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An Insight Into Demographics, Mechanisms, Trauma Scores & Management Modalities of Blunt Thoracic Trauma: Study From Upper Assam

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Abstract

Introduction

Chest trauma is of prime concern because of increasing incidence occuring at unpredictable hours in areas remote from medical care facility, and of extreme emergency if not treated promptly in evidence based algorithmic approach, leads to mortality. Aim -To study the mechanisms, emergency department presentation, symptoms and signs, associated injuries and their severity grading, treatment modality adopted for surgical management of thoracic trauma, length of hospital stay, prognosis (short term) of patients admitted with blunt thoracic trauma.

Methods

We prospectively observed all admitted patients with blunt thoracic trauma from June 2015 – May 2016. ISS (injury severity score) and RTS (revised trauma score) and AIS-90 (Abbreviated Injury Score) were obtained for rib fractures subgroups.

Results

Total 86 patients enrolled. Most of the patients were males (89.5%) with the peak incidence in the fourth decade of lives, most common mechanism being RTA. Chest pain (69.8%) and tenderness (83.7%) were frequent. Majority (n=43, 50%) had > 3 rib fractures. Maxillofacial (n=13, 15%), intrathoracic soft tissue injuries observed mostly with > 3 ribs fracture. Mostly associated injuries were skin structure (n=20, 22%) followed by faciomaxillary (n=15, 17.4%), craniocerebral (n=13, 15.2%). Mortality is significantly ($p<.05$) associated with severe head injury, flail chest, B/L hemopneumothorax with pneumomediastinum, ISS>16, low RTS≤5.23.. Mean ISS for flail chest and >3 rib fracture are respectively 22±6.5 and 17±5. Overall complication rate is 12.7%.

Conclusion

RTA is most common cause of injury with age group 40 – 50 years most vulnerable. The majority can be managed by simple intervention i.e. Intercostal water seal drainage (ICWSD). Thoracotomy in our series was required for empyema, and fibrothorax. Risk of mortality, length of hospital stay, injuries to other organ systems is attributable to rib fracture > 3 ($p<.05$) suggesting severe traumatic force.

Keywords: Injury score, thoracic trauma, thoracotomy

Introduction

Trauma or injury has been defined as damage to the body caused by environmental energy that is beyond the body's capacity to cope [1]. Injuries are fourth most common cause of mortality in western literature. It is responsible for sizable mortality among young adults ages 1–34 [2]. In the year 2000, mortality from injuries worldwide is 50 lakhs, and among them 45 lakhs died in third world middle/low income economies like India [3]. India is witnessing an upward growth in injuries, particularly due to road traffic accidents (RTA) at a disquitening annual rate of 3% [4]. The World Report on Road Traffic Injury Prevention indicates that by 2020, RTI will be number one killer causing 5 lakhs deaths and 150 lakhs Disability Adjusted Life

Years lost [5]. The World Health Organization has revealed in testimonial on Global Status Report on Road Safety that people dying of road accident in India is far more than anywhere else on earth even surpassing heavily populated China. Terming RTA an "epidemic" that will become the world's fifth major cause of mortality by 2030, the report declares that high income economies have been successful in reducing deaths in stark contrast with third world economies where its menance is rising [6]. The goal of the United Nations Decade of Action for Road Safety 2011- 2020 is to save 50 lakhs lives [7]. The incidence of blunt thoracic trauma related deaths in India is much higher than its western counterparts [8].

Aim and objective

To study the mechanisms, emergency department presentation, symptoms and signs, associated injuries and their severity grading, treatment modality adopted for surgical management of thoracic trauma, length of hospital stay, prognosis (short term) of patients admitted with blunt thoracic trauma.

Methods

We carried out a prospective descriptive study to assess the clinical spectrum of thoracic injuries on admitted patients(n=86) in department of surgery presenting with blunt trauma chest either singularly or with polytrauma and studied its various characteristics with regard to etiology , age, sex, mechanism of injury , clinical presentation in Emergency Department, clinical and radiological assessment, response to resuscitation, anatomical (Abbreviated injury scoring (AIS-90))(Injury severity Scoring(ISS)) and physiological (Revised Trauma Score(RTS)) trauma scales grading, management modalities adopted (conservative / tube thoracostomy / open thoracotomy), length of stay, analgesics (non steroidal anti-inflammatory drugs(nsaids) /opioids / nsaids +opioids / intercostal block/epidural catheter), need for invasive ventilation, along with mortality and morbidity profile.

Abreviated injury scale-90(AIS-90) [9-14] ,ISS [15] and RTS [16,17] was computed for rib fracture groups(I-no rib fracture, II-one rib fracture, III- 2 rib fracture, IV- 3 rib fractures, V >3 rib fractures, VI-flail chest). Pain management was done effectively using non narcotic parenteral analgesics followed by narcotic analgesics, intercostal blockage, or epidural analgesia if required. Vigorous pulmonary toileting was performed with aggressive physiotherapy, humidification, encourage coughing, mucolytic therapy postural drainage, Nasotracheal suctioning was used as an adjunct to remove tenacious secretions along with bronchoscopy to expand collapsed lung segments.. Indications of early thoracotomy 1) chest tube output>1500 ml, or 2) hourly output >200 ml/hour for 4 hours, hemopericardium, prolonged air leakage, radiologic or endoscopic indicators of injury in esophagus, trachea or bronchi, heart and great vessels. Indications of delayed thoracotomy were empyema, retained hemothorax, atelectasis

Sample size justification

We included all patients being admitted in the department of general surgery under cardiothoracic & Vascular Surgery of Assam Medical & Hospital after applying inclusion and exclusion criteria over a period of one year. (June 2015-May 2016)

Consent

The consent was obtained from Institutes Ethics Committee.

Patient selection

All the admitted patients with age > 12 years with signs and symptoms of blunt thoracic trauma were included for the study. Exclusion criteria being patients who did not complete their treatment in the hospital/

Isolated laryngeal or cervical injuries/ esophageal and tracheal injuries due to foreign body swallowing or aspiration/ penetrating injuries to the thorax/burn/electric shock injuries.

End points

The primary endpoint was death from any cause/ discharge from hospital after cure and secondary end point were 30 day all cause mortality.

Statistical Methods

The numeric data were summarised by descriptive statistics like N, mean, standard deviation, median, minimum and maximum. For statistical significance of numeric data, t tests were used. The categorical data were summarised by frequency count and significance was analysed using chi-square/fisher exact test. A value of $p < 0.05$ was considered significant. Data was recorded on Microsoft excel and further tabulated and analysed using SPSS Statistics for Windows, version 16.0 (SPSS Inc., Chicago,III, USA)

Results

A total of 13573 patients afflicted with trauma presented to emergency department/ casualty of AMCH over a period of one year from June 2015 – May 2016 out of which 1250 patients were admitted. Among all admissions, 86 patients were enrolled for the study. Maximum incidence of thoracic trauma occurred in age group 40-50 years 25.6%(n=22), followed by 50-60 years age group 23.3%(n=20). 89.5%(n=77) of patients were males.

Mechanism of injury were- Road traffic accident 57%(n=49) accounted followed by fall 34.9%(n=30), physical assault were 7.0%(n=6), occupational injury were 1.2%(n=1). (Table 1).

Mechanism of injury	Age group (in years)					
	18-30	30-40	40-50	50-60	60-70	>70
Fall	5	3	10	6	3	3
Rta	11	12	9	13	4	0
Physical assault	2	1	3	0	0	0
Occupational injury	0	0	0	1	0	0
Total	18	16	22	20	7	3

Table 1: Mechanism of injury incidence in age groups

The most common findings on clinical examination were unilateral chest tenderness (83.7%), palpable rib fracture (61.6%), crepitus (60.5%), subcutaneous emphysema (31.4%), paradoxical movement of chest (5.8%), and abdominal pain (7.9%).

Patients suffering from hemothorax (with no pneumo component) (/ and pulmonary contusion) were 44.1%(n=38). In this subset analysis, 81.5% had unilateral, and 18.5% had bilateral hemothorax while Hemopneumothorax (/ and pulmonary contusion) was observed in 28/86 i.e. 32.5% patients. Unilateral were 24/28 i.e.85.7% and rest 4/28 i.e. 14.3% were bilateral hemopneumothorax. Pneumothorax (with no hemothorax) (/ and pulmonary contusion) was found in 7/86 i.e. 8.1% patients. Lung contusion was found in 24/86 i.e.27.9% patients out of which unilateral were 18/24 i.e. 75% and bilateral were 6/24 i.e. 25%.

For purposes of analysis and objective assessment patients were divided into 6 groups on basis of no. of ribs fractured: Group I- 0 rib fracture were 18.6% (n=16), Group II- only 1 rib fractured were 5.8% (n=5), Group III- 2 ribs fractured were 9.3% (n=8), Group IV- 3 ribs fractured were 10.5% (n=9), Group V- >3 ribs fractured were 50.0% (n=43), and Group VI- Flail Chest were 5.8%(n=5). Bilateral rib fractures were found in 32.5% (n=28) patients. In patients with rib fractures > 3 and flail chest, significant hemopneumothorax were observed. Unilateral and bilateral isolated hemothorax is significantly ($p<.05$) associated with rib fractures > 3. Unilateral Lung contusion is significantly ($p<.05$) observed in rib fractures >3.

37.2 % (n=32) patients were managed conservatively only with analgesics (Table 2), physiotherapy, and tracheobronchial secretions drainage by postural therapy, bronchodilators.

	Analgesia	**No. of patients**	**Percentage (%)**
1.	NSAID	60	69.8
2.	Opioids	13	15.1
3.	NSAID+Opioids	12	14.0
4.	Intercostal block	0	0
5.	Epidural Anesthesia	1	1.2
	Total	**86**	**100.0**

Table 2 Distribution of requirement of type of analgesia.

55.8 %(n=48) patients required unilateral intercoastal water seal drainage (ICWSD) while 6.9 % (n=6) patients required bilateral ICWSD. 30.2 %(n=26) patients with rib fractures > 3 required unilateral ICWSD. (Table 3)

		Intercostal water seal drain		
		Not required	**Unilateral**	**Bilateral**
Rib # groups	none	7	8	1
	1 rib#	2	3	0
	2 rib#	6	1	1
	3 rib #	3	6	0
	>3 rib#	14	26	3
	Flail chest	0	4	1

Table 3: Need for Intercostal water seal drain in rib fracture groups #Fracture

None of the patients required early thoracotomy. However late thoracotomy was required in 8.1% (n=7). Of these 7 patients, 4 underwent thoracotomy for empyema thoracis which was diagnosed on follow up with patients presenting with fever, tachypnea, and fatiguability in varying severity. While 1 patient underwent late thoracotomy for retained hemothorax. For incomplete lung expansion 2 patients (2.3%) underwent

thoracotomy. Adequate pain relief was provided to 69.8% (n=60) of patients with Non Steroidal Antinflammatory agents (NSAIDS) while 15.1% (n=13) were administered opioids (renal impairement or known hypersensitivity to NSAIDS) while 14% (n=12) patients required supplemental analgesia in form of combination of NSAIDS and opioids. Intercoastal block was used in none of the patients while epidural analgesia was used in 1.2% (n=1) patient with flail chest.

The maximum AIS for head and neck observed in present study is 4/6 in 1.1% (n=1) while most of the injuries noted were 3/6 10.4% (n=9). The AIS observed in faciomaxillary trauma is 3/6 in 8.1 %(n=7) patients while scores of 2/6 is found in 6.9 %(n=6) patients all of which were associated with more than three rib fractures. All required maxillofacial fixations. Thoracic trauma score of 4/6 is observed in 5.6 %(n=4) patients while 5.8 %(n=5) patients of flail chest shared same score i.e. 4/6. (Table 4)

Associated injuries	No. of patients	Mean AIS-90 scores
Craniocerberal Trauma	13	2.9
Faciomaxillary injury	15	2.3
Pelvic & skeletal injury	8	3.38
Clavicle injury	10	Not Applicable
Skin structure injury	20	1.95
Abdominal injury	7	2.57
Diaphragmatic injury	2	Not Applicable

Table 4: Mean AIS-90 scores were calculated taking into account individual system specific injuries and mean calculated in patients having particular system specific injuries.

The mean ISS for flail chest is 22±6.5 (significant, p<.05) while that for more than 3 rib fracture group it is 17±5.4(significant, p<.05) while for the rest of the rib fractures group ISS is not significantly different than with patients of zero rib fracture subgroup of blunt thoracic trauma.(Table 5)

Rib fracture	Mean ISS values	No.of cases	Standard Deviation	p value
zero	13.87	16	10.07	>.05
1 rib #	13.60	5	4.77	>.05
2 rib #	15.50	8	13.58	>.05
3 rib #	13.77	9	3.59	>.05
>3 rib #	17.02	43	5.43	<.05*
flail chest	22.20	5	6.53	<.05*
total	16.05	86	7.51	<.05*

Table 5: Injury Severity Scores(ISS) among rib fracture groups #- fracture, *- significant

Mean RTS observed in present study is 7.64 with SD ± 0.56. In maximum numbers of patients 93%(n=80) have RTS of 7.84. While most of the patients belonging to >3 rib fractures have RTS of 7.84, 6.9%(n=6) patients have RTS of 7.85. Mortality rate is 3.4%(n=3). (Table 6)

Mortality in present series is 3.5% (n=3). In all deaths mechanism of injury is RTA with patients having high velocity and severe thoracic or craniocerebral truma. 2 patients who died had flail chest. Out of whom, 1) one died within 12 hours of ICU admission with shock, 2) the other died after 49 days of prolonged hospital & ICU stay with Multiple Organ Dysfunction Syndrome (MODS), sepsis, 3) another patient died 12 days after ICU admission with severe diffuse axonal injury having GCS 3/15 with intrathoracic pathology was bilateral pulmonary contusion.

	RTS values									
Rib# groups	5.03	5.23	5.96	6.81	6.9	7	7.1	7.55	7.84	7.85
None	1	0	1	0	0	0	1	0	13	0
1 rib#	0	0	0	0	0	0	0	0	4	1
2 rib#	0	1	0	0	0	0	0	0	5	2
3 rib #	0	0	0	0	0	0	0	1	7	1
>3 rib#	0	0	0	1	1	1	3	2	29	6
flail chest	0	1	0	0	0	0	0	1	3	0

Table 6: Tabulation of Revised trauma Score (RTS) frequency among Rib fracture groups#-fracture

Invasive ventilation was required in 4.8% (n=4) patients of flail chest while non-invasive ventilator support in form of CPAP was required in 10.5% (n=9) patients. Complication rate is 14% (n=12). Empyema was found in 4.6% (n=4) of chest injuries with hemothorax, who underwent thoracotomy. Superficial wound infection at site of ICWSD insertion was found in 5.90% (n=5) patients. While 2.36% (n=2) patients had incomplete lung expansion with collapse of underlying basal segment of lung with crowding of ribs underwent thoracotomy with decortication of pleura. Only 1.15% (n=1) patient presented with retained hemothorax.

The mean hospital stay is 13.5±7 days. Patients with flail chest remained in hospital for longest duration mean=22 days ($p<.05$) which was statistically significant from other groups with mean stays 11.93 days to 13.97 days. (Table 7)

Rib fractures	**mean**	**no. of cases**	**standard deviation**	**p value**
None	11.9375	16	6.78	0.12
1 rib #	11.2000	5	3.76	0.08
2 rib #	10.8750	8	4.85	0.09
3 rib #	13.0000	9	5.78	0.08
>3 rib #	13.9767	43	5.53	0.02*
flail chest	22.4000	5	19.60	0.001*
total	13.5349	86	7.30	0.01*

Table 7: Mean hospital stays of rib fracture groups #: fracture , * significant(<.05)

The discharged patients were followed up during the one year study period ranging from one month – 11 months. 86%(n=74) patients came for follow up out of which 62.7% (n=54) had complete recovery while 6.9%(n=6) patients had persistent chest pain, 3.4%(n=3) had cough, 6.1%(n=5) had skin infection at ICWSD insertion site while 2.3%(n=2) had incomplete lung expansion with basal atelectasis , 4.6%(n=4) developed thoracic empyema. 9.2 %(n=8) were lost to follow up as patients did not visit out patient department on scheduled days and/ could not be followed up.

Discussion

The peak incidence of blunt trauma was observed in the fourth decade of their lives in 25.6% of patients. Marya & Singla (1987) found that more than 80% of patients belonged to third, fourth and fifth decades of life [18]. Srimali M et al (2003) recorded mean age in patients of blunt trauma chest to be 43 years [19]. PP Sharma et al (2016) found peak age incidence of 62% in second decade followed by 13.7% in the age group 31-40 years [20].

Males comprised of 89.5% of cases. Male predominance in blunt thoracic trauma was also noted by Sharma PP et al (2016) in 88.2% and Al Koudmani et al (2012) in 87%. [20, 21].

The most common mechanism of injury is Road Traffic Accident (RTA) (57%) followed by fall (34.9%), physical assault (7.0) & occupational injury (1.2%). Srimali M et al (2003) also reported similar findings as RTA (60.2%), fall (22.2%) & physical assault (9.8%) [19]. Similarly Sharma PP et al (2016) also reported RTA (79.72%) as most common mechanism of injury followed by fall (11.5%), & physical assault (6.4%)[20]. However in war striven Syria, Al–Koudmani (2012) reports most common MOI as physical assault (41%), followed by RTA (33%) [21].

In the present study chest pain (69.8%) was the most common presenting symptom followed by dyspnea (30.2%), history of loss of consciousness (22.1%), ENT bleed (14%), vomiting (9.3%) and seizures (2.3%). Similarly Sharma PP et al (2016)[20] concluded chest pain and dyspnea as the most common symptoms. In the present study the most common physical finding noted in emergency department was unilateral chest tenderness (83.7%). Sharma PP et al (2016) [20] reported chest tenderness, crepitus and subcutaneous emphysema as most common signs. Cordice and Cabezon (1965) reported Chest pain as most common presenting symptom in 54.8%, followed by dyspnea in 50.2% [22]. However Cordice and Cabezon (1965) reports surgical emphysema (34.7%) as most common presenting sign. Marya and Singla (1987) reported surgical emphysema in 45% of the cases [18].

Group I- 0 rib fracture were 18.6% (n=16), Group II- only 1 rib fractured were 5.8% (n=5), Group III- 2 ribs fractured were 9.3% (n=8), Group IV- 3 ribs fractured were 10.5% (n=9), Group V- >3 ribs fractured were 50.0% (n=43), and Group VI- Flail Chest were 5.8%(n=5). Bilateral rib fractures were found in 32.5% (n=28) patients. Similarly Sharma PP et al (2016) found ≥3 rib fractures in 56.17% and flail chest in 6.3% [10]. Similarly Al-Koudmani et al [21] found prevalence of flail chest in 2.4%. In the present study, 36% (n= 31) had unilateral isolated hemothorax with maximum occurrence in rib fractures >3. Bilateral hemothorax was observed in only 8/86 i.e. 9.43% patients. Srimali M et al (2003) reported 26.8% of cases

having hemothorax [19], while data emanating from war ravaged Syria is 38% as depicted in study by Al Koudmani et al (2012) [21].

Hemothorax is associated with >3 rib fractures, and flail chest. ($p<.05$) In the present study unilateral hemopneumothorax is observed in 27.9% (n=24) while bilateral hemopneumothorax is observed in only 4.7% (n=4) patients.While Marya & Singla found incidence of hemopneumothorax as 44.5% and Sharma PP et al found 59.86% [18,20].

Unilateral lung contusion is observed in 20.9% (n=18) while maximum affected group is with rib fractures > 3, while bilateral lung contusion seen in 6.9% (n=6) patients. Patients with rib fracture > 3 have significant pulmonary contusion ($p<.05$). Most of the patients with lung contusion is associated with hemo /and pneumothorax. In present study incidence of pulmonary contusion is 27.8% which is significantly greater than 17.2% found by Srimali M et al (2003)[19]. 55.8% (n=48) required unilateral intercoastal water seal drainage (ICWSD) while 6.9% (n=6) required bilateral ICWSD.

30.2% (n=26) patients with rib fractures >3 required unilateral ICWSD which is significantly higher ($p<.05$) when compared to ≤ 3 rib fracture groups. While all patients with flail chest required ICWSD Marya & Singla (1987)[18] proposed it is better to put proper size ICWSD than repeated aspirations based on following advantages that ICWSD offers: continuous monitoring of pleural cavity for ongoing bleed, decreses repeated introduction of infection via repeated punctures, roentological exposure, faster relief, faster recovery, shortened hospital stay. Out of 28 patients having ***hemopneumothorax*** U/L ICWSD was required in 22 while B/L ICWSD in 4 patients. Out of 7 patients admitted with ***pneumothorax*** U/L ICWSD was required in 5 patients while B/L in 1 patient while 1 patient having minimal pneumothorax and with no respiratory/ cardiovascular compromise was managed without ICWSD. The 39 patients admitted with ***hemothorax***: 23 were managed with U/L ICWSD, 3 with B/L ICWSD while 13 patients who had ***minimal hemothorax*** were managed without ICWSD. 32/86 i.e. 37.2% patients were managed conservatively with analgesics, physiotherapy, postural drainage, and bronchodilators while 20% were managed conservatively by Sharma PP et al (2016) [20]. Trupka et al (1998) [23] observed similarly that most of the isolated thoracic injuries can be adequately treated by conservative means i.e. adequate analgesia, drainage of intrapleural air or blood, physiotherapy and clearance of bronchial secretions. Operative intervention is rarely indicated. Maloney (1961) proposed “wait and watch” policy for patients with minimal hemothorax as it gets resorbed and needs no further surgical intervention [24]. In another study by Trupka et al 41% of thoracic injuries were managed by ICWSD [25]. Adegboyeas et al (2002) found requirement of ICWSD placements in 72.9% of patients [26]. Following removal of ICWSD, residual intrapleural collections were found in 6.9% (n=6) patients. Minimal collections responded to conservative approach while thoracotomy was needed in 2.4% (n=2) patients. None of the patients in present study developed persistent air leak or pneumothorax following removal of ICWSD.

Types of analgesia used for adequate pain relief are NSAIDS in 69.8%, opioids in 15.1% combination of NSAIDS and opioids in 14% and epidural analgesia in only 1.2% (n=1) patient with flail chest who was on ventilatory support. Pain in blunt chest trauma is associated with restricted ventilatory function, which can

lead to serious complications. Multiple methods of analgesia have been evaluated and compared in the rib fracture population, including non-steroid anti-inflammatory medications, epidural catheters, intravenous narcotics, patient controlled analgesia (PCA), lidocaine patches, intercostal blocks and paravertebral blocks. Studies in western literature support epidural analgesia. The available evidence for patients with three or more rib fractures suggests that epidural analgesia provides more effective pain relief in comparison with other analgesic modalities, and it is most applicable to patients with functional respiratory compromise secondary to pain [27].

Thoracotomy is of two types: early or late. Early thoracotomy as advocated by Demetriades et al (1986) is required in cardiac arrest, persistent shock, tracheobronchial, and esophageal injury in setting of blunt thoracic trauma [28]. In the present study, none of the patients required emergency or urgent resuscitative thoracotomy or early planned thoracotomy. In the present study thoracotomy (late) was required only in 6.9% (n=6) of patients. Late thoracotomy was required in 4.6%(n=4) for empyema, 1.15% (n=1) for retained hemothorax and 2.3% (n=2) for atelectasis/trapped lung. While in 4.6%(n=4) of patients, thoracotomy was required at a later date when patient presented with cough and fever and diagnosed as empyema thoracis which was managed by late thoracotomy and decortication. Samson & Burford recommended thoracotomy and decortication in post traumatic empyema in presence of more than 25% lung compression [29]. McElvein & Maya[86] (1996) recommended decortication if patient is febrile and toxic for 10 days despite ICWSD and woody layer feel on thoracocentesis/ X-Ray showing multiple air fluid levels [30]. Canserver L et al (2005)[31] was of opinion that the decision of exploration or conservative treatment rests on patient's clinical status after removal of chest tube. [87] While 1.56%(n=1) presented with retained collection after removal of ICWSD which was not resorbed fully after conservative trial, underwent late thoracotomy. While canserver L et al reports a higher number of patients (20.3%) to have required thoracotomy and all for residual hemothorax [31].

2.3% (n=2) of patients underwent thoracotomy for incomplete lung expansion. These patients presented at about end of 1 month on follow up with complaints of cough. On Chest Xray and CECT Scan (Thorax) basal atelectasis with pleural thickening were present which were managed with late thoracotomy. Similarly Kulshrestha et al[27] reported 6.4% of patients to have required late thoracotomy [32].

Associated head injuries were noted in 11.5% while Al Koudmani et al (2012) reported associated head injury as 8.4% [21]. Naclerio et al (1969) stressed that combined thoracic and head injured patients should be closely monitored for signs of raised ICT and should be taken up for decopmressive craniotomy based on the intracranial pathology [33].

The maximum score noted for faciomaxillary trauma is 3/6 in 7 patients (8.1%) while scores of 2/6 is found in 6 patients (6.9%) who had >3 rib fractures. All required maxillofacial fixations. Faced with facial injuries Emil A Naclerio (1971) opined that it is dangerous only if complicated by profuse bleeding or airway obstruction [33]. The ISS varies from 3 to 75. 3 is the best score for favourable prognosis whilst 75 being unsurvivable injury. The highest score recorded in present study is 41 of a patient with 2 rib fracture with bilateral hemopneumothorax with significant maxillofacial and craniocereberal injury. This patient was

managed with bilateral ICWSD and supportive measures. The patient's ICWSD was removed after 19 days and discharged after 26 days of stay.

The mean ISS score for flail chest is 22±6.5 while that for more than 3 rib fracture group is 17±5.4 which is significantly($p < .05$) higher than with rib fracture groups 3 or less. Intra group variations of ISS SCORE among fracture groups with 0,1,2,3 number of rib fractures are not significant (ANOVA $p = .236$ i.e. $p > .05$). These results are in accordance with the finding of Liman ST et al (2003) who found that mortality rate increases with increasing ISS and an ISS of 16 or more has been found in major trauma. [34] When comparing ISS with mortality, Pearson's correlation coefficient is 0.194($p < .05$) which means that there is weak positive correlation between the two parameters. As severity of injury increases so does mortality. Similarly Mayberry et al (1997) found that hospital rates for mortality for isolated chest injuries was 4 to 8% which increased to 13 to 15% when another organ system was involved and 30-35% when more than 1 organ was involved [35]. While attempting to find a relation between intrathoracic injuries and ISS, we found strong assosciation of hemopneumothorax with ISS (correlation cefficient= 0.406 ($p < .05$)).

There is a strong correlation between RTS and mortality. (0.580 Pearson's two tailed test ($p < .01$) at 99% Confidence interval). This indicates as the grade of physiological injury scale increases the probability of mortality increases. This is in accordance with findings of Watts FH. (2012) who found RTS had strong correlation with mortality [36]. The correlation between RTS and number of ribs fractured is though positive but very weak which signifies that other factors play role i.e. physiological state of patient, presence of hemopneumothorax and associated head injury. But again while comparing > 3 ribs fractures, a significant correlation is found with RTS scores than with rib fractures ≤ 3.

Essentially high scores of ISS and low scores of RTS are significant predictors of mortality. Similarly Watts HF et al (2012) reported ISS and RTS were better predictors of mortality and correlate with each other [36]. In hospital complications of blunt thoracic trauma noted in present study were: empyema in 4.6% (n=4), Superficial wound infection at site of ICWSD insertion in 5.7% (n=5) patients, atelectasis in 2.36% (n=2) patients and retained hemothorax in 1.2% (n=1). Hence complication rate in present study was observed in 14% which is quite lower than complication rate of 38% as reported by Shorr RM et al in 1987. Shorr et al reported: Atelectasis(8.5%), pneumonia (7.2%), ARDS(6.6%), Empyema(4.1%), persistent air leak(4.3%), aspiration (1.8%) and miscellaneous(6.5%) in the form of lung abscess, lung cyst, arrhythmias, sternal dehisence, chylothorax, aortoesophageal fistula were complications of blunt trauma in the study conducted at blatimore maryland emergency trauma services by Shorr RM et al [37].

The discharged patients were followed up during the one year study period ranging from one month – 11 months. 86%(n=74) patients came for follow up out of which 62.7% (n=54) had complete recovery while 6.9%(n=6) patients had persistent chest pain, 3.4%(n=3) had cough, 6.1%(n=5) had skin infection at ICWSD insertion site while 2.3%(n=2) had incomplete lung expansion with basal atelectasis , 4.6%(n=4) developed thoracic empyema. Wilson et al concluded that shock on admission; pleural contamination & prolonged catheter drainage were factors responsible for development of empyema thoracis [38].

Conclusion

Chest injuries are an important aspect of trauma as it manifests individually or part of polytrauma in a sizeable number of patients presenting in casualty/emergency. Blunt trauma, mainly RTA, followed by fall from height and physical assault formed the most common causes of injury and most commonly affected group in population of Assam and surrounding areas in age group 20 – 50 years, with age group 40 to 50 years most commonly affected. Since RTA accounted for majority of thoracic trauma in present study, traffic controls and security belt use should be strictly obeyed. Commonly affected are males of productive age.

Chest pain is the most common presenting symptom followed by dyspnea. Majority of the patients admitted with blunt thoracic trauma suffered from more than 3 rib fractures. Incidence of significant maxillofacial injuries, intrathoracic injuries viz. hemopneumothorax, hemothorax & lung contusion were highest in patients with more than 3 ribs fracture group. Abdominal injuries and associated injuries in polytrauma were significantly associated with more than 2 rib fractures, suggesting severe force of trauma as etiology and almost mostly in RTA. Incidences of hemopneumothorax, hemothorax, requirement of ICWSD, ventilatory support, mortality and length of hospital stay were significantly high in patients with flail chest.

The most common associated injuries were skin structure followed by faciomaxillary & craniocerebral injuries. Orthopedic skeletal injuries were the most severe associated. Since associated extrathoracic injuries cause a higher mortality rate clinicians involved with trauma care should have a high index of suspicion for diagnosis of associated injuries. Further an understanding on modes of presentation of polytrauma allows prompt diagnosis and early treatment, making treatment management more efficient.

Mortality is associated with severe head injury, flail chest, B/L hemopneumothorax with pneumomediastinum, ISS Score > 16, low RTS Score. Though low RTS Scores predicts poor prognosis, a cut off level of score couldn't be calculated since mortality in present study is low. Probably study with even larger sample sizes can address this issue.

The majority of patients with blunt thoracic trauma can be managed by simple intervention i.e. Intercostal water seal drainage (ICWSD). Patients with flail chest require ventilator support in event of respiratory failure and as a means of internal fixation. Thoracotomy in present study was required for empyema, retained hemothorax, and incomplete chest expansion in minority of patients.The risk of mortality, length of hospital stay, severity of other injuries in cases of polytrauma is attributable to rib fracture > 3 suggesting severe force of trauma as etiology and almost mostly in RTA.

The ability to identify high risk cases quite early in Emergency Department based on history regarding mechanisms of injury, past medical history, meticulous clinical examination, prompt radiological assessment, ICWSD in emergency department if urgent and in CTVS OT if non urgent, nonoverzealous thoracotomies and intensive ICU care with ventilatory support as means of internal fixation particularly in flail chest when required, ensures efficient management of blunt thoracic injuries.

Limitation

The study was limited by exclusion of penetrating injuries to chest which involves laceration of tracheobronchial tree, heart, great vessels and more emergent kind of presentations.

Declaration

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Conflicts of interest/Competing interests: none of the authors have any conflict of interests.

Ethics approval : approved by institutional ethical committee with ***clearance number-AMC/EC/PG1799***

Consent to participate : consent from patients were taken on patient information sheet(PIS) and patient informed consent sheet(PICS) in English and vernacular language (Assamese)

Consent for publication: Patients were explained that their participation and publication of study may contribute to the advancement of the knowledge about blunt chest injury regarding recovery, management, updating guidelines for such patients, in India which may translate into management strategies conforming to Indian needs which might have a positive implication on overall health status of patients.

Availability of data and material all the data and material is maintained in SPSS Statistics for Windows, version 16.0 (SPSS Inc., Chicago, Ill., USA)

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