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ORIGINAL ARTICLE

Autopsy Study to Analyze Correlation between Survival Period & New Injury Severity Score of Thoraco Abdominal Injuries in Fatal Road Traffic Accident Cases

Pratima R. Bhat[1], Pratibha R. Kulkarni[2]

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ABSTRACT

Introduction: Leading causes for mortality and morbidity among young, productive group of population is thoraco abdominal trauma brought on by traffic accidents. Most basic use of injury severity grading is probably in predicting period of survival following trauma.

Aim: Study's aim is to analyze correlation between survival period & new injury severity score.

Materials and methods: 105 Road traffic accident autopsy cases involving thoracoabdominal injuries brought to morgue of Belagavi Civil Hospital and Dr. Prabhakar Kore Hospital were taken for study. Universal sampling method was used for calculating sample size.

Results: The new injury severity score (NISS) was 51-75 in total 65 (61.9%) cases. When age group of 21-40 years was evaluated NISS was 51-75 in about 34 cases. When the period of survival was less than 2 hrs NISS was 51-75 in 28 cases, when period of survival was 2-6 hours NISS was 51-75 in 20 cases. However when period of survival was more than 1 week NISS score was 0-25.

Conclusion: Injury severity score had very high negative correlation with period of survival that means victims who had very high injury ISS had very less survival period.

AUTHOR'S AFFILIATION:

[1] Assistant Professor, Department of Forensic Medicine and Toxicology, SDM College of Medical Sciences and Hospital, Shri Dharmasthala Manjunatheswara University, Sattur Colony, Dharwad, Karnataka, India.

[2] Associate Professor, Department of Forensic Medicine and Toxicology, SDM College of Medical Sciences and Hospital, Shri Dharmasthala Manjunatheswara University, Dharwad, Karnataka, India.

CORRESPONDING AUTHOR:

Pratima R. Bhat, Assistant Professor, Department of Forensic Medicine and Toxicology, SDM College of Medical Sciences and Hospital, Shri Dharmasthala Manjunatheswara University, Sattur Colony, Dharwad, Karnataka, India.

E-mail: pbhatt0106@gmail.com

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Highlights: Trauma scores help in determining quality of treatment and thereby reducing mortality. Study's aim is to analyze correlation between survival period & new injury severity score. Study's conclusions and outcomes will help shape policies and actions to reduce death rates and morbidity rates from injuries to the abdomen and thorax.

KEYWORDS

• Survival period • New injury severity score • Thoracic injuries • Abdominal injuries

INTRODUCTION

Of all accidental deaths, 10% are caused by road accidents and thus resulting in significant financial loss for the person, victim's family, and the nation.[1]

NISS is one of the most effective injury scoring systems for post mortem injuries. Hence I have used it in my study. Trauma scores help in determining quality of treatment and thereby reducing mortality. These scoring systems are extremely useful in classification of trauma patients and their appropriate triage. It is also helpful in predicting survival time and study outcome of patients

Study's conclusions and outcomes will help shape policies and actions to reduce death rates and morbidity rates from injuries to the abdomen and thorax.

MATERIALS AND METHODS

Source of data: Autopsy cases of road traffic accidents sustaining thoracoabdominal injuries which are brought to morgue of Belagavi Civil Hospital and KLE's Dr. Prabhakar Kore Hospital.

Study period: 1st January 2021 - 31st January 2022 (13 months).

Sample size was 105.

Universal sampling method is used.

Sample size is computed with 95% confidence limits, 20% allowable error and 10% attrition

$$n = Z21\text{-}\alpha/2\ SD2 \qquad 1.1$$

(20% SD)2

Where z21-α/2 = 1.96 n = sample size SD= standard deviation

n = 105

Method of collecting data:

All fatal cases of thoracic abdominal injuries subjected for postmortem were taken up for study. Detailed dissection and examination of thoracic abdominal region was carried out as per standard medico-legal autopsy technique. All injuries were documented photographically during autopsy using high-resolution digital camera. All images were obtained during autopsies with due institutional approval. Identifying features have been excluded to maintain confidentiality and ethical standards. Each injury was classified according to AIS. NISS was calculated by squaring three highest AIS scores irrespective of body region and summing them.

Statistical analysis:

1. Microsoft Excel was used to code and input the data that had been gathered.
2. Frequencies and percentages were used to represent collected data.
3. Charts and tables are created.
4. To determine coefficient of correlation and establish relationship between NISS and survival time regression analysis was used.

RESULTS

Injury Severity Score

In our study about 62.9% cases had very high NISS score of 51-75 (Table 1)

Table 1: Distribution of cases according to New Injury Severity Score

NISS Score	Number of cases	Percentage
0-25	19	18.09
26-50	21	20
51-75	65	61.9
Total	105	100

Age group of 21-40 years had high NISS score of 51-75 (Table 2)

Table 2: Age groups in relation to New Injury Severity Score

Age group (years)	NISS 0-25	NISS 26- 50	NISS 51-75	Total
0 – 20	0	1	9	10
21 – 40	8	13	34	55
41 – 60	9	5	19	33
61 and above	2	2	3	7
Total	19	21	65	105

In cases where NISS score of 51-75 was found 28 cases had less than 2 hours survival period and 20 cases had 2-6 hours period of survival. (Table 3)

Table 3: Survival period in relation to New Injury Severity Score

	New Injury Severity Score			
Period of survival	**0 - 25**	**26 – 50**	**51- 75**	**Total**
< 2 hours	0	2	28	30
2 – 6 hours	0	2	20	22
6 – 12 hours	0	4	9	13
12 – 24 hours	1	4	7	12
1 – 7 days	2	8	1	11
1 – 4 weeks	14	1	0	15
> 4 weeks	2	0	0	2
Total	19	21	65	105

ASSOCIATIONS AND CORRELATIONS

Association between NISS and Survival period:

To find out the association between period of survival and New Injury Severity Score CHI-Square test is applied.

The value is less than 0.0001 (highly significant)

The smaller values of Period of survival and higher values of New Injury Severity Score have high frequencies and vice versa

Correlation between NISS and Survival period

Although any deviation from independence of two or more random variables can be referred to as correlation or co-relation, term is most frequently used to describe more specific kind of link between mean values. Degree of correlation is measured by number of correlation coefficients, which are frequently represented by the symbols ρ or r. Spearman Rank Correlation Coefficient is calculated in order to determine correlation coefficient because parameters are discrete in nature. For every parameter, the values are ranked in ascending order. D represents the rank difference.

The formula for the Spearman rank correlation coefficient is:

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$

p = Spearman rank correlation coefficient

d = difference between the two ranks of each observation

n = number of observations

Spearman Returns a value from – 1 to 1 where

+1 = perfect positive correlation between the ranks

-1 = perfect negative correlation between the ranks

0 = no correlation between the ranks

Rank correlation coefficient of our study is – 0.7524.

The value is less than 0.0001 (highly significant)

There is high degree of negative correlation between period of survival and New Injury Severity Score.

This means that as NISS increases survival time decreases.

DISCUSSION

Over 3 decades ago, trauma scores were developed to assign numerical values to anatomical abnormalities following accident. They are used to stratify trauma victims and quantify severity of lesions.[2]

Trauma scoring is a key component of strategies to improve trauma care. Standardized trauma scoring systems help triage and categorize trauma patients, forecast outcomes, and compensate for risk when evaluating hospital performance.[3]

Injury scoring system[4]

1. Anatomic
   b. Abbreviated Injury Scale (AIS)
   c. Injury Severity Score (ISS)
   d. New Injury Severity Score (NISS)

a. AIS is a straightforward numerical technique for comparing and rating injuries according to their severity.

b. ISS is calculated by adding squares of highest AIS grade in three body parts with the most injuries. ISS has a number of restrictions. Most evident drawback is that it cannot take into consideration multiple injuries to same body part. Additionally, as indicated in table 4 below, it restricts the total number of contributing injuries to only three, which frequently leaves out serious injuries entirely.

c. Three most serious injuries, independent of body area, are taken into account by NISS, which differs from ISS. Three most severe AIS are simply added together to calculate NISS. According to preliminary research, the NISS predicts trauma death more accurately than ISS.

Body segments on AIS scale (Table 4-6)

The distribution of injuries across different anatomical body regions, as categorized by AIS, is presented in Tables 4–6. These tables illustrate the regional severity patterns that contributed to the overall NISS and its correlation with survival period.

Table 4: Body segments and their specifications

Body segments	Specifications
The thorax	include injuries to all of the internal chest cavity organs, the diaphragm, thoracic spine and rib cage
Abdomen and pelvic region	include injuries to all of the internal abdominal organs, the pelvis and the lumbar spine
Head and neck	include any injury of the cervical spine, cervical spinal cord, skull, brain and ears
Face	include mouth, eye, nose and facial bone injuries
Extremities	include all sprains, fractures, amputations and dislocations.
External structures	include all contusions, abrasions and lacerations over skin

Table 5: Classification of thoracic injuries on AIS

Skeleton injury	Injury to soft tissue
Rib fracture	Contusion to bronchus
Fracture of 2-3 ribs, fracture of sternum	Partial tear of bronchus
4 or more rib fractures on a side/ 2 or 3 rib fractures with haemothorax or pneumothorax	Pulmonary contusion, minor cardiac contusion
Fracture of 4 or more ribs on a side with haemothorax or pneumothorax	Bilateral pulmonary laceration, small aortic laceration, large bruise to heart
Bilateral fracture of ribs	Severe aortic laceration, pulmonary laceration with tension pneumothorax
	Aortic laceration with haemorrhage

Table 6: Classification of abdominal injuries on AIS

AIS	Grade	Injury
1	Minor	Contusion of abdominal organ
2	Moderate	Small laceration over abdominal organ
3	Serious	Laceration of abdominal organ with hemoperitoneum (>1 L)
4	Severe	Rupture of abdominal organ
5	Critical	Laceration of abdominal organ involving vessels
6	Maximum	Avulsion of abdominal organ/ viscera

Autopsy findings and severity grading (Figure 1 to Figure 10)

The photographs (figures 1 to 10) documented during autopsy included in this study depict the range and morphological patterns of thoracoabdominal injuries observed in fatal road traffic accidents. Each injury was systematically graded using AIS, as specified in the respective figure legends, ensuring standardized and objective severity assessment.

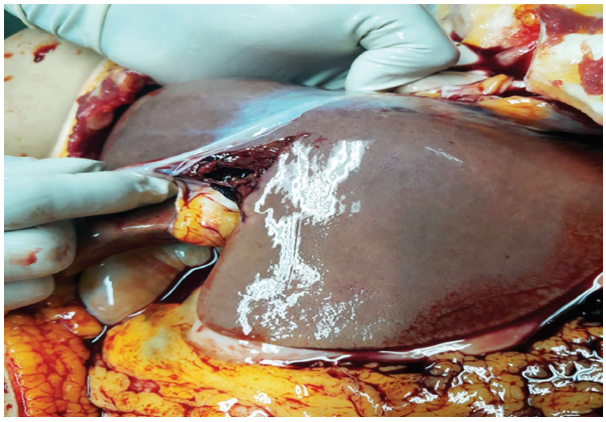

Figure 1: Hepatic laceration with hemoperitoneum

Deep laceration with extensive parenchymal disruption and intraperitoneal blood collection. This injury was graded as AIS grade 3 and the assigned score was incorporated into NISS calculation.

Figure 2: Pulmonary laceration with contusion

Gross specimen demonstrating deep lacerations of the lower lobe of the lung with surrounding hemorrhagic contusion. The injury was scored as per AIS grade 4 based on depth and extent of parenchymal involvement and the assigned score was incorporated into NISS calculation.

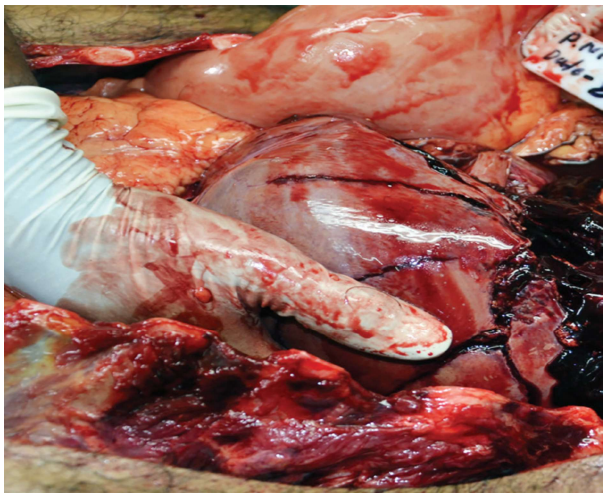

Figure 3: Liver rupture with massive hemoperitoneum

Autopsy photograph demonstrating extensive rupture of the hepatic parenchyma with capsular disruption and deep irregular lacerations. Large quantities of free and clotted blood are present within the peritoneal cavity, consistent with massive hemoperitoneum. The severity of hepatic injury was graded as AIS grade 6 based on the extent of parenchymal disruption and associated hemorrhage, and assigned score was incorporated into NISS calculation.

Figure 4 : Splenic laceration with subcapsular hematoma

Gross autopsy specimen of the spleen demonstrating elongated capsular tears with underlying parenchymal lacerations and areas of subcapsular hemorrhage. The extent of capsular disruption and parenchymal injury was graded as AIS 5 and the assigned score was incorporated into NISS calculation.

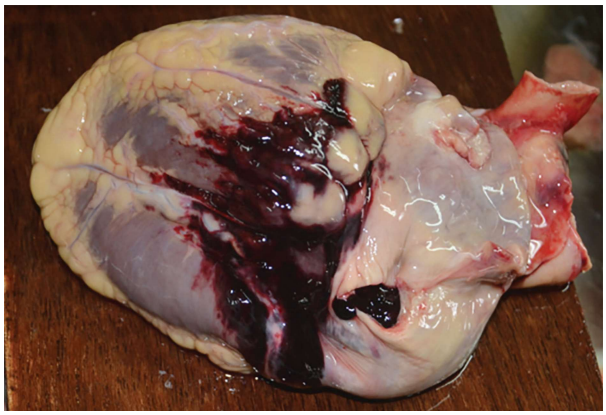

Figure 5: Cardiac contusion with epicardial hemorrhage

Gross specimen of the heart demonstrating extensive epicardial and subepicardial hemorrhage over the ventricular surface. Areas of dark hemorrhagic infiltration are visible without complete chamber rupture. The injury was graded as AIS grade 4 and the assigned score was incorporated into NISS calculation.

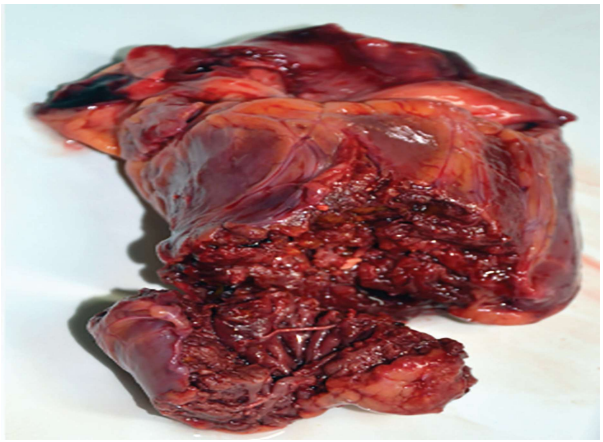

Figure 6: Traumatic cardiac rupture

Gross autopsy specimen of the heart demonstrating extensive full-thickness myocardial disruption with irregular tear and extrusion of underlying muscle fibers, consistent with traumatic cardiac rupture. Surrounding hemorrhagic infiltration is evident. The injury was graded as AIS grade 6 and the assigned score was incorporated into NISS calculation.

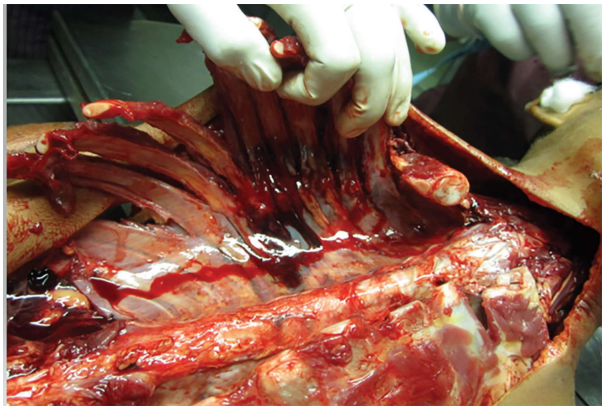

Figure 7: Multiple rib fractures and intercostal hemorrhage

Autopsy photograph showing multiple adjacent rib fractures. Marked intercostal muscle hemorrhage and underlying hemothorax are evident. The thoracic injuries were graded as AIS grade 4, and the corresponding score was incorporated into NISS calculation.

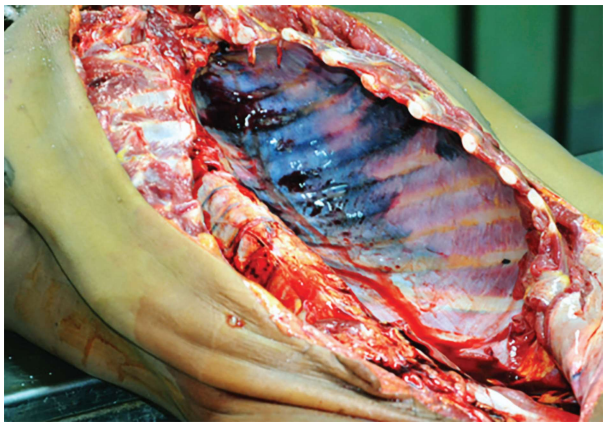

Figure 8: Multiple rib fractures with underlying hemothorax and contusion

Autopsy photograph of the opened thoracic cavity demonstrating multiple rib fractures along the lateral chest wall with subpleural hemorrhage. The pleural cavity contains significant hemothorax, and shows dark hemorrhagic areas consistent with contusion. Injuries were graded as AIS grade 3, and the respective score was incorporated into NISS calculation.

Figure 9: Pulmonary contusion with focal laceration

Gross autopsy specimen of the lung demonstrating diffuse subpleural hemorrhagic discoloration consistent with pulmonary contusion, along with a focal parenchymal tear. The injury was graded as AIS grade 3 for thoracic trauma and score was incorporated into the NISS calculation.

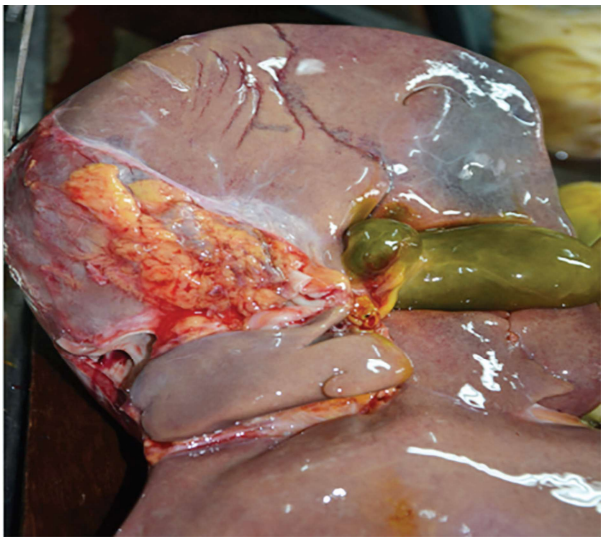

Figure 10: Hepatic contusion with perihepatic hemorrhage

Gross autopsy specimen of the liver showing subcapsular hemorrhage and parenchymal contusion near the porta hepatis region, with associated perihepatic blood collection. The severity of hepatic injury was graded as AIS grade 1 and incorporated into NISS calculation.

Top of Form

The calculated AIS scores were subsequently utilized to derive NISS, which enabled quantitative evaluation of overall trauma

burden and its correlation with survival period. This structured injury scoring approach enhances reproducibility and strengthens the reliability of the study findings.

Injury Severity Score

In present study new injury severity score was 51-75 in 65 (61.9%) cases. Injury severity score had very high negative correlation with period of survival that means victims who had very high ISS had very less survival period. Correlation coefficient was – 0.7524 suggesting high degree of negative correlation.

Weak negative correlation was seen in Raoof[5] *et al* study where correlation coefficient was -0.418 and in Srivastava[6] *et al* study where correlation coefficient was -0.472. Also the Nikolic [7] *et al* study showed weak negative correlation with correlation coefficient as -0.458.

Negative correlation was also appreciated in Meera[8] *et al*, Gaur[9] *et al*, Dipayan[10] *et al*, Rautaji[11] *et al*, friedman[12] *et al* studies.

Similar findings were also seen in Dipayan[10] *et al* study where 50% cases had ISS between 51-75. In Gaur[9] *et al* study only 10% of total cases had injury severity score between 51-75 but negative correlation between ISS and survival period was present in Gaur[9] *et al* study too. In Friedman[12] *et al* study about 39.4% victims had injury severity score of 75.

We have taken new injury severity score into consideration because unlike Injury severity score it is not limited to one injury in one anatomic region. In injury severity score there is high chance of elimination of summative effect of multiple severe injuries of same region.

Conclusion and clinical significance: Injury severity score had very high negative correlation with period of survival that means victims who had very high ISS had very less survival period. The correlation coefficient was – 0.7524 suggesting high degree of negative correlation.

1. In cases of mass causalities in road traffic accidents the patients with higher injury score should be given preference in treatment.
2. Injury severity scoring should done immediately in emergency department or casualties so as lessen fatalities.

Abbreviations: NISS - New injury severity score, AIS - Abbreviated Injury Scale, ISS – Injury severity score

Ethics Approval and consent to participate: Ethical approval was obtained from Institutional Ethics Committee of Belagavi Institute of Medical Sciences (BIMS – IEC /163/) and Jawaharlal Nehru Medical College, Belagavi, Karnataka (MDC- DOME 52)

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Competing interests: The authors declare no competing interests.

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