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Endoscopic failure for foreign body ingestion and food bolus impaction in the upper gastrointestinal tract: An updated analysis in a European tertiary care hospital

This is the final peer-reviewed author's accepted manuscript (postprint) of the following publication:

Published Version:

Calini G., Ortolan N., Battistella C., Marino M., Bresadola V., Terrosu G. (2023). Endoscopic failure for foreign body ingestion and food bolus impaction in the upper gastrointestinal tract: An updated analysis in a European tertiary care hospital. EUROPEAN JOURNAL OF GASTROENTEROLOGY & HEPATOLOGY, 35(9), 962-967 [10.1097/MEG.0000000000002602].

Availability:

This version is available at: <https://hdl.handle.net/11585/951772> since: 2024-01-02

Published:

DOI: <http://doi.org/10.1097/MEG.0000000000002602>

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Eur J Gastroenterol Hepatol. 2023 Sep 1 ;35(9): 962-967.

The final published version is available online at: [10.1097/MEG.0000000000002602](https://doi.org/10.1097/MEG.0000000000002602)

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Endoscopic failure for foreign body ingestion and food bolus impaction in the upper gastrointestinal tract: an updated analysis in a European tertiary-care hospital.

Short running head: foreign bodies' endoscopic management

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ABSTRACT

Objective: Foreign body ingestion and food bolus impaction (FBIs) harmfulness vary according to geographical areas, populations, habits, and diet. So, studies may not draw generalizable conclusions, and FBIs management's data in Europe are limited and out of date. This study aims to analyze FBIs endoscopic management and outcomes in an Italian tertiary-care hospital to identify risk factors for endoscopic failure.

Methods: We retrospectively reviewed all patients who underwent upper gastrointestinal endoscopy for FBIs from 2007 to 2017. Baseline, clinical, FBIs, endoscopic characteristics and outcomes were collected and reported with descriptive statistics and logistic regression analysis.

Results: Of the 381 endoscopies for FBIs, 288 [75,5%] were emergent endoscopy and 135 [35,4%] with an underlying upper gastrointestinal condition. Populations included 44 [11.5%] pediatric patients, 54 [15.8%] prisoners and 283 [74.2%] adults.

The most common FBIs' type and location were food boluses [52.9%] and upper esophagus [36,5%]. While 8 patients [2,1%] developed major adverse events requiring hospital admission, the others [97,9%] were discharged after observation. No mortality occurred.

Endoscopic success was achieved in 263 of 286 [91,9%] verified FBIs endoscopy. Endoscopic failure [8.04%] was associated with age, bone, disk battery, intentional ingestion, razor blade, prisoners, and stomach, at the univariate analysis. Multivariate logistic regression found that intentional ingestion was associated at endoscopic failure [OR=7,31, I.C.(95%)=2,06-25,99, p=0,002].

Conclusions: Endoscopy for FBIs is safe with a high success rate and low hospital admission rate in both children, prisoners, and adults. Intentional ingestion appears to be a risk factor for endoscopic failure.

KEYWORDS: Endoscopy; Food; Foreign Bodies; Risk Factors; Treatment Outcome.

INTRODUCTION

Foreign body ingestion and food bolus impaction (FBIs) are relatively frequent endoscopic emergencies that involve the population heterogeneously (1-4). Children, adults, prisoners, elderly, and patients with psychiatric disorders or cognitive impairment are affected, and they can develop severe morbidity and even mortality if not treated promptly and adequately (1-7). Severe complications are rare, but aspiration, perforation, and bleeding could be life-threatening (7-9).

Parallel to the different subjects affected by FBIs, types and harmfulness of objects and food diverge between geographical area, countries, and according to cultural habits and diet (8). Indeed, the most frequent FBIs are bones and fish bones in Asia and Eastern countries, in contrast to food bolus in Europe, while in the US is reported a broad variability between foreign bodies, bones, and food bolus (10-15). In addition, data on FBIs management in Europe are limited and out of date (7, 15-17).

Therefore, the aim of this study is to analyze the 11-year experience of FBIs endoscopic management in an Italian tertiary-care hospital to report outcomes and identify risk factors associated with endoscopy failure.

PATIENTS AND METHODS

After the approval of the Institutional Review Board, we retrospectively reviewed all the endoscopies for suspected or confirmed foreign body ingestions and food bolus impaction (FBIs) in an Italian tertiary-care academic hospital between 1/1/2007 and 31/12/2017. The hospital is serving about half a million inhabitants (18). Patients who underwent endoscopy were identified using the hospital intranet software "G2 clinico" (propriety of Insiel S.p.A - Italy) starting from 2007 since all the variables became available. We reviewed medical records, clinic notes from the emergency department, radiology, endoscopy reports, and imaging. Data collection included: baseline of the population (sex, age, nationality, population subgroups, intentional ingestion, mental health disorders, and other comorbidities). The population subgroups were pediatric (age < 16 years old), prisoners, and adult. We collected FBIs type, location, recurrence, clinical presentation, and imaging performed. Endoscopic procedure, type of anesthesia, timing of endoscopy, retrieving technique, devices used, underlying gastrointestinal diseases, endoscopic operative complication, adverse event, failure of endoscopy and need of surgery were collected. According to the 2016 European Society of Gastrointestinal Endoscopy (ESGE) guidelines, we classified timing of endoscopy as emergent (within 2 hours, at least within 6 hours) urgent (within 24 hours) or non-urgent (within 72 hours), and FBI types as food bolus, blunt objects, sharp-pointed objects, long objects, or others (1). The primary outcome was the endoscopy success rate. Secondary outcomes were to identify risk factors associated with endoscopy failure and to describe endoscopic operative complications, need for surgery, adverse events, and mortality.

Endoscopic success was defined as complete retrieval of the FBIs. For esophageal food boluses, the push technique into the stomach was considered an endoscopy success. On the contrary, endoscopic failure was defined as incomplete retrieval of the foreign objects, need for a second endoscopy, and surgery.

In our hospital, FBIs management follows the 2016 ESGE guidelines (1). In particular, emergent endoscopy for esophageal sharp-pointed objects, batteries, complete esophageal obstruction, and symptomatic esophageal food bolus; non-urgent endoscopy for blunt FBIs in the stomach failing to advance; urgent endoscopy in the other circumstances. Endoscopy for FBIs is performed in most cases with deep sedation with Propofol, sometimes with conscious sedation eventually-converted to deep sedation. We consider general anaesthesia with endotracheal intubation to ensure airway protection only in difficult cases (young patients, poor tolerance, multiple sharp-pointed foreign bodies, and high risk of aspiration). Local pharyngeal anaesthesia is seldom used, usually in non-complex EGDS when the patient refuses sedation. After the procedure, patients follow a period of observation and are discharged the same day. In this study, medical treatment has not been considered as it is not a usual practice for FBIs management at our center.

Statistical analysis was run with STATA13 (StataCorp. 2013. Stata Statistical Software: Release 13. College Station, TX: StataCorp LP). Categorical variables were described as absolute (n) and relative frequencies (%), continuous variables were described using median interquartile range. Chi-squared test and Fisher's exact test (when appropriate) were used to evaluate differences in the distribution of the outcome in relation to the other variables. The univariate logistic regression analysis was performed to evaluate the association between the considered variables and the outcome variable. Variables with $p < 0,10$ at the univariate logistic regression were included in the multivariate logistic regression model. The multivariate model was generated by applying the backward stepwise selection method. An association was considered statistically significant with $p < 0,05$.

RESULTS

Between 2007 and 2017, 381 endoscopies were performed for foreign body ingestion and food bolus impaction (FBIs) in 341 patients with an overall median age of 49.2 years and male prevalence [61%]; other baseline demographics are shown in **Table 1**. The populations' distribution included 44 procedures in 43 children (61% male), 54 procedures in 41 prisoners (100% male), and 283 procedures in 257 adults (55% male). Radiological evaluation of neck, chest, and abdomen was obtained in 195 patients with a suspected but not reliable history of FBIs to assess the presence, type, location, size, and number and rule out complications. Of the 184 plain radiography and 12 CT scans taken, FBIs were detected by 107 [55%] of the imaging performed.

Overall, 203 patients [53,3%] were asymptomatic and 135 [35,4%] had an underlying upper gastrointestinal condition associated with the FBIs such as esophageal stricture, previous surgery, stent, gastritis, and esophagitis (**Table 2**).

The most common FBIs' location and type were upper esophagus [36,5%] and food bolus [52.9%], respectively. The other location and types are in **Table 3**.

Table 4 reports the endoscopic intervention and outcomes for 381 procedures. Of them, 288 [75,5%] were emergent endoscopy, mainly under conscious or deep sedation. The most used devices were polypectomy snare 117 [40,9%] and endoscopy alone 110 [38,5%]. Local adverse events were observed in 24,7% (94 of 381) of the endoscopies, all mild superficial mucosal lesions and mucosal erythema due to the object itself. 8 patients [2,1%] developed major adverse events following the endoscopy requiring hospital admission: two bleedings (treated with adrenaline and argon plasma coagulation), an esophageal perforation (surgery), an esophageal micro-perforation with subcutaneous emphysema (nonoperative treatment), a deep lower esophageal ulcer (IV proton pump inhibitors), a systemic inflammatory response syndrome associated with a thick esophageal ring and ulcers, aspiration pneumonia, and allergic reaction. The median length of stay

of these 8 patients was 2 (1,5-8) days. The other 373 patients [97,9%] were same-day discharged after a period of observation.

Endoscopic operative complications happened during retraction of sharp FBIs in two patients: a mild superficial mucosal injury in the lower esophageal sphincter and self-limiting oral bleeding. No specific treatment was needed. Between 381 endoscopic procedures performed for FBIs, surgery was needed in 2 cases [0,5%]: the esophageal perforation described above and a lid-can partially unfolded in the stomach, impossible to retrieve endoscopically.

Endoscopic success was achieved in 263 of 286 [91,9%] FBIs verified by patient's history, symptoms, imaging, or endoscopy. Endoscopic failure (unsuccessful primary retrieving) happened in 23 of 286 [8.04%] procedures.

The results of the logistic regression are shown in **Table 5**. At the univariate analysis age, intentional ingestion, bone, disk battery, razor blade, stomach location, and prisoners showed a statistically significant association with endoscopic failure. While, only intentional ingestion was associated with technical failure [OR=7,31, I.C.(95%)=2,06-25,99, p=0,002] at the multivariate analysis.

DISCUSSION

In this 11-year period analysis conducted in an Italian tertiary-care hospital, we found that the endoscopy procedure for foreign body ingestion and food bolus impaction (FBIs) is safe and successful. However, intentional ingestion was found to be a risk factor for endoscopic failure. Endoscopic success was achieved in 91,9% of the FBIs with low endoscopic intraoperative complication [0,5%] and low major adverse event requiring hospital admission [2,1%], while the other patients were discharged the same day.

This study brings up-to-date evidence about the endoscopic management of FBIs in Europe. Indeed, recent studies describe small cohorts of selected patients' populations, while large heterogeneous studies report data from the past century **Table 6**. In particular, food bolus [52,9%] has higher rates and bones/fish bones [9,1%] lower compared to the rates reported by Athanassiadi et al. (7) and Mosca et al. (15) in the study period 1962-1999. A possible reason for this difference might be the food habits' change towards processed and out-of-home food, especially in Northern Italy (19). Secondly, one-third of the endoscopy for FBIs was related to an underlying upper gastrointestinal condition that was previously unknown for one-fourth (94 patients). Since a similar rate was also described by previous studies (11, 15, 20), FBIs removal is not the only advantage of endoscopic management. Indeed, endoscopy for FBIs seems to have also a diagnostic role. During the procedure, no use of devices was registered in over 38,5% of the endoscopy because a gentle pressure directed to the center of the object (almost all were food boluses) was enough to advance them into the stomach. In all the other cases, different devices have been used to retrieve the FB: polypectomy snare, rat-tooth forceps, grasping forceps, retrieval net, basket and rubber hood. The decision among the different types of devices has been taken on a case by case basis according to FBIs type, location and endoscopist preferences.

Importantly, endoscopy is confirmed safe to manage different FBIs in either children, prisoners, and adults. Indeed, 2,1% rate of major adverse events in our cohort is low and in line with the published literature (5, 11-13, 16, 20-23). Thus, the endoscopic success rate is lower in our study than Athanassiadi et al. (7) and Mosca et al. (15). However, it needs to be adjusted to the different intentional ingestion rates and the different definitions of endoscopic failure. Indeed, we considered the incomplete retrieval of the foreign object, the need for a second endoscopy, and surgery as an endoscopic failure. However, partial removal might be resolute for the symptoms allowing the advancement of the residual FBIs and nonendoscopic management in selected cases. Indeed, we afterward found a 97,7% rate of clinical success (symptoms resolution or unneeded secondary treatment) after the first endoscopy.

Endoscopic failure was associated with age, intentional ingestion, bone, disk battery, razor blade, stomach location, and prisoners at the univariate analysis. Hence, the multivariable logistic regression model was set with independent variables (age, intentional ingestion, FB types, and anatomical location). The prisoner population wasn't considered an independent variable because of its collinearity with intentional ingestions (Table 1). At the multivariate analysis, intentional ingestion was statistically associated with endoscopic failure with an OR=7,3. This result is confirmed by previous studies (23-26), as intentional ingestors swallow mostly sharp metallic objects, had a longer duration of FBs impaction, and delayed endoscopic management (6, 14, 26). In particular, the delayed endoscopic management might cause FBIs to travel along the gastrointestinal system and sharp object to determine mucosal inflammation, erosion or perforation. Indeed, all the aforementioned factors negatively impact the success of FBs endoscopic removal.

The retrospective nature of this single-center study and the lack of randomization are the main limitations. The represented data from a single tertiary-care hospital might limit the generalizability

of the study outcomes despite similarity with previous studies (Table 6). Also, medical treatment has not been considered as it is not the usual practice at our center. In addition, the association between populations and FBIs type and the different populations analyzed might carry both types I and II errors. However, this study represents the overall actual practice in a European tertiary-care hospital. On the other hand, the different populations and FBIs types might compromise univariate analysis variables to reach significance in the multivariate model. Besides, the relatively low rates of adverse events debar the statistical power to investigate risk factors associated with major adverse events, perforation, or surgical intervention. Future studies should investigate endoscopic failure within the different populations.

CONCLUSION

Endoscopy for FBIs is safe with a high success rate and low hospital admission rate in both children, prisoners, and adults. One-third of patients have an underlying upper gastrointestinal disease. Intentional ingestion appears to be a risk factor for endoscopic failure.

Notes

Conflict of Interest

Giacomo Calini, Naima Ortolan, Claudio Battistella, Marco Marino, Vittorio Bresadola, and Giovanni Terrosu have no conflicts of interest or financial ties to disclose.

Fundings

The authors report no involvement in the research by the sponsor that could have influenced the outcome of this work.

Authors' contribution

GC, and NO have given substantial contributions to the conception and the design of the study, to acquisition and interpretation of the data, to draft the manuscript.

CB to acquisition, analysis, interpretation of the data, and critical revision of the manuscript

MM, VB, GT have given substantial contributions to the conception, the design, the supervision, the interpretation, and to critically review the manuscript. All authors read and approved the final version of the manuscript.

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Table 1. Baseline demographics

Total endoscopy	381 [%]
Male	237 [62.2%]
Median age, y	49.2 (28.9-70.2)
Populations	
Pediatric population (<16 y)	44 [11.5%]
Adults population	283 [74.2%]
Prisoners population	54 [15.8%]
Intentional ingestion	57 [15,4] ^
Non-intentional ingestion	313 [84,6]
Nationality/Country	
Italy	315 [82,7]
Extra-EU country	55 [14,4]
EU country	11 [2,9]
Mental health disorders *	36 [9.5%] ~
Neurological disease †	28 [7,3]

Abbreviation: IQR interquartile range, EU European Union

^ 54 prisoners, 3 adults

* depression, anxiety, substance abuse, schizophrenia.

~ 16 prisoners, 20 adults

† cognitive impairment, stroke, muscular atrophy, epilepsy.

Table 2. Symptoms and upper gastrointestinal condition associated with FBIs

Total	381 [%]
Symptoms ^	178 [46,7]
Dysphagia/odynophagia	128 [71,9]
Hypersalivation	59 [33,2]
Foreign body sensation	41 [23,0]
Retching	22 [12,4]
Respiratory symptoms	8 [4,5]
Other (sore throat, asthenia, bleeding, fever, vomit)	19 [10,7]
Asymptomatic	203 [53,3]
Associated upper gastrointestinal condition ^	135 [35,4]
Esophageal stricture (ring and web)	42 [31,1]
Previous surgery or stent	41 [30,4]
Mucosal inflammatory disease (gastritis, esophagitis)	24 [17,8]
Eosinophilic esophagitis	13 [9,6]
Hiatus hernia	20 [14,8]
Esophageal motility disease or achalasia	11 [8,2]
Upper gastrointestinal tumor	10 [7,4]
Esophageal diverticulum	8 [5,9]
Duodenal diverticulum	3 [2,2]
Recurrence	58 [15,2] *

FBIs: foreign body ingestion and food bolus impaction

^ two or more in the same patient.

* 5 pediatric patients, 37 adults, and 16 prisoners.

Table 3. Location and types of FBIs

Location of FBIs ^	
Pharynx	5 [1,8]
Upper esophagus	101 [36,5]
Mid esophagus	35 [12,6]
Lower esophagus	56 [20,2]
Stomach	58 [20,9]
Duodenum	11 [4,0]
Other (jejunum, anastomosis, stent)	11 [4,0]
Total FBIs detected ^	385 [%]
Food bolus	204 [52,9]
Sharp-pointed objects	105 [27,3]
Fine objects	
Bone, fish bone	35 [9,1]
Toothpick	7 [1,8]
Glass	4 [1,0]
Piercing	2 [0,5]
Others	6 [1,6]
Sharp irregular objects	
Razor blades	29 [7,5]
Dental prosthesis	14 [3,6]
Nail clipper	2 [0,5]
Others	6 [1,6]
Blunt objects	69 [17,9]
Battery	22 [5,7]
Disk battery	7 [1,8]
Coin	22 [5,7]
Plastic	10 [2,6]
Tablet	6 [1,6]
Lighter	2 [0,5]
Long objects	5 [1,4]
Fork	3 [0,8]
Toothbrush	2 [0,5]
Other	2 [0,5]

FBIs: foreign body ingestion and food bolus impaction

^ FBIs identified by endoscopy or imaging

Table 4. Endoscopic intervention and outcomes

Endoscopy	381 [%]
Time of endoscopy	
Emergent	288 [75,5]
Urgent	77 [20,3]
Non-urgent	16 [4,2]
Anesthesia	
Conscious and deep sedation	309 [81,2]
Intubation	41 [10,8]
Local anesthesia	31 [8,1]
Endoscopic devices ^*	
Polipectomy snare	117 [40,9]
Rat-tooth forceps	59 [20,6]
Grasping forceps	23 [8,0]
Retrieval net	19 [6,6]
Basket	13 [4,5]
Rubber hood	10 [3,5]
Endoscope alone (push technique)	110 [38,5]
Outcomes	
Endoscopic operative complications~	2 [0,5]
Surgery †	2
Local adverse events (superficial mucosal lesion or erythema)	94 [24,7]
Major adverse event (requiring hospital admission) °	8 [2.1]
Median length of stay, days	2 (1,5-8)
Mortality	0
Endoscopic success *	263 [91,9]
Endoscopic failure *	23 [8,0]

^ two or more in the same patient.

* of 286 FBIs verified with history, imaging, or endoscopy.

~ retraction damage injuries: lower esophageal sphincter and mild oral bleeding.

† Surgery performed for esophageal perforation, and an unfolded lid-can in the stomach

° bleedings (2), esophageal perforations (2), deep esophageal ulcer, systemic inflammatory response syndrome, aspiration, and allergic reaction.

Table 5. Univariate and multivariate analysis for endoscopic failure

	OR (95% CI)	p-value
Univariate analysis		
Age	0.98 (0.97-0.99)	0.031
Intentional ingestion	8.83 (3.52-22.13)	<0.001
Prisoner status	7.38 (2.85-19.12)	<0.001
Razor blade	33.00 (6.04-180.29)	<0.001
Disk battery	35.75 (2.23-574.33)	0.012
Bone	16.93 (3.51-81.67)	<0.001
Fish bone	2.97 (0.26-34.15)	0.30
Stomach location	5.33 (1.35-21.02)	0.017
Mental health disorder	2.19 (0.69-7.01)	0.184
Pediatric population	0.52 (0.07-4.21)	0.546
Multivariate analysis		
Intentional ingestion	7.31 (2.06-25.99)	0.002

Table 6. Review of European studies regarding endoscopic management of foreign body ingestion and food bolus impaction (FBIs).

Author	This study	Volpi et al. (17)	Geraci et al. (16)	Athanassiadi et al. (7)	Mosca et al. (15)
Year	2021	2017	2016	2002	2001
Study period	2007 - 2017	2005-2015	2012-2014	1962-1998	1995-1999
Study design	Retrospective	Retrospective	Retrospective	Retrospective	Retrospective
Location	Udine - Italy	Bari - Italy	Palermo - Italy	Piraeus - Greece	Napoli - Italy
Hospital	Accademic tertiary care	Academic tertiary care	Accademic tertiary care	General State Hospital	Accademic tertiary care
Endoscopy	381	10	67	400	419
Patients populations	Pediatric (44) Prisoners (54) Adult (283)	Prisoners (10)	Adults (67)	Pediatric (28) Adult (372)	Pediatric (/) Adult (/)
Intentional	57 [15,4]	8 [80,0]	17 [25,3]	0	12 [2,9]
Non-intentional	313 [84,6]	2 [20,0]	50 [74,7]	400 [100]	407 [97,1]
Associated upperGI condition	135 [35,4]	/	/	23 [5,8]	82 [30,7]
Time of endoscopy					
Emergent	288 [75,5]	/	67 [100]	/	/
Urgent	77 [20,3]	/	/	/	/
Non-urgent	16 [4,2]	/	/	/	/
Location	274	/	67	400	275
Pharynx	5 [1,8]	/	5 [7,5]	/	17 [6,4]
Esophagus	192 [50,4]	/	31 [46,3]	400 [100]	201 [48,0]
Upper	101 [36,5]	/	4 [6,1]	228 [57]	97 [36,3]
Mid	35 [12,6]	/	/	104 [26]	53 [19,8]
Lower	56 [20,2]	/	27 [40,5]	68 [17]	51 [19,1]
Stomach	58 [20,9]	/	27 [40,5]	/	44 [16,5]
Duodenum	8 [2,9]	/	4 [6,1]	/	5 [1,9]
Other	11 [4,0]	/	/	/	/
FBIs classification ^	385	34	67	/	411
Food bolus	204 [52,9]	0	20 [30,2]	/	143 [37,9]
Sharp-pointed	105 [27,3]	23 [67,6]	32 [47,8]	/	/
Fine objects	54 [14,0]	7 [20,6]	23 [34,3]	/	/
Bone, fish bone	35 [9,1]	/	13 [19,4]	/	113 [27,5]
Toothpick	7 [1,8]	/	/	/	12 [2,9]
Glass	4 [1,0]	3 [8,8]	3 [4,5]	/	/
Piercing, nails, screw	2 [0,5]	3 [8,8]	7 [10,4]	/	/
Other	6 [1,6]	1 [2,9]	/	/	/
Sharp irregular objects	51 [13,2]	16 [47,1]	9 [13,4]	/	/
Razor blades	29 [7,5]	12 [35,3]	3 [4,5]	/	/
Dental prosthesis	14 [3,6]	/	4 [6,1]	/	43 [10,5]
Nail clipper	2 [0,5]	2 [5,9]	/	/	/
Other	6 [1,6]	2 [5,9]	2 [3,0]	/	22 [5,4]
Blunt objects	69 [17,9]	6 [17,6]	12 [17,9]	/	/
Battery	22 [5,7]	/	/	/	/
Disk battery	7 [1,8]	4 [11,8]	8 [11,9]	/	/
Coin	22 [5,7]	/	/	/	8 [1,9]
Plastic	10 [2,6]	/	/	/	/
Tablet	6 [1,6]	/	/	/	/
Lighter	2 [0,5]	/	/	/	/
Other	/	2 [5,9]	4 [6,1]	/	/
Long objects	5 [1,3]	/	/	/	/
Fork	3 [0,8]	/	/	/	/
Toothbrush	2 [0,5]	/	/	/	/
Other	4 [1,0]	5 [14,7]	3 [4,5]	/	70 [17,0]
Operative complications	2/381 [0,5]	0	/	/	/
Surgery	2/381 [0,5]	1/10 [10,0]	/	12 [3]	3 [1,1%]
Local adverse event	94/381 [24,7]	/	5 [7,5]	/	/
Major adverse event	8/381 [2,1]	0	4 [6,0]	2	0
Mortality	0	0	0	1 [0,25]	0
Endoscopic success~	263/286* [91,9]	8/10 [80,0]	67/67 [100]	387/400 [96,7]	256/267 [95,9]
Endoscopic failure†	23/286* [8,1]	2/10 [20,0]	0	13/400 [3,3]	11/267 [4,1]

^ according to the European Society of Gastrointestinal Endoscopy (ESGE) guidelines classification (1).

* 286 FBIs verified with history, imaging, or endoscopy.

~ complete retrieval or push technique for food boluses was considered an endoscopic success.

† incomplete foreign object's retrieval, need of a second endoscopy, or surgery was considered an endoscopic failure.