Foreign Bodies in the Pediatric Aerodigestive Tract

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Foreign bodies in the air and food passages are the sixth most common cause of accidental death in the United States. There are more than 3,000 deaths per year resulting from such aspirations and there are many more cases that are not fatal. Children between the ages of 2 and 3 are most commonly affected since it is at this age that children are ambulatory and are frequently putting objects in their mouths. Blazer et al noted that 85% of aspirations occurred under the age of 3 with the youngest in their series of 200 aspirations being 6 months old.1 Although many believe that children under the age of 6 months are incapable of putting a foreign body in their mouths, aspirations do occur in this age group usually with the assistance of older siblings (see Figure 1).

The diagnosis of acute obstruction may be quite straightforward. Initially there is a dramatic episode of choking, gagging, coughing, or wheezing. Frequently the child's face turns red and there may be associated hoarseness, aphony, or dysphonia. As the foreign body moves through the larynx, down the trachea, and into the bronchi, these symptoms subside; the acute phase has passed and a relatively asymptomatic period begins. It is at this time that the commonly described triad of cough, wheeze, and decreased inspiration may be noted as the foreign body becomes lodged.2

As toddlers roam, they may put a foreign body in their mouths unnoticed by an adult observer. Without adult witness it can become difficult to document the acute event, and without the confirming history the diagnosis of a foreign body aspiration may be overlooked. Retained foreign bodies may produce any of a variety of respiratory symptoms. Frequently these children are treated for prolonged periods for asthma, pneumonia, or allergy. Intermittent tracheobronchitis or recurrent pneumonia may occur, causing more confusion since aspirations occur in an age group that also has a high incidence of tracheobronchitis, inflammatory diseases, and asthma. Nevertheless, unexplained recurrent pneumonia, other respiratory illnesses, or conditions that do not respond to appropriate medical management in children should always raise the suspicion of an aspirated foreign body.3

The most commonly aspirated objects are food products such as peanuts, seeds, or raisins. Peanuts are by far the most commonly aspirated foreign body. In a national report by Harris et al, 17% of fatal aspirations secondary to food substances occurred solely because of hot dog aspirations.4 Six percent of foreign bodies continued on page 642.
Appropriate radiographic studies are essential in establishing and localizing the foreign body.

Continued from page 640

are radiopaque plastic objects, and as inert materials can be tolerated for a long period.

Appropriate radiographic studies are essential in establishing the diagnosis and localizing the foreign body. Only metallic foreign bodies will actually be seen; however, the resulting obstruction with non-radiopaque foreign bodies can be demonstrated on x-ray. Lateral and posterior-anterior chest x-ray may be insufficient to document the presence of a foreign body. In 1981 Stromme reported a 34% failure rate of plain films to document an inhaled foreign body within the first 24 hours following the incident.4 Radiography markedly improves the statistical chance of documenting a mediastinal shift, air trapping, and obstructive emphysema with the dynamic changes in the phase of respiration (see Figure 2). If fluoroscopy is not available, similar findings can be demonstrated on right lateral and left lateral decubitus films. Physiologically, the down-sided lung should deflate independent of the phase of respiration due to gravity. If the down-sided lung is obstructed with a foreign body it will not be able to deflate and therefore will point to the location of a foreign body. Another distinctive radiographic finding with retained organic materials is arachnoid bronchiectasis, in which a diffuse (spider) pattern is noted.

Foreign bodies in the esophagus are particularly interesting because the most common symptoms are laryngeal irritation, coughing, or choking caused by the highly compliant party wall between the trachea and the esophagus in the child. Dysphagia is a later finding and its absence may lead to a low level of suspicion concerning this diagnosis. Coins are the most frequent esophageal foreign body in children although indigested food, fish bones, and safety pins are also common.

The most common location for a foreign body in the esophagus is at C6 or the cricopharyngeus, the first continued on page 644

Precautions:

- GENERAL: Although transient elevations of BUN and serum creatinine have been observed at the recommended dosages, the nephrotoxic potential of rocephin is similar to that of other cephalosporins. Ceftriaxone is excreted via both bile and renal excretion (see Clinical Pharmacology). Therefore, patients with renal failure normally require no adjustment in dosage when usual doses of rocephin are administered; however, concentrations of drug in the serum should be monitored periodically, if evidence of accumulation exists, dosage should be decreased. The incidence of crystalluria is low with cephalosporins. Patients with hepatic dysfunction should be observed carefully, but the degree of hepatic dysfunction does not substantially affect the concentration of the drug in the serum or the urinary excretion. Alterations in prothrombin times have occurred rarely in patients treated with ceftriaxone. Patients with impaired vitamin K synthesis or low vitamin K stores (e.g., chronic hepatic disease and malnutrition) may require monitoring of prothrombin time during ceftriaxone treatment.

- MALIGNANCY: In one patient with a leucocyte-rich neoplasm, Ceftriaxone did not appear to alter the rate of tumor progression.

- Mutagenesis: Ceftriaxone has been shown to be a positive mutagen in bacterial tests. Ceftriaxone has been shown to be positive in a chromosome aberration test in human fibroblasts. However, the relevance of these findings to humans is unknown.

- Impairment of Fertility: Ceftriaxone has been shown to have no demonstrable effect on reproduction in rats at a dose of 2 g/kg/day.
continued from page 642

foreign bodies

normal anatomic narrowing of the esophagus. Turtz and Stool point to the area of the aortic crossing and the cardio-esophageal sphincter as possible sites for foreign bodies. Other pre-existing areas of narrowing (i.e., congenital or acquired esophageal structure or the site of a tracheoesophageal fistula repair) may also lead to obstruction with food boluses.

Radiographic workup is facilitated when the esophageal foreign body is a coin or other metallic object. Barium swallow with cotton swabs should be avoided since it may confuse the endoscopic picture, thereby making identification of the foreign body and retrieval more difficult. Twenty percent of patients with an aspirated foreign body will have a negative history and the radiographic workup may not reveal the foreign object. Therefore, even in the view of a negative clinical history and a normal chest x-ray, a child indeed may have an aspirated foreign body. As mentioned above, this diagnosis must be suspected in all children with acute respiratory distress or prolonged upper respiratory symptoms.

Definitive care requires endoscopic removal of the foreign body. Endoscopy preferably should be carried out within 24 hours of the initial episode by a team including an experienced anesthesiologist and endoscopist. Coordination, cooperation, and communication are essential. Advances in both anesthesia and the technical removal of foreign bodies have markedly improved the outcome in these cases. The ventilating rigid bronchoscope is preferred as it allows improved ventilation, maximal visualization, and a secure airway at the time of endoscopic removal. Telescope forces may also aid the endoscopist in extracting foreign bodies from small patients (see Figure 3). A wide variety of forces are available and greatly aid in the extraction of the unusually shaped foreign body. It is crucial that metallic or sharp foreign bodies are removed as gently as possible in order to avoid extensive mucosal damage of the tracheobronchial tree. Also, one must bear in mind that the presence of one foreign body does not preclude the likelihood of another in a separate location. It is not uncommon to have radiographic findings suggest a right-sided foreign body and find at endoscopy that the foreign body has moved to the left side secondary to severe coughing. One must always avoid fragmenting the foreign body or impacting it in a yet more distal location. It is for these reasons that experience is particularly important.

Esophageal foreign bodies should be removed under general anesthesia with a secured airway. With the advantage of a variety of extraction forces and a protected airway, retrieval should be straightforward. The major hazard of this possibility is the extensive mucosal injury when removing a sharp, metallic foreign body, such as an open safety pin. With experience and meticulous technique this risk can be minimized, but all such cases should be monitored postoperatively
as if a perforation had actually occurred. Management includes placing the head at a 45° angle, a chest x-ray, and nothing by mouth for 12 to 24 hours.

The current practice of removing foreign bodies in the radiology suite under fluoroscopic control with a Fogherty catheter should be seriously discouraged. Although most reports of catheter extraction include only minor complications such as epistaxis or mild laryngeal stridor following extraction, several cases have occurred wherein the foreign body has become dislodged from the esophagus and become impacted in the laryngeal inlet with subsequent respiratory arrest. Furthermore, the use of enzymes to dissolve impacted food in the esophagus may also be dangerous. Esophageal perforation and death may occur as a result of the enzymatic action on the hypoxic esophageal wall.

Cohen reports that although approximately 50% of children who have aspirated a foreign body will be seen by a physician within three days of the initial episode, almost 20% will not receive care until more than a month has passed from the time of the initial aspiration. It is not uncommon for these children to have undergone extensive medical workup for cystic fibrosis, allergy, asthma, immunodeficiency, or mucociliary dysfunction. These cases also may have an elusive
presentation, such as failure to thrive with vague or very nonspecific symptomatology. While the foreign body remains in position the child may have recurrent pneumonia or a migratory pneumonia pattern on chest x-ray. Early diagnosis and removal will clearly save the patient chronic illnesses, prolonged inappropriate medical management, and possibly long term complications from an aspiration. Cohen analytically studied the mismanagement of aspirated foreign bodies. Among the explanations for a retained foreign body are absence of a positive history, absence of positive x-ray findings, inadequate x-ray studies, or omission from the primary diagnosis. This reiterates the need for early suspicions of a foreign body even in the absence of a history of aspiration or with a negative chest x-ray. The retrieval of a retained foreign body presents another set of serious problems. Granulation tissue and infection make removal more difficult and dangerous. Long term complications of a retained foreign body include perforation of the bronchus with abscess, mediastinitis, bronchiectasis, tracheoesophageal fistula, or erosion of a major blood vessel. Banks and Pestic confirm that long term complications are even more common in foreign bodies in the esophagus.

CASE REPORTS

VT, a 2-year-old female, was seen choking on a piece of lemon. Her mother scooped out most of the food from her mouth and shortly thereafter her gagging ceased. Within 12 hours she developed a cough and wheezing. The pediatrician examined her and confirmed the wheezing. Although the mother had described the history of recent choking, the physician, knowing that both parents were medication-dependent asthmatics, felt that this episode was the first evidence of asthma in the young child. She was treated with theophylline for three weeks with no clinical improvement before she underwent endoscopy. On bronchoscopy, the 2.5 cm piece of lemon rind was removed from her right mainstem bronchus. This illustrates the importance of not overlooking a positive history.

CP, a 2-year-old male, was wandering about the house while his family was eating snacks and watching a football game on television. Although no one witnessed an acute choking episode, before halftime the child was noted to have an audible wheeze. The family immediately went to the emergency room where fluoroscopy demonstrated obstruction on the left side. On bronchoscopy, two peanuts were located in the left
main stem bronchus. When there is one foreign body, there may be two.

NW, a 3-year-old male, was brought to the emergency room due to a one day history of coughing. His mother said that his favorite plastic truck was missing a wheel and perhaps he had swallowed it. Nevertheless, a medical workup proceeded. The initial chest x-ray demonstrated pneumonia. He was treated with an antibiotic for ten days. Over the ensuing 12 months, he was admitted six times for recurrent pulmonary problems. Eventually, bronchoscopy revealed a mass in the left main stem bronchus. Due to the size of the mass and the fear of bleeding, endoscopic removal was not favored. A thoracotomy was performed with partial lung resection. Examination of the mass revealed that it was not the expected bronchial adenoma; it was a foreign body granuloma with a plastic wheel in the center. Again, do not overlook a positive history.

CONCLUSION

Certain manufacturers and public service organizations have spontaneously taken steps to alert the public to the risk of foreign body aspiration and ingestion. The 3M Company voluntarily modified a frequently ingested decorative bow to make it safer. The Mattel Company has devised a radiopaque plastic for their toys to facilitate earlier detection of aspirated pieces. Food products that are unsuitable for certain ages may require warning labels, a concept already practiced in Sweden. However, the best therapy is prevention in the home, including withholding food that requires significant chewing from children under the age of 4. Children should not be allowed to run or play while eating and infants should be supervised so that older children do not give them ingestible objects by intention or error. Keeping small objects out of the reach of young children will also decrease the likelihood of a foreign body aspiration. It is hoped with increased parental awareness foreign body aspirations and ingestions will occur less frequently and, with increased physician alertness, foreign body aspirations and ingestions will be recognized earlier thereby allowing for safer retrieval.

REFERENCES