



## Review

# Foreign Body Ingestion, an Important Cause of Mortality and Morbidity

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### Abstract

Foreign body ingestion (FBI) is a common clinical condition, especially in childhood age groups. The aim of this study was to analyze and discuss 118 articles related to FBI, to determine the clinical approaches used in FBI, and to emphasize the importance of subject. The data of this study were compiled through a search of the Web of Science (Clarivate Analytics, Philadelphia, PA, USA). "Foreign body ingestion" was the search term used to select relevant article titles from all years available. The analysis of 118 articles included the publishing journal, the medical specialty of the research, the country of origin, the institution that performed the study, and the date of publication. Pediatric and surgical studies were most common, numbering 37 (31.3%) and 25 (21.1%), in the respective fields of research. The greatest portion of articles, 39 (33%), was published in the United States of America, and the greatest quantity of articles was published in 2005. The mean age of the patient presenting with FBI was 3.1-5 years. FBI can cause asphyxia and mortality in situations affecting the aerodigestive tract. Conservative treatment was the most common approach used; however, at times endoscopy or surgical intervention is required. FBI should be kept in mind, particularly for pediatric patients, when there are complaints of shortness of breath, abdominal pain, and vomiting.

**Keywords:** Body, endoscopy, foreign, ingestion, surgery

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Foreign body ingestion (FBI) is a common clinical condition, and is particularly encountered in pediatric age groups.<sup>[1]</sup> Every year, some 182,000 cases of FBI in children are seen in the United States.<sup>[2]</sup> The most common items swallowed that can cause trouble are coins, food, metal objects, and fishbones. However, FBI cases can include all kinds of objects, such as forks, magnets, and nails. Pre-schoolers of both sexes and individuals with mental health issues are in the high-risk group. FBI in adults most often occurs accidentally. While most foreign bodies are excreted from the gastrointestinal tract without causing harm, in some instances they can cause clinical conditions, such as obstruction, perforation, or a burn-like illness.<sup>[3, 4]</sup>

Clinical findings, X-rays, metal detectors, tomography, and endoscopy can all aid in diagnosis. While endoscopic removal is usually performed when treatment is necessary, surgical intervention may be required in some cases.<sup>[5]</sup> Conservative approaches are applied in the majority of cases.

A multidisciplinary approach is very important in diagnosis and treatment, since FBI can be related to several specialties. As a result, since the incidence is common and because FBI can affect such a wide range of health professionals, it is very useful to be aware of and monitor the milestone FBI studies.

The aim of this study was to analyze and discuss 118 FBI articles published on the Web of Science (WOS) (Clarivate

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Analytics, Philadelphia, PA, USA), determine the clinical approaches used, and to emphasize the importance of the subject.

## Methods

The data of this study were compiled through a search of the WOS collection. The Science Citation Index Expanded database includes more than 8,500 notable major journals and encompasses 150 disciplines. The WOS collection includes items published from 1900 to the present.<sup>[6]</sup> All journals that have been indexed in the Science Citation Index Expanded were included in this study. "Foreign body ingestion" was the term used to search all titles from every year. The initial result was 226 articles published between 1975 and 2017. The study analysis was conducted using a list of

118 marked as classic articles based on the journal title, the research discipline, the country, the institution where the study was performed, and the date of publication. Given the nature of this research, approval from an ethical committee was not required; however, it was conducted in accordance with the Declaration of Helsinki. No advanced statistical methods were used in the study analysis; all of the data have been reported as percentage, number, and in bar charts in tables.

## Results

In all, 118 articles related to FBI were included in the study. The research fields publishing the most studies were the pediatric and surgical specialties, with 37 (31.3%) and 25 (21.1%), respectively (Table 1). The United States of America published the greatest portion of articles, a total of 39 (33%). Turkey was ranked fifth, with 8 articles (6.7%) (Table 2). Harvard University published 4 articles concerning FBI, which made it the organization with the largest number of studies (Table 3). Articles related to FBI were published in a total of 88 journals, and the largest quantity was published in the International Journal of Pediatric Otorhinolaryngology (3.4%) (Table 4).

It was determined that articles concerning FBI have been

**Table 1.** Research area

	n	%
Pediatrics	37	31.356
Surgery	25	21.186
Emergency medicine	16	13.559
Gastroenterology/hepatology	14	11.864
Otorhinolaryngology	12	10.169
General internal medicine	11	9.322
Dentistry/oral surgery	5	4.237
Radiology/nuclear medicine/medical imaging	5	4.237
Psychiatry	4	3.390
Legal medicine	3	2.542
Psychology	2	1.695
Urology/nephrology	2	1.695
Cardiovascular system/cardiology	1	0.847
Government/law	1	0.847
Immunology	1	0.847
Infectious diseases	1	0.847
Neurosciences/neurology	1	0.847
Nutrition/dietetics	1	0.847
Pathology	1	0.847
Public environmental & occupational health	1	0.847
Toxicology	1	0.847

**Table 2.** Country of origin of articles

Country	Record count	% of 118
USA	39	33.051
Germany	9	7.627
Peoples Republic of China	8	6.780
Spain	8	6.780
Turkey	8	6.780
England	5	4.237
Australia	3	2.542
India	3	2.542
Italy	3	2.542
Japan	3	2.542

**Table 3.** Institution of origin

Organization	Record count	% of 118
Harvard University	4	3.390
University of Pennsylvania	3	2.542
Children's Hospital of Philadelphia	2	1.695
Ege University	2	1.695
Mie University	2	1.695
Queen Elizabeth Hospital	2	1.695
Singapore General Hospital	2	1.695
Suleyman Demirel University	2	1.695
United Christian Hospital	2	1.695
University of Basel	2	1.695

**Table 4.** Journal of publication

	n	%
International Journal of Pediatric Otorhinolaryngology	4	3.390 %
Journal of Emergency Medicine	4	3.390 %
Monatsschrift Kinderheilkunde	4	3.390 %
Pediatric Surgery International	4	3.390 %
American Surgeon	3	2.542 %
Gastrointestinal Endoscopy	3	2.542 %
Journal of Laryngology and Otology	3	2.542 %
Pediatric Emergency Care	3	2.542 %
Archives De Pediatrie	2	1.695 %
Canadian Journal of Gastroenterology	2	1.695 %

**Table 5.** Distribution of articles by publication date

Publication year	Record count	% of 118
2005	9	7.627
2013	8	6.780
2016	8	6.780
2010	7	5.932
2012	7	5.932
2007	6	5.085
2009	6	5.085
2015	6	5.085
1984	5	4.237
2006	5	4.237
2011	5	4.237
1997	4	3.390
1998	4	3.390
1999	4	3.390
2001	4	3.390
2017	4	3.390
1987	3	2.542
2000	3	2.542
2003	3	2.542
2004	3	2.542
1989	2	1.695
1996	2	1.695
2014	2	1.695
1980	1	0.847
1981	1	0.847
1983	1	0.847
1990	1	0.847
1991	1	0.847
1993	1	0.847
1994	1	0.847
2008	1	0.847

published since 1984 (Table 5). More articles were published in 2005 than in any other year, and, as could be expected, the least cited articles were published in 2017. The article "Management of Foreign-Body Ingestion," published by Selivanov et al. in 1984, was found to be the most cited article, with 122 citations (Table 6).

Based on an analysis of the search results, the mean age of presentation with FBI was 3.1-5 years. The incidence of mental retardation or psychiatric disease was high in adult FBI patients. The most common symptoms associated with the FBI were dysphagia, respiratory distress, and vomiting. The upper gastrointestinal system is the most frequent localization in the first evaluation of FBI. While a conservative approach can be taken in many patients, endoscopic removal is a preferred treatment option in addition to being a means of localization of the foreign body. However, in some patients, surgical intervention is required as a result of complications caused by the foreign object. Foreign bodies caught in the aerodigestive tract can cause asphyxia and mortality. Clinical scenarios that may be caused by foreign bodies are summarized in Table 7.

## Discussion

Pediatrics, surgery, emergency medicine, gastroenterology, hepatology, and otolaryngology were the fields from which most of the articles were written. An analysis of pe-

**Table 6.** The top 10 most cited articles in foreign body ingestion research

No.	Author	Title	Journal	No of citations
1	Selivanov et al.	Management of foreign body ingestion	Ann Surg. 1984 Feb; 199(2):187-91.	122
2	Cheng et al.	Foreign-body ingestion in children: Experience with 1,265 cases	J Pediatr Surg. 1999 Oct; 34(10):1472-6.	105
3	Goh et al.	Perforation of the gastrointestinal tract secondary to ingestion of foreign bodies	World J Surg. 2006 Mar; 30(3):372-7.	87
4	Uyemura et al.	Foreign body ingestion in children	Am Fam Physician. 2005 Jul 15;72(2):287-91.	73
5	Lai et al.	Risk factors predicting the development of complications after foreign body ingestion	Br J Surg. 2003 Dec; 90(12):1531-5.	56
6	Palta et al.	Foreign-body ingestion: characteristics and outcomes in a lower socioeconomic population with predominantly intentional ingestion	Gastrointest Endosc. 2009 Mar; 69(3 Pt 1):426-33.	50
7	Binder et al.	Pediatric gastrointestinal foreign body ingestions	Ann Emerg Med. 1984 Feb; 13(2):112-7.	42
8	Chung et al.	Small bowel complication caused by magnetic foreign body ingestion of children: two case reports	J Pediatr Surg. 2003 Oct; 38(10):1548-50.	39
9	Barros et al.	Foreign body ingestion: management of 167 cases.	World J Surg. 1991 Nov-Dec;15(6):783-8.	39
10	Byard	Mechanisms of unexpected death in infants and young children following foreign body ingestion	J Forensic Sci. 1996 May; 41(3):438-41.	38

**Table 7.** Clinical conditions caused by foreign body ingestion**Clinical situation**

Bowel perforation
Traumatic epiglottitis
Intestinal malrotation
Duodenocolonic fistula
Gastric and diaphragmatic perforation
Bowel obstruction
Liver abscess
Esophageal hematoma, esophageal stricture
Sacral osteomyelitis
Aerodigestive tract obstruction
Carotid artery rupture
Common carotid artery pseudoaneurysm
Subclavian pseudoaneurysm
Bezoar formation
Scrotal abscess
Acute appendicitis

diatric studies revealed that 0.7% of the patients at pediatric emergency services were there due to FBI. Although the age of children who applied to emergency service ranged between 0 and 17 years, the mean age was reported to be 3.1-5 years.<sup>[7-9]</sup>

Of the 118 articles analyzed in our study, pediatrics represented 31.3%, surgery 21.1%, emergency medicine 13.5%, gastroenterology and hepatology 11.8%, and otorhinolaryngology 10.1%. Though fewer, the specialties of cardiology, immunology, pathology, and toxicology also had articles related to FBI, at a ratio of 0.8%. FBI is most often seen in the pediatric age groups; however, a multidisciplinary approach is often needed in diagnosis and treatment.

It was determined that most of the articles related to FBI were published in international, high-impact journals, such as the International Journal of Pediatric Otorhinolaryngology, the Journal of Emergency Medicine, Monatschrift Kinderheilkunde, and Pediatric Surgery International. Most often, however, consistent with our other results, the journals were related to field of pediatrics, providing maximum exposure to readers most likely to come across FBI and emphasize its importance.

While the most frequently seen objects ingested were fish-bones, coins, and seeds, for children who are under the age of 1, most often it was a plastic object. Nonmetallic, sharp-edged objects, such as glass and magnets, were also observed, as well as batteries, which can be lethal.<sup>[7, 10, 11]</sup>

The most common symptoms of FBI seen in emergency service are dysphagia, respiratory distress, and vomiting. Dyspnea may be seen in a case of tracheal aspiration. FBI can also be asymptomatic in some patients.<sup>[10]</sup>

The most frequent localization of ingested objects was the upper gastrointestinal system. Dereci et al. and Çevik et al.<sup>[9, 12]</sup> reported that the most frequent localization was the upper esophagus. Vukovic et al.<sup>[13]</sup> reported that foreign bodies were seen in the distal esophagus at a rate of 87%. However, Aydogdu et al.<sup>[14]</sup> found the small bowel to be the most common localization with 61%. Localization may be related to the timing of patient arrival to the hospital.

Endoscopy is often used to detect the foreign object and for removal.<sup>[12]</sup> Vukovic et al.<sup>[13]</sup> reported frequent use of urgent endoscopy due to FBI at a rate of 67.9%; however, they acknowledged that it is often unnecessary, and that observation and follow-up is typically the best approach, with the exception of long objects or objects with sharp edges. Denney et al.<sup>[8]</sup> found that foreign body localization occurred most frequently in the upper esophagus and reported a success rate of 99% with endoscopic removal. Lakdhar-Idrissi et al.<sup>[15]</sup> reported a success rate of 84% with endoscopy, and noted that when the foreign body can be observed in the lower esophagus and cannot be removed during endoscopy, it can be followed-up by pressing on the stomach. Cheng et al.<sup>[16]</sup> suggested that oesophago-gastro-duodenoscopy was justified in cases of male gender, old age, and early presentation; however they recommended that a conservative approach was appropriate in low-risk patients.

Handheld metal detectors can also be used to diagnose ingestion of metallic foreign bodies and identify the point of localization, a technique that avoids radiation intake in the pediatric patient group.<sup>[17]</sup> Computerized tomography was reported to have a high negative predictive value in the correct identification of foreign bodies. Therefore, if there is a negative finding endoscopically but symptoms persist, computerized tomography scanning may be useful.<sup>[18]</sup>

Because of the complications that FBI can cause, surgical intervention is required for some patients.<sup>[9, 19]</sup> The prognosis for children is good in most cases. Small objects that do not have sharp, pointed edges and will not create toxicity will be eliminated from the body by progressing through the gastrointestinal tract.<sup>[7, 19]</sup> However, large objects may cause obstruction, especially at the ileocecal valve level.<sup>[20]</sup> In some cases, foreign bodies can cause complications that lead to morbidity and mortality.

Magnetic foreign bodies can cause local inflammation, pressure necrosis, and perforations in tissue by generating magnetic power, especially when more than one is ingested. For this reason, rapid diagnosis and treatment are very important in suspected magnetic foreign body ingestion.<sup>[21]</sup> August et al.<sup>[22]</sup> reported that a 10-year-old boy had ingested 33 magnets. Removal was performed using both

endoscopy and laparotomy. Kircher et al. reported multiple bowel perforations in a 3-year-old child as a result of the ingestion of multiple magnets.<sup>[23]</sup>

FBI can cause rare clinical conditions. Kavanagh<sup>[24]</sup> reported a case of traumatic epiglottitis as a result of FBI. Although epiglottitis is rare, it is a life-threatening clinical condition.<sup>[24]</sup> De la Fuente et al.<sup>[25]</sup> reported that the battery ingested by a 2-year-old child caused intestinal malrotation, necessitating surgical treatment. In a study conducted by Liu<sup>[26]</sup>, it was reported that a magnetic foreign body caused duodenocolonic fistula. Another rare case was reported by Antao<sup>[27]</sup>: ingestion of an eyeliner pencil led to gastric and diaphragmatic perforations. Small bowel obstruction following ingestion of a plastic part of a towel rack has also been reported in an unusual case.<sup>[28]</sup> Furthermore, Noel<sup>[29]</sup> reported a liver abscess developing as a result of FBI.<sup>[29]</sup> Esophageal hematoma, esophageal stricture, and sacral osteomyelitis are other rare clinical conditions that have occurred due to FBI.<sup>[30-32]</sup>

There is a risk of asphyxia and mortality as a result of developing airway aspiration in cases of an object becoming trapped in the aerodigestive tract. Aspiration most often occurs in the right main bronchus. In their study, Cevik et al.<sup>[9]</sup> reported mortality of 4 patients following aerodigestive tract obstruction.

Otolaryngology is one of the fields that is most interested in FBI. Among the fatal complications that can develop, carotid artery rupture due to hypopharyngeal and cervical esophageal FBI was reported in 9 patients by Wang et al.<sup>[33]</sup> One of the patients died of massive hemorrhage due to uncontrollable infection, and another patient died of severe cerebral edema. One patient also developed hemiplegia. FBI may also cause common carotid and subclavian artery pseudoaneurysms or retropharyngeal abscess.<sup>[34, 35]</sup>

Cases of FBI can also develop complications along the gastrointestinal tract. Some of these complications require emergency surgical intervention. Specifically, perforations and mechanical obstruction of the stomach, small bowel, and colon have been reported.<sup>[28, 36]</sup>

Goh et al.<sup>[37]</sup> reported that the most frequent perforations were seen in the ileum, at a ratio of 39% in the analysis of 62 cases of FBI causing gastrointestinal perforation, and it was reported that the perforation area was in the distal rectal level in 29% of the patients.

Foreign body ingestion is not unusual in people with mental retardation. Yildiz et al.<sup>[38]</sup> reported ileal perforation in a patient with mental retardation who had ingested a teaspoon. Gastrointestinal tract complications are also often seen in psychiatric patients as the result of swallowing foreign bodies such as screws, nails, scrap metal, lighters,

pegs, and coins. Another potential complication is bezoars.<sup>[39]</sup> In addition, Fry et al.<sup>[40]</sup> reported a right scrotal abscess in a schizophrenic patient who had swallowed 2 nails, which were found in the pelvis. Most often, however, FBI in adult patients is accidental. Two adult patients were treated at our center due to accidental FBI. One of the patients had a sigmoid colon perforation due to the ingestion of a plastic fork, and the other patient had a perforation and pericardial injury as a result of swallowing a chicken bone.<sup>[41]</sup> Acute appendicitis following FBI has also been reported.<sup>[42]</sup>

Laparoscopy can be used to safely and successfully remove foreign objects, as well as to treat complications, such as the repair of perforations caused by FBI, and to drain abscesses.<sup>[43]</sup>

There are currently no guidelines for the management of FBI. But recommendations on approach are provided in high volume series. Several risk factors have also been determined as predictors of complications that may develop, such as late presentation at the hospital, and involvement of the cricopharyngeus or esophagus.<sup>[44, 45]</sup>

FBI can also occur due to iatrogenic conditions. Santos et al.<sup>[46]</sup> reported that an implant had been ingested by 2 patients in the course of dental implant procedures. A colonoscopy under general anesthesia was required to remove the implant for 1 of those patients.

When the distribution of the 118 articles analyzed was examined in terms of publication date, it was determined that most of the articles were published in the 10-year period between 2005 and 2015, with 65 articles printed during that time. The content of the studies and the reporting specialty were dispersed homogeneously over time. While the treatment modality applied was mostly surgical intervention until the 1990s, endoscopic interventions became the primary treatment method in the last 10 years. The detection of metallic foreign bodies using handheld metal detectors is another recent development.<sup>[17]</sup>

In this review, 39 (33%) of the articles were published in the United States. Germany contributed 9 articles (7.6%), and was followed by the People's Republic of China, Spain, and Turkey, with 8 articles each (6.7%). These findings reflect that the United States is at the forefront concerning studies on foreign body ingestion, perhaps at least in part as a result of the large, broad patient population and substantial financial support provided to researchers. Harvard University and the University of Pennsylvania were the institutions that had the largest number of publications related to FBI.

## Conclusion

FBI is a clinical condition that is seen most often in the pediatric age group, but one that is also observed in adults,

and particularly psychiatric patients. FBI can cause asphyxia and mortality in situations affecting the aerodigestive tract. Conservative treatment is a common method of approach; however, it is necessary to remove a foreign body endoscopically in some patients, and in others, surgical intervention is required due to complications that develop. The greatest number of articles on FBI was published in 2005. The United States was the source of most of the publications studied, and Harvard University was the most frequently encountered research institution. FBI is a clinical condition that can lead to morbidity and mortality when proper diagnosis and treatment are not performed. A multidisciplinary approach is needed for optimal diagnosis and treatment. FBI should be kept in mind, especially for patients in the pediatric age group, in cases of complaints of shortness of breath, abdominal pain, and vomiting.

#### Disclosures

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