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Pneumothorax: What's a Pediatric Pulmonologist To Do?

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Abstract

A pneumothorax is a collection of air in the pleural space commonly associated with respiratory symptoms. Patients may be relatively asymptomatic but may present with life-threatening distress. Confirmation of a clinically suspected pneumothorax is most often by chest x-ray when patients have been stabilized. Pneumothoraces are first categorized as primary, secondary, or iatrogenic and informs the evaluation and treatment plan. However, despite management guidelines in the literature, their applicability for pediatric patients is limited. Understanding of the historical risk factors including the acute clinical course and how radiographs, both chest X-ray and CT chest illuminate which patients are at highest risk for pneumothorax recurrence remains controversial. Over time most surgeons have adopted video-assisted thoracoscopic surgery (VATS) versus an open (limited axillary thoracotomy) approach mostly related to improved patient comfort, perceived improved risk-benefit ratio including similar recurrence rates of PTX. The method of surgical stapling, need for pleurodesis, and other aspects of the surgical approach remain controversial. Common practice for first episodes of primary spontaneous pneumothorax without persistent air leak includes the acute treatment and then observation with further evaluation and treatment typically reserved for a subsequent PTX. Special circumstances may be considered for a more aggressive surgical approach. Lack of consistency in current guidelines and lack of quality data in pediatric aged patients limits our ability to create clear treatment algorithms. Further research is needed and likely will require a multicenter approach.

Keywords: *Pneumothorax; Pediatric Pulmonologist; Video-Assisted Thoracoscopic Surgery (VATS)*

Overview of pneumothoraces

A pneumothorax (PTX) is a collection of air in the pleural space commonly associated with acute chest pain and dyspnea. Physical exam may be minimally abnormal with tachycardia and dyspnea with a smaller PTX and decreased breath sounds, hyperresonant percussion, and decreased vocal fremitus with larger air collections. Tension pneumothorax with mediastinal shift away from the PTX, hypotension, and cyanosis requires emergent treatment most often by needle thoracocentesis. When less emergent, confirmation of the clinically suspected PTX is most often by chest X ray (CXR) perhaps using an expiratory view, lateral, or lateral decubitus views to potentially improve detection. Several methods have been utilized in calculating PTX volume and size of the PTX at least partially informs treatment options [1,2].

Pediatric pulmonologists are occasionally consulted in cases of pneumothorax. Pneumothoraces are first categorized as primary, secondary, or iatrogenic. Primary pneumothoraces are generally subcategorized as traumatic or spontaneous and without a clear trigger. Secondary pneumothoraces have a component of underlying lung disease such as congenital malformation, interstitial lung disease, asthma, or cystic fibrosis; or perhaps associated with more systemic diseases such as malignancy or connective tissue disorders.

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Secondary pneumothorax cases are treated in a large part based on the underlying lung/systemic disease and further discussion will not be covered here given the breadth of those disease processes.

Guidelines for treatment

Treatment of the acute pneumothorax is often initiated by others typically by those with emergency or surgical training. Management guidelines are found in the literature but their applicability for pediatric patients has been questioned as was based on only adult patients defined as aged 18 years or over [3]. Some authors have given more specific guidance in pediatric cases but are quick to point out the lack of data in pediatric age groups [1]. Acute treatment often provided includes analgesics, supplemental oxygen, and evacuation of the PTX with aspiration or longer-term intercostal chest catheter insertion with ongoing air leak important in the ongoing step wise approach to therapy adjusted to avoid re-expansion pulmonary edema.

Much of the literature has attempted to more clearly inform future evaluation and treatment options. Once the initial excitement of the acute process has been quieted, longer term implications especially for primary spontaneous pneumothorax and the likelihood of recurrence are brought to fore.

Potential risk factors for recurrence and next steps

Some patients are addressed by a pediatric pulmonologist during initial hospitalization, but others are addressed during outpatient follow-up. As is often the case in medicine, a thorough history is critical. An often first step is to define if the pneumothorax was primary or secondary. Does the patient's history have any suggestions of chronic lung disease or systemic disease affecting the lungs; suggesting the pneumothorax may be secondary? Is there a history of trauma, especially to the chest; helping to differentiate if the pneumothorax was spontaneous? Was the patient coughing just prior to the series of events leading to the diagnosis of pneumothorax suggesting lung disease?

Gathering the specifics from the acute pneumothorax treatment such as the number of days of air leak, size and severity of symptoms as previously mentioned not only inform the acute pneumothorax treatment but are also potentially important in guiding longer term treatment options.

In hopes of more accurately recognizing who will likely have a subsequent PTX several risk factors have been evaluated but may be age dependent [4]. For example, adult women were found to be at higher risk but in pediatrics males appear to have the higher risk [1].

Growth determinations, including higher height/weight ratio and total height as well as a recent growth spurt may predispose to a pneumothorax.

Previous history of pneumothorax noting whether ipsilateral or contralateral will likely guide evaluation and treatment as surgical intervention is typically undertaken with recurrent or bilateral PTX [1].

Unfortunately, there is inconsistency in the data found in the literature limiting a clinician's confidence in making dogmatic conclusions. Limitations as per usual; most studies are relatively small in number, inclusion and exclusion criteria differed, theories of causation have introduced bias, and changes in medical treatment are confounders.

Radiographs---what to do with the information

Chest X-ray (CXR)

The CXR showing the size of the pneumothorax and those following chest tube placement can help inform the scope of the patient's acute course such as days of air leak. A plain CXR is not very sensitive for blebs and bulla and often require a chest CT for more clear anatomic imaging [1], however bullae when seen on CXR are an important risk factor for future PTX recurrence [5].

CT chest

Blebs and bulla are inconsistently defined in the literature as air collections less than 2 cm in diameter and greater than 2 cm in diameter respectively but sometime smaller [1,5]. Interpretation of the clinical usefulness of finding these air collections has varied at least in part because they have been reported in healthy controls [1,5-8]. Again there may be some bias based on theory of pneumothorax etiology, length of study follow-up especially when trying to predict recurrence rates, quality of the scanner used and ability to detect abnormality, and the definition and clinical significance regarding the size of the air collection. Using radiographic data to predict recurrence rates and therefore guide therapy remains limited.

Surgery

Information in this section is meant only to help the pediatric pulmonologist understand broadly surgical options but is not meant to be an exhaustive review of the literature [1,9-16]. The surgical goal(s) are to stop any present air leak and to prevent recurrence with minimal morbidity. The definitive decision regarding the surgical approach will likely be made by others but a pediatric pulmonologist should be able to render an educated opinion. Over time most surgeons have adopted video-assisted thoracoscopic surgery (VATS) versus an open (limited axillary thoracotomy) approach mostly related to improved patient comfort, perceived improved risk-benefit ratio including similar recurrence rates of PTX. Specifics of the stapling approach are debated. Additional variables related to the surgical approach include whether to provide either chemical or mechanical pleurodesis as part of the initial operation as additional protection for pneumothorax recurrence balanced with potential for harm. Common practice for first episodes of primary spontaneous pneumothorax without persistent air leak includes the acute treatment and then observation with further evaluation and treatment typically reserved for a subsequent PTX. Special circumstances may be considered for a more aggressive surgical approach including patients with more severe initial presentation, those with limited access to care, and those involved with certain occupations/activities such as pilots and divers.

Conclusion

Lack of consistency in current guidelines and lack of quality data in pediatric aged patients limits our ability to create clear treatment algorithms. Further research is needed and likely will require a multicenter approach.

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