



The removal of foreign body ingestion in the upper gastrointestinal tract: a retrospective study of 1,182 adult cases

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Background: Foreign body (FB) ingestion in the gastrointestinal tract is a common and urgent problem observed in children and adults. However, there may be difficulty locating FBs and complications associated with their removal. This study aimed to identify risk factors and complications correlated to the presence and removal of FBs.

Methods: This 5-year retrospective study enrolled 1,311 patients between June 2014 and April 2019. Demographic and endoscopic data were collected, containing age, gender, types and location of FBs, duration of FB ingestion, accessory devices, endoscopic methods, and complications. Logistic regression analysis was applied to evaluate the predictive risk factors.

Results: Among 1,131 patients, FBs were found in 90.16% of cases. A major predictor for the presence of FB was a presentation of less than 24 hours (h). The types of FBs were jujube pits (36.72%) and fish bones (22.00%), and over 80% of the FBs were discovered in the esophagus. Complications were found in 239 cases (20.22%), of which hemorrhage (162/239, 67.78%) was the most frequent. Age ≥ 60 , duration ≥ 24 h, and FBs ingested in the esophagus were considered as risk factors for developing complications.

Conclusions: In conclusion, the longer duration, age ≥ 60 , and impaction in the esophagus were risk factors for developing complications following the ingestion of FBs. These factors should be considered when developing assessment and treatment plans in the management of FB ingestion.

Keywords: Foreign body ingestion; endoscopy; upper gastrointestinal tract; complication; risk factors

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Introduction

Foreign body (FB) ingestion is a common and urgent problem presenting to gastroenterology (GI) departments and is defined as swallowing anything purposely or unintentionally, including food, medication, toys, coins or other objects (1). An American survey reported the estimated annual incidence of FBs ingestion was 120,000 cases (2). In those patients, most ingestions were linked to dining, whilst others were associated with psychiatric disorders, alcohol

dependence, drug abuse, digestive diseases (including achalasia of the cardia), or other abnormal conditions (3-5). The majority of ingested FBs (80-90%) pass through the GI tract spontaneously and only 10-20% require endoscopic intervention and <1% need surgery (6-9). Endoscopy has become the preferred choice to remove FBs not only because it avoids the need for surgery, but because it uses conveniently accessible technical devices and advanced visualization, may simultaneously diagnosis

other diseases, and is cost efficient in comparison to other methods (10-12). However, FBs may not be discovered in every procedure (13,14) and the detection rate may be as low as 75%. Older age and early presentation have been shown to be independent predictors for the presence of FBs (15,16), and occasionally, FB ingestion in the upper-GI tract may cause severe complications, such as perforation, internal bleeding or death (17). According to a previous study (18), an average of 1,500 people died from FBs ingestion each year in the United States. Moreover, most researchers agree that the types, sizes, and the duration of impaction were considered as risk factors linked with complications (12,19,20). This retrospective study aimed to identify factors correlated to the presence of FBs as well as complications associated with their presence and removal, such that timely and appropriate treatments may be applied for patients with FB ingestion. We present the following article in accordance with the STROBE reporting checklist (available at <http://dx.doi.org/10.21037/atm-21-829>).

Methods

Patients

This retrospective study was conducted in the Department of the Gastroenterology, Tianjin Medical University General Hospital. A total of 1,438 patients presenting with suspected FBs between June 2014 and April 2019 were included. Patients with capsule endoscopies and stents, repeated endoscopies, and others whose FBs were extracted from the lower GI tract were excluded from the study. Eventually, the study enrolled 1,311 adult patients (781 women and 530 men) ranging from 18 to 89 years of age and with a mean age of 54.27 ± 3.03 years. This study was approved by the Institutional Review Board of Tianjin Medical University General Hospital (Ethical No. IRB2020-WZ-141). All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013). Individual consent for this retrospective analysis was waived.

Endoscopic procedures

The vital signs, temperature, breathe, pulse and blood pressure should be recorded for every patients. And a physical examination focused on the patient's general condition and was to assess signs of any complications (21). Before the foreign-body extraction procedure, plain chest

radiography, or abdominal radiography if there was a suspicion of a gastric or duodenal foreign body. Upper GI endoscopy was performed in each patient under topical pharyngeal anesthesia using lidocaine, or general anesthesia using propofol or ketamine. Flexible endoscopes (mainly GIF-Q260 and GIF-Q290; Olympus Optical Co, Ltd, Tokyo, Japan) were adopted. Devices used included foreign body forceps, snare, rat-tooth forceps, basket, biopsy forceps, and alligator jaws forceps. A snare was used to extract irregular objects such as dental prostheses or metallic FBs and a latex protector hood or a transparent cap was utilized to avoid damage to the GI tract during endoscopic procedures.

Data collection

Demographic data including age, gender, clinical data containing history of other diseases, time from ingestion to presentation to the emergency department, and endoscopic data recording types, location of FBs, duration of FBs ingestion, endoscopic devices, the methods of anesthesia, and complications were collected for analysis.

Statistical analysis

T tests were used to compare the mean and standard deviation, Chi-square tests were to contrast proportions, and logistic regression analyses were to assess the risk factors of FBs presence and complications. All tests were two-tailed and $P < 0.05$ was defined as statistically significant. SPSS statistical software (ver. 13.0; SPSS Inc., Chicago, IL, USA) was applied to complete the statistical analyses.

Results

Characteristics and risk factors of patients with foreign body ingestion

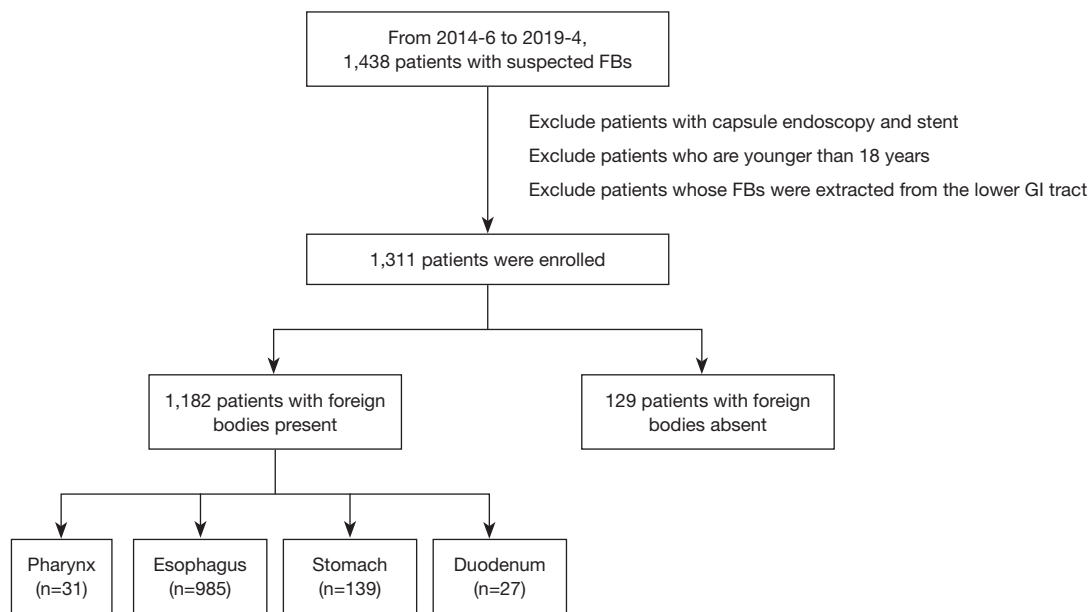
A total of 1,311 patients with suspected FBs ingestion underwent endoscopic management and FBs were found in 1,182 (90.16%) individuals. Compared to patients without FB, those with FB present were of older age (55.09 ± 15.72 vs. 46.70 ± 16.22 years, $P < 0.0001$), more frequently female (61.17% vs. 44.96%, $P < 0.0001$), and of shorter ingestion duration (23.78 ± 2.12 vs. 41.24 ± 7.46 hours, $P = 0.014$).

Significant variables that estimated the presence of FBs based on Pearson's Chi-square tests included gender, age, and duration of FB ingestion ($P < 0.05$). The risk factor of FBs

Table 1 Characteristics and risk factors of patients with foreign body ingestion

Characteristics/items	Foreign bodies present, n=1,182 (%)	Foreign bodies absent, n=129 (%)	P value ^a	P value ^b (logistic)	OR	95% CI
Age, mean ± SD (years)	55.09±15.72	46.70±16.22	<0.0001	0.429	–	–
Female: male	723:459	58:71	<0.0001	0.543	–	–
Impaction time (h)	23.78±2.12	41.24±7.46	0.014	–	–	–
<24 vs. ≥24 h	–	–	–	<0.0001	3.67	2.05–6.64

P value^a: Pearson's Chi-square test or *t* test; P value^b: logistic regression analysis; SD, standard deviation; OR, odds ratio; CI, confidence interval.

**Figure 1** Gastroenterology Department flow sheet of patient with foreign body ingestion. FBs, foreign bodies.

presence was the duration less than 24 h (OR 3.67; 95% CI: 2.05–6.64) via the logistic regression analysis (Table 1).

The type and location of FB

Various types of FBs were detected in the upper GI tract, consisting of jujube pits (36.72%), fish bones (22.00%), dental prostheses (6.60%), other bones such as chicken or duck bones (10.49%), and small metallic FBs (5.24%) such as needles, spoons, rings, and coins, and medicine or its packaging (3.64%). Other objects included lighters, technological products, chopsticks, plastics, nuts, shears, pens, chinaware fragments, and plastic knives (Table S1). Anatomically, most FBs were detected in the esophagus (n=985, 83.33%), with the stomach (n=139, 11.76%),

pharynx (n=31, 2.62%), and duodenum (n=27, 2.28%) following (Figure 1).

Types of accessory device

The selection of tools to remove FBs mainly depends on the type and location of the FB (21,22). The most frequently used devices were foreign body forceps (70.55%), snare (8.63%), and rat-tooth forceps (6.77%). Others, such as biopsy forceps (0.85%), alligator jaws forceps (0.34%), and retrieval basket (0.34%) were rarely adopted. Foreign body forceps (forceps) were more frequently applied in managing routine types of FBs like jujube pits (OR 5.87; 95% CI: 3.09–11.13) or fish bones (OR 31.65; 95% CI: 4.39–228.35). The most successful method for removing FBs was forceps

Table 2 Type of accessory devices

Accessory devices (No./%)	Success rate (No./%)	P value	Location of foreign bodies ingestion/number	P value
Foreign body forceps (only) (834/70.55)	796/95.44	0.147	Pharynx/20	
			Esophagus/734	
			Stomach and duodenum/77	
Snare (only) (102/8.63)	94/92.15	0.634	Pharynx/2	
			Esophagus/55	<0.0001 ¹
			Stomach and duodenum/44	<0.0001 ¹
Rat-tooth forceps (88/7.38)	83/94.32	0.625	Pharynx/6	
			Esophagus/76	0.653 ¹
			Stomach and duodenum/6	
Alligator jaws forceps (5/0.42)	5/100	0.415	Pharynx/0	
			Esophagus/4	0.474 ¹
			Stomach and duodenum/1	
Biopsy forceps (10/0.85)	9/90.0	0.053	Esophagus/5	0.004 ¹
			Stomach and duodenum/5	
			Pharynx/0	
Retrieval basket (4/0.34)	3/75.0	0.155	Esophagus/3	0.402 ¹
			Stomach and duodenum/1	
			Pharynx/0	
Use at least 2 tools (118/9.38)	109/92.37	0.138 ¹ , <0.0001 ²	Esophagus/98	
			Stomach and duodenum/20	<0.0001 ²
			Pharynx/0	

¹, means compared to foreign body forceps; ², means compared to snare.

(796/834, 95.44%), the application of which was higher in the esophagus compared to snare (88.01% *vs.* 53.92%). Snares were used in 102 patients with 44 (43.14%) cases in the stomach where their utilization was more effective than that of forceps (43.14% *vs.* 9.23%) in extracting metallic objects (OR 4.51; 95% CI: 2.67–7.64) and dental prosthesis (OR 6.35; 95% CI: 3.42–11.83) (Tables 2,3).

Endoscopy method

All patients underwent endoscopy via topical pharyngeal anesthesia (n=1,100) or general anesthesia (n=82). Patients who experienced the former had a higher average age (55.64±0.47 *vs.* 47.84±1.80, P<0.0001). Compared with topical approaches, removal using general endoscopy on the successful rate was higher (96.34% *vs.* 92.73%, P=0.225) and exhibited a lower complication rate (20.55%

vs. 15.85%, P=0.308) (Table 4). Unfortunately, these given data seem to disagree that endoscopic process with general anesthesia has evident superiorities.

Complications of FB

While there were no deaths, 239 patients (20.22%) developed complications when endoscopy was used. The most frequent of these were hemorrhage (n=162, 67.78%) and perforation (n=65, 27.20%) as shown in Table S2. However other serious complications such as neck subcutaneous emphysema or mediastinum emphysema, esophagitis and cervical space infection or mediastinitis, rupture of large blood vessels, or esophagotracheal fistula observed in previous studies (23), were not seen in ours.

There were no differences in gender and anesthetic methods between patients with complication and without

Table 3 Comparison of two tools for removing foreign bodies

Items	Foreign body forceps (only), n=834/70.55%	Snare (only), n=102/8.63%	P value ^a	P value ^b (logistics)	OR; 95% CI
Success rate	796/95.44%	94/92.15%	0.147	–	–
Location					
Pharynx	20/2.40%	2/1.96%	1.0		
Esophagus	734/88.01%	55/53.92%	<0.0001		
Stomach and duodenum	77/9.23%	44/43.14%	<0.0001		
The type of foreign bodies					
Jujube pits	346/41.49%	11/10.78%	<0.0001	<0.0001	5.87; 3.09–11.13
Fish bone	199/23.86%	1/0.98%	<0.0001	<0.0001	31.65; 4.39–228.35
Metallic foreign bodies	56/6.71%	25/24.51%	<0.0001	<0.0001	4.51; 2.67–7.64
Dental prosthesis	29/3.48%	19/18.63%	<0.0001	<0.0001	6.35; 3.42–11.83

P value^a: Pearson's Chi-square test; P value^b: logistic regression analysis. OR, odds ratio; CI, confidence interval.

Table 4 The method of endoscopy

Parameters	Topical pharyngeal anesthesia (n=1,100)	General anesthesia (n=82)	P value
Male	410/37.27%	49/59.76%	<0.0001
Mean age (years)	55.64±0.47	47.84±1.80	<0.0001
Successful endoscopic removal	1020/92.73%	79/96.34%	0.225
Complications	226/20.55%	13/15.85%	0.308
Mean of duration of impaction (h)	29.24	41.60	0.331

complication ($P=0.265$ and 0.392). However, patients who experienced complications were older than those who did not (58.71 ± 1.43 vs. 54.19 ± 2.98 , $P<0.0001$), and the duration of FB presence prior to removal was significantly longer in the former (36.43 ± 4.22 vs. 18.00 ± 1.37 , $P<0.0001$). Interestingly, FBs were more likely to be found in the esophagus in patients with complications ($P=0.028$). Consistently, the consequence of logistics analysis showed that the independent risk factors of complications were age ≥ 60 (OR 1.54; 95% CI: 1.07–2.20), the presence of FBs beyond 24 h (OR 2.67; 95% CI: 2.00–3.57), and esophageal FBs (OR 2.07; 95% CI: 1.22–3.53) (Table 5).

Discussion

FB ingestion is a universal clinical problem. Of the 1,131 patients involved in this study FBs were found in 90.16% patients via endoscopic procedures. Complications

were observed in 239 cases (20.22%), of which hemorrhage (162/239, 67.78%) was the most frequent. Risk factors of complications included age ≥ 60 , duration of FB ingestion ≥ 24 h and esophageal FBs.

Although patients with FBs suffer symptoms such as throat discomfort, epigastric pain, vomiting, and dysphagia (14), some FBs produce no symptoms. In addition, a duration of less than 24 h was a possible factor indicating the presence of FBs in this study, which is consistent with previous findings that early presentation is one of the independent predictors of the presence of FBs (15,16). A duration of less than 24 h increased the risk of the presence of FBs by a 3.67-fold.

In our study, nearly 59% of FBs were fish bones and jujube pits, which is similar to previous findings indicating that most FB ingestions were accidental food and bone impactions (24–26). Moreover, a great majority of FBs were esophageal as also previously published (1,17). Foreign

Table 5 Risk factors for complications of foreign bodies

Possible factors	Non-complication (n=943)	Complication (n=239)	P value ^a	P value ^b (logistic)	OR	95% CI
Mean age ± SD (years)	54.19±2.98	58.71±1.43	<0.0001			
Age ≥60 vs. <60 years				0.019	1.54	1.07–2.20
Female: male	569:374	154:85	0.265	–		
Impaction time (h)	18.00±1.37	36.43±4.22	<0.0001			
≥24 vs. <24 h				<0.0001	2.67	2.00–3.57
Location			0.028			
Esophagus	774	221		0.007	2.07	1.22–3.53
Stomach	141	17				
Type of foreign body ingested			<0.0001			
Jujube pits	304	129		0.992	–	–
Fish bone	218	43		0.298	–	–
Others	421	67				
Anesthetic methods			0.392			
Topical pharyngeal anesthesia	874	226		–		
General anesthesia	69	13				

P value^a: Pearson's Chi-square test or *t*-test; P value^b: logistic regression analysis. SD, standard deviation; OR, odds ratio; CI, confidence interval.

bodies forceps successfully removed generous esophageal FBs including jujube pits, while snare was the best choice to remove FBs ingested in the stomach, such as dental prostheses. While our findings were largely consistent with those of Geng [2017] (17) who found no distinct differences in the success rates between general and topical pharyngeal anesthesia, our data conveyed a trend towards a lower complication rate (15.85% *vs.* 20.55%) and higher removal rate (96.34% *vs.* 92.73%) under general anesthesia. More research is required to determine whether these benefits of general anesthesia are more broadly apparent.

The complication rate after removal of FB ingestion was around 20% in our patients, although this has ranged from fewer than 5% to nearly 50% in other studies (20,27,28). A possible reason for the high complication rate seen in some studies may be that mucosal injury and hematoma are classified as mild complications, appearing in up to 29.5% in one study (17). Additionally, fever (≤ 38 °C), abrasions, small erosions, abscesses, ulcers, and mucosal laceration have also been listed as complications (27). Agreement on the criteria by which complications are classified and their reporting would greatly improve the validity and accuracy of findings.

Risk factors for FBs ingestion leading to complications have been previously observed in relation to the types and size of FBs, duration of FBs impaction and delay in endoscopic management (1,13,15,20). In our paper we also identified age ≥ 60 and esophageal FBs as additional risk factors. A longer duration of FB ingestion is associated with a greater risk of harm. The danger of complications in cases with a duration of over 24 h was 2.67-fold higher than those with a duration of less than 24 h. Furthermore, the frequency of complications increases with age. This might be due to several factors: firstly, the swallowing function and sensation are less sensitive in the elderly than in younger adults; secondly, most patients wearing dentures are elderly; thirdly, the overall physical condition of elderly patients is weaker and less able to tolerate trauma than those younger. Esophageal FBs carried a higher risk of complications in comparison to the stomach because of the narrower lumen and thinner muscular layer.

FBs ingestion can be treated successfully and safely in more than 92% of cases in this study, which was similar to most researches (16). The factors related to a successful procedure include the compliance of patients, appropriate extraction devices, experienced endoscopists, the

radiological evaluation, the degree of cooperation between endoscopists and nurses, and so on.

The chief limitations to this study are its retrospective nature and the uneven number of patients in the general anesthesia and endoscopy groups. Although retrospective research might increase the deviations of research results, we collected the associated data of patients with foreign bodies ingested from June 2014 and April 2019 to expand the sample size and avoid the condition. The latter result in the distribution of adverse outcomes towards the general anesthesia group. Further investigation into the benefits of general anesthesia in removing FBs is strongly recommended.

In conclusion, the duration of ingestion before removal was the common factor affecting the presence of FBs and its complications, while age ≥ 60 and esophageal FBs were other risk factors contributing to complications. Taking these possible risk factors into consideration, appropriate endoscopic interventions could be executed to treat patients with FB ingestion.

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/atm-21-829>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was approved by the Institutional Review Board of Tianjin

Medical University General Hospital (Ethical No. IRB2020-WZ-141). All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013). Individual consent for this retrospective analysis was waived.

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Supplementary

Table S1 The type of foreign bodies

Type	Number	Percentage (%)
Jujube pits	434	36.72
Fish bone	260	22.00
Other bone	124	10.49
Dental prosthesis	78	6.60
Metallic	62	5.24
Medicine or its packaging	43	3.64
Others	181	15.31
Total	1182	100

Table S2 The type of complications

Type of complications	Number	Percent (%)
Hemorrhage	162	67.78
Perforation	65	27.20
Perforation with bleeding	12	5.02
Total	239	100