Ashford and St. Peter's Hospitals
NHS Foundation Trust

Clinical Guideline for the Safe Insertion and Management of Chest Drains in Children and Young People

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Guideline History		
Date	**Comments**	**Approved By**
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22.11.21	Post Procedure Management amended and Observation Chart added	
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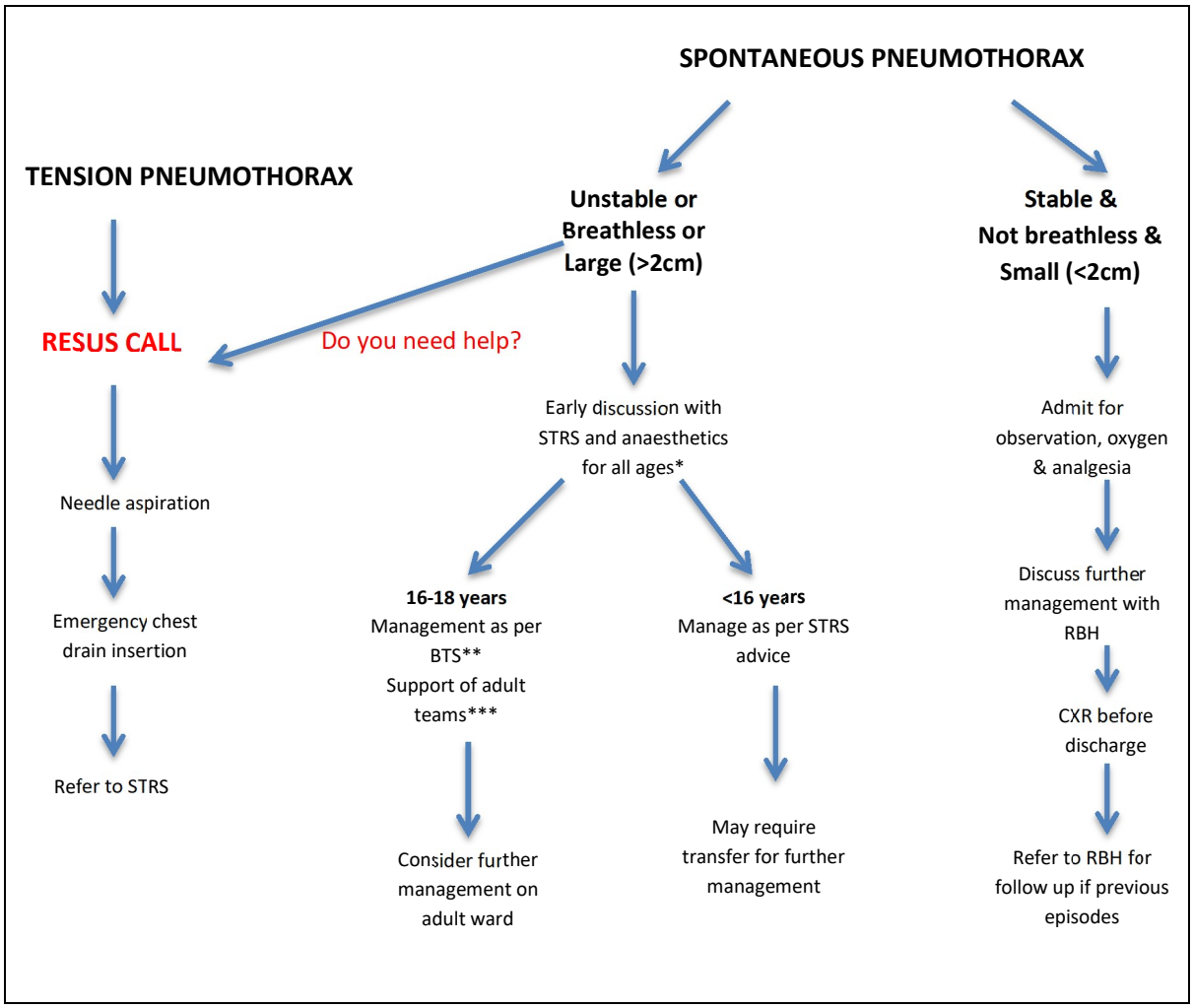
1. Introduction

This guideline outlines a consistent standard for the management of pneumothorax and pleural effusion in children. It includes advice regarding the safe insertion and management of chest drains in children and young people at Ashford and St Peters Hospitals. It has been produced in response to the risks outlined in the National Patient Safety Agency Rapid Response Report[1] and due to lack of paediatric evidence and consensus, has been written with reference to adult[2] and paediatric[3] BTS guidelines following discussion with Royal Brompton Hospital (RBH) and South Thames Retrieval Service (STRS). It should not be used for the management of neonates.

1. Pneumothorax algorithm



*STRS will offer advice for all age groups however may suggest local management by adult medical team for 16-18 years and may direct the referral to a tertiary paediatric respiratory team for < 16 years

**BTS Guideline[2] is Appendix A

**Discuss with A&E, adult medical team at ASPH or medical team at an alternative local hospital

a. Tension Pneumothorax

A tension pneumothorax is a medical emergency that requires immediate decompression. Tension pneumothorax can be rapidly fatal if not treated promptly. Air accumulates under pressure in the pleural space. This pushes the mediastinum across the chest and kinks the great vessels, compromising venous return to the heart and reducing cardiac output[4] .

The diagnosis is clinical[4]:

- The child will be hypoxic and may be shocked
- Unless the child is unconscious, there will be signs of respiratory distress
- There will be decreased air entry and possible asymmetrical air movement on inspection, with hyper-resonance to percussion on the side of the pneumothorax
- Distended neck veins may be apparent in some children
- The trachea deviates away from the side of the pneumothorax, although this is not always easy to identify clinically.

Resuscitation:

- High-flow oxygen
- Needle aspiration (thoracocentesis) for decompression should be performed as per APLS[4]. This is a life-threatening condition and there are no contraindications.
- Perform definitive treatment with an intercostal chest drain immediately after decompressing a tension pneumothorax[5]. In a medical emergency, the most experienced person available should insert the chest drain. Chest drain should be inserted as per APLS[4].

b. Spontaneous Pneumothorax

Primary spontaneous pneumothorax occurs with no underlying lung pathology. Secondary spontaneous pneumothorax occurs with pre-existing lung conditions (asthma, cystic fibrosis, infection). It is unusual for a primary spontaneous pneumothorax to cause a tension pneumothorax. Spontaneous pneumothorax is likely to occur in older children and can be managed in accordance with adult British Thoracic Society (BTS) guidelines[2]. The above algorithm has been adapted from BTS guidelines following discussion with RBH and STRS.

Diagnosis:

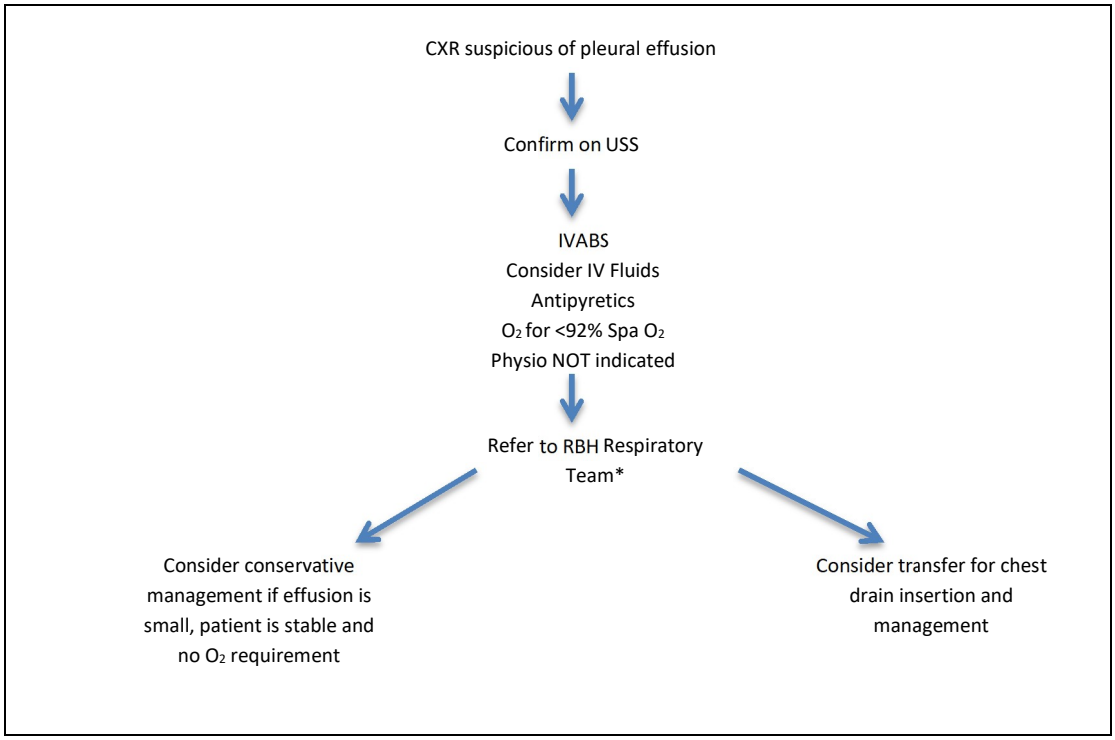
- The commonest presentation of primary spontaneous pneumothorax is the sudden onset pleuritic chest pain and dyspnoea.
- Erect CXR in inspiration is used for diagnosis[2].
- Bilateral pneumothoraxes are rare in children and should raise suspicion of an underlying diagnosis.

Resuscitation and management:

- Consider high-flow oxygen
- If a patient is **unstable**, early anaesthetic support and STRS involvement is required. An urgent ultrasound scan may be helpful but should not delay treatment. Following discussion with STRS, emergency management with needle aspiration and emergency chest drain insertion[2] may be required. Consider a resus call, including A&E team, at any stage.

- '**Large**' pneumothorax is the presence of a visible rim of >2cm between the lung margin and chest wall at the level of the hilum[2]. The size of the pneumothorax is less important than the degree of clinical compromise[2].
- Conservative management of '**small**' (<2cm) pneumothorax in patients with minimal symptoms is safe[2]. Admit for observation, analgesia and oxygen. Oxygen speeds up resolution fourfold[2]. Further management can be discussed with RBH. STRS should be contacted if the patient deteriorates. Patients may require a further CXR before discharge. Patients with a previous pneumothorax require a referral to RBH for outpatient follow up.

2. Pleural effusion algorithm



*RBH will offer management advice for < 16 years or patients already under their care. Refer to RBH paediatric respiratory team rather than paediatric surgeons or thoracic surgeons.
16 -18 years should be discussed with local adult medical team.

4. Needle aspiration

Needle aspiration for a tension pneumothorax should be performed immediately as per APLS guidelines. The most experienced person available should perform this procedure. A&E doctors may have more experience than Paediatricians. Insertion of a chest drain should be performed immediately after decompression of a tension pneumothorax with needle aspiration.

STRS may advise performing a needle aspiration for relief of a large pneumothorax or in a symptomatic patient. A chest drain will usually be required after this procedure. Further management should be guided by STRS.

Needle aspiration or needle thoracocentesis should not be performed for a pleural effusion.

Minimum equipment:[4]

- Alcohol swab
- Large intravenous cannula (16-gauge grey, 14-gauge orange)
- 20ml syringe

Procedure:[4]

- Identify 2nd intercostal space, mid-clavicular line
- Clean the chest with alcohol swab
- Attach the syringe to the cannula (fluid in the syringe can be used to help identify air bubbles)
- Insert the cannula vertically into the chest wall, just above the rib below, aspirating all the time
- If air is aspirated, remove the needle, leaving the cannula in place
- Tape the cannula and proceed to chest drain insertion as soon as possible

5. Chest drain insertion

In a medical emergency, the most experienced person available should insert the chest drain. A&E doctors may have more experience than paediatricians. A chest drain will be required immediately after needle aspiration in a tension pneumothorax.

Chest drain should be inserted as per APLS using the open technique to minimise lung damage and **should only be inserted by a doctor with expertise** unless it is a medical emergency.

Minimum equipment:[4]

- Skin preparation and surgical drapes
- Scalpel
- Large clamps x2
- Scissors
- Chest drain tube

Procedure:[4]

- Usual emergency chest drain position is 5th intercostal space, mid-axillary line on the side of the pneumothorax
- Clean the chest with alcohol swab
- Use local anaesthetic if necessary (may be omitted in a resuscitation)

- Make 2-3cm skin incision along the line of the intercostal space, just above the rib below
- Use blunt dissection "above rib below" to avoid intercostal nerves and vessels. Do not use a trocar or substantial force.
- Put a gloved finger into the incision and clear the path into the pleura. This will not be possible in small children
- Advance the chest drain into the pleural space during expiration. Once inserted, ensure all holes are within chest cavity.
- Ensure the tube is in the pleural space by listening for air movement, and by looking for fogging of the tube during expiration
- Connect the chest drain tube to an underwater seal
- Suture or tape the drain in place
- Obtain a CXR

In a non-emergency situation, informed consent must be obtained and documented. Chest drains should be inserted by adequately trained personnel to reduce the risk of complications[3]. A suitable assistant and trained nurse must be available[3]. For <16 years, chest drain insertion is usually be performed at a tertiary centre with radiology and anaesthetic support. If general anaesthetic is not used, sedation should only be provided by staff trained in the use of conscious sedation, airway management and resuscitation of children[3]. Full monitoring is required.

In a non-emergency, small-bore percutaneous drains should be inserted at the optimum site suggested by ultrasound[3].

6. Post procedure management

Chest drains should be managed on specialist wards by staff trained in chest drain management[3]. The management of chest drains in Paediatric Emergency Department or Ash ward is not usual and must be supported by discussion with STRS or RBH. Consider transferring 16-18 years to an adult respiratory ward.

Key Points:

- A CXR should be performed after insertion[3].
- All chest drains should be connected to a unidirectional system (underwater seal bottle) kept below the patient's chest level at all times[3].
- Check drain function by checking for bubbling in a pneumothorax and flow of fluid in an effusion.
- Ensure adequate analgesia

Monitoring and Observations:

Continuous monitoring should be performed for first 15 minutes. Observations should be performed every 15 minutes for next hour then 1 hourly. In addition to routine monitoring the following parameters should also be recorded and documented (Observation Chart: Appendix B)

- Air drainage: Bubbling of the drain or swinging of the water line occurs with respiratory cycle. Fluid should rise on inspiration and fall on expiration. **A bubbling**

chest drain should never be clamped[3] because there is a risk of pneumothorax. Re-expansion pulmonary oedema (RPO) may occur in pneumothorax with significant lung collapse if the re-inflation of the lung is very rapid. Suction should not be used at ASPH unless supported by RBH or STRS. Drains may kink or become occluded. If a drain is not swinging check for kinking or displacement.

- Fluid drainage: Monitor the type and volume of fluid drained. **Drains should be clamped for 1hr once 10ml/kg of fluid is initially removed**[3]. No more than 1.5litres of fluid should be drained at one time[3]. Re-expansion pulmonary oedema (RPO) following the drainage of large effusions is extremely rare in children. Discuss concerns about excessive fluid drainage with RBH.
- Drain site and tubing: Ensure all connections are secure and that the underwater seal remains functional. The water level is adequate and that the bottle is upright and below the level of the chest. Visually inspect the site and dressing.

Escalation of care:

Concerns should be escalated to Paediatric Registrar or Consultant. Concerns should be discussed with RBH or STRS.

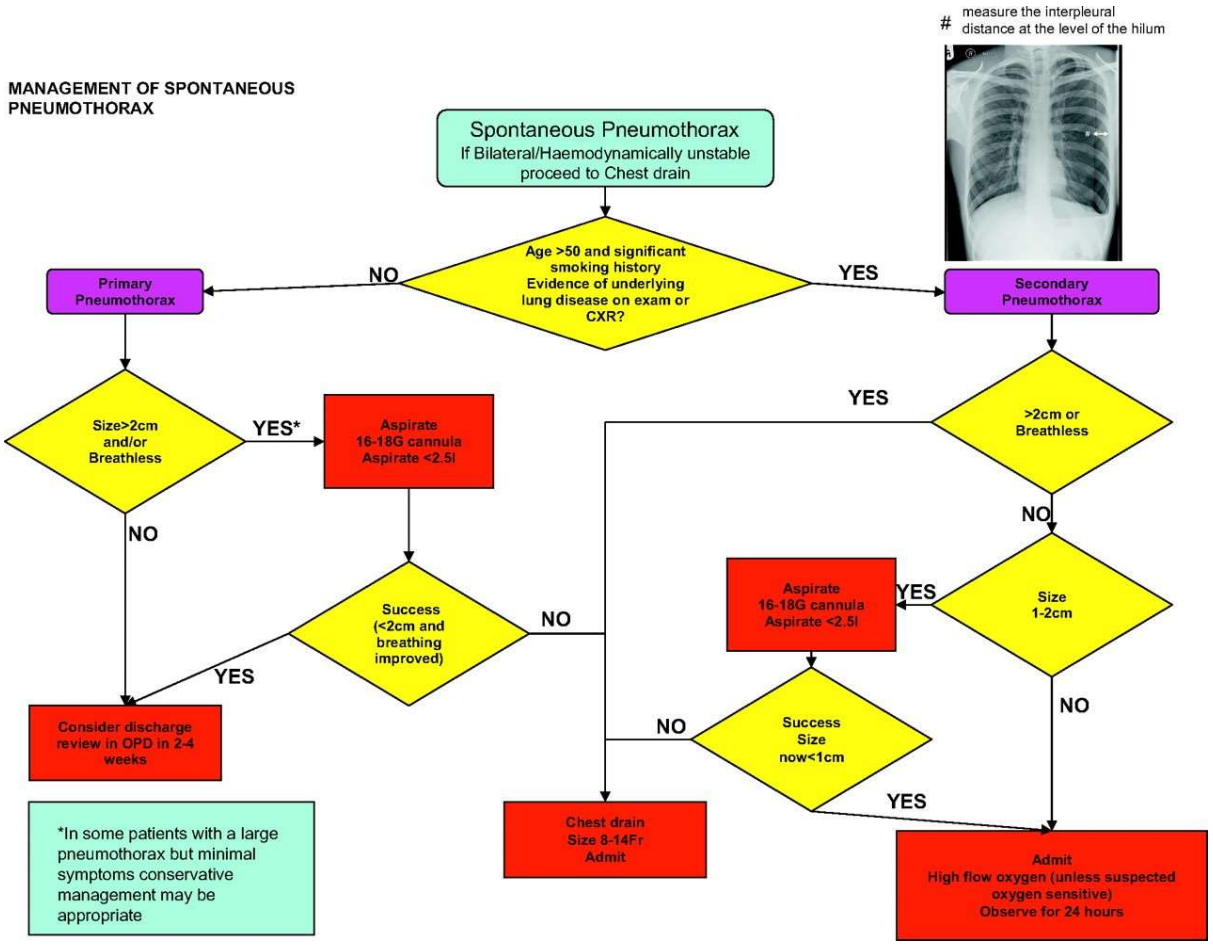
- **If a patient is breathless or complains of chest pain, a clamped drain must be unclamped**[3]. This may indicate a tension pneumothorax.
- 2 clamps should be available at the bedside.
- A drain should be removed once there is clinical resolution[3].

Supporting references

1. National Patient Safety Agency 'Rapid Response Report NPSA/2008/RRR003 - risk of chest drain insertion
2. MacDuff A, Arnold A, Harvey J. Management of spontaneous pneumothorax: British Thoracic Society pleural disease guideline 2010. Thorax. 2010 Aug 1;65(Suppl 2):ii18-31.
3. Balfour-Lynn IM, Abrahamson E, Cohen G, Hartley J, King S, Parikh D, Spencer D, Thomson AH, Urquhart D. BTS guidelines for the management of pleural infection in children. Thorax. 2005 Feb 1;60(suppl 1):i1-21.
4. APLS Guideline
5. BMJ Best Practice Pneumothorax. https://bestpractice.bmj.com/topics/en-gb/3000083. Latest update July 2020

Appendix A

1. Flow for the management of Spontaneous Pneumothorax from BTS Guidelines[2]



Appendix B: Chest Drain Observations Chart.

Name: Hospital Number: Date of Birth:

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Chest Drain Observation Chart

Time and date of insertion: Inserted by:

Observations: Direct for 15mins, every 15mins for 1st hour, then hourly

	Date and time	Swinging	Bubbling	Tubing & dressing intact	Underwater seal intact	Fluid volume drained	Total volume drained
		Y/N	Y/N	Y/N	Y/N	ml	ml
Direct for 15mins							
Every 15mins for 1st hour							
1 hourly							

Chest Drain Observation Chart

1 hourly	Date and time	Swinging	Bubbling	Tubing & dressing intact	Underwater seal intact	Fluid volume drained	Total volume drained
		Y/N	Y/N	Y/N	Y/N	ml	ml