

## Laparoscopic Transgastric Esophageal Mucosal Resection for High-Grade Dysplasia

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### ABSTRACT

**Background:** High-grade dysplasia of the esophageal mucosa has been shown to be a precursor to adenocarcinoma. In addition to esophagectomy, multiple ablative endoscopic techniques have evolved for the management of this condition. As a surgical alternative to esophagectomy, we describe for the first time a new option in the treatment of high-grade dysplasia.

**Materials and Methods:** Two patients with a history of gastroesophageal reflux disease (GERD) underwent upper gastrointestinal endoscopy which demonstrated high-grade dysplasia of the distal esophagus. The first patient had a short segment (0.5–1.0 cm), and the second patient had a longer (2 cm) segment of dysplasia. The patient is placed in the modified lithotomy position. Five trocars are placed as if to perform a fundoplication. A complete circumferential mobilization of the esophagus is performed. The short gastric vessels are divided with the harmonic scalpel, to free up the fundus of the stomach. An anterior horizontal gastrotomy is performed three to four centimeters below the gastroesophageal junction. A solution of epinephrine and normal saline (1:100,000) is injected into the mucosa at the Z-line and, utilizing specially designed hook electrocautery, the mucosa is incised circumferentially around a lighted bougie. Using blunt dissection the mucosa is undermined, elevated, and excised in four quadrants. Three centimeters of the distal esophageal mucosa are resected. The gastrotomy is then closed using a linear stapler, and a 360° fundoplication is performed around a 50 Fr bougie.

**Results:** High-grade dysplasia was identified in the specimens from both patients; however, neither patient was found to have carcinoma *in situ* or invasive esophageal cancer. Our first patient has been followed for twenty months, the second for ten months. Both patients underwent routine upper gastrointestinal endoscopy for surveillance of the healing process. At eight months, the mucosa of the first patient showed complete regeneration of squamous epithelium. Our most recent patient appears to be progressing without complications and has also demonstrated normal squamous epithelium at ten months postoperatively, without changes of Barrett's epithelium.

**Conclusion:** The technique of laparoscopic transgastric esophageal mucosal resection is feasible and may be proven to be an alternative to esophagectomy for the management of high-grade dysplasia.

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## INTRODUCTION

**A**N ACCEPTED TREATMENT for Barrett's esophagus with high-grade dysplasia is esophagectomy;<sup>1</sup> however, patients often are unable or unwilling to undergo esophagectomy due to the associated risks. The other two options utilized in the treatment of high-grade dysplasia are continued endoscopic surveillance and ablation therapy.<sup>1,2</sup> Various types of mucosal ablative therapies exist including thermal therapy, photodynamic therapy (PDT), and endoscopic mucosal resection (EMR).<sup>3-10</sup> Herein we describe a novel resectional technique for Barrett's with high-grade dysplasia: laparoscopic transgastric esophageal mucosal resection. We report the results of two individuals thus treated, and offer the technique as a potential alternative to esophagectomy in the Barrett's patient with high-grade dysplasia.

## MATERIALS AND METHODS

The first patient was a 44-year-old man presenting with a lifelong history of gastroesophageal reflux disease (GERD) who had a short (0.5 to 1.0 cm) segment of Barrett's esophagus and a hiatal hernia; one of the biopsies of the Barrett's segment demonstrated high-grade dysplasia. The second patient was a 52-year-old man with an eight-year history of GERD who had mild dysplasia in a segment of Barrett's which was managed with surveillance endoscopy. He was referred for resectional therapy when two consecutive biopsies revealed high-grade dysplasia. Medical and surgical options, including frequent endoscopic surveillance, ablation therapy, and esophagectomy, were discussed with both patients. Both patients chose laparoscopic transgastric esophageal mucosal resection; they both understood that this was a new procedure.

The surgical technique was similar in both cases. Five trocars were placed with the patient under general anesthesia in the modified lithotomy position (Fig. 1). After circumferential mobilization of the esophagus, a hiatal hernia repair was performed over a 50 Fr lighted bougie. A 5 cm transverse gastrotomy then was made 4 cm below the gastroesophageal junction. Sutures were placed on the lateral edges of the gastrotomy to facilitate visualization of the gastroesophageal junction. The lumen of the esophagus and the location of the Z-line were easily visualized through the gastrotomy.

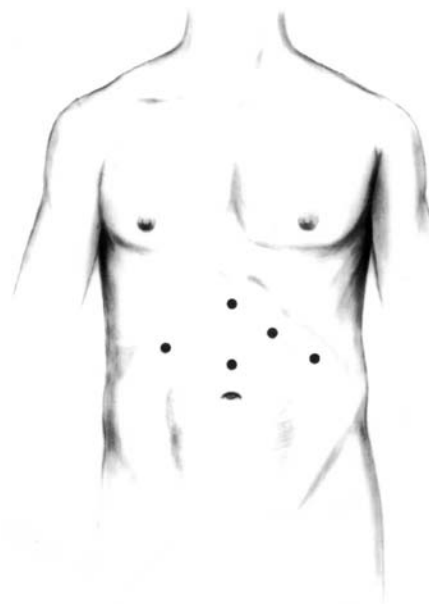
A solution of epinephrine and normal saline (1:100,000) was injected at the Z-line of the distal esophagus to aid in the elevation of the mucosa (Fig. 2). The submucosal plane was entered with a modified hook electrocautery instrument (a standard laparoscopic hook insulated on all but its anterior surface) (Arrow Medical Inc., Chicago, IL); this permitted electrosurgical dissec-

tion of the mucosa without damaging the underlying muscular layers (Fig. 3). The mucosa was dissected further from the underlying smooth muscle with a curved laparoscopic spatula; 2-3 cm of mucosa was circumferentially dissected and excised in four distinct quadrants (Fig. 4). The mucosal segment was excised using hook scissors (Fig. 5). The tapered end of a lighted bougie (as maneuvered by Babcock forceps [Pilling Surgical Co., Horsham, PA]) was used as a retractor for exposing the four quadrants of the mucosa (Fig. 6). The excised mucosa was oriented and marked for proximal and distal pathologic orientation.

The area was irrigated and hemostasis was obtained. The gastrotomy was approximated with interrupted 2-0 polyester sutures, and then closed with a laparoscopic linear stapler. The gastroesophageal junction and the gastrotomy site were tested for leaks with both air and methylene blue. A 3-stitch Nissen fundoplication then was performed.

## RESULTS

In each case an upper gastrointestinal study with water-soluble contrast was obtained on the first postoperative day; neither demonstrated extravasation. The patients were allowed liquids by mouth and both were discharged to home on the third postoperative day. Pathological evaluation of the surgical specimens demonstrated Barrett's esophagus with high-grade dysplasia in both cases, but no evidence of malignancy.



**FIG. 1.** Trocar positioning for laparoscopic esophageal mucosal resection.

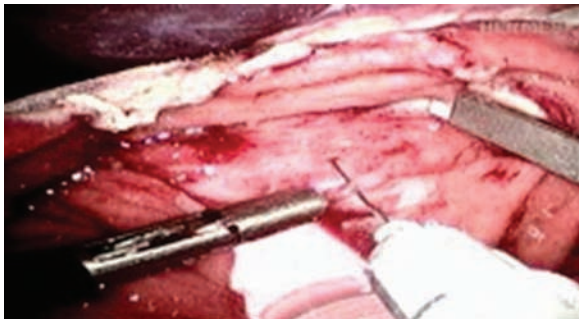


FIG. 2.

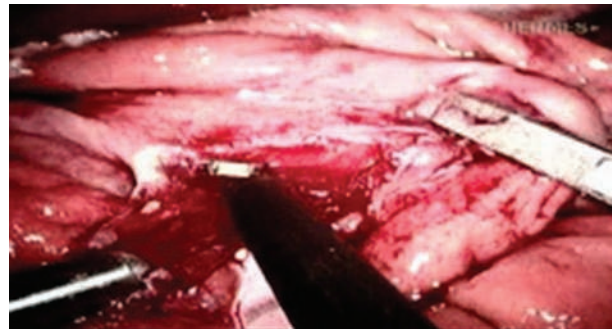


FIG. 3.

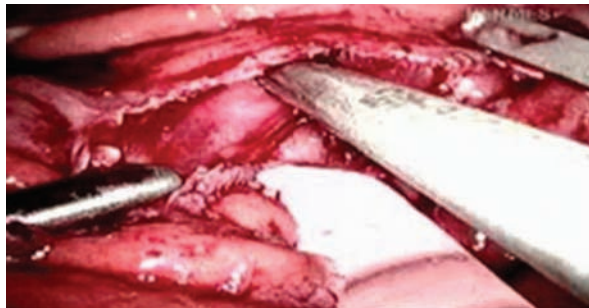


FIG. 4.

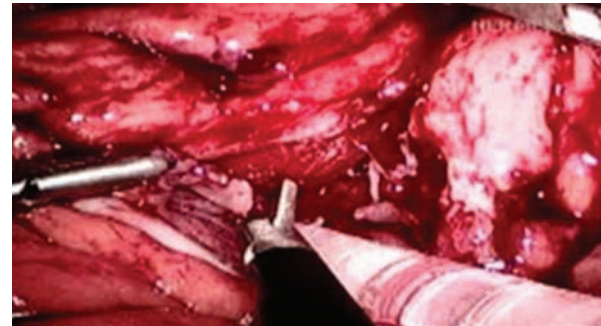


FIG. 5.

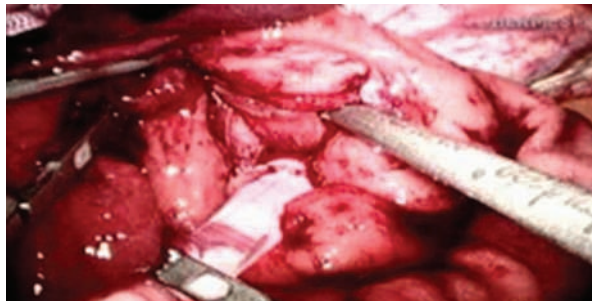


FIG. 6.

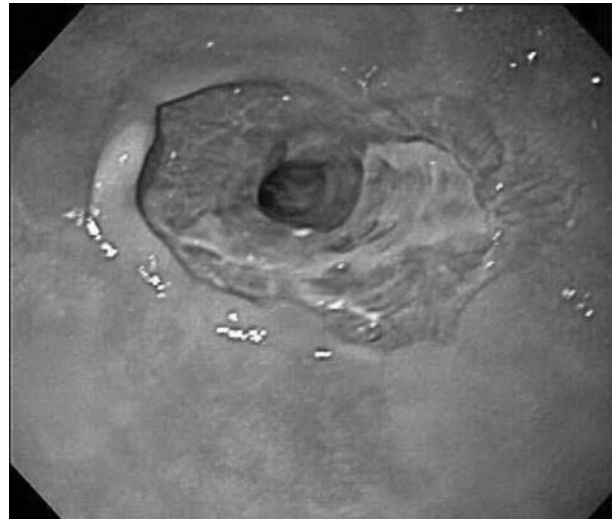


FIG. 7.



FIG. 8.

**FIG. 2.** Submucosal injection of epinephrine and normal saline (1:100,000).

**FIG. 3.** Incision of the esophageal mucosa at the Z-line.

**FIG. 4.** Dissection of the distal 2 cm of the esophageal mucosa.

**FIG. 5.** Excision of the raised mucosal flap.

**FIG. 6.** Completed esophageal mucosal resection.

**FIG. 7.** Endoscopic view of the mucosal resection two weeks postoperatively.

**FIG. 8.** Postoperative esophageal mucosal staining with methylene blue.

The first patient was readmitted for midsternal chest pain and dysphagia during the early postoperative course. Upper endoscopy revealed an edematous gastroesophageal junction that opened easily with endoscopic insufflation. The patient temporarily improved, but a repeat endoscopy was performed one month later for recurrent dysphagia. This demonstrated a pinpoint stricture at the gastroesophageal junction that required balloon dilation. This intervention was successful. At two months, the mucosal resection was evident and without luminal narrowing (Fig. 7). His symptoms promptly resolved, and he has needed no further dilatations. In addition, repeat mucosal biopsies demonstrated normal squamous epithelium in the distal esophagus and no evidence of Barrett's epithelium with methylene blue staining (Fig. 8). Twenty months postoperatively, the patient was off all medications and had no dysphagia, odynophagia, or pyrosis. The postoperative course of the second patient was uncomplicated and he remained asymptomatic; at his ten-month endoscopy, he also demonstrated normal squamous epithelium with no evidence of Barrett's epithelium.

## DISCUSSION

Due to the surgical morbidity and mortality associated with esophagectomy, other options have been developed in the treatment of Barrett's esophagus with high-grade dysplasia. One option is repeated endoscopic surveillance with the obvious advantage of avoiding esophagectomy. The major disadvantage of this option is that random mucosal biopsies may not show malignancy, and therefore the cancer may progress to more advanced stages before definitive treatment is initiated. In addition, experienced endoscopists and pathologists are necessary for proper surveillance. Other options include mucosal ablative therapy, including thermal therapy (multipolar electrocoagulation, argon plasma coagulator, heater probe, potassium-titanyl-phosphate laser, and neodymium:yttrium-aluminum laser)<sup>3-6</sup> and photodynamic therapy (PDT).<sup>7</sup> PDT relies on photosensitizing drugs that selectively accumulate in the Barrett's mucosa.

A concern with nonresective ablative therapy is that normal-appearing epithelium may conceal underlying malignancy. Endoscopic mucosal resection (EMR) was, until now, the only ablation therapy that allowed removal of specimens for pathologic sectioning and diagnosis. Reports of EMR in the treatment of Barrett's high-grade dysplasia or esophageal cancer have described initial success.<sup>11,12</sup> Our technique of laparoscopic mucosal resection allows for some advantages over the endoscopic method; the specimens can be removed in their entirety with proper orientation for pathology, and the excellent

laparoscopic visualization allows for hemorrhage control with minimal electrocautery use. A perforation also may be diagnosed and repaired during the procedure. Furthermore, a concomitant laparoscopic fundoplication can be performed.

The obvious disadvantages are the need for a general anesthetic and a gastrotomy, and also the possibility of a postoperative esophageal stricture. Circumferential endoscopic mucosal resections have been performed experimentally without any strictures;<sup>13</sup> however, the risk of stricture will likely be present after any circumferential stripping of the distal esophagus mucosa. It is our belief that early endoscopy will diagnose and treat early strictures (such as the one we encountered) with few longterm consequences.

We believe that this is the first report of laparoscopic transgastric esophageal mucosal resection for Barrett's epithelium with high-grade dysplasia. Two patients successfully underwent the procedure with minimal morbidity and excellent outcomes. This new approach may offer a less invasive modality for the treatment of high-grade dysplasia compared to esophagectomy. Obviously, more patients and longterm results will be needed in order to determine if this new type of mucosal resectional therapy is appropriate.

We acknowledge, at this point, that this paper was meant merely to describe our operative technique and the results on two patients. We are currently engaged in the development of protocols to explore the effectiveness and longterm benefits of this approach to the treatment of high-grade esophageal dysplasia.

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