Emergency Decompression & Chest Drain Insertion Guideline

Title:	**Emergency Chest Drain Insertion**
Version:	**1**
Supersedes:	n/a
Application:	The guideline is intended for use by any hospital team caring for infants, children and young people under 16 years age across the Paediatric Critical Care Network in the North-West (England) & North Wales region.

Originated /Modified By: **Designation:**	**Originated By:** North-West (England) & North Wales Paediatric Transport Service (NWTS) & North-west (England) and North Wales Paediatric Critical Care Network **Co-Authors:** 1. Elizabeth Simons, NWTS SCF 2. Mark Doran, EM & ICM consultant, Bolton NHS Foundation Trust 3. Kate Parkins, PICM Consultant, NWTS 4. Tamryn Miller, Senior Clinical Fellow, Anaesthetics, AHCH 5. Emma Roach, Band 6 nurse, NWTS 6. Nicola Longden, clinical nurse specialist, NWTS 7. Anna Parry, clinical nurse educator, NW PCC/SiC/LTV ODN **Consulted parties:** Paediatric respiratory and surgical teams at AHCH & RMCH North-West (England) & North Wales Paediatric Transport Service (NWTS) PICU, Royal Manchester Children's Hospital PICU, Alder Hey Children's Hospital
Reviewed by:	1. North-West (England) & North Wales a. Paediatric Critical Care Operational Delivery Network (ODN) b. Children's Major Trauma ODN c. Surgery in Children ODN (including tertiary surgical teams) 2. Sophina Mahmood, Paediatric Pharmacist, PCC ODN & RMCH 3. Lewis Nicholls, Paediatric Pharmacist, PCC ODN & RMCH
Ratified by:	1. North-West (England) & North Wales Paediatric Critical Care ODN 2. RMCH (Host Trust): Paediatric Policies & Guidelines & Pharmacy & Medicines Management Committees
Date of Ratification:	1. PCC Oversight: 03.12.25 2. PCC ODN guidelines committee 20.01.26 3. P&G Committee: 13.02.26

Issue / Circulation Date:	17.02.26
Circulated by:	PCC, SiC & LTV ODN
Dissemination and Implementation:	17.02.26
Date placed on websites: NWTS & PCC, SiC & LTV ODN	13.02.26
Planned Review Date:	February 2029
Responsibility of:	Clinical lead North-West (England) & North Wales Paediatric Critical Care ODN & NWTS guideline lead consultant
Minor amendment (if applicable) notified to:	
Date notified:	
EqIA Registration Number:	**2026-52**

1. Detail of Procedural Document

Emergency chest drain insertion – practical guide

2. Equality Impact Assessment

Equality Impact Assessment Please record the decision whether the policy, service change or other key decision was assessed as relevant to the equality duty to: Eliminate discrimination and eliminate harassment Advance equality of opportunity Advance good relations and attitudes between people		
Relevant	YES	Guideline relevant for paediatric age group only Intended for use across North-West (England) & North Wales region for those under 16 years of age. Appropriate PEWS and observation target ranges included for all age groups. Risk of occult hypoxaemia highlighted IE that it is more than 3 times greater in Black vs White pts AND may over-estimate SpO_2 between 1.5-5%.
Where the decision was RELEVANT, please record details of the outcome of the full impact assessment and summarise the actions that will be taken to eliminate or mitigate adverse impact, advance equality or justification for the impact.		
EqIA registration Number for RMCH:		2026-52

3. Consultation, Approval and Ratification Process

This guideline was developed with input from:
- North-West (England) and North Wales Paediatric Transport Service (NWTS).
- North-West (England) and North Wales Paediatric Critical Care Operational Delivery Network
- Representatives from the Local Hospital Teams within network above.

These guidelines were circulated amongst the North-West (England) and North Wales Paediatric Critical Care Operational Delivery Network for comments in November 2025.

All comments received have been reviewed and appropriate amendments incorporated.

These guidelines were signed off by the PCC ODN guidelines committee on 20.01.26

For ratification process for network guidelines see appendix 1.

4. Disclaimer

These clinical guidelines represent the views of the North-West (England) and North Wales Paediatric Transport Service (NWTS) and the North-West (England) and North Wales Paediatric Critical Care Operational Delivery Network (PCC ODN). They have been produced after careful consideration of available evidence in conjunction with clinical expertise and experience.
It is intended that trusts within the Network will adopt this guideline and educational resource after review and ratification (including equality impact assessment) through their own clinical governance structures.
The guidance does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient.
Clinical advice is always available from NWTS on a case-by-case basis.
Please feel free to **contact NWTS (01925 853 550)** regarding these documents if there are any queries.

Emergency Decompression & Chest Drain Insertion Guideline

INDICATIONS FOR CHEST DRAIN when pleural pathology seen on CXR
Pneumothorax, Empyema, Haemothorax, Pleural effusion, Chylothorax

STOP & ASSESS ABCDE

IS THERE A LIFE THREATENING A B C D E PROBLEM?
OR
ANY SIGNS OF TENSION PNEUMOTHORAX OR MASSIVE HAEMOTHORAX WITH SHOCK?

- Cyanosis, ↑RR, SOB +/- ↑WOB, +/- chest pain
- Signs of shock: ↑HR or ↓HR, +/- ↓BP (hypotension = LATE sign)
- Tracheal deviation AWAY from side of pneumothorax or massive haemothorax (late sign)

YES

PUT 2222 CALL OUT IMMEDIATELY
NB need both Anaes / ICU + Paeds
AND TRAUMA CALL if massive haemothorax

ACT NOW: don't delay (as below)

TENSION PNEUMOTHORAX
GIVE 100% O_2 or 15 L/min O_2
URGENT DECOMPRESSION
Under 12 yrs => needle decompression Size 14G (orange) or 16G (grey) cannula (page 5)
Over 12 yrs => finger thoracostomy (page 6)
Proceed to chest drain (pg 7 & pg 8)

MASSIVE HAEMOTHORAX with SHOCK
GIVE 100% O_2 or 15 L/min O_2
Decompression via finger thoracostomy (pg 6)
NB AVOID needle decompression as it will kink/block
Insert chest drain (pg 7 & pg 8)
TRIGGER PAEDIATRIC MAJOR HAEMORRHAGE

NO

PAUSE & CONSIDER:

- **Is a chest drain needed?**
- **Is it needed now vs later?**
- **Location ie tertiary or local hospital**
- **D/W NWTS +/- conference call with tertiary specialist**
- **Under 16 yr will need: Intubation & ventilation OR procedural sedation**
- **Prepare for cardiac instability? Get ready:**
  - **Fluid bolus OR blood (O Rh-ve)?**
  - **Dilute adrenaline (page 4)**
  - **Adrenaline infusion pre-drain?**
- **Volume fluid to drain:**
  - **ALWAYS clamp pleural effusions at 10 mL/kg drainage (EXCEPT haemothorax)**
- **Location of care post-drain**

PNEUMOTHORAX	EMPYEMA / PARAPNEUMONIC EFFUSION	HAEMOTHORAX	CHYLOTHORAX
SUSPECT IF: ↑WOB + new O2 requirement +/- chest pain **Assess clinical impact (+ size)** **To assess size on CXR** **Large > 50% hemithorax OR** **>12 years:** gap between lung & chest wall at apex >3cm OR at hilum > 2cm (erect CXR)	**SUSPECT IF:** acute LRTI pt remains pyrexial +/-unwell after 24-48 hrs antibiotics +/- whiteout on CXR **Urgent USS** to assess effusion size/need to drain **NB Risk of ↓BP** when chest drain inserted (SIRS – systemic inflammatory response syndrome)	**SUSPECT IF:** blunt or penetrating chest trauma May be associated with pneumothorax **Risk of ↓BP** when chest drain inserted **due to loss of blood volume**	**SUSPECT IF:** injury or obstruction of thoracic duct **Potential causes**: Surgical: Post cardiac or thoracic (oesophageal, lung) Trauma: chest or back Other: Lymphoma; Noonan's syndrome
Symptomatic (large) => give O_2 + consider drain **None or min symptoms (small) => FiO_2 ≥ 60% O_2** aids nitrogen reabsorption & watch closely **Caution:** $HFHO_2$ or NIV CPAP or BiPAP may worsen ongoing pneumothorax but be clinically needed. Conservative tx = best option in min/asymptomatic pt **D/W NWTS**	**Do NOT drain locally until D/W tertiary paediatric respiratory team + NWTS** **Vast majority requiring chest drain will need transfer to tertiary centre for management.** **D/W NWTS any pt needing transfer**	**Consider D/W Paeds Trauma Team Leader (TTL) before (or after) drain** **AHCH: 0151 252 5401** **RMCH: 0161 701 9191** **THINK: trigger paediatric major haemorrhage?** **Always have ORh-ve packed cells ready PRE-drain**	**Do NOT drain locally until D/W NWTS + appropriate surgical team or TTL (if trauma)** NB if post-cardiac surgery AVOID local drainage will need transfer to AHCH for chest drain & ongoing management **D/W NWTS**

Emergency Decompression & Chest Drain Insertion Guideline

PRE-INSERTION CONSIDERATIONS

Insertion of a chest drain ideally involves a multi-disciplinary approach: min paeds + anaes

- **If tension pneumothorax OR massive haemothorax with shock decompress & drain immediately**
- **Has CXR confirmed diagnosis?** (POCUS helpful but should not delay treatment). NB CXR NOT essential if tension pneumothorax
- **Paeds tertiary team agreed local insertion essential**? NB Majority will need to be transferred to tertiary centre for drain
- **Identify most appropriate clinician** to insert drain. Varies: intensive care, anaes, EM, paeds, respiratory medicine, surgery
- **Appropriate equipment ready?** (see below).
- **Sedation & airway support considered?** If < 16 yr old is awake, D/W NWTS & local paeds / anaes teams: local anaesthetic + procedural sedation (page 5) VS intubation & ventilation
- **Location of pt:** for procedure? Post-procedure?
- **Monitoring:** SpO_2 ECG, BP (3 min automatic repeat), +/- ET CO_2
- **Give 100% O_2** during the procedure unless contraindicated
- **IV or IO access** should be in place

For who don't have haemothorax or tension pneumothorax: HIGH RISK characteristics are

- Haemodynamic compromise
- Significant hypoxia
- Bilateral pneumothorax
- Underlying lung disease
- Haemopneumothorax

CONSIDER INTUBATION before drain IF:

- Reduced conscious level
- SpO_2 < 92% in 60% O_2
- Worsening ↑CO_2 & respiratory acidosis
- ↓BP
- Fluid resuscitation ≥ 40mL/kg
- Procedure won't be tolerated

EQUIPMENT REQUIRED

Needle thoracocentesis (under 12 years):

- Cleaning solution eg 2% chlorhexidine / 70% alcohol swabs
- 1% lidocaine for local anaesthetic (if aware)
- Topical anaesthetic (eg ametop) if appropriate/time allows
- 5 mL + 20 mL IV syringes & 25G (orange) + 21G (green) needles
- 3-way tap + single lumen short extension (T-piece)
- Waterproof dressing x2 / tape
- Large bore cannula (14G orange & 16G grey) – ideally 'stiffer' /longer cannula eg Abbocath. Smaller cannulas will not stay patent following removal of the needle, which will prevent successful drainage of pneumothorax.

NEVER use butterfly needles as not long enough to reach pleural cavity & drain pneumothorax & higher risk of causing pneumothorax

NB > 12 years OR larger chest wall, large cannula may not be long enough to reach pleural cavity => finger thoracostomy

Finger Thoracostomy/ Chest drain insertion:

- Cleaning solution eg 2% chlorhexidine
- Drain system: underwater, Heimlich/valved, Thopaz
- 500mL sterile water for underwater drain
- Spigot connector, 3-way tap & drain tubing
- Sterile gown, gloves, hat & facemask
- Sterile drapes x2 (or single fenestrated)
- Scalpel blade (eg no. 11)
- Non-absorbable suture (curved needle) & holder
- 5 mL syringes, 25G (orange) + 21G (green) needles (for lidocaine etc)
- 0.9% sodium chloride
- Instruments for blunt dissection/cut down set (eg arterial forceps, Roberts or Spencer Wells clamps)
- Chest drain/seldinger drain set (smaller size for air leak; larger for fluid/blood): size approx. 4x ETT

PREPARATION

- Fluid bolus OR packed cells (O Rh-ve) 10 mL/kg aliquots
- 'Dilute adrenaline': using 3-way tap, dilute 0.1 mL/kg adrenaline 1:10,000 (Minijet syringe) up to 10mL with 0.9% sodium chloride; final solution = 1 microgram/kg/mL. Bolus 1 - 2 mL aliquots to maintain BP if needed. Flush with 5 mL 0.9% NaCl
- Consider if need adrenaline infusion PRE-drain (see NWTS shock guideline)
- If NOT life-threatening emergency: check FBC & clotting. If deranged coagulopathy or platelet defect request appropriate products. NB platelets +/- clotting factors must be running at time of drain insertion to be effective.
- Operator with the most experience should insert drain with an assistant AND separate person to manage pt
- Written consent should be obtained if time permits

METHOD OF INSERTION CHEST DRAIN

- Seldinger technique or open procedure with blunt dissection/slit thoracostomy technique
- Choice of technique, and whether ultrasound (USS) guidance is used, will depend on operator experience and preference.

SAFE TRANSFER TIPS

- Check chest drain secured appropriately (see page 7)
- **IDEALLY** use one-way valve system drain eg Heimlich flutter valve or ambulatory chest drain (eg Roberts)
- Secure underwater drain below level of pt by taping to floor of ambulance for journey.
- Consider 3-way tap to allow for aspiration/flushing on-route
- Carry emergency needle thoracostomy equipment

CHEST DRAIN SIZE GUIDE

- Neonate: 8-12 Fr
- Infant: 8-14 Fr
- Child 10-18 Fr
- Adolescent: 12-22 Fr
- Use smallest (for pt) bore drains whenever possible to minimise patient discomfort
- **May need a larger drain haemothorax** to ↓risk of drain blocking but evidence exists to challenge this.
- **Larger drain estimate = 4 x ETT ID in mm = Fr**

Emergency Decompression & Chest Drain Insertion Guideline

OPTIONS FOR PROCEDURAL SEDATION (with anaesthetic support) FOR ALL INTERVENTIONS

Sedation: IV Ketamine 0.25—0.5 mg/kg give 1st dose slowly over 2-3 mins. Additional 0.25-0.5 mg/kg top if needed as tolerated. Benefits of ketamine: shorter duration of onset (1-5 minutes); duration of effectiveness (20-25 mins); ↓ nausea and vomiting; faster recovery (within 60 mins).

Plus, analgesia (if required): IV paracetamol (see BNFc). INTRANASAL: fentanyl: 1.5 microgram/kg max 75 microgram or diamorphine 0.1 mg/kg MAX 6 mg (see NPPG statement or see page 14)

AVOID Entonox: nitrous oxide will diffuse into air filled cavities IE will increase the size of a pneumothorax

INSERTION GUIDE: NEEDLE THORACOCENTESIS FOR TENSION PNEUMOTHORAX UNDER 12 YEARS

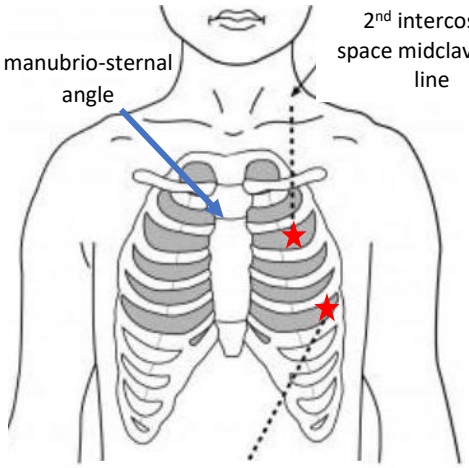
LANDMARKS for INSERTION

Under 12 years:

2nd intercostal space, mid-clavicular line

Identify 2nd intercostal space by locating end of the 2nd rib medially at manubrio-sternal angle. The rib space below the 2nd rib is the 2nd intercostal space

Position head-up, supine, arms by side



5th intercostal space between anterior axillary & midaxillary

NB OVER 12 years OR if significant chest wall thickness (obesity, large pectoral muscles): finger thoracostomy recommended to drain pneumothorax as cannula may not be long enough to reach pleural cavity (page 6)

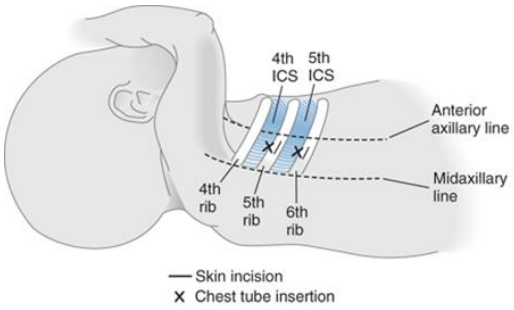
Under 12 years: if ↑ chest wall thickness (obesity, large pectoral muscles) OR initial attempt unsuccessful OR OVER 12 years & no-one has experience to do finger thoracostomy:

4th or 5th intercostal space (ICS) anterior to mid-axillary line (MAL) (known as 'triangle of safety').

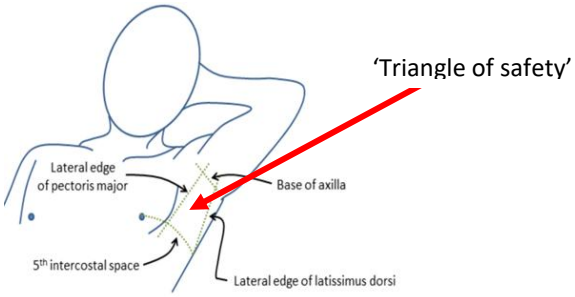
Key landmarks are lateral edge of pectoralis major; anterior border of latissimus dorsi; base of axilla; level of the nipple (typically 4th / 5th intercostal space)

To improve access to insertion site position patient either:

a) Slightly rotated onto side & head of bed tilted slightly up



b) Supine, 45° angle head up: ABduct arm > 90° & rest on forehead or with palm tucked behind head



ALWAYS INSERT ABOVE THE RIB BELOW – to avoid the neurovascular bundle

NEXT STEPS

- Clean the chest wall with 2% chlorhexidine solution
- Consider using local anaesthetic 1% lidocaine (MAX 3mg/kg or 0.3mL/kg maximum 200 mg) subcutaneous to all layers breached from skin down to pleura if time allows & patient not in extremis.
- Attach 5 –10 mL syringe with 3 mL 0.9% sodium chloride to cannula to help identify pleural space (ie air bubbles seen)
- Insert cannula at 90° to chest wall, aspirating continuously. When air is aspirated (air bubbles), remove the syringe & needle whilst gently advancing the cannula into the chest. Leave the uncapped cannula in the chest wall.
- If no air is aspirated, the cannula may need flushing with 1 mL 0.9% sodium chloride due to occlusion with tissue.
- Secure in place with 2 back-to-back IV dressings or tape
- 3-way tap + single-lumen extension may be used to aspirate with 10 - 20mL syringe whilst chest drain is inserted
- Proceed to chest drain insertion as soon as possible (see page 7 & 8). Use same incision/hole if thoracocentesis 4-5th ICS MAL.
- NB if needle thoracocentesis is attempted when there's no tension present, risk of causing pneumothorax is 10-20%

INSERTION GUIDE: FINGER THORACOSTOMY FOR TENSION PNEUMOTHORAX IN OVER 12 YEARS

LANDMARKS for INSERTION

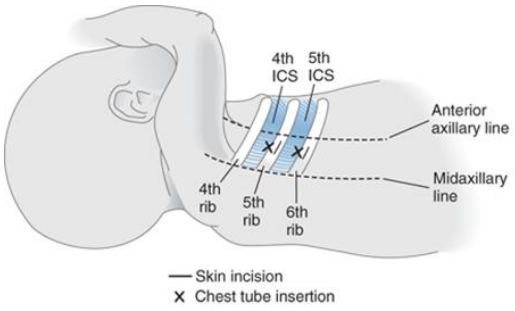
OVER 12 YEARS or significant chest wall thickness (obesity, large pectoral muscles) or if needle thoracocentesis unsuccessful 4th / 5th intercostal space anterior to mid-axillary line (known as 'triangle of safety').

Key landmarks are lateral edge of pectoralis major; anterior border of latissimus dorsi; base of axilla; 4th / 5th intercostal space

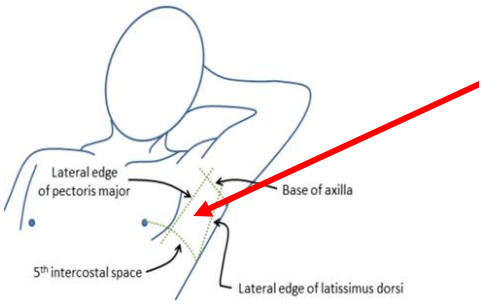
The level of the nipple typically = 4th / 5th intercostal space

To improve access to insertion site position patient either:

a) Slightly rotated onto side & head of bed tilted slightly up



b) Supine, 45° angle head up: ABduct arm > 90˚& rest on forehead or with palm tucked behind head



NEXT STEPS

- Finger thoracostomy may not be tolerated with just procedural sedation, especially in those under 16 years.
- Intubate & ventilate with person doing finger thoracostomy scrubbed, ready, & with kit ready to place drain straight after.
- Intubation & ventilation reduces the likelihood of re-accumulation of tension pneumothorax due to entrainment of external air through an open thoracostomy site
- Identify the appropriate incision site = 4th or 5th intercostal space, anterior to midaxillary line
- Check you are within the 'triangle of safety' (see above)
- Clean the chest wall with 2% chlorhexidine solution
- Consider using local anaesthetic 1% lidocaine (MAX 3mg/kg or 0.3mL/kg maximum 200 mg) subcutaneous to all layers breached from skin down to pleura if time allows & patient not in extremis.
- Make an incision (with scalpel) slightly larger than width of your index finger, above & parallel/in line with the rib below (to avoid neurovascular (NV) bundle)
- Dissect bluntly with an artery forceps (or similar) through the intercostal muscles & pleura
- Introduce a finger into the pleural space to decompress the pleural cavity, allowing evacuation of air and /or blood
- Decompression of pleura and maintenance of the formed tract may be optimised by gentle sweep of the finger within the pleural cavity (beware rib fractures in trauma as may injure gloved finger). Not always required or possible (especially in under 13-year-old) as may create a larger hole than needed for drain which will cause leakage (air/fluid) and/or need closing.

CARE POST-PROCEDURE

- Finger thoracostomy should make situation safe / improve stability of patient.
- Follow finger thoracostomy with chest drain insertion via newly made tract (see page 8) as soon as safe to do so.
- In < 16 years old it is appropriate to use finger thoracostomy tract for chest drain insertion (in hospital)
- Antimicrobials: to reduce the risk of empyema, consider giving broad spectrum antibiotic cover eg cefotaxime or ceftriaxone +/- metronidazole if soiled.

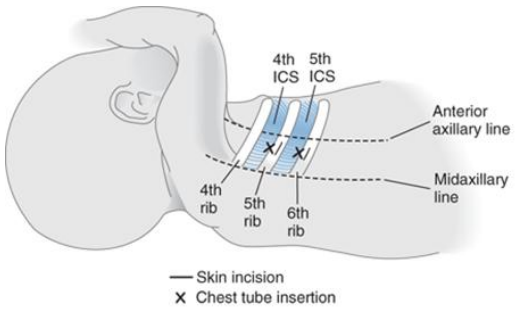
CHEST DRAIN INSERTION USING SELDINGER TECHNIQUE

Consider additional analgesia + sedation pg 5 Majority < 16 yrs likely to need intubation & ventilation (indications GA pg 4)
AVOID nitrous oxide: it will diffuse into air filled cavities & make pneumothorax larger (↑risk of tension)

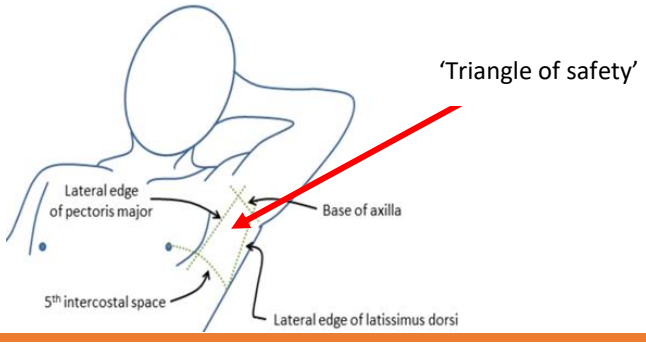
Before starting procedure complete LocSIPP for chest drain insertion

Position: To improve access to insertion site position patient either:

a) Rotated onto side & head of bed tilted slightly up

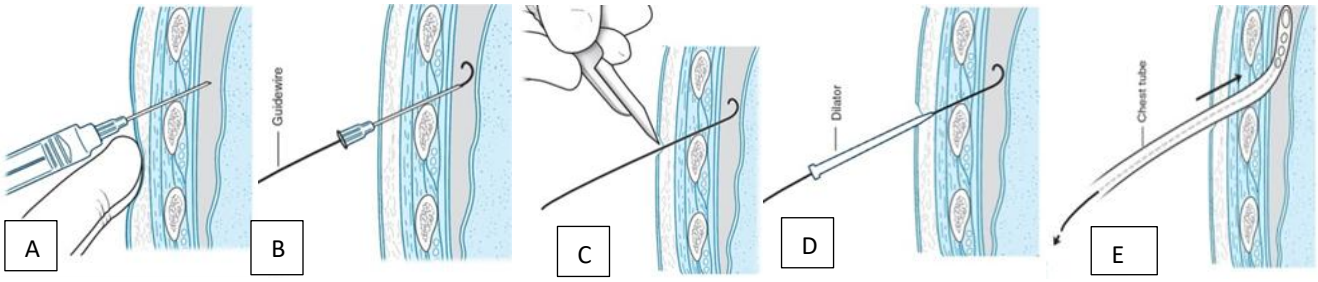


b) Supine, 45° angle head up: ABduct arm > 90°& rest on forehead or with palm tucked behind head

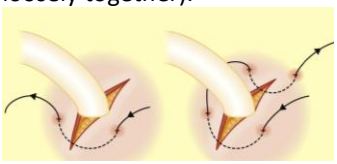


NEXT STEPS: SELDINGER TECHNIQUE (see diagram below)

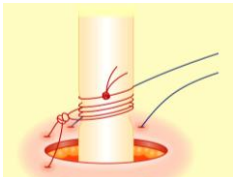
- Clean the chest wall with 2% chlorhexidine solution & drape area
- Infiltrate subcutaneous tissue down to pleura with local anaesthetic (if not already done). Always insert needles just above lower rib to avoid the neurovascular (NV) bundle. Maximum dose: 1% lidocaine 3mg/kg or 0.3mL/kg (MAX 200 mg).
- Distance of soft tissue-to-pleural lining varies with pt: may be estimated from needle length inserted when infiltrating with LA or consider measuring using ultrasound.
- A: Insert seldinger needle at 90° to skin, syringe attached containing 2-3 mL 0.9% sodium chloride & aspirate as advancing
- B: Once bubbles (pneumothorax) or blood (haemothorax) or fluid (effusion) seen/aspirated, disconnect syringe & thread the guidewire via needle into pleural space. Remove needle leaving guidewire in place.
- C: Make a small incision in skin alongside the wire (blade cutting edge directed away from wire) to aid dilator passage.
- D: Load dilator onto guidewire and advance into the pleural cavity (repeat with increasing size dilators as appropriate)
- **ALWAYS control the wire and dilators. Do not pass more than 1cm into the pleural space to avoid lung injury.**
- E: Remove the dilator and load chest drain onto guidewire**.** Always keep guidewire visible (out of non-patient end of the drain), advance drain into the pleural cavity until all holes of chest drain are well within the pleural cavity.
- **All drain holes must lie in the pleural space to avoid surgical emphysema.**
- Note & ideally mark (with steristrip or similar) length chest drain inserted, so any movement can be easily seen
- When anchoring the drain to the skin using the 'omental' tape technique (see pictures below) to support the tubing and prevent drag, always secure below insertion site. Dress the insertion site with an appropriate dressing.



To close the hole when drain removed: Steristrips = ideal for seldinger OR Mattress suture for non-seldinger = (tie ends loosely together).

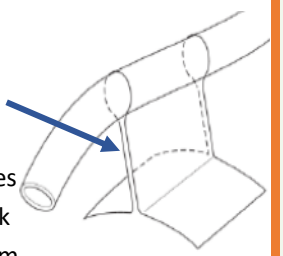


2nd suture = secures drain: initial suture loop (tied with min 3 knots) & lace up the drain to hold



Omental tape: to secure to skin (not clothes) below drain insertion site

Wrap middle section of long piece of non-stretchy tape around drain, then stick 2-sides together before tail ends stuck down onto pts skin or duoderm



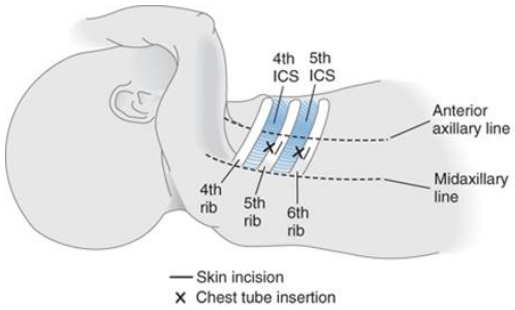
CHEST DRAIN INSERTION: BLUNT DISSECTION TECHNIQUE (trocar/stylet removed)

Consider additional analgesia + sedation pg 5 Majority < 16 yrs likely to need intubation & ventilation (indications GA pg 4)
AVOID nitrous oxide: it will diffuse into air filled cavities & make pneumothorax larger (↑risk of tension)

Before starting procedure complete LocSIPP for chest drain insertion

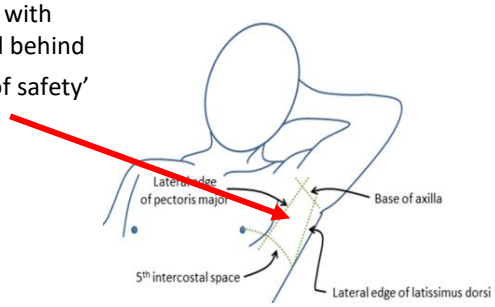
POSITION: To improve access to insertion site position patient either:

a) Rotated onto side & bed tilted slightly head up



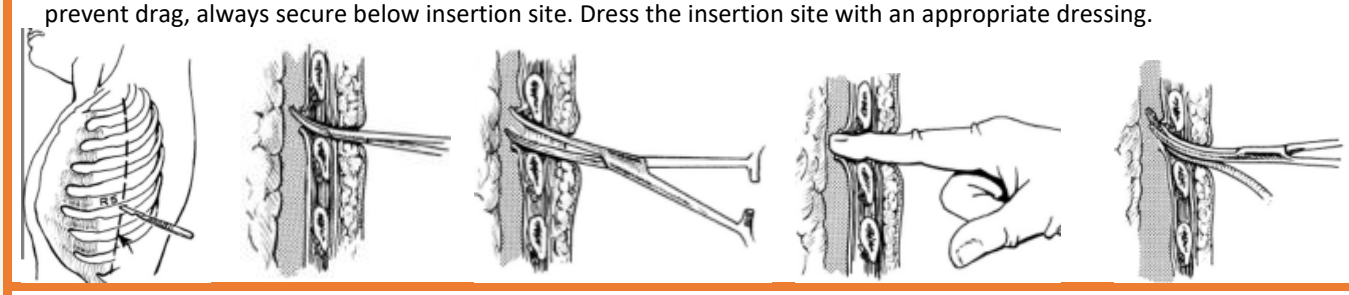
b) Supine, 45° angle head up: ABduct arm > 90° & rest on forehead or with palm tucked behind

'Triangle of safety'



NEXT STEPS: BLUNT DISSECTION TECHNIQUE (remove trocar or stylet prior to chest drain insertion)

- Select an appropriate size chest drain (see page 4) & **remove stylet / trocar.**
- Clean chest wall with 2% chlorhexidine solution & drape area
- Infiltrate subcutaneous tissue down to pleura with local anaesthetic (if not already done). Always insert needles just above rib below to avoid the neurovascular bundle. Maximum dose: 1% lidocaine 3mg/kg or 0.3mL/kg (MAX 200 mg)
- Distance of soft tissue-to-pleural varies with pt: may be estimated from needle length (LA) or consider measuring with USS
- Make 'drain size' incision with scalpel, thru' skin parallel to upper border of rib below (avoiding NV bundle) in intercostal space. Incise down to fascia. "Blunt dissect" (eg with artery forceps) down to pleura, enter pleural space, & then widen hole by opening the forceps. DON'T close clip/clamp/forceps (used for blunt dissection) in chest as may injure lung.
- Over 13 years: may consider sweeping the pleural space with gloved finger to widen the hole & push the lung away from the hole (beware rib fractures in trauma as may injure gloved finger). CAUTION: creating too large a hole will cause leakage (air/fluid) and/or need closing, so it is not always recommended (especially in younger child).
- Hold the tip of the drain with a curved artery clamp and advance it into the pleural space, directing the drain superiorly for air OR inferiorly for fluid/blood. **All drain holes must lie in the pleural space to avoid surgical emphysema.**
- When anchoring the drain to the skin using the 'omental' tape technique (see pictures below) to support the tubing and prevent drag, always secure below insertion site. Dress the insertion site with an appropriate dressing.



CARE POST-PROCEDURE: ANY DRAINS (Nursing observations/care of chest drains – see page 9)

- Connect the end of the drain to the underwater seal or Thopaz system, monitor for swinging and bubbling
- Listen to chest: check for equal/improved air entry and adequate chest expansion
- Monitor for complications including:
  - Haemorrhage (from intercostal vessel laceration)
  - Subcutaneous emphysema (fine crepitus felt under skin; air in chest wall on CXR)
  - Trauma to lung, liver, diaphragm perforation or infarction, or phrenic nerve injury
- Prescribe analgesia: oral or parenteral eg iv paracetamol +/- opiate
- Check drain position (including all drain holes in pleural cavity) & lung expansion or fluid drainage on chest x-ray

ADDITIONAL CONSIDERATIONS FOR MANAGEMENT OF TRAUMATIC HAEMOTHORAX

- **Output:** if massive haemothorax present (>20 mL/kg drains immediately or 3-4 mL/kg/hr for next 2-4 hours), strong consideration should be given to urgent thoracotomy to achieve haemorrhage control
- **Trigger paediatric major haemorrhage if >20 mL/kg via drains OR haemodynamic instability** (see NPEWS page 12; hypotension is a LATE sign, if present pt peri-arrest) **OR if in traumatic cardiac arrest.**
- **If need additional blood products eg https://www.nwts.nhs.uk/clinicalguidelines/national-guidance**
- **Give tranexamic acid: bolus 15 mg/kg & consider an infusion**

Emergency Decompression & Chest Drain Insertion Guideline

NURSING CARE: closely observe all patients following insertion of chest drain

Recommended bedside equipment

- Access to emergency equipment
- 2 chest drain clamps (non-serrated) & kept with child
- Gauze
- Sterile water
- Tape to secure drain to patient's side (never secure to clothing as risk of pulling on chest drain)
- Fluid balance + chest drain chart
- Sterile dressings

OBSERVATION FREQUENCY

FIRST HOUR AFTER INSERTION DRAIN	Continuous monitoring for first 15 minutes, followed by 15 minutely full set observations NB continuous SpO_2 monitoring is essential throughout
HOURLY **Any change in clinical condition, seek help and inform medical team**	Complete set of observations Chest drain unit: - Is it upright, & at level of floor or below level of patient's chest? (Not needed for Thopaz) - Securely positioned on skin below the insertion site (to avoid pressure injuries)? - Check fluid level in under water seal drain - Chest drain tubing free & unkinked? Document whether drain swinging or bubbling (air leaks) – under water drains only Assess & document drain output. Notify medical staff if there's a sudden increase ie: - More than 5mL/kg in 1 hour or more than 3mL/kg consistently for 3 hours
4-HOURLY	Temperature (more regularly if patient pyrexial) Check skin for pressure injuries particularly where the tubing is in contact with the skin. Pain assessment
12-HOURLY **Check drain site**	- Is dressing clean and dry? If not change using ANTT. If bleeding refer to medical team. - Check for signs of erythema/infection, bleeding or surgical emphysema - Check that sutures remain in intact & are secure - Check all connections between chest tubes & drainage unit are tight & secure

Fall in blood pressure and/or rise in heart rate may indicate recurring pneumothorax.
Inform senior nurse immediately. Urgent medical team review. Consider putting out a 2222 call

Swinging: Fluid should rise with inspiration & fall with expiration due to changes in intra-thoracic pressure. This will reduce as pneumothorax resolves.

No swinging (under water drains ONLY):
- Is chest drain still in situ? Check site
- May indicate blocked drain
- Check if tubing kinked or disconnected
- Resolution of pneumothorax?

Bubbling
Bubbles coming from draining tube into drainage bottle is normal in pneumothorax

Pneumothorax not bubbling?
- May indicate blockage
- Check if pneumothorax resolved?

Continuous bubbling (under water drain) OR Air Leak on indicator (Thopaz)?:
- Leak in drainage system (between drain & patient). Check drain for disconnection, dislodgement or loose connection. If dislodged check if all drain holes are still in pleural cavity? Check for surgical emphysema.
- Large air leak from lung or airway

Notify medical staff immediately if problem cannot be remedied. Consider discussing with paediatric surgical team at tertiary centre.

Clamping
Clamping can be achieved by turning 3-way tap off (if in drain tubing) or applying 2 clamps over gauze (to prevent damage to drain). Avoid use of serrated clamps as these can cause damage to chest drain tubing.

Only clamp in following circumstances & document reasons:
- Changing chest drain unit / under water seal
- If chest drain catheter and chest drain tubing become disconnected
- If >10 mL/kg fluid has drained in 1st hour after insertion – inform doctor
- **If known pneumothorax do not clamp chest drain (risk of creating tension pneumothorax)**
- If patient deteriorates after clamping, UNCLAMP immediately

CHEST DRAIN OBSERVATION CHART

Patient Name: *(Attach sticker if available)*

Hospital Number:

Date of Birth:

Position of drain:

Inserted on: *(dd/mm/yyyy)*

Today's Date: *(dd/mm/yyyy)*

	Time	Bubbling	Swinging	Suction Pressure if applicable	Correct Water Level	Chest Drain and connections intact	Site Check	Hourly Drainage	TOTAL
INITIAL INSERTION ONLY	*15mins*	*(Y/N)*	*(Y/N)*	*cmH2O*	*(Y/N)*	*(Y/N)*	*initials*	*millilitres*	*millilitres*
	30mins								
	45mins								
	60mins								

CHEST DRAIN REMOVAL

INDICATION: pneumothorax resolved

- Medical review confirming resolution of pneumothorax both clinically & on reviewing CXR

CHECK pre-procedure:

- Absence of an air leak ie fluttering or bubbling via a patent & unblocked chest drain
- No evidence of respiratory compromise ie SpO_2 within normal range for pt; no increased WOB; not amber/red on NPEWS
- CXR reviewed & shows lung re-expansion

EQUIPMENT REQUIRED

- Dressing pack: sterile towel, sterile gauze & clinical waste bag
- Sterile gloves, apron, mask & goggles
- Appropriate skin cleaning solution eg 2% chlorhexidine
- Steristrips: use if wound suture breaks or is absent
- Suture Cutter
- Clamps x2 (non-serrated)
- Sterile occlusive dressing for drain site
- Sharps container

PATIENT & PRE-PROCEDURE PREPARATION

- **Check pt fasted if using IV sedation (if needed):** for 6 hours following food; 4 hours following milk; 2 hours following clear fluids (NOT fizzy drinks or fresh fruit juice)
- **Check:** pain control, sedation & distraction therapy (see below) are adequate & age-appropriate
- **Location:** for procedure? Post-procedure?
- **Monitoring:** SpO_2 ECG, BP (2-3 min auto repeat), +/- ET CO_2
- **2 members staff** min 1 trained to remove chest drains (see below)
- **Anaesthetist** to administer procedural sedation (see below) if required (NB majority of patients will not need IV sedation)

ANALGESIA FOR CHEST DRAIN REMOVAL

Topical analgesia: do NOT use ametop as no evidence it is effective for chest drain removal

- **Under 12 months:** EMLA cream
- **Dose:** 1-12 months 1 gram of cream (approximately ¼ of 5gram tube)
- **Application:** large blob to procedure site & cover with occlusive dressing 2 hours before procedure; remains effective for up to 15 mins

- **Over 1 year:** LAT solution: lignocaine 4%, adrenaline 0.1% & tetracaine 0.5% solution
- **Dose:** 1-3 years Max 2 mL; >3 years Max 3 mL
- **Application:** Apply 30 mins before planned procedure. Draw up LAT solution into a syringe. Apply solution to procedure site by dripping from syringe. Squeeze any excess onto a piece of gauze & apply to site. Secure with a dressing to prevent child touching LAT using a dressing that is easy to remove.
  LAT remains effective for 15 mins after removal
  NB source LAT solution via pharmacy or emergency department

Options for Procedural Sedation (with anaesthetic support)

Ketamine sedation: initial dose 0.25—0.5 mg/kg given slowly over 2-3 mins plus additional 0.25-0.5 mg/kg top if needed. MAX 2 mg/kg

Benefits of ketamine: Shorter duration of onset (1-5 minutes); duration of effectiveness (20-25 mins); ↓ nausea and vomiting; faster recovery (within 60 mins).

Entonox over 6 years: administered by Entonox trained personnel. AVOID if patient had pneumothorax as risk may recur.

CHEST DRAIN REMOVAL

- Perform hand hygiene, don disposable gloves, apron, mask & goggles, & remove all dressings around chest drain site
- Remove disposable gloves, perform hand hygiene & don sterile gloves
- Place sterile towel under chest drain tubing.
- Clean around drain insertion site & 1-2 cm of tubing coming out of chest wall with appropriate skin cleaning solution
- If wound closure (mattress) suture in place, unwind/untie in preparation for assistant to tie to close wound
- Remove the suture securing the drain in place, being careful not to cut the wound suture.
- Ask the patient to breathe out & hold their breath (if understand & able to). If not, time drain removal with exhalation.
- Pinching the edges of the skin together, remove the drain using smooth, but fast, continuous traction.
- Inspect drain to ensure full drain removal.
- Assistant can then tie the wound suture (min 3 knots) OR use steristrips to close wound
- Cover the wound with a sterile occlusive dressing & monitor for any lifting (coming loose) or soiling

MANAGEMENT POST CHEST DRAIN REMOVAL

- Monitor GCS/AVPU post drain removal if sedation used every 15 mins for 1st hour, then hourly for next 2 hours.
- Check patients' pain score (eg FLACC) & give analgesia as required eg IV paracetamol
- CXR post drain removal, ideally within 2 hours (max 4 hours). Not required if Thopaz system used.
- Clinical status = best indicator of re-accumulation of air. Need URGENT CXR if patient's condition deteriorates
- Monitor: SpO_2, RR, WOB, ECG & BP on drain removal & then hourly for 4 hours post removal then as per clinical condition
- Remove sutures 4 days post drain removal
- Dressing to remain in situ for 24 hours unless contaminated or displaced/not achieving an airtight seal.

Emergency Chest Drain Insertion

TARGETS for managing any critically sick child			
ALL AGES	**SpO_2 ≥ 94% unless cyanotic CHD**	**Lactate ≤ 2 mmol/L**	**Glucose: ≥ 3 mmol/L**

CAUTION inaccurate pulse oximetry (SpO_2) readings can occur in severe anaemia, high carbon monoxide levels and hypoperfusion. IN ADDITION, SpO_2 may inaccurately over-read masking hypoxaemia (occult or unrecognised hypoxaemia), i.e. ARTERIAL (true) oxygen saturation < 88% when SpO_2 ≥ 92%.
Risk of occult hypoxaemia is >3xs greater in Black vs White pts AND may over-estimate SpO_2 between 1.5-5%.

AGE	TARGET MEAN BP	AGE	TARGET MEAN BP
0-11 Months	**45-55**	5-12 Years	**60**
1-4 Years	**55-60**	>13 Years	**60-65**

Respiratory Rate (Score up to 4)							
Score	**4**	**2**	**1**	**0**	**1**	**2**	**4**
0-11 months	0-10	11-20	21-20	31-49	50-59	60-69	≥70
1-4 years	0-10	11-20		21-39	40-49	50-59	≥ 60
5-12 years	0-10	11-15	16-20	21-24	25-39	40-49	≥ 50
>13 years	0-10		11-15	16-24	25-29	30-39	≥ 40

ALL AGES Score	Respiratory Distress (Score up to 4)
0 = none	None
1 = mild	Nasal flaring, subcostal recession
2 = moderate	Tracheal tug, intercostal recession, inspiratory or expiratory noises
4 = severe	Supraclavicular recession, grunting, exhaustion, impending respiratory arrest

ALL AGES Score	Oxygen Saturations (Score up to 4)
0	95-100%
2	92-94%
4	≤ 91%

ALL AGES Score	Oxygen Requirement (Score up to 4) - ALL AGES
0	Room Air
2	0.01 up to 4 litres/min
4	4 or more litres/min **NB** High flow humidified NC oxygen, NIV CPAP or BiPAP score 4 (irrespective of O_2 requirement)

Heart Rate (Score up to 4)							
Score	**4**	**2**	**1**	**0**	**1**	**2**	**4**
0-11 Months	0-80	81-90	91-110	111-149	150-169	170-179	≥ 180
1-4 Years	0-60	61-70	71-90	91-139	140-149	150-169	≥ 170
5-12 Years	0-60	61-70	71-80	80-119	120-139	140-159	≥ 160
>13 Years	0-50	51-60	61-70	71-99	100-119	120-129	≥ 130

Blood Pressure Systolic (Score up to 4)							
Score	**4**	**2**	**1**	**0**	**1**	**2**	**4**
0-11 Months	0-50	51-60	61-70	71-89	90-99	100-109	≥ 110
1-4 Years	0-50	51-60	61-80	81-99	100-119	120-129	≥ 130
5-12 Years	0-70	71-80	81-90	91-109	110-119	120-129	≥ 130
>13 Years	0-80	81-90	91-100	101-119	120-129	130-139	≥ 140

Capillary Refill Time (CRT) (Score up to 2)							
Score	**4**	**2**	**1**	**0**	**1**	**2**	**4**
All Ages		≥ 3 secs		<3 secs		≥ 3	

Emergency Chest Drain Insertion

CHECK IF YOUR PATIENT HAS ANY ADDITIONAL RISK FACTORS (NPEWS)		
RISK FACTOR	**THINK!**	
☐ Baseline vital signs outside normal reference ranges	Always score relevant PEWS value even if this is normal for the patient eg cyanotic heart disease	Vital sign: Eg SpO_2 Patient's normal value: Eg SpO_2 = 75-85%
☐ Tracheostomy / Airway Risk / Difficult Intubation	Do you need additional help in an airway emergency? Needs review by local anaesthetics & ENT teams. Consider d/w NWTS early	
☐ Invasive/Non-invasive ventilation/high flow	Check oxygen requirement on additional respiratory support. Remember High Flow/BiPAP & CPAP score max 4 on oxygen delivery	
☐ Neutropenic/immunocompromised	Sepsis recognition & escalation has a lower threshold	
☐ <40 weeks corrected gestational age	Sepsis recognition & escalation has a lower threshold (beware hypothermia)	
☐ Neurological condition (ie meningitis, seizures)	Remember: check pupil response if anything other than ALERT on AVPU	
☐ Neurodiversity or Learning Disability	Be aware of the range of responses to pain & physiological changes	

NPEWS ESCALATION LEVEL	ACTIONS	MEDICAL REVIEW	OBSERVATIONS / PLAN
E0 – no concerns **Score = 0**	None	Not required	Continue current observations
E1 – Increased monitoring **Score = 1- 4**	Inform Nurse-in-Charge Consider medical review (ST3+ or equivalent) Ensure feedback to parents	As required Discuss with Nurse-in-Charge whether medical review required	Reassess within 60 mins & document ongoing plan
E2 – Needs clinical review (within 30 mins) **Score = 5-8**	Review by Nurse-in-Charge Ensure feedback to parents	Within 30 mins Review by ST3+ or equivalent Discuss stabilisation plan with consultant	Reassess within 30 mins & document ongoing plan Continuous SpO_2 monitoring
E3 – Needs rapid review (within 15 mins) **Score = 9-12**	Immediate review by Nurse-in-charge Discuss medical plan with consultant Senior feedback to parents	Within 15 mins Alert to ST3+ or equivalent Stabilisation plan to be agreed after review by consultant Consider NWTS referral after consultant review	Reassess every 30 mins Continuous monitoring SpO_2, RR, & ECG Record full GCS if change in AVPU
E4 – Needs emergency review (immediate) **Score > 12**	Immediate review by Nurse-in-Charge Consider immediate 2222 call for immediate emergency medical response Inform paeds consultant Senior feedback to parents	Immediate Alert to ST3+ or equivalent Consultant review ASAP Anaesthetic review Consider NWTS referral after appropriate initial interventions	Reassess every 15 mins Continuous SpO_2, ECG, & RR Record full GCS if change in AVPU

NB Escalation levels can also be selected and triggered if parent or carer expresses concern that their child needs increased monitoring +/- clinical review despite PEWS, OR parent or nursing gut instinct irrespective of score.

Medical Plan for Stabilisation:

Structured plan must be documented including:

1. Specific actions to be taken
2. Expected outcome
3. Outcome deadline / in timeframe
4. Escalation if outcome not met by deadline / in timeframe

REFERENCES

1. Roberts ME, et al. Thorax 2023;78 (suppl 3):1–42. doi:10.1136/thorax-2022-219784; British Thoracic Society Guideline for pleural disease
2. Balfour-Lynn IM, Abrahamson E, Cohen G et al; BTS guidelines for management of pleural infection in children Thorax 2005;60(Suppl I):i1–i21
3. Brown SGA, Ball EL, Perrin K et al Conservative versus interventional treatment for spontaneous pneumothorax. N Engl J Med 2020 Jan 30; 382(5): 405-415
4. Advanced Life Support Group (ALSG), Advanced Paediatric Life Support: A Practical Approach to Emergencies 7th edition, Wiley Blackwell; 2023
5. https://vascufirst.com/vad-insertion/recommendations-regarding-catheter-vein-ratio/
6. Thames Valley & Wessex Chest drain guideline 2024
7. RCH trauma guideline: management of traumatic pneumothorax & haemothorax 2018
8. https://www.baps.org.uk/subspecialties/thoracic/spontaneous-pneumothorax/
9. Royal Children's Hospital, Melbourne. Chest drain management guideline 2022 https://www.rch.org.au/rchcpg/hospital_clinical_guideline_index/chest_drain_management/
10. Ginnis C, Snelson E, Herrieven E. Pneumothorax Guideline August 2022, Sheffield Children's Hospital
11. British Association of Paediatric Surgeons: Spontaneous Pneumothorax Guideline 2020
12. **Neonatal & Paediatric Pharmacists Statement on analgesics or sedatives via intranasal route 2023 https://nppg.org.uk/wp-content/uploads/2023/11/Position-Statement-Intranasal-Drugs-V1.pdf**
13. Lyons, NB; Abdelhamid, MO; Collie, BL et al. Small versus large bore thoracostomy for traumatic hemothorax: A systematic review and meta-analysis. Journal of Trauma and Acute Care Surgery 97(4): 631-638, October 2024.
14. Alder Hey Children's NHS Foundation Trust PICU guideline for removal of chest drains including use of LAT Gel.

Emergency Chest Drain Insertion

RESOURCES

FOR DRUG DOSES:

British National Formulary for Children

Neonatal & Paediatric Pharmacists Statement on analgesics or sedatives via intranasal route 2023
https://nppg.org.uk/wp-content/uploads/2023/11/Position-Statement-Intranasal-Drugs-V1.pdf

Emergency Drug Guide **(wt based) via NWTS website home page** for intubation drugs / sedation regime / inotropes
https://www.nwts.nhs.uk/emergency-drug-guides

GUIDELINES FOR <16 YEARS: www.nwts.nhs.uk/clinicalguidelines/regionalguidelines-a-z
STOPP tool: Safe Transfer of Pediatric Patients which includes risk assessment prior to transfer, and checklists
NWTS LocSIPPS: includes sizes of ETT, suction, NGT, CVL & arterial lines and checklist for paediatric intubation
Guidelines include: intubation and difficult airway, sepsis, shock, insertion of intraosseous needle, collapsed neonate or infant, management of under 16 years outside PCC level 3 unit, and transfer

Education: www.nwts.nhs.uk/education-website
Includes recordings of NWTS education eg time critical transfers, sepsis, airway management etc
Login details for NWTS education site are available from your nursing, AHP and medical paediatric critical care operational delivery network links
OR via email: info@nwts.nhs.uk

CONTACT NUMBERS:

NWTS (North-West (England) & North Wales Paediatric Transport Service): **Referrals 08000 84 83 82**
General enquiries: 01925 853 550
Regional Paediatric Intensive Care Unit Alder Hey Childrens Hospital: 0151 252 5241
Regional Paediatric Intensive Care Unit Royal Manchester Childrens Hospital: 0161 701 8000

Guideline authors: version 1

Elizabeth Simons, NWTS SCF
Mark Doran, EM & ICM consultant, Bolton NHS Foundation Trust
Kate Parkins, PICM/PCC transport consultant, NWTS
Tamryn Miller, Senior Clinical Fellow, Anaesthetics, AHCH
Emma Roach, Band 6 nurse, NWTS
Nicola Longden, Band 7 clinical nurse specialist, NWTS
Anna Parry, clinical nurse educator, NW PCC/SiC/LTV ODN
Sophina Mahmood, paediatric pharmacist, PCC ODN & RMCH
Lewis Nicholls, paediatric pharmacist, PCC ODN & RMCH

Consulted parties:

Paediatric Respiratory and Surgical Teams at both Alder Hey & Royal Manchester Children's Hospitals
North-West (England) & North Wales Paediatric Transport Service (NWTS)
North-West (England) and North Wales Paediatric Critical Care Operational Delivery Network
PICU, Royal Manchester Children's Hospital

Date of Review: January 2029

Guideline team at NWTS: kate.Parkins@nwts.nhs.uk or Constantinos.kanaris@mft.nhs.uk or Nicola.longden@mft.nhs.uk

For the most up to date version of this guideline please visit PCC / SiC / LTV https://northwestchildrensodnhub.nhs.uk
Or NWTS website: https://www,nwts.nhs.uk/clinicalguidelines/regionalguidelines-a-z

Emergency Chest Drain Insertion

RATIFICATION PATHWAY