Texas Children's Hospital

TEXAS CHILDREN'S HOSPITAL
EVIDENCE-BASED OUTCOMES CENTER
Primary Spontaneous Pneumothorax (PSP)
Evidence-Based Guideline

Definition: Pneumothorax refers to air in the pleural cavity (i.e., interspersed between the lung and the chest wall). [1,2] Primary spontaneous pneumothorax (PSP) occurs in otherwise healthy patients; secondary pneumothorax is associated with underlying lung disease. [1-4]

Etiology: Anatomical abnormalities have been demonstrated, even in the absence of overt underlying lung disease. [2] Smoking has been implicated in the etiology of PSP.

Inclusion Criteria
- Initial or recurrent spontaneous pneumothorax in otherwise healthy patients

Exclusion Criteria
- Underlying chronic lung disease
- Explained pneumothorax (e.g., traumatic, iatrogenic, or resulting from birth)
- Pregnant women

Differential Diagnosis
Tension pneumothorax
Secondary spontaneous pneumothorax
Traumatic pneumothorax

Diagnostic Evaluation [2,4]
History: Assess for
- Abrupt onset when at rest or with minimal exertion
- Exclusion of explained pneumothorax

Physical Examination
- Chest pain
- Dyspnea
- Asymmetric lung expansion
- Diminished breath sounds
- Hyperresonance on percussion
- Sweating, tachypnea, tachycardia

Critical Points of Evidence*

Evidence Supports
- Utilize inspiratory chest x-ray to detect and diagnose primary spontaneous pneumothorax. [1-16] – Strong recommendation, moderate quality evidence
- Obtain a CT for recurrent (>1) pneumothorax or suspected underlying lung pathology, or for surgical planning if persistent air leak >4 days. [5-16] – Strong recommendation, very low quality evidence
- Observe patients with a small pneumothorax and administer oxygen. Obtain a chest x-ray at 4-6 hours and if no progression of size, remove oxygen and consider discharging the patient, if the patient no longer requires oxygen and is on room air. If the pneumothorax has increased in size at the time of the subsequent chest x-ray, insert a pigtail catheter or chest tube. [1-4,10,13,15,17-30] – Strong recommendation, very low quality evidence
- Insert a pigtail catheter or chest tube for patients with a large pneumothorax. [1,3,10,13,14,17-30] – Strong recommendation, very low quality evidence
- Perform surgical intervention for patients with a recurrent pneumothorax or persistent air leak >4 days. [1-3,5,10,13,14,17-30] – Strong recommendation, very low quality evidence
- Consider surgical intervention for patients with blebs/bullae on CT, if obtained. [10,13,14,17-30] – Weak recommendation, very low quality evidence
- Consider bilateral surgical intervention if contralateral blebs/bullae are detected. [10,13,14,17-30] – Weak recommendation, very low quality evidence
- Insert a pigtail catheter vs. a chest tube to minimize patient discomfort. [1,2,26,32-39] – Strong recommendation, very low quality evidence
- Provide supervision for learners inserting a chest tube or pigtail catheter. [33,40-42] – Strong recommendation, very low quality evidence

Evidence Lacking/Inconclusive
- Manage each pneumothorax independently in the case of bilateral pneumothoraces. – Consensus recommendation
- Position the patient in a supine position when inserting a pigtail catheter/chest tube. – Consensus recommendation
- Utilize chest x-ray to confirm adequate placement of a pigtail catheter/chest tube. [33] – Consensus recommendation
- Administer oxygen via non-rebreather mask on initial diagnosis. If no further intervention is needed, transition to nasal cannula. – Consensus recommendation
- Remove the pigtail catheter/chest tube in a staged manner once a chest x-ray demonstrates complete resolution and there is no clinical evidence of air leak. Any suction should be discontinued. [1,3,33] – Consensus recommendation

Recommendations Adopted/Adapted from the American Pediatric Surgical Association (APSA) [43]

- The optimal initial management for pediatric primary spontaneous pneumothorax (PSP) [43]:
  - Initial therapy consists of observation if the severity of symptoms and patient stability allow
  - If an immediate intervention is required, aspiration is at least equivalent to chest tube placement
  - If a chest tube is required, a small bore tube (≤12 French) should be used
  - Primary VATS may reduce total hospital days and readmissions, but it is unclear if this would be cost-effective
- There appears to be no advantage to cross-sectional imaging for pediatric PSP. A positive test does not predict recurrence, and a negative test does not provide reassurance.
- The optimal time to operate on a child with PSP after initial management is [43]:
  - Air leak and/or inability to resolve the pneumothorax on chest x-ray may be of predictive of failure and guide decision-making to early surgery
  - Prolonged chest tube management is unlikely to change the overall outcome and is not recommended
  - Although early intervention is not well defined or standardized across studies, a range of 6 hours after failed aspiration up to 48 hours after chest tube placement with ongoing air leak seems to be a reasonable time frame for decision making to proceed with surgical intervention
- The most effective initial operation for children with PSP after initial management [43]
  - A stabled blebectomy via a VATS approach should be performed on bullae and blebs. Consideration can be given to apical wedge resection if no lesions are identified
  - A pleural procedure in addition to blebectomy is recommended to decrease recurrence, but the evidence is insufficient to identify the optimal technique
  - For higher risk lung surgery, consider staple line reinforcement and fibrin sealants
- Prophylactic VATS for contralateral BB (bullae or blebs) on CT in the absence of symptoms is not recommended
- Treatment for recurrent spontaneous pneumothorax after operative management is [43]:
  - For recurrent pneumothorax after VATS for PSP, observation is reasonable if the pneumothorax is small and minimally symptomatic. However, further recurrences will likely occur in over 50% of patients
  - For larger or more symptomatic recurrence, repeat VATS with blebectomy and intensification of pleural treatment is safe and results in very low repeat recurrence

*NOTE: The references cited represent the entire body of evidence reviewed to make each recommendation.

Condition-Specific Elements of Clinical Management

Admission Criteria

- Significant chest pain
- Oxygen requirement
- Respiratory distress (tachypnea, dyspnea, retractions)
- Need for chest tube placement

Discharge Criteria

- Afebrile
- Oxygen saturations >90% on room air
- Resolution of chest pain and/or respiratory distress
- Stable or resolving small pneumothorax by chest X-ray
- Removal of chest tube with normal/stable chest X-ray

Consults/Referrals

Consult surgery after radiologic confirmation of PSP.

Follow-Up Care

Outpatient visit with Surgery within 3 weeks

Measures

Process

- CXR vs. CT as initial diagnostic study
- Placement of chest tube by IR vs. surgery
- Chest tube requirement for patients who were initially only observed

Outcome

- “Immediate” recurrence after chest tube removal
- Length of stay
- Readmission for chest pain or dyspnea
- Ipsilateral recurrence within 30 days

TCH Evidence-Based Outcomes Center
Diagnosis and Management of Spontaneous Pneumothorax

Inclusion Criteria:
Initial or recurrent spontaneous pneumothorax in otherwise healthy patients

Exclusion Criteria:
Underlying chronic lung disease, explained pneumothorax (e.g., traumatic, iatrogenic, or resulting from birth)

Begin^

^If tension pneumothorax is suspected at any time, notify emergency medicine and surgery attendings. If unstable, perform needle thoracostomy.

Spontaneous pneumothorax confirmed by inspiratory chest x-ray

No → OFF algorithm

Yes

- Administer oxygen via non-rebreather mask
- Consult surgery

Yes

Recurrent (>1) pneumothorax or suspected underlying lung pathology

Yes →
- Obtain a non-contrast CT, if clinically indicated
- If suspected underlying lung pathology, consult pulmonary

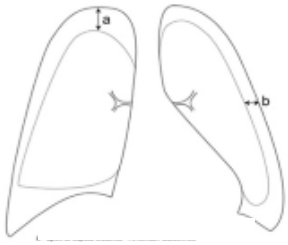
Surgical intervention as needed

No

- Assess size* and degree of clinical compromise.
- If bilateral pneumothoraces, manage each pneumothorax independently.

*The size of the pneumothorax is less important than the degree of clinical compromise.

For children >12 years, a pneumothorax is considered 'large' based on the following measurements:
- Measurement of the vertical distance between the lung and thoracic cage at the apex (a); if ≥3 cm, pneumothorax is large
OR
- Measurement of the distance between the lateral lung edge and chest wall at the level of the hilum (b); if >2 cm, pneumothorax is large



Small*

- Transition to nasal cannula as appropriate.
- Obtain a chest x-ray at 4-6 hours.

Progression of size

No → Remove oxygen and consider discharge if the patient no longer requires oxygen on room air.

Yes →
- Insert a pigtail catheter (preferred) or chest tube
- Confirm adequate placement with chest x-ray.

Large*

- Insert a pigtail catheter (preferred) or chest tube.
- Confirm adequate placement with chest x-ray.

- Remove the catheter in a staged manner once a chest x-ray demonstrates complete resolution and there is no clinical evidence of air leak.
- Manage as appropriate to clinical findings.

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Clinical Standards Preparation

This clinical standard was prepared by the Evidence-Based Outcomes Center (EBOC) team in collaboration with content experts at Texas Children's Hospital. Development of this clinical standard supports the TCH Quality and Patient Safety Program initiative to promote clinical standards and outcomes that build a culture of quality and safety within the organization.

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No relevant financial or intellectual conflicts to report.

Development Process

This clinical standard was developed using the process outlined in the EBOC Manual. The literature appraisal documents the following steps:

1. Review Preparation
   - PICO questions established
   - Evidence search confirmed with content experts

2. Review of Existing External Guidelines
   - Belgian Society of Pneumology Management of Spontaneous Pneumothorax, British Thoracic Society Management of Spontaneous Pneumothorax, British Thoracic Society Pleural Procedures and Thoracic Ultrasound, British Thoracic Society Management of Pleural Infection in Children, American College of Chest Physicians Management of Spontaneous Pneumothorax, The Royal Children's Hospital Melbourne Primary Spontaneous Pneumothorax
   - American Pediatric Surgical Association (ASPA) Evaluation and Management of Primary Spontaneous Pneumothorax in Adolescents and Young Adults: A Systematic Review From the APSA Outcomes & Evidence-Based Practice Committee

3. Literature Review of Relevant Evidence
   - Searched: Cochrane, PubMed, Google

4. Critically Analyze the Evidence
   - 1 randomized controlled trial and 39 nonrandomized studies

5. Summarize the Evidence
   - Materials used in the development of the guideline, evidence summary, and order sets are maintained in primary spontaneous pneumothorax evidence-based review manual within EBOC.

Evaluating the Quality of the Evidence

Published clinical guidelines were evaluated for this review using the **AGREE II** criteria. The summary of these guidelines are included in the literature appraisal. AGREE II criteria evaluate Guideline Scope and Purpose, Stakeholder Involvement, Rigor of Development, Clarity and Presentation, Applicability, and Editorial Independence using a 4-point Likert scale. The higher the score, the more comprehensive the guideline.
This clinical standard specifically summarizes the evidence *in support of* or *against* specific interventions and identifies where evidence is *lacking/inconclusive*. The following categories describe how research findings provide support for treatment interventions.
"Evidence Supports" provides evidence to support an intervention
"Evidence Against" provides evidence against an intervention.
"Evidence Lacking/Inconclusive" indicates there is insufficient evidence to support or refute an intervention and no conclusion can be drawn *from the evidence.*
The **GRADE** criteria were utilized to evaluate the body of evidence used to make practice recommendations. The table below defines how the quality of the evidence is rated and how a strong versus weak recommendation is established. The literature appraisal reflects the critical points of evidence.

Recommendation	
STRONG	Desirable effects clearly outweigh undesirable effects or vice versa
WEAK	Desirable effects closely balanced with undesirable effects
Quality	**Type of Evidence**
High	Consistent evidence from well-performed RCTs or exceptionally strong evidence from unbiased observational studies
Moderate	Evidence from RCTs with important limitations (e.g., inconsistent results, methodological flaws, indirect evidence, or imprecise results) or unusually strong evidence from unbiased observational studies
Low	Evidence for at least 1 critical outcome from observational studies, RCTs with serious flaws or indirect evidence
Very Low	Evidence for at least 1 critical outcome from unsystematic clinical observations or very indirect evidence

Recommendations

Practice recommendations were directed by the existing evidence and consensus amongst the content experts. Patient and family preferences were included when possible. The Content Expert Team and EBOC team remain aware of the controversies in the diagnosis and management of primary spontaneous pneumothorax in children. When evidence is lacking, options in care are provided in the clinical standard and the accompanying order sets (if applicable).

Approval Process

Clinical standards are reviewed and approved by hospital committees as deemed appropriate for its intended use. Clinical standards are reviewed as necessary within EBOC at Texas Children's Hospital. Content Expert Teams are involved with every review and update.

Disclaimer

Practice recommendations are based upon the evidence available at the time the clinical standard was developed. Clinical standards (guidelines, summaries, or pathways) do not set out the standard of care and are not intended to be used to dictate a course of care. Each physician/practitioner should use his or her independent judgment in the management of any specific patient and is responsible, in consultation with the patient and/or the patient's family, to make the ultimate judgment regarding care.

Permission of Use

Version History

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