

Mesenteric Adhesion and Poorer Perioperative Outcomes in Gastric Submucosal Tumors: A Retrospective Study of Endoscopic Full-Thickness Resection

Qin Zeng

the second clinical medical college of Zhejiang Chinese Medical University

Ziqi Sui

The Second Affiliated Hospital of Zhejiang Chinese Medical University

Yuxuan Chen

the second clinical medical college of Zhejiang Chinese Medical University

Liwen Feng

the second clinical medical college of Zhejiang Chinese Medical University

Mi Zhou

the second clinical medical college of Zhejiang Chinese Medical University

Xinli Chen

The Second Affiliated Hospital of Zhejiang Chinese Medical University

Shuo Zhang

zhangshuotcm@126.com

The Second Affiliated Hospital of Zhejiang Chinese Medical University

Research Article

Keywords: gastric submucosal tumors, endoscopic full-thickness resection, perioperative clinical outcomes, risk factors, case-control study, peritoneal adhesion

Posted Date: October 14th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10896964/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Background

Endoscopic full-thickness resection(EFTR) has become an increasingly common method for treating gastric submucosal tumors (SMTs). Adhesion between the SMT and the adjacent mesentery represents an intraoperative challenge that can affect the perioperative clinical outcomes for patients.

Objective

The aim of this study was to analyze the risk factors for SMT–mesentery adhesion and the effect of SMT–mesentery adhesion on perioperative clinical outcomes.

Methods

We retrospectively reviewed the information of patients with gastric SMTs who underwent EFTR in our center from January 2022 to August 2026. Patients were divided into adhesion and non-adhesion groups. Perioperative clinical outcomes were compared between the two groups, and risk factors for SMT–mesentery adhesion were analyzed.

Results

A total of 202 patients were enrolled, and mesenteric adhesion was observed in 64 patients (31.7%). The adhesion group had significantly longer operative time ($P < 0.001$), greater elevation in white blood cell count ($P < 0.001$), and higher total hospitalization costs ($P < 0.001$). Multivariable logistic regression analysis revealed that tumors located on the posterior gastric wall (OR = 4.110, 95% CI: 1.855–9.105, $P < 0.001$), maximum diameter > 30 mm (OR = 7.449, 95% CI: 2.499–22.403, $P < 0.001$), and extraluminal growth pattern (OR = 15.571, 95% CI: 5.803–41.781, $P < 0.001$) were independent risk factors for tumor–mesentery adhesion, whereas hypertension (OR = 0.396, 95% CI: 0.178–0.880, $P = 0.023$) was a protective factor.

Conclusion

Mesenteric adhesion is a significant predictor of worse perioperative outcomes following EFTR for gastric SMTs, underscoring the importance of thorough preoperative assessment. Accordingly, EFTR should be approached with caution in patients with imaging evidence of mesenteric adhesion.

Introduction

Gastric submucosal tumors (SMTs) or subepithelial lesions (SELs) are protruding gastric lesions that can be identified at endoscopy with intact overlying mucosa, originating from the dissection of muscularis mucosae, submucosa, or muscularis propria^[1]. As a result of limited effectiveness, it is difficult to achieve complete resection of larger or deeper gastric SMTs by endoscopic submucosal dissection (ESD); furthermore, the residual tumor often requires more invasive surgery^[2]. The recent rapid development of endoscopic techniques such as endoscopic full-thickness resection (EFTR), which involves intentional intraoperative perforation, has allowed en bloc tumor resection and, consequently, has resulted in fewer complications and reduced recurrence rate^[3, 4]. In addition, EFTR has a less-invasive phenotype and preserves gastric function, which has led to its use as a preferred treatment choice for gastric SMTs^[5, 6].

Some gastric SMTs require EFTR, during which mesenteric adhesions may be observed, which increases the difficulty of the procedure and is associated with considerable postoperative clinical symptoms and laboratory abnormalities. Consequently, in this study, we compared postoperative clinical outcomes of patients with and without mesenteric adhesions and identified risk factors associated with the development of mesenteric adhesions to assist endoscopists in preoperative risk assessment, improve surgical strategies, and facilitate intraoperative decision-making.

Methods

Study Design and Patient Population

A single-center retrospective study was performed at The Second Affiliated Hospital of Zhejiang Chinese Medical University. Written informed consent was obtained from all patients for the endoscopic procedure with awareness of the associated advantage and risk. The study protocol was approved by the institutional review board of the hospital and was conducted in accordance with the principles of the Declaration of Helsinki. All the authors had full access to the study data and all have read and approved this final manuscript.

Consecutive patients with gastric SMTs who underwent EFTR at the Digestive Endoscopy Center of our hospital between January 2022 and August 2026 were enrolled (Fig. 1).

Inclusion criteria were: (1) age 18–85 years; (2) no sex restriction; and (3) endoscopic diagnosis of SMT meeting the indications for endoscopic tumor resection.

Exclusion criteria were: (1) SMTs not originating from the muscularis propria; (2) patients with hematologic disorders, malignant tumors, tumors resected by other modalities, or those unwilling to receive treatment (Fig. 1). All enrolled patients underwent endoscopic ultrasound to confirm that the lesion originated from the muscularis propria and successfully underwent EFTR.

The following data were collected: 1) patient baseline characteristics, including sex, age, history of hypertension, diabetes, abdominal surgery, smoking, and alcohol consumption, as well as preoperative

white blood cell (WBC) count, hemoglobin (HGB), and C-reactive protein (CRP) levels; 2) tumor characteristics, including longitudinal location, gastric wall position, maximum diameter, growth pattern (intraluminal, intramural, or extraluminal) ^[7], and pathological diagnosis; and 3) clinical outcomes, including operative time (from marking to complete wound closure), maximum body temperature and abdominal pain within 24 hours postoperatively, postoperative elevations in WBC count and CRP, postoperative decrease in HGB (preoperative vs. postoperative day 1), length of hospital stay, and hospitalization costs.

R0 resection was defined as the absence of tumor cell infiltration at all resection margins (including both horizontal and vertical/basal margins) on microscopic examination.

In this study, mesenteric adhesion is defined as intraoperative adherence of the gastric SMT to the adjacent greater omentum or transverse mesocolon. Patients were divided into an adhesion group and a non-adhesion group. The endoscopic definition of adhesion was: after incision of the serosal layer during EFTR, mesenteric tissue was seen to be attached to or connected with the tumor (Fig. 2). After serosal incision, the tumor was found to be adherent to the mesentery, requiring active separation by the operator, with visible blood vessels traversing the adhesion plane. Endoscopic images or videos were independently reviewed by three gastroenterologists to confirm the presence or absence of tumor–mesentery adhesion.

EFTR Procedural Steps

EFTR was performed according to the following steps: 1) Marking: the lesion margin was marked by electrocoagulation; 2) Submucosal injection: normal saline containing indigo carmine was injected into the submucosal layer to create a lifting sign; 3) Mucosal incision and submucosal dissection: the mucosa was circumferentially incised, and the mucosa and submucosa were dissected to expose the tumor; 4) Full-thickness resection: the serosal layer was incised to create a controlled perforation, and the tumor was completely resected. For larger lesions, dental floss traction was used to facilitate resection; 5) Wound closure: after complete tumor resection, the defect was closed using metal clips. For larger or challenging defects, three-arm clips or endoloops were used when necessary (Fig. 3). Intra-abdominal pressure was monitored throughout the procedure, and a 50-mL syringe was used for abdominal decompression.

In cases where mesenteric adhesion was encountered, the following steps were taken: (1) careful traction and counter-traction were applied using dental floss to expose the adhesion plane; (2) the adherent mesenteric tissue was gradually dissected using an insulated-tip knife, with care taken to avoid injury to adjacent organs; (3) meticulous hemostasis was performed using coagulation forceps with a high-frequency coagulation current to prevent bleeding from the highly vascular adhesion site.

Statistical Analysis

Statistical analyses were performed using SPSS version 27.0. Preoperative WBC, HGB, and CRP contained a small proportion of missing data (< 5%), which were handled using multiple imputation with five imputations. Complete-case analysis yielded results consistent with the imputed data. Continuous variables following a normal distribution were expressed as mean $\pm$ standard deviation and compared using Student's t-test; those not following a normal distribution were expressed as medians (interquartile range) and compared using the Mann–Whitney U test. Categorical variables were expressed as frequencies (percentages) and compared using the chi-square test or Fisher's exact test. Univariate logistic regression analysis was used to identify factors associated with mesenteric adhesion, with odds ratios (ORs) and 95% confidence intervals (CIs) reported. Variables with $P < 0.10$ in univariate analysis were entered into a multivariable logistic regression model. A two-sided $P < 0.05$ was considered statistically significant.

Results

Patient Characteristics

Of 288 patients initially screened, 202 with gastric SMTs who underwent EFTR were included in the study, all achieving R0 resection. Among them, 64 (31.7%) were identified as having tumor-mesentery adhesion. Preoperative baseline characteristics of the two groups are shown in Table 1.

Table 1
Patient Characteristics

Age(years)	Total (n = 202)	non-adhesion group(n = 138, 68.3%)	adhesion group(n = 64, 31.7%)	p- value
		60.19 ± 10.65	59.36 ± 10.84	0.609
sex				0.256
male(%)	64(31.7)	40(29.0)	24(37.5)	
Female(%)	138(68.3)	98(71.0)	40(62.5)	
Smoking History				0.130
Yes(%)	29(14.4)	16(11.6)	13(20.3)	
No(%)	173(85.6)	122(88.4)	51(79.7)	
Drinking History				0.529
Yes(%)	30(14.9)	19(13.8)	11(17.2)	
No(%)	172(85.1)	119(86.2)	53(82.8)	
History of Hypertension				0.063
Yes(%)	80(39.6)	61(44.2)	19(29.7)	
No(%)	122(60.4)	77(55.8)	45(70.3)	
History of Diabetes Mellitus				0.477
Yes(%)	23(11.4)	14(10.1)	9(14.1)	
No(%)	179(88.6)	124(89.9)	55(85.9)	
History of Abdominal Surgery				0.879
Yes(%)	89(44.1)	60(43.5)	29(45.3)	
No(%)	113(55.9)	78(56.5)	35(54.7)	
WBC Count($\times 10^9/L$)	5.400 (IQR: 4.400, 6.200)	5.40 (4.48, 6.19)	5.80 (4.20, 6.55)	0.506
CRP(mg/L)	1.0000 (IQR: 0.5250, 1.9000)	1.20 (0.60, 2.00)	0.70 (0.40, 1.40)	0.014
HGB(g/L)	134.00 (IQR: 125.00, 143.00)	134.00 (123.00, 142.00)	137.20 (129.00, 147.00)	0.043

Gastric SMT Characteristics

Comparative analysis revealed significant differences between the two groups in terms of gastric wall location, maximum diameter, and growth pattern. In the adhesion group, tumors were more frequently located on the posterior gastric wall than on the anterior wall (41/64, 64.1% vs. 23/64, 35.9%). Tumors with a maximum diameter > 30 mm had a higher probability of adhesion compared with those ≤ 30 mm (17/27, 62.9% vs. 47/175, 26.8%). Pathologically, GISTs were the most common type in the adhesion group (45/64, 70.3%), followed by leiomyomas (14/64, 21.9%). Tumor growth patterns were defined according to established endoscopic guidelines as follows: intraluminal growth for tumors originating from the muscularis propria with predominant protrusion into the lumen; extraluminal growth for those with predominant protrusion toward the peritoneal cavity; and intramural growth for those not breaching the muscularis propria and presenting as elongated spindle-shaped tumors. In the adhesion group, extraluminal growth was the most common pattern (32/64, 50.0%), followed by intraluminal growth (23/64, 35.9%) (Table 2).

Table 2
Gastric SMT Characteristics

Longitudinal segmentation of the stomach	Total (n = 202)	non-adhesion group(n = 138, 68.3)	adhesion group(n = 64, 31.7)	p-value
				0.271
Gastric fundus	102(50.5)	75(54.3)	27(42.2)	
Gastric body	95(47.0)	60(43.5)	35(54.7)	
Gastric antrum	5(2.5)	3(2.2)	2(3.1)	
location at gastric wall				0.002
Anterior wall	105(52.0)	82(59.4)	23(35.9)	
posterior wall	97(48.0)	56(40.6)	41(64.1)	
Size(mm)				<0.001
≤ 30(mm)	175(86.6)	128(92.8)	47(73.4)	
>30(mm)	27(13.4)	10(7.2)	17(26.6)	
growth pattern				<0.001
intraluminal growth	119(58.9)	96(69.6)	23(35.9)	
intramural growth	38(18.8)	29(21.0)	9(14.1)	
extraluminal growth	45(22.3)	13(9.4)	32(50.0)	
Pathological Findings				0.109
GIST	130(64.4)	85(61.6)	45(70.3)	
Leiomyomas	62(30.7)	48(34.8)	14(21.9)	
others	10(5.0)	5(3.6)	5(7.8)	
Others including:	Adenomatous polyp 4(1.98%)schwannomas 20.99%lipomas 10.49% hemangiomas 10.49% Neurofibroma 20.99%			

Comparison of Postoperative Clinical Outcomes

Comparison of postoperative clinical outcomes showed significant differences between the adhesion and non-adhesion groups in operative time, postoperative WBC elevation, and hospitalization costs. The adhesion group, compared with the non-adhesion group, had significantly longer operative time (46.00 [25.00, 69.50] vs. 25.50 [19.00, 39.00] minutes, $P < 0.001$), greater elevation in WBC count (5.50 [3.90, 8.10] vs. 4.25 [2.40, 6.10] $\times 10^9/L$, $P < 0.001$), and higher hospitalization costs (RMB 21,134.96 [18,705.49,

23,868.11] vs. 17,945.80 [15,767.03, 21,096.89], $P < 0.001$). Although the differences did not reach statistical significance, patients in the adhesion group had higher postoperative body temperature, greater postoperative CRP elevation, and longer hospital stays than those in the non-adhesion group (Table 3).

Table 3
Comparison of Clinical Outcomes

Procedure time	Total (n = 202)	non-adhesion group(n = 138, 68.3)	adhesion group(n = 64, 31.7)	p- value
	29.00(20.00, 49.00)	25.50(19.00, 39.00)	46.00(25.00, 69.50)	<0.001
WBC increase($\times 10^9/L$)	4.70(2.87, 6.62)	4.25 (2.40, 6.10)	5.50 (3.90, 8.10)	<0.001
CRP increase(mg/L)	18.27(7.15, 42.11)	16.33 (5.43, 35.18)	24.50 (11.39, 55.00)	0.08
HGB decrease(g/L)	3.67 $\pm$ 8.97	3.77 $\pm$ 8.85	4.36 $\pm$ 8.95	0.990
maximum body temperature	37.40(37.10, 37.80)	37.30(37.10, 37.80)	37.50(37.20, 37.80)	0.055
abdominal pain				0.287
Yes	89(44.1)	57(41.3)	32(50.0)	
No	113(55.9)	81(58.7)	32(50.0)	
Hospitalization costs(¥)	19104.21(16309.07, 21702.30)	17945.80(15767.03, 21096.89)	21134.96(18705.49, 23868.11)	<0.001
LOS(day)	6(4, 7)	6(4, 7)	6(4, 7)	0.059

Risk Factors for Tumor–Mesentery Adhesion

To identify risk factors for mesenteric adhesion in gastric SMTs, univariate logistic regression analysis was first performed. Variables with $P < 0.10$ in univariate analysis—including history of hypertension, gastric wall location, maximum tumor diameter, tumor growth pattern, and pathological type—were subsequently entered into the multivariable model. After adjusting for all covariates, tumors located on the posterior gastric wall (OR = 4.110, 95% CI: 1.855–9.105, $P < 0.001$), maximum diameter > 30 mm (OR = 7.449, 95% CI: 2.499–22.403, $P < 0.001$), and extraluminal growth (OR = 15.571, 95% CI: 5.803–41.781, $P < 0.001$) remained independent risk factors for tumor–mesentery adhesion, whereas hypertension (OR = 0.396, 95% CI: 0.178–0.880, $P = 0.023$) was a protective factor (Table 4).

Table 4
Risk factors for omental adhesion of gastric SMT

		Univariate analysis			Multivariate analysis		
		OR	95% CI	p-value	OR	95% CI	p-value
Sex	Female	0.680	0.364–1.272	0.227			
Age		0.993	0.966–1.021	0.608			
History of Hypertension		0.533	0.283–1.003	0.051	0.396	0.178–0.880	0.023
History of Diabetes Mellitus		1.449	0.592–3.549	0.417			
History of Abdominal Surgery		1.077	0.593–1.955	0.807			
Drinking History		1.944	0.872–4.332	0.104			
Smoking History		1.836	0.826–4.081	0.136			
location at gastric wall	posterior wall	2.610	1.414–4.820	0.002	4.110	1.855–9.105	<0.001
Size of gastric SMT(mm)	>30	4.630	1.980–10.828	<0.001	7.449	2.499–22.403	<0.001
Longitudinal segmentation of the stomach							
	Gastric fundus			0.274			
	Gastric body	1.853	0.293–11.689	0.512			
	Gastric antrum	1.620	0.884–2.970	0.119			
Pathological Findings							
	Leiomyomas			0.116			0.366
	GIST	1.815	0.905–3.642	0.093	1.078	0.471–2.463	0.859
	others	3.429	0.867–13.562	0.079	3.436	0.604–19.547	0.164

		Univariate analysis			Multivariate analysis		
		OR	95% CI	p-value	OR	95% CI	p-value
growth pattern							
	intraluminal growth			<0.001			< 0.001
	intramural growth	1.295	0.540–3.109	0.562	1.679	0.648–4.347	0.286
	extraluminal growth	10.274	4.667–22.616	<0.001	15.571	5.803–41.781	< 0.001

Discussion

This study found that, during EFTR for gastric SMTs, a subset of tumors exhibited adhesion to the mesentery, resulting in significantly prolonged operative time, heightened postoperative inflammatory responses, and increased financial burden. Multivariable regression analysis further identified tumor location on the posterior gastric wall, maximum diameter > 30 mm, and extraluminal growth as independent risk factors for tumor–mesentery adhesion, while hypertension emerged as a protective factor. To our knowledge, this study provides the most systematic clinical data on mesenteric adhesion during EFTR to date.

Adhesions, characterized by abnormal proliferation of fibrous connective tissue, create abnormal connections between organs or structures; submucosal fibrosis can similarly prolong endoscopic procedural time^[8, 9]. Our study demonstrated that tumors in the adhesion group required longer operative time for EFTR. This is likely because separating the tumor from adhesions is time-consuming^[10]. Moreover, the highly vascular nature of the mesentery may increase the risk of intraoperative bleeding, further extending the operative time. The adhesion group also exhibited a more pronounced elevation in postoperative inflammatory markers, possibly attributable to prolonged electrocoagulation and exposure at the site of artificial perforation—factors that induce a more intense inflammatory stimulus^[11, 12]. Di Zhao et al. noted that prolonged operative time not only facilitates bacterial translocation from the surgical site into the bloodstream but also increases the risk of gastric fluid leakage into the peritoneal cavity, potentially leading to infection^[13]. In a retrospective study on esophageal ESD, Yi-Ru Zhao et al. found that electrocoagulation use was associated with significant elevations in WBC count and CRP levels^[14]. The greater financial burden in the adhesion group may reflect increased use of anesthetics and broad-spectrum antibiotics, as well as longer postoperative hospital stays^[15, 16].

We observed a higher proportion of SMTs located on the posterior gastric wall in the adhesion group, and this feature emerged as an independent risk factor for tumor–mesentery adhesion. This may have

an anatomical basis. The stomach is an intraperitoneal organ, and its posterior wall forms part of the anterior wall of the omental bursa (lesser sac). Major vessels such as the celiac trunk and splenic artery course posterior to the stomach. Thus, tumors on the posterior wall are anatomically closer to the mesentery and may receive a richer blood supply—a factor that may support tumor growth. Additionally, the transverse mesocolon originates from the posterior abdominal wall, and through embryonic developmental fusion, the posterior gastric wall becomes closely associated with a series of mesenteric structures originating from the posterior abdominal wall ^[17]. A maximum tumor diameter > 30 mm was also associated with a higher likelihood of mesenteric adhesion, consistent with previous reports identifying this threshold as a risk factor for severe intraoperative fibrosis ^[8]. As tumors enlarge, increased volume may exert greater pressure on the gastric wall, promoting serosal infiltration, facilitating contact with and traction on the mesentery, and potentially breaching the serosal layer to form direct adhesions. Tumor diameter > 30 mm has also been identified as an independent risk factor for failure of endoscopic resection of gastric SMTs ^[18]. Our study further identified extraluminal tumor growth as a risk factor for SMT–mesentery adhesion. Tumor surfaces express integrins, cell adhesion proteins that bind to structural proteins in surrounding tissue and actively establish adhesive interactions ^[19]. Extraluminal growth allows the tumor to breach the serosal barrier, exposing it to the intraperitoneal mesenteric environment and initiating integrin–fibronectin–mediated adhesion signaling pathways ^[20]. Tumor cells may also secrete factors that promote angiogenesis and tissue remodeling, potentially disrupting normal tissue structure and function. This may induce inflammation and fibrous tissue proliferation in the peritumoral environment, ultimately leading to pathological adhesion formation and difficult surgical dissection ^[21, 22]. Notably, hypertension was associated with reduced adhesion risk in our study. Nevertheless, the underlying mechanism remains unclear, and further studies are warranted. However, detailed medication information was not collected in this study, and further investigation is warranted.

Although previous case reports have suggested that GISTs may be associated with intra-abdominal adhesions ^[18], GISTs were not independently associated with adhesion after multivariable adjustment in our study (Table 4). This suggests that GISTs themselves may not be the primary driver of adhesion, and that their relationship with adhesion may be largely mediated by confounding factors such as tumor size, location, and growth pattern.

This study has several potential limitations. First, as a single-center retrospective study, the findings require validation in prospective, multicenter cohorts. Second, we did not perform detailed pathological or molecular biological analyses of tissue samples from adherent and non-adherent sites to explore the underlying mechanisms. Third, adhesion assessment relied on subjective visual judgment during and after surgery. Although we standardized the definition of SMT–mesentery adhesion before the study and used three independent gastroenterologists for consensus, objective evidence—such as pathological confirmation of adhesion tissue—is currently lacking. Future studies incorporating pathological evaluation of adherent tissues, detailed surgical history, and inflammatory marker analyses are warranted to elucidate the underlying mechanisms and optimize preoperative risk stratification.

Conclusions

In conclusion, gastric SMTs with adhesion to the adjacent mesentery are associated with poorer perioperative outcomes. For SMTs located on the posterior gastric wall, with a maximum diameter > 30 mm, or defined as extraluminal growth on endoscopic ultrasound or contrast-enhanced abdominal CT, we recommend that EFTR should be approached with caution to mitigate potential complications.

Abbreviations

Endoscopic Full-thickness Resection

EFTR

Submucosal Tumors

SMTs

Subepithelial Lesions

SELs

Endoscopic Submucosal Dissection

ESD

White Blood Cell

WBC

Hemoglobin

HGB

C-Reactive Protein

CRP

Odds Ratios

ORs

Confidence Intervals

CIs

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki. The study protocol was reviewed and approved by the Medical Research Ethics Committee of the Second Affiliated Hospital of Zhejiang Chinese Medical University .(Approval No. 浙医二院2025089-A01).

Consent for publication

Not applicable.

Competing interests

All authors have no conflicts of interest to disclose.

Funding

This study was supported by the Research Fund of National Health Commission under Grant NO.WKJ-ZJ-2435; the Zhejiang Provincial Traditional Chinese Medicine Science and Technology Program Young Talent Project under Grant NO. 2021ZQ086.

Author Contribution

Shuo Zhang:conception, design, critical revision, supervision. Qin Zeng:conception, design,writing. Ziqi Sui:conception, design,writing. Yuxuan Chen: Data curation. Liwen Feng:figure curation. Mi Zhou and Xinli Chen:Data curation. The manuscript has been read and approved by all the authors.

Acknowledgement

We extend our appreciation to all the doctors and nurses in the Gastroenterology Department for their kind assistance with this work.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

References

1. Nabi Z, Patil G, Puri R, Kothari T, et al. Outcomes of device assisted endoscopic full thickness resection in gastroduodenal submucosal lesions: A large, multicentre study (with videos)[J]. Dig Liver Dis, 2025.
2. Ferlitsch M, Hassan C, Bisschops R, et al. Colorectal polypectomy and endoscopic mucosal resection: European Society of Gastrointestinal Endoscopy (ESGE) Guideline - Update 2024[J]. Endoscopy,2024, 56(7):516–545.
3. Hsu WH, Wu TS, Hsieh MS, et al. Comparison of Endoscopic Submucosal Dissection Application on Mucosal Tumor and Subepithelial Tumor in stomach[J]. J Cancer,2021,12(3):765–770.
4. Dalal I, Andalib I. Advances in endoscopic resection: a review of endoscopic submucosal dissection (ESD), endoscopic full thickness resection (EFTR) and submucosal tunneling endoscopic resection

- (STER)[J]. *Transl Gastroenterol Hepatol*,2022, 7:19.
5. Granata A, Martino A, Ligresti D, et al. Exposed endoscopic full-thickness resection without laparoscopic assistance for gastric submucosal tumors: A systematic review and pooled analysis[J]. *Dig Liver Dis*,2022, 54(6):729–736.
 6. Chen T, Zhang YW, Lian JJ, et al. No-touch endoscopic full-thickness resection technique for gastric gastrointestinal stromal tumors[J]. *Endoscopy* ,2023, 55(6):557–562.
 7. Kim JY, Lee JM, Kim KW, et al. Ectopic pancreas: CT findings with emphasis on differentiation from small gastrointestinal stromal tumor and leiomyoma. *Radiology*. 2009;252(1):92–100.
 8. Lee SP, Kim JH, Sung IK, et al. Effect of submucosal fibrosis on endoscopic submucosal dissection of colorectal tumors: pathologic review of 173 case[J]. *J Gastroenterol Hepatol*,2015, 30(5):872–8.
 9. Wu QN, Xu XY, Zhang XC, et al. Submucosal fibrosis in achalasia patients is a rare cause of aborted peroral endoscopic myotomy procedures[J]. *Endoscopy*,2017, 49(8):736–744.
 10. Amri R, den Boon HC, Bordeianou LG, et al. The impact of adhesions on operations and postoperative recovery in colon cancer surgery. *Am J Surg*. 2013;206(2):166–71.
 11. Alali AA, Alkandari AA. Endoscopic management of intraprocedural bleeding during endoscopic interventions[J]. *Best Pract Res Clin Gastroenterol*,2024, 69:101912.
 12. Liao F, Liang J, Huang Y, et al. Development and validation of a model for predicting electrocoagulation syndrome after endoscopic full-thickness resection of gastric tumors[J]. *Surg Endosc*. 2025, 39(5):3087–3094.
 13. Zhao D, Liang GH, Pan JK, et al. Risk factors for postoperative surgical site infections after anterior cruciate ligament reconstruction: a systematic review and meta-analysis[J]. *Br J Sports Med*,2023, 57(2):118–128.
 14. Zhao YR, Zhang XQ. Antibiotic prophylaxis against electrocoagulation syndrome after esophageal endoscopic submucosal dissection: a single center retrospective study[J]. *Surg Endosc*,2026, 40(3):1967–1976.
 15. Pardo E, Camus M, Verdonk F. Anesthesia for digestive tract endoscopy[J]. *Curr Opin Anaesthesiol*, 2022,35(4):528–535.
 16. ASGE Standards of Practice Committee; Khashab MA, Chithadi KV, et al. Antibiotic prophylaxis for GI endoscopy[J]. *Gastrointest Endosc*,2015, 81(1):81–9.
 17. Suzuki D, Kim JH, Shibata S, et al. Topographical anatomy of the greater omentum and transverse mesocolon: a study using human fetuses[J]. *Anat Cell Biol*, 2019, 52(4):443–454.
 18. Yuan Y, Sun L, Zhou X, et al. Risk factors for the failure of endoscopic resection of gastric submucosal tumors: a long-term retrospective case-control study. *Gastric Cancer*. 2022;25(5):929–942.
 19. DU Y, Zhang H, Jiang Z, et al. Expression of L1 protein correlates with cluster of differentiation 24 and integrin β 1 expression in gastrointestinal stromal tumors. *Oncol Lett*. 2015;9(6):2595–2602.

20. Miyamoto S, Nagano Y, Miyazaki M, et al. Integrin $\alpha 5$ mediates cancer cell-fibroblast adhesion and peritoneal dissemination of diffuse-type gastric carcinoma. *Cancer Lett.* 2022;526:335–345.
21. Zeng Y, Li J, Zheng Y, et al. Development and validation of a predictive model for submucosal fibrosis in patients with early gastric cancer undergoing endoscopic submucosal dissection: experience from a large tertiary center[J]. *Ann Med*,2024, 56(1):2391536.
22. Wu J, Deng J, Theocharidis G, Sarrafian TL, et al. Adhesive anti-fibrotic interfaces on diverse organs[J]. *Nature*,2024, 630(8016):360–367.

Figures

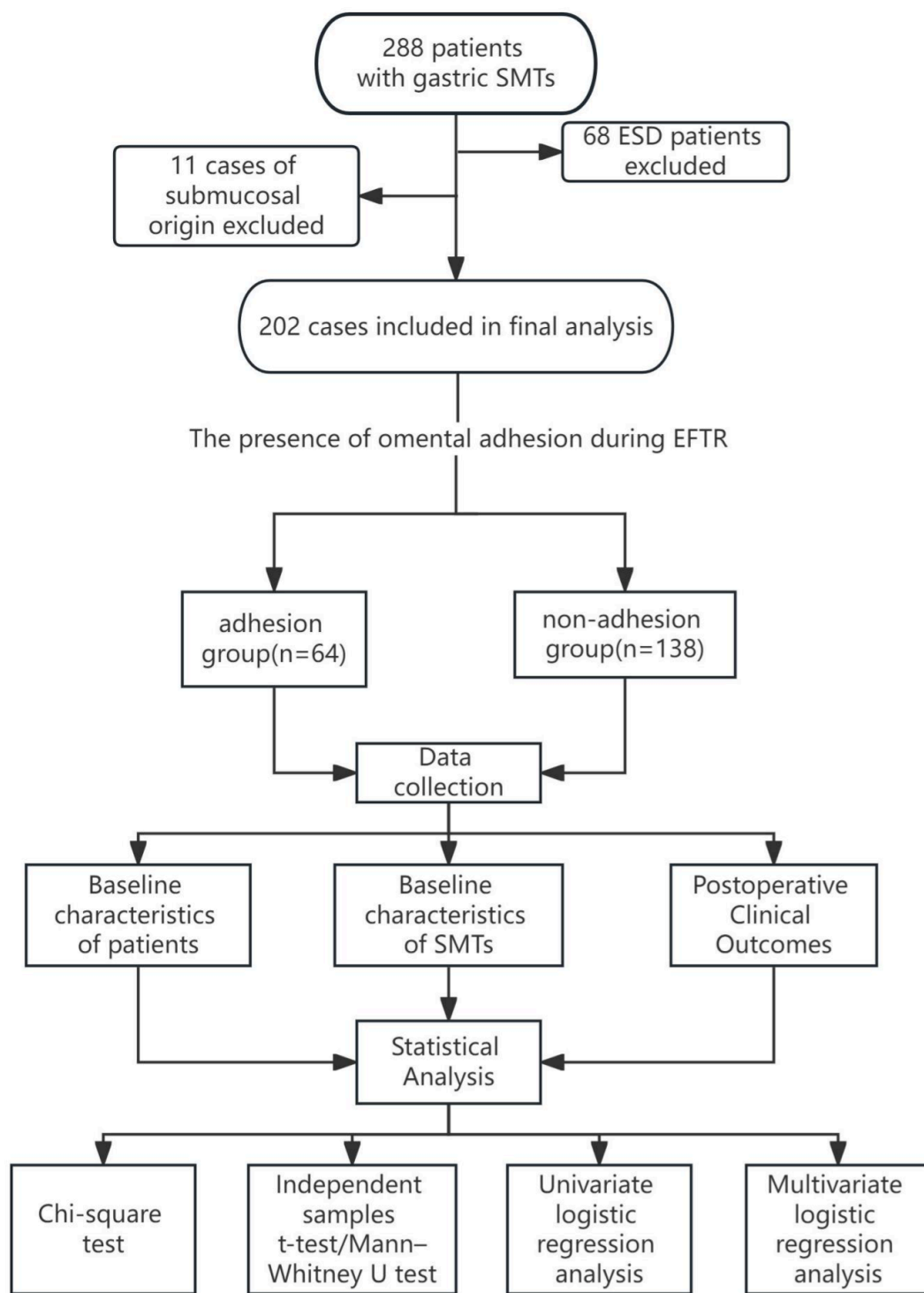


Figure 1

Flowchart of patient selection: 202 patients with gastric SMTs underwent EFTR and were included in the analysis.

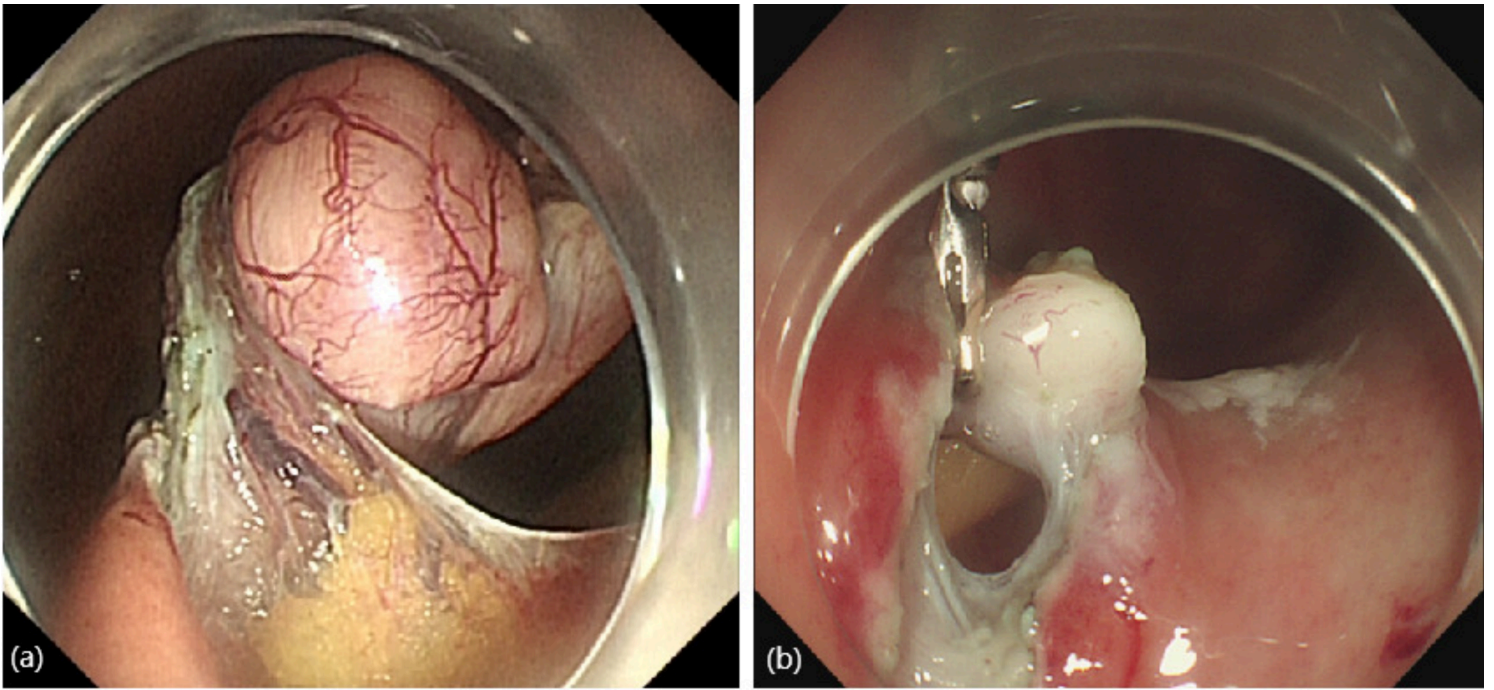


Figure 2

(a) Tumor adhesion to the omentum. (b) Absence of tumor-omental adhesion, showing the yellow omental tissue.

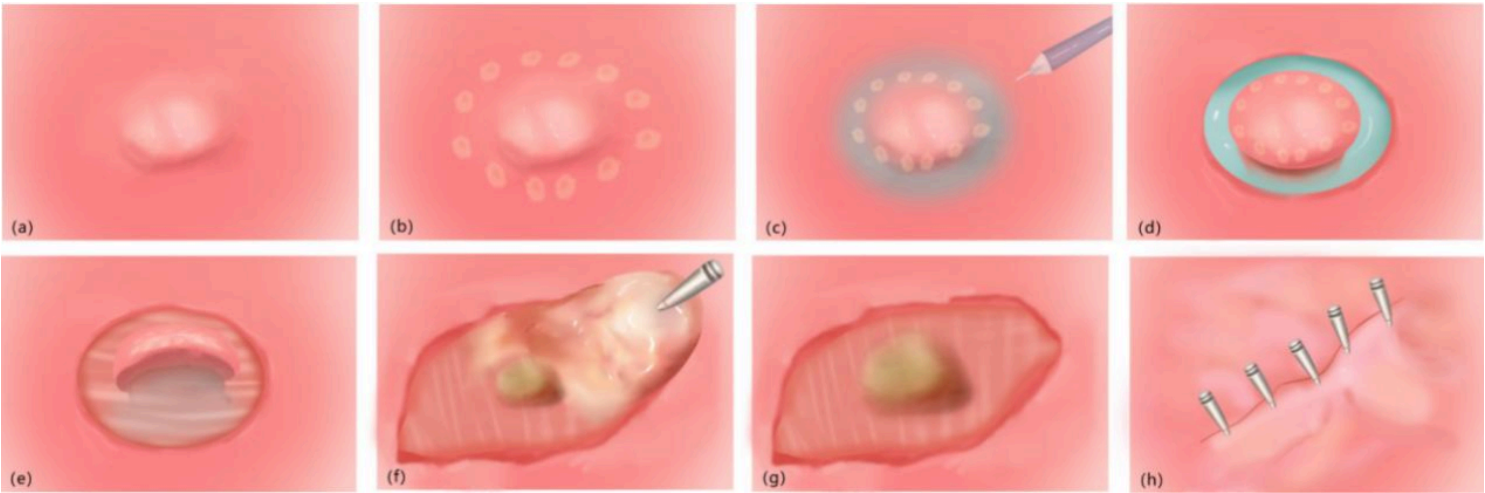


Figure 3

The steps of EFTR procedure. (a) Lesion identification. (b) Marginal marking. (c) Submucosal lifting: injection of diluted indigo carmine solution to elevate the lesion. (d) Circumferential mucosal incision. (e) Submucosal and muscular dissection. (f) Intentional perforation: a lesion with deep infiltration to the muscularis propria, serosal proximity, and malignant potential. (g) En bloc resection: the lesion was completely removed, creating a full-thickness wall defect. (h) Defect closure: the artificial perforation was closed with metallic clips.