ORIGINAL INVESTIGATION

Thoracic Traumas: A Single-Center Experience

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Abstract

OBJECTIVES: Trauma is currently among the most important health problems resulting in mortality. Approximately 25% of trauma-related deaths are associated with thoracic trauma. In the present study, morbidity and mortality rates and interventions performed in patients who had been treated as inpatients in Dr. Siyami Ersek Thoracic and Cardiovascular Surgery hospital after trauma were aimed to be evaluated.

MATERIAL AND METHODS: In our study, 404 patients who were treated as inpatients because of thoracic trauma between January 2005 and December 2008 were retrospectively evaluated.

RESULTS: The rates of blunt and penetrating trauma were 39.6% and 60.4%, respectively. In the study, 115 (28.4%) patients were noted to have pneumothorax, 99 (24.5%) had hemothorax, and 57 (14.1%) had hemopneumothorax. While tube thoracostomy was sufficient for treatment in approximately 80% of the patients, major surgical interventions were performed in 12.6% of the patients. Mortality rate was found to be 2.2%.

CONCLUSION: In patients with chest trauma, necessary interventions should be started at the time of the event, and the time from trauma to arriving at the emergency department should be made the best of. Mortality and morbidity rates in thoracic trauma cases may be reduced by timely interventions and effective intensive care monitoring.

KEYWORDS: Trauma, thorax, morbidity, mortality

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INTRODUCTION

Thoracic traumas have a wide spectrum from simple rib fractures to major vascular injuries. Traumas are the major cause of death in individuals younger than 40 years [1]. Approximately 50% of deaths following trauma are directly or indirectly associated with thoracic trauma [2]. However, recently published studies have reported a decrease in mortality rates related to thoracic trauma. Glinz [3] reported that 10% and 18% of 460 trauma-related deaths are directly and indirectly related to thoracic trauma, respectively.

Penetrating injuries are less common than blunt trauma in thoracic trauma patients, and mortality after penetrating injuries is lower than that after blunt traumas. However, mortality rate varies according to the trauma mechanism and organ damage after trauma. While mortality rate is between 1% and 8% after stab wounds, the rate is between 14% and 20% after gunshot wounds. Mortality is higher in patients with cardiac injury. Mortality rate rises to 25-28% in case there is diaphragmatic, pulmonary, or large vessel injury after trauma [2]. The pathological process after thoracic trauma is associated with respiratory and hemodynamic changes. The most common pathology observed is hypoxia. Hypoxia occurs because of reasons such as bleeding, collapse, or compression of the lung, respiratory or cardiac failure, pulmonary contusion, intrathoracic pressure change, and mediastinal shift.

Chest X-ray is the first and most valuable diagnostic tool to reveal the pathology after thoracic trauma and to determine the treatment approach. Computed tomography helps reveal the pathologies that cannot be determined by the chest X-ray.

Supportive or surgical treatment may be applied to patients after thoracic trauma. Tube thoracostomy, thoracotomy, sternotomy, and video-assisted thoracoscopy are the surgical procedures performed. As surgical treatment is required in approximately 15% of patients, supportive treatments such as fluid replacement, antibiotic treatment, mechanical venti-

Table 1. Distribution of cases according to the etiology of the trauma

Etiology of the trauma	Number of cases	%
Stab wounds	190	47.0
Traffic accidents	71	17.06
Falls from height	70	17.3
Gunshot wounds	50	12.4
Assault	18	4.5
Occupational accident	5	1.2

Table 2. Methods used in diagnosis

Diagnostic method	Number of cases	%
Chest X-ray	235	58.2
Computed tomography	126	31.2
Clinically	21	5.2
Echocardiography	11	2.7
Lateral X-ray	8	2.0
Flexible bronchoscopy	3	0.7
Chest X-ray: posteroanterior chest X-ray		

lation, and pain control are very important in patients who are exposed to thoracic trauma.

In the present study, we evaluated 404 thoracic trauma patients who were followed-up and treated in our thoracic surgery clinic. As Dr. Siyami Ersek Thoracic and Cardiovascular Surgery Center is a branch hospital, we are of the opinion that the evaluation of patients who are admitted to our hospital after trauma will contribute to literature in terms of patient approach and thoracic trauma management.

MATERIAL AND METHODS

A total of 3150 patients who were admitted to our hospital between January 2005 and December 2008 because of trauma were screened, and 404 patients who were hospitalized, followed-up, and treated in our clinic because of thoracic trauma were included in the present study.

After written informed consent was obtained from the patients, anamnesis forms, radiological examinations, surgery notes, post-operative monitoring charts, outpatient records, legal records, and epicrisis reports of the patients were reviewed. The patients were evaluated for gender, age, type and etiology of the trauma, clinical findings, concomitant injuries, diagnostic methods, bone and intrathoracic pathologies, surgical interventions, complications, length of intensive care stay, total duration of hospitalization, and mortality.

Statistical Analysis

In the evaluation of data, Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) 15.0 was used for the statistical analysis. Besides descriptive statistical methods (mean, standard deviation), Student's t-test was used for between-group comparisons of quantitative data with normal distribution. Chi-square test and Fisher's exact test were used for the comparison of qualitative data. Results were

Figure 1. PA chest X-ray of the patient who developed multiple rib fractures following trauma

evaluated within 95% confidence interval, and significance level was set at $p < 0.05$.

RESULTS

Of the 404 patients included in the study, 44 (10.9%) were females and 360 (89.1%) were males. The mean age of the female patients was 51.9 years (range, 5–93 years) and that of males was 35.6 years (range, 3–85 years). While the rate of trauma patients who were first admitted to our hospital was 31.3%, 63% of the patients were referred to our hospital within an average of 5 h (range, 1 h–6 days) after they had been evaluated at another center.

Overall, 160 (39.6%) patients had blunt trauma and 244 (60.4%) had penetrating trauma. When trauma types were evaluated according to gender, it was observed that blunt trauma was more common in female patients, whereas penetrating injuries were more common in males. Almost half of all trauma patients (47.5%) were at the age range of 20–40 years. The frequency of stab wounds was 60.2% within this age range. According to the order of frequency, the most common causes of trauma were stab wounds (47.0%) and falls from heights (17.3%). The reasons of trauma are presented in Table 1.

The main complaint at admission was dyspnea in 256 (63.4%) patients, and the other patients complained of chest pain. Chest X-ray was diagnostic in 235 (58.2%) patients. The diagnostic methods used in the evaluation of patients are presented in Table 2.

One hundred and eleven (27.5%) patients had rib fractures; 96 (23.8%) fractures were unilateral and 15 (3.7%) were bilateral. Thirteen patients had one rib fracture, 20 had two, and 78 had more than two rib fractures (Figure 1). In the study, 8 (1.9%) patients had sternum fractures, 7 (1.7%) had clavicular fractures, 4 (0.9%) suffered scapula fractures, and 2 (0.4%) had both clavicle and scapula fractures. The number and percentage of bone pathologies after trauma are demonstrated in Table 3.

The most common intrathoracic pathology after trauma was pneumothorax in 115 (28.4%) patients, followed by hemothorax in 99 (24.5%), hemopneumothorax in 57 (14.1%),

Table 3. Bone pathologies after trauma

Bone pathology	Number of cases	%
Rib fracture	111	27.5
Sternum fracture	8	1.9
Clavicle fracture	7	1.7
Scapular fracture	4	0.9
Clavicle and scapular fracture	2	0.4

Table 4. Intrathoracic pathologies after trauma

Intrathoracic pathology	Number of cases	%
Pneumothorax	117	28.8
Hemothorax	109	26.9
Hemopneumothorax	57	14.9
Pulmonary contusion	15	3.7
Pericardial tamponade	11	2.7
Pneumomediastinum	6	1.4
Elevation of the diaphragm	2	0.4
Flail chest	1	0.2

Table 5. Treatment methods used in patients

Treatment method	Number of cases	%
Tube thoracostomy	211	52.2
Conservative treatment	126	31.2
Major surgical intervention	51	12.6
Suturing of the incision	12	3.0
Mediastinotomy	1	0.2

Table 6. Types of surgical incisions

Type of surgical incision	Number of cases (51)	Percentage (12.6%)
Thoracotomy	36	8.8
Sternotomy	12	3.0
Subclavicular incision	3	0.7

and pulmonary contusion in 15 (3.7%) (Figure 2). The intrathoracic pathologies after trauma are demonstrated in Table 4.

Overall, 70 (18%) patients had concomitant injuries; extremity injury in 34 (8.4%) patients, abdominal injury in 13 (3.2%), cranial injury in 10 (2.4%), vertebral or spinal cord injury in 10 (2.4%), and other injuries in 3 (0.7%).

While tube thoracostomy was performed in more than half of the patients (n=211, 52.2%), 51 (12.6%) patients underwent major surgical interventions. One hundred and twenty-six patients (31.2%) were followed with medical treatment. A total of 36 (8.8%) patients underwent thoracotomy, 12 (3.0%) underwent sternotomy, and 3 underwent subclavian artery repair by subclavicular incision. Treatment methods are presented in Table 5, and incision types used in surgery are shown in Table 6.

Figure 2. Thoracic CT cross sections of the patient who developed subcutaneous emphysema and hemopneumothorax following trauma

The most common procedure applied in patients who underwent surgery was pulmonary parenchymal laceration repair in 11 (2.7%) patients. Additionally, 14 patients underwent laceration repair along with the other interventions. The surgery was completed by only intercostal artery ligation in 4 (0.9%) patients. Three (0.7%) patients underwent both pulmonary laceration repair and intercostal artery ligation and 4 (0.9%) underwent laceration repair along with diaphragm repair. Tracheal anastomosis was performed by thoracotomy in 2 (0.7%) patients with complete tracheal rupture, 1 (0.2%) patient who had a tear in the posterior tracheal membrane underwent primary repair via thoracotomy, and 1 (0.2%) patient who developed bronchial injury after blunt trauma underwent right upper bilobectomy.

The most frequent complications were atelectasis (5%) and pneumonia (3%). According to the clinical need, the necessary number of nasotracheal aspirations or flexible or rigid bronchoscopy was performed to aspirate the secretions in these patients.

In our study, the mean length of ward and intensive care stay was 4.8 (1-151) days and 1.2 (1-151) days, respectively. In the early period (0-30 days), the mortality rate was found to be 2.2% (9 patients).

DISCUSSION

Thoracic trauma patients constitute a considerable portion of patients who are admitted to thoracic surgery clinics and who are treated as outpatients or inpatients. Yalçinkaya et al. [4] indicated that 29.7% of the patients hospitalized in a thoracic surgery clinic were hospitalized because of trauma. During the course of the study, it was determined that approximately 1/3 of 9100 patients who were admitted to the polyclinic and emergency were admitted because of trauma, and 404 (12%) of these patients were hospitalized in our thoracic surgery clinic. In the study, while the rate of outpatients who were admitted to the clinic because of trauma was found to be higher, the rate of hospitalized patients was found to be lower than that in literature. The lower rate of hospitalized patients was due because of the insufficient number of thoracic surgery specialists in the centers near the hospital and the referral of thoracic trauma cases that can be treated as outpatients to our hospital for thoracic surgery consultation.

While blunt traumas constitute 70% of thoracic traumas, penetrating injuries constitute 30%. A study performed in our country by Çakan et al. [5] reported these rates to be 72% and 28%, respectively. In our series, while 39.6% of the patients had blunt trauma, 60.4% had penetrating thoracic injuries. Stab injuries were the cause of trauma in 47% of the patients. The second most common cause of trauma was falls. In our series, 27 of 44 female patients and 133 of 360 male patients had blunt trauma. When the relationship between gender and trauma type was evaluated, it was observed that blunt trauma was more common in female patients, whereas penetrating traumas were more common in males ($p < 0.05$). Considering the age groups, 72% of those over 40-years-old had blunt trauma, and 77% of those between 20 and 40 years had penetrating trauma. These values were statistically significant ($p < 0.05$). In our series, the higher rate of patients who were admitted because of stab wounds in comparison with literature may be attributed to the specific location of the hospital on the Anatolian Side of İstanbul. The lower rate of blunt traumas may be explained by the fact that thoracic traumas generally lead to injury that affects more than one system, and thoracic trauma patients are therefore referred to general emergency departments.

Multiple series reported the rate of rib fractures as >50% in thoracic traumas [5,6]. In our series, 111 patients (27.5%) had rib fractures. Only 1 patient had flail chest, and this patient did not undergo surgical intervention. The low rate of rib fractures found in the present study is due to the low rate of blunt trauma in our series. Pain control is important to prevent complications in patients with rib fractures. Pain control can be achieved by non-opioid analgesics, opioid analgesics, intercostal nerve blockade, and patient controlled analgesia. Narcotic analgesic infusion and respiratory physiotherapy were performed in all patients who had rib fractures and who were hospitalized in our clinic. Yörük et al. [7] reported that 24 (10%) patients had clavicle fractures, 8 (3.3%) had sternum fractures, and 4 (1.7%) had scapula fractures in their series of 239 cases. In our study, 8 (1.9%) patients had sternum fractures, 7 (1.7%) had clavicle fractures, 4 (0.9%) had scapula fractures, and 2 (0.4%) had both clavicle and scapula fractures.

The most common intrathoracic complications following thoracic traumas are hemothorax, pneumothorax, and hemopneumothorax [8,9]. The intrathoracic injuries reported in the study of Çobanoğlu et al. [10] are pneumothorax (26.3%), hemothorax (23.6%), and hemopneumothorax (14.5%). Similar to the study of Çobanoğlu et al. [10], the most frequent intrathoracic complication was pneumothorax seen in 115 (28.4%) patients, followed by hemothorax in 99 (24.5%), and hemopneumothorax in 57 (14.1%) in our series.

When the rate of major surgery in the studies evaluating thoracic trauma patients in literature was compared, it was found that the rate of thoracotomy is 2.9% in the study of Başoğlu et al. [11] in 521 cases, 8.4% in the study of Yörük et al. [7] in 239 cases, 5.5% in the study of Tekinbaş et al. [6] in 592 cases, 14% in the study of Çağırıcı et al. [12] in 270 cases, and 11.8% in the study of İmamoğlu et al. [13] in 110

cases. Washington and Richardson [14] reported the rate of cases requiring major surgery as 15%, whereas Gopinath [15] reported the corresponding rate as 20%. In our series, 51 (12.6%) of 404 patients were taken to surgery; 36 patients underwent thoracotomy, 12 underwent sternotomy, and 3 underwent subclavian artery repair by subclavicular incision.

Post-traumatic tracheobronchial rupture is a rare complication after trauma. Hwang et al. [16] reported a series of 23 patients who developed tracheobronchial injury after trauma over an 11-year period. Tekinbaş et al. [6] determined that 1% of patients had tracheobronchial injury. In our series, tracheobronchial rupture was determined in 4 (1%) patients, after blunt trauma in 3, and after penetrating in 1. Three patients underwent primary repair. One of the patients had a rupture extending from the carina to the right upper lobe bronchus. Primary repair of the rupture was performed, but as there was an extensive laceration in the right upper and middle lobe, the patient underwent right upper bilobectomy.

Thoracic trauma patients should necessarily undergo a careful systemic examination because of frequent concomitant extra-thoracic injuries. Shorr et al. [17] reported concomitant injuries in the order of frequency as follows: extremity fractures (39.8%), head trauma (43.1%), and abdominal trauma (28.5%). In the present study, concomitant injuries were extremity injuries in 34 (8.4%) patients, abdominal injuries in 13 (3.2%), cranial injuries in 10 (2.4%), vertebral or spinal cord in 10 (2.4%), and other injuries in 3 (0.7%). The low rate of concomitant injuries found in the present study is due to the fact that our center is a thoracic and cardiovascular surgery hospital and that patients with predominant thoracic pathology are admitted or referred to our emergency department.

Morbidity rates associated with chest injuries are reported as 36% in the study of Shorr et al. [17], 16% by Çağırıcı et al. [12], 4.6% in the series of Çakan et al. [5] comprising 987 cases, and 12.7% in the study of İmamoğlu et al. [13]. The morbidity rate was 12.6% in our series. The most common complication was atelectasis that was observed in 22 (5.1%) patients. The low morbidity rate in this present study was due to the fact that the majority of the patients were monitored under intensive care conditions in the early period after trauma and other reason was the low rate of concomitant injuries. In our series, the mean duration of hospitalization was 4.8 days, and the mean length of intensive care stay was 1.2 days. The mean length of hospital stay was reported to be 9.6 days in 987 case series of Çakan et al. [5] and 8.7 days in the study of Çağırıcı et al. [12]. The short length of hospital stay in our series may be explained by the low rate of concomitant injuries.

Mortality rate of thoracic trauma patients was reported as 15.5% by Shorr et al. [17] and as 7% by Gopinath [15]. In our series, the mortality rate was 2.2% (9 patients). Two of the patients died during surgery; these patients had been taken for emergency surgery because of multiple stab wounds. Two patients died 1 day postoperatively; one of them underwent emergency thoracotomy for subclavian artery, vein repair, and left internal mammary artery (LIMA) repair after a gun-

shot wound, and the other patients was hospitalized because of multiple rib fractures and left hemothorax after an in-vehicle traffic accident. Tube thoracostomy was performed to this patient. Because intra-abdominal bleeding was suspected by the general surgery specialists, laparotomy was performed, and active bleeding in the liver was taken under control. The patient developed cardiac arrest and died 6 h postoperatively. Four of the patients died after long-term follow-up in the post-operative intensive care unit. One of these patients underwent right ventricular repair, interventricular septum repair, innominate vein repair, LIMA ligation, and parenchymal laceration repair by sternotomy because of stab wounds. The patient was unconscious during the post-operative intensive care stay and died 6 days postoperatively. The second patient was taken for emergency surgery because of paraplegia after a gunshot wound. Bleeding was taken under control by carotid artery interposition and thoracotomy, and the patient died because of multiple organ failure 19 days postoperatively. The third patient also developed paraplegia and tracheal injury after a gunshot wound. The patient underwent thoracotomy. It was observed that the posterior and left lateral tracheal walls 2 cm above the carina were fragmented; end-to-end anastomosis was performed. The patient developed tracheoesophageal fistula 10 days postoperatively, and cervical esophagostomy and gastrostomy were performed. The patient who developed acute respiratory distress syndrome during the intensive care stay died 20 days postoperatively. The fourth patient underwent ventricular repair and parenchyma repair because of stab wounds. The patient who developed cerebral infarct and pneumonia died 151 days postoperatively because of multiple organ failure. In our series, except one patient with fatal course, all patients underwent emergency surgery. The patient with the fatal course underwent aorto-coronary bypass graft surgery because of coronary artery disease 3 years ago. Tube thoracostomy was performed to the patient who was determined to have multiple rib fractures and hemothorax on the right side after a fall. The patient, who had chest pain 1 day after tube thoracostomy, was transferred to the intensive care, developed cardiac arrest, and died.

The mortality rate in our series was close to the rate of 3.6%, which was reported by İmamoğlu et al. [13] on 110 cases. No statistically significant difference was found between the mortality rates of patients with blunt and penetrating trauma ($p>0.3$). The lower mortality and morbidity rates found in the present study may be because our center is a branch hospital where simultaneous thoracic and cardiovascular surgical interventions can be performed and because of the improved surgical intensive care facilities and the low rate of concomitant pathologies.

Thoracic trauma patients constitute a significant portion of patients who are hospitalized in thoracic surgery clinics. As in all trauma types, the patients who are subjected to thoracic traumas should be treated by experienced teams that are accomplished in approaching trauma patients. The mor-

bidity and mortality rates of thoracic trauma cases that are transported to appropriate centers without delay can be significantly decreased by timely interventions and effective intensive care monitoring.

Ethics Committee Approval: We did not receive approval from the ethical committee because the file of the patient was evaluated retrospectively.

Informed Consent: Inform consent were not approved by patients. Because this was a retrospective study.

Peer-review: Externally peer-reviewed.

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