

Original Research Article

A study to validate thoracic trauma severity score in chest trauma patients

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ABSTRACT

Background: Aim of this study was to validate thoracic trauma severity score (TTSS) in assessing the requirement of mechanical ventilation, mortality, and predicting prognosis in chest injury patients.

Methods: This study was conducted in department of general surgery, Dr. S. N. Medical College, Jodhpur, Rajasthan, from December 2018 to September 2019. This was a single centred, prospective, observational study, conducted in 110 patients, aged >18 years, of isolated chest injury, excluding polytrauma patients. Data was summarized in the form of proportions, histograms and tables to show relationships of parameters with results. Data was presented as mean±SD and proportions as appropriate. Chi square test, z test or t tests were used wherever necessary for association analysis between categorical variables. Diagnostic test characteristics for mortality and complications was calculated from the ROC curves. A two sided of p values of less than 0.05 was considered statistically significant.

Results: Most common mode of chest injury was blunt trauma and most common age group affected was 42-54 years. Maximum mortality was seen in TTSS between 16-20, shows higher the TTSS more the mortality. Ventilator requirement was more in high TTSS. Patients with higher TTSS had longer hospital stay as compared to patients with lower TTSS.

Conclusions: On application of TTSS on admission, TTSS had direct correlation with need for oxygenation, ventilator need, duration of hospital stay, mortality or outcome in chest trauma patients. Thus we recommend TTSS as a good useful score for evaluation of prognosis, outcome and mortality in chest trauma patients.

Keywords: FiO₂, FAST, HRCT, PaO₂, SpO₂

INTRODUCTION

Chest injury, also known as chest trauma, is any form of physical injury to the chest including the ribs, heart, large vessels of thorax and lungs etc. Chest injuries accounts for 25% of all deaths from injuries due to trauma.¹ Chest injuries are caused by blunt mechanisms, such as motor vehicle collisions, fall from height or penetrating mechanisms such as stab injury, machine injury or gunshot injuries. In 2000, Pape et al described the thoracic trauma severity score (TTSS), a scale that

included both anatomical and functional parameters for assessment of severity of chest trauma.² TTSS combines the patient's age, resuscitation parameters and radiological assessment of thorax. TTSS employs 5 specific parameters: rib fractures, lung contusions, PaO₂/FiO₂ ratio, age, and pleural involvement. These parameters are scored from 0 to 5. The TTSS is calculated by adding the score of each of these five parameters; minimum score is 0 and maximum score is 25. Severity of chest injury is calculated by adding these coding severity points in TTSS. Higher the sum of all

parameters in this scale, indicates more severe chest trauma, which needs much attention and much aggressive treatment with direct life-saving and definitive management. An essential advantage of the TTSS is that all applied parameters can easily be ascertained in the emergency room. Therefore, an early identification of patients with thoracic trauma with high risk of complications, is possible. As the TTSS does not essentially require chest CT, it is usable in every hospital and can be calculated quickly.

METHODS

The study was single centred, prospective, observational study comprising 110 patients >18 years of age, with chest trauma as per the definition, admitted in department of surgery from December 2018 to September 2019, at Dr. S.N. Medical College Jodhpur. Study included, injury to the chest wall, pulmonary injuries and injuries of the pleural space, injuries to the airways, cardiac injuries, thoracic blood vessel injuries, esophageal injury and

diaphragm injury. Polytrauma patients and patients with medical comorbidities were excluded from study. All patients included as per the definition given above, were assessed on the basis of Thoracic trauma severity score, after managing the patient with all standard treatment protocols. After admitting the patient TTSS was assessed after getting chest X-ray, complete blood count, liver function tests, renal function tests, blood sugar random, chest X-ray, focused abdominal sonography for trauma (FAST), arterial blood gas analysis, and high resolution computed tomography (HRCT) thorax on the day of admission. Data was summarized in the form of proportions, histograms and tables to show relationships of parameters with results. Data was presented as mean±SD and proportions as appropriate. Chi-square test, z test or t tests were used wherever necessary for association analysis between categorical variables. Diagnostic test characteristics for mortality and complications was calculated from the ROC curves. A two sided of p values of less than 0.05 was considered statistically significant.

Table 1: Thoracic trauma severity score.²

Grade	PaO ₂ /FiO ₂	Rib fracture	Lung contusions	Pleura	Age (yrs)	Point
0	>400	0	No	No	<30	0
1	300-400	01-Mar	Unilobar Unilateral	Pneumothorax	30-41	1
2	200-300	>3 unilateral	Unilobar bilateral or bilobar unilateral	Hemothorax or hemo-pneumothorax, unilateral	42-54	2
3	150-200	>3 bilateral	Bilateral <2 lobules	Hemothorax or hemo-pneumothorax bilateral	55-70	3
4	<150	Flail chest	Bilateral > 2 lobules	Tension pneumothorax	>70	5

RESULTS

In present study most common age group affected in chest injury was 42-54 years followed by 30-41 years (mean±SD in discharged patients was 45.12±14.86 years and in expired patients was 61±25.59 years). Older age had poor outcome as compared to younger i.e., 25% mortality in >70 years, no mortality in 30-41 years age group (significant p value 0.050). Males were predominantly involved (91.82%) as compared to females in chest trauma (M:F, 11:1). Blunt trauma of chest was most common mode of injury sustained (85.45%), as compared to penetrating injury of chest (ratio 6:1). Maximum number of patients had 1-3 rib fractures i.e., 34 (30.91%), followed by >3 unilateral in 28 (25.45%) patients.

Flail chest seen in 25 (22.73%) patients, 1st rib fracture in 23 (20.91%) patients, sternum fracture in 8 (7.27%) patients, were associated with more severe injury and had higher TTSS. There was no significant association of isolated rib fractures with mortality (p value 0.138).

Pleural involvement was seen in 73 (66.3%) patients, 73 had haemothorax and 73 had pneumothorax.

Pneumothorax patients had mortality of 4 patients (5.48%, p value 1.000), and haemothorax patients had mortality of 5 patients (6.85%, p value 1.000). Study showed no significant association between mortality and isolated haemothorax or pneumothorax or haemo-pneumothorax. Lung contusions were seen in total 59 patients (53.63%), among them, 45 unilateral and 14 bilateral lung contusions. Mortality of 5 patients (8.47%) reported in lung contused patients and 54 patients discharged. All mortality belonged to unilateral lung contusions (11.11% for unilateral group). Study shows no significant association between mortality and isolated lung contusions (p value 0.325).

Table 2: Compared with TTSS.

Correlation	R value	P value
TTSS v/s ICU stay (hours)	0.088	0.689
TTSS v/s oxygenation (hours)	0.560	<0.0001
TTSS v/s ventilator (hours)	0.477	0.038

SpO₂ had a significant correlation with patient outcome (p value <0.0001). Maximum 27 (24.55%) patients had PaO₂/FiO₂ ratio <150, out of total 110 patients (mean±SD

in discharged was 259.79 ± 125.95 and in expired was 84.4 ± 20.25). Mortality of total 5 patients (4.55%) seen in $\text{PaO}_2/\text{FiO}_2$ ratio <150 . No mortality seen in other groups of $\text{PaO}_2/\text{FiO}_2$ ratio. With increase in $\text{PaO}_2/\text{FiO}_2$ ratio, mortality decreased. Patients with <150 $\text{PaO}_2/\text{FiO}_2$ ratio had worse outcome than higher score patients. This significant correlation had p value 0.002. $\text{PaO}_2/\text{FiO}_2$ ratio at the time of admission is a good predictor of patient outcome.

Table 3: Correlation of TTSS with outcome.

TTSS	No. of patients	Discharged	Expired	Percentage
0-5	27	27	0	0.00
6-10	39	39	0	0.00
11-15	31	30	1	3.22
16-20	13	9	4	30.76
21-25	0	0	0	0.00
Total	110	105	5	4.54

TTSS had significant correlation with age i.e. as age advanced, value of TTSS increased (p value 0.0001), while in younger age group more patients belonged to lower TTSS. For higher $\text{PaO}_2/\text{FiO}_2$ ratio, TTSS was low and for lower $\text{PaO}_2/\text{FiO}_2$ ratio, TTSS was higher. This showed a significant correlation between TTSS and $\text{PaO}_2/\text{FiO}_2$ ratio (p value <0.0001 , r value- 0.779). TTSS along with $\text{PaO}_2/\text{FiO}_2$ ratio predicts outcome and mortality of patient, if applied at the time of admission. Out of 110 patients in study, 72 (65.45%) patients managed surgically (thoracostomy or thoracotomy) and 38 patients (34.55%) managed conservatively. Our study shows significant correlation between TTSS and oxygenation (hours.) of patients (p value <0.0001 , r value 0.560). Present study shows no significant correlation between TTSS and ICU stay (hours) of patients (p value 0.689, r value 0.088).

Only 19 (17.27%) patients needed ventilator support. Those who needed ventilator support had higher TTS Scores. Thus, there is significant correlation between TTSS and mechanical ventilation (hours) of patients (p value 0.038, r value 0.477). Higher TTSS scores attributable to need for ICU shifting of patient and need for mechanical ventilation. When compared with TTSS, hospital stay showed a significant correlation, with p value of <0.0001 and r value of 0.413. It suggested that patients with higher TTSS had longer hospital stay as compared to patients with lower TTS scores. Out of total 110 patients, 5 expired, 1 had TTSS 11-15 and 4 had TTSS 16-20 with mortality of 4.54% (Mean \pm SD of TTSS in discharged was 9.02 ± 4.39 and in expired was 16.4 ± 1.51).

Present study showed maximum mortality for TTSS 16-20, 4 (30.76%) patients expired, out of 13 in that group. No mortality reported in 0-5 and 6-10 TTSS groups. No patient was there with TTSS >20 . This showed

significant correlation between TTSS and outcome of patients (p value 0.0003). These results shows that TTSS on admission, is a good predictor of prognosis, outcome and mortality of patients in chest trauma patients.

DISCUSSION

In study of Seong et al, the median duration of ICU stay and association between the TTSS and in-hospital mortality was not statistically significant (p value 0.547) 85 and also not had correlation with lung contusion.³ While in present study positive correlation was seen between TTSS and mortality. Okabe et al stated that, elderly patients with chest trauma were reported to have higher rates of mortality and morbidity than younger patients.⁴ In present study higher TTSS was associated with high mortality, similar results seen in study of Adel Elbaih et al showed the TTSS, 33.3% patients scored 0-5, 26.6% scored 6-10, 20% scored 11-15, 13.3% patients scored 16-20, and only 6.7% scored ≥ 21 with highest mortality in high scores.⁵ Out of those who scored 0-5, 2 patients was discharged, and 8 patients admitted to inpatient ward. With a score of 6-10, 4 patients admitted to inpatient ward and 4 patients in ICU. All of those who scored 11-20 admitted to ICU, and score $\geq 21-25$ the fate was the early death of two patients, showing higher scores attributed to high risk of mortality, similar to our study results. In study of Casas et al in which average TTSS of patients was 4.8 ± 1.9 points, only 8 out of 239 patients (3.3%) required mechanical ventilation in their study and showed 2.1% patients mortality in their study with the mean hospital stay of patients was 1.5 ± 4.3 days (range 0-45 days).⁶ In present study mechanical ventilation requirement was 17.27% of total patients, but with higher TTS scores.

In study of Daurat et al, TTS score on admission predicted the lowest $\text{PaO}_2/\text{FiO}_2$ ratio observed subsequently during ICU stays (p value <0.001), each additional point for the TTS score on admission was associated with a decrease in the expected lowest $\text{PaO}_2/\text{FiO}_2$ ratio of 19.2.⁷ The variable TTS score 13-25 was found to be independently associated with the occurrence of ARDS. While in present study TTSS was not statistically significant with duration of ICU stay but association seen between TTSS and need for mechanical ventilation and oxygenation.

Study of Samar et al showed, in 43.2% of cases tube thoracostomy was done for haemothorax and pneumothorax and 1% cases required thoracotomy for haemothorax.⁸ Mean hospital stay was 11.07 ± 7.4 days, outcome of the patient worsened with increase in TTSS. These results are comparable to results of present study. Aukema et al showed similar results, patients who died of thorax-related complications had a higher TTSS than patients who survived ($p \leq 0.001$).⁹ Phillip Mommsen et al, 10 stated that, TTSS had the best prediction power for ARDS, MODS, and mortality among the examined thoracic trauma scores.

CONCLUSION

Results of this study suggested that on application of TTSS on admission to emergency room, TTSS has direct correlation with need for oxygenation, ventilator need, duration of hospital stay, mortality or outcome in chest trauma patients. It was recommended and validated that TTSS as a good useful score for evaluation of prognosis, outcome and mortality in chest trauma patients. Thus, more workup is required to develop a standard score for assessment of mortality, outcome and severity of chest trauma patients.

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