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Injury Severity Score (ISS) versus Revised Trauma Score (RTS) as a predictive value and outcome in polytrauma patients

Y.E.Rizk[1], M.E.Rizk[1], A.H.Abd El-Rahman[2], A.M.El-Nahas[1] and A.M. El Sherbini[2]
[1]Cadiothoracic Surgery Dept., Faculty of Medicine, Benha Univ., Benha, Egypt
[2]Anesthesia and Intensive Care Dept., Faculty of Medicine, Benha Univ., Benha, Egypt
E-Mail: gogohodo83@gmail.com

Abstract

Back ground: Trauma score are used to obtain a numerical description of the severity of an individual's injuries and clinical condition, which in turn is associated with prognosis. Trauma score that used in predicting mortality among polytraumatized patients could be anatomical or physiological or combined. The Injury severity score (ISS) is the most commonly used measure of injury severity. It is an anatomical scoring system that provides an overall score for patients with multiple injuries. Each injury is assigned an Abbreviated Injury Scale (AIS) score. The Revised Trauma score (RTS) is a physiological scoring system with high inter-rater reliability and demonstrated accuracy in predicting death. The present study aimed to study outcome value of RTS in comparison to ISS and try to find a relation between initial scores and their outcome. Fifty patients randomly collected presented to the Critical Care Departments. The Injury Severity Score (ISS) and Revised Trauma Score (RTS) was calculated ,the patients had a mean ± SD age of 37.04 ± 13.42 years. They comprised 42 males (84%) and 8 females (16%). The major mechanism of injury in polytrauma patient was road traffic accidents (76.0%). The majority of cases in the age group 20 to 49 (72%). Males were 3 times more affected than females. The most common cause of death was respiratory. RTS was better than ISS in predicting mortality among polytraumatized patients.

Keywords: Injury severity score, ISS, Revised trauma score, RTS, Polytrauma**.**

1. Introduction

With the recent increase in traffic, the degree of trauma has become increasingly serious. In addition, disasters such as earthquake, tsunamis, and typhoons occur frequently. Trauma has become the leading cause of morbidity and mortality among individuals aged <40 years and is the third main cause for death worldwide [1]. Meanwhile, there are approximately 5 million deaths due to injuries annually worldwide [2]. A systematically organized approach to trauma evaluation and management has been shown to reduce mortality, morbidity, and length of hospital stay [3]. To study the outcomes of trauma, accurate and reliable methodological tools are required for appropriate scoring of severity and outcome prediction [4].More than 50 scoring systems have been published for the classification of trauma patients in the field, emergency room, and intensive care settings. There are three main groups of trauma scores: (a) Anatomical, (b) Physiological, (c) Comorbidity scores. The three types of scores can be combined in different ways to obtain more accurate information from all possible aspects [5]. The Injury Severity Score (ISS) is the most commonly used measure of injury severity. It is an anatomical scoring system that provides an overall score for patients with multiple injuries. Each injury is assigned an Abbreviated Injury Scale (AIS) score [6]. The Revised Trauma Score (RTS) stems from the trauma score which was published in 1981 as a tool for triage of patients in the field [7].The aim of this work is to study the outcome value of Revised Trauma Score (RTS) in comparison to Injury Severity Score (ISS) in the Critical Care Departments of both Benha University Hospital and Mansoura International Hospital in Multiple Trauma Patients to find a relation between the initial scores and their outcome.

2. Patients and methods

This prospective study was performed at Critical Care Departments of both Benha University Hospital and Mansoura International Hospital. The data was collected from 50 patients admitted to Critical Care Department with multiple trauma and fulfillment of inclusion criteria from June 2018 to June 2019.

2.1 Inclusion criteria

The present study was conducted on traumatic patients with multiple trauma of both genders “without intently selected certain gender” and had 16 years old or more.

2.2 Exclusion criteria

Patients who were less than 16 years old or with end stage chronic disease were excluded from this study. Furthermore, patients refusing study were excluded.

A written informed consent was obtained from each patient involved in the study or their first degree relatives.

All trauma patients were initially assessed and managed according to the principles of the ATLS guidelines.

All the patients were subjected to the following:

2.2.1 Initial resuscitation and Primary survey will be done as management of poly trauma patients (ABCDE)

- A = Airway preservation and cervical spine protection.
- B = Breathing and ventilation.
- C = Circulation and hemorrhage control.

- D = Disability (rapid assessment of neurological status)
- E = Exposure / Environment control: the patient is completely undressed to allow full examination but prevent hypothermia.

  After completing the primary survey and resuscitation of the patient, a secondary survey and examination were started then reevaluation had been repeated.

2.2.2 History and Demographic data reporting

History was taken from patients or their relatives. Age, gender, mode of trauma, and presence of any chronic diseases had been considered. The AMPLE history for this purpose:

- A = Allergy.
- M = Medication.
- P = Past Medical History, Pregnancy.
- L = Last Meal.
- E = Events and Environment.

2.2.3 Examination

- General examination: pulse, BP, RR, temperature and oxygen saturation were assessed and documented.
- Local examination: head, neck, maxillofacial, chest, abdomen, musculoskeletal, neurological and perineum examination were performed.
- 4- Investigations:
- Laboratory (if needed): Complete blood cell count, blood group, arterial blood gas, liver function test, renal function tests and pregnancy test.
- Radiology (if needed): X rays, CTs, FAST and duplex.

2.2.4 The Injury Severity Score (ISS) and Revised Trauma Score (RTS) was calculated

2.3 Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (SPSS Inc, Chicago, IL, USA). Qualitative data was presented as number and Percent. Comparison between groups was done by Chi-Square test ($\chi 2$). Quantitative data was presented as mean ± standard deviation. Normally distributed quantitative data within two groups was compared by Student t-test. P-value <0.05 was considered statistically significant.

3. Results

This study was conducted on 50 patients admitted to Critical Care Department with multiple trauma and fulfillment of inclusion criteria from June 2018 to October 2018. Regarding the patients' gender, the 50 randomly collected included in this study were 42 males (84%) and 8 females (16%). The mean age ± SD of the studied cases was 37.04 ± 13.42, ranging from 16 to 68 years.

According to cause of trauma, RTA was the main cause of trauma in 38 (76%) patients, gunshot was the cause of trauma in 2 patients (4%), FFH was the cause of trauma in 7 (14%) patients and assault was the cause of trauma in 3 patients (6%). It was found in this study that RTA was the highest mode of trauma Table (1).

Table (1) Distribution of the studied cases according to cause of trauma (n= 50).

Mode of trauma	N	%
RTA	38	76
Shooting	2	4
FFH	7	14
Assault	3	6

According to site of trauma there were 45 (90%) patients with chest trauma, 36 (72%) patients with head trauma, 35 (70%) patients with abdominal trauma and 24 (48%) patients with skeletal trauma. The chest was the most common site of trauma by comparing to the other sites Fig (1).

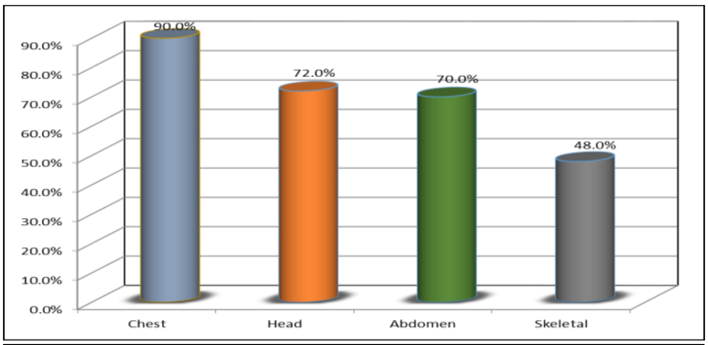

Fig (1) Injury sites among the studied cases

As regarding to the causes of death. In this study the most common cause of death was respiratory, which cause death in 8 (53.3%) patients. Patients die due to central causes were 4 (26.7%). Multiple organ failure was the cause in 2 (13.3%) patients, whereas circulatory causes were blamed in 1 (6.7%) patient. 1 (6.7%) patients were died in the 1st peak (1st hour after trauma), 3 (20%) patients in the 2nd peak (1st day after trauma) and 11 (73.3%) patients in the 3rd peak (more than one day). The mean ± SD of RTS in dead patients was 6.9 ± 1.4 whereas in alive was 10.6 ± 1. There was significant association between low RTS and number of death cases (P= 0.001), Fig (2).

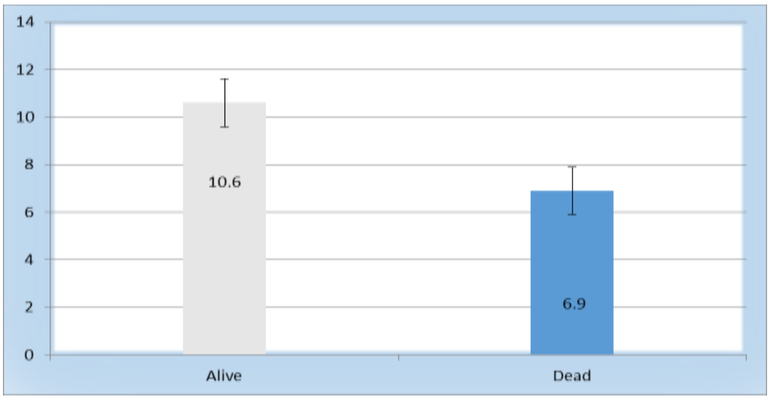

Fig (2) Comparison between alive and dead cases regarding RTS scale on admission**.**

The mean ± SD of lSS in dead patients was 42.4 ± 7.8, whereas in alive was 21.6 ± 4.8. It was found that increase the number of dead cases significantly associated with higher ISS grades (P=0.001), Fig (3).

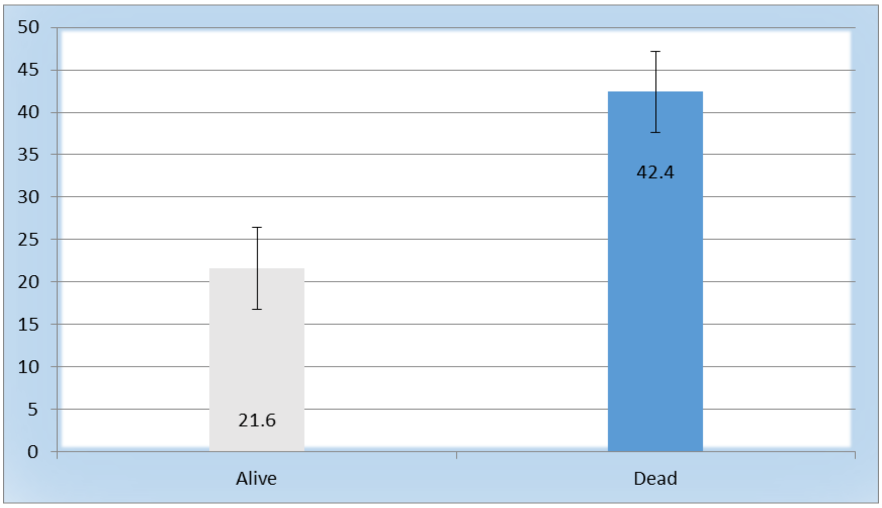

Fig (3) Comparison between alive and dead cases regarding ISS scale on admission.

The statistical performance of ISS and RTS in predicting the trauma outcome is assessed by using receiver operating characteristics (ROC) curves and the area under the curve (AUC). The AUCs for the predictive ability of the RTS and ISS were 0.990 and 0.987 respectively. RTS and ISS had significantly high diagnostic performance in predicting death cases (P=0.001). The cut-off value of the RTS was 8 or less, with a sensitivity of 93.3 % and specificity of 97.1%; through which the mortality was predicted with an accuracy of 90.5%. The positive predictive value was 93.3%, which was higher than that of the ISS, and the negative predictive value was 97.1%. The cut-off value of the ISS was 29 or higher, with a sensitivity of 93.3% and specificity of 94.3%; through which the mortality was predicted with an accuracy of 88.6%. The positive predictive value was (87.5%), whereas the negative predictive value was 97.1%, Fig (4 & 5).

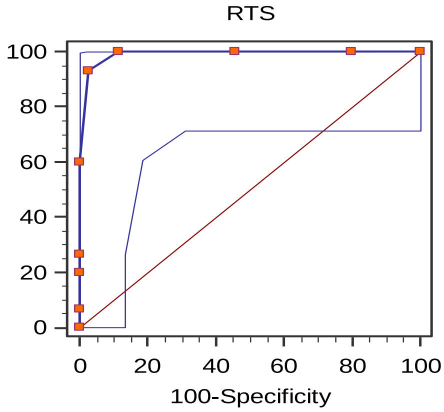

Fig (4) ROC curve for RTS scales in predicting death (sensitivity and specificity) for RTS.

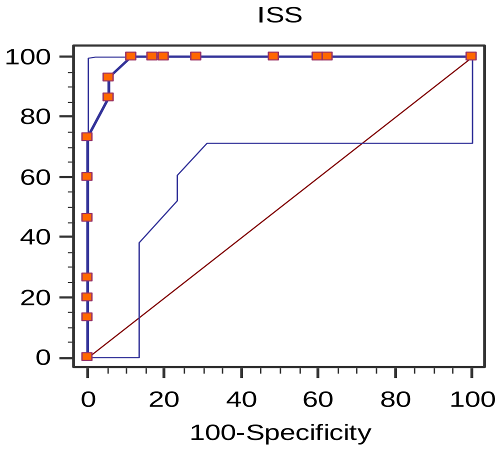

Fig (5) ROC curve for ISS scales in predicting death (sensitivity and specificity) for ISS.

4. Discussion

In the current study regarding to gender, studied patients were 42 males (84%) and 8 females (16%). Male dominance among the studied patients was also reported by the study of Salehi et al. [1] who studied Length of Hospital Stay in 511 multiple trauma patients and noted that males constituted 87.3% of the study participants. In addition, Jung and his colleague reported male prevalence of 64.9% in their study on 1746 patients with multiple trauma. Male patients were significantly more affected in polytrauma than females due to their greater tendency towards participating in outdoor activities [8].In the present study the age ranged from 16 to 68 years with mean (37.04 ± 13.42) in this study. It was noted that trauma was more common among age group from 30 to 50 years, whereas, the study was done by Wong et al. [9] the polytrauma was more common in age group from 18 to 44 years. Jung et al. [8] revealed that polytrauma was more common in age between 15 to 54 years; on the other hand Heydari et al. [10] study showed that the most affected patients were in age group between 5 to 47 years. Moreover, many previous studies reported that the most common affected age group was lower than our study, from 16 to 25 years Hyder et al. [11] and from 13 to 22 years Norouzi et al. [12]In the present study, the main cause of polytrauma was RTA accounting 38 (76%) patients. This goes with the study was done by Jung et al. [8] in which, RTA was the first cause of trauma accounting (40.2%) and in the study was done by Heydari et al. [10] RTA was the most common cause of polytrauma patients (74.2%). Norouzi et al. [12] reported that about (67%) of the patients trauma caused by RTA. Similar finding was announced by Negoi et al. [13] RTA was the most common cause of polytrauma patients (68.3%) in their study. We noticed that in all of the previous studies RTA was the major cause of trauma, this is due to many reasons such as rapid motorization, coupled with poor road conditions, rapid population growth, lack of safety features in cars, crowded roads, poor road maintenance lack of police enforcement, over speeding, driving without a seat belt or motorcycle helmet, driving under the influence of alcohol and drugs, and ignoring traffic signals.We found that in the current study that 45 (90%) patients with chest trauma, 36 (72%) patients with head trauma, 35 (70%) patients with abdominal trauma and 24 (48%) patients with skeletal trauma. Chest trauma was markedly high than other sites of trauma as previously mentioned. The same results were found in a study was done by Mater [14] who reported that the chest trauma was more common site of injury in poly trauma patients. Whereas, in a study was done by Norouzi et al. [12] the head trauma were more prevalent in poly trauma patients (75%). The study of Wong et al. [9] also showed that head trauma was more prevalent in poly trauma patients (43.6%). The extremities were more common site of injury in poly trauma patients accounting (35%) in a study was done by Heydari et al. [10] and (93.5%) in another study was done by Yousefzadeh et al. [15] who reported also that head injury came in the second place accounted (37.8%).In the present study, death was the outcome in 15 (30%) patients and discharge was the outcome in 35 (70%) patients. Alongside with our results, death was the outcome in 49 (13.9%) patients and discharge was the outcome in 303 (86.1%) patients in [15] study. However mortality rate reached 76 (40%) patients in a study was done by [16] and 562 (7.9%) patient in Jung et al. [8] study. Trauma outcome has been suggested to be influenced by many factors such as types and severity of injury, patient's age, pre-hospital and intra hospital medical services during trauma.In the current study, the cause of death was respiratory in 8 (53.3%) patients, and the central cause of death was in 4 (26.7%) patients. Multiple organ failure (MOF) was the cause of death in 2 (13.3%) patients and circulatory was the cause of death in 1 (6.7%) patients. Whereas, in the study which was done by [17] the most frequent causes of death were central nervous system (CNS) injury 431 (59.9%), followed by circulatory 93 (12.9%), pneumonia/respiratory insufficiency 61 (8.5%) and last of all MOF in 32 (4.4%). In another study performed by [18] the most common cause of death was the CNS and was represent by (51.6%) followed by circulatory (30%). While Negoi et al. [13] reported that the main cause of death was MOF (38%) then circulatory in (36%) and central (26%).Of note there were three death peaks in the present study. The first peak was in the first hours after trauma or the patients who died in critical care department; the cases were found in this peak were 1 (6.7%) patient. The second peak was in the first day after trauma; the dead cases in this peak were 3 (20%) patients. The third peak was during 16 days after trauma, the dead cases were 11 (73.3%) patients. Whereas in the study was done by [19] the mortality rate in the first, second and third peaks were 61%, 29% and 10% respectively.[17] reported in their study that the immediate deaths were 55 patients, 82 patients died early in hospital and 180 patients late death. There was no trimodal time distribution for mortality found in the study done by[13].In the current study, the percentage of the cases in the 1st peak cannot be estimated precisely because most of the people who died in this peak did not arrive to ICU and so we didn’t have enough information about their exact number.The outcome of cases regarding demographic characteristics, 13 died patients were males (86.7%) and 2 were females (13.3%).As regarding the outcome of cases and the relation to cause of trauma, in RTA 13 (86.7%) patients died, 25 (71.4%) patients discharged. While in Shooting 1 (6.7%) patients died, 1 (2.9%) patients discharged. In FFH 7 (20%) patients discharged while in assault 1 (6.7%) patients died, 2 (5.7%) patients discharged.According to our study, we measure the association between Revised Trauma Score (RTS) and mortality and between Injury Severity Score (ISS) and mortality, in order to compare between RTS as a physiologic scoring system and ISS as an anatomical scoring system to evaluate the predictive power of both of them in trauma mortality.In the present study also showed that, death frequency was significantly high in patients with low RTS scores and high ISS grades. This difference was statistically significant ($p<0.001$). The distribution of dead cases among the RTS categories and ISS grades was showed in the result chapter Fig (5 & 6). [20] also reported similar findings.In the current study, the minimum and the maximum revised trauma scores (RTS) in injured patients were 4 and 12 respectively, with a mean ± SD of 9.5 ± 2.03, whereas the ISS scores ranging from 17–54 with a mean ± SD of 27.84 ± 11.25. In the studded cases more than 50% of them were found to have a high RTS score ≥10.In consistent with our finding [21] performed a study 27, 154 patients with trauma, the mean ± SD for RTS of 13, 463 derivation patients was (10.6 ± 2.9) and of ISS was (16.9 ± 13.5) and for 13,691 validation patients was (10.6 ± 3.0) and (17. l ± 13.5) for RTS and ISS respectively.In another study conducted by [22] in Pakistan who studded revised trauma score as a predictor of outcome in 501 trauma cases from October 2006 to October 2009, The mean for RTS found to be 11.5 .In the present study, there were significant differences according to the RTS and the outcome; in the non-survivor patients their RTS were ranged from 4 to 12 with mean (5.3) while in survivor patients their RTS were ranged from 5 to 12 with mean (10.9) ($P<0.001$). This goes with the study was done by [23], who reported that there was significance difference between RTS and outcome as mortality rate increased in low RTS. There were also significant differences according to the ISS and the outcome as in the non-survivor patients the ISS was ranged from 29 to 54 with mean ± SD (42.4±7.8), while in survivor patients the ISS was ranged from 17 to 34 with mean± SD (21.6±4.8) ($P<0.001$).In a research conducted by[24], the mean of RTS was 11.6 and 8.3 in survivors and non-survivors respectively, while the mean of ISS was 8 in survivors and 20 in non-survivors. In a prospective study was done by[25], reported that, ISS ranged between 5 to 75 with a mean ±SD of 46.8 and median of 38. [26] also reviewed all trauma patient deaths at Liverpool hospital, Sydney, Australia and found that ISS ranged between 5-75 with median of 34. The conclusion of this study was the significant difference in ISS in deaths and the inverse proportion correlation between ISS and probability of survival.In fact, as clearly depicted in our results, RTS of 8 or less could clearly be correlated to a statistically significant higher mortality (P-value ≤0.001). And at a cut-off point of RTS 8 or less, RTS can predict mortality with sensitivity 93.3% and specificity of 97.1% , with AUC = 0.990. On the other hand ISS of 29 or more could clearly be correlated to a statistically significant higher mortality (P-value ≤0.001). And at a cut-off point of ISS 29 or more, ISS can predict mortality with sensitivity 93.3% and specificity of 94.4%, with AUC = 0.987.In our study, RTS showed a better performance in predicting mortality with AUC=0.990 whereas ISS also had a good discrimination with AUC=0.987.Alongside with our results, [8] who studied 7,120 trauma patients , the ISS ROC curve showed AUC=0.866 with 86.7% sensitivity and 74.6% specificity. While in the study done by [27], ISS ROC curve showed AUC=0.900 with 64% sensitivity and 93% specificity.Multiple studies indicate that the revised trauma score can be used as a good tool to predict the mortality rate of traumatic patients. as in the study done by[10], who reported sensitivity and specificity of the revised trauma score in predicting mortality of traumatic patients were 88% and 90%, respectively[28] also reported a sensitivity of the RTS was 85% and specificity was 93%.These findings are not too much different from the results of the study by [29] who evaluated the ability of the RTS to identify trauma patients who subsequently died or who sustained injuries resulting in an injury severity score (ISS) greater than 15. The RTS· identified 97% of deaths at the cut-off of RTS less than 12 (i.e. abnormal) [29].Moreover in this study it was found that there was significant positive correlation between RTS and duration of hospital stay in admitted patients (r=0.576). That means the increase in the RTS was associated with decrease in hospital stay and vice versa (P-value <0.001).This go with study done by [22] how divided the cases into two groups (RTS <10 and RTS > 10); they found the length of hospital stay was significantly lower in the latter group.As we notice that the performance of RTS was better than ISS because of a number of reasons. Firstly, for the injured patients, the direct cause of mortality was the physiologic derangement of different body systems. Secondly, the patients with similar injury severity score may have totally different physiologic derangement. As a result to this group of patients, the predicting power of ISS will be limited and RTS can better reflect the injury severity. Thirdly, there were significant correlation between the RTS and duration of hospital stay in admitted patients. Furthermore ISS has inherent drawbacks when more than one severe injury occurs on the same body region.Multiple studies indicated that ISS might underestimate the injury severity as in the studies were done by [8] and [15].

5. Conclusion

The major mechanism of injury in polytrauma patient was road traffic accidents (76.0%). The majority of cases in the age group 20 to 49 (72%). Males were 3 times more affected than females. The most common cause of death was respiratory. The mortality rate in poly trauma patient was (30%). RTA was the most common cause of injury leading to death representing (86.7%) of all causes leading to death. RTS was better than ISS in predicting mortality among polytraumatized patients.

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