Can the Lung Density Measurement Help in Diagnosis of Foreign Body Aspiration in Children?

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Foreign body aspiration is a frequently encountered pediatric emergency and a common cause of accidental death, with incidence peaking at two years of age [1]. More commonly, aspiration is not fatal and symptoms are nonspecific. This often leads to delayed diagnosis and increased morbidity. Therefore, imaging evaluation and familiarity with the imaging findings in foreign body aspiration is essential.

Three main imaging modalities that are currently utilized in the evaluation of suspected tracheobronchial foreign body are radiography, fluoroscopy and computed tomography (CT). Radiopaque foreign bodies are easily identified on any of these modalities. However, 90% of aspirated foreign bodies are radiolucent and detection is often difficult [2,3]. Plain radiographic findings of radiolucent tracheobronchial foreign bodies rely on secondary phenomena, including air trapping, atelectasis and consolidation. Unlike easily identifiable radiopaque foreign bodies, radiolucent foreign bodies are much more difficult to detect and chest radiographs are frequently interpreted as normal, with standard anterior-posterior (AP) and lateral chest radiographs having a reported sensitivity of 55%, specificity of 50%, positive predictive value (PPV) of 80% and negative predictive value (NPV) of 23% [4]. Inspiratory and expiratory radiographs in older cooperative children and bilateral decubitus radiographs in younger non-cooperative children are often performed in an attempt to improve diagnostic accuracy. However the utility of these additional views has been questioned [4,5]. Assefa, *et al*. [4] found lateral decubitus radiographs to have a sensitivity of 27%, specificity of 67%, PPV of 75% and NPV of 20%. Brown, *et al*. [5] reported that the addition of decubitus views increased false positives by decreasing the specificity of standard chest radiographs without changing the sensitivity, and adding expiratory views increased the number of true positives without reducing the number of false positives. Fluoroscopy has traditionally been used to better detect secondary signs of air trapping by visualizing contralateral mediastinal shift and ipsilateral decreased diaphragmatic excursion [6], however, interpretation is operator-dependent and is increasingly being replaced by CT [7]. Findings of air trapping, atelectasis and consolidation are easily and accurately demonstrated by CT [8], and CT has a reported sensitivity close to 100% and specificity between 66.7% and 100% in studies utilizing cine CT and 3D volume-rendered imaging of the large airway [2,9,10]. However, CT must be utilized judiciously given concerns about radiation exposure particularly in the pediatric population, and plain radiographs remain the first line imaging modality.

In this issue of *Indian Pediatrics*, Song, *et al*. [11] take a novel approach to the interpretation of the chest radiograph in cases of foreign body aspiration and apply a quantitative tool to measure lung radiodensity in order to objectively assess the radiolucency caused by air trapping. The authors retrospectively reviewed standard AP chest radiographs of 59 children who had confirmed tracheobronchial foreign bodies seen on bronchoscopy, and found that in cases of bronchial foreign body, the radiodensity of the ipsilateral lung is significantly lower than the contralateral lung. Thirty patients also underwent CT, and density measurements on chest radiograph correlated well with density measurements on CT. An objective and quantitative tool, such as the one that the authors of this article suggest, has the great potential to improve diagnostic accuracy and confidence in cases of suspected bronchial foreign body with unilateral air trapping. This study is particularly interesting because it investigates a way to improve accuracy of the simple plain radiograph, but further investigation is needed to determine whether this quantitative density metric can prospectively aid in the diagnosis of aspirated foreign body. Much recent work has directed focus on CT, and has shown that new tools like cine CT imaging, 3-D reconstructions and 4-D imaging can be very useful [2,8-

10]. As these tools become more widely available, they will certainly play a larger role in the diagnosis of tracheobronchial foreign body. However, they must be used judiciously given concerns about radiation exposure. Due to these concerns, MRI is an attractive modality for future investigation given its lack of radiation. Several papers in the 1990s described the use of MRI in diagnosis of radiolucent tracheobronchial foreign bodies [12-15]; however little work has been published on this topic in the past 15 years, and this is an important direction for future research.

In summary, foreign body aspiration is a frequent cause of morbidity and mortality in children. Imaging plays an important role in the diagnosis and management of tracheobronchial foreign bodies. Plain radiographs are the first line imaging modality, but they have a well-known limited diagnostic accuracy when foreign bodies are radiolucent. Song, *et al*. [11] describe a quantitative measure of lung radiodensity which can be used to detect air trapping in cases of aspirated radiolucent foreign body. This technique may improve the diagnostic accuracy of plain radiographs and have a potential beneficial effect on diagnosis and management of this common pediatric condition.

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