Original Article

The prognostic value of trauma scoring systems for gunshot injuries

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ABSTRACT

Objective: We aimed to evaluate the trauma scoring systems on gunshot injured patients to predict trauma severity.

Methodology: All patients with gunshot injury admitted to the emergency department (ED) from January 2007 through January 2009 were enrolled in the study. The demographic characteristics of patients such as age, gender, cause of the injury, type of the weapon used, the injured body parts, Glasgow Coma Scale (GCS), Shock Index (SI), the length of stay in the hospital and mortality were recorded from the patient charts. Injury Severity Score (ISS), Revised **Trauma** Score (RTS) and Trauma and Injury Severity Score (TRISS) have been calculated. The differences between the groups for these parameters were compared using the Mann-Whitney U test.

Results: The mean age of patients was 33.2±16.1 and 79 of 87 patients were male. The causes of GSIs were homicidal in 73.6% and bullet cartridge in 51.7%. Calculated GCS, ISS, RTS, TRISS and SI were 13.8±2.9, 13.0±9.3, 7.38±1.1, 93.9±14.9% and 1.9±0.9 respectively. GCS, RTS and TRISS scores for survivors were significantly higher than non-survivors ($p<0.001$). ISS score and SI for survivors were significantly lower than non-survivors ($p<0.001$). There were no statistically significant differences between the groups in terms of the length of stay in hospital ($p>0.05$). There was no statistically significant correlation of the length of stay in hospital with GCS, RTS and TRISS ($p>0.05$). The length of stay in hospital was found to correlate with ISS and SI positively ($p<0.001$).

Conclusion: It is concluded that Gun Shot Injury (GSI) is much more likely in young males than the other types of trauma in the population. We recommend that trauma scoring systems should be used to show trauma severity and mortality.

KEY WORDS: Gunshot injuries, Trauma scoring systems, Mortality, Length of stay.

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INTRODUCTION

Gunshot injuries (GSI) are more frequently experienced trauma form in the world and also seen often in our country, GSI is used often for attack and suicidal intends is significant reason of mortality and morbidity nowadays. Mortality and morbidity due to GSI differ based on the injured organ, the injury grade by the bullet characteristic that has been built up with the compressed powder and could reach to 1500 m/s of velocity. The patients with

hemodynamic stability and airway safety require reassessment for setting of the severity of injury and subsequent treatment.[1]

Trauma scoring systems have been developed to represent the severity of injury. Also several prognostic predictive scores have been developed for assessing critically ill traumatic patients. Glasgow Coma Scale (GCS), Trauma and Injury Severity Score (TRISS), Revised Trauma Score (RTS), and Injury Severity Score (ISS), Shock Index (SI) have been used widely for the prediction of trauma-related morbidity and mortality.[2,3] The Glasgow Coma Scale (GCS) has been the gold standard of neurologic assessment for trauma patients since its development by Jennett and Teasdale in the early 1970s.[4] The GCS is a tool that the practitioner can use to score the level of consciousness by assessing the patient's ability to open his or her eyes, verbally communicate, obey commands, and move his or her extremities.[5] This score ranged from 3 for deepest coma to 14 for fully alert and oriented. Only later was abnormal flexion added to the motor score, making 15 the top score.[6]

Originally conceived in 1983, TRISS uses a weighted combination of patient age (AGE), Injury Severity Score (ISS) and Revised Trauma Score (RTS) to predict a patient's probability of survival following traumatic injury.[7] The GCS, along with cardiovascular and respiratory status, are the major components of the Revised Trauma Score, a well-recognized predictive tool for determining outcome in trauma patients.[8] The Injury Severity Score (ISS) has been the "gold standard" for anatomical severity scoring since it was introduced in 1974. The ISS sums the severity score for the three most severe injuries, but it only considers one injury per body region. Therefore, one can suspect that the ISS underscores the severity in trauma victims with multiple injuries confined to one body region.[9] Several authors suggest that shock index (SI), calculated as HR divided by SBP, may be a beter measure of the degree of hemodynamic stability than HR or SBP alone.[10] SI has been suggested as a predictor of early postinjury outcome.[11] Due to higher mortality of GSI especially occurred in three body space; trauma scoring systems have an important value. However the majority of these were derived from patients in the intensive care unit (ICU) and their applicability to patients in the emergency department remains questionable.

In this study, we aimed to evaluate the effect of GCS, TRISS, RTS, ISS and SI on the length of stay in hospital and mortality of gunshot injured patients.

METHODOLOGY

This retrospective study was conducted in the Emergency Department (ED) of Medicine Faculty. All patients with gunshot injury admitted to the ED from January 2007 through January 2009 were enrolled in the study. The demographic characteristics of patients such as age, gender, cause of the injury, type of the weapon used, the injured body parts, GCS, SI, the length of stay in hospital and mortality were recorded from the patient charts.

Abbreviated Injury Scale (AIS), was developed in 1969 and revised in 1998 and 2008, was also calculated. In order to calculate AIS, the body has been categorized as six different areas: head-neck, face, thorax, abdomen, extremities and the external surface and injuries at the each part of the body were classified as minor injuries (AIS score 1) and mortal injuries (AIS score 6). ISS has been calculated by summing the squared AIS scores of the three most damaged body parts.[3] RTS was calculated by using of GCS score at admission, respiratory rate and arterial blood pressure[12], and TRISS has been calculated by using age, RTS and ISS scores.

The study data was analyzed with SPSS 13.0 software. Descriptive statistics were used for demographic data and the correlation between the mortality and length of stay evaluated by Mann Whitney U Test and the values with $p<0.05$ were considered as significant.

The patients were divided into groups as survivors and non-survivors. For each group age (years), trauma scores, length of stay in hospital were computed. The differences between the groups for these parameters were compared using the Mann-Whitney U test. Correlations of the length of stay in hospital and trauma scores were examined using the simple linear regression and Pearson's correlation analysis.

RESULTS

A total of 87 patients were enrolled the study. The mean age of patients was 33.2±16.1 years and 79 of 87 patients (90.8%) were male. The causes of GSIs were homicidal in 64 (73.6%), accidental in 14 (16.1%) and suicidal in 9 (10.3%) of the study patients. Fourty five of GSIs (51.7%) were due to the bullet cartridge and 42 (48.3%) with pellets.

Calculated GCS, ISS, RTS, TRISS and SI were 13.8±2.9, 13.0±9.3, 7.38±1.1, 93.9±14.9%, and 1.9±0.9 respectively. The mean length of hospital stay was 7.08 ± 8.64 days (min-max: 1-45 days). The mortality rate was 12.6%. The most injured body parts were

36.8% (32) extremities, 27.6% (24) head and neck, 6.9% (6) abdomen, 4.6% (4) thorax. Twenty one (24.1%) of 87 patients had at least two injured body parts.

Eighty seven patients were divided into 2 groups according to survival. Seventy six of them were survivors and 11 were non-survivor. There were no statistically significant differences between the groups in terms of age (p>0.05). GCS, RTS and TRISS scores for survivors were significantly higher than non-survivors (p<0.001). ISS and SI for survivors were significantly lower than non-survivors (p<0.001). There were no statistically significant differences between the groups in terms of the length of stay in hospital (p>0.05) (Table-I).

There was no statistical significant correlation of the length of stay in hospital with GCS, RTS and TRISS (p>0.05). The length of stay in hospital was found to correlate with ISS and SI positively (Rsq=0.26 and 0.14 respectively, p<0.001) (Figure 1 and 2).

Table-I: Comparison of survivors and non-survivors.

	Survivors (n=76) Mean±SD	*Non-survivors (n=11) Mean±SD*	
Age (years)	33.0±16.7	34.6±12.3	p=0.466
GCS	14.4±1.8	9.4±5.2	p<0.001
ISS	11.5±8.7	23.7±6.5	p<0.001
TRISS	97.1±5.6	71.8±32.3	p<0.001
RTS	7.6±0.6	5.6±1.9	p<0.001
SI	0.8±0.2	1.2±0.4	p<0.001
Length of stay in hospital (days)	7.3±9.1	5.6±5.0	p=0.913

GCS (Glasgow Coma Scale) ISS (Injury Severity Score)
TRISS (Trauma and Injury Severity Score)
RTS (Revised Trauma Score) SI (Shock Index)

DISCUSSION

GSI is a trauma form that differs by the countries and the regions and it also can have different characteristics according to the socioeconomic and educational background of the region. About half a million people yearly are declared dead from GSI according to World Health Organization (WHO) 2001 reports.[13] GSI affects the young population as well as all trauma patients and is seen more in males as has been suggested in the earlier studies.[14,15] The major cause of GSI has been determined as violent armed attacks in a study performed in our country. In our study it has been showed that most of the GSI have occurred as a result of violent armed attacks (73.6%). This rate has been found as 60–80% in a similar study performed in Pakistan while an incidence of 11% was determined in a study done in Sweden.[16,17]

These rates are different according to WHO data: 42% is suicidal and 38% is homicidal considering 2001 WHO reports.[16,17] The highest mortality rate is observed at the suicidal GSI patients. In our study, the causes of GSIs were homicidal in 73.6%, accidental in 16.1% and suicidal in 10.3% of the study patients. In our study most affected parts were found as extremities while different parts have been declared affected in other studies as abdomen and head-neck areas.

Various trauma scoring systems are used to assess the traumatic patients. GCS which has been developed by Jennett and Teasdale is most fre-

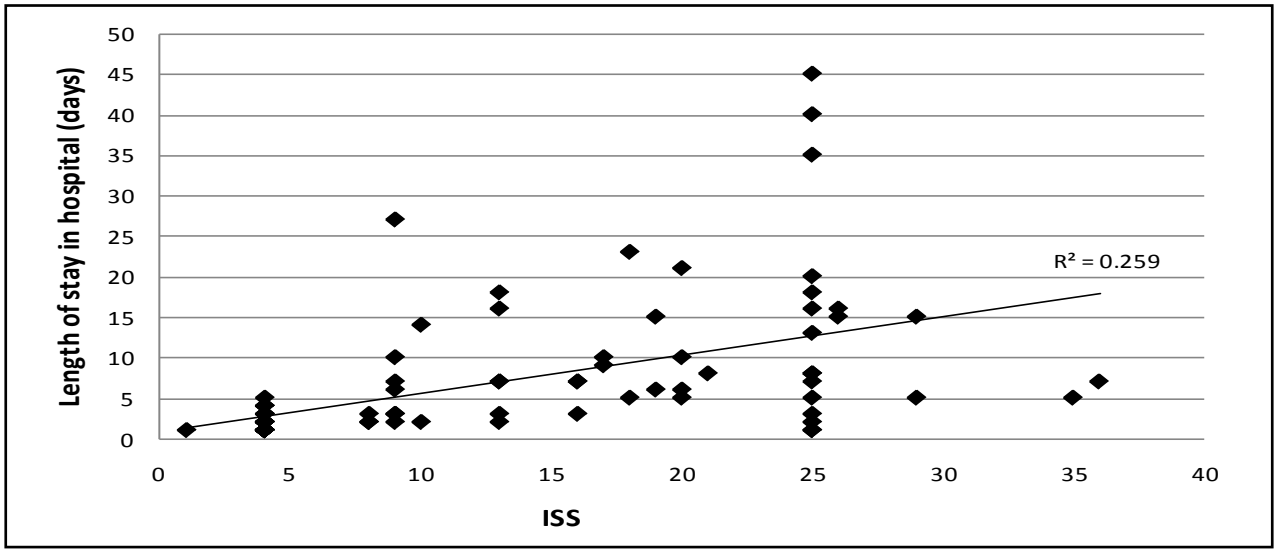

Figure.1: The relationship between length of stay in hospital and Injury Severity Score (ISS)

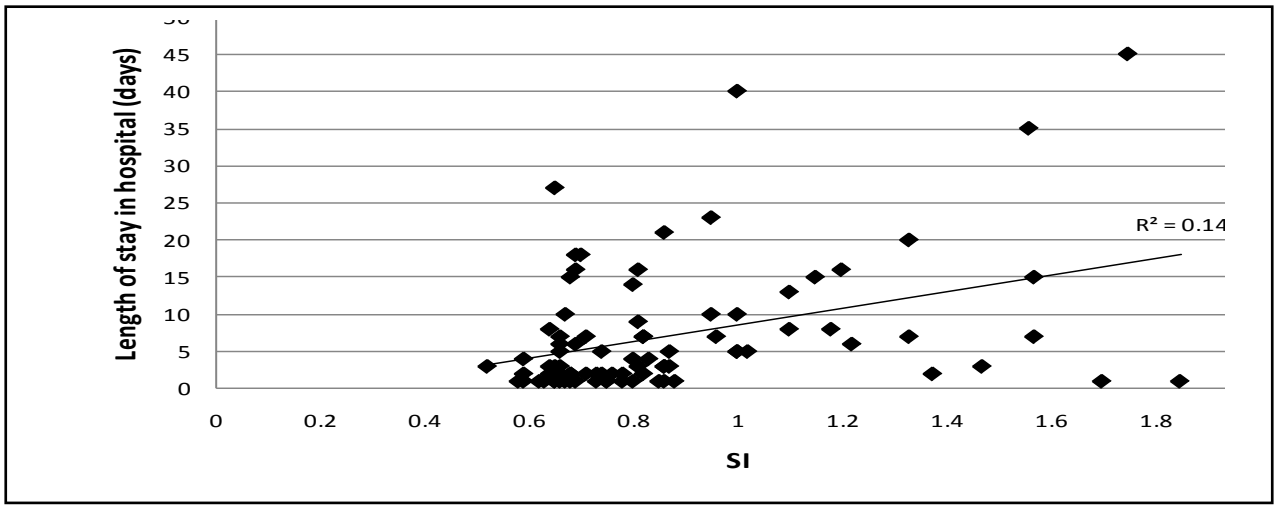

Figure.2: The relationship between length of stay in hospital and Shock Index (SI)

quently used system between the scoring systems for assessing of patient's neurological status.[18] Zhao et al have reported that GCS values and shock index are useful to predict mortality and morbidity of patients in a study they performed on the various traumatic patients.[19] GCS has been found useful to predict mortality in a study performed with 89 patients experienced head trauma because of GSI.[20] Our study has also revealed a significant relationship between the mortality and GSI just like the similar studies.

RTS is also a physiologic trauma scoring system like GCS and is used to assess the pathophysiological condition of patients and earlier studies have suggested that RTS is useful for predicting the prognosis.[12] Our study has also showed this scoring system is considerably useful at penetrating traumas like GSI.

AIS is a trauma scoring system that has been indicated to be more effective particularly at multitraumas and to predict the patient's prognosis.[3] A correlation between AIS and GIS severity has been found in a study performed by Cernak et al between 1991 and 1994 including 1303 patients. Average AIS score was found as 13 at these patients.[21] Although there are some authors who suggested the effectiveness of AIS is limited at penetrating traumas and at multi traumas that formed in a single body part, in this study we found that AIS is also effective at penetrating traumas.[22,23]

This study showed that TRISS is quite useful at predicting of mortality at traumas because of GSI. In a similar study performed by Larsen et al. with 206 trauma patients caused by stab wounds and GSI, TRISS has been suggested to be useful to determine patients' prognosis.[24] SI is a parameter that gives information on the patient current hemodynamic and can be easily calculated. Ciftci et al have examined 250 thoraco-abdominal injured patients and determined a significant mortality increasing at the existing shock condition.[25] In this study the mortality increase with the higher shock index has also been observed.

Esme et al have analyzed the effects of trauma scoring systems on length of stay in hospital with 150 blunt thoracic trauma patients. They have revealed RTS, AIS and TRISS values are effective on the length of stay.[26] In our study a statistically significant correlation has been determined only between ISS and SI values and the length of stay in hospital. Other trauma scoring systems were not effective on predicting the length of stay in hospital. However this study should be considered as has been performed only on penetrating traumas.

CONCLUSION

This study has revealed the trauma scoring systems are useful to predict the mortality at penetrating traumas as well as GSI. It can also be suggested that use of trauma scoring systems is very useful to indicate trauma severity and mortality.

REFERENCES

1. Karger B. Penetrating gunshots to the head and lack of immediate incapacitation. I. Wound ballistics and mechanisms of incapacitation. Int J Legal Med 1995;108(2):53-61.
2. Alvarez M, Nava JM, Rue M, Quintana S. Mortality prediction in head trauma patients: Performance of Glasgow Coma Score and general severity systems. Crit Care Med 1998;26(1):142-148.

3. Baker SP, O'Neill B, Haddon W Jr. The injury severity score: A method for describing patients with multiple injuries and evaluating emergency care. J Trauma 1974;14:187-196.
4. Rush C. The History of the Glasgow Coma Scale: An Interview with Professor Bryan Jennett Int J Trauma Nur 1997;3:114-118.
5. Fischer J, Mathieson C. The History of the Glasgow Coma Scale: Implication for Practice Crit Care Nurs Q 2001;23:52-58.
6. Jennett B. The Glasgow Coma scale: History and Current Practice. Trauma. 2002;4:91-103
7. Schluter PJ. The Trauma and Injury Severity Score. Int J Care Injured 2011;42:90-96.
8. Champion HR, Sacco WJ, Copes WS, Gann DS, Gennarelli TA, Flanagan ME, et al. A revision of the trauma score. J Trauma 1989;29:623–629.
9. Husum H, Strada G. Injury Severity Score Versus New Injury Severity Score for Penetrating Injuries. Prehosp Disast Med 2002;17:27-32.
10. Rady MY, Smithline HA, Blake H, Nowak R, Rivers E. A comparison of the shock index and conventional vital signs to identify acute, critical illness in the emergency department. Ann Emerg Med 1994;24:685-690.
11. King RW, Plewa MC, Buderer NM, Knotts FB. Shock index as a marker for significant injury in trauma patients. Acad Emerg Med 1996;3:1041-1045.
12. Champion HR, Sacco WJ, Copes WS, Gann DS, Gennarelli TA, Flanagan ME. A revision of the Trauma Score. J Trauma 1989;29(5):623–629.
13. World Health Organization (WHO). Small arms and global health. Paper prepared for SALW talks. Geneva: July 2001.
14. Mattila VM, Mkitie I, Pihlajamäki H. Trends in hospitalization for firearm-related injury in Finland from 1990 to 2003. J Trauma 2006;61(5):1222–1227.
15. Buyuk Y, Eke M, Dinc AH. Firearm fatalities autopsied in Ankara (2001-2004). Turkiye Klinikleri J Foren Med 2008;5:6-12.
16. Mujahid M, Hassan Q, Arif M , Gandapur J, Shah H. Homicidal deaths by firearms in Dera Ismail Khan: An autopsy study. Pak J Med Res 2006;45(1):14–16.
17. Bostrom L, Nilsson B. A review of serious injury and death from gunshot wounds in Sweden: 1987 to 1994. Eur J Surg 1999;165(10):930-936.
18. Teasdale G, Jennet B. Assessment of coma and impaired consciousness. A practical scale. Lancet 1974:13;2(7872):81-84.
19. Zhao XJ, Kong LW, DU DY, Su HJ. Analysis on care outcome of patients with polytrauma and coma. Chin J Traumatol. 2007;10(1):53-8.
20. Helling TS, Mc Nabney WK, Whittaker CK, Schultz CC, Watkins, M. The role of early surgical intervention in civilian gunshot wounds to the head. J Trauma 1992;32:398-400.
21. Cernak I, Savic J, Zunic G , Pejnovic N, Jovanikic O, Vladislav S. Recognizing, scoring, and predicting blast injuries. World J Surg 1999;23(1):44-53.
22. Yates DW. Scoring systems for trauma. BMJ 1990;301:1090-1094.
23. Fani-Salek MH, Totten YV, Terezakis AS. Trauma scoring systems explained: Emergency Medicine 1999;11:155-166.
24. Pillgram-Larsen J, Marcus M, Svennevig JL. Assessment of probability of survival in penetrating injuries using the TRISS methodology. Injury 1989;20(1):10-12.
25. Ciftci F, Girgin S, Gedik E, Onat S, Tacyildiz IH, Keles C. The evaluation of 250 patients with thoracoabdominal injuries: Ulus Travma Acil Cerrahi Derg 2008;14(3):231-238.
26. Esme H, Solak O, Yurumez Y, Yavuz Y, Terzi Y, Sezer M, et al. The prognostic importance of trauma scoring systems for blunt thoracic trauma: Thorac Cardiovasc Surg 2007;55(3):190-195.

Author's Contributions:

Dr. Ali Dur, Dr. Sedat Kocak, and Dr. Defne Zerrin Dundar have conducted follow-up of patients at emergency service. Dr. Mehmet Nuri Bozdemir and Dr. Sadik Girisgin were leader and member of trauma team. Dr. Mehmet Gul and Dr. Basar Cander were academic staff responsible for intensive care unit and Dr. Mehmet Uyar made statistical calculations.

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