# CSOP 017 – Chest Injury

Version No: 2.4 Effective date: 28/04/2023

## APPROVALS

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|---|---|---|---|
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## HISTORY

| Effective Date | Version No. | Summary of Amendment |
|---|---|---|
| 14/12/12 | 2.0 | Reformatted |
| Jan 2015 | 2.1 | Reviewed with minor amendments |
| March 2017 | 2.2 | Review |
| July 2019 | 2.3 | Review |
| March 2022 | 2.4 | Reviewed with major amendments |

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## REFERENCES


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## DEFINITIONS/ACRONYMS:

| Abbreviations/Acronym | Definitions |
|---|---|
| ECG | Electrocardiogram |
| IV | Intravenous |
| PPV | Positive Pressure Ventilation |
| RT | Resuscitative Thoracotomy |
| SOP | Standard Operating Procedure |
| SV | Spontaneous Ventilation |

## ANNEX/APPENDIX

| Document Reference Number | Document Title |
|---|---|
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## 1. Purpose

To provide a clear overview of the assessment and treatment of blunt and penetrating chest trauma.

## 2. Scope

It is a requirement of registration that a practitioner will only act within his or her scope of practice. Critical care paramedics that have undergone the appropriate training and have been authorised to do so, are enabled to carry out thoracostomies independently.

## 3. Background

- The treatment priority is to maximise oxygen delivery as early as possible and avoid any ventilatory component to cellular hypoxia.
- Patients should have any obstructive element to their shock state corrected as soon as possible and should not arrive at hospital with reversible lung pathology.

## 4. Clinical Assessment

- An understanding of the mechanism of injury, trajectory of the patient's physiology and a thorough clinical assessment is key. Expose the patient to assess ALL areas.
- The common signs and symptoms of a chest wall and lung injury are:
    - Dyspnoea (patient's often state 'I can't breathe')
    - Increased work of breathing
    - Surgical emphysema

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- Bony crepitus to chest wall
- Flail chest
- Decreased air entry
- Wheeze on auscultation

– The presence of surgical emphysema early after injury indicates a significant air leak with a risk of tension pneumothorax development, especially after PPV.
– Oxygen desaturation will be a late sign of significant chest pathology in patients on high flow oxygen, reinforcing the importance of serial clinical examination.
– Auscultation is often difficult due to location and noise. Auscultate laterally on the chest to avoid misinterpretation of transmitted sound from the contra-lateral chest.
– Unilateral reduced air entry can be indicative of a simple pneumothorax, tension pneumothorax, haemothorax, pulmonary contusion or splinting due to pain.
– Ultrasound has been shown to be an effective tool for diagnosing or excluding significant lung pathologies such as haemothorax, pneumothorax or pulmonary contusions.

## 5. Rib Fractures & Flail Segment

– Rib fractures and flail segments can result in rapid and profound hypoxia secondary to pain related ventilatory insufficiency or mechanical ventilatory failure.
– Flail segments can be difficult to diagnose, and present late due to splinting. Inspect from the patients' feet for anterior flails and stand over the patient to inspect for lateral flails.
– Early analgesia (see analgesia SOP) in the haemodynamically stable patient should be the priority and will facilitate a thorough clinical examination.

- Correction of hypoxia with effective analgesia will help differentiate patients with pain related ventilatory insufficiency and those with mechanical ventilatory failure.

**Management**

- In conscious patients with an isolated chest injury and no spinal precautions, sitting the patient up will optimise gas exchange and patient comfort.
- Effective analgesia with a rapidly titratable agent such as fentanyl or ketamine should be prioritised.
- Persistent hypoxia secondary to large flail segments and mechanical ventilatory failure may warrant a prehospital anaesthetic and positive pressure ventilation (see RSI SOP).
- Following intubation and PPV, be prepared to decompress a haemopneumothorax that causes physiological deterioration.

## 6. Pulmonary Contusion

- Pulmonary contusions are associated with rib fractures and flail segments in adults but can occur in isolation in younger patients.
- Early analgesia (see analgesia SOP) in the haemodynamically stable patient should be the priority and will facilitate a thorough clinical examination.
- Persistent hypoxia despite effective analgesia may indicate an underlying lung pathology such as pulmonary contusion, haemothorax or pneumothorax.

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**Management**

- Persistent hypoxia secondary to pulmonary contusions may warrant a prehospital anaesthetic and PPV (see RSI SOP).
- Following intubation and PPV, be prepared to decompress a haemopneumothorax that causes physiological deterioration.

## 7. Pneumothorax

- A simple pneumothorax without significant oxygen debt does not require prehospital treatment. A simple pneumothorax can be converted to a tension on PPV.
- A tension pneumothorax in the spontaneously ventilating (SV) patient presents with respiratory failure, whereas in PPV often presents with haemodynamic instability.
- Any haemodynamic compromise in the SV patient with a suspected pneumothorax should be considered secondary to bleeding rather than due to tension physiology.
- An open pneumothorax resulting in ventilatory failure only occurs with a large chest wall defect with obvious passage of air on clinical examination.

**Management**

- A tension pneumothorax requires decompression by needle thoracocentesis followed by a thoracostomy.
- SV patients requiring thoracostomy will require an intercostal drain, whereas patients who are PPV only require a finger thoracostomy.

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- A chest seal can be applied to open thoracic wounds with clinical evidence of air leak (sucking chest wound) and associated ventilatory compromise.
- Chest seals blocked with blood can precipitate a tension pneumothorax and either require removal or milking of the valve to clear the blockage.

## 8. Haemothorax

- A significant haemothorax can cause concurrent hypovolaemia and hypoxia secondary to bleeding and lobar collapse.
- Decompression of a haemopneumothorax in the ventilated patient will allow lung reinflation, encouraging haemostasis and optimising gas exchange.

### Management

- Hypovolaemia should be managed as per the blood transfusion SOP with wide bore IV access, tranexamic acid and appropriate volume resuscitation.
- Thoracostomy in the PPV patient may be warranted if pulmonary lobar collapse is contributing to significant oxygen debt.
- The insertion of an intercostal drain should be considered to contain any ongoing blood loss, quantify thoracic bleeding and optimise lung re-inflation.

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## 9. Cardiac Tamponade

- Penetrating wounds to the thorax, supraclavicular region or upper abdomen can cause cardiac injury and tamponade.
- Rare case reports of blunt trauma to the chest causing bone fragment mediated cardiac injury, or coronary vessel rupture can also cause cardiac tamponade.
- Collection of blood in the pericardial space results in rapid onset obstructive shock and requires immediate surgical decompression in the context of cardiac arrest.
- Clinical signs of impending cardiac tamponade include a distended internal jugular vein, electrical alternans on ECG and ultrasound visualisation.

**Management**

- Patients with clinical signs of cardiac tamponade may be appropriate for immediate resuscitative thoracotomy (see resuscitative thoracotomy SOP).
- There is no place for needle pericardiocentesis for the management of acute traumatic cardiac tamponade in the prehospital setting.

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## 10. Clinical Interventions

- Most chest injuries are effectively managed with oxygen, analgesia (see analgesia SOP) and transfer to an appropriate trauma unit/centre.
- Patients with refractory ventilatory failure despite adequate analgesia (see analgesia SOP) may warrant a prehospital anaesthetic and PPV (see RSI SOP).

### Needle Thoracocentesis

- Indications
  - Peri-arrest tension pneumothorax with planned subsequent thoracostomy
  - Tension pneumothorax with difficult patient access (trapped)
- Advantages
  - Quick
- Disadvantages
  - False reassurance of pathology resolution
  - Failure to breach pleural space
  - Easily dislodged/blocked
  - Does not facilitate lung reinflation
- Procedure
  1. Introduce a 14G cannula just above the rib in the 2$^{nd}$ intercostal space midclavicular line or the 4$^{th}$-5$^{th}$ intercostal space midaxillary line (caution with occlusion by the patients arm on packaging for transfer to hospital)

2. Attach a saline primed 5ml syringe to the cannula hub, and aspirate during insertion until pleural breach is detected.
3. Removed the needle and dispose of safely. Secure the cannula in place using a roll of tape for protection, to avoid kinking.
4. Clinically re-evaluate the patient for tension physiology resolution.

**Finger Thoracostomy**

- Indications:
  - Bilateral
    - Traumatic cardiac arrest with suspected chest injury
    - Cardiac arrest in diving emergencies (see diving SOP) or asthma
    - Unexplained hypotension in polytrauma
  - Unilateral
    - Pneumothorax or haemothorax with signs of physiological compromise
    - Suspected or confirmed (on ultrasound) pneumothorax prior to air transfer in the PPV patient
- Advantages
  - Definitive decompression
  - Lung re-expansion can be palpated
  - Re-fingered as required
  - Avoids re-tension caused by tube thoracostomy blockage

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- Disadvantages
  - Invasive procedure
  - Occlusion (during packaging) can precipitate re-tension
- Procedure
  1. In the non-emergent setting clean the axilla with chlorhexidine 2% in alcohol (Chloraprep™) and wear sterile gloves.
  2. Identify the landmarks for the procedure.
  3. Make a 1–2-inch incision along the line of the ribs in the 4th or 5th intercostal space in the mid-axillary line (aim high in obese and pregnant*).
  4. Use a scalpel for the skin. Thereafter blunt dissect with Spencer Wells forceps to create a tract and pass through the intercostal muscles into the pleura.
  5. Introduce a finger into the pleural cavity, be careful to avoid bone fragment injuries, and sweep 360° to ensure no adherent lung and assess lung position.
  6. Verbally report whether the lung is up, down or whether there is a significant amount of bleeding.

*In patients progressing to a resuscitative thoracotomy, avoid committing to the 3rd ICS if a 'high' thoracostomy was undertaken in the obese/pregnant, as this will significantly impede access to the heart. If necessary, identify landmarks and undertake a repeat thoracostomy.

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**Tube Thoracostomy**

- Indications:
  - SV tension pneumothorax with oxygen debt, AND
  - Single system pathology, AND
  - Unilateral disease
- Advantages
  - Definitive decompression
  - Facilitates complete lung reinflation
- Disadvantages
  - Invasive procedure
  - Drain blockage (blood, kinking, lung apposition) can precipitate re-tension
  - Rapid air leak filling bag can result in re-tension (empty the bag regularly)
- Procedure
  1. Layout a sterile kit dump, obtain consent from the awake patient.
  2. In the non-emergent setting clean the axilla with chlorhexidine 2% in alcohol (Chloraprep™) and wear sterile gloves.
  3. Consider procedural sedation the patient (see sedation SOP) and infiltrate 1% lignocaine (max 3mg/kg) into the skin and deep tissues to provide local anaesthesia.
  4. Identify the landmarks for the procedure.
  5. Make a 1–2-inch incision along the line of the ribs in the 4th or 5th intercostal space in the mid-axillary line (aim high in the obese and pregnant).

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6. Use a scalpel for the skin. Thereafter blunt dissect with Spencer Wells forceps to create a tract and pass through the intercostal muscles into the pleura.
7. Introduce a finger into the pleural cavity, be careful to avoid bone fragment injuries, and sweep 360º to ensure no adherent lung and assess lung position.
8. Verbally report whether the lung is up, down or whether there is a significant amount of bleeding.
9. Insert the intercostal drain making note of the position at skin level, attach to a Portex™ drainage bag with a one-way valve.
10. Secure the drain using handheld suture and sleek tape/nightingale dressing. Tape the drain to the chest wall to avoid accidental removal.
11. Re-assess the patient and the drain to ensure optimal position, ensure the drain is well secured and the bag/tube are free during patient transfer.

**Resuscitative Thoracotomy**

- Please see resuscitative thoracotomy SOP

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