



CATS

Children's Acute Transport Service



Clinical Guidelines

Pleural disease and chest drain insertion

Document Control Information

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Document Version	Version 3	Replaces Version	2
First Introduced	2021	Review Schedule	2 Yearly
Active Date	2026	Next Review	2028
Applicable to	All CATS employees		



Introduction

Chest drain insertion for treatment of pleural disease in children is an uncommon event in the local hospital, but there will be occasions where inserting a drain cannot be postponed until a child has been transported to a tertiary centre. The decision making around drain insertion can be complex, and should involve the attending consultant paediatrician and anaesthetist, and the CATS team.

Pneumothorax

Diagnosis

Gas in the pleural space due to a leak in the pleura (visceral or parietal) results in equalisation of intrapleural and atmospheric pressure leading to partial lung collapse. If gas can enter the pleural space but cannot leave by the same route (a 'one way valve') a tension pneumothorax will develop. The lung will then collapse completely and the increased intra(hemi)thoracic pressure will result in mediastinal shift, impaired venous return, and circulatory collapse.

A spontaneous pneumothorax can be:

- primary (no underlying lung disease); typically, in tall, thin males; usually occurring at rest; some cases familial;
- secondary (underlying lung disease); asthma, cystic fibrosis, pneumonia, ILD, malignancy.

A traumatic pneumothorax can be:

- non-iatrogenic (blunt, crush or penetrating trauma).
- iatrogenic (mechanical ventilation or procedure related).

Clinical features:

History - sudden onset pleuritic chest pain and dyspnoea. Dry cough. Consider potential causes of secondary pneumothorax.

On examination:

- Tachypnoea
- Increased work of breathing
- Cyanosis
- Decreased chest wall movement
- Quiet or absent breath sounds
- Hyper-resonant percussion

If tension pneumothorax the child may also have:

- Tracheal deviation
- Tachycardia
- Hypotension
- Decreased conscious level
- Quiet heart sounds and deviated apical impulse
- Jugular venous distension

Investigations

- CXR (taken in upright position, if possible):
 - Gas in pleural space outlining the visceral pleura (sharp, thin, white line)
 - Hyperlucency / no lung markings peripheral to this pleural line
 - Atelectasis/collapse due to compression by pleural gas
 - Flat or inverted diaphragm
 - Deep sulcus sign (a deep costophrenic angle)
 - Mediastinal deviation (tension)
 - Complete lung collapse (tension)
- Blood gas

Management

	Tension pneumothorax	Symptomatic pneumothorax	Pneumothorax with no or minimal symptoms
Initial management strategy	High flow oxygen by facemask Decompress pneumothorax immediately CXR and procedural sedation not normally indicated before decompression	Chest drain indicated The procedure may be performed using local anaesthetic and/or procedural sedation or following intubation. It may be desirable in some circumstances to transport the child to a tertiary centre for drain insertion. Management strategy will depend on: clinical condition,	Observe

		age/size of child, co-morbidities, and local skill mix	
		Avoid NIV prior to chest drain insertion	
Procedure	Insert a cannula into the second intercostal space, mid clavicular line Alternatively, a needle can be inserted in the 5th intercostal space, mid-axillary line Suggested cannula size: a) 0 years → 22G (blue) b) 5 years → 20G (pink) c) 10 years → 18G (green) d) 15 years → 16G (grey)	A small-bore chest drain is required See below for guidance on insertion	
Ongoing management	Following needle decompression, a chest drain must be inserted. Transport to tertiary centre	Transport to a tertiary centre is usually required	A discussion with tertiary respiratory team may be indicated to discuss optimal location for patient and/or investigations required

Pneumonia with effusion

Diagnosis

A para-pneumonic effusion is a collection of fluid within the pleural cavity secondary to a pneumonia. Early in the disease process the effusion is usually free flowing ('simple'). A loculated para-pneumonic effusion refers to the presence of septations, usually detected on ultrasound (US). Empyema is a purulent effusion containing micro-organisms and can be loculated.

Aetiology:

- 20% of patients with pneumonia will develop a para-pneumonic effusion;
- *Streptococcus pneumoniae* and Group A streptococci are the most common causative organisms

Clinical features:

- History - fever, increased work of breathing, cough
- Examination:
 - Tachypnoea
 - Increased work of breathing
 - Cyanosis
 - Decreased chest wall movement
 - Unilateral quiet or absent breath sounds
 - Dull to percussion

Investigations

- **CXR:**
 - Complete or partial white out of (usually) one lung
 - Meniscus sign
 - Air/fluid levels
 - Adjacent lung collapse/consolidation
- **US scan**
 - Highly recommended for evaluation of an effusion
 - Formal US report should identify effusion size/depth and loculation. The most appropriate site for drain insertion may be marked. A chest drain may be inserted under US guidance depending on expertise of operator
- Blood gas

- Blood and sputum cultures, FBC, CRP, ASOT, U&E, albumin, coagulation screen
- Pleural fluid – gram stain, bacterial culture, differential cell count, TB, cytological analysis

Management

- A symptomatic, hospitalised child with a para-pneumonic effusion is likely to need a chest drain, but in most cases, this can be delayed until the child is transported to a tertiary centre. Involve a tertiary respiratory/ID team +/- CATS early. Refer to NTPN empyema pathway: https://ntpn.co.uk/wp-content/uploads/2024/02/2023_NTPN-Empyema-pathway_V1-1.pdf
- Treat with antibiotics:
 - Empirical first line therapy: co-amoxiclav +/- clindamycin.
 - If suspicion of MRSA – add vancomycin.
 - Be guided by clinical picture and local microbiology advice.
- Anaesthetic review; ensure airway patency; oxygen and respiratory support (HFNC, CPAP) should be provided as required, targeting SpO₂ 88-92%
- Chest physiotherapy is not recommended.
- The child may be septic, and fluid boluses +/- vasoactive drugs may be required (see CATS Sepsis guideline).
- Indications for intubation:
 - Reduced conscious level
 - Worsening hypoxaemia (SpO₂ <88% with FIO₂ >0.6)
 - Worsening hypercarbia and respiratory acidosis
 - >40-60ml/kg fluid resuscitation
- If an effusion/empyema is thought to be impairing oxygenation and/or ventilation after intubation, then urgent chest drainage may be indicated.

Chest Drain Insertion

Preparation

- If the child is awake, a discussion between CATS and the paediatric and anaesthetic consultants should take place regarding the need for local anaesthetic, procedural sedation, or intubation.
- Check coagulation profile and platelets if time allows. Coagulopathy is not an absolute contra-indication to insertion.
- The most experienced operator should undertake the procedure.
- The operator should have an assistant.

- Written consent should be taken, if time permits.

Methods

- Seldinger technique or blunt dissection / slit thoracostomy technique.
- Choice of technique, and whether US guidance is used, will depend on operator experience and preference. Both methods are covered in the APLS/EPALS manuals.
- Evidence for optimal drain size in children is lacking. As an approximate guide:
 - Infants - young children: 8-12Fr
 - Children – young adults: 14-20Fr

Post Procedure

- Attach the drain to an underwater seal drain (UWSD) system, which should be kept below the level of the patient.
- Observe the child for haemodynamic and respiratory changes.
- Check for drain bubbling and/or swinging.
- If suction is to be used, the UWSD system should be attached to low flow wall suction at -5 to -10 cmH₂O
- Check the site for erythema, bleeding and surgical emphysema.
- If the drain output is >10ml/kg in one hour, clamp the drain (risk of re-expansion pulmonary oedema and hypotension) and re-assess the child.
- CXR to confirm drain position.
- Ensure regular analgesia.

Transport Considerations

- Ensure the chest drain is secured appropriately (suture and transparent dressing).
- Confirm UWSD system is working appropriately, and secure below the level of the patient.
- For a pneumothorax, a Heimlich/flutter valve can be considered in place of the UWSD system, but this may not provide effective drainage in neonates and small children.
- Consider incorporating a three way tap to allow drain flushing and aspiration *en route*.
- Ensure suction is available.
- Carry emergency needle thoracotomy equipment during transport.