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Analysis of the Pattern of Chest Trauma- A Forensic Approach

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Abstract **Background:** After cardiovascular and cancer, the third leading cause of death is trauma. Death due to trauma usually occurs in the first four decades of life. Thoracic injuries are a severe problem due to high-speed vehicle accidents. The two significant types of trauma are penetrating trauma and blunt trauma. Penetrating injuries usually result in the disruption of tissue structure, while blunt injuries result in organ damage or any structure under the tissue without damaging the integrity of that tissue. Blunt injuries include falling from a height, a traffic accident, or job-related injuries. **Method:** This is a cross-sectional study conducted for one year, and a sample size of 293 was taken. The study encompassed the bodies of patients eligible for autopsy, excluding those with mutilated or decomposed bodies, as well as those with insufficient historical information. Autopsies were conducted following proper patient identification and examination. A T-test was employed to compare male and female groups, while the chi-squared test assessed differences in categorical variables between groups. Data analysis was performed using SPSS version 24.0. A value of $P < 0.05$ was considered significant. **Result:** The study revealed that most of the chest trauma cases occurred in males 70.3% and females 29.7%. Maximum number of trauma was seen between the age group of 21 to 30 years. Out of 293 victims, 235 have blunt injuries, and 58 have penetrating injuries, lung contusion is the most common 51.8% followed by rib fracture, which has occurred in 46.4% victims. **Conclusion:** The rate of occurrence of chest trauma is higher in males between the age group of 21 to 30 years than females of the same age group. Similarly, the prevalence of blunt chest trauma is much higher as compared to penetrating chest trauma. In blunt injury, the incidence of traffic-related injuries is higher, while in penetrating injuries, stabbing is more common than any other injuries.

Key Words Blunt injury, Chest trauma, Penetrating injury, Thoracic injury

1. Introduction

After cardiovascular and cancer, the third leading cause of death is trauma [1]. Death due to trauma usually occurs in the first four decades of life. Injuries related to trauma can occur in any part of the body; 1 out of 4 die due to chest trauma or its complications [2]. Thoracic injuries are a severe problem due to high-speed vehicle accidents. It occurs in 60% of people with other complications and has a mortality rate of up to 25% [3], [4].

There are two primary types of trauma: penetrating trauma and blunt trauma. Penetrating injuries typically lead to the disruption of tissue structure. In contrast, blunt injuries damage organs or structures beneath the tissue without compromising the integrity of the tissue itself. Examples of blunt injuries include falls from heights, traffic accidents, or job-related incidents. Recognizing the significance of blunt injuries is crucial, as 70% of all chest traumas are predominantly attributed to blunt trauma [5], [6], and globally, blunt injuries account for 15% of all trauma cases [7]. In the primary survey of chest trauma patients, six life-threatening conditions necessitating immediate investigation and treatment include airway obstruction, tension pneumothorax, open pneumothorax, massive hemothorax, flail chest, and pericardial tamponade [8].

If the mechanism of chest trauma injury is blunt, then it may involve many organs, tissues, and systems. For this purpose, a multidisciplinary approach is needed for these patients. 90% of patients with chest trauma injuries are treated conservatively with oxygen support, tube thoracostomy, and adequate pain control, while the other 10% of blunt chest trauma demands surgical treatment [9]. Moreover, the age of the patient is a significant factor in the evaluation of blunt chest trauma. Trauma in a neonate may not be severe due to the bone elasticity and may not cause any chest wall injury. However, in geriatrics, it may cause complications or life-threatening conditions and may lead to death. In other words, we can say that even severe trauma in neonates may cause fewer fractures due to the elasticity of bone. However, even

a slight trauma can cause many fractures in the geriatric population [9]. The rates of morality are high in chest traumas. Many patients with chest trauma die on the spot before hospitalization or any simple treatment. The main reason for this is the delayed treatment of pulmonary complications [10], [11].

Injuries resulting from blunt trauma encompass incidents such as road traffic accidents, falls, and injuries sustained in the workplace. In the context of blunt injuries, knowing the incident's history is crucial for prompt diagnosis and treatment. This importance arises from the fact that distinct mechanisms lead to specific injuries, and the mechanism of injury independently influences mortality [12]. The severity of a blunt injury is determined by two factors: the force and duration of the impact. Acceleration and deceleration during blunt impact can cause compression damage, a phenomenon observed in traumatic events. Blunt injuries primarily occur through four major processes: direct impact, thorax compression, acceleration and deceleration injury, and blast injury. Acceleration and deceleration injuries, commonly seen in road traffic accidents, result from the sudden and rapid deceleration of the anterior side of the thorax, leading to damage to vascular structures, bones, soft tissues, and organs [13].

In blunt trauma injuries, clinical findings suggest that all structure in the thorax gets damaged. In this type of injury, the knowledge of the mechanism of injury is more important than the patient's general history and physical examination. Patient's history and physical examination should be done later as it is an integral part of diagnosis [14]. Indications of chest trauma in a patient encompass the presence of bluish discoloration in the fingers, lips, or face [cyanosis], difficulty in breathing, either through shallow or diminished breaths, as well as noticeable signs such as contusions, lacerations, perforations, distension, and other trauma-related observations. Additional symptoms include coughing up blood [hemoptysis], reduced blood flow [hypoperfusion], a shift in the position of the windpipe [tracheal deviation], abnormal chest wall movements [paradoxical movement], distended jugular veins, diminished or absent breath sounds, pain—particularly pain associated with respiratory activities—and a failure of the chest to expand adequately during normal inhalation [15].

In chest trauma, the chest wall is more likely to get damaged, which also includes bone fractures. Bone fracture also includes clavicle or sternum fracture with or without rib fracture. Rib fractures are not life-threatening remotely. However, rib fractures can cause damage to the pleura and lung tissue, including additional damage such as pneumothorax, hemothorax, pulmonary contusion, parenchymal laceration, etc. [16]. The first two ribs are unlikely to get fractured [17]. 4 to 9 ribs are most likely to get fractured [18], and if a rib is broken in two or more two parts or three or more ribs are broken then it gives rise to the condition called flail chest. It results in paradoxical movement in that the ribs move outward during inspiration, but the flail chest moves inward, and vice versa in expiration [19].

Traumatic pneumothorax arises from trapped air between the lung and chest wall, with the air accumulating between the visceral and parietal pleura of the lung. It stands as the most prevalent life-threatening condition [20]. Traumatic hemothorax commonly results from rib fractures following blunt trauma and is characterized by the presence of blood or fluid trapped between the visceral and parietal pleura. Confirmation of hemothorax occurs when the pleural fluid's hematocrit exceeds 5% of the blood hematocrit [21]. Pulmonary contusion occurs in the absence of laceration, damaging the pulmonary structure and leading to alveolar hemorrhage [22]. Penetrating injuries typically cause pulmonary laceration, resulting in damage to the parenchymal structure of the lung [23]. Tracheobronchial injury, although rare, is exceptionally severe with fatal consequences, involving damage to the trachea, bronchi, and tracheobronchial tree [24]. Therefore, the present study aims to review and describe the epidemiology, modes, types, characteristics, and patterns of chest injury.

2. Methodology

Injuries resulting from various mechanisms of trauma exhibit distinct characteristics. The nature of these mechanisms depends on the circumstances surrounding thoracic trauma. We conducted a one-year cross-sectional study at a tertiary health center to investigate potential disparities among these injury mechanisms. A total of 293 patients were added in this study, including males and females with chest trauma of all types. Demographic information, along with the cause of injury, was collected. Victims were categorized based on the type of chest trauma, whether it was blunt or penetrating. The study also considered the male-to-female ratio. It encompassed the bodies of patients eligible for autopsy while excluding those with mutilated or decomposed bodies, as well as those bodies whose history is not adequately available. Autopsies were conducted only after thorough identification and examination of the patient's body. Data related to injuries, damage to internal organs, and cause of death were collected during the post-mortem. Quantitive data was expressed in the form of percentages. A T-test was used to compare the male and female groups. Differences in categorical variables between groups were compared using the chi-squared test. The data was analyzed using SPSS [statistical package for the social science] version 24.0. A value of $P < 0.05$ was considered significant. All the data are thus collected, compiled, and presented in the tables.

3. Results

Table 1 represents the demographic of victims. It suggests maximum number of traumas was seen between the age group of 21 to 30 years.

Out of 293 victims, 235 have blunt injuries and 58 have penetrating injuries. Out of 235 from blunt injury, the majority had the injury due to road traffic accidents which is 55.9% and is more common in males than females followed by fall from height 9.9% which is more common in females than in males. Table 2 also shows that chest injuries are more common in the age group of less than 30 years. In penetrating

Age	Male [%]	Female [%]	Total no. of victim
0-20 years	25 [12.1%]	10 [11.5%]	35
21-30 years	91 [44.2%]	35 [40.2%]	126
31-40 years	60 [29.1%]	13 [14.9%]	73
>41 years	30 [14.6%]	29 [33.4%]	59
Total	206 [70.3%]	87 [29.7%]	293

Table 1: Age and sex distribution [n=293]

injuries, stabbing is the most common before 30 years and blast injuries are less common.

Table 4 represents which type of injury occurred and it states that lung contusion is the most common followed by rib fracture which has occurred in 136 victims and lung injury due to sternum fracture is the least commonand is present in only 15 victims.

Tables 3 represent that blunt injury is more common in males which is 164 than the penetrating injury which is 42 and is highly significant with the p-value of <0.001. This study shows lung injuries in females are less common and also in the age of less than 20 years. Blunt chest traumas are more common in the age group between 21-30 years and showed a significant p-value.Blunt injuries cause lung contusion in 112 victims with a p-value of 0.034 which is not significant.

4. Discussion

Chest trauma is the common cause of death after cancer and cardiovascular issues in both adults and children [25]. In this study, out of 293, 235 patients had blunt trauma while 58 had penetrating trauma, which is also suggested by Ulutas et al. Out of 996 patients, 761 suffered from blunt injury. In contrast, 235 had suffered from penetrating injury [26]. Despite that, Khorsandi et al. showed the result which said more prevalence of penetrating injury as compared to blunt injuries [27].

This study suggests more males in the blunt group than females. This is in agreement with Ekpe and Eyo, who also showed that blunt chest trauma is more common in males than females [28].

This study reveals that blunt injury can mostly occur between 21 to 30 years,. In contrast, penetrating injury is less likely to happen, according to the results from Saaiq and Shah, who took 143 patients and reported the mean age of victims 36.53 ± 14.43 years [29].

In terms of the causes of trauma in the blunt injury sector, road traffic accidents were more common which is 55.9% than any other reason, which agrees with El-Menyar et al. that traffic-related accidents are more common in the blunt sector, which 63% in their study [30]. Saaiq and Shah also represented the same result, that the leading cause of blunt injury is road traffic accidents, and in males, calculations showed 46% of them [29]. El Wakeel did another study, along with others, showing the same result as this study. They observed the CT scan of the patients with blunt trauma and reported that 80% of blunt injury is traffic traffic-related [31].

The study done by Quistberg et al. reported that this could be due to the bad construction of roads or because of the elevated density of traffic vehicles, blockage of roads by street vendors, less walking space for people, and reduced visibility by parked vehicles [32]. In contrast to this study, Huisinh et al. stated that drivers over 30 years old can suffer due to road accidents, and he explained that this can be due to the reduced or impaired visual field [33]. This study showed that road traffic accidents are more common in the age group of less than 30 years.

This study, in terms of penetrating injuries, shows that stabbing is the most common type of injury in 27% of patients, which agrees with the result shown by Ber et al. Their study showed that 69.3% of victims with stab wounds [34]. Yazici did another study along with others in Ankara on penetrating traumas and showed similar results to our study, accounting for 89.9% of victims and 10.1 with gunshot wounds [35]. Meanwhile, Khan et al. showed the opposite result of our study. They considered 120 patients with penetrating wounds and showed that gunshot is more likely to happen as compared to stabbing [36].

A study done by Huber et al. [37] showed the results after the chest trauma in multiple injured patients, and the significant injury was rib fracture in 51% of patients, which contrasts with this study as it suggests that lung contusion is more common.

5. Conclusion

The rate of occurrence of chest trauma is higher in males between the age group of 21 to 30 years than females of the same age group. Similarly, the prevalence of blunt chest trauma is much higher as compared to penetrating chest trauma. In blunt injury, the incidence of traffic-related injuries is higher, while in penetrating injuries, stabbing is more common than any other injuries.

Conflict of interest

The author declares no conflict of interests. Author read and approved final version of the paper.

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	Mode of Injury	<30 years	>30 years	Total
Blunt Injury [n=235]	Road traffic accident	91 [56.5%]	73 [55.4%]	164 [55.9%]
	Fall from height	10 [6.2%]	19 [14.4%	29 [9.9%]
	Assault/Violence	17 [10.6%]	6 [4.5%]	23 [7.8%]
	Work-related	8 [4.9%]	11 [8.3%]	19 [6.5%]
Penetrating Injury [n=58]	Stabbing	17 [10.6%]	10 [7.6%]	27 [9.3%]
	Firearm injury	12 [7.5%]	9 [6.8%]	21 [7.2%]
	Blast injury	6 [3.7%]	4 [3.0%]	10 [3.4%]
	Total	161	132	293
	X2	4.49		
	P- value	0.124		

Table 2: Age-wise distribution according to the mode of injury

Profile	Blunt injury [n=235]	Penetrating injury [n=58]	P-value
Gender Male	164 [69.8%]	42 [72.5%]	0.001
Female	71 [30.2%]	16 [27.5%]	
Age 0-20 years	28 [11.9%]	6 [10.3%]	0.345
21-30 years	103 [43.8%]	23 [39.6%]	0.001
31-40 years	68 [28.9%]	8 [13.7%]	0.015
>41 years	36 [15.3%]	21 [36.2%]	0.076
Injury Type Rib fracture	104 [44.3%]	20 [43.4%]	0.001
Lung contusion	112 [47.6%	24 [41.3%]	0.034
Pneumothorax	63 [26.8%	13 [22.4%]	0.617
Hemothorax	28 [11.9%]	6 [10.3%]	0.121
Hemopneumothorax	32 [13.6%]	9 [15.5%]	0.105
Sternum fracture	18 [7.6%]	4 [6.8%]	0.001
Major vessel injury	19 [8.0%]	6 [10.3%]	0.185
Other injuries	55 [23.4%]	12 [20.6%]	0.001
P<0.05 – Significant, P<0.001 — highly significant			

Table 3: Characteristics of blunt injury in comparison with penetrating injury related to chest trauma

Injury	No. & percentage of victim
Ribs fracture	136 [46.4%]
Lung contusion	152 [51.8%]
Pneumothorax	73 [29.9%]
Hemothorax	41 [13.9%]
Hemopneumothorax	46 [15.7%]
Sternum Fracture	15 [5.1%]
Major vessel injury	18 [6.1%]
Other injuries	73 [24.9%]

Table 4: Distribution according to type of injury

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