Management of foreign body ingestion and food bolus impaction in children: a retrospective analysis of 675 cases

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Although foreign body ingestion is a common problem in children, there are no clear guidelines regarding the management of ingested foreign bodies. The aim of this study was to evaluate the effectiveness of our protocol in the work-up and management of children with ingested foreign bodies. Between September 2002 and August 2010, a total of 675 children with suspected foreign body ingestion were seen in the emergency department. At initial presentation, the majority of foreign bodies were located in the stomach (n=392, 58.1%) followed by the small intestine (n=221, 32.7%) and esophagus (n=62, 9.2%). Based on our protocol, 84 (12.4%) patients were admitted at initial presentation, and 5 after a 48-hour observation period at home; 61 (9%) required prompt endoscopic removal. Sixty-eight (10.1%) patients returned for endoscopic removal after a four-week observation period, and 3 (0.4%) patients underwent delayed surgery due to complications. The overall success rate of endoscopic retrieval was 96.1%. There were no major complications. The majority of ingested foreign bodies will pass spontaneously and most children can be safely observed at home. Selective endoscopic intervention is the preferable method for the removal of ingested foreign bodies in pediatric patients.

Key words: foreign body ingestion, children, endoscopy, food bolus impaction.

Foreign body (FB) ingestion and food bolus impaction is a common occurrence among children, with a peak incidence between 6 months and 6 years of age[1]. Although most incidents are of minor consequence, some can pose a challenging problem and may present serious life-threatening complications. It is essential to decide whether the patient requires intervention since the majority of ingested FBs will pass spontaneously and patients can be safely observed. However, 10-20% of pediatric cases may require endoscopic removal, while only 1% will possibly require surgical intervention[2]. Rapid diagnosis and proper management are integral to minimizing morbidity. The indication and timing of endoscopic removal in the management of pediatric patients who have accidentally swallowed a FB depend on the type, the anatomic location in which the FB is lodged and the clinical picture of the patient. The aim of this study was to report our experience and to evaluate the effectiveness of our protocol in the work-up and management of children with ingested FBs, emphasizing the options of treatment management according to the type of FB and the site of its impaction.

Material and Methods

The records of all children referred to our hospital for suspected FB ingestion and food bolus impaction between September 2002 and August 2010 were evaluated retrospectively. Data including age, gender, type and location of FB, management, associated upper gastrointestinal disease, outcome, and complications were registered and analyzed.

All patients were managed according to a strict management protocol as shown in Figure 1. FBs located proximal to the upper esophageal sphincter were excluded from this study since they were extracted by an otolaryngologist. In

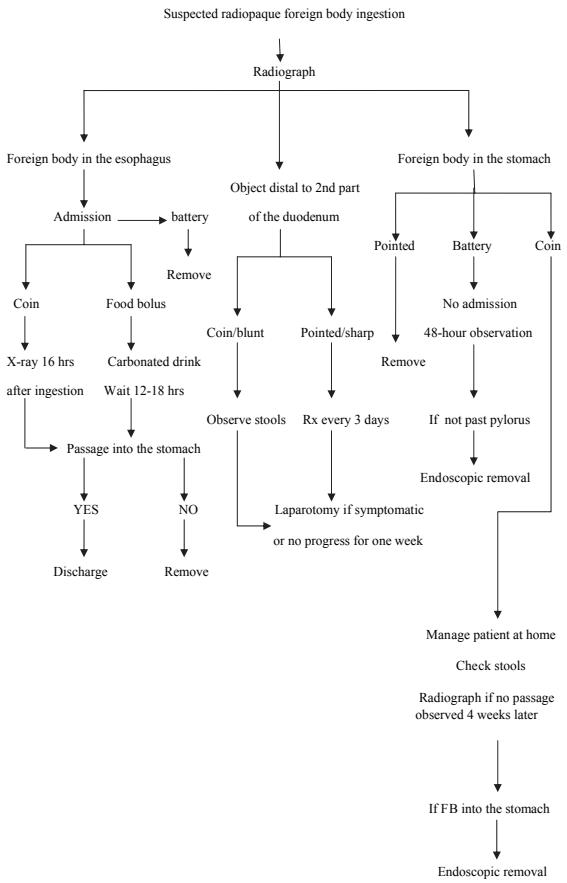

Fig. 1. Management protocol for patients admitted with suspected foreign body ingestion.

addition, patients referred to our department from other regions of the country, especially the islands, were also excluded because endoscopic retrieval was performed immediately. X-rays of the neck, chest and abdomen were obtained in order to determine the location of the FB. If the patient was symptomatic and/or the FB was considered unsafe, they were admitted for observation and an upper flexible endoscopy was carried out under general anesthesia by an experienced pediatric surgeon. Aiming to liquefy the esophageal contents, the patients with food bolus impaction were asked to drink a fizzy and carbonated beverage (Coca-Cola, soda water) at a dose of 100 ml every 6 hours (h), in small sips, always in a sitting position. Accessory devices used to remove FB included a retrieval net basket, snares, Roth net (US Endoscopy Inc., Mentor, OH), rat-tooth, and biopsy forceps. After removal, a follow-up endoscopy was performed. Providing there were no complications and oral intake had resumed, the patient was usually sent home the same day.

Results

During the study period, 675 children were referred to our emergency department for suspected ingestion of FBs, of whom according to our protocol, 160 (23.7%) were admitted to the Department of Pediatric Surgery. The male to female ratio was 374:301, and the mean age was 3.25 years (range: 4 months–14 years). In 589 cases (87.2%), the ingestion of the FB was witnessed or strongly suspected by one of the family members. Most of the patients (72%) were referred to the hospital within the first 6 h of having swallowed the FB, 20% within 72 hours and 8% after a minimum of 3 days. An underlying upper gastrointestinal tract disorder was identified in 8 patients (1.1%), of whom 5 had a stricture following esophageal atresia repair in the neonatal period, 2 had a stricture related to eosinophilic esophagitis and 1 had a history of pyloric stenosis operation. Based on our protocol, 84 (12.4%) patients were admitted at initial presentation and 5 after a 36- to 48-h observation period at home; 61 (9%) underwent upper endoscopic examination within 48 h, and 68 (10.1%) children returned to the hospital for delayed endoscopic removal of a FB located in the stomach. The anatomic location at initial presentation, nature of the FB and the management strategy are depicted in Table I. Delayed surgical treatment was considered in 3 children (0.4%) with a FB lodged in the intestine. In the first case, a glass bead had caused a duodenal obstruction and in the second a metallic stopper had obstructed the terminal ileum. The third patient presented with a clinical picture suggesting appendicitis; the laparotomy revealed a perforation of the ileocecal valve caused by a toothpick.

The majority of FBs were located in the stomach (n=392, 58.1%); coins, safety pins and jewelry were among the most common items found. In 221 patients (32.7%), FBs that frequently included small coins and safety pins were detected in the distal small intestine; in 62 children (9.2%), they were located in the esophagus. Thirty-five patients with different types of food bolus impaction were admitted, of whom 23 (65.7%) underwent an urgent endoscopy and 12 (34.3%) were managed

Table I. Anatomic Location, Nature of Foreign Bodies and Management Strategy

Location	Foreign body	No (%)	Admission	Urgent endoscopy	Delayed endoscopy
Esophagus	Food bolus	35 (56.4)	35	23	-
	Safety pins	10 (16.1)	10	3	-
	Coins	6 (9.6)	6	6	-
	Bones	6 (9.6)	6	6	-
	Battery	3 (4.8)	3	3	-
	Other	2 (3.2)	2	2	-
Stomach	Coins	125 (31.8)	33	-	33
	Safety pins	82 (20.9)	10	-	10
	Jewelry	49 (12.5)	19	-	19
	Pins-needles	33 (8.4)	7	7	-
	Battery	25 (6.3)	5	5	-
	Keys	21 (5.3)	7	5	2
	Other	57 (14.5)	5	1	4
Bowel	Coins	83 (37.5)	-	-	-
	Safety pins	52 (23.5)	-	-	-
	Jewelry	40 (18)	-	-	-
	Pins-needles	19 (8.5)	3	-	-
	Other	27 (12.2)	9	-	3*

Urgent Endoscopy = within 48 hours from admission.
* Required surgical intervention.

by the administration of an aerated drink, preferably Coca-Cola, after which an upper endoscopy was scheduled.

Esophageal biopsies were taken in 16 of these patients in order to exclude a concomitant esophageal pathology; in 2 cases, an eosinophilic esophagitis was revealed. The most common presenting symptoms were retrosternal pain, drooling, vomiting, and cough; none of the patients displayed major symptoms such as cyanosis or respiratory distress.

The ingested FB was not observed in the stools of 156 patients (23.1%), and 68 patients (10.1%) returned to the hospital for endoscopic removal after a 4-week observation period and a positive X-ray investigation prior to the procedure. Thus, in 56.5% of cases, the FB was not recovered in the stools by the parents. Overall, 129 patients (18.6%) underwent endoscopic removal of an ingested FB. Endoscopy failed to extract the whole FB at the first intervention in 5 patients (3.9%); hence, the success rate of endoscopic retrieval was 96.1%. Accessory devices included a retrieval net basket and snare for coins and batteries and Roth net and rat-tooth forceps for safety pins and pointed objects (Table II). Only 3 patients required a protective cap to remove blunted or pointed FBs from the stomach. No major complications, such as esophageal abscess, perforation or bleeding, were recorded. A total of 9 patients remained hospitalized for further observation and were only discharged after the object had passed through spontaneously.

Discussion

In the pediatric population, FB ingestion is a common event occurring especially in children younger than five years of age[1]. Although most incidents result in minor inconvenience, in some cases, rapid diagnosis and proper management could be crucial to minimizing morbidity and life-threatening complications. The general consensus supports the emergent extraction of FBs lodged in the esophagus. The policy concerning objects that have reached the stomach is less consistent. Which approach should be adopted depends on the clinical status, location, nature, and the number of objects ingested. The incidence and type of FB varies by geographic region, cultures and age. In the pediatric population, coins account for up to 89% of objects swallowed[3].

Table II. Endoscopic Techniques Used for the Management of Ingested Foreign Bodies

FB	Push	Fragmentation	Snare	Basket	Roth net	Forceps
Food bolus	9	14	-	-	-	-
Safety pins	-	-	-	-	-	13
Coins	-	-	24	15	-	-
Bones	-	-	6	-	-	-
Battery	-	-	4	2	2	-
Jewelry	-	-	5	5	2	7
Pins-needles	-	-	-	-	-	7
Keys	-	-	3	1	-	3
Other	-	-	2	2	1	2
Total No (%)	9 (6.9)	14 (10.8)	44 (34.1)	25 (19.3)	5 (3.8)	32 (24.8)

FB: Foreign body

Endoscopic intervention for esophageal coins in asymptomatic patients remains controversial, as up to 30% of coins trapped in the esophagus will probably pass into the stomach spontaneously within 12 hours of ingestion. Some authors recommend observing such patients for up to 16 hours before attempting an endoscopy[4,5]; others suggest a five-day observation period on the basis that oral fluid intake could facilitate the passage of the coins into the stomach[6]. In the early stages of our study, our practice was to immediately remove all coins lodged in the esophagus, but during the last two years, we adopted the 16-hour observation period policy for patients with no functional or post-surgical abnormalities. Although observation is related to increased family anxiety and repeated radiological examination with the consequent exposure to radiation, such an approach reduces the need for anesthesia and endoscopy, thereby avoiding the inconvenience and expense of transferring patients to referral centers. Age, gender and coin location are predicting factors for spontaneous passage into the stomach, with the latter being the strongest; coin type and size do not influence the outcome. Spontaneous passage of an esophageal coin is more likely to occur in older children, males and when it is located distally in the esophagus[4]. The intravenous administration of glucagon 1 mg appears to be ineffective in the dislodgment of esophageal coins in children, and the published success rates for this procedure range from 12-50%, which are similar to those of spontaneous passage without intervention[7]. A coin in the stomach does not require immediate endoscopic intervention because it will probably be eliminated spontaneously[8]. The transit time is estimated to be 3.8 days and the recommended management strategy is to wait up to several weeks[1,9]. In the present study, coin ingestion involving almost exclusively "euro" coins, was observed in 214 (31.7%) children, only 39 (18.2%) of whom required endoscopic removal. "Euro" coins present the same toxicity rate as coins of other currencies, and no consequence is expected unless an excessive coin ingestion occurs[10].

The incidence of disc battery ingestion has increased during the past several years because an increasing number of battery-powered electronic devices are used by children. The presence of a disc battery in the stomach may cause a dilemma between the "watchful waiting" approach and an urgent endoscopic retrieval, since batteries carry the risk of direct pressure necrosis on the gastric wall and contain corrosive substances that could cause erosion or necrosis of the gastric mucosa[9,11]. Disc battery splitting is related to the corrosive action of the acid gastric fluids with subsequent leakage of caustic substances. Hence, the amount of time a disc battery remains in the gastric cavity is critical, whereas when the battery passes the pylorus, the risk of splitting decreases. Recent studies suggest that most disc batteries will easily traverse the upper digestive tract and will have a benign course. Consequently, some authors recommend that the asymptomatic patient be observed and managed at home and X-rayed to confirm passage 4 days after ingestion if the child concerned is younger than 6 years, or after 10-14 days if the child is older[2,12]. Our strategy involves a 36-48-hour observation period to allow spontaneous passage of the battery into the duodenum. The patient is observed

at home and evaluated in the emergency department 48 hours after ingestion. An X-ray is obtained to identify the disc battery location; if the battery has failed to pass into the intestine, the child undergoes endoscopic removal of the battery at that time. In contrast, a button battery lodged in the esophagus is a true emergency situation and is associated with significant morbidity. The removal of an esophageal battery within 2 hours is considered safe and without risk of tissue injury, although previous reports claim that the damage-free period is shorter[12,13]. These batteries contain a concentrated (20-45%) solution of sodium or potassium hydroxide, which may leak and cause liquefactive necrosis within 6 hours[14]. The chances of perforation are very high 8 hours from the time of ingestion and retention at a specific site[13]. Occasionally, button and coin cell batteries are indistinguishable from coins as their shape, size and contour can be similar; thus, they may require repeated X-rays for a correct diagnosis. Delayed diagnosis is associated with serious complications such as tracheoesophageal fistula (TEF), esophageal perforation and esophageal stricture[15,16]. Should diagnosis be delayed and substantial esophageal erosion is detected during esophagoscopy, a bronchoscopy should be performed to evaluate the tracheal wall; a radiographic contrast test is also advised in order to rule out esophageal perforation before oral feeding is started[17]. After battery removal, persistent respiratory symptoms and feeding intolerance should alert to the possibility of TEF formation. In order to confirm the diagnosis, esophagography and/or esophagoscopy should be performed[16].

Objects with sharp edges or points present a special problem owing to their capacity for erosion or perforation. These objects include pins, needles, nails, toothpicks, fish and chicken bones, pieces of glass, or open safety pins. Although the majority of long sharp-pointed objects will pass through the gastrointestinal tract uneventfully, the risk of a complication can reach 35%[18,19]. Therefore, these objects should be retrieved endoscopically before they pass into the duodenum; otherwise, children who have swallowed such objects must be vigilantly observed. Gastrointestinal hemorrhage or signs of peritonitis mandate surgical exploration and removal of the object. Although the literature reports high rates of complication, only one patient in our study presented with a clinical picture mimicking acute appendicitis, and during laparotomy, a perforation of the ileocecal valve by a toothpick was observed. In four cases, the ingested sharp objects were in the distal duodenum at the time of presentation, and their progress through the gastrointestinal tract was followed with daily radiographs; they were eliminated spontaneously within five days. Although FBs can rarely cause duodenal or intestinal obstruction[20], in our series, two children presented with signs of intestinal obstruction and required surgical exploration. Once it is decided to observe a FB located in the stomach, we do not obtain abdominal radiographs on a weekly basis in order to monitor passage of the object; we prefer to instruct parents to inspect the stools and if elimination is not confirmed within four weeks of ingestion, an endoscopic removal is scheduled. Prior to the procedure, a repeated abdominal radiograph in the anteroposterior supine projection should be performed because parents may have failed to detect elimination of the object, rendering the procedure unnecessary. We found that 56.5% of the parents failed to detect the elimination of the FB, a finding similar to the 66% reported by Arana et al.[9] and the 50% reported by Macgregor and Ferguson[21].

Many foods can lodge in the esophagus; several methods have been suggested to relieve impacted food. If the patient is unable to swallow oral secretions or if they suffer from chest pain and odynophagia, intervention needs to be immediate. In any case, endoscopic removal should be performed within 24 hours from presentation. The most accepted endoscopic method is the "push technique", which involves insufflating air that distends the esophageal lumen, facilitating the dislodgement of the food bolus as the tip of the endoscope gently pushes it into the stomach[22]. Another method is to push after fragmentation of the impacted food bolus, thereby avoiding the risk of perforation due to an existing underlying obstructive esophageal pathology. As a first-line endoscopic method, we prefer the "push technique", and use the "push after fragmentation" method only in the event that the patient has a known underlying anatomic abnormality or if disimpaction of the bolus has failed. In this series, the "push technique" was

efficient in 9 patients (25.7%). Fragmentation was required in 14 patients (74.3%), five of whom presented an underlying pathology (an esophageal stricture following esophageal atresia repair in 3 cases and eosinophilic esophagitis in the other 2). It is estimated that esophageal FB ingestion occurs in about 13% of children after esophageal atresia repair and may be the leading symptom of reflux esophagitis without stricture[23]. Gastroesophageal reflux (GER) is known to be associated with motility disorders and esophageal contraction abnormalities, conditions that predispose to FB impaction[24,25]. Carbonated and aerated drinks have successfully resolved esophageal food impaction in a number of cases, as these drinks might penetrate and disintegrate the bolus by releasing carbon dioxide gas, which further distends the esophagus, facilitating the passage of the liquified bolus into the stomach[26]. In this series, a fizzy drink was administered in 15 patients before endoscopy, resulting in the clearance of the bolus in 12 (80%). Currently, our policy is to advise all patients with food bolus impaction to drink a carbonated beverage before endoscopic intervention and to evaluate them for an underlying pathology in a second instance. In the literature, the reported success rate of flexible upper endoscopy is 76-98.5%, with a morbidity rate of 0-0.5%[27]. These results coincide with those of our study (96.1%), supporting that the endoscopic removal of ingested FBs can be accomplished safely and effectively.

In conclusion, our experience with FB ingestion in children suggests that, selectively, most children can be observed at home. At presentation, an initial X-ray should be performed, and depending on the type, location and duration of the ingested FB, the physician will decide whether the patient requires immediate endoscopic intervention or can simply be observed on an outpatient basis. The key to a successful endoscopic intervention is the expertise of a skilled and experienced pediatric endoscopic surgeon at a specialist referral center.

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