Diverticulectomy, Myotomy, and Fundoplication Through Laparoscopy

A New Option to Treat Epiphrenic Esophageal Diverticula?

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Objective
To describe the technique and the results of laparoscopic diverticulectomy combined with esophageal myotomy and antireflux wrap for epiphrenic diverticula of the esophagus.

Summary Background Data
The epiphrenic diverticulum of the esophagus is a rare disease probably caused by a longstanding impairment of the esophageal motor activity. Although there is almost universal agreement to operate only on symptomatic patients, the optimal treatment is controversial. The best-accepted guideline is to treat the underlying motor disorder. This is generally done through a left thoracotomic approach that allows diverticulectomy, esophageal myotomy, and partial fundoplication.

Methods
From January 1994 through February 1996, 4 patients underwent laparoscopic transhiatal diverticulectomy, esophageal myotomy, and partial fundoplication at our institution. A thorough preoperative study was done with barium swallow, esophagoscopy, and manometry in all patients; 24-hour pH monitoring was done in one case.

Results
No postoperative complications were observed. Short- and medium-term results are satisfactory.

Conclusions
No theoretical objection should be made to this approach, because the principle of treatment of the diverticular pouch and the underlying motor disorder and the prevention of reflux is respected. Longer follow-up and a wider series are mandatory to substantiate these initially favorable results.
The epiphrenic diverticulum of the esophagus is an uncommon disease. Its pathogenesis remains unclear, and the optimal treatment is controversial. From a theoretical point of view, a motor disorder is the most likely underlying cause of the diverticulum,\(^1\,^2\) and this determines the different surgical approaches.\(^3\,^5\) The indication for surgical treatment should be carefully evaluated on the basis of the patient's symptoms and general condition.\(^2\,^6\,^8\) Asymptomatic diverticula are diagnosed occasionally, and in our opinion surgery should be reserved for symptomatic patients.

The undetermined etiology has led to controversy about surgical treatment, such as whether to add a myotomy to the diverticulectomy routinely. Also, the length of a myotomy associated with a diverticulectomy remains controversial.\(^7\) In the past, in open surgery we have selectively used myotomy, with satisfactory results. The results in a pilot series of 10 patients who underwent thoracoscopic diverticulectomy\(^8\) have been less satisfactory and convinced us of the need for a myotomy. In light of the benefits of minimally invasive treatment of such a functional disorder, we used the laparoscopic approach described below in four patients with an epiphrenic diverticulum.

**SURGICAL TECHNIQUE**

The patient is placed on the operating table in the lithotomy position with a 20°/30° reverse Trendelenburg. The surgeon stands between the legs in the standard position for surgery of the hiatal region. Pneumoperitoneum is established and five operating ports are placed as usual. Use of a 30° scope is recommended. After incision of the phrenoesophageal membrane, dissection is begun on the right crus and is then moved along the esophageal ring to the upper part of the left crus. The right crus is then dissected downward and the esophagus is completely encircled with an umbilical tape for traction. Mediastinal dissection is then started bluntly using smooth instruments and swabs, staying close to the esophageal surface until the diverticular pouch is reached. A flexible endoscope is advanced into the esophageal lumen at the level of the diverticular neck. Inflation, deflation, and transillumination of the diverticular pouch are of the utmost importance to facilitate safe dissection. The pouch must be thoroughly dissected until the diverticular neck is completely cleaned from all adherent tissue (Fig. 1). Care should be taken to avoid injury to the pleural sacs.

An EndoGIA 3.0 (United States Surgical Corporation, Norwalk, CT) with a parenchymal cartridge is introduced through the operative trocar placed in the left upper quadrant and is advanced to the level of the diverticular neck. The stapler jaws are closed under simultaneous endoscopic control, and the endoscope is advanced into the stomach and then withdrawn to ensure that not too much mucosa is excised. The stapler is then fired and staple closure is verified (Fig. 2). Further stapler application may be necessary to cut completely and suture the diverticular neck. The pouch is removed and endoscopic evaluation of the staple line is accomplished. Two or three interrupted nonabsorbable sutures are placed to close the muscular layer over the suture.

A myotomy is performed on the opposite esophageal wall. Longitudinal and circular muscular fibers are divided and the submucosal plane is carefully dissected, as we previously described for achalasia.\(^10\) The myotomy is extended cranially, above the upper limit of the diverticular neck, using either mini-scissors or modified Sugabaker's pericardiotomy scissors\(^11\) (Fig. 3). The myotomy is carried distally for almost 1.5 cm onto the cardia with a sharpened hook. A posterior closure of the hiatus is accomplished with two or three interrupted sutures. The partial fundoplication is then constructed. The anterior wrap (Dor) is performed with the anterior fundic wall sutured to the muscular edges of the myotomy. The cra-
copy, the mean distance of the diverticular neck from the dental margin was 34 cm (range, 29–39). In one case, a short segment of Barrett’s epithelium was diagnosed. No dysplasia was found at biopsies.

Esophageal manometry was performed with a six-channel perfusion assembly. There were 3 lateral sensing sites at 5-cm intervals; the distal 3 sensing sites were located at the same level with a radial orientation so that each covered 120° for evaluation of the lower esophageal sphincter (LES) (Synetics PC Polygraph HR [Synetics Medical, Irving, Texas]—Arndorfer pump [Arndorfer Specialties, Greendale, Wisconsin]). The LES was studied with the technique of rapid pull-through. Manometric findings were hypertensive LES (50 mmHg) with a manometric pattern of achalasia; esophageal body hypertensive waves; and uncoordinated and hypotonic LES with reflux.

Mean duration of surgery was 162.5 minutes (range, 140–180). Associated procedures were cholecystectomy in one patient and adhesiolysis after a previous open cholecystectomy in another one. Mean length of the myotomy was 7.67 cm (range, 6–11). Partial fundoplication was a 90° anterior (Dor) in 3 patients and a 270° posterior (Toupet) in the patient with Barrett’s esophagus. None of the procedures was converted to open surgery.

The postoperative course was uneventful in all patients. Oral feeding with a soft diet resumed on the fourth day after a Gastrografin swallow had shown no leaks.

RESULTS

From January 1994 to February 1996, 4 patients (1 man, 3 women) with a mean age of 57.7 years (range, 54–62) underwent surgical treatment of a symptomatic epiphrenic diverticulum of the esophagus. Symptoms, either alone or in combination, consisted of pain (three patients), pyrosis (two patients), regurgitation (two patients), and dysphagia (one patient). Mean duration of symptoms was 90 months (range, 6–240). The preoperative workup of patients included barium swallow, esophagoscopy, and manometry in all patients; 24-hour pH monitoring was done in one case. The mean diameter of the diverticular pouch was 4.67 cm (range, 3–7). At endoscopic suture, the mean distance of the diverticular neck from the dental margin was 34 cm (range, 29–39). In one case, a short segment of Barrett’s epithelium was diagnosed. No dysplasia was found at biopsies.

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The postoperative course was uneventful in all patients. Oral feeding with a soft diet resumed on the fourth day after a Gastrografin swallow had shown no leaks.
At a mean follow-up of 21 months (range, 12–36 months), clinical controls were satisfactory in all patients. Barium swallow and endoscopy showed no diverticular recurrence and no esophagitis. Esophageal manometry (performed in 3 patients) showed a mean basal LES pressure of 10 mmHg and a mean residual pressure of 4 mmHg. Twenty-four-hour pH monitoring (done in the patient with Barrett’s) showed a total acid contact time with pH < 4 of 0.1%, with a DeMeester score of 0.7.

**DISCUSSION**

Pathophysiology of the epiphrenic diverticulum of the esophagus is still unclear. The herniation of the mucosa and submucosa through a defect in the muscular layer is probably caused by a longstanding impairment of the esophageal motor activity. However, notwithstanding the most recent progress in the knowledge of pathophysiology of esophageal functional disease, the motor disorder associated with an esophageal diverticulum is not always recognized and diagnosed. In fact, if a nonspecific abnormality in esophageal motility is detected in association with the diverticulum, it is rather difficult to establish whether this is a subclinical form of motor disorder or a deviation from normal without clinical significance.

This has led to controversies in the therapeutic approach. Although there is almost consensus that surgery should be reserved for symptomatic patients, the procedure these patients should undergo is still a matter of discussion. There are three therapeutic possibilities: 1) diverticulectomy with long myotomy (extended high in the mediastinum) and antireflux procedure; 2) diverticulectomy with tailored myotomy according to the results of manometry and antireflux procedure; and 3) diverticulectomy alone if no motor abnormality is detected. The latter is the most controversial, despite the lack of literature to demonstrate a direct relation between the absence of the myotomy and the incidence of postoperative complications (leaks) or recurrent disease.

All these procedures have traditionally been performed through a thoracic approach, but in a recent series of 10 patients at our institution, we attempted a thorascopic approach to this disease. We performed thorascoscopic diverticulectomy either alone, in the case of normal manometry (5 patients), or combined with a previous endoscopic pneumatic dilation of the cardia, manometrically proved effective, in the case of LES hypertension (pressure >30 mmHg) or incoordination (uncoordinated peristalsis) (5 patients). There were two leaks from the staple line in the group of patients with diverticulectomy alone, and symptomatic reflux occurred in a previously dilated patient. Moreover, the long-term effect of the endoscopic dilation of the cardia for this indication is unknown. These results were deemed unacceptable; therefore, this trial was abandoned.

Given the potential value of a minimally invasive approach in the treatment of functional esophageal disease, a laparoscopic approach has been developed that allows treatment of even huge diverticula of the lower thoracic esophagus. Advantages of the laparoscopic approach include: 1) perfect alignment of the staple cartridge to the longitudinal axis of the esophagus, thus avoiding blind remnants at the level of the suture line; 2) optimal visualization of the esophagogastric junction, and thus ease in performing the lower part of the myotomy; 3) facilitation of the proximal part of the myotomy, which can be safely extended high in the mediastinum above the level of the diverticular neck; and 4) relative ease of the crural repair and antireflux wrap. The disadvantages of this approach are mainly technical: 1) difficult dissection of the upper part of the diverticular neck (made easier, in our opinion, by the use of a 45° angled scope) and 2) risk of pleural tear in the mediastinal dissection and the subsequent development of an intraoperative tension pneumothorax.

The potential advantages of laparoscopy clearly outweigh the disadvantages. In fact, all pathophysiologic problems of this disorder are addressed via laparoscopy: the removal of the pouch, the treatment of the motor disorder, and the prevention of postsurgical reflux. As to this latter point, we strongly recommend the use of a partial wrap that is preferably anterior (Dor) or posterior (Toupet) if the patient has concurrent reflux on preoperative workup. We do not recommend a total fundoplication (Nissen): this wrap causes an increase in the LES pressure, which could create an obstacle to the esophageal outflow. This increased LES pressure could result in early leaks from the suture line or potential long-term problems, such as recurrence of the diverticulum.

In conclusion, the procedure was safe, and short- and medium-term results were good in our initial experience. More cases and a longer follow-up are necessary to determine the possible role of this operation in clinical practice.

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