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Prevalence and Survival Rate of Trauma Patients who Underwent Resuscitative Thoracotomy in a Level One Trauma Center in Southern Iran

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ABSTRACT

Objective: This study aimed to determine the prevalence and survival rate of trauma patients who underwent resuscitative thoracotomy (RT) in a level I trauma center in southern Iran.
Methods: This cross-sectional descriptive study conducted at Rajaee Hospital (Shiraz, Iran) from March 2018 to October 2022, included trauma patients who underwent RT surgery. Demographic information, vital signs at arrival, mechanism of injury, type of trauma, admission and discharge dates, length of hospital stay, blood transfusions, associated injuries, and clinical and laboratory parameters were evaluated. Statistical analyses were conducted using SPSS software.
Results: A total of 147 trauma patients underwent RT. The patients' mean age was 39±18.49 years. The majority of participants were men (82.40%). The most prevalent type of damage was blunt trauma, with a survival rate of 3%, followed by penetrating trauma, which had a 20% survival rate. The leading cause of trauma-related fatalities was road traffic accidents (78.9%). The majority of RT procedures (75.5%) took place in cardiopulmonary resuscitation (CPR) rooms. The survival group had lower systolic and diastolic blood pressure levels than the non-survival (83.0±34.96 vs. 97.83±33.10) and (40.75±20.91 vs. 62.48±25.36), respectively. Survivors exhibited a significantly higher Glasgow Coma Scale than non-survivors (8.40±6.14 vs. 4.75±3.84).
Conclusion: The study revealed a low survival rate among trauma patients undergoing RT. Blunt chest trauma emerged as an independent predictor of poor outcomes. Future studies should further explore indications and outcomes of RT to better inform clinical practice.

Keywords: Thoracotomy, Thoracic surgery, Cardiac arrest, Injury.

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Introduction

Thoracotomy is a critical surgical procedure in trauma patients that allows for the evacuation of pericardial tamponade, direct control of intrathoracic hemorrhage, control of massive air-embolism, open cardiac massage, and cross-clamping of the descending aorta to redistribute blood flow and limit sub-diaphragmatic hemorrhage [1]. While many cases of thoracic trauma can be managed without surgery, a significant subset, approximately one-fifth, requires resuscitative thoracotomy (RT) during the early stages of resuscitation [2-4]. RT is typically performed on patients who are either in a state of "pre-arrest" or during "cardiac arrest", often following traumatic incidents. It also serves other crucial objectives such as restoring cardiac output, alleviating cardiac tamponade, providing direct cardiac massage, and preserving severe blood loss [4].

Recent studies suggest that RT is relatively futile in patients with no sign of life (SOL) and has a better prognosis in those with penetrating injuries of extremities [5, 6]. A nationwide study in Japan found a survival rate of 13.5% for RT in the emergency department [7]. Another study in a Dutch level-one trauma center found a staggering 32% survival rate among the patients [8]. Penetrating trauma, any sign of life upon admission to the hospital, a GCS of 15, and a thoracotomy in the operating room were found to be associated with the success rate of RT in trauma patients [8]. RT performed in the emergency department required more frequent hemostatic surgeries and also required more transfusions [9].

Despite its usefulness in life-saving trauma interventions, studies evaluating the outcomes of RT are limited, especially within the Iranian healthcare system [10]. To address this knowledge gap, this study investigated the prevalence and survival rates of trauma patients undergoing RT at Rajaee Hospital (Shiraz, Iran) from March 2018 to October 2022. Given Rajaee Hospital's extensive experience in trauma care, it provided a comprehensive setting for analyzing the role of RT in the management of severe thoracic injuries.

By examining the demographic data, injury mechanisms, and clinical outcomes of patients undergoing RT, this research aimed to provide valuable insights into the effectiveness of RT. The findings might serve to improve clinical guidelines, trauma care protocols, and ultimately, patient survival. Through this retrospective analysis, the researchers aimed to contribute to evidence-based strategies for managing critically injured trauma patients, especially those requiring RT.

Materials and Methods

This retrospective cross-sectional descriptive study included all trauma patients who underwent RT at Shahid Rajaee (Emtiaz) Hospital (Shiraz, Iran) from March 2018 to October 2022. During the study period, 206 patient records were found to have undergone RT; however, 59 (28.6%) were excluded from the analysis due to the following criteria: elective and scheduled emergency thoracotomies (such as for rib fixations for flail chest), patients with associated severe intracranial injuries, RT related to non-traumatic indications (i.e., ruptured abdominal aortic aneurysm, severe gastrointestinal hemorrhage), patients with cardiac arrest, and loss of signs of life upon ED arrival, patients who underwent RT more than 24 h after ED arrival, patients who underwent RT at the accident site, and patients with insufficient outcome data.

Finally, 147 patients were included in the study. For each patient, the following data were recorded: demographic details, vital signs at arrival, mechanism of injury, type of trauma, admission date, mortality discharge date, length of hospital stay, ward name, blood transfusion, related injury, and clinical and laboratory factors. All emergency thoracotomies in this study were performed within one hour of the patient's arrival at the emergency department.

The statistical analysis was conducted using SPSS software (version 27.0) and MedCalc software (version 22.021). The means and standard deviations were reported as crude numbers and percentages. The normality of the data was evaluated using a T-test.

Results

During the study period, 206 patient charts were identified as having received RT, with 59 (28.6%) patients being excluded from analysis due to missing data. Finally, 147 patients were involved in the study. The mean age of patients who underwent resuscitative thoracotomy (RT) was 39±18.49 years, and 121 out of 147 patients (82.3%) were men. The majority of patients (133 of 147 [90.5%]) underwent RT due to blunt trauma, with 4 survivors (3%). Conversely, 14 patients underwent RT for penetrating trauma, with only one survivor (20%). Overall, 5 patients (3.4%) survived, while 142 patients (96.6%) did not. Car turnover 40 (27.2%) and car-to-pedestrian accidents 28 (19.7%) were the most common causes of trauma, primarily occurring in road traffic accidents (RTAs), which had the highest fatality rate among RT cases. The most frequently affected body parts among RT patients were the thorax 79 (53.7%), multiple trauma 61 (41.5%), and the head and neck 58 (39.5%). No patients with thoracic or head and neck traumas survived. The majority of RT procedures were conducted in the cardiopulmonary resuscitation (CPR) room, 111 patients (75.5%), while 32 patients (21.8%) were performed in the operating room. Only four patients (2.7%) were transferred to the intensive care unit (ICU). Notably, survival rates were one patient (20%) in CPR and ICU, and 3 patients (60%) in the operating room (Table 1).

Table 1. Demographic characteristics, mechanism of trauma, and type of injury in patients who underwent a resuscitative thoracotomy

Variables		Total (n=147)	Survivor (n=5)	Non-survivor (n=142)
Age, Year (Mean±SD)		39±18.49	24.6±9.7	39.51±18.54
Sex, n (%)				
Male		121 (82.3)	4 (80)	117 (82.4)
Female		26 (17.7)	1 (20)	25 (17.6)
Type of trauma, n (%)				
Blunt		133 (90.5)	4 (80)	129 (90.8)
Penetrating		14 (9.5)	1 (20)	13 (9.2)
Mechanism of trauma, n (%)				
Car to pedestrian		28 (19.7)	0 (0)	28 (19.7)
Car turn over		40 (27.2)	1 (20)	39 (27.5)
Car to car		16 (10.9)	1 (20)	15 (10.6)
Motor to car		17 (11.6)	1 (20)	16 (11.3)
Motor to pedestrian		2 (1.4)	0 (0)	2 (1.4)
Motor to motor		2 (1.4)	0 (0)	2 (1.4)
Vehicle turns over		10 (6.8)	0 (0)	10 (7)
Gunshot		4 (2.7)	0 (0)	4 (2.8)
Falling		16 (10.9)	0 (0)	16 (11.3)
Stab wound		9 (6.1)	1 (20)	8 (5.6)
Other		3 (2)	1 (20)	2 (1.4)
Body region injury, n (%)				
Head and neck	No	89 (60.5)	4 (80)	85 (59.5)
	Yes	58 (39.5)	1 (20)	57 (40.1)
Face	No	136 (92.5)	5 (100)	131 (92.3)
	Yes	11 (7.5)	0 (0)	11 (7.7)
Thorax	No	68 (46.3)	3 (60)	65 (45.8)
	Yes	79 (53.7)	2 (40)	77 (54.2)
Abdomen	No	96 (65.3)	2 (40)	94 (66.2)
	Yes	51 (34.7)	3 (60)	48 (33.8)
Extremities	No	123 (83.7)	4 (80)	119 (83.8)
	Yes	24 (16.3)	1 (20)	23 (16.2)
External	No	142 (93.2)	5 (100)	137 (96.6)
	Yes	5 (3.5)	0 (0)	5 (3.4)
Multiple trauma	No	86 (58.5)	5 (100)	81 (57)
	Yes	61 (41.5)	0 (0)	61 (43)

SD: standard deviation

The laboratory parameters showed that pressure O_2 (67.04±23.76 vs. 49.27±31.98) and saturated O_2 (59.82±52.66 vs. 52.3±59.8) were higher in survivors than in non-survivors. On the other hand, survivors who underwent RT showed lower levels of PCO_2 (39.26±10.14 vs. 53.08±17.84) and HCO_3 (16.16±5.36 vs. 17.09±4.92). Survivors had higher white blood cell (WBC) and neutrophil counts (75.66±5.65 vs. 59.35±14.95) than non-survivors, while lymphocyte cells decreased (19.82±7.02 vs. 39.62±17.31). Compared to non-survivors, survivors had lower fibrinogen levels (169.6±56.81 vs. 176.29±96.16). Survivors exhibited significantly higher GCS, SBP, DBP, heart rate, and respiratory rate than non-survivors (Table 2).

In addition, survivors received more pack cells (23.80±11.03 vs. 3.37±4.32), fresh frozen plasma (13.0±7.74 vs. 2.22±4.01), platelet (5.80±11.88 vs. 1.28±4.11), and normal saline fluid (1020.0±44.72 vs. 827.46±491.65) transfusions than non-survivors. In addition, it was found that patients who had RT also underwent surgical interventions, with laparotomy being the most frequent (n=53, 36.1%), of which 49 patients (34.5%) died. Furthermore, data analysis showed that the frequency of thoracotomy performed within the hospital was higher than the outside 102 (69.4%) vs. 45 (30.6%). In total, 111 patients (75.5%) underwent an RT in the cardiopulmonary resuscitation room (CPR), which was the critical unit for the patients who underwent an RT in the present study. Moreover, 32 (21.8%) patients underwent RT in the operating room (OR), and only four patients (2.7%) were transferred to the hospital ICU. It is worth noting that the survival rate in CPR and ICU was identical for one patient (20%), whereas three patients (60%) survived in OR. Non-survivors had an average survival time of 1188.38±7694.53 minutes following thoracotomy (Table 3).

Table 4 shows the demographic characteristics of patients who died before and after 24 hours. Patients who died before 24 hours had a lower mean age than those who died after (39.07±18.66 vs. 46.88±15.67).

Table 2. Laboratory and clinical factors in patients who underwent a resuscitative thoracotomy

Variables	Total (n=147)	Survivor (n=5)	Non-survivor (n=142)
Laboratory Factors			
PCO2, mmHg	52.42±17.77	39.26±10.14	53.08±17.84
PO2, mmHg	52.66±57.73	59.82±52.66	52.3±59.8
SO2, DU	50.12±31.78	67.04±23.76	49.27±31.98
HCO3, mEq/L	17.04±4.92	16.16±5.36	17.09±4.92
Be	-12.10±6.68	-11.6±7.0	-12.16±6.7
Hb, g/dL	11.62±2.46	11.5±1.84	11.62±2.49
Plt, plt/mL	215.49±70.94	248±20.83	213.9±72.18
WBC, WBC/µL	15.75±24.16	24.42±6.38	15.32±24.64
Neu, Neu/µL	60.33±15.06	75.66±5.65	59.35±14.95
Lymphocyte, Lymphocyte /µL	38.69±17.47	19.82±7.02	39.62±17.31
Na	139.45±3.85	137.4±4.39	139.56±3.82
K	4.21±0.85	3.74±0.42	4.24±0.86
Fibrinogen, mg/dL	175.98±94.5	169.6±56.81	176.29±96.16
PT, Seconds	23.16±15.64	16.32±3.55	23.50±15.93
PTT, Seconds	59.21±35.73	40.60±18.36	60.12±36.17
INR	2.68±1.98	1.79±0.66	2.72±2.01
Clinical Factors, Mean±SD			
GCS	4.87±3.96	8.40±6.14	4.75±3.84
SBP, mmHg	97.12±33.12	83.0±34.96	97.83±33.10
DBP, mmHg	61.77±25.26	40.75±20.91	62.48±25.36
H.R, Beats/min	72.93±59.8	97.60±55.53	72.06±52.94
R.R, Breathe/min	11.61±10.54	14.60±13.70	11.51±10.45

PCO2: Pressure CO_2; PO_2: Pressure O_2; Hb: Hemoglobin; Plt: Platelet; WBC: White blood cell; Neu: Neutrophil; GCS: Glasgow coma score; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; H.R: Heart rate; R.R: Respiratory rate

Table 3. Transfusion and surgical interventions in patients who underwent a resuscitative thoracotomy

Variables		Total (n=147)	Survivor (n=5)	Non-survivor (n=142)
Transfusion Interventions, Mean±SD				
Pack cell		4.07±5.93	23.80±11.03	3.37±4.32
FFP		2.59±4.58	13.0±7.74	2.22±4.01
Plt		1.44±4.57	5.80±11.88	1.28±4.11
Fluid (normal saline)		834.01±484.48	1020.0±44.72	827.46±491.65
Surgical interventions, n (%)				
Laparotomy	No	94 (63.9)	1 (20)	93 (65.5)
	Yes	53 (36.1)	4 (80)	49 (34.5)
Chest packing	No	141 (95.9)	4 (80)	137 (96.5)
	Yes	6 (4.1)	1 (20)	5 (3.5)
Abdominal packing	No	144 (97.9)	5 (100)	139 (98)
	Yes	3 (2.1)	0 (0)	3 (2)
Heart repair	No	140 (95.1)	5 (100)	135 (95.2)
	Yes	7 (4.9)	0 (0)	7 (4.8)
Pericardiotomy	No	139 (94.6)	4 (80)	135 (95.1)
	Yes	8 (5.4)	1 (20)	7 (4.9)
Pelvic packing	No	129 (87.8)	2 (40)	127 (89.4)
	Yes	18 (12.2)	3 (60)	15 (10.6)
Splenectomy	No	134 (91.2)	4 (80)	130 (91.5)
	Yes	13 (9.8)	1 (20)	12 (9.5)
Liver packing	No	132 (89.8)	4 (80)	128 (90.1)
	Yes	15 (10.2)	1 (20)	14 (9.9)
Arrest, N (%)				
Hospital inside		102 (69.4)	5 (100)	97 (68.3)
Hospital outside		45 (30.6)	0 (0)	45 (31.7)
Location thoracotomy, N (%)				
OR		32 (21.8)	3 (60)	29 (20.4)
CPR		111 (75.5)	1 (20)	110 (77.5)
ICU		4 (2.7)	1 (20)	3 (2.1)
Alive after thoracotomy, min (Mean±SD)		-	-	1188.38±7694.53

FFP: Fresh frozen plasma; Plt: Platelet; OR: Operating room; CPR: Cardiopulmonary resuscitation; ICU: Intensive cate unit

Table 4. Demographic characteristics, mechanism of trauma, and body of injury in non-survivors who underwent a resuscitative thoracotomy

Variables		Dead before 24 h (n=134)	Dead after 24 h (n=8)
Age, Year (Mean±SD)		39.07±18.66	46.88±15.67
Mechanism of trauma, n (%)			
Car to pedestrian		28 (19.7)	0 (0)
Car turn over		39 (27.5)	1 (20)
Car to car		15 (10.6)	1 (20)
Motor to car		16 (11.3)	1 (20)
Motor to pedestrian		2 (1.4)	0 (0)
Motor to motor		2 (1.4)	0 (0)
Motor turn over		10 (7)	0 (0)
Gunshot		4 (2.8)	0 (0)
Falling down		16 (11.3)	0 (0)
Stab wound		8 (5.6)	1 (20)
Other		2 (1.4)	1 (20)
Body region injury, n (%)			
Head and neck	No	85 (59.5)	4 (80)
	Yes	57 (40.1)	1 (20)
Face	No	131 (92.3)	5 (100)
	Yes	11 (7.7)	0 (0)
Thorax	No	65 (45.8)	3 (60)
	Yes	77 (54.2)	2 (40)
Abdomen	No	94 (66.2)	2 (40)
	Yes	48 (33.8)	3 (60)
Extremities	No	119 (83.8)	4 (80)
	Yes	23 (16.2)	1 (20)
External	No	137 (96.6)	5 (100)
	Yes	5 (3.4)	0 (0)
Multiple trauma	No	81 (57)	5 (100)
	Yes	61 (43)	0 (0)

While car turnover was the leading cause of trauma, with 39 (27.5%) of the patients dying before 24 hours, followed by car-to-pedestrian accidents 28 (19.7%), car-related accidents and stab wounds were the primary mechanism of trauma in the patients who died after 24 hours. Moreover, the frequency distribution of body region injuries among patients who died before 24 hours was evaluated. The most common injuries among patients who died before 24 hours were thorax injury (n=77, 54.2%), multiple-trauma (n=61, 43%), and head and neck injury (n=57, 40.1%), while the most common body injury regions in patients who died after 24 hours were abdomen (3 patients) and thorax traumas (2 patients).

Furthermore, Table 5 showed that patients who died before or after 24 hours, required surgical operations in addition to thoracotomy, with laparotomy being the most frequent in both groups (n=43, 32.1% vs. n=6, 75%). The data analysis revealed that, although the frequency of thoracotomy performed within the hospital was higher than that performed outside, the former was more prevalent among patients who died within 24 hours (66.4% vs. 33.6%). Conversely, all patients who died after 24 hours underwent an RT within the hospital. It was also observed that 107 (79.9%) of patients who died before 24 hours underwent an RT in CPR, while four patients (50%) died after 24 hours sustained an RT in OR.

Discussion

The findings of this study shed light on the appropriateness and effectiveness of RT at a level I trauma center in southern Iran. The present study, which included 147 patients undergoing RT, yielded a combined survival rate of 3.4% (5 patients).

The majority of patients who received RT in our study were men, which was consistent with prior research demonstrating a higher prevalence of traumatic injuries among men, particularly in hazardous occupations and road traffic accidents (RTAs) [7, 11-15]. Moreover, this study showed a higher proportion of young patients undergoing RT, particularly those with thoracic injuries [13-15]. However, several investigations reported contradictory findings, highlighting the variation in patient demographics and injury patterns across different populations [16].

The prevalence of blunt trauma among survivors (4 out of 5 or 80%) in our study was consistent with prior research, which suggested that blunt trauma patients undergoing RT might have better outcomes than those with penetrating injuries. There is a controversy among different studies. This difference in survival rates might stem from the lower likelihood of surgically correctable causes of shock in blunt trauma cases [7].

Table 5. Surgical interventions and location of thoracotomy in non-survivors who underwent a resuscitative thoracotomy

Variables		Dead before 24 h (n=134)	Dead after 24 h (n=8)
Surgical interventions, N (%)			
Laparotomy	No	91 (67.9)	2 (25)
	Yes	43 (32.1)	6 (75)
Chest packing	No	130 (97)	7 (87.5)
	Yes	4 (3)	1 (12.5)
Abdominal packing	No	131 (97.8)	8 (100)
	Yes	3 (2.2)	0 (0)
Heart repair	No	128 (95.5)	7 (87.5)
	Yes	6 (4.5)	1 (12.5)
Pericardiotomy	No	128 (95.5)	7 (87.5)
	Yes	6 (4.5)	1 (12.5)
Pelvic packing	No	123 (91.8)	4 (50)
	Yes	11 (9.2)	4 (50)
Splenectomy	No	124 (92.5)	6 (75)
	Yes	10 (7.5)	2 (25)
Liver packing	No	122 (91)	6 (75)
	Yes	12 (9)	2 (25)
Arrest, n (%)			
Hospital inside		89 (66.4)	8 (100)
Hospital outside		45 (33.6)	0 (0)
Location thoracotomy, n (%)			
OR		25 (18.7)	4 (50)
CPR		107 (79.9)	3 (37.5)
ICU		2 (1.4)	1 (12.5)

OR: Operating room; CPR: Cardiopulmonary resuscitation; ICU: Intensive care unit

Several meta-analysis studies supported these findings, with mortality rates for penetrating trauma ranging from 8 to 22% and for blunt trauma varying from 2 to 7% [5, 17, 18]. Furthermore, considering the 96.6% mortality rate in our study and the fact that the majority of them sustained blunt trauma, it is suggested that RT for cases of blunt trauma should be meticulously selected.

Paydar and colleagues studied 58 cases who underwent EDT following multiple traumas and found that four patients (6.9%) survived [13]. The findings of the present study added to the growing corpus of research on RT outcomes in Iranian trauma centers. Other regions, such as Japan and Toronto, reported similar survival rates, with variances due to differences in patient populations and healthcare systems [19-21]. The reported survival rates in RT patients vary widely among various studies. Factors such as patient selection criteria, trauma severity, and pre-hospital care protocols might influence these disparities [22-24]factors that positively influence 30-day survival rates were investigated. METHODS: A retrospective study of patients (> 16 years.

Early identification of patients who are appropriate for prompt transfer to the OR for damage control surgery, supported by activation protocols such as "code crimson" and "trauma attend", can optimize outcomes for thoracic trauma patients [14]. In our study, multiple trauma and head and neck injuries were prevalent concomitant injuries in patients with thoracic trauma, highlighting the multifaceted nature of traumatic injuries and the need for comprehensive management strategies [25].

Analysis of laboratory and clinical factors indicated differences between survivors and non-survivors, highlighting the potential prognostic value of parameters such as signs of life (SOL), blood pressure, and Glasgow Coma Scale (GCS). Trauma scoring systems such as NEWS2, RTS, GAP, and MGAP could be beneficial in prompt evaluation and prediction of patients' clinical prognosis [26-29]. Yousefi *et al.,* proved that NEWS2 could effectively predict the mortality rate of trauma patients based on their prehospital clinical status [30]. Moreover, markers of inflammatory response, such as neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR), emerged as potential predictors of outcomes in RT patients [31, 32].

We found that survivors received a higher volume of transfusion, consisting of fluid normal saline, packed cell, FFP, and platelet than non-survivors, which was compatible with previous studies indicating the need for aggressive resuscitation and hemostatic surgery in severely injured patients. Laparotomy was the most common concurrent surgical procedure, indicating a high prevalence of abdominal injuries in patients, which was in agreement with previous investigations [9, 33].

This study had several important limitations. Firstly, the lack of specific data on the optimal timing for performing resuscitative thoracotomy (RT) in critically injured patients was a major shortcoming. This is a

crucial omission, as the effectiveness of RT largely hinges on the time interval between cardiac arrest and the procedure. Thus, this needs to be addressed [34]. Previous research showed that the time from loss of pulse to thoracotomy was significantly shorter in survivors [35], which was biologically plausible and supported by literature. For instance, better outcomes were observed in patients who underwent RT within 30 minutes of injury than those who had the procedure after 30 minutes [36]. Subsequently, the study was conducted at a single center, focused on an uncommon intervention, and had a small sample size, which limited our ability to perform detailed statistical analyses and identify independent variables associated with survival outcomes. Furthermore, while the study population was heterogeneous in terms of injury types, ages, and comorbidities, the high volume of major trauma cases at the study site might limit the generalizability of these findings to other institutions. Therefore, the specific interventions and outcomes observed in this study might not be directly applicable elsewhere. As a retrospective review of medical records, the study was also subject to biases inherent to this method of data collection. Incomplete data, such as gaps in full medical histories, CPR times, injury severity scores (ISS), and FAST (Focused Assessment with Sonography for Trauma) results, might impair the robustness of our conclusions. Ultimately, the data available on patients' hemodynamic status during RT and the details of intrathoracic injuries encountered during the procedure were insufficient. Although hemorrhage during the procedure and delayed hemostasis outside the thoracic cavity could contribute to poor outcomes following emergency thoracotomy (EDT), these physiological factors were not measured, and therefore, could not be validated with objective data. Despite these limitations, this study highlighted the limited efficacy of RT in patients with critical blunt trauma. Future research should focus on determining the optimal time frames for intervention, using larger multicenter cohorts to improve generalizability, and including more detailed physiological and hemodynamic measurements to provide a better understanding of mortality risk factors.

The findings of this study revealed that trauma patients who underwent RT had a survival rate of 3.4%. Additionally, it was observed that patients with blunt chest trauma had better outcomes. Future studies should focus on identifying predictors of EDT survival and outcomes by analyzing data from other Iranian centers. It is important to note that, while current literature suggests specific indications for RT, its implementation necessitates rapid decision-making, precise surgical techniques, and careful patient selection. Indications and outcomes should ideally be based on hospital-specific data.

Declaration

Ethics approval and consent to participate: This study was approved by the Institutional Review Board of the Shiraz University of Medical Science (Approval ID: IR.SUMS.REC.1402.554). Due to the retrospective nature of the study, the ethics committee of Shiraz University of Medical Sciences waived the necessity of providing informed consent.

Consent for publication: Not applicable.

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Conflict of Interest: The authors declared that they had no conflict of interest.

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Authors' Contribution: ALN designed the original intellectual content of the study. MK, MRY, LS, and SP have designed the concepts of the study. LS and MK did data analysis and statistical analysis. ALN, MK, MRY, LS, and SP prepared, reviewed, and edited the manuscript. MK is the corresponding author of the study.

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