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Assessment of Isolated Blunt Chest Trauma Patients in Benha University Hospital According to Thoracic Trauma Severity Score

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Abstract

Background: Chest trauma, in the younger population, is considered a significant cause of morbidity and mortality. A scoring system that can give us a prediction of the thorax related complications in thoracic trauma patients is especially needed. So, the Thoracic Trauma Severity Score (TTSS) was described.

The aim of this work: To assess the validity of the Thoracic Trauma Severity Score and its efficacy to predict outcome in blunt thoracic trauma patients.

Methodology: Our study included 160 patients of isolated blunt chest trauma attending to emergency room at Benha University Hospital.

Results: TTSS when larger than or equal 8 is a good test for prediction of outcome as sensitivity of it reaches 92.3% while specificity is 100% with 97.5% accuracy.

Conclusion: This study shows how the usefulness of the TTSS for predicting outcome in thoracic trauma patients, as poor outcome was associated with higher scores.

Keywords: Thorax trauma severity score; Blunt thoracic trauma; Trauma outcome

Introduction

In blunt trauma patients, thoracic trauma occurs in more than 50% [1]. It is considered a significant cause of mortality and morbidity more in the younger population [2].

Road Traffic Accidents (RTAs) are the commonest cause of blunt chest injuries accounting for up to 70%.

Mechanism of injury after blunt trauma is mainly due to either: Acceleration /deceleration injury after motor car accidents or falling from a height, Compression /decompression injury as after falling of a heavy object on the chest that can lead to rupture diaphragm. Or marked increase in air way pressure against a closed glottis [4].

Control of Pain, aggressive pulmonary toilet, and mechanical ventilatory support if necessary are the way of supportive treatment [5].

The great majority of patients with chest trauma have an excellent outcome and prognosis. More than 80% require either non-invasive therapy or just thoracostomy tube. The presence or absence of associated injuries such as central nervous system, abdomen and pelvis is the most important factor of outcome [6].

Early and accurate assessment of the severity of thoracic trauma is of great value for correct treatment, from predicting intensive care need, to avoid future complications [7].

Recently, in cases of thoracic trauma and pulmonary contusion, variable scoring systems have been developed to define injury severity. Some of the scores are global with no detailed analysis of injuries [8].

On the other hand, some scores focus on one injury only (e.g. Wagner score for pulmonary contusion) and don't care with gas exchange or the patient's condition, which are important determinants in assessing respiratory risk [9].

On the contrary, the Thoracic Trauma Severity (TTSS) score table 1 is especially account for demographic data such as age, respiratory status, most thoracic injuries (pulmonary contusions, pleural effusions, rib fractures) [10].

The aim of this study was to evaluate isolated blunt chest trauma patients admitted to Benha University Hospital, according to Thoracic Trauma Severity Score and to evaluate the ability of the score to predict outcome of such injuries.

Patient and Methods

This is a prospective study which was carried out in Benha University Hospital at Cardiothoracic Surgery Department from the beginning of July 2017 to the end of June 2019. Our study was approved by Institutional Research Board (IRB). All consecutive patients, meeting the inclusion criteria, were included in the study. Only 160 patients with isolated blunt thoracic trauma attending to emergency department were included on our study. The Exclusion criteria included poly traumatized patients, penetrating chest trauma ,blunt trauma associated with penetrating trauma, any respiratory disease that affect pulmonary functions and end organ failure .

Table 1: Thoracic Trauma Severity Score (TTSS)

Parameter	Finding	Points
Age	<30 years of age	0
	30 to 41 years of age	1
	42 to 54 years of age	2
	55 to 70 years of age	3
	>70 years of age	5
PaO_2 to FIO_2 ratio	>400	0
	301-400	1
	201-300	2
	150-200	3
	<150	5
Pulmonary contusion	None	0
	1 lobe, unilateral	1
	1 lobe, bilateral,2 lobes, unilateral	2
	<2 lobes, bilateral	3
	≥ 2 lobes, bilateral	5
Pleural involvement	None	0
	Pneumothorax	1
	Unilateral hemothorax or hemopneumothorax	2
	Bilateral hemothorax or hemopneumothorax	3
	Tension pneumothorax	5
Rib fractures	None	0
	1 to 3	1
	3 to 6 unilateral	2
	>3, bilateral	3
	flail chest	5

Initial management of patients was done on emergency department by trauma team based upon protocols from Advanced Trauma Life Support (ATLS) follows the ABCDE pattern: Airway, Breathing, Circulation, Disability (Neurologic status), and Exposure. On admission, vital signs: pulse, blood pressure and respiratory rate were assessed. Laboratory Investigation including arterial blood gases to assess the patient Pao2. Imaging studies including CT chest to determine lung affection, involvement of pleura and fractured ribs, echocardiography to evaluate cardiac injuries. Then, all patients' data met our inclusion criteria will be included in the scoring system.

Statistical Analysis

Continuous data were presented as mean ± standard deviation and were compared using the t-test. Categorical data were presented as numbers and percentages and were compared using Chi-square and Fisher tests. Data were analyzed using IBM SPSS software package version20.0 (Belmont, Calf, 2013). A p-value 0.05 was considered statistically significant.

Results

The study revealed that (32.5%) of the studied patients were below 30 years old and (67.5%) were males. regarding the cause of trauma; road traffic accidents was cause of injury in (77.5 %) of cases while (12.5%) was due to Falling from height, (5.0%) was due to Falling of heavy object on the chest and (5.0%) was due to Animal kick.

Regarding clinical presentation; (57.5%) of cases presented with dyspnea and chest pain, (30%) presented with chest pain without dyspnea, (5%) of cases presented with hemoptysis (5%) of cases presented with Fever (delayed presentation two weeks after trauma) and (2.5%) were shocked.

Table 2: Distribution of the studied group outcome regarding the clinical findings. (N=160)

	Discharge N(44)	Morbidity N(96)	Mortality N(20)	FET	P value
HR (/min)					
<100	32(72.7)	60(62.5)	0(00.0)		
100-120	12(27.3)	28(29.2)	0(0.0)		
120-140	0(0.0)	8(8.3)	8(40.0)	13.65	0.009**
>140	0(0.0)	0(0.0)	12(60.0)		
RR (/min)					
12-	20(45.5)	32(33.3)	0(0.0)		
20-	24(54.5)	52(54.3)	0(0.0)	14.65	0.002**
>29	0(0.0)	12(12.4)	20(100)		
SBP (mmHg)					
≥110	36(81.8)	84(87.5)	8(40.0)		
90-109	8(18.2)	12(12.5)	4(20.0)	8.83	0. 24
<90	0(0.0)	0(0.0)	8(40.0)		
Hb level (mg/dl)					
≥ 9.6	44(100)	96(100)	8(40.0)		
<9.6	0(0.0)	0(0.0)	12(60.0)	11.96	0.001**
*Statistically significant at p value > 0.05					

Regarding pleural involvement; (32.5%) of cases was free from any Pleural injury. (12.5%) had Pneumothorax, (42.5%) had unilateral hemopneumothorax or hemothorax, (10%) had bilateral hemopneumothorax, or hemothorax and (2.5%) had tension pneumothorax. Bilateral Pleural involvement with a P-value (0.001) and tension pneumothorax with a P-value (0.002) had a significant relation to poor outcome Table 3.

Regarding bony injuries; (25.5%) of cases had no skeletal injuries, (35%) of cases had 1 to 3 fractured ribs,(17.5%) had 3 to 6 fractured ribs, followed by flail chest in (12.5%) and only (9.5%) had bilateral fractures of more than 3 ribs. Also the study showed that (7.5%) of cases had sternal fractures and only (5%) had cardiac contusion. Our study showed that bilateral rib fractures had a significant effect on outcome with a P-value of (0.03) Table 3.

Our study showed that regarding Lung contusion ; (40.5%) of patients were free from any lung contusion, (37.5%) had unilateral lung contusion of one lobe, (7.5%) had contusion of One lobe bilateral or 2lobes unilateral and (9.5%) had bilateral contusion of more than 2 lobes and only (5%) had bilateral contusion of less than 2 lobes. Also our study showed that bilateral parenchymal lung injury has a significant effect on outcome with a significant p-value of (0.042) Table 3.

This study showed that regarding Pao2/Fio2 ratio; (37.5%) of cases had Pao2/Fio2 ratio 301-400, (27.5%) of cases had Pao2/Fio2 ratio > 400, also (17.5%) of cases had ratio 201-300 and only (10%) of cases had ratio 150-200 and (7.5%) had Pao2/Fio2 ratio>150. Pao2 /Fio2 >200 has significant P value (0.043) Table 3

Also the study showed that regarding clinical signs; (60.0%) of cases had HR<100 beat/minute , also showed that (42.5%) of cases had respiratory rate of 12-20 breath /minute , ,regarding blood pressure ; (80.0%) of cases had SBP ≥110 mmHg, regarding Hb level was ≥ 9.6 in (92.5%) of cases , and was<9.6 in only (7.5%) of cases. Also showed that respiratory rate has significant effect on outcome with P value (0.002), also tachycardia >140 beat per minute has a significant effect on outcome with P value (0.009) Table 2.

Our study showed that only a small percentage of cases had mediastinal injuries, cardiac contusion or major vascular injuries that are not a part of the TTSS parameters; however it showed a significant relation to poor outcomes , as half (50%) of cases that had cardiac contusion and major vascular injuries died .

Regarding management; (52.5%) of patients were managed with thoracostomy tube, (27.5 %) of cases had supportive measures (pain control and physiotherapy), (15%) intubated and mechanically ventilated, only (5.0%) underwent emergent thoracotomy. The early need for Mechanical ventilation has significant effect on outcome with P value 0.001, as out of 24 cases that needed mechanical ventilation, 16 cases died and 8 cases had chest infection and prolonged ventilation and prolonged hospital stay Table 5.

Regarding outcome; (12.5%) of patients admitted to ICU; of them 7. % died and 5% weaned off ventilator within few days but complicated with chest infection and prolonged hospital stay. (22.5) % of patients admitted for observation then discharged next day. (52.5 %) of cases admitted to ward and underwent tube thoracostomy; (5%) complicated with clotted hemothorax; some treated with intra pleural streptokinase injection and others underwent decortication. (3%) died at ER, and (5%) were discharged home from the ER. (5%) of cases had emergent thoracotomy; (2.5%) survived but (2.5%) died Table 5.

Regarding application of the thoracic trauma severity score; 45.5% scored 0-5, also 35 % of cases scored 6-10, 7.5% scored 11-15 and another 12 % scored 16-25.also showed that total score has a significant effect on outcome with P value 0.003 , with increased mortality rates with higher scores Table 4, Figure 1.

ROC curve analysis of the tested score shows that TTSS when larger than or equal 8 is a good test to predict poor outcome (ICU admission and death) versus good outcome (inpatient admission after discharge from ER) as sensitivity of it reach (92.3%) while specificity is (100%) with (97.5%) accuracy Figure 2.

Table 3: Distribution of the studied group outcome regarding the trauma finding (N=160)

	N	%	Points
Pleural involvement			
None	52	32.5	0
Pneumothorax	20	12.5	1
Unilateral hemothorax or hemopneumothorax	68	42.5	2
bilateral hemothorax or hemopneumothorax	16	10	3
Tension pneumothorax	4	2.5	5
Lung contusion			
None	65	40.5	0
One lobe unilateral	60	37.5	1
One lobe bilateral, 2lobes unilateral	12	7.5	2
< 2lobes bilateral	8	5	3
≥ 2lobes bilateral	15	9.5	5
Mean ± SD	1.05±1.47		
Rib fracture			
0 none	41	25.5	0
1 to 3	56	35	1
3 to 6	28	17.5	2
>3 bilateral	15	9.5	3
Flail chest	20	12.5	5
Mean ± SD	1.78±1.66		
Pao2/fio2			
>400	44	27.5	0
301-400	60	37.5	1
201-300	28	17.5	2
150-200	16	10	3
>150	12	7.5	5
Mean ± SD	1.08±0.89		
Sternal fracture	12	7.5	
Cardiac contusion	8	5.0	

*Statistically significant at p value > 0.05

Table 4: Distribution of the studied group outcome regarding TTSS and trauma grades (N=160)

	Discharge N(44)	Morbidity N(96)	Mortality N(20)	FET	P value
Trauma Grades					
I (0-5)	36(81.8)	36(37.5)	1(5.0)		
II(6-10)	8(18.2)	48(50)	0(0.0)		
III (11-15)	0(0.0)	12(12.5)	0		
IV (16-25)	0(0.0)	0(0.0)	19(95.0)	21.86	0.001**
Total score					
≥10	0(0.0)	24(25.0)	19(95.0)	10.45	0.003**
<10	44(100)	72(75.0)	1(5.0)		
*Statistically significant at p value > 0.05					

Table 5: Distribution of the studied group regarding management, total score and outcome (N : 160)

Management	Outcome	Number	%	Score
Tube thoracostomy (N:84)	Improved and discharged without further complications	68	42.5%	2-7
	Clotted hemothorax and decortication	5	3.1%	10
	Clotted hemothorax treated with intra pleural streptokinase injection	3	1.9%	8%
	Complicated with atelectasis	8	5%	8,11
Supportive measures (pain control, physiotherapy) (N:44)	Discharged at ER	8	5%	1
	Observation for one day then discharged	36	22.5%	2-7
Intubation and ventilation (N:24)	Died short time after arrival to ER	5	3.1%	20-23
	ICU admission, death within with in 48 hrs	7	4.4%	18,19
	ICU admission died after 2 weeks (ARDS)	4	2.5%	17%
	ICU admission, extubated within few days but complicated by chest infection, atelectasis and prolonged hospital stay	8	5%	12,14
EMERGENT THORACOTOMY (N:8)	Failed resuscitation	4	2.5%	5,18,19,20
	Survived after surgical control of bleeding	4	2.5%	5, 6,7,11
*Statistically significant at p value > 0.05				

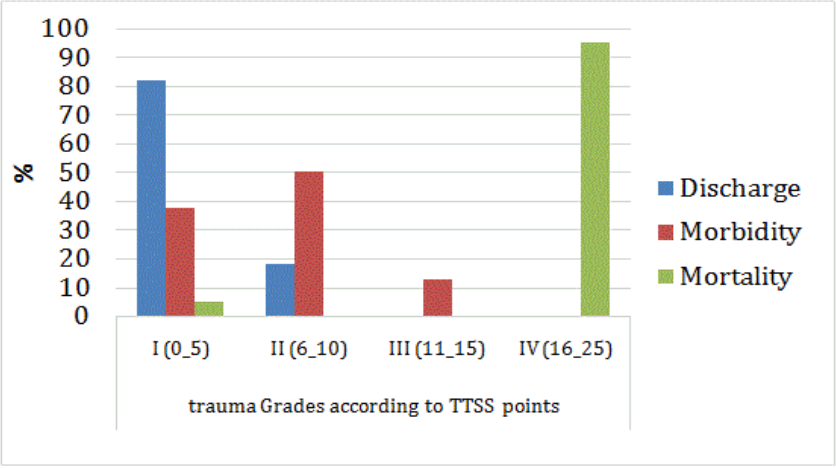

Figure 1: Distribution of patients' outcomes regarding chest trauma grades and TTSS

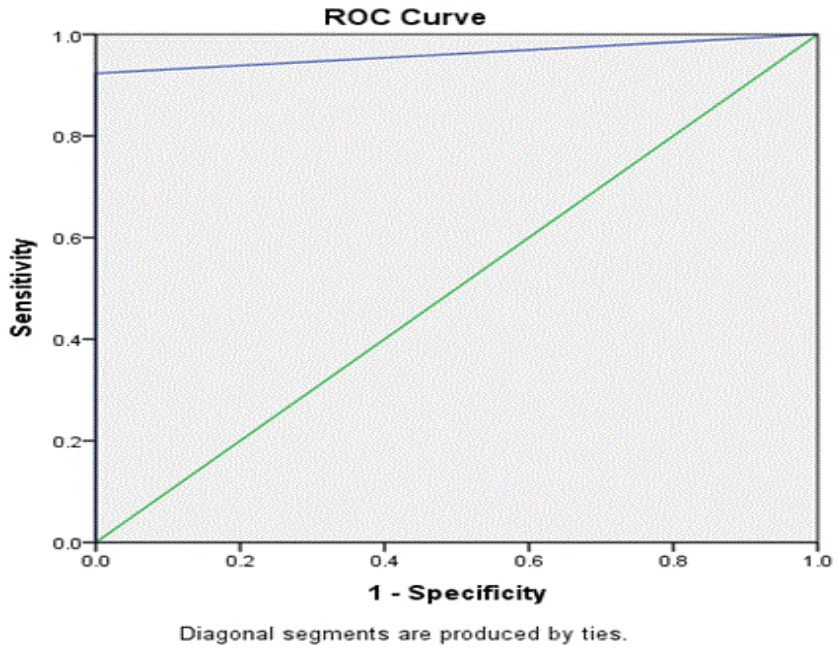

Figure 2: DROC curve findings regarding sensitivity and specificity of the TTSS shows that TTSS when larger than or equal 8 is a good test for prediction of poor outcome as sensitivity of it reaches 92.3% while specificity is 100 %

Discussion

Our study revealed that (32.5%) of the studied patients were less than 30 years old with the mean age 39.8±20.0 years and that (67.5 %) were males, this was matching a study performed in 2016 by Adel Elbaih et al , where the mean age was 40.3±17.24 years ,and 76% were males [11].

In our study, the mean age was 39.8±20.0; there were 108 males (67.5%) and 52 females (32.5%) with male to female ratio ~ 2:1. In 2012, a study was conducted on patients with multiple injuries; the mean age was (42.7±17.0) years: (73%) were males and (27%) were females. It seems that the demographic characteristics of chest injury have remained the same over the years and across geographic regions with male predominance and predominance of young age [12].

Regarding the mechanism of injury, (77.5 %) of cases in our study, road traffic accidents were the cause of injury while other trauma mechanisms accounts only for (22.5%). This was also documented by Gabal et al in 2013, where road traffic accidents were accused for injury in (81.25%), and other mechanisms accounted for (18.75%) [13].

Regarding the characteristics of trauma findings; our study revealed that the Pa02/fi02 ratio was >400 in (27.5%) of cases, it was ranging from 301-400 in (37.5%) of cases, then range from 201-300 in (17.5%) and >200 in (17.5%).Our study showed that a Pa02/fi02 ratio >150 has a significant effect on outcome with a p-value of 0.043. That was somehow related to what Shahzadi et al found in 2014; the ratio was >300 in (43.4%) of cases, 300-400 in (47%) and <400 in (9.6 %) of cases [14].

In our study thoracic bony injuries were mostly in the form of 1 to 3 fractured ribs in (35%) of cases, (27.5%) had no fractured ribs, (17.5%) had unilateral fracture of 3 to 6 ribs, bilateral fracture of more than 3 ribs was found in (7.5%) of cases and (12.5%) had flail chest. This is quiet relevant to what was stated by Shahzadi et al; (37.8%) had 3-6 fractured ribs, (23.8%) of patients were having 1-3 fractured ribs, flail chest was found in (21%) and >3 bilateral fractured ribs in (17.4%) [14].

In our study we found that (42.5%) of cases were free from parenchymal lung injury, (37.5%) had unilateral one lobe contused, (7.5%) had contusion of one lobe bilateral or two lobes unilateral, (5%) had contusion of less than 2lobes bilateral and (7.5%) had bilateral contusion of two lobes or more. This also coincides with what was documented by Shahzadi et al; no contusion was found in (39%) of patients, unilateral 1 lobe was involved in (21%) bilateral 1 lobe in (21%) , less than 2 lobes were contused in (8%) of patients while more than 2 lobes were contused in (11%) of cases with increased mortality rates with bilateral lung contusions [14].

In our study' we noticed that bilateral lung contusion had a significant effect on outcome with a p-value of 0.042. This also coincides with what was documented by Adel et al where bilateral contusion had a P value of 0.04 [11].

During our study we noticed that 95% of cases are free from mediastinal injuries, while 5% only had mediastinal injury in the form of cardiac contusion, aortic injury etc., which are not included in the score despite their obvious effect on outcome as out of those with positive injuries 50% of them died. In 2009, Manuel et al addressed that the mortality rate was 38%

in patients with blunt chest trauma that was diagnosed with pneumomediastinum [15].

Management of the majority of studied patients was conservative in (80%) of cases in the form of tube thoracostomy, pain control and physiotherapy , (15%) intubated and mechanically ventilated , only (5.0%) underwent emergent thoracotomy. That coincides with what Adel at al concluded in 2016 [11].

Also regarding management; our study revealed that the early need for mechanical ventilation has a significant effect on outcome with P value 0.001,as out of 24 cases that needed mechanical ventilation ,16 cases died(75%) and 8 cases(25%) had chest infection , prolonged ventilation and prolonged hospital stay. This also matching the study of Adel et al where the need for early ventilation affected outcome with a P value of 0.028 [11].

On application of the thoracic trauma severity score, (45.6%) of our studied cases scored 0-5, (35%) scored 6-10, (7.5%) scored 11-15 and (11.9%) with a score of 16-25. Low scores were associated with good outcome (discharge or inpatient admission) versus poor outcomes with higher scores (ICU admission and mortality).

After our data analysis, the ROC curve analysis showed that TTSS when larger than or equal 8 is a good test for prediction of outcome as sensitivity of it reach 92.3% while specificity is 100% with 97.5% accuracy with statistically significant p value of 0.001. That meets with the study of Shahzadi et al in 2014, where they assured that there is a significant relationship between predicted outcome and TTSS with p value (0.000) [14].

In 2016, Adel et al, concluded that the ROC curve analysis showed that the TTSS above a score of 7 showed 100% sensitivity and also 100% specificity for predicting the outcome of isolated blunt thoracic trauma patients. the ROC curve analysis, In our study showed that the TTSS above or equal to 8 showed 92.5% sensitivity and also 100% specificity for predicting the outcome of isolated blunt trauma of the thorax [14].

In 2016, Isidro et al concluded that The TTSS is a feasible and appropriate tool to predict the development of morbidity or mortality in a population of thoracic trauma. The area under the curve for TTSS was significant for predicting complications (0.848) and mortality (0.856) values. TTSS with a cut off value of 8 points had a sensitivity of 66% and specificity of 94% to predict complications and 80% sensitivity and 94% specificity for predicting mortality [16].

In 2017, Abo El Nasr et al had a study to compare many trauma scoring systems to assess their morbidity and mortality predictability in chest trauma patients. They concluded that for prolonged hospital stay in blunt thoracic injuries, TTSS score was more predictive [17].

Conclusion

Management for the majority of patients was conservative in the form of tube thoracostomy, pain control and physiotherapy. Some cases needed early intubation and mechanical ventilation, which was also associated with poor outcomes, only small percentage underwent emergent thoracotomy.

Regarding outcomes; the majority of cases were admitted to inpatient ward, another group admitted to ICU and only a small fraction were on two extremes, either discharged from ER or died at ER.

Our study encourages the use of the TTSS for outcome predication in thoracic trauma as higher scores were associated with higher morbidity and mortality. TTSS when larger than or equal to eight is a good test for prediction of poor outcome versus good outcome [17].

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