Endoscopic Stapling Technique for the Treatment of Zenker Diverticulum vs Standard Open-Neck Technique

A Direct Comparison and Charge Analysis

Shane R. Smith, MD; Eric M. Genden, MD; Mark L. Urken, MD

Background: Presently, the 2 most widely used methods for the treatment of Zenker diverticulum are endoscopic stapling of the common party wall between the diverticulum sac and the esophagus and the standard open-neck technique involving diverticulectomy and cricopharyngeal myotomy.

Objective: To perform an analysis of the hospital charges to determine the economic efficiency of each technique based on our experience at the Mt Sinai Medical Center, New York, NY.

Methods: A retrospective analysis of 16 patients diagnosed as having Zenker diverticulum was conducted. Eight randomly chosen patients underwent endoscopic stapling with an EndoGIA 35-mm endoscopic stapler (Ethicon Inc, Somerville, NJ), and 8 randomly chosen patients underwent a standard open approach with diverticulectomy. Medical records were reviewed to determine operative time, length of hospital stay, time to oral intake, and postoperative complications. A charge analysis of the operative and postoperative fees was also performed. Statistical analysis between the 2 groups was conducted using analysis of variance and the paired t test.

Results: The mean ± SD operative time for the endoscopic stapling technique was 25.5 ± 15.78 minutes, which was significantly less (P < .001) than that for the open procedure, 87.6 ± 35.10 minutes. The mean operative charges were roughly equivalent at $5178 for the endoscopic procedure and $5113 for the open procedure. The endoscopic procedure, while shorter in operative time, had the added expense of specialized equipment, specifically the EndoGIA endoscopic stapler. The mean ± SD length of hospital stay for the endoscopic procedure was significantly shorter (P < .001) at 1.3 ± 0.39 days vs 5.2 ± 1.03 days for the open procedure. The inpatient hospital charges for the endoscopic group was also significantly less (P < .001) at a mean of $3589 per stay vs $11439 for the open group. The mean ± SD time to oral intake was significantly shorter (P < .001) in the endoscopic group at 0.8 ± 0.26 days vs 5.1 ± 1.25 days for the open group. There were no major complications in either group, and all patients experienced resolution of preoperative symptoms.

Conclusions: Compared with the standard open technique, the endoscopic stapling technique for the treatment of Zenker diverticulum results in a statistically significant shorter operative time, hospital stay, and time to resume oral feedings. While the charges of the operative procedures were roughly equivalent, the total hospital charges were significantly less for the patients treated endoscopically.

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PATIENTS, MATERIALS, AND METHODS

A retrospective analysis of 16 patients diagnosed as having ZD was conducted. All 16 patients were operated on by the senior author (M.L.U.). Eight patients (5 men and 3 women) had undergone the endoscopic stapling technique. Each patient underwent the same procedure. Following the induction of general endotracheal anesthesia, a Weerda bivalved laryngoscope (Karl Storz, Tuttlingen, Germany) was placed into the hypopharynx. The superior blade was placed into the esophagus, and the inferior blade was placed into the lumen of the diverticulum. Next, an EndoGIA 35-mm endoscopic stapler (Ethicon Inc, Somerville, NJ) was then placed through the scope, engaged, and fired, thereby dividing the common wall between the esophagus and diverticulum. Reaplication of the stapler was performed as needed for larger diverticula in which a residual portion of the common party wall was identified. Postoperatively, patients underwent a barium swallow within the first 24 hours following surgery. If no evidence of a leak existed, the patient resumed oral feedings (typically liquids, with rapid advancement to solids).

Eight patients (4 men and 4 women) in the review had undergone the standard open diverticulectomy and CP myotomy procedure. In this procedure, the diverticulum was mobilized and its base was stapled. Supplemental sutures were placed as needed. Following the removal of the diverticulum, the fibers of the CP muscle were identified and divided sharply. Patients were hospitalized for approximately 5 days and fed by a nasogastric tube. At the end of that period, a barium swallow was performed prior to resumption of oral intake of nutrition.

Each patient’s medical record was reviewed for operative time, length of hospital stay, time to oral intake, and postoperative complications. Statistical analysis between the 2 groups was conducted using the paired t test. Results are presented as mean ± SD.

RESULTS

The results of endoscopic technique are summarized in Table 2. Table 3 summarizes the results of the open (diverticulectomy) technique.

OPERATIVE TIME

The operative time for the endoscopic stapling technique was 25.5±15.78 minutes. The operative time for the open procedure was 87.6±35.10 minutes. There was a statistically significant difference between these 2 groups (P<.001).

LENGTH OF HOSPITAL STAY

The hospital stay for the endoscopic stapling group was 1.3±0.59 days. The hospital stay for the open procedure group was 5.2±1.03 days. Again, a statistically significant difference between these 2 groups was noted (P<.001).

TIME TO ORAL INTAKE

The time to oral intake was defined as the time from the procedure until the patient was allowed to begin oral intake of nutrition. No nasogastric tube was placed in patients undergoing the endoscopic stapling procedure: 6 patients began oral intake on postoperative day 1, and 2 patients began oral intake of nutrition within several hours following surgery. The time to oral intake for the endoscopic group was 0.8±0.26 days. All patients in the open procedure group required postoperative feedings by nasogastric tube. The time to oral intake for this group was 5.1±1.25 days. Again, the time to oral intake was significantly shorter (P<.001) for the endoscopic group.

Table 1. Literature Review of Endoscopic Stapling Technique for Repair of Zenker Diverticulum

<table>
<thead>
<tr>
<th>Source, y</th>
<th>No. of Patients</th>
<th>Operative Time, min</th>
<th>Hospital Days</th>
<th>Days to Oral Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omote et al, 1999</td>
<td>21</td>
<td>22</td>
<td>4.7</td>
<td>1-2</td>
</tr>
<tr>
<td>Narne et al, 1999</td>
<td>102</td>
<td>20</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Baldwin and Toma, 1998</td>
<td>51</td>
<td>NA*</td>
<td>NA</td>
<td>1.5, 73%; 3, 93%</td>
</tr>
<tr>
<td>Scher and Richtsmeier, 1998</td>
<td>36</td>
<td>40</td>
<td>1.3</td>
<td>0.8, liquids; 5, solids</td>
</tr>
<tr>
<td>Koay and Bates, 1996</td>
<td>14</td>
<td>14.3</td>
<td>2.2</td>
<td>0.87, liquids; 1.6, solids</td>
</tr>
</tbody>
</table>

*NA indicates data not available.
COMPLICATIONS

Among the 16 patients, 1 patient in the endoscopic group had mild postoperative bleeding, which spontaneously resolved without evidence of further sequelae. There were no major complications in either group, including infection, fistula, subcutaneous emphysema, or adverse pulmonary sequelae.

CHARGE ANALYSIS

A charge analysis of these 2 surgical procedures was performed by comparing operative charges and in-hospital stay charges. For operative costs, fees were based primarily on length of the surgery, which was divided into 30-minute blocks. The surgeon’s fees were included as part of the analysis and were equivalent for both procedures. As for special equipment, no special equipment was needed for the open procedure. However, the endoscopic procedure required the use of an EndoGIA stapler, which added significantly to the overall costs. The mean operative costs for the endoscopic procedure was approximately $5178, which was slightly higher than the mean operative costs for the open procedure at $5113. There was no statistically significant difference between the two. The cost of hospitalization for the endoscopic procedure stay was $3589±$1711. The cost for the open procedure was $5113±$2372. Again, there was a statistically significant difference between the two (P<.001).

COMMENT

The goal of surgical treatment of ZD is 2-fold: (1) elimination of the reservoir that traps food particles and secretions and results in the classic array of symptoms, and (2) release of the upper esophageal sphincter via a CP myotomy, thereby eliminating increased pressures of the upper esophageal sphincter, which are believed to be the main causative factor in the development of ZD. There are 4 basic surgical approaches that are used with varying frequency for the treatment of ZD: (1) open diverticulectomy and CP myotomy, (2) diverticulopexy and CP myotomy, (3) imbrication of the diverticulum sac and CP myotomy, and (4) endoscopic division of the common wall between the esophagus and diverticulum.

Open diverticulectomy includes a lateral neck incision, exposure and excision of the offending pouch, and meticulous closure of the pharyngotomy wound site. A cricopharyngeal myotomy is also performed at this time. Postoperatively, oral feedings are performed for approximately 5 days while the pharyngotomy site is allowed to heal. Over the years, other less invasive techniques have evolved in an attempt to avoid the pharyngotomy, thereby reducing postoperative healing time and time to resume oral intake as well as reducing potential complications associated with a pharyngotomy. Many authors during the 1960s and 1970s reported that ZD could be treated with CP myotomy alone without addressing the reservoir itself. However, studies by Payne and King in 1983 and Bonafede et al in 1997 showed that this method was associated with higher rates of recurrence and persistent dysphagia.

There are a number of open surgical procedures that were designed to eliminate the dependent diverticulum, while avoiding the creation of a pharyngotomy that would require closure and a delay in instituting oral intake of nutrition as well as the attendant risks of infection and fistula formation. Diverticulopexy involves suspending the diverticulum sac superiorly to the prevertebral fascia, thereby removing it from a dependent position. Imbrication involves dissecting the diverticulum and inverting it into the lumen of the esophagus and closing the mucosa over with a “purse string” suture. Both techniques have been shown to be successful and are generally associated with a decreased hospital stay and time to resume oral intake because the pharyngoesophageal mucosa is not violated. However, a lateral neck incision is still required, and recurrence of symptoms has been reported.

The endoscopic approach is the only approach in which an external excision is avoided. This technique, originally described by Mosher in 1917, was abandoned early because of an increased complication rate, in particular, mediastinitis, which in the preantibiotic era had devastating consequences. The endoscopic stapling technique has revolutionized the treatment of ZD. With this technique, not only is a lateral neck incision avoided, but the patient is allowed to resume oral intake rapidly, usually within 24 hours of surgery. A further advantage is the decreased morbidity associated with this technique. Most patients had no complications, and the 1 mi-

<table>
<thead>
<tr>
<th>Patient No./Sex/Age, y</th>
<th>Operative Time, min</th>
<th>Hospital Days</th>
<th>Days to Oral Intake</th>
<th>Operative Charges, $</th>
<th>Total Hospital Charges, $</th>
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<tr>
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<td>4/M/71</td>
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<tr>
<td>Mean 76.6</td>
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<td>1.3</td>
<td>0.8</td>
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<td>3589</td>
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<tr>
<th>Patient No./Sex/Age, y</th>
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<th>Hospital Days</th>
<th>Days to Oral Intake</th>
<th>Operative Charges, $</th>
<th>Total Hospital Charges, $</th>
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<td>5300</td>
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<tr>
<td>4/F/74</td>
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<td>5000</td>
<td>10 895</td>
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<td>5600</td>
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<tr>
<td>8/M/50</td>
<td>144</td>
<td>6</td>
<td>6</td>
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<td>13 182</td>
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<tr>
<td>Mean 72.2</td>
<td>87.6</td>
<td>5.2</td>
<td>5.1</td>
<td>5113</td>
<td>11 439</td>
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</tbody>
</table>

Table 2. Results of Endoscopic Technique

Table 3. Results of Open (Diverticulectomy) Technique
nor complication of mild postoperative bleeding resolved quickly and spontaneously with no long-term sequelae.

In our charge analysis, we found the intraoperative charges to be slightly higher for the endoscopic approach, although the difference between the 2 procedures did not reach statistical significance. Because the endoscopic technique is faster, it is logical to think that this would result in lower operative charges. However, this benefit is offset by the specialized equipment needed, specifically the EndoGIA stapler. Our analysis did not include the enhanced revenue that could be generated by “back filling” the operating room following a shorter endoscopic procedure. This analysis would surely favor the endoscopic approach. However, the major benefit from the endoscopic procedure is derived from the greatly reduced postoperative hospital stay. By reducing the hospital stay by a mean of 3.9 days, the total fees were decreased by a mean of $7850. One might argue that patients should be able to go home earlier following an open procedure and continue their tube feedings as an outpatient. While this strategy may be entertained in a younger population, there are often extenuating circumstances in the older population who most often present with ZD, which make shorter hospitalizations more difficult. Finally, one other parameter that was not analyzed in this study was the days in lost earnings to the patients from undergoing either of the 2 procedures. Clearly, for those individuals who are employed, the shortened procedure would provide an optimal financial analysis that would further favor the minimally invasive approach.

It is important to state that not all patients with a diagnosis of ZD are candidates for an endoscopic stapling procedure. Exposure of the diverticulum and the esophagus is critical to provide access to the common party wall for application of the stapling device. Patients with limited neck extension or limited oral apertures are not favorable candidates, and transition to an open procedure may be required to resolve the patient’s symptoms.

The endoscopic stapling technique for the treatment of ZD has been proven to be as equally effective and safe as the open procedure, with a marked reduction in the postoperative recovery time. This results in a statistically significant shorter hospital stay and time to resume oral feedings compared with the standard open technique. This faster recovery time translates into a markedly reduced hospital fee for the patient and easily counterbalances the slightly increased charges of the surgery.

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REFERENCES