Review of Foreign Body Ingestion and Esophageal Food Impaction Management in Adolescents

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Abstract

Foreign body ingestion is a common clinical scenario among patients of all ages. The immediate risk to the patient ranges from negligible to life threatening. Initial and follow-up management strategies depend on multiple patient and ingested object-related factors. Available literature on this topic tends to focus on the small child or adult, leaving the clinician caring for adolescents to extrapolate this information to guide decision making for individual patients. This article reviews foreign body ingestion literature with important implications to the adolescent patient and raises awareness of some highly dangerous objects such as large button batteries, high-powered magnets, long sharps, narcotic packages, and super absorbent objects. An additional focus includes the management of esophageal food impaction. We highlight the unique aspects to the care of the adolescent with intentional ingestion and comorbid psychiatric illness. The article concludes by discussing the challenges to prevention of ingestion in the at-risk patient.

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FBI refers to nonfood impaction-related ingestions. The majority of pediatric FBI encounters are accidental, occurring in toddlers and young children, with an important minority occurring in adolescents. According to the American Association of Poison Control Centers’ annual report for 2011, over 95,000 FBIs were reported in children, with >3,000 of those in patients 13–19 years of age [1]. Regardless of the patient age, the key diagnostic and therapeutic decisions are based on common factors: the ingested object, the number of objects, timing between ingestion and presentation, anatomic location of the object, and presence or absence of symptoms. The age and size of the patient will have some impact as well. There are no large case series or meta-analyses specifically on FBI in the adolescents; therefore much of the management practice in this population combines available data and expertise with FBIs in younger children and adults.

Esophageal food impaction (EFI) accounts for most accidental encounters in adolescents, with the occasional misadventure of an object being in or near one’s mouth during a sudden trauma such as a motor vehicle accident, causing ingestion. Much more common in the adolescent is intentional FBI, which may present unique challenges compared with accidental ones. In a recent review of 262 adult FBI cases, 92% were intentional and 85% of patients had underlying psychiatric illness [2]. A majority of these cases had a delay >48 hours from ingestion to medical presentation and
ingested long objects. In this report, 11% required surgical removal and 6% suffered perforation. One might conclude that delay in presentation and ingestion of larger or more dangerous objects lead to increase potential for endoscopic technical difficulties and complication risk. However, other studies reporting on a similar patient population have not demonstrated increased endoscopy complications or surgical rates [3,4].

High medical costs have been associated with the care of patients with intentional FBI, in both human and monetary resources. In a retrospective review of 33 adults who accounted for 305 separate FBI encounters over 8 years, the total cost of care was >2 million dollars; costs were significantly higher for patients requiring inpatient admission [3]. The major indication for admission in this series was management of the psychiatric disorder. Poynter et al.[5] published a systematic review on deliberate FBI in adults with psychiatric illness and found four predominant underlying conditions: psychosis, borderline personality disorder, obsessive–compulsive disorder, and malingering (while incarcerated). It is unknown if these co-morbid conditions mirror the adolescent population with intentional ingestions.

In combination with psychiatric illness, some adolescents may obtain secondary gain by an inpatient admission after FBI, which may unintentionally result in reinforcement of FBI, making the decision to admit even more complicated. Our experience has revealed that some psychiatric care facilities are resistant to accepting patients until the object is removed or passed, further prolonging the hospital stay and cost of care for those with nonretrievable foreign bodies.

Many more services are frequently utilized for the adolescent with intentional FBI compared with the younger child, and a multidisciplinary treatment approach has been advocated [6]. In our hospital, management of an adolescent with intentional FBI may utilize clinical resources from emergency medicine, gastroenterology (and/or general surgery or otolaryngology), anesthesia, radiology, adolescent medicine, nursing, and psychiatry. Supporting resources include security staff, social work, child life specialists, and 1:1 staff. Such support staff may not be readily available at many medical centers, further adding to the time devoted by the clinical team. Additionally, many hospitals do not have pediatric specialists on staff or adult providers willing to perform procedures on a minor. Medical transport is then required to bring the patient to a referral center with 24-hour pediatric procedural ability. Regarding those patients who reside at inpatient psychiatric facilities, liaisons at the home institution may need to be contacted to provide additional history or provide procedure consent.

Regardless of the patient’s intentions or presence of an underlying psychiatric disorder, the common factors that guide management of all patients still remain the most important. In this review, we summarize management of EFI and highlight important elements to FBI management based on the type of object introduced to the gastrointestinal tract. These include button and cylindrical batteries, magnets, sharp objects, long and large objects, coins and blunt objects, narcotic packets, and super absorbent objects (Table 1).

### Esophageal Food Impaction

Any patient who develops acute symptoms at the time of eating, including chest pain, dysphagia, odynophagia, respiratory distress, coughing with further oral intake, or drooling, should be suspected of having an EFI. This scenario is invariably unintentional and typically occurs in the setting of underlying esophageal pathology. In the adolescent without a history of esophageal surgery, the primary underlying condition to consider is eosinophilic esophagitis, an inflammatory disorder of the esophagus due to food allergy [7]. If the first presentation to medical attention is at the time of food impaction, these patients often report, in retrospect, chronic symptoms of dysphagia, needing to cut food into small pieces or drink a large amount of fluids with meals to facilitate food passage after swallowing. Peptic esophagitis or stricture is important for other diagnostic considerations. When a patient presents with EFI, removal of the food bolus within 24 hours is indicated for all patients, with more urgent removal performed if acute symptoms are present. The clinician following up a patient after EFI removal should ensure referral to a pediatric gastroenterologist for evaluation because a majority of these events are secondary to a treatable underlying condition [7]. General surgeons or otolaryngologists often remove food impactions by performing rigid endoscopy, and the patient may not be referred to a gastroenterologist at the time. Additionally, the patient may incorrectly excuse the event from eating too quickly and not seek a gastroenterology follow-up appointment independently. If the diagnosis of eosinophilic esophagitis is made by esophageal mucosal biopsy at the time of EFI removal or at a subsequent date, referral to an allergist is also indicated, as the mainstay therapy at this time is elimination of the identified food allergen from the diet [8].

Table 1

<table>
<thead>
<tr>
<th>Tips and caveats for management of the adolescent after foreign body ingestion</th>
<th>BBs*</th>
<th>Magnets</th>
<th>Sharp object</th>
<th>Blunt objects</th>
<th>Narcotic package</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endoscopic or surgical removal</td>
<td>- Esophageal: emergent removal</td>
<td>- Symptomatic location</td>
<td>- Esophageal location</td>
<td>- Never endoscopic removal</td>
<td></td>
</tr>
<tr>
<td>Consider hospital admission</td>
<td>- Stomach + symptoms: Urgent removal</td>
<td>- Symptomatic + within reach</td>
<td>- Symptomatic location: within 12–24 hours</td>
<td>- Presence of toxidrome symptoms or high suspicion for package ingestion</td>
<td></td>
</tr>
<tr>
<td>Beyond esophageal reach + symptoms or magnet co-ingestion</td>
<td>- Multiple magnets beyond endoscopic reach</td>
<td>- Long OR</td>
<td>Symptomatic and unsure of object identity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consider discharge and follow-up x-ray</td>
<td>Single magnet: serial x-rays to ensure passage and no further magnet ingestion</td>
<td>- Asymptomatic, short object, reliable follow-up. X-ray 2–3 days</td>
<td>- Stomach location: X-ray in 2–3 weeks</td>
<td></td>
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</tr>
</tbody>
</table>

BB = button battery.

* See algorithm from Litovitz et al. [9] for more detailed management recommendations of BB ingestion in children and adolescents.
Foreign Body Ingestions

Button and cylindrical batteries

The two primary battery types ingested are button and cylindrical batteries. Of any FBI, button (also called disc) batteries have the most potential to cause dangerous or fatal injury. A button battery impacted in the esophagus becomes a closed circuit and will discharge its electrical current, leading to tissue burn and liquefaction necrosis. Severe tissue injury has been known to occur within 2–3 hours of ingestion. This scenario represents the most emergent of all endoscopic indications, and button battery removal should not be delayed under any circumstance. Comlications of this injury include esophageal stricture, tracheoesophageal, or aorto-esophageal fistula; the latter of which can cause fatal exsanguination. Therefore, any person with witnessed or suspected button battery ingestion should be referred to the nearest medical center for rapid evaluation regardless of symptoms. An immediate x-ray of the neck, chest, and abdomen is performed to identify the anatomic location of the battery, as the initial and most critical management decision is based on whether the battery is located in the esophagus or beyond. A button battery in the esophagus will demonstrate a “double halo” sign on anteroposterior view and a “step-off sign” on lateral view. These signs are subtle and are the key distinguishing features between a battery and a coin (Figure 1). The size of the battery is the other major determining risk factor for severe injury. Any battery ≥15 mm in diameter is associated with much higher risk, and batteries as large as 20 mm are the cause of most of the button battery-related morbidity and mortality.

Litovitz et al. [9] published an algorithm in 2010 providing guidelines for the management of button battery ingestions. A button battery in the esophagus should be emergently removed endoscopically. Medications to induce vomiting (such as ipecac) should never be given regardless of battery location. According to this guideline, a large button battery ingested by a teenager is of equal risk compared with the same battery in smaller children, whereas an asymptomatic teenager ingesting a single small (<12 mm) button battery without co-ingestion and with reliable follow-up is at lower risk. A single button battery in the stomach or beyond carries much less immediate risk. However, the potential for a battery to be temporarily impacted in the esophagus causing serious injury, then fall into the stomach by the time of detection on radiograph, must be considered (see Table 1 for management considerations). Despite this, if symptoms develop at any point after discharge, urgent return to an emergency department is indicated.

Less abundant literature is available regarding cylindrical battery ingestion; no algorithm exists to systematically guide management strategies. These batteries do not typically discharge electrical current the way button batteries do, but they have potential to leak caustic fluid if the outer casing is compromised. In the largest published series identified, of 62 children with cylindrical battery ingestions, about 82% went unaffected, while no patient had major complications or death [10]. Of particular interest to the practitioner caring for adolescents, suicide attempt was the reason for ingestion in only 1.3% of the 2,382 total battery ingestions in this series, which is lower compared with other objects or poisons sought out for the same purposes [1,10]. For single cylindrical battery ingestions, our institution’s current practice calls for endoscopic removal in <24 hours for esophageal location. If in the stomach, the patient can be monitored as an outpatient and followed by x-ray within 1 week if not observed to pass in the stool, at which time we remove the battery by endoscopy if not passed. Once these batteries pass the pylorus, they almost universally pass the remaining gastrointestinal (GI) tract without incident. For the teenager with multiple gastric cylindrical batteries as the result of intentional ingestion, we advocate for endoscopic removal of the batteries at the time of presentation.

Magnets

The danger of high-powered magnet ingestion has received significant press within medical and mainstream media since 2009 when sales of adult desk toy magnet sets rose exponentially. The majority of case reports of serious injury have been in small children, although teenagers have also been seriously injured. A North American Society of Pediatric Gastroenterology Hepatology and Nutrition survey identified risk factors beyond toddlerhood for magnet ingestion and found 24% were related to accidental ingestion of magnets used in oral and nasal piercings and 5% affecting patients with co-morbid psychiatric disorders [11].

![Figure 1](source_url). Button battery in esophagus. (A) AP view radiograph demonstrating a “halo sign” noted by ring around outer edge of disc. (B) Lateral view radiograph demonstrating a “step-off” sign noted by the change in diameter between positive pole (anterior) and negative pole (posterior) of the battery. AP = anteroposterior.
Guidelines published in 2012, largely based on expert opinion, have aided in the management of patients who ingest high-powered magnets (Figure 2) [12]. Ingestion of a single magnet is typically of little danger once it passes into the stomach, as long as further ingestions do not occur, and other magnets or metallic objects are not worn on the body or clothes of the patient until completely passed. All patients should be referred to an emergency department, as it may not be readily discernable if more than one magnet was ingested. Neck, chest, and abdominal x-rays are recommended. If a magnet is present on an x-ray, a lateral film is recommended to determine whether there is a single versus multiple magnet ingestion and to better determine location. If a single magnet is found in the esophagus, management mirrors that of any other blunt object with endoscopic removal within 24 hours if failing to pass the lower esophageal sphincter. If beyond the esophagus, spontaneous passage is likely and outpatient management is indicated.

The heightened awareness needed for magnets surrounds ingestion of multiple magnets, which can attract each other across tissues, causing a pressure necrosis to the bowel wall and ischemia or fistula [13]. Any patient suspected of multiple magnet ingestion should be immediately referred to an emergency department for evaluation regardless of symptoms. Urgent endoscopic removal is indicated in all cases when the magnets are within reach (Figure 3). Any patient in whom the magnets cannot be retrieved should be admitted to an inpatient ward for monitoring, serial x-ray evaluation, and potential surgical removal if not progressing or development of symptoms worrisome for gastrointestinal ischemia or obstruction, such as pain, vomiting, or tachycardia. All metallic and magnetic objects should be removed from the patient’s clothes and environment. For patients with self-injurious behaviors, careful inspection of the inpatient room is necessary as routine metallic objects may pose a serious risk if ingested in this setting; one-on-one observation is also typically required to minimize risk of recurrent FBI.

**Sharp objects**

The management of adolescents with sharp object ingestion can be challenging for multiple reasons. When the ingestion is intentional and/or repeated, the patient is often engaging in self-destructive behavior, and the possibility of undergoing an invasive procedure to remove the object may be additional motivation for the ingestion. Perpetuating the cycle of behavior when urgent endoscopy is performed may be unfortunate consequence. The clinician may wonder if the negative implication for the patient’s psychiatric disorder outweighs the need for object retrieval. A recent European survey of gastroenterologists, surgeons, and

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**Figure 2.** Management algorithm for magnet ingestion in children. From “Management of ingested magnets in children” by Hussain et al., 2012, *Journal of Pediatric Gastroenterology and Nutrition, 55*, p. 239–242, with permission.
Magnets are attached to each other without bowel tissue between them. Magnets were removed by colonoscopy. AP radiograph if the magnets are attached within a bowel lumen or across tissue planes. (B) Colonoscopic image of the same ingestion depicted in (A). Two high-powered trists [14].

Ingestions, the largest percentage change being among psychiatrists regarding the management of adults with borderline personality disorder and repeated sharp object ingestions found 96% of respondents agreed with emergent endoscopic removal at the time of the first ingestion but decreased to 86% with repeated ingestions, the largest percentage change being among psychiatrists [14].

Second, there are many controversies regarding how aggressive endoscopic or surgical removal of the object should be. It is well accepted by both pediatric and adult gastroenterologists that sharp objects in the esophagus or in the symptomatic patient should be removed emergently [15,16]. Many review articles cite perforation rates as high as 35% after sharp ingestions; however, these data from reports published prior to today's modern endoscopic practices and technology may be outdated. Small bowel enteroscopes now exist that can examine the entire small bowel length and retrieve a dangerous foreign object from the small bowel in select cases. More contemporary reviews suggest that the perforation rate is lower [17]. Sites of highest risk for perforation include the esophagus, duodenum, and particularly at the ileocecal valve. Therefore, passage beyond the duodenum does not preclude the need for follow-up, as is the case in other ingestions.

In general, straight pins and like objects with a heavier weighted blunt-end and lighter sharp-end have a fairly good track record of passing spontaneously without complication, as long as it passes beyond the esophagus and is a length that can traverse the duodenal C-loop (discussed below). Yet, expert opinions vary on the need for straight sharps retrieval as there are readily identifiable case reports of these objects causing perforation and even migration through the bowel into other solid organs as well [17–19]. There is better consensus that nonstraight sharps such as open safety pins and dual-ended sharp objects such as toothpicks or food bones should be urgently removed if possible, with close inpatient observation if not retrieved. Radiolucent objects pose an additional challenge because identifying the anatomic location is not possible with x-ray. Conservative management may be more risky, and proceeding directly to endoscopic removal is a common practice. The use of other imaging studies in asymptomatic patients, such as barium swallow studies or computed tomography scan, could be used if the likelihood of ingestion is unclear.

There are no validated prediction rules for spontaneous passage of objects based on ratios of object size to patient size or weight. The American Society for Gastrointestinal Endoscopy guidelines on FBI suggests objects >6 cm in length are less likely to pass the duodenal C-loop and should be retrieved if possible [15]. While many adolescents are adult size and are served well by this cut off, many other teens are considerably smaller and cannot pass smaller objects. In general, our current practice is to consider a conservative approach (close outpatient observation and repeat x-ray to ensure progression through the GI tract) in the asymptomatic teenager with a single, small (approximately <3 cm), and straight sharp object beyond the esophagus. When multiple or longer sharps are ingested, removal is preferred due to higher risks for complications.

**Long and large objects**

As mentioned above, there are no precise ways to estimate what objects can pass based on patient size. While the American Society for Gastrointestinal Endoscopy guidelines for adults can be applied appropriately for many adolescent patients, pediatric gastroenterologists frequently use measurements of 5 cm long or 2 cm wide as cut offs for removal in larger patients [16,17]. These measurements must be used in context of the actual object ingested, as a quarter is 2.4 cm in diameter and will often pass the pylorus in an average size adolescent or younger child. The primary sites of impediment are the pylorus, duodenal C-loop, and ileocecal valve. Once an object reaches the colon, it should spontaneously pass.

Extrapolating from available pediatric and adult data, patients with intentional ingestion and psychiatric disorders (which often overlap) may be more likely to ingest longer objects, including pens, pencils, knives, other cutlery, and toothbrushes [2,3,5,20–22]. In a 10-year review of pediatric FBI (mean patient age 3.9 years), endoscopic removal was performed 248 times; 81% of objects removed were coins and at least 94% in total were smaller objects [23]. In contrast, the adult series of 305 ingestions by 33 patients (mean age 35.3 years) described previously revealed 47.8% of ingested objects were pens, pencils, knives, spoons, and...
toothbrushes [3]. In this study, 27 of 33 patients had an established co-morbid psychiatric diagnosis.

When an object of this size is retained in the upper GI tract, it should be removed by endoscopy if possible. When the patient is symptomatic, surgical consultation before an emergent endoscopy is advised, as objects may be fixed in, or perforate the viscous wall. If asymptomatic and the object is not sharp, a satisfactory time with nothing by mouth prior to anesthesia is appropriate. In this scenario, we recommend an 8-hour period for solid food and 2 hours for clear liquid intake prior to anesthesia. It is worth reiterating that highly dangerous objects such as esophageal button batteries are to be removed immediately regardless of the last food or liquid ingestion.

A significant percentage of adolescents who ingest such long objects do so intentionally. These patients should be provided with psychiatric consultation if no underlying psychiatric diagnosis exists. When a large object is reportedly ingested by accident, the patient should additionally be screened for bulimia nervosa as such objects may be used to induce vomiting by individuals with bulimia. Sastry et al. [20] report on the case of a 19-year-old female with repeat ingestions of a spoon, after which time bulimia was identified and appropriate long-term follow-up care was provided.

Blunt objects/coins

Coins and similar objects are the most commonly encountered FBI in small children. On average, teenagers swallow fewer coins in favor of objects perceived to be higher risk, be it with intentions of self-harm, a dare, or some other misadventure. For the average size teenager, smaller blunt objects, defined in our practice as <5 cm long and <2 cm wide, are not likely to have any more risk than a coin. We caution the practitioner to be vigilant nonetheless, as there are so many potential objects in this category that generalized statements about object risk are difficult. Commonly encountered objects that frequently raise concern for families, psychiatric inpatient facilities, or health care providers are blunt screws, bolts, and similar hardware. While potentially anxiety provoking, such objects are highly likely to pass the GI tract uneventfully if swallowed as a single object, and inpatient observation for passage need not be the norm.

Any coin or similar shaped object located in the esophagus should always be evaluated with anteroposterior and lateral x-rays to thoroughly differentiate from a button battery (the latter has the characteristic step-off sign; Figure 1). Blunt foreign bodies in the esophagus are removed within 24 hours to avoid erosion into the esophageal wall, unless the patient is symptomatic necessitating more expedited removal. Regarding gastric blunt foreign bodies, there is a high likelihood of spontaneous passage. Multiple objects in the stomach may be an impediment to passage. If the patient is symptomatic, the object should be removed by endoscopy within reach. In the asymptomatic patient, our current practice is to obtain an x-ray 2–3 weeks after ingestion if it is not observed to pass in the stool and prepare for endoscopic removal around 4 weeks if still retained. On initial evaluation, if the object is in the small bowel or colon, a follow-up x-ray is not needed routinely with spontaneous passage expected.

Narcotic packets

The practice of body packing to conceal and transport illicit drugs is well described in adults. Rarer cases of adolescents and children participating in this practice have been published [24,25]. Cocaine, heroin, prescription opioids, amphetamines, marijuana, and ecstasy have all been reported in cases of body packing. Body packers refer to those smuggling drug by orally ingesting a securely packaged vehicle such as a latex or rubber glove finger, balloon, or condom with the drug inside. In comparison, body pushers conceal similar packets within a body orifice (typically the rectum or vagina) rather than swallowing it, and body stuffers expeditiously swallow poorly wrapped or open drug to avoid law enforcement detection [26]. Body stuffers tend to be much lower risk compared with body packers due to the significantly smaller amount of drug usually ingested [26]. Traub et al. [24] first published cases of body packing in pediatrics, describing a 12- and 16-year-old presenting with symptoms of heroin intoxication. Ingested drug packets are frequently visible on plain x-ray. Computed tomography scan can be used in cases of high suspicion not identified on x-ray. Initial management depends on the drug ingested and the presence or absence of toxidrome symptoms. Physical exam should include inspection of each orifice—ear, nose, mouth, rectum, and vagina—for any additional foreign body packets. Endoscopic retrieval of the packets should never be attempted, as rupture of the package can be fatal, especially with cocaine packets. Patients with signs or symptoms of bowel obstruction or perforation should proceed immediately to surgery. In clinically stable patients, bowel irrigation with laxative such as polyethylene glycol solution has been described [24]. Medications to treat the toxidrome symptoms, such as naloxone with heroin ingestion or benzodiazepines with cocaine ingestion, are adjunctive while the packets are passed or removed by laparotomy.

Super absorbent objects

There are vast numbers of available industrial products and personal-use objects made of chemical polymers with a cross-linking agent to allow for large amounts of liquid absorption. Commonly found examples include those in baby diapers and those previously used in female tampons until case reports of toxic shock syndrome from tampons led to their removal. Recently, toy products were sold as small colorful objects that could grow 30–60 times the original volume when placed in water. Some of these toys sold were voluntarily recalled after reports of child ingestions leading to bowel obstruction [27]. Many generic and similar products of this kind remain on the market today. While the manufacturing of female pads and tampons has changed, they maintain the ability to expand in size when introduced to liquids and should be considered of similar bowel obstruction risk.

The management of an adolescent who ingests one of these objects has not been clearly defined. Unpublished communications with our local poison control center indicate that there have been reports of young children ingesting these water-retaining toys going unharmed, whereas an adolescent intentional ingestion of these objects has not been reported. Risks from this ingestion remain high, and given the radiolucent nature of the object, some have advocated for endoscopic removal. If a patient is symptomatic, endoscopic or surgical removal is warranted. In the asymptomatic teenager who can reliably report symptoms, endoscopic removal is at the medical team’s discretion. Should a teenager manage to swallow an unused tampon, which has been reported anecdotaly but yet to be published, our practice would be to attempt endoscopic removal at that time.
Prevention

Repeat intentional ingestions are unfortunately common, and prevention of future ingestions in these individuals is often difficult. Grimes et al. [4] recently published a retrospective review of 159 adults with FBI, with the aim of identifying risk factors for recurrent ingestion. Being a prisoner, male, and having a psychiatric disorder had an odds ratio of 4.2, 3.8, and 2.9, respectively, for recurrent ingestion. Type of foreign body, the need for surgical removal, and procedure complications were among characteristics that did not predict high risk for recurrence. Knowing these risk factors may provide caregivers with heightened awareness for this occurring again in selected individuals, although predictors of recurrent FBI in adolescents have not been well studied. Transferring a patient to an inpatient psychiatric facility after intentional ingestion may not decrease the risk of recurrent ingestion [3]. Intensifying the pharmacological or behavioral psychiatric therapies is frequently needed but is not universally successful either.

Clinical Implications

Clinicians who provide adolescent health care are well advised to recognize the complexities of FBI in this population. One must appreciate that the presence of an esophageal button battery is a life-threatening emergency and the importance of expedited removal of multiple magnets or nonstraight sharp objects. It is also useful to understand which patients need to be hospitalized and which patients are safe to monitor in the outpatient setting. The patient with a history of multiple ingestions is challenging both medically and psychosocially. A multidisciplinary team approach is best when possible, and future research is needed to develop helpful prevention strategies for further ingestions.

References