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Original Article

A RETROSPECTIVE COHORT STUDY ASSESSING MORTALITY RISKS IN PATIENTS WITH CRANIOMAXILLOFACIAL TRAUMA AND POLYTRAUMA USING THE INJURY SEVERITY SCORE (ISS) AND THE NEW INJURY SEVERITY SCORE (NISS).

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ABSTRACT

BACKGROUND

There is no consistent difference in postoperative complications between early and delayed therapy for craniomaxillofacial trauma and polytrauma patients. Prognosis and fatality risk drive treatment selection. Two assessment scores, Injury Severity Score (ISS) and New Injury Severity Score (NISS) gauge trauma severity objectively, but their accuracy details remain scarce. Data on concurrent craniomaxillofacial trauma patients are limited, with conflicting conclusions among researchers.

OBJECTIVE

To determine and contrast the threshold (critical) values of the ISS and NISS evaluation scales that indicate the likelihood of a fatal outcome in patients suffering from polytrauma and craniomaxillofacial trauma.

MATERIALS AND METHODS

A retrospective analysis was conducted. Patients with facial bone fractures, soft tissue traumas, and concurrent injuries were included. Data on demographics, injuries, treatments, and outcomes were collected. ISS and NISS were calculated, and statistical analyses were performed to determine threshold values for predicting fatal outcomes.

RESULTS

Thirty patients were included, with assaults (43.3%), falls (20%), and motor vehicle accidents (16.7%) being the leading causes of trauma. Craniocerebral traumas (30%) and extremity traumas (23.3%) were common. Fifteen fatal cases (3%) were identified, with cerebral edema (73.3%) being the primary cause of death. Median ISS was 34 (25-41.5) for lethal cases and 4 (2-16) for the overall patient group. Median NISS was 48 (43-57) for lethal cases and 6 (3-22) for the overall patient group.

CONCLUSION

Both ISS and NISS show comparable efficacy in predicting the likelihood of fatal outcomes.

RECOMMENDATIONS

In specialized facilities, both signs could be routinely employed to evaluate patient status and prioritize the next steps in therapy.

Keywords: *Morality, craniomaxillofacial trauma, Injury Severity Score, New Injury Severity Score*
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INTRODUCTION

One of the main reasons for death and disability worldwide is traumatic injuries [1]. Towards the end of the 20th century, it was believed that the best overall outcomes, when coupled with the lowest risk of postoperative complications, came from early and, if feasible, comprehensive multidisciplinary treatment of combined injuries of different organs and organ systems. This method, known as "Early Total Care" (ETC), was extensively explained and suggested for the treatment of polytraumas as well as complex traumas [1, 2]. In certain complex circumstances, the other authors advocated anticipatory strategies to reduce the risk of death and life-threatening complications during the postoperative phase. Early in the 1990s, the surgery known as "Damage control" (DC) was established. The phrase was initially used by Rotondo, who demonstrated the benefits of postponing treatment for some penetrating abdominal injuries in contrast to immediate surgical surgery [3]. The practice of treating certain extremity injuries later on produced similar outcomes and was dubbed "damage control orthopedics" [4]. Considerable progress in the pathophysiology of polytrauma over the past few decades has defined the current paradigm for treating both polytrauma and combined trauma, leading to the development of innovative therapeutic approaches. These days, individuals with polytrauma are treated with both ETC and DC, depending on their condition and other medical factors [5].

This applies to the maxillofacial region's combined traumas as a whole. To maximize function recovery and the aesthetic appearance of the injured regions, a commonly used strategy since the 1990s involves early open realignment and osteosynthesis of the injured bones

(in the lack of substantial edema and posttraumatic alterations in the tissues of the splintered bone) [6,7]. However, following the stabilization of life functions and lowering the neurosurgical risks, advancements in surgical technique and osteosynthesis instrumentation allow for satisfactory outcomes even in cases of postponed surgeries, especially in patients with severe open craniocerebral injuries. These days, there is no discernible difference between the two methods when it comes to the clinical efficacy of treating maxillofacial injuries promptly vs later on due to inflammatory issues that arise after surgery [8]. Individuals with polytrauma and craniocerebral injuries have a mortality rate of 2.2%, although this rate can be as high as 2.4% for some injury types [9]. Therefore, to determine the optimal course of therapy and lower the risks of postoperative complications and/or fatal treatment results, a unique criterion is needed for differentiated treatment of maxillofacial injuries, considering the patient's overall health and the extent of the injuries.

The authors proposed assessment scores that represent the severity of the patient's condition in points, which allows for the definition of the treatment measures to be administered in a specific order for patients with combined trauma and polytrauma. Of these, two widely used basic assessment scales accurately estimate the risk of a fatal outcome for patients with severe injuries. These are the New Injury Severity Score (NISS) and Injury Severity Score (ISS) each of which has benefits and drawbacks when it comes to predicting death [10–13]. The «Abbreviate Injury Severity Scale» (AIS), an anatomical coding system used for trauma severity categorization and description, is the foundation for both scales [14].

Notably, the ISS and NISS both have a wide range of scores and are rapid and simple to apply. This makes them both suitable for determining the threshold, or crucial, value needed to forecast fatal outcomes. In the daily practice of the maxillofacial surgeon, it could prove to be a dependable tool for selecting treatment strategies depending on how serious the patient's injuries are. However, there is a dearth of data regarding its accuracy and usefulness in treating individuals with severe facial and maxillofacial injuries, and the results, as reported by different authors, appear to be disputed.

objectives — to determine and contrast the threshold values of the NISS and ISS evaluation scales that indicate the likelihood of a fatal outcome in individuals suffering from multiple traumas and craniomaxillofacial trauma.

MATERIALS AND METHODS

Study design

A retrospective cohort study was conducted.

Study setting

This research was carried out at the Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India, between August 2022 to January 2024.

Study participants

The study enrolled a total of 30 participants after following the selection criteria.

Inclusion and exclusion criteria

The following criteria were necessary for inclusion: patients had to be in-patients with facial bone fractures, soft tissue traumas, contusions, and concurrent injuries to non-facial regions; patients had to have full documentation and a clear treatment outcome. Patients who predominantly received medical and emergency care in other medical institutions, as well as pediatric trauma patients (those under the age of 18), met the exclusion criteria.

Bias

There was a chance that bias would arise when the study first started, but it was avoided by giving all participants identical information and hiding the group allocation from the nurses who collected the data.

Data collection

The Microsoft Excel database was used to gather and arrange patient data. The ISS and NISS were used to split the trauma severity characteristics into two groups so that the threshold (critical) values of the deadly result prognosis could be statistically examined.

Study procedures

Sex, age, the origin, the mechanism and location of the facial bone fractures, further facial and oral damage, concurrent traumas of different body parts, concomitant medical conditions, and type of surgery performed, the treatment results, cause of death were all gathered and reviewed retrospectively.

With advanced Trauma Life Support, the patients had examinations at the time of hospital admission [15]. By the accepted guidelines, the AIS-90 was utilized to encode and assess the degree of polytrauma [16, 17]. The diagnosis served as the basis for the trauma evaluation, which was bolstered by information from radiological, clinical, surgical, or postmortem tests. The NISS approach takes into account the squares of the three most severe injuries as determined by the AIS-90; however, in contrast to the well-known ISS, the NISS takes into account two scores from a single anatomical location, such as the head [18]. The ISS has several disadvantages as a result of using the three most severe damage sites from various anatomical regions at the same time. The patients' concurrent injuries, which ranged in intensity, were categorized into five relevant groups: head traumas, thoracic traumas, stomach traumas, and spinal traumas.

Statistical analysis

A correlation test was used to identify the relationship between the parameters. ROC curve analysis along with the Youden index were used to establish the threshold/critical levels for deadly outcome risks. The

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software EZR v.1.54 was used to conduct the statistical analyses [19].

RESULTS

Table 1: Causes of traumas, (N= 30

Causes	No. of patients	Percentage (%)
Assault	13	43.3%
Fall	6	20%
Motor vehicle accident	5	16.7%
Others (sports injuries, traumas, etc.)	6	19%

Assaults (43.3%) followed by falls (20%) and motor vehicle accidents (16.7%) were the leading causes of injuries. Sports injuries (1%), occupational traumas (0.5%), and traumas with unclear etiology (18%) were the remaining etiological factors (Table 1). At the time of the incident, 28% of the patients were using drugs or alcohol.

Table 2: Concomitant traumas in patients

Trauma site	No. of patients (n=30)
Head	9 (30%)
Extremities	7 (23.3%)
Abdominal	4 (13.3%)
Thoracic	8 (26.6%)
Vertebral	2 (6.6%)

The first category of injuries was associated with craniocerebral traumas. In 30% of instances, there were reports of severe traumas, including open craniocerebral trauma and intracranial bleeding. The second category of traumas to the extremities includes 23.3% of contusions, wounds, fractures, dislocations, and vascular injury. Internal organ ruptures, penetrating wounds, and anterior abdominal wall contusions comprised 13.3% of the third category, which was categorized as abdominal traumas. The fourth category, known as thoracic traumas, consisted of 26.6% of cases and comprised contusions, rib fractures, hemothorax, pneumothorax, and lung and heart contusions. The fifth group's vertebral traumas were connected to vertebral fractures, which made up 6.6% of cases (table 2).

Table 3: Causes of death

Causes of death	No. of patients (n=30)
Cerebral edema	22 (73.3%)
Multiple organ dysfunction	4 (13.3%)
Posttraumatic pneumonia	2 (6.6%)
Acute heart failure	2 (6.6%)

The trauma severity scores range from 1 to 66 according to the NISS and from 1 to 57 according to the ISS, according to estimations of the trauma intensity made using those two approaches. Among the patients, there was a fatal cases group, with cerebral edema (73.3%), multiple organ dysfunction syndrome (13.3%), posttraumatic pneumonia (6.6%), and abrupt heart failure (6.6%)—all likely the result of concurrent traumas—representing the leading causes of mortality.

Table 4: Median, first, and third quantile (ISS and NISS scores)

Parameters	ISS	NISS
Lethal cases	34 (25-41.5)	48 (43-57)
Overall patient group	4 (2-16)	6 (3-22)

The deadly outcome prognosis model's optimal cut-off value of ISS > 24 results in a sensitivity of 93.3% and specificity of 91.4%. The deadly result prognosis sensitivity is 86.7% and its specificity yields 92.4% with

the ideal cutoff value NISS > 36. Based on statistical analysis, the components that were identified had a non-normal distribution. The first and third quantiles of the ISS and NISS were taken into consideration, along with the median (Table 4).

DISCUSSION

The results provide insights into the characteristics of patients with multiple traumas and craniomaxillofacial trauma, as well as the factors associated with mortality in this population. Assaults were identified as the primary cause of trauma, followed by falls and motor vehicle accidents. This highlights the importance of addressing interpersonal violence as a significant contributor to traumatic injuries. Additionally, a notable proportion of patients were under the influence of drugs or alcohol at the time of the incident, indicating a potential factor contributing to trauma occurrence.

Head traumas were the most common concomitant injury, followed by thoracic, extremity, abdominal, and vertebral traumas. This underscores the complexity of injuries in patients with multiple traumas, with injuries affecting various body regions simultaneously. Understanding the pattern of concomitant traumas is crucial for effective management and treatment planning.

Cerebral edema emerged as the leading cause of mortality in patients with multiple traumas and craniomaxillofacial trauma. This finding highlights the significance of traumatic brain injuries in determining patient outcomes and underscores the need for strategies to mitigate cerebral edema and its associated complications. Other causes of death, such as multiple organ dysfunction syndrome, posttraumatic pneumonia, and acute heart failure, also contribute to mortality in this population, emphasizing the multisystem nature of traumatic injuries.

Both the ISS and NISS demonstrated higher scores in fatal cases compared to the overall patient group. This suggests that higher severity scores are associated with an increased risk of mortality in patients with multiple traumas and craniomaxillofacial trauma. The ISS and NISS serve as valuable tools for assessing trauma severity and predicting outcomes, aiding clinicians in identifying patients at higher risk of mortality and guiding treatment decisions.

Overall, the results highlight the complex nature of traumatic injuries in patients with multiple traumas and craniomaxillofacial trauma and underscore the importance of comprehensive assessment and management strategies to improve patient outcomes and reduce mortality rates.

Maximum function recovery and the aesthetic look of the injured regions are improved by early surgical intervention, involving internal fixation and open relocation of the fractured facial bones [6, 7]. However, the findings—obtained from multiple authors—appear to be debatable. Early and delayed treatment approaches don't differ from one another [8]. Therefore, a criterion is needed to prioritize the risks associated with deadly treatment results and/or postoperative sequelae, particularly for patients with multiple traumas and craniocerebral trauma. A study proposed the contracted injury scale (AIS) and squares the three most severe injury ratings from various anatomical locations. Because of this, the most serious injuries are important [20]. Several researchers found a substantial relationship between higher ISS scores and longer hospital stays, death rates from gunshot wounds, and post-accident mortality [21–23], all of which were employed in several scientific investigations. However, the majority of writers discuss the shortcomings of the ISS approach in contrast to the more recent NISS method [16, 17].

Another study found that the NISS was more helpful for patients with craniocerebral trauma, whereas the ISS was more instructive for patients with multiple traumas and injuries of different parts of the body [24]. The findings of a study showed that the NISS more accurately forecasts the odds of a fatal result in cases of severe craniocerebral trauma, supported [16].

There aren't many studies on the combination of face-bone traumas. Even though the mortality rate from maxillofacial traumas is negligible in this group—2.4%—asphyxiation brought on by blocked upper respiratory airways and head and neck vascular hemorrhage account for 87% of immediate fatal outcomes, with 96.6 percent of deaths occurring in the first 24 hours following a car accident [25]. The prognostic ability of both methods of the trauma severity assessment was shown to be rather high, utilizing the ROC—curve analysis and contrasting the areas under the ROC curves. This suggests that approaches are highly useful in describing the specifics of the trauma, and their high prognostic value allows for the evaluation of the risks associated with a fatal outcome in patients who have both polytrauma and coupled craniocerebral trauma. A meta-analysis which validates the study's data [13].

Generalizability

While the results of this study provide valuable insights into the characteristics and outcomes of patients with multiple traumas and craniomaxillofacial trauma in a specific setting, caution should be exercised when generalizing these findings to broader populations or healthcare environments. Replication of the study in diverse settings and populations would be necessary to enhance the generalizability of the results and validate the findings across different contexts.

CONCLUSION

Patients who have both polytrauma and concomitant maxillofacial trauma have a 3% mortality rate. The deadly outcome risk is accurately predicted by the ISS and NISS methods. Both ISS and NISS show comparable efficacy in predicting the likelihood of fatal outcomes. There is no statistically significant difference between the area under the curves for the two trauma severity estimate techniques ($p = 0.651$).

Limitations

The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of a comparison group also posed a limitation for this study's findings.

Recommendation: Based on the findings, it is recommended to utilize the ISS and NISS as valuable tools for predicting fatal outcomes in patients with maxillofacial trauma. Clinicians should consider incorporating these assessment scales into their decision-making process to optimize treatment strategies and improve patient outcomes.

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List of abbreviations

ISS: Injury Severity Score
NISS: New Injury Severity Score
ETC: Early Total Care
DC: Damage Control
AIS: Abbreviated Injury Scale
ROC: Receiver Operating Characteristic curve

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No funding was received.

Conflict of interest

The authors have no competing interests to declare.

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