Pneumothorax, Pneumomediastinum, and Pulmonary Embolism

Nakia N. Johnson, MD, Alexander Toledo, DO, PharmD, Erin E. Endom, MD*

KEYWORDS

• Pneumothorax • Pneumomediastinum • Pulmonary embolism
• Pediatrics

This article discusses pneumothorax (PTX), pneumomediastinum, and pulmonary embolism (PE); including incidence, presentation, diagnosis, and management of each.

PNEUMOTHORAX

Pneumothorax (PTX) is defined as the presence of gas in the potential space between the visceral and parietal pleura. It can be classified into two causal categories.

The first, spontaneous PTX, occurs in the absence of trauma. These pneumothoraces (PTXs) can be further broken down into primary and secondary classifications. A primary spontaneous PTX occurs in a patient with either no or subclinical underlying lung disease. Often attributed to ruptured apical blebs, primary spontaneous PTX is often associated with smoking in adults, but can also be seen in healthy children. A secondary spontaneous PTX occurs as a complication of a chronic or acute underlying pulmonary disease process.

The second, traumatic PTX, occurs via blunt or penetrating mechanisms. Rib fractures may or may not be present. Traumatic PTX takes place when air enters the pleural space from pulmonary, esophageal, chest wall, or tracheobronchial tree injuries.[1] Iatrogenic PTX is an important subset that can occur secondary to medical procedures such as thoracentesis, central venous cannulation, and mechanical ventilation.

The most concerning adverse outcome of traumatic and iatrogenic PTX is progression to a tension PTX. This occurs when the lung or airway defect acts as a one-way

Section of Emergency Medicine, Department of Pediatrics, Baylor College of Medicine, Texas Children's Hospital, 6621 Fannin, Suite A-210, Houston, TX 77030, USA
* Corresponding author.
E-mail address: eendom@bcm.tmc.edu

Pediatr Clin N Am 57 (2010) 1357–1383
doi:10.1016/j.pcl.2010.09.009 **pediatric.theclinics.com**
0031-3955/10/$ – see front matter

valve, allowing air to flow into the pleural cavity without a means of escape. As the volume of air increases, the pressure leads to vascular compromise of the heart and great vessels. The circulatory system decompensates from mechanical impingement on blood flow and hypoxia due to respiratory compromise. Tension PTX in the absence of trauma is relatively rare and is associated with spontaneous PTX in 1% to 3% of cases.[2]

Incidence, Risk Factors, and Mortality

In the United States the incidence of spontaneous PTX is approximately 7.4 to 18 cases per 100,000 boys and 1.2 to 6 cases per 100,000 girls, with a male-to-female ratio of about 2:1.[3] This ratio appears to be reversed, however, below the age of 9 years.[4] Mean age at presentation has been reported to be 14 to 15.9 years, with one pediatric cohort reporting mean age at diagnosis of 13.8 years.[5,6] It appears to present most typically in tall, thin males with low body mass index. Mortality is considered low in children.[3]

Although the incidence of secondary PTX in children is not well described, those with asthma and cystic fibrosis are considered at particular risk.[7,8] The probability of PTX is thought to increase as the lung function decreases, and the mortality is considered higher because of decreased reserve of the ill lung.[9] Infectious causes such as *Pneumocystis jirovecii* pneumonia in immune disorders and necrotizing pneumonias (anaerobic gram-negative or staphylococcal) are associated with a higher incidence of PTX.[9] Individuals with underlying connective tissue disease, such as Marfan syndrome, Ehlers-Danlos, and ankylosing spondylitis, are also at higher risk.[10]

In the setting of thoracic trauma, PTX occurs in one-third of pediatric cases, with the majority of these having associated intrathoracic and extrathoracic injuries, and only one-third occurring in isolation.[11] In a review of 1533 victims of thoracic trauma listed in the National Pediatric Trauma Registry database, the incidence of isolated PTX in blunt and penetrating trauma was similar, 24% (306:1288) and 23% (52:230) respectively. Of note, PTX not complicated by hemothorax was present in 30% (58:228) of blunt and 0% (0:228) of penetrating trauma patients who died in this series.[12]

Iatrogenic PTX is an unfortunate consequence of medical procedures. A recent review found that 57% of the procedures that lead to PTX at a teaching hospital were performed under emergent conditions. The most frequent procedure types were central venous catheterization (43.8% of iatrogenic PTX), thoracentesis (20.1%), and barotrauma due to mechanical ventilation (9.1%).[13] The internal jugular and subclavian approaches to central venous access are considered to have the highest risk of PTX.[14] A systematic review reported an overall incidence of PTX resulting from thoracentesis of 6%, with 34.1% of these requiring chest tube insertion.[15] The introduction of real-time ultrasound guidance has been shown to reduce the incidence of PTX for both central venous access and thoracentesis in adults.[16,17] A recent meta-analysis of the pediatric literature of ultrasound-guided central venous access, however, failed to show any statistical difference in adverse outcomes.[18]

Presentation, Physical Examination Findings, and Differential Diagnosis

Children with spontaneous PTX typically present with a sudden onset of unilateral thoracic pain and dyspnea while at rest. Valsalva maneuvers such as lifting or straining have also been implicated.[5] In a chart review, 100% of patients presented with chest pain and 42% with dyspnea.[6] Children presenting after 24 hours may have little to no pain.[10] Patients with secondary spontaneous PTX can present in greater cardiopulmonary distress. Vital signs may include tachycardia, tachypnea with hypoxia, and hypotension in the most severe cases. Physical examination findings depend on the size of