**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 2nd 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
	+ 5th 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 recommended for transport – a Heimlich valve, pneumostat or dry chest drainage system is preferred

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

**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**](#Appendix3)

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 positionif 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 thoracostostomies, 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**](#Appendix3) **- Resuscitative thoracotomy algorithm and useful links**

**Appendix 3 – Resuscitative thoracotomy flow chart**

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**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/uploads/5/1/8/9/51899421/traumatic_cardiac_arrest_-_indications_for_resuscitative_thoracotomy.pdf>