



Queensland
Trauma Education



CHEST TRAUMA

Intercostal catheter insertion

Procedural skill

Facilitator resource kit

CSDS



Clinical Skills Development Service



Queensland Trauma Education

The resources developed for Queensland Trauma Education are designed for use in any Queensland Health facility that cares for patients who have been injured as a result of trauma. Each resource can be modified by the facilitator and scaled to the learners needs as well as the environment in which the education is being delivered, from tertiary to rural and remote facilities.

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Chest Trauma – Intercostal catheter insertion: Procedural skill – Facilitator resource kit
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About this training resource kit

This resource kit provides healthcare workers with knowledge of the technical skills required for the insertion of an intercostal catheter (ICC) for the management of haemothorax or pneumothorax following trauma.

National Safety and Quality Health Service (NSQHS) Standards



Target audience

Medical clinicians.

Duration

30 minutes.

Group size

Small group participation (2-4 participants).

Learning objectives

By the end of this session the participant will be able to:

- Demonstrate knowledge of the indications and contraindications for ICC insertion.
- Identify the anatomical landmarks for safe insertion.
- Identify the essential equipment required for set up.
- Perform the insertion of an ICC utilising the correct procedure.
- Demonstrate knowledge of post-procedure cares.

Facilitation guide

1. Facilitator to provide participant resource kit to participants.
2. Facilitator to utilise facilitation guide to lead procedural skill station for ICC insertion.
3. Facilitator to outline the following:
 - a. Indications and contraindications.
 - b. Discuss equipment and preparation.
4. Facilitator to demonstrate procedure (use ICC insertion video if required).
5. Participants to perform procedure.
6. Facilitator to demonstrate UWSD set up or play instructional video.

Overview ICC insertion

An intercostal catheter is a tube used to drain air, blood or other fluid by insertion into the pleural space. In trauma this is commonly used to manage either pneumothorax or haemothorax or a combination of both.

Contraindications in the acute trauma patient are relatively limited, due to the emergent requirement to improve either haemodynamics and/or oxygenation/ventilation in the setting of tension or significant haemo/pneumothorax. However, a known history of previous pleurodesis and local infection may result in the clinician using alternate insertion techniques or location.

An intercostal catheter should be placed in the triangle of safety to avoid the neurovascular bundle, reduce risk of injury to the mammary artery or breast tissue and avoid inadvertent intraperitoneal insertion.

The size of pneumothorax that requires treatment may vary depending on both clinical situation and patient factors. A patient with signs of tension clinically (tachycardia, hypotension and hypoxia) should be managed with surgical thoracostomy followed by the insertion of an intercostal catheter connected to a chest drainage system.. In the stable patient, who does not require positive pressure ventilation or transfer in a non-pressurised aircraft, a conservative approach may be taken.

The supine CXR can be challenging to accurately measure the size of the pneumothorax, with CT measurement of <35mm measured between the parietal and visceral pleura/mediastinum shown to be safe for an observational approach.¹

Longer term complications of intercostal catheter insertion include empyema, pain, bleeding and damage to underlying structures.

Further reading

Online course: Intercostal Catheter Insertion ICC	
Organisation	Clinical Skills Development Service
Link	https://central.csds.qld.edu.au/central/courses/326

ICC insertion consent form	
Organisation	Queensland Health
Link	https://www.health.qld.gov.au/_data/assets/pdf_file/0025/154915/medical_imaging_105.pdf

Princess Alexandra Hospital ED ICC procedure	
Organisation	Metro South Hospital and Health Service
Link	http://paweb.sth.health.qld.gov.au/medicine/emergency/documents/PAHED007.pdf

ICC procedure documentation	
Organisation	Queensland Health
Link	https://qheps.health.qld.gov.au/_data/assets/pdf_file/0027/2153565/2218.pdf

ICC procedural video	
Organisation	Queensland Trauma Education
Link	<i>Coming soon</i>

UWSD video demonstration	
Organisation	Queensland Trauma Education
Link	<i>Coming soon</i>

NSW Health ICC guideline	
Organisation	NSW Health
Link	https://www.aci.health.nsw.gov.au/_data/assets/pdf_file/0018/201906/PleuralDrains_Guideline-021116.pdf

Procedural skill

Resources required

Preparation considerations	<ul style="list-style-type: none"> • Consent • Time out: Correct patient, correct procedure, correct site and side • Baseline observations • Supplemental O₂ • Analgesia/sedation • SpO₂ continuous monitoring
Equipment	<ul style="list-style-type: none"> • Part-task trainer ICC insertion eg. Super Annie (available through the Clinical Skills Development Service) • Room with resus and safety equipment • Large procedure trolley • Large sterile ICC procedure tray/sterile procedural pack • Sterile gloves, gown and mask • Skin antiseptic solution (2% chlorhexidine in 70% alcohol or Providine) • Sterile window drapes • Drawing up needle • 23g and 25g needle • 10 and 20ml syringe • Local anaesthetic – 1% lignocaine +/- adrenaline • Scalpel and blade • Sutures – 1.0 silk or nylon • Needle holder • Curved Harrison's forceps • Chest tube – MO to determine size • Drainage system (e.g. Atrium dry seal chest drain) • Dressing products (eg. IV3000, tegaderm) • Fixamol • Large non-toothed artery forceps x2 • Optional – Heimlich valve

Procedure

1. Identify triangle of safety - can mark with sterile pen (NB. Remember to return patient to the exact same position after marking triangle of safety).
2. Perform hand hygiene.
3. Position patient with arm abducted and supported by assistant.
4. Aseptic technique – everyone in the room should wear PPE. The operator requires: sterile gown and gloves in addition to a mask.

5. Clean the skin and apply 2% chlorhexidine skin prep (or equivalent) from at least the nipple line to the posterior axillary line. Allow the prep to dry fully. Drape widely.
6. Infiltrate local anaesthetic widely around the incision site and down to the pleural space. Allow five minutes for local anaesthetic to work. If insufficient analgesia, obtain a new syringe of local anaesthetic and re-inject to a maximum of 20mL of 1% lignocaine solution (healthy 70kg adult male).
7. Do not inject into the tissues once fluid has been aspirated into the local anaesthetic syringe.
8. Do not proceed without further imaging if air/fluid is not confirmed at the time of local anaesthetic infiltration in the pleural space.
9. Incise the skin (along the rib or perpendicular to the rib) to a sufficient length to allow passage of finger or tube.
10. Blunt dissect tissue to pleural space using curved Harrison forceps. When dissecting, it is helpful to imagine where you want the tip to lie once it is placed, and to make your dissection in that direction as the tube will generally follow the tract that you have prepared for it.
11. It is difficult to anaesthetise the parietal pleura. Addition of more clean local anaesthetic (total within the maximum volume limit) at this point may be required.
12. Blunt dissect into the pleural space. Take care at this stage to ensure that you are dissecting towards the same intercostal space. It is easy for the skin to ride up or down one space. Upon entering the pleura, the operator will feel and/or hear a 'pop'.
13. Insert the tube into the tract formed by blunt dissection. It may help to pre-load the tube using the distal part of the curved Harrison's forceps to make for easier insertion. In spontaneous breathing patients, clamping the ICC prevents the creation of an 'open pneumothorax' and risks of developing a tension pneumothorax.
14. Insert the tube to ensure the most distal tube hole is within the pleural space. If possible, direct the tube tip basally to collect fluid or apically to collect air but this is less critical if there are no areas of loculation.
15. Attach the tube to a chest drainage system which has been set up per manufacturer's instructions.
16. Release the clamp (if used) from the distal tube once connected to chest drainage system.
17. Suture the skin to close any gaping. A mattress suture or sutures across the incision are usually employed and, whatever closure is used, the stitch must be of a type that is appropriate for a linear incision. Complicated purse string sutures are not to be used as they convert a linear wound into a circular one that is more painful for the patient and may leave an unsightly scar.
18. The tube should be secured using a separate deep suture tied at the skin.
19. The ends of this suture are left long, then wrapped tightly and repeatedly around the chest tube and tied securely. The sutures must be tied tightly enough to avoid slippage. A Roman-sandal type suture along the tube is not encouraged as it will slip. Locked hand ties are employed to create tension on the ICC to prevent movement.
20. Secure the drain by taping to the skin at another site. This does not replace the need to stitch the drain firmly in place.

21. Include adequate skin and subcutaneous tissue to ensure it is secure.
22. Apply a sterile occlusive dressing.
23. Secure all connections with tape or equivalent - allowing the connection to remain visualised to ensure if disconnection occurs it is rapidly recognised.
24. Observe the five moments of hand hygiene.

Confirming position

A chest x-ray should be performed within one hour and be reviewed by the inserting MO to confirm the tube position, exclude new pneumothorax and confirm the successful drainage of air or fluid.

The CXR should confirm placement within the thoracic cavity, but not abutting major structures (mediastinum, diaphragm).

Clinical assessment of drain position is performed in addition to radiological assessment, by confirming initial bubbling in the canister, swing noted along the tubing and improvement in clinical status.

Additional notes

- Large bore intercostal catheters should only be inserted by operators who have specific competency in this technique.
- Care should be taken that an intercostal catheter NOT a thoracic drain is used (the former has drainage ports to 2.5cm vs 10cm necessitating deeper insertion into the thoracic cavity).
- Thoracic ultrasound can be utilized to confirm the position of the pleural collection/ pneumothorax. This may be done immediately prior to the procedure at the bedside (ensuring the patient's position during the chest drain insertion remains the same as during the ultrasound) or ultrasound may be performed during the procedure if the machine is appropriately set up before hand and a sterile sleeve is used for the ultrasound transducer.
- Do not insert pleural drain through breast tissue.
- Mark the 5th intercostal space in the mid axillary line (or use the site identified by real time ultrasound). As a rule of thumb in male adults, use a hand's breadth lateral to and no lower than the nipple.
- Trocars should not be used.
- ICC if not secured may displace out of the chest wall - this will result in ICC failure, and if ongoing drainage is required will necessitate another drain being inserted.

Documentation in patient medical record and medication chart:

- Sedation given and total local anaesthetic instilled.
- Depth of catheter insertion and any complications.
- Type of tube inserted.
- Method of fixation and wound closure.
- Clinical confirmation of position and CXR results.
- If sutures are required to be removed.
- Any additional orders including ongoing analgesia/regional blockade, suction, specific instructions regarding repeat CXR.

Supporting document

Pleural procedures and thoracic ultrasound: British Thoracic Society pleural disease guideline 2010

<http://dx.doi.org/10.1136/thx.2010.137026>

BTS guidelines

Pleural procedures and thoracic ultrasound: British Thoracic Society pleural disease guideline 2010

Tom Havelock,¹ Richard Teoh,² Diane Laws,³ Fergus Gleeson,⁴ on behalf of the BTS Pleural Disease Guideline Group

BACKGROUND
In hospital practice, pleural aspiration (thoracentesis) and chest drain insertion may be required in many different clinical settings for a variety of indications. Doctors in most specialities will be exposed to patients requiring pleural drainage and need to be aware of safe techniques. There have been many reports of complications with large-bore chest drains and it has been suggested that, with the previous guidelines and the advent of small-bore S-chest drains, there would have been a reduction in complications. Unfortunately the descriptions of complications continue, and in the Patient Safety Agency (NPSA) making recommendations for safe practice. Updated guidelines take into account recommendations from this report and the technique of pleural aspiration and chest drain insertion and ultrasound in this guideline consists of describing these procedures but, where possible, giving evidence is available.

TRAINING
All doctors expected to insert a chest drain should be given a combination of didactic training and supervised practice and be considered competent. (✓)
Before undertaking an invasive procedure, all operators should be appropriately supervised. Many of the complications reported in the NPSA report were the result of inadequate training or supervision. A recent survey showed that the majority did not have a training policy for chest drain insertion. Studies of clinical practice have shown a wide variation in the knowledge of doctors inserting chest drains. In a survey where doctors were asked to insert a chest drain, 4% would insert the drain outside the triangle of safety, with the majority of doctors being too low. Knowledge of the triangle of safety was higher in the group with more experience and higher in doctors who had received training to insert drains without supervision. Training should include a theoretical component describing the risks and technique of the procedure, prior to assessed manual supervised procedure. In the UK it is currently not possible to obtain a certificate of competence for chest drain insertion as part of the curriculum for core medical training and trainees should be expected to describe the procedure and complications in an examination. The trainee should ensure each procedure is documented in their log book and signed by the trainer. A Directly Observed Procedure (DOP) assessment should be completed in support of this.

Supplementary appendices
1-4 are published online only. To view these files please visit the journal online (<http://thx.bmj.com>).
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Figure 2 The 'triangle of safety'. The triangle is bordered anteriorly by the lateral edge of pectoralis major, laterally by the lateral edge of latissimus dorsi, inferiorly by the line of the fifth intercostal space and superiorly by the base of the axilla.

Acronyms and abbreviations

Term	Definition
ICC	intercostal catheter insertion
UWSD	under water seal drain

References

1. Eddine, S., Boyle, K., Dodgion, C., et al. Observing pneumothoraces: The 35-milimeter rule is safe for both blunt and penetrating chest trauma. *Journal of Trauma and Acute Care Surgery* 2019; 86(4), 557-564. <https://doi.org/10.1097/ta.00000000000002192>
2. NSW Health ICC guideline https://www.aci.health.nsw.gov.au/data/assets/pdf_file/0018/201906/PleuralDrains_Guideline-021116.pdf

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