Transparent Cap-Assisted Blunt Endoscopic Dissection of Gastric Submucosal Tumours Smaller than 2cm

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ABSTRACT

Objective: To evaluate the safety and effectiveness of transparent cap-assisted blunt dissection (TCABD) in the endoscopic resection of gastric submucosal tumours (G-SMT) smaller than 2cm, as compared with conventional electronic knife dissection.

Study Design: Randomised controlled analysis.

Place and Duration of the Study: Department of Gastrointestinal Surgery, The School of Clinical Medicine, Fujian Medical University, The First Hospital of Putian City, Putian, China, from July 2020 to 2022.

Methodology: Fifty-eight patients having G-SMT smaller than 2cm were included. They were randomly divided into two groups; undergoing transparent cap-assisted blunt dissection (BD group) and conventional endoscopic submucosal excavation (ESE group). The pathology, lesion size in long diameter (mm), operation time, the number of clips used to close the wounds, the number of snare used to resect the tumour, hospital days, hospitalisation expense, *en bloc* resection rate, and the complications including perforation, postoperative bleeding, and postoperative infection were compared between the two groups.

Results: The mean long diameter in the BD group was 9.6 ± 3.6mm, while the conventional ESE group was 10.7 ± 4.5mm. As compared with the conventional ESE group, the operation time, the number of clips used to close the wounds, the number of snare used to resect the tumours, the hospital days, and the hospitalisation expense were all significantly decreased ($p < 0.05$). The perforation rate was lower in the BD group ($p < 0.05$).

Conclusion: TCABD was effective and safe in the endoscopic resection of G-SMT smaller than 2cm. TCABD could help to reduce the perforation rate, shorten the operation time and hospital days, and decrease the hospitalisation expense in the endoscopic resection of G-SMT.

Key Words: *Endoscopic submucosal excavation, Endoscopic full-thickness resection, Endoscopic resection, Submucosal tumour, Transparent cap-assisted blunt dissection.*

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INTRODUCTION

Gastric submucosal tumours (G-SMT) including gastrointes-tinal stromal tumour (GIST), leiomyoma, heterotopic pancreas etc. are common endoscopic findings. Minimally invasive approaches form the mainstay of surgical treatment for small submucosal tumours (G-SMT).[1] Recently, endoscopic resection has become the first-line treatment because of its effectiveness and minimal invasiveness.[2,3] The methods used to remove the G-SMT include endoscopic submucosal dissection (ESD), endoscopic submucosal excavation (ESE), and endoscopic full-thickness resection (EFR).[4,5]

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The main complications of endoscopic resection are perioperative bleeding, delayed bleeding, localised peritonitis, or perforation, and localised peritonitis usually caused by perforation.[5,6]

Once the G-SMT originated from muscularis propria, ESE is more often used. The anatomic structures of the gastric wall are mucosa, *lamina muscularis muscosae*, submucosa, *muscularis propria* (MP), and serosa layer by turns from inside to outside. During the separation of the G-SMT from the MP by ESE, the electric knife may damage the serosa layer and cause perforation. Minimising electrocautery and employing blunt dissection during surgery may reduce the risk of perforation to some extent. Electrocautery typically produces heat, potentially leading to thermal damage to adjacent tissues and heightening the risk of perforation. Blunt dissection achieves separation by gently pushing the tissue apart, causing comparatively less direct damage to the tissue. This study aimed to evaluate the safety and effectiveness of transparent cap-assisted blunt dissection in the endoscopic resection of G-SMT which is smaller than 2cm, as compared with conventional ESE with electronic knife dissection.

METHODOLOGY

This randomised study was conducted at the Department of Gastrointestinal Surgery, The School of Clinical Medicine, Fujian Medical University, The First Hospital of Putian City, Putian, China, from July 2020 to 2022. Fifty-eight patients diagnosed with G-SMT were enrolled in this study. Patients underwent endoscopic ultrasonography (EUS) had confirmed the existence of the G-SMT (smaller than 2cm) with clear boundaries, and the G-SMT were intrinsic to the gastric wall. Computed tomography (CT) was conducted preoperatively to evaluate the G-SMT and exclude high-risk features of malignancy that were not amenable to the endoscopic treatment. The patients complicated by other viscera and lymph nodes metastasis, those who suffered from severe failure of the heart and lung, or from coagulopathy were excluded. EUS was performed to confirm the existence of the G-SMT with clear boundaries. Of the 58 G-SMT, only two tumours originated from submucosa, and all the others originated from MP. All 58 patients were randomly assigned into two groups: Transparent cap-assisted blunt dissection group (BD group) and the conventional ESE group, each having 29 patients. A restricted randomisation method (blocked randomisation) was used for patient allocation to either group. The size of each block was 10 people, five of whom were BD group and five were ESE group. All the patients were followed up with endoscopy in the third month to observe wound healing and annually thereafter to detect recurrent lesions after operation. All the patients signed a consent form, and the study was conducted and monitored under Institutional Review Board Committee's approval.

In the BD group, all the G-SMT were dissected by ESE. The procedure was regularly performed with a single-channel endoscope with a transparent cap attached. After identification of the G-SMT under white light endoscopy, a high-frequency electric knife (MFK, Anrei Medical Co Ltd., China) was used to perform the semicircle incision around the tumour without margin marking and solution injection. The submucosal layer was dissected until the exposure of the tumour body. Lower margin of the transparent cap was G-SMT on the conjunction of tumour body and MP, and it aspirated the tumour body until the cap was fully filled, then pushed and revolved the endoscope to blunt-dissect the tumour. If the basal tissue between the tumour body and MP was loose, it pulled out the whole tumour. If there was a connection between the tumour body and MP, TCABD combined with electric knife dissection was used to separate it more easily. The surface flap was reserved, and clips were used to close the wound. The details are shown in Figure 1 and 2.

In the conventional ESE group, a 2 / 3 circle incision was performed with an electric knife without margin marking. Subsequently, the knife was used to make the submucosal excavation as deep as the muscular layer around the tumour body. The dissection of the tumour was started by the knife or the snare after it was fully exposed. If the perforation happened during tumour separation, EFR was performed, and the wound was closed with clips and / or nylon.

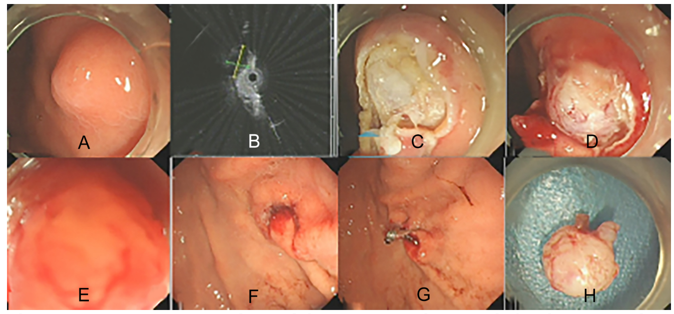

Figure 1: (A) Gastroscopy showed the G-SMT on the gastric fundus; (B) Endoscopic ultrasound showed the G-SMT (diameter: 6mm) originated from the MP; (C) High-frequency electric knife was used to perform the semicircle incision around the tumour without margin marking and solution injection; (D) The submucosal layer was dissected until the exposure of the tumour body; (E) Used the transparent cap to aspirate the tumour body until the cap was fully filled, then pushed and revolved the endoscope to blunt-dissect the tumour; (F) The tumour was successfully separated from the MP without perforation and bleeding; (G) The surface flap was reserved on the wound; (H) Two clips were used to close the wound.

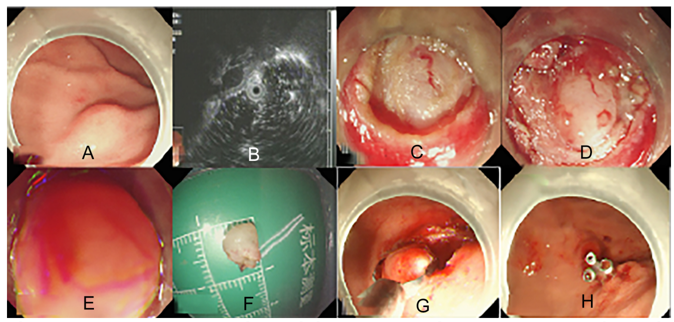

Figure 2: (A) Gastroscopy showed the G-SMT on the greater curve of gastric body; (B) Endoscopic ultrasound showed the G-SMT (diameter: 8mm) originated from the MP; (C) High-frequency electric knife was used to perform the semicircle incision around the tumour without margin marking and solution injection; (D) The submucosal layer was dissected until the exposure of the tumour body; (E) The tumour body was aspirated by the transparent cap until the cap was fully filled, then pushed and revolved the endoscope to blunt-dissect the tumour; (F) The tumour was successfully separated from the MP without perforation and bleeding; (G) The surface flap was reserved on the wound; (H) Three clips were used to close the wound.

The pathology, lesion size in long diameter (cm), operation time, the number of clips used to close the wounds, the number of the snare used to resect the tumour, hospital days, hospitalisation expense, *en bloc* resection rate (defined as tumour removed as a single piece), and the complications including perforation, postoperative bleeding, and postoperative infection were recorded.

Data were analysed by SPSS version 22.0. The count data were tested by Chi-square test, showed as number and percentages; measurement data were tested by t-test, showed as mean ± standard deviation. A value of $p < 0.05$ was defined as a significant difference.

RESULTS

Most of the G-SMT were gastrointestinal stromal tumours (GIST) and leiomyoma. All the GIST were low-risk degrees. The mean long diameter was 9.6 ± 3.6mm in the BD group and 10.7 ± 4.5mm in the conventional ESE group. There was no significant difference between the two groups in the histology and size (Table I).

Table I: The general data of the patients and the pathology.

Patients / pathology	BD group (29 cases)	Conventional ESE group (29 cases)	p-value
Male / female	6 / 23	10 / 19	0.023
Age	53 ± 9.2 years (35 to 70)	56.3 ± 9.4 years (31 to 74)	0.938
Location (gastric fundus / corpus / angle / antrum)	12 /16/0/1 tumours	6/21/1/1 tumours	-
Origin of tumours (submucosal / MP)	1 submucosal / 28 MP	1 submucosal / 28 MP	-
Long diameter of G-SMT	9.6 ± 3.6mm (5mm to 18mm)	10.7 ± 4.5mm (4mm to 19mm)	0.240
Histology	12 leiomyoma / 17 GIST	15 leiomyoma / 12 GIST /1 carcinoid / 1 neurofibroma	-

BD group: Transparent cap-assisted blunt dissection group; ESE: Endoscopic submucosal excavation; G-SMT: Submucosal tumours; GIST: Gastrointestinal stromal tumour; Age was shown as mean +/- SD (years); Long diameter of G-SMT was shown as mean +/- SD (mm).

Table II: Peroperative and postoperative comparison between the two groups.

	BD group (n = 29)	Conventional ESE group (n = 29)	p-value
Clips (N)	4.45 ± 1.30	6.55 ± 2.41	<0.001*
The cases needed snare (n,%)	2 (6.9%)	9 (31%)	0.019*
Operation time (min)	10.34 ± 4.46	17.55 ± 8.48	<0.001*
Hospital days (day)	5.34 ± 0.61	5.93 ± 0.88	0.005*
Hospitalisation expenses (RMB)	16797.88 ± 590.23	18331.39 ± 691.37	<0.001*
Perforation cases (n, %)	3 (10.3%)	11 (37.9%)	0.032**
Postoperative bleeding (n, %)	0 (0%)	0 (0%)	-
Postoperative infection (n, %)	0 (0%)	2 (6.9%)	0.154**

Tested by t-test.* *********Tested by Chi-square test.*

The *en bloc* resection rates were both 100% of the two groups. As compared with the conventional ESE group, the operation time, the number of clips used to close the wounds, the number of snare used to resect the tumours, the hospital days, and the hospitalisation expenses were all significantly decreased ($p < 0.05$, Table II). The hospitalisation expenses were especially higher in patients complicated with perforation.For the complications, the perforation rate was lower in the BD group than in the conventional ESE group ($p < 0.05$, Table II), but there were no significant differences in postoperative bleeding and postoperative infection between the two groups. The three tumours of the BD group that were complicated by perforation had poor motility. The two postoperative infections occured in the same cases that were complicated by perforation.

DISCUSSION

With the popularity of the endoscopic technology, the detection rate of G-SMT has reached to 0.33 to 0.89%.[7] Even though most of the G-SMT are suggested to be benign, and recent European guidelines recommended considering the removal of histologically proven gastric GISTs <20 mm with a weak recommendation and low level of evidence. However, small G-SMT, especially by GIST still accompany a potential risk of malignancy.[8] Some studies suggest that G-SMT can be evaluated by EUS and puncture biopsies,[9,10] but the accuracy is interfered by the variation depending on observer proficiency. Repeated endoscopic follow-ups not only increase the extra medical expenses but also make the patients anxious because of the fear of delaying diagnosis of malignancy. With the development of the endoscopic technology, endoscopic resection of small G-SMT is feasible and safe with low recurrence.[11,12] Patients may prefer to remove the tumour and get an accurate diagnosis with minimal invasiveness than follow-ups.

Endoscopic treatment for G-SMT has the advantages of being less invasive, faster recovery, lower cost, safety, and effectiveness when compared with surgical operation.[13,14] A study suggested that the complications of endoscopic resection of G-SMT were related to the size of tumours and the operation times, the complication rate was increased in the tumours larger than 30mm.[15] Early endoscopic resection of small G-SMT may be safer. In this study, the G-SMT smaller than 20mm get *en bloc* resection by endoscopy with low complication rates. The histological examination can be enhanced through the utilisation of EUS combined with puncture biopsy; however, there is a need for improvement in the accuracy of histological results due to potential risks such as tumour rupture, bleeding, and metastasis.[16]

Most of the G-SMT originated from MP, and it is easier to cause the gastric wall defect neither ESD or ESE, as comparing with the G-SMT originated from *lamina muscularis mucosae* and submucosa. The study by An *et al.* suggested that the perforation rate reached 42.3%.[17] In this study, the perforation rate was 37.9% in the conventional ESE group, which is similar with the data reported by An *et al.*, but the perforation rate was lower in the TCABD group. During endoscopic resection, perforation is usually caused by the penetrating injury of the electric knife while separating the tumour from the basal tissue. It also occurs when repeated electrocautery haemostasis leads to mucosal ischaemia. However, the adaptation of the TCABD during ESE can reduce the penetrating damage of electrocoagulation, and therefore can reduce the probability of perforation. The main difference between the two techniques is that TCABD removes the tumour body mostly by blunt separation, such as aspiration, pushing, and revolving the endoscope. The more blunt the separation procedure, the less is the electric injury. Even for conventional ESE, endoscopists also use a transparent cap when they perform ESD, but the cap is mostly used to broaden the view for electric cutting.

Most of the G-SMT smaller than 2cm belonged to benign categories and were loosely connected with surrounding tissues having clear boundaries. Especially to the G-SMT which have good motility when touched with forceps, the aspiration assisted by the transparent cap can pull the tumours out of the incised wound after exposure of the tumour body, and the damage is extremely low. In this study, there were three cases of passive perforation in the BD group, all of them were patients with sub-optimal contact mobility under endoscope, so the poor motility of the tumour was one of the main risk factors of perforation.

In this study, both conventional ESE and TCABD ESE could successfully resect the G-SMT smaller than 2cm in whole piece. Zhang *et al*. also showed that G-SMT larger than 2cm had a significantly higher endoscopic rate of complete resection than G-SMT smaller than 2cm.[18] Therefore, it is suggested that early intervention of G-SMT is helpful to improve the rate of complete resection under endoscopy. Perforation was the main complication in both groups in this study, but it can be managed intra-operatively without abdominal infection. None of the cases in either groups were complicated with postoperative bleeding in this study. However, two patients in the conventional ESE group with developed pulmonary infections also suffered from perforation. Li *et al*. also reported that postoperative infection was related to the sizes of the tumours, operation time, and perforation.[19] This study's findings are consistent with the results reported by Li *et al*. In this study, transparent cap-assisted blunt dissection ESE significantly decreased the perforation rate, cut down the operation time, shortened the hospital stays and reduced hospitalisation expenses. Careful management of the wound and postoperative drug prevention and good communication between doctors and patients are helpful to reduce the incidence of postoperative bleeding. The limitation of this study is that it is only suitable for G-SMT with non-tight adhesion to the surrounding tissue, such lesions can be separated from the surrounding tissue by negative pressure suction through the transparent cap. At the same time, because of the small sample size of this study, it is necessary to further expand the sample size to confirm the efficacy.

CONCLUSION

Endoscopic resection is feasible, safe, and minimal invasive for G-SMT that are relatively small, including GISTs. Transparent cap-assisted blunt dissection ESE seems to be possibly decrease the perforation rate, cut down the operation time, and then reduce the complication rate and hospitalisation expenses, especially to the G-SMT with good motility when touched with forceps.

ETHICAL APPROVAL:
Ethical approval for this study was granted by Institutional Review Board of The School of Clinical Medicine, The First Hospital of Putian City, China (Approval Number: 2020-013, Dated: 10 June 2020).

PATIENTS' CONSENT:
Written informed consent was provided by the patients.

COMPETING INTEREST:
The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:
LX: Concept, literature, and drafting of the manuscript.
YC: Design, analysis, interpretation, literature review, report writing, and data collection.
JX, PX, ZH, WC: Acquisition and drafting of the manuscript.
All authors approved the final version of the manuscript to be published.

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