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ORIGINAL ARTICLE

Foreign body ingestion in pediatrics: A 5-years' experience from a tertiary center

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ABSTRACT

Background: Foreign body ingestion is a common problem in pediatric population. The present study was conducted in a tertiary care center with high pediatric population census to describe the clinical, radiographic and management characteristics in pediatric patients with FB ingestion.

Methods: A retrospective descriptive and analytical study was performed on pediatric patients admitted with foreign body ingestion over a five-year-period from July, 2016 to July, 2021. The inclusion criteria were patients from 0 to 12 years of age who presented to the emergency department with FB swallow during the study period.

Results: Ninety-four patients were included. The mean age was 3.28±2.14 years. The most commonly ingested FB was coins (44.68%), followed by magnets (27.65%), button batteries (12.76%), sharp FB (9.57%), other blunt objects (5.31%). Upper GI endoscopy was used for extraction of the ingested object in 34 patients (36.17%) and successful retrieval was accomplished in 21 patients. Coin ingestion was the predominant type in children under 5 years compared to older children (49.29% vs 30.43%), resulting in 2.2-fold increased risk in children under 5 years.

Conclusion: Foreign body ingestion in pediatrics is a common problem. Coins are the most prevalent while batteries are more dangerous.

Keywords: foreign body, ingestion, endoscopy, magnets, coins, battery.

INTRODUCTION

Foreign body (FB) ingestion in pediatric population is a common and frequently encountered problem in each emergency department worldwide [1]. The majority of presenting patients are aged 6 months to 3 years old [2]. Most children ingest FB during playing or exploring their surroundings, so almost 98% of the reported cases are accidental and intentional ingestion is reported in some psychologically impaired older children [3].

By far, coins are the most frequently encountered FB ingested by children (up to 60%) [4]. Other reported FBs include magnets, button battery, small toys, rubber toys, pins and nails [5].

Symptoms of FB ingestion vary according to nature of the FB and the location of it. Most swallowed foreign bodies will harmlessly pass through the Gastrointestinal tract and patients can be totally asymptomatic, but some will lead to health problems if they become lodged (e.g., too large to pass or small objects like a pill that may adhere to a moist surface); traumatize the mucosa (e.g., sharp or pointed object, like a razor blade or pin), or cause caustic burn injury (e.g., biologically active substances, such as a button battery or a medication patch) [6,7].

In such cases, patients may present with symptoms of vomiting, nausea, dysphagia, respiratory distress, abdominal pain, bleeding per

rectum or hematemesis or symptoms of peritonitis in case of sharp objects or multiple magnets causing perforation[8,9].

Evaluation of a patient with a history of FB ingestion starts with history taking about the nature of the FB and timing of ingestion followed by physical examination to exclude respiratory distress or other respiratory symptoms. X-rays are often ordered after that to establish whether the FB ingested is radiolucent or radio-opaque as this is an important information to be confirmed. X-rays can locate radio-opaque FBs in the gastrointestinal tract and be a starting point for follow up for detection of impaction or failure of progression[10].

The majority of ingested foreign bodies will pass spontaneously with no events while only 10-20% of patients will require removal either endoscopically or surgically for its location or complications[11]. The reported complications are mainly related to either sharp objects, multiple magnets or batteries. Those types of FBs require special attention and careful management[12].

The present study was conducted in a tertiary care center with high pediatric population census to describe the clinical, radiographic and management characteristics in pediatric patients with FB ingestion. The main objectives included collecting and analyzing data regarding age of patients, type of FB, its location, management required and its findings.

METHODS

After Institutional Review Board (IRB) approval, a retrospective descriptive case series and analytical study was performed on pediatric patients with foreign body ingestion over a five-year-period from July, 2016 to July, 2021 in Pediatric Surgery department, Zagazig University Hospitals. The inclusion criteria were patients from 0 to 12 years of age who presented to the emergency department with FB swallow during the study period. Patients who had FB outside the gastrointestinal tract (e.g. respiratory system FB), patients who failed to follow up regularly and patients with missing data were excluded from the study.

Data was collected regarding age and sex of the included patients, the type of ingested foreign body and its number and location, time interval between ingestion and presenting to the emergency department, presence of symptoms and its duration, radiolucent or radio-opaque, type of management and associated findings, time to passage of the FB or impaction, extraction method if needed, surgery and its outcomes if needed, presence or absence of complications.

Our standard management for ingested FB depends on the nature and location of the FB. For high-risk foreign bodies e.g. (button batteries in esophagus, multiple magnets, single magnet + metallic FB, sharp objects lodged in esophagus, large-sized FB >6cm, ...), the management depends on location e.g. if the FB is still in esophagus or stomach, urgent removal by upper GI endoscopy is mandatory. If the FB passed beyond the stomach, then admission for urgent surgical removal is indicated. In case of low-risk FB (coins, small metallic FB, single magnet, button battery that passed distal to stomach, small plastic toys), patients are discharged for follow up in outpatient clinic provided there is no abnormal GI symptoms and the child is well. In case of radio-opaque FB, a baseline x-ray is obtained to compare the progression later on. Patients are followed up every third day in clinic until spontaneous passage of FB in stool or occurrence of abnormal GI symptoms (pain, tenderness, rigidity, hematemesis or melena, ...) or failure of passage with fixed or impacted FB in x-ray which may necessitate admission for surgical removal.

The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical Analysis

The recorded data were collected and tabulated. Frequencies and percentages were obtained from the qualitative variables of sex, symptoms, imaging findings, FB type and location, endoscopic findings, extraction procedure, and complications. medians were obtained from the quantitative variables of age and the time interval from ingestion to hospital arrival. Intersections between the complications and the type of object

ingested, between endoscopic location and type of object, between location and object diameter, and between type of object and age under 3 years were carried out. The chi-square test was used to determine associations, and statistical significance was set at a $p < 0.05$.

RESULTS

Ninety-four patients were included during the five-years period of the study. Sixty-one patients were males (64.89%) while 33 were females (35.10%). The mean age was 3.28 ± 2.14 years (with a median of 30 months). Most presenting patients were between 1 and 5 years of age (63 patients, 67.02%) while patients younger than 1 year (8 patients) represented 8.51% of all patients and patients over 5 years represented 24.46%. Five patients (5.31%) had mental retardation and three patients had history of non-related GI surgeries. The mean time of presenting to hospital after ingestion was 5.24 ± 1.32 hours with a minimum of 0.5 hour and a maximum of 12 hours.

The presenting symptoms were variable among patients. Fifty-seven patients (60.6%) were asymptomatic at time of presentation, while the rest of patients had one or more GI symptoms. The most frequently reported symptom was vomiting (14 patients, 14.89%) followed by abdominal pain in 10 patients (10.63%) and dysphagia in 8 patients (8.51%).

Regarding the number of ingested FBs, seventy-six patients (80.85%) had a single FB ingested while fifteen patients (15.95%) had two ingested FB (Fig. 1), two patients (2.12%) had three ingested FBs while one patient had a surprisingly 30 ingested metallic FBs consisting of 29 magnets and 1 screw-nut.

The most commonly ingested FB was coins (44.68%), followed by magnets (27.65%), button batteries (12.76%), sharp FB (9.57%), other blunt objects (5.31%). Regarding the site of the FB within the GIT, the most frequent site visualized was within the small bowel (41.48%), followed by the stomach (23.40%), then the esophagus (12.76%) and lastly the colon (11.70%). The location of the FB in relation to its nature is reported in Table (1).

Upper GI endoscopy was used for extraction of the ingested object in 34 patients (36.17%) and successful retrieval was accomplished in 21 patients. The endoscopic location of the FB was concordant with the radiographic location of the object in 82.14%. The endoscopic view of the esophagus in all patients revealed only erythema in 30.85%, erythema and erosions in 52.12%, ulcerations in 15.95%, unfortunately, esophageal perforation was found in 1 patient with button battery ingestion which was extracted by upper GI endoscopy after 48 hours of ingestion and contrast swallow showed esophageal perforation in the upper third of esophagus (Fig. 2). The patient was managed conservatively with nothing per oral and parenteral nutrition, drainage with chest tube and feeding gastrostomy was inserted later on. The most common findings in correlation to the nature of the FB were as follow: coin ingestion was correlated with erosion (52.38%), while sharp objects were commonly associated with erosions (55.55%) rather than perforation (0%). Button batteries were highly associated with erosions (58.33%) followed by erythema (8.3%). Regarding magnets ingestion, most patients had erosions (50%). The endoscopic findings in correlation to the type of the FB are summarized in Table (2).

In patients younger than 5 years old, the most common location for FB was the small intestine (39.43%) with no statistical significance ($P > 0.05$). Meanwhile, coins were the most commonly ingested FB in children less than 5 years, while older children had magnets ingestion more often (Table 3). The presenting symptoms were didn't show statistical significance apart from the abdominal pain which was significantly more reported in patients older than 5 years, probably due to the ability to express their symptoms unlike younger patients.

Coin ingestion was the predominant type in children under 5 years compared to older children (49.29% vs 30.43%), resulting in 2.2-fold increased risk in children under 5 years (95% CI 0.82 - 6.06).

One of the included patients had a special interesting story with FB ingestion, a 1.5-year-old female patient who presented with persistent vomiting for 1 week and the parents denied history of FB ingestion. On investigation, her plain x-ray showed multiple aggregated radio-

opaque shadows in the right hypochondrium and a diagnosis of impacted FB was suspected and exploration decided. On laparotomy, a large mobile metallic mass was palpated in the stomach and gastrostomy was done to see what is inside, to our surprise, we found 30 FB inside the stomach (29 magnets and a screw-nut) adherent to each other and extraction was done through the stomach wall (Fig. 3). The surprise didn't end here, after removal of the FB a palpable mass (7x6x4cm) was felt in the pelvis bulging into the abdomen and stretching the mesentery of the intestine. Dissection of the mass revealed a

retroperitoneal presacral mass displacing the bowel with hemorrhagic surface and adherent to the external iliac artery. Complete excision of the mass was done and sent to histopathology which revealed a malignant round cell tumor, poorly differentiated neuroblastoma with unfavorable histology and the patient was referred to pediatric oncology department for starting chemotherapy. The silver lining of this patient scenario is that the accidental FB ingestion served as a guide for early detection and excision of the mass despite being asymptomatic before it becomes irresectable or metastatic.

Table (1): Location of the FB at time of presentation in correlation to its type.

Type	Location														Total	
	Pharynx		Esophagus		Stomach		Small bowel		Large Bowel		Rectum		Unknown			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Coins	2	4.76	7	16.66	9	21.42	18	42.85	4	9.52	2	4.76	0	0	42	44.68
Sharp	0	0	1	11.11	1	11.11	5	55.55	1	11.11	0	0	1	11.11	9	9.57
Battery	1	8.33	3	25	1	8.33	5	41.66	1	8.33	1	8.33	0	0	12	12.76
Magnet	0	0	1	3.84	11	42.30	9	34.61	4	15.38	1	3.84	0	0	26	27.65
Blunt	0	0	0	0	0	0	2	20	1	20	0	0	2	40	5	5.31
Total	3	3.19	12	12.76	22	23.40	39	41.48	11	11.70	4	4.25	3	3.19	94	

Table (2): Predominant endoscopic findings in correlation to the type of FB.

Type	Endoscopic Finding								Total
	Erythema		Erosion		Ulceration		Perforation		
	No.	%	No.	%	No.	%	No.	%	
Coins	14	33.33	22	52.38	6	14.28	0	0	42
Sharp	3	33.33	5	55.55	1	11.11	0	0	9
Battery	1	8.3	7	58.33	3	25	1	8.3	12
Magnet	8	30.76	13	50	5	19.23	0	0	26
Blunt	3	60	2	40	0	0	0	0	5
Total	29		49		15		1		94

Table (3): Statistical analysis of type, location and predominant symptoms in relation to age.

Variable	Age < 5 years (n=71)		Age > 5 years (n=23)		P Value
	N	%	N	%	
Type of F.B					
Coins	35	49.29%	7	30.43%	0.11
Sharp	7	9.85%	2	8.69%	0.87
Battery	8	11.26%	4	17.39%	0.44
Magnet	18	25.35%	8	34.78%	0.38
Blunt	3	4.22%	2	8.69%	0.41
Location					
Pharynx	3	4.22%	0	0%	0.32
Esophagus	10	14.08%	2	8.69%	0.50
Stomach	15	21.12%	7	30.43%	0.36
Small bowel	28	39.43%	11	47.82%	0.48
Large bowel	9	12.67%	2	8.69%	0.61
Rectum	4	5.63%	0	0%	0.24
Predominant Symptom					
Dysphagia	5	7.04%	3	13.04%	0.37
Vomiting	11	15.49%	3	13.04%	0.77
Abdominal Pain	3	4.22%	7	30.43%	<0.01*

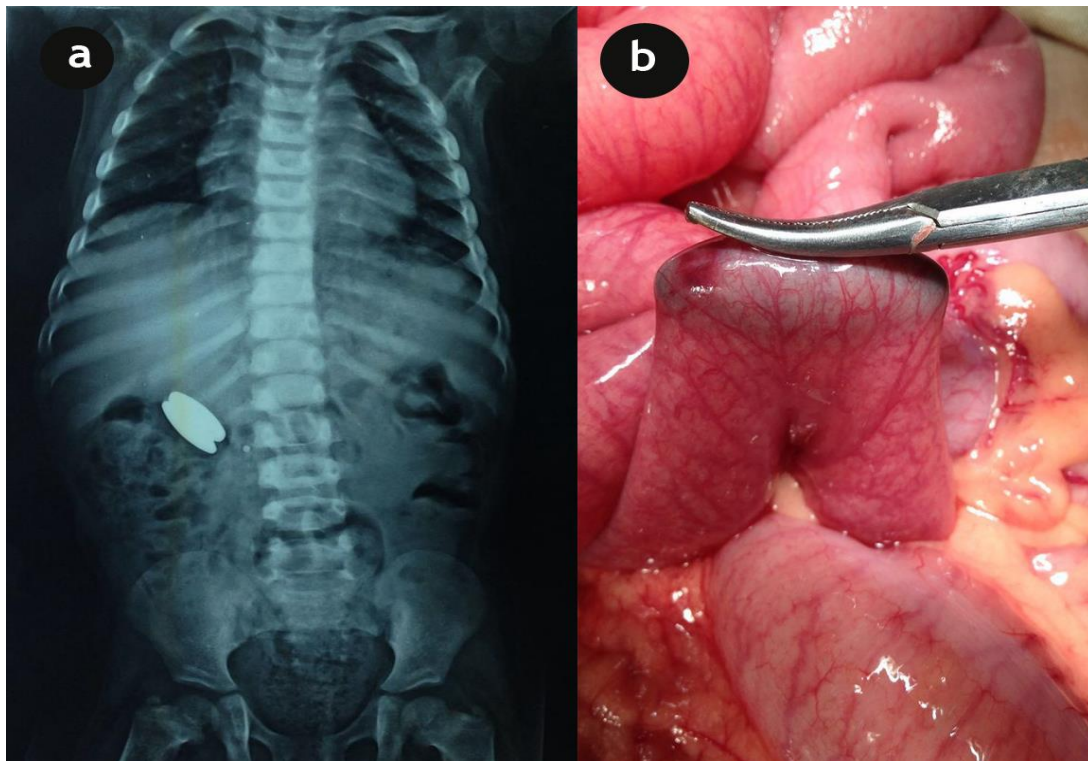


Fig. (1): Two ingested magnets. (a) Plain x-ray showing two oblong radio-opaque shadows consistent with magnets sticking together; (b) Intraoperative finding of one magnet in a loop of the small bowel and the other in another loop.

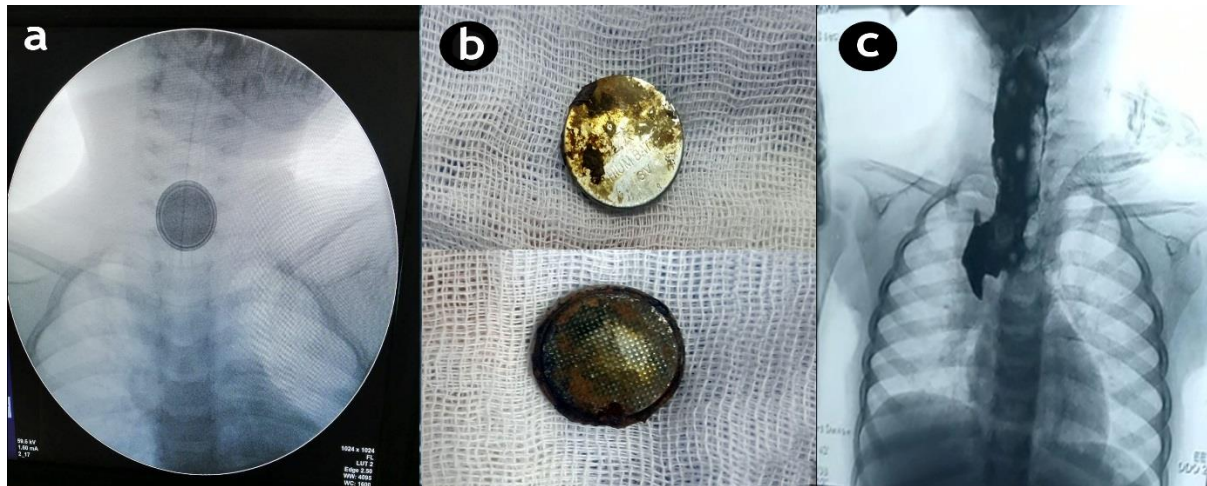


Fig. (2): Button battery ingestion causing esophageal perforation. (a) Plain x-ray showing classic double ring or halo sign confirming a battery FB; (b) The extracted lithium battery from both sides; (c) Post extraction contrast swallow showing esophageal leak in the right hemithorax.

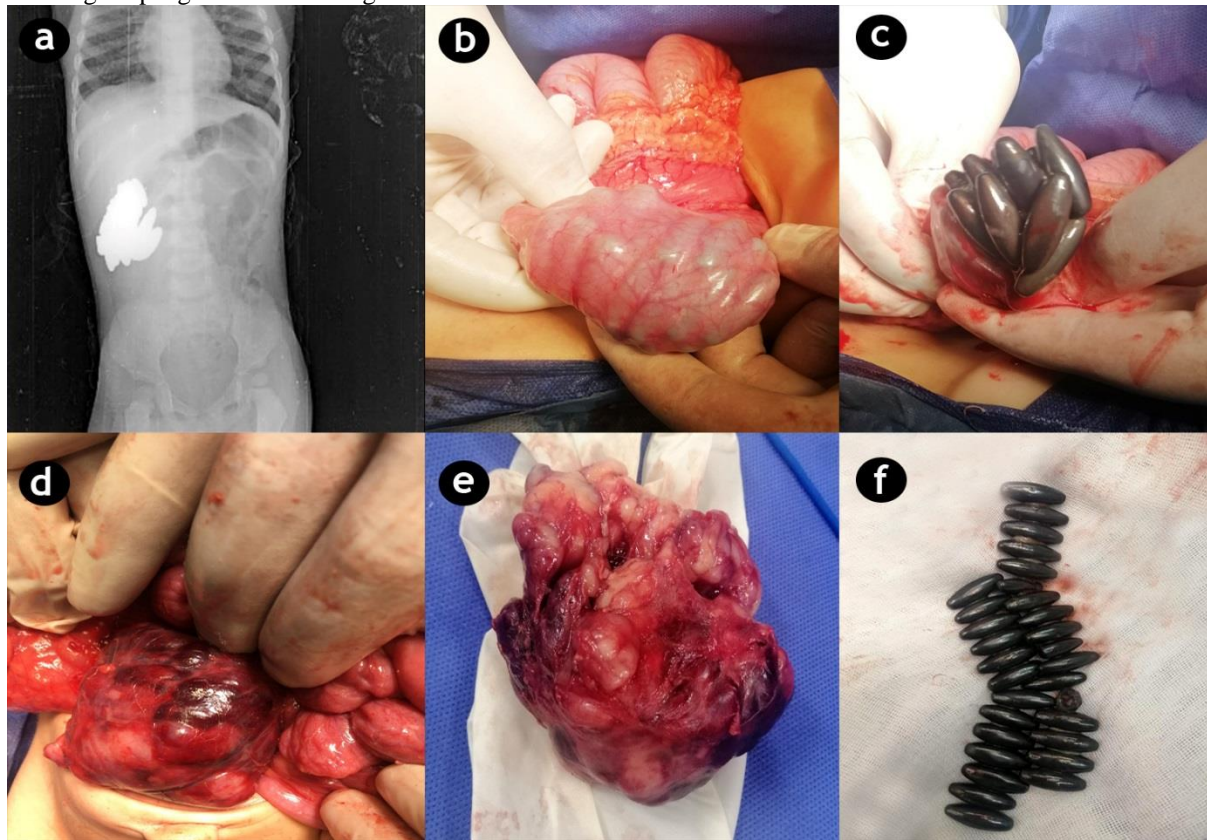


Fig. (3): Multiple FB ingestion. (a) Plain x-ray showing aggregated radio-opaque shadows in the right hypochondrium; (b) Multiple FBs inside the stomach; (c) After opening the anterior wall of stomach to extract the FBs; (d) The accidentally discovered mass; (e) After complete excision of the mass; (f) Extracted FBs.

DISCUSSION

FB ingestion is a commonly reported incident in pediatric population and is considered a leading cause for endoscopy in this age group. During our study, 94 patients (64.89% males), with a male to female ratio of 1.84:1 which is comparable to

other studies [13]. Most of the studied population ranged in age between 1 to 5 years, which is the peak age reported in literature [14]. In our analysis, a 2.2-fold increased risk for coin ingestion in patients under 5 years of age was found. Apart from swallowing disorders,

stricture, motility alterations, achalasia, esophagitis, adjusted Nissen fundoplication, and congenital defects of the esophagus that have required surgical repair (esophageal atresia and tracheoesophageal fistula), most patients presenting with FB ingestion are otherwise healthy [15].

The mean time of presenting to hospital after ingestion was 5.24±1.32 hours with a minimum of 0.5 hour and a maximum of 12 hours. Many patients had to travel long distances, and subsequently that might have affected the time of presentation or feasibility of early endoscopic extraction.

According to the international societies, extraction time can be divided into emergent (<2 hours from presentation), urgent (<24 hours from the time of ingestion), and elective (>24 hours post-ingestion) [16]. Multiple factors affect those times including location of the FB, patient's age, type of FB, symptoms or signs, ... etc [17].

The majority of patients are usually asymptomatic or can present with nonspecific symptoms [18]. The results of the present study confirmed this finding as 60% of our patients were asymptomatic at time of presentation and only witnessed history from the parents was confirming the incident. The predominant symptom in our patients was vomiting (almost 15%), while the commonly observed and described symptoms in literature are sialorrhea (15%), nausea or vomiting (15-30%), dysphagia (23%), and odynophagia [19].

The initial imaging step in suspected FB ingestion is generally radiography. The preferred initial investigation includes frontal and lateral radiographs of the chest, neck and abdomen. Including the neck and abdomen in the imaging evaluation is important because using chest radiographs alone may result in missing multiple foreign bodies, impacted FB above thoracic inlet, or objects that have passed the pylorus [20]. Lateral views are also important to confirm location. With this in mind, x-rays were carried out in all our patients as a first-choice imaging modality. The x-ray was able to localize the FB in almost 97% of cases included in this study.

As opposed to adults, 98% of foreign body ingestions in children are accidental and involve common objects found in the home environment, such as coins, toys, jewelry,

magnets, and batteries [21]. The most commonly ingested FB in the present study was coins (44%) followed by magnets (27%). The high prevalence of magnets ingestion is probably due to using it in many toys and using it in many industries and workshops operating near houses where children may be playing unchaperoned.

The impaction of FB anywhere along its passage is an expected complication and the most commonly reported sites for impaction include the esophagus, pylorus and ileo-cecal valve [22]. In our study, the most frequent site visualized was within the small bowel (41.48%), followed by the stomach (23.40%), then the esophagus (12.76%) and lastly the colon (11.70%). This sequence of frequency may be related to the timing of presentation or time consumed during referral from primary health care centers. Coin ingestion was predominant in children under 5 years of age with a 2.2-fold increased risk than older children. The number of ingested coin affect the decision in management and follow up of the patient. Multiple FB ingestion can be problematic specially with magnets, which presents no increased risk if ingested simultaneously and adherent to each other from start, but if these pieces go through separately, they may attract different loops to each other and stick together and compress the intestinal wall and subsequent ischemia and necrosis of the intervening wall or fistula formation [23]. We had a surprising patient who presented with persistent vomiting and after investigation, a radio-opaque irregular shadow was found in the abdomen and the parents denied any history of FB ingestion. Exploration revealed 29 magnets ingested and adherent to each other in the stomach which were extracted through a gastrostomy incision which was closed primarily after extraction. It is likely that the patient has swallowed the FBs during playing in the neighborhood as the parents stated that they live in an area with many blacksmiths and workshop in their street. This is probably the highest number of simultaneously ingested FB in a pediatric patient reported in the literature so far. It is worth mentioning that this patient had also a malignant mass discovered accidentally during exploration which was resected and proved to be a poorly differentiated neuroblastoma.

The usual initial management in cases of suspected FB ingestion associated with

symptoms is endoscopy, even in cases where the FB is not radiologically localized [24]. This is due to the fact that some FB are radiolucent and may be impacted in the upper esophagus or airway causing distress. In our study, upper GI endoscopy was used for extraction of the ingested object in 34 patients (36.17%) and successful retrieval was accomplished in 21 patients. There were 3 cases where the FB was expected to be found in the stomach and when endoscopy was performed, the FB was not found as expected. This is possibly because the time elapsed between the radiography and the endoscopy allowed the FB to move forward beyond the accessible limit for endoscopy.

The main endoscopic findings included erythema and erosion as well as ulcerations which can be explained by the pressure effect and friction against the esophageal wall during its passage while perforation occurred in only 1 patient due to battery ingestion which was impacted in the upper esophagus and subsequently led to the additional chemical and electrical injury leading to necrosis and perforation[25].

Conclusion

FB ingestion in pediatric population is a commonly encountered problem and every practitioner should be familiar with the basics of management and indications of referral. The present study contributes to describing the epidemiology and characterization of FB ingestion. Coins have the highest prevalence as a FB mainly in the group below 5 years of age with 2 folds of increased risk. Batteries and multiple magnet ingestion are the most serious as they may result in perforations and fistula formation. Proper management and time-oriented extraction of the potentially risky FBs can prevent complications.

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