Abstract:
The prompt diagnosis of foreign body aspiration (FBA) in children is essential to avoid complications such as post-obstructive pneumonia and bronchiectasis. The conventional approach of diagnosing FBA by clinical history, physical examination, and chest radiography is limited by the modest sensitivity and specificity of these techniques, and diagnostic laryngoscopy and bronchoscopy is limited by operative risks and high costs. Chest computed tomography is highly sensitive and specific for the diagnosis of FBA and for conditions that can mimic the clinical presentation of FBA. The judicious use of chest computed tomography in selected children with suspected FBA can help achieve a favorable balance between the risks of ionizing radiation, misdiagnosis, and negative diagnostic laryngoscopy and bronchoscopy.

Keywords:
foreign body aspiration; bronchoscopy; computed tomography; diagnostic laryngoscopy

*Department of Surgery, Otolaryngology, Baylor College of Medicine, Houston, TX; †Department of Pediatric Radiology, Texas Children's Hospital, Baylor College of Medicine, Houston, TX.
Reprint requests and correspondence: Carla M. Giannoni, MD, Department of Surgery, Otolaryngology, Baylor College of Medicine, 6701 Fannin, Suite 640, Houston, TX 77030.
cmgianno@texaschildrens.org (C.M.Giannoni), rpguille@texaschildrens.org (R.P.Guillerman)

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Computed Tomography for the Evaluation of Suspected Airway Foreign Bodies

Carla M. Giannoni, MD*, R. Paul Guillerman, MD†

The diagnosis of foreign body aspiration (FBA) can be challenging. Many upper and lower respiratory tract disorders can mimic FBA and vice versa. The reported sensitivity and specificity of the clinical history, physical examination (PE), and/or chest radiography (CXR) for the diagnosis of FBA in children are widely variable, ranging from 10 to 90%, according to a recent review of the literature.[1]

Clinical practice has customarily entailed the use of empirical diagnostic rigid bronchoscopy, also termed *direct laryngoscopy and bronchoscopy* (*DL&B*), when the clinical presentation and findings on CXR are suspicious for FBA. However, many children referred for DL&B to diagnose and treat suspected FBA have negative operative examinations. A review of our own hospital's experience over the period 2008 to 2012 revealed that 39 (34%) of 115 consults for DL&B to evaluate for FBA were negative for foreign body (FB).

The clinical and radiographic findings associated with FBA are summarized in Table 1. In 2008, Kadmon et al[2] published a study in which the authors sought to develop a predictive score assessing the probability of FBA based on these findings. They found the most significant parameters to be:

- Age 10 to 24 months;
- Foreign body in the child's mouth;
- Choking episode with severe respiratory complaints;
- Postchoking hypoxemia, dyspnea, or stridor;

TABLE 1. Reported findings in foreign body aspiration.

Evaluation Mode	Positive Findings
History	Witnessed choking event
	Cough, acute or chronic
	Dyspnea
	Recurrent pneumonia
	No relevant history
PE	Wheezing, unilateral or bilateral (occasionally)
	Diminished breath sounds, unilateral or bilateral (occasionally)
	Stridor
CXR, including decubitus views	Hyperinflation, unilateral
	Atelectasis, unilateral
	Radiopaque FB

- Asymmetric (1 sided) lung findings;
- Abnormal trachea on x-ray; and
- Chest x-ray with unilateral infiltrate, atelectasis, local hyperinflation, or obstructive emphysema.

One of the benefits of DL&B is that when an FB is identified, the FB can be both diagnosed and treated in the same setting. In the case of negative DL&B, however, the need to wait for stomach emptying and operating room availability delays the disposition and discharge of a patient, as well as introducing the risk and costs of general anesthesia and an operative procedure. An additional risk of DL&B is a missed FB due to incomplete visualization of the airways. According to a review by Hitter et al,[1] the complication rate related to rigid bronchoscopy ranges from 2 to 22%. The lower end of the range was reported in the setting of experienced pediatric bronchoscopy teams.

Chest computed tomography (CT) is a valuable, noninvasive method to consider in the evaluation of a child with a possible airway FB. Air normally present within the airway provides intrinsic contrast to highlight an intraluminal FB on CT. The presence of a metallic or fatty (as in the case of a peanut) FB can be inferred in some cases by the ability of CT to resolve substances of differing x-ray attenuation. Plastic FBs that are invisible on CXR are often appreciable on CT. Multiplanar and 3-dimensional "virtual bronchoscopy" CT image reconstructions provide exquisite anatomical detail to improve diagnostic confidence and precisely localize an FB for preoperative planning (Figure 1). In addition to revealing the FB, CT may demonstrate secondary signs such as air trapping or postobstructive atelectasis, pneumonitis, or bronchiectasis. Computed tomography can also be used to identify a retained FB fragment in the setting of persistent symptoms or signs after attempted FB removal. In the absence of an FB, CT may reveal alternative diagnoses such as hilar lymphadenopathy or an aberrant vessel compressing the airway. Potential causes of a false-positive CT examination for an airway FB include an endobronchial mucus plug, or tumor, whereas false-negative CT examinations may occur in the setting of an FB that is too tiny to resolve or is obscured by motion artifact or other technical limitation.[3]

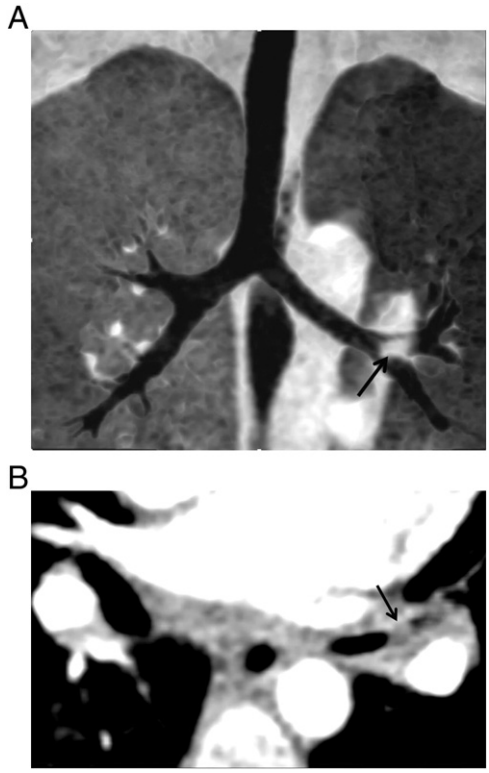

Figure 1. A 2-year-old with cough and wheezing. A, Coronal CT minimum intensity projection image depicting a filling defect (arrow) at the origin of the left upper lobe bronchus from the distal left main stem bronchus, with associated narrowing of the airway lumen and hyperlucency of the left lung related to air trapping from ball valve effect. B, Corresponding axial CT image shows a low-attenuation intraluminal filling defect (arrow) representing an aspirated peanut found at bronchoscopy.

Several publications report the diagnostic efficacy of CT in the diagnosis of pediatric FBA. Bhat et al[4]