

# Pitfalls in the Diagnosis of Aerodigestive Tract Foreign Bodies

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**Summary:** In the young child, particularly those between the ages of 1 and 3 years, aerodigestive tract foreign bodies continue to be a significant problem. Early diagnosis and treatment can decrease morbidity and length of hospital stay in these children. Three cases of delayed diagnosis in children with bronchial (2) and esophageal (1) foreign bodies are presented. In dealing with young children it is important to maintain a high clinical suspicion of a foreign body and to perform a detailed history and physical examination. Options in radiographic analysis of the patient with a suspected foreign body, probable locations of the foreign body, and the likelihood of definitive radiographic findings are discussed. Importantly, a negative radiographic analysis does not rule out the presence of an aerodigestive tract foreign body. Two flow charts for the evaluation of patients who have possibly ingested or inhaled a foreign body are presented to aid the primary care physician in diagnosis. *Clin Pediatr.* 1998;37:359-366

## Introduction

Aerodigestive tract foreign bodies, either tracheobronchial or esophageal, remain a significant problem in the young child. Prior to the turn of this century a mortality rate of 50% resulted from inhaled foreign bodies, a figure that has decreased to approximately 1% with the advent of bronchoscopic techniques.<sup>1</sup> Similarly, the morbidity following esophageal foreign body ingestion can be significant

in the patient who is unable to eat owing to blockage of the esophagus, and in rare cases the item can erode through the esophageal lumen and lead to fistulization into neighboring structures.<sup>2,3</sup>

Approximately 75% of aerodigestive tract foreign body ingestions occur in children under the age of 3 years, the most common age being between 1 and 2 years.<sup>1,4-6</sup> In most cases a child who has aspirated a foreign body that has lodged itself in the larynx, trachea, or bronchi will pre-

sent with a history of paroxysmal coughing, followed by wheezing and/or decreased air entry (often unilateral) and a persistent cough.<sup>4</sup> In some, a symptomless quiescent period of hours to days and in rare cases even months is present after the aspiration event. If the foreign body remains undetected, pneumonia frequently develops within days of the aspiration if the object obstructs a bronchus. In contrast, the child who has an impacted esophageal foreign body most commonly presents with a history of a witnessed ingestion, followed by vomiting, odynophagia, dysphagia, and sometimes drooling.<sup>5</sup> These children may also have a history of a choking episode and cough, and in a small percentage of cases they present with airway symptoms such as stridor and dyspnea. Importantly, children with either an

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esophageal or airway foreign body can present with no history of ingestion and/or no symptoms.<sup>5,7,8</sup>

It is well known that in North America and most other areas of the world the most common esophageal foreign body is a coin, and the most common bronchial foreign body is a peanut.<sup>4,9</sup> After coins, food items are the most common type of blockage seen in the esophagus, followed by a variety of items found in the home. Tracheobronchial foreign bodies are typically small, firm items that become slick when coated with saliva and are not easily chewed by the child with few molar teeth.

Ideally, the child with a foreign body will be identified within hours of the ingestion event and have the foreign body removed within 24 hours. When the foreign body is readily identified, the endoscopic removal can be performed as an outpatient procedure in most cases. Extraction from either the bronchus or esophagus is a much more difficult procedure if the object has been impacted for an extended period of time, owing to inflammation and granulation tissue around the object. These children typically have to stay in the hospital for one or more days and have an extended recovery time.

Atypical histories and misleading clinical and radiologic findings sometimes result in delayed diagnoses owing to misinterpretations by patients or their physicians. The purpose of this report is to highlight some of the pitfalls in the diagnosis of aerodigestive tract foreign bodies.

## Patient Reports

### Patient 1

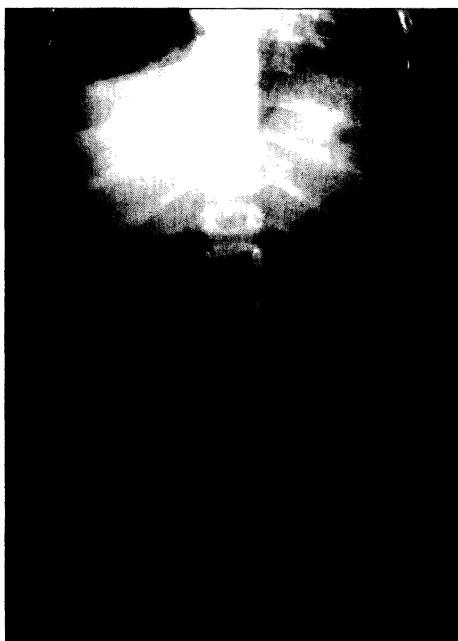
A 27-month-old female was

napping with her mother on a Sunday afternoon. When the mother awoke she found the child vomiting and noticed that the child's star-shaped toy was missing. The vomiting subsided and when the parents asked where the toy had gone the patient pointed to her mouth. A thorough search revealed no toy. The patient was taken to a local 24-hour clinic and a radiograph was obtained (Figure 1), which showed no foreign body. She was discharged home. For the next 4 days the child vomited all solid food although she was able to take liquids. When the patient was seen by her regular pediatrician on Thursday morning, repeat radiographs showed an obvious star-shaped radioopaque foreign body at the level of the cricopharyngeus (Figure 2). She was transferred to a tertiary care children's hospital where the foreign body was removed by rigid endoscopy with some difficulty. There was significant edema and granulation tissue around the points of the star, causing the object to be securely enmeshed in the esophageal lumen. Postoperatively, she was watched closely in the intensive care unit for signs of an esophageal perforation. She was discharged home 36 hours after admission, and a follow-up barium swallow 2 weeks after the incident showed no signs of stricture.

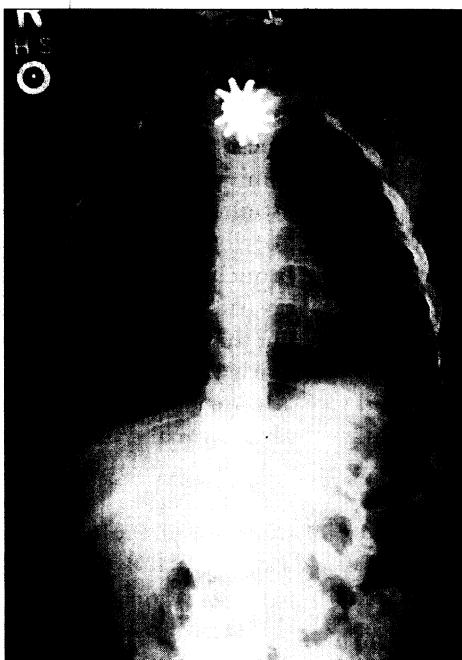
### Patient 2

A 20-month-old male with a previous history of four episodes of reactive airway disease, each triggered by an upper respiratory infection, was eating walnuts with his father on a Thursday evening. The child fell off his

chair, began to choke and sputter, and then spat out a handful of nuts. Soon thereafter he began to wheeze and have a wet cough. Throughout that night the child continued to have intermittent coughing. He was seen by medical personnel the following morning and a fluoroscopic examination was obtained, which appeared normal. He was administered an antibiotic and albuterol nebulizer treatments. He continued to have worrisome coughing and thus he was taken to the physician's office on Saturday and Monday. A chest radiograph taken Monday revealed hyperinflation of the right upper lobe and the patient was referred to a tertiary care children's hospital on Tuesday. Evaluation at the children's hospital found the patient to be in mild respiratory distress, with a respiratory rate of 60, audible wheezing, and decreased breath sounds on the



**Figure 1.** Chest radiograph in a patient following suspected ingestion of a foreign body. The radiograph did not include the level of the cricopharyngeus muscle and thus missed the foreign body.



**Figure 2. A, B.** Chest and neck radiographs 4 days later in the same patient as Figure 1. A star-shaped toy is seen.

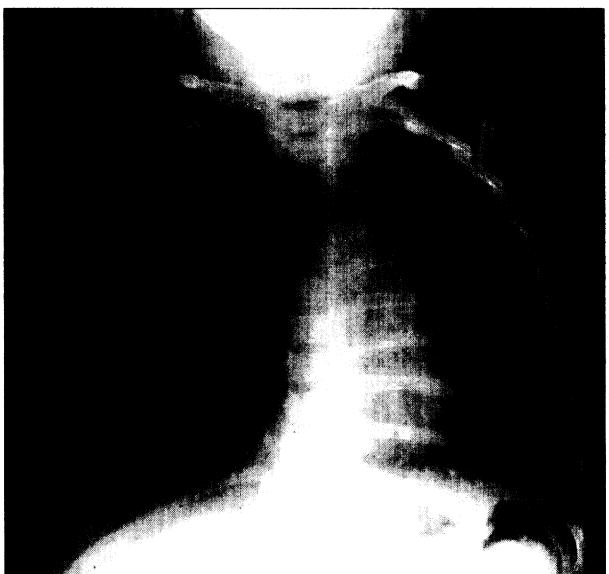
right. A chest radiograph showed marked hyperinflation of the right lung with deviation of the right upper lobe into the left chest (Figure 3). He was taken to the operating room that afternoon for rigid bronchoscopy, and a large piece of nut was removed from the right mainstem bronchus. A tremendous amount of inflammation was present throughout the tracheobronchial tree. Post-operatively, the patient required oxygen for 12 hours to maintain his oxygen saturation over 92%. He was discharged home off the oxygen 24 hours after admission.

### Patient 3

A 12-month-old previously healthy male had sudden onset of wheezing while outside at the construction site of his family's future home. He was taken to his local emergency room where his physical examination was consistent with asthma and he was treated medically; his symptoms improved. For the next 5 months the

patient had continued respiratory symptoms and was treated for asthma. At 17 months of age his breathing worsened and he was taken to the local emergency room. A chest radiograph showed a radioopaque object in the right

mainstem bronchus, and he was taken to the operating room where bronchial foreign body removal via rigid bronchoscopy was attempted. The foreign body could not be directly seen owing to a mass of granulation tissue fill-



**Figure 3.** Chest radiograph of a patient who inhaled a nut 6 days earlier. Hyperinflation of the right upper lobe with deviation of the right upper lobe into the left chest can be seen.

ing the right mainstem bronchus and the retrieval attempt was aborted. The patient was awakened and transferred to a tertiary care children's hospital. On arrival the patient was given intravenous and inhaled steroids in an effort to reduce the inflammation surrounding the foreign body before extraction. His respiratory status worsened, however, and the patient was taken to the operating room for rigid bronchoscopy and removal of the foreign body several hours after he was admitted. At endoscopy the foreign body again could not be seen owing to the mass of granulation tissue surrounding the object. Only with fluoroscopic guidance was the metallic object extracted from the granulation tissue.

Immediately following the surgery a chest radiograph showed no foreign body and improved lung aeration. Initially he did well with improved oxygen saturation. Several hours later, however, the patient developed acute respiratory distress and a portable chest radiograph at that time revealed a tension pneumothorax. The chest cavity was needle-decompressed, a chest tube was then placed, and the patient's symptoms improved. The hole in the bronchus where the foreign body had eroded healed slowly. He required two chest tubes to reinflate the lung and shortly after the chest tubes were removed 11 days later the patient developed a second pneumothorax. The chest tubes were replaced and the patient was discharged home 1 month after he was admitted—with the chest tubes in place. They were eventually removed 2 weeks later, and the patient had no further symptoms suggestive of asthma.

## Discussion

Two algorithms are presented regarding evaluation of the child with a history of a choking spell (Algorithm 1) or a history of swallowing a foreign object (Algorithm 2). The delayed diagnosis of the first two patients could have been avoided if the physicians had placed more trust in the history and physical examination, rather than the radiograph findings. Unfortunately, not all children will have the usual history, as in the third patient, and it is these children who are particularly at risk for delayed diagnosis.

The longer a foreign body is in place the greater the inflammatory response to the foreign body and the greater the likelihood of complications. Hard foreign bodies, particularly metallic ones, can erode through a bronchus and lead to significant morbidity as seen in patient 3. Likewise, sharp or corrosive foreign bodies can erode through the esophageal lumen, making extensive surgery necessary.<sup>2,3</sup> In all three patients discharge from the hospital was delayed owing to the difficult nature of the extraction of the foreign body. The first patient required close observation to rule out an esophageal perforation, and the second patient required oxygen for 12 hours following extraction owing to the intense airway inflammation. The third patient was hospitalized for 1 month owing to the hole in his bronchus, which resulted in a pneumothorax.

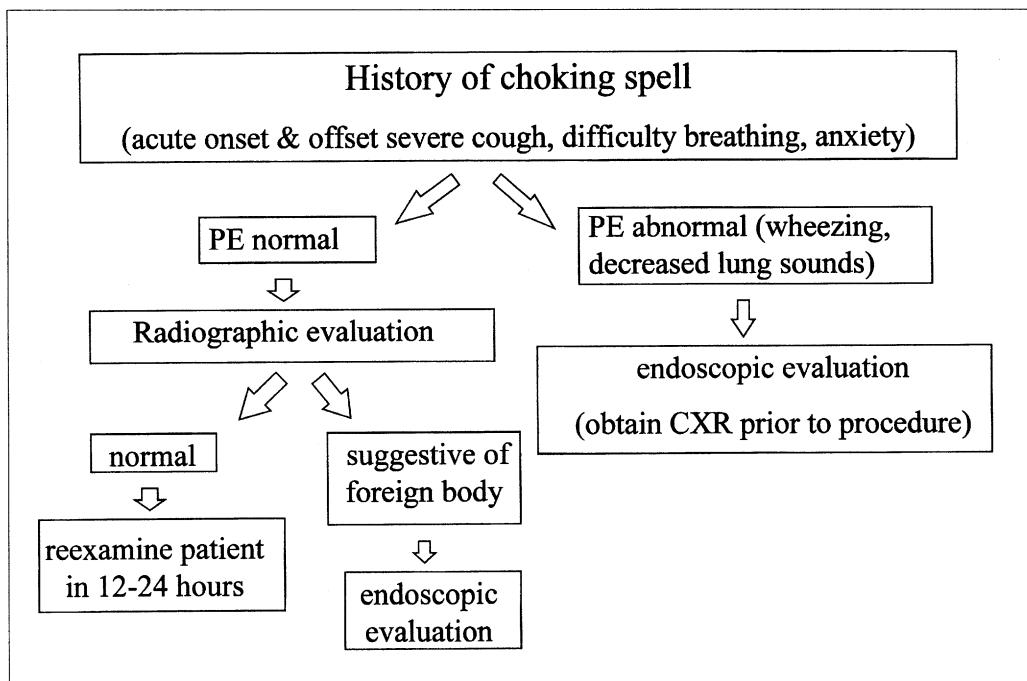
Radiographic examination of the child with an aerodigestive tract foreign body can be extremely useful in making the diagnosis, but it can also be misleading. There are three points within the esophagus where foreign bodies typically lodge. First, and most common, is the level of

the cricopharyngeus muscle, i.e., the postcricoid area.<sup>9</sup> Next most common is the level of the lower esophageal sphincter at the gastroesophageal junction, and third is in the midesophagus where the esophagus is compressed by the aortic arch and left mainstem bronchus. The level at which the obstruction occurs may be different than one of these spots, particularly in the at-risk child who has a history of an esophageal anomaly requiring surgery (e.g., tracheoesophageal fistula). In case 1 a radiograph was obtained, but the level of the cricopharyngeus was not included and thus the diagnosis was delayed for 4 days.

When an esophageal foreign body is suspected, an anterior-posterior and lateral chest and neck radiographs should be obtained. In the child with an esophageal foreign body the radiographs will appear abnormal 80% of the time (and consequently normal approximately 20% of the time).<sup>5</sup> The lateral radiograph is important to evaluate any soft-tissue swelling of the esophagus and helps to rule out the presence of multiple foreign bodies, which have been reported in 5% of cases.<sup>5,9</sup> Because more than half of esophageal foreign bodies are coins, the radiographs are frequently helpful in confirming the diagnosis. However, nonradioopaque foreign bodies will not show up on radiograph, and the diagnosis cannot be definitively ruled out if the radiograph appears normal.

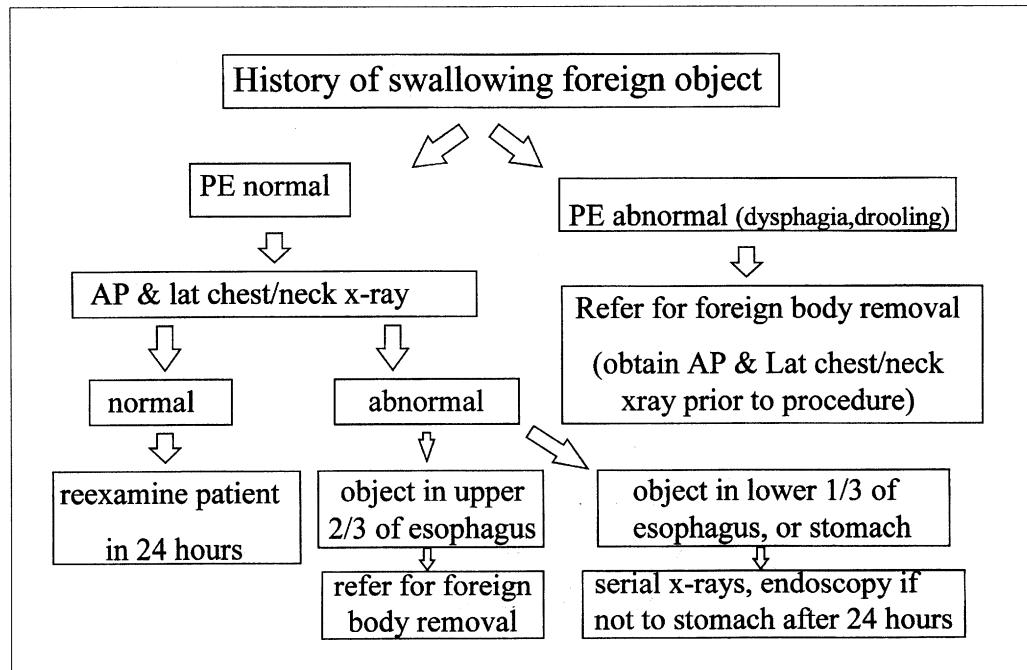
A contrast swallow study can be used to evaluate the possibility of an esophageal foreign body and, as with the chest radiographs, will appear abnormal approximately 80% of the time.<sup>5</sup> This study is not recommended if suspicion of an esophageal foreign body is high because instill-

## *Diagnosing Aerodigestive Tract Foreign Bodies*



**Algorithm 1.** Evaluation of the child with possible airway foreign body.

PE=physical examination, CXR=chest radiograph.



**Algorithm 2.** Evaluation of the child with possible esophageal foreign body.

AP=anterior-posterior, lat=lateral, PE=physical examination, x-ray=radiograph.

ing barium in the esophagus increases the risk of contrast aspiration and also makes extraction of the foreign body considerably more difficult if one should be identified.

Inspiratory and expiratory radiographs or lateral decubitus radiographs are commonly ordered for evaluating a child with a possible tracheobronchial foreign body. In 5–15% of patients a radioopaque object can be seen confirming the diagnosis, as in patient 3.<sup>10</sup> The common indirect radiologic signs of a tracheobronchial foreign body include air-trapping (obstructive emphysema), expiratory mediastinal shift, atelectasis, and pneumonia. Air-trapping is seen in approximately 65% of patients, typically those in whom the foreign body aspiration was recent.<sup>10–13</sup> This finding results as air passes around the object into the distal lung on inspiration but is unable to egress from the lung on expiration when the lumen of the bronchus is smaller and makes contact with the object (check-valve obstruction).

A comparison of inspiratory and expiratory chest films will reveal a shift of the mediastinum on expiration in 27–73% of cases.<sup>11,14</sup> Approximately one quarter of plain thorax radiographs show resorptional atelectasis due to stop-valve obstruction.<sup>10,11,13,14</sup> Resorptional atelectasis results when the foreign body is embedded in the swollen mucosa and completely obstructs the bronchial lumen in both stages of respiration. Absorption of the air in the distal lung soon results in collapse. If the obstruction persists, pneumonia develops in the distal lung; this can be seen in 9–26% of cases.<sup>11–13</sup> Rarely, a pneumothorax will be seen.<sup>11</sup>

Fluoroscopy can be a useful examination in the patient who

has possibly aspirated. Typically, air-trapping and mediastinal shift will be seen.<sup>10</sup> In the second patient fluoroscopy was initially used to evaluate the possibility of a foreign body and was misleading because the examination appeared normal. This study can be helpful when positive but is known to appear normal anywhere from 11 to 45% of the time.<sup>11,12,15</sup>

If the foreign body is lodged in the larynx or trachea, a radiograph will appear normal 60–80% of the time, whereas if lodged in a bronchus, a radiograph will appear normal 7–32% of the time.<sup>1,10–13,15</sup> Not surprisingly, the radiographs appear increasingly abnormal as time elapses since the aspirating event. In one study of 343 children with tracheobronchial foreign bodies, more than half the patients who were diagnosed within 24 hours of the event had normal-appearing radiographs compared with only one third of patients who had a delay in diagnosis of more than 24 hours.<sup>13</sup>

The third patient demonstrates the adage that "all that wheezes is not asthma," first proclaimed by Chevalier Jackson, one of the fathers of modern bronchoscopy.<sup>1</sup> There was no witnessed choking episode in this patient and thus the suspicion of a bronchial foreign body was not raised. While the diagnosis of an airway foreign body is aided considerably with a history of a choking episode, it must be remembered that up to one quarter of patients do not present with a history of inhalation.<sup>16</sup> While most children who have aspirated a foreign body present with some physical findings suggestive of an airway foreign body, in up to 40% no abnormalities will be detectable.<sup>11,15</sup> While radiographic evaluation is not always necessary

in children who present with new onset of wheezing, the third case demonstrates the importance of radiographic evaluation in selected cases.

In summary, the diagnosis of aerodigestive tract foreign bodies can be difficult owing to misleading histories, physical findings, and unrevealing radiographs. To avoid delay in diagnosis the practicing physician must maintain a high index of suspicion when examining the young child, and when the initial examination is inconclusive, provide close follow-up within 24 hours.

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