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HOW I DO IT

Thoracoscopic and Laparoscopic Enucleation of Esophageal Leiomyomas

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Abstract Although infrequent, esophageal leiomyomas are the most common benign intramural tumors of the esophagus. As malignant potential is not a concern in these lesions, they represent ideal candidates for an organ-preserving approach. Due to their well-circumscribed growth, a minimally invasive approach should be pursued in almost all patients. We present our recent techniques and results associated with totally minimally invasive thoracoscopic and laparoscopic approaches to resection of esophageal leiomyomas. These approaches require technical expertise but can be accomplished with a short learning curve.

Keywords Thoracoscopic · Laparoscopic · Enucleation · Esophageal leiomyomas

Introduction

Leiomyomas of the esophagus are interlacing bundles of smooth muscle cells originating from the inner circular muscle layer of the distal and midthoracic esophagus.[1] Although not as common as esophageal carcinoma, these benign lesions affect more males than females and are often asymptomatic.[2] Depending on the size and location of the leiomyoma, various treatment options have been described in the literature for patients who are symptomatic.

The first reported resection and enucleation of esophageal leiomyoma were described in the early 1930s by Sauerbruch and Ohsawa, respectively.[3] Since then, multiple surgical techniques from open resection[4,5] to minimally invasive robotic and endoscopic[6,7]enucleation have been published but not standardized.[1,2,8–11] Advances in minimally invasive surgical instrumentation and techniques have enabled surgeons to perform enucleation using either thoracoscopy or laparoscopy depending on the location of the lesion since surgical resection is widely accepted as the definitive treatment for these benign esophageal tumors. In this study, we review our experience with thoracoscopic and laparoscopic approaches to enucleation of benign esophageal tumor in nine consecutive patients and discuss our minimally invasive surgical approaches based on the location of the tumor.

Methods

We performed a retrospective review of consecutive patients who had thoracoscopic or laparoscopic enucleation of esophageal leiomyoma between July 2010 and December 2014. The division's database was interrogated after institutional review board approval. The patient demographic characteristics, operative details, and postoperative outcomes were collected and analyzed. During the time frame of this study, all patients with esophageal leiomyomas were treated with a MIS approach. No conversion was necessary

All patients had a computed tomography study illustrating an esophageal mass in the mid thoracic (seven patients) or distal esophagus (two patients). Endoscopic ultrasound showed the presence of submucosal tumors in all patients without invasion of adjacent organs or the mucosal layer. All lesions were biopsied at the time of endoscopy to rule out a carcinoma or presence of gastrointestinal stromal tumor.

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Results

We identified nine patients from this time period who had a minimally invasive surgical enucleation of their esophageal leiomyoma via a right thoracoscopic or laparoscopic approach. Table 1 shows the patient demographic and surgical characteristics. Mean age was 43 years, 78 % were females, 67 % were Caucasians, two were Hispanic, and one was African-American. Dysphagia was the dominating presenting symptom.

Mean operative time was 100 min for the thoracoscopic approach versus 82.5 min for the transabdominal laparoscopic technique. Average blood loss was 25 mL for both approaches. Average leiomyoma size was 6 cm (range, 4–12 cm). Median and mean length of postoperative stay was 2 days with no intensive care unit admission regardless of approach. There were no perioperative mortalities or complications. All patients had an intraoperative endoscopy to test the integrity of the esophageal mucosa with no injury identified. The esophageal mucosa is evaluated endoscopically under direct vision to ensure that there are no holes. In addition, endoscopic air insufflation is performed under saline to check for an air leak. The esophageal muscles are re-approximated following the enucleation in a running fashion using 2-0 silk suture. All thoracoscopic leiomyoma enucleation had a right thoracostomy tube removed on post-operative day 1 and no drainage was placed in the two patients who had the laparoscopic approach. The azygous vein was divided in six of the seven patients with mid-thoracic leiomyoma in order to help mobilize and enucleate the lesion. All patients were discharged on a full-liquid diet following a contrasted Gastrografin esophogram study. Mean follow-up was 36 months with no lesion recurrences. Follow-up was performed within a few weeks after discharge from clinic to evaluate swallowing and to advance diets from full liquids to solid foods. Subsequently, follow-up was done to ensure that a regular diet was being tolerated. After this, no regular scheduled follow-up was done as the resected tumor was benign, and recurrence of these tumors should be extremely low. One patient, who underwent a transabdominal laparoscopic leiomyoma enucleation from the distal esophagus, required an anti-reflux operation 4 months following their enucleation for symptomatic and elevated Demesteer score on a 24-h pH probe study. The antireflux procedure was performed secondary to the enucleation procedure as the leiomyoma was in the GE junction and the distal esophagus required extensive mobilization. There were no preoperative symptoms prior to the initial procedure. No other functional impairment was identified after resecting large leiomyomas.

Description of Procedure

Thoracic Enucleation

Our trocar placement and video-assisted thoracoscopic procedure is similar to methods we have previously described.[12,13] The patient is intubated with a double-lumen endotracheal tube with isolated left lung ventilation. A nasogastric tube is placed to stiffen the esophagus during the enucleation. The patient is placed in the left lateral decubitus position, and a 5-mm trocar is placed under direct vision inferior to the tip of the right scapula. The right chest cavity is insufflated with 8 mm Hg of carbon dioxide (CO_2) pressure. A 12-mm port is placed in the posterior axillary line along the fifth or sixth intercostal space to retract the lung anteriorly. In some thin patients, a 5-mm port with a 5-mm fan retractor is adequate to retract the lung. A 12-mm port and a 5-mm port are placed in the ninth or tenth intercostal space, just above the diaphragmatic insertion and the sixth or seventh intercostal space, respectively (Fig. 1). When indicated, the azygous vein is divided with a vascular load linear stapler so that the esophagus can be dissected from underneath the azygous vein. Often, the dissection continues with mobilization of the proximal

Table 1 Characteristics and operative outcomes of nine patients who underwent minimally invasive surgical enucleation of esophageal leiomyoma

Age	Sex	Symptoms	OR time (min)	Hospital stay (days)	Surgical treatment	Location	Tumor size (cm)
53	F	Dysphagia	95	2	TE	Middle esophagus	5
33	F	Dysphagia and chest pain	125	2	TE	Middle esophagus	12
36	F	Dysphagia	90	2	TE	Middle esophagus	6
47	F	Dysphagia and odnophagia	70	3	TE	Proximal thoracic esophagus	4
46	M	Dysphagia	110	2	TE	Middle esophagus	4
44	F	Dysphagia	120	3	LE	Middle esophagus	8
63	F	Dysphagia	90	3	TE	Middle esophagus	4
36	F	Dysphagia	70	2	LE	Distal esophagus	5
31	M	Dysphagia and epigastric pain	95	2	LE	Gastroesophageal junction	8

OR operative time, *TE* thoracoscopic enucleation, *LE* laparoscopic enucleation

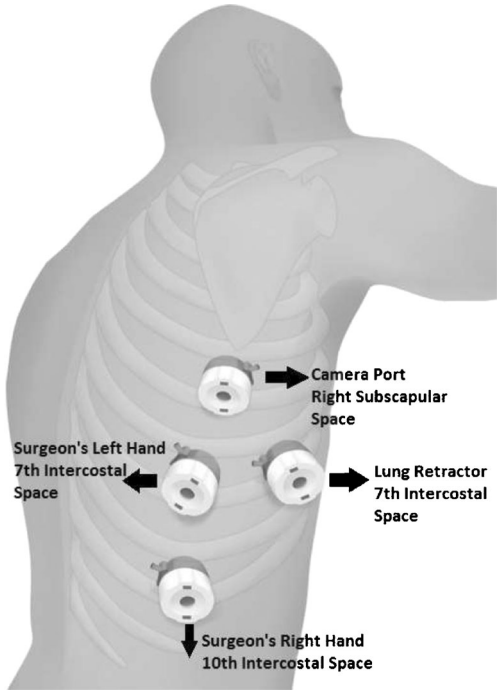

Fig. 1 Thoracoscopic port placement

esophagus away from the trachea up toward the thoracic inlet depending on the size and location of the lesion. The longitudinal and circular esophageal muscle fibers are divided over the lesion using hook electrocautery at minimal setting (10–15 ohms) (Fig. 2). The lesion is retracted and carefully enucleated from the esophageal mucosa (Fig. 3a, b). A retraction suture is often placed through the lesion to aid with mobilization and retraction as it is being enucleated. Endoscopic peanut devices are useful for dissection of the mucosa away from the lesion. The integrity of the mucosa is evaluated endoscopically under saline irrigation. The esophageal myotomy is reapproximated in a running fashion using non-absorbable braided suture. A 24 F BLAKE® Silicone Drain (Ethicon, Johnson & Johnson Health Care Systems Inc., NJ) is positioned along the posterior mediastinum and is set to water seal. It is removed on post-operative day 1 following a contrasted esophagram illustrating no leak.

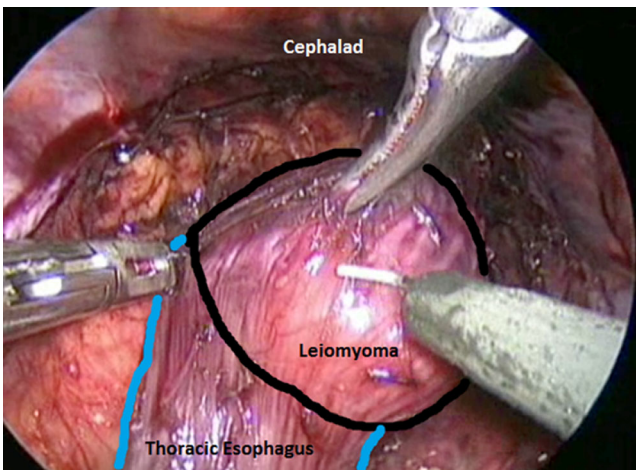

Fig. 2 Longitudinal and circular esophageal muscle fibers are divided over the lesion using electrocautery

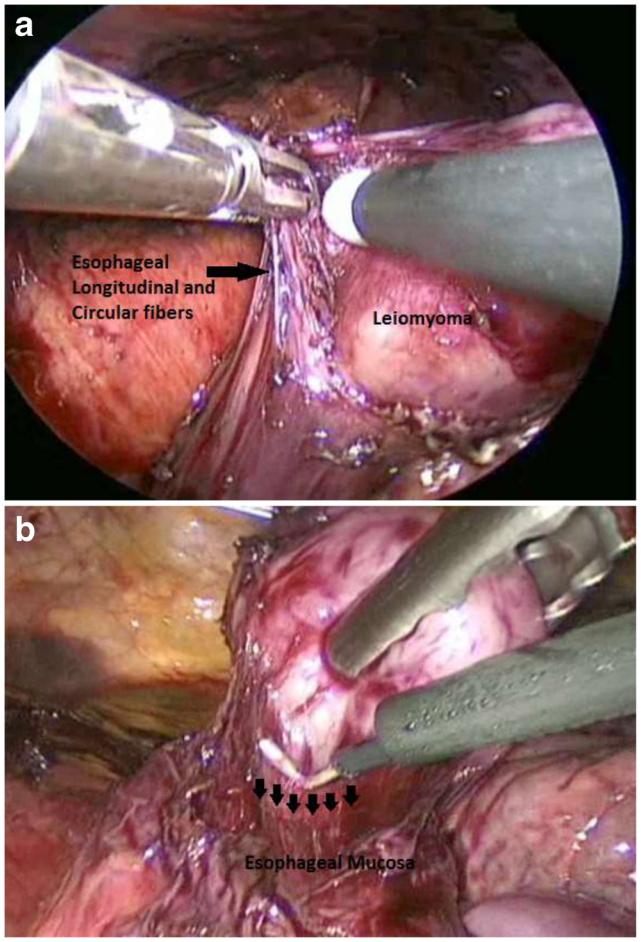

Fig. 3 **a** Leiomyoma is bluntly retracted and carefully separated from the esophageal mucosa. **b** Leiomyoma is meticulously and carefully enucleated from the esophageal mucosa

Transabdominal Laparoscopic Enucleation

Our initial trocar is a 5-mm optiview port which is placed under direct visualization in the left lateral aspect of the left subcostal region. Additional ports include a 5-mm camera trocar, 2 cm to the left and above the umbilicus. The assistant surgeon controls these two ports, while the12-mm port placed on the contralateral side of the camera port and the 5 mm port along the right subcostal area are the surgeon's working ports. A liver retractor is used to elevate the left lobe of the liver (Fig. 4).

The phrenoesophageal ligament is widely divided, and the esophageal hiatus is dissected. A Penrose drain is placed around the gastroesophageal (GE) junction via retrogastric window a along the right crus of the diaphragm. The Penrose is secured around the GE junction with an endo-loop.

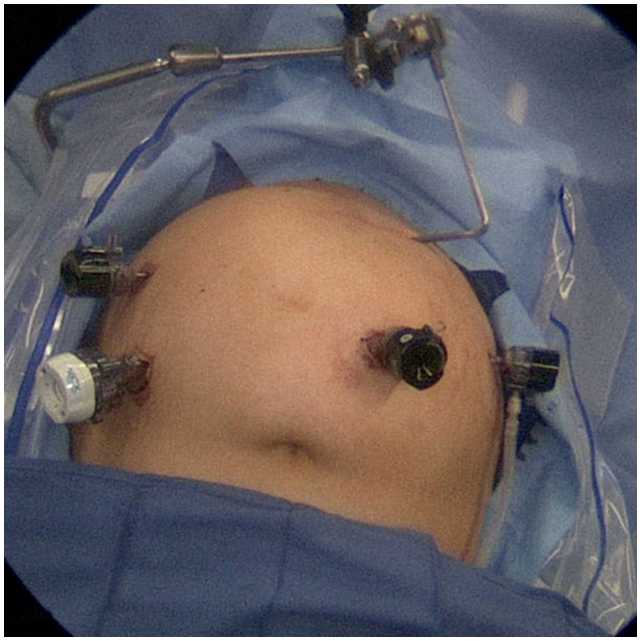

Fig. 4 Laparoscopic ports and liver retractor placement

The GE junction and lower esophagus are dissected until the proximal portion of the lesion is visualized. In a similar fashion to the thoracic enucleation, the longitudinal and circular esophageal muscle fibers are divided over the lesion using electrocautery. The lesion is meticulously enucleated from the normal esophageal wall with care taken to preserve the integrity of the esophageal mucosa (Fig. 5). Intraoperative endoscopy with air insufflation under saline irrigation is performed to check for air leak. The muscularis propria layer is reapproximated in a running fashion but no drain is left in place. All patients have a radiographic esophageal swallow study the following day to further ensure no mucosal injury or leak. After tolerating full liquids, they are discharged home on post-operative day 2.

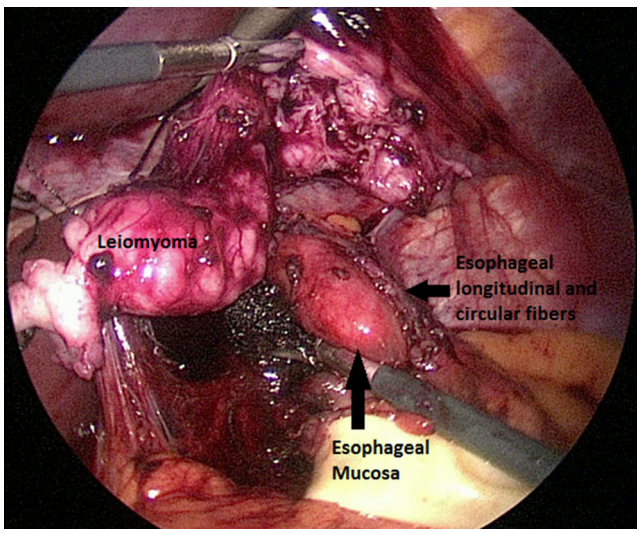

Fig. 5 Laparoscopic enucleation of esophageal leiomyoma

Discussion

The ideal technique for minimally invasive enucleation of esophageal leiomymoma is under debate depending on the size and location with various methods described.[3–10] Our small experience with nine patients illustrated that a minimally invasive thoracoscopic or laparoscopic surgical enucleation of esophageal leiomyoma tumor is safe, feasible, and inexpensive considering the use of a simple electrocautery probe to dissect and enucleate the lesion from surrounding esophageal mucosa without the use of robotic and/or endoscopic techniques requiring special and fairly costly instrumentations. All components of the operation are done under direct vision allowing for complete enucleation and hemostasis control.

Obviously, the operative approach to enucleation should be based on the anatomic location. In most cases, localization of the tumor can be accomplished preoperatively via computed tomography and endoscopy. However, tumors located near the gastroesophageal junction pose a challenging dilemma due to the potential esophageal narrowing or destruction of the acid protective gastroesophageal junction barrier. This was noted in one of our patients who required a laparoscopic Nissen fundoplication 4 months following their enucleation for symptomatic gastroesophageal reflux noted on an upper gastrointestinal radiographic study and pH probe study which was refractory to high-dose medication.

In summary, we describe a technique for esophageal leiomyoma enucleation. This method is applicable to the majority of patients with this rare yet benign lesion. This has become our standard approach to minimally invasive enucleation of leiomymoma of the esophagus and overcomes many of the limitations and prohibitive costs associated with open or robotic surgery and the unnecessary resection of these often-asymptomatic lesions. Performing this procedure does require pre-requisite technical skills to ensure safe results as described in this article but can be replicated with a short learning curve. Furthermore, if the technical skills are present, then three to five cases should be all that is necessary to become proficient in this operative technique.

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