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# Pattern and Outcomes of Chest Injuries in a Tertiary Care Hospital: A Comprehensive Analysis

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## ABSTRACT

***Objective:*** The objective of the current study is to assess chest injury management, focusing on the etiological spectrum, injury patterns, and outcomes.

***Study design:*** Prospective comparative study

***Place and Duration of Study:*** Department of Accident and Emergency, Combined Military Hospital Rawalpindi, Pakistan, from Aug 2023-Jul 2024

***Methodology:*** A total of 928 patients presenting with chest injuries were included in the study based on inclusion and exclusion criteria, and demographic data, fracture patterns, mechanisms of injury, associated injuries, interventions performed, length of hospital stay, and patient outcomes were analyzed. Statistical analysis was employed to assess associations between injury types and characteristics of injuries, and management strategies.

***Results:*** The study revealed that blunt trauma was predominant (94.0%) compared to penetrating trauma (6.0%), with lateral chest fractures (51.3%) being most frequent. Pneumothorax (35.8%) and hemothorax (26.7%) were the most common associated injuries. Surgical interventions, including rib fixation (5.2%) and VATS (4.4%), were performed in 27.2% of patients. Most patients (94.8%) were discharged with follow-up appointments, while the mortality rate was 5.2%.

***Conclusion:*** The current study concluded that blunt trauma was the primary cause of chest injuries, resulting in longer hospital stays and a significant incidence of flail chest, with a 5.2% mortality rate mainly due to complications like head injuries. While surgical interventions were more frequent in cases of penetrating injuries, most blunt trauma patients were successfully discharged and managed through follow-up care, highlighting the complexities of trauma management and the impact of associated injuries on outcomes.

**Keywords:** Hemothorax, Pneumothorax, Rib Fractures

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## INTRODUCTION

Following abdominal & head trauma, chest injuries are the most common, with a high mortality rate that may reach as high as 60%.[1] Among patients with severe traumatic injuries, it is estimated that approximately 25% of fatalities result from chest injuries.[2] In developing countries, chest trauma is often attributed to road traffic accidents, interpersonal violence, and inadequate safety measures.[3] Limited access to healthcare facilities can exacerbate the severity of injuries sustained, ultimately leading to higher morbidity and mortality rates associated with thoracic trauma.[4]

Blunt chest injuries are more common compared to penetrating injuries. Rib fractures frequently coexist with complications such as pneumo-hemothorax and pulmonary injuries, leading to high morbidity and mortality.[5] Penetrating injuries, such as gunshot and stab wounds, can cause fatal lung lacerations and vascular injuries.[6]

Tube thoracostomy is the most common procedure used for chest injuries, which provides respiratory and hemodynamic stability, alleviating pressure on the affected lung, thereby improving lung expansion.[7] Eighty percent of chest trauma cases can be managed with tube thoracostomy, adequate analgesia, and aggressive respiratory therapy.[8] Sometimes early, aggressive interventions, such as rib fixation, video-assisted thoracoscopic surgery(VATS), and prompt treatment of associated injuries ensure optimal patient outcomes.[9,10]

This study establishes a clear baseline of chest injury patterns and etiological factors within an institutional setting to identify high-risk demographics and major trauma trends. By systematically cataloging specific thoracic presentations, the research provides a critical framework for recognizing the most common and complex complications. Furthermore, it evaluates the effectiveness of current management protocols by

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analyzing specific patient outcomes, survival rates, and recovery timelines.

**Table-I: Characteristics of the Injuries and their Management (n=928)**

| Biographics | | Values |
|---|---|---|
| Age, mean ± SD | | 40.93 ± 15.6 |
| Gender | Male | 621 (66.9%) |
| | Female | 307 (33.1%) |
| Comorbidity | Yes | 168 (18.1%) |
| | No | 760 (81.9%) |
| **Nature and characteristics of injury** | | |
| Mech. Of injury | Blunt | 872 (94.0%) |
| | Penetrating | 56 (6.0%) |
| Side of fracture | Right | 358 (38.6%) |
| | Left | 514 (55.4%) |
| | Bilateral | 56 (6.0%) |
| Site of fracture | Anterior | 61 (6.6%) |
| | Posterior | 221 (23.8%) |
| | Lateral | 476 (51.3%) |
| | Anterior + Lateral | 46 (5.0%) |
| | Anterior + Posterior | 49 (5.3%) |
| | Lateral + Posterior | 75 (8.1%) |
| Flail chest | Yes | 120 (12.9%) |
| | No | 808 (87.1%) |
| Associated Injuries | Yes | 928 (100.0%) |
| | No | 0 (0.0%) |
| Extra-thoracic injuries | Yes | 319 (34.4%) |
| | No | 609 (65.6%) |
| Extra thoracic injuries | Upper Limb Injuries | 45 (4.8%) |
| | Lower Limb Injuries | 43 (4.6%) |
| | Bowel Injury | 14 (1.5%) |
| | Liver Injury | 16 (1.7%) |
| | Spleen Injury | 5 (0.5%) |
| | Head Injury | 76 (8.2%) |
| | Spinal Injury | 34 (3.7%) |
| | Clavicle/Scapular Injury | 61 (6.6%) |
| | None | 634 (68.3%) |
| **Management** | | |
| Chest intubation done | Yes | 804 (86.6) |
| | No | 124 (13.4%) |
| Type of intervention | Conservative | 676 (72.8%) |
| | Surgery | 252 (27.2%) |
| Surgical intervention | None | 680 (73.3%) |
| | VATS | 41 (4.4%) |
| | Thoracotomy+ Repair | 31 (3.3%) |
| | Ribs Fixations | 48 (5.2%) |
| | Diaphragmatic Repair | 7 (0.8%) |
| | Laparotomy+ Bowel Repair/Stoma | 10 (1.1%) |
| | Craniotomy | 27 (2.9%) |
| | ORIF | 59 (6.4%) |
| | Laparotomy+ Splenectomy | 6 (0.6%) |
| | Liver Injury Repair | 1 (0.1%) |
| | Open Wound Repair/Debridement | 5 (0.5%) |
| | Thoracotomy + Cardiac Repair/Pericardiotomy | 4 (0.4%) |
| | Tracheal Injury Repair | 0 (0.0%) |
| | Spinal Fixation/Laminectomy | 4 (0.4%) |
| | Esophageal Repair | 5 (0.5%) |
| **Outcome** | | |
| Length of stay (days) | 1-4 | 287 (30.9%) |
| | 5-6 | 322 (34.7%) |
| | 7-10 | 164 (17.7%) |
| | 11-15 | 94 (10.1%) |
| | 16-20 | 37 (4.0%) |
| | > 20 | 24 (2.6%) |
| Outcomes after management | Discharged and called for a follow-up | 881 (94.9%) |
| | Death | 48 (5.2%) |
| | Referred to other specialty | 0 (0.0%) |

**ORIF - Open Reduction and Internal Fixation, VATS - Video-Assisted Thoracoscopic Surgery*

## METHODOLOGY

A prospective comparative study of patients presenting with chest injuries to the Accident and Emergency Department was conducted between Aug 2023 and July 2024 at Combined Military Hospital Rawalpindi, Pakistan. Ethical Committee of CMH Rawalpindi approved the study(Serial #682). Informed consent was obtained before patient inclusion in the study before data collection.

**Inclusion Criteria:** Patients of either gender aged 2 to 85 years, presenting with blunt & penetrating chest injuries confirmed by imaging, chest X-ray & computed tomography (CT) scans.

**Exclusion Criteria:** Patients with minor injuries, incomplete medical records, and pre-existing chest conditions(e.g., COPD, lung cancer) were excluded from the study.

Data were collected according to the objectives of the pilot study based on patients' demographics, clinical details of the fracture, and outcome details, including discharge, referral to another specialty, or death. A sample size of 220 was calculated using G*Power software, with the following input parameters: effect size = 0.3, level of significance 5%, power of the test 0.95, and degrees of freedom 5. The data were analyzed using the Statistical Package for the Social Sciences (SPSS v25).Descriptive statistics were used to summarize the data. The categorical variable was presented as frequency and percentage, whereas the continuous variable was tabulated as mean and standard deviation. Inferential statistics were used to assess the association of type of surgery with study variables. The chi-square test was used to assess the association of injury type with surgery, characteristics, and its management. The *p*-value was considered significant at the 0.05 level.

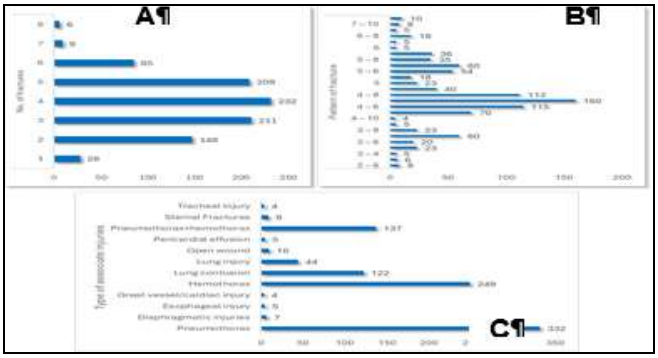



**Figure-1: Details and characteristics of the injuries in the included sample (A. No. of fractures, B. pattern of fracture, C. type of associated injuries)**

## RESULTS

The study included a total of 928 patients. Among them, 66.9% were male (n=621)& 33.1% were female(n=307). Age of patients ranged from 2 to 89 years, with a mean age of 40.93 years(SD = 15.641). Fracture patterns varied significantly among patients:

**Table-II: The Comparison of Injury Type With Injury Characteristics and Management (928)**

| | | Mech. Of injury | | *p*-value |
|---|---|---|---|---|
| | | Blunt n (%) | Penetrating n (%) | |
| **Characteristics of the injury** | | | | |
| Side of fracture | Right | 344 (39.4%) | 14 (25.0%) | 0.08 |
| | Left | 477 (54.7%) | 37 (66.1%) | |
| | Bilateral | 51 (5.8%) | 5 (8.9%) | |
| Site of fracture | Anterior | 47 (5.4%) | 14 (25.0%) | <0.001 |
| | Posterior | 206 (23.6%) | 15 (26.8%) | |
| | Lateral | 455 (52.2%) | 21 (37.5%) | |
| | Anterior + Lateral | 46 (5.3%) | 0 (0.0%) | |
| | Anterior + Posterior | 44 (5.0%) | 5 (8.9%) | |
| | Lateral + Posterior | 74 (8.5%) | 1 (1.8%) | |
| No. of Fractures | 1 | 5 (0.6%) | 23 (41.1%) | <0.001 |
| | 2 | 124 (14.2%) | 24 (42.9%) | |
| | 3 | 203 (23.3%) | 8 (14.3%) | |
| | 4 | 231 (26.5%) | 1 (1.8%) | |
| | 5 | 209 (24.0%) | 0 (0.0%) | |
| | 6 | 85 (9.7%) | 0 (0.0%) | |
| | 7 | 9 (1.0%) | 0 (0.0%) | |
| | 8 | 6 (0.7%) | 0 (0.0%) | |
| Flail Chest | Yes | 120 (13.76%) | 0 (0.0%) | <0.001 |
| | No | 753 (86.4%) | 55 (98.2%) | |
| Associated Injuries | Yes | 872 (100.0%) | 56 (100.0%) | - |
| | No | 0 (0.0%) | 0 (0.0%) | |
| Type Of Associated Injuries | Pneumothorax | 324 (37.2%) | 8 (14.3%) | <0.001 |
| | Hemothorax | 243 (27.9%) | 6 (10.7%) | |
| | Sternal Fractures | 9 (1.0%) | 0 (0.0%) | |
| | Lung Contusion | 122 (14.0%) | 0 (0.0%) | |
| | Diaphragmatic Injuries | 6 (0.7%) | 1 (1.8%) | |
| | Open Wound | 10 (1.1%) | 0 (0.0%) | |
| | Tracheal Injury | 4 (0.5%) | 0 (0.0%) | |
| | Lung Injury | 26 (3.0%) | 18 (32.1%) | |
| | Pericardial Effusion | 5 (0.6%) | 0 (0.0%) | |
| | Great Vessel/Cardiac Injury | 0 (0.0%) | 4 (7.1%) | |
| | Esophageal Injury | 0 (0.0%) | 5 (8.9%) | |
| | Pneumothorax + Hemothorax | 123 (14.1%) | 14 (25.0%) | |
| | None | 595 (68.2%) | 39 (69.6%) | |
| Extra thoracic injuries | Yes | 303 (34.7%) | 16 (28.6%) | 0.34 |
| | No | 569 (65.3%) | 40 (71.4%) | |
| Extra thoracic injuries | Upper Limb Injuries | 45 (5.2%) | 0 (0.0%) | <0.001 |
| | Lower Limb Injuries | 43 (4.9%) | 0 (0.0%) | |
| | Bowel Injury | 6 (0.7%) | 8 (14.3%) | |
| | Liver Injury | 11 (1.3%) | 5 (8.9%) | |
| | Spleen Injury | 5 (0.6%) | 0 (0.0%) | |
| | Head Injury | 75 (8.6%) | 1 (1.8%) | |
| | Spinal Injury | 32 (3.7%) | 2 (3.6%) | |
| | Clavicle/Scapular Injury | 60 (6.9%) | 1 (1.8%) | |
| | None | 595 (68.2%) | 39 (69.6%) | |
| Pattern of fracture | 2-6 | 8 (0.9%) | 0 (0.0%) | <0.001 |
| | 3-10 | 6 (0.7%) | 0 (0.0%) | |
| | 3-4 | 0 (0.0%) | 5 (8.9%) | |
| | 3-5 | 23 (2.6%) | 0 (0.0%) | |
| | 3-6 | 20 (2.3%) | 0 (0.0%) | |
| | 3-7 | 56 (6.4%) | 4 (7.1%) | |
| | 3-8 | 23 (2.6%) | 0 (0.0%) | |
| | 3-9 | 5 (0.6%) | 0 (0.0%) | |
| | 4-10 | 4 (0.5%) | 0 (0.0%) | |
| | 4-5 | 55 (6.3%) | 15 (26.8%) | |
| | 4-6 | 115 (13.2%) | 0 (0.0%) | |
| | 4-7 | 160 (18.3%) | 0 (0.0%) | |
| | 4-8 | 112 (12.8%) | 0 (0.0%) | |
| | 4-9 | 40 (4.6%) | 0 (0.0%) | |
| | 5 | 9 (1.0%) | 14 (25.0%) | |
| | 5-10 | 18 (2.1%) | 0 (0.0%) | |
| | 5-6 | 50 (5.7%) | 4 (7.1%) | |
| | 5-7 | 52 (6.0%) | 8 (14.3%) | |
| | 5-8 | 34 (3.9%) | 1 (1.8%) | |
| | 5-9 | 36 (4.1%) | 0 (0.0%) | |
| | 6 | 0 (0.0%) | 5 (8.9%) | |
| | 6-7 | 5 (0.6%) | 0 (0.0%) | |
| | 6-8 | 18 (2.1%) | 0 (0.0%) | |
| | 6-9 | 5 (0.6%) | 0 (0.0%) | |
| | 7-10 | 8 (0.9%) | 0 (0.0%) | |
| | 7-8 | 10 (1.1%) | 0 (0.0%) | |
| **Management** | | | | |
| Chest intubation | Yes | 753 (86.4%) | 51 (91.1%) | 0.31 |
| | No | 119 (13.6%) | 5 (8.9%) | |
| Type of intervention | Conservative | 671 (76.9%) | 5 (8.9%) | <0.001 |
| | Surgery | 201 (23.1%) | 51 (91.1%) | |
| Surgical intervention | None | 679 (77.9%) | 1 (1.8%) | <0.001 |
| | VATS | 23 (2.6%) | 18 (32.%) | |
| | Thoracotomy + Repair | 9 (1.0%) | 22 (39.3%) | |
| | Ribs Fixations | 48 (5.5%) | 0 (0.0%) | |
| | Diaphragmatic Repair | 6 (0.7%) | 1 (1.8%) | |
| | Laparotomy + Bowel Repair/Stoma | 6 (0.7%) | 4 (7.1%) | |
| | Craniotomy | 26 (3.0%) | 1 (1.8%) | |
| | ORIF | 59 (6.8%) | 0 (0.0%) | |
| | Laparotomy + Splenectomy | 6 (0.7%) | 0 (0.0%) | |
| | Liver Injury Repair | 1 (0.1%) | 0 (0.0%) | |
| | Open Wound Repair/Debridement | 5 (0.6%) | 0 (0.0%) | |
| | Thoracotomy + Cardiac Repair/Pericardiotomy | 0 (0.0%) | 4 (7.1%) | |
| | Tracheal Injury Repair | 0 (0.0%) | 0 (0.0%) | |
| | Spinal Fixation/Laminectomy | 4 (0.5%) | 0 (0.0%) | |
| | Esophageal Repair | 0 (0.0%) | 5 (8.9%) | |
| **Outcome** | | | | |
| Length of stay (days) | 1-4 | 282 (32.3%) | 5 (8.9%) | <0.001 |
| | 5-6 | 317 (36.4%) | 5 (8.9%) | |
| | 7-10 | 136 (15.6%) | 28 (50.0%) | |
| | 11-15 | 81 (9.3%) | 13 (23.2%) | |
| | 16-20 | 36 (4.1%) | 1 (1.8%) | |
| | > 20 | 20 (2.3%) | 4 (7.1%) | |
| Outcomes after management | Discharged and called for follow-up | 834 (95.6%) | 47 (83.9%) | <0.001 |
| | Death | 39 (4.4%) | 9 (16.%) | |
| | Referred to other specialty | 0 (0.0%) | 0 (0.0%) | |

The most common number of fractures per patient was four fractures(25.0%, n=232), followed closely by five fractures (22.5%, n=209).Other frequent occurrences included three fractures(22.7%, n=211),six fractures(9.2%, n=85), and two fractures (15.9%, n=148). Blunt trauma was the predominant mechanism(94.0%, n=872) compared to penetrating trauma(6.0%, n=56). Fractures were more commonly located on the left side (55.4%, n=514) than on the right side (38.6%, n=358). Bilateral fractures were less common(6.0%, n=56).The lateral aspect of the chest was the most frequent site of fracture(51.3%, n=476), followed by posterior fractures(23.8%, n=221)and combinations like lateral + posterior (8.1%, n=75), anterior(6.6%, n=61), and anterior + lateral (5.0%, n=46). Flail chest was observed in 12.9%(n=120) with blunt trauma & absent in penetrating injuries, of which 66.66%(n=80) were managed non-operatively and 33.33%(n=40)were managed operatively. Out of 120 Patients with flail chest, 11.74% (n=109) recovered, with 1.18% (n=11) mortality observed.

Associated injuries were present in all patients(100.0%,n=928),with pneumothorax(35.8%, n=332) and hemothorax(26.7%,n=248) being most common. Other notable injuries included lung contusion (13.1%, n=122)& pneumo-hemothorax (14.8%,n=137).Chest intubation was necessary for 86.6% of patients(n=804), while surgical intervention was performed in 27.2% (n=252). The most common surgical procdure was rib fixation(5.2%,n=48), VATS(4.4%,n=41),and thoracotomy with repair(3.3%, n=31). The majority of patients(94.8%,n=880) were discharged and scheduled for follow-up, while the mortality rate was 5.2%(n=48).Out of 48 mortalities,39 patients had head injuries(4.20%),thus demonstrating statistically significantly higher rates of complications and poor prognosis.Patients had varying lengths of hospitalization:30.9% (n=287) stayed for 1-4 days,34.7% (n=322) for 5-6 days, and 17.7%(n=164) for 7-10 days.Smaller percentages stayed longer,with 10.1% (n=94) for 11-15 days,4.0%(n=37) for 16-20 days, and 2.6% (n=24) for more than 20 days.Majority of injuries were due to blunt trauma(94%), with a smaller proportion due to penetrating trauma(6%).

Comorbidities were more prevalent in blunt trauma cases (94%) compared to penetrating injuries (6%). Blunt traumas were significantly associated with a higher incidence of associated injuries (94%) compared to penetrating injuries(6%) ($p$<0.001). Blunt traumas were more likely to result in extra-thoracic injuries(34.74%) compared to penetrating injuries(28.75%). Surgery was more frequently required in penetrating injuries(92.9%) compared to

blunt traumas(24.9%)($p$<0.001). Blunt traumas had more extended hospital stays, with 32.24% staying 1-4 days,36.46% staying 5-6 days,15.6% staying 7-10 days,9.28% staying 11-15 days,4.1% staying 16-20 days and 2.3% staying more than 20 days. Penetrating injuries showed a different pattern, with 8.92% staying 1-4 days,50.0% staying 7-10 days, and 23.2% staying 11-15 days($p$<0.001).

The majority of blunt trauma patients were discharged for follow-up (95.1%), whereas 16.1% of penetrating injury patients died. Blunt trauma showed significant associations with pneumothorax (37.2%), hemothorax (27.9%), lung contusion (14.0%), and rib fractures (14.0%), among others($p$ < 0.001).

## DISCUSSION

Chest injuries present significant challenges in emergency and trauma care settings. This study of 928 patients provides comprehensive insights into epidemiology, patterns, management strategies, and outcomes associated with chest trauma. The predominance of blunt trauma (94.0%) over penetrating trauma (6.0%) reflects common scenarios in trauma settings, such as RTA and falls. This pattern correlates with global trauma epidemiology, where blunt trauma often leads to multi-system injuries involving the chest due to deceleration forces and impacts.[11] Lateral chest fractures were the most prevalent (51.3%), followed by posterior (23.8%) and anterior (6.6%) fractures. The distribution of fractures underscores the vulnerability of these regions to blunt trauma impacts. The variation in the number of fractures per patient (ranging from 1 to 8 fractures) highlights the complexity and severity of injuries encountered.[12]

Clinical features of thoracic trauma differ and vary from a superficial injury to a life-threatening condition.5 Rib fractures, lung or pulmonary contusion, pneumothorax, and hemothorax are the most common findings. In our study, pneumothorax(35.8%) and hemothorax(26.7%) emerged as the most frequent associated injuries, necessitating prompt intervention to prevent respiratory compromise and hemodynamic instability. The presence of extra-thoracic injuries in 34.6% of cases of chest trauma with other associated injuries was associated with higher complications, longer ICU stay with poor outcomes, and thus increased mortality rates, co-requiring a multidisciplinary approach to address concurrent injuries effectively. Moreover, invasive ventilation, lung parenchymal injury, and contusions correlate with worse outcomes, as reported by Schieren *et al*.[13]

A substantial proportion of patients, 252(27.2%), required surgical interventions, including rib fixation 48(5.2%) & Video-assisted thoracoscopic surgery (VATS) 41(4.4%). Of patients undergoing rib fixation, out of 48 patients, 4(8.33%) have died. In contrast, 44(91.66%) showed early recovery, thus depicting fewer complications as compared to patients undergoing conservative management and emphasizing the critical role of surgical management in severe chest trauma.[14]

Dehghan *et al.* reviewed the National Trauma Data Bank and reported that emergency thoracotomy increases the duration of hospital stay and worsens the outcome.[15] However, recent studies like Shi *et al.,* have shown that VATS is safer, resulting in better pain management, early recovery, and decreased incidence of post-operative wound site infection.[16] In our study, 22 patients underwent Thoracotomies, and 31 patients underwent VATS, with both thoracotomies &VATS had equal number of deaths(n=9). Results in comparison depict an increase in mortality with thoracotomies at 40.9% vs 29.03% in VATS. Conservative management was predominant in 676 (72.8%) of cases; however, Coughin et al., advocated favorable results for early operative management of unstable chest trauma, with reduced ICU, ventilatory, and hospital length of stay.[17] Dehghan et al., reported in an RCT that there may be potential benefit of surgical intervention in selected patients with an unstable chest wall injury who require early invasive mechanical ventilation, with a statistically significantly lower complications rate.[18]

Despite the complexity of injuries, the majority of patients (94.8%) were discharged with scheduled follow-up. However, the mortality rate of 5.2% is comparable to other studies, which state mortality rates range from 2.2% to 33%.19 Chest injury is a common emergency worldwide and is associated with significant morbidity and mortality.20 Understanding the pattern and outcomes of chest injuries is crucial for optimizing management strategies and improving patient outcomes.

## LIMITATIONS OF STUDY

This study is subject to various limitations. Firstly, this was a single-center study, which may limit its generalizability to other settings or areas. Secondly, the exclusion of patients with minor chest injuries and pre-

existing conditions like COPD or lung cancer may introduce selection bias.

## CONCLUSION

The study showed that blunt trauma was predominant cause of chest injuries, leading to a higher incidence of associated injuries and longer hospital stays compared to penetrating trauma. A significant proportion of patients experienced flail chest, with a notable recovery rate despite a 5.2% mortality attributed to complications, particularly head injuries. Surgical interventions were more common in penetrating injuries, while the majority of blunt trauma patients were successfully discharged and scheduled for follow-up.

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**Funding Source:** None.

**Authors' Contribution**

Following authors have made substantial contributions to the manuscript as under:

JZK & FAM: Data acquisition, data analysis, critical review, approval of the final version to be published.

FU & SSC: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

QUAM & MU: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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