Section: General Surgery

Original Research Article

EPIDEMIOLOGY OF BLUNT CHEST TRAUMA PATIENTS REPORTING TO A TERTIARY CARE HOSPITAL IN HARYANA, INDIA: A CROSS SECTIONAL STUDY

Anamika Verma[1], Anupma[2], Madan Gopal Bhardwaj[3], Mahipal[4]

[1]Junior resident, Department of General Surgery, PT.B.D.S. PGIMS, Rohtak, Haryana, India
[2]Senior Resident, Department of Anesthesia, Pt.B.D.S. PGIMS, Rohtak, Haryana, India
[3]Senior Resident, Department of General Surgery, Pt.B.D.S. PGIMS, Rohtak, Haryana, India
[4]Assistant Professor, Department of General Surgery, Pt.B.D.S. PGIMS, Rohtak, Haryana, India

Received : 12/04/2023
Received in revised form : 24/05/2023
Accepted : 06/06/2023

Keywords:
Blunt Chest Trauma, Haryana, Epidemiology of chest trauma.

Corresponding Author:
Dr. Madan Gopal Bhardwaj,
Email: mgisaround@gmail.com

DOI: 10.47009/jamp.2023.5.3.338

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2023; 5 (3); 1683-1690

Abstract

Background: To understand the epidemiological profile of patients reporting to the trauma center of our hospital with blunt thoracic trauma and to ascertain the impact of various etiologies of blunt chest trauma. **Materials and Methods:** A prospective cross sectional study was conducted comprising of 100 patients that reported with blunt chest trauma. **Result:** Majority of the patients were males who were involved in RTA. Presentation was mostly in the form of rib fractures, hemothorax, pneumothorax and flail chest. Most of the patients could be managed conservatively with inserting an ICD and supportive treatment. None required an operative intervention. **Conclusion:** A bigger study with a higher number of patients is required to know the full magnitude of the problem and its burden on health care facilities.

INTRODUCTION

Trauma is the third leading cause of death in all age groups after cardiovascular diseases and cancer. However, trauma is the most common cause of death in the age of first four decades. Although trauma-related injuries can occur in many parts of body, one out of four trauma patients die due to thoracic injury or its complications.[1]

Chest trauma remains a serious problem as high-speed vehicle accidents increase. Thoracic trauma occurs in approximately 60% of patients with polytrauma and has a mortality of 20% - 25%.[2]

Considering that 70% of all chest traumas constitute blunt injuries, the importance of blunt injuries is understood with the most frequent causes being motor vehicle accidents, falls and crush injuries.[3]

Chest traumas are continuously increasing and many patients with chest trauma die before hospitalization despite using simple treatment methods. The cause of the mortality and morbidity in blunt chest trauma is mostly due to delayed pulmonary complications. It is worth to notice that the preventable in-hospital mortality rate in trauma patients is between 4% and 60% worldwide.[4-6]

Thoracic trauma comprises 20-25% of all traumas worldwide and constitutes the third most common cause of death after abdominal injury and head trauma in polytrauma patients.[7,8]

Thoracic trauma (TT) is classified as open (penetrating) or closed (blunt), and the lesion spectrum will determine its gravity.[9] According to the type of trauma, lesions can be divided into four big groups: lesions of the thoracic wall, pulmonary, mediastinal and diaphragmatic lesions. The most frequent lesions are rib fractures, injuries of the heart, aorta, airways and diaphragm.[10] Injuries that present greater risk of immediate death are: airways obstructions, tension pneumothorax, open pneumothorax, cardiac tamponade and massive hemothorax. The ones that represent a potential death risk and must be diagnosed and treated in a secondary examination are: simple pneumothorax, hemothorax, pulmonary contusion, unstable thorax, cardiac contusion, traumatic aortic rupture, traumatic diaphragmatic rupture, and mediastinum transfixing injuries.[11]

The severity of injury may depend on the strength and duration of the blunt impact as well as the acceleration-deceleration injury and compression damage that occur during trauma. There are four mechanisms of blunt chest trauma: (1) direct impacts on the thorax, (2) thorax compression, (3) acceleration/deceleration injuries, and (4) blast injuries.[12]

The best example of acceleration-deceleration damage is motor vehicle accident.[1] The most common condition is the sudden and high-speed deceleration of the anterior thorax, resulting in injury to the vascular structures, bones, soft tissues and organs. At the same time, the presence of steering wheel deformity caused by the driver

ISSN (O): 2687-5365; ISSN (P): 2753-6556

hitting the steering wheel increases thoracic injuries, complications and mortality. Thoracic compression is usually caused by crush, occupational accident and fall from height.[13]

Most of the blunt thoracic trauma are caused by motor vehicle accidents (includes pedestrian accidents) and falls from height.[14,15] Motor vehicle accidents are the most common cause of severe thorax trauma. In motor vehicle accidents, the most common trauma patients are pedestrians, vehicle drivers and motorcyclists, respectively.[16,17]

Therefore, to understand the epidemiological profile of patients reporting to the trauma center of our hospital with blunt thoracic trauma we conducted this cross sectional study.

MATERIALS AND METHODS

Aim: To ascertain the impact of various aetiologies of blunt chest trauma on immediate resuscitation and long-term patient morbidity and mortality.

Objectives:

1. To study the prevalence and incidence of the blunt chest trauma in trauma patients.
2. To assess etiological factors.
3. To assess the various factors influencing the final outcome in patients.
4. To study the incidence of pneumonia, ARDS, pneumothorax, hemothorax and vascular injuries in blunt chest trauma patients.

The present descriptive cross-sectional type of study was conducted in the Department of General Surgery, Pt. B. D. Sharma Institute of Medical Sciences, Rohtak. The study period was from September 2021 to August 2022.

Inclusion Criteria

Adult patients (older than 16 years) who suffered multiple trauma involving blunt injury to the chest, admitted to hospital for more than 72 hours, having sustained chest injuries and age <65 years.

Exclusion Criteria

Isolated injuries to the head and/or to the abdomen, not involving chest, stab injury to the chest, gunshot injury to chest, patients with burns or inhalation injuries as well as patients transferred to other units within 48 hours of admission were excluded.

Sample Size: 100

Formula used,[7]

$$\text{Sample size (N)} = \frac{\left(Z_{1-\alpha/2}\right)^2 Pq}{L^2}$$

$Z_{1-\alpha/2}$ = 1.96 (at 95% confidence level)

P = 64.6% [0.646] prevalence of blunt chest trauma in chest trauma patients

q = 1-P

L = 5% relative error (15% of prevalance)

N = 94

Total Sample size = 100

Methods

The following data was collected using proforma:

Patient profile including Name, Age, Sex, Address, Contact No. and CR No. were taken. Past history, Personal history, Occupation history, Mode of injury, Time since injury taken and General physical examination was done.

All basic investigations were performed, and all the collected data was entered in Microsoft excel spreadsheet. Descriptive statistics was analyzed with SPSS software. Continuous variables were presented as mean ± SD. Categorical variables were expressed as frequencies and percentages. The Pearson's chi-square test or the chi-square test of association was used to determine if there is a relationship between two categorical variables. A p value of <0.05 was considered statistically significant.

RESULTS

$$\text{Incidence rate (per 100 trauma patients)} = \frac{\text{total number of blunt chest trauma cases} \times 100}{\text{total patients of trauma of all types}}$$

$$= \frac{1302 \times 100}{8190}$$

$$= 15.89$$

Mean age of patients suffering from blunt chest trauma was 41.59±14.22 and most of the patient were in the age group 20-30 years. The study group comprised of 8(8%) female patients and 92(92%) male patients. RSA 54(54%) was the most common cause of blunt chest trauma in patients, 33(33%) from fall and 18(18%) from physical assault. Majority of the patients who suffered blunt chest trauma were not under the influence of alcohol 88(88%), however 12(12%) of patient were under the influence of alcohol.

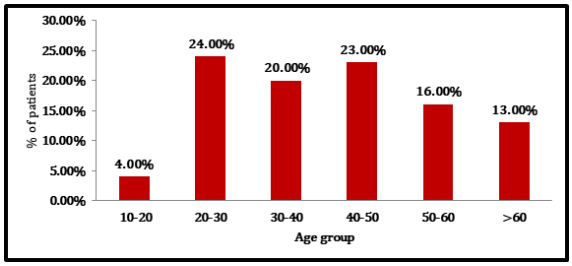

Figure 1: Percentage of patients in various age groups

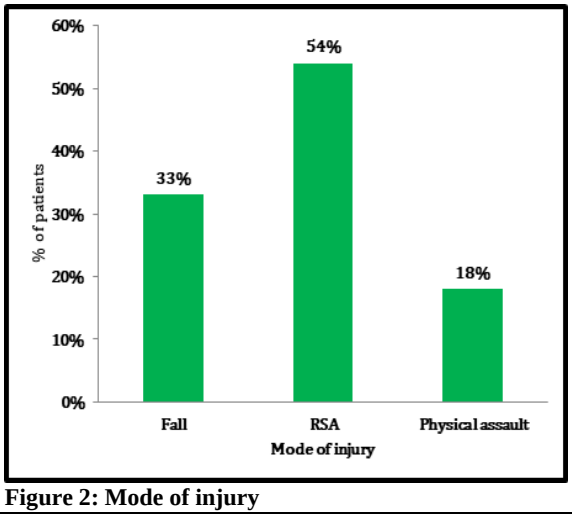

Figure 2: Mode of injury

ISSN (O): 2687-5365; ISSN (P): 2753-6556

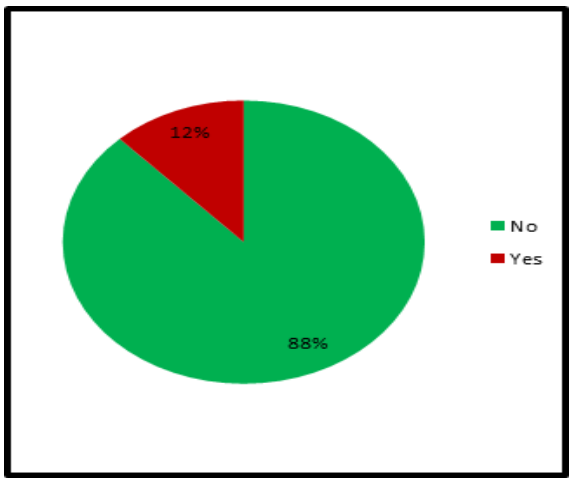

Figure 3: Alcohol influence

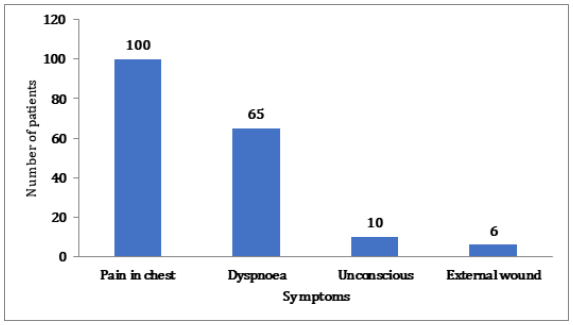

Figure 4: Symptomatology

Tenderness was the most common clinical finding followed by bony crepitus 50 patients, bruise 15 patients and subcutaneous emphysema 14 patients. Most common associated injury with blunt chest trauma was head injury 19 patients followed by spinal injury 9 patients, blunt trauma abdomen 8 patients, long bone fracture 6 patients and pelvis fracture 3 patients.

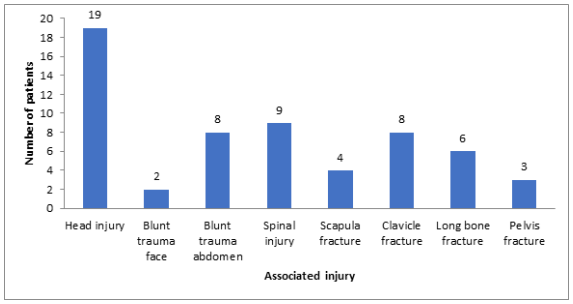

Figure 5: Associated injuries

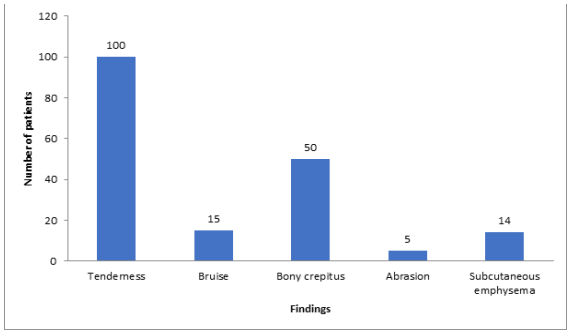

Figure 6: USG Whole abdomen and Bilateral thorax

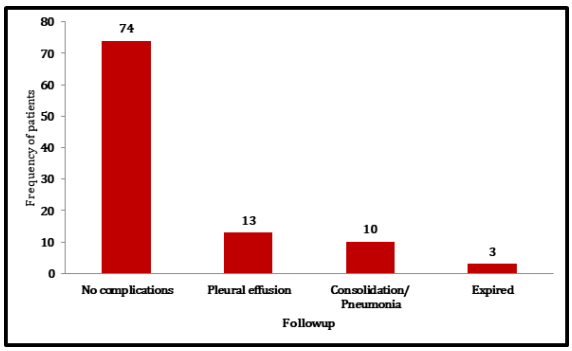

Figure 7: Follow-up

Out of 100 patients of blunt chest trauma ICD was inserted in 58(58%) patients and 42(42%) were managed conservatively without ICD. 97(97%) patients were discharged and 3(3%) expired. On followup 74 patients had no complications after discharge, 13 patients developed pleural effusion, 10 patients developed pneumonia during the hospital stay and 3 patients expired with a pulmonary complication. Patients having bilateral hemothorax had increased length of hospital stay and increased morbidity. Chest x-ray of all the patients (n=100) showed rib fractures, 26 had hemothorax, 23 had pneumothorax, 11 had hemopenumothorax and 5 had flail chest.

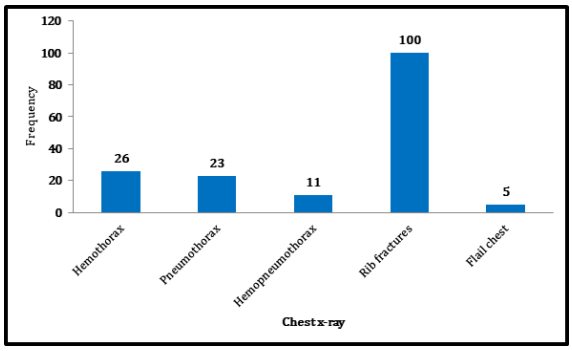

Figure 8: Chest x-ray findings

DISCUSSION

In our study blunt chest injuries were predominantly seen in males and more in the 3rd decade of life with mean age of presentation being 41.59 years of age. Among peer studies conducted by Sharma et al,[18] Thomas et al,[19] Atri et al,[20] & Iyer et al,[21] it was seen that maximum incidence of blunt chest trauma was among the age group of 25-38 years.

The demographic analysis of sex and age conforms to the general norms of trauma incidence, with road traffic accidents (RTAs) being the commonest mode of injury in the study constituting 35.2% of cases followed by railway accidents (27.6%), a mode of injury commonly seen in the Indian subcontinent and virtually unknown in the western world. Studies conducted by LoCicero et al,[1] using data from western and Indian studies reported RTAs as the most common mode of injury. Most of the road traffic accident victims in the study were pedestrians

ISSN (O): 2687-5365; ISSN (P): 2753-6556

or pillion riders thrown off in the accident while those involved in the railway accidents had fallen off a running train.

In our study, similarly we found that all patients (100%) of blunt chest trauma presented with rib fractures. Hemothorax was present in 26% cases, pneumothorax was present in 23% cases and hemopneumothorax was present in 11% cases. Flail chest was present in five (5%) patients. Only one (1%) case of bronchial injury and one (1%) case of lung laceration was seen. No case of cardiac, diaphragmatic, vascular or esophageal injury was reported in our study. Atri et al,[20] studied 240 cases of blunt chest trauma and observed that rib fractures present were in 60% of cases. This is followed by surgical emphysema in 37% cases, hemopneumothorax in 27.1% cases, hemothorax in 21.7% and lung contusion in 10% cases. In another study conducted by Kumar et al,[22] hemothorax was found in 38.3% and pneumothorax in 20.7% of cases. In other studies also similar result was seen, Lin et al.23 found 31.8% traumatic hemothorax, 15.6%pneumothorax and 9.6% hemopneumothorax. Most of these patients were managed with standard intercostal drainage procedure.

Helling et al,[24] published that tension pneumothorax and cardiac tamponade are clinical diagnosis and should be managed aggressively without waiting for any prior investigation. In our study we observed six cases of tension pneumothorax which were managed by immediate intercostal chest tube placement in the triangle of safety.

de Lesquin et al,[25] mentioned in their review that all traumatic pneumothoraces and symptomatic hemothoraces should be considered for chest tube insertion in the first 48 hours following blunt chest trauma. However, observation is possible for selected patients without respiratory disease or the need for positive pressure ventilation with small unilateral pneumothoraces.[26] Late drainage is usually required in patients with progression of pneumothoraces, hemothoraces or respiratory distress.[27,28] In our study ICD placement was done in 58(58%) patients who had either pneumothorax or hemopneumothorax or hemothorax. Around 42(42%) patients were managed conservatively without ICD who were vitally stable and had no or minimal collection in their pleural cavity.

Flail chest is commonly encountered in blunt chest trauma. It is seen to be associated with other injuries most commonly pulmonary contusions.[29] In a study done by Nazish Sikander et al.[30] 10 (12.5%) patients had flail chest and all of them were associated with lung contusion. A retrospective analysis of injury patterns and clinical outcomes associated with flail chest indicated that the patients with sustained flail chest have significant morbidity and mortality.[30] Flail chest causes atelectasis, resulting in decreased lung volume due to inadequate and paradoxical chest movement. Alhadhrami et al,[31] found out that epidural analgesia was enough to minimize the morbidity, mortality, and hospital staying such patients.

In another cross-sectional study conducted by Kumar et al,[32] including 200 patients it was observed that incidence of pneumothorax was 44% as compared to 24% in the Nigerian study and 18.45% in MIEMSS. All cases of pneumothorax were treated with tube thoracostomy. ICD was removed usually within 5-6 days. Twelve patients had pneumomediastinum. Incidence of hemothorax was 60% as compared to 20% in the Nigerian study. Minimal hemothorax found on CT were treated conservatively. Most cases required ICD. CT was found to be more sensitive for hemothorax, rib fractures and parenchymal lung injuries. Prophylactic antibiotics, bronchodilators, nebulization and incentive spirometry were given to the patients who underwent tube thoracostomy. Decision for ICD was most often taken based on plain chest x-ray findings. Chest x-ray was found to be sensitive particularly for rib fractures, pneumothorax and surgical emphysema. Chest x-ray showed mediastinal widening in the only case of thoracic aorta injury cases in the study. ICD tube was inserted in the triangle of safety in all cases. All cases of lung collapse were partial and most improved with incentive spirometric exercise. One case in the study had residual collapse during follow up. They had 4 cases of lung laceration and it required thoracostomy only. They had 4 cases of diaphragmatic injury. Left dome was disrupted with herniation of splenic flexure and gastric fundus into thoracic cavity in 2 cases which later underwent laparotomy and repair of diaphragm. They had 4 cases of cardiac injury i.e, a 2% incidence as compared to 0.8% in the study conducted in Nigeria. One patient sustained ventricular septal rupture following fall from bicycle. Emergency closure of the defect with PTFE was done under cardiopulmonary bypass. On follow up he had mild residual defect with pan systolic murmur.

The associated injuries noted in our study included head injury (19 patients), which contributed significantly to the total Injury severity score (ISS) and mortality and morbidity of patients, blunt trauma abdomen (8 patients), pelvic fracture (3 patients), and long bone fracture (6 patients), which all contributed to the final ISS and mortality especially in patients who presented late. The overall mortality rate in this study was 5.4% and this is comparable to other similar studies conducted by which have documented mortality rates ranging from 2.2% to 33%. This indicates the heterogeneous nature of chest trauma in terms of severity and differing expertise and facility available in the different geographical regions of the world.

In our study the most common associated fracture with blunt chest trauma was vertebral fractures 9(9%), 8(8%) cases had clavicle fractures, 6(6%) had long bone fractures and 4(4%) cases had scapula fractures. In our study 7(7%) patients had pneumomediastinum. In accordance with other

ISSN (O): 2687-5365; ISSN (P): 2753-6556

studies only 10% of polytrauma patients in Chrysou et al,[33] study required surgical treatment for their chest injuries due to unsuccessful non operative treatment such as non- resolving pneumothorax despite thoracic drainage and /or observation of a persisting air leak in the underwater seal. Condition of bilateral chest with paradoxical movement and /or the need for positive pressure ventilation for more than 48 hours was considered as an indication for surgery as well.[34-37] Therefore patients requiring thoracic surgery are usually operated on average of 4.5 days after admission due to the efforts for conservative treatment for patients with stable respiratory function at presentation in the emergency room. Early ICU admissions should be considered for patients of blunt thoracic trauma as it has been shown to improve the trauma outcome in these patients.[38] Failure of timely management with analgesia, physiotherapy and respiratory support also increases the risk of complications including pneumonia, ARDS and respiratory failure resulting in the need for emergency intubation and ventilation.[39] Pulmonary contusions also increase the likelihood of adverse outcomes in these patients.[40]

In the study conducted by the most common associated fracture with blunt chest trauma was that of clavicle (44 cases, i.e., 22%), 12% cases had vertebral fractures. 6%cases had scapula fracture, 22% cases sustained abdominal solid organ injury. In a study conducted by Section of Trauma Surgery, Department of Surgery, Hamad General Hospital Doha, Qatar, the proportion of abdominal solid organ injury was 29%. They found liver injuries in 13.5% cases as opposed to 16%. Splenic trauma was found in 15% cases in Qatar study and 8% cases. study. In the study conducted by Kumar et al,[32] liver injury was the most common abdominal solid organ injury followed by spleen. 32 patients had liver injury. Four cases required laparotomy and suturing of liver laceration. All other were managed conservatively. They had four cases each of pancreatic and renal injury. Sixteen patients sustained splenic injury. All cases improved with conservative measures. The three major mechanisms involved in blunt thoracic trauma are direct compression, rotational mechanism and deceleration. Direct compression played role in 96% of cases. Rotational mechanism and deceleration played role in 16 and 12 cases respectively. Altogether 152 cases required tube thoracostomy, 44 underwent bilateral procedure. They were given antibiotics throughout the period of intercostal drainage. The decision for tube removal was taken based on clinical and radiological improvement as well as the amount of drainage and absence of air leak. In our study 8(8%) patients had sustained associated abdominal injury out of which 2 patients underwent laparotomy–one patient underwent laparotomy for jejunal perforation where primary repair of jejunal perforation was done and another one underwent laparotomy for urinary bladder rupture where primary repair of urinary bladder was done. Rest other cases of abdominal injuries were solid organ injury and were managed conservatively.

Table 1: CECT Abdomen findings

CECT Abdomen	Frequency
Hepatic injury	2
Splenic injury	1
Renal injury + Hepatic injury + splenic injury	1
Hepatic injury + Adrenal gland injury	1
Hepatic injury + splenic injury	1
Jejunal perforation	1
Splenic injury + urinary bladder rupture	1

In a study conducted by Iyer et al,[41] and Wang et al,[42] found that shock on admission, hypoxia and acidosis on ABG parameters were associated with higher mortality. In a study conducted by Guy Elgar et al,[43] elderly and young adult patients both displayed relatively low mortality rates of 1%. Their study revealed no statistically significant association between mortality and age in patients with blunt chest trauma. Their findings were incongruent with previous studies who found advanced age to be associated with higher rates of mortality. Similarly, Harrington et al,[31] displayed increasing age and injury severity scores as independent predictors of survival among patients following blunt chest trauma.

Svennevig et al,[44] in their study emphasized that age, hemodynamic status and several comorbidities are the most important survival factors. However, Vollrath et al,[45] conducted a large-scale study involving 43,289 patients to assess lung failure after polytrauma with concomitant blunt thoracic injury in the elderly. They revealed that lung failure markedly increased length of hospital stay, ICU duration and mechanical ventilation, independent of age. In addition, lung failure increased mortality significantly more in the oldest patients. These results provide contradicting findings regarding the relationship between age and mortality in blunt chest trauma.

Guy Elgar et al,[43] study also indicates that the relationship between mortality and advanced age in blunt chest trauma may be more nuanced than previously suspected. They presumed that the incongruency found in the current literature was due to lack of control for injury severity, mechanism of blunt chest wall trauma and severity of comorbidities. Without controlling these patient characteristics, age can serve as surrogate factor that potentially contains the true mortality associated variables. Hence, they concluded that further investigations controlling for patient characteristics, mechanism of injury and injury severity are necessary to further elucidate the relationship between age, blunt chest wall trauma and mortality.

Guy Elgar et al,[43] in their study also showed that for every additional day patients with blunt thoracic

ISSN (O): 2687-5365; ISSN (P): 2753-6556

trauma stayed in the hospital, the odds of mortality increased by 9%. The presence of cardiopulmonary disease and markers of chest wall injury severity such as increased number of rib fractures were associated with increased length of hospital stay and morbidity.[47-49] Murni et al conducted a 43 months prospective cohort study that demonstrated that hospital length of stay>7 days significantly increased risk of healthcare associated infections. Also, in multiple large scale retrospective studies it has been shown that patients with blunt thoracic trauma have an average hospital length of stay slightly above 9 days on average.[46] Hence, they suspected that the increased mortality rates observed in patients with increased hospital length of stay may be attributed to nosocomial infections and correspondingly patients with higher acuity who require longer hospital length of stay. Goiburu et al,[52] concluded that malnutrition on admission in trauma patients is an independent risk factor for increased length of hospital stay, morbidity and mortality.

Beshay et al,[53] assessed 630 patients with blunt chest trauma to determine independent risk factors of mortality. Their study found that the presence of severe lung contusion and advanced age as independent risk factors directly related to mortality involving blunt chest trauma. Similarly, Degirmenci et al,[54] analyzed clinical outcomes in blunt thoracic injuries and conducted that injury severity, associated organ injuries and pleural and pulmonary parenchymal injuries are the factors most associated with poor clinical outcomes.

Battle et al,[55] concluded that age of 65 years or more, three or more rib fractures, pre-existing cardiopulmonary disease and post injury pneumonia were significant risk factors for mortality in patients with blunt chest wall trauma. Guy Elgar et al,[43] study indicated that patients admitted for blunt chest trauma with liver diseases and respiratory diseases had significantly higher mortality rates. The presence of respiratory diseases and liver diseases increased risk of mortality by 7.4 and 8.3 times, respectively. Huber et al,[56] demonstrated that injuries to the lung, advanced age and heart and thoracic vessel injuries significantly influence mortality after significant blunt chest trauma. Perna et al,[57] investigated factors influencing the outcomes in 500 patients with blunt chest trauma and that revealed increased mortality risk was associated with an injury severity score above 25, presence of three or more rib fractures with flail chest, pulmonary contusion, ARDS and an age above 55 years.

In our study mortality was 3%. Association with severe head injury and abdominal injury was seen in 2 out of 3 patients that expired. Pulmonary complications secondary to massive air leak and flail chest in association with previous COPD leading up to respiratory failure was seen as the cause of death in the last patient.

CONCLUSION

Concluding the study, we would like to say that larger studies encompassing higher sample size and duration are required to determine the burden of trauma in society and also paving the way for stricter implementation of laws and regulations that govern road safety, particularly two wheelers. Psycho-social help, awareness programs and interventions should be available to curb the menace of alcohol related trauma and people involved in railway tract injuries.

Nevertheless, with proper training, timely diagnosis, transportation, and intervention can be vital to prevent death due to chest trauma in acute life-threatening injuries. In the same perspective, basic knowledge of diagnosing a chest injury, needle thoracostomy and insertion of ICD should be taught to paramedical staff. Protocols governing trauma care should be strengthened while in hospital. One should be cautious about identifying which patient can be treated conservatively and by applying basic clinical skills and radiological investigations in the form of chest X ray USG- FAST and CT chest in selected patients and what are immediate life threatening chest injuries which need immediate intervention and ICU management. A close communication with the critical care team, shifting the patient to the ICU for intermittent positive pressure ventilation along with round the clock pain killers, IC blocks, epidural catheters may be considered as useful adjuncts in helping to prevent atelectasis and other pulmonary complications.

REFERENCES

1. LoCicero J., Mattox K.L. Epidemiology of chest trauma. Surg Clin. 1989;69:15–19.
2. Broderick S.R. Hemothorax: etiology, diagnosis, and management. Thorac Surg Clin. 2013;23:89–96.
3. O'Connor JV, Adamski J. The diagnosis and treatment of non-cardiac thoracic trauma. J R Army Med Corps 2010;156:5–14
4. Roy N, Kizhakke Veetil D, Khajanchi MU, Kumar V, Solomon H, Kamble J, et al. Learning from 2523 trauma deaths in India-opportunities to prevent in-hospital deaths. BMC Health Serv Res 2017;17(1):1-8.
5. Chan O., Hiorns M. Chest trauma. Eur J Radiol. 1996;23:23–34.
6. Sakran JV, Greer SE, Werlin E, McCunn M. Care of the injured worldwide: Trauma still the neglected disease of modern society. Scand J Trauma Resusc Emerg Med 2012;20:64.
7. Demirhan R, Onan B, Oz K, Halezeroglu S. Comprehensive analysis of 4205 patients with chest trauma: a 10-year experience. Interact Cardiovasc Thorac Surg. 2009;9:450–3.
8. Lecky FE, Bouamra O, Woodford M, Alexandrescu R, O'Brien SJ. In: Pape H-C, Peitzman AB, Schwab CW, Giannoudis PV, editors. Epidemiology of polytrauma. New York: Springer: Damage Control Management in the Polytrauma Patient; 2010. pp. 13–24.
9. Pasha MA, Mokhtar MF, Ghazali MZA. A 10-year retrospective review of chest trauma in Hospital Universiti Sains Malaysia. IOSR J Dent Med Sci 2015;14:68-74.
10. Whizar-Lugo V, Sauceda-Gastelum A, Hernández-Armas A, Garzón-Garnica F, Granados-Gómez M. Chest trauma: an overview. J Anesth Crit Care Open Access 2015;3:2-11.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

11. American College of Surgeons. ATLS: Advanced Trauma Life Support for Doctors: student course manual. 10th ed. Chicago (IL): American College of Surgeons; 2018
12. Oikonomou A., Prassopoulos P. CT imaging of blunt chest trauma. Insights Imaging. 2011;2:281–295.
13. Cassuto J., Ezuddin N., Danton G. Blunt chest trauma: a radiologic approach and review. CurrRadiol Rep. 2018;6:23.
14. Yadollahi M., Arabi A.H., Mahmoudi A. Blunt thoracic injury mortality and clinical presentation. Trauma Mon. 2018;23
15. Martin T.J., Eltorai A.S., Dunn R. Clinical management of rib fractures and methods for prevention of pulmonary complications: a review. Injury. 2019;50:1159–1165.
16. Grubmüller M., Kerschbaum M., Diepold E. Severe thoracic trauma – still an independent predictor for death in multiple injured patients? Scand J Trauma Resuscitation Emerg Med. 2018;26:6.
17. Narayanan R., Kumar S., Gupta A. An analysis of presentation, pattern and outcome of chest trauma patients at an urban level 1 trauma center. Indian J Surg. 2018;80:36–41.
18. Sharma PP, Jhanwar A, Sharma D, Sharma S. Blunt trauma chest: Our experience at rural tertiary care centre. Int Surg J 2016;3:261-5.
19. Thomas MO, Ogunleye EO. Etiopathology and management challenges of blunt chest trauma in Nigeria. Asian cardiovascular and thoracic annals. 2009 Dec;17(6):608-11.
20. Atri M, Singh G, Kohli A. Chest trauma in Jammu region an institutional study. Indian journal of thoracic and cardiovascular surgery. 2006 Oct;22(4):219-22.
21. Iyer S, Singh M, Jathen V. Study of epidemiology and outcome of chest trauma at an apex tertiary care trauma centre. International Surgery Journal. 2018 Oct 26;5(11):3621-6.
22. Kumar AG, Honnungar RS, Kumar TS, Hallikeri VR. Pattern of chest injuries in road traffic incident victims: A six-year retrospective study. Med Sci Law 2011;51:93-6.
23. Lin FC, Li RY, Tung YW, Jeng KC, Tsai SC. Morbidity, mortality, associated injuries, and management of traumatic rib fractures. J Chin Med Assoc 2016;79:329-34.
24. Helling TS, Gyles NR 3rd, Eisenstein CL, Soracco CA. Complications following blunt and penetrating injuries in 216 victims of chest trauma requiring tube thoracostomy. J Trauma 1989;29:1367 70.
25. de Lesquen H., Avaro J.P., Gust L. Surgical management for the first 48 h following blunt chest trauma: state of the art (excluding vascular injuries) Interact Cardiovasc Thorac Surg. 2015;20:399–408.
26. Moore FO, Goslar PW, Coimbra R, Velmahos G, Brown CV, Coopwood Jr TB, et al. Blunt traumatic occult pneumothorax: is observation safe?--results of a prospective, AAST multicenter study. J Trauma. 2011;70(5):1019–25.
27. Wanek S, Mayberry JC. Blunt thoracic trauma: flail chest, pulmonary contusion and blast injury. Crit Care Clin. 2004;20(1):71–81.
28. Velmahos GC, Vassiliu P, Chan LS, Murray JA, Berne TV, Demetriades D. Influence of flail chest on outcome among patients with severe thoracic cage trauma. Int Surg. 2002;87(4):240–4.
29. Chapman BC, Herbert B, Rodil M, et al.: RibScore: a novel radiographic score based on fracture pattern that predicts pneumonia, respiratory failure, and tracheostomy. J Trauma Acute Care Surg. 2016, 80:95-101.
30. Dehghan N, de Mestral C, McKee MD, Schemitsch EH, Nathens A: Flail chest injuries: a review of outcomes and treatment practices from the National Trauma Data Bank. J Trauma Acute Care Surg. 2014, 76:462-468.
31. Alhadhrami B, Babsail A, Elhusseini M, Alhabboubi M, Chughtai TB. Traumatic flail chest injuries and the benefits of epidural analgesia. Clin Res Trials. 2017;3:1-5.
32. Kumar AB, Chakravarthy RG, Bharath A. Blunt Trauma Chest: A Study on Clinical Pattern. Journal of Dental and Medical Sciences. 2017;16(3):1-7.
33. Chrysou K., Halat G., Hoksch B. Lessons from a large trauma center: impact of blunt chest trauma in polytrauma patients—still a relevant problem? Scand J Trauma Resuscitation Emerg Med. 2017;25:42.
34. Pape HC, Remmers D, Rice J, Ebisch M, Krettek C, Tscherne H. Appraisal of early evaluation of blunt chest trauma: development of a standardized scoring system for initial clinical decision making. J Trauma 2000;49:496–504.
35. Stahel PF, Schneider P, Buhr HJ, Kruschewski M. Emergency management of thoracic trauma. Orthopade. 2005;34(9):865–79.
36. Johnson G. Traumatic pneumothorax: is a chest drain always necessary? J Accid Emerg Med. 1996;13(3):173–4.
37. Marasco SF, Davies AR, Cooper J, Varma D, Bennett V, Nevill R, et al. Prospective randomized controlled trial of operative rib fixation in traumatic flail chest. J Am Coll Surg. 2013;216(5):924–32.
38. Pyke Jr OJ, Rubano JA, Vosswinkel JA, et al.: Admission of elderly blunt thoracic trauma patients directly to the intensive care unit improves outcomes. J Surg Res. 2017, 219:334-340.
39. Harrington DT, Phillips B, Machan J, et al.: Factors associated with survival following blunt chest trauma in older patients: results from a large regional trauma cooperative. Arch Surg. 2010, 145:432-437.
40. Bader A, Rahman U, Morris M, et al.: Pulmonary contusions in the elderly after blunt trauma: incidence and outcomes. J Surg Res. 2018, 230:110-116.
41. Iyer S, Singh M, Jathen V. Study of epidemiology and outcome of chest trauma at an apex tertiary care trauma centre. International Surgery Journal. 2018 Oct 26;5(11):3621-6.
42. Wang SH, Wei TS, Chen CP. Prognostic analysis of patients with blunt chest trauma admitted to an intensive care unit. Journal of the Formosan Medical Association. 2007 Jan 1;106(6):444-51.
43. Elgar G, Smiley A, Latifi R. Major Risk Factors for Mortality in Elderly and Non-Elderly Adult Patients Emergently Admitted for Blunt Chest Wall Trauma: Hospital Length of Stay as an Independent Predictor. International Journal of Environmental Research and Public Health. 2022 Jul 18;19(14):8729.
44. Svennevig, J.L.; Bugge-Asperheim, B.; Geiran, O.R.; Vaage, J.; Pillgram-Larsen, J.; Fjeld, N.B.; Birkeland, S. Prognostic Factors in Blunt Chest Trauma. Analysis of 652 Cases. Ann. Chir. Gynaecol. 1996, 75, 8–14.
45. Vollrath JT, Schindler CR, Marzi I, Lefering R, Störmann P. Lung failure after polytrauma with concomitant thoracic trauma in the elderly: an analysis from the TraumaRegister DGU®. World Journal of Emergency Surgery. 2022 Dec;17(1):1-10.
46. Murni, I.K.; Duke, T.; Kinney, S.; Daley, A.J.; Wirawan, M.T.; Soenarto, Y. Risk factors for healthcare-associated infection among children in a low-and middle-income country. BMC Infect. Dis. 2022, 22, 406
47. Kozanlı, F. Effect of Presence of Rib Fracture on Mortality and Morbidity in Blunt Thoracic Traumas. Turk. J. Trauma Emerg. Surg. 2020, 28, 440–446.
48. Alexander, J.Q.; Gutierrez, C.J.; Mariano, M.C.; Laan, T.V.; Gaspard, D.J.; Carpenter, C.; Stain, S.C. Blunt chest trauma in the elderly patient: How cardiopulmonary disease affects outcome. Am. Surg. 2000, 66, 855–857.
49. Chabok, S.Y.; Taklimie, F.R.; Malekpouri, R.; Razzaghi, A. Predicting mortality, hospital length of stay and need for surgery in pediatric trauma patients. Chin. J. Traumatol. 2017, 20, 339–342.
50. Kuimi, B.L.B.; Moore, L.; Cissé, B.; Gagné, M.; Lavoie, A.; Bourgeois, G.; Lapointe, J. Influence of access to an integrated trauma system on in-hospital mortality and length of stay. Injury 2015, 46, 1257–1261.
51. Moore, L.; Stelfox, H.T.; Turgeon, A.F.; Nathens, A.; Bourgeois, G.; Lapointe, J.; Gagné, M.; Lavoie, A. Hospital Length of Stay After Admission for Traumatic Injury in Canada. Ann. Surg. 2014, 260, 179–187.
52. Goiburu, M.E.; Jure Goiburu, M.M.; Bianco, H.; Ruiz Díaz, J.; Alderete, F.; Palacios, M.C.; Cabral, V.; Escobar, D.; López, R.; Waitzberg, D.L. The Impact of Malnutrition on Morbidity, Mortality and Length of Hospital Stay in Trauma Patients. Nutr. Hosp. 2006, 21, 604–610.
53. Beshay, M.; Mertzlufft, F.; Kottkamp, H.W.; Reymond, M.; Schmid, R.A.; Branscheid, D.; Vordemvenne, T. Analysis of

ISSN (O): 2687-5365; ISSN (P): 2753-6556

risk factors in thoracic trauma patients with a comparison of a modern trauma centre: A mono-centre study. World J. Emerg. Surg. 2020, 15, 45
54. Degirmenci, M. Factors related to clinical outcomes in blunt thoracic injuries. Gen. Thorac. Cardiovasc. Surg. 2022, 1–8.
55. Battle CE, Hutchings H, Evans PA. Risk factors that predict mortality in patients with blunt chest wall trauma: a systematic review and meta-analysis. Injury. 2012;43(1):8-17.
56. Huber S, Biberthaler P, Delhey P, Trentzsch H, Winter H, Van Griensven M, Lefering R, Huber-Wagner S. Predictors of poor outcomes after significant chest trauma in multiply injured patients: a retrospective analysis from the German Trauma Registry (Trauma Register DGU®). Scandinavian journal of trauma, resuscitation and emergency medicine. 2014 Dec;22(1):1-9.
57. Perna, V.; Morera, R. Factores pronóstico del traumatismo torácico: Estudio prospectivo de 500 pacientes. Cirugía Española 2010, 87, 165–170.

ISSN (O): 2687-5365; ISSN (P): 2753-6556