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Original Article

Internal Medicine Section

Effectiveness of the STUMBL Scoring System in Predicting Outcomes of Blunt Chest Trauma Patients Admitted to the Trauma ICU: A Retrospective Cohort Study

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ABSTRACT

Introduction: Blunt chest trauma is one of the leading causes of trauma related admission to the Emergency Department (ED). Risk prediction tools are widely used to estimate patient outcomes and guide clinical decision making. The Study of Management of Blunt Chest Wall Trauma (STUMBL) (Study of Management of Blunt chest wall trauma) score is a prognostic score developed to aid in the management of patients presenting with blunt chest injuries in the ED.

Aim: The present study aimed to evaluate the STUMBL scoring system to predict the outcomes in blunt chest trauma patients admitted to the trauma ICU.

Materials and Methods: The present retrospective analysis was conducted on adult blunt chest trauma patients admitted to the trauma ICU between January 2023 and January 2024. Patients less than 18 years of age, severe head injury and life threatening polytrauma were excluded from the study. Patient demographics, STUMBL scores, clinical interventions and outcomes were analysed.

Results: A total of 99 patients were enrolled in the study. The mean (SD) age was 44.83 (14.87) years, with a male/female ratio of 10:1 and a median Charlson comorbidity index of 0.50 (0.00, 2.00). Blunt chest trauma from road traffic accidents accounted for 76 (82.61%) of cases. Isolated blunt chest trauma was observed in 32 (32.32%) of patients and 95 (95.9%) patients had at least one rib fracture. The mean (SD) STUMBL score was 23.26 (11.65). There was a statistically significant association between higher STUMBL scores and the need for ventilatory support. Patients requiring NIV had significantly higher STUMBL scores (p=0.0002). STUMBL score>=26 had sensitivity of 68.00%, specificity of 67.65%, positive likelihood ratio of 2.10 and negative likelihood ratio of 0.47. Similarly, for HFNC use, Score>=26, had sensitivity of 60.98%, specificity of 72.55%, positive likelihood ratio of 2.22 and negative likelihood ratio of 0.53(p=0.0018). Higher STUMBL score were also significantly associated with longer ICU stay (p=0.0104) with a positive correlation (Spearman's rho=0.2709).

Conclusion: The STUMBL score demonstrated good discrimination in predicting the need for ventilatory support (NIV/HFNC) and longer ICU stay in patients with blunt chest trauma admitted to trauma ICU. A score of >/=26 was associated with increased need for respiratory support and prolonged ICU length of stay. These findings support the utility of the STUMBL score as a valuable prognostic tool in guiding early management decisions for blunt chest trauma patients in the ICU setting.

Keywords: Endotracheal intubation, High flow nasal cannula, Intensive Care Unit (ICU), Pneumonia, Study of management of blunt chest wall trauma, Sepsis, Tracheostomy

INTRODUCTION

Blunt chest trauma accounts for around 15% of all Emergency Department (ED) trauma presentations worldwide with significant morbidity and mortality [1]. Several scoring system have been proposed to predict complications and guide management of non-major blunt chest trauma.

Battle CE et al., [1] developed and validated the STUMBL (Study of the Management of Blunt chest wall trauma) score-also known as the Battle score to predict complications and guide management in blunt chest trauma patients. This score incorporates five key variables: age, number of rib fractures, chronic lung disease, use of preinjury anticoagulants and initial oxygen saturation (SpO_2) [1,2]. Unlike other scoring system, STUMBL score integrates clinical variables rather than relying on anatomical variables and age alone [3].

The score had a sensitivity of 80%, specificity of 96%, Positive Predictive Value (PPV) of 93% and a Negative Predictive Value (NPV) of 86% for predicting complications. A cut off score of 11 or greater indicated a significant risk for complications requiring hospital admission, while a score of 26 or greater suggested a need for critical care admission [2]. However, existing literature on the utility of the STUMBL score in predicting ICU outcomes following blunt chest trauma remains inconclusive. The present study aims to evaluate the effectiveness of the STUMBL scoring system in predicting outcomes among blunt chest trauma patients admitted to the trauma ICU.

MATERIALS AND METHODS

The present retrospective cohort study was conducted to evaluate blunt chest trauma patients admitted to trauma ICU in Christian Medical college, Vellore, Tamil Nadu, India. Time period for which data was considered is between January 2023 to January 2024. Study was planned during February to April 2024. Collected data was analysed between June 2024 to December 2024. The present study adhered to the principles set forth by the STROBE guidelines and the Declaration of Helsinki. As it was a retrospective analysis, the need for obtaining informed consent was waived. Ethical clearance was granted by the Instituitional Review Board of the institute. (IRB Min No. 2412163).

Inclusion and Exclusion criteria: All adult patients aged 18 years and above with blunt chest trauma were included. Patients less than 18 years of age, severe head/spine injury, penetrating abdominal injury and life threatening polytrauma were excluded from the study.

Sample size calculation: As this was a retrospective study including all eligible patients during the study period, no prior sample size calculation was performed. A total of 99 patients were enrolled in the study.

Study Procedure

Data was retrieved from a hospital database. Collected variables included patient demographics, STUMBL score [2], Charlson co-morbidity index [4], Acute Physiology and Chronic Health Evaluation (APACHE)-2 score, Revised Trauma Score (RTS) [5] and outcomes included the association of STUMBL score for the need of non-invasive ventilation (HFNC, NIV), invasive ventilation (Endotracheal Tracheal intubation and tracheostomy) pneumonia, sepsis and septic shock, ICU and hospital length of stay and in-hospital mortality. These data were analysed to assess the predictive utility of the STUMBL scoring system.

STATISTICAL ANALYSIS

The quantitative parameters were represented as Mean (Standard Deviation) and Median(Inter Quartile Range). Qualitative parameters were expressed as frequencies and percentages. The statistical test used was Chi-square test and Independent t-test. Data was analysed data using Statistical Package for Social Sciences (SPSS) 22 version software and a p-value less than 0.05 was considered statistically significant.

RESULTS

A total of 99 patients were enrolled in the study. The mean (SD) age was 44.83 (14.87) years, Of the 99 patients, 90 (90.9%) were male and 9 (9.1%) were female and a median Charlson comorbidity index of 0.50 (0.00, 2.00). The median Revised Trauma Score (RTS) was 7.55 (6.82, 7.83) and and APACHE 2 score 9.00 (5.00, 14.00). The most common mechanism of injury was road traffic accidents accounted for 76 (82.61%) of cases. Isolated blunt chest trauma was observed in 32 (32.32%) of patients and 95(95.9%) patients had at least one rib fracture. The mean (SD) STUMBL score was 23.26 (11.65) [Table/Fig-1].

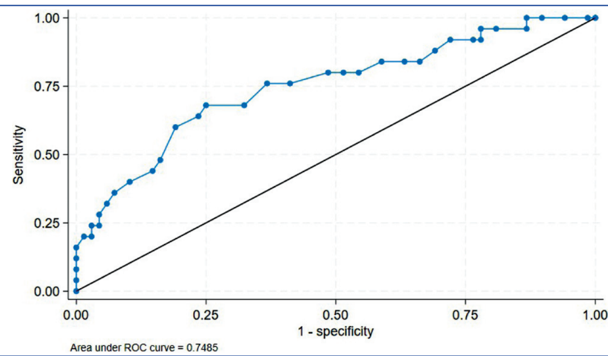
Variables	Total (N=99)
Age, (Mean±SD)	44.83 (14.87)
Gender	
Female, N (%)	9 (9.09%)
Male, N (%)	90 (90.91%)
Mechanism of Injury	
Fall from height	16 (16.84%)
Direct chest trauma, N (%)	1 (1.05%)
Assault, N (%)	3 (3.16%)
Road traffic accident, N (%)	76 (82.61%)
Unknown mechanism, N (%)	3 (3.03%)
Referred From Other Hospital, N (%)	77 (77.78%)
Charlson Comorbity Index, Median (Iqr)	0.50 (0.00, 2.00)
Revised Trauma Score, Median (Iqr)	7.55 (6.82, 7.83)
APACHE-2 Score Median (Iqr)	9.00 (5.00, 14.00)
GCS, Median (Iqr)	15.00 (12.00, 15.00)
Isolated chest trauma, N (%)	32 (32.32%)
Patient with rib fracture, N (%)	95 (95.96%)
No/. of rib fracture , Mean (Sd)	5.74 (3.55)
Patient with first 4 rib fracture,N (%)	73 (73.74%)
Flail chest, N (%)	34 (34.34%)
Sternal fracture, N (%)	8 (8.16%)
Clavicle/scapula fracture, N (%)	42 (42.42%)
Hemothorax, N (%)	62 (63.92%)
Pneumothorax, N (%)	75 (78.12%)
Past H/O chronic lung disease, N (%)	8 (8.16%)
Preinjury anticoagulant use, N (%)	3 (3.03)
Alcohol/drug addiction, N (%)	11 (11.34%)
STUMBL score Mean (Sd)	23.26 (11.65)
Analgesia	
Epidural block, N (%)	21 (21.21%)
Erector Spinae Block (ESB) ,N (%)	10 (10.10%)
Patient Controlled Analgesia (PCA), N (%)	18 (18.18%)
ESB+PCA, N (%)	3 (3.03%)
Oral analgesics+transdermal patch, N (%)	39 (39.39%)
Oral anagesics+intravenous infusion, N (%)	8 (8.08%)

[Table/Fig-1]: Baseline patient characteristics.

Among 99 patients, 31(31.31%) required NIV. Patients who required NIV had significantly higher STUMBL scores compared to those who did not (median:30 Vs 22; p=0.0002). A STUMBL Score >= 26, had sensitivity of 68.00%, specificity of 67.65%, positive likelihood ratio (LR+) of 2.10 and negative Likelihood Ratio (LR-) of 0.47 [Table/Fig-2]. The area under the ROC curve {Area Under the Curve (AUC)} for NIV prediction was 0.7485 (95% CI: 0.63061-0.86645) [Table/Fig-3].

Variables	Yes (n)	Median STUMBL score (P25, P75)	No (n)	Median STUMBL score (P25, P75)	p-value
NIV	31	30 (25,37)	68	22 (14,27)	0.0002
HFNC	48	29 (20,34)	51	21 (14,26)	0.0018

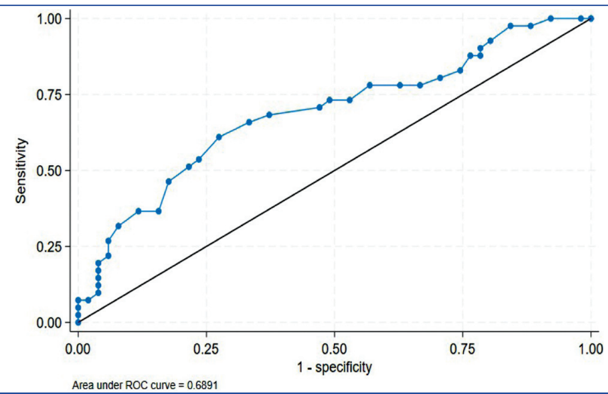
[Table/Fig-2]: Comparison between STUMBL score and NIV/HFNC requirement.



[Table/Fig-3]: Reciever operator curve for STUMBL score in predicting the need for NIV. The Area Under the Curve (AUC) was 0.7485 (95%CI:0.63061-0.86645).

High Flow Nasal Cannula (HFNC)

Of the 99 patients, 48 (48.48%) requiring HFNC also had significantly higher STUMBL scores (median:29 vs 21; p=0.0018). A score >= 26, showed a sensitivity of 60.98.%, specificity of 72.55%, Positive likelihood ratio (LR+) of 2.22 and negative likelihood ratio (LR-) of 0.53. [Table/Fig-2]. The area under the ROC curve (AUC) was 0.6891 (95% CI: 0.57823-0.80005) indicating moderate predictive power [Table/Fig-4].



[Table/Fig-4]: Reciever operator curve for STUMBL score in predicting the need for HFNC. The Area Under the Curve (AUC) was 0.6891 (95%CI: 0.57823- 0.80005).

There was no significant association between STUMBL score and the need for endotracheal intubation (p=0.367) or tracheostomy (p=0.118) [Table/Fig-5].

Variables	Yes (n)	Median STUMBL score (P25, P75)	No (n)	Median STUMBL score (P25, P75)	p-value
Endotracheal (ET) intubation	45	23 (14,30)	54	25 (16,31)	0.367
Tracheostomy	11	17 (6,31)	88	24 (15,31)	0.118

[Table/Fig-5]: Comparison between STUMBL score and Endotracheal intubation/ Tracheostomy requirement.

Although patients who developed sepsis, septic shock or pneumonia had higher median STUMBL score, the associations were not statistically significant (p=0.571,0.378 and 0.581 respectively) [Table/Fig-6]. However, patients with sepsis had significantly higher rates of Endotracheal intubation (80%vs 38.55%, p=0.002), tracheostomy (46.67% vs 4.76%, p<0.001) longer hospital stay (mean:17.93 vs 9.05 days p<0.001) and ICU stay (median:10 vs 3 days p<0.001) and ICU readmission (13.33% vs 2.38% p=0.047) [Table/Fig-7].

Variables	Yes (n)	Median STUMBL score (P25, P75)	No (n)	Median STUMBL score (P25, P75)	p-value
Sepsis	15	30 (10,34)	84	23 (15,30)	0.571
Septic shock	8	28 (17.50,32)	91	23 (15,31)	0.378
Pneumonia	16	26 (13,31)	83	23 (15,31)	0.581

[Table/Fig-6]: Comparison between STUMBL score and sepsis/septic shock/ pneumonia.

Variables	Patient with-out SEPSIS (n=84)	Patient with SEPSIS (n=15)	p-value
Endotracheal intubation, n (%)	32 (38.55%)	12 (80%)	0.002
Tracheostomy, n (%)	4 (4.76%)	7 (46.67%)	<0.001
Hospital length of stay mean (SD)	9.05 (4.92)	17.93 (6.68)	<0.001
ICU length of stay median (IQR)	3.00 (2.00, 5.00)	10.00 (6.00, 12.00)	<0.001
ICU re-admission, n (%)	2 (2.38%)	2 (13.33%)	0.047

[Table/Fig-7]: Comparison of outcomes between patient with and without sepsis.

There was a statistically significant moderate positive correlation between STUMBL score and ICU length of stay (rho=0.2709, p=0.0104). A weak positive correlation was observed between STUMBL score and total hospital length of stay (rho=0.1906, p=0.0736) which was not statistically significant. There was a strong positive correlation between ICU and hospital length of stay (rho=0.5813, p<0.0001) [Table/Fig-8]. In-hospital mortality was 2 (2.02%). However, the sample size was too small to perform statistical analysis.

Variables	Spearman's rho	p-value
STUMBL score and hospital length of stay	0.1906	0.0736
STUMBL score and ICU length of stay	0.2709	0.0104
Hospital and ICU length of stay	0.5813	<0.0001

[Table/Fig-8]: Comparison between STUMBL score and hospital/ICU length of stay.

DISCUSSION

Blunt chest trauma remains a significant contributor to trauma related morbidity and mortality, especially in patients requiring intensive care [6]. Blunt chest wall trauma accounts for over 10% of all trauma admissions to Emergency Departments worldwide. Reported mortality rates vary between 3% and 20% [7]. Accurately identifying individuals at high risk of complications is essential for early intervention and improved outcomes. The present study evaluated the effectiveness of the STUMBL scoring system in predicting outcomes among blunt chest trauma patients admitted to the trauma ICU.

The STUMBL score is a clinical prediction model that was developed and externally validated in 2014 in the UK. The final model demonstrated an excellent c-index of 0.96 (95% confidence intervals:0.93 to 0.98) [1,8]. The score was initially developed and validated to aid discharge disposition from Emergency Care, but has since been implemented in the clinical setting with extended uses, such as to direct referral to physiotherapy, or direct choice of analgesia [8].

A multi-centre, retrospective study involving 445 patients in New Zealand, reported that STUMBL score at a cut-off of <12 did not predict all complications sufficiently however, a score >18 predicted mortality sufficiently to be clinically useful. AUROC for all complications composite were {0.73, 95% Confidence Interval (CI) 0.68-0.77}, mortality (0.92, 95% CI 0.89-0.94), ICU admissions (0.78, 95% CI 0.73-0.81) and prolonged LOS (0.80, 95% CI 0.76-0.83). The score performed better in the New Zealand European (Pa¯keha¯) sub-group compared to Ma¯ori and Pasifika {AUROC (95% CI): 0.80 (0.73-0.85), 0.69 (0.56-0.79), 0.66 (0.46-0.82), respectively} [9]. When compared to the above study, the present study showed the STUMBL score cut off of >26 to predict respiratory support and complications. The STUMBL score had moderate discrimination for the need of non-invasive ventilatory support, with AUROC of 0.7485 (95% CI: 0.63-0.86) for NIV and 0.6891 (95% CI: 0.57-0.80) for HFNC. Higher STUMBL score was also significantly associated with longer ICU stays (p=0.0104) with a positive correlation (Spearman's rho=0.2709). Patients who developed sepsis exhibited worse outcomes, including higher rates of intubation, tracheostomy, ICU re-admission and longer hospital stay, but these were not significantly associated with higher STUMBL scores. This may indicate that secondary infections and systemic complications are influenced by factors beyond those captured by the STUMBL score. Mortality prediction could not be adequately assessed in the present cohort due to low in-hospital mortality (2.02%), limiting comparative analysis, suggesting a possible prognostic signal that warrants further exploration in larger cohorts.

A retrospective, Italian study involving 745 patients in Emergency Department, concluded that a score of 16 demonstrated excellent discrimination and calibration within a local sample of the population. AUROC of STUMBL score: 0.90 (95% CI: 0.88-0.93). The STUMBL score was significantly different in patients with complications compared to those without complications {9 (5;13) vs 21 (17;25), p<0.001)}. STUMBL score of 16 had a sensitivity of 0.80 (95% CI 0.75-0.85), specificity of 0.87 (95% CI 0.84-0.90), a positive predictive value of 0.70 (95% CI 0.64-0.76), and a negative predictive value of 0.92 (95% CI 0.90-0.94) [10]. In comparison to the above study, the present study showed STUMBL score >= 26 had sensitivity of 68.00%, specificity of 67.65 %, positive likelihood ratio of 2.10 and negative likelihood ratio of 0.47(p=0.0002). Similarly, for HFNC use, Score >=26, had sensitivity of 60.98%, specificity of 72.55%, positive likelihood ratio of 2.22 and negative likelihood ratio of 0.53(p=0.0018). STUMBL score was not significantly associated with the need for invasive ventilation (endotracheal intubation or tracheostomy),sepsis,septic shock and pneumonia. This suggests that the STUMBL score is effective in identifying patients likely to require early respiratory support, it may not predict the full spectrum of complications encountered in ICU.

These differences may be explained by population and setting variation; both the New zealand study and Italian study [9,10] evaluated patients presenting to the Emergency Department with early presentation of blunt chest trauma, where systemic complications were less frequent, allowing clearer prediction of respiratory deterioration. In contrast, the present study was conducted in trauma ICU patients with more severe injury and overlapping secondary complications (eg., sepsis, pneumonia, multi-organ dysfunction), which may have diluted the predictive strength of the STUMBL score.

Studies have evaluated the association of the STUMBL score to other outcomes. One of the study is the IAEM (Irish Association for Emergency Medicine) document which recommends the STUMBL

Score for guiding decisions regarding analgesia where the score is categorised as conservative (0-10), progressive (11-20), aggressive (21-30) and emergent (≥31), with a suggested corresponding analgesia regime. For the aggressive cohort, they also recommend the consideration of Continuous Positive Airway Pressure (CPAP) and in the emergent group, adding referral to the cardiothoracic surgical team for review [11]. Similarly, Williams A et al., (2020), used STUMBL Score to recommend a number of management decisions including a chest trauma analgesic bundle, referral to anaesthetics for regional analgesia, referral to the acute care team, referral to critical care if ventilatory support likely, and the cardiothoracic team for rib fixation [12]. Chowdhury D et al., (2016), Jeffery Z et al., (2019) and McLaughlin D (2020) adapted the STUMBL score for recommendations of analgesia and respiratory support (non-invasive and invasive mechanical ventilation [11,13,14]. The Rib Injury Outcome Study (RIOS) investigated 6-month outcomes after blunt chest wall injury and included the STUMBL score in the modelling for risk models for long term outcomes including chronic pain states, neuropathic pain and poor physical function [15].

Practice reviews by Morley EJ et al. (2016) and Maher P (2021) and an online 'rapid reference' by MD Sam Ashoo (2021) all provide an overview of the score's use in clinical practice [16-18]. The current findings suggest that the STUMBL score is a practical and moderately effective tool in early risk stratification for respiratory support needs in ICU patients with blunt chest trauma. However, its predictive utility for infection related outcomes and invasive interventions is limited.

Limitation(s)

The present study's retrospective nature makes it inherently susceptible to selection and recall bias. Being a single centre study may also reduce the generalisibility of the findings. The relatively small sample size and low event rates, suggests that the study was likely underpowered to detect associations with rarer but critical outcomes like mortality or sepsis. Although this study recorded APACHE II and Revised Trauma Score (RTS), it did not compare STUMBL's performance with other validated scoring system such as Chest Trauma Score (CTS) and Injury Severity Score (ISS), which could have contextualised its predictive utility. Potential confounders such as pain management strategy, physiotherapy, timing of interventions and clinician judgement in initiating ventilatory support were not adjusted for and could have influenced outcome such as respiratory support need and length of stay.

CONCLUSION(S)

The STUMBL score demonstrated moderate discriminatory ability in predicting the need for non-invasive ventilatory support (NIV and HFNC) and longer ICU stay among patients with blunt chest trauma admitted to the trauma ICU.A threshold score of >/26 was significantly associated with increased respiratory support requirements and extended ICU length of stay. Further prospective, multi-centre studies with large sample sizes are required to validate and refine the STUMBL model for ICU setting.

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