Physiologic Basis for the Treatment of Epiphrenic Diverticulum

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Objective
To quantitate and characterize the motility abnormalities present in patients with epiphrenic diverticula and to assess the outcome of surgical treatment undertaken according to these abnormalities.

Summary Background Data
The concept that epiphrenic diverticula are complications of esophageal motility disorders rather than primary anatomic abnormalities is gradually becoming accepted. The inconsistency in identifying motility abnormalities in patients with epiphrenic diverticula is a major obstacle to the general acceptance of this concept.

Methods
The study population consisted of 21 consecutive patients with epiphrenic diverticula. All patients underwent video-esophagography, upper gastrointestinal endoscopy, and esophageal motility studies. The diverticula ranged in size from 3 to 10 cm and were predominantly right-sided. Seventeen patients underwent transthoracic diverticulectomy or diverticulopexy with esophageal myotomy and an antireflux procedure. The length of the myotomy was determined by the extent of the motility abnormality. Transhiatal esophagectomy was performed in one patient with multiple diverticula. Two patients declined surgical treatment and another patient died of aspiration before surgery. Symptomatic outcome was assessed via a questionnaire at a median of 24 months after surgery.

Results
The primary symptoms were dysphagia in 5 (24%) patients, dysphagia and regurgitation in 11 (52%) patients, and pulmonary symptoms in 5 (24%) patients. The median duration of the primary symptoms was 10 years. Esophageal motility abnormalities were identified in all patients. An esophageal motor disorder was diagnosed only by 24-hour ambulatory motility testing in one patient, and 24-hour ambulatory motility testing clarified the motility diagnosis in five other patients. The most common underlying disorder was achalasia, which was detected in nine (43%) patients. A hypertensive lower esophageal sphincter was diagnosed in three patients, diffuse esophageal spasm in five, “nutcracker” esophagus in two, and a nonspecific motor disorder in two patients. One patient had an intraoperative myocardial infarction and died. Two patients had persistent mild dysphagia after surgery. The remaining patients had complete relief of their primary symptoms.

Conclusions
There is a high prevalence of named motility disorders in patients with epiphrenic diverticula, and this condition is associated with the potential for lethal aspiration. Twenty-four-hour ambulatory motility testing can be helpful if the results of the stationary examination are normal or indefinite. Resection of the diverticula and a surgical myotomy of the manometrically defined abnormal segment results in relief of symptoms and protection from aspiration.

An association between esophageal diverticula and esophageal motility disorders has been recognized since 1833, when Mondiere first suggested that increased intralu-
controversy over the use and extent of an esophageal myotomy in the therapy of the disease.\textsuperscript{7–10} The aims of this study were to quantify and characterize, using modern technology, the motility abnormalities in patients with epiphrenic diverticula and to assess the outcome of surgical myotomy, tailored to the motility findings, as an adjunct to diverticulectomy or diverticula suspension.

**PATIENTS AND METHODS**

**Study Population**

The study population consisted of 21 consecutive symptomatic patients with epiphrenic diverticulum seen between January 1987 and December 1996 at Creighton University Medical Center in Omaha, Nebraska, and the University of Southern California, Los Angeles. There were 12 men and 9 women with ages ranging from 45 to 88 years (median 66). One patient had a recurrent diverticulum after a laparoscopic diverticulectomy with myotomy. Three patients had been treated by endoscopic dilatation but remained symptomatic.

**Patient Evaluation**

Each patient underwent barium videoesophagography, upper gastrointestinal endoscopy, and a stationary esophageal motility study. Videoesophagograms were obtained in the prone oblique and upright positions using liquid barium and a barium-impregnated hamburger.\textsuperscript{11} The stationary esophageal motility study (5th and 95th percentile), used for the expressed as mean (5th and 95th percentile), used for the esophageal body amplitudes were 79 mm Hg (30–171) in the caudal portion and 94 mm Hg (32–187) in the proximal portion of the distal third of the esophagus.\textsuperscript{13} The diagnosis of ineffective esophageal motility was made in patients with low-amplitude (<30 mm Hg) or nontransmitted contractions in 30% or more of 10 wet swallows in the distal esophagus.\textsuperscript{14,15} A 24-hour ambulatory esophageal motility study was also performed in 6 of the 21 patients for better definition of the esophageal body function. The ambulatory motility study is especially useful for detecting motor abnormalities associated with ingestion of a solid meal. The procedure and normal values for the ambulatory esophageal motility examination are given elsewhere.\textsuperscript{16–18}

**Surgical Procedure**

The operation was designed to meet four objectives: minimal disruption of the hiatus and gastroesophageal junction when dissecting out the diverticulum; adequate myotomy to relieve outflow obstruction; protection against postoperative reflux with an antireflux procedure that adds little outflow obstruction; and prevention of rehealing of the myotomy site. The epiphrenic diverticula were approached transthoracically through a posterolateral thoracotomy in the seventh intercostal space. The inferior pulmonary ligament was divided and the left lung was retracted superiorly. The pleura overlying the esophagus was incised for a distance of 10 cm and the diverticulum was meticulously dissected with minimal disruption to adjacent structures. Unless necessary, the esophagus was not circumferentially dissected. If the diverticulum was large, a 60F bougie was passed and the neck of the diverticulum was stapled using a proximate access TA-55 stapler (Ethicon, Somerville, NJ). The muscular layer was closed over the mucosal staple line with interrupted sutures.

Suspension of the diverticulum was performed if the neck was wide and it was located in close approximation to the vertebral column. This was completed by suturing the fundus of the suspended diverticulum to the prevertebral fascia with fine nonabsorbable sutures in a manner that allowed dependent drainage. All patients had a myotomy performed on the same side of the esophagus if the diverticulum was suspended and on the opposite side if it was excised. The proximal limit of the myotomy was determined by the extent of the motility abnormality and site of the neck of the diverticulum. In most patients the motility abnormality was distal to the diverticulum. In patients in whom the motility abnormality extended proximal to the diverticulum, the proximal length of the myotomy was determined by inserting a nasogastric tube during surgery to the proximal level of the recorded abnormality on the preoperative motility study. A 2-cm incision was made through the phrenoesophageal membrane into the abdomen along the midlateral border of the left crus. A tongue of gastric fundus was pulled up into the chest. This exposed the gastroesophageal junction and its associated fat pad, which was excised, and the myotomy was extended distally onto the stomach for at least 2 cm.\textsuperscript{19}

The cardia was reconstructed in two patients by suturing the tongue of gastric fundus to the margins of the myotomy for a distance of about 4 cm, as described by Dor et al.\textsuperscript{20} If extensive dissection of the hiatus was required to mobilize the diverticulum or if the tongue of the stomach could not be reduced into the abdomen without deforming the gastroesophageal junction, a modified Belsey Mark IV partial fundoplication was performed.\textsuperscript{7,21} This was necessary in 14 patients. One patient had a complete Nissen fundoplication.

**Outcome Assessment**

Symptomatic outcome of surgical therapy was assessed at a personal interview using a detailed questionnaire. Patients...
were asked to comment on whether they were relieved of their original symptoms, had recurrence of their symptoms, or experienced new symptoms such as pain in the thoracotomy site, change in meal capacity, discomfort associated with eating changes, or change in body weight. The outcome was judged to be excellent if there was complete relief of symptoms with no recurrence, good if only occasional well-tolerated mild symptoms were present, fair if there were occasional symptoms requiring therapy, and poor if there was no relief or worsening of symptoms. Patients were also asked whether, in retrospect, they would choose the surgical therapy again.

RESULTS

Dysphagia with regurgitation was the predominant symptom in 11 (52%) patients; 5 patients (24%) had dysphagia alone. Five (24%) patients presented predominantly with pulmonary complications: recurrent pneumonia in three patients, aspiration pneumonitis in one, and lung abscess in one. Associated symptoms included chest pain in three patients and intractable hiccups in one patient. The median duration of symptoms was 10 years (range 2–40).

The diagnosis of epiphrenic diverticulum was made by videoesophagography and endoscopy. All the diverticula were located in the distal 10 cm of the esophagus. They protruded predominantly to the right (15/21; 71%) and ranged in size from 3 to 10 cm (median 7). Two patients had multiple diverticula; one had a second diverticulum in the midesophagus and another had nine diverticula in the distal esophagus. Three patients had an associated hiatal hernia.

Stationary manometric studies showed the overall length of the LES to be 2.0 to 5.6 cm (median 2.4); the abdominal length was 1.0 to 3.6 cm (median 1.6). None of the patients had a structurally defective LES. Seven patients had a resting LES pressure within the normal range, whereas 14 patients had sphincter pressures greater than 26 mm Hg. An esophageal body motility abnormality was present in 11 of these 14 patients, so that the final diagnosis of hypertensive LES was made in only 3 patients.

Motor abnormalities were present in all 21 patients (Table 1). The stationary motility examination identified the motor abnormality in 20 of 21 (95%) patients. A 24-hour ambulatory esophageal motility study was performed in six patients in whom the results of the stationary study were not sufficiently clear to characterize the motility abnormality. The one patient in whom the stationary examination did not detect a motor abnormality had the abnormal motility identified by an ambulatory motility study. The 24-hour ambulatory motility study clarified the motility abnormality in five other patients who also had this test. Results of the ambulatory study are compared with those of the stationary study in Table 2.

A consistent finding in the ambulatory motility studies compared with the stationary studies was a higher percentage of simultaneous waveforms with esophageal body contractions of increased amplitude and duration during the meal period. As expected, this would not be observed with 5-mL wet swallows in the stationary motility study. In five patients the diagnosis of diffuse esophageal spasm was clarified on ambulatory motility by the observation of increased simultaneous contractions associated with the presence of multi-peaked waveforms, especially during the meal period.

Five distinct motor abnormalities were identified (see Table 1). Achalasia was diagnosed in nine (43%) patients, six of whom had the characteristic manometric findings of a nonrelaxing high-pressure LES with aperistalsis of the esophageal body (100% simultaneous “mirror image” contractions of low amplitude; median 20 mm Hg). Three patients with achalasia had a normotensive but incompletely relaxing LES. Two of these patients were categorized as having “vigorous” achalasia based on the presence of simultaneous esophageal body contractions of normal amplitude.

Five patients had features of diffuse esophageal spasm with multipeaked high-amplitude (>80 mm Hg) esophageal body contractions with at least 30% simultaneous waveforms. Three patients had a hypertensive LES (mean pres-
sure 34 mm Hg) that relaxed normally. These patients had peristaltic body contractions of normal amplitude. Two patients had the criteria for “nutcracker” esophagus with high-amplitude (mean >180 mm Hg), long-duration contractions in the distal esophagus and normal esophageal peristalsis. Several other patients also had mean distal esophageal contraction amplitudes greater than 180 mm Hg, but they had waveform abnormalities and were thus not classified as having nutcracker esophagus.

Two patients had a nonspecific esophageal motor disorder. One of the patients who had a final diagnosis of nonspecific esophageal motor disorder had normal findings on the stationary motility test. The 24-hour test in this patient showed an increased percentage of simultaneous waveforms during mealtimes, multipeaked waveforms, and a high bolus “ramp” pressure. The other patient was also diagnosed with a nonspecific esophageal motility disorder as a result of the 24-hour motility study. He had previously been diagnosed as having a nutcracker esophagus with normal peristalsis after the stationary test. This patient also had an increased percentage of simultaneous waveforms, especially during mealtimes, and multipeaked waveforms. The nonspecific disorders did not meet the criteria for ineffective motility disorder.

The barium esophagrams and esophageal motility profiles of two patients are shown in Figure 1 (patient 1, achalasia associated with a single large diverticula) and Figure 2 (patient 2, hypertensive LES and associated spastic motor disorder in a patient with multiple esophageal diverticula).

Eighteen patients were treated surgically. One patient with multiple diverticula in the distal esophagus had a transhiatal esophagectomy. The remaining 17 patients underwent a transthoracic myotomy with either diverticulectomy (13 patients) or suspension of the diverticulum (diverticulopexy, 4 patients). In 10 patients the myotomy was limited to the LES, and in 7 it extended over various lengths of the distal esophageal body. Of the seven patients who had a long myotomy, three (one with achalasia and two with a hypertensive LES) had high-pressure zones longer than 5 cm. Four patients had motility abnormalities (diffuse esophageal spasm in two and nutcracker esophagus in two) that involved various lengths of the distal esophagus. Two patients declined surgery and one patient died of aspiration pneumonia before surgery could be performed.

There was one postoperative death from a myocardial infarction in the immediate postoperative period. Two patients required reoperations, one to control bleeding from the thoracic cavity and another because of a leak at the site of resection. All 17 surviving operated patients were contacted with a median follow-up of 24 months (range 9 months to 8 years) after surgery. Fourteen patients (82%) had an excellent outcome, with complete relief of all symptoms. Two patients were scored as having a good outcome because of persistent mild dysphagia requiring dietary modification for relief at 1 year after surgery. One patient was scored as having a fair outcome because of the development of reflux symptoms that responded to medication. All patients reported an increase in meal capacity and a gain in weight. Nine patients experienced some discomfort in the thoracotomy scar lasting between 6 months and 2 years, but only three patients required prolonged analgesia for the

### Table 2. RESULTS OF STATIONARY AND AMBULATORY MOTILITY STUDIES IN SIX PATIENTS

<table>
<thead>
<tr>
<th>Patient</th>
<th>Measurement</th>
<th>Stationary Motility</th>
<th>Ambulatory Motility</th>
<th>Final Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Amplitudes (mm Hg)</td>
<td>205</td>
<td>&gt;150 (20% of the time)</td>
<td>NSMD</td>
</tr>
<tr>
<td></td>
<td>Wave progression</td>
<td>peristaltic</td>
<td>20% simultaneous</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wave morphology</td>
<td>normal</td>
<td>5% double- and triple-peaked during mealtimes</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Amplitudes</td>
<td>209</td>
<td>142</td>
<td>DES</td>
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<tr>
<td></td>
<td>Wave progression</td>
<td>10% simultaneous</td>
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<td>Wave morphology</td>
<td>normal</td>
<td>normal</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Amplitudes</td>
<td>55</td>
<td>62</td>
<td>DES</td>
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<tr>
<td></td>
<td>Wave progression</td>
<td>20% simultaneous</td>
<td>45% simultaneous during mealtimes</td>
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<tr>
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<td>Wave morphology</td>
<td>double-peaked</td>
<td>triple-peaked</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Amplitudes</td>
<td>182</td>
<td>160</td>
<td>DES</td>
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<td>48% simultaneous</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wave morphology</td>
<td>triple-peaked</td>
<td>normal</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Amplitudes</td>
<td>186</td>
<td>178</td>
<td>DES</td>
</tr>
<tr>
<td></td>
<td>Wave progression</td>
<td>30% simultaneous</td>
<td>75% simultaneous</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wave morphology</td>
<td>double-peaked</td>
<td>double- and triple-peaked</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Amplitudes</td>
<td>82</td>
<td>158</td>
<td>NSMD</td>
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<tr>
<td></td>
<td>Wave progression</td>
<td>peristaltic</td>
<td>15% simultaneous during mealtimes</td>
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<td></td>
<td>Wave morphology</td>
<td>normal</td>
<td>double- and triple-peaked</td>
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</table>

DES, diffuse esophageal spasm; NSMD, nonspecific motor disorder.
pain. Overall, 15 of 17 (88%) patients were completely satisfied with the outcome of surgery and would opt for the same procedure under similar circumstances. Histopathologic examination of all the resected diverticula showed only benign features.

**DISCUSSION**

Our experience with epiphrenic diverticula has shown that abnormal esophageal motility is present in all patients with this abnormality and likely is the underlying cause of its development. This prevalence is higher than that reported in other series. The difference is probably explained by our efforts to clarify the motility findings in questionable situations by obtaining a 24-hour ambulatory motility study. In this situation, instead of making a diagnosis based on 10 swallows in the fasting state, as occurs with stationary motility, we were able to analyze more than 1,000 swallows, during and between meals, awake and asleep, over a complete day. The ambulatory study was especially useful for patients with complex motility pat-
terns on the stationary study. It provided the diagnosis of a motility disorder in one patient whose stationary examination results were within normal limits. Abnormal esophageal body motility was also detected by the ambulatory study in four patients who were classified as having normal body contractility on the stationary motility study. The main finding in these patients was an increase in the percentage of simultaneous contractions that was particularly evident during the meal periods. Nearly half of our patients had achalasia, making it the most common motor disorder associated with epiphrenic diverticulum.

Bennacci et al., reporting on a large series from the Mayo Clinic, found motility abnormalities in 60% of their operated patients, but they were unable to pass the manometric probe into the stomach in the remaining patients. By endoscopically placing the catheter in difficult situations, we were able to perform a motility study in all patients. The combination of endoscopic motility catheter placement and
The 24-hour motility study helps account for our finding of a motor disorder in all patients.

The majority of the patients in our series had a large diverticulum (>5 cm in diameter) and all were symptomatic, with dysphagia the main symptom. Dysphagia occurred in patients with a normotensive LES as well as in those with a hypertensive LES. The high prevalence of regurgitation related to posture suggests that the large size of the diverticula in this series may be a factor in our patients’ symptomatology, although it has been recognized that symptoms correlate better with the esophageal dysmotility characteristics than with the size of the diverticulum.22

Opinions vary regarding the indications and need for surgical treatment for epiphrenic diverticula. Support for a policy of actively treating patients with this condition is provided by our finding of pulmonary complications in 25% of the patients. Pulmonary complications can be lethal, and one patient in our series died as a result of regurgitation and aspiration before surgery could be performed. Similarly, Altorki et al.9 reported a 45% frequency of aspiration pneumonia in their series and concluded that all patients should undergo surgical intervention, regardless of whether they are symptomatic or not.

Although we consider that symptomatic patients should undergo surgical treatment, surgery is not without risk. The Mayo Clinic series of 33 patients 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, from which the authors concluded that surgical treatment should be reserved for patients with incapacitating symptoms.9

Table 3 summarizes the results of recent published series on the management of epiphrenic diverticula. There is a wide variation in the results of the manometric studies and inpatient management. A success rate of more than 90%, similar to that presented in this series, was reported by Altorki et al.,9 who also combined a transthoracic diverticulectomy/diverticulopexy with myotomy and an antireflux procedure.

Although the majority of the diverticula in our patients were right-sided, a left thoracotomy approach was preferred. There was no difficulty with dissection of the diverticula with this approach, and the left chest incision provides superior access to the cardia for extension of the myotomy and construction of the fundoplication. Suspension of the diverticulum or diverticulopexy was reserved for more proximally situated diverticula if endoscopy revealed a wide mouth into the esophagus.

Several decades ago, Effler et al.23 and Belsey24 stated that it is pointless to treat the diverticulum without also correcting the motor dysfunction. We perform a myotomy routinely in patients with epiphrenic diverticula. Failure to do so encourages higher surgical death and complication rates. Diverticulectomy without myotomy has been associated with a higher incidence of diverticulum recurrence and a suture line leak rate of 10% to 20%.4,8,25

The optimal extent of the myotomy remains controversial. Streitz et al.3 advocated performing myotomy only in the area of the motor abnormality, sparing the LES unless it was hypertensive and thus avoiding the need for an antireflux procedure. They argued that the complication rate was minimized and patients had fewer postoperative reflux symptoms. Our concern is that myotomy of the esophageal body reduces contraction amplitudes to below the fifth

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**Table 3a and 3b. MANOMETRIC FINDINGS AND SUMMARY OF RESULTS OF MANAGEMENT OF EPIPHRENIC DIVERTICULUM IN RECENT SERIES**

<table>
<thead>
<tr>
<th>Series</th>
<th>Operation</th>
<th>OUTCOME</th>
<th>Diagnosis</th>
<th>Achalasia</th>
<th>DES</th>
<th>Hypertensive LES</th>
<th>NSMD</th>
<th>Nutcracker</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fekete 1992</td>
<td>DM‡</td>
<td>DM‡</td>
<td>Diagnoses</td>
<td>27</td>
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<td>9</td>
<td>0</td>
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<tr>
<td>Streitz 1992</td>
<td>DM‡</td>
<td>DM‡</td>
<td>Diagnoses</td>
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<td>4</td>
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<td>1</td>
<td>0</td>
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<tr>
<td>Altorki 1993</td>
<td>DM‡</td>
<td>DM‡</td>
<td>Diagnoses</td>
<td>20</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>0</td>
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<tr>
<td>Benacci 1993</td>
<td>DM‡</td>
<td>DM‡</td>
<td>Diagnoses</td>
<td>33</td>
<td>8</td>
<td>3</td>
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<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Present study</td>
<td>DM‡</td>
<td>DM‡</td>
<td>Diagnoses</td>
<td>17</td>
<td>9</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

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* D = Diverticulectomy/pexy; † M = Myotomy; ‡ A = Antireflux procedure; § DMA = Combined “triple treat” procedure: diverticulectomy or diverticulopexy, myotomy, and an antireflux procedure.

† Prior to 1979.
percentile of normal and thereby creates a potential for dysphagia if the LES that is left relaxes properly manometrically but not anatomically. We believe that the myotomy should include the entire sphincter zone and the proximal length of motor abnormality, as determined by the preoperative manometric findings. The usual practice is to perform the myotomy to the neck of the diverticulum, but if the symptoms are due primarily to the motor disorder rather than the diverticulum, failure to extend the myotomy over the length of the motor abnormality may lead to persistent symptoms. It is also important to realize that large diverticula can masquerade as achalasia when they become dependent and resemble the terminal portion of the esophagus while displacing the true gastroesophageal junction laterally so that it enters at a right angle to the esophageal body (Fig. 3).

If the sphincter is divided, it becomes necessary to perform an antireflux procedure. In patients with impaired motility, especially those with achalasia, a partial fundoplication may be preferred because it creates less outflow obstruction. The Dor patch is adequate unless the dissection of the hiatus is extensive, in which case a modified Belsey partial fundoplication is preferred. Although laparoscopic diverticulectomy combined with a myotomy and fundoplication has been shown to be feasible for the treatment of epiphrenic diverticula, it may be difficult using this approach to reach the upper part of the diverticulum neck if the diverticulum is situated more than a few centimeters from the gastroesophageal junction, and it may also be difficult to perform an adequate long myotomy. Laparoscopic dissection within the mediastinum can be complicated by breach of the mediastinal pleura leading to pneumothorax, including tension pneumothorax. A thorascopic approach may be adequate for patients with diverticula located more than a few centimeters from the gastroesophageal junction or those requiring long myotomy, but the laparoscopic approach seems preferable for construction of the fundoplication. Laparoscopic management is likely to be particularly difficult for large dependent diverticula that masquerade as achalasia.

The extent of manometric abnormalities indicates that endoscopic dilatation is unlikely to be reliably successful for these patients. Three patients with achalasia and an epiphrenic diverticulum in our series failed to respond to dilatations. We believe dilatation is contraindicated in patients with large diverticula, who need definitive surgical treatment. Patients with multiple diverticula may require esophagectomy. Although a transhiatal esophagectomy was performed in this series, we now prefer to perform a vagal-sparing esophagectomy for benign disease.

In summary, this study confirms that there is a high prevalence of esophageal motility abnormalities in patients with epiphrenic diverticula and thus reaffirms the need for a myotomy. Patients with pulmonary symptoms, particularly those with life-threatening aspiration, should not be treated conservatively. The myotomy should be performed across the entire LES to prevent leakage at the suture line or recurrence of the diverticulum. It should be extended to include the length of the motor abnormality, as determined on preoperative studies, to achieve complete alleviation of all symptoms. Preoperative evaluation should include 24-hour ambulatory motility testing when the results of the stationary motility examination are inconclusive. The good results obtained in this and other series suggest that the optimal management of this condition combines diverticulectomy with myotomy and Dor fundoplication. Our current approach is to manage all symptomatic diverticula using this combination, with the exception of those that are juxtaposed to the spinal column; in that situation, diverticulopexy is preferred. Diverticula juxtaposed to the spine are more proximal and are usually wide-mouthed.

References