# Overview on Gastrointestinal Foreign Bodies in Children


## Abstract:

Most upper gastro intestinal foreign bodies in adults are related to food bolus impaction with meat. Patients who swallow a true foreign body typically are younger, more often male, and often have significant psychiatric illness and/or drug abuse. Foreign body (FB) ingestion is a common problem in children. FB may pass through gastrointestinal (GI) system silently without any symptom, or it may requirement an intervention to prevent complications. The diagnosis, decision for involvement and management may have some difficulties, especially in cases with protracted lodgment. Complications caused by lodgment of ingested GI FBs are associated with important morbidity and mortality in children.




## Introduction

Management of foreign body ingestion (FBI) can be one of the most challenging issues in pediatric endoscopy. The myriad distinctions in size, type, and timing of foreign object ingested, compounded by patient factors, such as age, underlying medical issues, and clinical presentation, make each case inherently unique. Button battery (BB) ingestions (BBIs) epitomize the task of pediatric FBI, as the result can range from harmless to death. As the authors' center has personally experienced, when death occurs as a consequence of BBIs in an else healthy child, it is one of the most tragic occurrences that a physician may encounter in a career. (1)

US surveillance data have demonstrated a clear growth in morbidity and mortality due to BBI in the last 2 decades, powering public health and advocacy efforts to broadcast the danger of BBs for small children. The urgency to endoscopically eliminate esophageal batteries is now well appreciated, but further consensus on management has been hard to develop(8,9)From the clinical standpoint, there are 2 specific areas of supervision where there is considerable controversy and/or ambiguity. First is the postremoval management of children through moderate/severe esophageal injury. Clinicians must first escalate the spectrum of esophageal and para-esophageal complications connected with BBI in children and the specific management dilemmas encountered. The risk for delayed existence of aortoenteric fistula (AEF) days or weeks following BB removal further experiments our decision making, specifically around patient character after battery removal.(1)

The second controversial area in the management of BBI surrounds the management of asymptomatic patients with batteries beyond the esophagus (eg, intragastric, duodenal, and so forth). Recent expert opinion-based guidelines from the Endoscopy Committee of the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) recommended consideration of endoscopic assessment and removal in certain cases of BBI whereby the battery lies beyond the esophagus(9) This recommendation contradicts previous guidelines from the National Battery Ingestion Hotline (NBIH) and the National Capital Poison Center, which had suggested only conservative preliminary management in asymptomatic children with postesophageal BB.In this article, the novelists review their single-center experience with BBI with the primary aim of offering data that may help better inform and support management decisions(1).

A retrospective study was achieved to determine the predisposing factors associated with the complications of ingested gastrointestinal (GI) tract foreign bodies (FBs) in children who had surgical or endoscopic removal. The study was achieved in 161 children who had endoscopic or surgical removal. The clinical data were appraised in two groups. In groups I and II, respectively, 135 patients with no complications and 26 patients with difficulties were analyzed. The relative risk analysis was performed for the risk factors. The numeral of the patients with an accurate history and the radiopaque FBs was suggestively higher in group I. Metal, especially sharp

objects, and food plugs obstructing a diseased esophagus were the most public FBs found in group II. The common of the FBs of both groups were entrapped in esophagus, the number of the FBs distal to esophagus was significantly higher and period of lodgment was significantly longer in collection II. Esophageal abrasion, laceration and bleeding, complete esophageal obstruction, caustic injury, severe esophageal stricture, laryngeal edema, recurrent aspiration pneumonia, loss of weight, intestinal perforation, constipation and intestinal obstruction were determined as complications. The relative hazard was >1 for duration of lodgment more than 24 h, for sharp or pointed objects, button batteries, nonopaque objects, unhealthy esophagus and for the objects situated below the upper third of esophagus. Type, radiopacity, location and duration of the ingested GI tract FB determine the consequence. A delayed diagnosis is the most significant influence increasing the risk of complications. Physician must maintain a high index of suspicion and a more extensive history; physical check and radiodiagnostic investigation should be obtained in assumed cases.(2)

## Epidemiology

The types of ingested substances vary with patient age. Coins accounted for 66% of the upper GI foreign bodies found in patients less than 10 years of age; in contrast, food boluses account for 60% of upper GI foreign bodies in those over 11 years old. A diet bolus impaction, in the adult patients, if often due to an underlying structural anomaly, such as an esophageal web, ring, a benign or malignant stricture or eosinophilic esophagitis . Noted that 99% of ingested foreign bodies, in their sequences of 242 patients, become lodged in the upper GI tract; these foreign bodies were found in the pharynx in 39 patients, in the esophagus in 181 patients, in the stomach in 19 patients and in the small intestine in 3 patients.(6)

## Pathophysiology

The majority (80%-90%) of foreign bodies and food impactions will pass spontaneously. Ten to twenty percent of gastrointestinal foreign bodies will require endoscopic intervention. Few patients who ingest foreign bodies require surgery(29-30). Impaction, perforation, or obstruction most often occurs at areas of acute angulations or physiologic narrowing. Potential

sites for blocking include the cricopharyngeus muscle or upper sphincter, aortic arch, left main stem bronchus, gastroesophageal junction or lower sphincter, pylorus, duodenal sweep, ileocecal valve, and anus. Foreign bodies and food impactions in the esophagus have the highest incidence of complications with the complication rate directly proportional to the dwell time in the esophagus. Perforation is most common with sharp objects, and ranges from 15%-35%(29-31)

Materials retained in the upper GI tract generally fall into two groups, namely, a food bolus impaction and a true foreign body. Arrangements for foreign bodies, which define anatomic region and shape, are important for defining optimal therapy. Sharp-pointed objects, food bolus impaction, and button batteries may lead to upper GI tract perforation, obstruction or bleeding, thereby necessitating earlier intervention (6).

## Location

## Esophagus

Unlike adults, young children accidentally swallow FBs. Esophageal FBs should be suspected in children who present with a sore throat, or difficulty swallowing saliva or food without an obvious reason. If an esophageal FB is not passed spontaneously within 24 hours, it must be removed considering the possibility of an anatomical anomaly or esophageal perforation (10-11)

Recently, the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) Endoscopy Committee revised the recommendations pertaining to the timing of endoscopic intervention. The presence of esophageal button batteries mandates emergency removal within 2 hours regardless of the presence of symptoms (12)

Coins, magnets, sharp FBs, or food impaction in the esophagus all mandate removal within 2 hours if the children's secretions cannot be controlled. In asymptomatic children, they may be removed within 24 hours. Long FBs lodged in the esophagus mandate removal within 24 hours regardless of the presence of symptoms.(3)

## Stomach

The NASPGHAN Endoscopy Committee recommends button battery removal within 2 hours in a symptomatic children regardless of size (12)A button battery ≥20 mm located in the stomach of an asymptomatic children aged <5 years should be removed within 24 to 48 hours. If serial X-rays do not expression progressive movement of an ingested FB in asymptomatic children, it can be detected for 24 hours. Magnets retained in the stomach in symptomatic children necessitate removal within 2 hours. In asymptomatic children, they should be removed within 24 hours. Coins in the stomach of symptomatic children should be removed within 24 hours. In asymptomatic children, these can be observed for 24 hours. Long or large FBs in the stomach require removal within 24 hours.(3)

## Small bowel

Most FBs in the small bowel are passed extemporaneously without complications. Therefore, physicians would comfort the children and/or caregivers and advise them to check the children's stool for the FB. If the FB is not exterminated even after a week, children need to visit the hospital and obtain an X-ray to recognize the exact location of the FB.

Children should be sternly recommended of the need to visit the hospital earlier if they develop signs of perforation or obstruction of the intestine, such as vomiting, severe abdominal pain, fever, or intestinal bleeding.(3)

## Types of foreign bodies

## Coins

Coins are the most commonly ingested FB in children. Over 250,000 coin ingestions in children have been reported in the United States (13). Factors influencing the spontaneous passage of a coin are its location in the esophagus, age of the child, and the size of the coin. Usually, the rate of spontaneous passage of swallowed coins in children is approximately 30%

(14) Thus, children presenting with an ingested coin without complications (a single coin lodged for <24 hours, without any history of esophageal disease or surgery, and no respiratory symptoms) can be observed over 12–24 hours before performing an invasive procedure (endoscopic or surgical removal). Conners et al. suggested that coins lodged in the upper and mid esophagus require endoscopic removal, although 60% of coins lodged in the lower esophagus have been observed to pass spontaneously (15) Once coins are observed to successfully pass through the esophagus, they are likely to progress and pass spontaneously (3) Coins measuring >23.5 mm in size are more likely to become impacted, particularly in children aged <5 years. Coins measuring >25 mm in diameter are unlikely to pass through the pylorus, particularly in younger children even though they might have successfully passed through the esophagus (16). Children in whom coin ingestion is observed or supposed need to undergo an X-ray to confirm the presence, size, and location of the coin, and the inspection should be performed with close attention to discriminate the coin from a button battery, which shows the characteristic double halo sign. Esophageal coins must be removed within 24 hours to decrease the incidence of complications. Symptomatic children awarding with difficulty swallowing saliva or respiratory problems warrant emergency endoscopic removal. After removal of esophageal coins, careful endoscopic examination of the esophageal mucosa is essential to assess any evidence of significant injury.

Ingested coins present in the stomach can be detected in asymptomatic children in whom stool should be monitored for the passage of the coin, and serial X-rays should be gotten every 1 or 2 weeks until passage of the coin has been established. If the coin is observed to remain in the stomach even after 2–4 weeks, elective endoscopic amputation can be considered. If the coin is located within the small bowel but the children are asymptomatic, clinical remark is indicated. However, in children presenting with signs of bowel obstruction or perforation, surgical removal needs to be considered (3)

## Button batteries

The frequency of button battery ingestion has been increasing owing to the widespread use of such batteries as power sources in electronic devices(17). Button batteries resemble

coins in size and shape; thus, because these two FBs are often indistinguishable, a careful X-ray examination is important to avoid a delay in diagnosis. Button batteries can cause severe damage secondary to local hydrolysis and the action of hydroxide on the mucosa, caustic injury secondary to a high pH, and minor electrical burns secondary to lithium. Button batteries impacted within the esophagus can cause burns within 4 hours. Usually, small button batteries (diameter ≤20 mm) do not cause serious complications that are observed in association with larger button batteries (diameter ≥20 mm) (18). A study has shown that all 7 children who ingested button batteries <15 mm in size were asymptomatic without any complications, whereas all 5 children who swallowed batteries >15 mm in size showed moderate (*n*=3) to severe (*n*=2) complications (4). The author described a 13-month-old infant who had ingested 15-mm sized button battery 24 hours prior to presentation. He presented to the emergency room with vomiting and poor oral intake over a day prior to presentation. Unfortunately, nobody was aware that he had ingested the FB; however, an X-ray showed a round metal FB with a halo sign in his upper esophagus. An emergency endoscopic examination revealed a button battery that had caused an ulcer and corrosion of the esophageal mucosa. Young children presenting with uncertain/undetermined evidence of ingested FBs need special attention.

The NASPGHAN Endoscopy Committee recommends removal of esophageal button batteries within 2 hours (19) However, endoscopic removal of button batteries from the stomach remains a controversial issue. A large cohort study has shown that no previous reports have described significant gastric injury from button batteries (20) Thus, the NASPGHAN Endoscopy Committee recommends observation of asymptomatic children (aged ≥5 years) who present with a short duration of ingestion (<2 hours) of a small-sized battery (<20 mm). Large batteries (>20 mm) remaining after 48 hours require removal (3)

## Magnets

Recently, the frequency of magnet ingestion has increased in children. If a single magnet is ingested, it can be expected to be passed spontaneously if the magnet is not too large. However, if multiple magnets or a single magnet with a metallic FB has been ingested, the

contact between these ingested magnets or the magnet and the metallic FB and the mucosal surfaces of different body parts can cause mucosal pressure necrosis, as well as intestinal obstruction, fistula, and/or perforation; therefore, surgical removal is needed in such cases (21-22)

If magnet ingestion is detected on an X-ray, the physician must confirm whether the ingested FBs are single or multiple magnets or magnets with a metallic FB. Occasionally, two or more magnets may be attached to each other and may appear like one piece, and misdiagnosis of multiple magnets as solitary magnet ingestion can lead to delayed institution of treatment and cause significant complications. Given this risk, if multiple magnets or a single magnet with a metallic FB are located within the esophagus or the stomach, these FBs must be endoscopically removed even in asymptomatic children.

If multiple magnets or a single magnet with a metallic FB are located in sites beyond the stomach, symptomatic children need to consult a pediatric surgeon to plan surgery and asymptomatic children may be closely followed using serial X-rays to monitor progression of the FBs. Recently newer and smaller neodymium magnets that are at least 5 to 10 times stronger than traditional magnets are available as adult toys and can attract each other with powerful forces(23). A neodymium magnet appears like a ball-bearing on an X-ray, and clinicians should be careful to not misdiagnose it as a metal ball.

## Sharp or pointed foreign bodies

Ingestion of sharp or pointed FBs in children is known to be associated with high morbidity and mortality, and delayed diagnosis and management increases the risk of serious complications.

Sharp or pointed FBs such as safety pins, nails, hair-pins, screws, pine needles, thumbtacks, or dental prostheses can cause serious complications such as esophageal ulceration and/or perforation, trachea-fistula, and/or abscess formation, peritonitis, an aorto-esophageal fistula, and even death (24-25). Usually, intestinal FBs are known to cause perforation in <1% of patients; however, sharp or pointed FBs can cause perforation in 15%–35% of patients.

Therefore, it is preferable to remove FBs from the esophagus or stomach whenever possible. Notably, in recent times, early diagnosis and prompt endoscopic removal have reduced the incidence of adverse events related to the ingestion of sharp or pointed FBs (26). Early diagnosis needs accurate information regarding the children's history or a high index of clinical suspicion for the ingestion of a sharp FB and an urgent X-ray examination. Radiolucent FBs such as plastic, glass, fish bones or wood cannot be recognized using X-ray examination. Thus, in children with supposed ingestion of sharp FBs, even if an X-ray does not reveal a FB, an emergency endoscopy is suggested. A sharp FB present in the esophagus constitutes a medical emergency because of the high risk of perforation and migration and permits emergency elimination even if the children have not been maintained on a nil per os status. Overtubes may be utilized during endoscopic variceal band ligation when eliminating sharp FBs in adults, although their use is difficult in children because of a large diameter. Removal of sharp FBs using an endoscopic cap can prevent esophageal injury in children. If the sharp end of the FB is observed to be opposite the proximal site, it may be safest to push the FB into the stomach and rotate its sharp end toward the distal site before removal. Sharp or pointed FBs, long objects (>4–5 cm in infants and young children, those >6–10 cm in older children), or large and wide objects (>2 cm in diameter in infants and young children, >2.5 cm in diameter in older children) that are located in the stomach, warrant endoscopic elimination. If a sharp FB has passed into the small bowel (distal to the ligament of Treitz), surgical elimination can be considered in symptomatic children. In asymptomatic patients, close clinical follow-up with serial X-rays obtained after acknowledging the patient are recommended. The mean GI transit time for FBs in children is nearly 3.6 days (5). Therefore, if the FB does not show the expected passage after 4 days, a bowel perforation or a congenital anomaly is suspected, and surgical removal of the FB needs to be considered (3)

## Large or long foreign bodies

Ingestion of large or long FBs is an issue of special concern. These FBs must be removed within 24 hours because long (those >6 cm in length) or large FBs are unlikely to pass through the duodenum and the ileocecal valve (34)

Sharp or pointed objects, long objects (>4–5 cm in infants and young children, >6–10 cm in older children), or large and wide objects (>2 cm in diameter in infants and young children, or >2.5 cm in diameter in older children) located in the stomach warrant endoscopic removal (3)

## Fish bones

Fish bones comprise the most common food-related FB ingested by children. Both Korea and China, which show a high intake of fish demonstrate a higher incidence of fish bone ingestion than that in other countries (27)

Children usually show fish bone impaction in the palatine tonsils, tongue base, vallecula and pyriform sinus because the laryngopharynx is narrower and the tonsils are larger in children than in adults. A Korean study has reported that ingested fish bones in children were most commonly detected in the pharynx (57.7%) (28). In fact, fish bone impaction is rare in the esophagus below the pharynx. However, fish bones lodged in the esophagus can cause mucosal ulceration or a topical inflammatory reaction leading to esophageal stenosis, perforation, a deep neck abscess, mediastinitis, a lung abscess, or even aortic fistulae. Therefore, prompt and accurate diagnosis and treatment are required. (3)

## Diagnosis

The diagnosis is often apparent from the patient's history. The patient may report a sudden onset of dysphagia while eating, often accompanied by chest pain or odynophagia and an inability to handle secretions. When children are unable to provide a history, a sudden refusal to eat, drooling, or respiratory symptoms such as coughing or wheezing due to aspiration should alert the physician to suspect foreign body ingestion. A careful physical examination should assess for signs of perforation such as subcutaneous emphysema or peritoneal signs. Drooling suggests complete esophageal obstruction.

Plain radiography may show the foreign body; perforation is suggested by subcutaneous air, pneumomediastinum, or pleural effusion. Barium studies also have a very low yield; gastrographic is not recommended in the obstructed esophagus because it is hypertonic and can lead to pulmonary edema if aspirated. CT scanning is superior to plain radiography and identifies the foreign bodies in 70%-100% of patients (32-33)

Urgent endoscopy is indicated when there is respiratory distress, airway compromise, or when complete obstruction is suspected because a patient cannot handle internal secretions. Endoscopic diagnosis and therapeutic removal can be performed at the same time (6)

## Management

A clear history or a thought of an ingested sharp foreign body necessitates urgent radiographic evaluation. The positive predictive value of radiographs is 100% for metallic objects, but is much lower for substances made of glass (43%), fish bones (26%), and wood, which is completely radiolucent (35-36). If the x-ray is negative but suspicion for a foreign body remains high, it may be prudent to proceed to endoscopic evaluation. Otherwise, computed tomography scan, ultrasounds, magnetic resonance imaging, and upper GI barium swallow have been used to identify radiolucent foreign bodies but may delay definitive treatment, especially if contrast is used (37-38-39). A sharp object in the esophagus is a medical emergency because of the high risk of perforation and migration. It should be detached even if the patient has not been appropriately fasted. If the patient exhibits signs of respiratory compromise, neck swelling, crepitus, or peritonitis, a surgical consultation is mandatory and the patient should be transferred to a facility with suitable expertise.

Once identified, optimal management depends on the location and type of the foreign body(40). Success rates then depend on the experience level of the endoscopist and device choice(41). Magill forceps are most useful for removal of sharp foreign bodies in the oropharynx and upper esophagus such as fish bones. Direct laryngoscopy can be used for objects lodged at or above the cricopharyngeus(42). For sharp foreign bodies below the cricopharyngeus, a flexible endoscope has the lowest complication rates(42). It may be helpful

to replicate the foreign body before the procedure, and some endoscopists use a practice run to identify the best tools for removal(43).The best grasping tools for sharp objects include retrieval forceps, retrieval net, and polypectomy snare Size of the child, however, will limit access to some devices, especially if the patient weighs <5 kg. A 6-mm gastroscope has a 2-mm channel and will accommodate only small polypectomy retrieval nets (diameter of 20 mm), polypectomy snares, or Dormia basket devices, as well as several commercially available forceps. Success rates of 96% have been reported for removal of sharp objects from the upper GI tract using rat tooth forceps. Polypectomy snare is a good option for longer sharp objects such as toothpicks and can been used to close open safety pins in the stomach before withdrawal. If the sharp end of the object is facing cephalad, it may be safest to push the object into the stomach with rat tooth forceps and rotate the sharp end caudally before removal (44).

## Timing

Once foreign body ingestion is diagnosed, the physician must choose whether intervention is necessary, what degree of urgency is deserved, and what the optimal modality of intervention might be. The timing of endoscopic intervention is verbalized by the perceived risks of aspiration and/or perforation. Patients with sharp objects and disk batteries lodged in the esophagus need urgent endoscopic intervention. Urgent intervention is likewise needed for foreign bodies, such as food impactions, producing obstruction and the inability to manage secretions. Those without evidence of high-grade obstruction, or acute distress, can be handled less urgently as spontaneous passage may happen. However, no foreign object or food bolus impaction should be allowed to remain in the esophagus beyond 24-h after presentation(6)

## Sedation

Conscious sedation is passable for the majority of adult patients. General anesthesia with endotracheal intubation will give full guard of the airway and is ideal in most pediatric patients. Furthermore, general anesthesia with endotracheal intubation is best for the disobliging psychotic patient and those who have ingested multiple objects, thereby, delaying extrication time.(6)

## Conclusion

A variety of endoscopic techniques and instruments are indicated for different situations. Flexible endoscopic treatment is a safe and reliable procedure for a skilled endoscopist, with a high success rate, low morbidity, and no mortality. EFBs are a relatively common problem in pediatric patients and underlying predisposing factors to EFB impaction are not uncommon. Long-retained EFBs are associated with a higher incidence of complications. Rigid esophagoscopy was reported to be successful in extracting most of the EFBs and was shown to be a safe and effective procedure.

## References


1-Leinwand, k. Brumbaugh, D.E., and . Kramer,R.E. (2016): Button Battery Ingestion in ChildrenGastrointest Endosc Clin N Am. 2016 Jan; 26(1): 99–118.

doi: 10.1016/j.giec.2015.08.003

2- Tokar, B. Cevik, A.A. and Ilhan ,H.,(2007): Ingested gastrointestinal foreign bodies: predisposing factors for complications in children having surgical or endoscopic removal. 23, pages135–139 (2007)

**3- Lee, J.H., (2018): Foreign Body Ingestion in Children**

Clin Endosc. 2018 Mar; 51(2): 129–136.

Published online 2018 Mar 30. doi: 10.5946/ce.2018.039

4- Lee JH, Lee JH, Shim JO, Lee JH, Eun BL, Yoo KH. Foreign body ingestion in children: should button batteries in the stomach be urgently removed? *Pediatr Gastroenterol Hepatol Nutr.* 2016;19:20–28. [PMC free article] [PubMed] [Google Scholar]

5-Paul RI, Christoffel KK, Binns HJ, Jaffe DM. Foreign body ingestions in children: risk of complication varies with site of initial health care contact. Pediatric practice research group. *Pediatrics.* 1993;91:121–127. [PubMed] [Google Scholar]

6-Sugawa.C, Ono,H. Taleb, M., and LucasC.E.,(2014): Endoscopic management of foreign bodies in the upper gastrointestinal tract: A reviewWorld J Gastrointest Endosc. 2014 Oct 16; 6(10): 475–481.

Published online 2014 Oct 16. doi: 10.4253/wjge.v6.i10.475

7- Altokhais, T.I., Al-Saleem. A., Gado, A., Al-Qahtani, A., Bassam. A., (2017): Esophageal foreign bodies in children: Emphasis on complicated cases

Volume 40, Issue 5, September 2017, Pages 362-366

8- Brumbaugh DE, Colson SB, Sandoval JA, et al. Management of button battery-induced hemorrhage in children. *J Pediatr Gastroenterol Nutr.* 2011;52(5):585–9. [PubMed] [Google Scholar]

9- Kramer RE, Lerner DG, Lin T, et al. Management of ingested foreign bodies in children: a clinical report of the NASPGHAN Endoscopy Committee. *J Pediatr Gastroenterol Nutr.* 2015;60(4):562–74. [PubMed] [Google Scholar]

10- . Brayer AF, Conners GP, Ochsenschlager DW. Spontaneous passage of coins lodged in the upper esophagus. *Int J Pediatr Otorhinolaryngol.* 1998;44:59–61. [PubMed] [Google Scholar]

11- Waltzman ML. Management of esophageal coins. *Curr Opin Pediatr.* 2006;18:571–574. [PubMed] [Google Scholar]

12-. Kramer RE, Lerner DG, Lin T, et al. Management of ingested foreign bodies in children: a clinical report of the NASPGHAN endoscopy committee. *J Pediatr Gastroenterol Nutr.* 2015;60:562–574. [PubMed] [Google Scholar]

13- Chen X, Milkovich S, Stool D, van As AB, Reilly J, Rider G. Pediatric coin ingestion and aspiration. *Int J Pediatr Otorhinolaryngol.* 2006;70:325–329. [PubMed] [Google Scholar]

14- . Waltzman ML, Baskin M, Wypij D, Mooney D, Jones D, Fleisher G. A randomized clinical trial of the management of esophageal coins in children. *Pediatrics.* 2005;116:614–619. [PubMed] [Google Scholar]

15- Conners GP, Chamberlain JM, Ochsenschlager DW. Symptoms and spontaneous passage of esophageal coins. *Arch Pediatr Adolesc Med.* 1995;149:36–39. [PubMed] [Google Scholar]

16- ASGE Standards of Practice Committee. Ikenberry SO, Jue TL, et al. Management of ingested foreign bodies and food impactions. *Gastrointest Endosc.* 2011;73:1085–1091. [PubMed] [Google Scholar]

17-. Litovitz T, Whitaker N, Clark L, White NC, Marsolek M. Emerging battery-ingestion hazard: clinical implications. *Pediatrics.* 2010;125:1168–1177. [PubMed] [Google Scholar]

18-. Litovitz T, Whitaker N, Clark L. Preventing battery ingestions: an analysis of 8648 cases. *Pediatrics.* 2010;125:1178–1183. [PubMed] [Google Scholar]

19- Kramer RE, Lerner DG, Lin T, et al. Management of ingested foreign bodies in children: a clinical report of the NASPGHAN endoscopy committee. *J Pediatr Gastroenterol Nutr.* 2015;60:562–574. [PubMed] [Google Scholar]

20-. Litovitz T, Whitaker N, Clark L. Preventing battery ingestions: an analysis of 8648 cases. *Pediatrics.* 2010;125:1178–1183. [PubMed] [Google Scholar]

21-. Hwang JB, Park MH, Choi SO, Park WH, Kim AS. How strong construction toy magnets are! A gastro-gastro-duodenal fistula formation. *J Pediatr Gastroenterol Nutr.* 2007;44:291–292. [PubMed] [Google Scholar]

22-. Lee JH, Lee JS, Kim MJ, Choe YH. Initial location determines spontaneous passage of foreign bodies from the gastrointestinal tract in children. *Pediatr Emerg Care.* 2011;27:284–289. [PubMed] [Google Scholar]

23- Hussain SZ, Bousvaros A, Gilger M, et al. Management of ingested magnets in children. *J Pediatr Gastroenterol Nutr.* 2012;55:239–242. [PubMed] [Google Scholar]

24-. Tokar B, Cevik AA, Ilhan H. Ingested gastrointestinal foreign bodies: predisposing factors for complications in children having surgical or endoscopic removal. *Pediatr Surg Int.* 2007;23:135–139. [PubMed] [Google Scholar]

25-. Aktay AN, Werlin SL. Penetration of the stomach by an accidentally ingested straight pin. *J Pediatr Gastroenterol Nutr.* 2002;34:81–82. [PubMed] [Google Scholar]

26-. Palta R, Sahota A, Bemarki A, Salama P, Simpson N, Laine L. Foreign-body ingestion: characteristics and outcomes in a lower socioeconomic population with predominantly intentional ingestion. *Gastrointest Endosc.* 2009;69(3 Pt 1):426–433. [PubMed] [Google Scholar]

27- Zhang S, Cui Y, Gong X, Gu F, Chen M, Zhong B. Endoscopic management of foreign bodies in the upper gastrointestinal tract in South China: a retrospective study of 561 cases. *Dig Dis Sci.* 2010;55:1305–1312. [PubMed] [Google Scholar]

28- Lim CW, Park MH, Do HJ, et al. Factors associated with removal of impactted fishbone in children, suspected ingestion. *Pediatr Gastroenterol Hepatol Nutr.* 2016;19:168–174. [PMC free article] [PubMed] [Google Scholar]

29-Webb WA. Management of foreign bodies of the upper gastrointestinal tract: update. Gastrointest Endosc. 1995;**41**:39–51. [PubMed] [Google Scholar]

30- Smith MT, Wong RK. Foreign bodies. Gastrointest Endosc Clin N Am. 2007;**17**:361–482, vii. [PubMed] [Google Scholar]

31-Ikenberry SO, Jue TL, Anderson MA, Appalaneni V, Banerjee S, Ben-Menachem T, Decker GA, Fanelli RD, Fisher LR, Fukami N, et al. Management of ingested foreign bodies and food impactions. Gastrointest Endosc. 2011;**73**:1085–1091. [PubMed] [Google Scholar]

32-Young CA, Menias CO, Bhalla S, Prasad SR. CT features of esophageal emergencies. Radiographics. 2008;**28**:1541–1553. [PubMed] [Google Scholar]

33- Goh BK, Tan YM, Lin SE, Chow PK, Cheah FK, Ooi LL, Wong WK. CT in the preoperative diagnosis of fish bone perforation of the gastrointestinal tract. AJR Am J Roentgenol. 2006;**187**:710–714. [PubMed] [Google Scholar]

34-. Velitchkov NG, Grigorov GI, Losanoff JE, Kjossev KT. Ingested foreign bodies of the gastrointestinal tract: retrospective analysis of 542 cases. *World J Surg.* 1996;20:1001–1005. [PubMed] [Google Scholar]

35- Cheng W, Tam PK. Foreign-body ingestion in children: experience with 1265 cases. *J Pediatr Surg* 1999; 34:1472–1476.

36- 50. Horton LK, Jacobson JA, Powell A, et al. Sonography and radiography of soft-tissue foreign bodies. *AJR Am J Roentgenol* 2001; 176:1155–1159.

37. Pinero Madrona A, Fernández Hernández JA, Carrasco Prats M, et al. Intestinal perforation by foreign bodies. *Eur J Surg* 2000; 166:307–309.

38. Binder L, Anderson WA. Pediatric gastrointestinal foreign body ingestions. *Ann Emerg Med* 1984; 13:112–117.

39. Uyemura MC. Foreign body ingestion in children. *Am Fam Physician* 2005; 72:287–291.

40-. Webb WA. Management of foreign bodies of the upper gastrointestinal tract: update. *Gastrointest Endosc* 1995; 41:39–51.

41-Faigel DO, Stotland BR, Kochman ML, et al. Device choice and experience level in endoscopic foreign object retrieval: an in vivo study. *Gastrointest Endosc* 1997; 45:490–492.

42-. Ikenberry SO, Jue TL, Anderson MA, et al. Management of ingested foreign bodies and food impactions. *Gastrointest Endosc* 2011; 73:1085–1091.

43- . Webb WA. Management of foreign bodies of the upper gastrointestinal tract: update. *Gastrointest Endosc* 1995; 41:39–51.

44. Kay M, Wyllie R. Pediatric foreign bodies and their management. *Curr Gastroenterol Rep* 2005; 7:212–218.