Comparison of MBM and ESD in the Treatment of Single Early Esophageal Cancer and Precancerous Lesions

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Jianhao Zheng[1,†], Jiamin Yang[2,†], Zhifeng Zhao[1]

[1]Department of Digestive Endoscopy, The Fourth Affiliated Hospital of China Medical University, 110032 Shenyang, Liaoning, China
[2]Department of Ultrasound, The First Affiliated Hospital of China Medical University, 110001 Shenyang, Liaoning, China

AIM: Esophageal cancer is a disease with high morbidity and mortality, exploring effective treatment methods is the key to the treatment of this disease. This study aims to compare the clinical efficacy and safety of multi-band mucosectomy (MBM) and endoscopic submucosal dissection (ESD) in the treatment of single early esophageal cancer (EEC) and precancerous lesions, and whether MBM can achieve better clinical effect as an effective treatment method.

METHODS: The clinical data of 70 patients with EEC and precancerous lesions who were treated with MBM and ESD in the Fourth Affiliated Hospital of China Medical University from May 2021 to May 2023 and could be followed up were retrospectively analyzed. They were divided into two groups according to different treatment methods: MBM group (31 cases) and ESD group (39 cases). The general data, perioperative conditions, endoscopic treatment effect and pathological results of the two groups were compared.

RESULTS: The duration of endoscopic treatment in MBM group was shorter than that in ESD group [36 (25~39) min vs 46 (41~57) min, $p < 0.05$], and there was no significant difference in the intraoperative bleeding rate between the two groups (12.90% vs 7.69%, $p > 0.05$). There was no significant difference in the rate of intraoperative perforation between the two groups (3.23% vs 7.69%, $p > 0.05$), and the hospitalization time in MBM group was shorter than that in ESD group [5 (4~7) days vs 8 (7~12) days, $p < 0.05$]. The hospitalization cost was less [2535 (2423~2786) dollars vs 4485 (3858~5794) dollars, $p < 0.05$]. No postoperative bleeding occurred in both groups. There was no statistically significant difference in postoperative stenosis rate between MBM group and ESD group (3.23% vs 12.82%, $p > 0.05$), and no statistically significant difference in postoperative local recurrence rate (12.90% vs 5.13%, $p > 0.05$). There was no significant difference in the rate of additional surgery (9.68% vs 2.56%, $p > 0.05$). The en bloc resection rate of MBM group was lower than that of ESD group (77.42% vs 97.44%, $p < 0.05$), but there was no significant difference in the complete resection rate between the two groups (87.10% vs 97.44%, $p > 0.05$). The postoperative pathological results of MBM group showed 13 cases of low-grade intraepithelial neoplasia (LGIN), 11 cases of high-grade intraepithelial neoplasia (HGIN), and 7 cases of canceration, while the postoperative pathological results of ESD group showed 10 cases of LGIN, 14 cases of HGIN, and 15 cases of canceration, with no statistical significance ($p > 0.05$).

CONCLUSIONS: MBM and ESD are effective methods for the treatment of EEC and precancerous lesions. MBM has the advantages of short hospital stay, quick recovery and low cost. However, compared with MBM, ESD can improve the complete resection rate of the lesion, avoid the occurrence of positive incisal margin, and reduce the risk of secondary treatment and additional surgery.

Keywords: early esophageal cancer; precancerous lesions; endoscopic mucosal dissection; multi-band mucosectomy

Introduction

Esophageal cancer is the eighth most common cancer and the sixth cause of cancer-related death in the world. In 2020 alone, 604,100 people were diagnosed with esophageal cancer, and 53.7% of all esophageal cancer cases occurred in China [1]. Due to the lack of typical clinical features and symptoms, esophageal cancer is usually diagnosed at an advanced stage. High recurrence and metastasis rates always affect the long-term efficacy of esophageal cancer treatment, and the 5-year survival rate of patients is only 25–40% [2]. Therefore, early diagnosis and treatment are the key to improve prognosis and survival rate. In recent years, with the improvement of national health awareness and the application of magnifying endoscope and staining technology, the detection rate of early esophageal cancer (EEC) has gradually increased, and more minimally invasive endoscopic treatment methods have been applied to EEC and precancerous lesions. Study has shown that endoscopic techniques can improve the 5-year survival rate of EEC patients to 95% [2]. The global incidence of esophageal cancer is expected to reach 31.4% by 2030 and 63.5% by 2040 [3]. Endoscopic resection techniques mainly include endoscopic submucosal dissection (ESD) and endoscopic mucosal resection (EMR), and multi-band mucosectomy

Correspondence to: Zhifeng Zhao, Department of Digestive Endoscopy, The Fourth Affiliated Hospital of China Medical University, 110032 Shenyang, Liaoning, China (e-mail: zhaozhifeng66@163.com).
† *These authors contributed equally.*

(MBM) is a commonly used derivative technique in EMR technology. Compared with surgery, the two techniques have the advantages of less trauma, faster recovery and fewer complications.

By comparing the efficacy and prognosis of MBM and ESD in the treatment of single EEC and precancerous lesions, to verify whether MBM is a simpler and more effective treatment. This study selected 70 patients with EEC and precancerous lesions who met the inclusion criteria and were admitted to the Fourth Affiliated Hospital of China Medical University from May 2021 to May 2023, including 31 patients who received MBM treatment and 39 patients who received ESD treatment.

Materials and Methods

General Information

A total of 70 patients with preoperative diagnosis of EEC and precancerous lesions admitted to the Fourth Affiliated Hospital of China Medical University from May 2021 to May 2023 were enrolled in this study. According to the endoscopic treatment method, they were divided into MBM group (n = 31) and ESD group (n = 39).

Inclusion Criteria

(1) Mucosal lesions diagnosed by preoperative gastroscopy, and pathological results suggested EEC and precancerous lesions; (2) Preoperative micro-probe ultrasound showed that the invasion depth of the lesion was not more than 1/3 of the submucosa; (3) There are indications for MBM or ESD; (4) There is no history of gastrointestinal radiotherapy, chemotherapy and surgery; (5) Single lesion of esophagus; (6) No esophageal stenosis; (7) Complete medical records.

Exclusion Criteria

(1) History of other malignant tumors or organ injury; (2) Lymph node or distant metastasis indicated by imaging; (3) There were contraindications to MBM/ESD treatment; (4) Incomplete medical records.

Treatment Methods

Instruments

Electronic gastroscope (GIF-HQ290, Olympus, Tokyo, Japan), electronic gastroscope (HD-550, Sonoscape, Hangzhou, China), high-frequency electric cutting instrument (VIO 300D, ERBE, Tubingen, Germany), mucosal incision knife (AMH-EK-O-2.4×2300(4)-N, Anrui, Hangzhou, China), disposable injection needle (AMH-SYB-2418-2304, Anrui, Hangzhou, China), thermal coagulation forceps (AMH-HF-A-2.4×2300, Anrui, Hangzhou, China), disposable hemostatic clip (AMH-HCG-195-135, Anrui, Hangzhou, China), disposable injection needle (AMH-SYB-2418-2304, Anrui, Hangzhou, China), multi-ring mucosal ligation device (MBL-6-F, COOK MEDICAL, Bloomington, IN, USA), electric snare (AMH-ANER181512, Anrui, Hangzhou, China), ultrasonic probe (UM-S20-20R, Olympus, Tokyo, Japan), transparent cap (D-206, Olympus, Tokyo, Japan), sodium hyaluronate (15 mg/mL, C1053J1, HTL Biotechnology, Javernay, France), UCR carbon dioxide pump.

Surgical Methods

MBM procedure: All procedures were performed under general anesthesia with the patient in the left decubitus position and carbon dioxide (CO_2) perfusion was applied during the operation. (1) The location of the lesion was confirmed under white light, and the lesion and its attached mucus were washed with normal saline. The lesion was observed under narrow band imaging (NBI), and 1% Lugol's iodine solution was sprayed to determine the boundary and scope of the lesion. (2) Argon plasma knife was used to mark the area 2–3 mm from the outer edge of the lesion. (3) A ligator was installed at the front of the gastroscope, and after adjusting the appropriate negative pressure, the gastroscope was inserted again. (4) The lesion was viewed directly under the gastroscope, and the target lesion was inhaled into the band along the edge of the marker point from the mouth side. The rubber band was tied to the root of the lesion by the release device to form a pseudopolyp, the lesion was pushed repeatedly several times to avoid the muscularis propria being placed into the rubber band. (5) The electric snare was placed under the rubber band to tighten the lesion, and 80 W pure coagulation current was used to remove the pseudopolyp. If the size of the lesion is large, the above steps can be repeated until the lesion is completely resected. (6) Normal saline was used to wash the wound, and thermal coagulation forceps was used to treat the wound and the edge of the wound. If there is muscularis propria injury, hemostatic clips can be used to clip the wound. (7) The specimens were collected and sent for examination. See Fig. 1.

ESD procedure: All procedures were performed under general anesthesia with the patient in the left decubitus position and carbon dioxide (CO_2) perfusion was applied during the operation. (1) The location of the lesion was confirmed under white light, and the lesion and the attached mucus were washed with normal saline. The lesion was observed with the assistance of NBI mode, and 1% Lugol's iodine solution was sprayed for staining to determine the boundary and scope of the lesion. (2) Argon plasma knife was used to mark the area 2–3 mm from the outer edge of the lesion. (3) The target lesion was fully lifted by submucosal injection of normal saline containing sodium hyaluronate and methylene blue. (4) The lesion was viewed directly under the gastroscope, with the mouth side as the starting point, the mucosa layer was cut around the outer edge of the marking point using a mucosal cutter to fully expose the submucosa. (5) The lesions were dissected along the submucosa to the muscularis propria layer, and then grad-

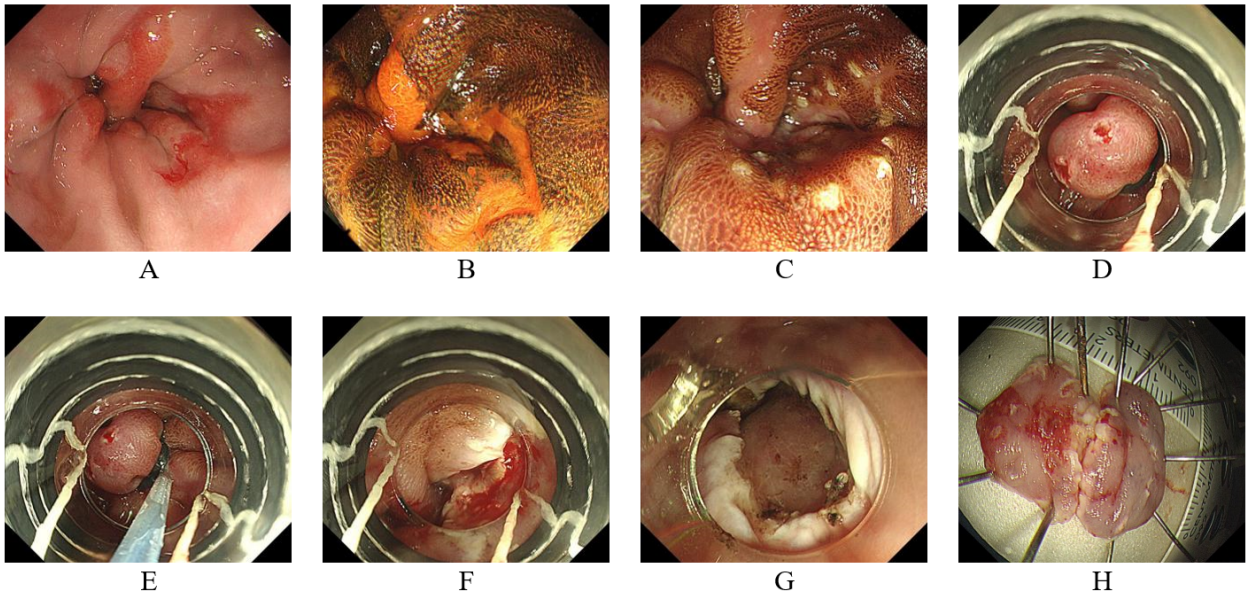

Fig. 1. Multi-band mucosectomy (MBM) operation diagram. (A) The lesions were observed under white light; (B) Iodine staining to determine the lesion range; (C) The extent of the lesion was marked; (D) Ligation of partial lesions; (E) Snare resection of the lesion; (F) Residual lesion ligation; (G) Complete resection of the lesion; (H) Specimen recovery.

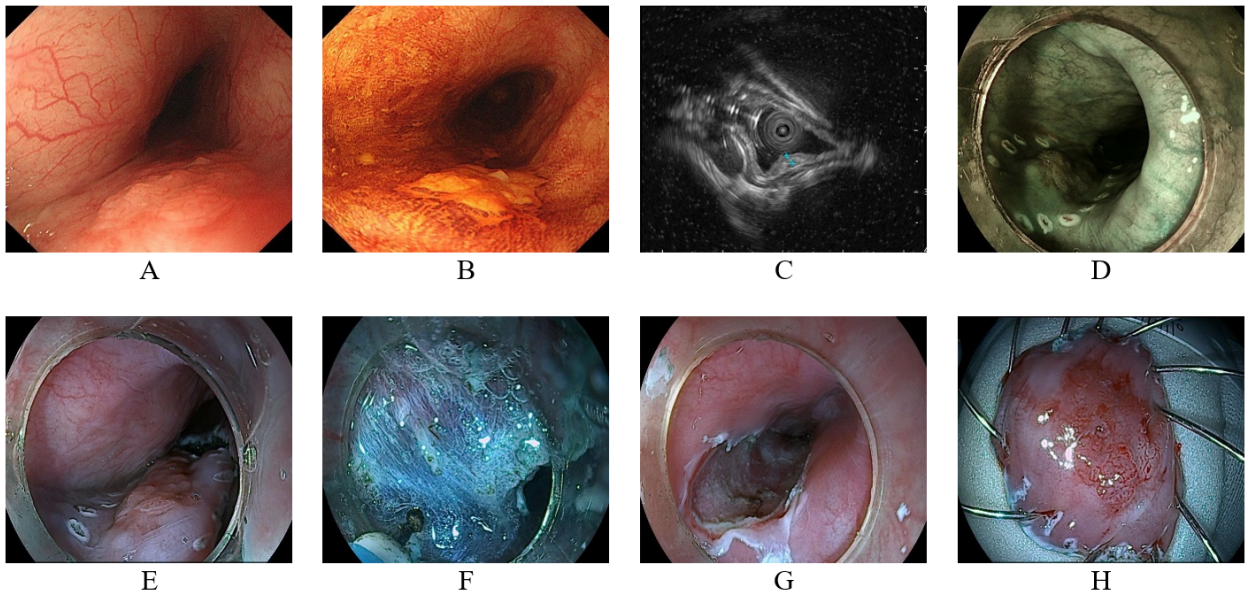

Fig. 2. Endoscopic submucosal dissection (ESD) operation diagram. (A) The lesions were observed under white light; (B) Iodine staining to determine the lesion range; (C) Endoscopic ultrasound observation; (D) Range of lesion; (E) Circumferential incision of the mucosal layer; (F) Gradual dissection of lesions; (G) Complete resection of the lesion; (H) Specimen recovery.

ually removed from the muscularis propria layer until the lesions were completely removed; For the cases with poor position and difficulty in continuing endoscopic dissection, the mucosa and submucosa were cut in a circular way, and the residual tissue was resected with a snare, and the residual tissue was removed with a bowl-shaped thermocoagulation forceps. (6) Normal saline was used to wash the wound, and thermal coagulation forceps was used to treat the wound and the edge of the wound. If there is muscularis propria injury, hemostatic clips can be used to clip the wound. (7) The specimens were collected and sent for examination. See Fig. 2.

Specimen Processing and Pathological Evaluation

The resected specimens were expanded and fixed on a foam plate, the size was measured, the oral and anal sides were marked, and then placed in formalin solution for examination. According to the Vienna classification of esophageal

tumors [4], low-grade intraepithelial neoplasia (LGIN) includes mild and moderate dysplasia, and high-grade intraepithelial neoplasia (HGIN) includes carcinoma *in situ* and severe dysplasia. At present, the generally accepted definition of EEC is that cancer tissues are limited to the mucosa and submucosa without lymph node metastasis, including carcinoma *in situ*, intramucosal carcinoma, and submucosal carcinoma.

Postoperative Management and Definition of Indicators

Electrocardiogram (ECG), blood pressure (BP) and oxygen saturation (SPO_2) were measured routinely for 8 hours after operation. Antacids, hemostatic drugs, anti-inflammatory drugs and intravenous nutritional support were given. En bloc resection means that the lesion is removed endoscopically en bloc and a single specimen is obtained. Complete resection was defined as negative horizontal and vertical margins of the resected specimen. Local recurrence was defined as the presence of diseased mucosa within 1 cm of or around the resection site at 6 months after surgery. Stenosis was defined as postoperative dysphagia of varying degrees and endoscopic confirmation of luminal stenosis in the postoperative area. Bleeding included intraoperative bleeding and postoperative bleeding. Intraoperative bleeding was defined as oozing blood or jetting bleeding on the wound for more than 1 minute, and postoperative bleeding was defined as hematemesis or melena and a decrease in hemoglobin of more than 20 g/L after surgery.

Follow-up

The patients were followed up by outpatient examination, telephone interview and electronic medical record follow-up, and all the patients included in this study were followed-up. Gastroscopy was performed every 3, 6, and 12 months after treatment, as well as blood routine, liver and kidney function, tumor markers and other biochemical indicators, and chest and abdominal CT examination was performed when necessary. The study was followed through July 31, 2023.

Statistical Analysis

Statistic Package for Social Science (SPSS) 25.0 statistical software (IBM, Armonk, NY, USA) was used for statistical data analysis. Count data were expressed as examples or percentages, and comparison between groups was performed using the chi-square test or Fisher exact test. Measurement data consistent with normal distribution were expressed in the form of, and the comparison between groups was analyzed by *t* test. Measurement data not consistent with normal distribution were expressed in the form of M (P_{25}–P_{75}), and the comparison between groups was analyzed by Mann-Whitney U test. KolMogorov-Smirnov test was used to test the normality of the data. p value < 0.05 was considered statistically significant.

Results

Comparison of General Information

There were 25 males and 6 females in the MBM group, aged from 54 to 81 years, with an average age of 64.48 $\pm$ 8.85 years. The lesions were located in the middle segment of the esophagus in 19 cases and in the upper and lower segments of the esophagus in 12 cases. The size of the lesions ranged from 0.79 to 4.71 cm^2, with a median size of 3.06 cm^2. The length of the lesions ranged from 1.00 to 3.80 cm, with a median length of 2.20 cm. There were 32 males and 7 females in the ESD group, aged from 41 to 81 years, with an average age of 63.27 $\pm$ 9.25 years. The lesions were located in the middle part of the esophagus in 22 cases, and in the upper and lower part of the esophagus in 17 cases. The size of the lesions ranged from 0.75 to 7.80 cm^2, with a median size of 2.75 cm^2. The length of the lesions ranged from 1.00 to 5.20 cm, with a median length of 2.40 cm. There was no significant difference in general data between the two groups ($p > 0.05$). See Table 1.

Comparison of Perioperative Conditions

The treatment time of MBM group was 21.00 min to 50.00 min, the median treatment time was 36 min, the treatment time of ESD group was 32.00 min to 93.00 min, the median treatment time was 46 min, the endoscopic treatment time of ESD group was significantly longer than that of MBM group. The difference was statistically significant ($p < 0.05$). One perforation occurred during endoscopic treatment in the MBM group, and 3 perforation occurred during endoscopic treatment in the ESD group, all of which were treated under endoscopy and improved after conservative treatment without conversion to or additional surgery. There was no significant difference in intraoperative perforation between the two groups ($p > 0.05$). There were 4 cases of bleeding after electric snare resection in the MBM group and 3 cases of intraoperative bleeding in the ESD group, all of which were caused by perforator vessel injury. There was no significant difference in intraoperative bleeding between the two groups ($p > 0.05$). The median hospitalization time was 5 days in the MBM group and 8 days in the ESD group. The hospitalization time was longer in the ESD group than in the MBM group, the difference was statistically significant ($p < 0.05$). The hospitalization cost of the MBM group ranged from 1992 to 3496 dollars, with a median cost of 2535 dollars. The hospitalization cost of the ESD group ranged from 3092 to 7550 dollars, with a median cost of 4485 dollars, the difference was statistically significant ($p < 0.05$). See Table 2.

Comparison of Treatment Effects

There was no delayed postoperative bleeding in the MBM group and the ESD group, and the difference was not statistically significant ($p > 0.05$). The complete resection rate of the lesion in MBM group was 87.10%, and 4 lesions were not completely resected, all of which were resected by multi-ring mucosal band ligation. The complete

Table 1. Comparison of general data between the two groups.

Groups	Number of patients	Male/ Female (n)	Age (years)	Tumor location (n)		Tumor area (cm^2)	Tumor length (cm)	Preoperative pathological type (n)		
				Mide esophagus	Upper and lower esophagus			LGIN	HGIN	Canceration
MBM group	31	25/6	64.48 ± 8.85	19	12	3.06 (2.14∼3.58)	2.20 (2.00∼2.50)	15	13	3
ESD group	39	32/7	63.27 ± 9.25	22	17	2.75 (1.78∼3.52)	2.40 (2.00∼2.60)	11	17	11
$\chi^2/t/Z$		0.023	0.554	0.170		–0.905	–0.232	4.869		
p		0.881	0.581	0.681		0.365	0.817	0.088		

LGIN, low-grade intraepithelial neoplasia; HGIN, high-grade intraepithelial neoplasia.

Table 2. Comparison of perioperative conditions between the two groups.

Groups	Treatment time (min)	Intraoperative bleeding [n (%)]	Intraoperative perforation [n (%)]	Hospitalization time (days)	Hospitalization cost (dollars)
MBM group (n = 31)	36 (25∼39)	4 (12.90)	1 (3.23)	5 (4∼7)	2535 (2423∼2786)
ESD group (n = 39)	46 (41∼57)	3 (7.69)	3 (7.69)	8 (7∼12)	4485 (3858∼5794)
χ^2/Z	–5.569	0.103	0.079	–4.436	–7.057
p	<0.001	0.748	0.778	0.001	<0.001

resection rate of the lesion in ESD group was 97.44%, and 1 lesion was resected by piecewise dissection due to difficulties in dissection. In the MBM group, the en bloc resection rate was 77.42%, 3 lesions with positive vertical margins were treated with additional surgical treatment, 4 lesions with positive horizontal margins were treated with endoscopic radiofrequency ablation, and the other 2 lesions with HGIN were treated with additional MBM treatment. The en bloc resection rate of the ESD group was 97.44%, and the vertical margin of one lesion was positive. This patient underwent additional surgery after surgery. There was no significant difference in additional surgery between the two groups ($p > 0.05$), but compared with the MBM group, the ESD group could achieve better negative margin effect. The difference of en bloc resection between the two groups was statistically significant ($p < 0.05$). One patient in MBM group had esophageal stenosis after operation, and the symptoms were improved after repeated balloon dilatation. Five patients in ESD group had esophageal stenosis, of which 3 patients were improved after repeated balloon dilatation, and the other 2 patients had poor effect of balloon dilatation, and the symptoms were improved after implantation of covered metal stent. There was no significant difference in postoperative stenosis between the two groups ($p > 0.05$). In MBM group, 4 patients had local recurrence after operation, and the results of pathological biopsy indicated LGIN. All patients underwent endoscopic radiofrequency ablation or argon plasma coagulation, and there was no recurrence during follow-up. In ESD group, 2 patients had local recurrence after operation, and the local light staining of 1% Lugol's iodine solution was observed. One case of LGIN was treated with endoscopic radiofrequency ablation, and the other case of HGIN was treated with MBM. Both patients had no recurrence during follow-up, and there was no significant difference between the two groups ($p > 0.05$). See Table 3.

Pathological Results

The postoperative pathological results of MBM group showed 13 cases of LGIN, 11 cases of HGIN, and 7 cases of cancer. In the MBM group, 4 lesions were upgraded from HGIN to cancer, 3 lesions were upgraded from LGIN to HGIN, and 1 lesion was downgraded from HGIN to LGIN. The postoperative pathological results of the ESD group showed 10 cases of LGIN, 14 cases of HGIN, and 15 cases of canceration. In the ESD group, 3 lesions were upgraded from HGIN to cancer, and 1 lesion was upgraded from LGIN to cancer. There was no significant difference in postoperative pathological classification between the two groups ($p > 0.05$). See Table 4.

Discussion

In recent years, with the development of endoscopic technology, endoscopy has become an effective method for the detection and treatment of early gastrointestinal cancer. It has many advantages, such as less cost, less trauma, less complications and maximum preservation of organ function, and has become an alternative choice for surgical treatment. EMR technology has been proven to be an effective method for the treatment of early esophageal cancer since 1998 [5]. In 2006, some scholars improved on the basis of EMR technology and performed mucosal ligation and resection of EEC with the assistance of a transparent cap and a ligation device, which confirmed the feasibility and safety of this "suck-cut" technique [6]. Long-term study has shown that the 5-year overall survival rate of EEC patients treated with MBM can reach 95%–98%, and the 10-year survival rate can reach 75% [7]. However, relevant studies have found that MBM technology has more advantages for mucosal lesions <20 mm, which has also become the limitation of MBM [8, 9]. Ishihara *et al*. [10] found that ESD had more advantages for lesions >15 mm and the depth of

Table 3. Comparison of treatment effect between the two groups.

Groups	Postoperative stenosis [n (%)]	Local recurrence [n (%)]	Additional operation [n (%)]	Complete resection [n (%)]	En bloc resection [n (%)]	Postoperative hemorrhage [n (%)]
MBM group (n = 31)	1 (3.23)	4 (12.90)	3 (9.68)	27 (87.10)	24 (77.42)	0 (0.00)
ESD group (n = 39)	5 (12.82)	2 (5.13)	1 (2.56)	38 (97.44)	38 (97.44)	0 (0.00)
χ^2	0.989	0.525	0.570	1.443	5.002	0.000
p	0.320	0.469	0.450	0.230	0.025	1.000

Table 4. Comparison of postoperative pathological types between the two groups.

Groups	Postoperative pathological classification (n)		
	LGIN	HGIN	Canceration
MBM group (n = 31)	13	11	7
ESD group (n = 39)	10	14	15
χ^2		2.782	
p		0.249	

invasion to submucosa, but there was no significant difference between MBM and ESD for lesions ≤15 mm and mucosal layer lesions. Compared with MBM, ESD requires a higher technical level and a longer learning curve, which also limits the wide development of ESD. However, the advantage of ESD is that there is no clear limit on the size of the lesion. Relevant study has confirmed that regardless of lesion size, ESD can achieve a high cure rate, and the 5-year survival rate can reach 96% [11]. Therefore, MBM and ESD are both effective methods for the treatment of EEC, and the choice of treatment method according to the size of the lesion and the depth of invasion can achieve the best therapeutic effect. In this study, the average long diameter of MBM group was 2.36 ± 0.57 cm, and the average long diameter of ESD group was 2.50 ± 0.88 cm, and the difference was not statistically significant. The overall long diameter of the single lesion included in this study was small, so the two treatment methods did not have a clear size limit for the lesion.

Accurate resection of the lesion is the goal of endoscopic treatment, and it is also the key factor to effectively reduce the local recurrence rate. Spadaccini *et al*. [12] found that MBM could achieve 96.7% complete resection rate and 7.9% local recurrence rate in the treatment of EEC. Chen *et al*. [13] found that the complete resection rate of MBM was 91.43%, and the complete resection rate of ESD was 96.97%, with no significant difference. Local recurrence occurred in 2 of 33 patients in the MBM group and in 1 of 35 patients in the ESD group. A meta-analysis showed [14] that ESD could achieve 99%–100% en bloc resection rate and 90%–92% complete resection rate in the treatment of EEC. Piecewise ligation resection of the lesions by MBM technique is the reason for its low complete resection rate. During the process of piecewise ligation resection, it is easy to affect the accurate judgment of the resection margin, which leads to the increase of the residual lesion and local recurrence rate [15]. In this study, the complete resection rate of the lesion was 87.10% and the en bloc resection rate was 77.42% in the MBM group, and 97.44% and 97.44% in the ESD group. There was no significant difference in the en bloc resection rate between the two groups, but the ESD group had a better en bloc resection effect. There were 4 cases of local recurrence in MBM group and 2 cases in ESD group. The number of recurrence in MBM group was higher than that in ESD group, but there was no significant difference between the two groups. A previous multi-center study showed that the perforation rate after MBM was 0.4% and the bleeding rate was 0.9%, but this study did not show bleeding and perforation due to the small number of patients included [16]. The results of this study show that the efficacy of the two treatment methods is similar, but ESD can achieve more complete resection, which is an important means to effectively reduce tumor residual and recurrence.

Complications affect the quality of life of patients after surgery. The study by Chen *et al*. [13] showed that the esophageal stenosis rate after MBM was 14.29%, and that after ESD was 9.09%, with no significant difference. One study showed that the intraoperative bleeding rate of MBM was 4.00%, all of which were rupture of larger vessels during ligation [15]. Study has shown that there is no significant difference in intraoperative bleeding, perforation and postoperative stenosis between ESD and MBM [17]. Relevant study has confirmed that lesions with a long diameter of >5 cm are a high-risk factor for postoperative stenosis after ESD [18]. The results of this study were similar to the results of previous studies. The intraoperative bleeding rate was 12.90% in the MBM group and 7.69% in the ESD group, which were all caused by the injury of large blood vessels during ligation resection and dissection. The postoperative stenosis was also consistent with the results of previous studies. The postoperative stenosis rate was 3.23% in the MBM group and 12.82% in the ESD group, which were improved with endoscopic intervention. Esophageal stenosis is a common complication after MBM and ESD. Endoscopic balloon dilatation, stent implantation, steroid hormone use and regenerative medicine technology have been proved to be effective in alleviating esophageal stenosis [19]. In this study, the intraoperative perforation rate of MBM group was 3.22%, and that of ESD was 7.69%. In contrast, ESD treatment is more prone to perforation. Many factors, such as difficult endoscopic operation, thin esophageal wall, inadequate submucosal injection, and long

electrocoagulation time, can cause damage to the muscularis propria, and even perforation. Therefore, intraoperative injection of carbon dioxide can improve the safety of ESD. There was no significant difference in complications between the two groups, confirming that the two treatment methods can achieve similar prognosis. Some research results showed that the average treatment time of MBM group was 31.31 $\pm$ 4.04 min, and that of ESD group was 47.18 $\pm$ 4.57 min [15], the conclusions of this study is consistent with his base. There are few studies on the operation cost and hospitalization time of single early esophageal cancer and precancerous lesions at home and abroad. The conclusion of this study is that the median hospitalization time of MBM group is 5 days, and the median hospitalization cost is 2535 dollars, which are significantly better than those of ESD group. Therefore, MBM is an effective treatment with less complications, faster prognosis, and less financial burden for patients.

This study was a single-center retrospective study, and the sample size was insufficient due to limited inclusion criteria and loss of patients to follow-up, which may lead to selection bias and potential bias. In addition, the follow-up time of this study was limited, and long-term follow-up of prognosis was not achieved. In the future, large samples, long follow-up and prospective studies are still needed to confirm the clinical value of the two techniques. How to more effectively control the ligation depth and margin of MBM is the key to future technical research. More research investment and technology promotion are important to reduce the incidence and improve the prognosis of esophageal cancer.

Conclusions

Both MBM and ESD are effective methods for the treatment of single EEC and precancerous lesions, and both can be selected. MBM has the advantages of shorter hospitalization time, faster recovery and lower cost, can be used as a good treatment of the EEC and precancerous lesions. Compared with MBM, ESD has more trauma, higher cost and longer hospitalization time, but it can improve the en bloc resection rate of lesions, avoid the occurrence of positive surgical margins, and reduce the risk of secondary treatment and additional surgery. The significance of this study is to provide a reference for the selection of treatment options for patients with different economic conditions and physical conditions, and also to provide theoretical guidance for clinical nursing work.

Availability of Data and Materials

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

Author Contributions

JZ: conceptualization, methodology, investigation, formal analysis, software, writing-original draft. JY: conceptualization, methodology, investigation, visualization, writing-review & editing. ZZ: methodology, investigation, supervision. All authors have been involved in revising it critically for important intellectual content. All authors gave final approval of the version to be published. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the Fourth Affiliated Hospital of China Medical University (EC-2022-056). Signed written informed consents were obtained from the patients and guardians. This study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki.

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Conflict of Interest

The authors declare no conflict of interest.

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