Original Article

Injury Severity Score as a Predictor of Mortality in Patients with Abdominal Trauma at a Tertiary Nigerian Hospital

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Abstract

Background: Abdominal trauma is a major cause of morbidity and mortality in low-and middle-income countries. Typical patients present late and very sick with early recognition key to improving outcome. There is a paucity of trauma data in this environment and trauma scoring systems which have been validated in the developed world are yet to find widespread use here. **Aim:** This study aimed at evaluating role of injury severity score (ISS) in predicting mortality. **Patients and Methods:** This is a retrospective observational study of patients with abdominal trauma who presented at the University of Ilorin Teaching Hospital from 2013 to 2019. Records were identified and data were extracted and analyzed using Statistical package for social sciences 23. **Results:** A total of 87 patients were included in the study. There were 73 males and 14 females. The mean overall ISS in this study was 16.06 ± 7.9. Concerning morbidity, the area under the receiver operating characteristic curve in predicting morbidity was 0.843 (95% confidence interval 0.737-0.928). ISS had a strong sensitivity of 90% and specificity 55% at a cut-off of 14.50. Also, the area under the receiver operating characteristic curve in predicting mortality was 0.746 (95% confidence interval 0.588-0.908) and at a cut-off of 16.50; ISS had a specificity of 80% and sensitivity of 60%. The mean ISS of patients with mortality was 22.60 ± 10.5 while the survivors had a mean ISS of 14.7 ± 6.5 (P <.001). The mean ISS for patients who had morbidity was 22.8 ± 8.1 while those without morbidity had a mean ISS of 13.1 ± 5.7 (P <.05). **Conclusion:** ISS was a good predictor of morbidity and mortality in abdominal trauma in patients in this study. A prospective study with standardized abdominal imaging would be needed to further validate this scoring tool.

Keywords: *Abdominal trauma mortality, abdominal trauma morbidity, abdominal trauma scoring tool, abdominal trauma in Nigeria, injury severity score*

Introduction

Up to 6 million people die each year as a result of trauma and about 90% of these deaths occur in low-and middle-income countries (LMICs).[1] Abdominal injuries are common and are the leading cause of mortality for people aged less than 45 years.[2] The abdomen is the third most frequently injured body region and about 25% of all abdominal trauma require abdominal exploration.[3,4]

The management of patients with trauma in LMICs poses great logistic, organizational, and technical challenges. The hospitals are sparse and poorly funded with pre-existing strain in these facilities due to infectious and other noninfectious cases. Patients with abdominal trauma often present in delayed fashion with their clinical presentation worsened by complications and a concomitant high mortality rate.

In the light of the limitations in LMICs, there is a need to identify patients with a high risk of developing

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postoperative complications (requiring prolonged and more intensive treatment) and mortality in a bid to improve outcome through processes and procedures which may be clinical or administrative.

Trauma scoring is a major initial step at improvement in care of abdominal trauma patients as it importantly allows for classification and identification of patients at risk of poor outcomes (morbidity, mortality, and increased length of stay). It also allows comparison of trauma outcomes, provides a definition for preventable deaths, predicts probability of survival, and helps in laying benchmarks for audit processes and quality improvement initiatives.[5]

The injury severity score (ISS) was introduced in 1974 has been described as the gold standard tool in injury severity scoring.[6] The ISS is generally regarded as a good measure of mortality and has been tested in various trauma databases, it is easy to calculate, the results are valid irrespective of age, sex and race, and also, the scores correlate to clinically relevant outcome measures such as morbidity, mortality, length of hospital stay, and cost of treatment.[7-10]

It is noteworthy that majority of the current abdominal trauma scoring scales were developed in high-income countries. There is a paucity of validation of the common scoring systems in LMICs and it has been suggested that these scoring systems actually underpredict mortality in our setting.[11] Despite the limitations of most of these scoring systems, their use continues without any adaptation or modification to suit the reality on ground in LMICs.

There appears to be a paucity of information arising from the North-Central region. There are even fewer reports originating from this part of the world relating ISS with clinical outcome and to the best of our knowledge; there are no local studies suggesting an ISS threshold to suggest major abdominal injury nationally. Therefore, this study aimed to determine the relationship between the ISS score and morbidity and mortality following abdominal trauma at the University of Ilorin teaching hospital.

Methods

The study was done at the University of Ilorin Teaching Hospital which is a tertiary hospital located within Ilorin which is a confluence state linking most parts of the South-Western region of the country to the North. Institutional Ethical approval was obtained for this study from the ethical board of the University of Ilorin Teaching Hospital with Ethical approval number ERC PAN/2020/12/0106.

This was a retrospective observational study. The data of patients with documented abdominal trauma with evidence of gastrointestinal tract injury from January 2013 to December 2019 were extracted. Patients included in the study were patients with abdominal injuries (stomach, small bowel, large bowel, spleen, diaphragm, mesentery, and rectal injuries). Patients with incomplete data, patients who died within 24 hours of presentation, associated extra-abdominal injuries that required emergency surgery, and pregnant patients were excluded from the study.

The injury severity score was obtained from the patient documentation, imaging studies, and intraoperative finding. The ISS is defined as the sum of the squares of the highest abbreviated injury scale (AIS) grade in the 3 most severely injured body regions. Six body regions are defined which include the thorax, abdomen and visceral pelvis, head and neck, face, bony pelvis and extremities, and external structures.

The ISS ranges from 1-75 and an ISS of 75 was assigned to anyone with an AIS of 6.

ISS = (A)2 + (B)2 + (C)2

The data were analyzed using Statistical Package for Social Sciences (SPSS version 23.0) software (2015 SPSS Inc., Chicago Illinois, USA). Analyses were performed using Student's *t*-test for normally distributed data. Mann-Whitney U test was used to test the significance of differences between the ISS scores between variables while Chi-squared test was used for categorical variables. Receiver operating characteristic (ROC) curves were used to generate relationship between ISS scores and morbidity and mortality. Differences were considered statistically significant when *P* value was less than. 05 ($P < .05$).

Results

A total of 87 patients fit the inclusion criteria and were included in the study [Figure 1]. The mean age of patients was 34.2 ± 11.9 (range 16-65) years including 73 (83.9%) males and 14 (16.1%) females. Moreover, 70 patients (80.5%) needed surgery while 17 (19.5%) patients were managed nonoperatively. Other baseline information is as seen in Table 1 below.

A total of 14 extra-abdominal injuries were noted in 10 patients with abdominal injuries. Chest injury was the commonest extra-abdominal injury closely followed by head injury. Others are as shown in Table 2. Concerning trauma imaging, 5 patients (6%) had abdominal computed tomography while the remaining patients had other forms of imaging with abdominal ultrasound being the commonest (36 patients, 41%).

Table 1: Characteristics of patients at presentation

Characteristic	Data (*n*=87)
Age (years), mean±SD (Range)	34.2±11.9 (16-65)
Sex	
Male	73 (83.9%)
Female	14 (16.1%)
Prehospital care	
Yes	37 (42.5%)
No	50 (57.5%)
Comorbidity	
Yes	11 (12.6%)
No	76 (87.4%)
Anemia (PCV <30%)	
Yes	31 (35.6%)
No	56 (64.4%)
Shock	
Yes	18 (20.7%)
No	69 (79.3%)
Mechanism of injury	
Motor vehicular	32 (36.8%)
Motorcycle	15 (17.2%)
Pedestrian	2 (2.3%)
Falls	4 (4.6%)
Gunshot	26 (29.9%)
Stabs	8 (9.2%)
Type of Injury	
Blunt	53 (60.9%)
Penetrating	34 (39.1%)
Clinical presentation	
Hemorrhage	34 (39.1%)
Peritonitis	49 (56.4%)
Evisceration	3 (3.4%)
Impalement	1 (1.1%)

SD=Standard deviation; PCV=Packed cell volume

Table 2: Distribution of extra-abdominal injuries

Injury	Frequency	Percentage
Chest	7	50%
Head	4	28.6%
Femoral fractures	2	14.3%
Humeral fracture	1	7.1%

A total of 27 of the 70 patients (38.6%) operated had postoperative morbidity while 15 mortalities occurred accounting for 17% of all patients. The overall mean ISS in patients was 16.06 ± 7.9. The ROC curve was used to analyse the effectiveness of ISS in predicting morbidity and mortality. The area under the curve (AUC) of the ISS score in relation to mortality shows that the ISS predictor of mortality was 16.50 (Sensitivity = 60%, Specificity = 80%, AUC = 0.746, 95% confidence interval [CI] 0.588-0.908) [Figure 2]. The mean ISS

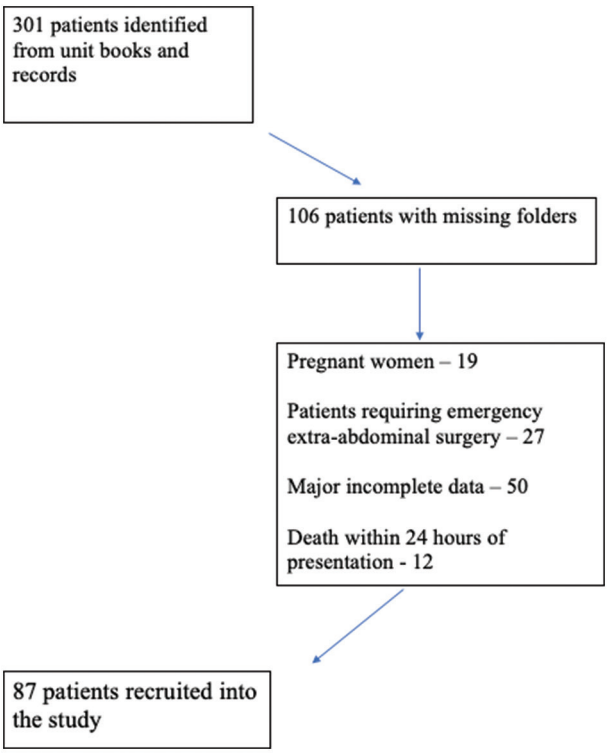

Figure 1: Flow of data collection process

of patients with mortality was 22.60 ± 10.5 while the survivors had a mean ISS of 14.7 ± 6.5 (P <.001). On the other hand, the mean ISS for patients who had morbidity was 22.8 ± 8.1 while those without morbidity had a mean ISS of 13.1 ± 5.7. The AUC of the plot when morbidity is plotted against ISS shows AUC = 0.832 (95% CI 0.737-0.928) [Figure 3]. Predictor of morbidity was ISS score 14.5 (Sensitivity 90%, specificity 55%).

Discussion

This study set out to determine the relationship between ISS and outcome in patients presenting with abdominal trauma at the University of Ilorin Teaching Hospital, North-central Nigeria.

The ISS is the commonest trauma scoring tool and is often referred to as the gold standard of injury severity scoring.[6] ISS is derived from the AIS and the value ranges from 1 (minor injury) to 75 (maximum injury).[12]

The mean overall ISS in this study was 16.06 ± 7.9 which was comparable to the study of Agroko *et al.* (15.8 ± 7.7).[13] These values are lower than western values of Šikić *et al.*[14] (21.8 ± 8.5) and Singh *et al.*[15] (20.90 ± 9.03). Compared to developed climes, the relatively lower ISS may be because of reasons peculiar to LMICs such as incomplete evaluation and underestimation of injury severity due to limitations of imaging, laboratory, and intraoperative data.[11]

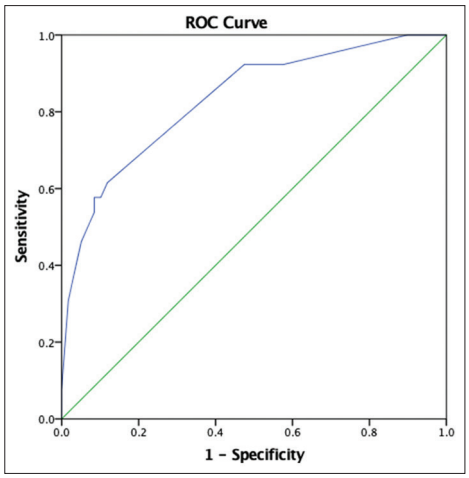

Figure 2: ROC curve of ISS in relation to mortality

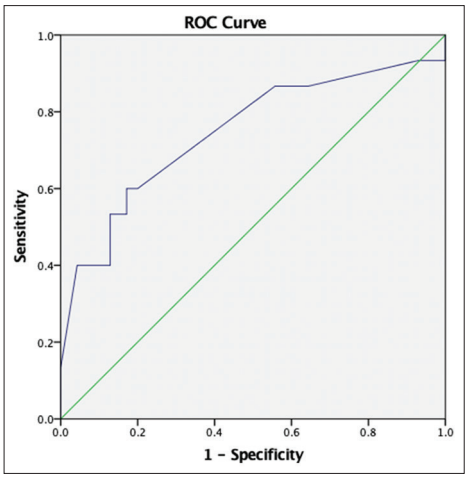

Figure 3: ROC curve of ISS in relation to mortality

The mean ISS was significantly higher for those who died (22.60 ± 10.5) compared to the survivors who had a mean ISS of 14.7 ± 6.5 (P <.001). The mean ISS was also significantly higher for those who had morbidity (22.8 ± 8.1) than those without morbidity (13.1 ± 5.7) (P <.001). The higher mean ISS of patients who died compared to survivors shows that the former had more severe injuries.

In this study, the area under the ROC curve in predicting death was 0.746. A cut-off point of ISS score of 16.50 gave sensitivity of 60% and specificity of 80%. Concerning morbidity, the area under the ROC curve in predicting morbidity was 0.843. A cut-off point of ISS score of 14.50 gave sensitivity of 90% and specificity of 55%. In terms of the ability to diagnose or predict patients with or without a condition, AUC of a test between 0.7 and 0.8 is considered acceptable and between 0.8 and 0.9 considered excellent.[16,17] Thus, the ISS is a better predictor of morbidity than mortality in this study. Generally, in terms of prediction of mortality and morbidity, an ISS threshold of 15 is used as the benchmark for distinguishing between major and minor injury and for admission into intensive care and high level trauma centers but this value is regarded as being arbitrary and dependent on the study population and variations are seen in several studies with thresholds varying from 8 to 20.[18-23] We searched MEDLINE for local studies on abdominal trauma that included ISS and found three reports. The first was done in Northern Nigeria and was a prospective study of patients who had abdominal trauma.[24] The study mentioned the range of ISS in the 109 patients (8-52) and the mean score of 20.8. Based on their ISS, patients were classified as having mild (ISS <16), severe injury (16-25), and critical injury (ISS >25). There was no documentation of the rationale behind the benchmark scoring for the classification or the mortality associated with these different ISS classes.

The other studies were done in Southern Nigeria. Agbroko *et al*.[13] published their findings on a prospective study on the determinants of outcome of abdominal trauma that included 76 patients. The mean ISS score of patients who had mortality was 23.7 ± 9.8 while that of survivors was 15.1 ± 7.2 (P =0.008). They had no threshold for classification of major or minor injury and no ROC curves for mortality or morbidity were analyzed. The study by Asuquo *et al*.[25] in South-South Nigeria of 48 patients with blunt abdominal trauma reported the range (4-12) and mean of ISS in these patients (9.9) with no statement on the relationship with mortality or morbidity. In the study, there was no severity stratification based on ISS scores.

One of the main advantages of the ISS is its simplicity and often a quick calculation of the extent of injury severity is possible from a simple list of the patient's injuries.[26,27]

Being anatomical scores, the ISS and AIS have significant limitation in LMICs as appropriate AIS, and by proxy ISS scores, require diagnostic or radiographic procedures which may include computed tomography scans.[28,29] This is often out of the reach of the patient as health insurance schemes are still rudimentary and most patients still must pay out-of-pocket costs. Other limitations of the ISS include heterogeneity (the same ISS may occur in the presence of different anatomic injuries and reflect entirely different probabilities of survival); it also underestimates injury severity when multiple injuries occur in one body region as only one injury per body region is recorded.[6]

Other scoring systems have been tried in LMICs such as the Revised Trauma score which is a physiologic score that reflects the patient's response to injury and is estimated using the Glasgow coma score (GCS), systolic blood pressure, and respiratory rate.[10] Trauma and

Injury Severity Score, MGAP (mechanism, GCS, Age, systolic blood pressure), and GAP (GCS, age, systolic blood pressure) are still relatively uncommon.[11] Another alternative such as the Kampala trauma score developed in Uganda uses simple easily gotten values: the patients age, systolic blood pressure, respiratory rate, neurologic status, and number of serious injuries.[30] These scoring systems being majorly physiological depend on accurate estimates and underestimation is not uncommon as the measurements are observer dependent and highly subjective due to the difficulty in exact estimation of physiological measurements.[31]

Regarding demographic variables in the population under study, patients presenting with trauma had a mean age of 34.2 ± 11.9 which is similar to many local and international studies.[23-25,28] Men are more likely than women to have abdominal trauma which is also consistent with many trauma-related studies.[23,28,31]

The present study had several strong points which include the relatively large number of patients, follow-up from admission to discharge, or mortality; also, there are very few related studies in Nigeria and our study expanded the literature in this domain.

There are a few limitations of this study: the retrospective nature mean that proxy values were obtained and data were based on documented information which may have been deficient in some aspects. Furthermore, there was nonstandardization of imaging in patients presenting with abdominal trauma with some patients having ultrasound alone, some radiographs while some had no imaging. The ISS being an anatomic score depends largely on imaging to evaluate organ injury, particularly in nonoperated patients and any imaging less than an abdominal computed tomography may be associated with underestimation of the severity of abdominal trauma. Despite these limitations, this study has presented our local data which can be used by providers of healthcare in management of patients. A dedicated prospective study evaluating various trauma scoring system option with a larger sample size may give better information on the appropriate injury scoring system best for our patients.

Conclusion

The ISS is a good trauma scoring tool for predicting morbidity and mortality in patients with abdominal trauma and its use should be encouraged.

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Conflicts of interest

There are no conflicts of interest.

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