

Institutional report - Thoracic non-oncologic Comprehensive analysis of 4205 patients with chest trauma: a 10-year experience[☆]

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Abstract

Thoracic trauma is one of the leading causes of morbidity and mortality in developing countries. In this retrospective study, we present our 10-year experience in the management and clinical outcome of 4205 cases with chest trauma associated with blunt and penetrating injuries in a level I trauma hospital in Turkey. In 66% of the cases, blunt injury mostly related to traffic accidents was the cause of chest trauma. Additional organ injuries were found in 35% ($n=1471$). Conservative treatment was administered for most patients. Tube thoracostomy was administered in 40% of all cases, whereas thoracotomy was performed in 6% ($n=252$), of which 209 were early interventions ($P=0.001$). The morbidity rate in all victims was 25.2%. The mortality rate was 9.3% for all patients and was 6.8% in blunt, 1.4% in penetrating, and 17.7% in associated organ injuries. Mortality and injury severity score (ISS) increased in patients having early surgery ($P=0.001$). Although most patients could be managed with conservative approaches, early thoracotomy was required in some cases. We believe that urgent hospital admission, early diagnosis, and multidisciplinary approach are very important to improve outcome. © 2009 Published by European Association for Cardio-Thoracic Surgery. All rights reserved.

Keywords: Chest trauma; Blunt injury; Penetrating injury; Thoracotomy

1. Introduction

Thoracic trauma associated with blunt or penetrating injury is a major cause of hospitalisation in the world and is associated with a mortality rate ranging from 15 to 77% [1]. Thoracic trauma comprises 10–15% of all traumas and represents 25% of all fatalities due to trauma [2]. The incidence of trauma varies, and relatively higher numbers of chest injuries are observed in some regions. This obviously allows the casualty teams in those centres to experience different presentations and life-threatening conditions related to chest injury. Our hospital is a level I trauma centre and teaching hospital in Istanbul, Turkey, a city with a population of 12 million. Since our facility covers a large region and is located near an important motorway, the incidence of chest injury is relatively higher than at other centres in nearby areas. In this retrospective study, we present our 10-year experience in the management and clinical outcome of chest trauma associated with blunt and penetrating injuries.

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2. Patients and methods

Between January 1998 and January 2008, 4205 victims with chest injury were admitted to the emergency department of our hospital. The records of all patients were reviewed and data were collected retrospectively. The demographic features, type of the trauma, injury severity score (ISS), clinical and radiological findings, associated organ injuries, management of the pathologies, surgical interventions, morbidity, and mortality were analysed.

In the emergency department, the hospital triage doctor, who was a specialist in emergency medicine, first assessed the victims, and patient priority for admission to the emergency room and for treatment was determined. Patients presenting with hypotension, massive blood loss, or disabling dyspnoea were evaluated immediately on admission. Patients were referred to the thoracic surgeon as soon as possible whenever needed. The ISS was calculated for all patients.

Thoracic pathologies requiring a chest tube insertion were diagnosed on physical examination; chest X-rays were taken on admission and chest CT imaging was performed in severe injuries or in the late course of a hospital stay. Chest-tube insertion was performed in patients with pleural complications and in those with severe subcutaneous emphysema and prominent dyspnoea, even if there was no evidence of pneumothorax in the chest X-ray. Thoracotomy was performed if the initial chest tube output was >1500 ml or

the hourly output was 200 ml for 4 h. For purposes of our study, thoracotomies performed within 4 h of admission were recorded as 'early', while thoracotomy performed after 4 h was termed 'late'.

This is a descriptive study. Statistical calculations were performed using the GraphPad Prisma V.3 program for Windows (GraphPad Software, Inc, La Jolla, CA, USA). All values were expressed as mean \pm S.D. A $P < 0.05$ was considered significant.

3. Results

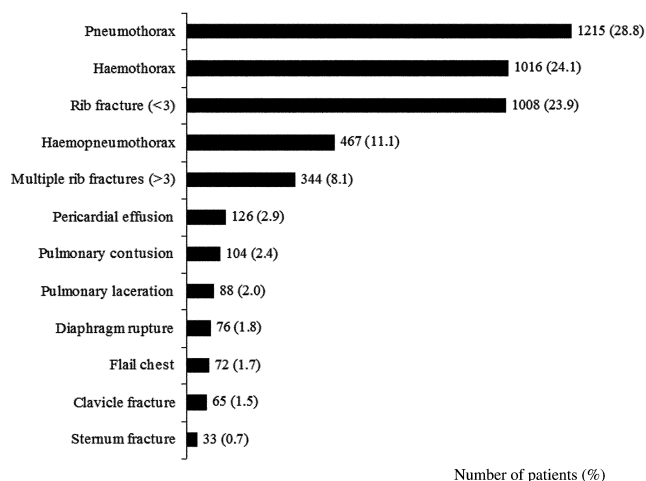
There were 3575 male (85%), and 630 female (15%) patients, and the mean age was 36.2 years (range, 1–89 years). Blunt and penetrating injuries were documented in 2775 (66%) and 1430 (34%) patients, respectively (Table 1). No patients were identified as having both major blunt and penetrating injuries. Associated organ injuries were observed in 1471 cases (35%). Traffic accidents were the leading cause of blunt injury, while stab wounds were the most common type of injury in penetrating trauma. Mean ISS was 16.6 ± 7.4 in blunt, 12.7 ± 2.9 in penetrating, and 18.0 ± 5.5 in associated organ injuries. Of the patients, 2229 (53%) were hospitalised with a mean hospital stay of 9.2 days, ranging from 1 day to 24 days; 12.6 days in blunt, 7.1 days in penetrating, and 15.3 days in associated injury.

Chest wall pathologies presented in 36.1% of cases in this series (Fig. 1). Rib fractures were diagnosed in 1424 patients, of which 1008 (23.9%) had one or two rib fractures and 344 (8.1%) had more than two rib fractures. Clavicle ($n=65$) and sternum ($n=33$) fractures were detected less commonly. Pleural complications were noted in 2698 patients (64.1%). In total, 64.1% of patients with thoracic trauma needed tube thoracostomy in our series. This represented 28.2% of patients with blunt trauma and 73.6% of those with penetrating trauma. Pulmonary contusion and laceration were diagnosed in 104 and 88 patients, respectively. Flail chest was diagnosed in 72 patients (1.7%), and all were followed in the intensive care unit (ICU); surgical fixation was not applied. Seventy-six diaphragm ruptures (1.8%) were discovered either at the time of admission to the hospital ($n=22$; 28.9%), late in their stay, or after discharge from the hospital ($n=54$; 71.1%). In most cases, repair of the diaphragm was performed via thoracotomy, while 14 underwent laparotomy in the follow-up period.

Tube thoracostomy was performed in 1934 patients (46%). Thoracotomy was performed in 255 cases (6%), of which 209 (4.9%) were designated as early, and 46 (1.1%) were designated as late ($P=0.001$). The most common indication

Table 1
The causes of chest injury

	Causes	Number of patients (%)
Blunt injury ($n=2775$, 66%)	Traffic accidents	1998 (47.5)
	Criminal activity	417 (9.8)
	Falls	222 (5.2)
	Occupational	138 (3.2)
Penetrating injury ($n=1430$, 34%)	Stab wounds	1001 (23.8)
	Gunshot wounds	315 (7.4)
	Foreign body	114 (2.7)



Number of patients (%)

Fig. 1. Clinical and radiological findings.

for early thoracotomy was intrathoracic haemorrhage. Table 2 shows thoracotomy findings. Lobectomy and pneumectomy were performed in only 71 (1.6%) and 48 (1.1%) cases, respectively. Of these cases, 17 had re-exploration due to prolonged air leakage.

The overall morbidity rate in the management of chest trauma in our series was 25.2% (Table 3). Atelectasia was the most common morbidity, with an incidence of 14.6% in all cases. On the other hand, in associated injuries, adult respiratory distress syndrome (ARDS) developed in 9.3% of patients as a secondary morbidity after atelectasia. Only 211 cases (5%) were followed-up in the ICU, and 109 (2.6%) needed mechanical ventilation.

In this series, mortality rate in all patients was 9.3% (Table 4). Respiratory failure was the most common reason for mortality (63.5%). There were significant differences between the mortality rates of blunt and penetrating injuries ($P=0.001$) as well as between 'pure thoracic' and thoracic with associated organ injury groups ($P=0.001$). The mortality rate and ISS was significantly higher in patients who underwent early thoracotomy (Table 5).

4. Discussion

Thoracic trauma is still a major cause of hospitalisation in civil populations. Although the ratio may change according to the social and economical conditions of the popula-

Table 2
Thoracotomy findings

	Blunt	Penetrating	P	Total
Pulmonary laceration	37 0.88%	99 2.35%	<0.05	136 3.23%
Cardiac injury	8 0.19%	74 1.76%	<0.001	82 1.95%
Diaphragm rupture	56 1.33%	20 0.47%	<0.001	76 1.80%
Intercostal vessel injury	13 0.31%	2 0.04%	NS	15 0.35%
Bronchial rupture	8 0.19%	3 0.07%	NS	11 0.26%
Fibrinous haemothorax	5 0.12%	3 0.07%	NS	8 0.19%
Tracheal laceration	4 0.09%	3 0.07%	NS	7 0.17%
Oesophageal rupture	4 0.09%	1 0.02%	NS	5 0.11%
Subclavian vein injury	2 0.04%	3 0.07%	NS	5 0.11%
Descending aortic transection	2 0.04%	0 0%	NS	2 0.04%
Chylothorax	2 0.04%	0 0%	NS	2 0.04%

Table 3
Morbidity in the management of chest trauma

Morbidities	Patients (%)
Atelectasia	616 (14.6)
Respiratory failure	232 (5.5)
Adult respiratory distress syndrome	138 (3.2)
Clotted haemothorax	39 (0.9)
Bronchopleural fistula	20 (0.4)
Empyema	14 (0.3)

tion as well as the location of the hospital, blunt traumas are generally much more frequent than penetrating traumas. In our series of 4205 patients, 66% of the victims had a blunt injury. In particular, high-speed vehicle accidents were the main cause of chest trauma in 47.5% of patients with thoracic trauma and in 72% of those with blunt injury, similar to previous studies [1–4]. However, our series did not confirm gunshots as the most common cause for penetrating injuries, as has been previously reported (60% of penetrating injuries) [5]. In chest trauma, associated extra-thoracic injuries complicate the presentation and management of the victims, resulting in increased mortality and hospital stay. The ratio of associated injuries was similar to the literature in this study (35%). We experienced that mortality and hospital stay increased when compared to isolated thoracic injuries.

In our series, the incidence of chest wall pathologies was 36.1%, of which rib fractures were identified in 32.1% of patients. This ratio shows correlation to that which has been reported in the literature [6]. Although the number of fractured ribs may indicate the severity of the injury, some authors believe that it has no significant relation with morbidities [2]. However, in our experience, 13% of patients had fractures involving more than three ribs. We observed that the morbidity rate and hospital stay were both increased in these patients. Therefore, we believe that hospitalisation at a level I centre is useful for patients with three or more fractured ribs. On the other hand, flail chest that results in paradoxical chest movement may cause pulmonary insufficiency and needs special care. In our series, flail chest occurred in 72 cases (1.7%), and all were followed in the ICU. In the treatment, the value of surgical stabilisation is still unclear. Some authors recommend surgical stabilisation of the chest wall only when thoracotomy is required for another indication or in the case of respiratory insufficiency during the follow-up period, but others recommend performing early fixation on diagnosis to decrease mortality and hospital stay [7]. In all cases with flail chest in this series, we did not apply surgical stabilisation. While the reported mortality rate in flail chest varies from 5.4 to 40% [8], mortality rate in this study was 11.1%, representing a relatively lower ratio.

Table 4
Analysis of patients according to type of injury, mortality, injury severity score, and hospital stay

	Blunt	Penetrating	P	Isolated	Associated	P	Total
Mortality (%)	6.8	1.4	0.001	5.8	17.7	0.001	9.3
Injury severity score	16.6±7.4	12.7±2.9	NS	14.2±2.5	18.0±5.5	NS	10.8±8.8
Hospital stay (days)	12.6	7.1	NS	10.7	15.3	NS	9.2

Table 5
Analysis of the patients after thoracotomy according to mortality and injury severity score

	Thoracotomy			Non-thoracotomy
	Early	Late	P	
Mortality (%)	4.9	1.1	0.001	3.3
Injury severity score	21.0±5.1	14.0±5.5	0.001	13.0±5.5

Though some patients immediately die after DI, its incidence in penetrating and blunt injury has been reported as 3.4 and 2.1%, respectively [9]. In this series, we had 76 (1.8%) patients with DI, which was significantly higher in blunt chest trauma; 56 due to blunt injury (traffic accidents in 44, falls in 12), and the remaining 20 DIs due to penetrating injury. In cases of DI, the choice of surgical approach depends greatly on associated injuries; we repaired 22 DIs via early thoracotomy, whereas 40 patients underwent a late thoracotomy within three days, and 14 were repaired via laparotomy. The number of diaphragmatic ruptures repaired by thoracotomy in this study is relatively high because of the presence of associated organ injury that mandated thoracotomy, and, therefore, the repair was done using this approach rather than laparotomy.

Patients with tracheobronchial injury suffer from a high prehospital mortality rate. In the literature, tracheobronchial rupture has been reported in 1–2% of cases with blunt injury admitted to the hospital [10]. In our series, bronchial rupture was confirmed in 11 cases, of which eight had a blunt injury. In these patients, primary repair through thoracotomy was successful. Based on our experience, bronchoscopy is a valuable diagnostic modality for radiologically inconclusive tracheobronchial tears and can be used perioperatively. On the other hand, tracheal laceration was diagnosed in seven patients, and primary repair was applied in the treatment of these pathologies. We observed that blunt chest trauma frequently caused smaller tears in the airways, leading to a better survival rate. Patients presenting with larger tears that had resulted from penetrating trauma were rare.

Tube thoracostomy is the choice of treatment in chest trauma complicated with rib fractures and haemopneumothorax. In our series, tube thoracostomy was performed in 1934 patients (46%) with favourable outcomes. However, 114 patients with chest tube drainage underwent an early operation due to bleeding while 13 had a late exploration during the follow-up period. On the other hand, the ratio of thoracotomy in this study was 6%, which is similar to previously published results [11]. Intrathoracic bleeding was the leading pathology in 50% of patients. In 209 patients, thoracotomy was an early procedure performed primarily because of intrathoracic bleeding, whereas a late thora-

cotomy was conducted in 46 patients, who were primarily diagnosed with diaphragmatic rupture. We observed that mortality and ISS in patients who underwent early thoracotomy were significantly higher than in those cases receiving late thoracotomy.

The mortality rate for isolated chest injuries has been reported to range from 4 to 8%; this value increases to 13–15% when another organ system is involved and to 30–35% when more than one organ system is involved [12]. In our series, overall mortality rate was 9.3% in chest injury patients. Morbidity and mortality were both higher in blunt chest injury. Because traffic accidents accounted for 72% of blunt trauma cases in our series, traffic controls and security belt use should be obeyed strictly. We observed that associated extrathoracic injuries caused a higher mortality rate. Thus, clinicians should have a high index of suspicion for associated diagnoses after an injury. An understanding of the modes of presentation allows prompt diagnosis and early treatment, making treatment management more efficient.

In conclusion, multidisciplinary approach in the management of trauma cases is life saving and decreases morbidity and mortality. Mortality in chest injury could be significantly reduced if traffic accidents, violent activity, and social problems are solved. The majority of patients with simple chest injuries can be managed at the level of primary health care centres or as outpatients at district hospitals. However, patients with associated injuries need

special care and, therefore, should always be referred to a level I trauma centre.

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