Ingested Foreign Bodies and Toxic Materials: Who Needs to be Scoped and When?

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EDUCATION GAPS

Providers should be able to identify the signs and symptoms of foreign body and toxic material ingestion in children, select the proper diagnostic tests needed to confirm the diagnosis, and describe adequate treatment modalities for the described ingestions.

OBJECTIVES *After completing this article, readers should be able to:*

1. Understand the common types of foreign body and toxic material ingestions.
2. Recognize the presenting symptoms of the described ingestions.
3. Recognize which patients warrant emergency endoscopic intervention.
4. Recognize which patients warrant nonemergency endoscopic intervention.
5. Recognize which patients warrant noninvasive medical management.
6. Review the role of prevention.

INTRODUCTION

Foreign body and toxic substance ingestions are a common reason for families to seek emergency care. Often, the pediatric patient is unable to describe the nature of the ingestion and/or the timing of the event. This can pose significant barriers to both caregivers and the medical team. Coins, button batteries, magnets, pointed and/or large objects, food, absorptive substances, alcohol, acidic and alkaline substances, detergent pods, and hydrocarbons are all frequently reported ingestions. Each ingested object or substance requires an individualized approach to management.

AUTHOR DISCLOSURE Drs Cagil, Diaz, and Iskowitz have disclosed no financial relationships relevant to this article. Dr Muñiz Crim is on the AbbVie speakers bureau. This commentary does not contain a discussion of an unapproved/investigative use of a commercial product/device.

FOREIGN BODY INGESTIONS

The most common site for foreign bodies to become entrapped is in the proximal esophagus at the site of the cricopharyngeus muscle. Other common locations include the midesophagus, at the site of compression from the aortic arch, and at the

lower esophageal sphincter. Most foreign bodies that are ingested by children pass spontaneously without complications; however, endoscopic removal may be necessary in some situations. Parameters that must be considered regarding the need for endoscopic removal of ingested foreign bodies include the child's age, weight, clinical presentation, time since ingestion, type and size of the foreign body, location in the gastrointestinal tract, and underlying intestinal abnormalities. This section describes the most commonly ingested foreign bodies and their management. (1)

Coins

Coins remain the most commonly ingested objects by children in the United States. Spontaneous clearance of coins occurs in approximately 30% of patients. Once a coin successfully passes through the esophagus, it is more likely to progress and pass spontaneously. Factors that influence the likelihood of spontaneous passage include coin size and location, as well as the age of the individual. American and Canadian quarters are more likely to require endoscopic intervention due to their size, ranging between 23.5 and 25 mm in diameter. In general, coins greater than 25 mm are more difficult to pass through the pylorus. This is especially true for children younger than 5 years. (1)

Coin ingestions may vary in presentation. Patients may be asymptomatic or may demonstrate drooling, pain, or respiratory distress secondary to tracheal compression. Initial evaluation for suspected coin ingestion should begin with abdominal radiographs to identify their presence and location. Lateral films are extremely helpful in differentiating button batteries from coins (Fig 1).

Coins lodged in the esophagus should be removed within 24 hours to minimize risk of injury and/or erosion of the esophageal tissue. If the patient presents more than 24 hours after ingestion or if timing is unknown, immediate endoscopic removal is recommended. Radiographic imaging should be performed before endoscopy because spontaneous passage of coins may occur in up to 25% of patients within 16 hours of ingestion. (2) After endoscopic coin removal, careful endoscopic examination of the esophageal mucosa is required to evaluate for mucosal damage. Mucosal damage may require treatment, including acid suppression and/or alternate feeding options, until clinical improvement is demonstrated. Gastric coins can be monitored without intervention unless active symptoms, such as abdominal pain, are present. Radiographic imaging performed every 1 to 2 weeks and careful stool monitoring are recommended until the coin has cleared. If the coin is greater than 25 mm in diameter or has not passed the pylorus within 4 weeks, elective endoscopic removal is recommended (Fig 2). (2)

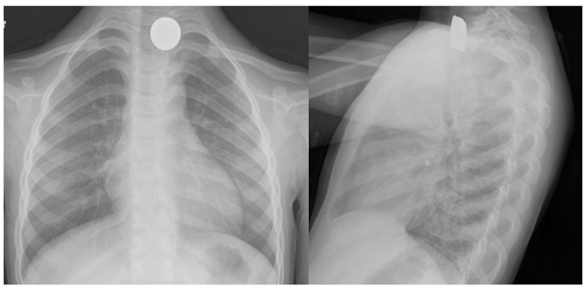

Figure 1. Stack of coins in the upper esophageal sphincter on anteroposterior and lateral views. (© Copyright by George W. Gross, MD. All rights reserved. Used with permission.) (6)

Button Batteries

Button batteries are present in many common household items, including watches, toothbrushes, toys, and popular musical greeting cards. Batteries are easily ingested and pose a considerable risk of mucosal damage, necrosis, and perforation. Button battery ingestion is considered a medical emergency. Once there is contact with the esophageal mucosa, the battery produces hydroxide radicals, which result in chemical damage. In addition, the electrical current resulting from the battery poles coming into contact with the mucous membranes causes electrical damage to the esophageal tissue. Animal models have demonstrated necrosis of esophageal lamina propria within 15 minutes of ingestion. (2)(3)

In a national study examining battery-related emergency department visits in the United States from 1990 to 2009, approximately 3,300 visits occurred annually among children younger than 18 years, and the frequency continues to increase. (4) The rise in the use of 3-V 20-mm lithium button batteries has also led to an increase in the frequency and severity of button battery ingestions.

Children who ingest button batteries may present with pain, drooling, stridor, respiratory distress, fussiness, fever, or refusal to feed. Some children may be asymptomatic and are brought in after a witnessed ingestion. Providers should be on high alert for possible button battery ingestion and begin investigation as soon as possible. (3)

Plain radiographic imaging of the chest and abdomen is recommended for all suspected button battery ingestions. Clues to the presence of button batteries include the "double shadow" or "halo" sign, which is the 2-layer appearance of the battery edges on frontal views, and the "step off" sign, described as a central bulge suggestive of the presence of a battery on lateral views (Fig 3). (3)

According to pediatric national guidelines, esophageal button batteries must be removed emergently (<2 hours)

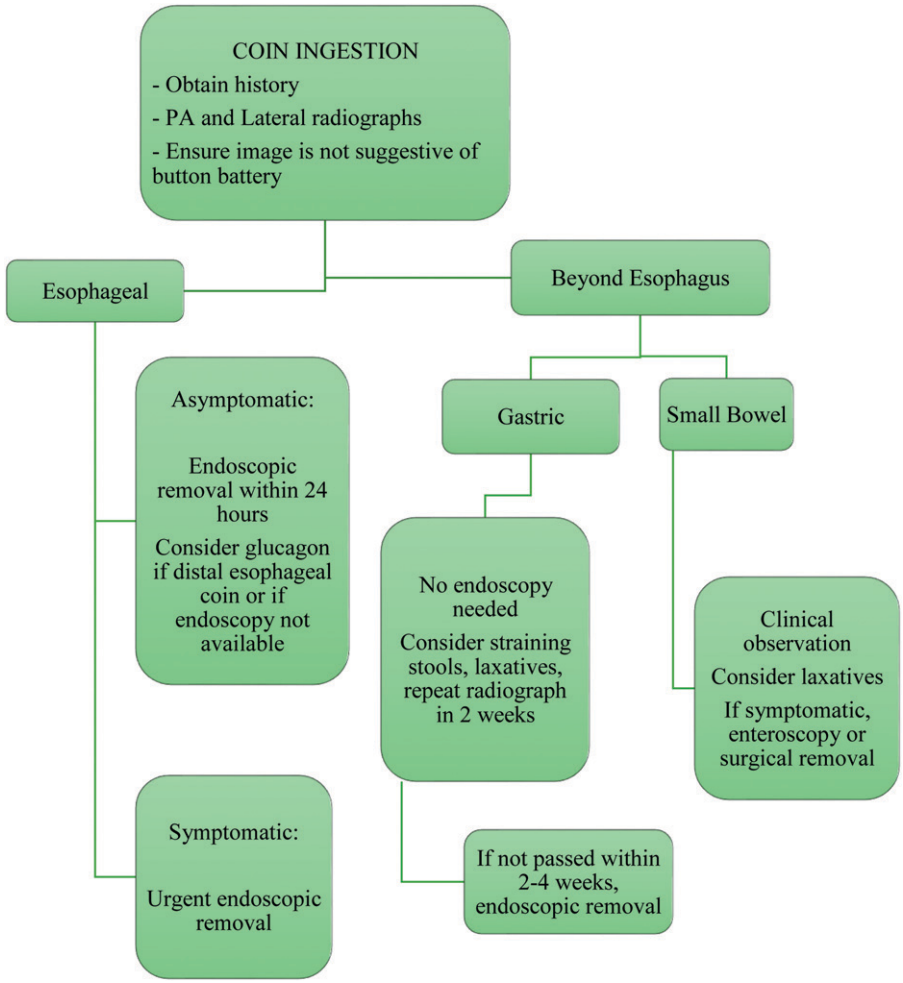

Figure 2. Algorithm for coin ingestion in children (© Copyright 2015 by Robert Kramer, MD. All rights reserved. Adapted with permission.) (2)

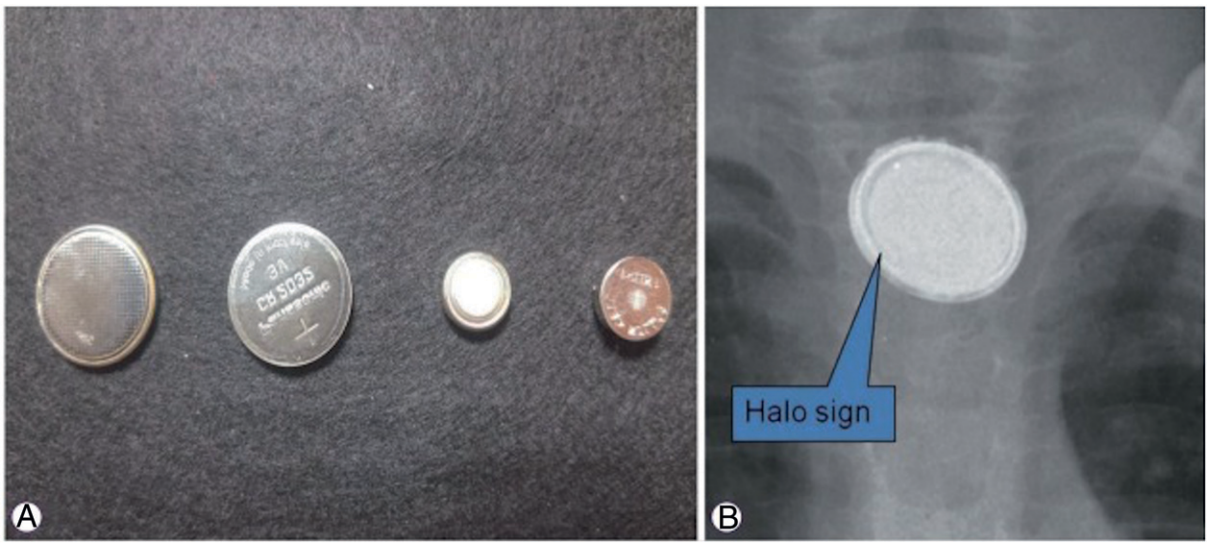

Figure 3. Button batteries. A. Various-sized button batteries. B. Button battery as seen on radiography. (© Copyright 2018 by Ji Hyuk Lee, MD. Cheongju, Korea. All rights reserved. Used with permission.) (1)

regardless of the presence of symptoms. If the battery is located in the stomach and the child is symptomatic or has a history of structural abnormalities, emergency endoscopy is required. If the button battery has reached the duodenum, it can be expected to pass in less than 72 hours and does not require endoscopic removal (Table). (3)

The high degree of morbidity with button battery ingestions has led to explorations for optimal management. A recent study by Anfang et al (5) demonstrated that the use of honey or sucralfate as a pH-neutralizing agent to mitigate esophageal injury is highly beneficial. Clinical guidelines by the National Capital Poison Control Center have been updated to recommend honey or sucralfate (10 mL every 10 minutes × 6 for honey and × 3 for sucralfate) treatment in cases of suspected lithium battery ingestion in children older than 12 months and in whom the ingestion occurred less than 12 hours before presentation (Fig 4).

Serious complications from button battery ingestion result from tissue necrosis and can include formation of a tracheoesophageal fistula, perforation of the esophagus, esophageal stricture development, vocal cord paralysis, mediastinitis, pneumothorax, and aorto-enteric fistula. (3)

In a survey performed by the National Electronic Injury Surveillance System, 62% of button batteries were obtained directly from the product containing the battery and 30% were found to be outside of a product. Monitoring of young children around products containing batteries should be advocated in routine pediatric visits. The Consumer Product Safety Commission requires manufacturers to secure battery compartments in any product marketed to children younger than 3 years. (2)(3)

Magnets

The frequency of magnet ingestion in children has been increasing, with more than 22,000 ingestions reported between 2002 and 2011. Fifty percent of magnet ingestions include 2 or more magnets. (6) Often a single, small magnet can pass spontaneously. Ingestions of multiple magnets, neodymium magnets, or magnets with attached foreign bodies are associated with increased risk of serious complications. (1)

Neodymium magnets are found in toys and small objects. These magnets have more than 5 times the attractive force of more standard, conventional magnets. They had previously been recalled by the Consumer Product Safety Commission due to safety concerns, but sales of products marketed to individuals older than 14 years has been allowed to resume since 2017. These magnets have the appearance of a ball bearing on radiographs and may at times be confused with a metal ball. Neodymium magnets are also used in body and facial piercings and are, thus, among the more common objects ingested by older children and adolescents. (2)

In patients with suspected or confirmed magnet ingestion, timeliness of treatment is essential because symptoms of ingestion may be nonspecific. Physical examination will require assessment for obstruction or perforation. (7) Symptoms may appear up to 7 days after magnet ingestion. When there is suspicion of magnet ingestion, radiography should be performed to discern the number and location of the magnets. (1)

In a patient who has ingested multiple magnets, emergency endoscopic removal is indicated regardless of symptoms to prevent latent perforation. Involvement of pediatric surgery should be considered when magnet ingestion occurred more than 12 hours before presentation (Fig 5). (7)

For patients who ingest a single magnet, conservative management, including observation and laxative therapy, is a reasonable therapeutic option. These patients should be observed in a controlled manner with serial radiographs until the magnet has passed. (2)

Endoscopic removal may be warranted in single-magnet ingestion when the magnet is large or unusual in

Table. Summary Recommendations for Endoscopic Evaluation

EMERGENCY	URGENT (WITHIN 48 HOURS)	INDICATED IF SYMPTOMATIC	UNLIKELY TO REQUIRE ENDOSCOPY
Button battery (esophagus)[a]	Coins (esophagus)[b]	Coins (stomach and beyond)	Methanol
Multiple magnets	Large/wide objects	Button battery (stomach)[c]	Ethanol
Sharp objects (esophagus)[a]	Caustic ingestions[d]	Single magnets	Hydrocarbons
Sharp objects (stomach)		Laundry detergent pods	
Obstructive food impaction (esophagus)			
Absorptive objects			

[a]Endoscopic removal within 2 hours is ideal to avoid substantial mucosal injury and/or perforation.
[b]Recommend endoscopic removal within 24 hours of ingestion.
[c]Endoscopic removal is recommended for all button batteries greater than 2 cm, persistent symptoms, or those that have remained in the stomach for longer than 48 hours.
[d]Endoscopy should be performed within 12 to 24 hours of ingestion to evaluate for mucosal damage. Endoscopy has been safely performed within first 48 hours after ingestion but should not be delayed further due to increased risk of perforation.

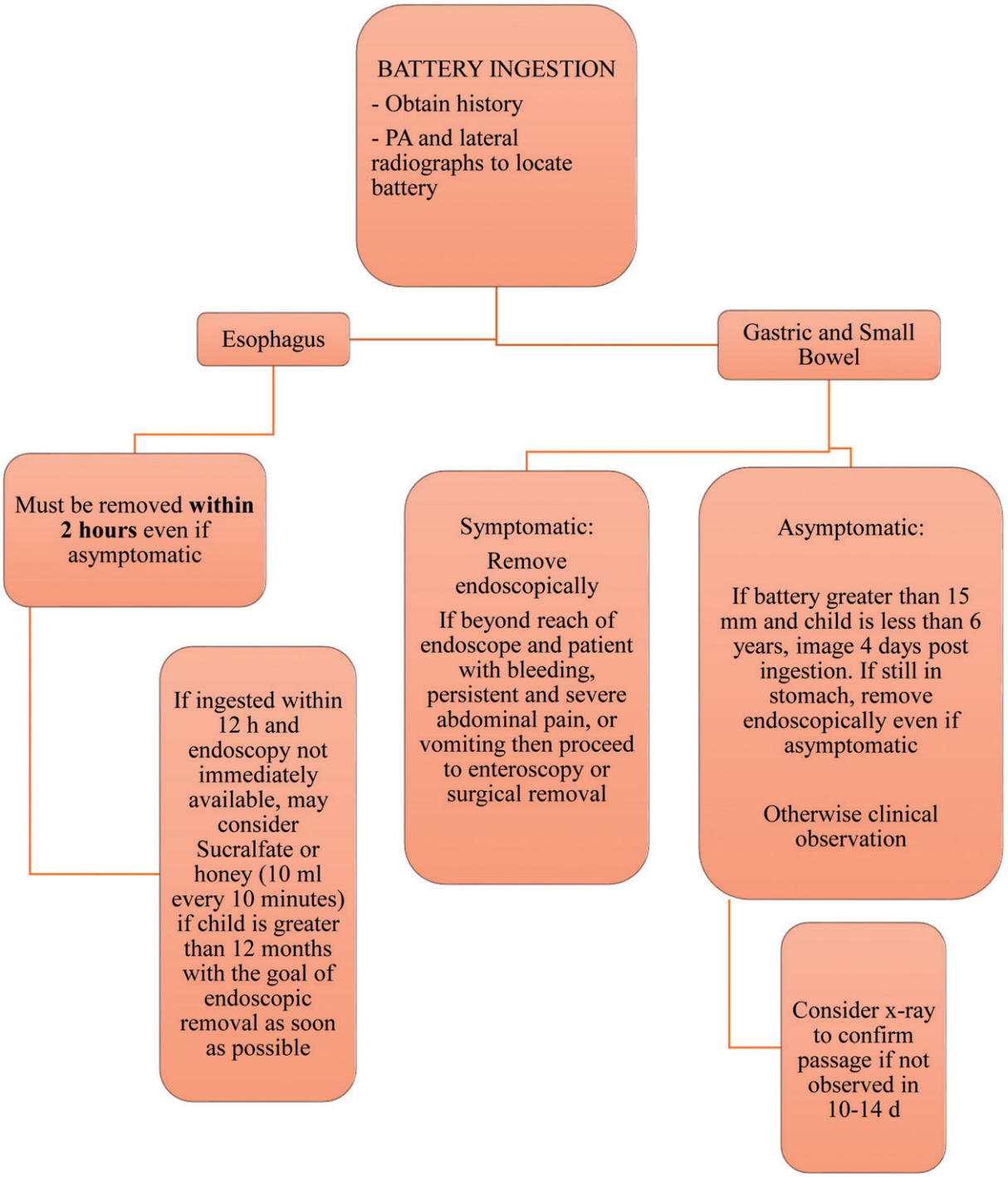

Figure 4. Algorithm for battery ingestion in children () (20)

shape or when the child is younger than 5 years. If there is concern that the magnet may not pass as expected, endoscopic removal may be warranted even when a single magnet has been ingested. For magnets that are beyond the ligament of Treitz but have not yet reached the terminal ileum, management is controversial. In medical centers that have the capacity to perform small bowel enteroscopy, endoscopic removal may be considered. In centers without this highly specialized capability, or in the setting of perforation or obstruction,

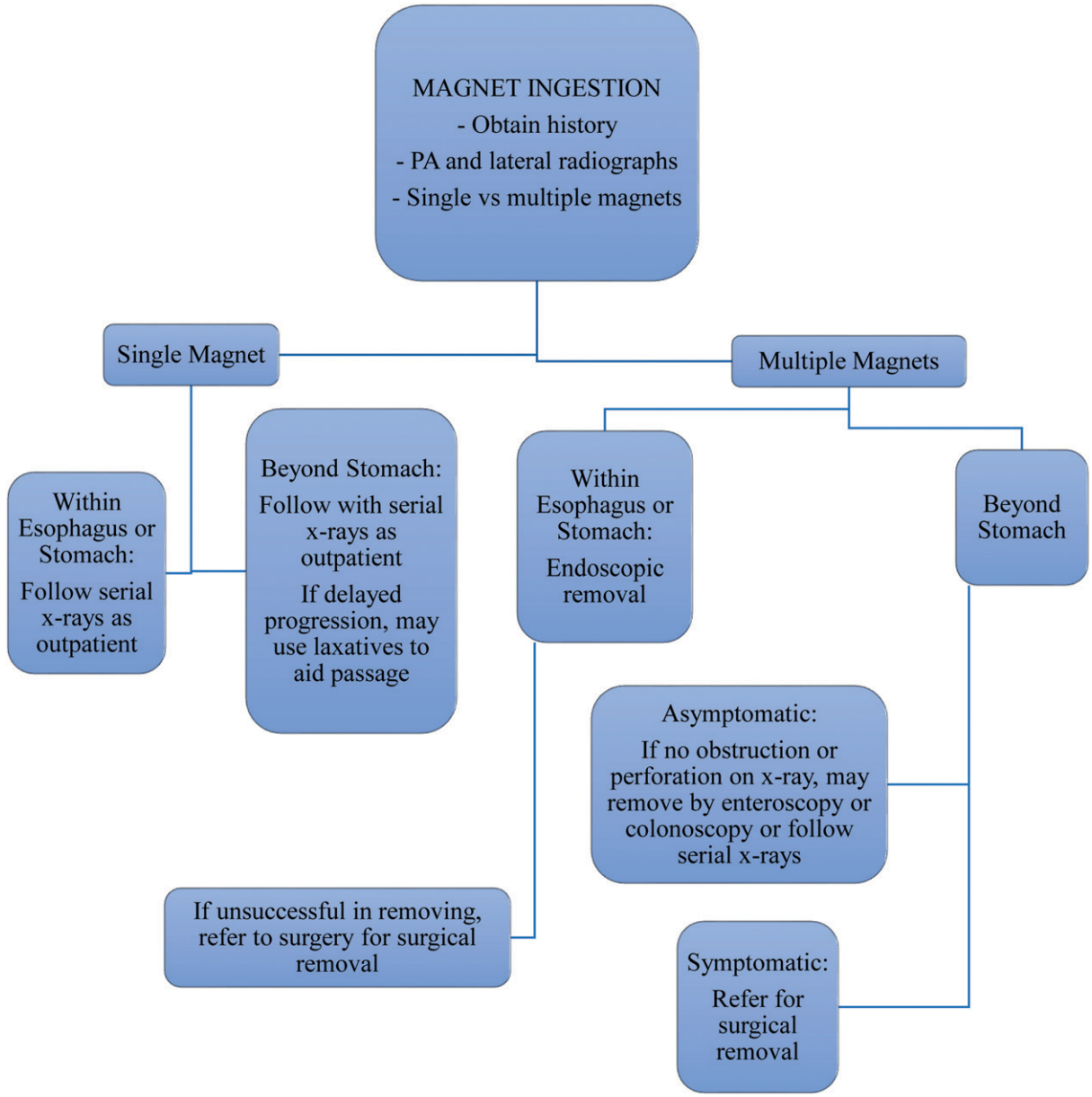

Figure 5. Algorithm for magnet ingestion in children (© Copyright 2015 by Robert Kramer, MD. All rights reserved. Adapted with permission.) (2)

intervention requires surgical laparotomy or laparoscopy (Fig 5). (2)

Failure to promptly or adequately remove ingested magnets may lead to entero-enteric fistula formation, perforation, peritonitis, and bowel ischemia/necrosis, particularly when multiple magnets have been ingested. (2)

Pointed or Large Objects

In the 1900s, sharp objects were commonly ingested, likely as a result of the popularity of cloth diapers and diaper pins. The frequency and type of ingested sharp objects over time has depended greatly on cultural factors and on an individual's age. For example, pin ingestions are more common in cultures where pins are used to fasten clothing, and toothpick ingestions are more prevalent in older age groups. Long objects are typically ingested by adolescents and adults, and frequently ingestions are found to be intentional in origin.

If sharp objects are not promptly removed, they pose a significant risk for serious complications. Perforation from sharp objects is reported in up to 30% of patients, with a mean onset of 10.4 days. (2)

As with the ingestion of coins, management of the ingestion of large objects depends on the size of the object

and the age of the child. Objects greater than 25 mm in diameter are unlikely to pass the pylorus, particularly in young children. Objects longer than 6 cm frequently become entrapped either in the second portion of the duodenum or at the ileocecal valve. Objects that become lodged in the esophagus are of the highest concern due to an increased risk of perforation, and they are also more likely to provoke symptoms such as dysphagia and/or pain. Fifty percent of patients with a history of ingestion of a sharp object may remain asymptomatic for an extended period, even when an intestinal perforation is present. (2)

If ingestion of a sharp object is suspected, radiographic imaging should be obtained urgently. In cases where esophageal entrapment is suspected, emergency endoscopy is recommended regardless of fasting status. (2)

Radiography, computed tomography, magnetic resonance imaging, ultrasonography, and upper gastrointestinal series may all be used to identify radiopaque foreign bodies. Objects that are not radiopaque, such as those made of plastic, bone, glass, and wood, will not be identified without oral contrast-assisted imaging techniques; therefore, a high index of suspicion should warrant endoscopic evaluation. (2)(8) Radiographic imaging may delay treatment when oral contrast is administered.

Otolaryngology consultation, when available, should be considered for direct laryngoscopy and removal of items lodged at or above the cricopharyngeus muscle. If the sharp object has passed into the small bowel (distal to the ligament of Treitz), surgical removal should be considered in symptomatic children. (1)

If the patient is asymptomatic and the object is beyond the duodenum, monitoring in a hospital setting with daily abdominal radiographs is warranted. If the sharp object does not pass within the expected 4 days, a bowel perforation or a congenital anomaly should be considered and surgical removal may be indicated. (1)

Objects longer than 5 cm or wider than 2 cm in infants and young children (longer than 10 cm or wider than 2.5 cm in older children) require prompt endoscopic removal within 24 hours when located in the stomach (Table).

Complications of ingesting a sharp object may include perforation (most commonly in the ileocecal region), extraluminal migration, abscess, peritonitis, fistulae, organ penetration, rupture of the common carotid artery, aortoesophageal fistula formation, and death. (1)

Risk of complications is increased with delay in diagnosis, particularly in those diagnosed more than 48 hours after ingestion. Ingestion of long or large objects has added risks, such as pressure necrosis, obstruction, or perforation. (6)

Foods

Food impaction is often the presenting symptom of an underlying pathologic esophageal disorder. Careful history for the evaluation of eosinophilic esophagitis, reflux esophagitis, esophageal strictures (either de novo or after esophageal surgical repair for patients with a history of tracheoesophageal fistula), achalasia, and other esophageal motility disorders should be taken into consideration. Meat is the most commonly impacted food. (2) Presentation will vary and can range from mild dysphagia to esophageal obstruction with associated symptoms of neck pain and/or drooling. (2)(6) If impacted food has not spontaneously passed within 24 hours of ingestion or the patient is demonstrating symptoms of esophageal impaction, endoscopic removal should be performed. Obstruction of the esophagus with presentation of drooling and neck pain requires emergency endoscopy. Oral contrast should not be given because it can pool above the impaction and may be aspirated. (2) Removal of impacted food may require a piecemeal approach during endoscopy. (3) Biopsy samples should be obtained from both the distal and proximal esophagus to evaluate for underlying esophageal pathology. These patients require the establishment of appropriate follow-up to ensure that evaluation for these possible underlying illnesses can be performed and that preventive measures are initiated to limit the recurrence of repeated food impactions. (2)

Absorptive Objects

The most common absorptive objects are disposable diapers and feminine hygiene products. Certain toy manufacturers have marketed toys with superabsorbent polymers. Examples include "magic" grow-in-water toys ranging from dinosaurs to water beads and more. They may become dangerous when ingested due to risk of rapid expansion in the gastrointestinal tract resulting in bowel obstruction. (2)

Patients will present with abdominal pain, abdominal distention, and/or vomiting. Most ingested absorptive objects are radiolucent, hence radiographic imaging is not likely to be helpful. Contrast studies should not be performed because they may delay definitive treatment. Patients should undergo emergency endoscopy. (2) Timely removal of these substances is of utmost importance because continued expansion of the objects will lead to worsening obstruction and complications. Even when the object has made its way to the stomach, we recommend urgent endoscopic removal to prevent obstruction (Table).

Complications include bowel obstruction, perforation, sepsis, and potentially death.

TOXIC SUBSTANCE INGESTIONS

Nonpharmaceutical household products are in every home and are commonly ingested by children. Typically these substances are not toxic if ingested in limited quantities; however, some substances have the potential to cause severe injury and may be fatal. Unintentional exposures occur most often in children younger than 5 years. The most frequent ingested nonpharmaceutical household products include cosmetics, cleaning products, pesticides, arts and crafts supplies, deodorizers, and essential oils. The key to preventing ingestion of household substances is to ensure that substances are kept in their original, labeled containers out of the reach of small children.

It can be stressful for caregivers to decide whether an ingestion requires immediate medical care. To label an ingestion as nontoxic, the product and ingredients must be identified clearly, the ingested amount must be known and should be below the toxic level, and the child should be asymptomatic.

Alcohols

Alcohol in its various forms can be found in every household. Products containing alcohol include perfumes, colognes, mouthwash, and hand sanitizers. Ethanol is often used as a solvent in medications such as cough and cold medications to prolong shelf life. Even with small quantities ingested accidentally, young children are at risk for complications. (9)

Children exposed to alcohol may present with coma, hypothermia, hypoglycemia, or lactic acidosis. Methanol and ethylene glycol can lead to profound anion gap metabolic acidosis and result in ocular toxicity and nephrotoxicity, respectively. Ingestion of isopropyl alcohol may lead to gastritis and in large quantities can depress myocardial function, resulting in hypotension and shock. (10)

Ingestion of greater than or equal to 1.2 mL/kg of pure ethanol often requires hospitalization and medical management. Serum ethanol levels should be checked 1 hour after ingestion, and blood glucose levels should be monitored closely and replenished as necessary. Electrolytes, blood urea nitrogen, creatinine, arterial blood gases, electrocardiography, and serum toxicology screen are recommended. (9)

In the event of methanol or ethylene glycol ingestion, treatment with fomepizole, an alcohol dehydrogenase inhibitor, should be initiated even if ingestion is not confirmed due to the exceptional risk of complications. The present recommended intravenous dosing of fomepizole is 15 mg/kg per loading, followed by 10 mg/kg every 12 hours × 4 doses, then 15 mg/kg every 12 hours until ethylene glycol or methanol concentrations are less than 20 mg/dL (<3.22 mmol/L) and the patient is asymptomatic. (11) If fomepizole is not available, intravenous ethanol may be substituted because it competitively inhibits the metabolism of ethylene glycol and methanol. (9) Hemodialysis may be considered in children with significant metabolic acidosis.

Treatment of isopropyl alcohol is supportive, with a focus on preventing and managing the development of multiorgan failure.

The Consumer Product Safety Commission of 1995 required all mouthwash bottles containing more than 3 g of ethanol to have childproof closures. Clear product labeling also provides information that parents can give when contacting Poison Control and health-care providers. (9)

Acidic and Alkaline Substances

Common household acidic substances include sulfuric acid (stain removers, car batteries, drain cleaners), nitric acid (cleaning agents, fertilizers), hydrochloric acid (toilet bowel cleaners), and phosphoric acid (hair dyes). (10)(12) Injuries due to acidic substances are more common in the stomach than in the esophagus due to the decreased surface tension of acidic substances, allowing them to pass rapidly into the stomach. Despite this effect, large-volume ingestions can lead to severe esophageal injury. Mucosal injury occurs secondary to superficial necrosis and formation of intravascular thrombi. Scarring of the connective tissue may ensue over time. Deeper injuries tend to be less common in these patients but may still occur. (13)

Acidic substances cause severe oropharyngeal pain when initially swallowed. As a result, patients often ingest small volumes. Patients may develop dysphagia, odynophagia, abdominal tenderness, vomiting, and hematemesis. Concerning symptoms such as retrosternal pain may indicate a possible esophageal perforation. (13) Some patients remain asymptomatic at presentation.

Alkaline substances tend to be both colorless and odorless and, therefore, are more likely to be ingested in larger volumes. (12) Strong alkaline substances may contain sodium hydroxide or potassium hydroxide and are present in disinfectants, discoid batteries, lye, and soaps. When ingested, alkaline substances lead to liquefactive necrosis and saponification of the exposed tissue, allowing for deeper penetration into the submucosa and muscularis

tissues, resulting in significant tissue injury. Alkaline fluids have higher surface tension than acidic agents, which allows the substances to stay in the tissue for a longer period. Highly caustic agents tend to have a pH greater than 12. (12)

Patients present similarly to those with ingestion of acidic substances. In addition, burns or ulcerations of the mouth, lips, and tongue may be present. Upper respiratory tract symptoms, such as hoarseness and stridor, are seen with more severe injury. (12) Perforation of the esophagus is more common in patients with alkaline ingestions.

Laboratory tests are often used to determine the level of monitoring and supportive care required, although results do not always correlate with the degree of mucosal injury. (12)

Chest radiographs are recommended for all symptomatic patients to assess for aspiration and perforation of the esophagus or stomach. (12) Computed tomography should be reserved for the minority of cases with severe injury to avoid unnecessary radiation exposure. (13)

Evaluation of the airway is the initial step in all patients with a caustic ingestion. Fluid resuscitation should be started in hypotensive patients. Supportive management includes intravenous proton pump inhibitors and opioids. The use of activated charcoal is no longer advised because it has been shown to lead to emesis and potential aspiration and re-exposure to the toxin. Attempts to neutralize the substance should be avoided because heat may be produced from the ensuing chemical reaction and further aggravate postcorrosive injury. A nasogastric tube should not be inserted without endoscopic guidance because it can lead to infection, acid reflux, and increased risk of strictures. (12)(13) A meta-analysis by Katibe et al (14) demonstrated no evidence for the utility of corticosteroids in the prevention of strictures. In symptomatic patients, urgent endoscopic evaluation should be completed within 12 to 24 hours of ingestion. (10) In asymptomatic patients, the role of endoscopy remains controversial. (15) It is generally recommended to avoid endoscopy between days 5 and 15 after ingestion given increased tissue friability and risk of perforation. Antibiotics are recommended in any child with perforation secondary to caustic substance ingestion. In those without perforation, empirical antibiotics have not been associated with improved outcomes. (10)

One of the most common sequelae of caustic injury is the formation of an esophageal stricture, which may require endoscopic dilation or surgical management. Other late complications include dysmotility of the esophagus and stomach, increased risk of esophageal cancer (adenocarcinoma and squamous cell carcinoma) and gastric outlet obstruction. (12)

Laundry Detergents, Dishwasher Packets, and Pods

Laundry detergent packets, or pods, were introduced into the European market in 2001 and into the US market in 2012. (16)(17) They have been associated with numerous reports of exposure and ingestion. Risk of ingestion is greatest in children younger than 6 years, and more specifically in those younger than 3 years. (10)

Evidence suggests that the clinical effects of exposure to laundry detergent pods are greater than those of non-packet laundry formulations and dishwasher packets. (17)

Symptoms vary largely between patients. The most common symptoms include emesis, cough, drooling, ocular pain and conjunctivitis (from direct conjunctival contact), and lethargy. Patients may also present with damage to oropharyngeal mucosa, pneumonitis, and respiratory depression. (17)

Management of detergent pod exposure and ingestion is largely supportive. Intubation and mechanical ventilation is indicated in cases where respiratory distress is observed. Those with ocular involvement should receive copious flushes with isotonic saline. (10)

Serious complications from ingestion may include seizures, coma, respiratory failure, cardiac arrest, and death. Long-term complications have not been well-studied. Esophageal injury including stricture has been reported, and endoscopy may be warranted if the patient demonstrates symptoms of dysphagia or persistent abdominal pain. (18) Multiple case reports have demonstrated persistent swallowing dysfunction, leading to nasogastric feeds or thickened feeds at the time of discharge. (19) These patients will require long-term follow-up with pediatric gastroenterology and speech therapy.

Hydrocarbons

Hydrocarbons are organic compounds composed of entirely hydrogen and carbon. Common environmental hydrocarbons include gasoline additives, motor oil, lamp oil, solvents, synthetic waxes, and some household cleaning products. Hydrocarbons may be subdivided into aliphatic hydrocarbons (petroleum), aromatic hydrocarbons (toluene, benzene, and zylene), and halogenated hydrocarbons. The type of ingested substance can suggest the level of toxicity present. (10) All hydrocarbons have the ability to cause severe pulmonary toxicity.

Unintentional ingestion can lead to signs of acute aspiration and/or chemical pneumonitis. Symptoms may include cough, tachypnea, hypoxia, and dyspnea. Certain hydrocarbons (those derived from woods, such as pine oil) can be absorbed in the intestinal tract and lead to pulmonary edema even without a

history of aspiration. Vapor exposures of complex hydrocarbons are associated with significant neurologic effects, including central nervous system depression, coma, and seizures. Cardiac arrhythmias have been seen after exposure to carbon tetrachloride (lava lamps) as well as other hydrocarbon toxicities.

Radiographic imaging of the chest should be performed in patients with respiratory distress. If imaging is interpreted as normal, repeated imaging within 4 to 6 hours should be performed to assess for latent pulmonary injury. (10)

Management of these patients is primarily supportive. Gastric lavage and activated charcoal are not indicated. Patients may require supplemental oxygen, intubation, and mechanical ventilation. Bronchodilators may be used for patients with wheezing. Empirical corticosteroids and prophylactic antibiotics are not recommended. (10) Admission for cardiorespiratory monitoring is recommended for those with symptoms or abnormal imaging (Table).

PREVENTION OF FOREIGN BODY AND TOXIC SUBSTANCE INGESTIONS

Parental education is key to ensuring safety for young children. Parents should be advised to keep all products in their original labeled containers. This practice prevents the child from mistaking the item for something less hazardous and allows for easy assessment of ingredients if ingested. All potentially hazardous items should be stored out of reach of children. Innovations for safer packaging are currently under way. Nevertheless, these packaging alterations have not been shown to significantly reduce pediatric exposures; therefore, parental education remains the most important factor available to ensure a child's safety. (19)

Summary

- Based on strong research evidence, foreign body and toxic material ingestions are frequently encountered in pediatric patients. Providers should be familiar with the complications, initial management, and indications for endoscopy. (2)
- Based on strong research evidence, in the management of ingestions, securing the airway is the first priority. Once secured, one should follow the proposed algorithms as described. (13)
- Based on some research evidence as well as consensus, when reviewing radiographic imaging, every effort should be made to identify the location of the foreign body (airway, esophagus, stomach), the type of object ingested (coin, button battery, magnet), and the number of items ingested before proceeding with medical management. (1)(6)
- Based on strong research evidence, ingestion of button batteries is considered a medical emergency, and they should be removed within 2 hours when located in the esophagus. (3)
- Based on strong research evidence, absorptive objects are not always visible on radiography; however, timely removal is imperative due to risk of rapid expansion and resultant obstruction and/or perforation. (2)
- Based on strong research evidence, urgent endoscopic evaluation is recommended for those with symptomatic caustic ingestions within 12 to 24 hours. Endoscopy between 5 and 15 days of caustic ingestion should be avoided due to increased risk of perforation. (10)
- Based primarily on consensus due to a lack of relevant clinical studies, education of the public is the most important prevention against foreign body and toxic material ingestions. All potentially hazardous products should be properly labeled and kept out of reach of children. (19)

***To view teaching slides that accompany this article, visit* http://pedsinreview.aappublications.org/content/42/6/290.**

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PIR QUIZ

1. A mother brings her 6-year-old son to your office because he swallowed a penny 3 days earlier. The child was with his father when he swallowed the penny because he "was bored." His dad did nothing and only let mom know about it on the morning of the visit. The child is otherwise well with no underlying health conditions. He is tolerating all his meals and has not had emesis or abdominal pain. His physical examination findings are normal. An abdominal radiograph shows a circular object, consistent with a penny, in the body of the stomach. Which of the following is the most appropriate course of action in the management of this patient?

   A. Fluoroscopic upper gastrointestinal (GI) series.
   B. Induce emesis with oral ipecac.
   C. Refer to the local children's hospital for emergency endoscopic coin removal.
   D. Repeat radiography in 1 to 2 weeks.
   E. Start an oral proton pump inhibitor.

2. A 3-year-old girl is brought to the emergency department by her panicked mother. The mother reports that she witnessed the child ingesting a button battery from the remote control of a toy approximately 25 minutes before presentation to the emergency department. The child is unable to swallow her secretions but is breathing normally. A radiograph shows a button battery in the midline at the level of the aortic arch. The evaluating clinician arranges for transfer to a children's hospital with pediatric gastroenterology coverage that is 3 hours away. While awaiting transfer, which of the following is recommended to be given to the patient?

   A. Intravenous famotidine.
   B. Intravenous pantoprazole.
   C. Oral honey.
   D. Oral milk of magnesia.
   E. Subcutaneous glucagon.

3. A 16-year-old boy is brought to the office by his mother. He was in physics class and doing an activity with spherical neodymium magnets. He was trying to give the appearance of having a pierced tongue and placed a magnet on each side of his tongue. He then accidentally swallowed them. He presents to the office a few hours later for an urgent visit. He is otherwise healthy and denies belly pain, nausea, chest pain, emesis, or dysphagia. His physical examination findings are normal. Which of the following is the next best step in the management of this patient?

   A. Emergency endoscopic removal.
   B. Fluoroscopic upper GI examination.
   C. Inpatient admission for observation and serial physical examinations.
   D. Observation of his stool for 1 to 2 weeks to ensure that the magnets pass.
   E. Start an oral proton pump inhibitor.

4. A 15-year-old boy is brought to the emergency department because has been unable to swallow anything since eating a dinner with his family. Dinner consisted of a chicken sandwich with tomato and lettuce, mashed potatoes, corn and milk. He says he feels like he has something stuck in his throat and points to his thyroid cartilage. Similar episodes have happened

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before, which required swallowing multiple times with extra water to get the blockage to pass. This maneuver has not helped this time. He has moderate persistent asthma and environmental allergies. He has had no previous surgeries. Physical examination is notable for a well-appearing young man in some distress who is spitting his oral secretions into an emesis basin. Which of the following foods is most likely to be causing his esophageal obstruction?

A. Bread.
B. Chicken.
C. Corn.
D. Mashed potatoes.
E. Tomato.

5. A 3-year-old boy is brought to your office by his father after having ingested a toy whose packaging indicates that it grows in size when exposed to water. The child is previously well and has had no emesis or abdominal pain. Physical examination findings are normal. Which of the following is the most appropriate next step in the management of this patient?

A. Abdominal radiography.
B. Endoscopic retrieval of the toy.
C. Fluoroscopic upper GI examination.
D. Home observation.
E. Keep the child nothing by mouth for now and resume a regular diet in 12 hours.