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Demographic Characteristics and Injury Patterns in Patients with Flail Chest Trauma

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ABSTRACT
Background: *Flail chest is a serious form of blunt thoracic trauma associated with significant respiratory compromise and frequently accompanied by other thoracic injuries. Understanding the demographic characteristics and injury patterns of affected patients is important for timely diagnosis and management.* ***Methods & Materials:*** *This cross-sectional study was conducted in the Department of Thoracic Surgery, National Institute of Diseases of the Chest and Hospital (NIDCH), Dhaka, Bangladesh, from January 2010 to December 2010. A total of 60 patients with flail chest were included. Patients were divided into Group I (Central Flail Chest, n=22) and Group II (Other Flail Chest, n=38).* ***Results:*** *The mean age was 38.3 ± 14.4 years in Group I and 41.4 ± 18.2 years in Group II (p=0.471). Male patients predominated in both groups, accounting for 81.8% and 65.8% of Group I and Group II, respectively (p=0.184). Chest pain was present in all patients. Respiratory distress occurred in 72.7% of Group I and 57.9% of Group II patients, while cyanosis was observed in 40.9% and 15.8%, respectively. The mean number of fractured ribs was significantly higher in Group I than in Group II (9 ± 2 vs. 5 ± 1; p<0.001). Road traffic accidents were the leading cause of injury in both groups. Haemopneumothorax was the most common associated condition, followed by lung contusion and surgical emphysema.* ***Conclusion:*** *Flail chest trauma predominantly affected males and was most commonly caused by road traffic accidents. Central flail chest was associated with a higher number of rib fractures and more severe clinical manifestations.*

Keywords: *Flail chest, chest trauma, rib fractures, road traffic accident, haemopneumothorax.*

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INTRODUCTION

Flail chest is a severe and life-threatening manifestation of blunt thoracic trauma characterized by the fracture of multiple consecutive ribs in two or more places, resulting in a free-floating segment of the chest wall [1]. This condition leads to paradoxical movement of the affected chest segment during respiration, causing impaired ventilation, reduced oxygenation and significant respiratory compromise [2]. It is commonly associated with high-energy trauma and often coexists with other intrathoracic and extrathoracic injuries, which further increase morbidity and mortality [3].
Blunt chest trauma continues to be a major public health concern in developing settings, particularly among young and economically active populations [4]. The burden of injury is closely linked with mechanisms such as road traffic accidents, falls from height and physical assaults, which remain predominant causes of severe thoracic injuries [5]. The severity of flail chest is not only determined by the extent of rib fractures but also by associated injuries such as pulmonary contusion, hemothorax, pneumothorax and injuries to other body regions. These associated conditions significantly influence clinical presentation and patient outcomes [6].
The demographic profile of patients with flail chest injury is an important aspect in understanding risk distribution and planning preventive strategies. Age and sex distribution often reflect exposure to high-risk activities and occupational hazards [7]. In addition, injury patterns including the mechanism of trauma, laterality of chest involvement and associated injuries provide critical insight into the nature and severity of trauma [8].
Clinical management of flail chest requires prompt recognition and a multidisciplinary approach focusing on respiratory stabilization, pain control and treatment of associated injuries [9]. Despite advances in trauma care, flail chest remains associated with considerable morbidity due to respiratory failure, infection and prolonged hospital stay [10].
Understanding the demographic characteristics and injury patterns of patients with flail chest is essential for improving trauma care systems, optimizing management strategies and guiding preventive measures. Detailed analysis of these factors also helps in identifying high-risk groups and common injury mechanisms, which may assist in developing targeted public health interventions.
This study aimed to evaluate the demographic characteristics and injury patterns among patients presenting with flail chest trauma, with particular emphasis on age distribution, sex distribution, causes of injury, clinical presentation and associated injuries.

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METHODS & MATERIALS

This cross-sectional study was conducted in the Department of Thoracic Surgery, National Institute of Diseases of the Chest and Hospital (NIDCH), Mohakhali, Dhaka, Bangladesh, from January 2010 to December 2010. The study population comprised patients with chest injuries presenting with flail chest who were admitted during the study period. Patients of any age and either sex with flail chest were included in the study. Patients with pelvic and limb injuries, unconscious patients with chest injuries, patients with extensive burns associated with chest injuries and those who refused to provide informed consent were excluded.

A total of 60 patients fulfilling the selection criteria were enrolled consecutively. Of them, 22 patients had central flail chest injury and were assigned to Group I, while 38 patients had other types of flail chest injury and were assigned to Group II. Data were collected through interview, clinical examination, observation and review of relevant investigations using a structured data collection form.

The variables analyzed in the present study included age, sex, clinical presentation, causes of injury and associated clinical conditions. Clinical presentation was assessed by the presence of chest pain, respiratory distress, cyanosis and the number of fractured ribs. Causes of injury were recorded according to the history provided by the patients or attendants. Associated clinical conditions evaluated were haemothorax, haemopneumothorax, lung contusion and surgical emphysema.

Ethical approval was obtained from the appropriate authority of NIDCH before commencement of the study. Informed consent was obtained from all participants or their legal guardians after explaining the objectives and procedures of the study. Confidentiality of all collected information was maintained throughout the study.

Data were processed and analyzed using Statistical Package for Social Sciences (SPSS). Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequency and percentage. Comparisons between groups were performed using Student's t-test, Chi-square test, or Fisher's Exact Probability Test as appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 60 patients were selected to find out the factors influencing morbidity and mortality in flail chest injuries. Of them, 22 were randomly assigned to Group-I (Central Flail Chest) and 38 to Group-II (Others Flail Chest). The findings of the study obtained from data analysis are presented below.

Table I shows that the percentage of patients with age category ≤20 years Group-I 3(13.6) and Group-II 6(15.8), 21 – 30 years Group-I 5(22.7) and Group-II 5(13.2), 31 – 40 years Group-I 6(27.3) Group-II 8(21.1). However >40 years Group-I 8(36.4) and Group-II 19(50.0), mean age of Group-I being 38.3 ± 14.4 years Group-II 41.4 ± 18.2 years respectively. The groups were homogeneously distributed in terms of age (p = 0.471).

Table I: Comparison of age between groups.

Age (years)	Group		p-value
	Group-I (n = 22)	Group-II (n = 38)	
≤ 20	3(13.6)	6(15.8)	
21 – 30	5(22.7)	5(13.2)	
31 – 40	6(27.3)	8(21.1)	
>40	8(36.4)	19(50.0)	
Mean ± SD	38.3 ± 14.4	41.4 ± 18.2	0.471

 # Data were analysed using Student's t Test and presented as Mean ± SD.

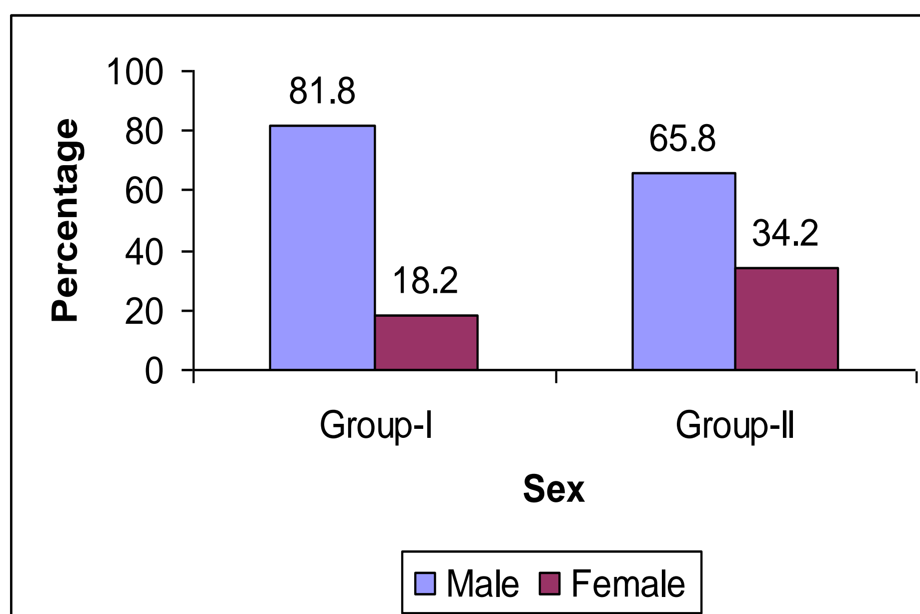

Figure 1: Distribution of patients by sex

Figure 1 show that in Group-I male 81.8 % and female 18.2%. Conversely in Group-II male 65.8 % and female 34.2%. The groups were identically distributed with respect to sex as evident by p = 0.184.

Table II shows that all the patients of both groups had chest pain, 16(72.7%) patients in Group-I and 22(57.9%) in Group-II had respiratory distress (p = 0.251). Cyanosis was present in 9(40.9%) in Group-I and 6(15.8%) in Group-II. The mean number of fracture of rib 9 ± 2 in Group-I and in Group-II was 5 ± 1 (p < 0.001).

Table II: Comparison of clinical presentation between groups.

Clinical presentation	Group		p-value
	Group-I (n = 22)	Group-II (n = 38)	
Chest pain			
Present	22(100.0)	38(100.0)	
Absent	0(0.0)	0(0.0)	---
Respiratory distress			
Present	16(72.7)	22(57.9)	0.251
Absent	6(27.3)	16(42.1)	
Cyanosis			
Present	9(40.9)	6(15.8)	0.030
Absent	13(59.1)	32(84.2)	
Number of fractured ribs	9 ± 2	5 ± 1	< 0.001

 # Data were analysed using Student's t-Test and presented as Mean ± SD.

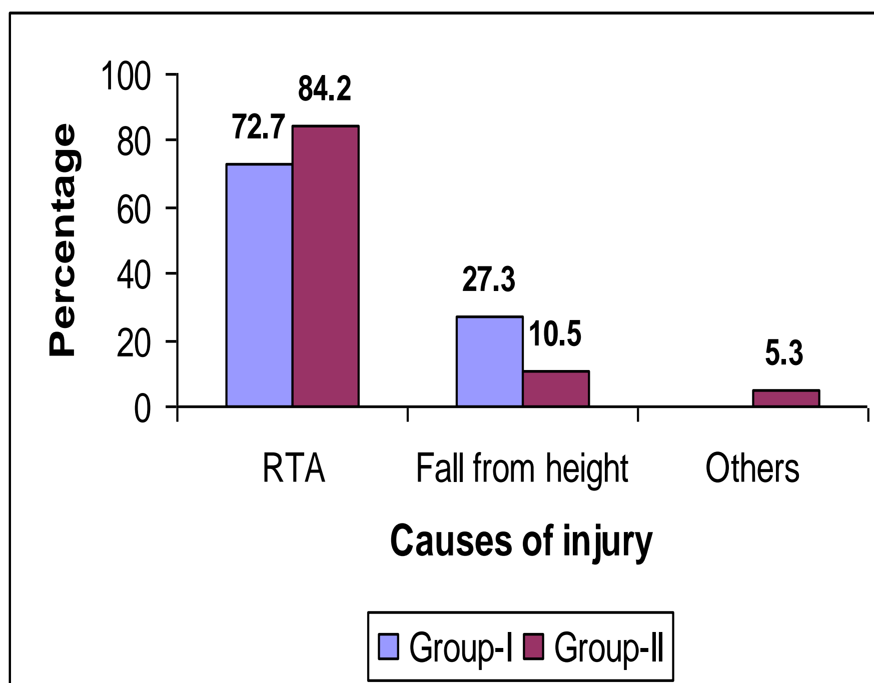

Figure 2: Comparison of causes of injury between groups.

Road traffic accident (RTA) accounted for 72.7% of injuries in Group-I and 84.2% in Group-II, fall from height were 27.3% in Group-I and 10.5% in Group-II, while 5.3% by other causes (*Figure 2*).

Table III shows that haemothorax was present in group-I 5(22.7%) and in Group-II 11(29.7%). Haemopneumothorax were present in group-I 17(77.3%) and in Group-II 26(68.4%). Lung contusion were present in Group-I 13(59.1%) and in Group-II 9(23.7%) patients. Surgical emphysema were present in patients of Group-I 13(59.1%) those in Group-II 9(23.7%).

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Table III: Comparison of associated clinical conditions between groups.

Associated conditions	Group		p-value
	Group-I (n = 22)	Group-II (n = 38)	
Haemothorax			
Present	5(22.7)	11(29.7)	0.559
Absent	17(77.3)	27(70.3)	
Haemopneumothorax			
Present	17(77.3)	26(68.4)	0.671
Absent	5(22.7)	12(31.6)	
Lung contusion			
Present	13(59.1)	9(23.7)	0.006
Absent	9(40.9)	29(76.3)	
Surgical emphysema			
Present	13(59.1)	9(23.7)	0.006
Absent	9(40.9)	29(76.3)	

 # Chi-square Test was employed to analyse the data;
Figures in the parenthesis denote corresponding %;

DISCUSSION

The present study evaluated the demographic characteristics and injury patterns among patients with flail chest trauma and compared the findings between patients with central flail chest and those with other types of flail chest. The mean age of the patients was 38.3 ± 14.4 years in Group I and 41.4 ± 18.2 years in Group II, with no significant difference between the groups. The predominance of patients in the older age categories is consistent with the observations of El-Menyar et al. and Harrington et al., who reported that chest trauma is frequently encountered among middle-aged and older adults due to greater exposure to high-energy trauma and increased vulnerability to severe thoracic injuries [11,12].

Male patients predominated in both groups, accounting for 81.8% in Group I and 65.8% in Group II. Similar male predominance has been documented by Islam et al., Lema et al., Sharma et al. and Hanafi et al [13-16]. This finding may be explained by the greater involvement of men in outdoor activities, transportation and occupations associated with an increased risk of traumatic injury.

Chest pain was present in all patients, making it the most common presenting symptom. Respiratory distress was observed in 72.7% of patients with central flail chest and 57.9% of patients with other flail chest injuries. Cyanosis was also more frequent among patients with central flail chest. These findings are in agreement with the reports of Yadollahi et al. and Simon et al., who described chest pain, respiratory compromise and impaired oxygenation as the principal clinical manifestations of flail chest [17,18]. The higher frequency of respiratory distress and cyanosis in central flail chest may reflect greater impairment of chest wall mechanics and pulmonary function.

An important finding of the present study was the significantly higher number of fractured ribs in Group I compared with Group II (9 ± 2 versus 5 ± 1, $p < 0.001$). This observation supports the findings of Chien et al., who reported that an increasing number of rib fractures is associated with greater injury severity and a higher risk of complications [19]. Similarly, Majercik and Pieracci emphasized that extensive rib fractures are characteristic of severe chest wall trauma and contribute substantially to respiratory dysfunction [20].

Road traffic accidents were the leading cause of injury in both groups, accounting for 72.7% of injuries in Group I and 84.2% in Group II. Falls from height represented the second most common mechanism of injury. These findings highlight the continuing burden of transportation-related injuries in the development of flail chest.

Associated thoracic injuries were common in the present study. Haemopneumothorax was the most frequent associated condition, occurring in 77.3% of patients in Group I and 68.4% in Group II. Lung contusion and surgical emphysema were observed in 59.1% of Group I patients and 23.7% of Group II patients. Similar patterns have been described by Veysi et al., Simon et al. and Lema et al., who noted that pulmonary contusion, haemothorax, pneumothorax and chest wall soft-tissue injuries commonly accompany flail chest [14,18,21]. The higher prevalence of lung contusion and surgical emphysema among patients with central flail chest suggests a greater degree of underlying thoracic injury in this subgroup.

LIMITATIONS

This study had several limitations. The sample size was relatively small and data were collected from a single tertiary care center, which may limit the generalizability of the findings. In addition, the cross-sectional design allowed assessment of demographic characteristics and injury patterns but did not permit evaluation of long-term outcomes or causal relationships between injury characteristics and clinical consequences.

CONCLUSION

Flail chest trauma predominantly affected male patients and was most commonly associated with road traffic accidents. Chest pain was the universal presenting symptom, while respiratory distress, cyanosis, multiple rib fractures, haemopneumothorax, lung contusion and surgical emphysema were frequently observed injury-related findings. Patients with central flail chest demonstrated a greater number of rib fractures and more severe clinical manifestations, highlighting the importance of prompt assessment and appropriate management of these injuries.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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