

Analysis of patients with emergency thoracic trauma

ABSTRACT

Background: Trauma is an important health problem because it causes high morbidity and mortality. Thoracic trauma is generally categorized as blunt and penetrating trauma. Thoracic traumas are life-threatening and require rapid intervention. Successful treatment is achieved with multidisciplinary management and rapid diagnosis.

Aims: It was aimed to investigate clinical outcomes of emergency thoracic trauma in the study.

Study Design: Trauma patients older than 18 years old hospitalized to the thoracic surgery clinic from the emergency department were included and, patients were excluded without thoracic trauma, not hospitalized, and younger than 18 years of ages in the study.

Place and Duration of Study: Ersin Arslan Training and Research Hospital wards of thoracic surgery from January 1, 2021 to December 31, 2021.

Methodology: A total of 114 patients were analyzed. The data of the patients were analyzed ages, gender, comorbidities, smoking, use of alcohol and other substances, types of trauma, localization and variety of injuries, pathological findings on thoracic and extrathoracic organs, methods of medical and surgical treatments, length of stays in Intensive-care Unit and hospital, recovery and mortality. Statistical analysis of the study was done using the Chi-square test.

Results: Patients were 87.7% males and 12.3% females. The mean age was 40.3+/-10.8. Comorbidities were 20.2. The rates of use of substances were cigarettes 75.4%, alcohol 14.8% and other substances 15.7%. The rates of types of traumas were 14% Motor Vehicle Collisions, 6.1% Vehicles Striking Pedestrians, 3.5% Acts of Violence, 29.8% stabbing, 13.2% gunshot wounds, 33.4% falls. Findings of thoracic injuries were 75.4% hemothorax, 72.8% pneumothorax, 61.4% contusion of the lungs, 49.1% fractures of the ribs, 18.4% subcutaneous emphysema, 9.6% cardiac injury, 5.2% diaphragmatic, 1.7% tracheobronchial and 0.8% esophageal injury. Surgically, which were 32.4% tube thoracostomy, 15.7% primary repair, and 10.5% thoracotomy among all traumas. The maximum length of stay in the Intensive-care Unit were for acts of violence and gunshot wounds and the maximum length of stay in the hospital were in acts of violence and falls from height.

Conclusions: Thoracic traumas were more often in males. Penetrating injuries were more common in adults younger than 40 years and blunt traumas in adults older than 40 years. The majority of patients were without comorbidity. Surgically, these were done 100% parenchyma of the lung repair, 75% intercostal ligation, 41.6% thoracic wall reconstruction, 33.3% mediastinal surgery and 25% diaphragm repair in patients with thoracotomy. Rates of mortality were 13.3% in gunshot wounds and 2.9% in stabbing. Mortality rate was 2.6% in all thoracic traumas in the study.

Keywords: blunt, emergency, penetrating, thorax, trauma.

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1.INTRODUCTION

Trauma is an important health problem because it causes high morbidity and mortality. Thoracic trauma accounts for 25% of all traumas, and it is among the most common causes of death [1]. Thoracic trauma is generally categorized as blunt and penetrating trauma. The most common cause of blunt trauma is motor vehicle collisions with a rates of 80%. Falls, acts of violence, vehicles hitting pedestrians, and blast injuries are other types of blunt trauma. The majority of penetrating traumas are stabbing and gunshots [2]. Thoracic traumas are life-threatening and require rapid intervention. Successful treatment is achieved with multidisciplinary management and rapid diagnosis. These are a wide variety injuries from simple rib fracture to lung contusion, pneumothorax, hemothorax and even cardiac injuries. According to the degree of thoracic traumas, in order from noninvasive to invasive are analgesia, oxygen therapy, needle aspiration, tube thoracostomy, video-assisted thoracoscopic surgery and thoracotomy. The outcomes of emergency thoracic traumas were aimed hospitalized to thoracic surgery wards in the study.

2.MATERIALS AND METHOD

The study was done in thoracic surgery wards of Ersin Arslan Training and Research Hospital between Jan 1, 2021 and Dec 31, 2021. Trauma patients older than 18 years old hospitalized to the thoracic surgery clinic from the emergency department were included in the study. Patients were excluded without thoracic trauma, not hospitalized, and younger than 18 years of ages in the study. A total of 114 patients were analyzed. The data of the patients who met the study criteria were analyzed ages, gender, comorbidities, smoking, use of alcohol and other substances, types of trauma, localization and variety of injuries, pathological findings on thoracic and extrathoracic organs, methods of medical and surgical treatments, length of stays in intensive-care unit and hospital, recovery and mortality. Republic of Turkey Ministry of Health 2021-12-06T14_33_10 numbered and Gaziantep University Medical Ethics Committee 2022/05 numbered approvals were received. Statistical analysis of the study was done (95% confidence interval and $p < 0.05$ statistical significance) using the Chi-square test.

3.RESULTS

A total of 114 patients were analyzed. 87.7% of the patients were male and 12.3% were female. The mean age was 40.3 +/-10.8. The rate of patients with comorbidities were 20.2%. Comorbidities were hypertension (HT, 14%), diabetes mellitus (DM, 14%), coronary artery disease (CAD, 7%), chronic obstructive pulmonary disease (COPD, 6.1%) and others (5.2%). There was no additional illness in 79.8% of the trauma patients. The rates of use of substances were cigarettes (75.4%), alcohol (14.8%) and other substances (15.7%, marijuana and synthetic stimulants), respectively. 24.6% of trauma patients weren't using any substances (Table I).

Table I. Demographic data of the study

	All (n=114)	MVC	Blunt trauma		Penetrating Object	Gunshot Injuries	Falls	
			VSP	AOV			Same Level	Height
Gender								
Male	100 (87.7%)	14 (87.5%)	6 (85.7%)	2 (50.0%)	33 (97.1%)	14 (93.3%)	18 (72.0%)	11 (84.6%)
Female	14 (12.3%)	2 (12.5%)	1 (14.3%)	2 (50.0%)	1 (2.9%)	1 (6.70%)	7 (28.0%)	2 (15.4)
Ages								
	40.3 +/-10.8	45.9 +/-12.8	39.1 +/-16.1	32.5 +/-21.5	27.2 +/-9.6	32.3 +/-15.2	56.2 +/-18.1	48.3 +/-17.1
18-40 years	65 (57.0%)	6 (37.5%)	3 (42.8%)	2 (50.0%)	32 (94.1%)	12 (80.0%)	5 (20%)	6 (46.2%)
41-60 years	31 (27.2%)	8 (50.0%)	4 (57.2%)	2 (50.0%)	2 (5.88%)	2 (13.3%)	8 (32%)	4 (30.7%)
>60 years	18 (15.8%)	2 (12.5%)	0	0	0	1 (6.70%)	12 (48%)	3 (23.1%)
Comorbidities								
Yes	23 (20.2%)	3 (18.7%)	1 (14.2%)	0	3 (2.9%)	1 (6.6%)	14 (56.0%)	3 (23.1%)
HT	16 (14.0%)	0	1 (14.3%)	0	1 (2.94%)	1 (6.70%)	10 (40.0%)	3 (23.1%)
DM	16 (14.0%)	1 (6.25%)	1 (14.3%)	0	1 (2.94%)	1 (6.70%)	11 (44.0%)	1 (7.7%)
CAD	8 (7.0%)	0	0	0	0	1 (6.70%)	5 (20.0%)	2 (15.4%)
COPD	7 (6.1%)	3 (18.7%)	0	0	0	0 (0%)	3 (12.0%)	1 (7.7%)
Others	6 (5.2%)	1 (6.25%)	1 (14.3%)	0	1 (2.94%)	0 (0%)	2 (8.0%)	1 (7.7%)
No	91 (79.8%)	13 (81.3%)	6 (85.8%)	4 (100%)	33 (97.1%)	14 (93.4%)	11 (44.0%)	10 (76.9%)
Substance use								
Yes	86 (75.4%)	14 (87.5%)	5 (71.4%)	2 (50.0%)	28 (82.3%)	14 (93.3%)	14 (56.0%)	9 (69.2%)
Smoke	86 (75.4%)	14 (87.5%)	5 (71.4%)	2 (50.0%)	28 (82.3%)	14 (93.3%)	13 (52.0%)	9 (69.2%)
Alcohol	17 (14.8%)	3 (18.7%)	0	0	7 (20.6%)	3 (20.0%)	1 (4.0%)	3 (23.1%)
Others	18 (15.7%)	1 (6.25%)	0	0	11 (32.3%)	4 (26.7%)	0	2 (15.4%)
No	28 (24.6%)	2 (12.5%)	2 (28.6%)	2 (50.0%)	6 (17.7%)	1 (6.70%)	11 (44.0%)	4 (30.8%)

*MVC: Motor Vehicle Collisions, VSP: Vehicles Striking Pedestrians, AOV: Acts of Violence

*HT: Hypertension, DM: Diabetes Mellitus, CAD: Coronary Artery Disease, COPD: Chronic Obstructive Pulmonary Disease

The rates of types of traumas were 14% Motor Vehicle Collisions (MVC), 6.1% Vehicles Striking Pedestrians (VSP), 3.5% Acts of Violence (AOV), 29.8% penetrating (stabbing) injuries, 13.2% gunshot wounds, 33.4% falls (same level 21.9% and height 11.5%). The localizations of thoracic traumas were 52.6% left, 40.3% right, 5.4% bilateral and 1.7% parasternal, respectively. Other accompanying system traumas were 16.5% orthopedic (9.6% upper extremity, 4.3% lower extremity and 2.6% vertebra), 7.8% brain injury and 7.1% abdominal trauma. Findings of thoracic injuries were 75.4% hemothorax, 72.8% pneumothorax, 61.4% contusion of the lungs, 49.1% fractures of the ribs, 18.4% subcutaneous emphysema, 9.6% cardiac injury, 5.2% diaphragmatic, 1.7% tracheobronchial and 0.8% esophageal injury. Treatments of thorax traumas were 53.5% medical and 46.5% surgical. Medical treatments were analgesia, antibiotics, bronchodilators, oxygen therapy, and pulmonary exercise. Surgical treatments were tube thoracostomy 69.8%, emergency thoracotomy 22.6%, and others were primary repair. These rates were 32.4% tube thoracostomy, 15.7% primary repair, and 10.5% thoracotomy among all traumas. In explorations of the thorax with thoracotomy were done parenchyma of the lung repair, intercostal ligation, reconstruction of the thoracic wall, surgery of mediastinum (tracheobronchial or esophageal) and repair of the diaphragm respectively. The mean length of stays of tube thoracostomy were 1.47 +/- 1.9 days. The length of stays were 1.61 +/-0.9 days in the intensive-care unit and 5.1 +/-3.8 days in the hospital. The mortality rates of thoracic traumas were 2.6% (Table II).

Table II. Distribution of clinical findings of thoracic traumas

	All (n=114)	Blunt trauma			Penetrating Object	Gunshot Injuries	Falls	
		MVC	VSP	AOV			Same Level	Height
Localization of trauma								
Left	60 (52.6%)	7 (43.7%)	2 (28.5%)	1 (25.0%)	23 (67.6%)	5 (33.3%)	16 (64%)	6 (46.2%)
Right	46 (40.3%)	7 (43.7%)	4 (57.1%)	0	11 (32.3%)	8 (53.3%)	9 (36%)	7 (53.8%)
Parasternal	2 (1.7%)	1 (6.2%)	0 (0%)	0	0	1 (6.7%)	0	0
Bilateral	6 (5.4%)	3 (18.7%)	1 (14.3%)	1 (25.0%)	0	1 (6.7%)	0	0
Findings of trauma								
Brain injury	9 (7.8%)	1 (6.2%)	1 (14.3%)	1 (25.0%)	0	0	1 (4%)	5 (38.4%)
Thoracic injury								
Pneumothorax	83 (72.8%)	12 (75.0%)	6 (85.7%)	2 (50.0%)	32 (94.1%)	12 (80.0%)	7 (28.0%)	12 (92.3%)
Hemothorax	86 (75.4%)	11 (68.7%)	5 (71.4%)	3 (75.0%)	32 (94.1%)	11 (73.3%)	13 (52.0%)	11 (84.6%)
Lung contusion	70 (61.4%)	12 (75.0%)	6 (85.7%)	3 (75.0%)	5 (14.7%)	13 (86.6%)	18 (72.0%)	13 (100%)
Pneumomediastinum	6 (5.2%)	0	0	1 (25.0%)	1 (2.94%)	3 (20.0%)	0	1 (7.7%)
Cardiac	11 (9.6%)	2 (12.5%)	2 (28.5%)	1 (25.0%)	1 (2.94%)	1 (6.7%)	0	4 (30.8%)
Bronchial	2 (1.7%)	0	0	0	0	2 (13.3%)	0	0
Esophageal	1 (0.8%)	0	0	0	0	1 (6.7%)	0	0
Diaphragm	6 (5.2%)	0	0	1 (25.0%)	2 (5.88%)	1 (6.7%)	0	2 (15.4%)
Subcutaneous	21 (18.4%)	7 (43.7%)	1 (14.3%)	1 (25.0%)	1 (2.94%)	2 (13.3%)	1 (4.0%)	8 (61.5%)
Ribs								
0	56 (49.1%)	13 (81.2%)	4 (57.1%)	3 (75.0%)	1 (2.94%)	2 (13.3%)	23 (92.0%)	12 (92.3%)
1-3	22 (19.2%)	3 (18.7%)	3 (42.8%)	1 (25.0%)	33 (97.0%)	13 (80.0%)	2 (8.0%)	1 (7.7%)
4-6	51 (44.7%)	6 (37.5%)	1 (14.3%)	2 (50.0%)	0	0	6 (24.0%)	7 (53.8%)
7-9	51 (44.7%)	12 (75.0%)	4 (57.1%)	3 (75.0%)	1 (2.94%)	2 (13.3%)	19 (76.0%)	10 (76.9%)
10-12	34 (29.8%)	10 (62.5%)	3 (42.8%)	1 (25.0%)	0	1 (6.7%)	10 (40.0%)	9 (69.2%)
Abdominal injury	11 (9.6%)	4 (25.0%)	0	2 (50.0%)	0	0	2 (8.0%)	3 (23.1%)
Ortopedic injury								
Upper extremity	8 (7.1%)	2 (12.5%)	0	1 (25.0%)	2 (5.88%)	1 (6.7%)	0	2 (15.4%)
Lower extremity	11 (9.6%)	4 (25.0%)	1 (14.3%)	1 (25.0%)	0	2 (13.3%)	0	3 (23.1%)
Vertebra	5 (4.3%)	1 (6.2%)	1 (14.3%)	0	0	0	0	3 (23.1%)
Treatment of trauma								
Medical	3 (2.6%)	0	0	1 (25.0%)	0	0	0	2 (15.4%)
Surgical	61 (53.5%)	14 (87.5%)	4 (57.1%)	2 (50.0%)	9 (26.4%)	5 (33.4%)	21 (84%)	6 (46.2%)
Primary repair								
Tube thoracostomy	53 (46.5%)	2 (12.5%)	3 (42.8%)	2 (50.0%)	25 (73.6%)	10 (66.6%)	4 (16.0%)	7 (53.8%)
Thoracotomy	18 (15.7%)	0	3 (42.8%)	0	9 (26.4%)	5 (33.4%)	1 (4.0%)	0
Parenchyma repair	37 (32.4%)	1 (6.2%)	4 (57.1%)	1 (25.0%)	21 (61.7%)	3 (20.0%)	3 (12.0%)	4 (30.8%)
Mediastinal surgery	12 (10.5%)	1 (6.2%)	0	0	4 (11.6%)	4 (26.6%)	1 (4.0%)	2 (15.4%)
Intercostal ligation	12 (10.5%)	4 (25.0%)	0	0	4 (11.6%)	1 (6.7%)	1 (4.0%)	2 (15.4%)
Diaphragm repair	4 (3.5%)	0	0	0	1 (2.94%)	3 (20.0%)	0	0
Thoracic reconstruction	9 (7.8%)	4 (25.0%)	0	0	4 (11.6%)	1 (6.7%)	0	0
Others	3 (2.6%)	0	0	0	2 (5.88%)	1 (6.7%)	0	0
LOS of tube thoracostomy	5 (4.3%)	1 (6.2%)	0	0	0	2 (13.3%)	1 (4.0%)	1 (7.7%)
LOS of ICU	3 (2.6%)	0	0	0	2 (5.88%)	1 (6.7%)	0	0
LOS of hospital	1.47 +/-1.9	0.5 +/-2.3	0.7 +/-1.9	4.0 +/-0.3	2.2 +/-1.9	0.7 +/-1.6	0.4 +/-1.3	1.8 +/-2.2
Mortality	1.61 +/-0.9	1.6 +/-2.1	1.4 +/-1.3	3.5 +/-0.7	1.1 +/-1.2	2.0 +/-1.8	0.3 +/-0.9	1.4 +/-1.6
	5.1 +/-3.8	4.9 +/-3.2	4.7 +/-2.8	8.1 +/-1.4	4.0 +/-1.9	4.9 +/-2.8	3.5 +/-1.2	5.5 +/-2.4

*MVC: Motor Vehicle Collisions, VSP: Vehicles Striking Pedestrians, AOV: Acts of Violence

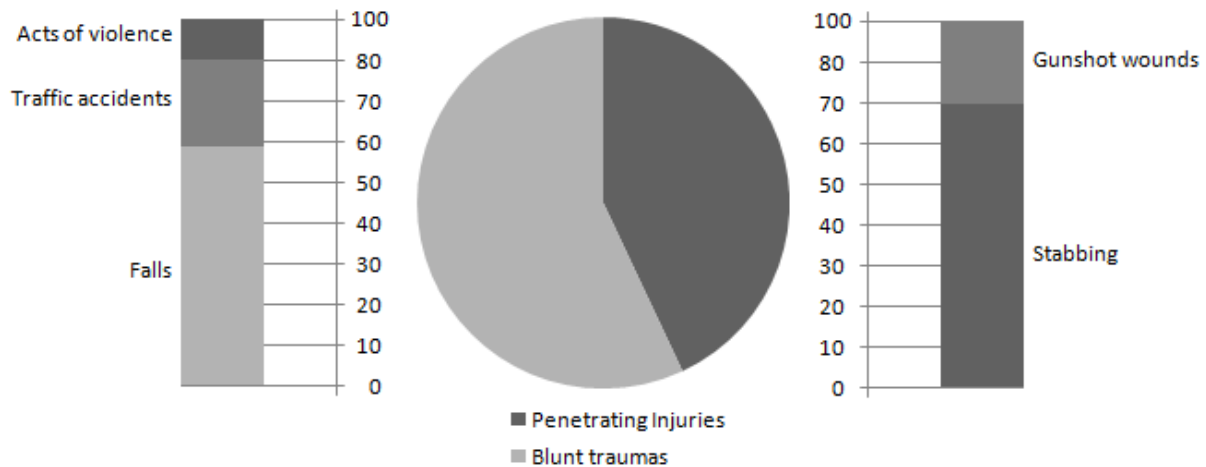
*LOS: Length of Stay, ICU: Intensive-care Unit

Statistical analysis of the study was done with the Chi-square test. Thoracic traumas were more often in males. Stabbing injuries were associated with male gender^(p<0.023). Falls from the same level were more often in females^(p<0.006). The ages range of 18-40 years were statistically related with stabbing^(p<0.0001), gunshot wounds^(p<0.05) and same level falls^(p<0.0001). MVC^(p<0.003) and stabbing^(p<0.001) were related with the 41-60 ages range. Patients older than 60 years were related with stabbing^(p<0.002) and falling from the same level^(p<0.0001). Comorbidities weren't associated with traffic accidents. However, it was related with stabbing^(p<0.002) and falling from the same level^(p<0.0001). Smoking and alcohol weren't statistically associated with traffic accidents. Use of

4.DISCUSSION

Thoracic trauma is one of the most common causes of death among multiple injuries [3]. Success is achieved in treatment with rapid diagnosis and multidisciplinary methods. Thoracic injury directly accounts for 25% of trauma-related deaths [1]. Direct deaths due to thoracic trauma were excluded in the study because they occurred after admission to the emergency department as an arrest. According to the study criteria, patients who were hospitalized in thoracic surgery were included in the study. The mortality rate of the study was found to be 2.6% (in stabbing and gunshot injuries). Blunt traumas of thoracic are more often than penetrating wounds. The most common blunt thoracic traumas are motor vehicle accidents, falls and crush injuries [4]. Penetrating injuries were 42.9% and blunt traumas 57.1% in the study (Figure I).

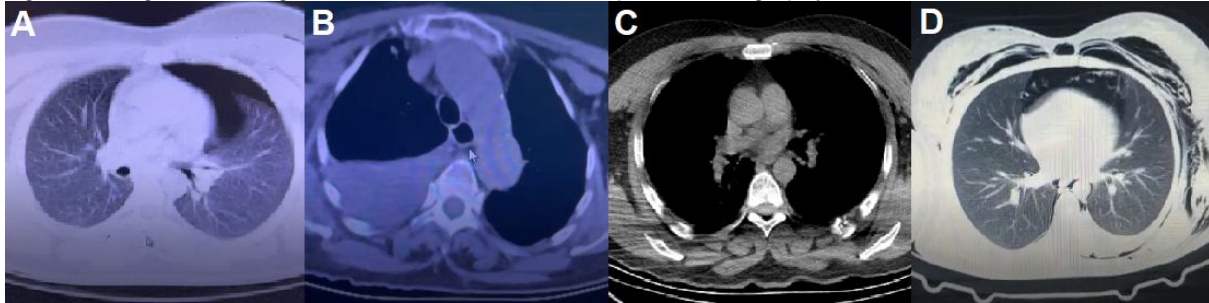
Figure I. Distribution of thoracic trauma types



Penetrating injuries cause pathological findings according to the anatomical localizations that the instrument can reach. Therefore, depth is very important in stabbing. In medical evaluation, it is always accepted that the entire blade reaches the tissues [4]. Stabbing injuries rarely cause ribs and extremities fractures. Ribs fractures were detected at a rate of 2.9% in stabbing in the study. Hemopneumothorax was seen at a rate of 94.1% in all stabbings that reached the thorax. Other injuries were lung contusion, diaphragm and abdomen, mediasten and cardiac injuries respectively. The injury rate may increase according to the trajectory of the bullet and the tissues it reaches in gunshot injuries. In the study, these were found to be lung contusion, pneumothorax, hemothorax, pneumomediastinum, bronchial injury, fractures of ribs and upper extremities, esophageal injury, cardiac, diaphragm and abdominal injuries respectively. Blunt traumas of the thorax were 58.4% falls, 24.6% motor vehicle collisions, 10.7% vehicles striking pedestrians, and 6.3% acts of violence in the study. The most common finding in blunt trauma was lung contusion. Other findings were fractures of ribs, hemothorax, pneumothorax, cardiac and brain injury, upper

extremity fractures, abdomen, lower extremity fractures, diaphragm injury, and fractures of vertebra respectively (Figure II).

Figure II. Images of findings of thoracic traumas on Computed Tomography



A. Left Pneumothorax (penetrating trauma), B. Right hemothorax (penetrating trauma), C. Left fracture of rib (blunt trauma)
D. Subcutaneous and mediastinal emphysema (blunt trauma)

Surgeries are required in 10-15% of blunt thoracic traumas and 15-30% of penetrating thoracic traumas [5]. Medical treatments (analgesia, antibiotics, oxygen therapy, bronchodilators, pulmonary exercises) were sufficient in 53.5% of all traumas in the study. Treatments of non-surgical were required in 72.3% of blunt traumas and 22.4% of penetrating traumas. Observation is sufficient instead of tube thoracostomy in the treatment of asymptomatic pneumothorax in (shorter than 8 mm, measured on Computed Tomography) blunt thoracic traumas [6-8]. Tube thoracostomy or needle aspiration are performed in the treatment of symptomatic and major pneumothorax. A volume of 300 mL is required to detect hemothorax on chest X-ray. A hemothorax larger than 300 to 500 mL is traditionally treated with tube thoracostomy [9-11]. Surgical treatments were required in stabbing, falls, gunshot wounds, traffic accidents, and acts of violence respectively in the study. Surgically, these were done 69.8% tube thoracostomy, 22.6% thoracotomy and 7.6% only primary skin repair. Of all traumas, which were required 32.4% tube thoracostomy, 15.7% primary skin repair, and 10.5% thoracotomy. The length of stays of tube thoracostomy were highest in acts of violence and stabbing, and at least falling from the same level. The average length of stays for tube thoracostomy were 1.47 days in all traumas.

Approximately 1500 mL (≥ 20 mL/kg) bloody drainage at the first moment, shock and hemodynamic instability, significant amount of bleeding (200-300 mL/hour) are generally accepted as thoracotomy indication [12,13]. In life-threatening situations, thoracotomy in the emergency wards can be done in order not to waste time. They were excluded, and treated patients were included in the thoracic surgery department in the study. The parenchyma of the lung was repaired in all traumas that done thoracotomy. No segmental or lobar resections of the lung were done. In patients with thoracotomy were done 75% intercostal ligation, 41.6% thoracic wall reconstruction, 33.3% mediastinal surgery and 25% diaphragm repair. Parenchyma of the lung repair and intercostal ligation were most commonly done in MVC and stabbing. Diaphragm repair was most often performed in stabbing. Reconstruction of the thoracic wall and mediastinal surgery were done mostly in gunshot wounds.

The maximum length of stay in the Intensive-care Unit were for acts of violence and gunshot wounds. This stays were at least in the falls from same level. The mean ICU stays were 1.61 days. The maximum length of stay in the hospital were in acts of violence and falls from height. This stays were at least in the falls from same level. The mean hospital stays were 5.1 days. Death was observed in stabbing and gunshot wounds. No death was observed in other causes of thoracic traumas. Rates of mortality were 13.3% in gunshot wounds and 2.9% in stabbing. Mortality rate was 2.6% in all thoracic traumas in the study.

5. CONCLUSIONS

Thoracic traumas were more often in males. Penetrating injuries were more common in adults younger than 40 years and blunt traumas in adults older than 40 years. The majority of patients

were without comorbidity. Non-surgical treatments were sufficient in 53.5% of all traumas. As surgical treatment were required 32.4% tube thoracostomy and 10.5% thoracotomy. These were done 100% parenchyma of the lung repair, 75% intercostal ligation, 41.6% thoracic wall reconstruction, 33.3% mediastinal surgery and 25% diaphragm repair in patients with thoracotomy. The maximum length of stay in the Intensive-care Unit were for acts of violence and gunshot wounds and the maximum length of stay in the hospital were in acts of violence and falls from height. Rates of mortality were 13.3% in gunshot wounds and 2.9% in stabbing. Mortality rate was 2.6% in all thoracic traumas in the study.

COMPETING INTERESTS

Author has declared that no competing interests exist.

FUNDING

No financial support

AUTHORS' CONTRIBUTIONS

The sole author designed, analyzed, interpreted and prepared the manuscript.

ETHICAL APPROVAL

Republic of Turkey Ministry of Health 2021-12-06T14_33_10 numbered and Gaziantep University Medical Ethics Committee 2022/05 numbered approvals were received.

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