

## 7. Chest injuries including chest drains, penetrating cardiac injuries and resuscitative thoracotomy

### Chest drains

Chest trauma is common.

Only a minority of patients with chest trauma require surgical intervention.

Insertion of an appropriately sized correctly positioned chest drain is the only procedure required in the management of most chest injuries.

#### Indications:

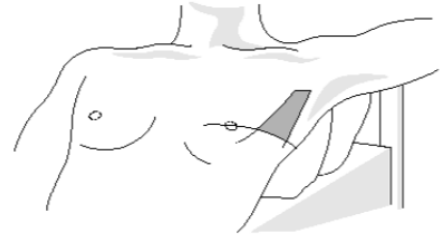
- **Potentially life-threatening conditions identified in the primary survey requiring a chest drain:**
  - **Tension pneumothorax**
  - **Open pneumothorax, in conjunction with closing / covering the open wound**
  - **Massive haemothorax**
- **Other indications:**
  - 'Large' simple pneumothorax not under clinical tension
  - Any pneumothorax in a haemodynamically unstable patient
  - Any pneumothorax in a child who is intubated for transfer to another hospital
  - Bilateral pneumothoraces
  - Large pleural effusions
  - Formal drain after thoracostomy (best to insert drain in separate site)

#### Cautions:

- The presence of surgical emphysema **is not** an indication for a chest drain if no pneumothorax can be identified on imaging
  - Consider a chest drain in worsening surgical emphysema
- The identification of an asymptomatic pneumothorax on a Trauma CT scan is **not** an indication for a chest drain in an otherwise stable patient
- The presence of needle catheters in the 2<sup>nd</sup> intercostal space, mid-clavicular line that have been inserted prior to arrival in A&E does not mandate the insertion of a chest drain unless clinically indicated
- There is no evidence to support **not** inserting a chest drain in a patient with a symptomatic large haemothorax, for fear of releasing the tamponade effect. Large effusions usually cause tension, and these patients have a "B" problem due to their lung collapse as well as a "C" problem
- It is **not** mandatory to insert a chest drain in a patient with an asymptomatic pneumothorax who is to be intubated and ventilated for theatre, although awareness of the presence of a pneumothorax is essential.
- It **is** mandatory to insert a chest drain in a patient with pneumothorax who is intubated for transfer.

## Procedure

- Chest drain size is dependent on age/size of the child, but a 20Fr chest drain should be sufficient in most situations. In the trauma situation, small bore Seldinger drains should be avoided unless there is a specific indication after discussion with an appropriate specialist team
- Insertion is in the triangle of safety, as per ATLS/APLS guidelines on chest drain insertion. If a small bore Seldinger drain is considered appropriate it can be inserted at the same site.
  - Position patient if feasible
  - In a conscious, alert child, give sufficient local anaesthetic & enough time to work
  - Assess length of drain needed - insertion site to apex or base depending upon need
  - 5<sup>th</sup> intercostal space + anterior axillary line
  - Incision through skin and subcutaneous tissues to intercostal muscles
  - Blunt dissection with large clip + “above rib below” to avoid intercostal nerves and vessels
  - Insert drain to required length, angling drain posteriorly in most cases
  - Ensure all holes are within chest cavity
  - Secure drain (suture or tape)
  - Connect to underwater seal
  - Place simple dressing around drain site
  - Obtain a CXR to confirm position, unless going for chest CT
- **Cautions:**
  - Beware the rare patient with chest scars and previous chest surgery - adhesion risk
  - A ruptured left hemidiaphragm and an intrathoracic stomach can mimic a pneumothorax
  - A ruptured right hemidiaphragm and an intrathoracic liver can mimic an effusion
  - **NEVER clamp a chest drain**
- **Note:**
  - Underwater seal drains are not suitable for transport – a Heimlich valve, pneumostat or dry chest drainage system is required



For further guidance on analgesia (other than local anaesthetic) refer [here](#), Section 18.

## Management of the patient with a chest drain

- **What to measure:**
  - Swinging or not
  - Presence of an air leak
    - Constant
    - On expiration
    - On coughing
  - Fluid
    - Volume
    - Colour / consistency
- **When to measure:**
  - Hourly
  - 24-hour total
- **Inspect the drain site**
- **Suction:**
  - Avoid suction on chest drains unless advised by paediatric surgery
- **Cautions:**
  - In most trauma situations the effusion will be haemorrhagic
  - Involve early the paediatric surgical team involved in the patient's care, or if in a Trauma Unit discuss with a paediatric surgeon at the MTC, if there is
    - persistent air leak
    - persistent blood loss after initial drain insertion
    - effusion suggestive of gastric contents (which may indicate oesophageal rupture or a ruptured hemidiaphragm with an intragastric drain)

## When to remove a chest drain

- When the reason for the chest drain insertion is gone, the drain should be gone
- When the drain has stopped draining it is no longer needed
- In a pneumothorax, there should be no air leak for 24 hours
- Usually there is no need for a stitch to close the drain hole
- Chest drain removal is usually a two-person job – one person to remove the drain and the other to cover the wound.
  - There is some evidence (following elective thoracic surgery) that removing the drain at the end of full expiration leads to a lower incidence of non-clinically significant pneumothorax. This can be difficult in children
- It is **not mandatory** to obtain a CXR following drain removal, if the patient remains well and there are no concerns on auscultation. If in any doubt, a CXR is indicated
- **Caution:**
  - Occasionally drains stop working because they are blocked, kinked or dislodged
  - Assess patient clinically +/- CXR if this suspected

## Resuscitative thoracotomy – see [Appendix 3](#)

Loss of vital signs < 10 minutes and 1:20 chance of response

### Indications

- **Penetrating trauma to chest/epigastrium:** if **NO** signs of life
  - Pupillary response
  - Spontaneous ventilation
  - Presence of carotid pulse
  - Measurable or palpable BP
  - Extremity movement
  - Cardiac electrical activity
- **Blunt trauma to chest:** if they lose cardiac output in front of your eyes



### Contraindications

- Prehospital CPR performed for **>15 minutes** after **penetrating** chest injury without response
- Prehospital CPR performed for **>10 minutes** after **blunt** chest injury without response
- Presence of **coexistent injuries that are unsurvivable**, e.g. severe head trauma (**an exception may be the patient who is a potential organ donor**)
- **Asystole** is the presenting rhythm, and there is **no pericardial tamponade**

### Findings / Interventions in order most likely to save life

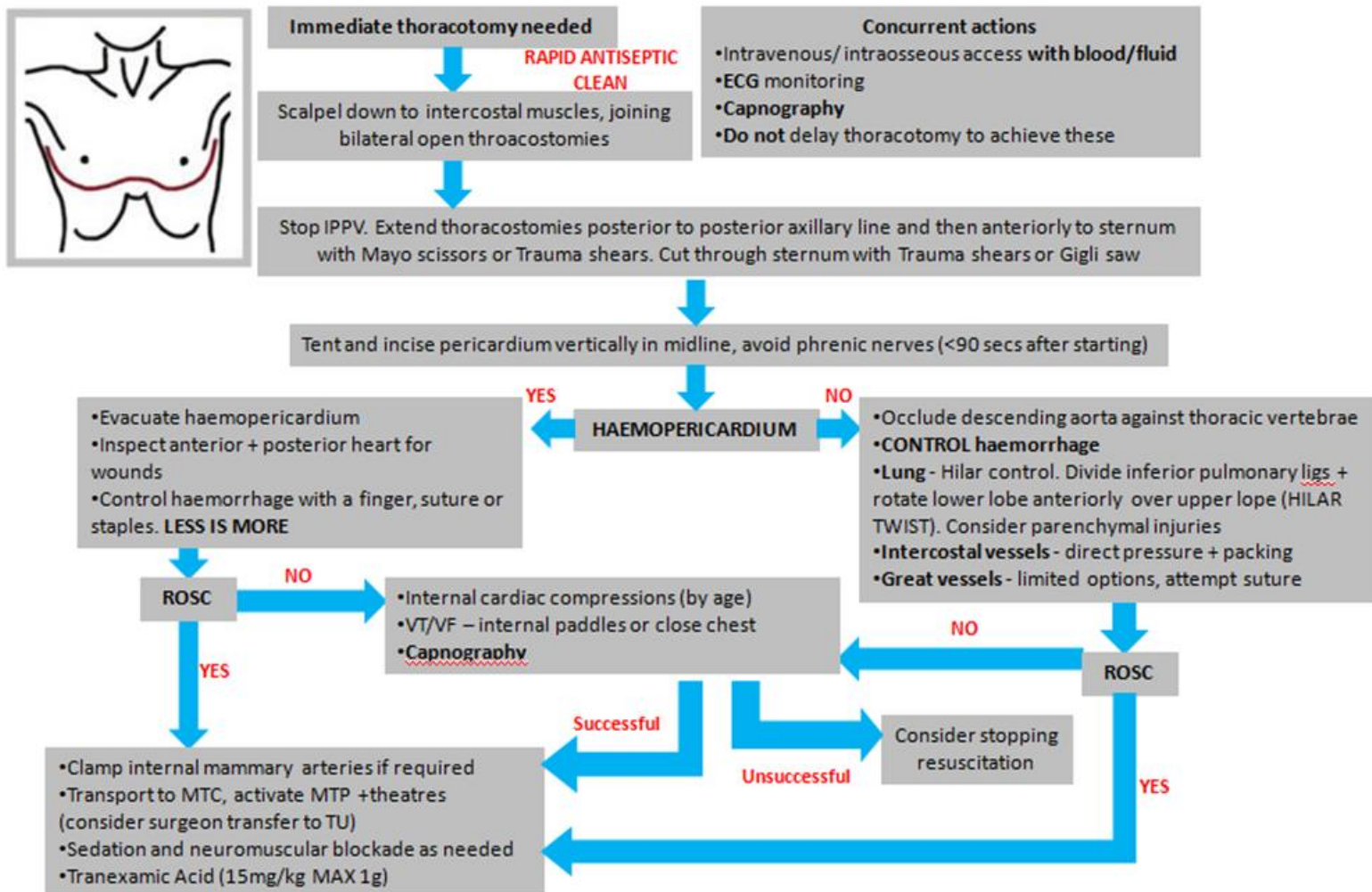
1. **Pericardial tamponade / Relieve**
2. **Haemorrhage / Control**
3. **Open CPR**

### Procedure

- **Supine** – arms as far from chest as possible, crucifix position if feasible. Venous access to both arms simultaneously
- **Bilateral antero-lateral open thoracostomies (same interspace)** - see if improves condition
- **Always do a clamshell** (Flaris et al. World J Surg 2015, 39: 1306-1311)
- **Be bold, don't hesitate** - aim to enter pericardium in <90 seconds
- **Simple kit** - scalpel, forceps, Tuff cuts (big scissors), Big clip + Gigli
- **Join two thoracostomies, as one thoracotomy** - like an underwired bra - NOT straight across
- **Open Pericardium vertically** - avoid phrenic nerves
- **Cardiac wounds** - finger pressure on hole (**NOT IN**), close with sutures or staples
- **Descending aortic compression early** - flat of hand through left chest, compression against spinal column
- **Have blood ready** - wait until haemorrhage controlled, fill heart before releasing aortic compression
- **After ROSC, control internal mammary arteries**

See also [Appendix 3](#) - Resuscitative thoracotomy algorithm and useful links

## Appendix 3 – Resuscitative thoracotomy flow chart



### Useful links

<https://emcrit.org/racc/procedure-of-thoracotomy/>

<http://www.trauma.org/archive/atlas/clamshell.html>

<http://emj.bmj.com/content/22/1/22>

<https://www.wymtn.com/traumatic-cardiac-arrest---indications-for-rt.html>