Endoscopic full-thickness resection with clip- and snare-assisted traction for gastric submucosal tumours in the fundus: A single-centre case series

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Abstract. Exposed endoscopic full-thickness resection (Eo-EFTR) has been recognized as a feasible therapy for gastrointestinal submucosal tumours (SMTs) originating deep in the muscularis propria layer; however, Eo-EFTR is difficult to perform in a retroflexed fashion in the gastric fundus. As a supportive technique, clip- and snare-assisted traction may help expose the surgical field and shorten the operation time in endoscopic resection of difficult regions. However, the application of clip- and snare-assisted traction in Eo-EFTR of SMTs in the gastric fundus is limited. Between April 2018 and December 2021, Eo-EFTR with clip- and snare-assisted traction was performed in 20 patients with SMTs in the gastric fundus at The First Affiliated Hospital of Soochow University. The relevant clinical data were collected retrospectively for all of the patients and analysed. All 20 patients underwent Eo-EFTR successfully without conversion to open surgery or severe adverse events. The *en bloc* resection rate and R0 resection rate were both 100%. Two patients had abdominal pain and fever after the operation, and five patients had fever, which recovered with medical therapy. No complications, such as delayed bleeding or delayed perforation, were observed. The postoperative pathology indicated that 19 cases were gastrointestinal stromal tumours and one case was leiomyoma. During the follow-up, no residual tumour, local recurrence or distant metastasis was detected by endoscopy or abdominal computed tomography. In conclusion, Eo-EFTR with clip- and snare-assisted traction appears to be a relatively safe and effective treatment for gastric SMTs in the fundus. However, prospective studies on a larger sample size are required to verify the effect of the clip- and snare-assisted traction in Eo-EFTR.

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Introduction

Submucosal tumours (SMTs) are a kind of lesion that originates below the mucosal layer (1). The incidence of gastric SMTs (G-SMTs) is lower than that of gastric mucosal tumours, and the related clinical symptoms appear later (2). G-SMTs generally do not produce clinical symptoms in the early stage of onset. Most of them are found by physical examination or for other reasons (3). Most G-SMTs are benign, and only some are malignant (4,5). The most common type of SMT is a gastrointestinal stromal tumour (GIST), followed by leiomyoma and ectopic pancreas (6). All GISTs have the potential for malignant transformation, with 10-30% becoming malignant tumours, so it is of great significance to diagnose and treat them early (7-9). GISTs are the most common mesenchymal tumours in the gastrointestinal tract and are widely located, especially in the stomach (10). In GISTs, endoscopic ultrasonography (EUS) showed hypoechoic lesions in the muscularis propria (MP) of the stomach (11). At present, the clinical treatment of G-SMTs, including GISTs, is mainly surgical resection (12).

With the development of endoscopic technology, early carcinoma of the digestive tract and some SMTs can now be resected endoscopically (13,14). In recent years, endoscopic submucosal dissection (ESD) has been widely used to treat gastrointestinal tumours, including SMTs (15-17). The feasibility, safety, and effectiveness of endoscopic therapy have been proven by many studies (18-22). ESD can completely remove gastric lesions with a diameter smaller than 3 cm, which is conducive to postoperative recovery and reduces body damage (23). If the tumours originate deep in the MP or adhere to the serosa layer, perforation and incomplete resection more easily occur during ESD (24,25). In this case, exposed endoscopic full-thickness resection (Eo-EFTR), derived from ESD, is used to address the problem and reduces the incidence of residual tumours (26,27). Based on ESD, Eo-EFTR is a treatment method involving completely removing the tumours by actively manufacturing digestive tract perforations and then closing the perforation sites (28). Eo-EFTR effectively removes the tissue of SMTs, reduces the risk of recurrence, and does not increase the incidence of complications (29,30).

The effect of surgical resection is easily affected by the location and size of the tumours (31). For example, the gastric fundus is a difficult area in which to operate because of its peculiar anatomical location. The lesions in the gastric fundus are difficult to access with the front end of the endoscope, especially when they have extraluminal growth (32-34). Therefore, our study selected a method called clip- and snare-assisted traction to promote the resection of SMTs. Clip- and snare-assisted traction is performed by clamping the edge of the cut lesion mucosa with the snare device and metallic clip and then pushing or pulling the snare device to achieve traction and expose the submucosa, providing a better surgical field of vision (35). Clip- and snare-assisted traction technology can effectively shorten the operation time and reduce complications (36).

Therefore, our study recorded and reported 20 consecutive cases to explore the safety and effectivity of Eo-EFTR with clip- and snare-assisted traction for G-SMTs in the fundus.

Materials and methods

Study design and patients. This study was designed as a single-arm, retrospective, case-series study. Data from 20 patients who underwent EUS and abdominal computed tomography (CT) before undergoing Eo-EFTR for SMTs in the gastric fundus at the First Affiliated Hospital of Soochow University from April 2018 to December 2021 were retrospectively enrolled. The median age of the patients was 58 (50-68) years.

The patient inclusion criteria were as follows: i) G-SMTs arising from the muscularis propria (MP) layer, which were confirmed by EUS; ii) abdominal CT before endoscopic resection showed no sign of lymph node involvement or distant metastasis; iii) the location of the SMTs was in the gastric fundus; and iv) Eo-EFTR with clip- and snare-assisted traction was chosen to resect the tumours.

Patients who met any of the following criteria were excluded: i) Metastatic disease revealed on EUS or abdominal CT; ii) continuous use of anticoagulants or coagulation disorders; iii) severe cardiopulmonary dysfunction; iv) anaesthesia allergy; and v) lack of informed consent.

The following data were extracted: Sex, age, lesion characteristics (size, location, and origin of tumours), operating time (from submucosal injection to the accomplishment of the wound suture), *en bloc* resection (that is, complete resection without tumour rupture or bleeding), R0 resection (that is, the tumours are removed completely without disruption of the tumour capsule, and the lateral and vertical margins were negative), the success rate of the procedure, surgical conversion, intraoperative complication, pro-operative complication, hospital stay after the procedure, pathology, National Institutes of Health (NIH) classification of GISTs, and follow-up period.

All of our patients underwent Eo-EFTR by an experienced endoscopist. This study was approved by the Ethics Committee of the First Affiliated Hospital of Soochow University [ethical approval number: (2022) No. 384], and it was performed following The Helsinki Declaration. The requirement for informed consent was waived due to the retrospective nature of the study.

Endoscopic equipment and accessories. Full-thickness resection was performed by employing a standard single-channel endoscope (GIT-H290, Olympus). A transparent cap (D-201-11304; Olympus) was attached to the front of the endoscope. An IT knife (KD-611 L; Olympus, Tokyo, Japan) and a Dual Knife (KD-655 L; Olympus) were used for incision and dissection. A clip (ROCC-D-26-195, Microtech Nanjing, China) and a snare (Snare Master; Olympus; Japan) were used to assist in the traction of lesions. A high frequency generator (ICC-200, ERBE, Erbe Elektromedizin GmbH, Tübingen, Germany) and hot biopsy forceps (FD-410LR, Olympus) were used to achieve intraoperative haemostasis. Other equipment consisted of injection needles (NM-4L-1, Olympus), endoloops (LeCampTM, Changzhou, China), and carbon dioxide insufflation (Olympus).

Preoperative evaluation and procedures. All patients underwent a preoperative evaluation to identify contraindications for Eo-EFTR. EUS was performed to identify the depth of invasion and the risk of malignant transformation. Abdominal enhanced CT was performed to exclude lymph node involvement and distant metastasis before Eo-EFTR, in which case patients were converted to surgery.

Conventional examinations were performed to evaluate the health condition of the patients, such as electrocardiograms, routine blood tests, liver and kidney function tests, serum electrolyte assessments, etc.

All patients underwent procedures under monitored anaesthesia care with endotracheal intubation.

The Eo-EFTR procedure involved the following consecutive steps (Fig. 1): (a) Marking: The edge of the lesion was marked with a Dual Knife; (b) Injection: A mixed solution (including indigo carmine, 1:2,000 epinephrine, and normal saline) was injected submucosally; (c) Incision: An incision was made in the mucosal and submucosal layers along the marked points by a Dual knife. (d) Clip- and snare-assisted traction: i) The gastroscope was withdrawn from the body, and the snare was opened and placed on the front end of the transparent cap of the gastroscope. ii) The gastroscope was used to bring the snare into the gastric cavity. iii) A metallic clip was inserted into the gastroscopic biopsy hole, and the snare was grabbed by the metallic clip to trap the tumour. iv) The snare was tightened, the tumour was pushed or pulled upwards, and the surgical field was exposed at the edge of the lesion after traction. (e) Resection: The MP and serosa around the tumour were resected with an IT knife. (f) After complete resection, the tumour was removed from the stomach with the help of the tightened snare. (g) Defect closure: When the diameter of the perforation was relatively small (<1 cm), metallic clips were used to repair the defect. In other cases of a larger wound or perforation, the purse-string suture technique was used instead. The specific operation method of purse-string suture: The metal clip fixes the nylon rope along the perforation edge, then uses the nylon rope to surround the wound to be closed, and finally tightens the nylon rope to make the gastric wall mucosa around the wound converge to the perforation centre to close

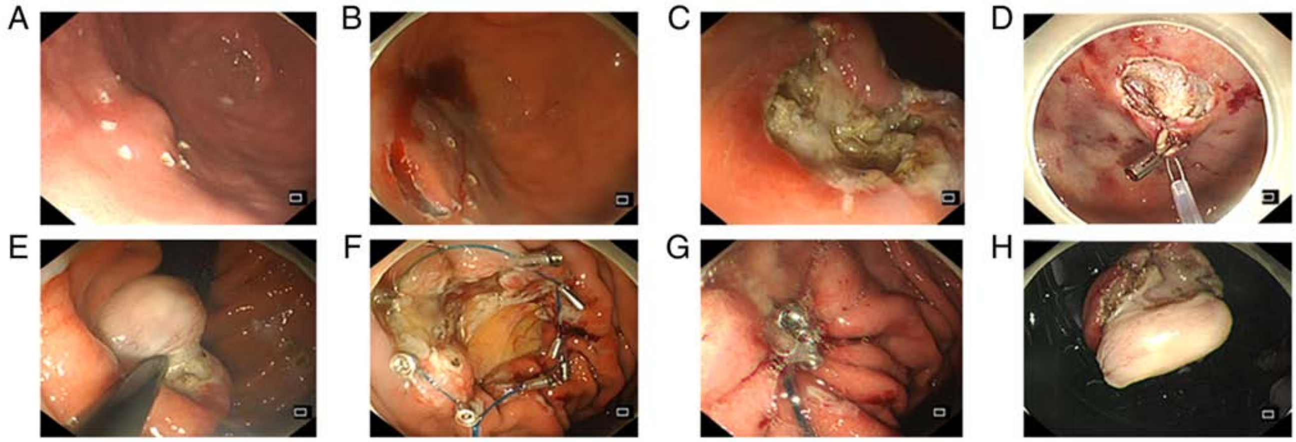

Figure 1. Eo-EFTR procedure: (A) The edge of the lesion was marked; (B) A mixed solution was injected submucosally which showed a non-lifting sign; (C) An incision was made in the mucosal and submucosal layers along the marked points; (D) clip- and snare-assisted traction; (E) The MP and serosa around the tumour were resected with an IT knife; (F and G) The defect was closed by the purse-string suture technique; (H) The tumour was removed from the stomach after complete resection.

the perforation. (h) Haemostasis: Throughout the procedure, adequate haemostasis was ensured as soon as a bleeding spot or active bleeding was detected. (i) Finally, the lesions were fixed and sent for pathological examination.

Postoperative management and follow-up. The patients were monitored with electrocardiography on the day of surgery, and oxygen was administered if necessary. The patients fasted for 24-48 h after the operation. During the fasting period, they were given intravenous fluids, including antibiotics, proton pump inhibitors (PPIs), haemostasis and nutritional support. Gastrointestinal decompression was administered to reduce the stimulation of digestive juice in response to the lesions. If there was no significant discomfort, the gastric tube was removed, and a liquid diet was started. Patients gradually returned to a normal diet as tolerated. The patients were monitored for bleeding, perforation, fever, abdominal pain, and other complications through observation of clinical symptoms and laboratory examinations. The patients were discharged when no obvious symptoms or complications were present. Gastroscopy and abdominal CT were performed regularly after the operation to monitor wound healing in cases of tumour recurrence or metastasis.

Results

Patient characteristics. The patients' characteristics are listed in Table I. There were 20 patients undergoing Eo-EFTR for SMTs in the gastric fundus at the First Affiliated Hospital of Soochow University from April 2018 to December 2021. Among these 20 patients, there were 12 males and 8 females, with a median age of 58 years. In the 20 patients, the lesions were located in the gastric fundus. All tumours originated from the deep part of the MP or adhered to the serosa layer, and some of them showed partial extraluminal growth. The median diameter of the lesions was 1.0 cm (range 0.3-2.0 cm). Of the 20 patients, the indications for endoscopic resection included EUS features of irregular edges (1/20), short-term enlargement of the tumours (1/20), patients' preference (5/20), and EUS features of heterogeneous echoes (13/20).

Operation-related data. The procedure-associated data are shown in Table II. The average operation time was 62.90 min (range 25-130 min). Haemorrhaging was effectively treated during the operation, and there was no severe bleeding due to the high-frequency generator, metallic clips, and hot biopsy forceps. Intraoperative perforations were closed via the purse-string suture technique or simple metallic clips, with 11 cases treated with clips and the rest treated with the purse-string suture technique. All endoscopic resections were performed successfully, and none of them were converted to open surgery. The *en bloc* resection rate was 100%. None the tumours resected during the operation fell into the abdominal cavity, which can lead to a risk of tumour dissemination. No pneumoperitoneum occurred during the procedure. The average length of hospital stay after the procedure was 5.2 days (range 4-9 days).

Complications. Delayed perforation, delayed haemorrhage, fistula, abdominal abscess or peritonitis were not observed after the procedure. After the procedure, 2 patients developed abdominal pain and fever, 5 patient developed fever only, and all of them returned to normal after conservative treatment (Table II).

A 68-year-old male developed median abdominal pain and bloating, along with fever. The maximum body temperature was 38.0˚C. Mild tenderness over the left upper abdomen was found on physical examination. Thereafter, abdominal CT was performed to exclude delayed perforation and peritonitis and revealed mild pneumoperitoneum and hydrothorax. After administering anti-infection (imipenem), spasm relieving (magnesium sulphate), and acid suppression (esomeprazole) treatments, his symptoms were resolved completely. The patient was discharged on the seventh day after the procedure. Other patients who developed mild abdominal pain or fever were treated with symptomatic treatment.

Pathology. The postoperative pathology showed GISTs in 19 patients, and leiomyoma in one patient (Table I; Fig. 2). The R0 resection rate was 100% (Table II). 19 GISTs had a very low risk or a low risk of recurrence because no more than 5

Table I. Patient characteristics (n=20).

Variable	Value
Median age, years (range)	58 (50-68)
Sex, n	
Male/female	12/8
Median tumour diameter, cm (range)	1.0 (0.3-2.0)
Tumour location, n	
Gastric fundus	20
Origin of tumours, n	
Muscularis propria	20
Indication for resection, n	
Short-term enlargement of the tumour	1
EUS features of irregular edges	1
Patient preference	5
EUS features of heterogeneous echoes	13
Pathology, n	
GIST	19
Leiomyoma	1
NIH classification of GISTs, n	
Very low	16
Low	2
Intermediate	1
High	0

GIST, gastrointestinal stromal tumour; EUS, endoscopic ultrasonography; NIH, National Institutes of Health.

Table II. Procedure-associated data for patients (n=20).

Variable	Value
En bloc resection, %	100
R0 resection, %	100
Surgical conversion, %	0
Intraoperative complications, n (%)	
Active perforation	20 (100)
Severe haemorrhage	0 (0)
Pneumoperitoneum	0 (0)
Tumour falling into the abdominal cavity	0 (0)
Perforation repair method, n (%)	
Conventional metallic clip closure	11 (55)
Purse-string suturing	9 (45)
Postoperative complications, n (%)	
Abdominal pain	2 (10)
Fever	7 (35)
Delayed perforation	0 (0)
Delayed haemorrhage	0 (0)
Abdominal abscess	0 (0)
Peritonitis	0 (0)
Average procedure time, min (range)	62.9 (25-130)
Average hospital stay after procedure, days (range)	5.2 (4-9)
Average follow-up period, months (range)	15.3 (6-45)
Local recurrence, %	0 (0)
Residual/Metastatic tumour, %	0 (0)

mitoses were seen per 50 high-power fields (HPF). One GIST showed 8 mitoses per 50 HPF, indicating an intermediate risk of recurrence (Table I).

Follow-up. Each patient underwent endoscopic surveillance after Eo-EFTR. The average follow-up time was 15.3 months (range 6-45 months). The wound healed well, and no local recurrence or residual tumour was observed. Abdominal CT is not performed routinely except for in medium- and high-risk patients. The medium-risk patient aged 55 was examined by CT every six months, and no metastatic tumours were found (Table II).

Discussion

Most G-SMTs are identified by chance with endoscopy because of atypical symptoms (37). G-SMTs include GISTs, leiomyomas, calcifying fibroma lipoma, ectopic pancreas, and so on (38). Among these, GISTs are the most common mesenchymal tissue-derived tumours in the gastrointestinal tract (39). Nevertheless, GISTs have a certain probability of malignant transformation (7). It is estimated that the annual incidence of GIST is approximately 11-15 per million individuals (40,41). Therefore, early diagnosis and treatment are quite significant for GISTs. According to the National Comprehensive Cancer Network (NCCN) guidelines, EUS-guided fine-needle aspiration biopsy is the preferred method to use in the diagnosis of GISTs owing to the risk of tumour haemorrhage or rupture with other methods, such as endoscopic biopsy and hollow-core needle biopsy (42). GISTs can usually be successfully diagnosed based on histopathological morphology, immunohistochemistry, and molecular biology (43,44). The treatment for GISTs includes surgical treatment, drug treatment, and endoscopic treatment (43). When the diameter is ≥2 cm, surgical resection with or without targeted therapy is usually the first choice for GISTs. When the GIST diameter is <2 cm, the NCCN guidelines recommend active follow-up if there is no sign of high-risk malignant transformation (45). Studies in Japan and Europe suggest that once a GIST is confirmed histologically, resection should be performed regardless of the diameter (43,46,47).

With the development of endoscopic technology, endoscopic surgery has gradually begun to be applied to the treatment of SMTs such as GISTs. Most studies have shown that the *en bloc* resection rate for endoscopic resection of tumours originating from the MP can reach up to 96-100% (34,48-51). Compared with surgery, endoscopic treatment has the advantages of equivalent curative effects, less trauma, rapid recovery, and less impact on organ function (52). A retrospective study comparing the efficacy of surgery and endoscopic treatment showed that EFTR has the advantage of less blood loss, shorter bowel function restoration time, and lower hospital costs. The lower *en bloc* resection rate and higher tumour capsule rupture rate of EFTR should be

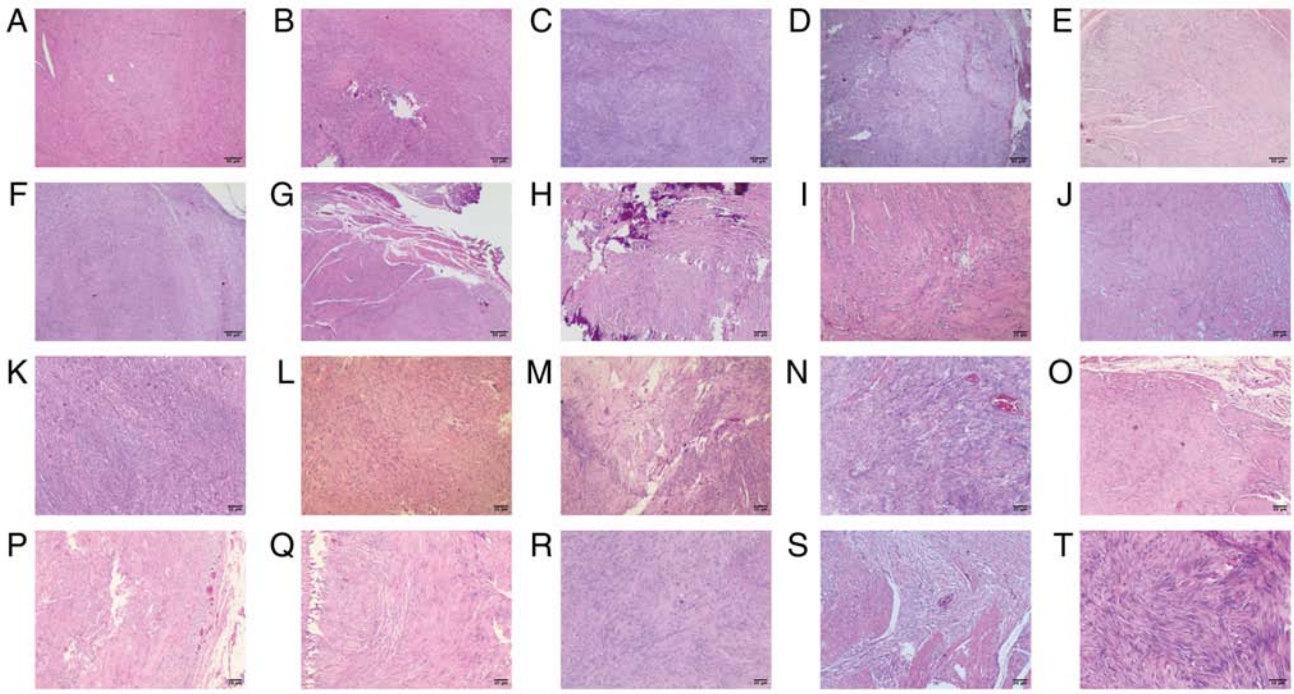

Figure 2. Histopathology of G-SMTs: (A) The pathology image suggested a leiomyoma (HE x20); (B-T): The pathology images suggested GISTs (B-G: HE x20, H-S: HE x40, T: HE x100). G-SMTs, gastric submucosal tumours; GISTs, gastrointestinal stromal tumours.

notable (48,53). To date, the main indications for endoscopic treatment of GISTs include i) GISTs with tumour enlargement in a short time and a strong willingness for endoscopic treatment; ii) preoperative evaluation excluding lymph nodes or distant metastasis; and iii) low-risk GISTs with diameters between 2 and 5 cm (54). However, when the tumour diameter is less than 2 cm, regular follow-up may increase the economic burden and anxiety. Once the tumour suddenly increases, the opportunity for timely treatment may be lost, resulting in increased risks. Therefore, patients who cannot be followed up regularly may choose elective endoscopic resection (55). The commonly used endoscopic treatments for GISTs include ESD, submucosal tunnelling endoscopic resection, EFTR and laparoscopic and endoscopic cooperative surgery (56-58). EFTR should be selected when EUS and abdominal enhanced CT identify that the tumour originates from the MP adhering to the serosa layer or with the exophytic growth pattern (27,59). Therefore, 20 cases of gastric SMTs in the fundus originating from the MP were treated with Eo-EFTR. Due to the need for retroflexion of the endoscope when tumours are located in the gastric fundus, the gastroscope has difficulty getting close to the deep part of lesions, which increases the difficulty of complete resection (36,60,61). Given this, plenty of auxiliary traction options have been developed for use during endoscopic treatment, including the clip-with-line method, snare traction, clip-snare traction, grasping forceps traction, transparent cap traction, the suture loop needle-T tag tissue anchors method, the robot-assisted method, and magnetic anchor technology (62).

The advantages of the clip- and snare-assisted traction featured in our study consist of the following: i) Simple device: Clips and snares are common devices that are available in most hospitals. ii) Widespread application: Clip- and snare-assisted traction can be used in multiple parts of the gastrointestinal tract. For difficult parts, the surgical field of vision can be effectively expanded by applying auxiliary traction to improve the success rate of the operation. iii) Flexible traction: Different directions can be selected by pushing or pulling the snare. The snare can also be used to adjust the traction force to meet the different needs of the treatment (36,63).

However, there are also some knacks and pitfalls in the clip- and snare-assisted traction. First, the operation of clip- and snare-assisted traction is difficult, which requires endoscopists to have rich experience and competent operative ability. Second, the traction force is affected by the hardness of the snare, and the softer snare is not easy to change the direction of the tumour during the operation. Finally, excessive traction force or clamping too little gastric mucosa will easily cause the titanium clip to fall off from the mucosa, consuming the operation time and increasing mucosal damage (64).

Compared with traditional ESD, EFTR involves an iatrogenic perforation. The larger the postoperative wound is, the slower the wound healing. Therefore, it is critical to effectively close the lesion defect (65). In this study, two methods were used to repair the perforation. When the perforation was <1 cm, conventional metallic clip closure was used. When the defect was ≥1 cm, purse-string suturing was selected. The advantages of purse-string suturing are as follows: i) It is suitable for perforations with a relatively large diameter. ii) It is easily controlled. iii) The spacing between metallic clips is more than 5 mm, which can reduce the need for additional clips. iv) By tightening the nylon rope, mucosal aggregation can promote wound closure without leaving gaps and prevent the leakage of gastrointestinal contents into the abdominal cavity (66,67). There are other methods of defect closure after Eo-EFTR, such as over-the-scope clips (OTSCs), which are suitable for closing larger defects after Eo-EFTR than endoscopic purse-string sutures, but the equipment is expensive and limited to lesions <3 cm, resulting in limitations to their clinical application (68-73). Omental patches, fibrin glue, endoscopic puncture suture devices, and the overstitch system are also used to repair therapeutic perforations (74-77).

The operation time in our study was 62.9 min (range 25-130 min). Tan *et al* reported that the mean procedure time for conventional EFTR (n=32) for GISTs was 69.1±27.0 min (78). In addition, Hu *et al* showed a procedure time of 130.6±51.9 min in the traditional EFTR group (n=20) (61), indicating that our study had a shorter operative time than other studies that did not use traction. Li *et al* found that the mean time for EFTR assisted by dental floss and a haemoclip for G-SMTs in the fundus was 44.2±24.4 min (79). In a retrospective study consisting of 13 patients treated with thread-traction-assisted EFTR, the mean procedure time was 71.9±30.5 min (80). Effective traction methods can reduce the difficulty of endoscopic surgery, reduce the operation time to a certain extent, and reduce the risk of complications, while the efficacy and safety of surgery are also affected by the experience of the endoscopist and the size and location of the lesions (81,82).

The main complications of EFTR were delayed bleeding and perforation. Related studies have reported that complications after EFTR also include peritonitis, abdominal abscess, subcutaneous emphysema, and mediastinal emphysema (59). Granata A *et al* reported that the pooled estimates for overall delayed bleeding and delayed perforation were 0.14 and 0.14%, respectively (83). Appropriate haemostasis measures and defect repair are important means to preventing postoperative bleeding and perforations. Additionally, the time of resumption of a normal diet, gastrointestinal decompression, and the use of PPIs and antibiotics also have a certain impact on the occurrence of postoperative complications (84). When conservative treatment is ineffective, endoscopic exploration should be carried out in a timely manner to effectively treat bleeding points or perforation sites. If endoscopic treatment is ineffective, further surgery is required (59). Most studies reported no major complications in EFTR (51,61,73,85). None of our patients experienced delayed perforation or haemorrhage. In a study reported by Tan *et al* where 32 patients with tumours originating from the MP were treated with EFTR, delayed bleeding was seen in 1 patient, and abdominal pain with low-grade fever was seen in 4 patients (78). Another study including 192 patients by Li *et al* (79) reported that pneumoperitoneum was seen in 7 (3.6%) patients, hydrothorax was seen in 6 (3.1%) patients, and post-EFTR electrocoagulation syndrome was seen in 18 (9.4%). No significant pneumoperitoneum occurred in our study. The reasons may be: i) The use of carbon dioxide insufflation during the operation could reduce the incidence of pneumoperitoneum; ii) The exposure time of abdominal cavity is controlled by endoscopists. iii) During the exposure of the patient's abdominal cavity, the endoscopy physician will try to reduce the gas injection to avoid excessive gas entering the abdominal cavity. In our study, after the endoscopic suture, the patients' abdomen will be palpated to assess the abdominal tension. If the tension is judged to be high, a Veress needle will be used for decompression.

The postoperative pathology of the 19 patients was GISTs, including 18 cases with mitotic images <5/50 HPF and 1 case with mitotic images of 8/50 HPF. Medium- and high-risk patients are advised to undergo additional treatment, such as molecular targeted therapy or additional surgery, according to the guidelines (43). The NIH grading standard divides the risk of postoperative recurrence into four grades by considering the size, location, and mitotic image of the patient's tumour (86). In our study, 16 cases were very low risk, 2 cases were low risk, and 1 case was medium risk. The patient with a moderate risk was given imatinib targeted therapy and followed up regularly. The last follow-up showed that the tumour had healed well without signs of recurrence or distant metastasis.

The success rate, complete resection rate, and R0 resection rate in this study were 100%. There was no conversion to surgery, and there were no serious adverse events or complications during or after the operation. During postoperative follow-up, all patients healed well without recurrence or distant metastasis. Our results show the feasibility, safety, and effectiveness of Eo-EFTR with clip- and snare-assisted traction for G-SMTs in the fundus. Most of the studies compared the effectiveness of EFTR and surgery, showing the advantages of EFTR, such as a shorter operation time and faster cure time (53,87). Some studies have indicated that when the lesions are too large (more than 3 cm) or there are contraindications (distant metastasis), the recurrence rate and complete resection rate of endoscopic treatment are lower than those of surgery (53). At this time, surgery is a more appropriate choice.

This study had several limitations. First of all, it is a single-centre and retrospective study, which may cause selection bias and retrospective bias. Secondly, this study was descriptive and lacked a control group. Due to the difficulty of traditional Eo-EFTR in the gastric fundus, it is difficult to collect cases in the control group. So more data need to be further collected in the future. Moreover, the object of this study are the G-SMTs, which does not involve gastric cancer cases. If possible, auxiliary traction can be applied to the endoscopic resection of gastric cancers in the future, and the effectiveness and safety of endoscopic therapy combined with auxiliary traction in gastric cancer cases can be evaluated. Finally, a prospective or retrospective study with a larger sample size is needed to further confirm the feasibility and efficacy of Eo-EFTR with clip- and snare-assisted traction for G-SMTs in the fundus, as the sample size of this study is small.

After this study, we will conduct a retrospective case-control study to compare the traditional and assisted traction Eo-EFTR and identify the specific advantages (such as less operative time and complications) of traction methods in Eo-EFTR through data analysis. In addition, we will also learn and study other traction methods, such as multiple clips- and snare-assisted traction, clip-with-line method, etc. Through the collection of data, the characteristics of different traction methods will be compared to find a more suitable and effective traction method for Eo-EFTR.

In conclusion, Eo-EFTR with clip- and snare-assisted traction appears to be a relatively safe and effective treatment for gastric SMTs in the fundus. The traction method can shorten the operative time to a certain extent and don't increase the incidence of complications.

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Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

LN and XG confirm the authenticity of all the raw data. All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated sufficiently in the work to take public responsibility for the content. LN, XL, CY, XG, CW and AW participated in the conception, design and data acquisition. LN, CZ and GX were involved with data analysis and interpretation. LN and CW wrote the draft. XG, XL and AW revised the final manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the First Affiliated Hospital of Soochow University [ethical approval number: (2022) No. 384]. The requirement for informed consent was waived due to the retrospective nature of the study.

Patient consent for publication

Written informed consent for publication was obtained from all participants in the study.

Competing interests

The authors declare that they have no competing interests.

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