

Patterns of Extra-Abdominal Injuries and Mortality Risk Factors in Penetrating Abdominal Trauma: A Cross-Sectional Study

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Annotation: Background: Penetrating abdominal trauma is a significant contributor to morbidity and mortality. Identifying associated extra-abdominal injuries and mortality risk factors is crucial for optimizing trauma care.

Objective: To analyze the frequency of associated extra-abdominal injuries and assess mortality risk based on the mechanism of injury in patients with penetrating abdominal trauma.

Methods: A cross-sectional study was conducted on 100 patients with penetrating abdominal injuries. Data on extra-abdominal injuries and mortality outcomes were collected and analyzed.

Results: Extra-abdominal injuries were observed in 27% of cases. Chest injuries were the most common (18%), while head and neck injuries were the least frequent (1%). Mortality was significantly associated with the mechanism of injury. Gunshot wounds had the highest mortality rate (13%, $p = 0.023$), followed by shrapnel (6%), and knife injuries (5%).

Conclusion: Chest injuries are the most frequent extra-abdominal injuries associated with penetrating abdominal trauma. Gunshot wounds represent a significant mortality risk and warrant focused clinical attention. Early identification of injury type and location is critical in improving trauma outcomes.

Introduction:

Penetrating abdominal trauma (PAT) represents one of the most serious forms of traumatic injury frequently encountered in both civilian and military settings. With rising urban violence, political instability, and warfare in many parts of the world, especially in conflict zones, the incidence of penetrating injuries has significantly increased. Gunshots, stab wounds, or explosive fragments primarily cause these injuries. They can result in substantial morbidity and mortality due to the involvement of multiple vital structures in the abdominal cavity [1,2].

While intra-abdominal organ injuries often take clinical precedence, extra-abdominal injuries—those affecting the thorax, limbs, spinal cord, and head/neck regions—can coexist and greatly influence the clinical outcome. These associated injuries may complicate the diagnosis, delay surgical intervention, and increase the risk of death or long-term disability [3]. For instance, concurrent chest injuries can lead to respiratory failure, hemothorax, or pneumothorax, while spinal injuries may result in paralysis or require specialized care. Despite this, extra-abdominal injuries are often underreported or undervalued in trauma scoring systems and clinical triage protocols.

Several studies have identified that the mechanism of injury plays a critical role in determining the severity and prognosis of penetrating trauma [4,5]. Gunshot wounds (GSWs), due to their high kinetic energy and unpredictable trajectory, often cause extensive tissue destruction and are associated with a higher rate of mortality and complications compared to low-energy injuries such as stabbings [6]. Shrapnel injuries, common in explosions, display a wide variability in severity depending on fragment size, number, and distribution. At the same time, stab wounds are generally more localized and may involve a single organ or structure [7].

Understanding the patterns of associated injuries and their link to mortality risk factors is essential for guiding early diagnosis, resuscitation, and surgical decision-making in trauma settings. This study aims to quantify the frequency and distribution of extra-abdominal injuries among patients with penetrating abdominal trauma and to assess the impact of different injury mechanisms on mortality. By analyzing these variables, the study seeks to provide valuable insights that could improve trauma protocols and resource allocation in both civilian and military hospitals.

Materials and Methods:

This cross-sectional observational study included 100 patients presenting with penetrating abdominal trauma at a private hospital in Baghdad between 2022 and 2024. The ethical approval number is available upon request.

Data collected included patient demographics, type of injury (gunshot, shrapnel, or knife), associated extra-abdominal injuries, and outcomes (mortality or survival). Extra-abdominal injuries were categorized into chest, upper limb, lower limb, head and neck, and spinal cord injuries.

Statistical analysis was conducted using SPSS software. Frequencies and percentages were calculated for categorical variables. The Chi-square test was used to assess the association between injury type and mortality. A p-value of <0.05 was considered statistically significant.

Results:

1. Frequency of Extra-Abdominal Injuries:

Extra-abdominal injuries were documented in 27 patients (27%). Chest injuries were the most common (18%), followed by upper limb injuries (4%). Head and neck injuries were the least frequent (1%) (Table 1).

Table 1: Frequency of Associated Extra-Abdominal Injuries

Injured Organ	Number	Percentage
Chest	18	18%
Upper limb	4	4%
Lower limb	2	2%
Head & Neck	1	1%
Spinal Cord	2	2%
Total	27	27%

2. Mortality Risk by Mechanism of Injury:

Gunshot wounds were the most frequent cause of injury (39%), followed by shrapnel (57%) and knife wounds (4%). The overall mortality rate was 9%. Gunshot wounds had the highest mortality rate (13%), which was statistically significant ($p = 0.023$) (Table 2).

Table 2: Mortality Rate by Type of Injury

Type of Injury	Number (%)	Dead (%)	Survived (%)	P-value
Gunshot	39 (39%)	5 (13%)	34 (87%)	0.023*
Shrapnel	57 (57%)	3 (6%)	54 (94%)	
Knife	4 (4%)	1 (5%)	3 (95%)	
Total	100 (100%)	9 (9%)	91 (91%)	

*Significant difference at $p < 0.05$

Discussion:

The results of this study underscore the importance of considering extra-abdominal injuries in the clinical management of penetrating abdominal trauma. In our cohort, 27% of patients sustained injuries beyond the abdominal cavity, with chest injuries accounting for the majority (18%). These findings are in line with previous literature indicating that the chest is particularly vulnerable in thoracoabdominal injuries, where the trauma often traverses both the thoracic and abdominal compartments [3,8]. Early detection and management of chest injuries are crucial, as they may rapidly progress to life-threatening conditions such as tension pneumothorax, massive hemothorax, or cardiac tamponade if not promptly addressed.

Upper and lower limb injuries, although less frequent, also pose significant challenges due to the potential for vascular compromise, nerve damage, and subsequent functional impairment. Spinal cord injuries, while rare (2%), are particularly devastating due to the risk of permanent neurologic deficits and paralysis. Head and neck injuries, though the least frequent in our series (1%), can result in airway compromise, cervical spine instability, or intracranial hemorrhage, making them critically important to identify early during trauma evaluation.

The mortality analysis revealed a clear association between injury mechanism and patient outcomes. Gunshot wounds were associated with the highest mortality rate (13%), which was statistically significant. This finding aligns with multiple prior studies reporting that GSWs are often more lethal due to the high-velocity nature of bullets, their capacity to disrupt various organ systems, and the increased likelihood of significant vascular injury [4,5,9]. Moreover, bullets may follow unpredictable paths and cause widespread cavitation, complicating both diagnosis and surgical repair.

Shrapnel injuries resulted in an intermediate mortality rate (6%), which may reflect the diversity in injury severity depending on the size and dispersion of explosive fragments. Shrapnel can cause multiple minor wounds that may be deceptive on physical examination but result in substantial internal damage, particularly in blast-related polytrauma [10].

Knife injuries, though the least frequent, demonstrated the lowest mortality rate (5%). This is

consistent with previous studies suggesting that stab wounds, being more localized and involving a lower energy transfer, are generally less lethal when promptly and appropriately managed [7,11]. However, this should not diminish the clinical importance of stab wounds, especially when significant vessels or vital organs are involved.

The study's findings carry important implications for trauma care systems. First, they advocate for mechanism-based triage protocols that prioritize patients with GSWs and chest involvement for rapid surgical intervention and critical care resources. Second, they support the inclusion of extra-abdominal injury assessment as a core component of trauma algorithms to prevent underdiagnosis and delayed treatment of potentially life-threatening injuries.

Moreover, in conflict or mass casualty scenarios where resources are limited, understanding injury patterns and associated mortality risks can aid in effective resource allocation and surgical prioritization. Integrating trauma scoring systems that account for extra-abdominal injuries may also enhance the accuracy of prognosis prediction and improve outcomes.

Limitations of this study include the relatively small sample size and single-center nature, which may limit the generalizability of the findings. Future multicenter studies with larger cohorts and stratification by trauma severity scores, time to intervention, and anatomical injury scoring systems (e.g., AIS or ISS) would provide more comprehensive insights.

Conclusion:

Chest injuries are the most frequent extra-abdominal injuries in patients with penetrating abdominal trauma, emphasizing the need for vigilant thoracic assessment. Gunshot wounds are significantly associated with increased mortality, underscoring the importance of early, aggressive management. Understanding injury patterns and their implications can help improve trauma triage, reduce preventable deaths, and optimize the utilization of resources.

Conflict of Interest:

The authors declare that they have no conflict of interest.

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