Children with Cough and Fever

Up-to-date Imaging Evaluation and Management

Gary R. Schooler, MD[a,*], Joseph T. Davis, MD[a],
Victoria M. Parente, MD[b], Edward Y. Lee, MD, MPH[c]

KEYWORDS

• Cough • Fever • Lung infection • Pneumonia • Imaging management • Pediatric patients

KEY POINTS

- A broad spectrum of pulmonary infectious disorders may present in the pediatric population, ranging from the commonly encountered viral and bacterial pathogens to fungal and other atypical entities occurring in those patients who are immune compromised.
- Complications of pneumonia, including pleural effusion, empyema, necrotizing pneumonia, and abscess formation, often require ultrasonography and/or computed tomography for complete imaging evaluation.
- Recurrent chest infections, especially those occurring in the same anatomic region in the lung, should raise suspicion for underlying congenital pulmonary abnormality.
- Airway foreign bodies are common in the pediatric population and may present with cough and fever when the airway is obstructed or partially obstructed on a subacute or chronic basis.
- Follow-up chest radiographs are not routinely recommended in pediatric patients who are adequately treated and have recovered from lung infections.

INTRODUCTION

Cough and fever in the pediatric population are frequent but nonspecific symptoms at presentation. There are a wide range of underlying causes for these symptoms and clinicians are charged with determining what disorders may be present and how best to detect and treat each process. One of the more commonly encountered causes in children with fever and cough is pneumonia, an entity with a broad scope of infectious causes ranging from common viral and bacterial pathogens to atypical infectious agents. The incidence of pneumonia approaches 150 million cases per year worldwide and in children less than 5 years of age accounts for approximately 15% of deaths.[1,2]

Although community-acquired viral and bacterial pneumonia are encountered most frequently, clinicians and radiologists must remain cognizant of less common but equally important situations.

Disclosure: The authors have nothing to disclose.
[a] Department of Radiology, Duke University Medical Center, 1905 Children's Health Center, Box 3808–DUMC, Durham, NC 27710, USA; [b] Department of Pediatrics, Duke University Medical Center, Box 3127–DUMC, Durham, NC 27710, USA; [c] Department of Radiology, Boston Children's Hospital and Harvard Medical School, 300 Longwood Avenue, Boston, MA 02115, USA
* Corresponding author.
E-mail address: gary.schooler@duke.edu

Radiol Clin N Am ■ (2017) ■–■
http://dx.doi.org/10.1016/j.rcl.2017.02.007

Such situations include when the inflammatory or infectious condition is superimposed on immune dysfunction/suppression or congenital/acquired structural airway and pulmonary abnormalities. Underlying immunologic or structural abnormality may not be known at the time of presentation, and the radiologist may be the first to suggest that such a disorder is potentially present.

In most pediatric patients with cough and fever, imaging plays an important role in the initial diagnosis and management of infants and children with signs and symptoms indicating the presence of an infectious or inflammatory airway or pulmonary process. This article reviews a range of pathologic entities occurring in children with cough and fever in daily clinical practice. In addition, this article also discusses updated imaging algorithms, typical imaging findings, and practical recommendations for follow-up imaging.

IMAGING MODALITIES AND TECHNIQUES

The 3 most commonly used imaging modalities for evaluating infants and children who present with cough and fever are radiography, computed tomography (CT), and ultrasonography.

Radiography

Imaging pediatric patients presenting with cough and fever usually begins with radiography, an imaging modality that remains a mainstay in pediatric diagnostic imaging assessment. Although imaging evaluation may not be needed in pediatric patients with typical mild lower respiratory symptoms,[1,3] the cluster of classic clinical symptoms of pneumonia may be less accurate in infants and young children compared with adults, prompting the need for imaging if pneumonia is clinically suspected.[4]

The current standard practice for the imaging assessment of pneumonia includes obtaining frontal and lateral radiographs of the chest with the lungs at maximum inspiration. In efforts to reduce radiation exposure and cost, the necessity of the lateral radiograph in the evaluation process has been evaluated, revealing that the frontal radiograph alone has a slightly lower sensitivity than a combination of frontal and lateral radiographs and that pneumonia can be underdiagnosed in approximately 15% of patients.[5] However, in circumstances in which a radiologist can preview the frontal radiograph and a confluent lobar pneumonia can be confidently identified based on the frontal radiograph alone, the lateral radiograph may be safely omitted.[5] Such tailored practice has great potential for reducing the overall radiation dose, which is particularly important in the pediatric population.

Computed Tomography

CT is generally reserved for assessment of complications in the setting of chest infection or inflammation. In this clinical situation, intravenous contrast administration is typically needed. CT has shown enhanced diagnostic accuracy in assessing complications of lung infection such as necrosis, cavitation, abscess formation, and pleural complications, including complex pleural effusion and empyema.[6] In addition, CT may be beneficial in pediatric patients with atypical infections in the setting of immune compromise as well as those with underlying congenital lung malformations. Particular attention should be paid to using child-sized radiation dosing strategies as well as dose optimization techniques (including automatic exposure control and body size–specific dose modulation) to assist radiologists in ensuring adherence to ALARA (as low as reasonably achievable) principles.

Ultrasonography

For the past several decades, ultrasonography has been used for evaluation of pleural complications of pneumonia, predominantly evaluating for the presence and complexity of pleural fluid. More specifically, ultrasonography has been shown to be capable of detecting effusions as small as 3 to 5 mL,[7] which is typically achieved using a systematic approach that includes obtaining anterior, lateral, and posterior views of the chest using high-frequency linear and/or curved ultrasonography probes.

More recently, the use of ultrasonography to evaluate the lung parenchyma in the setting of infection has been explored. A meta-analysis performed by Pereda and colleagues[8] found that performing lung ultrasonography with a high-resolution linear transducer had a collective sensitivity of 96% and specificity of 93% for diagnosis of pneumonia in children less than 18 years of age. However, it is important to recognize that the infective consolidative process must reach the pleura to be detected by ultrasonography. In addition, differentiating between atelectasis and pneumonia may be difficult, because both may display sonographic air bronchograms (airless lung with gas or fluid filling the bronchi) resulting in some question of reliability and accuracy of ultrasonography in diagnosis of pneumonia.[9] Other investigators have suggested lung ultrasonography as a follow-up examination that may be useful in detection of ongoing infection and pulmonary and pleural complications.[9,10]