

Foreign Body Ingestion and Aspiration

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Author Disclosure
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Objectives After completing this article, readers should be able to:

1. Recognize the presenting history, signs, and symptoms of patients who have swallowed or inhaled foreign bodies.
2. Discuss the long-term complications of gastrointestinal and airway foreign bodies.
3. Describe appropriate management strategies for patients who have common esophageal and gastric foreign bodies.
4. Identify the risks associated with ingestion of button batteries and recognize when emergent removal is necessary.
5. Maintain a high level of suspicion for aspirated foreign bodies, recognizing that delays in diagnosis can lead to increased complications.

Case Studies

Case 1

A 3-year-old boy is brought to his pediatrician's office by his mother after an older sibling saw him swallow two small pieces from a magnetic building set. He is playful and smiling. There is no history of choking or distress. Radiography reveals two small rodlike objects in his stomach.

Case 2

A 10-year-old girl who has developmental delay is brought to the emergency department after possibly swallowing a calculator battery 2 hours ago. She is asymptomatic. On the radiograph, a small round object is seen in the lower esophagus.

Case 3

A 2-year-old boy is brought into an urgent care facility for new-onset wheezing. He has a low-grade fever and cough but no rhinorrhea. He has mild tachypnea with wheezing on the right side. Albuterol treatments and steroids are started. In spite of several treatments, he continues to wheeze.

These three cases are examples of a common pediatric problem: foreign body ingestion and aspiration. Because toddlers explore the world with their mouths, tend to eat and run, and have a less developed chewing ability, they are the most common age group seen for foreign body complaints. Many studies report a slight male predominance. This review addresses foreign body ingestion and aspiration.

Foreign Body Ingestions

Background

Foreign body ingestion is a frequent reason for pediatric visits. Coins are common culprits, followed by small toys and sharp metallic objects such as pins. In addition to young children, patients who are developmentally delayed are at risk and may present with less frequently seen foreign bodies such as bezoars.

The primary site of entrapment for esophageal foreign bodies is the proximal esophagus due to the change from skeletal to smooth muscle and the cricopharyngeus muscle. Other areas include the mid-esophagus, where the aortic arch crosses over, and the lower esophageal sphincter. Sharp items can lodge anywhere, and patients who have esophageal abnormalities such as tracheoesophageal fistulas are at risk for entrapment in atypical locations.

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Although most objects pass easily through the intestine, entrapment can occur at the pylorus, the ligament of Treitz, and the ileocecal valve. Children who have intestinal abnormalities, including congenital, functional, and postsurgical changes, are at increased risk for failing to pass the object.

History and Physical Examination

Foreign body ingestions frequently are brought to medical attention after a caregiver witnesses the ingestion or the child reports it. This history may be unavailable in patients who present due to complications or in whom an incidental diagnosis is made.

Ingestions can vary in presentation from an asymptomatic state to respiratory distress or an acute abdomen (Table). Esophageal objects can cause a foreign body sensation, drooling, or respiratory distress due to tracheal compression. Children who have gastric foreign bodies often are asymptomatic, although they may have symptoms from esophageal injuries inflicted during passage. Less recently ingested objects may present when complications such as obstruction or erosion develop and cause emesis, abdominal distention, or gastrointestinal (GI) bleeding. Chronic presentations can include fever and weight loss.

Ancillary Diagnostic Studies

The initial evaluation of a patient suspected of having a GI foreign body should include plain films from mouth to anus because relying on symptom localization can be misleading. Posteroanterior (PA) and lateral films may be useful in the neck and chest, particularly when coins are involved. Esophageal coins usually are seen *en face* on the PA film and from the side on the lateral film (Fig. 1); coins in the trachea are seen from the side on the PA and *en face* on the lateral films. Lateral films can facilitate diagnosis of stacked esophageal coins. Radiography also may allow identification of multi-object ingestions. Plain films are less helpful in detecting radiolucent objects, although their location may be inferred by their effect on adjacent structures. Symptomatic patients who have a history consistent with ingestion but normal findings on films require additional evaluation such as contrast esophagography or endoscopy. Asymptomatic patients in whom study results are normal can be observed as outpatients.

Clinical studies have shown handheld metal detectors to be sensitive and specific in identifying and localizing coins. With experience, this technique may be quicker than radiography, and it avoids irradiation. It may be less

Table. Foreign Body Signs and Symptoms

| | Acute | Chronic |
|------------|------------------------|------------------------|
| Ingestion | Asymptomatic | Fever |
| | Neck/throat pain | Emesis |
| | Foreign body sensation | Hematemesis |
| | Choking | Abdominal pain |
| | Drooling | Distention |
| | Dysphagia | Abdominal rebound |
| | Stridor | tenderness/guarding |
| | Wheezing | Hematochezia |
| | Chest pain | Failure to thrive |
| | Emesis | Weight loss |
| | Food refusal | |
| Aspiration | Neck/throat pain | Fever |
| | Choking | Cough |
| | Cough | Hemoptysis |
| | Stridor | Dyspnea |
| | Dyspnea | Wheezing |
| | Wheezing | Asymmetric lung sounds |

sensitive for objects other than coins and requires removal of metallic objects on the patient or in the room.

Treatment

For GI foreign bodies, the type of object, its location, and the child's symptoms dictate treatment. Although most gastric objects pass without complication and can be observed in the outpatient setting, approximately 70% of esophageal objects remain entrapped, especially those in the upper or mid-esophagus. A significant proportion of coins in the lower esophagus progress into the stomach, so a short observation period can be attempted. Development of symptoms or failure to progress after 24 hours should prompt removal due to an increased risk for complications. A few reports suggest that oral intake may hasten the object's passage. No evidence supports the use of motility agents such as glucagon for esophageal foreign bodies.

Alternative techniques for removal or advancement of esophageal foreign bodies exist, particularly for coins. In experienced hands, a Foley catheter under fluoroscopic guidance can be advanced beyond the object. The balloon is inflated and the catheter withdrawn, pulling the object up with the balloon. Bougienage advancement also has been used successfully for coins. An esophageal dilator is passed quickly down the esophagus to a depth estimated to push the object into the stomach. This technique can be performed in the emergency department without anesthesia. Caution should be exer-

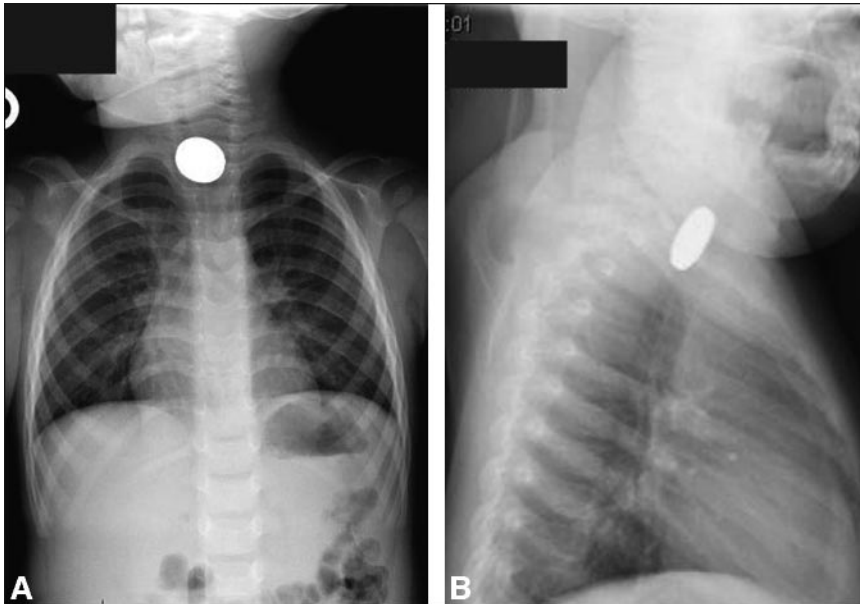


Figure 1. A. Esophageal coin projects *en face* on a posteroanterior chest radiograph. B. The same esophageal coin is seen from the side on a lateral chest radiograph.

cised with both techniques in patients who have esophageal abnormalities, and the procedures should be avoided if the object has been present for more than 24 hours.

Once the object has reached the stomach, it can be observed for eventual passage. Removal may be required for items such as long and sharp foreign bodies, multiple magnets, and bezoars as well as in patients who have GI abnormalities.

Endoscopy is used commonly for managing esophageal and gastric foreign bodies, serving both diagnostic and therapeutic purposes. The team performing the removal is institution-specific and may include pediatric surgeons, gastroenterologists, and otolaryngologists (Fig 2).

Special Situations: Button Batteries, Sharp Objects, and Magnets

Three ingestions necessitate special consideration: button disc batteries, sharp and pointed objects, and magnets. Button batteries are found in hearing aids, calculators, and other small devices and are easily swallowed. They easily can be

misdiagnosed as coins on radiography, although a double contour can be seen with larger button batteries (Fig. 3). Most are alkaline batteries that contain an electrolyte solution, usually sodium or potassium hydroxide. Leakage can cause alkali-induced corrosion with liquefaction necrosis within hours of ingestion. Batteries that do not contain an electrolyte solution, such as lithium batteries, also can cause corrosion by generating a small electrical current. Therefore, button batteries that lodge in the esophagus require urgent endoscopic removal. Removal by other techniques, including bougienage, is not recommended because only endoscopy allows for inspection of the esophageal mucosa. If the battery has passed into the stomach, it may be observed, as with other gas-

tric foreign bodies, with removal if complications occur or it fails to pass further. There are no reported symptomatic cases of mercury poisoning from a battery, but poisoning remains a theoretical risk if a mercury battery becomes fragmented.

The National Button Battery Hotline (202-625-

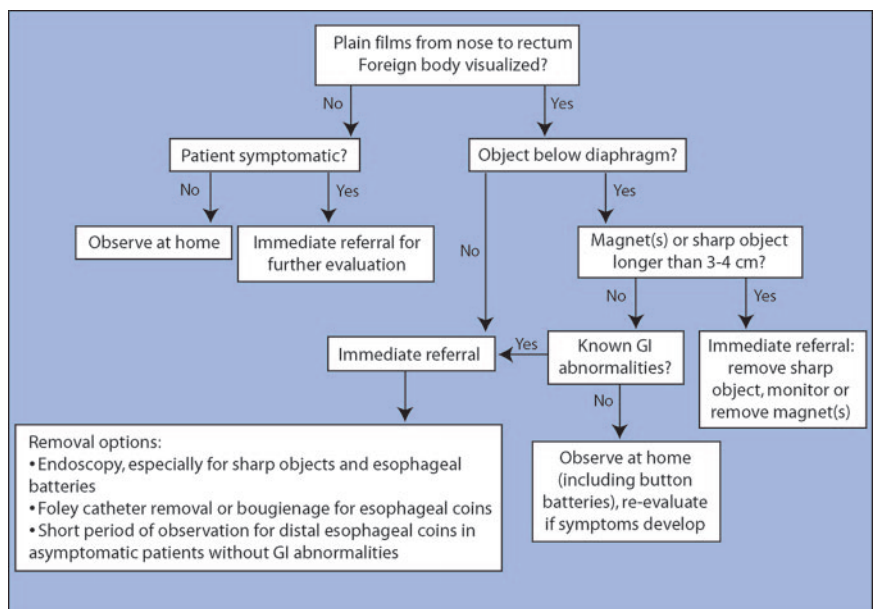


Figure 2. Suggested evaluation of an ingested foreign body. GI=gastrointestinal

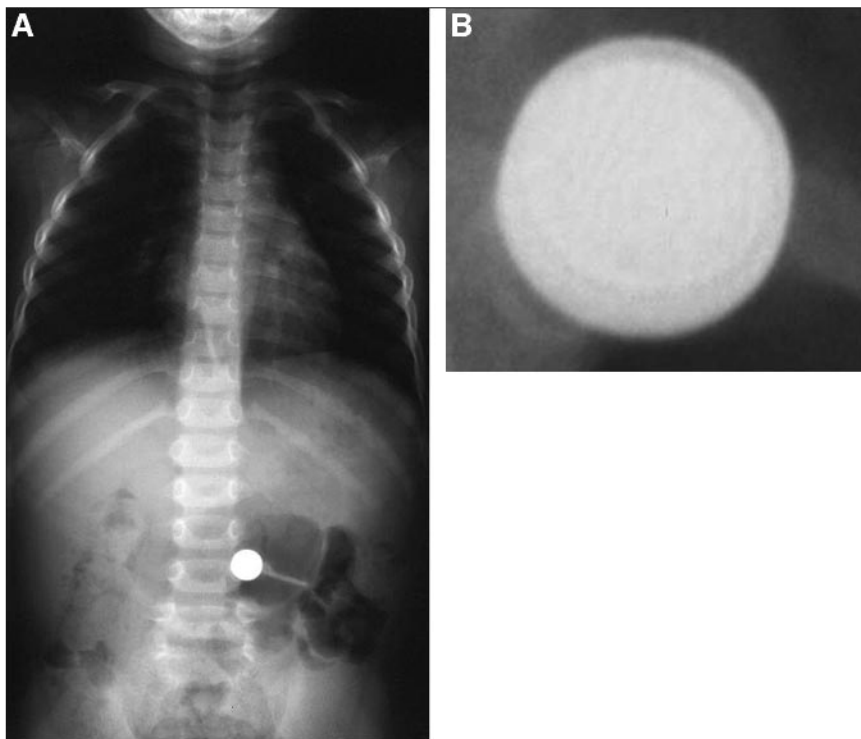


Figure 3. A. A round metallic-appearing object that may be consistent with a coin is seen in the stomach. B. Close-up of the object reveals the double contour characteristic of button batteries. Courtesy of Loren G. Yamamoto, MD, MPH, MBA.

3333), administered by the National Capital Poison Control Center, can provide information regarding battery type if the identification number is available. If possible, the batteries should be mailed to the Control Center after passage.

Sharp, elongated objects such as straight pins pose an increased risk for perforation. Those that are longer than 4 to 6 cm are more likely to fail passage through the small intestine. Removal should be considered, even if the object already has passed into the stomach.

Magnet ingestions have been the focus of several recent reports. Small magnets, found in building sets, jewelry, and other toys, may be ingested in multiples or with other metallic items. If the objects attract each other across different parts of the bowel, they can cause pressure necrosis, perforation, fistulas, obstruction, and volvulus that has led to death in at least one reported case. Multiple magnets may appear as one by radiography, causing some authors to suggest inpatient observation for all suspected magnet ingestions.

Complications

Most GI foreign bodies pass uneventfully once they have reached the stomach. Time to excretion varies but

often occurs within several days. Objects may be missed in the stool, for which repeat radiography can be considered. Asymptomatic progression through the intestinal tract requires no additional intervention. Patients who have ingested high-risk objects such as button batteries or magnets require closer monitoring.

Complications are most likely to occur when ingested objects remain lodged for more than 24 hours, which can result in mucosal erosion, abrasion, or perforation. Early symptoms are related to inflammation and include pain, bleeding, and obstruction. Scarring may lead to strictures; infectious complications include abscess development. Retained esophageal foreign bodies may cause tracheal compression and erosion through the mucosa, with migration into adjacent structures, such as the respiratory tract or aorta. Patients who have anatomic or functional GI abnormalities

are at increased risk for complications.

Complications resulting from foreign body removal include those related to the procedure and those resulting from anesthesia. Guided removal with a Foley catheter has been reported to cause complete airway obstruction in one case. Endoscopy may cause mucosal damage, particularly with removal of sharp objects.

Prevention

Caregiver education and attention to toy safety, with indication of age-appropriateness and elimination of small parts in toys for young children, are key preventive measures. The United States Consumer Product Safety Commission is one valuable resource for clinicians and families. In addition to issuing and enforcing toy regulations, recalls, and safety alerts, it administers the National Electronic Injury Surveillance System that collects information on injuries related to consumer products.

Foreign Body Aspiration

Background

Foreign body aspiration, or inhalation, is less common than ingestion but requires a high degree of suspicion. Foods are the most frequently aspirated items. Although specific food types vary regionally, round foods such as

peanuts commonly are described. Among nonorganic items, balloons are commonly implicated and often are involved in fatal aspirations.

There are three potential outcomes with aspirated foreign bodies: 1) the object may remain in the airway without causing significant obstruction, 2) the object may partially or completely occlude the airway, or 3) the object may be expelled by coughing. Although aspirated bodies below the carina may be found more commonly in the right bronchial tree than in the left, this trend is less pronounced in children than in adults.

History and Physical Examination

Children who have foreign bodies in the airway present for varying reasons. Parents may seek medical attention after a witnessed choking episode, but more often, the children present some time after the event has occurred. Frequently, patients have a preceding diagnosis of asthma or pneumonia as the explanation for their recurring symptoms, making the history potentially misleading. Although history of a choking event may be the most sensitive factor predicting foreign body aspiration, the history often must be elicited. Questions regarding potential choking episodes should be asked for any young patient presenting with new-onset wheezing and for those who fail to respond to therapy for asthma or pneumonia, as in Case 3. Failure to consider foreign body inhalation is a key reason that most airway foreign bodies evade detection. Studies report an average time from the event to diagnosis of several days to months if the event is not recognized immediately.

Children who have airway foreign bodies have a wide range of symptoms (Table). Families presenting immediately after an event describe the sudden onset of choking, cough, and shortness of breath. However, such early symptoms cease when mucosal cough receptors accommodate. Lung auscultation initially may yield normal results or may reveal signs of obstruction such as wheezing. Patients who present later may complain of cough, dyspnea, or fever and display the classic triad of cough, wheezing, and asymmetric breath sounds. However, many have only some or none of these signs.

Ancillary Diagnostic Studies

Patients suspected of having airway foreign bodies should undergo chest radiography if it is safe to do so, keeping in mind that most objects are organic and likely to be radiolucent. Positive findings on radiography can include hyperinflation, atelectasis, or infiltrate. Inspiratory/expiratory or decubital films may be helpful, although reports of sensitivity and specificity vary. Soft-tissue films of the neck can be beneficial for detecting objects in the upper airway. In general, although positive radiographic findings assist in making the diagnosis, the lack of findings never can be used to exclude an airway foreign body.

Treatment

Patients who have complete upper airway obstruction require back slaps and chest thrusts in the head-down position (for infants) or abdominal thrusts for older children. Direct viewing and removal with Magill forceps may be successful if undertaken by experienced practitioners. “Blind” sweeping of the mouth should not be performed.

Patients experiencing a partial airway obstruction should be placed in a position of comfort and emergently transferred to a facility capable of airway management and bronchoscopy. Transfer of a patient who has partial obstruction should not be delayed by imaging, and definitive care should not be postponed because plain radiographs appeared negative. Such delays increase the risk of complications.

Anecdotally, nebulized epinephrine has been administered to patients who have symptomatic partial obstruction while awaiting

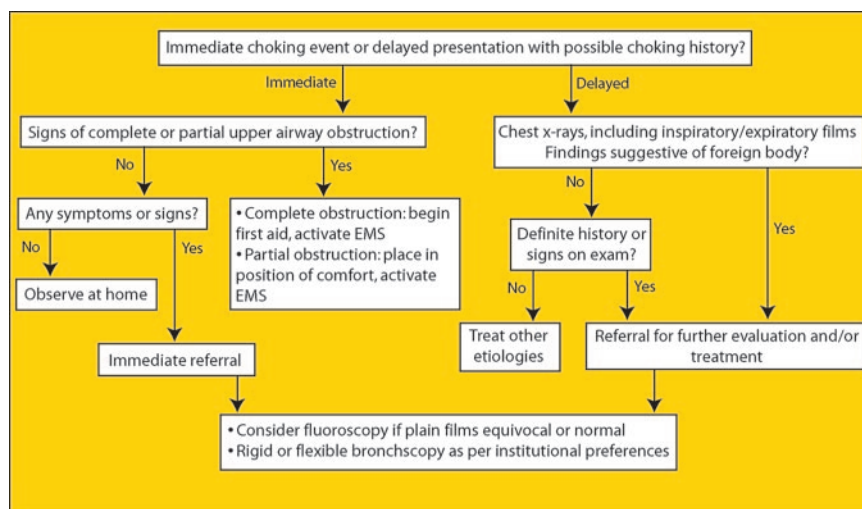


Figure 4. Suggested evaluation of an aspirated foreign body. EMS=emergency medical services

definitive treatment. There is no evidence that this treatment is beneficial, and at best, it provides only a temporary improvement in symptoms. Although the therapy is widely available in offices, ambulances, and emergency departments, it should be used only while awaiting definitive management and never should delay care.

Asymptomatic patients presenting immediately after a choking event who have normal examination findings should undergo radiography, as previously described. If radiographs appear normal, the child can be observed at home with instructions to return if any symptoms develop.

As noted, many children present with symptoms such as recurrent wheezing or pneumonia some time after the initial event. The index of suspicion in such patients must be high. Those who have positive radiographic findings should be referred to a specialist to pursue bronchoscopy or advanced imaging. The child whose films appear normal but for whom a definite choking event has been discovered also should see a specialist. The team providing bronchoscopic services varies by institution and includes pediatric otolaryngologists, pulmonologists, and surgeons. Institutions also differ on whether rigid bronchoscopy (which allows for diagnosis and therapy) or flexible bronchoscopy is pursued first (Fig. 4).

Complications

Patients who have not cleared a complete airway obstruction by the time they have reached medical care have a high mortality rate. Fortunately, most patients have a partial rather than complete obstruction. If foreign body aspiration is considered early, bronchoscopy generally is successful and the risk of complications low. Potential complications of bronchoscopy include progression from partial to complete obstruction, atelectasis, and pneumonia. Failure of bronchoscopy may necessitate thoracotomy. When the diagnosis is delayed, infectious complications predominate, including recurrent or persistent pneumonia and abscesses. Airway granulomas and bronchiectasis also can occur. Patients who have been misdiagnosed also are vulnerable to adverse effects from previous treatments, including repeat courses of steroids, bronchodilators, and antibiotics.

Prevention

Caregiver education, attention to toy safety, and labeling to indicate risk for aspiration are key preventive measures. Anticipatory guidance for parents should include information on inappropriate food types for young children, such as hot dog slices and peanuts. The American Academy of Pediatrics lists common objects and foods

that pose choking hazards along with choking prevention strategies on their website (http://www.aap.org/publiced/BR_Choking.htm).

Summary

- Foreign body aspirations frequently are missed on initial evaluation, and delay in diagnosis is associated with increased risk for complications. Specific questioning regarding choking episodes is crucial.
- Plain film radiography often is helpful in the diagnosis and localization of foreign bodies. However, studies suggest that sensitivity varies, and additional evaluation must be undertaken if clinical suspicion exists and the films are normal.
- Evidence is strong that gastric foreign bodies can be observed in the outpatient setting if the child has no GI abnormalities. Esophageal objects are unlikely to pass, although studies suggest that many coins progress without intervention.
- Many reports indicate that ingestion of button batteries, sharp and elongated objects, and magnets require extra caution because they are more likely to create complications. Esophageal button batteries pose an especially urgent problem and can cause complications that may develop within hours. Children in whom the batteries are in the stomach can be monitored as outpatients.

Suggested Reading

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PIR Quiz

Quiz also available online at pedsinreview.aappublications.org.

5. The mother of one of your patients calls you on the day after Christmas. Your office is closed. Her previously well 14-month-old son, who was playing in the living room, has just suffered a choking episode followed by several minutes of coughing. He now seems fine and has resumed playing. The *most* appropriate next step is to:
 - A. Advise her to observe her son for recurrence of symptoms.
 - B. Arrange for a chest radiograph today or tomorrow.
 - C. Prescribe a 10-day course of oral amoxicillin as a precaution.
 - D. Recommend immediate evaluation in the emergency department.
 - E. Suggest a visit to your office early next week.
6. The *greatest* risk to a previously well toddler who has undiagnosed foreign body aspiration is:
 - A. Acute fatal anaphylaxis.
 - B. Chronic bronchiectasis.
 - C. Lung abscess.
 - D. Recurrent pneumonia.
 - E. Sudden death from complete airway obstruction.
7. A previously well 2-year-old child suffers the acute onset of drooling. She is otherwise asymptomatic. Her grandmother notes that a button battery for her own hearing aid is missing and calls for advice. The girl is seen in the emergency department within 2 hours. If a radiograph reveals a characteristic opaque shadow, the location that demands urgent removal of the battery is the:
 - A. Duodenum.
 - B. Ileum.
 - C. Jejunum.
 - D. Mid-esophagus.
 - E. Stomach.
8. A 4-year-old boy has just ingested something. The object that is *most* likely to pass the intestine uneventfully is a:
 - A. Button battery.
 - B. Dime.
 - C. Needle.
 - D. Pair of small magnets.
 - E. Plastic toothpick.
9. Of the following, the *most* appropriate method for safe removal of a button battery lodged in the esophagus is:
 - A. Administration of glucagon.
 - B. Administration of syrup of ipecac.
 - C. Bougienage advancement.
 - D. Endoscopic extraction.
 - E. Inflation of a Foley catheter under fluoroscopic guidance.