Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/19511
DOI URL: http://dx.doi.org/10.21474/IJAR01/19511

RESEARCH ARTICLE

A STUDY ON THE DIFFERENT CLINICAL PRESENTATION PATTERNS OF BLUNT THORACIC TRAUMA AND ASSOCIATED MORBIDITY FOLLOWING ROAD TRAFFIC ACCIDENT IN A TERTIARY CARE CENTRE

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Manuscript Info

Manuscript History
Received: 21 July 2024
Final Accepted: 24 August 2024
Published: September 2024

Abstract

Introduction: Chest trauma is a significant cause of morbidity and mortality following road traffic accidents (RTA). Given the significant potential for complications including respiratory failure and shock, blunt chest trauma following RTA remains a priority in trauma care and so this study aims to look into the clinical pattern of presentation of patients following chest trauma with/without associated injuries to other parts of body i.e. head/abdomen/extremities along with morbidity and mortality associated with it.

Aims and objectives of the study :

1. To study the various clinical patterns of presentation of RTA patients with blunt chest trauma.
2. To study the disease burden and death rate of individuals with blunt chest trauma.

Methodology: The study has been conducted in the Department of General Surgery, Silchar Medical College and Hospital from March 2024 to August 2024 after taking appropriate consent from 53 patients diagnosed with chest trauma following RTA with/without associated extra- thoracic injuries. Their data was analyzed and results published.

Result and Analysis: Mean age in my study was 38.90 ± 6.57 years with male preponderance. Most patients had 3 rib fractures with pulmonary contusion being most common complication. Most common associated extra-thoracic trauma is abdominal injuries (24.5%) with mean ISS of 13.25 ± 7.73. most patients were managed conservatively with adequate pain control. Surgical intervention carried out were either tube thoracostomy (92.3%) or needle thoracostomy (7.2%). Most common secondary complication following blunt chest trauma is pneumonia (18.84%) while ARDS complication arose in 9.43% of the patients. Mortality rate was 5.6% and the most common cause that let to the demise was ARDS.

Conclusion: To conclude, blunt thoracic injury is a major health problem as it carries significant mortality and morbidity; more so, in case of RTA and association of other extra-thoracic injuries also play a pivotal role in the process of recovery of the patient. Presence of lung contusion, pneumothorax, hemothorax are to be dealt adequately with

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proper analgesia. Even though most cases of chest trauma can be dealt conservatively; need for emergency surgical intervention needs to be assessed promptly. One must look for number of rib fractures as they may reflect the disease burden of the patient. Pneumonia and ARDS are a major mortality factor following chest trauma and its complications.

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Introduction:-

Road traffic accidents (RTA) result in a substantial incidence of morbidity and mortality due to chest trauma. Given its high susceptibility in high-impact collisions, the thorax is prone to a wide range of injuries, including minor rib fractures as well as severe conditions like pneumothorax, hemothorax, and heart tissue damage. Blunt chest trauma in RTA can cause damage to the rib cage, lungs, heart, and major vessels, often leading to respiratory compromise and hemodynamic instability. The presence of concomitant injuries, including cranio- cerebral injury, abdominal injury, limb injuries can alter the prognosis of the patient. Quick recognition and treatment of chest injuries are key to better outcomes. The initial assessment follows the Advanced Trauma Life Support (ATLS) protocol, focusing on securing the airway, ensuring adequate ventilation, and stabilizing circulation. Imaging techniques such as chest X-rays, ultrasound, and CT scans are invaluable in diagnosing the extent of injuries. Depending on the nature of the trauma, treatment may range from conservative management with pain control and oxygen therapy to more invasive interventions like thoracostomy, chest tube placement, or even surgical repair. Given the significant potential for complications, including respiratory failure and shock, chest trauma following RTA remains a priority in trauma care, requiring rapid, coordinated, and expert management to minimize adverse outcomes. Advances in both diagnostic techniques and management strategies have improved outcomes, yet the complexity and variability of thoracic trauma continue to present substantial challenges in trauma care. In this study, we shall look into the clinical pattern of presentation of a patient following chest trauma with/without injuries to other parts of the body i.e. head/abdomen/extremities.

Aims and Objectives of the Study

1. To study the different clinical presentation patterns of RTA patients with blunt chest trauma.
2. To study the disease burden and death rate of individuals with blunt chest trauma.

Materials and Methods:-

A total of 354 patients were reported to the trauma department at Silchar Medical College & Hospital following road traffic accidents (RTA) over the 6 month period from 01/03/2024 to 01/08/2024. Among these patients, 62 had experienced thoracic trauma. Following the application ofinclusion and exclusion criteria, 53 out of the 62 patients were selected for my study.

Inclusion Criteria –

1. All patients presented with blunt chest trauma with/without other afflicted injuries following RTA are included.
2. Patients having radiological evidence of blunt chest trauma.

Exclusion Criteria-

1. Patients who did not wish to have the expected treatment and were discharged against medical advice or left against medical advice.
2. Patients who did not have radiological evidence of chest trauma.
3. Patients who were severely traumatized and expired before any relevant investigation could be done.

Study Setting-

The study will be conducted in Silchar Medical College and Hospital. The cases admitted in surgical wards and examined on OPD & Emergency basis from March 2024 to August 2024 formed the material of the study. The study areacaters to most of the Barak Valley including districts of Cachar, Karimganj & Hailakandi along with places including Manipur, Tripura, Meghalaya, Mizoram.

Study Design -

The study will be a prospective descriptive study.

Period of Study-
The study will be conducted from 01/03/2024 to 01/08/2024 for period of 6 months.

Methodology:-

All patients participating in this study would be diagnosed as cases of chest injury with/without abdominal/head/extremity trauma following RTA by the doctor-on- duty based on history, clinical examination and radiological findings.

The findings relevant to the study like time of accident, vitals of the patient at trauma center, radiological finds like chest x-ray and HRCT- thorax for thoracic region; USG-fast and CECT-abdomen for abdominal injuries; NCCT-head for cranio-cerebral trauma; various X-rays of limbs (as advised by orthopedics trauma team) for extremity injuries any urgent surgical intervention taken are noted down.

The patients underwent initial assessment and resuscitation following the Advanced Trauma Life Support (ATLS) protocol. The focus was on identifying and treating six immediately life-threatening conditions associated with the airway and chest: airway obstruction, tension/open pneumo-thorax, massive hemothorax, flail chest, and cardiac tamponade. Severity of trauma is quantified by Abbreviated injury score (AIS) and Injury Severity Score (ISS).

Depending on the condition of the patient and severity of trauma the patients were either admitted or discharged after proper pain management. Patients having pneumo-thorax either underwent needle thoracostomy or intercostal tube drainage and patients with hemothorax had ICD insertion done.

The patients would be followed from admission till discharge/death. The admitted patients are monitored strictly and need for ICU care, number of days of hospital stay, thoracic complications that may arise during the stay all are noted.

The data gathered would be analyzed using online statistical tools. Statistical models showing the morbidity and mortality profile would be analyzed and displayed.

Results and Observation:-

1). Age :

The age range of the participants in my study spanned from 10 to 85 years. A mean age of 38.90 years was observed, accompanied by a standard deviation of 6.57 years. The predominant age range was 31 to 40 years, whereas the least prevalent was 81 to 90 years, with 12 persons in the former category and only 1 in the latter.

Age (inyears)	Frequency (percentage)
10-20	**10(18.87%)**
21-30	**11(20.75%)**
31-40	**12(22.64%)**
41-50	**7(13.21%)**
51-60	**6(11.32%)**
61-70	**2(3.77%)**
71-80	**4(7.54%)**
81-90	**1(1.87%)**

Table1:-Frequencydistributionofage.

2). Gender :

Thegenderpreponderancebetweenmaleandfemalewas83.02%(44)and16.92%(9) respectively.

Sex	Frequency
Male	44(83.02%)
female	9(16.92%)

Table2:-Frequencydistributionofgender.

3). VariousCausesOfRTA :

Causeof RTA	Frequency
Pedestrian	8 (15.1%)
Bicycle	13 (24.5%)
Scooter/ Bike	16 (30.2%)
Threewheeler Rickshaw/Auto	12 (22.6%)
Fourwheeler	2 (3.8%)
Heavyvehicle	2 (3.8%)

Table3(a):-Frequencytableofcausesof RTA.

In our study, most common cause of RTA is found to be scooter/bike (30.2%); followed by bicycle (24.5%) and three wheeler auto at 22.6%. Pedestrian/bystander makes 15.1% of the victims while four wheelers and heavy vehicular accidents cause 3.8% of the total causes each.

Causeof RTA	Mean AIS (thorax)	Mean AIS (abdomen)	MeanAIS (head)	Mean AIS (extremity)	Mean ISS	Mean days of hospital stay	Percentage of ICU requirement
Pedestrian	2.3	2	3	0	9.4	6.3	12.5%
Bicycle	2	2	3	2	7	7.1	0 %
Scooter/ Bike	2.7	2.5	2.3	2	11.4	5.6	18.7%
Three-wheeler rickshaw/ auto	3	3	3	2	11.7	6.9	25 %
Four-wheeler	4	2	0	0	18	9.5	100 %
Heavy vehicle	4	3	0	3	26	8	100 %

Table3(b):-TableshowingcauseofRTAwithassociatedparametersinfluencing morbidity and mortality.

Fromtheabovetable,it canbeinferredthat :

1. Pedestrian accidents resulted in a mean ISS of 9.4, with an average hospital stay of 6.3 days, and 12.5% of patients required ICU care.
2. Bicycle accidents had a mean ISS of 7 and a longer hospital stay of 7.1 days, though none of the patients required ICU.
3. Scooter/Bike accidents had a higher mean ISS of 11.4, an average hospital stay of 5.6 days, and 18.7% required ICU care. Mortality rate is 6.25%.

4. Three-wheeler rickshaw/auto accidents resulted in a mean ISS of 11.7, with an average stay of 6.9 days, and 25% required ICU care.
5. Four-wheeler accidents had a significantly higher mean ISS of 18, a hospital stay of 9.5 days, and 100% of patients required ICU care. Mortality rate is 50%
6. Heavy vehicle accidents had the highest mean ISS of 26, with an average stay of 8 days, and 100% of these patients required ICU care. Mortality rate is 50%.

Mortality rate was 6.2 % in case of scooter / bike RTAwhile it was 50 % in both four-wheeler and heavy vehicle causing RTA.

4). PeriodOfPresentationFollowingTrauma :

Timeofpresentationfrom onset of trauma	Frequency
1 hour	7 (13.2%)
2 hours	11 (20.6%)
3 hours	21 (39.6%)
4 hours	6 (11.3%)
>4 hours	8 (15.1%)

Table4(a):-Frequencytableoftimeofpresentationfromonsetoftrauma.

In this study, only 13.2% of the patients presented within the "Golden Hour" following trauma. Majority of the patients (39.6%) reached within 3 hours of trauma. 20.6% of the patients reached within 2 hours while 11.3% patients took 4 hours to reach while 15.1% patients presented >4 hours post trauma.

Timeofpresentationfrom onset of trauma	Meandaysof hospitalstays
1 hour	6.3
2 hours	4.3
3 hours	6.9
4 hours	7.6
>4 hours	7.6

Table4(b):-TableoftimeofpresentationfromonsetoftraumavsMeandaysof hospital stay.

The data presented shows a correlation between the time of a patient's presentation after trauma and their average hospital stay.

1. Patients who arrived at the hospital within 1 hour of their trauma experienced an average hospital stay of 6.3 days.
2. Those who presented within 2 hours had the shortest average hospital stay, at 4.3 days.
3. Patients who arrived within 3 hours had a slightly longer hospital stay of6.9 days.
4. For patients arriving within 4 hours, the average hospital stay increased to7.6 days, which was the same for those presenting after 4 hours.

Timeofpresentation fromonsetof trauma	ICU requirement	Ventilation requirement
1 hour	0	0
2 hours	2	2 (100%)
3 hours	6	2 (33.3%)
4 hours	2	1 (50%)
>4 hours	1	1 (100%)

Table4(c):- Tableoftimeofpresentationfromonsetoftraumavsfrequencyof ICU and ventilation requirement.

This data describes the ICU and ventilation requirements for patients based on the time of their presentation after trauma.

1. Patients who arrived within 1 hour of their trauma did not require ICU admission or ventilation.
2. Patients presenting within 2 hours had a 100% rate of ICU and ventilation requirement, with 2 out of 2 patients needing both ICU care and ventilation.
3. Patients arriving within 3 hours showed 6 patients needing ICU care. However, only 2 out of 6 patients (33.3%) required ventilation.
4. Patients presenting within 4 hours showed a similar trend, with 2 patients needing ICU care, and 1 of these 2 patients (50%) requiring ventilation.
5. Patients who presented after 4 hours had a 100% rate of both ICU and ventilation requirement, although this applied to only 1 patient in this group.

5). Numberofribfractures :

Inmystudy,thenumberofribfracturesaredividedas<3,3,&>3numbersof rib fractures. Most of the patientssuffered from 3 numbers of rib fractures 39.62%(21)followedby>3ribfractures33.97%(18)followedby<3ribfractures26.42% (14).

Number of ribsfracture	Frequencyofrib fractures
<3	14(26.42%)
3	21(39.62%)
>3	18(33.97%)

Table5:-Frequencydistributionofnumberofribfracture.

6). Laterality of rib fractures :

In this study, most of the patients suffered from unilateral rib fractures rather than bilateral. 92.5% (49) patients had unilateral rib fractures as compared to 7.5% (4) patients suffering from bilateral rib fractures.

Laterality of rib fractures	Frequency
Unilateral	49 (92.5%)
Bilateral	4 (7.5 %)

Table 6(a):-Frequency distribution of laterality of rib fractures.

Out of the majority of unilateral rib fractures, 12.2% (6) patients had 1 rib fracture, 16.3% (8) patients had 2 rib fractures, 42.8% (21) patients had 3 rib fractures, 24.5% (12) patients had 4 rib fractures, none had 5 rib fractures, while 4.1% (2) patients had 6 rib fractures.

Laterality of rib fractures	Mean AIS(thorax)	Percentageof associated extrathoracic injury	Mean days of hospital stay	Percentage of intensive care requirement
Unilateral	2.5	34 %	6.25	16.32 %
Bilateral	3.75	50 %	10	75 %

Table 6(b):- Table showing association of laterality of rib fractures with different parameters affecting morbidity and mortality.

This data compares the impact of unilateral (UL) and bilateral (BL) rib fractures on associated injuries and patient outcomes:

- Unilateral Rib Fractures (UL):
- Mean AIS (thorax) = 2.5 (less severe injuries).
- 34% of these cases had associated extrathoracic injuries.
- Mean hospital stay was around 6.25 days.
- 16.32% of patients required intensive care.

- Bilateral Rib Fractures (BL):
- Mean AIS (thorax) = 3.75 (indicating more severe injuries).
- 50% of these cases had associated extrathoracic injuries.
- The mean hospital stay was longer, around 10 days.
- 75% of patients required intensive care.

7). Isolated rib fractures :

Isolatedrib fractures (total)	1Rib fracture	2Rib fractures	3Rib fractures	≥4Rib fractures
18	5(27.8%)	6 (33.3%)	7 (38.9%)	0

Table7:-Frequencydistributiontableisolatedribfracturepatients.

From the above chart it is evident that 33.96% (18) patients have isolated rib fractures. Out of 18 patients 27.8% had only a single rib fracture, 33.3% had 2 rib fractures and 38.9% had 3 rib fractures. When number of rib fractures is ≥ 4 rib fractures, it was always associated with other thoracic complication in my study.

8). Displacement of rib fracture :

In my study, majority of the patients suffered from undisplaced fractures (62.3%) and 37.7% of the patients had displaced rib fractures.

Fracturedisplacememnt	Frequency
Undisplaced	33 (62.3%)
Displaced	20 (37.7%)

Table8:-Frequencyofdisplacedandundisplacedfracturerib fractures.

9). Number ofdaysofhospitalstay :

Days of hospitalstay	Frequency
<3	1
3-6	27
7-10	13
>10	4

Table11:-Frequencydistributionofnumberofdaysofhospitalstay.

From the above chart, it is evident that only 1 patient was admitted for a duration of <3 days; majority of the patients (27) were having hospital LOS of 3-6 days followed by 13 patients having LOS of 7-10 days and 4 patients had >10 days of hospital stay. The mean length of hospital stay in this study is 6.58 ±0.96 days.

10.) Ribfracture vs number of days of hospital stay :

From the study it is seen that the average number of days of hospital stay increases with increase in the rib fracture.

Numberof rib fractures	Averagedays of hospital stay
<3	1.6
3	5.7
>3	8

Table10:-Averagelengthofhospitalstaycomparedtoribfractures.

In my study, patients with 3 or >3 rib fractures had an average LOS (length of stay) of 5.7 & 8 days respectively.

11). Pulmonary contusion:

54.7% (29) patients in this study suffered from pulmonary contusion as compared to 45.3% (24) as a result of blunt trauma abdomen.

Pulmonarycontusion	Frequency
No	24 (45.3%)
Yes	29 (54.7%)

Table11:-Frequencydistributionofpatientssufferedfrompulmonary contusion.

12). Hemothorax:

Of the total patients, 32.1% (17) suffered from hemothorax as compared to 67.9%(36) who did not suffer.

Hemothorax	Frequency
No	36 (67.9%)
Yes	17 (32.1%)

Table12:-Distributionofpatientssufferedfromhemothorax.

13). Pneumothorax:

30.2% (16) of the total patients presented with pneumothorax while rest 69.8%(37) patients did not.

Pneumothorax	Frequency
No	37 (69.8%)
Yes	16 (30.2%)

Table13:-Frequencydistributionofpneumothorax.

14). Ribfracture vs associated complications:

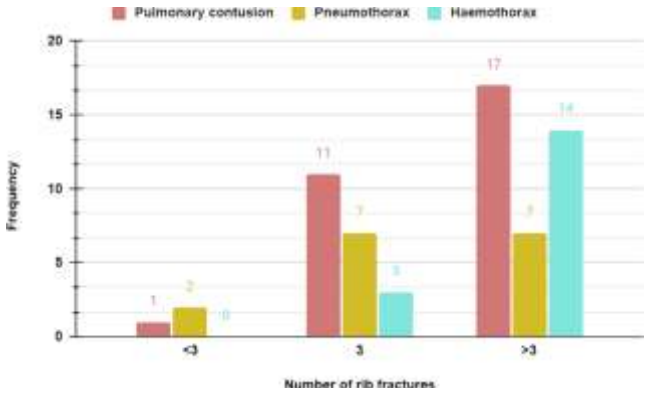

Figure 1:- Histogram showing association of rib fracture to pulmonary complication.

From the above chart there is 1000% increase in the percentage of pulmonary contusion when the number of rib fracture increases to 3; while there is 54.5% increase of the same when number of rib fractures are >3.

There is a percentage increase of 366.7% in frequency of hemothorax when the number of rib fracture increases to >3.

A percentage increase of 250% is observed in pneumothorax when the number of rib fractures are 3.

15). Flail Chest :

5.7% (3) patients presented with flail chest as compared to 94.3% (50) patients who did not.

Flail Chest	Frequency
No	50 (94.3%)
Yes	3 (5.7 %)

Table14:-FrequencytableofFlailchestpatients.

16). No patients in the study suffered from pulmonary laceration, trachea-bronchial injury or thoracic aorta injury.

The various extra-thoracic injuries the patients in my study suffered are :

I). Abdominal Injuries :

In this study, 24.5% of the total patients had associated abdominal

Abdominal Injury	Frequency of patients
No	40 (75.5%)
Yes	13 (24.5%)

Table15:-Frequencytableshowingabdominalinjuries.

II). Head Injuries :

13.2% of the patients suffered from associated head injuries.

Head injury	Frequency of patients
No	46(86.8 %)
Yes	7(13.2 %)

Table16:-Frequencyofassociatedheadinjurypatients.

III). Extremity Injury:

13.2 % patients in my study has associated extremity injury.

Extremity Injury	Frequencyof patients
No	46(86.8 %)
Yes	7(13.2 %)

Table17:-Frequencytableforextremityinjuryin patients.

The severity of injury suffered by the patients in my study are as follows :

a). Abbreviated Injury Scale (Thorax) :

In our study, mostofthe patients, i.e. 47.2% (25)haveAIS(thorax)score of 3 with 1 patient having maximum score of 5 and 4 patients having minimum score of 1 with a mean AIS score of 2.64 ±0.22.

b). AbbreviatedInjuryScale(Abdomen) :

In our study, out of 53 patients, 11.3% (6) have AIS(abdomen) score of 3 with 1 patient having maximum score of 4 and 3 patients having minimum score of 1 with a mean AIS score of 2.38 ±0.55.

c). AbbreviatedInjuryScale(Head) :

In our study, out of total patients, 13.2% (6) have AIS(head) score of 3 with all 6 patients having maximum score of 3 and 1 patients having minimum score of 1 with a mean AIS score of 2.71 ±0.56.

d). Abbreviated Injury Scale (Extremity) :

In our study, out of total patients, 13.2% (6) have AIS(extremity) score of 3 with all 6 patients having maximum score of 3 and 1 patients having minimum score of 1 with a mean AIS score of 2.71 ±0.56

e).InjurySeverityScale:

ISSGrade	Frequency
Mild(<9)	17 (32.07%)
Moderate(9-15)	22 (41.51%)
Severe(16-24)	10 (18.87%)
Profound (≥25)	4 (7.54%)

Table18:-FrequencydistributionofISS scale.

According to the above frequency table, it is evident that in my study the most of the patients (41.51%) suffered from injuries that can be attributed to a ISS scale of moderate grade. 32.07% (17) patients had ISS grade of mild injury followed by 18.87% (10) patients with severe ISS grade and only 7.54% (4) of the patients had profound ISS grade. Mean ISS was 13.25 ±7.73.

f). ISSvsAIS :

ISSgrade	MeanAISscores			
	AIS (thorax)	AIS (abdomen)	AIS (head)	AIS (extremity)
Mild(<9)	1.76	0.11	0	0.11
Moderate(9-15)	2.82	0.14	0.55	0.09
Severe(16-24)	3.3	1.6	0.4	0.6

Profound(≥25)	**3.75**	**2.5**	**0.75**	**1.25**

Table19:-ShowingthemeanAISvsISSgrades.

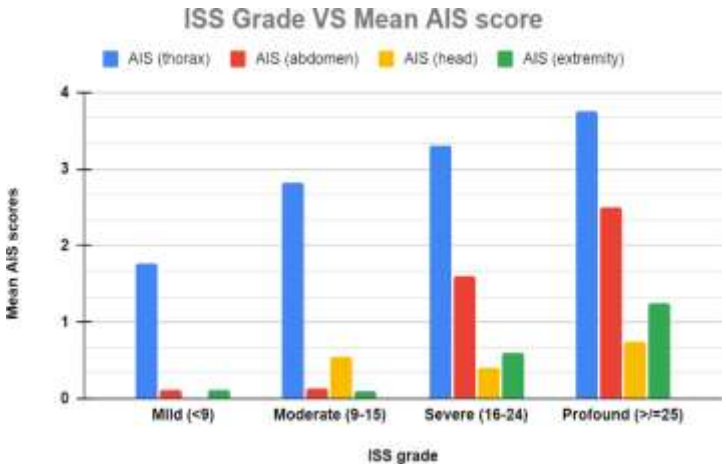

Figure2:-Barchartshowingassociation ofmeanAISscorewithISS grade.

The above charts show the association of severity of thoracic injury as indicated by mean of the AIS (thorax) to the ISS of the patients in my study. As the severity grading of ISS increases from mild, moderate, severe and profound the mean AIS (thorax) values are found to be 1.76 ±0.21, 2.82 ±0.16, 3.3 ±0.5 & 3.75 ±0.94 respectively.

g). ISSvsICUadmissions:

ICU admissions	**ISSgrade**			
	Mild (<9)	**Moderate (9-15)**	**Severe (16-24)**	**Profound (≥25)**
Yes	**0**	**2**	**6**	**3**
No	**17**	**20**	**4**	**1**

Table20:-FrequencyofICUadmittedpatientsaccordingtoISS grade.

From the chart above, it is seen that 2 patients with moderate ISS required ICU admission; 6 patients with severe ISS required ICU admission and 3 patients with profound ISS grade required ICU admission.

h). ISS vs deaths :

In our study, there was 1 death in a patient which translates to 10% of the patients with a severe ISS grade while death toll increased to 50% when ISS grade was profound.

ISSgrade	**Discharged**	**Deaths**
Mild (<9)	**7**	**0**
Moderate (9-15)	**23**	**0**

Severe (16-24)	**9**	**1**
Profound (≥25)	**2**	**2**

Table21:-OutcomeofpatientswithreferencetoISSgrade.

Various treatment modalities given were as follows :

1). Number of hospital admissions :

Out-patient treatment was given to 15% (8) and inpatient treatment was provided to 84% (45) of the total patients. Out of 44 admissions, the average hospital stay was 6.56 ±0.99 days, ranging from 2 to 16 days.

Number of hospital admissions	Frequency
Yes	**45(84 %)**
No	**8 (15 %)**

Table22:-Frequencydistributiontableofnumberofadmissions.

Out of the 45 hospital admissions 55.5% (25) patients had isolated thoracic injury with a mean hospital stay of 5.2 days. 4 out of 25 patients required ICU treatment out of which 2 patients required ventilation. 25% of these patients suffered from either pneumonia/ARDS; 17.8% (8) patients had isolated abdominal injury along with thoracic injury with a mean hospital stay of 10 days. 3 out of 8 patients required ICU treatment out of which 2 patients required ventilation. 37.5% of these patients suffered from either pneumonia/ARDS; 6.7%(3) patients had isolated head injury with thoracic injury with a mean hospital stay of 4.7 days. None of the patients needed ICU care and there were no secondary complications; 6.7% (3) patients had isolated extremity injury with thoracic injury with a mean hospital stay of 6.3 days. Only 1 patient was ventilated in ICU and later suffered from secondary complications.

Frequencyof isolatedchest injury	Mean days of hospital stay	Frequencyof ICU admissions	Frequencyof ventilation requirement	Frequencyof pneumonia / ARDS
25	**5.2**	**4**	**2**	**5**

Table23(a):-Frequencydistributiontableofmeandaysofhospitalstayfor isolatedchest injury patients.

Frequencyof isolatedchest and abdomen injury	Meandays of hospital stay	Frequency of ICU admissions	Frequencyofventilation requirement	Frequency of pneumonia / ARDS
8	**10**	**3**	**2**	**3**

Table23(b):-Frequencydistributiontableofmeandaysofhospitalstayfor isolated chest and abdomen injury patients.

Frequencyof isolated chestandhead injury	Meandays of hospital stay	Frequency of ICU admissions	Frequencyofventilation requirement	Frequency of pneumonia/ ARDS
3	**4.7**	**0**	**0**	**0**

Table23(c):-Frequencydistributiontableofmeandaysofhospitalstayfor isolated chest and head injury patients.

Frequencyof isolatedchest and extremity injury	Meandays of hospital stay	Frequency of ICU admissions	Frequencyofventilation requirement	Frequency of pneumonia/ ARDS
3	6.7	1	1	1

Table23(d):-Frequencydistributiontableofmeandaysofhospitalstayfor isolated chest and extremity injury patients

2). Number of ICU admissions :

Of the 44 admissions, there were 11 patients who required ICU admissions.

ICUadmission	Frequency
Yes	11 (25%)
No	42 (95.5%)

Table24:-FrequencytableofICUadmissions.

3). Numberofpatientsrequiringventilation:

Outofthetotaladmittedpatients11.3%(6)ofthemrequiredventilatory support.

Ventilation Required	Frequency
Yes	6 (11.3%)
No	47 (88.7%)

Table25:-Frequencydistributionofventilationrequirement.

4). Pain management :

All of the patients in this study received analgesia in the form of either oral or injectable diclofenac and tramadol. None of the patients required thoracic epidural analgesia or general anesthesia to alleviate pain.

5). Surgical intervention:

The patients who required surgical intervention were either treated with needle thoracostomy or tube thoracotomy. 49.06% (26) of total patients required surgical intervention out of which 2 patients underwent needle thoracostomy and rest 24 patients underwent tube thoracotomy.

Surgicalintervention	Frequency
Needlethoracostomy	2
Tubethoracostomy	24

Table26:-Frequencytableofsurgicalintervention.

In my study, all the patients (100%) who suffered from hemothorax underwent ICD while patients suffering from pneumothorax underwent either needle thoracotomy or ICD.

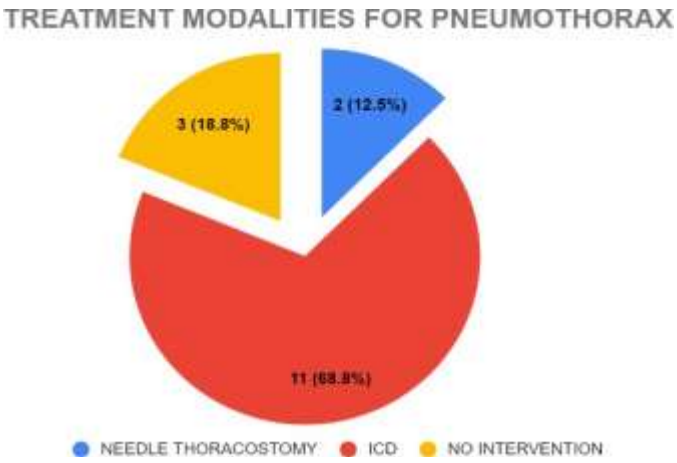

Figure 3:- Pie chart showing percentage of surgical intervention in pneumothorax.

In the above study it is seen that 68.8% (11) patients underwent ICD insertion while 12.8% (2) patients underwent needle thoracostomy.

6). Flail chest management :

Out of 3 patients that suffered from flail chest, 100% of the patients were managed conservatively in ICU with mechanical ventilation.

7). Flail chest vs complications :

Out of 3 patients 1 (33.3%) patient suffered from pneumonia while 2 (66.7%) patients suffered from ARDS. Mortality is found to be 33.3% following flail chest.

8). Complicationsfollowingbluntchesttrauma

Inourstudy,themostcommoncomplicationfollowingbluntchesttraumais pneumonia 18.84% whileARDS complication arose in 9.43% of the patients.

25% of the patients who presented with pneumothorax had pneumonia as complication compared 53% of the patients who presented with hemothorax. Also, there was 18.75% patients having ARDS as complication in pneumothorax as compared to 23.5% of the patients who presented with hemothorax.

9). Outcome :

There were 3 deaths (5.6%) in our study while rest 50 patients (94.4%) were discharged with no major complications.

All of the patients who expired had ARDS (100%) while only 1 (33.33%) had both pneumonia and ARDS before the patient succumbed to death.

None of the patients in my study presented with penetrating chest trauma.

Discussion:-

1). All our patients presented with rib fractures which is in accordance with a study by Verma et al. and Manay et al. (1)(2)

2). In our study, of all the patients presenting with chest trauma, none had penetrating injury. Similar studies conducted by Hajjar et al. 2021 (94%), Pal et al. 2019 (>90%), Kasabe et al. 2016 etc. shows that a major bulk of the chest trauma following RTA were blunt chest trauma. (3)(4)(5)

3).Age :

In our study, patients of all ages were included, the youngest being 10 years of age while the oldest was 85 years old. The mean age of our patients was (38.90 ±6.57) years. Of them, the largest group was (31-40) years old at 22.64% followed (21-30) years old at 20.75% while the smallest group was (81-90) years old at 1.87%.

This finding matches with a study by Narayanan et al. 2018, mean age was 37.82 years with a range of 3-86 years. (6)

In a study conducted by Khursheed et al. in 2019, it was found that the majority of patients belonged to the 21-30 years age group, accounting for 26.25% of the cases. The second largest age group was 31-40 years, making up 25.62% of the patients. Together, these age groups (21-40 years) constituted approximately 51.87% of the total patient population. (7)

In a study by Dalal et al. 2008 34.5% of the patients were in the age group of 21-30 years group while 24.4% of the patients were in the age group of 31-40 years group. (8)

4).Sex:

The gender preponderance between male and female was 83.02% (44) and 16.92% (9) respectively in my study.

In a study by Dalal et al. 2008 there was 84.5% males while 15.4% were females. (8)

Similar study seen in by Khursheed et al. 2019 where there were 82.5% were males and rest 17.5% were females. (7)

In a study by Walia et al. 2021, 70.65% are males while 29.35% were females. (9)

5).Causeof RTA:

In our study most common cause of RTA is found to be scooter/bike (30.2%); followed by bicycle (24.5%) and three-wheeler auto at 22.6%. Pedestrian/bystander makes 15.1% of the victims while four wheelers and heavy vehicular accidents cause 3.8% of the total causes each.

According to a study by Narayanan et al. 2018, 35% of the cases were linked to motorized two-wheeler accidents, while 30% of the patients sustained injuries involving four-wheelers. Additionally, 5% of the individuals were injured in bicycle-related incidents, and the remaining 30% were pedestrians struck by moving vehicles. (6)

In another study by Chien et al. 2017, motorbike accidents occurred in 40.2% cases, bicycle accidents in 4.6% cases. Additionally, 7.5% individuals were injured in car accident and remaining 6.3% were pedestrian victims. (10)

According to a study by Bahl et al. 2020, 30% of the cases were linked to motorized two-wheeler accidents, while 21% of the patients sustained injuries involving four-wheelers and 3% involved in heavy vehicle accidents. Additionally, 17% of the individuals were injured in bicycle-related incidents, and 8% were pedestrians struck by moving vehicles. (11)

6).Time of presentation after trauma:

In this study, only 13.2% of the patients presented within the “Golden Hour” following trauma. Majority of the patients (39.6%) reached within 3 hours of trauma. 20.6% of the patients reached within 2 hours while 11.3% patients took 4 hours to reach while 15.1% patients presented >4 hours post trauma.

This is similar to study by Narayanan et. al 2018, where 10% of the patients presented within "Golden Hour". (6)

7).Number of rib fractures :

In our study the number of patients with <3 rib fractures 26.42% (14) while ≥ 3 rib fractures are 73.5%.

In a study by Gilbert et al. 2017, similar findings are recorded where patients with >3 rib fractures are found to be 72%, while <3 rib fractures are at 12%. (12)

In a study by Chien et al. 2017, 32.81% of the patients had 1-2 rib fractures while 67.18% of the patients had ≥3 rib fractures. (10)

In yet another study by Liman et al. 2003 47% of the patients suffered from <3 rib fractures while 43% patients had ≥3 rib fractures. (13)

In a study by Sirmali et al. 2003, only 24.3% had <3 rib fractures as compared to 91.6% of ≥3 rib fractures. (14)

8).Laterality of rib fractures :

In our study, 92.5% (49) patients had unilateral rib fractures as compared to 7.5% (4) patients suffering from bilateral rib fractures.

This is in accordance with study by Chien et al. 2017, 93.1% patients had unilateral rib fracture while 6.9% of the patients had bilateral rib fractures and also study by Gupta et al. 2017 with unilateral rib fractures in 92% patients while 8% had bilateral rib fractures. (10)(15)

This is in contrast to a study by Ozdil et al. 2017 where 40.9% of patients had unilateral chest trauma and 41.7% had bilateral chest trauma. (16)
In a study by Gilbert et al. 2017, bilateral rib fractures are seen in 18.2 % of the recorded sample. (12)

9).Rib fracture and association with number of days of hospital stay :

From the study it is seen that the average number of days of admission increases with increase in the rib fracture. In my study, patients with 3 or >3 rib fractures had an average LOS (length of stay) of 5.7 days & 8 days respectively as the association of complications in the form of pneumothorax, hemothorax, pulmonary contusion etc. increases. In our study the average hospital stay is 6.57 ± 0.96 days.

Similar study was done by Sikander et al. 2020, where mean hospital stay was 5.3 days with increase in number of rib fracture of more than 2 lengthening the stay (p=0.004). (17)

In a study by Shah et al. 2022, mean hospital stay was 8 days, while in another study by Potey et al. 2020 average hospital stay was found to be 4.6 days. (18)(19)

This is also found to be similar in a study by Kim et al. 2020 in their study where they found that the mortality and morbidity increases significantly with increase in the number of rib fracture. (20)

In a study by Sharma et al. 2016, 84% of the patients were discharged within 7-9 days while 13.2 % patients had extended hospital stay upto 23 days due to multiple rib fractures. (21)

Yet in a study by Flagel et al. 2005, no association was there between hospital LOS and number of rib fractures. (22)

10).Complications following chest trauma :

54.7% (29) patients in this study suffered from pulmonary contusion; of the total patients, 32.1% (17) suffered from hemothorax and 30.2% (16) of the total patients presented with pneumothorax.

A study by Al-Koudmani et al. 2012 found 51% pneumothorax, 38% hemothorax, and 15% pulmonary contusion were the most frequent injuries. (23)

In a recent study by Alex et al. 2024, hemothorax was found to be 38.13%, 31.96% had pneumothorax while 13.99% were diagnosed to have pulmonary contusion (24). The findings of pneumothorax and hemothorax were comparable to our study except pulmonary contusion.
In a study by Kasabe et al. 2016, 62% of the trauma patients presented with pneumothorax, 57.33% with hemothorax while 42.67% presented with pulmonary contusion. (5)

In a study by Shah et al. 2022, 50% of the patients presented with hemothorax while only 10% had pneumothorax. (18)

11).Rib fracture vs associated complications :

In this study, it is clearly evident from figure-1 that the complications like pulmonary contusion, hemothorax, pneumothorax increases with increase in the number of rib fractures. In other words, number of rib fractures is a predictor for morbidity and mortality due to presence of above mentioned associated complications.

In a study by Al-Koudmani et al. 2012, it was observed that the incidence of complications such as pneumothorax, contusion, and hemothorax increased with the number of fractured ribs. Specifically, these complications occurred in 60% of patients with 1-2 fractured ribs, 71% of those with 3-5 fractured ribs, and 79% of patients with more than 5 fractured ribs. (23)

In a study by Kazunori Fukushima et al. 2023 they found out there was significant association of number of rib fracture with pulmonary complications like pneumothorax, hemothorax and pulmonary contusion. (25)

In yet another study by Sharma et al. 2016, presence of ≥ 2 rib fractures is almost always associated with increased severity due to presence of pneumothorax, hemothorax. (21)

12).Pain management :

All of the patients received injectable or oral NSAIDs as analgesic treatment. This is in the same vein with a study conducted by Mohta et al. 2003 where oral or parenteral, non-steroidal anti-inflammatory drugs (NSAID) especially diclofenac is most commonly used for pain relief. (26)

In another literature, diclofenac sodium along with acetaminophen and thiocolchicoside was given for pain management. (27)

In a study by Pal Naresh et al. 2019 all the patients were treated with parenteral analgesia using either NSAID or opioid analgesia. (4)

This is contrast to a study by Quereshi et al. where they advised regular use of oral/intravenous acetaminophen even if the effect is modest instead of NSAIDS due to associated side effects. (28)

13).Surgical management :

In this study surgical intervention was carried out in patients were in the form of tube thoracostomy or needle thoracotomy. Out of 26 patients, 24 patients underwent Intercostal tube drainage (ICD) and rest 2 patients underwent needle thoracotomy. In our study, all the patients (100%) who suffered from hemothorax underwent ICD while patients suffering from pneumothorax underwent either needle thoracotomy or ICD.

In a study by Michelle Kim et al. 2020, traumatic pneumothorax can be treated with needle thoracostomy via 5^{th} intercostal space in emergency situation or by ICD if patient vitals are stable. In the same study, it is mentioned that hemothorax to be treated with ICD. They insisted on a management that involves the decompression of the pleura by the placement of an intercostal drain, with subsequent restoration of volume utilizing a hemostatic resuscitative approach. (20)

In yet another study, most common surgical procedure carried out was ICD insertion in (75.35%) patients. 87% of patients with hemothorax required ICD insertion, whereas, 95% cases of pneumothorax required tube thoracostomy. (6)

In a study by Shah et al. 2022, all cases of hemothorax and pneumothorax were treated with tube thoracostomy. (18)

14).Managementof flail chest :

5.6% (3) of the patients in our study suffered from flail chest and all the patients were treated conservatively by mechanical ventilation.

In a study by Al-Koudmani et al., 2.4% of the patients suffered from flail chest. (23)

In a study by S Dalal et al. 2008, the prevalence of flail chest in their study was 9 %. (8)

This is in conjunction with a study where it is mentioned that the patients who do not meet specific operative indications, advances in the nonoperative care of flail chest injuries have improved outcomes. (29)

In a study by Sharma et al. 2016, patients with flail chest were admitted to the ICU for close monitoring and management. All patients underwent tube thoracostomies as part of their treatment regimen to address any associated complications such as pneumothorax or hemothorax. In cases where respiratory support was necessary, non-invasive ventilation was provided to stabilize the patient's breathing and ensure adequate oxygenation. This approach reflects a standard protocol in managing flail chest, focusing on minimizing invasive procedures while ensuring effective respiratory support. (21)

15).Associated extra-thoracic injuries :

In our study, 24.5% of the total patients had associated abdominal injuries 13.2% of the patients suffered from associated head injuries and extremity injuries. This is also evident that the severity of injury increases with associated extra-thoracic injuries.

In a study by Ram Gopal Sharma et al. 2021 intra-abdominal organ injury was present in 22% of the cases. Liver injury was most common (10%) followed by splenic injury (8%), renal and pancreatic injury both at 2%. (30)

This is in contrast with some literatures; In a study by Al Saigh et al. 1999 head injury presented in 19.05% cases, abdominal injuries in 12.01% cases, and extremity injuries in 11.1% cases. (31)

In a study conducted by Gupta et al. in 2020, extra-thoracic injuries were present in 42% of chest trauma cases. Among these injuries, head injuries were the most prevalent, occurring in 26.5% of cases, while extremity injuries were noted in 12% of cases. (32)

Also, in other study by Bahl et al. 2020, 56% had limb injury, 12% had head injury, 9% involved abdomen. (11)

16).Secondary complications of blunt chest trauma :

In our study, the most common complication following blunt chest trauma is Pneumonia 18.84% while ARDS complication arose in 9.43% of the patients. 25% of the patients who presented with pneumothorax had pneumonia as complication compared 53% of the patients who presented with hemothorax.

Also, there was 18.75% patients having ARDS as complication in pneumothorax as compared to 23.5% of the patients who presented with hemothorax.

In another literature, Hofman et al. 2020 suggests that there is a significant co-relation between the incidence of pneumonia and the development of both Acute Respiratory Distress Syndrome (ARDS) and Multiple Organ Dysfunction Syndrome (MODS). This association is statistically significant, indicating that as chest trauma severity increases, so does the likelihood of pneumonia. The study highlights that the Abbreviated Injury Scale (AIS) for the

thorax plays a role in this correlation, with more severe chest trauma cases showing a higher incidence of pneumonia. Moreover, a specific relationship was noted between hemothorax and the development of pneumonia, reinforcing the connection between chest trauma complications and respiratory infections. (33)

In another study, chest trauma score (CTS) was used to quantify severity of chest trauma and it was found that there was a significant association of pneumonia, ARDS with increase in CTS score. (17)

17).Outcome:

There were 3 deaths (5.6%) in our study while rest 50 patients (94.4%) were discharged with no major complications. All the patients who passed away had ARDS as complication.

In a literature there were (11%) deaths, in which majority of it was due to ARDS followed by MODS. (6)

This was similar to another study where mortality rate was 5.4%(1)

This is in contrast with another literature where 11.6 % patients died. A significant correlation was observed between the presence of associated extra-thoracic injuries and patient outcomes, with the association being statistically significant ($p < 0.001$). (34)

18). Our study did not report any cases of cardiac, diaphragmatic, vascular, or esophageal injury, a finding consistent with the study conducted by Verma et al. in 2023. (1)

19).Factors for morbidity and mortality :

Late presentation following trauma is associated with the development of complications, leading to higher morbidity and mortality rates. This association was statistically significant, with a p-value of 0.03. This suggests that the timing of a patient's arrival for treatment plays a critical role in their prognosis, with those arriving later experiencing worse outcomes, potentially due to delayed intervention and the progression of injuries. (35)

The above study co-relates with our study as evident from above mentioned table 4(b) and table 4(c) where late presentations are associated with increased hospital LOS and increased ICU admissions indicating increase in burden of the disease on the patient.

Same study mentions involvement of bilateral rib fractures with increased mortality and morbidity with a p-value of 0.02. (35)

In our study too, 50% of the cases with bilateral rib fractures had associated extra-thoracic injuries. The mean hospital stay was longer, around 10 days and 75% of patients required intensive care.

From figure-1 of our study, that the complications like pulmonary contusion, hemothorax, pneumothorax increases with increase in the number of rib fractures. In other words, number of rib fractures is a predictor for morbidity and mortality due to presence of above mentioned associated complications.

This is evident from various literature review by Flagel et al. 2005 (22), Al-Koudmani et al. 201 (23), Fukushima et. al 2023 (25), Sharma et al. 2016 (21) etc.

The study by Gupta et al. 2021 (15) reveals that several factors were significantly associated with higher disease burden in chest trauma patients:

1. Delayed presentation to the hospital
2. Multiple rib fractures
3. Bilateral thoracic injury
4. Associated extra-thoracic injury
5. Ventilatory support requirement.

The above study corroborates with the finding in my study which is reflected in the tables : 4(b), 4(c), 10, 6(b), 21 and 22 which show that delayed presentation in the hospital, presence of multiple rib fracture, presence of bilateral

rib fractures and associated extra-thoracic injuries all increase the mortality and morbidity in a patient either by increasing length of hospital stay or by complications in the form of pneumonia / ARDS.
In a study by Shah et al. 2022, association of abdominal injury carried increased mortality and morbidity as 25% in their study had to undergo emergency surgery and 1 patient expired. (18) A similar study conducted by Verma et al. also had increased morbidity due to associated abdominal injuries. (1)

This was comparable to our study where it is evident from table 23(b) which infers that association of abdominal injury increased the mean hospital stay to 10 days with 37.5% of those patients required intensive care thereby increasing morbidity. Out of 3 patients who expired 1 patient had abdominal injury with AIS of 4.

In a study by Bahl et al. 2020, most severe accidents are faced by motorcycle riders as out of 13% patients with extremity injury, approximately 73% of them were bike riders. They mentioned four-wheeler car injuries as second most common in causing severe trauma. (11)

In our study, scooter / bike accidents had a higher mean ISS of 11.4 and 18.7% required ICU care with most riders suffering from abdominal injuries contrasting to the study by Bahl et al. 2020. However, accidents caused by four-wheeler haver higher ISS of 18 with 100% requiring ICU care. We have a mortality rate of 6.25% for scooter / bike and a whopping 50% for four-wheeler accidents.

Hospital mortality rate for isolated chest trauma is <10% but increases >30% when associated with extra-thoracic injuries. Also increased ISS values co-relates with increased morbidity and mortality. (13)
This is in conjunction with our study where from table 20 and table 21 it is evident that increase in ISS of >16 is associated with increased ICU admissions and mortality.
Presence of flail chest too is a grave risk factor for mortality. Liman et al. had 17% mortality following flail chest (13) while in our study it was 33.3%.

Summary

Chest trauma is a significant cause of morbidity and mortality following road traffic accidents (RTA). Given the considerable potential for complications, including respiratory failure and shock, chest trauma following RTA remains a priority in trauma care and so this study aims to look into the clinical pattern of presentation of patients following chest trauma with/without associated injuries to other parts of body i.e. head/abdomen/extremities along with morbidity and mortality associated with it. The study was conducted in Silchar Medical College and Hospital from 01.03.24 to 01.08.24 in the department of General Surgery. Proper consent and due diligence were taken in recording data for the study. 53 patients were included in our study. Mean age was 38.90 ± 6.57 years. The gender preponderance between males and females was 83.02% and 16.92% respectively. Most common cause of RTA is found to be scooter/bike (30.2%). Most of the patients suffered from 3 numbers of rib fractures (39.62%). 33.96% of patients have isolated rib fractures which were mostly undisplaced (62.3%). The mean length of hospital stay is 6.58 ± 0.96 days which increases with an increase in rib fractures. 54.7% patients suffered from pulmonary contusion; 32.1% from hemothorax; 30.2% from pneumothorax while 5.7% patients presented with flail chest. No patients in the study suffered from pulmonary laceration, trachea- bronchial injury or thoracic aorta injury. Even though all cases of flail chest were managed conservatively in intensive care, mortality rate was 33.3%. The most commonly associated extra-thoracic trauma is abdominal injuries (24.5%) with head injuries and extremity injuries sharing 13.2% each. Mean ISS was 13.25 ±7.73. 25% of the admitted patients required ICU admissions with 11.3% requiring ventilatory support. 49.06% of the patients required surgical intervention out of which 92.3% underwent tube thoracostomy and the rest 7.2% underwent needle thoracostomy. Pain management is achieved with oral/injectable NSAIDs and opiods. Most common secondary complication following blunt chest trauma is pneumonia (18.84%) while ARDS complication arose in 9.43% of the patients. Mortality rate was 5.6% and the most common cause that led to the demise was ARDS.

Conclusion:-

To conclude, blunt thoracic injury is a major health problem as it carries significant mortality and morbidity more so in case of RTA and association of other extra-thoracic injuries also play a pivotal role in the process of recovery of the patient. A patient with blunt trauma to the chest may present with isolated rib fracture, pneumothorax, hemothorax or in severe cases flail chest. One must be very cautious as increased number of rib fracture may be present with underlying lung parenchymal injury. Every patient presenting in emergency with blunt trauma to the chest must go through ATLS protocol and associated extra-thoracic injury, if present must be addressed accordingly.

Pain management is of utmost importance as severe pain may be the reason for the patient's inability to breathe properly. Most pain can be alleviated by the use of injectable or oral analgesics in the form of NSAIDs and opioids. Severity of the trauma should be quantified, if possible, using various scores like Abbreviated Injury Score, Revised Trauma Score, Injury severity score etc. so that aggressive treatment can be given to the patient and also morbidity/mortality can be predicted as evident from the study. Pneumothorax can be dealt with tube thoracostomy or if urgency dictates one may use needle thoracostomy. Hemothorax needs an intercostal tube drainage to both relieve the patient and to quantify the amount of blood loss. One must be vigilant of the signs and symptoms of pneumonia and ARDS as these pose significant riskto mortality and morbidity. In summary, the various mortality and morbidity factors in a blunt chest trauma are-

1) number of rib fractures
2) increased injury severity scores
3) presence of pneumothorax/hemothorax/flail chest
4) severity of extra-thoracic injuries
5) effective pain modulation
6) need for ICU and ventilation
7) presence of complications like pneumonia / ARDS.

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