

Research Paper

The Success Rate of Emergency Department Thoracotomy for Emergency Penetrating Chest Trauma



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ABSTRACT

Background and Aim: Trauma is considered one of the causes of mortality worldwide, among which chest injury is responsible for most of these deaths. This study aims to investigate the success rate of emergency thoracotomy in penetrating chest trauma in the emergency department of Shahid Beheshti and Farghani Hospital.

Materials and Methods: This study was conducted retrospectively by reviewing the files of patients with penetrating trauma from 2011 to 2021. The inclusion criteria comprised all cases that underwent emergency thoracotomy with chest trauma. Meanwhile, the exclusion criteria were incomplete cases and cases that underwent thoracotomy for other reasons (such as non-emergency thoracotomy, open heart operation, or non-traumatic thoracotomy). In addition, the files of other patients who had underlying diseases, such as cardiovascular diseases were excluded from the study. The study variables, including age, gender, mechanism of trauma, the severity of the trauma, area of trauma, vital signs on arrival, time to reach the operating room, and death or survival of patients were extracted from patient files and entered into the SPSS software, version 22. Finally, the data were analyzed by the Chi-square test and the paired t-tests. The significance level for all tests was considered 0.5.

Results: The average age of the patients was 32.67±13.16 years and 50(34.7%) patients were female while 94(65.3%) patients were male. A total of 91(63.2%) patients died and 53(36.8%) patients survived. The average time from injury to thoracotomy in the emergency department was 20.4±8.9 minutes. Thoracotomy was successful in 19(13.2%) women and 94 (65.3%) men. No significant correlation was found between gender (P=0.82), the mechanism of injury (P=0.58), the severity of injury (P=0.27), and the location of injury (P=0.15). The referral method of patients with successful thoracotomy was not found (P=0.39). The average duration of patients reaching the hospital until thoracotomy was performed in the emergency department was 17.5±6.69 minutes among the patients who survived and 22.14±9.6 among the patients who died. A significant correlation was found between the time from the injury and thoracotomy and the success of thoracotomy in patients (P=0.03).

Conclusion: Finally, the results showed as the average time between injury and thoracotomy gets shorter, the chance of success in thoracotomy increases.

Keywords:

Thoracotomy, Trauma, Thorax

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1. Introduction

Emergency thoracotomy (ET) is a life-saving procedure that is most effective in penetrating trauma [1, 2]. If the cardiopulmonary resuscitation process before the hospital lasts less than 15 minutes [3], asystole rhythm becomes visible and at the same time, tamponade does not occur, thereby following the guidelines of the American Association of Surgeons regarding trauma [4]. This definition is from North America, where penetrating trauma is the predominant trauma and trauma systems are equipped and trained to perform ET. In comparison, ET is performed in European countries because, as Narvestad [5] stated in his study, penetrating trauma is less than 10% of traumas in Europe and ET is used less in blunt trauma due to its complications [5]. In two European studies, the success rate was in the range of 0% to 1.59%, which was almost the same for both blunt and penetrating trauma [6, 7]. According to a study conducted in Iran, blunt trauma comprised 96.7% and penetrating trauma 3.3% of subjects [8]. Regarding the treatment of penetrating heart lesions, the cause of heart damage is essential. Mild pericardial or myocardial damage with tamponade is successfully treated by pericardiocentesis. On the other hand, large and severe damage to the pericardium or myocardium should be done [9] and the patient should immediately undergo thoracotomy and cardiography. Median sternotomy is the preferred method in most stable patients when the diagnosis of penetrating heart damage is certain and the occurrence of other lesions is not suspected. In addition to the heart and large vessels, this method provides access to other structures of the mediastinum and both pleural cavities [10]. The left anterolateral thoracotomy provides quick access to the left and right ventricles of the heart and the pulmonary artery. This approach is a method for ET. This type of thoracotomy is less satisfactory for accessing the right atrium, superior and inferior vena cava, and the proximal aorta, although it is performed quickly. It may be extended to the right side of the chest as a clamshell incision, allowing examination of other injuries, and allowing transverse clamping of the descending thoracic aorta if the patient is losing blood. The chest is opened through the 5th intercostal space (below the nipple of men) and the sternum is cut transversely. Although the anterior heart wound is routinely repaired with a knife without transversal incision of the sternum [11]. Regardless of where ET is performed, it is a procedure associated with significant mortality and its importance has led to the need for careful investigations. This study aims to investigate the success rate of ET in penetrating chest

trauma in the emergency department of Shahid Beheshti Hospital in Qom City, Iran during the last 5 years.

2. Materials and Methods

This study was conducted retrospectively by reviewing the files of patients with penetrating trauma from 2011 to 2021. According to the sample size formula for prevalence studies [5] and considering a 40% probability, the 1st type error equal to 5%, and sampling accuracy equal to 8%, the required sample size for the current study was calculated at 144 people.

After approving the plan in the Research Council of the Faculty of Medicine and obtaining the Code of Ethics (IR.MUQ.REC.1399.179) from the Research Vice-Chancellor of Qom University of Medical Sciences, the researcher referred to the [Shahid Beheshti University of Medical Sciences](#) Training Center and Farghani Medical Training Center and coordinated with the head of the centers.

Subsequently, the researcher went to get the introduction letter for the medical documents from this unit. Having the checklist, the researcher extracted the study variables, namely age, gender, trauma mechanism, trauma severity, trauma area, vital signs on arrival, time to reach, and the death or survival of the patients from the patient's records. Also, the primary rescue was defined as having vital signs and being transferable to the operating room. The inclusion criteria comprised all cases that underwent ET with chest trauma. The exclusion criteria comprised incomplete cases and cases that underwent thoracotomy for other reasons (such as non-emergency thoracotomy, open heart operation, or non-traumatic thoracotomy). Also, the files of other patients who had underlying diseases, such as cardiovascular diseases were excluded from the study. Study variables, namely age, gender, mechanism of trauma, the severity of the trauma, area of trauma, vital signs on arrival, time to reach the operating room, and death or survival of patients were extracted from patient files and entered into the SPSS software, version 22. Finally, the data were analyzed via the Chi-square test and the paired t-test. The significance level for all tests was considered 0.5.

3. Results

In this study, 50(34.7%) female patients and 94(65.3%) male patients were studied. The average age of the participants from the patients who died was 32.46 ± 14.2 years and the average age of the patients who survived was 33.07 ± 11.2 . No significant difference was observed between the two groups in terms of age ($P=0.78$). The mech-



Figure 1. Anatomical location of the injury in patients

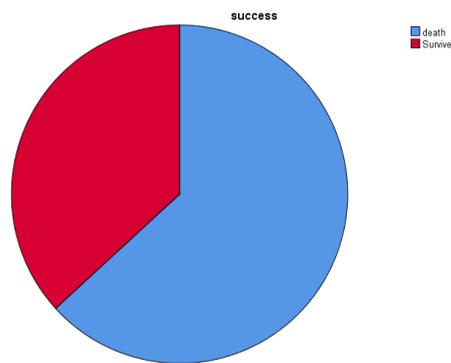


Figure 2. Prognosis of patients after thoracotomy

anism of injury in patients was accidents in 65(45.1%) patients, knife wounds and sharp objects in 39(27.1%) patients, gunshot wounds in 3(2.1%) cases, falls in 30(20.8%) cases, and other accidents in 7(4.9%) patients. In terms of the severity of the injury, only 20(13.9%) cases had mild injuries and 80(55.6%) cases had severe injuries. The most injured anatomical location was the midline area in 50(34.7%) cases and the least affected area was the right lower quadrant area in 19 cases (13.2%) (Figure 1). Among the participants, 44(37.5%) patients were brought to the hospital with their families and 90(100%) patients

were brought to the hospital by ambulance. The average duration of injury, until thoracotomy was performed in the emergency department, was 20.4 ± 8.9 minutes. In this study, 91(63.2%) patients died and 53(36.8%) patients survived (Figure 2). Thoracotomy was successful in 19(13.2%) women and 34(23.6%) men, and no significant relationship was found between gender and the success of thoracotomy in patients ($P=0.82$).

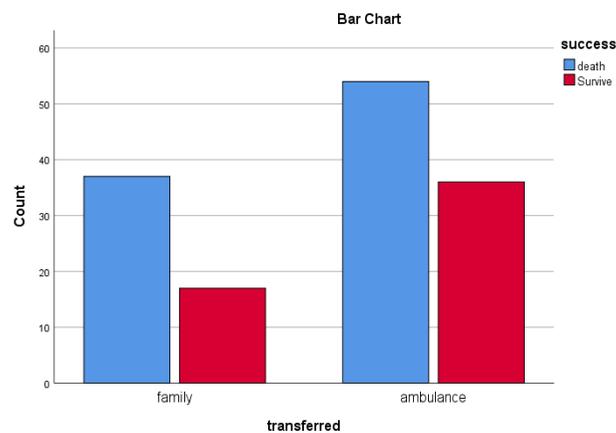


Figure 3. Referral of patients with successful thoracotomy

The success of thoracotomy in accident patients has a higher percentage for 65(45.1%) patients; however, in patients who came with gunshot wounds, thoracotomy was not successful (0%). No statistically significant relationship was found between the mechanism of injury and the success of thoracotomy ($P=0.58$). In examining the severity of the injury, a lower number of successful thoracotomies was seen in severe cases. Nonetheless, no significant statistical relationship was observed between the examination of the severity of the injury and success in thoracotomy ($P=0.27$). Of the patients who survived, most of them were injured in the left lower quadrant area, and the least of these patients were injured in the right chest area (7 cases [4.9%]). No significant relationship was found between the injury and the success of thoracotomy ($P=0.15$) (Table 1). Among the patients who survived, most of them (36 [25%] cases) were admitted to the hospital by emergency. No statistically significant relationship was found between the way patients were referred and the success of thoracotomy ($P=0.39$) (Figure 3). The average length of time the patients arrived at the hospital was 17.5 ± 6.69 minutes for the patients who

survived and 22.14 ± 9.6 minutes for the patients who died. A significant relationship was found between the duration of injury and thoracotomy in patients ($P=0.03$) (Table 2).

4. Discussion

The average duration of patients arriving at the hospital until performing thoracotomy in the emergency department was 17.5 ± 6.69 minutes for patients who survived and 22.14 ± 9.6 minutes for patients who died. A significant relationship was found between the time of injury and the conduction of thoracotomy in patients. In a study by Segalini [12] in 2018, titled "Consequences and Results of Emergency Thoracotomy After the Implementation of a Liberal Policy in a Level 1 Trauma Center in Western Europe," after an 8-year experience examining the course and results of emergency thoracotomy in blunt and penetrating trauma, he presented an algorithm for patient selection. The study was done retrospectively and patients were selected in the two periods of 2010 to 2012 and 2013 to 2017. Factors, such as demographic

Table 1. Trauma parameters in two groups according to the results of thoracotomy

Risk Factor	No. (%)			P	
	Died	Survived	Total		
Gender	Women	31(21.5)	19(13.2)	50(34.7)	0.82
	Men	60(41.7)	34(23.6)	94(65.3)	
Mechanism of injury	Accident	40(27.8)	25(17.4)	65(45.1)	0.58
	Penetrating lesion	23(16)	16(11.1)	39(27.1)	
	Gunshot	3(2.1)	0(0)	3(2.1)	
	Falling	21(14.6)	9(6.3)	30(20.8)	
	Others	4(2.8)	3(2.1)	7(4.9)	
Severity of injury	Low	9(6.3)	11(7.6)	20(13.9)	0.27
	Mid	24(16.7)	20(13.9)	44(30.6)	
	Sever	58(40.3)	22(15.3)	80(55.6)	
Location	Midline	36(25)	14(9.7)	50(34.7)	0.15
	RUQ	18(12.5)	7(4.9)	25(17.4)	
	LLQ	14(9.7)	16(11.11)	30(20.8)	0.15
	RLQ	12(8.3)	7(4.9)	19(13.2)	
	LUQ	11(7.6)	9(6.3)	20(13.9)	

Table 2. The time between injury and thoracotomy in two groups based on thoracotomy success

Variables	Success	F	Meant±SD	P
The time between injury and thoracotomy	Died	91	22.14±9.6	0.03
	Survived	53	17.5±6.69	

and clinical information, mechanism of injury, injury severity score, location of the injury, the time since the cardiac arrest, presence or absence of vital signs, expected length of stay, as well as survival rate and neurological sequelae were investigated. A total of 27 cases of emergency thoracotomy were performed. Of these, 21 cases were performed after blunt trauma and 6 after penetrating trauma. Motorcycle accidents and falling from a height were the most common injury mechanisms. The average age was 40.5 years and the average injury severity was 40 score. The most common injury was tamponade. The initial survival rate was 10% during the 1st period and 23.5% during the 2nd period (considering the study policy). No long-term neurological complications were reported. In the 1st period, an emergency thoracotomy was performed on 2 patients with penetrating trauma and both patients were alive; however, one of the patients died in the intensive care unit. In the 2nd period, considering the study policy and proposed algorithm, 4 patients with penetrating trauma were subjected to thoracotomy, of which all 4 patients survived and one of them died in the intensive care unit. In the study by DiGicamo et al. with the title “Emergency Thoracotomy in the Emergency Department for Resuscitation of Patients With Fatal Injuries,” which was performed retrospectively on patients who underwent emergency thoracotomy during resuscitation over 22 years, the early rescue was defined as having vital signs and being transferable to the operating room. Emergency thoracotomy was performed on 68 patients, of which 27 patients were saved and transferred to the operating room. By reviewing these patients, the subjects who were not saved by emergency thoracotomy showed fewer vital signs compared to the patients who were transferred to the operating room (those subjects who had no signs of life when they entered the emergency room).

This study found emergency thoracotomy effective for patients with thoracic or subdiaphragmatic trauma and minimal vital signs [13]. In Rhee’s (2000) study, titled “Rescue After Emergency Thoracotomy: A Review of Studies Published in the Past 25 Years,” a total of 4620 cases undergoing emergency department thoracotomy (EDT) following blunt and penetrating trauma were

studied. EDT had a success rate of 7.4% in this study and 92.4% of patients had neurological complications. Factors involved in causing complications were the mechanism of injury, the major site of injury, and vital signs were mentioned. The factors that were reported as effective outcomes included the mechanism of injury, the site of major injury, and vital signs. No independent and specific preoperative factor exists that could predict death in the same way [14]. Bijani et al. (2012) conducted a descriptive cross-sectional study on 300 injured patients with the title, “Study of Patients With Chest Trauma Referred to Hazrat Waliar (AS) Fasa Educational-Treatment Center: Epidemiology of Chest Trauma”. Among 240 men and 60 women who were referred to the emergency department of Valiasr Hospital, Fasa City, Iran, the most common cause of trauma was driving accidents (58.4%) and the least common cause was the use of cold weapons (2.7%) [15].

5. Conclusion

The results showed as the average time between injury and thoracotomy gets shorter, the thoracotomy success rate increases.

Ethical Considerations

Compliance with ethical guidelines

This article was approved in the form of a research project by the Research Council of the Faculty of Medicine, obtaining the following Code of Ethics from the Research Vice-Chancellor of [Qom University of Medical Sciences](#) (Code: IR.MUQ.REC.1399.179).

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Authors' contributions

All authors have contributed to the present research department’s design, implementation, and writing.

Conflict of interest

The authors declare no conflict of interest.

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