Evaluation of ISS, RTS, CASS and TRISS scoring systems for predicting outcomes of blunt trauma abdomen

Arshad Alam, Arun Kumar Gupta, Nikhil Gupta, Raghav Yelamanchi, Lalit Kumar Bansal, C K Durga
Department of Surgery, Atal Bihari Vajpayee Institute of Medical Sciences and Dr. Ram Manohar Lohia Hospital, New Delhi, India

ABSTRACT:

Introduction: Trauma is the leading cause of mortality in people below the age of 45 years. Abdominal trauma constitutes one-fourth of the trauma burden. Scoring systems in trauma are necessary for grading the severity of the injury and prior mobilization of resources in anticipation.

Aim: The aim of this study was to evaluate RTS, ISS, CASS and TRISS scoring systems in blunt trauma abdomen.

Materials and methods: A prospective single-center study was conducted on 43 patients of blunt trauma abdomen. Revised trauma score (RTS), Injury Severity Score (ISS), Clinical Abdominal Scoring System (CASS) and Trauma and Injury Severity Score (TRISS) were calculated and compared with the outcomes such as need for surgical intervention, post-operative complications and mortality.

Results: The majority of the study subjects were males (83.7%). The most common etiology for blunt trauma abdomen as per this study was road traffic accident (72.1%). Spleen was the most commonly injured organ as per the study. CASS and TRISS were significant in predicting the need for operative intervention. Only ISS significantly predicted post-operative complications. All scores except CASS significantly predicted mortality.

Conclusions: Among the scoring systems studied CASS and TRISS predicted the need for operative intervention with good accuracy. For the prediction of post-operative complications, only the ISS score showed statistical significance. ISS, RTS and TRISS predicted mortality with good accuracy but the superiority of one score over the other could not be proved.

KEYWORDS: blunt trauma abdomen, Clinical Abdominal Scoring System, Injury Severity Score, Revised Trauma Score, Trauma and Injury Severity Score

STRESZCZENIE:

Wstęp: Urazy pozostają główną przyczyną zgonów u osób poniżej 45. r.ż. Jedną czwartą wszystkich urazów stanowią urazy jamy brzusznej. Skale kliniczne stosowane w urazach są niezbędne dla oceny ich ciężkości i wcześniejszego zorganizowania środków w oczekiwaniu na przyjazd chorego.

Cel: Celem badania była ocena zastosowania skal RTS, ISS, CASS i TRISS w urazach tępych jamy brzusznej.

Materiały i metody: Przeprowadzono prospektywne jednoośrodkowe badanie kliniczne na 43 pacjentach z urazem tępym jamy brzusznej. Były to: Revised Trauma Score (RTS), Injury Severity Score (ISS), Clinical Abdominal Scoring System (CASS) oraz Trauma and Injury Severity Score (TRISS). Były obliczane i porównywane z punktami końcowymi, takimi jak: potrzeba leczenia zabiegowego, powikłań pooperacyjnych i zgon.

 Wyniki: W niniejszym badaniu większość stanowili mężczyźni (83,7%). Uraz jamy brzusznej był głównie wynikiem wypadku komunikacyjnego (72,1%). Spleen była najczęściej uszkodzonym organem. CASS i TRISS przewidywały konieczność interwencji zabiegowej. Jedynie ISS przewidywała istotność powikłań pooperacyjnych. ISS, RTS i TRISS przewidywały zgon z dużą dokładnością.

Wnioski: Medyczne skale przewidywały konieczność interwencji zabiegowej z dobrą dokładnością. Jedynie ISS przewidywała istotność powikłań pooperacyjnych. ISS, RTS i TRISS przewidywały zgon z dużą dokładnością.

SŁOWA KLUCZOWE: Clinical Abdominal Scoring System, Injury Severity Score, Revised Trauma Score, Trauma and Injury Severity Score

ABBREVIATIONS

AAST – American Association for the Surgery of Trauma
AIS – Abbreviated Injury Scale
ATLS – Advanced Trauma Life Support
AUC – area under the ROC curve
CASS – Clinical Abdominal Scoring System
CECT – contrast enhanced computerized tomography
FAST – Focused Assessment with Sonography for Trauma
GCS – Glasgow Coma Scale
ISS – Injury Severity Score
ROC – Receiver Operating Characteristic
RTS – Revised Trauma Score
TRISS – Trauma And Injury Severity Score
INTRODUCTION

Trauma is the leading cause of mortality in people below the age of 45 years who constitute the most productive population of society [1]. Apart from mortality, trauma will be the leading cause of years of productive life lost by the end of this decade as per the World Health Organization estimates [2]. Abdominal trauma constitutes one-fourth of the trauma burden and blunt trauma to the abdomen is the most common mechanism of injury [2, 3]. Blunt trauma most commonly leads to solid organ injury rather than hollow viscus injury. All trauma patients should undergo resuscitation as per a standardized protocol as it has been shown to reduce mortality by 15% in patients with severe trauma [4, 5]. Advanced Trauma Life Support (ATLS) is one of the most commonly followed trauma systems worldwide designed initially by dr. James Styner after the tragic private jet crash involving his family [6]. Apart from trauma management systems, many scoring systems have been designed for trauma for prediction of outcomes.

Revised Trauma Score (RTS) is a physiological scoring system and is based on Glasgow Coma Scale (GCS), systolic blood pressure and respiratory rate [7, 8]. RTS ranges from 0 to 7.8408. Injury Severity Score (ISS) is an anatomical scoring system based on the degree of injuries in six different body regions. Each region is assigned an Abbreviated Injury Scale (AIS). The AIS of the three most severely injured body regions is squared and added to derive the score [7].

Clinical Abdominal Scoring System (CASS) was initially designed as a predictor of the need for laparotomy in blunt trauma abdomen patients [9]. The various parameters considered in CASS are the time of presentation after trauma, pulse rate, systolic blood pressure, GCS and abdominal clinical findings [9]. Trauma And Injury Severity Score (TRISS) is based on ISS and RTS along with the inclusion of age as a parameter [7, 10]. It estimates the probability of survival of a trauma patient. It is hypothesized as a better scoring system as it includes an anatomical score as well as a physiological score.

Scoring systems in trauma are necessary for grading the severity of the injury and prior mobilization of resources in anticipation. Scoring systems can also be used to objectively convey the prognosis to the patients’ relatives. The aim of this study was to evaluate RTS, ISS, CASS and TRISS scoring systems in blunt trauma abdomen. Authors hypothesized that the above scoring systems significantly predicted the outcomes of patients of blunt trauma abdomen.

MATERIALS AND METHODS

Institutional ethics committee approval was taken prior to the commencement of the study. All patients were enrolled in the study after taking written informed consent.

STUDY DESIGN AND POPULATION

A prospective single-center study was conducted in our institution which is a tertiary care and academic center located in India from November 2017 to March 2019. Forty-three patients of blunt trauma abdomen were included in the study on accrual. All adult patients who were diagnosed with blunt trauma abdomen in the surgical department of our hospital during the study period, satisfying the inclusion and exclusion criteria, were included in the study (consecutive sampling). All patients belonged to a single cohort as per the protocol and were followed up prospectively till discharge or death.

INCLUSION CRITERIA

All adult patients of blunt trauma abdomen who presented to the surgical department of our hospital during the study period were included in the study.
EXCLUSION CRITERIA

Patients of blunt trauma abdomen with other significant comorbidities which may adversely affect outcomes such as uncontrolled diabetes mellitus, coronary artery disease with cardiac dysfunction, uncontrolled hypertension, etc. were excluded from the study.

MANAGEMENT

All patients with a history of blunt trauma abdomen who presented to the emergency initially underwent a primary survey as per the ATLS protocol. The vital parameters of patients were monitored continuously. RTS, ISS, CASS and TRIS scores were calculated for all patients.

All patients underwent Focused Assessment with Sonography for Trauma (FAST). All hemodynamically stable patients with positive FAST underwent contrast enhanced computerized tomography (CECT) of the abdomen for further assessment of the injury. Patients also underwent other investigations like non-contrast computerized tomography of the head and relevant X-rays based on the clinical history and examination findings. Based on the clinical and radiological findings further management of the patient was decided by the trauma team. The indications for operative intervention in a case of blunt trauma abdomen were:

- blunt trauma abdomen with hemodynamic instability with positive FAST,
- free intraperitoneal air or retroperitoneal air on imaging,
- abdominal CECT suggestive of perforated gastrointestinal tract, intraperitoneal bladder rupture, renal pedicle injury or severe solid organ injury as per the American Association for the Surgery of Trauma (AAST) grading,
- clinical features suggestive of peritonitis.

Patients with the above indications were shifted to the operation theatre and underwent all necessary procedures. Bleeding from solid organs was controlled by pressure, packing and by applying local haemostatic agents. Splenectomy was required in 2 cases in view of severe splenic injury in our study. Mesenteric and bowel injuries were repaired primarily if the vascularity of the bowel was preserved. If the vascularity of the bowel was not maintained, resection and anastomosis was performed. Urinary bladder injury was repaired primarily. In the post-operative period patients received routine post-operative care and were closely monitored for any complications such as wound infection, wound dehiscence, intraabdominal collections, respiratory complications, sepsis, etc. The scores calculated were evaluated for predicting the following outcomes:

- need for surgical intervention,
- post-operative complications,
- mortality.

STATISTICAL ANALYSIS

The sample size was 43 patients on accrual. The data acquired was coded and recorded in the MS Excel spreadsheet (Microsoft Office, Microsoft, Washington). Data was analyzed using Statistical Package for Social Sciences (SPSS) version 23.0 (IBM SPSS Statistics, International Business Machines Corporation, New York). Data was not normally distributed. Hence, non-parametric test such as the Wilcoxon-Mann-Whitney U Test was used to test statistical significance. Association between the scores and the outcomes was tested using receiver operating characteristic (ROC) curves and the cut-off values were calculated. The area under the ROC curve (AUC) of scores was compared using the De Long’s test.

RESULTS

The majority of the study subjects were males (83.7%). Females accounted for only 16.3% of patients (Tab. I.). The mean ± standard deviation of age of the population was 31.18 ± 12.564 years. The age distribution of patients is shown in Tab. I. The most common etiology for blunt trauma abdomen as per this study was road traffic accident (72.1%) followed by fall from height (18.6%) (Tab. I.). Other etiologies included fall of heavy objects (4.64%), physical assault (2.32%) and railway accidents (2.32%) (Tab. I.). Solid organs were more commonly injured when compared to hollow viscus (Tab. II.). The distribution of injuries of various organs is shown in Tab. II. Multiple organ injuries occurred in 13.95% of cases (Tab. II.). Conservative management was carried out in 21 cases and operative intervention was performed in 22 patients. Post-operative complications occurred in 8 patients. The mortality rate as per this study was 4.7% (Tab. II.).

### Tab. III. Summary of significance of scores in predicting outcomes.

<table>
<thead>
<tr>
<th>MANAGEMENT</th>
<th>Scores</th>
<th>Conservative (n = 21)</th>
<th>Surgical (n = 22)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTS</td>
<td>7.78 ± 0.89</td>
<td>7.56 ± 0.62</td>
<td>0.305*</td>
<td></td>
</tr>
<tr>
<td>ISS</td>
<td>19.95 ± 9.32</td>
<td>24.50 ± 6.75</td>
<td>0.05*</td>
<td></td>
</tr>
<tr>
<td>CASS*</td>
<td>9.29 ± 1.68</td>
<td>11.36 ± 1.09</td>
<td>&lt;0.001*</td>
<td></td>
</tr>
<tr>
<td>TRISS*</td>
<td>95.31 ± 12.03</td>
<td>94.70 ± 9.53</td>
<td>0.010*</td>
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</table>

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<thead>
<tr>
<th>POST-OPERATIVE COMPLICATIONS</th>
<th>Scores</th>
<th>Present (n = 9)</th>
<th>Absent (n = 14)</th>
<th>P-value</th>
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<tbody>
<tr>
<td>RTS*</td>
<td>7.41 ± 0.88</td>
<td>7.83 ± 0.70</td>
<td>0.596*</td>
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<tr>
<td>ISS*</td>
<td>27.78 ± 6.48</td>
<td>21.36 ± 6.78</td>
<td>0.038*</td>
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<td>CASS</td>
<td>11.56 ± 1.13</td>
<td>11.07 ± 1.21</td>
<td>0.318*</td>
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<tr>
<td>TRISS*</td>
<td>91.69 ± 14.60</td>
<td>96.96 ± 2.30</td>
<td>0.269*</td>
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<th>MORTALITY</th>
<th>Scores</th>
<th>Present (n = 2)</th>
<th>Absent (n = 41)</th>
<th>P-value</th>
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<tbody>
<tr>
<td>RTS*</td>
<td>5.44 ± 1.32</td>
<td>7.78 ± 0.55</td>
<td>0.001*</td>
<td></td>
</tr>
<tr>
<td>ISS*</td>
<td>37.50 ± 4.95</td>
<td>21.54 ± 7.76</td>
<td>0.032*</td>
<td></td>
</tr>
<tr>
<td>CASS</td>
<td>12.50 ± 2.12</td>
<td>10.24 ± 1.68</td>
<td>0.134*</td>
<td></td>
</tr>
<tr>
<td>TRISS*</td>
<td>48.65 ± 6.29</td>
<td>97.26 ± 2.56</td>
<td>0.019*</td>
<td></td>
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</tbody>
</table>

*Significant at P < 0.05, 1: Wilcoxon-Mann-Whitney U Test
There was no significant difference in the diagnostic performance of TRISS and CASS (De Long’s Test P = 0.889). There was no significant difference in the diagnostic performance of TRISS and RTS (De Long’s Test P = 0.384). There was no significant difference in the diagnostic performance of CASS and RTS (De Long’s Test P = 0.629) (Tab. IV.).

The ROC curve between the scores and the prediction of mortality revealed that TRISS has greater AUC and diagnostic accuracy than other scores (Fig. 1C.). There was no significant difference in the diagnostic performance of TRISS and RTS (De Long’s Test P = 0.480). There was no significant difference in the diagnostic performance of TRISS and ISS (De Long’s Test P = 0.371). There was no significant difference in the diagnostic performance of RTS and ISS (De Long’s Test P = 0.439). There was no significant difference in the diagnostic performance of ISS and RTS (De Long’s Test P = 0.981) (Tab. IV.).

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DISCUSSION

Males constituted the majority of trauma victims in this study as in many other previous studies [2, 7, 11]. Road traffic accident was the most common cause of blunt trauma abdomen as per this study and also in previous studies [2, 3, 7, 9]. Solid organs were more commonly injured when compared to hollow viscus in this study. Spleen was the most commonly injured organ followed by the liver as in previous studies [2].

Among the scoring systems, the need for surgical intervention was predicted by CASS and TRISS. The AUC and diagnostic accuracy
of CASS were higher when compared to TRISS but the difference was not statistically significant. The CASS score was originally designed to predict the need for laparotomy in blunt trauma patients. Even though the diagnostic accuracy of the CASS score in this study was lower when compared to the previous study by Erfantalab-Avini P et al. and Afifi RY (94%), it is still the highest among the scores compared [9, 12]. Historically, the decision of laparotomy when based only on clinical findings was associated with an accuracy of only 16–45% [13]. The cut-off value of CASS was ≥ 11 in this study which was close to other studies where a score of > 12 was used as a criterion for laparotomy [12]. CASS has also avoided auxiliary investigations in a significant proportion of cases in the study by Afifi RY [12].

Among the scores studied, a significant association was seen only with ISS in predicting post-operative complications. In a systematic review by Feldhaus I. et al., both ISS and RTS could be used to predict post-operative complications [14]. The feasibility of the ISS score is questionable as in many studies it was underestimated due to the lack of proper adjunct imaging modalities to accurately assess the severity of injury [14]. However, ISS is one of the commonly used scoring systems in low and middle income countries [14].

As per the study, all scores except CASS predicted mortality significantly. This can be explained as CASS was designed for predicting the need for laparotomy in trauma rather than to predict mortality. The significant association of ISS, RTS and TRISS with mortality was also proved in many other studies [7, 15–17]. The diagnostic accuracy of ISS, RTS and TRISS was very close and no statistical difference was observed between the scores in predicting mortality when AUC was compared using the De Long’s test. As TRISS consists of both ISS and RTS the calculation is cumbersome and some retrospective studies have shown that TRISS prediction of mortality was not accurate [14]. Further, comparison of cut-off values for mortality of this study with other studies can be erroneous as the mortality rate in this study was lower and the population studied was small. The limitations of the study are small sample size and the sample size was not based on any power factor calculation. Further, the study may have a centripetal bias as it was performed in a single tertiary care center.

CONCLUSIONS

Among the scoring systems studied CASS and TRISS predicted the need for operative intervention with good accuracy. For prediction of post-operative complications, only ISS score showed statistical significance. ISS, RTS and TRISS predicted mortality with good accuracy but the superiority of one score over the other could not be proved. Further studies in this regard need to be performed on a larger population and in multiple centers to validate the results of the study.

REFERENCES