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Faculty of Nursing, University of Jember, Ph (0331) 323450 Email: ianc@unej.ac.id

THORAX TRAUMA SEVERITY SCORE (TTSS) AS A PREDICTOR OF MORTALITY AND COMPLICATIONS IN PATIENTS WITH THORACIC TRAUMA

Nabilah Siregar

Nursing Program, Universitas Imelda Medan, North Sumatera, Indonesia
Corresponding author: nabilahsiregar92@gmail.com

ABSTRACT
Background: Thoracic trauma is the third most trauma incident following head and limb trauma. Thoracic trauma can involve multiple systems, thus increasing mortality about one-quarter of the total trauma mortality rate significantly. Thoracic trauma needs to be evaluated for its severity appropriately in order to provide proper treatments. Some trauma scores have not been able to predict mortality and complications accurately in patients with thoracic trauma, so TTSS was developed to overcome these problems. **Purpose**: This review aims to explain TTSS as a predictor of mortality and complications in patients with thoracic trauma. **Methods**: Literature analysis was carried out through general internet search processes and academic search sites through Science Direct, PubMed, and google scholar, with predetermined criteria. **Results**: From 10 eligible articles, 6 articles were synthesized. Almost all of the research results from these articles revealed by statistical analysis that TTSS has good sensitivity and specificity values and was able to predict mortality and complications in patient thoracic trauma, especially in patients with ARDS and MODS. **Conclusion**: TTSS is a feasible and appropriate tool in predicting mortality and complications in patients with thoracic trauma. The results of the TTSS could help us to determine the appropriate management or therapy for patients. Health workers including nurses are expected to understand and use TTSS in emergency care practices for patients with thoracic trauma to achieve better results.

Keywords: Thorax Trauma Severity Score; Predictor; Mortality; Complications

BACKGROUND

Trauma is one of major leading causes of death worldwide, accounts for 5.8 million deaths (Beshay, 2020). Thoracic trauma is the third most traumatic incident following head and limb trauma, accounts for 2.5% of trauma-related deaths in the world (Beshay, 2020). Thoracic trauma can involve multisystem so it could increase the incidence of mortality significantly about a quarter of the total mortality due to trauma. Thoracic trauma such as tension pneumothorax, flail chest, and pneumothorax should be assessed accurately because patient with trauma thoracic has a high risk and potential life threat (Mourgi, 2016).

Thoracic trauma is trauma or injury caused by blunt or sharp objects in the thoracic cavity which could damage the walls of the thorax or inside the thoracic cavity and cause acute thoracic emergency. Thoracic trauma includes bleeding, damage of alveoli or lung tissue, fracture of the ribs, compression or suction wounds that cause lung collapse. Thoracic trauma could be widespread and become serious, and restrict the heart's ability to pump blood or the lungs'

ability to exchange oxygen and carbon dioxide (Labora, 2015).

The severity of thoracic trauma needs to be evaluated appropriately to provide appropriate treatment. Several thoracic trauma scoring systems have been developed to assess and predict the severity of thoracic trauma. Trauma scoring system that already exists is the Trauma and Injury Severity Score (TRISS) which combines the Injurity Severity Score (ISS) and Revised Trauma Score (RTS) to predict mortality of trauma patients. However, this score assessment can take several hours in the Emergency Room (ER) to complete the diagnosis. It also has limitations in clinical decision making. Therefore, a special score was developed, namely Thorax Trauma Severity Score (TTSS) to predict mortality and complications in patients with thoracic trauma based on anatomical and functional parameters (Moon, 2017).

Based on these descriptions, TTSS was developed to help predict the outcome of patients with thoracic trauma. Therefore, this systematic review aims to explain Thorax Trauma Severity Score (TTSS) as a predictor of mortality and complications in patients with thoracic trauma.

METHODS

Literatures of this systematic review were obtained by searching databases such Science direct, PubMed and google scholar. Criteria of literatures are related to the Thorax Trauma Severity Score (TTSS) and published in 2010-2020. The process was carried out using the keywords: Thorax Trauma Score, and Thorax Trauma Severity Score. 6 Original research articles were reviewed on September 16 to 17 in 2020. All of these studies have been approved by medical ethic committees. The searching and selecting process is described using the Prism Chart (Chart 1):

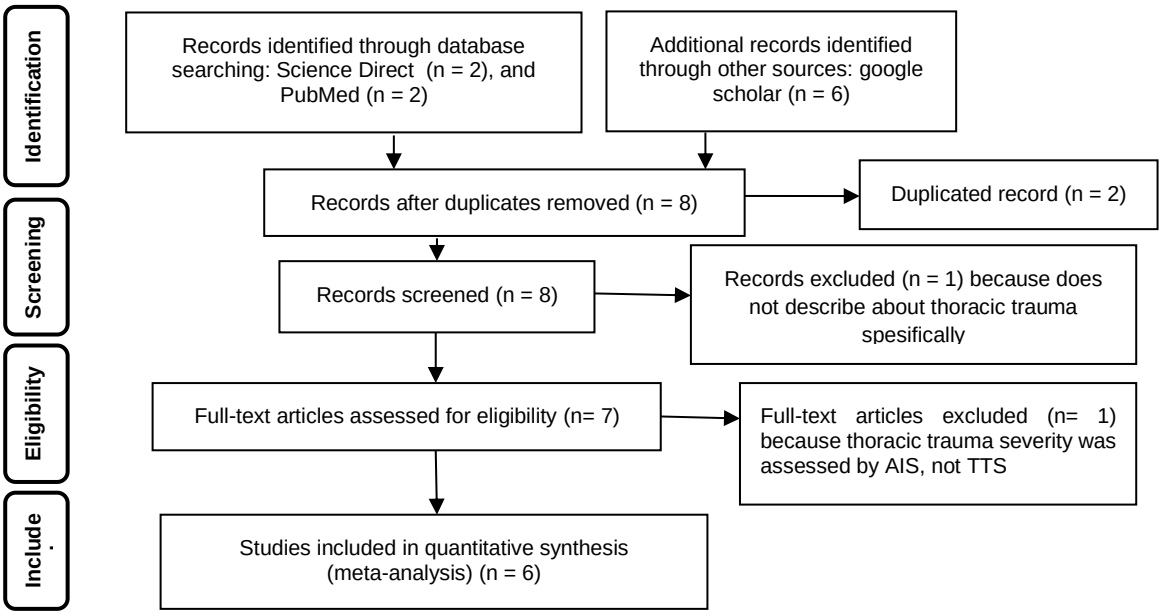

Chart 1. Flow chart of literature searching and selecting process

RESULTS

10 articles were found from Science Direct, PubMed, and google scholar site, which are related *Thorax Trauma Severity Score*. Then, these articles were screened, till included and finally 6 articles were analyzed, according to the PRISMA flowchart above. The results of this review found that TTSS has significant ROC (0.844, 0.82) indicates that this score is sensitive and specific scoring in predicting mortality in patients with thoracic trauma (Aukema, 2011; Daurat, 2016). Data

analysis of these articles also showed that AUC values predicted complications (0.848) and predicted mortality (0.856) significantly (Casas, 2016). The AUC values of TTSS for mortality, ARDS, MODS, SIRS, and sepsis were 0.79, 0.75, 0.82, 0.59, and 0.56, respectively (Mommsen, 2012). Furthermore, there was a significant difference (p= 0.000) between the outcome, which the high TTSS score the worse outcome of patients (Subhani, 2014).

DISCUSSION

Thoracic trauma is a type of trauma that damage the wall or inside of the thoracic cavity and can involve multisystem. So, patients with thoracic trauma has a high potential of life threatening. Therefore, an accurate and quick assessment is needed to help in making an appropriate clinical decision and management for patient (Mourgi, 2016). One of the assessment techniques is trauma score system. Thorax Trauma Severity Score (TTSS) is a score that was developed in 2000. According to the large number of thoracic trauma incidents, many studies about thoracic trauma scores were developed such as TRISS and RTS scores to predict mortality. However, the results showed that these two scores have limitations, that TRISS is difficult to predict outcome progression or mortality in thoracic trauma and takes a long time to be applied in ER. Whereas on RTS, the assessment can be influenced by the presence of actions at the pre-hospital such as intubation, sedation and others. Hence, to overcome these limitations, a special score for thoracic trauma cases was developed, namely TTSS. TTSS combines patient's age, Resuscitation parameters and radiological assessment of thoracic trauma. The value of each parameter is calculated. The minimum score is 0 and the maximum score is 25 (Moon, 2017).

TTSS parameters can be assessed from the results of an X-ray examination (Aukema, 2011). The purpose of developing TTSS is to assist in conducting emergency medical evaluations in identifying the risk of pulmonary complications in patients with thoracic trauma. Assessment using parameters can be applied both in primary and secondary hospitals level. Furthermore, this score was developed in predicting mortality in the population of patients with thoracic trauma (Casas, 2016). TTSS is described on table 1.

Table 1. Thorax Trauma Severity Score (Moon, 2017)

Grade	PaO_2/FiO_2	Rib Fracture	Contusion	Pulmonary Involvement	Age	Point
0	400≤S	0	None	None	<30 years old	0
I	300≤S≤400	1-3	1 lobus, unilateral	Pneumothoraks	30-41 years old	1
II	200≤S≤300	>3	Unilobar bilateral or bilobar unilateral	Hemotoraks/Hemopneumotraks unilateral	42-54 years old	2
III	1500≤S≤200	>3 Bilateral	<2 lobus bilateral	Hemotoraks/Hemopneumotraks bilateral	55-70 years old	3
IV	S≤150	Flail chest	≥2 lobus bilateral	Tension pneumothoraks	>70 years old	5

Various studies have been conducted to prove the feasibility of TTSS. A research conducted by Aukema, et al. (2011) retrospectively through database analysis in 516 patients who came with chest trauma to hospital emergency room. TTSS was analyzed to predict mortality. The results of the study found that the Receiving Operating Characteristic (ROC) curve= 0.844, which indicates that TTSS is a sensitive and specific

scoring system to predict mortality. TTSS significantly predictes mortality from complications of thoracic trauma with a higher value than survivors (p<0.001, 95% CI), and those who died from complications not related to thoracic trauma (p<0.014, 95% CI). 140 patients (27%) had hospital acquired pneumonia, followed by acute respiratory distress syndrome (ARDS), secondary pneumothorax, persistent hemothorax, and empyema. Patients with developing ARDS had a higher score than non-ARDS (p= 0.005, 95% CI) (Aukema, 2011).

Meanwhile, Mommsen, et al. (2012) explained on their research article that determining the severity of thoracic trauma in multiple trauma also determines the patient's clinical condition. The severity of thoracic trauma affects the decision-making for patients with mulitiple trauma in terms of timing and priority of surgery to prevent posttraumatic complications. They performed a retrospective study in 278 multiple trauma patients with blunt chest trauma. The results of their study found that there were several complications in post-traumatic patients during hospitalization, 143 (51.4%) patients had Systemic Inflammatory Response Syndrome (SIRS), 110 (39.6%) patients had sepsis, 60 (21.6%) patients had ARDS, 36 patients had Multiple Organ Dysfunction Syndrome (MODS), and 22 (7.9%) patients died, with the average length of stay of patients in ICU and hospital were 19 and 32 days. The results of statistical analysis revealed that TTSS is an independent predictor of mortality compared to other scoring systems, and can predict outcome in patients with blunt chest trauma. TTSS was significantly associated with length of stay in ICU and length of time using ventilator. The AUC values of TTSS for mortality, ARDS, MODS, SIRS, and sepsis were 0.79, 0.75, 0.82, 0.59, and 0.56, respectively. Meanwhile, sensitivity values of TTSS for mortality, ARDS, MODS, SIRS, and sepsis were 0.77, 0.63, 0.78, 0.52, and 0.51, respectively. While specificity values of TTSS for mortality, ARDS, MODS, SIRS, and sepsis were 0.69, 0.74, 0.72, 0.62, and 0.59, respectively. The significant P value for mortality, ARDS, and MODS were 0.004, <0.001 and <0.001 (Mommsen, 2012).

ARDS is a complication that can be suffered following trauma such as lung contusions. ARDS could appear within 24-48 hours after trauma, thus detection of ARDS is very important. A research conducted by Daurat, et al. (2016) retrospectively in 329 patients who came to the Trauma Center with blunt thoracic trauma. The diagnosis of lung contusions in patients was confirmed from results of CT scan. TTSS was used to predict ARDS that occured within 48 hours of trauma. From the analysis, the AUC ROC value of TTSS= 0.82 (95% CI 6.7-99.6). Score 13-25 of TTSS was found to be one of the risk factors for ARDS (OR= 25.8, 95% CI, p <0.001). The study showed that a high or extreme TTSS score of a patient with thoracic trauma admitted to the hospital can predict the occurrence of delayed ARDS in patients with blunt thoracic trauma due to pulmonary contusions accurately. This score can help in decision making of proper management for patient (Daurat, 2016).

Furthermore, Subhani, et al. (2014) also conducted a study related to TTSS in predicting morbidity and mortality of patients with blunt chest trauma by comparing the outcome among patients with low and with high TTSS scores. This cross-sectional descriptive study was conducted in 264 patients with blunt chest trauma at a hospital in Pakistan. The results of their study found that 70.8% of patients had a low TTSS score and 29.2% of the patients had a high TTSS score. The comparison of the outcomes from two groups was analyzed using the Chi square test. The results showed that there was a significant difference (p= 0.000) between the outcome, which the high TTSS score the worse outcome of patients (Subhani, 2014).

Casas, et al. (2016) also conducted a study about reliability of TTSS at secondary level hospitals retrospectively in 238 patients

with thoracic trauma, explains that morbidity and mortality rates of the total respondents were 2.5% and 2.1%, respectively which all patients had high TTSS scores. There was a significant relationship between the TTS score with complications and mortality. The analysis revealed that AUC value predicted complications (0.848) and predicted mortality (0.856) significantly. The TTSS sensitivity value was 66% and specificity was 94% in predicting complications, the sensitivity value was 80% and specificity was 94% in predicting mortality. The results of their research showed that TTSS is a feasible tool to predict worsening of complication or mortality in patients with thoracic trauma especially in mild thoracic trauma (Casas, 2016).

The results of these studies are also supported by a research conducted by Soesanto, et al. (2018) with descriptive analytic about TTSS in 50 patients with blunt thoracic trauma at a hospital in Manado. The finding showed that there were 25 (50%) patients had hematothorax, 20 (40%) patients had rib fractures, 12 (24%) patients had ARDS, 9 patients (18%) had pulmonary contusions, 6 (12%) patients had pneumothorax, and 5 (10%) patients had hypoxemia. This diagnosis was supported by the result of AP chest X-ray examination. They explained that treatment for patients with blunt thoracic trauma is a challenge for health workers because when the patients admitted to emergency room, they did not show symptoms of difficulty breathing, but within 48-72 hours their condition worsened due to complications. Therefore, a scoring system is urgently needed to predict complications that can be suffered by patients with thoracic trauma. Their results showed that TTSS predicted ARDS in patients with blunt thoracic trauma with sensitivity value= 100% and specificity was 92%. They stated that TTSS can be used as a tool to diagnose patients with blunt thoracic trauma early and accurately. The researchers explained that complications, especially ARDS in patients with blunt thoracic trauma, could appear within 24-48 hours. This is due to the release of large amounts of pro-inflammatory mediators in the early phase of trauma. These mediators trigger the movement and infiltration of neutrophils into the lungs and cause ARDS. This condition could be a cause of increasing of morbidity and mortality rate in patients with blunt thoracic trauma (Soesanto, 2018).

CONCLUSION

Based on 6 articles, it can be concluded that the Thorax Trauma Severity Score (TTSS) is a feasible and appropriate tool to be used in predicting mortality and complications in patients with thoracic trauma. The results of TTSS assessment can help us to determine appropriate management or therapy and prevent increasing of morbidity and mortality rate in patients with trauma, especially thoracic trauma. Hence, health workers including nurses are expected to be able to understand and practice using TTSS in emergency care for patients with thoracic trauma to achieve better outcomes.

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