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Spontaneous Pneumothorax In Paediatric Patients

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ABSTRACT *Spontaneous pneumothorax is a relatively rare condition in the pediatric population. The peak age of occurrence in this age group is bi-modal with most cases occurring either in the neonatal period or in late adolescence. In children, the air leak is often caused by a tear in the visceral pleura due to rupture of a subpleural bulla, either congenital or acquired. Procedures for the treatment of spontaneous pneumothorax include observation, needle aspiration, insertion of an intercostal catheter (ICC) or invasive thoracoscopy or thoracotomy with pleurodesis or pleurectomy. Surgical intervention may include removal of underlying cysts or bullae thought to be responsible for the occurrence or persistence of the pneumothorax*

INTRODUCTION

Pneumothorax, one type of lung disorder in the air leak syndrome spectrum, is defined as the presence of air between the visceral and parietal pleura that leads to lung collapse.[1] Air leaks through holes in the lung tissue into the spaces outside the lung airways. Normally, the pressure in the pleural space is lower than that inside the lungs. If air enters the pleural space, the pressure becomes greater than that in the lung, which then collapses partially or completely. A tension pneumothorax is caused when air enters the pleural space during inspiration but cannot exit during exhalation. The positive pressure results in collapse of the involved lung and a shift of the mediastinal structures to the contralateral side, leading to a decrease in cardiac output as a consequence of decreased venous return.[2]

Pneumothorax usually is classified as either traumatic or spontaneous. Trauma-related pneumothorax can be iatrogenic or accidental, and spontaneous pneumothorax can be primary (without clinically or radiographically apparent lung or chest wall disease) or secondary (a complication of chronic or acute lung disease).[3]

Primary spontaneous pneumothorax occurs in children without known lung disease, whereas secondary spontaneous pneumothorax occurs as a complication of chronic or acute lung disease. Traumatic pneumothorax is caused by blunt or penetrating trauma to the chest. Iatrogenic pneumothorax is a complication of certain diagnostic or therapeutic procedures such as central line placement or as a consequence of mechanical ventilation.

Pathophysiology[4]

Spontaneous pneumothorax occurs via rupture of the visceral pleura, whereas traumatic pneumothorax may occur following injury to either pleural layer. In both types, a loss of intrapleural negative pressure causes lung collapse.

The main physiologic consequences of a pneumothorax are a decrease in vital capacity and a decrease in partial pressure of oxygen (PaO_2). Most patients with a pneumothorax have a reduced PaO_2 and an increased alveolar-arterial oxygen tension difference. The reduction in PaO_2 appears to be caused by areas with low ventilation-perfusion ratios, anatomic shunts, and alveolar hypoventilation.

Pneumothorax can be classified as either simple or complicated. In a simple pneumothorax, air in the pleural space does not build up significant pressure but allows the lung to collapse by 10-30% without further expansion of the pneumothorax. A small pneumothorax may be asymptomatic and well tolerated.

A complicated pneumothorax is progressive and consists of continued air leakage into the pleural space that cannot exit during exhalation. This results in progressive lung collapse. The continued air leak results in positive pressure within the hemithorax and displacement of the mediastinum (ie, tension pneumothorax).

Tension pneumothorax is a life-threatening emergency. The positive pressure results in collapse of the involved lung and a shift of the mediastinal structures to the contralateral side (see the following image). This causes a decrease in cardiac output as a consequence of decreased venous return and leads to rapidly progressive shock and death if not treated.

Etiology[5]

Simple or complicated pneumothorax is very common in both blunt (38%) and penetrating (64%) pediatric chest injuries. Cases not associated with trauma are generally due to a pulmonary bleb rupture, with subsequent air leakage into the pleural space. Inhalation of some toxic substances, most notably crack cocaine, can also lead to this condition.

Spontaneous secondary pneumothoraces may occur in patients with underlying lung diseases such as asthma, cystic fibrosis, or pneumonia. When trauma results in pneumothorax, it may be secondary to blunt trauma or penetrating trauma. Penetrating trauma results in an open or communicating pneumothorax.

Epidemiology[4]

The annual incidence of primary spontaneous pneumothorax in the general population is estimated to be 5-10 per 100,000 population. Although all age groups are affected, the peak incidence of pneumothorax occurs in persons aged 16-24 years.

The disorder is less common in children than in adults; the rate of pneumothorax is relatively higher in the newborn period, even in full-term newborns, but it declines during

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infancy.[3] Premature neonates on mechanical ventilation are at high risk, and limited data in young children suggest a strong male predominance of primary spontaneous pneumothorax.

History
The severity of the symptoms depends on the extent of the lung collapse, rate of development, and underlying clinical status of the patient. A patient with a simple pneumothorax may be either asymptomatic or present with symptoms such as chest pain and dyspnea.

Spontaneous pneumothorax often occurs when a patient is at rest or with minimal exertion. Patients who are symptomatic may complain of the sudden onset of pleuritic chest pain that is sharp or stabbing and may be preceded by a popping sensation. These patients may also have sudden onset of dyspnea. Patients with small pneumothoraces may occasionally have a dry or nonproductive cough. Patients with a spontaneous pneumothorax secondary to underlying lung disease may have a more dramatic presentation.

Physical Examination[5]
A more extensive pneumothorax often produces pleuritic chest pain, dyspnea, tachypnea, cyanosis, and decreased breath sounds on the involved side. Acute pleuritic chest pain on the affected side occurs 95% of the time. In addition, hyperresonance to percussion may be noted on the affected side. Subcutaneous emphysema with crepitance is occasionally present.

Patients with a tension pneumothorax typically present in shock with severe respiratory distress and may have tracheal deviation to the unaffected side as a late sign.

If the pneumothorax is due to trauma, look for contusions or abrasions on the chest wall or a small puncture wound that does not allow free movement of air between the outside and the pleural cavity.

Differential Diagnosis[2]
The evaluation of patients presenting with a spontaneous pneumothorax should always include the investigation of potential causes such as use of inhaled drugs, asthma, foreign body aspiration, infections, and connective tissue diseases. The differential diagnosis includes Congenital Lung Malformations, Cystic Adenomatoid Malformation, Emergent Management of Pleural Effusion, Hemothorax, and Pediatric Bronchogenic Cyst.

Approach Consideration[6]
Patients who present with respiratory distress should have an arterial blood gas (ABG) assessment. Hypoxemia occurs because of significant ventilation perfusion mismatch; however, hypercapnia is unusual in patients without underlying lung disease. A tension pneumothorax should always be a clinical diagnosis, because death can occur before radiographs are obtained or developed. A noncontrast chest computed tomography (CT) scan may be helpful to look for preexisting pulmonary pathologies such as blebs or bullae. Ultrasonography has also been shown to be useful in detecting pneumothorax. Transillumination of the chest may help to establish the diagnosis in the newborn infant.

Chest Radiography[4]
Pneumothorax is generally a clinical diagnosis that is confirmed with upright chest radiography (see the following images). Anteroposterior (AP) and lateral views can reveal the presence of even small amounts of intrapleural air. Air in the pleural space that outlines the visceral pleura is a characteristic finding. Hyperlucency of vascular and lung markings on the affected side can be seen because of this air. Atelectasis may also be seen on the affected side, and the mediastinum and trachea may shift away from the pneumothorax.

A tension pneumothorax should always be a clinical diagnosis, because death can occur before the radiograph is obtained or developed. A small pneumothorax in a supine patient can be more easily detected in the lateral decubitus view.

When an infant is suspected of having a pneumothorax, AP radiographs are obtained in the supine position. Small pneumothoraces can be better visualized with a lateral decubitus film with the affected side up.

Management [6]
In general, a small (< 25%), simple pneumothorax conservatively, unless the patient is significantly symptomatic. The treating physician may want to consider using 100% oxygen via a nonrebreathing face mask to increase reabsorption of intrapleural air; however, the potential for oxygen toxicity should be considered, and this treatment should not be continued for long periods. The patient should be observed and chest radiography should be repeated to look for improvement.

If the patient is in a clinic or office setting, order an immediate transfer to an emergency department by ambulance (advanced cardiac life support capability is preferred).

A small, simple pneumothorax in a patient who experienced trauma is best treated with a chest tube, because the condition may rapidly convert into a tension pneumothorax, especially if positive pressure ventilation is applied. Large or significantly symptomatic pneumothoraces require chest tube placement and surgical intervention. A tension pneumothorax requires immediate decompression with needle thoracostomy.

Instruct parents to return if the child has chest pain or shortness of breath; pain medication should be given on discharge. In addition, the chest tube wound site should be monitored for infection and to ensure proper healing.

Complications [7]
Complications directly related to pneumothorax are few. Recognition and proper treatment of a pneumothorax are needed to prevent expansion, hypoxia (with its complications), and tension with subsequent cardiovascular collapse and death.

Chest tube insertion may result in significant bleeding, infection, or both. Insertion too far below the recommended fourth or fifth intercostal space may result in intra-abdominal placement, with possible abdominal visceral or diaphragmatic injury.

Conclusion
Conservative treatment including observation, thoracentesis, and chest tube insertion should suffice for most patients with first episode of primary spontaneous pneumothorax. Early surgery is warranted for any patient who fails conservative treatment, for which video assisted thoracoscopic surgery is safe and effective.

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