CHEST INJURIES IN BATTLE CASUALTIES

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ABSTRACT

Battle casualties treated as indoor patients at a military hospital between December 89 and December 94 were prospectively evaluated. Out of 3640 patients, 388 (10.7%) had chest injuries. Among the 388 patients 190 (48.9%) had haemothorax. Pleurocentesis was the fastest and the most reliable means of establishing the diagnosis of haemothorax. Thoracostomy with supportive care was adequate to manage 75 per cent of these cases which included more than 50 per cent of those with massive haemothorax. Twelve patients out of the 190 cases (6.3%) who presented with haemothorax needed thoracotomy. The overall mortality in this series was 7 per cent.

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KEYWORDS : Chest injury; Haemothorax; Pleurocentesis; Thoracostomy; Thoracotomy.

Introduction

Militancy and trauma have been aptly called the epidemics of the 20th century. Chest injuries occupy a very enviable status in all trauma series, since they are one of the most significant determinants of morbidity and mortality due to trauma. Patients with chest injuries have bleeding and disorders of oxygenation singly or in combination and pose a variety of challenges in diagnosis and management. They require urgent attention and vigilant post-operative monitoring in a critical care unit. We present here our experience in treating chest injuries in these patients.

Material and Methods

Between December 1989 and December 1994 we received 3640 casualties at our hospital. Only patients who were admitted for indoor treatment were included in this study. All patients were admitted either to the intensive care unit or the acute surgical ward directly, as per their seriousness, where assessment and resuscitation were carried out simultaneously. Intravenous fluid resuscitation with Ringer's lactate solution and Haemacell in the ratio of 2:1 was done in acute hypotensive

cases with a cannula placed usually in the external jugular vein.

Analgesia and broad spectrum parenteral antibiotics were provided to all along with oxygenation wherever indicated. All the patients with chest injuries were subjected to a pleurocentesis on their arrival into the unit. A positive tap led to a bedside thoracostomy under local anaesthesia utilizing readily available pre-packed sterilized thoracostomy sets. Thoracostomy was done usually in the 7th intercostal space along the mid or posterior axillary line. Only in 17 patients a high thoracostomy was done in the 5th space. Patients with central chest injuries, signs of cardiac tamponade, unexplained hypotension or cardiac arrests underwent pericardiocentesis. Blood grouping was done for all patients and portable chest radiographs were taken whenever possible.

Patients were then observed for a duration of 20-30 minutes. Intravenous fluid and blood transfusion was provided depending upon the clinical needs. If the drainage through the thoracostomy tube continued or the vital parameters deteriorated despite rigorous resuscitation, the patients were taken up for thoracotomy and exploration. Patients with massive haemothorax were managed on simi-

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lar lines.

Other indications for thoracotomy were torrential bleeding through the thoracostomy, cardiac tamponade, positive pericardiocentesis, critical air leaks, asphyxiating haemorrhage into the tracheobronchial tree or traumatic thoracotomy. In these situations the patients were immediately explored after a diagnostic thoracostomy without any delay. Patients who, while under observation, produced a drainage of more than 200 mL/hour or developed progressive cardiovascular decompensation were also subjected to thoracotomy.

Incisions for thoracotomy were made depending upon the size and site of the primary wound. If the patient did not have a large wound then a postero-lateral thoracotomy incision was used. Patients with suspected cardiac injuries had a left anterior or a median sternotomy incision. After clearing the haemothorax the extent of injury was assessed visually. Lacerated lung edges were trimmed, bleeders arrested and air leaks were sealed. Haemostasis was achieved at the intercostal vessels and then the lung parenchyma was approximated. Lobectomy or a pneumonectomy was carried out in those cases showing extensive injuries to the lobar bronchus and accompanying vessels or to hilar structures. Lobectomy was also done in patients with extensive lacerations involving the complete lobe. Patients with localized extensive parenchymal laceration underwent segmentectomy. In patients with haemopericardium the sac was evacuated by a vertical incision sparing the phrenic nerve.

Penetrating myocardial wounds were repaired using monofilament sutures over a pledget. The pericardium was then loosely approximated over a tube drain. Patients with tangential wounds of the chest wall with a small traumatic thoracotomy were managed with limited thoracotomy. In these situations the wounds were enlarged surgically, clots removed, bleeders arrested, air leaks sealed and chest wall closure done in layers. Chest wall defects were managed with repair. Shattered ribs and non-viable muscles were excised. The fractured ribs were anchored to the neighbouring ribs with wire or silk after trimming their edges. Flail segments were fixed using wires or Rheodin pins.

In patients with an associated abdominal injury

or poly-trauma another team of surgeons operated simultaneously. Chest wall wounds and other associated injuries were treated suitably. Post-operatively the patients were managed with rigorous chest physiotherapy, early ambulatory support, antibiotics and nutritional supports. Chest radiograms were done post-operatively to ensure correct placement of tube drains and adequate lung expansion. Patients undergoing pneumonectomy and those with chest wall defects, cardiac injuries, paraplegia or extensive associated injuries were provided ventilatory support in the critical care unit. Chest tubes were removed once the 24 hour drainage was less than 50 mL/hour and chest radiogram were taken before and after removal of the tube.

Observations

Out of 3640 casualties admitted during November 89 to December 94, 388 (10.7%) had injuries of the chest. Of these 198 (50.8%) had injuries confined to the chest wall without haemothorax and the remaining 190 (49.2%) had penetrating intrathoracic injuries with haemothorax. Gunshot was the cause of injury in 118 (62%) patients and 67 (35.5%) patients had splinter wounds. Haemothorax was caused by stab wounds in 3 patients and by blunt injury in 2 patients. Our further observation will be restricted to these 190 cases of haemothorax.

Right side haemothorax was found in 95 (50%) cases and 78 (41%) had left sided haemothorax. Significant bilateral haemothorax was found in 17 (9%) cases. The axilla was the most common site of wounds of entry and was seen in 19.2 per cent cases. Multiple wounds of entry were found in 27 (15.6%) cases and 39 (22.2%) casualties had thoracoabdominal injuries. Isolated chest injuries were found in 121 (63.4%) and the remaining had polytrauma. Out of the 48 (25.5%) cases with associated injury to one other major region, 32 had thoracoabdominal injuries and the remaining 16 had injuries to regions other than the abdomen. Seven patients had injuries to the limbs or head in addition to thoracoabdominal injuries and 14 had injury to thorax and 2 other regions.

The commonest radiological feature seen on chest radiography was pulmonary contusion in 63 (37.8%) cases. Fluid level indicating haemothorax

was seen in 27 (16.2%) patients. Other indicators of haemothorax were blunting of costophrenic angle in 4.2 per cent cases and subpulmonic collection in 2.4 per cent cases. Four patients each had widened mediastinal and cardiac shadows and 7 patients had evidence of significant pneumothorax. In 52 (31.3%) patients there were no radiological abnormalities.

Nearly two thirds of the patients with haemothorax had fractures of one or more ribs. Fracture of scapula and clavicle were found in 32 and 25 patients respectively. Surgical emphysema was seen in 54 patients. Sucking wounds, vertebral injuries, and flail chest were noted in 19 (10%), 14 (7.3%), and 11 (5.8%) patients respectively. Two patients developed tension pneumothorax and required immediate second Intercostal drainage (ICD).

Pleural tap was helpful in detecting haemothorax in nearly all patients with false positive and negative results in 2 patients each. Amount of blood at initial drainage ranged between 220 mL and 2450 mL. It was minimal (< 400 mL) in 40 patients (15%), moderate (400-1000 mL) in 75 (42.5%) and massive (> 1000 mL) in 75 (42.5%) patients.

Forty cases (21.6%) could be managed with ICD alone and 91 (48%) required wound excision and closure besides ICD. Nine (4.7%) and 48 (25.6%) cases needed limited and formal thoracotomy respectively. Eleven of these also required repair of chest wall.

A total of 48 thoracotomies were done on 46 patients, 2 patient underwent bilateral thoracotomy. The indications of thoracotomy in our series are shown in Table 1. Massive haemothorax was the most common indication for thoracotomy.

Intrathoracic injuries found on thoracotomy and procedures carried out for these are listed in Tables 2 and 3 respectively. Three patients had extensive blast injury with bleeders and leaks scattered over the whole lung, bilateral in 1 patient. Five patients had myocardial tears and 4 of these had haemopericardium and the fifth had a lacerated wound of the pericardium which prevented the formation of haemopericardium. Six patients had tears involving the complete thickness of the cardiac musculature and endocardium. One patient each had a car-

TABLE 1

Indications for thoracotomy in 46 patients with penetrating thoracic injuries and haemothorax

Indications	Number
Initial thoracotomy	
Massive haemothorax	29 (60.3)
Blood in trachea	4 (8.4)
Cardiac tamponade	10 (20.8)
Repeated cardiac arrest	2 (4.2)
Subsequent thoracotomy	
Continuous drainage in ICD	1 (2.1)
Persistent air leak	1 (2.1)
Post-operative air leak	1 (2.1)

ICD = Intercostal drainage

(Figures in parentheses are percentages)

TABLE 2

Intrathoracic injuries in 46 patients with penetrating thoracic injuries and haemothorax

Injuries	Number
Lacerated lung	40 (83.3)
Penetrating cardiac injury	6 (12.6)
Myocardial tears	5 (10.5)
Hilar injuries	5 (10.5)
Bronchial injuries	4 (8.4)
Blast lung	3 (6.3)
Myocardial contusion	1 (2.1)
Perforation proximal ascending aorta	1 (2.1)
Air leak from sloughed upper lobe bronchus	1 (2.1)

(Figures in parentheses are percentages)

TABLE 3

Management of intrathoracic injuries after thoracotomy

Procedure	Number
Repair of lacerated lung	40 (83.3)
Lobectomy	6 (12.6)
Repair of full thickness cardiac tear	6 (12.6)
Pericardiotomy and repair of myocardium	5 (10.5)
Repair of bronchus	3 (6.3)
Segmentectomy	3 (6.3)
Pneumonectomy	1 (2.1)
Pericardiotomy and evacuation of haemopericardium	1 (2.1)
Repair of aortic perforation	1 (2.1)

(Figures in parentheses are percentages)

diac contusion and perforation of the proximal ascending aorta causing haemopericardium. One of the patients explored post-operatively for air leak was found to have a sloughed bronchus.

Foreign bodies were found in a large number of patients in the chest wall, pleural cavity, lung parenchyma and cardiac musculature. These included bullets, splinters of improvised explosive devices and grenades, pieces of wood and of metal. One patient with thoracoabdominal injury had a large quantity of rice in the left hemithorax due to a ruptured stomach and diaphragm.

In 104 patients (50.6%) the ICD could be removed by the 4th day. Only in 13 patients (6.2%) ICD was required for more than 7 days and in 10 of these ICD had been placed in the 5th intercostal space. In the remaining patients the drain was removed within 5 to 7 days. In 3 cases ICD had to be reintroduced after removal for draining residual fluid.

Morbidity and Mortality

The most common complication was wound infection which occurred in 21 patients (5%). Seven patients had collapse of lung which was managed with bronchoscopic suction. Three patients developed pyothorax and 1 each had septicemia and sloughing of bronchus following pyo-thorax.

Twenty eight (7%) patients with chest injuries died. Eight out of these died during resuscitation or on the operating table due to extensive injuries. The mortality rate for patients with isolated intrathoracic injuries was 5.8 per cent (7/121) which tripled to 18.7 per cent (9/48) in patients with polytrauma. Mortality in patients with cardiac injuries was 30.8 per cent (4/13).

The most common cause of death was irreversible hypovolemic shock observed in 15 deaths (53.6%). Extensive cardiac injury and blast injury to the lung was the cause of death in 4 and 3 patients respectively. One patient each died due to aspiration, adult respiratory distress syndrome, multisystem organ failure, pulmonary edema, fat embolism due to associated multiple long bone fractures and severe head injuries.

Discussion

Chest injuries are encountered in 6-8 per cent of battle casualties [1]. These patients present with a

wide spectrum of cardiopulmonary instability ranging from those requiring simple observation to those requiring life saving thoracotomy. In our series though 10.7 per cent cases had injuries over the chest, only half of these (5.6%) had intrathoracic injuries with significant haemothorax.

Minimal haemothorax may be found in 80 per cent of patients with chest injuries [2]. Blunt injuries to chest occur in about 70 per cent cases and penetrating injuries in 79 per cent cases [3]. However, significant haemothorax requiring drainage has been found in 20-30 per cent [4]. The percentage is higher in our series (50.8%) and this may be due to the high incidence of gunshot wound in our series (62%). Tangential gunshot wounds especially if multiple are dangerous as they cause chest wall defects and extensive injuries.

Axilla was found to be the most common site of entry wounds in our series which warrants the use of protective jackets. The packs in the uniform probably provide some protection to the anterior and posterior chest wall leaving the axilla uncovered especially when the soldier is in the firing position with extended arms.

The assessment of severity of chest injuries in battle casualties is problematic due to the uncooperativeness of the patient because of pain, large wounds, associated injuries, and critical haemodynamic instability. Even a chest radiogram is not very reliable as an erect film is not possible in most of them. A supine film may not show collections even up to 1 L of fluid. As noted in our series 31.3 per cent of the cases had a normal chest radiogram. Hence pleural tap is the fastest and the most reliable means of diagnosing haemothorax and is thus recommended in all cases of chest injuries soon after admission.

Thoracostomy is the mainstay of the management of haemothorax and 80-85 per cent of haemothorax can be managed with ICD alone [4,5]. High drains placed in 5th or 6th spaces take longer time to drain the pleural cavity. Seventy per cent of our cases including nearly 40 per cent of those with massive haemothorax could be managed with fluid resuscitation, thoracostomy and vigilant observation only.

Though most of the chest injuries can be managed easily, the ones which significantly compli-

cate management are multiple fractures of the rib with chest wall defects or flail chest and vertebral injuries with paraplegia. In extensive vertebral injuries with loss of the vertebral bodies the two pleural cavities communicate warranting bilateral drainage and judicious surgical intervention and post-operative critical care. Flail chest carries a high mortality and hence all attempts should be made to fix the segment surgically using wires or pins.

The requirement of thoracotomy for haemothorax was 10 per cent earlier [3]. However with increasing severity of chest trauma this figure has gradually increased to 15-20 per cent [4]. In our series 25 per cent cases required thoracotomy probably due to the higher incidence of haemothorax. It is our experience that judiciously selected and correctly performed thoracotomy goes a long way in decreasing the mortality and morbidity in penetrating chest injuries.

The most common indication for thoracotomy is massive haemothorax. However, we observed that up to 40 per cent of patients with massive haemothorax did not require thoracotomy and another 20 per cent with massive haemothorax underwent thoracotomy for other associated indications. Only those patients with massive haemothorax who continue to be haemodynamically unstable inspite of adequate fluid replacement need thoracotomy.

All chest injuries are potentially serious and at times their exact contribution to mortality is difficult to decide due to associated multiple trauma. In our series though only 5.6 per cent cases had penetrating chest injuries they contributed to nearly 20 per cent of overall mortality. Mortality for isolated chest injuries is 4-12 per cent and is 13-15 per cent and 30-35 per cent when one or more than one other region is injured [6,7].

The mortality is chest injuries in World War I was 27-56 per cent and in World War II it was 6.9 per cent, 12.4 per cent and 27.3 per cent for iso-

lated chest injuries, following thoracotomy, and in thoracoabdominal injuries respectively. The mortality grossly reduced in Vietnam War to 7.9 per cent [6]. The overall mortality in our series was 7 per cent with a rate of 5.8 per cent and 18.7 per cent (9/49) for isolated chest injuries and in those with polytrauma respectively. Mortality in thoracoabdominal injuries is 30 per cent [8] and in our series it was 15.6 per cent (6/39).

The factors dictating poor prognosis of chest injury cases are irreversible hypovolemic shock at the time of arrival, bilateral thoracotomy, vertebral injuries with paraplegia, chest wall defects, associated polytrauma and extensive cardiac injury involving more than one chamber and or the septum. The factors that assist in reducing the mortality are, early evacuation, energetic resuscitation with simultaneous assessment, minimum pre-surgery time (maximum 20-30 mins), early surgical intervention, avoiding the hesitation to do a thoracotomy, high index of suspicion for cardiac injuries, minimum operative time (45-60 mins for thoracotomy), adequate pre-, intra- and post-operative blood transfusion and post-operative critical care.

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