

Children would taste anything: foreign body ingestion – a multidisciplinary perspective and clinical practice algorithm

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ABSTRACT

Foreign body ingestion is a frequent issue among the pediatric population, children under 4 years old being at high risk. The authors reviewed the literature considering the importance of a quick diagnosis and prompt distinction between various types of foreign bodies, thus resulting in the best therapeutic approach. The most common foreign bodies ingested are cited to be coins, button batteries, magnets and food bits. As for therapeutic approaches, references don’t place upper endoscopy as key curative method, in some cases outpatient follow-up is a better choice. Foreign body ingestion complications are usually rare, but sometimes life threatening (coins generate aorto-esophageal fistulas, fish bones cause intestinal perforation, magnets lead to intestinal obstructions and erosions). After carefully consulting the latest guidelines regarding management of foreign body ingestion, we put together an instructive diagram outlining curative procedures in these cases. This review summarizes diagnostic and therapeutic methods for the most common swallowed objects and provides a brief, concise, easy to use clinical practice algorithm, thus giving clinicians an excellent tool to manage these cases.

Keywords: foreign body, accidental ingestion, coin, button battery

INTRODUCTION

As children grow and gain the proper abilities to explore and interact with the environment, they will put in their mouth different objects and some of those will be inevitably swallowed. Foreign body ingestion is a common problem in the pediatric population, with most events happening between age 6 months - 3 years old and a fairly equal gender distribution. When referring to infants and small children, ingestion is mostly accidental, but if it happens in adolescents it should raise awareness regarding a psychiatric pathology or deviant behavior. Thereby, groups at high risk for foreign body ingestion include small children under the age of four, both pre-school boys and girls, boys at puberty and children with known psychiatric conditions [1-3].

Among the most common identified foreign bodies are coins, button batteries, magnets, parts of plastic toys, buttons or fish bones. Most swallowed objects pass spontaneously through the gastrointestinal tract, without any complications. However, in some situations, endoscopic or surgical techniques are required in order to remove the foreign body, due to its drawbacks: lodged objects (they are either too big to spontaneously pass or too small, like pills, and attach to the mucosa), objects which destroy the integrity of the mucosa (razor blades, needles), objects that cause chemical burn (disk batteries). Moreover, children presenting with functional or organic gastrointestinal anomalies such as congenital stenosis, tracheoesophageal fistula, diverticular disease or have surgical history regarding the gas-

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trointestinal area are at high risk of developing severe complications after ingestion of foreign body [1,2,4,5].

VARIOUS TYPES OF FOREIGN BODIES INGESTED BY CHILDREN

Button batteries, big objects (> 6 cm length, > 2 cm width) or sharp ones (like fish bones), magnets (multiple magnets or 1 magnet + 1 metal object) and coins count among the most dangerous swallowed foreign bodies due to their increased risk of lodgment. Regarding batteries, risk of drawbacks depends on their nature (> 20 mm diameter). Sodium/potassium hydroxide batteries cause chemical burn, those containing lithium produce tissue injury through an electric wave (that is why these types are the most dangerous). Likewise, button batteries can generate esophageal strictures or can go through the esophagus wall, becoming lodged in the mucosa and causing a continuous injury for several weeks, thus leading to aorto-esophageal fistula. Multiple magnets are responsible for intestinal obstructions and erosions (newer magnets contain neodymium, which makes them ten times stronger than the conventional ones, therefore the risk of attraction between these magnets in case of multiple ingestion and succeeding intestinal perforation is much higher). Swallowed fish bones often cause intestinal perforation because they become lodged in the duodenojejunal junction, appendix or ileocecal valve, but there have also been described cases of esophageal perforation. Big objects (especially rounded ones) can enter the appendix and lay there over time, leading to appendicitis, abscesses or perforation [2,4-6].

Coins are the most commonly ingested foreign body in the pediatric population. Approximately 30% of them will spontaneously pass through the gastrointestinal tract, but passage depends on child age, position in the esophagus and size. Coins measuring > 23,5 mm often become lodged and those above 25 mm, even if they successfully progress through esophagus, will not overcome the pylorus (especially in children younger than five years old). Placement in the upper and medium esophagus usually requires endoscopic maneuvers, while 60% of coins located in the lower esophagus will pass spontaneously. Coins can remain in the esophagus for long periods of time (even years), accompanied by loose symptoms (cough, dysphagia) or they can migrate into the mediastinum/thoracic structures such as the aorta causing mediastinitis or aorto-esophageal fistulas. Once coins get to the stomach, most of them will progress through the lower gastrointestinal tract without any complications. But, as some of them contain zinc, gastric ulcerations

may appear due to coin interaction with stomach acid [2,3,9].

Between august 2009 – august 2014, in the Pediatric Otolaryngology and Surgery Departments of “Grigore Alexandrescu” Emergency Children’s Hospital, 521 upper endoscopies were performed and 398 of those cases regarded esophageal foreign body ingestion. A number of 108 patients (27,1%) presented for coin ingestion (equally divided among genders), another 54 cases (13,5%) uncovered esophageal foreign bodies other than coins and for the rest, upper endoscopy ruled out foreign body ingestion. Most cases of coin ingestion were observed between the ages of 1 and 3 years old (70 children, 64,8%), second place being taken by the age range of 3 to 6 years old (28 children, 25,9%). Out of the 54 cases of esophageal foreign body ingestion other than coins, we came across 8 cases (14,8%) of fishbone ingestion, 5 cases (9,2%) of button battery ingestion, 1 case (1,8%) of shaving-blade ingestion and 11 children (20,3%) with food-bowl related foreign body ingestion.

CLINICAL PRESENTATION IN CHILDREN WITH FOREIGN BODY INGESTION

Most drawbacks regarding foreign body ingestion are due to esophageal lodgment (once object reaches the stomach, risk of complications decreases substantially). Anatomically speaking, the esophagus divides itself in 3 parts (upper, medium and lower). The upper third or cervical esophagus contains striated muscle capable of generating strong peristaltic waves, but the medium and lower third are made of smooth muscle, which enables weak peristaltic waves usually incapable of pushing the foreign body towards the stomach. Moreover, there are five anatomical areas where the esophagus becomes narrower, thus favoring lodgment of foreign bodies: C6 level (cricopharyngeal muscle), T1 level, T4 level (aortic arch), T6 level (trachea branching) and gastroesophageal junction. The most common site of lodgment mentioned in the literature (70% of cases) is the upper (cervical) esophagus (at the lower level of cricopharyngeal muscle); however, there have been many cases identified at the gastroesophageal junction (15%) or medium third esophagus next to aortic arch (15%) as well. If lodgment took place in a different area but those mentioned before, there’s a very high probability of an esophageal abnormality [2,4,7].

Emergency room address scenario is highly inconsistent: severe symptoms due to emerged complications after ingestion, loose symptoms which do not immediately suggest swallowing of a foreign body, child with no symptoms despite significantly drawbacks after ingestion. Clinical presentation de-

depends on site, nature, size and shape of swallowed object. If it's identified in the esophagus, symptoms should include: thoracic pain, dysphagia and foreign body sensation (which are enhanced by swallowing), excessive salivation, gag reflex, vomiting and food refusal are to be found in smaller children, stridor, cough or hematemesis. Gastric or intestinal site could cause abdominal pain, vomiting and bloody stools. Fever and failure to thrive can emerge if foreign object remains stuck in the esophagus over a long period of time. Systemic symptoms like rash or pruritus were described when foreign body contained nickel [2,4,5].

Physical examination can reveal stripping lesions, traces of blood or edema in hypopharynx area (these are all signs of post-ingestion trauma), rales on pulmonary auscultation or signs of peritoneal irritation (if object has migrated) [2].

PARACLINICAL EVALUATION IN PATIENTS WITH SUSPECTED FOREIGN BODY INGESTION

Laboratory assessment is not strictly necessary in case of foreign body ingestion, but is highly recommended if there's any suspicion of drawback after swallowing [2].

First hand imaging assessment is plain chest and abdominal x-ray (which is mandatory to include the pharynx). Most ingested foreign bodies are radio-paque (coins, batteries, metallic objects), unlike inhaled foreign bodies which are radiolucent. Sharp objects such as fish bones, chicken bones, wood, plastic, crushed glass are also radiolucent [2,8].

If plain x-ray identifies object in the esophagus, it's necessary to obtain a profile image x-ray in order to accurately indicate the site and nature of foreign body. For button batteries, the profile x-ray image shows two clearly separated edges, thus enabling the differential diagnosis with coin ingestion (a single smooth halo). Rarely, multiple coin ingestion leads to adhesion between these various size objects, therefore they can mimic the x-ray image of a button battery. Particular features of well-known coins can be identified on magnified x-ray imaging, making the diagnostic easier. To distinguish between coin ingestion and coin aspiration one should perform plain chest and abdominal x-ray: coin in the esophagus will appear coronal-sited (like a disk), while coin in the trachea will appear sagittal-sited. Regarding radiolucent foreign bodies such as meat or plastic objects, plain x-ray does not count as diagnostic procedure (even though sometimes vague

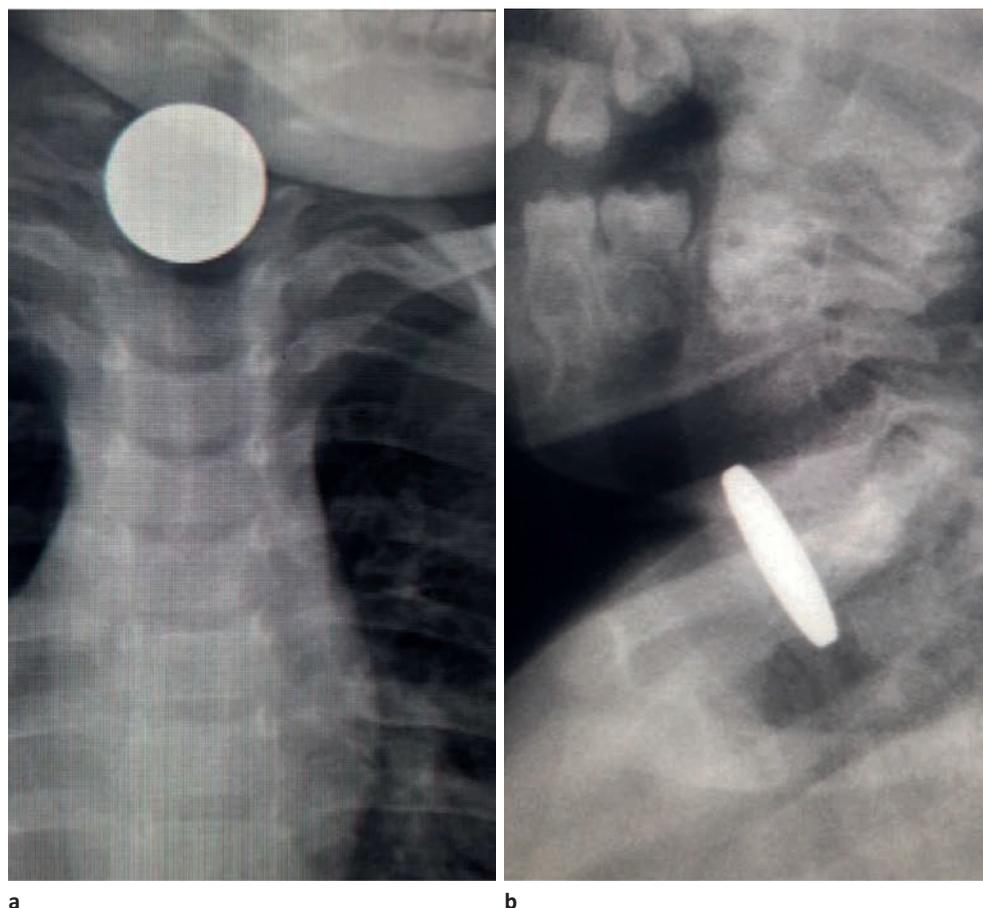


FIGURE 1. Plain (a) and lateral (b) X-ray of coin ingestion child ("Grigore Alexandrescu" Hospital Radiology Department Library)

edges of them can be observed on x-ray). If there's any suspicion regarding lodgment of radiolucent object in the esophagus, contrast x-ray should be performed (although most fitted option in this case would be diagnostic and therapeutic endoscopy, because in case of esophageal obstruction or perforation, use of contrast substance wouldn't be advisable) [2,4,8].

If plain x-ray identifies the object below the diaphragm muscle, there's no need to perform a profile image for an accurate diagnosis (except for those patients with already known gastrointestinal abnormalities, such as surgical corrected pyloric stenosis) [2].

Computed tomography, nuclear magnetic resonance or ultrasound count as alternative diagnostic means, rarely applied, but extremely useful in particular situations (identifying radiolucent foreign bodies such as fish bones and coins or metallic objects made from aluminum). Another method for finding esophagus coins, mentioned in the literature, yet hardly ever used in day-to-day practice, is the portable metal detector [8].

However, despite all these "handy" diagnostic techniques, identifying ingested foreign bodies can sometimes be a tricky task. In cases like that, using diagnostic and therapeutic endoscopy counts as the golden rule.

MANAGEMENT OF FOREIGN BODIES

Once site and nature of ingested foreign body has been determined, further management options depend on the risk of emerged complications. Most asymptomatic, prior healthy children, who have swallowed a low-risk lodgment object, do not need invasive therapeutic procedure and are discharged with the condition to return for reassessment if vomiting, abdominal pain or bleeding occurs. Patients will not be routinely intubated, although there is a risk of foreign body aspiration following vomiting. In a spontaneously-breathing patient do not temp to displace the ingested object by applying abdominal compressions or administrating ipecac sirups. Do not give the child emetics or muscle relaxants; laxatives are occasionally used with the intention of smoothing the intestinal passage of foreign bodies, though they haven't yet proved their efficiency [2,4,8].

Out of 398 patients evaluated in our clinic for foreign body ingestion, we found 15 cases (3,76%) of spontaneous passage in the stomach (4 out of 15 cases of spontaneous passage towards the intestines).

Regarding high-risk lodgment objects, delayed intervention versus endoscopic removal mainly depends on esophageal site. Connors et. al recom-

mends that a foreign body located in the upper or medium esophagus should be subjected to endoscopic removal, without expecting spontaneous passage, while a 24 hours window should be considered in case of objects located in the inferior esophagus (the study has shown that 60% of these patients experienced spontaneously passage) [3,9].

Right timing for endoscopy removal of a foreign body depends on child age, body weight, sign and symptoms at admission, time past from ingestion moment, last meal, object nature, shape and size, location in the gastroesophageal tract [3,9].

In our group, 62 children (15,5%) came to the emergency department in the first hour after ingestion, 18 patients (4,5%) presented 2 days later, 12 children (3%) were admitted 3 days after ingestion and 6 cases (1,5%) 5 days later. 65 of our patients (16,3%) were examined via upper endoscopy in the first 3 hours after foreign body ingestion and in all patients we performed upper endoscopy in the first 24 hours since admission.

Button batteries in the esophagus need immediate removal within 2 hours from ingestion, even if the patient has no symptoms. It's necessary to remove coins, magnets, sharp objects and food bowl lodged in the esophagus, in the first 2 hours after ingestion, if child secretions can't be managed (in the lack of symptoms, there's a 24 hours waiting window). After object has been withdrawn, careful endoscopic examination of the esophageal mucosa should be performed to rule out any injury. Long objects lodged in the esophagus need removal in the first 24 hours after ingestion, no matter the symptoms. NASPGHAN recommends removal of stomach located button batteries within 2 hours from ingestion, regardless of size or accompanying symptoms. Disk batteries > 20 mm in diameter discovered in the stomach of a child < 5 years old need removal in 24 to 48 hours from ingestion. Magnets located in the stomach of a symptomatic patient require endoscopic withdraw within 2 hours from ingestion, while in those remaining asymptomatic, there's a 24 hours waiting window. Sharp objects like fish bones, crushed glass, plastic are known to cause esophageal or gastric perforation in 15% to 35% of the cases (unlike other foreign bodies < 1%); that is why they should be immediately removed. Coins located in the stomach of a symptomatic child should be removed within 24 hours from ingestion, while in those remaining asymptomatic, the best attitude is waiting; assessment x-rays are to be performed every 1-2 weeks, until the coin passage into the stool has been confirmed (if coin persists in the stomach more than 2-4 weeks, endoscopic removal must be taken into consideration). Long objects (> 4-5 cm in infant/small child or 6-10 cm in older child) located

in the stomach must be removed in the first 24 hours after ingestion, regardless of accompanying symptoms. Most intestinal foreign bodies pass spontaneously without any complications (stool passage is to be observed); if they persist in the intestine more than one week, assessment abdominal x-ray needs to be performed and patients/caregivers are to be informed about the alarming symptoms: severe abdominal pain, vomiting, fever, bloody stools. No invasive procedures should be performed in asymptomatic child with intestinal located coin, but if obstruction or perforation signs emerge, immediate surgical intervention is required [3,8-10].

Although endoscopy is considered the gold standard in the management of ingested foreign body, there are two alternative extraction techniques, each one with its advantages and limitations.

Foley technique, used for the first time in 1966 by Bigler, involves using a Foley tube to extract an esophageal foreign body. The method is highly successful (> 85%) and is ideal for removing coins. This procedure requires exact location of foreign body by x-ray and tube (balloon) size depends on object's diameter. To prevent biting the tube (especially in small children), endoscope mouthpiece can be used. Foley tube is inserted through oral cavity (nasal insertion could cause epistaxis) and is placed remotely from coin, then the balloon is inflated with air/saline solution (5-30 ml). Excessive inflation of balloon can lead to laryngospasm or mechanic injury of esophageal mucosa. Foley technique is to be used for extracting recently ingested (< 24-48 hours) radiopaque foreign bodies from the upper/medium esophagus and button batteries swallowed under 2 hours (if endoscopy isn't available). Among the advantages of this method are the lack of need for anesthesia, radiological guidance while extracting the object or a medical team trained in endoscopic maneuvers. Foley procedure should not be performed if any of the following are encountered: complete esophageal obstruction, esophageal perforation, multiple or sharp foreign body ingestion, more than 24-48 hours passed from ingestion, more than 2 hours passed from disk battery ingestion, patient having trouble breathing. Reassessment isn't necessary if the procedure was successful and the child remains asymptomatic. Failure requires immediate endoscopic assessment [9,11].

Levin technique, used for the first time in 1945, involves using an orogastric tube with one end cut, where a strong neodymium magnet is attached, to extract metallic/magnetic foreign bodies from

upper gastrointestinal tract. Is considered the fastest method to remove ingested button batteries. This procedure has the advantage to remove foreign objects up to the proximal duodenum. Limitations of Levin technique include need for radiological guidance (foreign body attachment to the magnet must be confirmed), risk of detachment (while passing through the anatomically narrow areas of the esophagus), need for anesthesia in small children. If the object detaches frequently during procedure, Foley technique can be used instead once the object has been brought in the esophagus [9].

An instructive diagram outlining clinical practice management procedures according to current guidelines and recent literature data is depicted in Figure 2.

PROGNOSIS

In cases of foreign body ingestion prognosis is overall good (most patients experience spontaneously passage). Even situations requiring endoscopic maneuvers have low morbidity and mortality rates. High-risk foreign body ingestion (disk batteries, magnets) can lead to severe complications such as mucosal erosions, gastric/esophageal perforation, mediastinitis, aorto-esophageal fistula or peritonitis and rarely cause death [4].

CONCLUSIONS

Foreign body ingestion is a serious and potentially life threatening issue affecting primarily young children. Most common identified ingested foreign bodies are coins, button batteries, magnets, plastic toys and fish bones. The majority of swallowed objects pass spontaneously through the gastrointestinal tract, without complications, but in some situations endoscopic or surgical techniques are required in order to remove the foreign body.

This review summarizes diagnostic and therapeutic methods for the most common swallowed objects and provides a brief, concise, easy to use clinical practice algorithm, thus giving clinicians an excellent tool to manage these cases.

Conflict of interest and ethics statements

The authors declare that they have no competing interests.

The authors declare they have no financial relationships to disclose concerning the content of this work, nor any other conflicts of interest.

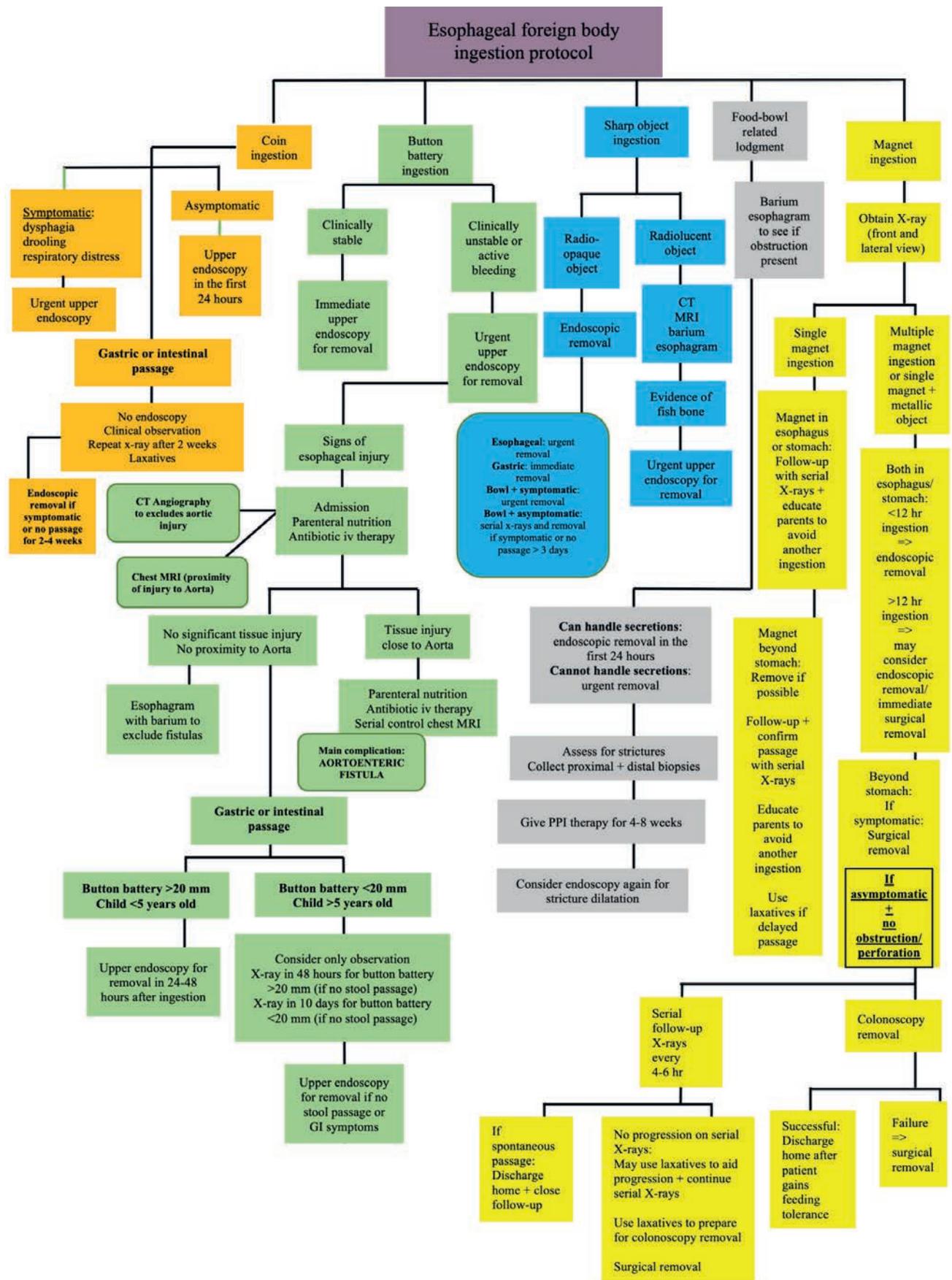


FIGURE 2. Foreign body ingestion management protocol [3,6,8,10,12]

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