



# Treatment of esophageal diverticula in uniportal video-assisted thoracoscopic surgery

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**Abstract:** Esophageal diverticulum is a rare disease caused by impaired esophageal motility. It may present with disorders like pain, heartburn, dysphagia, episodes of food regurgitation and halitosis, but often the patients are asymptomatic. Diagnosis is based on the esophagogram with barite meal, gastroscopy and esophageal manometry. The diverticula can be classified according to the site of onset in the esophagus: diverticula of the distal third (epiphrenic, 20%), mediathoracic or mediastinal (10%) and proximal diverticula (Zenker diverticula, 70%). Traditionally, surgical treatment involves a thoracotomy approach that allows diverticulectomy and esophageal myotomy. In our centre, we started to use the uniportal video-assisted thoracoscopic surgery (VATS) approach for the treatment of esophageal diseases, both neoplastic and benign. In our preliminary experience with uniportal VATS diverticulectomy, we obtained good results in terms of effectiveness, reduction in hospitalization time, complications, pain control and early recovery of patient's daily activities.

**Keywords:** Uniportal VATS; esophageal diverticula; diverticulectomy; esophageal surgery; minimally invasive surgery

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## Introduction

Esophageal diverticulum is a rare disease (incidence 1/100,000) caused by impairment of esophageal motility. Esophageal diverticula are classified according to the localization in: upper esophageal (Zenker: 70%), thoracic and mediastinal (10%) and epiphrenic diverticula (20%). Traditionally, surgical treatment involves a thoracotomy approach that allows diverticulectomy and esophageal myotomy. For many years, esophageal surgery has been recognized as a very challenging issue for surgeons and risky for patients. Indeed, the esophagus is really located deep in the neck and the posterior mediastinum and the absence of a formal serous layer leads to unsafe anastomosis with a

great risk of leakage.

The first description of thoracoscopic diverticulectomy dates back to 2001 (1). The minimally invasive surgery has been proven to guarantee many advantages such a reduction in pulmonary complications, wound infections, postoperative pain and length of postoperative stay compared to open surgery (2,3). A superior cosmetic result is an additional benefit, especially when dealing with benign diseases in younger patients. Nowadays there are not yet much data in the literature concerning the uniportal video-assisted thoracoscopic surgery (VATS) approach for esophageal diverticula (4).

In the present work, we report our preliminary experience in uniportal VATS esophageal diverticulectomy.

**Table 1** Population characteristics

Characteristics	N=3
Age (years)	63.5±1.5
Gender (Male)	2 (67%)
Smoking	2 (67%)
COPD	1 (33%)
Heart disease	2 (67%)
Arterial hypertension	2 (67%)
Diabetes	0
ASA score	2.3±0.57
Other diseases	2 (67%)
Hiatal hernia	1 (33%)
Fundoplication	1 (33%)
Preoperative dysphagia	3 (100%)
Weight loss	3 (100%)

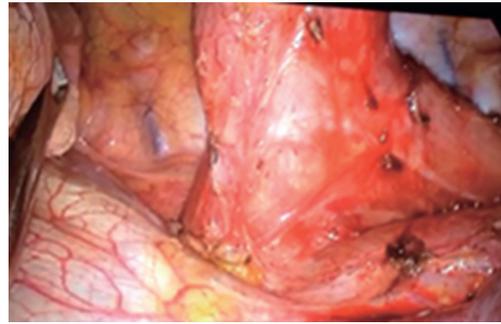
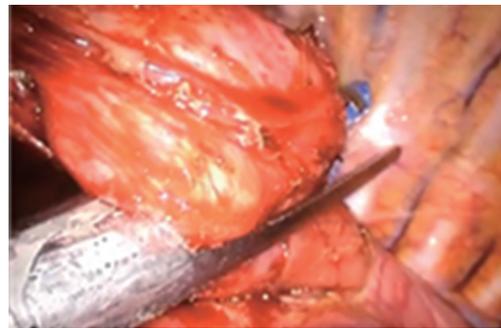
COPD, chronic obstructive pulmonary disease. The data were expressed as mean ± SD or n (%).

**Figure 1** Uniportal incision and instrument setting.

### Case presentation

Between December 2016 and January 2018, 3 patients (2 men, 1 woman) underwent diverticulum resection of the middle and distal esophagus (2 epiphrenic and 1 medium thoracic) and esophageal myotomy in uniportal VATS at our Center.

The average age of patients was 63.5±1.5 years. The

**Figure 2** Neck of the diverticulum.**Figure 3** Diverticulectomy.

clinical data of the three patients are reported in *Table 1*.

A Carlens dual lumen endotracheal tube was used under general anesthesia. The patient was positioned in a lateral left-side position, with the table slightly flexed. The surgeons stood in front of the patient's ventral side. A single 4 cm "muscle sparing" incision was performed at the level of the fifth right intercostal space on the mid-posterior axillary line. A skin retractor was introduced and all instruments passed through the same incision, with the 30° 10 mm-camera positioned above everything (*Figure 1*). The procedure started with dissection and mobilization of the esophagus (using an energy device) and the identification of the diverticulum (*Figure 2*).

In case of epiphrenic diverticula the dissection of the diaphragmatic crus could be necessary. Careful attention was paid to identify and preserve the vagus nerve. After that we proceeded with the preparation of the diverticular collar and its section along the major axis of esophagus, using an endoscopic linear stapler (sequential 2.5/45-mm vascular cartridges; *Figure 3*). The resected diverticulum was removed by a retrieval bag. A hydro-pneumatic test was performed for checking and excluding any staple-line leak.



**Figure 4** Pre-operative esophagogram showing a large epiphrenic diverticulum.



**Figure 5** Post-operative esophagogram after diverticulectomy.

The application of some Fibrin glue is useful to reinforce the staple line. The procedure was completed with a standard esophageal myotomy (4–5 cm along the esophagus, above and below the resected diverticulum). Hiataloplasty was performed if there was a story of reflux disease and hiatus hernia. A 28 Fr drainage was placed through the same skin incision, with the distal tip into the posterior mediastinum, near the esophageal suture and a nasogastric tube was left in place. At the end of the procedure a regional loco-anesthetic

**Table 2** Results

Variables	N=3
Operative time (min)	180±37
Conversion	0
No. pleural drainages	1
Chest drain removal (days)	6.5±0.5
Post-operative stay (days)	7.0±1.0
Esophagogram (days)	5.6±0.4
Beginning of postoperative oral intake (days)	5.6±0.4
Localization of the diverticulum	
Middle thoracic esophagus	1 (33%)
Lower thoracic esophagus	2 (67%)
Extension (cm)	3.88±1.26

The data were expressed as mean ± SD or n (%).

block of the intercostal spaces was also performed to further reduce postoperative pain. In the post-operative period, the patient received a total parenteral nutrition up to the execution of the esophagogram on the 5th postoperative day (*Figures 4, 5*). Subsequently, the pleural drainage and the nasogastric tube were removed.

The mean duration of the operation was 180±37 min. There were no conversions. The average hospital stay was 7.0±1.0 days (*Table 2*).

We did not have severe complications or dehiscences in the postoperative period. One patient developed atrial fibrillation (with a preoperative known story of pericarditis and recurrent atrial fibrillation) that was pharmacologically cardioverted.

The analgic therapy was based on intraoperative intercostal block and subsequent administration of only paracetamol and NSAIDs, without opioid use. The mean pain on I postoperative day was 2.3±1.1 measured on VAS scale, with complete resolution after pleural tube removal. We have not registered neuralgia, paresthesias or wound infections. The aesthetic result was also judged satisfactory (*Table 3*).

All patients were discharged in good condition with oral nutrition without any major complications. At the 6-month esophagogram control, we did not appreciate relapses and only one patient complained dysphagia, related to the

**Table 3** Postoperative pain and cosmetic results

Variables	N=3
Pain in first postoperative day (VAS scale)	2.3±1.1
Mean duration of pain (days)	3±1
Pain after chest tube removal (VAS scale)	0
Cosmetic result (1 to 3 points)	2.66±0.57
Postoperative paresthesia and neuralgia	0
Wound infections	0

The data were expressed as mean ± SD or n (%).

previous too tight Nissen Fundoplication. An endoscopic dilatation resolved the problem.

## Discussion

Abnormal esophageal motility is probably the main reason at the basis of diverticulum development (5). Dysphagia and posture-related regurgitation are usually the main symptoms. The dimension of diverticulum may worsen the symptomatology, although it is known that the symptoms correlate better with the esophageal motility characteristics than with the dimensions of the diverticulum (6).

Symptomatic patients should undergo surgical treatment, but surgery is not without risk. The Mayo Clinic series (7) reported a complication rate of 33% and a death rate of 9.1%. The Mayo Clinic study also found that patients with minimal symptoms were unlikely to progress clinically, so the surgical treatment should be reserved for patients with incapacitating symptoms.

Myotomy is routinely performed in patients with epiphrenic diverticula. Usually the myotomy is performed at the level of the diverticular collar and is extended both towards the cranial and at the distal level (over the lower esophageal sphincter), to treat the entire esophageal portion involved in the motility disorder. The only diverticulectomy without treatment of the underlying motor disorder is not advisable. It has been associated with a higher incidence of diverticulum recurrence and a suture line leak rate of 10% to 20% (7).

Laparoscopy is a possible approach to perform combining diverticulectomy, myotomy and fundoplication, as reported in recent studies (2). However, it may be difficult with this approach to reach the top of the diverticulum neck if the diverticulum is more than a few centimeters from the gastroesophageal junction and it may also be difficult

to perform a proper extension myotomy. Furthermore, laparoscopic dissection in the mediastinum can be complicated by the rupture of the mediastinal pleura leading to pneumothorax, also hypertensive. The thoracoscopic approach, vice versa, may be appropriate for diverticulectomy and myotomy (in particular for patients with diverticula located more than few centimeters from the gastroesophageal junction or those requiring a long myotomy) but the laparoscopic approach seems preferable for fundoplication, although it was even described by uniportal VATS approach in literature (8). In recent years, the standard multiport VATS has evolved into a uniportal approach (9), used for lung resection and other increasingly complex cases (10-12), that is showing potential postoperative benefits in terms of reduction of pain and faster patient's recovery.

Nowadays, however, there are not enough data in the literature, in particular on the uniportal thoracoscopic approach for esophageal diseases (13), to make a real and effective comparison between the different minimally invasive techniques. Nevertheless, it can be said that the minimally invasive approach has a positive impact from the point of view of pain control, ensuring early mobilization and reducing hospitalization time.

In our preliminary experience, the thoracoscopic uniportal approach seems to be feasible and safe, allowing the resection of diverticulum and the treatment of underlying motor disorder. Longer follow-up and more extensive studies are needed to clarify the role of uniportal VATS, compared to other mini-invasive techniques, such as robotic, laparoscopic or endoscopic techniques, in the treatment of esophageal diverticular disease.

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