

## **Definition**

- Pneumothorax is the accumulation of air in the pleural cavity, which can be classified as spontaneous, traumatic, or iatrogenic <sup>1</sup>.
- Spontaneous pneumothorax is defined as collection of air in the pleural space without apparent traumatic or iatrogenic mechanism <sup>21</sup>.
- It can be further classified into primary spontaneous pneumothorax (PSP), which occurs in patients without underlying lung disease; or secondary spontaneous pneumothorax (SSP) in those with preexisting lung conditions such as asthma, congenital cystic adenomatoid malformation, cystic fibrosis, or connective tissue disease such as Marfan syndrome or Ehlers–Danlos syndrome <sup>14</sup>.
- Roughly, PSP is thought to account for 55% of the incidence of SP as compared with 45% for SSP <sup>1</sup>.

## **Incidence** <sup>16</sup>

- The incidence of PSP ranges between 4.7 and 28/100,000/year in men and 1.2 and 6/100,000/year in women, with a higher prevalence in young, tall, and thin males.
- The incidence of PSP in the pediatric population is low and it has been reported to be around 3.4/100,000 children, with a male to female ratio of 4:1 and a peak of incidence during adolescence. However, it has been reported a higher recurrence rate in the pediatric population compared with adults (50–60% vs. 30–50%).

## **Etiology** <sup>20</sup>

- Spontaneous pneumothorax is considered primary if there is no underlying predisposing condition such as pulmonary pathology, connective tissue disease, or infection.
- The pathophysiology of PSP is believed to involve rupture of blebs or bullae.
- While chest radiographs or computed tomography (CT) scans may visualize these blebs, and the presence of blebs has been associated with a need for surgical intervention, the sensitivity and specificity of these imaging findings for predicting clinical outcome remain poor.

## **Guideline Eligibility Criteria**

Pediatric patients with suspected initial or recurrent primary spontaneous pneumothorax.

## **Guideline Exclusion Criteria**

Pediatric patients with:

- Bilateral pneumothoraces
- Underlying chronic lung disease
- Traumatic pneumothorax
- Pneumothorax that develops tension physiology

## **Diagnostic Evaluation**

### **History**

Evaluate for History of:

- Trauma
- Smoking/Vaping
- Barotrauma

## **Physical Examination**

Most common presenting symptoms

- Chest Pain
- Dyspnea
- Hypoxia
- Cough w/ Chest Pain
- Decreased Breath Sounds
- Evaluate for visual signs of chest wall trauma

## **Radiology Evaluation**

- Chest XR
- May consider screening POC chest US in ER
- Chest CT is not routinely indicated
  - Consult Surgery prior to obtaining

## **Critical Points of Evidence**

### **Evidence Supports**

- Initial therapy can consist of observation if the severity of symptoms and patient stability allow.
  - A large multicenter randomized controlled trial looked at outcomes for small pneumothoraces treated with observation versus intervention with chest tube placement and aspiration trial. Observation prevented an intervention in 85% of the patients and was associated with fewer hospital days, adverse events, and operations <sup>3</sup>.
  - Grade A recommendation supported by level 1,2, and 4 evidence
- If an immediate intervention is required, aspiration is at least equivalent to chest tube placement
  - Multiple studies have shown that there is no difference in success, recurrence, or complications with chest tube placement versus aspiration trial <sup>2 10 13</sup>.
  - Grade B recommendation supported by level 2 and 4 evidence
- If a chest tube is required, a small bore (12F or smaller) tube should be used.
  - In a pediatric meta-analysis that compared pigtail catheters to large bore chest tubes (14F) it was found that pigtail catheters were associated with a shorter duration of drainage and length of stay <sup>5</sup>.
  - Grade B recommendation supported by level 2 and 4 evidence
- Air leak and/or inability to resolve the pneumothorax on CXR may be predictive of failure and can guide decision making to early surgery.
  - In retrospective chart review it was noted that significant predictors of ultimately requiring VATS were presence of an air leak and partial lung expansion after chest tube placement <sup>20</sup>.
  - Grade C recommendation based on level 4 evidence
- Prolonged chest tube management is unlikely to change the overall outcome and is not recommended
  - In a multicenter review that compared management strategies and outcomes in children with PSP, the probability of surgery increased with each day of hospitalization after chest tube placement <sup>20</sup>.
  - Grade C recommendation based on level 3 and 4 evidence

### **Evidence Lacking/Inconclusive**

- Early VATS if chest tube placement fails is not well defined or standardized.
  - A range of 6-72 hours after chest tube placement with ongoing air leak is a reasonable time frame <sup>20</sup>.
  - Grade C recommendation based on level 2,3,4 evidence

### **Evidence Against**

- Advanced imaging, such as chest CT, is not recommended.
  - The presence of blebs, size, number and dystrophy severity score are not predictive of recurrence <sup>17</sup>.

- Grade B recommendation supported by level 3 and 4 evidence

## **Principles of Clinical Management**

- Apply O2 via Non-rebreather (NRB) if pneumothorax is suspected or confirmed by imaging
- Consult surgery for pneumothorax confirmed by chest radiograph

### **Evaluate for Size and Symptoms**

- Evaluate size of pneumothorax on chest radiograph.
- If pneumothorax is less than 2 rib spaces and the patient is asymptomatic (no hypoxemia (O2 sat <94%) and/or dyspnea), then admit for observation.
- If pneumothorax is greater than 2 rib spaces OR the patient is symptomatic (dyspnea, hypoxia), then proceed with chest tube placement.

### **Observation**

- If pneumothorax is less than 2 spaces from the apex of the lung, and the patient does not have hypoxia or dyspnea, then the patient may be admitted for observation.
  - Place the patient on O2 via non-rebreather facemask at 6Lpm or higher.
  - Repeat chest XR in AM or sooner if the patient becomes symptomatic (hypoxemia, worsening chest pain, or dyspnea).
  - Allow the patient clear liquids only in case urgent surgical intervention is needed.
  - If repeat chest XR shows stable or smaller pneumothorax, discharge the patient home with return precautions.
    - If pneumothorax becomes larger proceed with chest tube placement.

### **Chest Tube**

- Chest tube can be placed in ED if appropriate analgesia, or it may be placed under anesthesia in interventional radiology or OR, depending on surgeon and family preference
- A small chest tube is recommend (8-12 French)
- Obtain CXR after placement and daily while chest tube is in place
- Chest tube may be placed to suction or a trial of aspiration may be performed
- If chest tube is placed to suction, consider water seal trial in 12-24 hours if there is complete resolution of pneumothorax and no air leak is noted.
- If there is no increased pneumothorax with water seal trial, remove chest tube and discharge patient.

### **Trial of Aspiration**

- Connect chest tube to 3 way stop-cock immediately after placement
- Use 60 mL luer lock syringe and aspirate until resistance is met
- Connect chest tube to Pleur Evac (chest tube drainage system) and place to waterseal
- Immediately obtain chest radiograph
- If pneumothorax is less than 2 rib spaces, keep chest tube to water seal or clamp and repeat chest XR in 6 hours.
- If pneumothorax is greater than 2 rib spaces after aspiration or becomes larger on interval chest radiograph after waterseal/clamp trial, place chest tube to 20 cm suction
- If water seal/clamp trial is successful- no recurrence of pneumothorax, remove chest tube and discharge patient

### **Surgical Considerations**

- If the patient has a persistent air leak or incomplete resolution of pneumothorax within the first 48 hours of chest tube placement, these are strong predictors of failure of conservative management - consider VATS (video-assisted thoracoscopic surgery) with blebectomy.

### **Recurrent Pneumothorax**

- If a patient presents with recurrent primary spontaneous pneumothorax, may consider proceeding immediately to VATS per surgeon and family preference.

### **Discharge and Follow Up**

- For patients who are treated conservatively with observation or aspiration trial- follow up not required unless specified by surgeon or patient develops recurrent symptoms.
- For patients who undergo VATS with blebectomy, routine follow up in 2 weeks with chest radiograph prior to follow up appointment.
- All patients should be educated on return precautions- sudden or worsening chest pain, shortness of breath, avoid flying in an airplane or scuba diving for 2-4 weeks after pneumothorax.

## **Related Policies**

[Assessment and Reassessment of Pulmonary Patients](#)

December 2020

[Assisting with Insertion, Maintenance and Removal of a Chest Tube](#)

April 2020

## **Key Contributors**

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**Approvals**

The approval below indicates support for the attached guideline, protocol and/or algorithm. The intent is not to be prescriptive but to provide a cohesive, standardized, and evidence-based (when available) approach to patient care. The physician must consider each patient and family's circumstance to make the ultimate judgment regarding best care.

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