

## MANAGEMENT OF THORACIC INJURIES: OUR EXPERIENCE AT MILITARY HOSPITALS

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### ABSTRACT

**Background:** Thoracic trauma is a major health care problem accounting for a significant percentage of the morbidity and mortality associated with the management of trauma patients. We performed a prospective study with the purpose to review our experience of the management of thoracic injuries at military hospitals having no proper thoracic surgical set up.

**Material and Methods:** The study was conducted at Combined Military Hospital Quetta and Combined Military Hospital Peshawar from January 2001 to September 2005 and a total of 84 cases of thoracic trauma with blunt and penetrating injury were managed.

**Results:** Mean age of patients was 36.5 years and female to male ratio was 1:13. Penetrating trauma was more common cause, 51 (61.7%) cases of chest injuries as compared to the blunt trauma 33 (39.3%) cases. The clinical conditions resulting ribs fractures in 73 cases (86.9 %), flail chest in 3 patients (3.57%), haemothorax in 24 (28.57%) cases, pneumothorax in 8 (9.52%) cases, haemo-pneumothorax in 43 (51.19%) cases, pulmonary contusions in 5 (5.95%) cases, bronchial injury in 1 patient (1.19%), ruptured left diaphragm in 5 (5.95%) with herniation of abdominal contents in the left chest in 2 patients. Bilateral thoracic involvement was seen in 3 cases (3.57%). Right chest was involved in 48 patients (57.14%) while the left in 36 patients (42.86%). Extra-thoracic associated injuries were seen in 33 (39.3%) cases. Cardiac, great vessels, thoracic duct and esophageal injuries were not encountered during the course of this study. Seventy seven patients (91.66%) were treated initially with tube thoracostomy and it alone was effective in 69 patients (89.61%). Overall thoracotomy rate was 9.52% (8 cases). Emergency thoracotomy was performed in 3 (3.57%) cases and delayed thoracotomy in 5 (5.95%) cases. Empyema thoracic was seen in 3 patients (3.9%) with tube thoracostomy. Overall percentage of empyema was 3.57%. Seven patients (8.33%) were managed without the need of either tube thoracostomy or thoracotomy. Minor complications of tube thoracostomy were seen in 10 cases (12.99%). Overall mortality rate was 3.57% (3 deaths).

**Conclusions:** Tube thoracostomy remains the most effective treatment modality in the management of most of the cases of chest trauma.

**Keywords:** Trauma chest, blunt trauma, penetrating trauma, tube thoracostomy, thoracotomy

### INTRODUCTION

Trauma, being the leading cause of death in first four decades of life, constitutes a major health care problem [1]. Thoracic trauma is extremely common and accounts for a

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significant percentage of the morbidity and mortality associated with the management of trauma patients in spite of consistently improved therapeutic techniques for the management of patients with such injuries in the past century. The spectrum of chest injuries is broad, ranging from a simple rib fracture to ex-sanguinating major vascular

injuries. The management of chest injuries depends mainly on the mechanism of injuries and the evidence and type of associated injuries. Though the vast majority of such patients do not require thoracotomy and are successfully managed by the simple tube thoracostomy plus supportive measures alone, yet patients with these injuries require prompt evaluation and treatment to avoid preventable mortality [1,2].

Rapid assessment to identify life-threatening injuries along with the key interventions like management of the airway, performance of tube thoracostomy to improve ventilation, control of hemorrhage, and avoidance of massive fluids infusions is the current standard of care in patients with chest trauma [1,2].

The purpose of our study was to review our experience of the management of thoracic injuries at two military hospitals having no thoracic surgical unit.

### **PATIENTS AND METHODS**

This was a prospective study performed between January 2001 and September 2005 at Combined Military Hospital Quetta and Combined Military Hospital Peshawar, over a period of 4 years and 9 months. A total of 84 patients, of all age groups, males and females, having chest injuries caused by blunt or penetrating trauma either isolated or associated with other extra-thoracic injuries, were included in the study. Only the patients directly reporting to our hospitals were included in this study and those with chest trauma having initial treatment like tube thoracostomy in other hospitals were excluded from the study. All the patients were received in either Trauma centre or Medical Reception Centre (MRC) and were rapidly evaluated for vital signs, consciousness level, airway patency, ventilatory status, vascular integrity and cardiac pump function and were thoroughly examined for nature/number/site of chest and associated injuries. Hypotensive patients were particularly evaluated for any evidence of tension pneumothorax, cardiac tamponade,

flail chest or associated extra-thoracic injuries which could be responsible for shock. Quick information regarding mechanism / circumstances of injuries sustained and about associated medical problem/drug usage if any were obtained. After having assessed and managed the airway and establishment of adequate ventilation by immediate tube thoracostomy where required, circulation was supported with necessary resuscitative measures. After initial resuscitative / supportive measures like Tube thoracostomy, IV fluids infusions including blood transfusions when required, O<sub>2</sub> inhalation and analgesics at Trauma centre/MRC, stable patients with injuries not requiring immediate other surgical interventions were admitted in the high dependency wards/Intensive Treatment Centre (ITC) for observation / monitoring as well as further laboratory and radiological work up depending upon the nature of injuries. Those in need of immediate surgical interventions for their chest injuries as per the criteria mention by Battistella and Benfield [2] and others [3] or for other associated injuries were shifted to operation theatre for necessary surgical procedures after rapid stabilization and initial necessary work-up. Chest X-rays was the initial investigation in every patient with chest trauma and remained the basis for initiating other investigations. Chest X-Rays were performed in most of the patients on initial presentation but chest intubations were carried out purely on clinical grounds, without X-Rays, in patients who were unstable and having respiratory distress. Other investigations like CT-Scan chest and Ultrasound chest / abdomen when indicated because of the clinical condition were advised only once the patients were stable enough to go to radiology department. Patients with blunt trauma to lower chest were routinely subjected to Ultrasound abdomen to rule out/confirm any intra-abdominal injury but those with penetrating wounds of lower chest having entry wounds below nipples were subjected to urgent exploratory laparotomy without any further radiological work-up.

ECG was routinely done in all cases of blunt trauma particularly in old patients. Underlying medical conditions like diabetes etc were noted and treated appropriately.

Tube thoracostomies, where indicated, were performed, under local infiltrative anaesthesia, through the 4th or 5th intercostal spaces in the anterior or mid axillary line immediately behind the pectoralis major fold by the technique as described by Gregoire and Deslauriers [4 and others [5]. Chest tubes made up of transparent plastic having multiple side holes having a radio-opaque stripe, and with outer diameters 32-36Fr were used for haemothorax or haemo-pneumothorax while tubes with smaller outer diameters were used for pure pneumothorax. The lungs expansion was monitored with daily chest X-Rays and output in the under water-seal bottles as has been recommended by Gregoire and Deslauriers [4]. All sucking chest wounds were sealed immediately and soft tissue lacerations were dressed initially and subjected to proper debridements after complete diagnostic workup. Every patient with tube thoracostomy and open wounds was given IV antibiotics till the tubes were removed and oral antibiotics were continued for 2-3 days even after removal of the chest tubes. Every patient was advised first follow up visit after 2 weeks of discharge and then at monthly intervals when they were assessed both clinically as well as with X-Rays chest.

## RESULTS

Out of the 84 patients admitted with chest injuries, 6 (7.14 %) were females and 78 (92.86%) male with female to male ratio of 1: 13. Their ages ranged from 11- 65 years with median age of 36.5 years. Thirty-three (39.3%) patients had sustained blunt while 51 (60.7%) had penetrating injuries (table-1), with resulting chest lesions (table-2).

Involvements of chest sides (table-3). Overall percentage of right chest involvement was 48 (57.14%) cases, and that of left chest 36 (42.86%) cases.

The operative procedures performed on chest (table-4). A total of 80 tube thoracostomies were performed in 77 (91.67%) patients. Single tube was sufficient in all except in 1 patient who required second chest tube and suction was required in 4 patients for the expansion of the lungs. Chest tubes needed to be kept in varied from 3 to 7 days with an average of 5 days and the criteria for removal of chest tubes was fully expanded lung with drainage no more than 50 ml per 24 hours. Initial rate of chest intubation was 77 (91.67%) patients, 8 (10.39%) of them underwent thoracotomies and in 69 (89.61%) patients, chest intubation alone was sufficient to treat the chest lesions. We noticed minor complications like bleeding from the wound site, local infection, dislodgement of tube and painful scars, of tube thoracostomy in 10 (12.99%) patients.

Needle aspiration was carried in 1 patient with a small haemothorax, and in 2 other patients for residual effusions after the removal of chest tubes, otherwise we generally do not use needle aspiration as a routine for haemo-pneumothorax.

Eight patients (9.52%) with normal chest X-rays on initial presentation were admitted for observation/monitoring. One of them developed haemothorax on 3rd post injury day for which tube thoracotomy was performed.

Two patients in blunt trauma group had to undergo an early thoracotomy: for profuse bleeding from multiple posterior intercostal vessels in 1 and for persistent excessive air leak because of partial disruption of right intermediate lobe bronchus in the second. One patient with penetrating trauma had to undergo emergency left thoracotomy with tractotomy for profuse bleeding after bullet injury. Three patients (9.1%) with blunt trauma having multiple ribs fractures presented with features of flail chest. Two of them were managed conservatively but one having fractures of multiple ribs, right clavicle and manubrium sterni had to be put

on ventilatory support and could only be weaned off the ventilator after thirteen days.

Fifty-one patients (60.7%) had isolated thoracic injuries while 33 (39.3%) patients had associated extra-thoracic injuries (table-5) alongwith their operative treatment. The most common associated extra-thoracic injuries were of abdominal organs 25 (29.76%) cases in both the penetrating and blunt groups while the limbs injuries 17 (20.23%) cases were more common in the blunt group. However, spine injuries were only seen in the penetrating group 4 (4.76%) cases.

Four (7.8%) cases of penetrating left thoraco-abdominal wounds had diaphragmatic tears of different sizes with only one having herniation of greater omentum into the left chest and visible through chest wound.

Hospital stay varied from 2 to 90 days with an average of 9.63 days but the prolonged stay was mainly because of associated extra-thoracic injuries.

Death occurred in 3 (3.57%) case. All the three had severe blunt trauma to chest with associated extensive damage to the liver in 2 and severe head injury in 1.

## DISCUSSION

Chest is quite frequently injured by both the blunt as well as penetrating trauma with a spectrum of injuries ranging from a simple rib fracture to severe life threatening vital organs damage [6]. The clinical consequences of chest trauma depend on the mechanism and the location of the chest injury as well as associated extra-thoracic injuries and underlying medical illnesses.

Though the statistics regarding true incidence are scant [2], it has been estimated that chest injuries occur in 12 persons per million populations per day in USA of which 33% require hospitalization. While 20-25% of all trauma related deaths are due to chest injuries [2,7]; these are implicated as a contributing cause of death in an additional 25-50% of patients who die from other associated injuries [1,2]. In a 5 year Canadian

study of patients admitted to an urban trauma unit, the incidence of thoracic trauma was 46% and the patients with thoracic injuries had a mortality rate of 15.7% [8].

The predominant mechanism of injury differs depending upon setting whether military or civilian and urban or rural. The incidence of thoracic injuries particularly by penetrating trauma is on the rise in the recent past because of increasing level of urban violence and heightened military conflicts in different parts of the world [9,10].

Although blunt trauma from motor vehicles accidents has accounted for 70-80% of thoracic injuries in most of the urban civilian centers [1,2], more than 90% of the casualties were penetrating wounds in World War II and during military campaigns and urban violence [9,11,12] in different parts of the world. The percentage of penetrating injuries was 60.7% in our study. The bullet injuries accounted for 64.7% of these while splinter injuries were responsible for 31.37% and the stabs caused only 3.9% chest wounds. Blunt trauma accounted for 39.3% injuries of which road and train accidents were responsible for 90.90% cases in this study. The higher rate of penetrating injuries in our study is because of the reason that our patients, being mainly soldier, usually remain engaged in active duties like anti terrorist operations.

Blunt injuries to the chest have higher mortality than penetrating injuries because of being massive and having a higher incidence of multiple systemic damage [1,13]. Overall mortality from stab chest wounds has been sited as 2-3% while that due to GSW is in the range of 15-20% [9]. In our study, mortality rate was 3.57%, all the patient died had blunt trauma but no death occurred in patients with penetrating injuries. The reason for having no mortality in penetrating group in this study could possibly be that we did not encounter patients with severe penetrating injuries involving heart, great thoracic vessels etc, having reached hospital alive.

Observation alone or placement of chest tube, adequate volume resuscitation, pain control, chest physiotherapy, occasional need for respiratory support and serial chest radiographs are the only measures required in treating about 80-85% patients of chest trauma [13-16]. In our study, tube thoracotomy alone was effective in 89.61% cases in the treatment of different traumatic lesions of chest. The overall rate of chest intubation in our study was 91.67%.

Emergency thoracotomy is indicated for massive bleeding, severe air leak or injury to the great vessels, bronchial tree or oesophagus while elective thoracotomy is performed for clotted haemothorax, post-traumatic empyema, prolonged air leaks and non-healing chylothorax [3,17-19]. In our practice, we proceed for early thoracotomy if the initial chest tube output is greater than 1500ml; or if the hourly output continues at a rate greater than 200ml/hour for 4 to 5 hours; or if there is massive and persistent air leak.

**Table- 2: Type and frequency of chest lesions**

Lesions	Blunt Trauma (n=33)	Penetrating Trauma (n= 51)	Total Incidents (n=84)
Haemothorax	14 (42.42%)	10 (19.61%)	24 (28.57%)
Pneumothorax	6 (18.18%)	2 (3.92%)	8 (9.52%)
Haemopneumothorax	8 (24.24%)	35 (68.63%)	43 (51.19%)
Ribs fractures	31 (93.94%)	42 (82.35%)	73 (86.90%)
Scapular fractures	1 (3.03%)	3 (5.88%)	4 (4.76%)
Sternal #	1 (3.03%)	--	1 (1.19%)
Diaphragm ruptures	1 (3.03%)	4 (7.84%)	5 (5.95%)
Thoracic spine #	--	4 (7.84%)	4 (4.76%)
Clavicle #	2 (6.06%)	--	2 (2.38%)
Soft tissues injuries	2 (6.06%)	9 (17.65%)	11 (13.10%)
Surgical emphysema	17 (51.52%)	32 (62.74%)	49 (58.33%)
Contusion lung	4 (12.12%)	1 (1.96%)	5 (5.95%)
Tension pneumothorax	1 (3.03%)	--	1 (1.19%)

**Table-4: Surgical procedures for chest injuries**

Procedures	Blunt Group	Penetrating Group	Total
Tube thoracostomy	30	50	80
Emergency thoracotomy	2	1	3
Delayed thoracotomies/deloculations for clotted haemothorax	0	2	2
Late thoracotomies/decortications for empyemas	0	3	3
Evacuation of haematoma/ligation of Rt internal mammary artery	1	0	1
Debridements of soft tissue wounds of chest wall	2	50	52
Needle aspiration	1	2	3

Less than 10% of blunt and 2-25% of penetrating chest trauma patients have been

reported to have the need of surgery in terms of Thoracotomy for different indications [17-

**Table-1: Causes of chest injuries (n=84)**

Blunt Trauma (n=33)	No of patients	Percentage
Road traffic accidents	26	78.79%
Railway accidents	4	12.12%
Fall in a deep well	1	3.03%
Collapse of bricks wall on patient	1	3.03%
Blunt assault	1	3.03%
<b>Penetrating Trauma (n=51)</b>		
Fire arm wounds	33	64.71%
Splinter injuries(mine blast)	16	31.37%
Stabs with knife	2	3.92%

**Table-3: Involvement of chest side (n=84)**

	Right chest	Left chest	Both sides
Blunt (n=33)	19 (57.58%)	12(36.36%)	2 (6.06%)
Penetrating (n=51)	28 (54.90%)	22(43.14%)	1 (1.96%)
Total	47 (55.95%)	34(40.47%)	3 (3.57%)

19]. In this study, the percentage of thoracotomy with blunt trauma was 6.06 %

## Thoracic Injuries

and with penetrating trauma was 11.7%. Overall percentage of thoracotomy was 9.5% which is quite consistent with that reported in

combined intra-thoracic and intra-abdominal wounds has a markedly increased chance of dying [9]. In this study, percentage of death

**Table-5: Associated extra-thoracic injuries & their management (n=33)**

Injuries [Treatment]	Blunt Trauma	Penetrating Trauma	Total (%age)
<b>Abdominal</b>	<b>12</b>	<b>13</b>	<b>25 (29.76%)</b>
Stomach lacerations/gangrene [resection & repairs]	1	3	4 (16%)
Liver lacerations [debridement & repairs]	4	2	6 (24%)
Splenic lacerations [splenectomy]	4	1	5 (20%)
Small gut perforations [resections & repairs]	0	4	4 (16%)
Colon perforations [resection/repairs&colostomies]	1	2	3 (12%)
Shattered kidney It [nephrectomy It]	0	1	1 (4%)
Pelvic injuries [resuscitation + fractures treatment]	2	0	2 (8%)
<b>Cranio-facial-cervical</b>	<b>2</b>	<b>3</b>	<b>5 (5.95%)</b>
Only soft tissues [debridements+wounds closure]	0	3	3 (60%)
Skull/facial bones fractures	1	0	1 (20%)
Extradural haematoma [evacuation of haematoma]	1	0	1 (20%)
<b>Limbs</b>	<b>12</b>	<b>5</b>	<b>17 (20.23%)</b>
Only soft tissues injuries [debridements + wounds closure]	7	3	10 (58.8%)
Limbs bones fractures [management of fractures]	5	1	6 (35.3%)
Vascular/nerve injuries [repairs]	0	1	1 (5.9%)
<b>Spine injury with paraplegia</b>	<b>0</b>	<b>4</b>	<b>4 (4.76%)</b>

other studies.

The proportion of patients with penetrating chest trauma who can be treated without operation has been reported to vary from 29-94% [20]. The treatment of a stable patient with a normal initial chest radiograph remains controversial. Observation for some hours in selected group of patients with non-penetrating thoracic gun shot wounds and stab wounds with subsequent repeat chest radiograph revealed a 7% rate of delayed pneumothorax in one study [21]. In our study, delayed haemothorax developed in 1, out of 8 patients (12.5%) who were being observed, after non-penetrating chest splinter injury. We generally observe and monitor such patients for 24 to 48 hours with repeat X-Rays chest before discharge.

Associated extra-thoracic injuries have been reported to be in the range of 50-75% [6,22]. In our series, the overall percentage of associated injuries was 39.3 %. With the blunt trauma, this percentage was 51.5% while with penetrating injuries it was 31.4% and the most common injuries were that of abdominal organs in both the group. A patient with

incidence due to combined intra-thoracic and intra-abdominal injuries was 66.67%.

The location of penetrating wounds must be noted very carefully. If the wound is located below the fifth rib, evaluation of the abdomen is mandatory to rule out intra-abdominal injuries because of the possibility of diaphragmatic penetration by the offending agent [9]. In our study, we encountered 4 (7.8%) cases with such wounds, and all were subjected to urgent exploratory laparotomy and in all cases abdominal visceral injuries were found.

In haemodynamically unstable patients with injuries involving the lower chest/abdomen, as it is recommended, we perform laparotomy as the first intervention and drain the chest just before or during the laparotomy even if there is no evidence of haemopneumotorax in such patients.

The most common blunt chest injury is rib fracture [22-24]. Incidences of ribs fracture in our study 86.9%. Rib fractures are frequently associated with other injuries such as flail chest (23.1%), pulmonary contusions (65%), haemothorax (26%), or pneumothorax

(30%) [23]. The percentage of flail chest with blunt chest trauma in our study was 9.09%, while that of diaphragmatic rupture was 3%. Incidences of pneumothorax, haemothorax, and pulmonary contusions were 18.18%, 42.42% and 12.12% respectively in our blunt trauma cases. Diaphragm is frequently injured in penetrating thoraco-abdominal trauma but only 15% of these injuries are more than 2 cm long. Therefore, herniation of abdominal contents is rarely immediate [9]. The percentage of diaphragmatic injury in our study with penetrating chest wounds was 7.8% (4 cases) with only 1 patient having herniation of greater omentum through the torn left dome of diaphragm into left chest.

The incidence of empyema following thoracic trauma has been reported to be 2-6% [9]. Blood in the pleural space acts as a rich culture media which promotes bacterial growth in spite of antibiotics, and tube thoracostomy. If well placed tubes in the pleural space do not help in evacuating all infected blood from pleural space and complete re-expansion of the underlying lung, then consideration must be given to an early decortication [25]. In this study, we encountered complication of empyema in 3 (5.9%) cases with penetrating injuries while this complication was not seen in patients with blunt trauma.

Although tube thoracostomy is often a life saving procedure and is relatively straight forward, but it should not be taken too lightly. Different studies have cited complication rate of this procedure varying from 4% to as high as 37% [26-28]. We noticed complication rate of chest intubation to be 12.99% in our study. Although the use of antibiotics has remained controversial but use of prophylactic antibiotics was the main factor which determined the incidence of infective complications of chest with intubation in various studies [29-31]. We routinely use prophylactic antibiotics in all cases of thoracic trauma with tube thoracotomy. Percentage of empyema in our study was 3.57% and all of these were patients with penetrating injuries

below nipples and involving different abdominal viscera. Therefore, this infection can not be attributed only to chest intubation.

## CONCLUSION

Simple intervention like tube thoracostomy and supportive measures successfully manage the vast majority of chest injuries while major surgical interventions like thoracotomy are only infrequently required for the management of such patients.

Other organs or systems should be carefully assessed for associated injuries particularly those of abdomen as the overlap of upper abdomen by thoracic cage provides a border zone which is difficult to assess and is often the site of combination injuries. Any entry wound below the nipples anteriorly and the inferior scapular angles posteriorly should be considered an entry point for a course that may have carried the missile into the abdominal cavity.

The importance of attending to the whole of the patient and other progressive or subtle injuries must be emphasized.

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