

Resection of esophageal diverticulum through uniportal video-assisted thoracoscopic surgery

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Abstract: Open surgery remains the standard strategy for management of esophageal diverticulum in symptomatic patients. However, in the last years an increasing number of minimally invasive approaches have been proposed for this issue in order to reduce the surgical trauma and favor a fast return to daily activity. Herein, we describe a novel technique as uniportal video-assisted thoracoscopic surgery (VATS) for performing resection of esophageal diverticulum. This procedure was successfully carried out in three consecutive patients with giant mid-esophageal diverticulum (mean size: 6.5±0.5 cm). The mean post-operative time was 121±10 minutes. The chest drain was removed 48 hours later in all cases and the mean length of hospital stay was 9±1 days. No intraoperative neither postoperative complications were found in all patients but one. He had a small fistula 15 days later that was successfully treated with stent insertion. No recurrence of diverticulum was seen in all cases. Uniportal VATS is a feasible procedure that in theory could reduce the surgical trauma compared to standard open approach. However, future prospective studies should corroborate our impression before it can be recommended as acceptable therapy.

Keywords: Video-thoracoscopic; uniportal; esophageal diverticulum

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Introduction

Esophageal diverticulum is a clinical entity associated with esophageal motility disorders. Surgery is indicated in patients with severe symptoms as dysphagia, esophagitis, anorexia, regurgitation and weight loss. Open surgery is the standard strategy but in the last years an increasing number of papers have reported the use of minimally invasive approaches for performing diverticulectomy and myotomy in order to reduce the surgical trauma and favor a fast return to daily activity (1-6). Herein, we describe a novel technique as the surgical treatment of midthoracic

esophageal diverticulum using a uniportal video-assisted thoracoscopic surgery (VATS) approach.

Study population

In the last two years, three consecutive patients were referred to our attention for the treatment of giant mid-esophageal diverticulum (mean size: 6.5±0.5 cm). The characteristics of study population were summarized in *Table 1*. All patients presented severe symptoms including dysphagia, regurgitation, gastro-esophageal reflux, food retention, weight loss and chest pain. All patients

Table 1 Characteristics of study population

Age (year)	Sex	Symptoms	Site and size of diverticulum (cm)	Operative time (minutes)	Chest drainage (days)	Hospital stay (days)	Resolution of symptoms	Complications	Follow-up (months)
55	Male	Dysphagia, regurgitation, weight loss	Left mid-esophagus/7	130	48	9	Complete	Leaks	22
61	Male	Dysphagia, weight loss, chest pain	Left mid-esophagus/6	125	48	10	Complete	None	15
49	Male	Dysphagia, regurgitation, weight loss	Right mid-esophagus/6.5	110	48	8	Complete	None	11

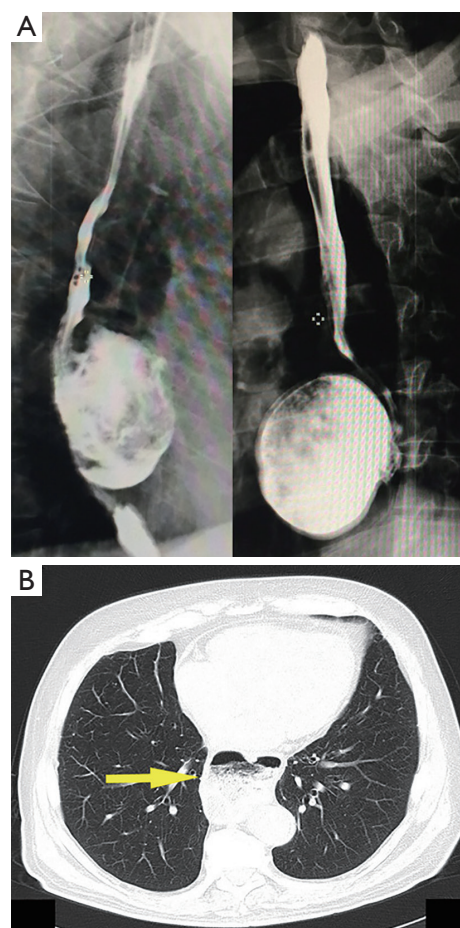


Figure 1 Gastrografin swallow (A), chest computed tomography scan (B) showed a giant mid-esophageal diverticulum. Yellow arrow shows esophageal diverticulum.

underwent standard pre-operative workup including barium swallow (*Figure 1A*), total body computed tomography scan (*Figure 1B*), manometry and 24-hour esophageal pH monitoring test. In all cases manometry showed an abnormal activity with diffuse esophageal spasm and impaired low esophageal sphincter (LES) relaxation.

All patients were aware of pros and cons of uniportal VATS approach and on the possibility of conversion to thoracotomy; they gave a specific written informed consent. Being uniportal VATS a procedure widely used in thoracic surgery, no specific approval by Institutional Review Board was required for this study.

Surgical technique

Under general anesthesia and single lung ventilation, the

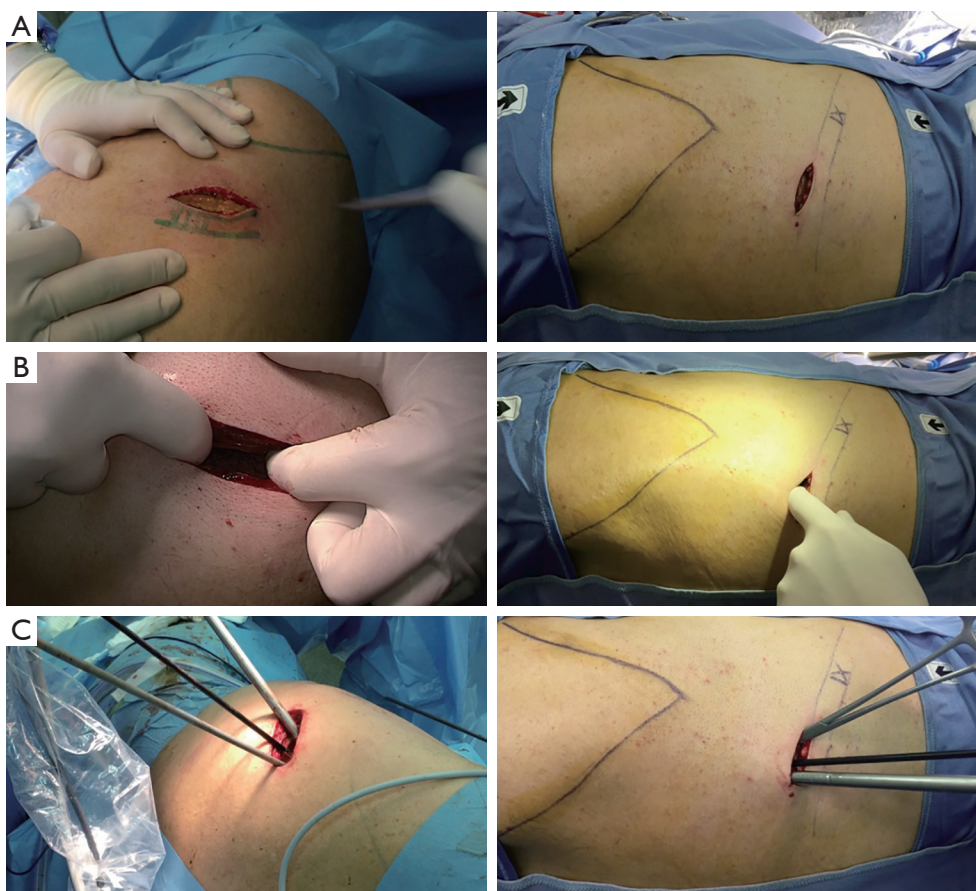


Figure 2 A 3–5-cm incision (A) was performed at level of the 7th–8th intercostal space (B) and through that a 30° camera and working instruments were inserted without rib spreading (C).

patient was placed in the supine position. Esophagoscopy aspirated the materials in the diverticulum and a guide-wire was inserted into the stomach under endoscopic view. The patient was then positioned in the left or right lateral decubitus position (according to the site of diverticulum) as for standard posterolateral thoracotomy and the left or right lung (according to the site of diverticulum) was deflated. As previously reported (7), local anesthetic (bupivacaine 10 mL) was injected at level of surgical site five minutes before incision to obtain a pre-emptive analgesic effect. A 3–5-cm incision (*Figure 2A*) was performed at level of the right or left (according to the site of diverticulum) 7th–8th intercostal space (*Figure 2B*), and through that a 30° camera and working instruments were inserted without rib spreading (*Figure 2C*).

Left diverticulum

After exploring pleural cavity, we dissected the pulmonary

ligament, the mediastinal pleura over the descending aorta (*Figure 3A*), and the esophagus (*Figure 3B*) in order to expose the entire esophageal body. The diverticulum was then dissected out with careful identification of the entire neck (*Figure 3C*). The left crus of diaphragm was elevated and the phreno-esophageal ligament underlying cardiac fat was grasped and retracted into the thorax to expose the gastroesophageal junction. A standard extramucosal myotomy was then performed longitudinally in the anterior esophageal axis using blunt dissection and cold scissors (*Figure 4A*). The myotomy started 2 cm above the gastroesophageal junction and extended 4–8 cm proximally and distally involving the LES and the gastric cardia. A 50 Fr bougie was introduced across the gastroesophageal junction over the guide wire and surgeons carefully evaluated the safe passage into the esophagus. Following, the neck of diverticulum was resected at its base with a 2.5 mm white TA 30 stapler (Covidien, auto-

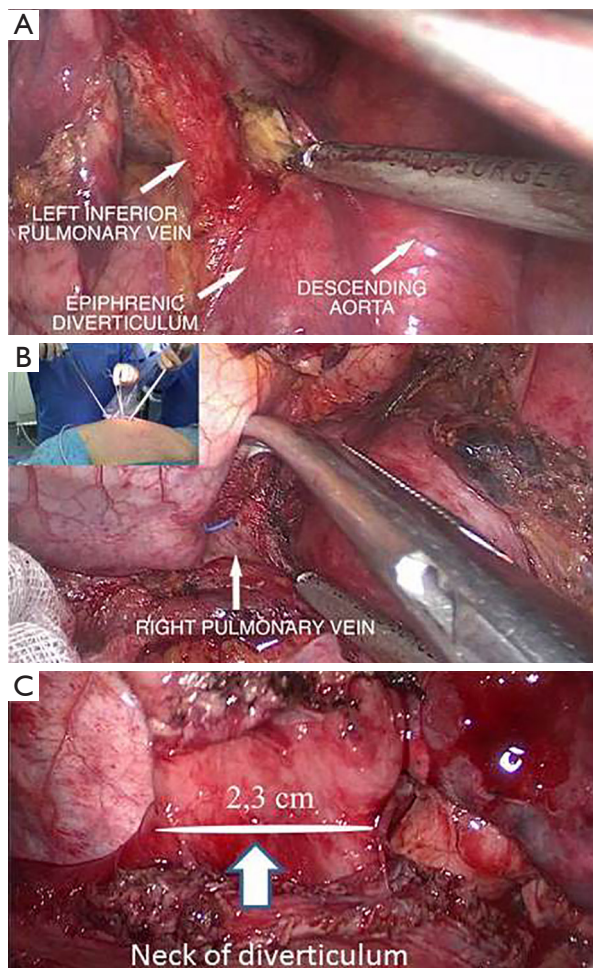


Figure 3 Dissection of mediastinal pleura over the aorta (A) and esophagus (B); complete exposition of diverticulum (C).

suture) (*Figure 4B*); the diverticulum was inserted into endo-bag and retrieved through the uniportal access to avoid contamination of surgical field. Finally, a Belsey-Mark IV fundoplication was performed in a standard manner so that the stomach, sutured to the esophagus 1 cm above the esophagogastric junction, encompassed 270° of the esophageal circumference (*Figure 5A*). In the first layer, the first stitch was inserted through the esophagus and gastric fundus, 2 cm below the gastroesophageal junction and medially to the myotomy. The suture was tied extracorporeal and the knots descended with a standard needle holder. The second suture was placed laterally to the myotomy 2 cm above the gastroesophageal junction and then placed through the fundus 2 cm below the gastroesophageal junction. In the second row, two

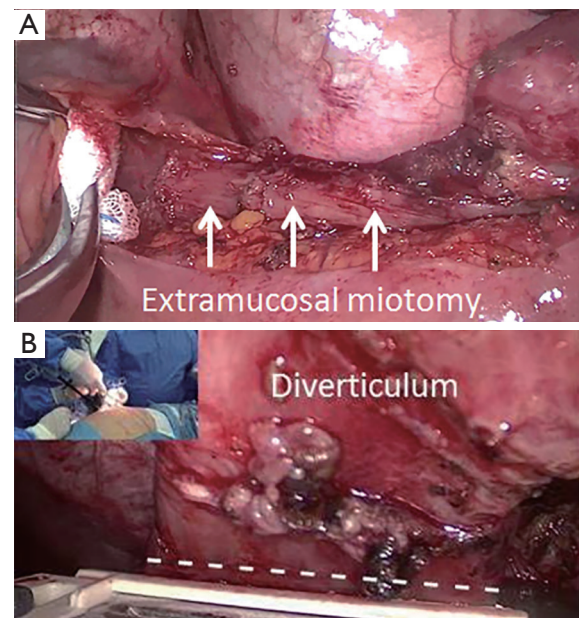


Figure 4 standard extramucosal myotomy (A) was performed and the diverticulum was then stapled at its base with an Endo GIA (B). Dashed line shows the neck of diverticulum.

sutures were placed through the esophagus medially and laterally to the myotomy, then through the stomach 4 cm below the gastroesophageal junction and then to the left crus intra-abdominally. The sutures were placed and tied extra corporeally anchoring the fundoplication and the gastroesophageal junction beneath the diaphragm. Finally, the suture of diverticulum was tested by insufflating air with gastroscopy under sailing. A chest drain was placed through the same uniportal incision (*Figure 5B*). Postoperative pain was managed with epidural analgesia in the first 24–48 hours and then with non-steroidal anti-inflammatory drugs. Oral feeding was not allowed until a contrast esophagram, performed 5–6 days postoperatively, excluded esophageal perforation. If the contrast study was normal, a clear liquid diet was initiated. Patients were discharged on a liquid diet for 2 weeks and were advanced progressively to solid food.

Right diverticulum

The procedure is similar to that of left diverticulum. The main difference was that a laparoscopic approach was needed to perform a Heller myotomy and anterior partial fundoplication as previous reported (3).

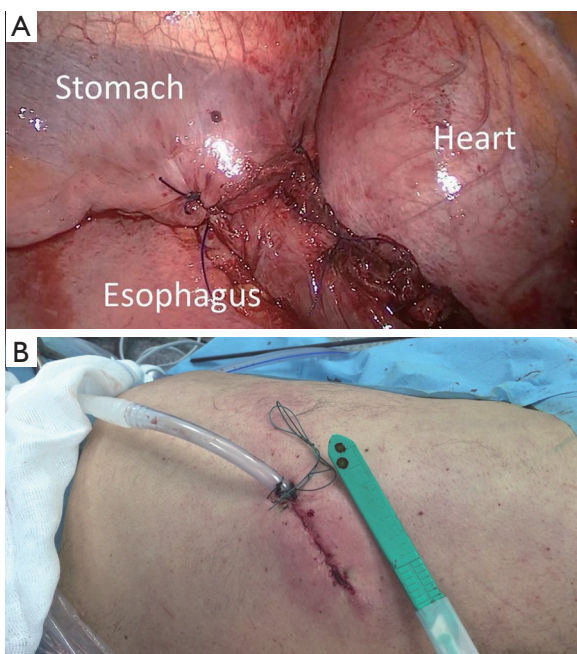


Figure 5 Standard Belsey-Mark IV fundoplication (A). Chest drainage inserted through the uniportal incision (B).

Results

In all cases the procedure was successfully performed without needing of conversion. The mean post-operative time was 121 ± 10 minutes. The chest drain was removed 48 hours later in all cases and the mean length of hospital stay was 9 ± 1 days. No intraoperative complications neither postoperative complications were found in all patients but one. He had a small fistula 15 days later that was successfully treated with stent insertion in another hospital. No recurrence of diverticulum was seen in all cases (mean follow-up: 16 ± 5.5 months).

Discussion

Open surgery is the treatment of choice in symptomatic patients with large esophageal diverticula. However, in the last two decades various minimally invasive techniques including laparoscopy and VATS have been developed to treat this condition (1-6). Traditional VATS is usually performed with three-four incisions but over the years there has been an evolution of VATS from multi-ports to single port. At beginning, uniportal VATS has been proposed only for minor thoracic procedures, but with the growing experience uniportal VATS has been used also to

perform complex thoracic procedures (8-12) and currently there is no-doubt that every thoracic procedure could be carried out with this technique in expert hands. The less surgical trauma, less postoperative acute pain, reduction of length of hospital stay, faster return to daily activity, and better cosmetic results are all well-defined advantages of traditional VATS versus open surgery and in theory they could be also more evident if only one incision (uniportal-VATS) rather than multiple-incisions (standard VATS) are made (13,14).

Several authors (1-6) showed that standard VATS is a feasible and safe technique for performing diverticulectomy and myotomy, but the use of uniportal VATS for this issue remained unexplored. Recently, our group reported the first case of uniportal VATS resection of giant esophageal diverticulum (15) and this procedure was then successfully reproduced in other two patients. Conversely to standard position of uniportal VATS where the surgeon and assistant were placed anteriorly to the patient, in our technique they were positioned behind the patient and had the same surgical view of standard thoracotomy. The working instruments entered into the chest parallel to the camera but with different angulation. It allowed approaching the diverticulum from a cranio-caudal perspective similar to open surgery. Yet, the different angulation between the camera and instruments allows maximal convergence of working instruments from each side of the target lesion without interference (16). Thus, surgeon works with his eyes and hands in the same plane, similarly to the open surgery.

From a technical point of view, the following recommendations should be taken in account for the success of the procedures: (I) the first step is to resect all adhesions between the diverticulum and the mediastinal pleura in order to fully expose the neck of the diverticulum. During this maneuver great care should be taken to avoid lesion of vagus nerve and/or an excessive skeletonization of the esophagus; (II) the esophageal myotomy should be tailored to the specific motility disorder. In presence of diffuse esophageal spasm, hypertensive LES and achalasia, a long extramucosal myotomy, extending proximally for 6–8 cm and distally for 0.5 to 2 cm involving the LES and the gastric cardia, is mandatory to avoid dysphagia (17). During this maneuver caution must be taken to avoid injury to the esophageal mucosa, especially if hook cautery or harmonic scalpel are used (18,19); (III) for the resection of diverticulum, the stapler should be placed at its base, parallel to the long axis of the esophagus but not perpendicular in

order to have a regular suture without tension and reduce the risk of leak. In case of tenacious adhesions or heavy calcified lymph nodes, uniportal VATS is contraindicated and open approach should be adopted.

One of three patients presented an esophageal leak that was treated with success with a temporary stent. Suture leakage is one of the main complications of esophageal diverticulectomy that occurred with rate of 15–20% patients after minimally invasive surgery (3,4).

Finally, uniportal VATS is a feasible procedure that in theory could reduce the surgical trauma and the post-operative morbidity and mortality compared to the standard open approach. However, future prospective study should corroborate our impression before it can be recommended as acceptable therapy.

Acknowledgements

None.

Footnote

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

Informed Consent: All patients were aware of pros and cons of uniportal VATS approach and on the possibility of conversion to thoracotomy; they gave a specific written informed consent.

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