

# Foreign body ingestion: children like to put objects in their mouth

H Hesham A-Kader

Tucson, Arizona, USA

**Background:** Foreign body ingestion is a common problem in the pediatric age group. Infants and young children explore objects by putting them in the mouth.

**Data sources:** We reviewed the most recent literatures regarding the incidence, clinical presentation, as well as the most recent advances in the diagnostic and therapeutic modalities of foreign body ingestion in children.

**Results:** In 2007 more than 125 000 foreign body ingestions in patients of 19 years old and younger were reported to American Poison Control Centers in the USA. The majority of ingested foreign bodies pass spontaneously.

**Conclusions:** Some foreign bodies can be harmful and require evaluation and intervention. The challenge in management is to distinguish the patients who require intervention from those who can be safely observed. In this review we suggest an algorithm for evaluation and management of children suspected to ingest a radiopaque foreign body.

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button batteries;  
coins;  
foreign body ingestion;  
meat impaction;  
narcotic packets;  
rectal foreign bodies

## Introduction

Foreign body ingestion is a worldwide problem. Infants and young children evaluate objects by tasting and swallowing them. Although the exact figures are not

known as many cases are not brought to medical attention, more than 125 000 foreign body ingestions in patients of 19 years old and younger were reported to American Poison Control Centers in 2007.<sup>[1]</sup> Although the majority of ingested foreign bodies pass spontaneously, some foreign bodies can be harmful and require special attention and immediate intervention. The challenge for the primary care and emergency medicine physicians is to distinguish those patients who require intervention from the majority who can be safely observed.

The peak incidence of foreign body ingestion is between 6 months and 3 years.<sup>[2]</sup> In children the incidence is equal in males and females.<sup>[3]</sup> Although coins are the mostly common ingested foreign body, fish bone impaction is common in countries where fish is the main diet.<sup>[4]</sup> Children can swallow a myriad of objects. Commonly ingested foreign bodies in children are coins, toys, batteries, needles, straight pins, safety pins, screws, earrings, pencils, erasers, glass fragments, pop tarts, keys, marble, fish and chicken bones, and meat.

It is not uncommon to see patients with recurrent foreign body ingestion especially mentally challenged children and patients with psychiatric disorders. A 42-year-old female with manic-depressive disorder and suicidal tendency was reported to swallow 2533 foreign bodies overtime, which had to be retrieved from her stomach.<sup>[5]</sup>

In the absence of controlled studies management of foreign body ingestion depends on clinical experience and should be decided in each case on an individual basis. At least 80% of swallowed foreign bodies pass the gastrointestinal system spontaneously whereas 20% will require endoscopic intervention. On the other hand less than 1% of foreign body ingestion cases will require surgical intervention in order to retrieve them or to deal with complications.<sup>[6]</sup> Therefore, the vast majority of cases can be observed until they pass through the gastrointestinal tract. Objects failing to pass are usually those with a large diameter or a long length. An exception is the swallowing of multiple magnets which may leave the stomach separated from one another but as they proceed through the adjacent loops of the bowel, they attract each other compressing the intervening bowel walls, causing pressure necrosis, resulting in perforation, fistula formation, or obstruction.<sup>[7,8]</sup>

**Author Affiliations:** Department of Pediatrics, The University of Arizona, Tucson, AZ 85750, USA (A-Kader HH)

**Corresponding Author:** H Hesham A-Kader, MD, M.Sc., Professor and Chief, Pediatric Gastroenterology and Nutrition, Department of Pediatrics, The University of Arizona, Tucson, AZ 85750, USA (Tel: (520) 626-4140; Fax: (520) 626-4141; Email: Hassan@peds.arizona.edu)

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## Clinical manifestations

In contrast to adults who can report ingestion of foreign bodies, children are commonly brought to medical attention after their caregivers witness the child swallowing a foreign body or suspect the ingestion due to the disappearance of an item. Most children are asymptomatic at the time of presentation. Common symptoms include drooling, gagging, dysphagia, odynophagia, decreased appetite, food refusal, fever, nausea, vomiting, hematemesis, rectal bleeding, neck pain, chest pain, abdominal pain, halitosis, cough, stridor, wheezing, and respiratory distress.

In most patients physical examination is normal and specific findings are usually absent. Physical examination should focus on signs related to possible complications. Abrasions in the mouth and hypopharynx may be seen secondary to the ingestion of sharp foreign body. Drooling may suggest esophageal impaction or abrasion. Patients may also present with signs related to gastric outlet obstruction (Fig. 1), intestinal obstruction or perforation such as mediastinitis and peritonitis. Other diagnoses, which can give similar presentations, should be considered including gastroenteritis, esophagitis, gastritis, peptic ulcer, acute appendicitis, pyloric stenosis, intussusception, reactive airway disease, pneumonia, and foreign body aspiration.

## Diagnosis

In general, there is no need for laboratory testing unless complications are suspected such as infection. Patients suspected to have ingested foreign body should have plain radiographs, which should cover the neck, the chest and the entire abdomen. Limited chest radiograph not including the thoracic inlet may miss a higher-up foreign body (Fig. 2). Although the largest diameter of the coin usually orients in the frontal plane on radiograph if in the esophagus and in the sagittal plane if in the trachea, a lateral view is usually needed to determine if the coin is in the trachea or posterior to it.<sup>[9]</sup> The lateral view can also help detect two or more items stuck together appearing as only one object in the frontal view. On lateral views disk batteries usually have a 2-step border compared to the smooth border of most coins.

Radiolucent foreign bodies may represent a challenge in diagnosis. Ingesting thin barium can outline the foreign body and help in its localization. Contrast studies are not useful in detecting foreign bodies in the stomach or small intestine. Barium is contraindicated if esophageal perforation is suspected. Gastrografin should be used in these cases if a study is needed.

Although CT scanning is rarely needed it can help to localize nonopaque foreign objects in the oropharynx or esophagus and it is the imaging of choice in cases of

suspected perforation or abscess formation.

The use of metal detector can help localize metallic objects such as coins. They can also be helpful in the case of radiolucent material such as aluminum (soda can flip top). However the use of metal detector needs experience, and the specificity of localization is poor, especially in differentiating lower esophagus impaction from coins in the stomach.<sup>[10]</sup>

Diagnosis of foreign body ingestion can be delayed for a long period of time especially in young children and mentally retarded individuals. The foreign body ingestion in these cases is commonly diagnosed by radiographs done for respiratory symptoms or during endoscopy performed due to gastrointestinal complaints.



Fig. 1. A puppet stuck at the pylorus causing gastric outlet obstruction.

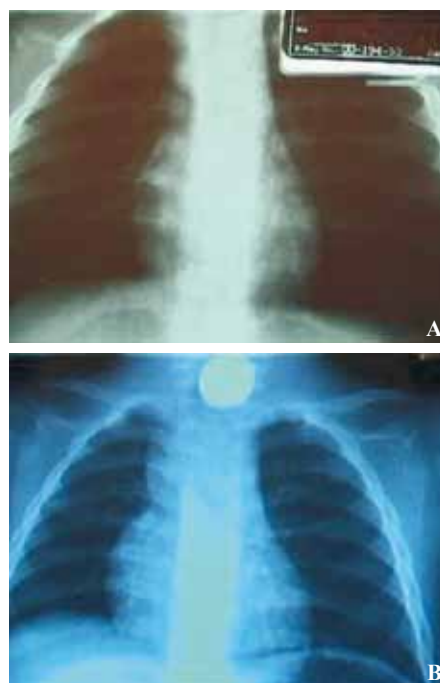


Fig. 2. A limited chest radiograph may miss a foreign body lodged at the thoracic inlet (A). The coin was noted when the radiograph was repeated (B).

## Complications

The vast majority of ingested foreign bodies will pass spontaneously without causing any damage. However, foreign bodies may become lodged in areas of normal narrowing or curvatures. Common sites for foreign body arrest include the upper esophageal sphincter, mid esophagus (crossover of aorta), lower esophageal sphincter, pylorus, ligament of Treitz, ileocecal valve, cecum, sigmoid colon, and rectum. The advent of fiber-optics endoscopes has facilitated the removal of foreign bodies especially in the pediatric age group and prevented the development of complications such as ulceration, bleeding, obstruction and migration resulting in mediastinitis, pneumonia, pneumothorax, pneumomediastinum, peritonitis and abscess formation. Aorto-esophageal fistula may lead to serious gastrointestinal bleeding.<sup>[11]</sup> Bleeding in the case of aorto-esophageal fistula may happen after removal of the foreign body which acts as tamponade and serious bleeding may follow its removal. Patients with previous gastrointestinal surgery, congenital abnormalities of the gastrointestinal tract, peptic stricture and cancer are at a higher risk for foreign body arrest and perforation. Although perforation is estimated to happen in less than 1% of the cases,<sup>[12,13]</sup> some investigators have reported a higher rate of 4.5% and 5.6%.<sup>[14,15]</sup> Although perforation usually presents acutely the presence of chronic aerodigestive symptoms and signs in infants and small children should prompt physicians to consider foreign body ingestion (Fig. 3).

Nickel dermatitis secondary to foreign body ingestion has been reported.<sup>[16]</sup> Traumatic epiglottitis can be seen in conjunction with foreign body ingestion due to finger sweep or due to trauma induced by the swallowed object.<sup>[17]</sup> Foreign body-induced appendicitis has also been described.<sup>[18]</sup>

The new penny (97.6% zinc, 2.4% copper) has replaced the old penny (95% copper, 5% zinc). Since zinc is more corrosive it is more likely to cause perforation. Fatal zinc intoxication may follow massive ingestion of coins. Four hundred and sixty-one coins were removed from the gastrointestinal tract of a schizophrenic patient who died 40 days after ingestion.<sup>[19]</sup>

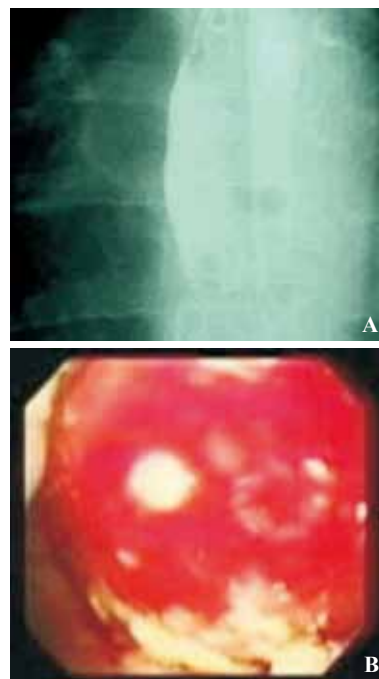
## Coins

Coins are the most frequently ingested foreign body in the pediatric age group and accounts for the majority of esophageal foreign bodies. In two studies 44% and 30% of children with impacted esophageal coins were asymptomatic.<sup>[20,21]</sup> Therefore it is important for patients with history or suspicion of foreign body ingestion to undergo radiographic evaluation.

Coins in the esophagus typically get stuck in one of 3 locations. The thoracic inlet is defined as the area between the two clavicles on chest radiograph. This is the site of transition of skeletal muscle into the smooth muscle of the esophagus. At least 75% of the coins are stuck at this site.<sup>[22]</sup> The other two sites include the mid esophagus at the region where the aortic arch carina overlaps the esophagus and the lower esophageal sphincter. Patients with esophageal abnormalities such as repair of tracheoesophageal fistula are more likely to have foreign body impaction at the site of abnormality.

Management of coin ingestion depends on several factors including coin location, size of coin, age of the patient and the presence of gastrointestinal pathology. Coins in the esophagus have to be removed. Observation for 24 hours awaiting passage of the coin to the stomach can be justified unless the patient is symptomatic. In a series of 86 patients reported by Chaikhouni et al,<sup>[23]</sup> the main risk factor for esophageal perforation was the presence of the coin in the esophagus for more than 24 hours.

In the stomach coins can be safely observed up to 4 weeks. Coins smaller than 2.5 cm in diameter will usually pass in small children in the absence of stenotic lesions. Coins larger than 2.5 in diameter usually pass in adults but may require retrieval in small children. It has been suggested recently that coins should be



**Fig. 3.** Barium swallow study showing perforation secondary to foreign body ingestion. The child presented with chronic abdominal pain. The study was initially read as esophageal duplication (A). Upper endoscopy revealed a foreign body (bingo chip) embedded in the esophageal mucosa (B).

redesigned so that they would either be too big to ingest or so small they would always pass spontaneously.<sup>[24]</sup> If it is determined to observe the coin in the stomach an abdominal film should be taken on a weekly basis in order to monitor passage of the coin. The parents should be instructed to inspect the stools for passage of the coin. The development of any unusual symptoms mandates evaluation and retrieval. Embedded coins in the gastric mucosa may cause abdominal pain, vomiting or gastric outlet obstruction. Failure to pass 4 weeks after ingestion is an indication for endoscopic removal.

### Button batteries

The miniaturization of electronic toys and gadgets, and the wide spread use of compact batteries in hearing aids, watches, cameras, and games over the last 2 decades have been associated with increased incidence of caustic injury of the esophagus in the pediatric age group.<sup>[25,26]</sup> Litovitz<sup>[27]</sup> reported a series of 119 cases of battery ingestion. Batteries smaller than 20 mm in diameter usually pass through the gastrointestinal system while larger ones may lodge in the esophagus and stomach.

Disk batteries are composed of 4 systems: mercuric oxide, silver oxide, manganese oxide and lithium system. The 4 systems contain 20% to 45% solution of potassium or sodium hydroxide. Batteries can cause tissue injury through 3 different mechanisms: pressure necrosis, low voltage electric current, and release of alkaline solution, which can cause liquefaction necrosis, and perforation of the esophagus if lodged for a sufficient time. Mercuric oxide reduction by gastric acidity or iron from the corroded steel case of the battery may produce elemental mercury. There have been reports of mercury poisoning following disk battery ingestion.<sup>[28,29]</sup>

Batteries in the esophagus should be removed urgently in order to prevent fatal complication. One hour of contact time may result in mucosal injury and all layers of the esophagus may be involved within 4 hours. On the other hand, those in the stomach can be watched for 2 days provided that the patient is asymptomatic. Continued presence in the stomach or the development of symptoms mandates urgent endoscopic removal. Once beyond the 2nd part of the duodenum batteries will pass the gastrointestinal system within 3 days.<sup>[30]</sup> Serial radiographs of the abdomen should be taken every 3-4 days and the parents should be instructed to strain stools in order to confirm elimination of the battery. Surgical removal is usually indicated if the battery fails to move after 5 days or if the patient develops abdominal symptoms or

signs of peritoneal irritation. A case of fatal perforation was reported in a patient due to lodging of the battery in a Meckel's diverticulum.<sup>[31]</sup> The use of cathartics and prokinetic agents has no proven efficacy. H<sub>2</sub> blockers or proton pump inhibitors may reduce acid formation and possibly reduce the risk of mercury poisoning. Emetics should be avoided as they may cause retrograde migration of the battery from the stomach to the esophagus or the airway.<sup>[32]</sup>

Batteries usually have a soft edge and therefore they cannot be removed from the esophagus using the usual foreign body forceps. Dormer basket and polypectomy snare can be successfully used to remove the battery. The use of Foley catheter does not allow inspection of the esophageal mucosa and can be hazardous as it may lead to aspiration into the airway. Another technique is to push the battery down to the stomach where it can be easily grasped with a snare or Roth net. The presence of significant tissue injury warrants an oral contrast swallow study within 36 hours to rule out fistula formation, and another study is needed after 2-3 weeks to rule out stricture formation or later development of a fistula.

### Meat impaction

Esophageal meat impaction is uncommon in young children and is usually seen in adolescents. Steak and hot dogs are the usual offenders. Patients with meat impaction usually present with chest pain and inability to handle secretions. In most cases urgent endoscopy is needed to remove the meat and relieve the discomfort. In less distressed patients observation for 12 hours may be appropriate. Sedation and glucagons may facilitate passage of the meat bolus.<sup>[33-35]</sup> A barium swallow is not usually needed as it may delay therapy, risks aspiration, and render the bolus softer, making it more difficult to retrieve as one piece. Management of meat impaction in the esophagus usually represents a challenge to the gastroenterologist as many of these patients have pathological changes in the esophagus such as stricture, motility disorder or eosinophilic esophagitis. Blind pushing of the meat bolus into the stomach using a scope or bougie should be avoided as it can be hazardous and may result in perforation. In most cases the bolus can be grasped and removed using a snare or Dormia basket. Soft boluses may be removed by piecemeal in fragments. The overtube can be advantageously used to avoid multiple passages of the scope. Glucagon infusion during the procedure may relieve the spasm and allows better visualization. After reducing the size of the bolus the remainder of the bolus can be pushed safely. Following the removal, careful inspection of the esophageal mucosa and biopsies are

needed in order to exclude esophageal pathology. It has been suggested that papain (meat tenderizer) may be used to digest the meat and disrupt the bolus facilitating its removal. However, the use of papain cannot be recommended because of the potential risk of injury to the esophageal wall. There are reports of perforation and death following papain use.<sup>[36-38]</sup>

### Radiolucent foreign bodies

Management of radiolucent foreign bodies can be difficult as they cannot be detected on plain radiograph. Commonly ingested radiolucent foreign bodies include wood, glass, plastic and aluminum pop tab. The use of thin barium can help outline the foreign body and facilitate its removal. Any foreign body in the esophagus has to be removed. In addition any foreign body causing symptoms should be retrieved in order to prevent complications. Objects in the stomach warrant observation in asymptomatic patients till passage in the stools.

### Sharp and elongated foreign bodies

Sharp and elongated foreign bodies carry significant morbidity and mortality as they are responsible for 15% to 35% of perforations following foreign body ingestion.<sup>[39-42]</sup> Perforation is more likely to happen with certain items such as toothpicks, bones, razors and long straight pins.<sup>[43-45]</sup> Although perforation can happen at any area in the digestive system, it is more likely to happen at areas of curvature or narrowing especially the ileocecal valve. As a general rule objects longer than 5 cm in length (3 cm in young children) and wider than 2 cm are unlikely to pass and should be removed endoscopically urgently before they pass the stomach. Smaller objects such as small nails, pins, and screws can be observed till they pass in the stools. Therefore, the majority of these can be managed conservatively. Serial abdominal films every 7 days can help monitor passage of the swallowed object through the gastrointestinal system.

In the absence of overtubes for pediatric scopes, retrieval of straight pins and needles is best done by grasping the blunt end and removal with the sharp end trailing to prevent perforation. Open safety pins usually present a major problem. Several techniques have been described for removal of open safety pins from the esophagus and stomach with flexible endoscopes.<sup>[9]</sup> Closure of safety pin can be attempted with a polypectomy snare, but this is usually difficult because of slippage of the snare from either ends of the pin. Closure of the pin can be facilitated by encircling the pin with a snare which is advanced through a rectal tube.<sup>[46]</sup>

### Narcotic packets

Drug smuggling by swallowing condoms or packets containing narcotics is now a common problem. Drug couriers conceal drugs within the body in order to evade detection hoping to retrieve them after traveling. These practices carry a high risk as they may leak or burst, leading to a potentially fatal drug overdose. Drugs commonly smuggled by body concealment include hashish, heroin, and cocaine.<sup>[47]</sup>

McCleave<sup>[48]</sup> and Wood<sup>[49]</sup> classified the packages carried by cocaine couriers into three types according to their packaging. Type 1 is the most basic type consisting of loosely wrapped packets (such as condoms, toy balloons, fingers of latex gloves), often leading to packet leakage and rupture in the gastrointestinal tract, acute cocaine toxicity, and death. Types 2 and 3 are relatively resistant to leaking or breakage compared to type 1 as they are composed of multiple layers of tubular latex which are tightly wrapped and securely tied at each end.

The management of ingested cocaine packets is controversial. Although successful endoscopic and bronchoscopic retrieval of narcotic packets have been reported from the digestive system and the airway.<sup>[50-53]</sup> Webb<sup>[30]</sup> in a review of the management of upper gastrointestinal foreign bodies has suggested that the endoscopist should not try to retrieve packets from the upper or lower gastrointestinal system with endoscopy since attempts at endoscopic removal may lead to acute cocaine toxicity.<sup>[54]</sup> Patients who are at increased risk of toxicity are those who have passed broken containers or demonstrate them on X-ray, symptomatic patients, patients with a time lapse of greater than 24 to 48 hours since ingestion, or those who have packets highly susceptible to breaking.<sup>[55]</sup> These patients require stabilization, activated charcoal and surgical removal of the containers. Surgical intervention is urgently needed in the presence of intestinal obstruction or signs suggesting rupture or leak including positive serum or urine test for narcotics.

### Bezoars

A bezoar is a tightly packed collection of partially digested or undigested material. The word bezoar is derived from the Arabic word "bazahr" or "badzehr" which means an antidote to poison. Bezoars obtained from sacrificed animals have been widely used as antidote.<sup>[56]</sup> Bezoars are usually seen in patients with delayed gastric emptying as a result of either vagotomy, antral resection, gastroparesis or gastric outlet obstruction.<sup>[57,58]</sup> However, no evidence of delayed gastric emptying was observed in a Japanese

study.<sup>[59]</sup> In addition, bezoar formation has been reported in association with achalasia, hypertrophic pyloric stenosis,<sup>[60]</sup> intestinal pseudo-obstruction<sup>[61]</sup> and scleroderma.<sup>[62]</sup>

Trichobezoars commonly present with symptoms indicating gastric outlet obstruction or intestinal obstruction including nausea, vomiting, and weight loss. A firm mass may be felt in the right upper quadrant of the abdomen and a crepitus may be elicited. Putrefaction may also lead to severe halitosis. Laboratory tests may show steatorrhea, iron deficiency anemia and hypoproteinemia. Lactobezoars present with feeding intolerance, vomiting and increased gastric residual volume. Gastric perforation secondary to Lactobezoars has been described.<sup>[63,64]</sup> Phytobezoars are more likely to produce ulcerations due to its abrasive effects.

Bezoars can be usually visualized on plain radiographs. Barium studies can show a moving mass or outline the bezoar mass on post-evacuation films. Bezoars can be also diagnosed by ultrasonography. Endoscopy provides definite diagnostic information and possible therapy.

Lactobezoars can be conservatively managed by withholding feedings for 2-3 days while maintaining hydration with intravenous solutions. Surgery is frequently resorted to for the removal of bezoars, especially the larger ones.<sup>[57,58,65]</sup> There is no easy way to dissolve hair and therefore surgical removal is usually needed for trichobezoars. On the other hand, medical therapy may be initially attempted in the case of phytobezoars. There are several reported techniques including metoclopramide combined with water lavage, fragmentation with endoscopy forceps or snare, Teledyne Water Pik and dissolving with acetylcysteine,<sup>[66]</sup> papain<sup>[67]</sup> or cellulose,<sup>[68-70]</sup> laser ignited mini-explosives,<sup>[71]</sup> mono-polar diathermy knife,<sup>[72]</sup> electrohydraulic lithotripsy<sup>[73]</sup> and combined oral and endoscopic injection of Coca Cola.<sup>[74]</sup>

### Colonic and rectal foreign bodies

Colonic and rectal foreign bodies can be either swallowed or inserted through the anus. Although the vast majority of swallowed foreign bodies pass through the gastrointestinal system, some foreign bodies may hang up at certain locations such as the ileocecal valve, cecum, sigmoid colon and rectum. In most of the cases the swallowed objects can be successfully retrieved by a colonoscope with a snare or other grasping forceps. The techniques for removal of colonic and rectal foreign bodies are not different from those for retrieving foreign bodies from the upper gastrointestinal tract.

Foreign bodies can also be inserted through the

anus and are usually divided into two categories: low-lying and high-lying depending on whether they are distal or proximal to the rectosigmoid junction. Rectal foreign bodies may present with rectal or abdominal pain, constipation and urinary retention. Sometimes the patients will not indicate that they have inserted the object rather they have sat or fallen on it in order to avoid embarrassment. Adolescents may insert foreign bodies or have someone insert it for them (sexual act). In infants and young children sexual abuse should be always considered. Flat and upright abdominal radiograph will help identify the size, shape and nature of the foreign body and may show other foreign bodies. The rectal foreign bodies which have been reported include ceramic insulation, metal Petanque ball, light bulbs, liquor bottles, shotgun barrels, candles, oven glove, portable stove, soft drink can, shoehorn, torch, ceramic mallet, broomstick, packets of drugs, umbrella, stones, batteries, magazine, and thermometers.<sup>[75]</sup> If complications such as perforation are suspected an urgent surgical consultation is needed.

Individualized removal must be dependent on the size, shape, consistency and fragility of the object. Low-lying objects can be manually retrieved. Local and general anesthesia can help relax the abdominal wall as well as the anal sphincter facilitating manual retrieval.<sup>[76-78]</sup> If the object cannot be grasped and pulled out with the fingers, a Foley catheter can be placed to pass the object after inflating the balloon. High-lying objects may be observed for 24-48 hours. If they fail to pass, endoscopic removal is indicated. In some cases the object can be visualized using an anoscope and then grasped and pulled out using tenaculum, sponge forceps, Kelly clamp or tonsil snare. Care should be taken so not to push the foreign body higher in the colon while attempting to remove it. Broken sharp objects such as glass should not be removed blindly and should be removed in the operating room under anesthesia. Other methods used include Sengstaken-Blakemore probes, electro-magnets to extract metal objects and pneumatic dilatation balloon normally used in achalasia patients.<sup>[79-82]</sup>

In some cases the impaction of the foreign body or its orientation may make it difficult to manipulate (Fig. 4). Finally when endoscopic or manual extraction fails or complications are present, laparoscopic or laparotomic approaches are the only considerations.<sup>[83]</sup> This enables the foreign body to be 'milked' towards the distal rectum and anus. However, open extraction may be necessary in the cases of very large objects.<sup>[75]</sup> In a large series of patients with rectal foreign bodies the likelihood of surgical approach is increased if the object is located proximal to the rectum, larger than 10 cm or retained for more than 2 days.<sup>[84]</sup>

## Fish bone

Fish bone is one of the most commonly encountered foreign body in the upper digestive tract in countries where fish is the main diet.<sup>[4]</sup> Fish bone impaction is commonly seen at the palatine tonsils, tongue base, vallecula, and pyriform sinus.<sup>[85]</sup> Although localization and removal of fish bone from these sites can be easily accomplished, fish bones impacted in the esophagus are difficult to localize and retrieve. Complications from perforation of the hypopharynx and upper esophagus include retropharyngeal abscesses, mediastinitis, and esophagoarterial fistula.<sup>[86]</sup>

Traditional approaches to diagnose esophageal fish bone impaction including physical examination and plain radiograph may be ineffective.<sup>[85,87]</sup> Similarly, barium studies are not very effective. In a study using barium-soaked cotton, Derowe and Ophir<sup>[88]</sup> found false-positive results in 26.9% of cases and false-negative results in 40%. Another study reported a false-negative rate of 50% and a false-positive rate of 19%.<sup>[89]</sup> Moreover, barium coating the foreign body may make it difficult to identify and retrieve with endoscopy. In addition there is always the risk of barium aspiration.

Several reports demonstrated the efficacy of CT in the detection of impacted fish bones in the esophagus. Eliashar et al<sup>[90]</sup> reported a sensitivity of 96.7% and a specificity of 100% for CT in 30 patients with suspected fish bone impaction. Watanabe et al<sup>[4]</sup> demonstrated a sensitivity of 90.9% for CT. In a study by Akazawa et al<sup>[91]</sup> which involved 76 cases, the sensitivity and specificity were both 100%. In addition to a high sensitivity and specificity, CT may provide useful information regarding the presence of vascular injuries as well as complications in the deep soft tissues of the neck.

Management of fish bone impaction should focus on securing the airway, retrieval of the foreign body, and treatment of any complications. Akazawa et al<sup>[91]</sup> suggested that patients with suspected fish bone impaction should have the pharynx and larynx examined with a laryngeal mirror and laryngeal fiberscope. If no foreign bodies are found, plain radiograph of the neck and chest and CT should be performed. CT can help determine whether any foreign body has remained inside the esophagus or has penetrated the esophageal wall. If the foreign body is within the esophagus, it can be removed with an endoscope under general anesthesia. Despite low sensitivity, plain radiograph can give useful information about the shape of the foreign body. In addition, plain radiograph may indicate the presence of abnormal cervical bones, which is useful information if surgery is needed. Even if no fish bone is detected on CT, soft tissue swelling indicating damage to the esophageal mucosa may be seen and should be treated to prevent

complications such as deep neck abscess. In order to avoid such complications these patients should be kept fasted and admitted for 24-hour observation. If symptoms persist, investigative surgery should be performed to ensure the absence of foreign bodies. Patients with normal CT can be observed for 24 hours before being discharged.<sup>[90]</sup>

## Further outpatient care

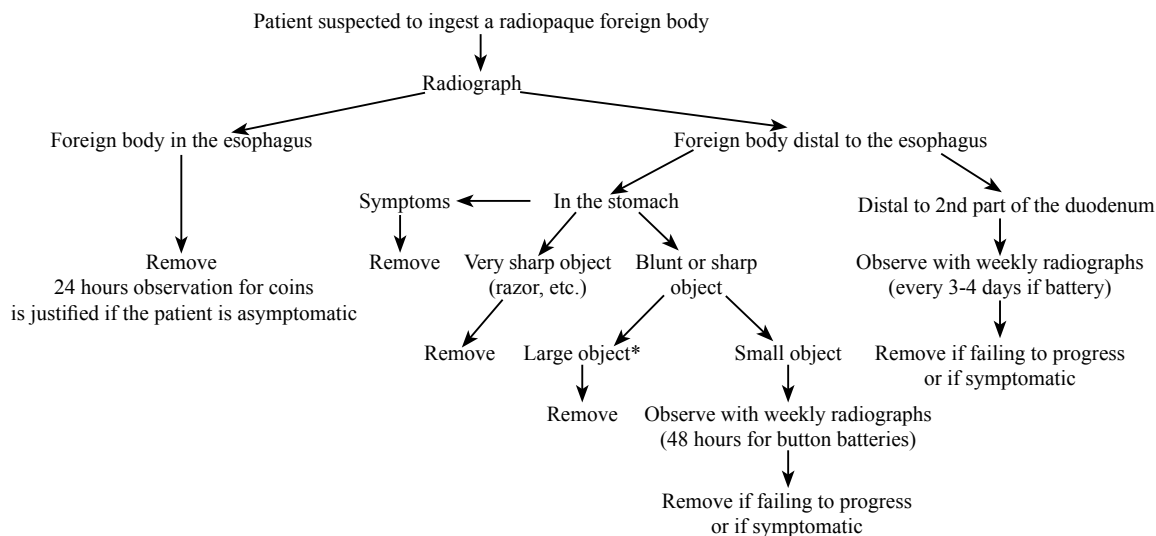
After removal of foreign bodies children with uncomplicated courses do not usually need further evaluation. Children with recurrent impaction of foreign bodies in the esophagus need work-up for possible esophageal disorder. Also patients with recurrent or unusual foreign body ingestion (Fig. 5) need psychological evaluation. The majority of patients can be safely discharged home with instructions to seek medical advice if there is appearance of any symptoms



**Fig. 4.** Candy thermometer inserted through the anus in a 12-year-old boy. Endoscopic retrieval failed and the thermometer had to be removed surgically.



**Fig. 5.** A toothbrush in the esophagus of a 17-year-old bulimic female who was using the brush to induce vomiting.



**Fig. 6.** Suggested algorithm for evaluation and management of children suspected to ingest a radiopaque foreign body. Please note that in the absence of controlled studies management of foreign body ingestion depends on clinical experience and should be decided in each case on an individual basis. \*: objects longer than 5 cm in length (3 cm in young children) and wider than 2 cm.

such as chest or abdominal pain, fever, vomiting or gastrointestinal bleeding.

## Prevention

Parents and caregivers should be cautioned not to leave small objects around children. This is especially important at times of holidays, parties and big gatherings.

Batteries must be stored in childproof containers as the majority of ingested batteries are either loose or discarded. Toys and gadgets battery compartment should be securely closed and carefully taped. Care should be taken when changing batteries and they should never be placed in the mouth. It is also advisable to change batteries on towels in order to facilitate locating them should they fall.

## Future directions

As more data are available we may be able to establish guidelines that will help practitioners to better evaluate and manage children with foreign body ingestion. The advent of fiber-optics endoscopes has facilitated removal of foreign bodies especially in children and prevented the development of complications. In the near future we will hopefully continue to develop more advanced scopes and overtubes for infants and children. New techniques to retrieve foreign bodies will continue to emerge. The development of new diagnostic modalities may help provide a more accurate and reliable diagnosis of foreign body ingestion and could conceivably lead to more effective therapeutic approaches.

## Key issues

- Foreign body ingestion is a common problem.
- Foreign body ingestion should be always considered in patients with aerodigestive symptoms and signs.
- The majority of swallowed objects will pass spontaneously.
- Any object in the esophagus has to be removed.
- Observation of coins in the esophagus for up to 24 hours can be justified provided that the patient remains asymptomatic.
- Any object causing symptoms has to be removed.
- Withhold oral food and fluids until the patient is evaluated by gastroenterologist.
- A repeated radiograph should be obtained prior to performing endoscopy.
- Suggested algorithm for evaluation and management of children suspected to ingest a radiopaque foreign body is illustrated in Fig. 6.

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**Contributors:** A-Kader HH is the single author of the paper.

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