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Trauma Mortality: Using Injury Severity Score (ISS) for Survival Prediction in East of Iran

Mohammad Reza Ehsaei [1]; Ahmad Sarreshtedar [2]; Hami Ashraf [3]; Ehsan Ghayoor Karimiani [4,*]

[1]Orthopedic and Trauma Research Center, Mashhad University of Medical Sciences, Mashhad, IR Iran
[2]Department of Cardiology, Ghaem Hospital, Mashhad University of Medical Sciences, Mashhad, IR Iran
[3]Department of Research and Education, Razavi Hospital, Mashhad, IR Iran
[4]Department of New Sciences and Technology, Mashhad University of Medical Sciences, Mashhad, IR Iran

*Corresponding author: Ehsan Ghayoor Karimiani, Department of New Sciences and Technology, Mashhad University of Medical Sciences, Mashhad, IR Iran. Tel: +98-5118828560, E-mail: ghayoure@mums.ac.ir

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Background: Numerous scoring systems have been proposed, and there is an inaccuracy in the anatomical and physiological differences between patients. Injury severity scoring (ISS) is a process by which the complexity of traumatic patients will be reduced to a single number.
Objectives: The objective of this study was to determine whether ISS scoring along with the sub-categories of the mechanism of injury, age and place where hospital traumatic deaths occurred are able to predict the clinical outcome.
Patients and Methods: The database registered accidents (DRAs) were gathered from Trauma Centre of Kamyab Hospital, Mashhad, East of Iran from March 2011 to April 2012. ISS was used to define the major trauma.
Results: 15496 traumatic patients referred to the hospital and traumatic deaths occurred in 289 patients. Blunt trauma accounted for 286 (99%) of death and penetrating trauma for only 1%. Our findings concerning the injury pattern, correlation between ISS and time of death suggest that patients who die in the first hour after admission have the highest ISS (average of 70.2); whereas those who die after 72 hours have the lowest ISS.
Conclusions: With regards to the predictive strength of the combination of GCS and ISS, a predictive system for analyzing the clinical outcome may be provided.

Keywords: Craniocerebral Trauma; Glasgow Coma Scale; Mortality

1. Background

The study of the time and place of deaths in trauma victims may be very useful in survival prediction in clinical practice. So far, the glasgow coma scale (GCS) has been accepted internationally in trauma centers to assess the severity of the brain injury or general medical condition. In addition, GCS has been used as a prognostic model applied by the international mission for prognosis and analysis of clinical trials (IMPACT) (1).

There are few drawbacks with the GCS and the assessing consciousness. Firstly, it is not a straightforward clinical exam (2) and also not reliable in sedated patients in ICU. Therefore, injury severity scoring (ISS) is a process by which the complexity of traumatic patients will be reduced to a single number. This number is precisely designed to characterize the patient's clinical grade of illness. In reality, achieving this level of informative accuracy may be useful in the process of clinical staging (3, 4). Numerous scoring systems having been proposed, and there is an inaccuracy in the anatomical and physiological differences between patients. Moreover, for an accurate estimation of the clinical outcome, the correct quantification of the patient's anatomic injury, traumatic injury, admission characteristics and any other medical problems are highly recommended (5, 6). It is worth mentioning that the trauma care has evolved considerably over the past few years in the east of Iran (7). Initially, there was only general emergency care in the trauma care centers and it is just recently that the neuro-care has been significantly improved and the updated guidelines have been implemented to the trauma care centers. Overall, the performance of the trauma care in Iran has been under scrutiny. In addition, the current guidelines in the advanced life support in patients with severe traumatic injury require comprehensive audit.

Implication for health policy makers/practice/research/medical education:
injury severity scoring (ISS) is a process by which the complexity of traumatic patients will be reduced to a single number. In the Eastern part of Iran the trauma care has evolved considerably over past few years. The performance of the trauma care in Iran has been under scrutiny and the current guidelines in the advanced life support in patients with severe traumatic injury require comprehensive audit. This study aims to determine whether ISS scoring along with the sub-categories of the mechanism of injury, age and place where hospital trauma deaths occurred are able to predict the clinical outcome.

2. Objectives

The objective of this study is to determine whether ISS along with the sub-categories of the mechanism of injury, age and place where hospital traumatic deaths occurred are able to predict the clinical outcome.

3. Patients and Methods

3.1. Study Design

The database registered accidents (DRAs) in Trauma Centre of Kamyab Hospital, Mashhad, East of Iran from March 2011 to April 2012 were matched by the Trauma Research Center in Mashhad University of Medical Sciences (MUMS) to create a specific medical data. In this study, all patients had a primary diagnosis of trauma. Subsequently, ISS coding was calculated in those in cases of traumatic death.

3.2. ISS Coding

The injury severity score (ISS) is a clinical score for evaluation of trauma severity. It correlates with mortality, morbidity and hospitalization period after trauma. It is used to define the term "major trauma". Coding of traumatic injuries with the ISS is based on anatomical location of six body zones. The body zones are as follows: 1) Head or neck including cervical spine, 2) Face including the facial skeleton, nose, mouth, eyes and ears, 3) Chest, thoracic spine and diaphragm, 4) Abdomen or pelvic contents, abdominal organs and lumbar spine, 5) Extremities or pelvic girdle, pelvic skeleton, 6) External. The abbreviated injury scale (AIS) is based on the anatomy of the injury and this scoring system classifies each injury in the body zone based on the severity on a six point scale (8). Thereafter, to calculate an ISS, the highest AIS severity code was taken in the three most severely injured ISS aforementioned body zones. Then, each AIS code was squared and the three squared numbers for an ISS were added ($ISS = A^2 + B^2 + C^2$ where A, B, C are the AIS scores of the three most injured ISS body regions). The ISS scores ranged from 1 to 75 and if any of the three scores is 6, the score is automatically set at 75. However, the score 6 which is unsurvivable may indicate a cessation of further care or ineffectiveness of further medical care in preserving (9). A major trauma is defined as the injury severity score being greater than 15 (10). Age, ISS and the year in which the trauma occurred were selected including GCS as prognostic factors to generate a baseline model to predict the survival. In this study, Pearson correlation coefficient analysis was used to assess the relationship between age and ISS. Multivariate regression analysis used to test the relation between ISS and GCS (Figure 1).

4. Results

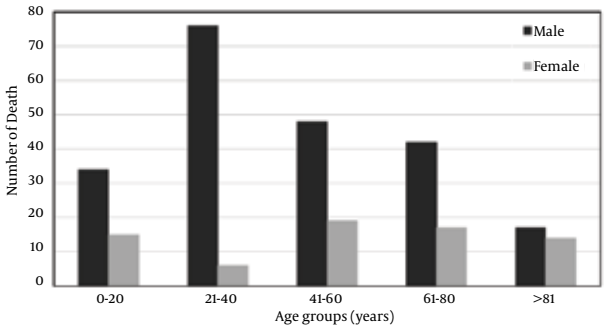
During the study period from March 2011 to April 2012, there were 15496 trauma admissions, in 289 of which traumatic deaths occurred. Blunt trauma accounted for 286 (99%) of death and penetrating trauma for only 1%. Overall mortality was 1.2% of total trauma admissions for trauma registry patients. For blunt trauma, the overall mortality was 1.1% with trauma registry of 286 deaths, and for penetrating trauma, the mortality was 0.01% with trauma registry of only 3 deaths. Motorized vehicle crashes accounted for 31% (91) followed by injuries of pedestrians struck by autos (62 deaths, or 21%), motor vehicle crashes with 51 deaths (17%), falls (44, or 15%), and other mechanisms. In our study, most of the deaths were among males (217 or 75%). The predominance of males was more striking in age group of 21 to 40, accounting for 25% of deaths. The overall mean age was 46.6 ± 21.3 years (range 1 to 102 years). Victims with motorized vehicle crashes were younger (mean 37.1 ± 8.05 years) than those with falls (mean 58.4 ± 11.34 years). The highest number of traumatic deaths occurred in the age group 21 to 40 years, in all types of trauma (Figure 2). After the age of 40, there was a reduction in the number of deaths in both mechanisms of injury, although the reduction was much steeper in female. The cause of death among all traumatic patients was divided into three major categories including severe head trauma, respiratory failure and hypovolemic shock, which include 50%, 27% and 3%, respectively. However, 55 (19%) patients died between 1 and 6 hours, 41 (14%) died between 6 and 24 hours, 26 (8%) died between 24 and 72 hours, and 151 (52%) died after 72 hours of admission. Overall, most of the death occurred after 72 hours of admission accounted for 52% of all trauma types among 289 of deaths (Figure 3). Our findings concerning injury pattern and the correlation between ISS and time of death suggest that patients who die in the first hour after admission have highest ISS, (average 70.2) whereas patients who die after 72 hours have lowest with ISS of 39 (Figure 4). These data show that victims of trauma with higher ISS are considerably younger than those with lower ISS (Figure 5).

In addition, in this study it was demonstrated that ISS values were higher in patients with lower GCS, showing an inverse correlation between GCS and Injury Severity Score ($P < 0.035$, $R^2 = 0.004577$). This study shows that some factors such as age, gender, mechanism of injury, GCS and ISS can act as the potential early predictors of death. Using multivariate regression analysis shows that there is a significant relation between ISS and GCS (Figure 1). Scatter plot with error bars indicating the standard deviation of the data, plotted on the graph to illustrate the correlation between GCS and ISS.

5. Discussion

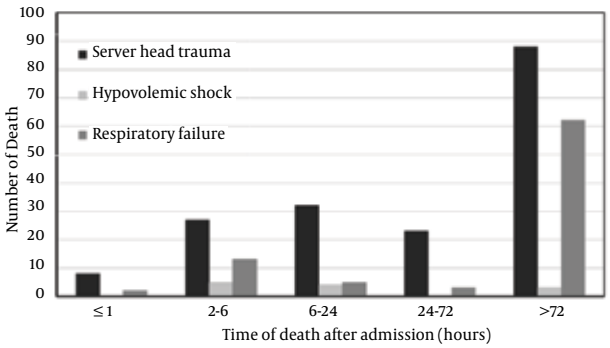
The analysis of the time and place of traumatic deaths may provide important assessment of trauma mortality that might advantage from personalized medicine and intensive education (11, 12). It has been known that a considerable number of deaths occur at the scene of the accident.

Figure 1. ISS Values in Correlation With GCS



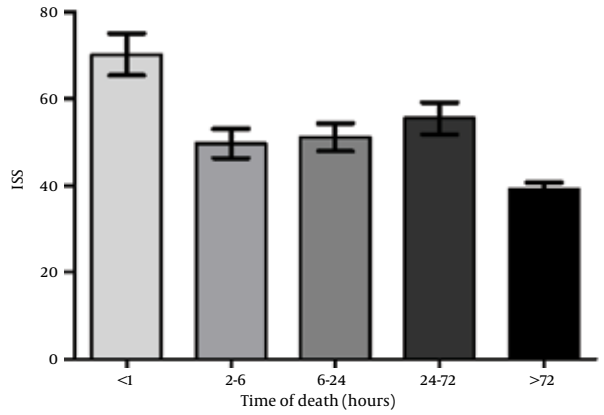
ISS values were higher in patients with lower GCS showing an inverse correlation between GCS and injury severity score.

Figure 2. Number of Death in Different Age Groups



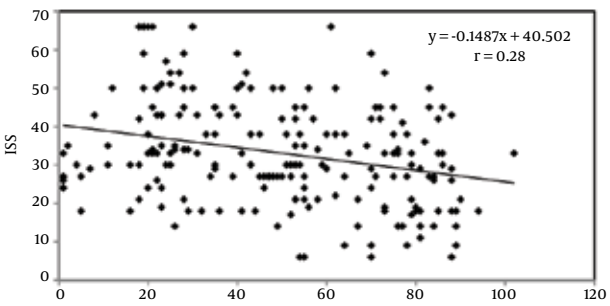
In our study it was shown that in all types of trauma the highest number of traumatic deaths occurs in the age group 21 to 40 years.

Figure 3. Number of Death in Different Times of Death After Admission



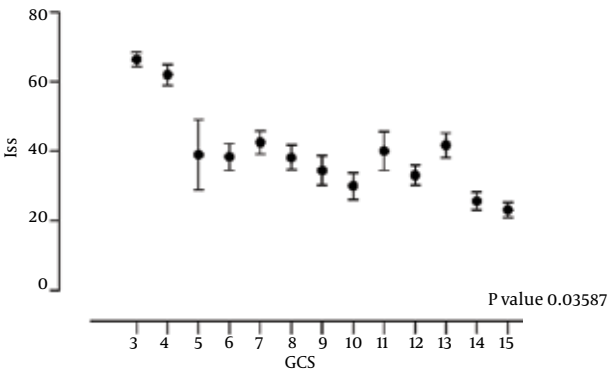
Most of death occurred after 72 hours of admission accounted for 52% of all trauma types among 289 of all deaths. ISS was significantly higher in the first hour after admission ($P < 0.005$).

Figure 4. Injury Severity Score in Different Times Post Admission



This graph depicts those patients who die in the first hour after admission has highest ISS score (average 70.2) whereas patients who die after 72 hours has lowest ISS (average 39)

Figure 5. The Relationship Between Age and Injury Severity Score



This graph shows statistical relationship between age and Injury Severity Score ($r = 0.28$; $P = 0.05$).

Demetriades et al. studied 2,895 trauma deaths in Los Angeles, where 1,929 victims (67%) were pronounced dead at a non-trauma hospital or nearest non-trauma hospital (13). In this study, we aimed to analyze the prognostic power of the ISS and other sub-scores to generate a baseline model to predict the clinical outcome of the traumatic patients. So far, GCS scale is designed to level the unconsciousness, which generally correlates to the clinical outcome. In the real case scenario, it is not used only for the aim of the prognostic assessment. It has been demonstrated that a GCS by its own cannot be generalized in monitoring the patients for a clinical decision (14). In addition, the descriptive capability of GCS may hold more information content compared with other scoring systems such as ones including combination of different sub-cores (15). In fact, each the combinations of GCS score and ISS can be the sum or a combination of each that might have predicted significantly different mortality rates.

In our study it was shown that most of the deaths occurred after 72 hours of admission, which accounted for 52% of all trauma types among 289 of all deaths. Demetriades and colleagues also demonstrated that the distribution of deaths in blunt trauma has the highest rate during 72 hours after admission and the lowest number during the first hour (12). Therefore, a supplementary clinical assessment to predict the death in order to be prepared for patients care is highly advisable particularly for patients suffered from the blunt trauma. With regards to the predictive strength of the combination of GCS and ISS in prediction of the clinical outcome, the results of our study are consistent with the findings of Bilello et al. (10). However, in our study, ISS and GCS were analyzed in different traumatic injuries combined with other factors such as the type of the accident and age; whereas, Bilello and colleagues studied the blunt trauma patients with pulmonary contusion (10).

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Authors' Contributions

Study concept and design: Dr. Ehsaei. Analysis and interpretation of data: Dr. Sarreshtedar. Drafting of the manuscript: Dr. Ghayoor Karimiani and Ehsaei. Critical revision of the manuscript for important intellectual content: Ghayoor Karimiani. Statistical analysis: Dr. Sarreshtedar and Ashraf.

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Authors have no financial interests.

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