International Surgery Journal
Dangi SK et al. Int Surg J. 2018 Mar;5(3):873-877
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20180482

Original Research Article

A prospective study of chest injuries and associated complications with special reference to surgical emphysema

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Received: 20 January 2018
Revised: 29 January 2018
Accepted: 03 February 2018

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ABSTRACT

Background: Chest trauma (or thoracic trauma) is a serious injury of the chest. Thoracic injuries may present extremely dramatic clinical problem that demand rapid diagnosis, decision making and aggressive management. Thoracic injuries can range from simple single rib fracture to major thoracic vessel injury and pulmonary contusion. Objective of this study was to describe the clinical characteristics and risk factors of thoracic trauma patients, and to evaluate their relationship in the development of complications with special emphasis to surgical emphysema.
Methods: Descriptive, prospective and analytical study of a cohort of patients with thoracic trauma who were followed up for a period of 30 days. Excluded from the study were those patients with moderate to severe cranio-encephalic trauma, long bone fractures, abdominal trauma, and patients who required mechanical ventilation.
Results: A total of 102 patients met the inclusion criteria out of which 90(88.23%)patients were male and 12(11.77%) female with male to female ratio of 7.5:1. Patients having surgical emphysema were all male 21(21.56%). Most common mode of the injury seen was road traffic accidents in 80 (80.95%) patients, followed by assault in 9(9.52%) patients, bull horn injury and fall from height in 4(4.76%) patients. Other chest injury which was most commonly associated with surgical emphysema was haemothorax in 11(52.38%) patients, followed by pneumothorax in 7(33.33%) patients, pulmonary contusion in 6(28.57%) patients and flail chest in 3(14.26%) patients. The risk of complications increases significantly in patients with more than 2 rib fractures, in older patients and in the presence of some comorbidities such as COPD and pathologies that require anticoagulation. The risk of re-admittance is greater in patients older than 60 years.
Conclusions: Patients with thoracic trauma who present with co-morbidities, are older than 60 years and have more than 2 ribs fractures may present with more complications. These factors should be contemplated in the evaluation, management and follow-up of these subjects.

Keywords: Comorbidities, Complications, Haemothorax, Peumothorax, Thoracic injuries

INTRODUCTION

Trauma is the third most common cause of death. Chest trauma (or thoracic trauma) is common and one of the most serious injuries of the chest that leads to significant disability and mortality. It is also the leading cause of death from physical trauma after head and spinal cord injury.[1] Thoracic injuries are found to be the primary or a contributing cause of about a quarter of all trauma related deaths.[1]

The mortality rate due to chest trauma is about 10%.[2] Thoracic injuries account for 20-25% of deaths due to trauma. Approximately 16,000 deaths per year in India

alone are the result of chest trauma.[2] The increased prevalence of penetrating chest injury and improved pre-hospital and intra operative care have led to increasing number of critically injured but potentially salvageable patients presenting to trauma centre. Chest trauma contributes to major accidental injuries in India, due to increased incidence of vehicular accidents (6% of global vehicular accidents) due to increased road traffic, availability of new high-speed vehicles, and ignorance or unawareness of traffic rules.[3,4]

In India, other causes of chest injuries are fall from the roof or wall of old houses, injuries due to increased construction activities, fall in well, injuries by cattle, violence, etc. Sometimes, the most difficult decision facing the surgeon is the allocation of the priorities in the treatment when more than one body system has been injured. Head injury, compound limb fracture and chest injury compete for the surgeon's attention. Chest injury is potentially the most dangerous of all and its management should be a matter of the most extreme urgency. The particular danger of the chest injury is that it threatens the vital transport of oxygen to the tissue by two ways. By hypovolemia, from severe bleeding and by trauma to the lung itself. Even this hypoxia is danger to life; it can adversely influence the outcome of associated brain trauma.

A very few studies have been conducted to analyse its magnitude and management in Indian scenario. This study describes the clinical characteristics, comorbidities and risk factors of patients with thoracic trauma, and closely monitor them, that allow to evaluate the evolution of complications with special reference and study of surgical emphysema. As the patients who survive initially they can develop complications in the following hours, days and weeks after the trauma, which can even lead to death.

METHODS

The study population was a total of 102 patients, who attended consecutively in the emergency department of Sardar Patel Medical College and associated group of Hospitals, Bikaner for thoracic trauma between 01 December 2016 to 30 June 2017. Patients excluded were those with moderate to severe cranioencephalic trauma, fractures of long bones, abdominal trauma, and patients who required mechanical ventilation.

The present study is descriptive, analytical and prospective of a cohort of patients. All were evaluated in the emergency room by a resident doctor and on call surgeon of department of surgery during the first hour of arrival in the emergency room, following the advanced trauma protocol life support for the management of thoracic trauma. According to the clinical and radiological evaluation, they were assigned to treatment ambulatory or hospital admission. The criteria for hospital admission were three or more rib fractures and or presence of complications like haemothorax and pneumothorax etc. The patients were observed during the following 30 days to trauma in the thoracic surgery consultation between the first and second week since the trauma. Author analysed: age (as an independent variable and stratified), sex, cause, type (according to the affectation radiological) and place of trauma, presence of comorbidities, development of complications and number of hospital admissions and readmissions, average length of stay in hospital and need of surgery.

RESULTS

A total of 102 patients met the inclusion criteria.90(88.23%) patients were male and 12(11.77%) were female, with a male to female ratio of 7.5:1. The age of patients ranged from 12 years to 77 years with a mean age of 38.75 years. The maximum number of patients, 28(28.5%) were in the age group of 31-40 years and the next common decade was the 3rd decade i.e., 21-30 years with 17(17.3%) patients. Hence nearly half of the incidence was in 3rd and 4th decade and was low for very young and very old population. Out of total 102 patients the incidence of surgical emphysema was 21.56% (21patients) all were male. Most of the patients were in the 3rd and 4th decade of their life. Blunt trauma was responsible for rib fractures in 100(98.03%) patients and 2 patients sustained rib fracture after penetrating trauma. Road traffic accidents was the commonest cause followed by fall from height, others being assaults, animal related injury, stab injury etc. About 47(46%) patients reported to the hospital in less than five hours of injury. Number of patients reporting within twenty hours was 92(90%) of total cases.

Table 1: Age distribution of male and female sex of the patients with rib fractures (n=102).

Age group (yrs)	Male	Percentage	Female	Percentage	Total	Percentage
<10	01	0.98	-		01	0.98
11-20	06	5.88	-		06	5.88
21-30	17	16.66	05	4.90	22	21.56
31-40	28	27.45	01	0.98	29	28.43
41-50	15	14.70	02	1.96	17	16.66
51-60	10	9.80	02	1.96	12	11.76
>60	13	12.74	02	1.96	15	14.70
Total	90	88.23	12	11.77	102	100

Table 2: Time lag between injury and reporting to the hospital.

Duration in hrs.	No. of cases	Percentage
0-5	47	46.08
6-10	29	28.43
11-15	5	4.90
16-20	13	12.74
21-25	2	1.96
26-30	3	2.94
31-35	0	-
36-40	2	1.96
41-45	0	-
45-50	0	-
>50	1	0.98
Total	102	100

In this series presenting complaint of patients at the time of admission were, chest pain in 89(88%) patients and breathlessness. Subcutaneous emphysema seen in 21(21.56%) patients was the next to draw the patient attention. In addition, 13(13%) patients had got lacerated wound on thoracic wall followed by 3(3%) patients having hemoptysis and abdominal distension and 2 patients brought unconscious. Single rib fracture was evident on x-rays in 15 (14.7%) patients, with 18(17.6%) patients having no associated injuries. Two fractured ribs were seen in 31(30.3%) patients and in 44(43.1%) patients there were multiple rib fractures (13 patients with multiple rib fractures were associated with flail chest). The maximum number of patients had 3-4 rib fractures with a total of 44(45.32%) patients. one patient had 1st to 8th fractured ribs on the left side who was subsequently discharged in satisfactory condition.

Table 3: Number of fractured ribs involved.

No. of rib fractured	No. of patients	Percentage
1-2	41	40.19
3-4	46	45.09
5-6	11	10.78
7-8	04	3.92
9-10	-	-
11-12	-	-
Total	102	100

The most common other chest injury associated with rib fractures has hemothorax in 39(38.24%) patients followed by surgical emphysema in 21(20.58%) patients. Pneumothorax was seen in 15(14.21%) patients which all required intercostal drain insertion. Flail chest was seen in 06(5.88%) patients, of which 1 required ventilatory support. One patient had lung laceration who expired due to associated injury (cardiac and liver injury). None of the patients had diaphragmatic injury and bronchopleural fistula. Out of the 21 patients of surgical emphysema none had local injuries. Most of the patients with surgical emphysema had other associated chest injury in the form of multiple rib fractures and pulmonary injuries. Six patients had flail chest out of the 18 patient who had associated other rib fractures. Other bony fractures (mostly upper limb) were seen in 04 patients. Head injury was seen in only 2 patients and similarly 2 patients had associated abdominal injury.

Table 4: Incidence of symptoms in thoracic trauma.

Symptoms	No. of cases	Percentage
Chest pain	89	88
Breathlessness	50	48
Swelling with crepitus sensation	21	20
Lacerated wound	14	13
Haemoptysis	3	3
Abdominal distension	3	3
Unconscious	2	2

Regarding treatment profile no active treatment was required in majority of 64(62.74%) patients without hemopneumothorax, though a few patients with mild hemothorax were also treated conservatively. Less than half of the patients (37.25%) required intercostal drainage with a mean duration of ICD being 7.96 days. No patients required thoracotomy in this study. Blood transfusion was required in nearly a quarter (27.45%) of patients with complication of rib fracture or associated other injury leading to blood loss.05(4.90%) patients required ICU care of which 3 required ventilator support to maintain oxygen saturation. Out of these 3 patients who required ventilatory support, 1 patient required it because of flail chest and the rest 2 patients, because of associated head injury. Three patients expired despite ICU care, but the majorities were discharged in satisfactory condition with mean duration of ICU stay being 7.3 days.

If author analyze the final outcome of all patients with rib fractures and associated injuries, 98 (97.05%) patients were discharged in satisfactory condition with mean duration of hospital stay being 9.99 days. In none of patients duration of hospital stay was prolonged due to the complications of ICD tube insertion. The mortality rate was 3.92% despite adequate and aggressive treatment. Among the 04 patients who expired only 2 patients had sole chest injury and the rest had multiple injuries, of which 02 patients had flail chest.

DISCUSSION

This study was designed to analyse the characteristics of the Patients with isolated thoracic trauma who come to the emergency department of a tertiary care hospital and its relation to the development of complications. Because the study includes all patients who come to the emergency room during the study period, gives a pretty

real idea of its characteristics, which can be extrapolated to the rest of the population.

Author have observed that road traffic accidents formed the most common cause of rib fractures, followed by fall from height, assaults, animal related, stab injuries etc. Increased automobile traffic and ever-increasing population together with intentional or unintentional ignorance of traffic rules account for the predominance of road traffic accidents resulting in chest trauma. Also, when excluding polytrauma patients with involvement of other organs, author is excluding a large number of traumas originated from traffic accidents, which is one of the limitations of present study.

Trauma is the leading cause of mortality, morbidity especially during the productive age, and is the third most common cause of death. In the study half of the patients with rib fractures were in the 3rd and 4th decades of life and the incidence was low in the very young and the very old patients. The higher percentage of younger age group patients in the present study was comparable to studies of Muckart and Locurto et al.[5,6] Males outnumbered females by a huge margin because of their exposure to outdoor activities like traveling, industrial works, labourers etc. These findings were comparable to other studies.[6] Blunt trauma, mainly road traffic accidents formed the most common cause of rib fractures, followed by fall from height, assaults, animal related injuries, stab injuries etc. Increased automobile traffic and ever-increasing population together with intention or unintentional ignorance of traffic rules account for the predominance or road traffic accidents resulting in chest trauma. These findings were in accordance with the studies Helling and Mattox, in which road traffic accidents constituted the maximum number of cases.[7,8]

The incidence of isolated rib fractures was found to be (15.68%) in this study which was comparable to other studies ranging from 6-12% by different studies. The majority of patients (45.08%) had fractures of 3-4 ribs and a good number of patients had fracture of either one or two ribs, most of them were managed by analgesics and observation with serial check X-rays of the chest. With single or two rib fractures the incidence of pneumothorax/hemothorax is not as high but there is increasing likelihood of this complication as the number of fractured ribs increases. Middle ribs (4-9th) were the most commonly involved (69.60%). Fractures of the lower ribs (11th and 12th) were associated with injury to the abdominal organs as well lung parenchyma. Majority of the patients with rib fractures had associated pulmonary injuries (44.11%) followed by other bony injuries (19.60%). Pulmonary complications such as hemothorax (36.27%), pneumothorax (15.68%), pulmonary contusion (11.76%), flail chest (5.88%), surgical emphysema (18.82%), and bronchopleural fistula were noted in this study.

In a study by Mehmet S et al, the etiology of the blunt thoracic trauma included road traffic accidents in 330 cases, fall in 122, assaults in 54, and industrial accidents in 42 cases. Pulmonary complications such as pneumothorax (37.2%), hemopneumothorax (15.3%), flail chest (5.8%), pulmonary contusion (17.2%), hemothorax (26.8%) and isolated subcutaneous emphysema (2.2%) were noted. The incidence of surgical emphysema is variable, and, in this study, it was found to be 20.58%. In other study when a fractured rib punctures a lung; in fact, 27% of patients who have rib fractures also have subcutaneous emphysema. In this study most, cases of the surgical emphysema occur in males due to more incidence of chest injury in males (100% vs 11.28%). Although only 16% of patients with occult pneumothorax had subcutaneous emphysema, 98% of the patients with subcutaneous emphysema had an underlying pneumothorax whether overt (82%) or occult (16%).[9,10] Therefore subcutaneous emphysema has a very high specificity for diagnosis of occult pneumothorax, but its absence is insufficient to rule out the diagnosis. In this study other chest injury which is most commonly associated with surgical emphysema is hemothorax (52.38%), followed by pneumothorax (33.33%), pulmonary contusion (28.57%) and flail chest (14.26%).

Regarding the treatment profile majority of the patients 62.74% were treated conservatively and intercostal drainage was required in 37.25% patients and none required thoracotomy. Time taken for full expansion of lung and removal of chest tube was 7.96 days. In a study by Locurto, the chest tube was kept for an average 4.5 day with simple underwater seal drainage.[11] Residual hemothorax was the commonest complication noted in 05 patients of the study, 02 of which required repeat intercostal drainage while 01 Patient required USG guided re-aspiration. Drummond observed residual hemothorax in about 15% of patients with hemopneumothorax where intercostal drainage was done. Overall, there were 04(3.92%) deaths in this study, with mostly patients having multiple rib fractures associated with head injury 02, others being spinal/other bony injury/abdominal injury. Only 02 patients expired with sole chest injury. The mortality rate after severe chest trauma was comparable with other studies reported in the literature.[12]

CONCLUSION

Chest trauma is one of the serious injuries following vehicular accident. Chest trauma leads to significant mortality and morbidity but with better management, there is declining mortality rate. Intercostal tube drainage with under seal is an acceptable and safe method for management of patients having pneumothorax, hemothorax or hemopneumothorax. Simple rib fracture is best managed by analgesics and in some patients with strapping and intercostals nerve block.

Every patient with chest trauma is to be checked for respiratory distress and patency of airway must be maintained before going for other pathology. Skeleton traction along with strapping and tracheostomy remains the procedure of choice for management of flail chest where positive pressure ventilation is not easily available. The outcome and prognosis for the majority of chest trauma are excellent. Majority of cases require either no invasive therapy or may require an intercostal tube drainage atmost. Some injuries, as in cardiac chamber rupture, thoracic aortic rupture, injuries of the intrathoracic inferior and superior vena cava and delayed recognition of esophageal rupture are associated with high morbidity and mortality rates.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Dangi SK, Meena N, Parmar A. A prospective study of chest injuries and associated complications with special reference to surgical emphysema. Int Surg J 2018;5:873-7.