Rib fractures, pneumothorax, haemothorax and chest drain insertion

Introduction

Thoracic trauma poses a significant threat to life and contributes significantly to deaths that occur within the so-called 'golden hour'. Therefore, it is important to recognize patients with significant chest trauma and to treat them immediately without the need for a definitive diagnosis. This article deals with the presentation and management of the most common chest injuries.

Rib fractures

More than 50% of chest traumas result in rib fractures, usually as a result of blunt injuries.

The site of the fracture correlates to injury of the underlying viscera; for example, left lower rib fractures are associated with splenic injuries and right lower fractures with hepatic injuries.

The close association of the major vessels to the first ribs corresponds to a high incidence of mortality, which can be as high as one in three patients. Multiple contiguous fractures are known as a flail segment and lead to impaired ventilation as a result of paradoxical movements. Overall, a third of rib fractures have an associated haemothorax or pneumothorax and 12% result in mortality (Ziegler and Agarwal, 1994).

Rib fractures in children are rare and should be viewed with suspicion regarding the mechanism (suspect non-accidental causes) and associated injuries.

Pneumothorax and haemothorax

Blunt or penetrating injuries can result in a collection of air within the pleural cavity causing a traumatic pneumothorax. Similarly, blood in the pleural space results in a haemothorax. If the injury results in the unidirectional flow of air into the pleural cavity with no route of escape, then a tension pneumothorax may develop. The resulting increased intrapleural pressure causes compression of the cardiopulmonary structures and death if not immediately treated.

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Resuscitation

Immediate attention to the airway, breathing and circulation in that order is necessary to decrease further morbidity and/or mortality. Administer high-flow oxygen and intravenous fluids.

If tension pneumothorax is suspected then it must be relieved immediately by needle decompression with a large bore cannula in the second intercostal space, mid-clavicular line. Only after this should a chest X-ray be contemplated.

Analgesia and a thoracostomy (chest drainage) are mandatory. A stepwise explanation of thoracostomy is given below.

Indications for chest drain placement

Indications for chest drain placement are traumatic haemothorax or pneumothorax:

Pneumothorax may occur in ventilated patients, with tension pneumothorax following immediate needle decompression, as an open pneumothorax or as a persistent or recurrent pneumothorax following simple aspiration.

Equipment

- Sterile gown and gloves
- Sterile drapes
- Antiseptic solution – povidone-iodine or chlorhexidine
- 10 ml syringe
- Needles (21–25 gauge)
- Lidocaine 1% 20 ml
- Gauze 10 cm x 10 cm
- Scalpel and size 11 blade
- Blunt instrument for dissection (e.g. curved artery forceps)
- Chest drain (24 F for air, 32 F for blood)
- Chest drain bottle (with sterile water filled above the end of chest drain)
- Silk suture (1'0).

Patient positioning

The procedure may be performed with the patient sitting up, and leaning over a table with an underlying pillow. However, for most traumatic indications it is preferable if the patient is lying supine with the ipsilateral arm behind the patient's head or simply abducted to 30°, so that the axillary region is visible.

Surface markings

The 'triangle of safety' (American College of Surgeons Committee on Trauma, 1993) has been identified as the site for insertion of the drain (*Figure 1*):

- Level with or above the fifth intercostal space (i.e. above the nipple)
- Below the axilla (to avoid the axillary vessels)
- Anterior border of latissimus dorsi
- Lateral border of the pectoralis major
- Above the rib (to avoid the intercostal neurovascular bundle).

Patient preparation

If the patient is lucid and stable, informed consent must be gained before performing the procedure. A competent patient maintains the right to refuse treatment.

Check that the identity of the patient and radiographs match and are correct, confirm the clinical signs, and then mark the site of insertion.

An aseptic technique is fundamental to reducing the incidence of infection, especially secondary empyema. For this reason, prophylactic antibiotics are indicated and have been proven to lower infective complications by 12% (Fallon and Wears, 1992).

Anaesthesia

- Begin infiltrating the marked site of insertion, by raising a subcutaneous bleb with lidocaine
- In the presence of a robust chest wall larger volumes of anaesthetic and a spinal needle may be required
- Infiltrate deeply so that the periosteum of the rib is anaesthetized as well
- Cover a 2 cm diameter around the marked site

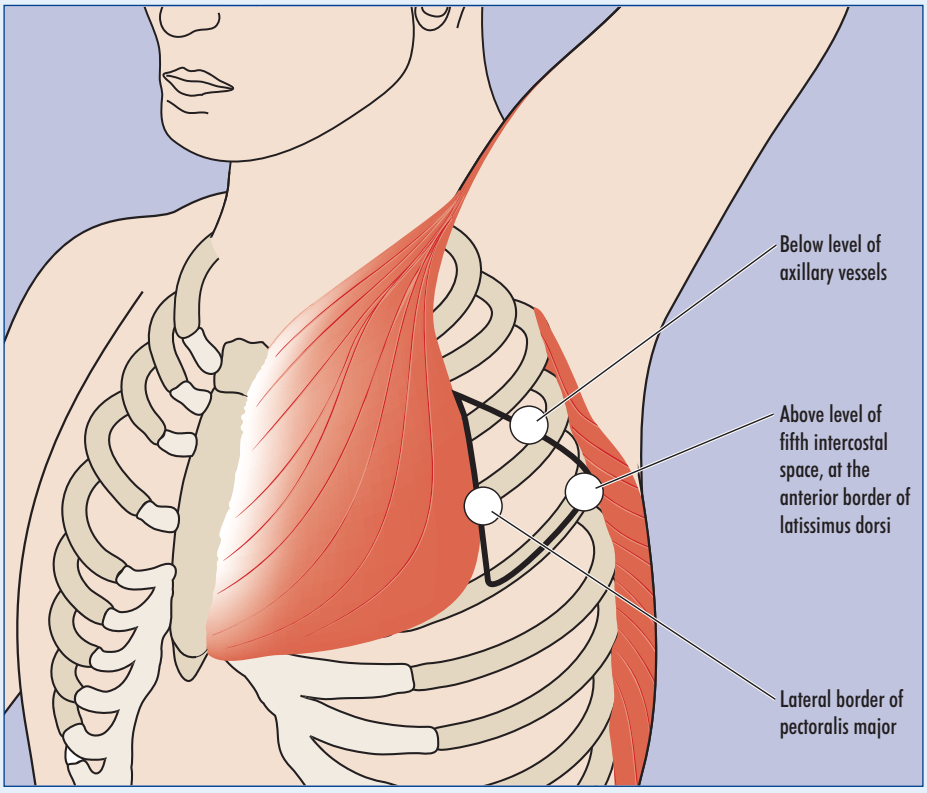

Figure 1. Triangle of safety.

- Confirm that the position is correct by carefully breaching the parietal pleura while aspirating for air/fluid
- Wait 5 minutes before inserting the chest drain to allow the lidocaine to work effectively.

Method

- Make an incision in the triangle of safety of sufficient diameter to allow the drain tube or operator's finger to pass through the skin.
- Insert an interrupted or mattress, silk (or equivalent) suture through the wound before drain insertion.
- Do not use a 'purse string' suture as this is both painful for the patient and leaves a cosmetically unacceptable scar.
- Use the forceps to dissect bluntly through the subcutaneous and muscular planes to create a straight track.
- The parietal pleura can be recognized when flimsy resistance is met; breach this with the artery forceps.
- Follow the newly created track with a finger to sweep away adhesions and confirm there are no underlying organs, such as the liver.
- Withdraw the trocar either partially or totally from the chest drain tube. Partially withdrawn, the trocar can help guide the direction of the drain placement; if totally withdrawn use the artery forceps to provide rigidity for positioning.
- If draining fluid aim the tube inferoposteriorly towards the diaphragm or superiorly in order to drain air. However, this position of the tip is not critical to provide effective drainage (Hyde et al, 1997)
- The chest tube is then connected to a drainage system that allows one-way flow. In most circumstances this will be a bottle filled with sufficient sterile water to submerge the end of the tube.
- Use the remainder of the suture material to secure the drain to the chest wall and prevent it falling out.
- Bubbling in the underwater seal confirms that the lung is re-expanding and that the drain is correctly positioned.
- Do not clamp the chest tube unless it is performed under direct supervision with nursing staff who are experienced in managing chest drains.
- Use a non-bulky dressing as this does not restrict chest wall excursion (Harriss and Graham, 1991).
- Always perform a chest X-ray after the procedure (Laws et al, 2003).

Drain removal

This is advisable when the chest drain has ceased bubbling and radiographs confirm re-expansion of the lung. The drain should be removed expeditiously while the patient is expiring or performing a Valsava manoeuvre so that air is prevented from re-entering the pleural cavity. BJHM

Conflict of interest: none.

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Further reading

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KEY POINTS

- Use a systematic approach to all trauma.
- Decompress a tension pneumothorax immediately.
- Definitive diagnosis is unnecessary before intervention.
- Avoid a trocar and use of excessive force.
- Do not use a 'purse string' suture.
- Experienced nursing staff are required to manage the patient while the chest drain is in situ.
- Clamping the drain requires vigilance.