

CHEST TRAUMA

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Abstract: The chest injuries commonly occur due to crush injuries following road side accidents, penetrating wounds, terrorist activities and war injuries. Pneumothorax It is a type of the injury to pleural cavity and chest wall when pleural cavity is open to exterior. It presents with an open sucking wound over the chest wall. It follows penetrating injury resulting in open suckling chest wound. The air freely passes in and out leading to decreased respiratory efficiency. They are often missed during primary survey but can be fatal if missed for longer period.

Key words: Pneumothorax, Cardiac Tamponade, Myocardial Contusion, Chest Tube, Hemothorax.

PATHOLOGY AND PATHOGENESIS

The chest injuries commonly occur due to crush injuries following road side accidents, penetrating wounds, terrorist activities and war injuries.

The chest injuries leading to haemothorax may follow ;

- Blunt injuries to the chest
- Penetrating injuries to the chest
- Missile injuries to the chest
- Iatrogenic

TYPES OF CHEST INJURIES

A. Immediately life threatening injuries

- Tension pneumothorax
- Open pneumothorax
- Haemothorax
- Flail Chest
- Cardiac Tamponade
- B. Potentially lethal Injuries
 - Major airway injuries
 - Lung contusion
 - Myocardial contusion
 - Ruptured aorta
 - Esophageal injuries
 - Diaphragm injuries
- C. Minor Injuries
 - Chest wall contusion
 - Ribs Fracture with out underlying lung or pleural injuries

IMMEDIATE LIFE THREATENING INJURIES

These are the injuries which if not dealt immediately can result in fatal consequences.

Tension Pneumothorax
It develops when there is one way air entry to pleural cavity without any escape passage. It is due to chest injuries causing valvular defect in the pleural cavity.

This leads to immediate collapse of lung as

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volume of air increases with every breath in pleural cavity. It shifts mediastinum and trachea to opposite side. This shift impairs venous return and finally other lung is also compressed thus compromising both gaseous diffusion & perfusion of lungs.

Patients present with severe respiratory distress with absent unilateral breath sounds and tracheal deviation along with engorged neck veins on clinical examination .

Treatment

Treatment is immediate decompression of pleural cavity either by needle thoracostomy or by chest intubation.

Open Pneumothorax

It is a type of the injury to pleural cavity and chest wall when pleural cavity is open to exterior. It presents with an open sucking wound over the chest wall.

It follows penetrating injury resulting in open sucking chest wound. The air freely passes in and out leading to decreased respiratory efficiency. Major diffusion perfusion deficit and through this wound.

Treatment

This defect is sealed with sterile dressing along with chest intubation through separate incision and underwater seal drainage for adequate and gaseous diffusion lung perfusion.

Haemothorax

The traumatic haemothorax is the collection of blood in the pleural cavities following injury. Bleeding occurs from lungs, intrathoracic vessels, aorta or heart.

The haemothorax may be of minor degree

not causing the ventilatory deficit or haemorrhagic shock or it may be severe enough requiring immediate drainage or thoracotomy and repair of bleeding vessels.

The blood loss may be very severe leading to immediate death of the patient.

At least 10% of the patients with traumatic haemothorax require thoracotomy and repair of the bleeding points.

Massive Haemothorax

It is a condition in which more than 1500ml of blood is lost within chest cavity or in chest drain. A loss of more than 200 mls of blood per hour through intrapleural drain requires surgical intervention and ligation of bleeding vessel or repair or excision of the bleeding organ.

The haemothorax mostly develops at the time of the injury but occasionally it may occur few days after the injury which may be due to the extra pleural hematoma breaking into the pleural cavity.

The movements of diaphragm and intrathoracic structures prevent the clotting of intrapleural blood and keep it in fluid form. This helps in efficient drainage of the pleural cavity.

Flail Chest

It is abnormal separation of a segment of chest wall from rest of thoracic cage after chest wall trauma. Fracture of more than two ribs at more than one site leads to this type of problem. Whenever a segment of chest wall loses bony continuity with the thoracic cage, it becomes flail and moves paradoxically with respiration thus reducing tidal volume and compromising ventilation.

Paradoxical Chest wall movement is visible and crepitus is felt on clinical examination .

Treatment

Treatment is chest intubation with underwater seal drainage, pain relief and intermittent positive pressure ventilation (if the patient is in respiratory distress and blood gases estimation determines need for assisted ventilation).

Cardiac Tamponade

It is a condition of collection of blood into the pericardial cavity. It develops either after penetrating or blunt chest trauma.

Central venous pressure (CVP) is increased, Blood pressure (BP) is decreased and muffled heart sounds are (Beck's triad) on examination. There is also presence of Kussmaul's sign that is increased CVP on inspiration. ECG Shows low voltage QRS complexes.

Ultrasound guided pericardiocentesis is performed. Some patients may need surgical intervention and inspection of heart.

POTENTIALLY LETHAL INJURIES

They are often missed during primary survey but can be fatal if missed for longer period.

Pulmonary Contusion

It is a condition of crushed lung injury following chest trauma. It can lead to development of (ARDS) Adult Respiratory Distress Syndrome which is threatening problem, associated with atelectasis, decreased lung compliance, shunting of blood and increased air way resistance.

It can be managed some times with out intubation or assisted ventilation. Early intubation is some times considered if there

is Disturbed (ABG's) Arterial Blood Gases.
Chronic Pulmonary disease Patient .

Major Airway Injury

Its is the injury to major airway. The level of major airway injury can be.

- Larynx
- Trachea
- Major bronchus.

It can follow either after blunt or penetrating injury.

Laryngeal fracture is a rare injury. It is suspected when there is hoarseness, surgical emphysema. It is difficult to secure airway in this injuries. It may require tracheostomy before surgical repair of the injured airway.

Injury to trachea or major bronchus (Proximal to pleural reflection) causes extensive deep cervical and mediastinal emphysema which rapidly spreads to subcutaneous tissues.

Injury to bronchus (distal to pleural reflection) leads to pneumothorax.

Signs of bronchial injury are;

- Hemoptysis
- Surgical emphysema
- Tension pneumothorax
- Pneumothorax with extensive air leak
- Most of bronchial injuries occur within 2-5cm of carina

Diagnosis is confirmed on broncho-scopy. bronchial tears are repaired through thoracotomy.

Esophageal Trauma

It is usually caused by penetrating injury.

Blunt injury of esophagus is rare. Rupture of esophagus leads to development of mediastinitis and associated pleural space. esopha-geal rupture leads to subcutaneous emphysema.

Signs of esophageal trauma are;

- Presence of mediastinal air on x-ray examination.
- Left pneumothorax or hydrothorax without ribs fracture.
- Presence of gastric contents in chest tube.
- Pain and shock out of proportion to apparent chest injury.
- Diagnosis is confirmed by esophagoscopy or by barium swallow.

Treatment is surgical repair along with chest intubation after thoracotomy.

Ruptured Aorta

90% of patients with this injury die before any treatment. It usually follows blunt chest trauma and site of rupture is distal to ligament arteriosum during deceleration injury because this part remains fixed.

High index of suspicion is the key to diagnosis.

X-ray chest finding are;

- Widened mediastinum.
- 1st and 2nd ribs fractures.
- Shift of trachea and esophagus to right side.
- Shift of right bronchus upwards and towards left bronchus downwards.

Diagnosis is confirmed either by;

- Aortography
- CT Scan
- MRI Scan
- Trans esophageal Echo cardiography

Treatment is surgical repair after thoracotomy but during resuscitation phase blood pressure should be kept below 100mm Hg to keep the blood loss to minimum.

Myocardial Contusion

It follows blunt chest trauma and is usually associated with sternal fracture.

Patient complains of sever chest pain. Diagnosis is established by ECG, serial cardiac enzyme estimations and two dimensional echocardiography . Contused area behaves like myocardial infarction and is treated accordingly symptomatically.

Diaphragmatic Tear

It can occur either after penetrating or blunt chest trauma. Penetrating injury can cause small perforation while blunt trauma produces large radial tear with herniation of abdominal organs into the chest. Left sided diaphragm injury is more common as right side is protected by liver.

X-ray chest shows raised hemidia-phragm or loculated pneumothorax. Contrast x-ray shows abnormal presence of stomach in the chest cavity.

Repair of diaphragm is often performed through exploratory laparotomy with non-absorbable sutures and associated abdominal injuries are dealt with at the same time.

MANAGEMENT PLAN OF CHEST INJURIES

Chest trauma compromises the normal physiology of respiration and circulation.

Objectives

The objectives of management of chest injuries are to achieve;

- Stable hemodynamics
- Adequate respiration
- Adequate circulation

These goals can be achieved by following plan;

Resuscitation

- Adequate airway establishment.
- Adequate control of haemorrhage.
- Pain relief.

Diagnosis,

- Trauma assessment and scoring
- Achievement of lung expansion
- Control of infection
- Follow up.

PRIMARY SURVEY RESUSCITATION

The active resuscitative measures are used according to the standard trauma management plan ABCDE such as ;

A. Air Way

Adequate airway should be secured. The debris and blood from the oral and tracheo-bronchial passages are mechanically removed or sucked with the help of an electric sucker.

The airway is maintained and breathing of patient is assessed and maintained as normal as possible.

Endotracheal intubation or tracheostomy ensures clear airway.

Assisted ventilatory support is offered if so required.

B. Breathing

Breathing problems are seen due to decreased respiratory drive and unstable

chest wall. These are commonly seen in patients with inhalation injuries. The breathing problems are worst in burnt patients who already suffer from respiratory diseases. It can be managed with assisted ventilation.

The common causes of ineffective ventilation after clear and patent airway are;

- Malposition of endotracheal tube
- Haemothorax
- Pneumothorax

These can be properly managed after correct diagnosis.

C. Circulatory Volume

Loss of blood may also occur from associated injuries or due to the thermal necrosis of the vessel wall. It is stopped as quickly as possible.

Bleeding from superficial wounds can be controlled by compression dressing, ligation or stitching of the wound. Internal bleeding requires surgery and control.

The lost amount of blood is replaced with blood or other intravenous fluids to keep the circulatory volume as normal as possible.

Regular and careful monitoring of the circulatory volume is done by measurement of pulse, blood pressure record, skin perfusion and by calculating urinary output.

D. Disability

The patients with associated brain trauma have various degrees of neurological disability.

Glasgow coma score is accurately documented mentioning clearly whether the patient is paralysed or intubated

endotracheally.

E. Exposure

Proper exposure is most important for accurate and complete examination. The patient is completely exposed after adequate resuscitation for reexamination.

It is advisable to perform structured examination so that nothing is missed and it should be ticked on the examination check list.

Anoxia and haemorrhage are the causes of early death in patients with severe chest injuries. Prompt resuscitation is the cornerstone of the management³.

Intravenous cannula is inserted immediately in a suitable vein for intravenous therapy.

Oxygen inhalation is started in patients with ventilatory deficit.

Pharyngeal airway is required in unconscious patients to prevent the backward falling of tongue and to keep the airway patent.

Endotracheal intubation and assisted ventilatory support may be required in cases of severe ventilatory deficit. Immediate active medical help is offered to these patients.

The patient is nursed in a comfortable position. Preferably the patient is nursed in propped up position.

SECONDARY SURVEY, DIAGNOSIS AND ASSESSMENT

The diagnosis is easy if proper history is taken and complete examination is conducted. The important part of diagnosis is not only the knowledge of haemothorax but the assessment of the amount and

speed of blood loss into the pleural cavity and presence of associated injuries (correct assessment of general condition).

After the adequate resuscitation, clinical history is taken and examination is conducted to assess the condition of the patient.

The chest injuries may be assessed for isolated management and prediction of outcome of the treatment.

The scoring is done according to chest wall injury scale in such cases.

CHEST WALL INJURY SCALE

The sensitivity of physical signs in the identification of major thoraco-abdominal injuries is not 100 %. Normal post injury vital signs may be misleading many times. These do not always predict the absence of potentially life threatening haemorrhage. However the abnormal vital signs at any point after injury require necessary investigations to rule out significant blood loss⁴.

It is essential to predict the outcome of the patient. When multiple injuries are associated with chest injuries, complete assessment is done by injury severity score (ISS).

INVESTIGATIONS

Following investigations are immediately requested;

- Blood examination
- Urine examination

Haemoglobin estimation is performed immediately and then it is repeated every twelve hours. The progressive fall in haemoglobin indicates continuous bleeding.

- Total leucocyte count
- Differential leucocyte count

- Sedimentation rate
- Blood sugar
- Urea and electrolytes level
- Arterial blood gases estimation
- Grouping and cross matching⁵.

Grade	Injury	Description	AIS-90
I	Contusion	Any size	1
	Laceration	Skin and subcutaneous	1
	Fracture	<3 ribs Closed & non-displaced Clavicle.	1-2
II	Laceration	Skin, subcutaneous and muscle	2
	Fracture	3 adjacent ribs, closed, open or displaced	2-3
		clavicle fracture.	2
		non-displaced & closed sternum fracture.	2
	open or closed scapular body fracture.	2	
III	Laceration	Full thickness including pleural penetration	2
	Fracture	Open or displaced sternum, flail sternum	2
		Unilateral flail segment (<3 ribs)	3-4
IV	Laceration	Avulsion of chest wall tissues with underlying rib fractures.	4
	Fracture	Unilateral flail chest (3 ribs)	3-4
V	Fracture	Bilateral flail chest 3 ribs on both sides.	5

X-RAY CHEST

Following views are exposed;

- P.A. view
- Lateral view
- Lateral decubitus view

The chest x-ray is diagnostic of the haemothorax and other chest injuries. The sensitivity and specificity of x-ray chest is more than CT scan⁷ in bony injuries.

ULTRASOUND (FAST)

The ultrasonography is an extremely helpful non invasive first line investigation. It can be done on the bedside of the patient in the emergency ward.

The sensitivity for the demonstration of intra abdominal fluid and organ lesions is 98.1% and 41.4% on ultrasound examination. The over all sensitivity is about 90% and specificity is about 99.5%⁸.

CT SCAN

MRI SCAN

CT and MRI scans help in the diagnosis of pulmonary contusions and effusions more accurately. These are expensive so used in selected patients⁷.

LAPAROSCOPY

Laparoscopy is helpful in injuries to the chest and sub-diaphragmatic (intra-thoracic) part of the abdomen. It is an excellent modality in the evaluation of intra-thoracic abdomen and the diaphragm⁹.

DEFINITIVE TREATMENT

Principles of management in chest trauma are;

- Airway control
- Oxygenation
- Underwater real drainage of pneumo-haemothorax
- Intravenous fluid / blood transfusion

The results and outcome is better with this basic management¹⁵. Treatment depends upon the under lying problem.

Intrapleural aspiration of the blood is sufficient in minor degrees of haemothorax which may have to be repeated two or three times.

Indwelling chest tube is inserted and underwater seal drainage of pleural cavity is performed in case of major intrapleural bleeding.

Thoracotomy and ligation of bleeding vessels is required in severe cases of haemothorax.

The mortality rate in isolated blunt chest trauma is low (approx 5%) but with associated severe injuries it rises to approx 37% 10.

Evacuation Of Tracheobronchial Secretions
Chest injuries may be associated with other injuries and may have secretions and blood in the tracheobronchial passages leading to respiratory embarrassment. These are cleared mechanically and immediately to avoid further chest complications.

The evacuation of tracheo bronchial secretions is further encouraged by regular chest physiotherapy after giving proper analgesia. Steam inhalations and sterilization with bronchodilator drugs improve the evacuation of these secretions.

Whenever it is not possible to keep the chest clear by simple means, bronchoscopic aspiration of the tracheo-bronchial secretions is performed. Tracheostomy helps in adequate evacuation of the tracheobronchial secretions difficult to expectorate by simple.

ASSISTED VENTILATION

The use of intermittent mandatory ventilation (IMV) and constant positive airway pressure ventilation (CPAP) has improved the prognosis in patients with ventilatory deficit. Assisted ventilation (intermittent positive pressure respiration) (IPPV) is used, if the patient is unable to breath properly due to any reason.

Repeated blood gas estimations are performed to evaluate the condition of the patient.

OXYGEN

Intermittent oxygen inhalations improve the oxygenation of the blood in chest injury patients.

BLOOD TRANSFUSION

The amount of the lost blood is measured accurately and it is replaced as early as possible.

ANALGESIA

The chest is a very dynamic part of the body in living persons. The chest injuries are very painful and the pain is experienced with every respiratory movement. Analgesia is required to relieve pain and anxiety. Sometimes even local anaesthetic infiltration may be required. Parenteral analgesics not affecting the respiratory center, are given.

The pain is relieved with strong analgesics and preferably with those, not causing respiratory depression.

Regional or intercostal nerve block may be used in case of multiple rib fractures.

The intra pleural use of marcaine gives excellent pain relief. Large volume injection of bupivacaine 0.5% in the thoracic paravertebral space achieves pain relief over several thoracic dermatomes in patients with respiratory compromise secondary to thoracic and upper abdominal injuries. It is quick and simple to perform¹¹.

STRAPPING

The use of zinc plaster strapping of the chest wall for external stabilization is

useless method as it depresses the chest movements and deteriorates already sub-normal ventilation. It masks the chest movements. It should preferably be avoided.

SURGERY

TRACHEOSTOMY

It is performed as it reduces the dead space and effort of respiration. It also helps in evacuation of thick & difficult tracheo-bronchial secretion.

STABILIZATION OF THE CHEST WALL

Chest wall is fixed if flail segment and paradoxical respiration are present. It can be achieved by

- Intermittent positive pressure ventilation.
- Mechanical fixation of flail chest is controversial because it increases morbidity and outcome may not be favorable.
- Internal fixation of the ribs with wire, cord clips or non absorbable sutures.
- Use of temporary external stabilization facilitates the weaning from mechanical ventilation¹².
- Open chest wall repair with multiple metallic clips is very helpful in patients with severe flail chest. It is comparable and better than prolonged assisted ventilation¹³.

Chest Intubation

It is done when ever there is presence of;

- Haemothorax
- Pneumothorax
- Fluid collection in pleural cavity.

Chest intubation is done in forth to sixth inter costal space in triangle of safety. It is always drained under water seal.

Thoracotomy

Thoracotomy is opening up of the chest

cavity. It is indicated in chest trauma victims when simpler procedures are not helpful.

Indications

The indications for thoracotomy are;

- Loss of more than 1500 mls of blood on intrapleural drainage.
- Loss of more than 200 mls of blood/hour through the intrathoracic tube in first 3 - 4 hours.
- Failure to resuscitate the patient even after adequate blood and fluid replacement.
- Failure to sustain the resuscitation.

Immediate antero-lateral thoraco-tomy is performed. Drainage of cardiac tamponade, repair of vessels, cardiac wounds, internal cardiac massage and cross clamping of descending aorta may be done.

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