

Chest Trauma Management in Hospitals with Limited Resources and Factors Affecting Mortality

*Kan AI,¹ Hossain F,² Siddiqua SS,³ Hossain MA,⁴ Islam MS,⁵ Masud MA,⁶ Alam M,⁷ Rahman AM⁸

Abstract

Background: Chest trauma is an important cause of death and disability worldwide and the impact is particularly more in developing countries with low and middle-income economy. Most of the death occurs within the first hours of injury; so effective emergency and urgent healthcare is essential for better outcome of trauma victims.

Objective: To observe the pattern and outcome of management of chest trauma in hospitals with limited resources and factors affecting mortality in patients with chest trauma.

Methods: This prospective study was conducted in 100 Bedded Zilla Hospital and General and Child Hospital, Narsingdi, from January 2008 to December 2016. All patients with chest trauma arrived alive to the emergency or outpatient department were evaluated. Patients were divided into 2 groups- group: A (survived following treatment) & group: B (died following enrollment in the study).

Results: Out of 358 patients with chest trauma of our study total 24 (6.70%) patients died at emergency department during resuscitation or in ambulance during transfer to other hospitals or in the intensive care unit of referred hospitals. No significant differences were observed in terms of age, sex, nature, type and cause of injury and time elapsed to reach hospital after injury among the groups. Group- B patients were significantly more severely injured as indicated by ISS (mean±SD = 30.75±5.45 versus 18.53±3.61 with a P-value <0.001). Associated other system injury were also significantly higher in group-B (83.30% versus 6.60% with a P-value <0.001). Among the associated injuries limb injuries were commonest but head injury either alone or in combination with abdominal or facial injuries were significantly more in group-B. None of the patients were found with major cardiovascular or respiratory injury. Most (86.87%) of the patients were managed confidently at our district level hospitals with limited resource facilities and most (91.01%) of them required treatment as outpatients or observations or simple tube thoracostomy. In 14 (58.33%) patients of group-B; mechanical ventilation support was sought either at emergency department of our hospitals or at ambulance during transfer to other hospitals; but was not available. In our study causes of death were respiratory failure and multiorgan failure in 18 (75%) and 6 (25%) of patients respectively.

Conclusion: Majority of the chest trauma patients can be managed confidently in a general hospital with limited resources but chest trauma may be a life threatening condition; so should be diagnosed early and treated immediately. Severity of injury, significant associated other system injury, capabilities of hospitals especially emergency services with mechanical ventilator support are important factors affecting mortality.

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Keywords: Chest trauma, Associated injury, Injury severity score, Observation, Tube thoracostomy, Mechanical ventilation, Limited resources, Mortality.

1. *Dr. Azizul Islam Khan, Assistant Professor (Cardiac Surgery), National Institute of Cardiovascular Diseases, Sher-E-Bangla Nagar, Dhaka, Bangladesh. drkhanazizulislam@gmail.com
2. Dr. Faruque Hossain, 100 Bedded Zilla Hospital, Narsingdi, Bangladesh.
3. Dr. Sadia Sajmin Siddiqua, Senior Consultant, (Surgery), Sarkari Karmachari Hospital, Fulbaria, Dhaka, Bangladesh.
4. Dr. Mohammad Awlad Hossain, Junior Consultant, (Orthopedic Surgery), 100 Bedded Zilla Hospital, Narsingdi, Bangladesh.
5. Dr. Md Shahidul Islam, 100 Bedded Zilla Hospital, Narsingdi, Bangladesh.
6. Dr. Md Abdullah Al Masud, Junior Consultant (Anesthesia), 100 Bedded Zilla Hospital, Narsingdi, Bangladesh.
7. Dr. Mazharul Alam, 100 Bedded Zilla Hospital, Narsingdi, Bangladesh.
8. Dr. ANM Mizanur Rahman, Resident Medical Officer, 100 Bedded Zilla Hospital, Narsingdi, Bangladesh.

* For correspondence

Introduction

Injury is the leading cause of death and disability in the first four decades of life and is the third most common cause of death overall. Among the causes of injuries road traffic accidents (RTA) are commonest.¹ Chest trauma is one of the most common injuries suffered by multiple injured patients, with an incidence of 45%-65%.² For every injury related death there are ten other survivors with serious injury, two of which will have permanent disabilities. Chest trauma is responsible for more than 70% of deaths following RTA. Isolated blunt trauma to chest is fatal in 10% cases and it may rise to 30% if other injuries are present. Incidence of penetrating chest injuries are increasing from both domestic and civil violence's; with a mortality rate of 3% for simple stab injury to 15% for gunshot injuries.^{1,3}

The most common complication in patients with chest trauma is respiratory failure due to altered chest wall mechanics from fractures and respiratory distress from fracture-associated pain. Underlying pulmonary contusion after chest wall injury also plays an important role in hypoxia. Lung is a target organ for secondary damage by post traumatic inflammation and it contribute to the development of multiple organ failure (MOF) which is a major cause of late death (24%) after severe trauma.^{4,5} Combination of these complex pathophysiology sometimes needs endotracheal intubation, mechanical ventilation, tracheostomy and or intensive care unit admission. Treatment of chest trauma should be methodical and exact because the sign's particularly in the presence of other injury may be missed.² Mortality following chest trauma varies on etiological factors, associated other injury and capabilities of the hospital especially emergency services.^{6,7} 80% of death following accidents occurs within first few hours of injury.¹ Trained multidisciplinary team and

well equipped facilities play important role in reducing morbidity and mortality.^{8,9} In semi urban and rural centers with limited resource settings managing a seriously injured patient is a clinical challenge. The combination of clinical foreknowledge, ability to understand spot changing clinical signs and surgical courage to perform simple but life saving procedures may cause a significant difference in outcome for the chest injured patient.¹⁰

The purpose of this study is to observe the outcome of managing patients with chest trauma in hospitals with limited facilities at district level and factors related to mortality following chest trauma.

Methods

This prospective observational study was done at 100 Bedded Zilla Hospital and General and Child Hospital, Narsingdi from January 2008 to December 2016. 358 consecutive patients with chest trauma either isolated or associated with multiple injury presented in emergency or outpatient department at both the hospitals were included in this study; brought dead patients with chest trauma were excluded. Patients were divided into 2 groups – group: A (334 patients) and group: B (24 patients). Group: A comprises all survived patients following treatment and group: B comprises all dead patients following enrollment in the study.

Initial diagnosis was based on primary survey. Life threatening conditions were managed in the emergency room as per primary trauma care (PTC) guide line in all patients. In some cases with major blood loss- patients were taken to operation theatre for immediate control of bleeding as a part of resuscitation. Patients in whom no life threatening condition was found or one whose condition responded well and in a sustained way following resuscitation was either discharged with treatment as outdoor patient or admitted in

hospital and secondary survey was done. Those patients failed to respond or responded transiently to initial resuscitation or with major neurotrauma or in need of mechanical ventilation or not willing to stay at study hospitals were referred to advanced hospitals having critical care facilities. Information's about the mode of treatment and the outcome of referred patients whether survived or died - either on the way to or at the advanced hospital, were achieved from the discharge or death certificate and or over telephone from patients guardians.

Investigations done included X-ray Chest, abdominal X-ray and ultrasound, blood grouping and complete blood count in all patients. Computerized tomography (CT) scan and arterial blood gas (ABG) analysis was not available in our settings. Patient's pulmonary status was relied to clinical eye and pulse oxymetry. Other investigations as per indications in individual patients and patients were managed accordingly.

Information regarding age and sex of patients, nature and cause of injury, time elapsed after injury, presence of associated injury, treatment done for chest trauma and the outcome of treatment were analyzed. Associated injury which needed some surgical procedure to the patient were considered significant. Data were entered into a computer and a data file was constructed. Data were described as percentage (%) and mean \pm SD (standard deviation) as appropriate. Data were analyzed by statistical program of social sciences (SPSS). Student's t-test (for continuous variable) and Chi-square test (for categorical variable) were used. P-value <0.05 were considered significant.

Results

Out of 358 patients of chest trauma of this study, 24 died (comprising the group- B) with a mortality rate of 6.70%. 4 patients died at

our hospital and 43 (12.01%) patients (23 patients of group- A and 20 patients of group- B) were referred to hospitals with critical care facilities and 311 (86.87%) patients were treated at our hospitals. Among the referred patients 10 patients died at ambulance before reaching the referred hospital and rest 10 after arrival at referred hospitals.

Age of the patients ranged from 15 to 75 years with a mean of 35.77 ± 9.86 and 38.50 ± 12.67 years in group A and B respectively. Most of the patients were male. In most of the patients nature of the injury was blunt trauma and cause of injury was RTA. Time elapsed to reach hospital in our study patients ranged from 5 minutes to 48 hours with a mean of 3.8 ± 1.76 and 2.8 ± 0.19 hours in group- A and B respectively. Base line characteristics of study patients in terms of age, sex, nature and cause of injury and time elapsed to reach hospital are summarized in Table-I and there were no significant difference among the groups regarding these base line characteristics. In our study rib fracture was most common type of chest injury followed by pneumothorax, haemothorax, haemopneumothorax, pulmonary contusion and chest wall soft tissue injury. Significant associated other system injury were present 6.60% and 83.3% of patients in group- A and B respectively. A detailed analysis of type of chest injury and associated other system injury is presented in Table-II and III respectively. Severity of trauma among the patients as indicated by injury severity score (ISS); most of the patients (94.9%) of group-A were mild to moderately injured and most of the patients (91.7%) of group-B were severely injured (Table-IV). Majority of the patients of this study were treated conservatively. Most (75%) of the patients died within first few hours of injury at emergency department during primary survey and resuscitation and at ambulance during transfer of patients from

one hospital to other hospital. Treatment required and place of death of the patients of

this study are summarized in Table-V and VI respectively.

Table I. Baseline characteristics of study patients (N=358).

Variables	Group-A (n=334) (Survivors)	Group-B(n=24) (Nonsurvivors)	P
Age (in years)			
≤ 20	15 (4.5%)	0 (0.0%)	
21 – 30	85 (25.4%)	7 (29.2%)	
31 – 40	127 (38.0%)	7 (29.2%)	
41 – 50	76 (22.8%)	5 (20.8%)	
51 - 60	27 (8.1%)	3 (12.5%)	
> 60	4 (1.2%)	2 (8.3%)	
Mean±SD	35.77±9.86	38.50±12.67	0.200 ^{NS}
Sex (%)			0.788 ^{NS}
Male	311 (93.1%)	22 (91.7%)	
Female	23 (6.9%)	2 (8.3%)	
Nature of injury (%)			0.202 ^{NS}
Blunt	308 (92.22%)	20 (83.34%)	
Penetrating	26 (7.78%)	4 (16.66%)	
Cause of injury (%)			0.877 ^{NS}
RTA	287 (85.92%)	21 (87.5%)	
Assault	37 (11.10%)	2 (8.3%)	
Fall from height	7 (2.09%)	1 (4.2%)	
Animal related	3 (0.89%)	0 (0.0%)	
Time elapsed to reach hospital(in hours)			
< 1	34 (10.18%)	8 (33.33%)	
1 – 3	195 (58.39%)	10 (41.68%)	
4 - 6	41 (12.28%)	3 (12.50%)	
7 - 12	38 (11.37%)	2 (8.33%)	
> 12	26 (7.78%)	1 (4.16%)	
Range	10 min. to 48 hours	5 min.to 24 hours	
Mean±SD	3.8±1.76	2.8±0.19	0.054 ^{NS}

Data were expressed frequency (%) and mean±SD.

Unpaired student t-test for quantitative variable and Chi-square test for qualitative variable.

NS = not significant.

Table II: Distribution of study patients by type of chest injury (N= 358).

Type of chest injury	Group-A(n=334) (Survivors) No. (%)	Group-B(n=24) (Nonsurvivors) No. (%)	P
Fracture rib(isolated - single or multiple)	91(27.25%)	0 (0.00%)	0.001*
Fracture rib + Pneumothorax	49 (14.69%)	2 (8.34%)	0.391 ^{NS}
Fracture rib + Haemothorax	20 (5.98%)	2 (8.34%)	0.644 ^{NS}
Fracture rib + Haemopneumothorax	15 (4.49%)	6 (25.00%)	<0.001*
Fracture rib + Pneumothorax + Surgicalempysema	14 (4.19%)	5 (20.78%)	0.001*
Haemopneumothorax	6(1.80%)	1 (4.17%)	0.418 ^{NS}
Haemopneumothorax + Diaphragm injury	4 (1.19%)	2 (8.34%)	0.008*
Fracture rib + Pulmonary contusion + Flail chest	3 (0.89%)	4 (16.69%)	<0.001*
Pulmonary contusion	15 (4.49%)	2 (8.34%)	0.265 ^{NS}
Chest wall soft tissue injury	117 (35.03%)	0 (0.00%)	<0.001*
Chest trauma associated with other system injury	22(6.60%)	20 (83.3%)	<0.001*

Data were expressed frequency (%).

Chi-square test, NS = not significant, * = Significant.

Table III: Distribution of study patients by associated injury (N= 42)

Type of associated injury	Group-A(n=22) (Survivors) No. (%)	Group-B(n=20) (Nonsurvivors) No. (%)	P
Limb	17 (77.3%)	2 (10.0%)	<0.001*
Abdominal	4(18.2%)	3 (15.0%)	0.782 ^{NS}
Head injury	1 (4.6%)	6 (30.0%)	0.027*
Abdominal + Head injury	0 (0.0%)	5 (25.0%)	0.012*
Head injury + Facial injury	0 (0.0%)	4 (20.0%)	0.027*

Data were expressed frequency (%).

Chi-square test, NS = not significant, * = Significant.

Table IV: Distribution patients according to severity of trauma as indicated by injury severity score (N=358).

Injury severity score (ISS).	Group-A(n=334) (Survivors) No. (%)	Group-B(n=24) (Nonsurvivors) No. (%)	P
Mild (<16)	172 (51.49%)	0 (0.0%)	
Moderate (16-24)	145 (43.41%)	4 (8.3%)	
Severe (>24)	17 (5.10%)	22 (91.7%)	
Mean±SD	18.53±3.61	30.75±5.46	<0.001*

Data were expressed frequency (%) and mean±SD.

Unpaired student t-test, * = Significant.

Table V. Distribution of study patients according to management done at our hospitals (N=358)

Treatment modality	Group-A(n=334) (Survivors) No. (%)	Group-B(n=24) (Nonsurvivors) No. (%)
Treated as outpatient	91 (27.24%)	0 (0.00%)
Observation	115 (34.43%)	0 (0.00%)
Tube thoracostomy	98 (29.34%)	4 (16.67%)(As a part of resuscitation for tension pneumothorax)
Thoracotomy	4 (1.20%)	0 (0.00%)
Laparotomy	3 (0.90%)	0 (0.00%)
Referred to other hospital after initial resuscitation	23 (6.89%)	20(83.33%)(Including 4 patients with tube thoracostomy for tension pneumothorax).

Table VI: Place and cause of death of group- B patients (n=24)

Place and cause of death	Number of patients	Percentage
At our hospital during primary survey and resuscitation due to respiratory failure with facial and head injury (mechanical ventilation support was sought but was not available).	4	16.67
At ambulance during transfer to other hospitals due to respiratory failure with head injury (mechanical ventilation support was sought but was not available).	10	41.66
At ICU in referred hospitals due to respiratory failure with head injury with abdominal trauma.	4	16.67
At ICU in referred hospitals due to multiorgan failure.	6	25.00

Discussion

Chest trauma comprises trauma to any or combination of different thoracic structures like chest wall, pleura, lung parenchyma and the mediastinum. In chest trauma when the pleural space does not communicate with exterior then it is called blunt trauma and when communicate with exterior then it is called open chest trauma. Diagnosis and management of chest trauma is based on Advanced Trauma Life Support (ATLS) course. Initial assessment and resuscitation focuses on identifying and correcting the immediate threats of life by using ATLS protocol. Management ranges from observation to tube thoracostomy, thoracotomy and or ventilatory support.^{1,3}

This study is a description of chest trauma management in hospitals with limited

technical infrastructure and without any social assistance. Some of the circumstances described here might be considered far away from what is gold standard elsewhere. It must be point out that about 75% of worlds surgeons work under such conditions.¹¹ Most general surgeons are competent in the management of multisystem injured patients and doing abdominal surgery for trauma but confidence is less in the management of cardiothoracic and vascular injuries.¹² An experienced general surgeon trained in the techniques required to perform life saving emergency surgery is vital for major trauma management.¹³ Management of severely injured patients at a hospital with specialist trauma service either through direct referral from road side or transfer from an acute receiving hospital after initial resuscitation and stabilization comprise the best

service.¹² In our study both the hospitals are at district level with limited resource facilities-both infrastructure and technical assistance; it is the general surgical team who is responsible for immediate surgical management of chest trauma patients. It is author's privilege to work with this general surgical team while posted at district level.

In our study it shows chest trauma occurred mainly in male patients at younger age. It is because male young persons are more mobile and active in the society. Similar results were found in other studies.¹⁴⁻¹⁸ In most of the patients of our study chest trauma was blunt in nature and was caused by RTA. These findings are consistent with some studies^{14,19-21} but not with some other studies¹⁵⁻¹⁷ where the difference between blunt and penetrating chest trauma incidence were relatively less. Higher percentage of patients with RTA in our study reflects increased mobilization of people by the use of vehicle with the pace of industrialization and urbanization in the developing economy of the country. Relatively less difference between the incidence of blunt and penetrating chest trauma in some studies coincides with the level of domestic and civil violence's of those society or country. Majority of the patients of our study reached hospitals within 6 hours. Some of the patients reached to hospitals in very short period of time due to location of both the hospitals besides a national high way of the country and occurrence of accidents in the vicinity of these hospitals. This finding is consistent with some studies.²²⁻²⁴ Most of the patients of our study were suffering from fracture of single or multiple rib with or without pneumothorax or haemothorax or a combination of haemopneumothorax. No critical lesion such as rupture of trachea, injury to great vessel or heart with pericardial tamponade was found; as because such patients- in the absence of prehospital management usually dies at the place of

occurrence of injury.^{1,2} Type of chest injury of our study consistent with some other studies.^{7,14,17,18,20,25-26} Statistically there were no significant difference in terms of age, sex, nature and cause of chest injury and time elapsed to reach hospitals among the group A and B patients and these findings are consistent with some other studies.^{11,17,18,22,23} Proportionately higher percentage of significant associated injury to other system in group-B patients reflects it is an important factor for the outcome of chest trauma victims. Among the associated injuries limb injuries were most common but head injury or facial injury or abdominal trauma either single or in combination significantly affects the outcome of chest trauma victims. These findings are consistent with other studies.^{7,11,17,18,25,26-30} In majority of the patients of our study injury were mild (ISS <16) to moderate (ISS 16-24) severity; which explain low rate of Intensive Care Unit (ICU) admission of our patients. Severe injury (ISS >24) in most of the patients of group-B of our study suggests ISS play an important role in the outcome of chest trauma, as it was observed in some studies.^{11,14}

Majority of the patients of our study were treated with observation and or tube thoracostomy. The overall rate of thoracotomy in our patients (8.9%) is consistent with other studies.^{15-17,24} Incidence of tube thoracostomy and thoracotomy were not significantly different among the group- A and B which suggests thoracotomy or tube thoracostomy itself does not influence the mortality as it was showed in other studies.^{11,17,18,22,23}

Overall mortality rate (6.7%) of our study is comparable to some other studies^{14,31} at hospitals with critical care facilities in developed countries. None of the patients of our study had major cardiovascular and respiratory injury, as it showed in several

studies^{11,15,16,25} in some developing countries. Such low mortality and absence of major cardiovascular and respiratory injury of our study patients reflects poor transport, inadequate ambulance services and lack of prehospital management of our area associated with limited infrastructure and resource facilities of our hospitals; causing death of some severely injured patient before and at arrival at hospital. For reduction of prehospital death preventive measures such as wearing of appropriate seat belts in automobiles, head protection on bicycles and motorcycles, road safety legislation and education for pedestrians are important.¹ In this current study it was observed that in 14 (58.33%) deaths ventilator support was sought- at emergency department and during transfer of patients but was not available. This signifies that ventilator support is an important factor in management of chest trauma patients and affects the outcome of treatment as it was showed in some other studies.^{12,20,21}

Conclusion

Majority of the chest trauma patients can be safely managed in a general hospital. Multidisciplinary approach with a trauma team in hospitals with well-equipped emergency services including mechanical ventilator support will significantly improve the outcome in severe chest trauma victims. Improvement in the educational and socioeconomic status along with health facilities should keep in pace with urbanization and industrialization of the country for the prevention of injury.

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