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ORIGINAL RESEARCH

Factors Influencing the Fasting Time in Adult Patients After the Endoscopic Management of Sharp Esophageal Foreign Bodies

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Background: Sharp esophageal foreign body (SEFB) impaction can cause varying degrees of damage to the esophagus. There are few studies analyzing the postoperative fasting time in SEFB patients.

Methods: We retrospectively collected 835 SEFB patients. According to the fasting time after the endoscopic removal (ER) of SEFBs, the patients were divided into two groups: short fasting time (SFT, fasted ≤24 h) and long fasting time (LFT, fasted >24 h).

Results: There were 216 and 619 patients in the SFT and LFT group, respectively. The average age of the SFT group (52.97 years) was younger than that of the LFT group (55.96 years) ($p = 0.025$). The LFT group had lower proportion of duration of impaction (DOI) within 12 hours (14.2% vs 22.2%, $p = 0.006$) and erosion rates (89.0% vs 94.0%, $p = 0.034$) as well as higher proportion of esophageal perforation (19.5 vs 6.5%, $p = 0.010$) and patients who got intravenous anesthesia (63.78% vs 31.9%, $p = 0.000$) than the SFT group. The longest diameter of the foreign body (Lmax) in the LFT group (2.60 ± 1.01 cm) was greater than that in the SFT group (2.41 ± 0.83 cm; $p = 0.01$). Multivariate regression analysis found that age (OR = 1.726[1.208–2.465], $p = 0.003$), DOI (OR = 1.793[1.175–2.737], $p = 0.007$), Lmax (OR = 1.477[1.033–2.111], $p = 0.032$), perforation (OR = 3.698[2.038–6.710]; $p < 0.01$) and intravenous anesthesia (OR = 3.734[2.642–5.278]; $p < 0.01$) were the independent factors that prolonged fasting time in patients with SEFBs, while esophageal mucosal erosion (OR = 0.433[0.229–0.820]; $p = 0.01$) was the influencing factor leading to shortened fasting time.

Conclusion: For the first time, we analyzed factors influencing the fasting time after ER in SEFB patients. Age, DOI, Lmax, perforation and intravenous anesthesia were risk factors for a prolonged postoperative fasting time.

Keywords: sharp esophageal foreign body, fasting time, endoscopic removal, esophageal perforation

Introduction

An esophageal foreign body (EFB) is a relatively common disorder in emergency departments. The types of foreign bodies found in patients of different ages and cultural regions vary greatly. In children, EFBs are mainly non-food sources, such as coins, batteries and toy parts.[1] In Western adults, EFBs are mainly soft food bolus,[2] and in Chinese adults, they are mainly sharp objects including fishbones, chicken bones, dentures and fruit pits.[3–5] The prognosis for such patients is closely related to the type and length of EFB obstruction. Soft EFBs, such as food boluses and meat pieces, cause complete or partial esophageal obstruction but relatively mild injury,[6] while sharp esophageal foreign bodies (SEFBs), for instance fish and chicken bones, can damage the esophageal walls, potentially leading to esophageal infection and perforation over time, more severely, even leading to mediastinal infection, which are life threatening, prolong the hospital staying, and would increase the medical burden.[7–9]

The treatment methods for EFBs vary according to the type and severity of the complications. Some impacted EFBs could slip from the esophagus spontaneously,[10] and these patients do not need special intervention. However, those who with esophageal perforations, deep neck abscesses, or mediastinal abscesses require surgery,[10] and the powerful anti-infective

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measures thereafter.[11] Regardless of the EFB type, timely removal is the most effective treatment. The endoscopic removal (ER) procedure for foreign bodies is time-efficient, minimally invasive, and highly successful, and it has become the primary clinical management method for EFBs.[3,12,13] The success rate of ER for EFBs reported in the literature ranged from 92.5% to 98.9%,[14,15] and our observations showed a success rate of 96.45%.[16]

An early postoperative diet can reduce surgical stress, improve the patient's immunity, reduce surgery-related complications, promote recovery and save medical resources.[17] However, SEFBs can cause varying degrees of damage to the esophagus, so an early diet could introduce various microorganisms to the aerodigestive tract, which could aggravate the local infection of the injured esophagus. Therefore, how to determine the appropriate fasting time for SEFB patients after ER is a problem that must be addressed by clinicians. Much of the current research focuses on the choice of EFB removal method and the relationship between intervention time and complications.[8,18] Few studies have discussed factors influencing the fasting time after EFB removal. Therefore, this study retrospectively analyzed the clinical and endoscopic characteristics of SEFB patients between short (fasted ≤ 24 h) fasting time (SFT) and long (>24 h) fasting time (LFT) groups after ER, and explored factors associated with long fasting time.

Materials and Methods

Study Design

We retrospectively collected clinical information for patients with SEFB who underwent endoscopic treatment at Zhongshan hospital from April 2019 to February 2021. All EFB patients were diagnosed according to the International Classification of Diseases, 10th edition diagnostic code (T18.100). Patients older than 18 years who experienced SEFB impaction and underwent ER at Zhongshan hospital were included in this study. Conversely, patients who did not undergo ER, had soft EFB impaction, had esophageal neoplastic lesions, or had an abnormal esophageal structure or function were excluded. This study was in accordance with the Helsinki declaration and was approved by the Ethics Committee of our hospital (B2022-163R). This study is a retrospective study and the data are anonymous; thus, the requirement for informed consent was waived.

Data Collection

Patient demographics and medical treatment data were reviewed. The information collected includes age, sex, the spontaneous slip of the foreign body (SSFB), success or failure of EFB removal, type of foreign body, shape of the foreign body, duration of impaction (DOI), distance of the foreign body or wound from the incisor (DFI), duration of endoscopy (DOE), the longest diameter of the foreign body (Lmax), the type of anesthesia, whether existed esophageal erosion or perforation.

Interventions

All SEFB patients underwent a detailed medical history and computed tomography (CT) examination, after which ER was performed by a highly experienced endoscopist at the endoscopy center of our hospital. A standard gastroscope system (GIF-Q260J; Olympus, Tokyo, Japan) with a transparent hood (D-201-11804; Olympus) adapted to the endoscope tip was used in the ER operation. Moreover, a rat tooth and alligator jaw grasping forceps (AF-D2416BTC; Alton, Shanghai, China) were used to remove the SEFBs during the ER procedures.[16] According to each patient's preoperative radiological appearance, endoscopic features from the surgery report of endoscopist, and the extent of damage to the esophageal mucosa, the otolaryngologist determined the postoperative fasting time of the SEFB patients.

According to the postoperative fasting time, we divided the cases into the SFT (≤24 h) and LFT (>24 h) groups. The SFT group started a liquid diet or cold liquid diet within 24 h after ER, while the LFT group started eating 24 hours to 4 weeks after ER. We compared the clinical as well as endoscopic features between the two groups.

Statistical Analysis

SPSS 25.0 software was used to perform the chi-square test or Mann Whitney *U*-test for each parameter between the two groups, and the data were presented in the form of percentages or means ± standard deviations (SD), where $p < 0.05$ indicated a statistically significant difference. Logistic regression analysis was performed to identify independent

predictive factors of prolonged fasting time after ER. Variables with $p < 0.1$ in a univariate analysis and clinically relevant variables were entered into the multivariate logistic model. Adjusted odds ratios (OR) and 95% confidence intervals (CI) were recorded, and two-tailed $p < 0.05$ was considered statistically significant.

Results

Demographics of Patients and Endoscopic Features of Sharp Esophageal Foreign Body

In total, 835 SEFB patients diagnosed by CT were included in this study, with an average age of 55.23 ± 16.92 years. Among them, 279 (33.4%) were male and 556 (66.6%) were female. There were 216 cases in the SFT group and 619 in the LFT group. Fishbones were the most common foreign body at 66.71%, followed by chicken bones at 10.03%, jujube pits at 9.19%, and duck bones and bullfrog bones at 6.13% and 2.79%, respectively. We used letters to describe the general shape of the foreign body,[16] most of which were in the shape of an "I" (56.00%), or a "D" (9.29%). For distance of the foreign body or wound from the incisor, 50.88% within 15–20 cm and 34.01% with 10–15 cm. For Lmax, 41.41% of the patients had an Lmax of the foreign body between 2 and 3 cm and, 40.26% between 3 and 4 cm. For duration of endoscopy, the DOE time for 81.3% of cases was within 4 minutes. For duration of impaction, in 216 (25.87%) patients, the foreign body was stuck for less than 12 hours, and in 619 (74.13%) patients, it was stuck for more than 12 hours. For outcomes, the SEFBs occurred in 122 patients (14.6%), the erosion occurred in 756 patients (90.3%), and perforation occurred in 135 patients (16.17%). For anaesthesia, 44.43% patients underwent local anaesthesia and 55.57% patients underwent general anaesthesia. For fasting time, 619 (74.13%) patients had more than 12 h fasting time.

Comparison of Endoscopic Features Between the SFT and LFT Groups

As shown in Table 1, the average age of the SFT group (52.97 ± 16.84 years) was younger than that of the LFT group (55.96 ± 16.85 years; $p = 0.025$). The LFT group had lower proportion of duration of impaction (DOI) within 12 hours (14.2% vs 22.2%, $p = 0.006$) and erosion rates (89.0% vs 94.0%, $p = 0.034$) as well as higher proportion of esophageal perforation (19.5 vs 6.5%, $p = 0.010$) and patients who got intravenous anesthesia (63.78% vs 31.9%, $p = 0.000$) than the SFT group. Besides, the Lmax of the foreign body in the LFT group (2.60 ± 1.01 cm) was greater than that in the SFT

Table 1 Patients Characteristics

Variables	SFT (N=216)	LFT (N=619)	p value
Gender(%)			0.061
F	155(71.8%)	401(64.8%)	
M	61(28.2%)	218(35.2%)	
Age (years)	52.97±16.84	55.96±16.85	**0.025**
DOI			**0.006**
Early intervention	48(22.2%)	88(14.2%)	
Delayed intervention	168(77.8%)	531(85.8%)	
DOE (seconds)	184.44±184.551	185.73±174.655	0.927
SSFB (%)			0.214
Y	26(12.0%)	96(15.5%)	
N	190(88.0%)	523(84.5%)	
Erosion(%)			**0.034**
Y	203(94.0%)	551(89.0%)	
N	13(6.0%)	68(11.0%)	
DFI (cm)	17.36±4.04	17.34±4.43	0.943
Type of Sharp foreign body (%)			0.915
Bullfrog bone	7(3.70%)	13(2.50%)	
Chicken bone	18(9.40%)	54(10.20%)	
Crab carapace	1(0.50%)	3(0.60%)	

(*Continued*)

Table 1 (Continued).

Variables	SFT (N=216)	LFT (N=619)	p value
Dove bone	2(1.00%)	2(0.40%)	
Duck bone	14(7.30%)	30(5.70%)	
Eggshell	1(0.50%)	1(0.20%)	
False tooth	0(0.00%)	1(0.20%)	
Fish bone	128(67.00%)	351(66.60%)	
Goose bone	1(0.50%)	1(0.20%)	
Jujube pit	14(7.30%)	52(9.90%)	
Pig bone	4(2.10%)	9(1.70%)	
Pill	0(0.00%)	3(0.60%)	
Rabbit bone	0(0.00%)	1(0.20%)	
Seashell	0(0.00%)	1(0.20%)	
Sheep bone	1(0.50%)	1(0.20%)	
Shrimp shell	0(0.00%)	2(0.40%)	
Turtle bone	0(0.00%)	2(0.40%)	
Shape of the Sharp foreign body (%)			0.226
A shape	1(0.50%)	15(2.90%)	
C shape	1(0.50%)	3(0.60%)	
D shape	13(6.90%)	52(10.20%)	
H shape	11(5.90%)	36(7.00%)	
I shape	107(57.40%)	284(55.50%)	
L shape	0(0.00%)	1(0.20%)	
Q shape	13(6.90%)	22(4.30%)	
S shape	10(5.30%)	38(7.40%)	
T shape	9(4.80%)	22(4.30%)	
U shape	1(0.50%)	0(0.00%)	
W shape	18(9.60%)	30(5.90%)	
Y shape	3(1.60%)	9(1.80%)	
Perforation (%)			**0.000**
Y	14(6.5%)	121(19.5%)	
N	202(93.5%)	498(80.5%)	
Lmax (cm)	2.41±0.83	2.60±1.01	**0.010**
Anesthesia (%)			**0.000**
Local	147(68.1%)	224(36.2%)	
Intravenous	69(31.9%)	395(63.8%)	

Notes: The bold p value indicate the significant difference between the SFT group and LFT group.
Abbreviations: SFT, short fasting time; LFT, long fasting time; DOI, duration of impaction; DOE, duration of endoscopy; DFI, distance of the foreign body or wound from the incisor; Lmax, longest diameter of the foreign body; SSFB, spontaneous slip of the foreign body. N, no, Y, yes.

group (2.41 ± 0.83 cm; p = 0.01). There were no statistically significant differences between the SFT and the LFT groups in terms of gender, DOE, DFI, the type and shape of SEFB, and the rate of SSFB (p > 0.05).

Exploring Factors That Prolonged Patients' Fasting Time After ER

Further multivariate logistic regression analyses were performed on the significance indicators in Table 1 (p < 0.1) to identify risk factors for prolonged fasting. Table 2 showed that age (OR = 1.726 [1.208–2.465], p = 0.003), DOI (OR = 1.793 [1.175–2.737], p = 0.007), Lmax (OR = 1.477 [1.033–2.111], p = 0.032), perforation (OR = 3.698 [2.038–6.710]; p < 0.01) and intravenous anesthesia (OR = 3.734 [2.642–5.278]; p < 0.01) were the independent factors that prolonged fasting time in patients with SEFBs, while esophageal mucosal erosion (OR = 0.433 [0.229–0.820]; p = 0.01) was the influencing factor leading to shortened fasting time.

Table 2 Multivariate Analysis of Risk Factors for Prolonged Fasting Time

	Odds Ratio	95% CI	p value
Gender	1.444	0.991–2.105	0.056
Age	1.726	1.208–2.465	0.003
DOI	1.793	1.175–2.737	0.007
Lmax	1.477	1.033–2.111	0.032
Erosion	0.433	0.229–0.820	0.010
Perforation	3.698	2.038–6.710	0.000
Intravenous anesthesia	3.734	2.642–5.278	0.000

Note: Significance levels, $p < 0.05$.
Abbreviations: CI, confidence interval; DOI, duration of impaction; Lmax, longest diameter of the foreign body.

Discussion

When medical professionals have to deal with the EFBs, the size, sharpness and shape of the EFBs should be be taken into consideration. The risk of injury increases when the size of the object is more than 5 cm or has a pointed shape.[19,20] For SEFB patients with vary degrees of esophageal injury, there is no standardized or consistent proposal for post-operative fasting time or nutritional support measures. Appropriate shortening of the fasting time after EFB removal could be more beneficial for the patient's recovery and could save medical resources. Therefore, we explore the factors influencing patients fasting time after EFB removal and found that age, DOI, Lmax, perforation and intravenous anesthesia use were closely related to prolonged fasting time while esophageal mucosal erosion was an influencing factor leading to shortened fasting time.

Treatment options for SEFBs include endoscopic approach, surgical intervention, drainage of the abscess if necessary, and use of appropriate antibiotics. The endoscopic approach could be performed safely for the removal of EFBs.[21] Much of the existing research focuses on observing the types of EFBs, and types of surgical methods and instruments used to remove them, the independent risk factors for serious complications of EFBs, and the surgical methods for foreign body induced esophageal perforation.[11,22,23] Thus far, little research has focused on the fasting time of patients after EFB removal by endoscopic approach. In this study, we found a higher rate of patients in the SFT group had a DOI within 12 h, this may be due to early ER intervention could reduce the esophageal damage.[16] Besides, we also found that the SFT group had a younger average age and shorter Lmax, which is consistent with previous studies reporting that a longer impaction time was associated with increased complications in SEFB patients.[8,24,25] Regarding the pattern of anesthesia, our study showed that the proportion of intravenous anesthesia was higher in the LFT group. We speculated that this may be related to the fact that intravenous anesthesia itself requires fasting, specifically a 6-hour fast after resuscitation. Further multivariate regression analysis showed that these indicators were independent factors leading to a prolonged postoperative fasting time.

Esophageal perforation caused by SEFBs often led to different degrees of infection, ranging from esophageal abscesses to mediastinal abscesses and sepsis.[26] For such patients, the fasting time was often very long, it was reported that SEFBs with perforation required 14 days of fasting.[27] Our study showed that the vast majority of patients with esophageal perforation (89.63%) fasted for more than 24 h and multivariate regression analysis showed that esophageal perforation was a risk factor for prolonged fasting. However, a small number of patients (10.37%) with esophageal perforation still fasted for less than 24 hours, which may be related to our method of classifying perforation. Cases with SEFBs piercing and penetrating the esophagus wall determined by a radiologist using preoperative CT, or by the endoscopist during ER were included in the esophageal perforation group. Thus, for some cases of esophageal perforation without comorbid infection, the extent of perforation was slight, and an early postoperative diet still did not affect the patient's recovery.

The SFT group had a higher rate of endoscopic mucosal erosion and multivariate regression analysis showed that esophageal mucosal erosion was an influencing factor leading to shortened fasting time, which was not in line with our expectations and may be related to the relatively small sample size of the SFT group. In addition, most patients with a perforation fasted for longer, so the remaining proportion of patients with erosion in the SFT group increased.

Moreover, it may also be due to the lack of objective definitions concerning the extent of erosion, such as its degree, size, and depth. We also found no statistical difference concerning whether the foreign body slipped spontaneously before ER between the two groups. This result suggested that mucosal erosion or whether the SEFB slipped before the ER procedure did not affect the doctor's decision of fasting time, and it may suggest that appropriately shortening the fasting time will not affect the recovery of SEFB patients with mucosal erosion after ER.

Our study is retrospective and has several limitations. For example, other than the anesthesia method and perforation, no clinically meaningful indicators affecting the fasting time for SEFB patients after ER were found. In addition, for patients whose fasting time was longer than 24 hours, their specific fasting time was still unknown. Moreover, our study did not consider the patients' hematological parameters, nor did it include underlying diseases that might affect the patients' infection, such as diabetes. As the complications of the endoscopic procedure were not observed in this study, whether the complications of the endoscopic procedure affect fasting time decisions need further explore. Future prospective studies are needed to remove confounding factors and to analyze more rigorously the risk factors affecting postoperative fasting time in patients with SEFBs.

Conclusion

Our study for the first time, analyzed the different clinical and endoscopic characteristics between SEFB patients with different fasting time. Multivariate regression analysis found that age, DOI, Lmax, perforation and intravenous anesthesia were independent factors leading to a prolonged postoperative fasting time.

Abbreviations

SEFB, sharp esophageal foreign body; ER, endoscopic removal; SFT, short fasting time; DOI, duration of impaction; EFB, esophageal foreign body; LFT, long fasting time; SSFB, spontaneous slip of the foreign body; DOE, duration of endoscopy; CT, computed tomography; SD, standard deviations; OR, odds ratios.

Data Sharing Statement

Datasets used in this article are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

All patients in this study signed the informed consent for biological sample donation, and the study protocol complied with the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a priori approval by the institution's human research committee. The study was approved by the Ethics Committee of Zhongshan Hospital, Fudan University (B2022-163R).

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Disclosure

The authors declare that they have no conflicts of interest in this work.

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