RCH Trauma Guideline

Management of Traumatic Pneumothorax & Haemothorax

Trauma Service, Division of Surgery

Aim

To describe safe and competent management of traumatic pneumothorax and haemothorax at RCH.

Definition of Terms

Haemothorax: collection of blood in the pleural space

Pneumothorax: collection of air in the pleural space

Tension Pneumothorax: one way valve effect which allows air to enter the pleural space, but not leave. Air and so intrapleural pressure (tension) builds up and forces a mediastinal shift. This leads to decreased venous return to the heart and lung collapse/compression causing acute life-threatening respiratory and cardiovascular compromise. Ventilated patients are particularly at risk due to the positive pressure forcing more air into the pleural space. Tension pneumothorax results in rapid clinical deterioration and is an emergency.

Finger thoracostomy: preferred method of emergency pleural decompression of a tension pneumothorax. It involves incising 3-4cm of skin over the 4th intercostal space just anterior to the mid-axillary line followed by blunt dissection to the pleura to allow introduction of a finger into the pleural space.

Main Points

1. Management of a clinically significant traumatic pneumothorax or haemothorax typically requires pleural decompression by chest drain insertion.
2. Anatomical landmarks should be used to determine the site of incision for pleural decompression within the 'triangle of safety' to reduce risk of harm.
3. All patients in traumatic cardiac arrest who do not respond immediately to airway opening should have their pleural cavities decompressed by finger thoracostomy, concurrent with efforts to restore the circulating blood volume.
4. With few exceptions, chest drain insertion follows immediately after finger thoracostomy, with the caveat that the time and place of insertion must be consistent with the child's overall clinical priorities. In the exceptional situation that finger thoracostomy in ED is **not** immediately followed by drain insertion, it is **imperative** that a clear plan for delayed drain insertion is communicated to relevant staff to ensure this procedure is safely completed at the earliest opportunity.

Mechanism of Injury

(a) Blunt chest trauma is far more common than penetrating injury in Australian children, Blunt trauma may cause sudden increased intrathoracic pressure with airway rupture.

(b) Penetrating chest trauma can result from stab wounds, gunshot wounds, and foreign body impalement (e.g. glass, metal). Penetrating traumas may primarily injure the lung, producing both a pneumothorax and haemothorax in more than 80% of all penetrating chest wounds. Primary *mediastinal* injury due to penetrating injury may be immediately life-threatening, and its management is not specifically dealt with by this guideline.

Management of Traumatic Pneumothorax

Clinically significant traumatic pneumothoraces require pleural decompression. Some traumatic penumothoraces are not clinically apparent and can be managed safely with observation, especially those first noted on CT. Positive pressure ventilation *per se* is not an absolute indication for presumptive pleural decompression with a chest drain.

Tension pneumothorax

A tension pneumothorax is the rapid accumulation of air in the extra pleural space that compresses intrathoracic vessels and obstructs venous returns to the heart. It leads to circulatory instability and may result in traumatic arrest. It is a life-threatening condition and thus it is imperative to recognise and treat it quickly, even before any investigations are performed. The treatment is effective pleural decompression, ideally by finger thoracostomy.

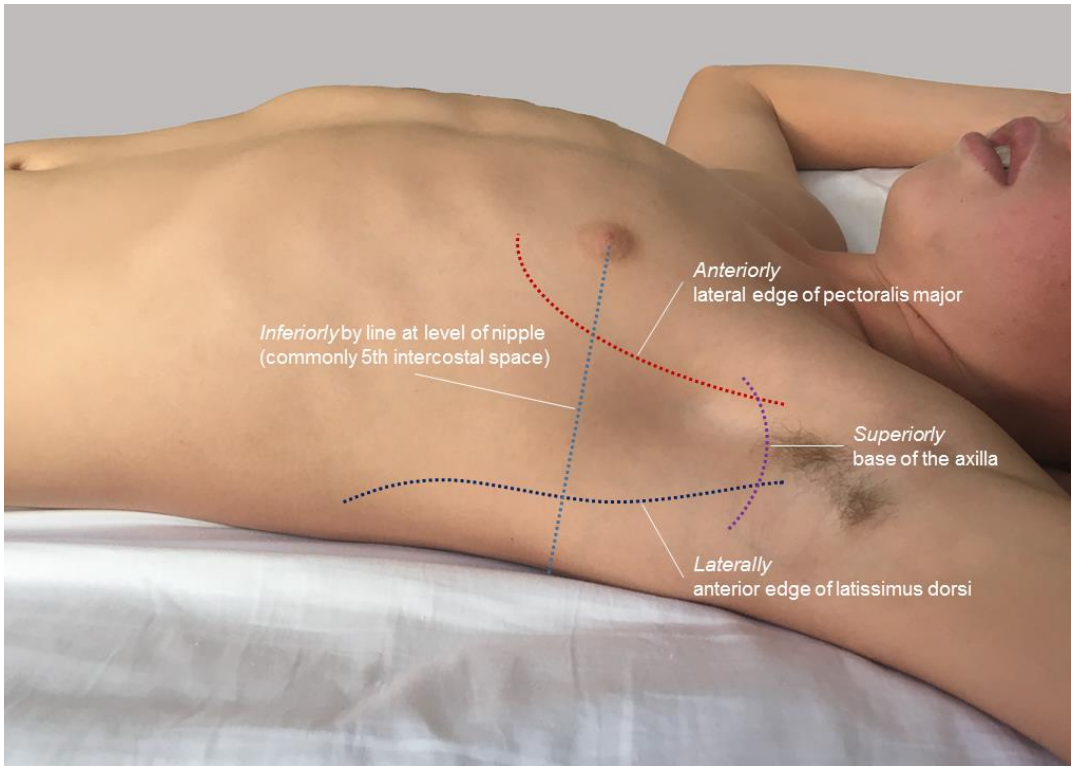
Following pleural decompression, a chest drain will ordinarily be inserted as a secondary step prior to leaving the ED; click **here** for RCH guideline on chest drain insertion.

In exceptional circumstances, the child's clinical priorities may dictate that chest drain insertion be delayed to another time and/or place, e.g. cardiac arrest, massive haemorrhage necessitating immediate transit to theatre for damage control, and rapidly deteriorating neurotrauma. This decision will be led by the Trauma Team Leader with expected consultation with relevant Senior Medical Staff present. In these exceptional instances, it is also imperative that a clear plan for delayed drain insertion is communicated to relevant staff to ensure this procedure is completed at the earliest opportunity.

All patients in **traumatic cardiac arrest** who do not respond immediately to airway opening should be assumed to have other treatable causes for cardiac arrest, including tension pneumothorax(ces). Therefore, these patients should have immediate and bilateral pleural decompression by finger thoracostomy, usually with immediate chest drain insertion, however this may rarely be delayed in accordance with the principles outlined above.

Pleural Decompression by Finger Thoracostomy

1. Judicious (but effective) skin decontamination using standard iodine or chlorhexidine skin preparation. This procedure is seldom so urgent as to preclude any skin preparation, which reduces the well-recognised risk of empyema in these patients.
2. ABduct the arms to >90 degrees and locate the "triangle of safety", which is generally at the level of the nipple in males or mammary fold in females. The key landmarks are:
   A. Lateral edge of pectoralis major
   B. Anterior border of latissimus dorsi
   C. Base of the axilla
   D. Level of the nipple (typically 5th intercostal space)



3. Identify the appropriate incision site (4th intercostal space, anterior to mid axillary line), ensuring you are within the "triangle of safety" as above.
4. Following incision, dissect bluntly with an artery forcep (or similar) to enter through the intercostal muscles and pleura. A finger is then introduced into the pleural space to decompress the pleural cavity, allowing evacuation of air and/or blood.
5. Decompression of the pleural and maintenance of the formed tract is optimised by gentle sweeping of the finger within the pleural cavity.

Please note, these are the same steps used when inserting a primary chest drain in trauma. A contralateral procedure is performed if bilateral tension pneumothoraces are suspected.

Important Comments Regarding Finger Thoracostomy

Insertion of a chest drain

With few exceptions, chest drain insertion follows immediately after thoracostomy, with the caveat that the time and place of insertion must be consistent with the clinical priorities. Chest drain insertion should add no more than 10 minutes to the overall procedural time, and minimises the risk of re-accumulation of pleural air under tension. This risk is greater in the spontaneously ventilating than if receiving positive pressure ventilation. In children, it is appropriate to use the finger thoracostomy tract for chest drain insertion, especially if the thoracostomy is performed in-hospital.

If the child's status precludes drain insertion in ED, application of a colostomy bag (with end open) over the finger thoracostomy site acts as a one-way valve and reduces the risk of the finger thoracostomy output posing additional risk by soiling the environment and/or staff.

Ventilation

Finger thoracostomy should be accompanied by **intubation and positive pressure ventilation** to ensure adequate ventilation despite air entering the pleural cavity, and reduce the likelihood of re-accumulation of a tension pneumothorax due to entrainment of external air through an open thoracostomy site.

Antibiotics

To reduce the risk of empyema, these children should receive broad spectrum intravenous antibiotic coverage, e.g. **cephazolin** with consideration for metronidazole if soiled.

Management of Traumatic Haemothorax

In the child with traumatic haemothorax it is necessary to decompress the pleural cavity and drain the blood. This may need to be done urgently in the ED. The technique for chest drain insertion has been published by RCH and can be found **here** (https://www.rch.org.au/clinicalguide/guideline_index/Chest_Drain_Intercostal_Catheter_Insertion/).

After the chest drain has been inserted and the blood drained it is essential to closely monitor the **output** and the **patient**.

1. **Output**: if a **massive haemothorax** is present (>20ml/kg blood drains immediately, or **>**3-4ml/kg/hr for the subsequent 2-4 hours), strong consideration should be given to urgent thoracotomy to achieve haemorrhage control.
2. **Patient**: if the patient's clinical condition does not improve, or there is deterioration, this may necessitate going to theatre for a thoracotomy.

General Comments re Chest Drains in Trauma

Connecting the chest drain

Once inserted, any ICC should be connected to an UWSD using cable ties and dressed as outlined in the *RCH Nursing Guideline for Chest Drain Management* (https://www.rch.org.au/rchcpg/hospital_clinical_guideline_index/Chest_Drain_Management/). Tubing should have no kinks or obstructions that may inhibit drainage, and ensure the water seal is maintained at 2cm at all times (unless suction is applied as qualified below).

Never clamp drain unless ordered to by medical staff.

There is a risk of the patient developing a tension pneumothorax if a drain is clamped while an air leak is present.

Never lift drain above chest level

The unit and all tubing should be below patient's chest level to facilitate drainage.

Suction

Suction is not always required, and may lead to tissue trauma and prolongation of an air leak in some patients. If suction is required, specific orders should be written by the relevant surgical staff in EMR.

Drainage

Milking of chest drains is only to be done with written orders from medical staff. Milking drains creates a high negative pressure that can cause pain, tissue trauma and bleeding.

Volume

The amount of fluid in the drainage chamber needs to be documented hourly in the Fluid Balance flowsheet on EMR.

Notify medical staff if there is a sudden increase in amount of drainage

- *Greater than 5mls/kg in 1 hour*
- *Greater than 3-4mls/kg consistently for 2-4 hours*

If a drain with ongoing loss **suddenly stops draining**, notify medical staff immediately.

Oscillation (swing)

The water in the water seal chamber will rise and fall (swing) with respirations, unless suction is applied. This will also diminish as the pneumothorax resolves. It is important to watch for unexpected cessation of swing, which may indicate the tube is blocked or kinked.