Chest trauma

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Abstract

This article summarizes major life-threatening injuries in thoracic trauma. Timing, clinical features, necessary investigations and interventions are described within the clinical approach of primary and secondary surveys. Emphasis is on immediate resuscitation with some discussion on further management. Injuries included are tension pneumothorax, open pneumothorax, massive haemothorax, pericardial tamponade, aortic injuries, cardiac injuries, lung contusion, flail chest, diaphragmatic injury, airway injury and oesophageal rupture.

Keywords Aorta; blunt; flail; haemothorax; penetrating; pneumothorax; tamponade; thorax; trauma

Royal College of Anaesthetists CPD Matrix: 2A02

Learning objectives

After reading this article, you should be able to:

- List the mechanism of common deadly injuries in chest trauma
- Describe why specific injuries require urgent interventions
- Describe a systematic approach to assessing and managing thoracic injuries

Chest injuries

Chest injuries contribute significantly to deaths from major trauma, although the incidence of life threatening injuries is relatively low. These injuries arise from penetrating (usually gunshot or knife) and non-penetrating or trauma (deceleration injuries and blunt trauma mechanisms such as motor vehicle accidents (MVA), falls, crushes, blasts, and burns). Penetrating wounds usually require earlier (sometimes during resuscitation) surgical intervention, with faster recovery. Blunt injuries are more likely to require stabilization, complex imaging and longer recovery times.

This article addresses common life-threatening injuries appearing immediately, early (in the primary survey) and late (hours to days after hospital presentation) (Table 1). These injuries may be single organ or more complex depending on the mechanism and pattern of injury (stabbing vs. motor vehicle crash).

Thoracic spine and spinal cord injuries, whilst significant and common, are not dealt with in this review, but are addressed in the article on Spinal Injuries on pages 00-00 of this issue.

Management of chest trauma and injuries

The approach to the management of chest trauma follows the generalized principles of trauma resuscitation as described in the Advanced Trauma Life Support (ATLS) protocol. The primary survey and correction of immediate life-threatening injuries includes a systematic, team approach to assessment and correction of respiratory, cardiovascular and neurological injuries.

This involves:

- securing or maintaining a patent airway. High flow oxygen with a reservoir mask should be commenced with target saturations of 94–98%
- protecting the patient from further spinal cord injury
- optimizing ventilation and oxygenation; controlling major external haemorrhage
- establishing large-bore intravenous access for necessary drug and fluid delivery
- blood sampling for cross-match, blood counts, biochemistry, blood gas analysis; assessing neurological deficits full exposure of the patient
- immediate access to chest and pelvic X-ray, and focused assessment with sonography for trauma (FAST)
- establishing early effective analgesia

Invasive procedures

Further invasive procedures are sometimes immediately necessary in the resuscitation of patients with chest trauma, as follows.

Tube thoracostomy (or finger thoracostomy) (Figure 1): an intercostal catheter (ICC) is placed in the mid-axillary line at the fourth or fifth intercostal space.

Emergency department thoracotomy is indicated in blunt and penetrating thoracic trauma, where arrest is witnessed or within 10 minutes of arrest if suitably skilled staff are present.[1] This allows for internal cardiac compressions. Closed chest compression is rarely successful in the trauma setting.

Needle chest decompression: a large-bore cannula is inserted through the second intercostal space in the mid-clavicular line.

Resuscitation during primary survey

There are five life threatening conditions that would require to be addressed immediately. They are:

- tension pneumothorax
- open pneumothorax
- massive haemothorax
- flail chest
- cardiac tamponade.

In the UK, the Trauma Audit Research Network (TARN) reports that flail chests (consisting of >3 rib fractures) are the most common type of life threatening injury (one in 50 incidence) and an open pneumothorax is the least common (one in 10,000

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Deadly injury; typical timing

Immediate (at scene)	Early (minutes to hours)	Late (hours to days)
• Aortic rupture • Cardiac chamber rupture • Cardiac arrhythmia	• Tension pneumothorax • Open pneumothorax • Massive haemothorax • Pericardial tamponade • Aortic tears then rupture	• Flail chest • Lung contusion • Sepsis

Table 1

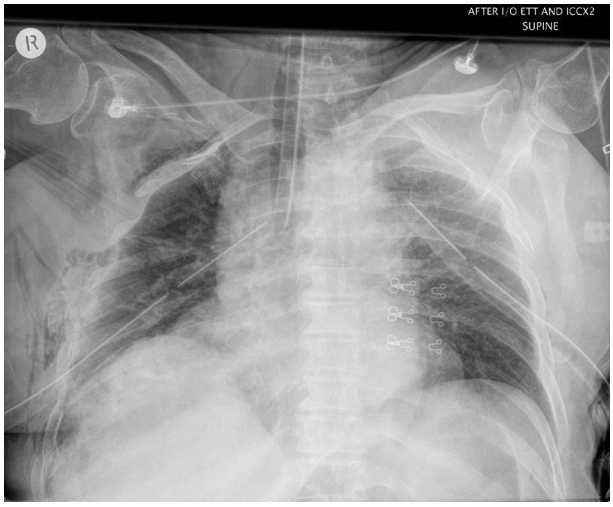

Figure 1 Multiple bilateral rib fractures seen laterally and right subcutaneous emphysema including gas tracking in the right pectoralis muscle. Bilateral intercostal catheters have been inserted (Case courtesy of Dr Andrew Dixon, Radiopaedia.org, rID: 31553).

incidence).[2] Common presenting signs of these conditions are discussed and compared in Table 2.

Tension pneumothorax, occurs when air accumulates under positive pressure in the pleural space, collapsing and shifting mediastinal structures away from the affected side. Obstruction to venous return causing obstructive shock, coupled with hypoxia due to lung collapse may result in death.

Signs: hypoxia, tachycardia, tachypnoea, hypotension and contralateral tracheal deviation. Reduced air sounds, hyperresonance, hyper-expansion and reduced thoracic wall movements on the affected side. Subcutaneous emphysema is common. Making a diagnosis on the spontaneously breathing patient may be difficult as the decompensation is more likely to occur during positive pressure ventilation.

The increasing use of ultrasound in emergency and critical care has made it possible to diagnose pneumothorax following chest trauma with much more accuracy than conventional chest radiographs. However, it is an operator dependent modality and may produce false negative results. Thus the use of ultrasound should not delay the treatment of life-threatening injuries.

Treatment traditionally was needle decompression followed by intercostal catheter insertion. Many now advocate tube thoracostomy rather than needle decompression due to higher failure rates of needle thoracostomy and the risk of iatrogenic pneumothorax.[3] The cannula may also get obstructed by blood, tissue or kinking and thus fail to decompress the pneumothorax. In the case of cardiac arrest, bilateral tube or finger thoracostomy is indicated rather than needle thoracostomy.

Where cardiorespiratory compromise is present and tension pneumothorax is suspected clinically, needle decompression may be performed without awaiting imaging, but must be followed by definitive intercostal catheter placement. The catheter usually need not be under suction. A one-way valve or single bottle drainage system will suffice.

Bilateral pneumothorax is a difficult diagnosis to make clinically. If suspected or confirmed on imaging, bilateral tube thoracostomies are indicated. Simple pneumothorax may be managed conservatively with surveillance chest X-ray (CXR) at 4–6 hours if small, but tube thoracostomy should be placed if intubation is required, or the pneumothorax is expanding.

Open pneumothorax (Figure 2a and b) is a rare complication and involves an open wound communicating with the pleural space, leading eventually to death by tension pneumothorax. Signs are the

Classic signs differentiating deadly injuries

	RR	BP	HR	O_2sats	JVP	Tracheal deviation	Chest examination/auscultation	Other signs
Tension pneumothorax	↑	↓	↑	↓	↑	Contralateral	Quieter, hyper-expanded, hyper-resonant	
Open pneumothorax	↑	↓/–	↑	↓	↑/–	Contralateral or midline	Quieter, hyper-expanded, hyper-resonant	Sucking wound
Massive haemothorax	↑	↓	↑	↓/–	↓/–	Contralateral or midline	Quieter, dull percussion. Reduced expansion	
Pericardial tamponade	↑	↓	↑	↓/–	↑↑	Midline	Muffled heart sounds	Pericardial fluid on FAST scan. Pulses paradoxus (10%)
Flail chest	↑	–	↑	↓/–	–	Midline	Paradoxical chest wall movement during spontaneous ventilation	Signs may disappear after intubation
Lung collapse (e.g. after right main bronchus intubation	↑	–	–	↓	–	Ipsilateral	Quieter and reduced expansion over collapse	

Table 2

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