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Evaluation of Thoracic Trauma Severity Score (Ttss) in Assessing and Predicting Severity of Chest Trauma

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ABSTRACT

Introduction:

Chest trauma, which is frequently caused by road traffic accidents (RTAs), is a major public health concern worldwide. The Thoracic Trauma Severity Score (TTSS) provides a standardized method for assessing the severity of chest injuries, which aids in treatment decisions and outcome prediction.

Material and Methods:

This observational study aimed to determine the effectiveness of the TTSS in predicting the outcomes of chest trauma patients. The study, which conducted from September 2019 to May 2021 at the Department of Emergency Medicine, Apollo BGS Hospital in Mysore, included 65 adult patients who presented with chest injuries. Data on demographics, injury types, clinical characteristics, and outcomes has been collected and analyzed.

Results:

The majority of patients (70.8%) were male, with a mean age of 46.1 years. Road traffic accidents accounted for 80% of injuries. Rib fractures (95.4%) and lung contusions (75.4%) were the most common thoracic injuries observed. Patients with higher TTSS had prolonged hospital and ICU stays and increased need for mechanical ventilation. Mortality rates increased with higher TTSS, with 6.2% overall mortality.

Conclusion:

The TTSS proved effective in predicting outcomes of chest trauma patients, with higher scores associated with poorer outcomes. The findings highlight the value of TTSS in guiding early assessment and management strategies for chest trauma, ultimately aiding in reducing morbidity and mortality.

Keyword: Chest trauma, Thoracic Trauma Severity Score, Chest injuries

INTRODUCTION

Injuries to the thorax rank third among trauma patients globally, with road traffic accidents (RTAs) significantly contributing to fatalities and disabilities annually [1]. In India, RTAs are the primary cause of trauma, accounting for 65% [2]. Blunt chest trauma, mainly from accidents, is predominant, while penetrating injuries, like gunshot wounds, occur less frequently [3].

Globally, blunt abdominal trauma ranges from 8% to 17%, and thoracic trauma from 18% to 35%, contrasting with India's lower rates [1, 2].

A significant proportion of trauma deaths due to chest injuries occur within the first day, with 76% in the first hour, emphasizing the critical importance of the "golden hour" for thoracic trauma management [4]. Swift resuscitation, stabilization, and support are imperative, often requiring parallel assessments of history, examination, investigation, and treatment.

The majority of chest injuries are managed non-operatively, with severe cases typically handled in specialized trauma centers [3]. Early diagnosis and prompt treatment are crucial for life-threatening thoracic injuries, although logistical challenges can hinder immediate radiological investigations [5].

Accurate assessment of thoracic trauma severity is pivotal, with the Thoracic Trauma Severity Score (TTSS) serving as a valuable tool [6]. This study aimed to evaluate the TTSS utility in assessing chest trauma severity among emergency department patients, informing the development of management protocols and policies to mitigate mortality and morbidity.

MATERIAL AND METHODS

Study Design:

This hospital-based observational study was conducted from September 2019 to May 2021 at the Department of Emergency Medicine, Apollo BGS Hospital, Mysore. The study included adult patients presenting with chest trauma.

Study Population:

The study enrolled 65 patients meeting the inclusion criteria: aged 18 years and above, of any gender, presenting with chest trauma, and providing written informed consent. Exclusion criteria comprised patients with respiratory diseases affecting pulmonary function, malignancy, diagnosed end organ failure, or pregnancy.

Methods

A pre-designed proforma was utilized to collect patient data, which included clinical assessment, blood sample analysis, and diagnostic imaging such as chest X-ray or computed tomography. The Thoracic Trauma Severity Score (TTSS) was calculated for each patient based on parameters including rib fractures, lung contusion, PaO/FiO ratio, age, and pleural involvement. Data on thoracic complications, hospital stay, intensive care unit (ICU) stay, ventilation support, and mortality were recorded.

Statistical Analysis:

Data were compiled and analyzed using Excel. Baseline characteristics were presented descriptively. GraphPad Prism (v9.2.0) was used to analyze predictive values and diagnostic characteristics from ROC curves. A significance threshold of $p < 0.05$ was used for statistical comparisons. Linear regression established relationships among variables.

RESULTS

The study's demographic analysis revealed a male predominance (70.8%), with a slightly higher mean age compared to females, and the majority of participants falling into the 40-59 age group (Table No.1). Road traffic accidents were identified as the primary cause of injury (80%), followed by falls from height (20%) (Table No.3). Among the observed chest wall injuries, rib fractures were the most common (95.4%), often unilateral, with lung contusions and pneumothorax also prevalent(Table No.3).

Table No. 1: Demographic Characteristics

Gender	**N**	**%**	**Mean age±SD (years)**
Male	46	70.8	46.6±13.97
Female	19	29.2	44.9±13.95
Total	65	100	46.1±13.87
Age group	N	%	Mean age±SD (years)
21–39 Yrs	24	36.9	31.9±4.4
40–59 Yrs	26	40.0	48.1±5.2
≥ 60 Yrs	15	23.1	65.5±6.8
Total	65	100	46.1±13.87

Table No. 2: Mechanism of Injury

Mechanism of Injury	**N**	**%**
Fall from height	13	20.0
Road traffic accident	52	80.0
Total	65	100

Table No.3 Type of chest wall injuries

Chest-wall injuries	**N**	**%**
Rib fractures	62	95.4
• Unilateral	57	91.9
• Bilateral	5	8.1
Lung contusion	49	75.4
• Unilateral	22	44.9
• Bilateral	27	55.1
Pneumothorax	33	50.8
• Unilateral	33	100
• Bilateral	0	0
Hemothorax	8	12.3
• Unilateral	8	100
• Bilateral	0	0
Hemopneumothorax	11	16.9
• Unilateral	6	54.5
• Bilateral	5	45.5
Tension pneumothorax	3	4.6
Flail chest	3	4.6
Sternal fracture	2	3.1
Diaphragmatic Rupture	4	6.2

Final Outcome Analysis Based on Thoracic Trauma Severity Score

The analysis of final outcomes based on the Thoracic Trauma Severity Score (TTSS) revealed a clear correlation between TTSS levels and patient prognosis. Patients with lower TTSS scores (0-10) demonstrated favorable outcomes, with all patients recovering and no fatalities reported. However, as TTSS scores increased (11-20), the mortality rate rose, indicating a poorer prognosis. (**Table No.4)**

Table No.4 Outcome in Patients with Respect to Severity Score

TTSS	Patients (%)	Recovered (%)	Death (%)
0–5	16 (24.6%)	16 (100%)	0
6–10	22 (33.8%)	22 (100%)	0
11–15	19 (29.2%)	18 (94.7%)	1 (5.3%)
16–20	8 (12.3%)	5 (62.5%)	3 (37.5%)
21 - 25	0	0	0
Total	65 (100%)	61 (93.8%)	4 (6.2%)

Results of The Regression Analysis and ROC Curve

The ROC curve analysis revealed a strong predictive performance of the model with an AUC of 0.9201 (95% CI: 0.7948 - 1.000, $p < 0.05$). This indicates its robust ability to distinguish between positive and negative outcomes based on TTSS. The high negative predictive power (96.77%) underscores its efficacy in identifying individuals not experiencing the outcome. However, the positive predictive power (66.67%) suggests some room for improvement. Overall, these results suggest the model's clinical utility in risk prediction based on TTSS (Table No. 5 to 7 and Figure No. 1).

Table No. 5 Multiple linear regression analysis of variables with respect to TTSS

Variable	95% CI (asymptotic)	|t|	P value
Gender	-1.547 to 2.649	0.5248	0.6017
Age	-0.03360 to 0.08377	0.8548	0.3960
ICD Insertion	4.736 to 9.616	5.881	<0.0001
Length of ICU Stay (days)	-0.5383 to 0.7019	0.2637	0.7929
Length of Hospital Stay (days)	0.6682 to 1.925	4.126	0.0001
Invasive Ventilation	4.895 to 12.12	4.710	<0.0001

Table 6: Logistic regression analysis of TTSS vs. outcome

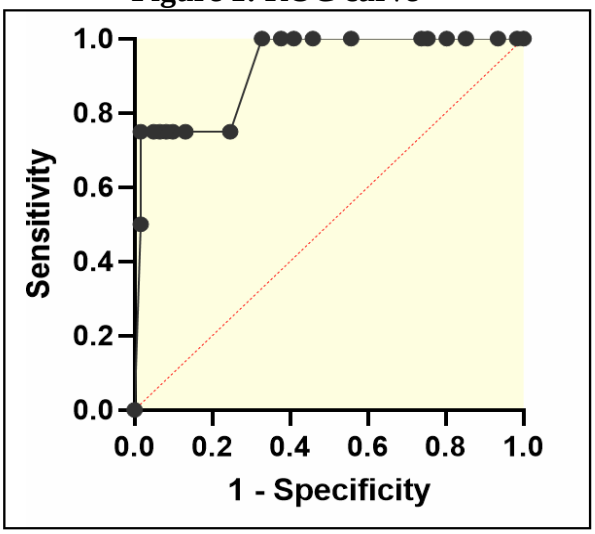
Variable	95% CI (profile likelihood)	P value
TTSS - Outcome	0.1819 to 0.9975	0.0137

Table 7: Area under the ROC curve

Variable	Value
Area	0.9201
Std. Error	0.06394
95% confidence interval	0.7948 to 1.000

P value	0.005
Negative predictive power (%)	96.77
Positive predictive power (%)	66.67

Figure 1: ROC curve



DISCUSSION

The present study investigated the utility of the Thoracic Trauma Severity Score (TTSS) in assessing and predicting the severity of chest trauma in patients presenting to the emergency department (ED). Our findings revealed distinct patterns in TTSS distribution among patients, with varying prognoses corresponding to different score ranges. Notably, patients with lower TTSS scores (0-5 and 6-10 points) demonstrated favorable outcomes, characterized by shorter hospital stays and higher rates of discharge. Conversely, those with higher TTSS scores (11-15 and 16-20 points) experienced poorer prognoses, evidenced by prolonged hospital stays, increased ICU admissions, and higher mortality rates. These observations align with previous research, emphasizing the prognostic value of TTSS in guiding clinical decision-making and resource allocation [7].

Importantly, our study highlights the practical advantages of the TTSS scoring system, particularly its simplicity and accessibility. Unlike some scoring systems that rely on advanced imaging techniques, TTSS can be calculated quickly and accurately using readily available clinical data, making it applicable in diverse healthcare settings [8]. Furthermore, our ROC curve analysis demonstrated the robust predictive performance of TTSS, with high negative predictive power indicating its effectiveness in identifying patients at low risk of adverse outcomes [9].

The comparability of our findings with those of previous studies, such as those by Adel Elbaih et al., Frank et al., and Aukema et al., underscores the consistency and reliability of TTSS as a prognostic tool across different populations and healthcare contexts [10-12]. Moreover, the validation of TTSS in settings where early chest CT scans may not be readily available underscores its practical utility in resource-limited settings, such as developing countries.

Our study also sheds light on the significant morbidity and mortality associated with thoracic trauma, particularly in polytraumatized patients. The observed mortality rate of 6.2% in our study aligns with previous literature, highlighting the substantial impact of severe thoracic trauma on patient outcomes [13]. Furthermore, our regression analysis revealed a significant association between TTSS and various clinical

parameters, including the need for mechanical ventilation and length of hospital and ICU stays, further corroborating the predictive validity of TTSS [14].

CONCLUSION

The study adds to the evidence supporting TTSS as a valuable tool in assessing chest trauma severity. TTSS aids in early risk assessment and guiding clinical decisions, potentially improving outcomes and resource use. However, more research and broader TTSS implementation are needed, especially in resource-limited settings. Establishing trauma care centers and comprehensive registries is crucial for enhancing trauma care and reducing thoracic trauma-related morbidity and mortality.

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