



Retrospective Study

Risk factors for complications associated with upper gastrointestinal foreign bodies

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Abstract

AIM: To investigate predictive risk factors associated with complications in the endoscopic removal of foreign bodies from the upper gastrointestinal tract.

METHODS: We retrospectively reviewed the medical records of 194 patients with a diagnosis of foreign body impaction in the upper gastrointestinal tract, confirmed by endoscopy, at two university hospital in South Korea. Patient demographic data, including age, gender, intention to ingestion, symptoms at admission, and comorbidities, were collected. Clinical features of the foreign bodies, such as type, size, sharpness of edges, number, and location, were analyzed. Endoscopic data those were analyzed included duration of foreign body impaction, duration of endoscopic performance, endoscopic device, days of hospitalization, complication rate, 30-d mortality rate, and the number of operations

related to foreign body removal.

RESULTS: The types of upper gastrointestinal foreign bodies included fish bones, drugs, shells, meat, metal, and animal bones. The locations of impacted foreign bodies were the upper esophagus (57.2%), mid esophagus (28.4%), stomach (10.8%), and lower esophagus (3.6%). The median size of the foreign bodies was 26.2 ± 16.7 mm. Among 194 patients, endoscopic removal was achieved in 189, and complications developed in 51 patients (26.9%). Significant complications associated with foreign body impaction and removal included deep lacerations with minor bleeding ($n = 31$, 16%), ulcer ($n = 11$, 5.7%), perforation ($n = 3$, 1.5%), and abscess ($n = 1$, 0.5%). Four patients underwent operations because of incomplete endoscopic foreign body extraction. In multivariate analyses, risk factors for endoscopic complications and failure were sharpness (HR = 2.48, 95%CI: 1.07-5.72; $P = 0.034$) and a greater than 12-h duration of impaction (HR = 2.42, 95%CI: 1.12-5.25, $P = 0.025$).

CONCLUSION: In cases of longer than 12 h since foreign body ingestion or sharp-pointed objects, rapid endoscopic intervention should be provided in patients with ingested foreign bodies.

Key words: Emergency department; Foreign body; Upper gastrointestinal tract; Endoscopy; Complication

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Core tip: We investigated the status of foreign bodies in the upper gastrointestinal tract and assessed risk factors for complications associated with the endoscopic removal of ingested foreign objects. We concluded that a longer duration of impaction, above 12 h, and sharp-pointed objects were related to the occurrence of endoscopic complications and failure. A strength of this study is that we evaluated risk factors for complications according to particular impaction time, in contrast to published studies that reported simply "long" impaction duration as a risk factor or that impaction time was not associated with the risk of complications.

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INTRODUCTION

Foreign body ingestion can be defined as materials swallowed accidentally or intentionally, or objects

swallowed naturally when taking medication or food. It is frequently seen in the emergency department and occurs commonly in the pediatric population^[1,2]. In adults, most foreign body ingestion occurs accidentally, but may be a result of contributory factors, such as psychiatric disorders, mental retardation, alcohol consumption, and an edentulous state^[3-8]. However, practically, we also encounter not a few seemingly healthy adults with no apparent risk factor with unintentional foreign body ingestion. Although pre-endoscopic series have shown that 80% or more of the ingested objects are likely to pass spontaneously, in approximately 20% of cases, foreign bodies may require endoscopic or surgical intervention^[9,10].

Endoscopic removal of foreign bodies generally has a low probability of complications, including impaction, perforation, and obstruction^[11-15]. However, it can also sometimes be associated with severe or even life-threatening complications^[16,17]. In previous reports, age, long duration of impaction, and impaction site, such as the upper esophagus or upper esophageal sphincter, were considered risk factors for endoscopic intervention^[18-20]. However, there has been no consensus regarding risk stratification for the prevention for complications related to endoscopic foreign body removal^[18,21]. Because an understanding of the predictive factors for complications with endoscopic removal may reduce morbidity and mortality, we investigated risk factors for complications in endoscopic upper gastrointestinal tract foreign body removal.

MATERIALS AND METHODS

Patients

We retrospectively reviewed the records of patients with a diagnosis of foreign bodies or food bolus impaction in the upper gastrointestinal tract, confirmed by endoscopy, at Kwandong University Myongji Hospital from January 2004 to August 2012, and at Dongguk University Ilsan Hospital from October 2005 to May 2013. After excluding pediatric patients, younger than 10 years, and those with insufficient data for analysis, in total, 194 cases were enrolled in this study. The protocol for the study was approved by the Institutional Review Boards of both hospitals.

Endoscopic procedures

All patients underwent an esophagoduodenoscopy (EGD) under local pharyngeal anesthesia, sedation using midazolam and/or pethidine, or general anesthesia using propofol and desflurane or sevoflurane. All examinations were undertaken by gastroenterologists who had performed at least 5000 EGD examinations and were qualified as Board of Gastrointestinal Endoscopy Specialists (Korean Society of Gastrointestinal Endoscopy) using flexible endoscopes (GIF-H260, Olympus Optical Co., Ltd., Tokyo, Japan). Cardiopulmonary function was

Table 1 Type of foreign bodies *n* (%)

Type of foreign body	Value
Fish bone	63 (32.5)
Drug	39 (20.1)
Shell	19 (9.8)
Meat	15 (7.7)
Metal	14 (7.2)
Animal bone	12 (6.2)
Stone	11 (5.7)
Plastic	9 (4.6)
Dental prosthetic	7 (3.6)
Tooth brush	2 (1.0)
Bean	1 (0.5)
Others	2 (1.0)
Total	194

monitored with pulse oximetry throughout the exam. All patients gave informed consent for the procedure. Endoscopic devices used for the removal of foreign bodies included alligator forceps, biopsy forceps, rat-tooth forceps, and a net. A protective cap, an overtube, or a latex protector hood was used to protect the pharyngeal and esophageal walls in cases of suspected sharp or pointed foreign bodies. In cases of failure to remove the foreign bodies using an endoscope, the patient was referred to the surgical department.

Data collection

Patient demographic data that were analyzed included age, gender, intention to ingestion, symptoms at admission, and comorbidities. Clinical features of foreign bodies were analyzed, including type, size, sharpness of edges, number, and location. Endoscopic data that were analyzed included duration of foreign body impaction, duration of endoscopic performance, endoscopic device, days of hospitalization, complication rate, 30-d mortality rate, and the number of operations related to foreign body removal.

Statistical analysis

For the identification of risk factors for complications after endoscopic intervention, categorical variables were analyzed using the χ^2 test or Fisher's exact test. OR with 95% CIs were calculated using logistic regression analysis for the evaluation of relative risk of complication occurrence and their association with variable parameters. *P* values < 0.05 were considered to indicate statistical significance in each analysis. All statistical analyses were performed using SPSS Statistics (ver. 13.0; SPSS Inc., Chicago, IL, United States).

RESULTS

Patient characteristics

In total, 194 patients with ingested foreign bodies underwent endoscopic management. The mean age at diagnosis was 54.84 ± 18.03 (range: 10-89) years.

Table 2 Anatomic location of foreign bodies *n* (%)

Location	Value
Esophagus	
Upper 1/3 (< 25 cm from incisor)	111 (57.2)
Mid 1/3 (≥ 25 cm, < 40 cm)	55 (28.4)
Lower 1/3 (≥ 40 cm)	7 (3.6)
Stomach	21 (10.8)
Total	194

Most patients were adults (age > 14 years, 191/194, 98.5%), while few were children (age ≤ 14 years, 3/194, 1.5%). There were 105 (54.1%) females and 89 (45.9%) male patients.

Characteristics and location of foreign bodies

The types of foreign body detected in the upper gastrointestinal tract varied markedly. The most common type of foreign object was a fish bone (63 patients; 32.5%), followed by drugs (39 patients; 20.1%), shells (19 patients; 9.8%), meat (15 patients; 7.7%), metal (14 patients; 7.2%), and animal bones (12 patients; 6.2%). Others included stones, plastic, dental prosthetics, teeth, beans, and a toothbrush (Table 1). The median size of the foreign bodies was 26.2 ± 16.7 (range: 3-140) mm. Regarding anatomical location, foreign bodies were located mainly in the upper esophagus (111 patients; 57.2%) and mid esophagus (55 patients; 28.4%), followed by the stomach (21 patients; 10.8%) and lower esophagus (7 patients; 3.6%; Table 2).

Endoscopic management

The median time interval between ingestion and endoscopic removal was about 5 h with a range of approximately 1 to 383 h. The median duration of the endoscopic procedure was 11.76 ± 25.05 (range: 1-320) min. The preferred accessory devices for extraction varied according to the type and location of the foreign bodies. For retrieval, frequently used devices were biopsy forceps (*n* = 96, 49.5%), a net (*n* = 32, 16.5%), and alligator forceps (*n* = 30, 15.4%). A push into the stomach was performed in 16 (8.2%) cases; 189 (97.4%) foreign bodies were removed successfully, while endoscopic removal failed in five patients (2.6%), and all then underwent additional surgery (Tables 3-5). There was no death associated with any foreign body ingestion or endoscopic procedure.

Complications associated with foreign body impaction

Among the 189 patients who underwent endoscopic removal of foreign bodies, minor mucosal injuries, such as abrasions or small erosions were noted in 58 cases (30.7%). Significant complications related to foreign body impaction and removal included deep lacerations with minor bleeding (*n* = 31, 16%), ulcer (*n* = 11, 5.7%), perforation (*n* = 3, 1.5%), and abscess

Table 3 Methods used for removal of foreign bodies n (%)

Method of removal	Value
Pull with biopsy forcep	96 (49.5)
Pull with net	32 (16.5)
Pull with alligator	29 (14.9)
Pull with snare	6 (3.1)
Pull with basket	5 (2.6)
Push into stomach	16 (8.2)
Others	4 (2.1)
Surgery	6 (3.1)
Total	194

Table 4 Complications by foreign bodies n (%)

Complication	Value
Ulcer	11 (5.7)
Laceration	31 (16.0)
Perforation	3 (1.5)
Abscess	1 (0.5)
Total	46 (23.7)

(*n* = 1, 0.5%) (Table 4). Of these, four patients with perforations or an abscess underwent surgical intervention (Table 5). Because foreign body impaction duration was a continuous variable, we divided it into two categorical variables using receiver-operating characteristic (ROC) curves for different durations. A cut-off value of 12 h had the highest sensitivity (76%) and specificity (43%) for significant complications. Both failure of endoscopic foreign body removal and related significant complications were categorized according to dependent variable stratification. In a multivariate analysis, risk factors were time interval beyond 12 h between ingestion and endoscopic management and the sharpness of the foreign body (Table 6).

DISCUSSION

Foreign body ingestion is a commonly encountered problem in the endoscopic department. According to previous reports, 80%-90% of ingested foreign bodies pass spontaneously and the complication rate is generally low^[5,21-23]. However, they are sometimes impacted in a physiological or pathological luminal narrowing or angulation site, which may lead to potentially life-threatening complications. A recent study showed that the rate of endoscopic intervention may be much higher (63%-76%) than expected, and long delays from ingestion to presentation and intervention may account for the relatively high rates of surgery and perforation in patients with intentional ingestion^[4]. Generally, identification and radiographic localization are the initial preferred steps in the management of foreign bodies^[24]. Biplane radiographs are useful for confirming ingested materials and complications, such as free air and lung aspirates,

prior to attempts at endoscopic extraction^[8,9,24]. In the current study, routine neck AP X-rays could not detect foreign bodies in two-thirds of patients, and radiopaque material was found in only 38% of patients (75/194). Although no small bony, thin metal, or plastic materials were detected on routine radiologic examinations, failure to locate an object on X-rays does not preclude its presence. Thus, in patients with typical clinical presentations or with highly suspected foreign body ingestion, an endoscopic evaluation should be performed even with a normal finding in radiography^[12,25-27].

Recently, the ASGE Standards of Practice Committee published guidelines for foreign body management and divided the timing of endoscopic intervention into three groups - emergency, urgent, and non-urgent - according to the characteristics of the foreign object^[9]. Emergency endoscopic intervention is required for patients with high-grade esophageal obstruction and ingestion of disk batteries or sharp-pointed long objects^[9]. Urgent endoscopic intervention is needed for esophageal foreign objects that are not sharp-pointed, food impaction without complete obstruction, sharp-pointed objects in the stomach or duodenum, objects longer than 6 cm in length, and magnets within endoscopic reach^[9]. They also recommended that because delay decreases the likelihood of successful removal and increases the risk of complications, including risk of perforation, endoscopic removal should not be delayed beyond 24 h for patients with esophageal foreign bodies or food impaction^[9]. However, even in that report, a relationship between impaction duration and risk of complications, such as perforation, bleeding, or ulcer formation, was not demonstrated and the differences between "emergency" and "urgent" were debatable.

In practice, the need for and timing of an endoscopic intervention depend on various factors, including the patient's age, clinical condition, foreign body size, shape, content, anatomical location, and duration time since ingestion^[9,28]. Additionally, because most patients visited the emergency department, we frequently encounter the problem of making a decision regarding the timing of an endoscopic intervention. A strength of our study is that we assessed the risk factors for complications according to particular impaction time, in contrast to some other published studies that mentioned simply "long" impaction duration as a risk factor or that impaction time showed no association with the risk of complications^[19,29]. The question of whether impaction time is a risk factor for complications has been controversial. As in the ASGE guidelines mentioned above, Loh *et al.*^[30] suggested that if the foreign body had been impacted for more than 1 d, there was a 14-fold greater risk of a major complication vs less than 24 h. Wu *et al.*^[20] reported that patients with delayed endoscopic intervention (> 24 h) may have additional symptoms, such as

Table 5 Cases of surgical intervention

No.	Cause of surgery	Foreign body type	Foreign body size (mm)	Foreign body location
1	Failure of endoscopic removal	Animal bone	25	Upper esophagus
2	Failure of endoscopic removal	Stone	35	Mid esophagus
3	Failure of endoscopic removal	Stone	30	Mid esophagus
4	Failure of endoscopic removal	Fish bone	35	Mid esophagus
5	Failure of endoscopic removal	Pin	35	Stomach
6	Perforation	Metal	25	Stomach
7	Perforation	Fish bone	25	Upper esophagus
8	Perforation	Shell	35	Upper esophagus
9	Abscess	Fish bone	15	Upper esophagus

Table 6 Results of multivariate analysis following univariate analysis of risk factors for foreign body removal related with complications

	Yes (n = 51)	No (n = 143)	P value	OR	P value
Age (yr, mean ± SD)	61.18 ± 17.26	52.58 ± 17.82	0.003		
> 60/≤ 60	27/24	57/86	0.106	1.84 (0.87-3.91)	0.112
Gender					
Male/female	26/25	63/80	0.394	1.42 (0.71-2.86)	0.327
Foreign body					
Location			0.381		
Upper esophagus	27	84		1	0.213
Mid and lower esophagus	20	42		0.55 (0.25-1.24)	0.151
Stomach	4	17		1.61 (0.46-5.64)	0.460
Size (cm, mean ± SD)	2.22 ± 0.83	1.87 ± 0.85	0.012		
> 3 cm / ≤ 3 cm	24/27	43/100	0.028	1.70 (0.82-3.54)	0.155
Sharpness (Yes/No)	36/15	74/69	0.02	2.48 (1.07- 5.72)	0.034
Radio-opacity (Yes/No)	20/31	55/88	0.924	0.98 (0.46-2.08)	0.955
Esophageal stricture (Yes/No)	3/48	24/119	0.053	0.27 (0.06-1.12)	0.071
Duration of impaction (min), mean ± SD,	2304 ± 4245,	853 ± 1195,	0.022, 0.094		
median (min-max)	390 (56-23000)	270 (60-18720)			
> 12 h/≤ 12 h	22/29	35/108	0.012	2.42 (1.12-5.25)	0.025

odynophagia and esophageal ulceration, although they also concluded that severe complications, including esophageal perforation and bleeding, showed no correlation with impaction time. Jung *et al.*^[19] reported a "long" duration of impaction without mentioning a particular time as a predictive factor for complications after foreign body ingestion. However, Park *et al.*^[29] reported no correlation of impaction time (> 24 h) with risk of complication, and that sharp-pointed objects, greater length of foreign bodies, and the presence of symptoms were significant risk factors for complications. In contrast, our results showed that impaction duration and sharpness of foreign bodies were the two important risk factors for the development of major complications. In particular, impaction duration over 12 h but less than 24 h had a 2.4-fold increased risk for major complications, whereas age over 60 years, presence of stricture, radio-opacity, foreign body location, and size over 30 mm did not show correlations with the development of complications.

Our study had several limitations. First, although emergency endoscopic removal should be advocated, and we did not experience asphyxia or aspiration, development of these complications due to insufficient fasting time is a possibility. Second, our analysis was limited to a retrospective review of available still

EGD images and medical records, so the degree of complications, such as mucosal damage, was not defined objectively, and some potential bias might have been added. Third, due to the relatively small numbers of cases with major complications, such as perforations, in this population, it is difficult to analyze the risk ratio for serious complications. Thus, further prospective studies with larger numbers of patients are needed to confirm these results.

In conclusion, when patients with foreign bodies in the upper gastrointestinal tract present for care, predictive factors for complications should be considered carefully. Because delayed endoscopic removal, beyond 12 h, and sharp objects decrease the likelihood of successful endoscopic removal and increase the risk of complications, early recognition and urgent endoscopic intervention after ingestion are necessary.

COMMENTS

Background

Foreign body ingestion is commonly encountered in the emergency department. Although 80% or more of the ingested objects are likely to pass spontaneously, in approximately 20% of cases, foreign bodies may require endoscopic or surgical intervention. Endoscopic removal of foreign bodies can sometimes be associated with severe or even life-threatening complications. However, there has been no consensus regarding risk stratification for the prevention for complications related to endoscopic foreign body removal.

Research frontiers

Many researchers have discussed the risk factors for complications associated with upper gastrointestinal foreign body impaction. And recently the ASGE Standards of Practice Committee published guidelines for foreign body management. However, there are still many debates regarding risk factors affecting complication occurrence.

Innovations and breakthroughs

Previous published studies reported age, impaction site and long duration of foreign body ingestion were considered the risk factors for complications of endoscopic foreign body removal. However, because consensus has not been reached regarding impaction time, the authors evaluate the risk factors for complications according to particular impaction time.

Applications

If foreign body ingestion is longer than 12 h or sharp-pointed object impaction is suspected, rapid endoscopic intervention may benefit patients with ingested foreign bodies.

Terminology

Foreign body ingestion in the upper gastrointestinal tract can be defined as objects swallowed accidentally or intentionally, or materials swallowed naturally when taking medication or food. Significant complications associated with foreign body impaction include deep lacerations with minor bleeding, ulcer, perforation, and abscess.

Peer-review

This article is to address the risk factors for complications associated with endoscopic removal of ingested foreign bodies in upper gastrointestinal tract, which is a retrospective study conducted on 194 patients at two university hospitals. In the article, sharpness (HR = 2.48, 95%CI: 1.07-5.72, *P* = 0.034) and longer than 12 h of impaction duration (HR = 2.42, 95%CI: 1.12-5.25, *P* = 0.025) are major risk factors for complications. These results suggest that early recognition and urgent endoscopic intervention are necessary for the management of foreign body ingestion.

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