Original Article

Accuracy of the New Injury Severity Score in the Evaluation of Patients with Blunt Trauma

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Abstract

Background and Objectives: Trauma is a worldwide problem that affects healthy people. Several scales such as Injury Severity Score (ISS) and New ISS (NISS) are used to evaluate trauma patients. This study aimed at evaluating the predictive values of ISS and NISS in predicting the possible mortality rate of trauma patients referred to the emergency department. **Methods:** This historical cohort study was conducted on multiple trauma patients admitted to the Emergency Department of Imam Reza Hospital in Tabriz, Iran, from January to March 2021. Pearson's regression, Spearman's correlation, and the receiver operating characteristic curve were used to analyze the data. ISS and NISS values were also calculated. **Results:** In NISS evaluation with the cutoff point of 24, the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were 93.65%, 82.33%, 51.3%, and 98.49%, respectively. Furthermore, positive likelihood ratio (PLR) and negative likelihood ratio (NLR) were 3.5 and 0.08, respectively. In ISS evaluation with the cutoff point of 21, the sensitivity, specificity, PPV, and NPV were 88.89%, 82.02%, 49.56%, and 97.38%, respectively. In addition, PLR and NLR were 4.94 and 0.14, respectively. **Conclusions:** Both ISS and NISS are useful in predicting outcomes in trauma patients, but NISS is more useful and better than ISS and has a higher sensitivity. Due to high sensitivity and a high NPV of NISS, using the high Abbreviated Injury Scale without considering the area of injury can be better and more effective. Therefore, the NISS value works better for patient evaluation and outcome prediction in the emergency department.

Keywords: Emergency department, Injury Severity Scoring System, multiple trauma, New Injury Severity Scoring System

INTRODUCTION

Trauma is a global health problem that affects healthy people with different severity manner[1] and is responsible for 10% of the world's deaths.[2] Trauma-related mortalities depend on factors, such as injury severity, age, sex, mechanism of injury, and quality of healthcare-provided and -related diseases.[1,3,4] Several scales are used to evaluate trauma patients such as Injury Severity Score (ISS) and New ISS (NISS).

ISS is one of the most widely used trauma scores, which is determined by rating each injury with the Abbreviated Injury Scale (AIS), then adding together the squares of the highest AIS rating for each of the three most severely injured body areas (six areas of the body including head, face, neck, chest, stomach, and extremities, especially pelvis). Therefore, it varies from 0 to 75.[5-8]

NISS is the sum of squares of the three most severe injuries regardless of body region injured.[6,9]

Most studies have shown that NISS is a better predictor than ISS to assess injured patients.[4,10-12] Some studies have

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similar accuracy.[13,14] ISS is still the most common score in the world.[12] Most deaths caused by trauma occur in developing countries;[15] however, few studies have been conducted on the value of ISS and NISS in these countries.

This study aimed to compare the NISS and ISS values in predicting the possible mortality risk of trauma patients referred to the emergency department.

METHODS

This historical cohort study was conducted on 386 multiple trauma patients admitted to the Emergency Department of Imam Reza Hospital in Tabriz, Iran. Patients who left the hospital before completing the evaluation, those who were taken to the operating room without staying in the emergency department due to their unstable situation, and those with a history of psychotropic medication or alcohol use were excluded from the study.

ISS was calculated by the sum of the highest square values of AIS of the three areas of the body that have received the most injury. Moreover, NISS was calculated by the sum of squares of three damages of AIS [Table 1] of the most severe injuries regardless of the body area.[4,5]

The data containing age, sex, type of trauma, ISS ($ISS = highest1^2 + highest2^2 + highest3^2$), NISS ($NISS = highest1^2 + highest2^2 + highest3^2$ without considering region), calculated after completing the secondary survey of Advanced Trauma Life Support® Guideline. Eventually, patient outcomes in the hospital were collected in the checklist. The main aim of the outcome is death or survival of victims. An emergency medicine specialist who was run this study calculated ISS and NISS. All data were analyzed by the SPSS 20.0.0 software (Microsoft Ltd., Chicago, IL, USA). Kolmogorov–Smirnov test was run for assessing normal distribution, and then, a descriptive study was run. To assess any relationship between ISS and NISS, Pearson's regression and Spearman's correlation were used. Furthermore, the receiver operating characteristic (ROC) curve was drawn for both scores.

RESULTS

A total of 386 patients came to the emergency department during winter 2021. The mean age of the patients was 35.29 ± 19.74 years. Interquartile range (IQR) of the population

was between 20 and 48 years old. The population diversity was 73.2% male and 26.8% female.

The distribution of the types of trauma reported as car crash, falling, motorcycle, car to pedestrian crash, motor to pedestrian crash, and bicycle crash with percentages of 42%, 25%, 18%, 11%, 2%, and 2%, respectively.

Regarding the characteristics of mortalities, 50 patients were male (79.4%) and 13 patients were female (20.6%). Mean age of these patients was 42.13 ± 22.37 years (IQR: 22–60). Furthermore, the mechanisms of trauma in fatal ones were car crashes in 24 (38.1%), motorcycle crash in 15 (23.8%), motor to pedestrian crash in 4 (6.3%), and falling in 19 (30.2%).

More than 169 patients had Glasgow coma scale (GCS) score equal to 15 at the time of emergency room visit.

The median of ISS was 13, and the IQR was 5–25. The median of NISS was 13, and the IQR was 5–30. Of the 386 patients, 69 eventually died, 116 were discharged uncomplicated, and 201 had morbidity. Fatality rate was 17.87%.

The results showed that there was a significant correlation between the GCS score with ISS, NISS, and patient outcomes ($P < 0.001$). Moreover, there was a significant correlation between ISS and NISS ($P < 0.001$).

Regarding assessing NISS and its correlation with outcome, based on the ROC curve, the area under the curve (AUC) was 0.913. Therefore, considering the cutoff point of 24 for NISS, the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), positive likelihood ratio (PLR), negative likelihood ratio (NLR) were 93.65%, 82.33%, 51.30%, 98.49%, 5.3, and 0.08, respectively. Regarding assessing ISS and its correlation with outcome, based on the ROC curve, the AUC was 0.875. Considering the cutoff point of 21 for ISS, the sensitivity, specificity, PPV, NPV, PLR, and NLR were 88.89%, 82.02%, 49.56%, 97.38%, 4.94, and 0.14, respectively.

DISCUSSION

In several studies as well as this study, the NISS value is higher than ISS. In the study of Balogh *et al.*,[16] the difference between ISS and NISS scores was very high in patients with penetrating trauma; a fact that was not found in the present study, either by Husum *et al.*[17] Given that the present study was conducted on patients with multiple trauma, in the evaluation of patients with ISS and NISS, the median of patients showed an equal number and there was a slight difference between quarters; however, based on the parametric Chi-square analysis, the difference in the comparison of the two scales was significant ($P < 0.001$) and NISS showed a higher value. Thus, NISS can be more accurate in prediction of outcome in multiple trauma. The percentage of the difference between ISS and NISS reported by Campos, 2001 in Brazil, among 63 outpatients who suffered from blunt head trauma was 82.5%. Therefore, head wounds

Table 1: Abbreviated Injury Scale regions

AIS	AIS section descriptor	Body regions included
1	Head	Cranium, brain
2	Face	Eyes, ears, lips
3	Neck	Neck, throat
4	Thorax	Thoracic contents, including rib-cage
5	Abdomen/pelvic content	Abdominal/pelvic organs
6	Spine	Spinal column/cord
7	Upper extremities	Upper limbs including shoulder
8	Lower extremities	Lower limbs including pelvis
9	External	Integumentary system, including burns

AIS: Abbreviated Injury Scale

are very important for calculating NISS, and in 74.6% of the patients, only wound scores from this area were used to determine this index.[18]

The NISS calculation method makes it possible to more accurately assess the severity of the injury of a patient with multiple trauma and higher AIS score in the same area of the body.

A study conducted by Sacco *et al*. about the comparison of alternative methods for assessing the severity of injury based on anatomical descriptions showed that NISS is better than ISS to predict hospital mortality.[19]

Gennari studied 222 people of which 79 people who had complete data to calculate trauma and ISS were analyzed. In this study, 10 patients out of 79 died unexpectedly. When comparing NISS and ISS for these 10 patients, it was confirmed that in two cases, the scores were the same, 48 and 50. In the eight remaining cases, NISS values were so much higher. In four cases, the difference was from 3 to 8 points, in three cases, it was from 16 to 25, and in 1 case, the difference was 49 points.[20]

The present shows that NISS is more simple and useful in assessing the outcome of the patients; there is not any necessity to evaluate regions for calculating highest AIS.

CONCLUSIONS

Both ISS and NISS are effective in predicting outcomes in trauma patients, but NISS is more efficient and better than ISS and has a higher sensitivity, although both are approximately equal in specificity. The predictive value of the NISS is higher and better than ISS; therefore, it works better for patient evaluation and prediction outcome. The numerical difference between ISS and NISS is significantly different, and due to its high sensitivity and NPV, using high AIS without considering the area of injury can be easy to calculate and is more effective.

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Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Morris JA Jr., MacKenzie EJ, Damiano AM, Bass SM. Mortality in trauma patients: The interaction between host factors and severity. J Trauma 1990;30:1476-82.
2. WHO. Injuries and Violence: The Facts; 2010. Available from: http://whqlibdoc.who.int/publications/2010/9789241599375_eng.pdf. [Last accessed on 2014 Feb 23].
3. Moini M, Rezaishiraz H, Zafarghandi MR. Characteristics and outcome of injured patients treated in urban trauma centers in Iran. J Trauma 2000;48:503-7.
4. Lavoie A, Moore L, LeSage N, Liberman M, Sampalis JS. The New Injury Severity Score: A more accurate predictor of in-hospital mortality than the Injury Severity Score. J Trauma 2004;56:1312-20.
5. Baker SP, O'Neill B, Haddon W Jr., Long WB. The Injury Severity Score: A method for describing patients with multiple injuries and evaluating emergency care. J Trauma 1974;14:187-96.
6. Rapsang AG, Shyam DC. Scoring systems of severity in patients with multiple trauma. Cir Esp 2015;93:213-21.
7. Eid HO, Abu-Zidan FM. New Injury Severity Score is a better predictor of mortality for blunt trauma patients than the Injury Severity Score. World J Surg 2015;39:165-71.
8. Kuo SC, Kuo PJ, Chen YC, Chien PC, Hsieh HY, Hsieh CH. Comparison of the New Exponential Injury Severity Score with the Injury Severity Score and the New Injury Severity Score in trauma patients: A cross-sectional study. PLoS One 2017;12:e0187871.
9. Lefering R. Trauma score systems for quality assessment. Eur J Trauma 2002;28:52-63.
10. Osler T, Baker SP, Long W. A modification of the Injury Severity Score that both improves accuracy and simplifies scoring. J Trauma 1997;43:922-5.
11. Jones JM, Skaga NO, Søvik S, Lossius HM, Eken T. Norwegian survival prediction model in trauma: Modelling effects of anatomic injury, acute physiology, age, and co-morbidity. Acta Anaesthesiol Scand 2014;58:303-15.
12. Nogueira LS, Domingues CA, Campos MA, Sousa RM. Ten years of New Injury Severity Score (NISS): Is it a possible change? Rev Lat Am Enfermagem 2008;16:314-9.
13. Tay SY, Sloan EP, Zun L, Zaret P. Comparison of the New Injury Severity Score and the Injury Severity Score. J Trauma 2004;56:162-4.
14. Tamim H, Al Hazzouri AZ, Mahfoud Z, Atoui M, El-Chemaly S. The Injury Severity Score or the New Injury Severity Score for predicting mortality, intensive care unit admission and length of hospital stay: Experience from a university hospital in a developing country. Injury 2008;39:115-20.
15. Hofman K, Primack A, Keusch G, Hrynkow S. Addressing the growing burden of trauma and injury in low-and middle-income countries. Am J Public Health 2005;95:13-7.
16. Balogh Z, Offner PJ, Moore EE, Biffl WL. NISS predicts postinjury multiple organ failure better than the ISS. J Trauma 2000;48:624-7.
17. Husum H, Strada G. Injury Severity Score versus New Injury Severity Score for penetrating injuries. Prehosp Disaster Med 2002;17:27-32.
18. Campos MA. The Injury Severity Score and its New Propose in Traumatic Brain Injury Victims: Differences in Outcome and Predictive Value Effectiveness. Brazil: Master of Nursing Thesis, Universidade de São Paulo; 2001.
19. Sacco WJ, MacKenzie EJ, Champion HR, Davis EG, Buckman RF. Comparison of alternative methods for assessing injury severity based on anatomic descriptors. J Trauma 1999;47:441-6.
20. Gennari TD. Injury Severity Analyzed by Means of Clinical Diagnosis and Autopsy. Brazil: Doctoral of Nursing Dissertation, Universidade de São Paulo; 2000.