Treatment of esophageal diverticula in uniportal video-assisted thoracoscopic surgery

Edoardo Zanfrini†, Dania Nachira†, Marco Chiappetta, Elisa Meacci, Maria Teresa Congedo, Gian Maria Ferretti, Luca Pogliani, Amedeo Iaffaldano, Maria Letizia Vita, Venanzio Porziella, Stefano Margaritora

Department of General Thoracic Surgery, Fondazione Policlinico Universitario “A.Gemelli” IRCCS, Università Cattolica del Sacro Cuore, Rome, Italy

†Both authors contributed equally in writing this paper.

Correspondence to: Dr. Edoardo Zanfrini. Department of General Thoracic Surgery, Fondazione Policlinico Universitario “A.Gemelli” IRCCS, Università Cattolica del Sacro Cuore, Largo A.Gemelli, 8, 00168, Rome, Italy. Email: edoardo.zanfrini@gmail.com.

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%), mediothoracic 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 as 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.
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 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 hydropneumatic test was performed for checking and excluding any staple-line leak.

Table 1 Population characteristics

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

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

Figure 1 Uniportal incision and instrument setting.

Figure 2 Neck of the diverticulum.

Figure 3 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). Hiatalplasty 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 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 antalgic 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

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**Table 2 Results**

<table>
<thead>
<tr>
<th>Variables</th>
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<tr>
<td>Operative time (min)</td>
<td>180±37</td>
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<tr>
<td>Conversion</td>
<td>0</td>
</tr>
<tr>
<td>No. pleural drainages</td>
<td>1</td>
</tr>
<tr>
<td>Chest drain removal (days)</td>
<td>6.5±0.5</td>
</tr>
<tr>
<td>Post-operative stay (days)</td>
<td>7.0±1.0</td>
</tr>
<tr>
<td>Esophagogram (days)</td>
<td>5.6±0.4</td>
</tr>
<tr>
<td>Beginning of postoperative oral intake (days)</td>
<td>5.6±0.4</td>
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</table>

Localization of the diverticulum

<table>
<thead>
<tr>
<th>Localization</th>
<th>Count (%)</th>
</tr>
</thead>
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<tr>
<td>Middle thoracic esophagus</td>
<td>1 (33%)</td>
</tr>
<tr>
<td>Lower thoracic esophagus</td>
<td>2 (67%)</td>
</tr>
<tr>
<td>Extension (cm)</td>
<td>3.88±1.26</td>
</tr>
</tbody>
</table>

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 thorascoscopic
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 thorascoscopic
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 thorascoscopic
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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**Footnote**

*Conflicts of Interest:* The authors have no conflicts of interest
to declare.

*Informed Consent:* Written informed consent was obtained
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accompanying images.

**References**

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