Single center experience of war-related thoracic injury in Syria

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Research

Keywords: Syrian civil war, War Surgery, Thoracic Trauma

Posted Date: May 26th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-29682/v1>

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Abstract

Background: The Syrian civil war caused serious deaths and injuries. Thoracic surgery has shown its effectiveness in this war as it is a war surgery. In this study, we analyzed war related chest trauma patients to describe the profile of chest trauma, determine the predictors' morbidity and mortality.

Methods: From 2012 to 2017, 47 consecutive patients underwent surgical treatment for chest trauma at the Gaziantep University Sahinbey Research and Practice Hospital, in Turkey. The demographic and relevant clinical information were retrospectively collected from the hospital records. Data included mechanism of injury, gender, and age, findings, treatment modality complications, and length of hospital stay, morbidity and mortality. Injuries were classified as penetrating (gunshot or shrapnel wounds) and blunt injuries.

Results: The average age of patients was 25.4 years (range, 4 to 43 years) and 40 patients were males (85%). Sadly, 6 patients were under 18 years old. There were 41 patients (%87,2) penetrating and 6 patients (%12,8) blunt injuries. The most penetrating injuries of the chest were caused by shrapnel (61,7%). Eleven patients had already had emergency thoracotomy in another hospital before admission. As multiple diagnoses, there were 50 (45,45%) pneumothorax, hemothorax, or both in patients. However, there were 26 (23,64%) lung contusions in patients. No surgery-related deaths or major morbidity occurred. One patient died 35 days after admission; the causes of death in this patient included bronchobiliary fistula, hypovolemic shock, and sepsis. So, all cases mortality rate was 2,13%.

Conclusion : Intervention in thoracic trauma patients is life-saving and satisfying compared to other system injuries. War surgery is a multidisciplinary approach, which is vital.

Background

The Syrian civil war caused serious deaths and injuries. Thoracic surgery has shown its value in this war. Necessary interventions and treatments were carried out on patients from neighboring Syria, which has deficiencies in terms of equipment.

Thoracic trauma is a major cause of morbidity and mortality in urban trauma centers [1]. Trauma is known to be the leading cause of death in the first four decades of life [1]. Thoracic traumas constitute a significant part of trauma-related deaths, but when all trauma numbers are considered, it is in the third place after cranium and limb traumas [2]. Chest trauma is the commonest cause of traumatic death in the United States after head trauma, accounting for approximately 20% of deaths [1, 3]. Thoracic trauma includes injury to the chest wall, tracheobronchial tree, lungs, diaphragm, esophagus, heart, and great vessels. The overall profile of chest injuries varies widely between different centers [4]. Most chest trauma can be managed without thoracotomy [5]. Aggressive management of the pulmonary system along with prompt treatment of associated injuries is essential for optimal patient outcome [6].

War-related trauma is surely challenging to study, because patients may have severe injuries in remote and inappropriate environments. The Global War on Terror, notably Operation Iraqi Freedom and Operation Enduring Freedom, has generated large amounts of data. During the war, injuries occur mostly with high-energy weapons, bombs, and fragmentation bombs. Considering that the main aim of these

weapons is to kill, the severity of the injuries in the war can be estimated. While most of the injuries that occur in such war environments result in death, survival of patients who reach the hospital right with proper treatment is a fight against the weapon produced to kill. In a study of military emergency departments in Iraq and Afghanistan from January 2007 to August 2016, the most common mechanism of injury was explosives (55.3%), followed by gunshot wounds (23.6%) [7]. In these patients, hemorrhage was the most frequent cause of death, followed by compromised airway. In a study examining battlefield fatalities from October 2001 to June 2011, torso hemorrhage accounted for 61.2% of 976 preventable deaths [3]. During war of Iraqi, thoracic injury occurred in 10% of casualties and the related mortality was around 10% [8].

In this study, we analyzed war related 47 chest trauma patients presenting to the Gaziantep University Sahinbey Research and Practice Hospital to describe the profile of chest trauma, determine the predictors morbidity and mortality.

Methods

Data Analyses

From 2012 to 2017, 47 consecutive patients underwent surgical treatment for chest trauma at the Gaziantep University Sahinbey Research and Practice Hospital, in Turkey.

The demographic and relevant clinical information were retrospectively collected from the hospital records. Data included mechanism of injury, gender, and age, findings, treatment modality complications, and length of hospital stay, morbidity and mortality.

Injuries were classified as penetrating (gunshot or shrapnel wounds) and blunt injuries. Diagnosis classified as Contusion of lung, Injury of blood vessels of thorax (including thoracic aorta), Injury of heart (pericardial), Traumatic pneumothorax, Traumatic hemothorax, Injury of thoracic trachea, Injury of Diaphragm, Injury of Lymphatic thoracic duct, Injury of Esophagus (thoracic part), Injury of brachial plexus.

Management

The initial management of the trauma patients was carried out in the emergency room. The Advanced Trauma Life Support protocol was followed for all patients. The primary and secondary surveys were performed. Most patients had lateral cervical spine, pelvic, and chest radiographs. Computed tomographic scanning of the head, abdomen, and chest; ultrasonography; echocardiography; bronchoscopy; and esophagoscopy were performed as indicated. The orthopedic, neurosurgical, abdominal, or chest surgical interventions were performed when indicated.

The operation (if required) was performed in a under general anesthesia using a single/double lumen endotracheal tube. Chest tubes were removed after a 24-hour period with no air leak, less than 150 mL of fluid discharge, and a complete expansion of the lung.

Statistical analysis

Continuous variables such as age, length of hospitalization were expressed as mean $\pm$ standard deviation and analyzed by the two-sample *t* test. All statistical analyses were performed with SPSS 25 for Windows. Approval was obtained from the respective institutional review boards before commencing the study.

Results

The average age of patients was 25.4 years (range, 4 to 43 years) Eleven patients had already had emergency thoracotomy in another hospital before admission. The goal of these patients' surgery was hemorrhage control due to hemothorax and great vessel injury 40 patients were males (85%). Sadly, 6 patients were under 18 years old.

The Mechanisms of Injury in patients are shown in table 1. There were 41 patients (%87,2) penetrating and 6 patients (%12,8) blunt injuries (Table 1). The most penetrating injuries of the chest were caused by shrapnel (61,7%)

The number of each Thoracic Trauma injuries seen in patients is shown in table 2. As multiple diagnoses, there were 50 (45,45%) pneumothorax, hemothorax, or both in patients. There were 26 (23,64%) lung contusions, 4 (3,64%) Injury of thoracic trachea, 4 (3,64%) Injury of Esophagus, 5 (4,55%) Injury of blood vessels of thorax (including thoracic aorta), 6 (5,45%) all chest wall trauma, 3 (2,73%) Injury of heart (Pericard), 7 (6,36%) Parenchyma Laceration, and the remaining (diaphragmatic injuries, Injury of brachial plexus, Bronchopleural fistula, Injury of Lymphatic thoracic duct and Broncho biliary fistula) are 1% (0,91%) in patients (Table 2).

The management of 47 cases of chest injury is shown in table 3. 15 (24,19%) patients had Foreign body removal (bullet or shrapnel). 13 (20,97%) patients required conservative treatment. Lung parenchyma repair surgery was performed on 7 (11,29%) patients. Chest wall reconstruction was done for 6 (9,68%) patients. Great vessel repair was done for 5 (8,06%) patients. Chest tube alone (6,45%), Esophagus repair (6,45%), Trachea resection (4,84%), Pericardial window opening (4,84%), Diaphragm rupture repair (1,61%) and Ductus thoracicus ligation (1,61%) was performed in 1 patients (Table 3). Thoracotomy was required in 11 cases. VATS was successfully performed in 1 patient with shrapnel near the aorta. Bronchoscopy was done in only 1 patient due to gunshot bullet in the main bronchus.

Complications of chest injuries in patients are shown in table 4. Late complications of the initial injury or subsequent treatment occurred in only 4 cases (%8,5). Two cases with prolonged air leak and were cured with conservative treatment. 1 case with tracheoesophageal fistula was cured with esophageal and tracheal stent. 1 case with mediastinitis was cured with drainage and medical treatment (Table 4). Average length of hospitalization was at 12 days.

No surgery-related deaths or major morbidity occurred. One patient died 35 days after admission; the causes of death in this patient included bronchobiliary fistula, hypovolemic shock, and sepsis. Thereby, all cases mortality rate was 2,13%.

Discussion

In our study, we report our war-related thoracic injury experience with patients surgical treatment blunt and penetrating chest injuries.

Thoracic injuries are among the most severe forms of trauma and a leading cause of morbidity and mortality centers [1]. Some patients sustain severe solitary or multiple injuries and arrive at the hospital in an unstable status. After a meticulous clinical and imaging evaluation, some of those patients require early surgical intervention to complete the investigation or to treat the intrathoracic injury. In the literature, tube thoracotomy and exploratory thoracotomy were the only therapeutic modalities [9]. Kandahar et al. [4] In 1354 disease studies that applied to the emergency trauma center in 2007, only cases thoracotomy was applied to 18%. The number of patients undergoing thoracotomy was reported as 2.6% [10]. In our study, Thoracotomy was required in 11 cases (23,4%).

Thoracic trauma is a notable cause of morbidity and mortality in American trauma centers, where 25% of traumatic deaths are related to injuries sustained within the thoracic cage [4]. These data and a review of the literature confirm that in patients with chest trauma. We strongly believe that in the modern management of trauma, these death rates will be reduced with new applications.

Patients who develop hemopneumothorax after chest trauma are followed up after tube thoracotomy. In case of an increase in hemothorax or pneumothorax and meeting the criteria of emergency thoracotomy, the patient is treated with thoracotomy [11, 12]. In our study, 50 (45,45%) patients had pneumothorax, hemothorax, or both. We also operated patients with emergency thoracotomy indication after chest tube application.

Most authors agree that patients with the best outcomes are those with the following features: isolated chest injury; single versus multiple chest injuries; penetrating rather than blunt mechanism; stab wounds rather than gunshot wounds; vital signs on presentation; and prehospital intubation [4, 13]. In our study, There were 41 patients (%87,2) penetrating and 6 patients (%12,8) blunt injuries. The most penetrating injuries of the chest were caused by shrapnel (61,7%). Eleven patients required emergency thoracotomy in the operation room other hospital before admission. The goal of these patients' surgery was hemorrhage control due to hemothorax and great vessel injury.

Several previous studies have also suggested that thoracotomy in the OR (operation room) results in better outcome, although this is clearly related to patient selection [4, 6]. Finally, varying definitions of what constitutes an "ER (emergency room) resuscitative thoracotomy" as well as differences in patient populations and prehospital systems confound generalizations [14, 15].

The most common chest injuries identified were pneumothorax, pulmonary contusion, and chest wall trauma (including rib fractures). This pattern agrees with the Proppe et al. report [16]. The goals of this study were to determine the incidence and mortality of combat-related thoracic trauma (CRTT) and identify factors associated with mortality. We conclude that most chest injury patients can be managed conservatively with observation and tube thoracotomy. In our series, 23,4% percent of the injuries were treated successfully by either single or double tubes. Minimal pneumohemothorax was treated by close observation, repeated chest X-ray films and antibiotics. However, Foreign body removal (bullet or shrapnel) was done 15 (24,19%) patients. 13 (20,97%) patients required conservative treatment. Lung parenchyma repair was done 7 (11,29%) patients. Chest wall reconstruction was done 6 (9,68%) patients. Great vessel repair was done 5 (8,06%) patients. Chest tube alone (6,45%), Esophagus repair (6,45%), Trachea resection (4,84%), Pericardial window opening (4,84%), Diaphragm rupture repair (1,61%) and Ductus thoracicus ligation (1,61%) was done in patients. Late complications of the initial injury or subsequent treatment occurred in only 4 cases (%8,5). Two cases with prolonged air leak and were cured with conservative treatment. 1 case with tracheoesophageal fistula was cured with esophageal and tracheal stent. 1 case with mediastinitis was cured with drainage and medical treatment (Table 4). Average length of hospitalization was at 12 days. No surgery-related deaths or major morbidity occurred. One patient died 35 days after admission; the causes of death in this patient included bronchobiliary fistula, hypovolemic shock, and sepsis. So, all cases mortality rate was 2,13%.

Conclusion

The most battle casualties with chest injuries may be treated by simple tube drainage of the pleural cavity. Thoracotomy is indicated for severe bleeding, damage to the chest wall and injuries to the heart and esophagus. Restriction of liquid intake, diuretics and corticosteroids is a useful method of treating selected simple cases of flail chest. However, intervention and referral to patients with thoracic trauma during the war should be fast and effective. Intervention in thoracic trauma patients is life-saving and satisfying compared to other system injuries. War surgery is a multidisciplinary approach, which is vital.

Abbreviations

TOF: Tracheoesophageal fistula

OR: Operation room

ER: Emergency room

Declarations

Acknowledgements

None.

Authors' contributions

AU, AFI had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis; IET, MS had analyzed and interpreted data of this study. All authors agreed with the results and conclusions of this article. All authors read and approved the final manuscript.

Funding

None.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on request.

Ethical approval

Ethical approval was obtained from Gaziantep University Clinical Research Ethical Committee (Approval no: 2020/157) and all steps of the current study were conducted according to the principles put forth by the Helsinki Declaration and Good Clinical Practice guidelines.

Consent for publication

Not applicable.

Competing interests

The authors declared no conflicts of interest.

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Tables

Table 1 Mechanisms of Injury in patients

Dominant Mechanism	Incidence Rate (%)
Penetrating Trauma	41 (%87,2)
Shrapnel	29 (%61,7)
Gunshot wound	12 (%25,5)
Blunt Trauma (due to explosion)	6 (%12,8)

Table 2 Rates of Thoracic Trauma Types in Patients

Diagnosis (ICD 11)	N	%
Traumatic pneumothorax	28	25,45
Traumatic hemothorax	22	20,00
Contusion of lung	26	23,64
Injury of thoracic trachea	4	3,64
Injury of Esophagus (Thoracic part)	4	3,64
Injury of blood vessels of thorax (including thoracic aorta)	5	4,55
Injury of Diaphragm	1	0,91
Injury of heart (Pericard)	3	2,73
All chest wall trauma	6	5,45
Injury of brachial plexus	1	0,91
Bronchopleural fistula	1	0,91
Injury of Lymphatic thoracic duct	1	0,91
Parenchyma Laceration	7	6,36
Bronchobiliary fistula	1	0,91
Total*	110	100

*Some patients have multiple diagnoses.

Table 3 Management of 47 cases of chest injury.

Procedure	N	%
Foreign body removal <bullet or shrapnel>	15	24,19
Conservative treatment	13	20,97
Lung parenchyma repair	7	11,29
Chest wall reconstruction	6	9,68
Great vessel repair	5	8,06
Chest tube alone	4	6,45
Esophagus repair	4	6,45
Trachea resection and reconstruction	3	4,84
Pericardial window opening	3	4,84
Diaphragm rupture repair	1	1,61
Ductus thoracicus ligation	1	1,61
Total	62	100

Table 4 Complications of chest injuries in patients.

Complication	No. of cases	Treatment
Prolonged air leak	2	Conservative treatment
TOF (Tracheoesophageal fistula)	1	Esophageal and tracheal stent
Mediastinitis	1	Drainage and medical treatment