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Factors Improve Outcome of Penetrating Chest Trauma

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ABSTRACT

Background: Penetrating chest trauma occurs internationally, and numerous studies on it have been found in the literature. Penetrating thoracic trauma (PTT) is a difficult problem, but fortunately most of these injuries can be treated without surgery.

Objective: The current work aimed to evaluate factors that improve outcome of patients of penetrating chest injuries in Al-Azhar University Hospitals.

Patients and Methods: A retrospective investigation conducted on (73) consecutive cases with penetrating chest trauma, mean age was (31.51±6.25) years, patients were divided into (13) patients presented with bullet injury and (60) patients presented with stab wound, Dissension of surgical intervention was done according to clinical examination, emergency laboratory and imaging investigations. Surgical approach depended on position, side, and type of trauma.

Results: Relation between hospital stay and demographic data showed highly statistically significant differences as regard to age, type of trauma, unconsciousness, shock, echo and surgical procedure. Younger patients needed ≤7 days to improve. Also the majority of patients with stab trauma (45 patients out of 60 patients) improved within 7 days. Most of patients with unconsciousness needed >7 days to improve and also patients with repair surgery needed >7 days to improve.

Conclusion: To improve outcome of patient with penetrating chest trauma, effort should be done for resuscitation of patient with early suspicion of danger of trauma with early laboratory and imaging investigation, to reduce the time from the trauma till operation with correction of any metabolic and laboratory abnormalities.

Keywords: Bullet injury, Cardiac injury, Penetrating chest trauma, Stab wound.

INTRODUCTION

The initial assessment of any affected case should begin immediately and systematically. Injuries to the thorax are frequent after blunt as well as penetrating trauma and, consequently, all cases who are admitted to the emergency department (ED) after trauma ought to be monitored for thoracic injury in accordance to the Advanced Trauma Life Support (ATLS) protocols. Fast assessment of the chest is early accomplished in the assessment of the injured case to search for any life-threatening accidents [(1-5)].

Penetrating thoracic trauma (PTT) is a problem encountered, but fortunately the majority of these injuries can be treated without surgery. Chest trauma treatment may be difficult; however, the case is generally rewarding if suitable measures are taken. While PTT diagnosing is generally built on clinically and laboratorial results, diagnosis of hemopneumothorax in PTT via physical examinations alone isn't adequately precise. All cases of PTT need chest radiographs as many of them could have hemopneumothorax. It is commonly approved that the majority PTT cases may be managed via easy measures like chest tube inserting only [(6-9)].

Cardiac injuries continue to increase in line with the steady increase in violence in our society. The majority of penetrating cardiac traumas provide massive and frequent fatal outcomes despite early surgical treatment. A cardiac tamponade is not a rare event with penetrating injuries to the chest, back, and upper abdomen [(10)].

The current work aimed to evaluate factors that improve outcome of patients of penetrating chest injuries in Al-Azhar University Hospitals.

PATIENTS AND METHODS

A retrospective comparative observational randomized cohort single center study was conducted on (73) consecutive adult patients who attended to emergency room with penetrating chest trauma between September 2017 and April 2020 in Al-Azhar University Hospitals.

Ethical consent:

An approval of the study was obtained from Al-Azhar University Academic and Ethical Committee.

We included patients with stab or bullet penetrating injuries who needed emergency thoracotomy or sternotomy, but patients with blunt trauma who needed surgical intervention, or patients needed minor procedures as chest tube insertion or just follow up and patients with associated injuries as head or abdomen were excluded.

All patients underwent emergency resuscitative measures including intravenous line access, emergency lab, X-ray of chest, intravenous colloid replacement to improve intravenous pressure,

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endotracheal intubation in patients of Glasgow coma scale less than 7 and emergency chest tube insertion.

Decision of surgical intervention was done according to clinical examination, emergency laboratory investigations, electrocardiogram, and echocardiography.

Emergency chest x-ray was performed for all stable non shocked cases, which gave background of amount of pleural collection as well as cardiac shadow. Electrocardiogram was done by 12 lead Schiller Devices, Switzerland, and interpreted by emergency team. In our study, there were one stab patient who had anterior and lateral lead ischemia and his echocardiography study confirmed pericardial collection and was transfer immediately to emergency operating room. Transthoracic echocardiography (Philips e33, USA) was done to all patients as emergency diagnosis for positive pericardial and pleural collections.

Surgical approach depended on position, side and type of trauma, all patients of bullet injury (13) underwent right thoracotomy while in stab patients (60) there were three patients (5.0%), fourteen patients (23.3%) and (43) patients (71.7%) underwent left, right thoracotomy and median sternotomy respectively.

After general anesthesia thoracotomy and sternotomy was done with control of bleeder and resuscitation of patient with colloids by anesthestics. One patient of stab group needed cardiopulmonary bypass for coronary artery bypass graft as there were in LAD and diagonal. Then retrosternal and thoracostomy tube were inserted using great saphenous vein using 7/0 and 6/0 proline sutures for distal and proximal anastomosis, respectively.

Other injuries; left, and right ventricular tear were controlled by 4/0 proline with pericardial patch, while intercostal, left internal mammary artery (LIMA) and right internal mammary artery (RIMA) were controlled be clips and silk suture ligation, also lung tear was controlled by 3/0 proline while making sure of absence of any air leak.

All patients were transferred to ICU until they were extubated, and they stayed in ICU until they became stable, then in ward with follow up with postoperative x-ray of the chest and echocardiography. Follow up was performed for all cases one week after discharge for removal of sutures and follow up chest X-ray and echocardiography.

Statistical analysis

The collected data analysis was performed via the windows-based Microsoft Excel and the IBM-SPSS (statistical package for the social sciences). Continuous variables were introduced in the form of mean± SD and categorical variables in the form of frequency and percent. P-value < 0.05 was considered significant. To make a comparison for the means of groups, the Student's t-test was used. X^2 test or Fisher's exact test were utilized to compare categorical variables among groups.

RESULTS

Table (1) demonstrate demographic data for all patients and it shows that the mean of patients age was 30.26±8.190 years and majority of them had stab trauma (82.2%).

Table (1): Study group distribution regarding demographic data

Parameters	N (%)
Age	
Mean±SD	30.26±8.190
Type of Trauma	
Bullet	13 (17.8%)
Stab	60 (82.2%)
Site of Trauma	
Left	40 (54.8%)
Right	31 (42.5%)
Bilateral	2 (2.7%)
Position of Trauma	
Parasternal	35 (47.9%)
Chest	24 (32.9%)
Posterior Axillary line	8 (11.0%)
Anterior Axillary line	4 (5.5%)
Lower sternum	2 (2.7%)
Unconscious	41 (56.2%)
Shock	52 (71.2%)
ECG changes	1 (1.4%)
ECHO	
Moderate Collection	30 (41.1%)
Massive Collection	27 (37.0%)
Massive + Pericardial Collection	16 (21.9%)
Approach	
Thoracotomy	30 (41.1%)
Median Sternotomy	43 (58.9%)
Site of injury	
Lung tear	26 (35.6%)
Intercostal Vessels	17 (23.3%)
LV	16 (21.9%)
LIMA	11 (15.1%)
RV	4 (5.5%)
RIMA	2 (2.7%)
Distal	2 (2.7%)
LAD	1 (1.4%)
Surgical Procedure	
Repair	43 (58.9%)
Ligation	29 (39.7%)
Coronary artery bypass grafting (CABG)	1 (1.4%)
Need to cardiopulmonary bypass (CPB)	1 (1.4%)

Comparison between pre- and postoperative showed highly statistically significant differences as regard to Hb, mean arterial blood pressure, heart rate and blood loss as shown in table (2).

Table (2): Comparison between pre- and postoperative as regard to vital sign and blood loss

	Preoperative	Postoperative	P Value
Hb	7.58± 0.999	10.88± 0.912	<0.001*
Mean Arterial Blood Pressure	60.41± 10.920	89.01± 5.448	<0.001*
Heart rate	124.11± 7.423	86.30± 4.861	<0.001*
Blood Loss	1984.93± 406.773	189.73± 62.893	<0.001*
Blood Transfusion	2205.48± 730.466	---------	

Postoperative data and hospital stay are demonstrated in table (3).

Table (3): Postoperative data of the studied patients

Ventilation time (hours)	8.18±1.593
ICU stay (days)	2.90±0.900
Hospital Stay (days)	6.66±1.356

Relation between hospital stay and demographic data showed highly statistically significant differences as regard to age, type of trauma, unconscious, shock, Echo and surgical procedure. Younger patients needed ≤7 days to improve. Also the majority of patients with stab trauma (45 Patients out of 60 patients) improved within 7 days. Most of patients with unconscious need >7 days to improved and also patients with repair surgery needed >7 days to improved (Table 4).

There was no mortality in all patients during this study within hospital follow up of patients.

Table (4): Relation between hospital stay and demographic data

	Hospital Stay		P Value
	≤7 (n=47)	>7 (n=26)	
Age	28.34±7.257	33.73±8.766	<0.006*
Type of Trauma			
Bullet	2 (4.3%)	11 (42.3%)	<0.001*
Stab	45 (95.7%)	15 (57.7%)	
Site of Trauma			
Left	23(48.9%)	17(65.4%)	
Right	22(46.8%)	9(34.6%)	0.284
Bilateral	2(4.3%)	0(0%)	
Position of Trauma			
Parasternal	21(44.7%)	14(53.8%)	
Chest	12(25.5%)	12(46.2%)	
Posterior Axillary line	8(17.0%)	0(0%)	0.037*
Anterior Axillary line	4(8.5%)	0(0%)	
Lower sternum	2(4.3%)	0(0%)	
Unconscious	15(31.9%)	26(100%)	<0.001*
Shock	26(55.3%)	26(100.0%)	<0.001*
ECG changes	1(2.1%)	0(0%)	1.000
ECHO			
Moderate Collection	30 (63.8%)	0(0%)	
Massive Collection	14 (29.8%)	12(46.2%)	<0.001*
Massive + Pericardial Collection	3 (6.4%)	14(43.8%)	
Approach			
Thoracotomy	18 (38.3%)	12(46.2%)	0.621
Median Sternotomy	29 (61.7%)	14(53.8%)	
Site of injury			
Lung tear	14 (29.8%)	12(46.2%)	0.205
Intercostal Vessels	17(36.2%)	0(0%)	<0.001*
LV	2 (4.3%)	14 (53.8%)	<0.001*
LIMA	11 (23.4%)	0(0%)	0.006*
RV	6(12.8%)	0(0%)	0.083
RIMA	2(4.3%)	0(0%)	0.535
Distal	2(4.3%)	0(0%)	0.535
LAD	1(2.1%)	0(0%)	1.000
Surgical Procedure			
Repair	19(40.4%)	26(100%)	
Ligation	27(57.4%)	0(0%)	<0.001*
CABG	1(2.1%)	0(0%)	
Need to CPB	1(2.1%)	0(0%)	1.000

DISCUSSION

Chest trauma is a major cause of morbidity and death in adults as well as children. It is a leading cause of death in 25% of multiple trauma cases, and when it is accompanied by other damage, the proportion rises to 50% [(11)]. Regardless of the mechanisms, the main consequences of chest trauma are the collective effects on respiratory function as well as cardiovascular function, leading to hypovolemia, hypoxia and reduced cardiac output through direct effects on the chest organs [(12)].

Penetrating chest trauma happens universally, and several accounts of it were stated in literatures. Blunt trauma is infrequently accompanied with military or civilian violence, although penetrating chest trauma frequently is. Penetrating chest trauma is usually the result of gunshot and non-gunshot accidents such as traffic accidents, stabs, and impalements [(13)].

Analysis of our findings revealed that the mean of patient's age was 30.26±8.190 years and majority of them had stab trauma (82.2%), 54% was in left side, 47% was parasternal, 56.2% were unconscious, 71.2% were shocked, 58.9% were approached by median sternotomy, one patient needed CABG and one patient needed CPB. In agreement with our findings, the study of **Ekpe and Eyo** [(14)] which was conducted on 149 cases with thoracic trauma, 40% of them satisfied the criteria of inclusion of the unit workload. There were 121 male and 28 female (81.2% versus 18.8%; males: females = 4:1) with ages ranging between 7 to 76 years (mean: 37.42 years) and around 55% had ages of 45 years or younger, while there were more blunt trauma in comparison with penetrating trauma (65.1% versus 34.9%). Another study of **Robison *et al.*** [(15)] reported that out of 30 cases, 23 (76.7%) cases were <45-years, 5 (14.7%) were ranging from 45 to 65 years and residual 2 (6.7%) cases were greater than 65 years. The mean ± SD age of the cases registered with isolated chest trauma was 34.50 ± 15.861-yrs. Out of 30 cases, 26 (86.7%) were males and 4 (13.3%) were females. Also, the study of **Thomas and Ogunleye** [(13)] was conducted on 168 cases with penetrating chest injury, Minor chest injuries (those that penetrated the chest wall only) were in 49 patients (29.2%). The cases consisted of 142 male and 26 female, with a ratio of 5.5:1. The ages ranged between 4 and 66 years. Of the injuries, 101 injuries were from gunshot and 67 injuries were non-gunshot, Injuries continued throughout an armed robbery were 77 (76.2%) of the gun-shot injuries. Car accidents were 46 (68.7%) out of the non-gunshot injuries, those who had gunshot had the uppermost scoring of injury severity. Thoracotomy was made in 27-cases (16.1%) and 124-cases (73.8%) were managed with chest tube inserting only.

In the current study, comparison between pre- and postoperative findings showed highly statistically significant differences as regard to Hb, mean arterial blood pressure, heart rate and blood loss. **Lema *et al.*** [(16)] reported that bleeding after locating the primary chest tube in cases experiencing surgery for non-mediastinal chest injury are presented in Table III. Significantly, chest tube drainage wasn't suitable as a predictor of injury severity in those cases needing surgery, nor was it a sign of organ systems injuries in this work, while cases with high blood losing frequently had hilar injuries, some injuries of chest wall, however, as well were accompanying with high bleeding.

Moreover, in the present study; postoperative data showed that ventilation time had a mean value of 8.18±1.593 hours and ICU stay had a mean value of 2.90±0.900 days while hospital stay had a mean value of 6.66±1.356 days. In comparison, the study of **Robison *et al.*** [(15)] reported that a significant change was found among the studied groups in ICU admission (P = 0.013). Only 17.9% of penetrating trauma cases were welcomed in the ICU in comparison with 44.4% of blunt trauma patients. A highly significant change was detected between both groups in ICU stay (P = 0.009) as, in the blunt trauma group, ICU stay was 2.74 ± 5.59 days in comparison with 0.36 ± 0.91 days reported for the group with penetrating trauma.

Lema *et al.* [(16)] unsuccessful to discover postponement in presentations of cases who prolonged chest injuries to the hospital beyond 24-h to influence length of stay (LOS) in ICU and death but still supposed that it does due to the existence of complications was reported to impact both LOS and death. Also, this study and others have concluded complications rate to be straightly correlated with postponement in presentations[(17)].

Total, the mean ICU staying was 7.31± 6.3 days with a median of 5-days (ranging between 0 and 35-days). Mean hospitalization period was 10.09 ± 8.18-days with a median of 8-days (ranging between 0 and 68-days).

Hospital death rate for isolated chest injuries were recorded to vary from 4% to 8 %, which increased to be 13% to 15 % when one more organ system was included and to 30% to 35 % when multi organ system was included [(18)]. **Lee *et al.*** [(19)] concluded the death rate as 1.8 % in all cases with blunt trauma chest.

In a systematic review and meta-analysis of **Battle *et al.*** [(20)] the 3 main risk-factors for death in blunt chest trauma were of ages >65-yrs, 3 or more rib fractures and existence of preexisting disorders, particularly cardiopulmonary disorder. It is quite obvious from many investigations that old people have higher death and morbidity subsequent to thoracic injuries in comparison with young aged group.

Instant and accurate evaluation of the severity levels in thoracic trauma is vital for quick and right treatment, to predict outcomes, complication and necessity of intensive care and as well clarify prediction to cases and relatives. If the evaluation of the chest trauma severity is reliable and uniform built on standard system of scoring, sorting and triage could be performed rapidly and application of management protocol will be rapid in the room of emergency [17].

Relation between hospital stay and demographic data showed highly statistically significant differences as regard to age, type of trauma, unconscious, shock, Echo and surgical procedure. Younger patients needed ≤7 days to improve. Also the majority of patients with stab trauma (45 Patients out of 60 patients) improved within ≤7 days. Most of patients with unconscious needed >7 days to improve. Also patient with repair surgery needed >7 days to improve. This is in agreement with the study of **Ekpe and Eyo** [14] in which outcomes analysis was done via 7-parameters of ages, gender, chest trauma kind, existence of accompanied injuries, period lapse between injuries and presentations, on-admission modified early warning score (MEWS) scoring and injury severity built on the number of sides of chest included in the injury. As non-dependent parameters, ages, gender and chest injury kind didn't show to be connected to death with P-values of 0.468, 1.000 and 1.000 respectively. But, existence of accompanying extra thoracic organ injuries, high on-admission MEWS scoring > 9, late presentations with injuries to presentations period longer than a day, and severe chest injury as described by bilateral chest involvement connected positively with death with P-values of 0.0003, 0.0001, 0.0293 and 0.0236 respectively.

In addition to above findings, we found that there was no mortality in all patients during this study within hospital follow up of patients. Similar to our findings, **Alam El-Din *et al.*** [21] reported that no mortalities were recorded in the penetrating chest trauma group, whereas in the blunt trauma group, five (6.9%) patients passed away, 59 (81.9%) were discharged after intervention, and eight (11.1%) were not admitted as no admission was required. In terms of mortality, four patients had traumatic brain injury and one had massive bilateral lung contusions.

Huber *et al.* [22] investigated poor outcomes predictors after vital chest trauma in multi-injury cases; they reported rib fractures in 11 475 (51%) patients involving 35% rib fractures (7794 patients), 16% flail chest (3681 patients), which is in agreement with the current work results. Among 37 (51.4%) patients, 36.1% had multi rib fractures, 12.5% had flail chest, and 2.8% single rib fractures.

Kessel *et al.* [23] reported that death rate of rib fracture cases was frequently impacted by the existence of additional thoracic injury. This result is in contrast to **Saaiq and Shah** [24] who found four patients of traumatic diaphragmatic ruptures; all were because of blunt trauma. Associated injuries in the **Ekpe and Eyo** [14] study were 25.5% of patients and were positively correlated with mortality ($P = 0.0003$).

To decrease the incidence of penetrating chest trauma in Egypt, our results revealed that the Egyptian public and their property require better safety. The pre-hospital levels of care for trauma sufferers and facilities at the secondary and tertiary hospitals requires improvements as well.

The current work has restrictions; retrospective statistics were utilized. This study was prone to selective bias and, generally, are more appropriate for improving study queries instead of replying scientific queries. Secondly, the analysis of cases was done in only one facility. Third, the cases number of the study is limited. Since we detected only 73 events, the consequences gotten with our multi-variate model may be non-stable. A further multi-center studies are wanted to approve with our results.

CONCLUSION

To improve outcome of patient with penetrating chest trauma, effort should be done for resuscitation of patient with early suspicion of danger of trauma by site of stab and inlet of bullet and early laboratory and imaging investigation, to reduce the time from the trauma till performing operation, and at the same time correction of any metabolic and laboratory abnormalities.

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