

Significant trauma to the chest can affect the Airway, organs of Breathing & Circulation pump.

Epidemiology

- Chest trauma responsible for 25% of all trauma deaths.
- Chest trauma contributes to another 25% of trauma deaths.
- In Australia & UK 90-95% of chest trauma is secondary to blunt injury.
- MVA responsible for 80% of (blunt) chest trauma & 50% deaths.
- Knife wounds most common cause of penetrating trauma.
- Only 10-15% of chest traumas require surgery.

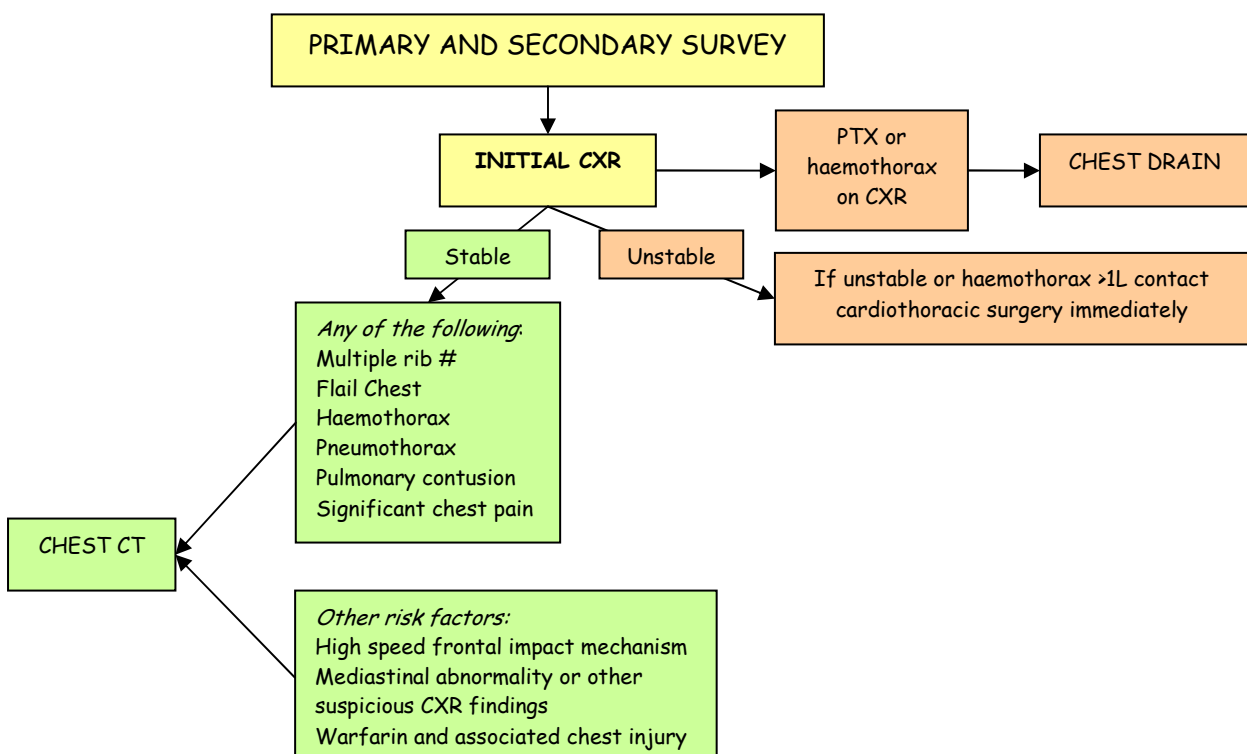
Primary & Secondary Survey Notes

Primary Survey

- Immediate life-threatening injuries to be sought & treated are:
 - Airway obstruction
 - Tension Pneumothorax
 - Open Pneumothorax
 - Massive Haemothorax
 - Flail Chest
 - Cardiac Tamponade
- Monitoring adjuncts: ECG, BP & Pulse oximetry, End-tidal CO₂
- Diagnostic adjuncts: CXR, FAST Ultrasound, Arterial Blood Gas
- Procs: ETT, needle thoracostomy, chest drain, ED thoracotomy, pericardiocentesis

Secondary Survey

- Detailed & complete examination.
- Identification chest wall, pulmonary, mediastinal, diaphragmatic & other injuries
- Further investigations. CT, Angiography
- Instigation of definitive treatment & disposition to Theatre, ICU, Ward, Home.



Chest Wall Injuries

Rib Fractures

- Most common chest injury
- Uncommon in children as more pliable, but may still have serious underlying contusions.
- Blunt trauma usually the cause.
- *Clinically*: Local tenderness/bruising, pain on inspiration/coughing.
- *Cx*: flail chest, pneumothorax, haemothorax, pulmonary contusion, aortic injury
- *Inv*: CXR \pm rib views may show #, or complications. CT chest if Cx suspected.
- *Mx*: Aggressive analgesia. Deep breathing/coughing. Chest drain if pneumothorax.
- *Admit*: if Cx, >3 #s, elderly, respiratory disease, or requiring IV analgesia.
- Strapping not recommended as \downarrow ventilation. Pain may last 6-8wks.
- Analgesia may include intercostal block (bupivacaine 8-12h, post approach blocks ant & lat branches, need to block level above & below too, Cx pneumothorax) or epidural (in ICU)

Sternal fracture

- Fairly frequent in MVA
- If isolated - very low mortality
- *Clinically*: local tenderness & haematoma
- *Inv*: CXR, sternal XR (often done - doesn't change Mx), ECG, Trp (only if ECG abnormal)
- *Mx*: Analgesia. Deep breathing/coughing.
- *Admit*: criteria as for rib #

Flail chest.

- Two or more adjacent multiply-fractured ribs (+/- sternum)
- Free chest wall segment shows paradoxical movement with respiration.
- Very often (75%) associated with underlying pulmonary contusion.
- *Mx*: Analgesia, pulmonary toilet, ventilation (positive pressure) for hypoxia & chest wall instability. Usually don't require immediate intubation or surgical external fixation.

Pulmonary Injuries

Simple Pneumothorax

See also Pneumothorax article in Respiratory section.

- Non-expanding collection of air in pleural cavity.
- Secondary to lung trauma e.g. rib #, bronchial tear.
- Causes varying degree of lung collapse.
- Not immediately life-threatening.
- *Clinically*: Haemodynamically stable, reduced breath sounds and expansion, hyperresonant percussion, trachea central. \pm Hypoxia.
- *Inv*: CXR (ideally erect). May be detected with USS too.
- *Mx*: High-flow O₂. Traditionally all require chest drain, however if isolated chest injury and not likely to need IPPV then small traumatic PTX may be treated conservatively or with aspiration & serial CXR.

Tension Pneumothorax

- Life-threatening PTX.
- One-way-valve effect prevents release.
- Deviation of mediastinal contents away from affected lung.
- Reduction in venous return.
- *Classic signs:* Shock (hypotension, tachycardia), hypoxia, tracheal deviation to contralateral side, hyperresonant & reduced breath sounds, hyperexpanded hemithorax with ↓ expansion, distended neck veins.
- *Mx:* Do not delay with a CXR. Decompress with emergent needle thoracostomy:
 - 14-16G cannula in 2nd i.c.s.m.c.l. - Converts tension into open pneumothorax.
 - Chest drain and CXR will then be required.
 - *Cx:* Cannula/needle can become blocked, kinked, dislodged, lacerate lung or cause air embolism.

Open Pneumothorax

- Pneumothorax with chest wall breach.
- Air entry via chest wall if hole >70% tracheal diameter.
- Impairs ventilation and potential for tension pneumothorax.
- *Clinically:* As for Simple Pneumothorax. Sucking/bubbling at chest wound.
- *Inv:* Pneumothorax confirmed on CXR.
- *Management:* High-flow O₂. Chest drain. If unable to place drain immediately - tape an occlusive dressing over wound on 3 sides.

Haemothorax

- Collection of blood in pleural cavity.
- Usually secondary to rib #, lung trauma, venous injury. Rarely due to arterial injury.
- *Clinically:* As for simple pneumothorax, except percussion is dull with large haemothorax. Massive haemothorax may cause mediastinal deviation.
- *Inv:* CXR, FAST USS, CT.
- *Mx:* High flow O₂. Large bore (28-32F) chest drain/s. Occasionally thoracotomy for:
 - Initial drainage of >1500ml if stable, 1000ml if unstable.
 - Persistent bleeding over 2-4hrs of >200ml/hr if stable, >100ml/hr if unstable.
 - Arterial bleeding.
 - Retained clot (thoracoscopy may suffice).

Pulmonary Contusion

- Occurs in 20% chest blunt trauma ± rib fractures. 75% flail chests.
- Develops over 24-48hrs.
- Alveolar rupture, oedema and blood collection → poor gas exchange & increasing hypoxia.
- Clinically: dyspnoea, tachycardia, blood-tinged resp secretions, chest wall injury.
- *Cx:* atelectasis, pneumonia, respiratory failure. If significant (>20%), 80% get ARDS.
- *Inv:* CXR (patchy opacification, may underestimate extent). CT is more sensitive.
- *Mx:* O₂. 40-60% need mechanical ventilation. Supportive for 2-3 wks.
- Mortality 10-25%.

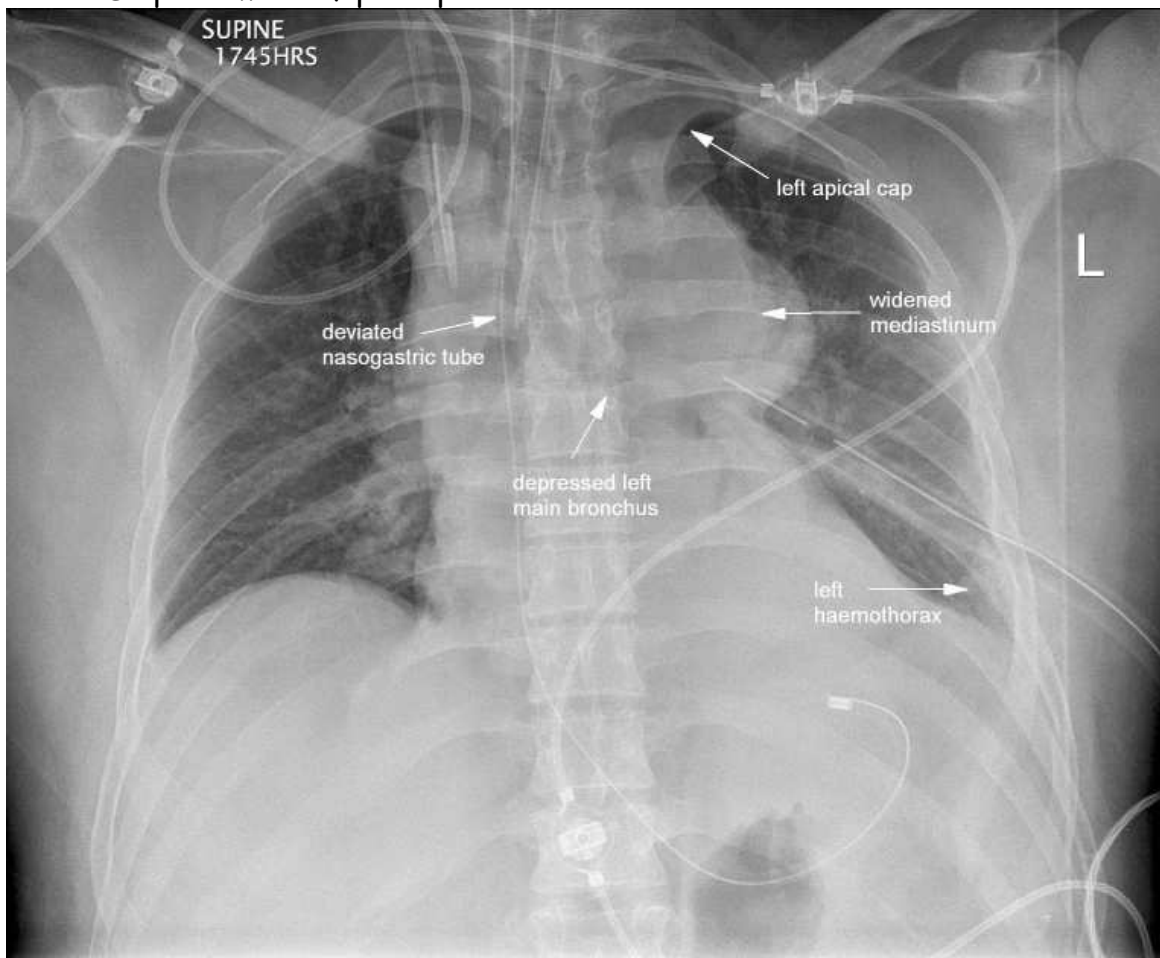
Others:

Lung laceration: Mainly from penetrating trauma. Rarely massive. *Mx:* as per haemothorax +Abx.
Lung haematoma: Most resolve spontaneously. *CXR:* poorly define opacity may become cystic.

Mediastinal Injuries

Aortic Rupture

- High speed frontal deceleration injury. More commonly side impact.
- Site:
 - Proximal desc aorta 65% (junction of desc aorta & L subclavian artery)
 - Asc aorta or arch 10%
 - Distal aorta 10%
 - Multiple sites 15%
- ~90% die at scene, only 50% of rest survive 24hrs.
- Clinically: Chest pain, decreased left arm pulses, may be shocked, may have upper rib # (but 75% have no rib #s), 30% no external sign of chest trauma.
- Investigations:
 - CXR (ideally erect) may show:
 - Wide mediastinum (supine CXR > 8 cm; erect CXR >6 cm) [\sim 80% sens]
 - Obscured aortic knob; abnormal aortic contour
 - Left "apical cap" (i.e., pleural blood above apex of left lung)
 - Large left haemothorax
 - Deviation of nasogastric tube rightward
 - Deviation of trachea rightward and/or left main stem bronchus downward
 - Wide left paravertebral stripe
 - Displacement of paraspinal lines



- CT chest (ideally helical) + contrast: 90-95% sensitive.
- Aortic angiography if stable for transfer to angio suite & duration of procedure.
- TOE: 100% sensitive, 98% specific op-dependent, if too unstable for CT/angio

- Grading:
 - I - Intramural haematoma or limited intimal flap
 - II - Sub-adventitial rupture or alteration of aorta shape
 - III - Aortic transection + active bleeding or aortic obstruction + ischaemia
- Management:
 - β -blocker to \downarrow HR (aim ~60bpm) & SNP for hypertension (aim sysBP 100-120mmHg).
 - Usually primary repair - endovascular or open.

Myocardial rupture

- Blunt trauma. Rarely survive to hospital. Usually R atrium or ventricle. Urgent surgery.

Myocardial contusion

- Usually insignificant.
- Chest pain in only 50%. May have sternal #.
- Significant signs are pleural rub, new murmur, low cardiac output.
- Inv: ECG. TOE helpful if suspected. Angio if ST elevation.
- ECG sensitive but not specific
 - Arrhythmias: VF at impact ('commotio cordis'). Often AF if sig. else ectopics.
 - ST \uparrow predicts myocardial injury > Trop > CK. Only do enzymes if ECG abnormal.
- Normal ECG with haemodynamic stability = D/C. Otherwise cardiac monitoring and if failure/unstable give inotropes/fluids + further inv.

Cardiac Tamponade

- Usually caused by penetrating trauma to myocardium. Most don't survive to ED.
- Only small amount fluid (>100ml) required to impede cardiac function.
- *Clinically*: Beck's triad (\downarrow BP, \uparrow JVP, muffled HS.), Kussmaul's (\uparrow JVP on inspiration), pulsus paradoxus, cardiac arrest (PEA). Alternatively all vitals may be normal.
- *Inv*: FAST or Echo (echo-free zone >1cm around heart \pm diastolic collapse of RA & RV), CXR (big globular heart if >250mL fluid), ECG (low amp QRS \pm electrical alternans), CT/MRI if Echo not avail.
- *Mx*: O₂, (fluid/inotropes may be briefly temporising), needle pericardiocentesis - often unsuccessful (as myocardial damage & clot more likely) and shouldn't delay thoracotomy for pericardiotomy ('pericardial window') & repair. CPR ineffective in tamponade
- Indications for ED (resuscitative) thoracotomy (See Procedures below)

Oesophageal perforation

- Infrequent with penetrating and rare with blunt trauma.
- *Clinically*: dysphagia, regurg blood, subcut emphysema, early fever.
- *Invs*: CXR - pneumomediastinum or widened. Gastrograffin swallow or careful endoscopy.
- *Mx*: NGT, ABx, PPI, surgery, pleural drain.

Other Injuries

- *Pneumomediastinum*: Subcut. emphysema. Hamman's sign (crunch on heart beat/respiration). CXR: air stripe around heart. *Mx*: Conservative unless tension (rare).
- *Tracheobronchial injuries*: Rare. May cause pneumomediastinum, persistent PTX or lung segment collapse. *Inv*: CXR, bronchoscopy. *Mx*: ABx and usually surgery.
- *Thoracic duct injuries*: Rare. Assoc with Zone I penetrating neck injuries. *Dx*: pleural aspiration of chyle. *Mx*: Chest drain. Fat-free diet or TPN if persistent. Occ. surgery.
- *Gas embolism*: More often after penetrating trauma (airway \rightarrow pulm vein connection) or iatrogenic with CVC insertion. Sudden collapse. *Mx*: Lie flat, O₂, fluid challenge.

Diaphragm Injuries

Rupture

- If blunt - 90% are from MVAs.
- If penetrating - 85% are from stabbing, rest mainly GSW.
- Right hemidiaphragm affected probably ~as often as left (despite classical teaching).
- Often difficult diagnosis.
- Tendinous diaphragm least susceptible.
- Membranous defects usually enlarge and 50% present late.
- Late presentations are of obstructed herniated viscera.
- Commonly associated with other (esp abdominal) injuries.
- *Inv:* CXR 70% non-specific anomalies. Diagnostic in only 10-50%. NG may curve back from under diaphragm into chest. CT/MRI. LAD on ECG. Upper GI series.
- *Mx:* Laparotomy ± thoracotomy.

Procedures

Chest Drain

- See Pneumothorax article.

FAST Ultrasound

- See FAST Scan article

ED Thoracotomy

- Overall survival by trauma type:
 - Penetrating: 2-33% vs. Blunt: 0-2.5%
 - Best outcome for single stab wounds causing tamponade (~70%)
- Accepted indications:
 - Penetrating or blunt thoracic trauma and unresponsive hypotension (sysBP < 70 mmHg) despite vigorous resuscitation
 - Penetrating thoracic injury **with** prev witnessed cardiac activity in last 10-15mins (pre-/in-hospital)
 - Blunt thoracic injury and rapid exsanguination from chest tube (>1500ml)
- Relative indications in traumatic arrest:
 - Blunt thoracic or penetrating non-thoracic injury **with** prev witnessed cardiac activity (pre-/in-hospital)
 - Penetrating thoracic injury **without** prev witnessed cardiac activity
- Contraindications:
 - Blunt trauma with no witnessed cardiac activity
 - Multiple blunt trauma
 - Severe head injuries
 - No training or no thoracic/trauma surgeon
- Aims:
 - Release of cardiac tamponade
 - Control of haemorrhage (heart, lungs, great vessels).
 - Access for internal cardiac massage.
 - Opportunity for aortic cross-clamping.