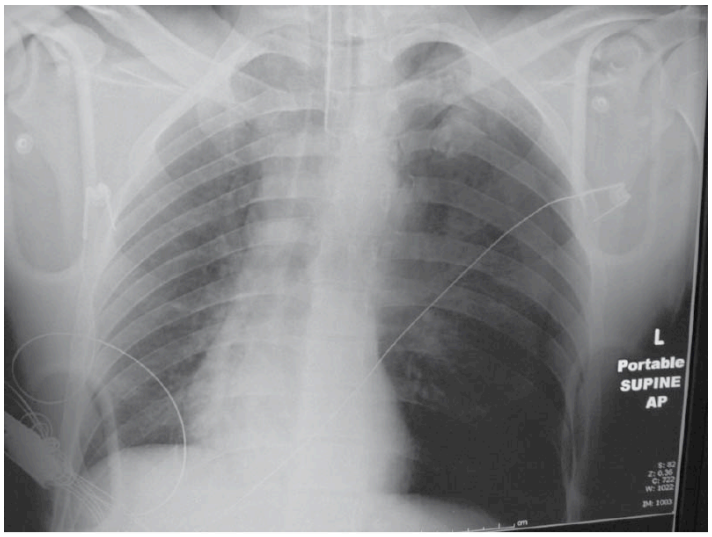
PULMONARY TRAUMA

BLUNT THORACIC INJURIES ACCOUNT FOR 25% OF ALL INJURY-RELATED DEATHS.

IN MOST CASES, THE MECHANISM OF INJURY PREDICTS THE CLINICAL COURSE AND OUTCOME

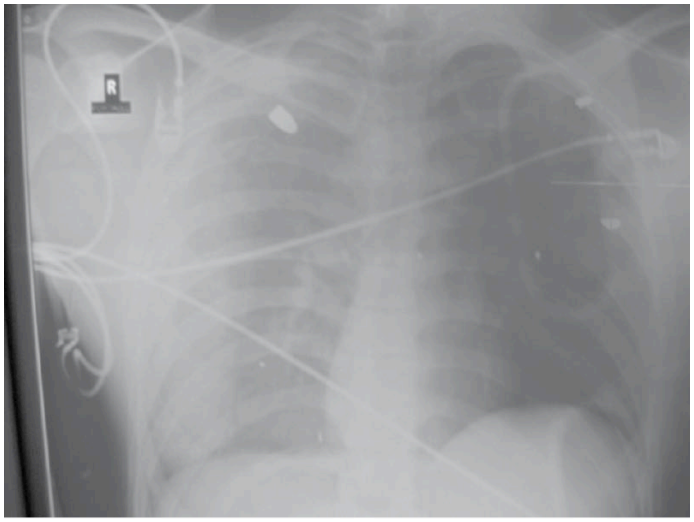
PRIMARY SURVEY – LIFE-THREATENING INJURIES:

TENSION PNEUMOTHORAX:



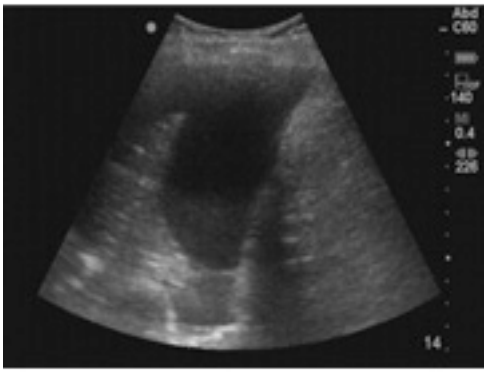
- Diagnosis should be made clinical
- CLASSIC PRESENTATION:
  - Distended neck veins
  - Hypotension/hypoperfusion
  - Absent breath sounds
  - Tracheal deviation
- IMMEDIATE NEEDLE DECOMPRESSION → 2nd intercostal space, mid-clavicular line → too medial → internal mammary vessels
  - Temporising measure → follow with large bore chest tube

MASSIVE HAEMOTHORAX



- Common causes include injury to intercostal artery, internal mammary artery or injury to lung parenchymal/vasculature
- Each hemithorax can hold ~40% circulating volume
- Life threatening in **3 WAYS:**
  - Acute hypovolaemia, ↓ preload and CO
  - Collapsed lung → hypoxia due to alveolar hypoventilation, VQ mismatch and shunting
  - Venacaval compression → ↓ preload

X – RAY

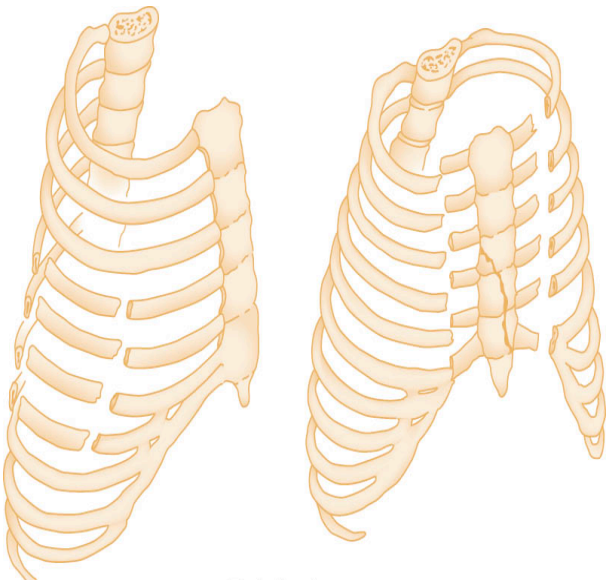


- Tube thoracostomy is both diagnostic and therapeutic
- Evacuation of > 1500mL immediately or 200mL per hour four four hours = thoracotomy
- Other considerations for OT include ↑g haemothorax, persistent hypotension (other sites ruled out), decompensation

OPEN PNEUMOTHORAX:

- Communication between the pleural space and surrounding atmospheric pressure
- SUCKING CHEST WOUND
- Cover wound with three-sided dressing (avoid occlusion) and place tube through separate site, due to risks of infection but also tube will follow tract formed by bullet/knife

FLAIL CHEST:



- Free-floating segment of ribs that occurs when three or more adjacent ribs are fractured at two points
- Assess for segmental PARADOXICAL MOVEMENT ¥ greatly increases work of breathing
- Commonly associated with underlying pulmonary contusion ¥ it is this that causes hypoxia
- Rapid fatigue is common
- Vicious cycle of ↓'g ventilation, ↑'d fatigue and hypoxia develop ¥ sudden respiratory arrest
- EARLY INTERVENTION AND VENTILATROY SUPPORT CRUCIAL ¥ NIPPV OR INTUBATION

EMERGENCY INTERVENTIONS:

VENTILATORY SUPPORT

- MAINTAINING ADEQUATE OXYGENATION AND VENTILATION IN ACUTE CHEST TRAUMA IS ESSENTIAL

SHOCK MANAGEMENT:

- Consider also alternative sources, as most deaths are due to non-cardiothoracic injuries (overall mortality from chest trauma is ~10%)
- Direct efforts to early and rapid restoration of adequate vascular volume and blood pressure
- The goal of trauma resuscitation is to stabilize the intravascular volume sufficiently to provide time to definitively manage haemorrhage
- In previously healthy trauma patients requiring massive transfusion, hypotension for > 30 minutes ↑s mortality from 10 to 50%!!
    - In patients > 65, mortality goes to 90% if hypotensive and requiring transfusion

PERMISSIVE HYPOTENSION:

- Aggressive resuscitation and restoration of normal blood pressure can ↑ rate of haemorrhage
- Hypotensive resuscitation is WITHOUT DEMONSTRABLE HARM and likely beneficial in some subsets of trauma (esp penetrating)

CHEST TUBE AND THORACOTOMY:

- A large haemothorax or haemopneumothorax should be evacuated as soon as possible to ↓ the significant effects on ventilation and venous return
- See specific discussions for methodology
- Loss of vital signs and deterioration after tube placement indicates exsanguinating injury [illegible] CLAMP THE TUBE AND TRANSFER TO OT ASAP
- If there is continuing air leakage after tube placement [illegible] can rapidly collapse the lung and lead to tension [illegible] second tube on the affected side
- PROPHYLACTIC ANTIBIOTICS
    - ↓ empyema by 6% and infectious complications by 12%
- Operative intervention is indicated in < 5% of chest trauma patients
- If > 1L evacuated immediately and if drainage of 150-200mL per hour for four hours

CARDIAC ARREST IN THORACIC TRAUMA:

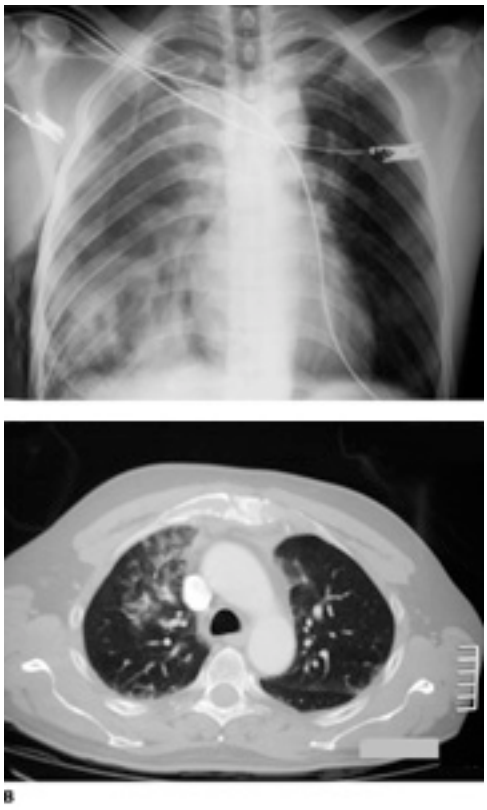
- Arrest is usually due to exsanguination and thus CPR is ineffective due to profound hypovolaemia
- Consider resuscitative thoracotomy [illegible] see other chapter for discussion

INJURY TO THE LUNGS:

SUBCUTANEOUS EMPHYSEMA:

- Indicates a more serious injury
- Extrapleural tears in tracheobronchial tree allow air to leak into the mediastinum and soft tissues of the anterior neck
- Presence of localised subcutaneous emphysema in the presence of blunt trauma is usually indicative of TRAUMATIC PNEUMOTHORAX
- TREAT UNDERLYING CAUSE

PULMONARY CONTUSION:



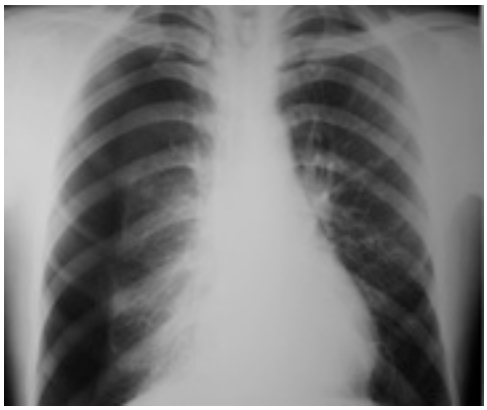
- Direct injury to the lung resulting in both haemorrhage and oedema in absence of pulmonary laceration
- Two phases ☒ direct injury, then secondary injury after resuscitation, due to capillary hydrostatic pressure ☒ fluid into interstitium and alveoli
- Leads to ↑d shunting, resistance to airflow, ↓ elasticity, ↑WOB ☒ hypoxia/hypercarbia and decompensation
- Areas of opacification within 6 hours of trauma considered diagnostic of contusion, but 70% NOT VISIBLE ON INITIAL RADIOGRAPH
- If contusion involves ≥20% of lung volume ☒ 80% risk of ALI
- Mainstay of treatment involves maintaining adequate ventilation. Adequate analgesia crucial and consider invasive ventilation in severe cases (non-injured lung down, high frequency oscillation are options)

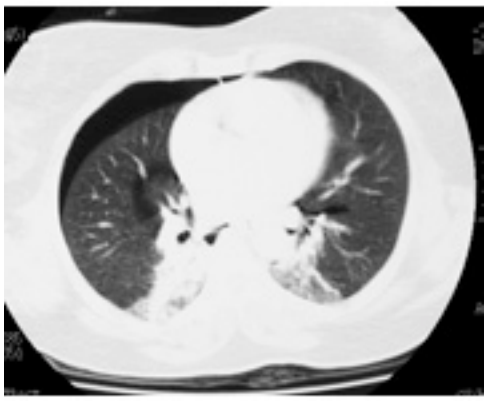
HAEMOTHORAX:

- Most frequently caused by bleeding from direct lung injury
- Compressing effect of blood within pleural space, along with high concentrations of lung thromboplastin and low pulmonary arterial pressure combine to LIMIT BLEEDING
- Bleeding from venous origin usually tamponades without intervention
- Severe bleeding from mammary, pulmonary or intercostal vessels require invasive management

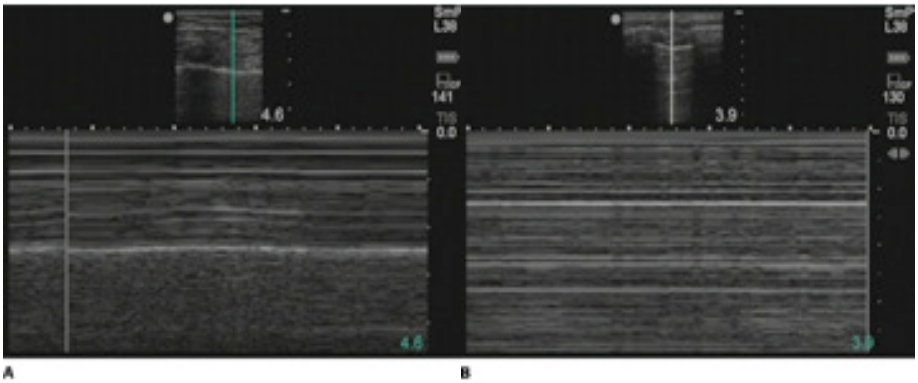
- Large haemothorax RESTRICTS VENTILATION AND IMPAIRS VENOUS RETURN
- X-ray not perfect as up to 1L blood may be missed due to layering of blood posteriorly
    - CT has highest sensitivity and specificity, also able to show ongoing arterial bleeding
- Treat with large bore chest tube

PNEUMOTHORAX:

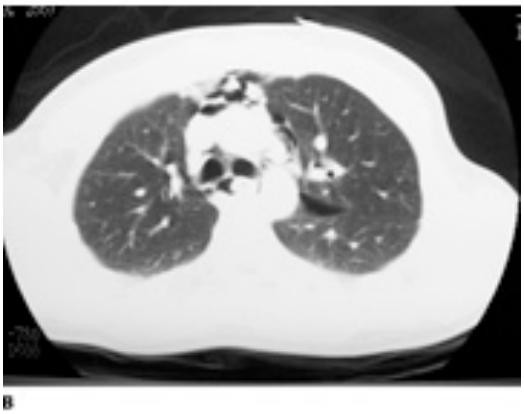




- Any collection of blood or air within the pleural cavity may ↓ vital capacity, ↑intrathoracic pressure, ↓minute ventilation and venous return
- Isolated pneumothorax usually won't cause symptoms until ≥40% of hemithorax involved, if tension has developed or if patient has underlying cardiopulmonary disease
- CXR most common tool in ED, but consider US (see below)[illegible] near 100% sensitive but not specific
- If picture suggests tension [illegible] treat with needle decompression and tube thoracostomy.
- Small pneumothoraces (≤1cm wide, confined to upper chest) that are unchanged on serial films, are observed and patient given high flow O2 to aid reabsorption
- Occult pneumothoraces due not require treatment unless patient requires mechanical ventilation
- Do not cause significant problems unless there is a continuous air leak or pre-existing cardiopulmonary disease [illegible] ↑d incidence of empyema and bronchopleural fistula if leak persists beyond 24-48 hours



PNEUMOMEDIASTINUM:



- Subcutaneous emphysema or presence of Hamman crunch (over precordium) suggests pneumomediastium.
- Results from blunt chest trauma & alveolar rupture, with dissection of air along bronchoalveolar sheath.
- May be asymptomatic or result in mild-moderate chest pain, voice change, cough or stridor.
- ESSENTIAL:
    - Search for other injuries to larynx, trachea, bronchus, pharynx or oesophagus.

SYSTEMIC AIR EMBOLISM:

- An acute complication of severe chest trauma ∴ disastrous circulatory and cerebral complications
- Those with penetrating chest wounds who require PPV are at most risk
- If suspected ∴ supine position with 100% oxygen, trendelenburg position (no evidence)
- Other options:
    - Hyperbaric oxygen, ↓size ↑resorption
    - In event of circulatory collapse ∴ immediate thoracotomy

INTRABRONCHIAL BLEEDING:

- Poorly tolerated ∴ rapidly leads to hypoxaemia and death
    - Haemorrhage into dependent alveoli hinders gas exchange
- Options:
    - ETT with frequent suctioning
    - Bronchoscopy to localize bleeding vessel
    - Double lumen tube to isolate bleeding to one lung

ASPIRATION:

- Common post trauma
- Leads to chemical pneumonitis
- No evidence for prophylactic antibiotics

TRACHEOBRONCHIAL INJURY:

- LOWER (INTRATHORACIC) TRACHEA/MAJOR BRONCHI:
    - Injured due to RAPID DECELERATION ∴ shear forces to mobile distal bronchi relative to more fixed proximal structures
    - MOST TRACHEOBRONCHIAL INJURIES OCCUR WITHIN 2CM OF THE CARINA OR AT THE ORIGIN OF THE LOBAR BRONCHI
    - ~10% have mild symptoms, but most are SOB, have haemoptysis or subcutaneous emphysema
    - Consider with large pneumothorax or pneumomediastinum

    - AIR LEAK DUE TO BRONCHOPLEURAL FISTULA FOLLOWING TUBE THORACOSTOMY IS MASSIVE AND CONTINUOUS
    - All lacerations of the bronchi involving ≥ 1/3 circumference should be surgically repaired
    - Untreated tracheal tears [illegible] SEVERE MEDIASTINITIS and can lead to bronchial stenosis
    - Tracheal transection almost always fatal [illegible] if survives, injury usually in cervical trachea
    - Concurrent OESOPHAGEAL injuries in 25% of those with penetrating tracheobronchial injuries
- CERVICAL TRACHEAL INJURIES:
    - Blunt injuries are usually found at junction of trachea and cricoid cartilage
    - Evidence of direct trauma to the neck, including subcutaneous emphysema and inspiratory stridor, should raise suspicion for this injury
        - DON'T FORGET ASSOCIATED VASCULAR AND SPINAL INJURY THAT GO ALONG WITH THIS MECHANISM

DIAPHRAGMATIC INJURY:

- Caused most often by penetrating trauma, esp GSW
- Right-sided thought to be less common, but in fact left = right in incidence, it is just that right-sided injuries may be undiagnosed as the liver prevents herniation of abdominal contents in to the chest
- If a penetrating wound of the abdomen is associated with intrathoracic injury or foreign body, it should be assumed that the injury traversed the diaphragm
- CT has high sensitivity, but still, many injuries are only picked up at OT
- Complications:
    - Abdominal viscera migrate into the chest [illegible] can then become obstructed or ischaemic due to torsion or strangulation
    - Can cause severe compression of the adjacent lung [illegible] TENSION ENTEROTHORAX
- Needs surgical repair

OESOPHAGEAL INJURIES:

- Penetrating injury more common than blunt
- HIGH MORTALITY due to associated injuries
- If suspected [illegible] oesophagogram should be performed due to risk of chemical mediastinitis with barium [illegible] HIGH FALSE NEGATIVES
    - Higher sensitivity when combined with flexible oesophagoscopy

THORACIC DUCT INJURIES:

- Suspect in cases of penetrating trauma near the left proximal subclavian vein
- Usually only diagnosed after development of CHYLOTHORAX

RIB FRACTURES:

- SIMPLE RIB FRACTURES:
  - Assumed in any trauma patient with localised pain and tenderness over one or more ribs
  - Up to 50% not apparent on plain films
  - Principal goal with clinically suspected rib fractures is the DETECTION OF SIGNIFICANT ASSOCIATED COMPLICATIONS ⚠ haemopneumothorax, contusion, intra-abdominal injury
  - Pain can greatly interfere with ventilation and cause splinting and atelectasis
- FIRST/SECOND RIB FRACTURES:
  - It takes GREAT FORCE to fracture these ribs, given short length, relative immobility and protection by other structures (focal blunt trauma can do it, but this is rare)
  - Associated with other injuries:
    - Blunt myocardial injury
    - Bronchial tears
    - Major vascular injury
  - 15-30% associated with poor outcome

STERNUM FRACTURES:

- Usually occur at the body or manubrium
- Diagnosis usually on CT
- Used to be thought to be associated with life-threatening injury/arrhythmia
  - Sternal fracture associated with MVA actually only has 1.5% incidence of dysrhythmia and <1% risk of death
  - If patients with normal vital signs, a normal initial ECG with normal repeat ECG at six hours ⚠ DO NOT REQUIRE ANY FURTHER WORK UP