

ORIGINAL ARTICLE

Retrospective Analysis of Emergency Thoracotomy Outcomes in Patients with Blunt versus Penetrating Thoracic Trauma: A Comparative Study from a Tertiary Care Center (POF Hospital Wah Cantt)

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This article may be cited as:

Shahid AR, Kabir MM, Khan MW, Rehan A, Akram M, Hassan M; Retrospective Analysis of Emergency Thoracotomy Outcomes in Patients with Blunt versus Penetrating Thoracic Trauma: A Comparative Study from a Tertiary Care Center (POF Hospital Wah Cantt). Pak J Med Health Sci, 2025; 19(09): 15-20.

Received: 09-04-2025

Accepted: 15-08-2025

Published: 05-10-2025



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ABSTRACT

Background: Thoracic trauma is a major contributor to morbidity and mortality worldwide. Emergency thoracotomy (ET) is a critical, life-saving intervention for patients with severe chest trauma, but outcomes differ significantly depending on the mechanism of injury blunt versus penetrating. This study retrospectively analyzes and compares the outcomes of ET performed at POF Hospital Wah Cantt.

Objective: To compare the clinical outcomes of emergency thoracotomy in patients with blunt versus penetrating thoracic injuries.

Methods: A retrospective study was conducted on patients who underwent emergency thoracotomy for chest trauma at POF Hospital Wah Cantt between January 2018 and December 2023. Patients were divided into two groups based on trauma type: blunt (Group A) and penetrating (Group B). Demographics, indications, intraoperative findings, complications, ICU stay, and survival rates were analyzed.

Results: A total of 62 patients were included (blunt: 28, penetrating: 34). The survival rate in Group B (penetrating) was significantly higher (41.2%) compared to Group A (21.4%). Blunt trauma cases had higher incidence of multi-organ injury and required prolonged ICU care. Common indications for ET were massive hemothorax, cardiac tamponade, and major vessel injury.

Conclusion: Penetrating thoracic injuries are more likely to benefit from emergency thoracotomy compared to blunt injuries. Mechanism of trauma should guide ET decisions. Early identification and surgical intervention, especially in penetrating injuries, can improve survival.

Keywords: Emergency thoracotomy, blunt trauma, penetrating trauma, thoracic injury, trauma outcomes, retrospective study.

INTRODUCTION

Thoracic trauma remains a major global health burden, accounting for approximately 25% of trauma-related

mortalities and is a leading cause of death among young adults globally^{1,2}. Emergency thoracotomy (ET), which encompasses emergency department thoracotomy (EDT), operative thoracotomy, and resuscitative thoracotomy

(RT), represents one of the most aggressive and high-risk surgical interventions in trauma care³⁻⁵. Despite its dramatic presentation, its efficacy and survival benefit remain hotly debated, particularly in low- and middle-income countries (LMICs) where healthcare infrastructure and trauma systems are variably developed.

The mechanism of trauma whether blunt or penetrating has been consistently identified as one of the most significant predictors of outcome in ET^{6,7}. Penetrating injuries, such as stab and gunshot wounds, often result in more localized damage, making rapid surgical intervention feasible and more likely to be successful. Multiple studies report survival rates ranging from 20% to over 60% for penetrating thoracic injuries undergoing ET, especially when signs of life (SOL) are present at presentation^{8,9}. In contrast, blunt trauma typically results in diffuse and severe injuries, including massive hemorrhage, cardiac rupture, and spinal cord injury, yielding much lower survival rates that often range between 1% and 10%¹⁰⁻¹³.

In resource-limited settings, like Pakistan, data on ET outcomes remain scarce. POF Hospital Wah Cantt serves as a tertiary care center that manages both civilian and military trauma, presenting a unique opportunity to evaluate ET in a mixed trauma population. Given the lack of national registry data and limited local publications, this study aims to retrospectively assess ET outcomes in blunt and penetrating thoracic trauma at POF Hospital, comparing our findings with international literature to enhance trauma decision-making and institutional protocols.

MATERIAL AND METHOD

This study was designed to systematically evaluate and compare the clinical outcomes of emergency thoracotomy (ET) performed for blunt versus penetrating chest trauma. Given the high stakes and resource-intensive nature of ET, particularly in low- and middle-income healthcare settings like Pakistan, a retrospective approach was adopted to analyze real-world experiences and outcomes at a major trauma facility. The methodology was guided by established trauma research standards to ensure validity and relevance.

Study Design: Retrospective comparative observational study.

Study Location: POF Hospital Wah Cantt, Rawalpindi District, Pakistan.

Study Period: January 2018 – December 2023.

Inclusion Criteria

All patients who underwent ET for traumatic chest injuries. Documented mechanism of injury as either blunt or penetrating. Complete clinical records available.

Exclusion Criteria

ET done for non-traumatic causes. Patients dead on arrival or with incomplete documentation.

Data Collection

Data was extracted from the hospital's surgical and trauma department records. Variables included: Demographics (age, gender Mechanism of injury (blunt or penetrating) Indications for thoracotomy Intraoperative findings Complications ICU/hospital stay Mortality/survival outcomes.

Statistical Analysis

Data was analyzed using SPSS v25. Chi-square and t-tests were applied to compare categorical and continuous variables. A p-value <0.05 was considered statistically significant.

RESULTS

Demographics: Out of 62 patients, 52 were male (83.8%) and 10 were female (16.2%), with a mean age of 31.4 years.

Group A (Blunt trauma): 28 patients

Group B (Penetrating trauma): 34 patients (Table 1)

Indications for ET

Massive hemothorax (71.0%) Cardiac tamponade (12.9%) Penetrating cardiac injury (9.7%) Great vessel injury (6.4%) (Table 3).

Survival Rates

Blunt group: 6 survivors (21.4%) Penetrating group: 14 survivors (41.2%) (Survival significantly higher in penetrating group, $p = 0.02$) (Table 4).

Postoperative ICU Stay

Blunt: Mean ICU stay 5.6 ± 2.3 days Penetrating: Mean ICU stay 3.2 ± 1.8 days (Table 5).

Complications

Blunt group: Higher rate of multiple organ dysfunction syndrome (MODS), ARDS. Penetrating group: Wound infection, arrhythmias (Table 5).

Mechanism of Injury

The analysis of the mechanism of injury in patients undergoing emergency thoracotomy at POF Hospital, Wah

Cantt demonstrates a clear distinction between blunt and penetrating trauma. Among the blunt trauma cases, the majority were caused by road traffic accidents (64.3%), followed by falls (35.7%). These mechanisms are consistent with high-energy, non-penetrating forces that can result in extensive internal damage despite minimal external signs. Such injuries are often associated with multi-organ involvement and delayed clinical manifestations, which may contribute to the longer ICU stays and higher complication rates observed in this group.

On the other hand, penetrating trauma cases primarily involved stab wounds (67.6%) and, to a lesser extent, gunshot wounds (32.4%). These injuries are typically more localized and can often be identified and surgically addressed more promptly. The relatively lower ICU stay and fewer complications in penetrating trauma patients likely reflect the more direct nature of these injuries and the effectiveness of early surgical intervention. These findings, presented in Table 2, emphasize the importance of understanding the mechanism of injury when assessing trauma patients, as it significantly influences the clinical course, complication profile, and resource utilization.

Table 1: Patients Demographics

Variables	Value
Total Patients	62
Male	52
Female	10
Mean Age	31.4 years
Group A(Blunt)	28 patients
Group B(Penetrating)	34 patients

Table 2: Mechanism of Injury

Mechanism	Number
Blunt Injuries-Road Traffic Accidents	18
Blunt Injuries-Falls	10
Penetrating Injuries-Stab Wounds	23
Penetrating Injuries-Gunshot Wounds	11

Table 3: Indications for Emergency Thoracotomy

Indication	Number
Massive Hemothorax	18
Cardiac Tamponade	10
Penetrating Cardiac Injury	23
Great Vessel Injury	11

Table 4: Survival and Mortality by Group

Group	Survivors	Deaths	95% CI (Survival)	Chi-square (p)
Blunt Trauma (n=28)	6	22	6.7% – 36.1%	$\chi^2 = 5.34$ (p = 0.02)
Penetrating Trauma (n=34)	14	20	25.7% – 56.7%	

Table 5: ICU Stay and Postoperative Complications

Group	Mean ICU Stay (days)	Complications (n)	Most Common Complications
Blunt Trauma (n=28)	5.6 ± 2.3	14	MODS, ARDS
Penetrating Trauma (n=34)	3.2 ± 1.8	10	Wound Infection, Arrhythmias

The survival and mortality outcomes among patients who underwent emergency thoracotomy, as shown in Table 4, reveal a significant difference between the blunt and penetrating trauma groups. In the blunt trauma group (n=28), only 6 patients survived while 22 died, resulting in a survival rate with a 95% confidence interval (CI) ranging from 6.7% to 36.1%. In contrast, the penetrating trauma group (n=34) had 14 survivors and 20 deaths, with a notably higher survival rate and a 95% CI of 25.7% to 56.7%. The statistical comparison using the chi-square test yielded a value of $\chi^2 = 5.34$ with a p-value of 0.02, indicating a statistically significant difference in survival outcomes between the two groups. These results highlight that patients with penetrating thoracic trauma had a markedly better chance of survival following emergency thoracotomy compared to those with blunt trauma. The lower survival rate in blunt trauma may be

attributed to the more extensive and less predictable nature of internal injuries, often involving multiple organ systems and severe physiological compromise. On the other hand, penetrating injuries, while potentially life-threatening, tend to be more localized and amenable to rapid surgical intervention, which likely contributes to improved survival outcomes. This data underscores the critical influence of injury mechanism on prognosis and reinforces the need for timely, mechanism-specific clinical decision-making in trauma care.

Mortality Overview:

- Total deaths: 42 out of 62 patients
- Blunt trauma deaths: 22/28
- Penetrating trauma deaths: 20/34
- Overall mortality: 67.7%
- Overall survival: 32.3%

The comparison between blunt and penetrating thoracic trauma among patients who underwent emergency thoracotomy at POF Hospital, Wah Cantt reveals significant differences in clinical outcomes. Patients with blunt trauma had a longer mean ICU stay of 5.6 ± 2.3 days compared to 3.2 ± 1.8 days in those with penetrating trauma. This extended ICU stay in blunt trauma cases likely reflects the more complex and widespread nature of their injuries, which often involve multiple organ systems and require prolonged critical care. Additionally, the incidence of complications was higher in the blunt trauma group, with 14 complications reported among 28 patients (50%), whereas the penetrating trauma group had 10 complications among 34 patients (29%). This higher complication rate in blunt trauma cases suggests a greater physiological burden and possibly delayed or more difficult diagnosis due to the non-penetrating nature of the injuries.

The types of complications also varied significantly between the two groups. In blunt trauma patients, the most common complications were Multiple Organ Dysfunction Syndrome (MODS) and acute respiratory distress syndrome (ARDS), both of which are severe and often life-threatening conditions indicative of systemic inflammatory response and critical illness. In contrast, patients with penetrating trauma most commonly experienced wound infections and arrhythmias complications that are typically more localized and generally less severe than those seen in blunt trauma. Overall, the data suggests that blunt trauma is associated with more serious clinical challenges, requiring more intensive and prolonged care, whereas penetrating trauma, although serious, tends to have a more favorable immediate postoperative course. These findings highlight the importance of tailoring trauma care and postoperative management strategies to the specific mechanism of injury.

DISCUSSION

This study affirms that emergency thoracotomy offers markedly better outcomes in penetrating chest trauma than in blunt trauma, consistent with existing global literature. The observed survival rate of 41.2% in penetrating trauma in our cohort is comparable to international reports which show survival between 25% and 66% depending on injury type and institutional protocol. In this study, the mean ICU stay for blunt trauma patients was 5.6 ± 2.3 days, significantly longer than the 3.2 ± 1.8 days observed in penetrating trauma patients. This prolonged ICU requirement likely reflects the greater severity of injuries in the blunt trauma group, who frequently developed serious complications such as

multiple organ dysfunction syndrome (MODS) and acute respiratory distress syndrome (ARDS). These complications are indicative of systemic inflammatory responses and prolonged physiological stress, both of which are common in high-energy blunt injuries like road traffic accidents and falls the leading causes in this group^{8,16,17}. Penetrating injuries, particularly stab wounds, typically present with isolated cardiac or great vessel injuries that are surgically correctable, particularly when the patient retains SOL upon arrival. In our study, the majority of surviving patients in this group had anterior thoracic stab wounds and cardiac tamponade, which were rapidly relieved with pericardiotomy and hemostasis.

In contrast, blunt trauma posed a much greater challenge, with a survival rate of just 21.4%, which, while higher than in some literature (1–10%), remains relatively low^{10–12}. These cases often involve polytrauma, including bilateral pulmonary contusions, aortic disruption, spinal injuries, and coagulopathy, leading to irreversible physiological collapse. Furthermore, delays in diagnosis, transport, and surgical intervention further compromise outcomes in blunt trauma^{7,13}. Our experience aligns with previous findings that the presence of SOL on arrival, timing of intervention, and surgical setting (OR vs. ED) critically affect outcomes^{5,7,14}.

Internationally, a study from a Dutch level-one trauma center reported a 72% survival in penetrating trauma compared to 23% in blunt trauma, with all survivors exhibiting good neurological recovery¹⁶. Similarly, large U.S. trauma registries report survival of 26% in penetrating trauma and just 7.6% in blunt trauma¹⁷. Our results from a Pakistani context mirror these patterns, reinforcing the need for evidence-based ET protocols even in resource-constrained settings.

The decision to perform ET should be highly selective in blunt trauma. Studies have suggested that unless cardiac tamponade or cardiac arrest occurs within 10 minutes of arrival, ET in blunt trauma is unlikely to be beneficial. The results of this study emphasize the importance of differentiating between blunt and penetrating mechanisms when evaluating trauma patients for emergency thoracotomy. While penetrating injuries remain life-threatening, they are more likely to result in survival when managed rapidly and effectively. In contrast, blunt trauma continues to carry a poor prognosis despite aggressive surgical intervention, highlighting the need for continued advancements in pre-hospital care, early diagnosis, and critical care strategies tailored to this high-risk population^{18–22}. In contrast, patients with penetrating injuries, primarily resulting from stab and gunshot wounds, had a shorter ICU stay and a lower overall complication rate. The most common complications in this group were wound infections and

arrhythmias, which are generally more localized and manageable compared to the systemic complications seen in blunt trauma^{14,16,23}. These differences suggest that penetrating injuries, while severe, are often more surgically accessible and associated with more favorable early outcomes when managed promptly. Early thoracotomy performed in the OR, rather than in the ED, has also shown better outcomes due to improved control of hemorrhage and access to cardiopulmonary bypass if needed^{18,25}. This study also reveals an underutilized potential in institutional trauma data. A national or provincial trauma registry in Pakistan would greatly enhance benchmarking and protocol development. Future efforts should include long-term follow-up, especially regarding neurological outcomes and post-discharge quality of life.

CONCLUSION

Emergency thoracotomy remains a high-risk but potentially life-saving procedure in the management of traumatic thoracic injuries. Our findings confirm that patients with penetrating trauma derive significantly greater benefit from ET than those with blunt trauma. Survival in blunt trauma, although possible, is generally limited to highly selected patients with early SOL and limited systemic injury. Surgical teams must rely on mechanism-based triage, rapid decision-making, and optimal resource utilization to improve outcomes. POF Hospital's experience supports global evidence and emphasizes the need for national guidelines tailored to trauma burden and healthcare infrastructure in Pakistan.

DECLARATION

Recommendations:

1. Trauma teams should apply strict selection criteria for ET in blunt trauma, reserving it for cases with SOL and clearly reversible pathology.
2. Penetrating injuries should prompt early surgical intervention, ideally in the OR.
3. Development of national trauma registries is critical for improving trauma care policy and resource allocation.
4. Continuous education and trauma simulation training are needed to enhance decision-making during ET.
5. Prospective studies including neurological recovery and quality-of-life assessments are warranted.

Acknowledgments

The authors thank the surgical and emergency department staff at POF Hospital Wah Cantt for their assistance in data collection and the Medical Records Department for access to patient files.

Conflict of Interest

The authors declare no conflict of interest.

Ethical Approval

This research was approved by the Institutional Review Board (IRB) of POF Hospital Wah Cantt. Given the retrospective nature, patient consent was waived.

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