Published in final edited form as:

Endoscopy. 2013 ; 45(3): 167–173. doi:10.1055/s-0032-1326011.

Prospective feasibility study on the use of multiband mucosectomy for endoscopic resection of early squamous neoplasia in the esophagus

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Abstract

Background and study aims—Endoscopic resection for esophageal squamous high-grade intraepithelial neoplasia (HGIN) or intramucosal cancer (esophageal squamous cell carcinoma [ESCC]) with the endoscopic resection cap technique is technically difficult, and requires submucosal lifting and multiple snares for piecemeal resections. Multiband mucosectomy (MBM) is an easy-to-use endoscopic resection technique and may be the modality of choice in China, where ESCC is extremely prevalent. The aim of the current study was to prospectively evaluate MBM for piecemeal endoscopic resection of squamous neoplasia of the esophagus.

Methods—Patients with HGIN/ESCC and no signs of submucosal invasion or metastatic disease were included in the study. Lesions were delineated using electrocoagulation and resected using the MBM technique. Endpoints were procedure time, endoscopic radicality, complications, histology of the endoscopic resection specimens, and absence of HGIN/ESCC at the endoscopic resection scar during follow-up.

Results—a total of 41 patients (26 male; mean age 61 years) underwent MBM; all lesions were visible with white light endoscopy (median length 5 cm, interquartile range [IQR] 4–6 cm; median circumferential extent 42%, IQR 25%–50%). Median procedure time was 12 minutes (IQR 8–24 minutes). Median number of resections was 5 (IQR 3–6). Endoscopic complete resection was achieved in all lesions. There was one perforation, which was treated by application of clips. No other complications were observed. The worst histology was ESCC (n = 19), HGIN (n = 17),

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Competing interests: None.

middle grade intraepithelial neoplasia (n = 4), and normal squamous epithelium (n = 1). Endoscopic follow-up at 3 months showed HGIN at the endoscopic resection scar in two patients, which was effectively treated endoscopically, and showed normal squamous epithelium in all patients at final follow-up (median 15 months, IQR 12–24 months).

Conclusion—This first prospective study on MBM for piecemeal endoscopic resection of early esophageal squamous neoplasia showed that MBM was effective for the complete removal of lesions with short procedure time, few complications, effective histological assessment of resected specimens, and durable treatment effect.

Introduction

Endoscopic resection is the treatment of choice for early esophageal squamous cell neoplasia (ESCN), such as high grade intraepithelial neoplasia (HGIN) and early stages of esophageal squamous cell carcinoma (ESCC) [1]. ESCC is the 6th most common cause of cancer-related death worldwide, and has a particularly high incidence in certain high risk areas, such as Central Asia, East Africa, Iran, and China [2,3]. Nearly half of the worldwide ESCC cases occur in China where ESCC is the fourth leading cause of cancer-related death. ESCC reaches a remarkable incidence of 1/1000 in certain densely populated areas comprising over 100 million people [4].

ESCC is usually diagnosed at a late stage and has a poor prognosis due to a relative thin esophageal wall and a rich lymphatic network, which contributes to metastatic spread of the disease at an early stage [5]. The chance of lymph node metastasis is dependent upon the penetration depth and the differentiation of the lesion. Lesions restricted to the epithelial layer (m1) or the lamina propria (m2) have a low rate of lymph node metastases (<5%); lesions that penetrate into the muscularis mucosae (m3) or the first third of the submucosa (sm1) have an intermediate risk (5%–15%). Lesions infiltrating further into the submucosa (sm2 and sm3) have a high risk of lymph node metastasis and should be referred for surgery [6]. The m1 and m2 lesions warrant prompt endoscopic treatment such as endoscopic resection [7,8], which is associated with significantly less morbidity and mortality compared with esophagectomy [9,10]. The choice between endoscopic or surgical treatment of m3 and sm1 lesions is determined on an individual patient basis, depending on relative indications for endoscopic treatment, such as co-morbidity.

The most widely used technique for endoscopic resection of ESCN is the endoscopic resection cap technique. With this technique lesions up to 2 cm in diameter can be removed en bloc; larger lesions require removal in multiple pieces (i.e. piecemeal resection). Endoscopic resection cap resections are, however, technically demanding, especially during piecemeal procedures that require repeated submucosal lifting and positioning of the electrosurgical snare in the cap. In addition, a new snare is required for every resection [1].

An alternative endoscopic resection technique is the multiband mucosectomy (MBM) technique, using a modified variceal band ligator [11]. MBM does not require submucosal lifting, positioning of the snare is much easier, and the same snare can be used for all resections. Previous studies in Barrett's esophagus have shown that MBM is safe and effective for removal of mucosal neoplasia, with shorter procedure times and lower costs

compared with the endoscopic resection cap technique [12–14]. However, limited data are available on its use for endoscopic resection for esophageal squamous neoplasia.

In China, high volume screening programs are currently being conducted, in which over 150 000 subjects undergo an endoscopy with Lugol's staining each year. Areas suspicious for neoplasia will appear as unstained lesions (USLs) in the brown iodine-stained normal squamous esophagus. In approximately 5% of screened subjects endoscopic therapy is warranted. The rate-limiting step for the screening programs is the limited availability of endoscopic expertise. A less complex treatment modality would have many advantages in this situation. We therefore hypothesized that MBM may have significant advantages over the endoscopic resection cap technique, especially in countries where endoscopic expertise is limited.

The aim of this study was to assess the feasibility, safety, and effectiveness of the MBM technique for piecemeal endoscopic resection of early mucosal squamous cell neoplasia of the esophagus.

Patients and methods

Setting

All endoscopic procedures were performed at the Cancer Institute and Hospital, Chinese Academy of Medical Sciences, Beijing, or the Feicheng People's Hospital, Feicheng, China. The departments of endoscopy and pathology in these hospitals are tertiary referral centers with extensive experience in the detection and treatment of early neoplasia in the esophagus, and all endoscopies were performed by highly experienced endoscopists (B.W., J.B., and G.W.).

The study was approved by the medical ethical committee of the two hospitals and informed consent was obtained from all patients.

Patients

In this prospective feasibility study, consecutive patients enrolled in a screening program for ESCC were eligible if they met all of the following inclusion criteria: age 18–85 years; histologically proven HGIN or ESCC in a lesion in the squamous esophagus; lesion consistent with Paris classification [15] type 0-IIa, 0-IIb or 0-IIc, or a combination of these; lesion and surrounding Lugol's USLs (i.e. the treatment area) measuring 2 cm and 6 cm and encompassing 2/3 of the circumference (circumferential extent was measured as hours in a clock and percentage of circumferential extent was calculated as 100/12 (8.3%) per hour); no signs of submucosal invasion or metastatic disease, as assessed by endoscopic ultrasonography (EUS) and computed tomography (CT) scan; written informed consent.

Patients were not eligible if they met any of the following exclusion criteria: any other neoplastic lesion in the squamous esophagus visible with white light endoscopy or visible with Lugol's staining containing HGIN/ESCC that could not be included in the maximum size treatment area; prior endoscopic treatment <3 cm from the treatment area, prior

radiation therapy, or prior esophageal surgery other than uncomplicated fundoplication; any uncontrolled bleeding risk (e.g. due to coagulopathy, esophageal varices).

Baseline qualifying endoscopy

Patients underwent a baseline qualifying endoscopy 4 weeks prior to the MBM procedure. During the endoscopy, the esophagus was first assessed with white light endoscopy and lesions were classified according to the Paris classification of superficial neoplastic lesions of the esophagus [15]. Subsequently, the esophagus was inspected by narrow band imaging (NBI), and after chromoendoscopy with Lugol's staining (1.25%), the location and extent of the neoplastic epithelium were recorded. EUS and CT scans were performed on all patients to exclude metastatic disease.

Multiband mucosectomy procedure

MBM procedures were performed under conscious sedation using a combination of propofol and alfentanil. After introducing the endoscope without the assembled MBM kit, the esophagus was first inspected with white light endoscopy followed by NBI and chromoendoscopy with Lugol's staining (1.25%). The treatment area according to the baseline qualifying endoscopy was identified and delineated by placing several electrocoagulation markers 1–2 mm outside all margins of the treatment area.

After delineation, the endoscope was removed and the single-use Duette Multi-Band Mucosectomy kit (Cook Medical, Limerick, Ireland) was assembled on the endoscope. This kit consisted of six rubber bands on a transparent cap (inner Ø 9 mm), releasing wires attached to a specially designed releasing handle, and a 7-Fr hexagonal braided polypectomy snare. After assembling the MBM kit on the endoscope, the endoscope was re-introduced and the delineated treatment area was identified. Next, the treatment area was sucked into the cap and a rubber band was released. In this way a pseudo-polyp was created. The hexagonal snare was positioned and closed underneath the rubber band of the pseudo-polyp which was then resected using 80 W pure coagulation current (ERBE VIO 300D; Erbe Elektromedizin GmbH, Tübingen, Germany). If subsequent resections were required to remove the treatment area, pseudo-polyp formation and resection were repeated with the same kit until the treatment area was removed endoscopically. If more than six resections were required, an additional MBM kit was used.

After resection of the treatment area, the wound was inspected and evaluated for complete removal of all coagulation markers. Lugol's staining was repeated to assess whether or not residual USLs at the resection margins of the wound were present. Any remaining USLs were then further resected with MBM. In cases where additional resections were considered to be contraindicated (e.g. due to increased risk of stenosis or residual tissue being too small to justify resection), the remaining USLs were treated with argon plasma coagulation (APC; 40–60 W forced coagulation; ERBE VIO 300D). Resected specimens were retrieved from the stomach using a foreign body retrieval basket (Roth net, US Endoscopy, Mentor, Ohio, USA).

During the procedure, times were recorded at the initial introduction of the endoscope, the re-introduction with the assembled MBM kit, and the final removal of the endoscope (after retrieval of all specimens and treatment of any complications).

Post-procedural care

Post-procedural management was conducted according to standard guidelines. Generally, patients were admitted for clinical observation for 24 hours. Patients had a clear liquid diet for the day of the endoscopic resection, followed by a soft diet the day after. Oral analgesics (lidocaine oral suspension) were given on demand. Nonsteroidal anti-inflammatory drugs were not allowed.

Histological evaluation

Resection specimens were pinned onto cork with the luminal side facing up. For those lesions that had undergone piecemeal resection, the treatment area was reconstructed after staining with Lugol's solution. Maximum and minimum diameters of the reconstructed area were measured after pinning onto the cork. Specimens were subsequently fixed in formalin for 24 hours, then cut into 2-mm sections and embedded in paraffin.

Slices were cut and mounted on glass slides and stained with hematoxylin and eosin. All slides were evaluated independently by two expert gastrointestinal pathologists (L.X. and N.L.) for the following parameters.

- Worst grade of squamous neoplasia (no intraepithelial neoplasia; low grade intraepithelial neoplasia [LGIN]; middle grade intraepithelial neoplasia [MGIN]; HGIN; ESCC).
- For ESCC: depth of tumor invasion (m1, m2, m3, or sm), grade of differentiation, presence of lymphatic or vascular invasion.
- Presence of neoplasia at the deep (vertical) resection margin.
- The maximum thickness of resection specimens (in μm).
- The maximum thickness of the resected submucosal layer (in μm).

Follow-up endoscopy

All patients were scheduled for a follow-up endoscopy at 3 and 12 months after the MBM procedure. The resection scar was identified and inspected using white light endoscopy and Lugol's staining to assess the presence of USLs. USLs within 1 cm of the endoscopic resection scar were considered to be residual lesions (at 3-month follow-up) or recurrent lesions (>3-month follow-up), whereas those >1 cm from the scar were considered to be new lesions. Biopsy samples were obtained from the resection scar and any residual USLs using standard biopsy forceps. Biopsy specimens were removed from the forceps using a toothpick or other non-traumatic technique and spread out flat on a gloved finger. Each specimen was then separately attached to filter paper and fixed flat within the specimen jar. Upon completion of fixation, the filter paper was removed and the tissue was embedded manually in the paraffin block so that the flat surface was oriented perpendicular to the cut surface of

the block. All biopsies were evaluated independently by two expert gastrointestinal pathologists (L.X. and N.L.).

For USLs within 1 cm of the endoscopic resection scar, or HGIN/ESCC detected in any lesion during a follow-up endoscopy, the lesion was managed by APC (40–60 W forced coagulation) or radiofrequency ablation (RFA; Bârx Medical, Sunnyville, California, USA) or by repeat endoscopic resection, according to the preference of the endoscopist. An extra 3-month follow-up visit was scheduled after this repeat procedure.

Study endpoints

Primary endpoints for this study were the endoscopic complete removal of neoplasia (defined as the complete removal of the delineated treatment area including all electrocoagulation markers as assessed endoscopically and macroscopically at the initial MBM session), and the complete histological remission of neoplasia (defined as the absence of USLs containing HGIN/ESCC within 1 cm of the endoscopic resection scar at 3-month follow-up).

Secondary endpoints were: the complete histological remission of neoplasia (defined as the absence of USLs containing HGIN/ESCC within 1 cm of the endoscopic resection scar at final follow-up); the procedure time (defined as the time between introduction of the endoscope with assembled MBM kit and the end of the MBM procedure, including removal of specimens and treatment of complications); the number and severity of acute (during procedure), early (0–48 hours), and delayed (>48 hours) clinically relevant complications, graded as “mild” (unplanned hospital admission, hospitalization <3 days, hemoglobin drop <3 g/dL, no transfusion), “moderate” (4–10 days hospitalization, <4 units blood transfusion, need for repeat endoscopic intervention), “severe” (hospitalization >10 days, ICU admission, need for surgery, >4 units blood transfusion) or “fatal” (death attributable to procedure); maximum diameter and thickness of the specimens and thickness of the submucosa; presence of USLs >1 cm from the endoscopic resection scar containing HGIN/ESCC during follow-up.

Statistical analysis

Statistical analysis was performed using SPSS 16.0.2/18 software for Windows (IBM, Armonk, New York, USA). For variables with a normal distribution the mean ($\pm$ SD) was used and for variables with a skewed distribution the median (interquartile range [IQR]) was used. Where appropriate, the Student's *t* test and the Mann–Whitney test were used. A *P* < 0.05 was considered to be statistically significant.

Results

Patients

A total of 41 patients were included (26 men and 15 women), with a mean age of 61 years (SD $\pm$ 7 years). The worst histology prior to MBM was HGIN (*n* = 33) or ESCC (*n* = 8). No signs of submucosal involvement or lymph node metastasis were found on EUS and/or CT.

The majority of the USLs were classified as 0-IIb. The median length of the treatment area was 5 cm (IQR 4–6 cm) with a median circumferential extent of 42% (IQR 25%–50%) (Table 1; Fig. 1).

Primary endpoints

Endoscopic complete removal of the delineated area with the MBM technique was achieved in all 41 patients (100%; Fig. 1d–f). Five patients were treated with additional APC for small residual USLs (1%–5% of the treatment area) at the treatment area margin, which were not large enough to justify additional resections.

Histological assessment of the resection specimens showed ESCC in 19 patients (46%), HGIN in 17 patients (41%), and MGIN in four patients (10%). In one small lesion (2 cm, 17% of the circumference) that showed HGIN on biopsy during the baseline qualifying endoscopy, HGIN could not be confirmed and the resection specimen showed only normal squamous epithelium.

Endoscopic follow-up was performed in all 41 patients, with a median follow-up period of 15 months (IQR 12–24 months) and a median number of follow-up visits of 3 (IQR 2–3). At 3-month follow-up, all endoscopic resection wounds had completely healed (Fig. 1h–i). Complete histological remission of HGIN/ESCC was seen in 39/41 patients (95%) at 3-month follow-up; biopsies of the scar revealed HGIN in 2 patients, LGIN in 3 patients, and normal squamous epithelium in 36 patients (Table 2).

In one patient, the residual HGIN at the site of the scar was treated by RFA, and histological sampling at 9, 15, 21, and 27 months' follow-up confirmed normal squamous epithelium at the treatment site. The other patient with HGIN at the site of the EMR scar withdrew from follow-up, but presented with a visual lesion 13 months after initial resection. The lesion was resected with endoscopic submucosal dissection (ESD) and showed HGIN. Further follow-up at 3 and 6 months after this procedure showed normal squamous epithelium.

Secondary endpoints

The median number of resections performed was 5 (IQR 3–6). Median MBM resection time was 12 minutes (IQR 8–24 minutes), and the median total endoscopy time was 32 minutes (IQR 27–42 minutes).

One small perforation occurred during the last of four resections in a patient with a lesion of 6 cm and almost half of the circumference (Fig. 2). The procedure was completed, after which the perforation was treated by the application of clips and the patient was admitted for observation after an esophageal contrast radiograph. The patient was discharged the next day. Follow-up at 3, 9, and 15 months showed a completely healed esophagus without stenosis or residual/recurrent neoplasia. No other acute or early complications were observed. Eight patients showed an asymptomatic stenosis at follow-up endoscopy. Treatment of stenosis was not required for any of these patients (Table 2).

At the last follow-up visit (median duration 15 months), complete histological remission of HGIN/ESCC at the site of, and within 1 cm of, the endoscopic resection scar was shown for

all patients. A total of 12 patients demonstrated a USL >1 cm of the scar. Biopsies of these USLs showed MGIN in 2 and LGIN in 10 cases (Table 2).

Resection specimens and histology

The median maximum diameter of the individual resection specimens was 17 mm (IQR 15–21 mm), with a total thickness of 1650 μ m (IQR 1400–2000 μ m) and a submucosal thickness of 750 μ m (IQR 600–1000 μ m). Invasion depth in the cases of ESCC (n = 19) were: T1m1 (n = 3), T1m2 (n = 6), T1m3 (n = 6), and T1sm (n = 4). Tumor involvement was observed at the deep resection margin in one patient (G2T1sm3, submucosal penetration depth 1050 μ m), and lymphatic infiltration was seen in another patient (G2T1m3). These two patients and the three other patients with submucosal invasion of the lesion decided not to undergo additional (surgical) treatment. During a median follow-up of 4 visits (IQR 2–5) and 19 months (IQR 13–27 months), no HGIN/ESCC was observed at or near the site of the resection scar on endoscopy, and follow-up CTs did not show signs of metastasis (Table 2).

Discussion

This is the first prospective assessment of MBM for endoscopic resection of mucosal squamous neoplasia in the esophagus. Apart from one case series of five patients [16], there are no reports on MBM for this indication.

Endoscopic complete resection was achieved in all patients, which is in concordance with the results of a randomized study comparing endoscopic resection cap with MBM for early neoplasia in Barrett's esophagus, in which a success rate of 100% for MBM was reported [14]. In the current study, at 3-month follow-up, 95% of patients were histologically free of intraepithelial neoplasia at or in close proximity to the site of the endoscopic resection, and the remaining 5% were effectively treated by additional endoscopic procedures.

MBM has been investigated mainly as a resection technique for neoplasia in Barrett's esophagus. In a prospective series of 1060 MBM resections performed in 243 procedures, Alvarez Herrero et al. found the procedure to be safe: there were no perforations and only 3% early and 2% delayed bleedings [12]. In the current study, one small perforation was observed that was adequately managed endoscopically. Eight patients developed asymptomatic stenosis that did not require intervention.

In the current study, a median MBM procedure time of 12 minutes for a median of 5 resections was observed, which reflects the relative ease and practicality of MBM. In a randomized study comparing the endoscopic resection cap technique with MBM for endoscopic resection of early neoplasia in Barrett's esophagus, Pouw et al. showed that MBM is significantly faster (32% time reduction), with a median of 7 minutes per resection when performing piecemeal resections [14].

In Chinese areas where a high incidence of ESCC and high patient volumes pose a significant burden on a healthcare system with relatively limited endoscopic experience, the ease-of-use, safety, and effectiveness of MBM may be of pivotal importance.

The current study has some limitations that need to be addressed. First, all procedures were conducted by highly trained endoscopists, which possibly contributed to the favorable outcomes. Although MBM appears to be a relatively easy technique that may also be applied in a secondary care setting, this should be studied appropriately in the future.

Second, in this feasibility study on the use of MBM for early squamous cell neoplasia, no comparison was made with other endoscopic resection techniques, such as endoscopic resection cap or ESD. ESD is a resection technique that applies fluid injection to lift the lesion from the submucosa, after which the surrounding mucosa is cut and the lesion is dissected en bloc from the submucosal layer. ESD is a complicated, laborious technique and has a long learning curve [17–19]. In some areas where ESCC is very common, ESD cannot be implemented on a large scale. The sheer number of ESCC cases and the limited availability of resources and endoscopic experience justify the use of a less complicated endoscopic resection technique such as MBM.

En bloc resection by ESD allows for effective assessment of all resection margins and is associated with a lower risk of local recurrence compared with piecemeal resection [17,20,21]. It is important to note, however, that the deeper (vertical) resection margin can be adequately evaluated on piecemeal resection specimens [14]. Piecemeal resections are inevitably associated with uncertainty regarding the histology of the lateral margins. The rate of local recurrence is, however, low, and given a strict follow-up regimen, local recurrences are generally detected at a stage at which endoscopic re-treatment is still possible. Most patients in the current study had flat-type (0-IIb) lesions. One could argue that 0-IIa, 0-IIc or a combination would pose a greater challenge to the effectiveness of MBM. Furthermore, given the favorable results of recent investigations on RFA for the treatment of ESCC, RFA may be a good alternative for endoscopic resection of flat-type lesions [22,23]. The drawback of RFA, however, is the lack of histological staging.

Interestingly, during follow-up, a relative high number of patients were observed to have developed new USLs containing LGIN away from the initial treatment site. This observation suggests a genetic field defect, which is consistent with previous reports [24]. LGIN has a risk of progression to carcinoma of 24% [8]. Local resection of HGIN/ESCC may therefore not be sufficient in a subset of patients, who are at increased risk of developing new intraepithelial and invasive neoplastic lesions. A combination with RFA may therefore be a good option to eradicate larger mucosal areas. Moreover, future research to investigate the genetic field defect and a possible risk-stratification model based on genetic markers is warranted.

In conclusion, endoscopic resection with the MBM technique appears to be a safe, effective, and easy endoscopic treatment modality for early esophageal squamous neoplasia. In high risk areas where endoscopic expertise is limited and high volume poses great demands on resources, MBM may offer a valuable tool to make minimal invasive therapy for early esophageal neoplasia more widely available. In the future, a randomized controlled trial comparing MBM with other endoscopic resection techniques, such as endoscopic resection cap or ESD, will be needed to prove whether or not MBM is an equally effective, safe, and possibly more simple resection method. Perhaps MBM can then be implemented in

secondary care settings, which will bring relief to many patients and healthcare facilities in areas with high numbers of ESCC cases.

Acknowledgments

The authors would like to acknowledge Huaying Xun, Guixiang Yu, Fenghuan Ju, Yongqiang Xie, Li Sun, Liang Zuo, Haiyan Wang, and Hai Wang from the Departments of Endoscopy, Pathology, and Anesthesiology, Cancer Institute and Hospital, Chinese Academy of Medical Sciences (Beijing, China), and Ruixue Zhou, Deli Zhao, Peng Ji, Shengyong Liang from the Feicheng People's Hospital (Feicheng, Shandong Province, China), for their valuable contributions to this study.

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Fig. 1.

Endoscopic images of an early squamous neoplastic lesion in the esophagus. **a** White light endoscopy. **b** Narrow band imaging. **c** 1.25% Lugol's staining. **d** Delineation with coagulation marks. **e** The view through the multiband mucosectomy cap with three rubber bands and the pseudopolyp created by the release of a rubber band. **f** The resection wound after completion of the endoscopic resection. **g** Endoscopic view of the reconstructed resection specimen, in which the lesion can be appreciated. At 3-month follow-up, endoscopic view of the endoscopic resection scar: **h** with white light endoscopy; **i** with 1.25% Lugol's staining.

Fig. 2.
a Perforation following multiband mucosectomy. **b** The perforation was treated successfully by application of clips.

Table 1

Patient and lesion characteristics (n = 41).

Male : female, n	26 : 15
Age at time of MBM procedure, mean $\pm$ SD, years	61 $\pm$ 7
Worst histology prior to endoscopic resection, n	
HGIN	33
ESCC	8
Paris classification, n	
0-IIa	1
0-IIb	34
0-IIc	3
0-IIa+b	3
Length of treatment area, median (IQR), cm	5 (4–6)
Circumferential extent, median (IQR), %	42 (25–50)

ESCC, esophageal squamous cell carcinoma; HGIN, high grade intraepithelial neoplasia; IQR, interquartile range.

Table 2

Endoscopic procedures, histological characteristics, and follow-up.

Endoscopic complete removal of lesions, n/N (%)	41/41 (100)
Number of resections, median (IQR), n	5 (3–6)
MBM resection time, median (IQR), minutes *	12 (8–24)
Total endoscopy time, median (IQR), minutes †	32 (27–42)
Complications, n	
Acute	1 perforation (treated with clips)
Delayed	8 mild stenoses (no dilation required)
Max. diameter of individual resection specimens, median (IQR), mm	17 (15–21)
Max. thickness of resected lesions, median (IQR), $\mu\text{m}^{\ddagger}$	1650 (1400–2000)
Max. submucosal thickness, median, (IQR), $\mu\text{m}^{\ddagger}$	750 (600–1000)
Worst histology of endoscopic resection specimens, n	
Normal squamous epithelium	1
LGIN	0
MGIN	4
HGIN	17
ESCC	19
Max. penetration depth ESCC (n = 19), n	
m1	3
m2	6
m3	6
sm	4
Max. differentiation grade ESCC (n = 19), n	
G1	1
G2	14
G3	4
Follow-up, median (IQR), months	15 (12–24)
Number of follow-up visits, median (IQR), n	3 (2–3)
Worst histology within 1 cm of scar at 3-month follow-up, n	
Normal squamous	36
LGIN	3
HGIN	2
Worst histology of USLs >1 cm from scar at 3-month follow-up (n = 19), n	
Normal squamous	15
LGIN	2
MGIN	2
Worst histology within 1 cm of scar at last follow-up, n	
Normal squamous	27
LGIN	12
MGIN	1
Worst histology of USL >1cm from scar at last follow up (n = 12), n	

LGIN	10
MGIN	2

ESCC, esophageal squamous cell carcinoma; HGIN, high grade intraepithelial neoplasia; IQR, interquartile range; LGIN, low grade intraepithelial neoplasia; MBM, multiband mucosectomy; MGIN, middle grade intraepithelial neoplasia.

* Time between introduction of endoscope with assembled MBM kit and end of the MBM procedure, inclusive of removal of resection specimens and treatment of complications.

[†] Time between first introduction of the endoscope and removal of the endoscope after the full procedure.

[‡] Maximum thickness of the reconstructed lesion.