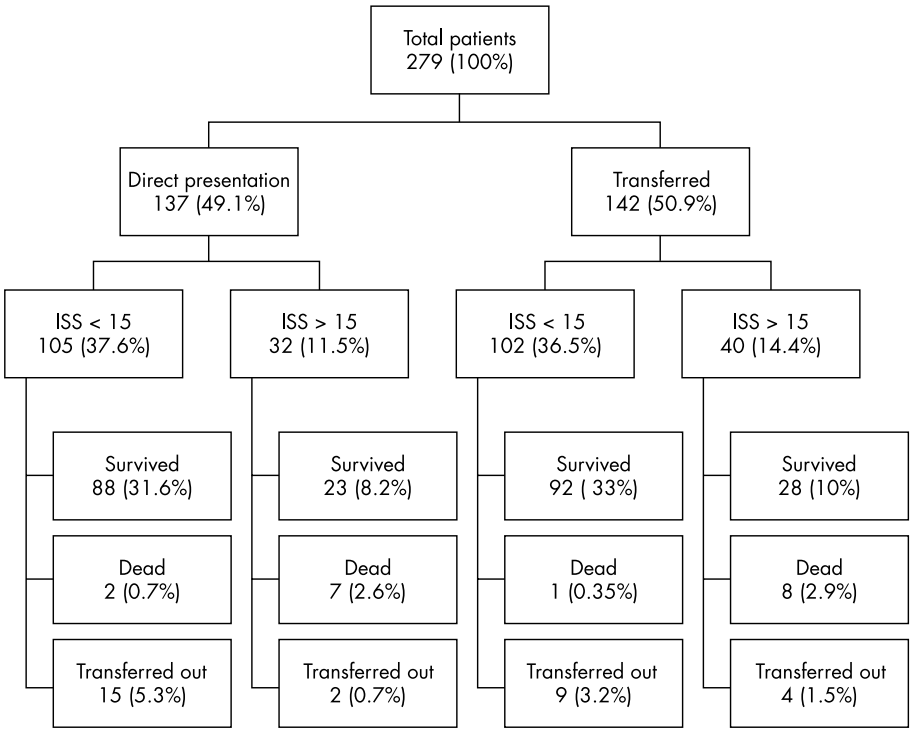

Figure 1 Outcome related to transfer status and Injury Severity Score.

Table 2 Distribution of M statistic in study group and MTOS dataset

	Fraction of patients within the range	
MTOS p range	Study subset	Baseline subset
0.96–1.00	0.846	0.828
0.91–0.95	0.060	0.045
0.76–0.90	0.045	0.044
0.51–0.75	0.026	0.029
0.26–0.50	0.008	0.017
0.00–0.25	0.015	0.036

Trauma and Life Support (ATLS) principles and recorded on the preprinted trauma form. The trauma form contains information necessary to calculate probability of survival (Ps) based on TRISS methodology.[5] Step two is an audit by a consultant recording all identified injuries at disposition. Step three is data entry by a surgical research officer in the registry software, according to standard case criteria based on a Trauma Registry Workshop.[7] Trauma Registry (v3.0 Centers for Disease Control and Prevention, US Department of Health and Human Sciences) is a DOS-based software. Registry contains demographic, clinical (anatomical and physiological scores), and process of care data. Assessment of patients' outcome was based on patients' anatomical injury and physiological state after injury, mechanism of injury, and age of the patient. Anatomical injury was coded according to the Abbreviated Injury Scale (AIS-90).[10] The AIS-90 score was used to calculate the injury severity score (ISS).[11] Physiological information collected included systolic blood pressure, respiratory rate, and Glasgow Coma Scale. The coded value of physiological parameters on arrival in the emergency room is a weighted statistic and is used to yield Revised Trauma Score.[12] Finally the patient's physiological score, anatomical scores, age, and type of injury (blunt or penetrating) was used to predict survival probability by TRISS analysis[13] The TRISS coefficients in our study have been updated based on AIS-90 coding for anatomical injury.[14] This method offers a means of assessing a patient's survival probability (Ps) by comparing actual survival to predict survival based on norms established through the MTOS on data submitted from 139 American and Canadian Hospitals on 80 544 patients.[6] We used the M statistic[13] to evaluate match of injury severity between our registry patients and the MTOS database. Value of M closer to 1 indicates a good match (range 0 to 1). Low valves of M indicate a disparity in the severity matching. The W statistic was calculated to evaluate the difference between actual and predicted survival of patients.[15] In addition Z statistic,[13]the statistical significance of this difference, was also calculated.

RESULTS

A total of 279 patients presenting between 1 January 1998 to 31 December 1999 were included in the study. There were 235 (84.2%) men and 44(15.8%) women. Mean age was 33 years (range 15–75). Blunt injury accounted for 204 (73.1%) patients, of these 180 (64.5%) were admitted after road traffic accidents. Penetrating injury accounted for 75 (26.9%), of which the most common cause was gunshot injury in 46 (16.48%) patients. After injury the predominant mode of transport to the hospital was public/private vehicles, accounting for 261(93.5%) patients. Only 18 (6.4%) patients were transported to the hospital in an ambulance. Patients presenting directly to our hospital had a mean prehospital time of 98 minutes (133 patients) with a range of 5–1425 minutes. Interhospital and intercity transfers accounted for142 (50.9%) patients. The mean prehospital time of such patients was available in 138 patients and was 439 minutes with a range of 100–2020 minutes. The prehospital time was not available in eight patients. Emergency room stay was available for 260 (93.1%) patients who were admitted to the wards. The mean emergency room stay for the patients was 244 minutes with a range of 13–950 minutes. Data were not available in 19 (6.9%) patients.

In 57(20.4%) patients requiring operative intervention the mean stay in emergency room was 50 minutes with a maximum of 375 minutes. Injury Severity Score was available in all 279 (100%) patients. The median Injury Severity Score of

Table 3 Body region cause of death and scores

Body region	Number	AIS <3	AIS ⩾3	ISS*	RTS†
Head or neck	13	1 (7.7%)	13 (92.8%)	28 (10–75)	3.5 (2.4)
Abdomen or pelvis	3	0	3 (100%)	26 (17–34)	6.9 (0.88)
Chest	1	0	1 (100%)	21	7.5

*Median ISS and range. †Mean (SD) RTS.

survivors was 10 with a range of 1–41 and 23 in case of non-survivors with a range 9–75. The outcome of patients according to ISS and their transfer to and from hospital is shown in figure 1.

The Revised Trauma Score (RTS) was calculable in 265 (94.98%) patients. The mean RTS was 7.5 (range of 3–7.8) for survivors and 4.8 (range 0–7.8) in non-survivors.The M Statistic for our patients was 0.97 indicating a good match between our group of patients and MTOS cohort (table 2).

There were 231(82.8%) survivors who were discharged from the hospital, 30 (10.79%) were transferred to another hospital and were not followed up. There were 18 (6.5%) deaths, of these five (1.8%) patients died in the emergency room and 13 (4.7%) after admission. The predominant body region, anatomical and physiological score of non-survivors is shown in table 3. The TRISS probability of survival could be calculated in 17 non-survivors, five patients had probability of survival of less 50%. The remaining patients had more than 50% chance of survival. There was only one unexpected survivor. The expected number of deaths in our study population should have been 12.8 according to MTOS norms, however there were 18 deaths. W statistic was calculated as −1.8 with a Z score of 1.58.

DISCUSSION

Traditionally surgeons have analysed trauma mortality to evaluate the effectiveness and quality of care. TRISS methodology increases objectivity in assessing outcomes and is widely applied in developed countries. Application of TRISS methods in developing countries with western norms has not been widely reported.[16] TRISS methodology was chosen in this study based on its reputation and ability to identify trends in the quality of trauma care. The actual incidence rate of injury related deaths are often higher in developing countries.[2] The actual mortality was higher than what was predicted based on TRISS norms—that is, W statistic of −1.8 (Z score 1.58). This reflects poor performance in the management of patients with major injuries. The difference in expected and observed mortality can be attributed to poor quality trauma care in hospital setting alone but this also reflects the quality of prehospital care including time to definitive care. In addition norms developed in United States and Canada needed modification when applied to United Kingdom.[17] Similarly in a developing country with limited infrastructure, significant W score should be interpreted cautiously. Injury Severity Score as an instrument to assess severity of injury is not sufficiently developed to account for difference in outcome of patients based on difference in treatment alone.[18 19] Patients are scored based on clinical, operative, radiological, and necropsy data. MTOS norms have used necropsy data to a varying extent in calculation of ISS; and complete lack of necropsy data because of cultural reasons may have resulted in systematic underestimation of ISS in our patients, specifically 18 trauma deaths. Trauma care begins in the field; the first encounter is with a paramedic followed by a complex series of events that determine outcome. In a well developed emergency medical system, patients in extremis can arrive in hospital who otherwise would not survive in a developing country; consequently not all studies based on TRISS methods include emergency room deaths. We have included all five patients presenting with vital signs who died in the emergency room favouring a bias toward worse outcome. However, it can be argued that this group is an extension of patients who are dying at scene or in the emergency room because of delays in definitive treatment. It is highly likely there are a significant proportion of patients who died at the scene or during transfers without medical intervention. This explains overall low Injury Severity Scores with only 72 patients having score of more than 15, which is commonly accepted as a severe injury.[17] We recommend inclusion of emergency room deaths in developing countries to assess trauma care. Rapid transport affects survival; 60% of the deaths from trauma are reported to occur within four hours of injury and the prognosis of intracranial haemoharrage is markedly improved when treated within this time frame.[20 21] The mean time from injury to arrival in hospital of patients dying with major injuries was 5.1 hours; details of prehospital treatment, airway management, and resuscitation were not retrievable in this group. An additional four hours were spent in hospital emergency room before moving to definitive care areas. The delays in definite treatment had a considerable negative impact on the outcome in our setting. The "golden hour" concept of major trauma care was not fulfilled in most of the cases. The role of triage and transport is left to a "Good Samaritan" in our patients with only 18 (6.5%) arriving by ambulance. Patients are often transported to the nearest hospital from the accident scene even though these hospitals may not have the resources to treat the patient.[3] In our study 142 (50.9%) patients were inter-hospital transfers; this makes our population distinctly different from MTOS database. Again additional 30 (10.6%) patients were transferred out from the hospital because of resource limitation and could not be followed up. Although the study did not demonstrate any significant difference between ISS and mortality of patients transferred from other hospitals, inappropriate inter-hospital transfers are significant contributors in poor outcome.[22 23] Improved prehospital care, rapid transport, and institution of transfer protocol between hospitals will dramatically improve survival of patients. The study did not predict outcome based on probability of survival calculations. In 265 (94.98%) patients with a calculable probability of survival we had one unexpected survivor, five patients out of 18 deaths had survival probability of less than 50%. Present injury severity instruments using MTOS coefficients do not accurately correlate with observed survival rates in a developing country.[16] International norms have failed to account for adjustments based on quality of all phases of care and other factors that influence the outcome. However, the utility of TRISS methodology in developing countries will be comparative audit between hospitals in the same country and between periods of time in the same unit by indicating variation in outcome, it will act as a catalyst to stimulate changes that will improve performance. In the long term development of contemporary national norms based on indigenous data will overcome the deficiencies listed above. A logical question would be what might be done to improve the outcome. A simple answer will be improvement in prehospital phase of care and decrease time to definitive treatment.

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