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A 4-Year-Old Boy with Abdominal Pain

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Foreign body ingestions are a common occurrence in pediatric patients and frequently result in visits to the emergency department (ED). At some point in their careers, all pediatricians will encounter a child with a suspected or confirmed foreign body ingestion. The diagnosis of foreign body ingestion can be difficult to make in children, and a high clinical index of suspicion is necessary to diagnose foreign body ingestion accurately and promptly. The diagnosis of foreign body ingestion can be delayed by a lack of appropriate patient history; the child may be too young to verbalize the incident or be reluctant to admit to the ingestion because of fear of punishment. Older siblings may be participants or witnesses to the ingestion, but again, they are often unwilling informants in these situations. Delays in establishing a diagnosis can lead to a delay in treatment and can complicate management.

CASE PRESENTATION

History

A 4-year-old boy was brought to the ED with a 2-day history of abdominal pain and vomiting. His parents described 5 episodes of nonprojectile and nonbilious vomiting without diarrhea or fever. They reported no travel or unusual events surrounding the onset of the child's pain. The child described his pain as constant but could not localize it. He had no anorexia and wanted to eat, but he vomited after any oral intake.

The patient previously had been in good health and had regularly seen his pediatric primary care physician. He had never had surgery or an illness requiring hospitalization. He was the youngest child in his home and attended kindergarten.

Key Point

Many young children have a limited ability to give an accurate history; therefore, a wide differential diagnosis must always be considered.

Physical Examination

On examination, the following vital signs were obtained: oral temperature, 37.6°C (99.6°F); heart rate, 94 bpm; respiratory rate, 24 breaths/min; blood pressure, 90/50 mm Hg. The patient appeared adequately hydrated and did not appear ill. He was breathing comfortably without stridor or an audible wheeze. His voice sounded normal, but he appeared reluctant to speak. He tolerated his saliva without difficulty but vomited during the examination. The examiner noted no icterus.

No lesions or foreign bodies were noted in the oropharynx. The patient's neck was supple and nontender, with full range of motion. The trachea was midline, and no lymphadenopathy was present. Symmetrical chest rise was noted, and auscultation of the chest revealed clear breath sounds bilaterally to the bases and no wheezes. Auscultation also revealed normal heart sounds.

The child's abdomen was nondistended and soft on palpation. His upper abdomen was tender, but no rigidity or guarding was noted. No palpable masses, organomegaly, or hernias were present. Bowel sounds were normal, and rectal examination revealed no fissures, impacted feces, or blood.

His extremities were well perfused, with a capillary refill time of less than 2 seconds. No edema or rashes were present.

Neurologic examination revealed a very alert and

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Table 1. Laboratory Values of Case Patient

Variable	Result
Blood/serum	
Leukocyte count	15.0 × 10 ³ /mm ³
Segmented neutrophils	81.9%
Platelet count	282 × 10 ³ /mm ³
Hemoglobin	13.2 g/dL
Hematocrit	38.5%
Electrolytes	
Sodium	138 mEq/L
Potassium	3.7 mEq/L
Chloride	104 mEq/L
Carbon dioxide	22 mEq/L
Blood urea nitrogen	11 mg/dL
Glucose	198 mg/dL
Serum creatinine	0.6 mg/dL
Urine	
Ketones	Trace
Specific gravity	1.028
Protein	Negative
Blood	Negative
Bilirubin	Negative
Glucose	Trace
Leukocytes	0–2/mm ³
Erythrocytes	0–2/mm ³
Feces	
Occult blood	Negative

interactive boy who had a good rapport with his mother. His muscle tone, strength, and reflexes were normal. His gait was normal, but he was reluctant to walk because of the abdominal pain.

Because the child experienced recurrent nonbloody vomiting, intravenous access was established, and hydration was started.

Laboratory and Radiographic Studies

The results of laboratory studies are shown in **Table 1**. Radiographic studies were obtained (**Figure 1**), and the correct diagnosis was later confirmed when the patient's history was re-explored.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of abdominal pain and vomiting is extensive. The most common causes of abdominal pain are inflammatory processes (eg, gastroen-

teritis, urinary tract infection). In a patient with acute pain, the physician should look for surgical conditions and search for signs of obstruction or peritoneal inflammation before attributing the cause to a nonsurgical problem. The most significant surgical causes of abdominal pain to be considered in this age group are acute appendicitis, intussusception, and volvulus.

In preschool-aged children, accidental ingestion of poisonous substances is a common problem. Unintentional medication overdose and ingestion of other toxins occur for various reasons. Inappropriate storage of toxic liquids (eg, keeping antifreeze in soda bottles) is one such example. Although pharmaceutical companies are required to package products in "child-safe" containers, many children obtain access to them despite these measures. Acute poisonings can present in different ways, depending on the exact toxin ingested. Some acute poisonings (ie, aspirin, iron sulfate) produce vomiting and abdominal pain as prominent symptoms. Pill fragments of certain substances, including iron, phenothiazines, enteric-coated products, and some sustained-release preparations, can be identified on radiographs. Other poisonings (eg, acetaminophen toxicity) may not produce symptoms early on and could easily be overlooked unless a high index of suspicion is maintained.

If acute poisoning is suspected, efforts should be made to identify the product. Caregivers should be instructed to search the home for empty containers and identify products to which the child had access. Early consultation with the local poison control center is important to discuss the most appropriate method of decontamination and to obtain advice on antidote use in certain circumstances.

In addition to accidental poisoning, accidental foreign body ingestion is a common problem during childhood and is an important consideration in the differential diagnosis of abdominal pain in children. During play, experimentation, and normal daily activities, children are likely to place foreign bodies almost anywhere. Young age, a tendency to hold objects in the mouth, and easy distractibility place children at risk for foreign body ingestion. Coins remain the most commonly ingested foreign body,¹ followed by toy parts and a variety of common household items (eg, earrings, paperclips, pins). The diagnosis of an ingested foreign body can be difficult to reach in the absence of relevant patient history.

Key Point

The retained foreign body may manifest no symptoms, or it may mimic other pathologic conditions.

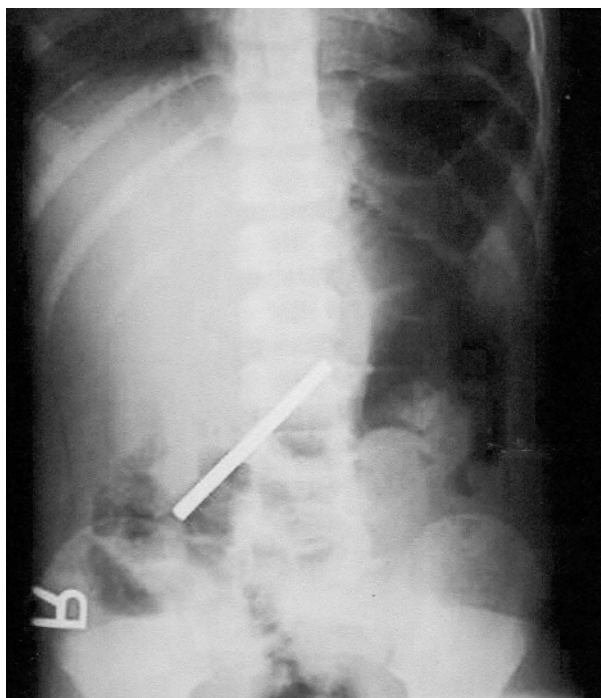
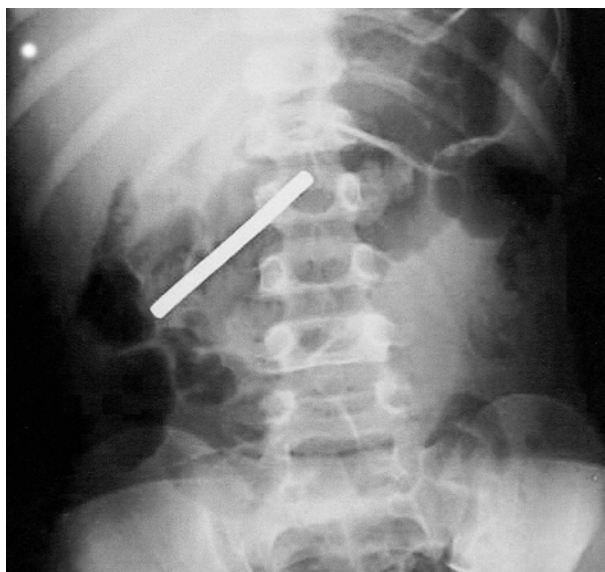


Figure 1. Radiographs of the foreign bodies swallowed by the case patient.

CLINICAL COURSE

The patient was admitted to the hospital after surgical consultation. Review of history with the patient's older sibling confirmed foreign body ingestion; his brother disclosed that the patient swallowed a series of toy magnets while they were playing. The surgeon recommended obtaining serial radiographic films of the abdomen; the foreign bodies did not change their position at all over a period of 48 hours. Subsequently, the child was transferred to a tertiary care center and was taken to the operation room, where a total of 11 magnets were recovered endoscopically (**Figure 2**).

GASTROINTESTINAL FOREIGN BODIES

General Considerations

Human technologic ingenuity has led to the production of countless small objects that are especially attractive to toddlers, who often swallow them. Although manufacturers of children's toys are required to warn consumers of potential choking hazards for small children, some do not comply, and such warnings are often ignored. Children usually ingest foreign objects as a result of orolingual curiosity. When a child ingests a foreign body, it causes great family concern. Parental anxiety and, at times, a sense of guilt are commonly seen. For the clinician, the presence of a foreign body in the gastrointestinal tract is a challenging problem.

Epidemiology

The pediatric population accounts for approximately 80% of all foreign body ingestions.² The majority of ingestions occur in children age 6 months to 6 years. The period of high risk begins when the toddler becomes orally inquisitive.³ Young age, a tendency to hold objects in the mouth, easy distractibility, age-inappropriate food, and inappropriate toys place the child at risk for foreign body aspiration or ingestion. A wide variety of foreign body ingestions have been reported in children; the most common include coins, small toys, crayons, buttons, pins, and batteries (**Table 2**). Unusual or multiple foreign body ingestions in children may be the result of child abuse.⁴

Pathology

Depending on the type of foreign body, it may pass uneventfully through the gastrointestinal tract or may become impacted and produce symptoms. The esophagus, pylorus, duodenum, and ileocecal valve are areas where foreign bodies may have difficulty passing. Impaction at these sites can produce obstruction or perforation. Intraluminal foreign bodies have also been associated with appendicitis.⁵

The esophagus is a common site for entrapment of ingested foreign bodies. The esophagus is a muscular tube and has 3 areas of narrowing: the cricopharyngeal muscle, the crossover of the aortic arch in the

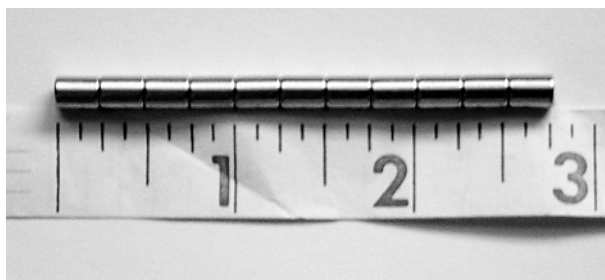


Figure 2. Magnets after endoscopic removal from the case patient's abdomen.

midesophagus, and the lower esophageal sphincter. In pediatric patients, 63% to 84% of entrapments occur at the level of the cricopharyngeal muscle, 10% to 17% occur at the level of the aortic crossover, and 5% to 20% occur at the lower esophageal sphincter.⁶

Clinical Manifestations

Children with esophageal foreign bodies may remain asymptomatic or manifest symptoms after ingestion. They are more likely to have a history of having swallowed the object(s) than are those with foreign bodies at other sites. Often, children are observed with "something in their mouth," with or without any subsequent symptoms. In fact, 7% to 35% of pediatric patients with proven esophageal foreign bodies are asymptomatic.^{7–9} Esophageal foreign bodies in pediatric patients can present in various other ways, including poor feeding, irritability, fever, stridor, cough, and aspiration.^{6,10,11} In the absence of a history of ingestion, the diagnosis may be subtle, because these same symptoms may occur with other common childhood conditions. The combined symptoms of dysphagia and hypersalivation indicate high suspicion of foreign body entrapment in the esophagus. The absence of such symptoms, however, does not exclude this diagnosis. Although the majority of children see a physician within hours of such ingestion, delays in presentation as long as 6 months have been reported.¹² Delayed presentation may be very atypical and can result from complications, such as fistula formation.¹³

A diligent search for physical findings is necessary but will most likely be unrewarding. Fewer than 20% of children who have ingested a foreign body have abnormalities revealed by physical examination, making radiological evaluation the cornerstone of diagnosis.¹⁴

Food products can become impacted in the gastrointestinal tract and cause problems similar to other foreign bodies, as outlined above. Food particles or boluses may fail to pass normally through the esophagus for

Table 2. Foreign Bodies Commonly Ingested by Children

Coins
Food
Small metal and plastic toys
Buttons
Bones
Batteries
Pins, safety pins, thumbtacks
Wood
Glass

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a variety of reasons. In adults, an underlying esophageal abnormality (eg, a mass, dysmotility syndrome) is the most common cause. In children, congenital abnormalities can occur; however, not chewing food properly or eating age-inappropriate foods are important contributing factors. Patients with food bolus impaction should have a plain radiographic film taken to search for imbedded bone fragments that may affect the therapeutic intervention selected. Often, plain radiographic films in these patients are not helpful, and a barium swallow or contrast esophagography should be considered.

Aspiration Versus Ingestion

Distinction should be made between foreign bodies in the gastrointestinal tract and foreign bodies in the upper airway. Once an object or piece of food is in a child's mouth, it can pass into the respiratory tract (ie, be aspirated) or into the gastrointestinal tract (ie, be ingested). Aspirated foreign bodies that lodge in the upper airway can immediately become life threatening. Affected children have acute respiratory distress and increased respiratory effort. Stridor may be present, signaling incomplete obstruction. In patients with complete airway obstruction, ineffective respiratory efforts are rapidly followed by loss of consciousness, and death is imminent unless the obstruction is promptly relieved.

Aspirations of foreign bodies are responsible for more than 300 childhood deaths per year.¹⁵ Fatal aspirations are most commonly associated with food products; hot dogs account for the majority of these occurrences. Of all food-related fatalities, 65% occur in children younger than 2 years.¹⁵ Balloons are the second major foreign body that can cause childhood

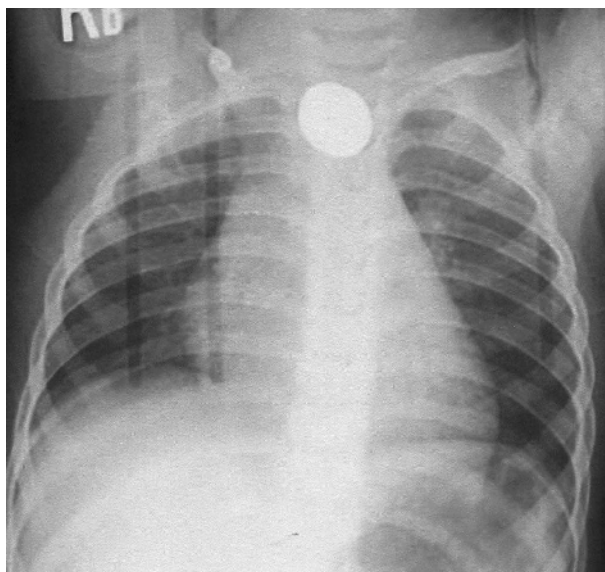


Figure 3. Anteroposterior radiograph of a coin lodged in a patient's esophagus.



Figure 4. Lateral radiograph of a coin lodged in a patient's esophagus.

deaths. Most deaths occur when fragments of popped balloons are chewed and then aspirated. Because the fragments conform easily, they effectively occlude a child's airway.

Some foreign bodies can pass the glottis and then lodge in the lower airway. Clinically, the child has a brief choking or coughing episode, which appears to resolve spontaneously. The foreign body passes to the lower airway (typically, the right mainstem bronchus), producing atelectasis or air trapping. These may be the only findings on chest radiographs, because many foreign bodies are radiolucent. Symptoms, including new onset wheeze¹⁶ or recurrent pneumonia, may develop days or weeks later.

Key Point

The index of suspicion for aspirated and ingested foreign bodies should be high in the pediatric population.

Radiographic Studies

Radiography is the main diagnostic technique used to confirm the presence of an ingested or aspirated foreign body and to assist in its localization. Plain radiographic films are indicated in any patient with suspected foreign body ingestion because of the high incidence of asymptomatic children with confirmed ingestion.⁷ Clinicians must remember that not all foreign bodies are radiopaque. If the suspicion of foreign body ingestion remains high, but the plain radiographic films reveal

nothing, the possibility of a radiolucent foreign body must be considered and further investigated.

Key Point

If the patient history suggests foreign body ingestion, a radiograph that evaluates the area from the nasopharynx to the stomach should be obtained.

Coins lodged in the esophagus are seen en face in the frontal plane and on edge in the lateral view on radiographs¹⁷ (Figures 3 and 4). The opposite is true of tracheal foreign bodies. Because of the configuration of tracheal rings with the cartilage incomplete posteriorly, coins lodged in the trachea are seen in sagittal and coronal orientations on anteroposterior (AP) and lateral radiographic films, respectively. Both AP and lateral films are necessary to obtain, because foreign objects noted on an AP film can appear to be in the esophagus when they are actually in the pulmonary tree. Clinicians should be aware that multiple coins stacked on top of each other will give the appearance of a single coin if only an AP film is obtained.

Key Point

If the suspicion of foreign body ingestion remains high but results on plain radiographic films are negative, the possibility of a radiolucent foreign body must be considered and further investigation should be undertaken.

Table 3. Presentations of Esophageal Foreign Bodies Warranting Endoscopy Consultation

Sharp or elongated objects
Multiple foreign bodies
Button batteries
Nickel or quarter at the level of the cricopharyngeus muscle
Evidence of perforation
Airway compromise
Presence of the foreign body for more than 24 hours

Adapted with permission from Munter DW. Disorders of the esophagus. In: Howell JM, et al, editors. Emergency medicine. Philadelphia: Saunders; 1998:318.

Management

Esophageal foreign bodies. Most foreign bodies that pass through the esophagus make their way uneventfully through the gastrointestinal tract. Correct decision making in the management of ingested foreign bodies is, at times, difficult. Generally, objects smaller than 2 cm will traverse the normal esophagus.¹⁸ Objects thicker than 2 cm and longer than 5 cm tend to lodge in the stomach. All retained esophageal foreign bodies must be removed because of the risk of erosion, mechanical obstruction, and possible aspiration. The timeliness of this diagnosis is a clinically important issue, because esophageal foreign bodies are more difficult to remove when prolonged impaction leads to anatomic injury (eg, edema, swelling, necrosis).

Management of an impacted esophageal foreign body is dependent on the type of object and the location of its entrapment. Objects that are sharp (eg, open safety pins, straight pins, razor blades, bones) carry an additional risk for bowel perforation and should be removed immediately. Removal can usually be achieved endoscopically¹⁸ (**Table 3**). Elongated objects (eg, bobby pins or objects longer than 6 cm in children or 13 cm in adults) are likely to lodge in the duodenal sweep; these patients also should be referred to a gastroenterologist for removal of the object.^{18,19}

Removal methods currently used include rigid esophagoscopy under general anesthesia, flexible endoscopy, and, for round objects, a balloon-tipped catheter under fluoroscopic guidance or bougienage to advance the object into the stomach. The advantages of rigid esophagoscopy include excellent visualization of the esophagus, use of extraction instruments in a variety of types and sizes, the ability to examine the esophagus directly after removal of the foreign body, and virtually a 100% success rate.

Once a foreign body reaches the stomach, it has 80% to 90% chance of passage.¹⁴ This is true for coins and other small foreign bodies. The gastrointestinal transit time for such foreign bodies in children is approximately 5 days. Most children who swallow coins do not require surgical intervention. However, objects greater than 6 cm in length may have difficulty negotiating the duodenal sweep, and objects greater than 2 cm in diameter may not pass easily through the pyloric sphincter.²⁰

Upper airway foreign bodies. Management of upper airway foreign bodies with complete obstruction is challenging and requires proper application of basic life-support skills. Back blows and chest compressions are used in infants, and the Heimlich maneuver is used in toddlers, children, and adolescents. If these methods fail to dislodge the foreign body, rapid progression to direct visualization and manual extraction is required.

Batteries. A foreign body that deserves special mention is the battery. Batteries contain alkaline substances, and if the contents leak, extensive damage can occur rapidly, resulting in chemical injury and perforation.²¹ Button (ie, disc) batteries are far more commonly ingested than cylindrical ones,²² and most literature refers primarily to them. A battery lodged in the esophagus is considered a true emergency¹⁴ because of the potential for corrosive injury to the esophagus. Early diagnosis is essential to ensure timely removal from the esophagus. Plain radiographic films are helpful in confirming the diagnosis and location of the disc.

The endoscopic removal of the button battery can be challenging, especially if leakage has already occurred. Once the battery has been removed, the area of involved esophagus needs to be closely evaluated for the presence of tissue damage. Resection and repair may be indicated.²¹

A disc battery that reaches the stomach safely is likely to pass through the remainder of gastrointestinal tract without complications, and a noninvasive approach is favored.²² Operative intervention is reserved for patients who fail to pass the battery spontaneously or who have symptoms suggestive of serious sequelae (eg, obstruction, perforation).²³

CONCLUSION

In pediatric patients, the history of foreign body ingestion may not be clear, and clinicians must maintain a high index of suspicion. This case demonstrates how easy it is for a child to surreptitiously ingest a foreign body without it initially being detected by a parent or discovered by a physician. All patients with suspected foreign body ingestion should undergo radiographic evaluation. Negative results on radiographic films do not

exclude the diagnosis of an ingested or aspirated foreign body, because radiolucent foreign bodies can easily be missed on plain films. If suspicion of foreign body ingestion remains high, further investigation is warranted, despite negative results on plain radiographic films. **HP**

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