Original Article

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Foreign Body Ingestion in Children: Distribution and Complications in a Tertiary Center of Pediatrics

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Abstract

Background: Foreign body ingestion is a common event in pediatric population. Children swallow different object including, coins, toys, batteries, *etc*. Most instances of foreign body ingestion are uncomplicated and the foreign body is excreted spontaneously. In some cases, the foreign body is lodged in the gastrointestinal tract and leads to complications. This study investigated the distribution of foreign body ingestion, and associated complications in a tertiary center of pediatrics.

Methods: In this retrospective study, electronic records of patients with diagnosis of foreign body ingestion in two consecutive years in a tertiary center were reviewed. The associated data were extracted and analyzed.

Results: 1125 cases were identified. 633(56.3%) patients were male. Median age was 3.7 years. The most common swallowed objects were batteries, followed by coins, and sharp objects. The most common location of foreign body was the esophagus. The median time interval between ingestion and presentation was 4 *hr*. In patients with disk battery ingestion, there was a significant statistical relationship between time interval and presence of complications. Most patients (84.4%) needed no intervention. 14.9% were managed by a non-surgical intervention, and 0.6% needed surgery. No mortalities were recorded. Two cases of peritonitis were documented, following ingestion of magnets. Eight cases of esophageal burn, and one case of mediastinitis were documented following disk battery ingestion.

Conclusion: Foreign body ingestion is a common occurrence in children under 5 years of age. In this study, batteries were the most common swallowed objects. Most serious complications were following batteries, or magnet ingestion. Preventive measures focusing on batteries and high-powered magnets could decrease the incidence of these complications.

Keywords: Burns, Eating, Electronics, Esophageal diseases, Foreign bodies, Mediastinitis, Numismatics, Peritonitis

Introduction

Foreign body ingestion is a common occurrence in the pediatric population. Most cases of foreign body ingestion occur in children under 4 years of age (1,2). Toddlers tend to explore the world by putting objects in their mouths, and most episodes of foreign body ingestion in children are accidental (3-6). Children may swallow a wide variety of objects, including coins, batteries, toys, jewels, magnets, pins, *etc*. In most studies, coins have been the most commonly swallowed objects (3,5-9). However, swallowed objects may vary depending on the difference in culture and household items in each region.

Almost all ingested foreign bodies pass spontaneously without any complications (3,6) but in some occasions, a foreign body could lodge in the Gastrointestinal (GI) tract. Depending on factors such as characteristics of foreign body, location of lodgment, and the duration of lodgment , it can lead to a range of complications including mucosal erosions, ulcers, burns, necrosis, fistula formation, and perforation (10-15). Thus, endoscopic or surgical procedures may be required in some instances to remove the foreign body.

This study investigated all cases presented to the Children's Medical Center, a tertiary center in Tehran, with the diagnosis of foreign body ingestion in two consecutive years. The aim of this study is to identify the distribution of foreign body ingestion, different types of ingested foreign bodies, and associated complications in the pediatric population.

Material and Methods

In this retrospective, all the children (under 18 years old) with the diagnosis of foreign body ingestion (ICD code: T18.9) presented to Children's Medical Center from March 2018 to March 2020 were included. Data from both inpatient and outpatient departments were included.

Patients with foreign bodies in the respiratory tract, ingestion of caustic or toxic agents, and also patients with history of structural diseases of the GI tract (*e.g*., esophageal atresia) were excluded.

Associated data including age, sex, the time interval from ingestion to presentation, type of foreign body, location of the foreign body in the GI tract, interventions, associated complications, and spontaneous passage were gathered from electronic medical records of the patients. Patients were managed according to the latest guideline American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) on management of ingested foreign bodies (14).

Statistical analysis was performed using IBM SPSS Statistics (Version 22, IBM Corp., Armonk, NY). Chi-square test was used for analysis of the categorical variables. P-values lower than 0.05 were considered statistically significant.

Results

Demographic data

1125 cases with diagnosis of foreign body ingestion were identified from March 2018 to March 2020. 633 (56.3%) patients were male and 492 (43.7%) females. Median age of the children was 3.7 years, and 75% were under 5 years of age.

Type of foreign body

Among 1125 cases, the type of foreign body was not recorded in 324 cases. Among 801 cases in which the foreign body was recorded, 267 (33.3%) were batteries. Shape and type of the batteries were not precisely described and the 267 cases included all types of batteries. Coins were the second most ingested objects with 170 cases (21.2%). Sharp objects (including needles, nails, open safety pins, bones, *etc*.) were the third most ingested objects with 92 cases (11.5%). Distribution of types of foreign bodies in all patients is shown in table 1.

Table 1. Types of identified foreign bodies in all the patients

Foreign body	Count	Percentage
Batteries	267	33.3
Coin	170	21.2
Sharp objects	92	11.5
Metal	91	11.4
Plastic	65	8.1
Other *	64	8.0
Magnet	52	6.5
Total	801	100.0

*Other: nuts, seeds, pits, food bolus, fruit, marbles, paper, stone.

In the admitted patients, type of foreign body was identified in 240 cases. The most common swallowed object was coin (67 cases, 27.7%) followed by sharp objects (57 cases, 23.6%), and disk batteries (47 cases, 19.4%). Distribution of types of foreign bodies in the admitted patients is shown in table 2.

Admission and interventions

Of 1125 patients, 242 (21.5%) needed admission for observation or interventions, and others were managed as outpatients. In patients who needed admission, 141 (58.3%) were male, and 101 (41.7%) female. Median age was 3 years, with 75% under 5.6 years of age. Of all the patients, 950 (84.4%) needed no intervention. They were observed as inpatients or were discharged. 168 patients (14.9%) were managed by a non-surgical intervention, including Esophagogastroduodenoscopy (EGD), rigid esophagoscopy, or direct laryngoscopy. And 7 patients (0.6%) needed surgery. The location of foreign body, the time interval between ingesting the foreign body and presentation, and description of complications were only reliably documented in the admitted patients' records (Table 3).

Location of foreign body

In the admitted patients, the most common location of the foreign body at presentation was the esophagus (78 cases, 32.2%). In the esophagus, the upper third was the most common place. Fruit pits (*e.g.*, apricot, peach) in 71.4% and coins in 64.2% instances, were lodged in the esophagus. Disk batteries were 14.9% lodged in the esophagus, and all the patients with disk battery lodged in the esophagus had complications. In 68.9% of the cases that foreign body had passed the esophagus, the foreign body was spontaneously excreted from the body.

Table 2. Types of foreign bodies in the admitted patients

Foreign body	Count	Percentage
Coin	67	27.7
Sharp Objects	57	23.6
Disk Battery	47	19.4
Metal	21	8.7
Plastic	18	7.4
Other batteries	9	3.7
Magnet	8	3.3
Fruit pits	7	2.9
Food	3	1.2
Glass	3	1.2
Not identified	2	0.8
Total	242	100.0

Table 3. Required interventions

Intervention	Count	Percentage
None	950	84.4
Non-surgical	168	14.9
Surgical	7	0.6
Total	1125	100.0

Time interval from ingestion to presentation

In 237 admitted cases, the time interval between ingesting the foreign body and presenting to the center was recorded. The median time interval was 4 (IQR 2-12) *hr*. 68.8% presented in less than 6 hours, and 16.5% after 24 *hr* (Table 4). Altogether, there was no statistically significant relationship between the time interval and occurrence of the complications. However, in children with disk battery ingestion, presence of complications was 11.8% in patients who presented in less than 2 *hr*, and 56.7% in those who presented after 2 *hr*. There was a significant statistical relationship between time interval and presence of

Table 4. Time interval from ingestion of foreign body to presentation in the admitted patients

Time interval (*hr*)	Count	Percentage
=<2	70	29.5
2-6	93	39.2
6-12	20	8.4
12-24	15	6.3
>24	39	16.5
Total	237	100.0

complications, in patients with disk battery ingestion. Presentation after 2 *hr* or more following disk battery ingestion was significantly associated with a higher complication rate compared to presentation within 2 hours (p=0.003).

Complications

188 (77.7%) of the admitted patients had no complications. 54 (22.3%) had complications that are shown in table 5. No mortalities were recorded. Most cases (38.9%) of esophageal, gastric, or duodenal mucosal erosions reported in endoscopy had ingested a sharp object. All the cases of esophageal burn and/or necrosis happened following ingestion of disk batteries. Two cases of peritonitis were documented, both following ingestion of magnets, and one case of mediastinitis following disk battery ingestion.

In the admitted patients with coin ingestion, 94% had no complication. On the other hand, complication rates in disk battery, and magnet ingestions were 40.4% and 37.5%, respectively. There was a significant statistical relationship between type of foreign body and complication rates in the admitted patients (p=0.0002) (Table 6).

Table 5. Complications occurred in the admitted patients

Complication	Count	Percentage
None	188	77.7
Mucosal erosion	36	14.9
Esophageal burn +/- necrosis	8	3.3
Ulcers	7	2.9
Bowel perforation and peritonitis	2	0.8
Mediastinitis	1	0.4
Total	242	100.0

Discussion

Foreign body ingestion occurs commonly in the pediatric population. Children put different objects such as coins, batteries, magnets, jewels, *etc*. in their mouths. If swallowed, these foreign bodies might bring about critical complications, or necessitate an endoscopic or surgical intervention. In this study, 1125 cases with the diagnosis of foreign body ingestion were investigated in a tertiary center of pediatrics in Tehran, in two consecutive years.

In this study, in keeping with most previous studies (4,5,16,17), nearly all cases of foreign body ingestion occurred in children under 5 years of age. Coins have been generally the most commonly swallowed object in the pediatric population (3-9,16,18). In this study, coins were also the most swallowed object in the admitted patients. In contrast, considering all the patients, batteries (including all types and shapes of batteries) were the most common ingested objects overall. The high prevalence of battery ingestion in this study could be attributable to a few factors. First, a few studies have mentioned an increase in episodes of battery ingestion and associated complications, following advancement and widespread use of electronic devices in recent decades (19-22). This trend could take place in Iran as well. In this regard, two previous studies carried out in Iran by Jafari *et al*, and Amini *et al*, reported disk batteries as the most commonly swallowed objects (23,24).

In addition, Children's Medical Center is a tertiary center in the capital. Almost all cases of foreign body ingestion are uncomplicated and manageable

Table 6. Complication rates in different groups of foreign bodies in the admitted patients

Complications	Foreign body type						Total
	Coin	Disk battery	Magnet	Sharp objects	Other batteries	Other	
No	63(94.0%)	28(59.6%)	5(62.5%)	43(75.4%)	5(55.6%)	44(81.5%)	188(77.7%)
Yes	4(6.0%)	19(40.4%)	3(37.5%)	14(24.6%)	4(44.4%)	10(18.5%)	54(22.3%)
Total	67(100.0%)	47(100.0%)	8(100.0%)	57(100.0%)	9(100.0%)	54(100.0%)	242(100.0%)

*Other: plastic, metal, glass, fruit pits, food, unidentified objects (p=0.002).

at primary care centers. Battery ingestion, however, is known as an alarming event. Thus, children with battery ingestion are more frequently referred to higher-level facilities, like our center. As a result, the number of patients with battery ingestion increases. Furthermore, due to economic reasons and currency depreciation coins are no longer used routinely in Iran. Few people hold coins in Iran nowadays. Therefore, this could explain the lower prevalence of coin ingestion compared to other countries.

In general, most patients with foreign body ingestion require no interventions. Regularly, 10-20% of the cases need endoscopy, and less than 1% undergo surgery (25). Likewise, in the current study, the majority of patients needed no interventions. These patients were observed and mostly followed up with serial x-rays, and checking the stool for foreign body excretion.

Foreign body ingestion is a concerning event for children's caregivers, prompting them to seek medical attention. Similar to previous studies (5,17), nearly all the patients in this study presented in less than 48 *hr*. Tokar *et al* mentioned that increased time interval after ingesting the foreign body is accompanied by higher risks of complications (15). In contrast, there was no significant relationship between the time interval and complications in all the patients in the current study. On the other hand, in children with disk battery ingestion, presentation after 2 *hr* was significantly associated with higher complication rates. In this regard, in animal studies conducted by Tanaka *et al* on electrochemical burns by lithium disk batteries, it was demonstrated that as soon as 30 *min* after fixation of disk battery in the esophagus, the esophageal epithelium was completely destroyed and partial necrosis was observed in muscular layers (26). Furthermore, Chung *et al* mentioned in their review that in children, disk batteries in the esophagus may lead to esophageal burn in less than 2:30 *hr*, and esophageal perforation in as soon as 5 *hr* (16,19,27,28).

Therefore, instructing the caregivers to present immediately after such incidents, in addition to timely diagnosis, could be effective in reducing the complications associated with battery ingestion. Ingested foreign bodies could be placed in different parts of the GI tract. However, the esophagus is the narrowest segment of the GI tract. In this study, objects were most commonly lodged in the esophagus. Foreign bodies were more likely to pass spontaneously, when they had passed the esophagus. These findings are similar to many previous studies (3,4,23,29).

Disk batteries lodged in the esophagus have been associated with significant, and even fatal complications (16,22). Mortalities have been reported due to esophageal disk batteries leading to perforation, and hemorrhage following vascular injury to the aorta (30-32). Likewise, in this study, all the patients with disk batteries lodged in the esophagus had complications including burns, necrosis, and mediastinitis. These findings again highlight the fact that patients with disk battery in the esophagus should be diagnosed, and taken care of immediately. In addition, manufacturers should be encouraged to produce these batteries in smaller sizes so that they pass through the esophagus.

Complications following foreign body ingestion range from mucosal erosions to ulcer formation, necrosis, and even perforation. In this study, majority of the patients had no complications. There was a significant relationship between the type of foreign body and the presence of complications. Batteries and magnets were associated with higher complication rates.

Among patients with serious complications, there was one case of mediastinitis, leading to long ICU stay. Mediastinitis had occurred following a disk battery being lodged in the esophagus for 3 *hr*. Also, there were 8 cases of esophageal burn and/or necrosis, all following disk battery ingestion. Batteries are known to cause tissue damage by different mechanisms, including generating electrical current leading to hydroxide radicals' formations, leakage of alkaline content and tissue damage, and tissue necrosis following pressure. As previously mentioned, longer durations of lodgment of the disk battery in the GI tract are associated with more damage (15,19). Furthermore, morbidity and mortality associated with disk battery ingestion seem to be increasing in recent decades (19,33). Litovitz *et al* believed that a shift in disk batteries diameter to >20 *mm* in combination with an increase in the availability of lithium batteries were attributable to the increased morbidity and

mortality. Larger battery sizes result in batteries being stuck in the esophagus. On the other hand, lithium batteries have higher voltage capacities compared to batteries with other chemical compositions. Thus, ingestion of >20 *mm* lithium batteries has been known to cause more complications (19). Another serious complication following foreign body ingestion is bowel perforation and peritonitis. In this study, there were two cases of peritonitis. One occurred following ingestion of a magnet with a few metal screws, and the other following ingestion of 7 magnets. Both patients needed laparotomy and long ICU stay. Magnet ingestion could be potentially dangerous, if swallowed along with another magnet, or other ferromagnetic objects. In the current study, 5 out of 8 admitted patients with magnet ingestion, had swallowed more than one piece. These pieces stick together in the GI tract and lead to fistula formation, bowel necrosis, and perforation (22). This mechanism explains the higher incidence of complications in children with magnet ingestion. Especially, high-powered magnets containing Neodymium should be the focus of attention as they have stronger attractive force than conventional magnets (34). Raising awareness, and keeping high-powered magnets out of reach of children, could be effective in preventing such potentially fatal incidences.

This study was a retrospective study, and the data were gathered from the medical records. The limitations were missing data, or inaccurately documented data in some records. The strengths of this study were the high number and diversity of the cases.

Conclusion

Foreign body ingestion occurs commonly in children under 5 years of age. In this study, batteries were the most frequently swallowed objects, overall. Many cases of foreign body ingestion neither have a complication nor require intervention. In a few cases, however, foreign body ingestion leads to serious complications. In the present study, most serious complications were following batteries or magnet ingestion. We recommend raising awareness about risks of foreign body ingestion among caregivers, in addition to taking preventive measures focusing on batteries and high-powered magnets.

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Conflict of Interest

Authors declare no conflict of interest.

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