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Original Research Article

Study of epidemiology and outcome of chest trauma at an apex tertiary care trauma centre

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ABSTRACT

Background: Trauma accounts for 12% of the world's burden of disease. Chest trauma is present in about 50% of trauma victims and is the cause of death in about 25%. Present study focuses on the epidemiology and outcome associated with both, blunt and penetrating chest trauma, over a period of one year in our high-volume tertiary level trauma centre in Mumbai.
Methods: A prospective study including all patients between the ages of 18-60 years who suffered from chest trauma and were admitted to trauma ICU over a period of one year. Master chart was maintained of all data collected and Revised trauma Score and Apache II Score was calculated.
Results: Using Stepwise Logistic Regression Analysis it was found that factors significantly affecting mortality were Age, Revised Trauma Score <7, Apache II score >18 and infective complications.
Conclusions: Mortality from chest trauma can be significantly reduced by development of better trauma care systems, prevention of shock and hypoxia and adherence to strict aseptic precautions to prevent infective complications.

Keywords: Chest trauma, RTS, APACHE II

INTRODUCTION

Trauma represents a major epidemic of non-communicable disease in the present century. This burden of disease accounts for almost 12% of the world's burden of disease.

In India over 80,000 persons die in the traffic crashes annually. Over 1.2 million are injured seriously and about 3,00,000 disabled permanently. The economic loss estimated to our country due to accidents amounts to Rs.5000 crores annually.[1] Trauma strikes down society's youngest and potentially most productive members. Of the innumerable modalities of accidental trauma, chest trauma is potentially dangerous as far as risk to life is concerned. Chest trauma is present in about 50% of trauma victims and is the cause of death in about 25%.[2]

Less than 10% of blunt chest injuries and only 15% to 30% of penetrating chest injuries require operative intervention.[3] Present study focuses on the epidemiology and outcome associated with both, blunt and penetrating chest trauma, over a period of one year in our high-volume tertiary level trauma centre in Mumbai.

Our centre is situated at the epicenter of an industrialized area along a major national highway and at the helm of the largest slum in Asia with a vast suburban transport system obviously catering to a large quantum of the population.

Objectives

- To study incidence and mode of injury in chest trauma patients
- To assess the severity of chest trauma using RTS (Revised Trauma Score) and APACHE II (Acute Physiology and Chronic Health Evaluation) scoring systems.
- To assess the outcome in terms of morbidity and mortality in patients of chest trauma.

METHODS

Present study is a prospective study which focuses on the epidemiology and outcome associated with both blunt and penetrating chest trauma over a period of one year in our high-volume tertiary level trauma centre in Mumbai. A total of 250 patients with a mix of isolated chest trauma and polytrauma patients with a component of chest trauma (i.e. associated with head injury, abdominal injury, pelvic injury or extremity injuries)

Inclusion criteria

All patients in the age group of 18-60 years admitted to specialized Trauma ICU with:

- Palpable fracture ribs
- Surgical emphysema
- Visible flail chest
- Decreased air entry
- Mediastinal shift
- Sucking chest wound
- Penetrating chest wound which is pleura deep

With/ without

- Head Injury
- Abdominal Injury
- Pelvic Injury
- Upper/Lower Extremity Injury

Exclusion criteria

Age < 18 yrs or > 60 yrs. Patients with pre-existing co-morbidities like Diabetes Mellitus, Hypertension, Bronchial Asthma and Pulmonary Koch's. Pregnant females. All patients were assessed and managed as per ATLS protocols. The Revised Trauma Score (RTS) and APACHE II score is also calculated using clinical and laboratory criteria on admission.

Pain relief methods included

- Intravenous Analgesics like NSAIDS, Tramadol, Buprenorphine.
- Oral Analgesics like NSAIDS, Tramadol.
- Analgesic patch (Diclofenac/Fentanyl/Ketolorac)
- Intercostal Nerve Block in special cases
- Epidural block in multiple rib fractures, flail chest, thoracotomies, etc.

The various forms of chest injuries were managed definitively as per their merits and hospital protocols. In patients who expired, the cause of death was ascertained by post-mortem. A comprehensive master chart was maintained of all patients included in the study.

Parameters to be studied

- Demographic data (Age/Sex)
- Mechanism and Mode of Injury
- Scoring System (RTS and APACHE II)
- Resuscitative Methods adopted
- Definitive Management done
- Pain relief given
- Outcome (Recovery/Complications/Death)

Statistical analysis

Data analysis for survival and death recorded using Mean +/- 2 S.D. Statistical analysis performed using 2 tailed Student 't' test and Chi-square test to compare "p" value. Stepwise logistic regression analysis done to determine independent predictors of morbidity/mortality.

RESULTS

The various observations and results of present study carried out at our high-volume trauma centre in the study period are elucidated below. Of a total of 1818 patients admitted at our trauma centre during the study period, 250 who fulfilled our inclusion criteria were enrolled in present study, constituting 13.75% of the total admissions. 84.8% of cases were male and 15.2% of cases were female. Majority of patients were males in the age bracket of 25-38 years (37.2%) [Table 1].

Table 1: Mode of injury among study cases.

Mode of Injury	No. of Cases (N = 250)	%	Percentage of patients with associated injury	% of deaths
Road traffic accident	88	35.2	61.0	29.9
Railway accident	69	27.6	78.3	60.3
Fall from height	39	15.6	66.2	38.9
Fall of heavy object on chest	07	02.8	15.1	16.7
Assault	32	12.8	31.0	3.3
Miscellaneous	15	06.0	23.0	30.8

Although, Road Traffic Accident was the commonest cause of chest trauma; Railway accidents were associated

with a higher mortality rate, because they were associated with a higher percentage (78.3%) of associated injuries as seen in the table above. This difference in mortality rates was found to be statistically significant [p <0.001] [Table 2].

Table 2: Profile of associated injuries among study cases.

Associated Injuries	No. of Cases	%
Head injury	174	69.6
Abdominal injury	064	25.6
Pelvic injury	008	03.2
Orthopaedic injury	045	18.0

Head Injury was the most common associated injury followed by abdominal injuries. Morbidity and mortality rates were also found to increase in cases associated with severe head injury and significant abdominal trauma.

Table 3: Revised trauma score and mortality.

RTS value	No. of cases (N = 250)	No. of cases died	Mortality %
< 7	022(8.8%)	21*	95.5
7 – 11	226(90.4%)	69	30.5
12	002(0.8%)	00	-

By Chi Square Test; *p=0.0001, Significant

As regards to the various types of chest injuries encountered in present study, rib fractures were the commonest. 154 patients presented with rib fractures, 140 unilateral and 14 bilateral constituting 64.17% of the morbidity due to chest trauma.

Table 4: APACHE II score and mortality.

APACHE II score	No. of cases (N = 250)	No. of cases died	Mortality %
6 - 8	12 (4.8%)	00	-
9 - 11	68 (27.2%)	00	-
12 - 14	61 (24.4%)	02*	3.3
15 - 17	29 (11.6%)	10	34.5
18 - 20	39 (15.6%)	37	94.9
21 - 23	26 (10.4%)	26	100
24 - 26	14 (5.6%)	14	100
27 - 29	01 (0.4%)	01	100

By Chi Square Test; *p=0.0001 (Significant)

20 patients had flail chest in present study constituting 8.33% of total injuries, with unilateral injury in 18 cases and bilateral in the rest. Of these 7 patients survived and 13 expired. This high mortality was found to be statistically significant when compared to mortality from other types of chest trauma.[4,5]

In present study, incidence of pneumothorax was 43.33% being unilateral in 101 cases and bilateral in 3 patients. Incidence of pneumothorax reported in different series varied from 15-50% with bilateral pneumothorax reported in about 5-20% cases.[6] One patient had persistent air leak and needed late thoracotomy.

Incidence of haemothorax in our series was 46.25% being unilateral in 106 patients and bilateral in 5 patients. Similarly, the incidence of hemothorax reported in various series differed depending on the mode of injury and the demographics of the patients. Three patients in our series with massive haemothorax required emergency thoracotomy. Incidence of pulmonary contusion was 35% in present study with 83 patients having unilateral injury and bilateral injury in one patient. Tracheobronchial injuries were seen in 11 patients with 3 succumbing to their injuries. A higher mortality rate was seen with flail chest type of injuries and this association was statistically significant [Table 3].

Table 5: Cause of death.

Cause of death	No. of cases (N = 90)	%
Due to chest trauma	08	09.0
Complications of chest trauma	12	13.5
Head injury	48	53.9
Abdominal/pelvic injury	10	11.2
Other causes of death	08	09.0
Septicemia (chest trauma related)	01	01.1
Septicemia (due to causes other than chest trauma)	02	02.3
Cause not given	01	01.1

In the above table, 226 patients had RTS in the range of 7-11 followed by 22 patients with a score of < 7 and 2 cases had a score of 12. From this it was found that in those patients with RTS<7, mortality was 95.5% compared to patients who had RTS score 7-11 where the mortality was 30.5%. This difference was found to be statistically significant on applying the Chi-square test. Thus, a lower RTS score was associated with a higher mortality (RTS < 7) (Table 4).

As seen in the above table 170 patients had an APACHE II score < 17, while 39 patients had an APACHE II score between 18-20 and 41 patients had an APACHE II score> 21. Though the association between APACHE II scores and mortality starts with values greater than 14, the association is stronger with scores of 18 and above. In present study, the higher mortality rate with APACHE II scores> 18 was found to be statistically significant when

compared with mortality rates in APACHE II scores< 14. Hence APACHE II scores correlate well as predictors of mortality. (Scores>21 were associated with 100% mortality) 33.2% cases had an adequate airway. Majority of the cases with a compromised airway were managed with oral suctioning to clear the airway. Endotracheal intubation was required in 78 cases of which 41 survived. Emergency tracheostomy was done in 2 cases, one for inability to intubate and the other due to severe maxillo-facial trauma. Late tracheostomy, on the other hand was done in 33 cases with a dismal outcome of 8 cases surviving. Majority were done for patients on prolonged ventilatory support.

Table 6: Results of logistic regression analysis for mortality.

Factor	Exponentiated coefficient	p-value
Age	1.0724	<0.0001*
Revised Trauma Score	0.5118	0.0003*
Systolic BP at admission	0.6435	0.2084
pO2 at admission	0.9963	0.6934
pH on admission	0.1362	0.5634
APACHE II score	1.1604	0.0022*
Airway on admission	1.2472	0.6574
Emergency ICD insertion	1.0002	0.9926
Emergency ventilator support	0.2080	0.0727
Fluids transfused in 1st 24 hours	0.5423	0.0075
Blood transfused in 1st 24 hours	1.0542	0.8229
Infective complications	1.0278	0.0045*
Collapse	0.9883	0.2595

*= Significant association

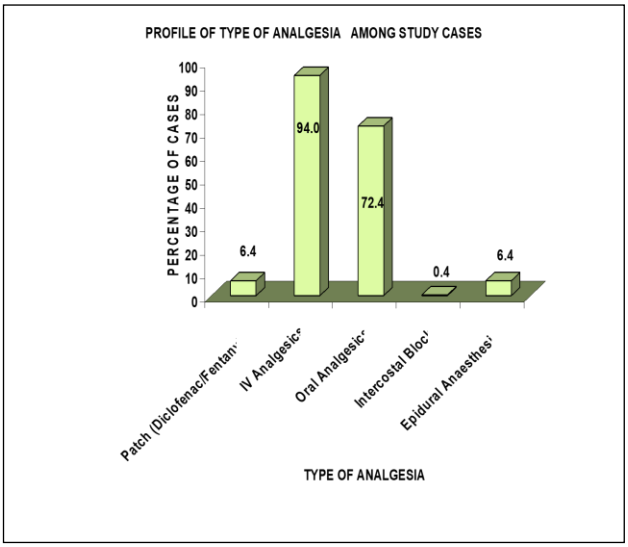

Figure 1: Types of analgesia.

ICD insertion was done in 179 patients, of which 168 were inserted unilaterally and 11 bilaterally. Day of removal of ICD was in the range of 3.0 – 20.0 days with average being 6.33days. 91 patients required ventilatory support in present study, 62 on an emergent basis and 29 required late ventilatory support. The range of weaning off ventilator was 1.0 to 17.0 days with an average of 3.94 days.

Intravenous Analgesics (NSAIDs/Opioids) were the most common form of analgesia used (94.0%) followed by oral analgesics. Epidural Anesthesia was used in 6.4% cases, mainly in cases of multiple rib fractures and flail chest. Analgesic patches were also used in cases of rib fractures although, less frequently [Figure 1].

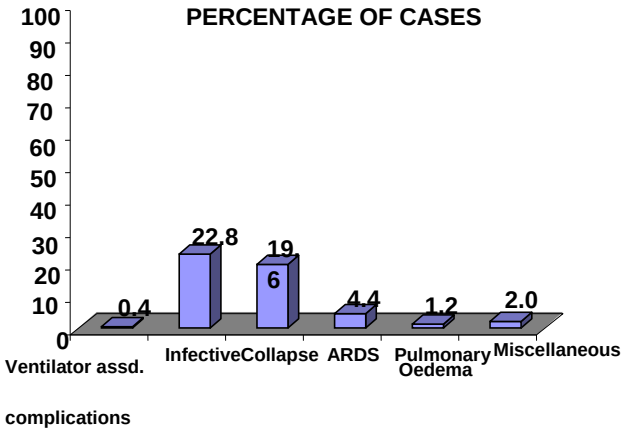

Figure 2: Profile of complications among study cases.

Figure 2 above observations suggest that infective complications were the commonest followed by collapse. Infective complications were also associated with a higher mortality. Pulmonary oedema and ARDS were less common but were associated with a poorer outcome.

Mean duration of hospital stay was ranging from 1.0-28.0 days with average being 7.24 days. The outcome of present study shows a death rate of 36% from various causes which will be elucidated below.

Only 9% deaths were attributed directly to chest trauma. Thus, Chest trauma was responsible for 23.6% of deaths either directly or indirectly [Table 5]. Age, Revised Trauma Score, APACHE II score and infective complications were found to be significant predictors of mortality, as per logistic regression analysis [Table 6].

DISCUSSION

Present study was carried out over a period of one year (June 2012 to June 2013) in our high-volume tertiary level trauma centre in Mumbai. The location of our

trauma centre is such that we get a large volume of polytrauma patients daily, a large number being referred from peripheral institutes not equipped to manage such trauma cases. Since ours is the primary referral point for numerous such institutions present study gives a comprehensive idea of the epidemiology of chest trauma in our State. Moreover, since the Railways form an integral part of the public transport system of Mumbai we see the unique subset of railway accident victims who generally suffer polytrauma with high morbidity and mortality.

The data of 'Accidental Deaths - Year 2014' available with the Government Railway Police (GRP) states 2,221 deaths occurred on Central Railway (CR) network and 1,202 fatalities on the Western Railway (WR), an average of nine persons daily. The number of injured was 2,062 on the CR and 1,237 on the WR, the total of which comes to 3,299 last year. This means on an average eight passengers suffered injuries daily.[7] 250 patients constituting 13.75% of the total admissions were a part of present study. A demographic analysis shows a male to female ratio of 5.57:1.[8] Present study included patients in the age group of 18 years to 60 years with a mean age of 37.75 years. Maximum incidence of chest trauma was seen in the age group of 25-38 years.[6]

The demographic analysis of sex and age conforms to the general norms of trauma incidence, i.e. higher incidence in the working population possibly due to exposure to trauma. Road Traffic Accidents (RTAs) were found to be the commonest mode of injury in present 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. Almost all western and Indian studies report RTAs as the most common cause of injury.[9]

Most of the road traffic accident victims in present study were pedestrians or pillion-riders thrown off in the accident while those involved in railway accidents had fallen off a running train, an injury almost exclusive to the suburban transport system in our city. Mortality from railway accidents was 60.3% compared to 29.9% from RTAS.

Among associated injuries, head injury was found to be the most common associated injury (69.6%), as well as the most common cause of mortality due to trauma.[10] Abdominal injury was the next most common associated injury. Sixty one percent of RTAs were associated with other system injuries, while up to 78.3% of railway accidents were found to be associated with other system injuries. This could explain the higher rate of mortality from railway accidents. It was found in present study that shock on admission; hypoxia and acidosis on ABG parameters were associated with a higher mortality. Wang SH et al identified the presence of shock, acidosis and low PaO2/FiO2 as some of the variables associated with higher chances of non-survival.[11] Hence, every possible attempt has to be made to prevent hypotension, hypoxia and acidosis by proper resuscitation in order to decrease mortality.

We also studied two scoring systems and their ability to predict mortality in cases of chest trauma, the revised trauma score (RTS) and acute physiology and chronic health evaluation II (APACHE II) score.

Revised Trauma Score (RTS) is a physiologic scoring system, designed for use based on the initial vital signs of a patient. A lower score indicates a higher severity of injury. The Revised Trauma Score is made up of three categories: Glasgow Coma Scale, systolic blood pressure, and respiratory rate. In present study, 226 patients had RTS in the range of 7-11 followed by 22 patients with a score of < 7 and 2 cases had a score of 12/12. It was found in present study that mortality was 95.5% in patients with RTS<7, as compared to patients who had RTS score 7-11, where the mortality was 30.5%. This difference was found to be statistically significant on applying the Chi-square test.

Thus, a lower RTS score was associated with a higher mortality (RTS < 7).[12,13] The advantages of using RTS are ease of calculation, the need for only one measure (GCS) for triage and mortality prediction purposes and universal adaptation to a broad range of trauma populations.

APACHE II scores correlate well as predictors of mortality. In present study, 170 patients had an APACHE II score < 17, while 39 patients had an APACHE II score between 18-20 and 41 patients had an APACHE II score> 21. Though the association between APACHE II scores and mortality starts with values greater than 14, the association is stronger with scores of 18 and above. In present study, the higher mortality rate with APACHE II scores> 18 was found to be statistically significant when compared with mortality rates in APACHE II scores< 14. Hence APACHE II scores correlate well as predictors of mortality. (Scores> 21 were associated with 100% mortality).[8,14,15] The components of APACHE II that contributed the most to its accuracy included temperature, serum creatinine and the Glasgow Coma Scale (GCS).

On review of literature, there have been no prominent studies which have used both the Revised Trauma Score and APACHE II scores together in the same study on chest trauma. Thus, present study shows statistically significant data regarding poor prognosis related to adverse scorings in both the RTS as well as APACHE II scoring systems.

Intravenous Analgesics (NSAIDs/Opioids) were the most common form of analgesia used (94.0%) followed by oral analgesics. Epidural Anaesthesia was used in 6.4% cases, mainly in cases of multiple rib fractures and flail chest. Analgesic patches were also used in cases of rib fractures although, less frequently.[16]

Infective complications were seen in 57 patients with survival of 31 patients and 26 patients having expired. Infective complications ranged from pneumonitis to full-blown septicaemia. Infective complications were one of the reasons for prolongation of Length of Stay (LOS) in the hospital as well as for increasing costs. Infective complications, in a small subset also occurred iatrogenically, often post-ICD insertion. Multiple studies report the incidence of infective complications to be from 10-15%.[4] Collapse was seen in 49 patients (38 survived and 11 died). It was found that good chest physiotherapy with tracheal toileting improved chest expansion and subsequently survival. ARDS was seen in 11 patients out of which 8 survived and Pulmonary oedema was seen in 3 patients out of which only one survived.[6]

Mortality in present study was found to be 36.0% of which 53.9% of deaths were unrelated to Chest Trauma (were as a consequence of Head Injury).13.5% of the cases died from complications of Chest Trauma and 11.2% died due to abdominal/pelvic injury. Chest trauma was responsible for 23.6% of deaths either directly or indirectly (complications or septicaemia). Various series estimate the mortality due to chest trauma to be between 10-30%.[6,10] The mean length of hospital stays of patients in our series ranged from 1.0-28 days with an average of 7.24 days.[6] Using a stepwise logistic regression analysis of factors affecting mortality in chest trauma, in present study (Table 18), it was found that factors significantly affecting mortality were as follows:

- Age
- Revised Trauma Score
- APACHE II score
- Infective complications.

Thus, it has been observed in present study that advancing age, RTS < 7, APACHE II scores > 18 and the development of infective complications were associated with a poorer outcome.

CONCLUSION

Present study highlights the high mortality from railway accidents which is unique to the city of Mumbai. It is therefore important to enact preventive measures and improve the suburban railway system. Infective complications increase the length of stay as well as mortality from chest trauma, thus strict adherence to aseptic precautions and vigorous chest physiotherapy is essential. The application of stepwise logistic regression analysis shows that revised trauma score and Apache II can be used in combination to predict severity of chest trauma.

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