

Endoscopically stapled diverticulostomy for Zenker's diverticulum: results of a multidisciplinary team approach

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Abstract

Background A variety of open and endoscopic surgical approaches for the treatment of Zenker's diverticulum have been described. In recent years, growing evidence has shown that the endoscopic techniques are superior to the open approaches in many aspects. Among the endoscopic techniques, endoscopically stapled diverticulostomy (ESD) appears to have better efficacy and safety than the other endoscopic techniques.

Methods This study retrospectively reviewed the medical records of all the patients with Zenker's diverticulum treated surgically by the same team, which involved an ear, nose, and throat surgeon and an endoscopic surgeon.

Results From January 2002 to March 2008, 55 consecutive patients with Zenker's diverticulum underwent 60 ESDs. The mean follow-up time was 32.6 months (range, 1–72 months). The mean operative time was 21.8 min (range, 5–45 min), and the average hospital stay was 2.24 days (range, 1–30 days). The treatment was technically feasible for 51 patients (93%), and initial symptom relief without recurrence was achieved for 46 patients (90.2%) after a single procedure. Five patients with recurrent symptoms underwent a successful revision ESD,

with a 100% success rate among the patients for whom the procedure was technically feasible. Only two major post-operative complications (3.64%) occurred: one esophageal perforation and pneumomediastinum and one severe esophageal edema. Both patients had complete resolution of their complications with conservative treatment and no long-term sequelae.

Conclusion The findings showed endoscopic stapled diverticulostomy to be both safe and effective. Compared with the historical results of open diverticulectomy and myotomy, the reported procedure has fewer complications and better outcomes and should become the procedure of choice for the treatment of most patients with a diagnosis of Zenker's diverticulum.

Keywords Diverticulum · Endoscopy · Esophagoscopy · Stapling · Zenker

Hypopharyngeal (Zenker's) diverticulum is an esophageal pouch presenting posterolateral to the pharynx just above the level of the upper esophageal sphincter. First described in 1769 by Ludlow [1], this disorder was characterized more completely by Zenker and Ziemssen in 1877 [2]. The most common symptoms are dysphagia, food regurgitation, weight loss, chronic cough, and halitosis. Until recently, the common surgical approach was transcervical excision or diverticulopexy. However, in recent years, an endoscopic approach was developed that seems to be a substitute for the open approach.

The endoscopic approach, first described by Mosher [3] in 1917, originally included division of the septum between the cervical esophagus and the pouch. Mosher himself abandoned this method because of an increased incidence of complications, particularly mediastinitis. In 1960, Dohlman

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and Mattson [4] reintroduced the endoscopic technique, and several series since then using this technique with either electrocoagulation or lasers have been reported [5–7].

In 1993, Collard et al. [8] introduced the endoscopic stapling technique using an endosurgical stapler that simultaneously divides the wall between the esophagus and the pouch, then staples the wound edges closed. Its advantages over the standard open-neck technique, as reported in many series [9–13], include a shorter operative time, hospital stay, and interval from surgery to oral intake as well as a lower rate of complications, lower morbidity and mortality rates, and decreased costs [14, 15]. Furthermore, the endoscopic stapled diverticulostomy (ESD) was found to be superior also to the other endoscopic approaches (carbon dioxide [CO₂] laser and cautery) in terms of safety and efficacy, in addition to the lower recurrence rate offered by the cautery technique [15, 16].

We present our experience involving 55 consecutive patients with Zenker's diverticulum who underwent ESD by a team consisting of an otolaryngology (head and neck) surgeon and a general endoscopic surgeon. Our rationale was that because the otolaryngology (head and neck) surgeon is well trained in performing rigid esophagoscopy and the general surgeon is highly experienced in using a stapling device, the collaboration between these two disciplines could reduce morbidity and enhance efficacy.

Methods

The medical records of all the patients with Zenker's diverticulum treated surgically at both the Tel Aviv Sourasky Medical Center and the Assuta Medical Center by the same team were reviewed retrospectively. The database (Microsoft Excel, Redmond, WA, USA) included demographic variables, preoperative symptoms, size of the diverticulum, operative time, time to resumption of oral liquids, length of hospital stay, complications, follow-up time, and recurrence rate. Our team consisted of an otolaryngology (head and neck) surgeon and a general endoscopic surgeon. The former performed the esophagoscopy, after which the latter conducted the stapling procedure.

Operative technique

Preoperatively, the patient is given intravenous second-generation cephalosporine. All procedures are conducted with the patient under general anesthesia and with a reinforced endotracheal tube. A Weerda laryngoscope (Karl Storz, Tuttlingen, Germany) is placed into the hypopharynx by the ear, nose, and throat (ENT) surgeon. The inferior blade is inserted into the lumen of the diverticulum, and the superior blade is inserted into the esophagus.

We do not use retraction sutures in the common wall routinely nor for difficult or complicated cases.

A 5-mm 0° endoscope is inserted alongside to an EndoGIA 35-mm endoscopic stapler (Ethicon Inc., Somerville, NJ, USA). The stapler, applied under endoscopic vision through the scope, engaged, and fired, divides the common wall between the esophagus and the diverticulum. One to three applications of the stapler are used until the common wall is completely divided. The operative field is inspected for bleeding, and the Weerda scope is removed.

After completion of the procedure, the patient is transferred to the surgical ward and allowed to drink clear liquids until the next morning. Intravenous antibiotics, given routinely, include a single dose before the operation and another dose in the recovery room. All patients are hospitalized for at least 1 day postoperatively regardless of the surgical course or their general health condition. Contrast esophagograms are obtained only in cases suspected for postoperative complications or recurrence of symptoms.

Patients are assessed 1 week after surgery for postoperative results. Follow-up evaluation is continued in our outpatient clinic at variable intervals according to the clinical course and relief of symptoms.

Results

Study population

From January 2002 to March 2008, 55 consecutive patients with Zenker's diverticulum underwent 60 ESDs. The male-to-female ratio was 1:1.75, and the mean age was 66.5 years (range, 39–93 years). The symptoms included dysphagia, regurgitation, weight loss, coughing, choking sensation, recurrent pneumonia, and reduced compliance with medical treatment because of inability to swallow tablets and capsules. All the patients were proved to have Zenker's diverticulum by barium esophagogram. Some of the patients also underwent gastroscopy because of suspected gastroesophageal reflux.

Of the 55 patients, seven underwent a prior surgical attempt to treat Zenker's diverticulum. Four patients underwent diverticulectomy through a transcervical approach, and three patients underwent flexible endoscopic attempts in other medical institutions.

Surgical results

The mean operative time was 21.8 min (range, 5–45 min). We noted a typical learning curve. The operative time became shorter with no increase in the complication rate. The estimated blood loss was negligible in all cases. A clear liquids diet was resumed 0.6 days (range, 0–28 days)

after surgery, and a regular diet was resumed gradually as tolerated by the patient.

The average hospital stay was 2.24 days (range, 1–30 days). However, this parameter is somewhat biased because our protocol states that all patients are to be hospitalized routinely for a minimum of 1 day for observation of possible early complications regardless of their general health condition or perioperative course. Overall, only 18 patients (32%) were hospitalized more than 1 day.

Treatment was technically feasible for 51 (93%) of the 55 patients. Surgery was aborted after esophagoscopy for four patients due to inadequate exposure of the common wall or inability to apply the stapling device safely. This resulted from severe micrognathia in two cases and severe osteoarthritis of the neck in two cases. The procedure was aborted and not converted to open procedure for fear of complications arising from tissue edema, and the patients were referred to open diverticulotomy at a later stage. The mean follow-up period was 32.6 months (range, 1–72 months).

Relief of symptoms without recurrence was achieved for 46 patients (90.2%), who stated that “symptoms no longer exist or are very subtle and hence do not require further treatment.” Symptoms recurred or were not adequately relieved after ESD for five patients, representing a 9.8% failure/recurrence rate. All five patients underwent successful revision ESD at our institution, and to date, none have had recurrence. Remarkably, when the procedure was technically feasible, 100% success could be expected, with a 90.2% chance of achieving the ESD in a single procedure.

Complications

Table 1 summarizes the complications. Minor complications occurred for five patients (9%) including two cases of chipped teeth requiring no further treatment, two cases of oropharyngeal mucosal tears with no sequela, and one case of subcutaneous emphysema in the upper cervical region with no other findings and no specific treatment. The major

complication rate was 3.6% (2 patients). One patient experienced esophageal perforation and pneumomediastinum, whereas the other patient had severe esophageal edema necessitating percutaneous endoscopic gastrostomy (PEG) insertion.

The patient who experienced esophageal perforation was a generally healthy 76-year-old woman. The procedure was technically difficult because the esophagoscopy enabled only limited exposure of the surgical field, and manipulation of the common wall caused mucosal tears, necessitating the local application of Surgicel (Ethicon, Inc., Cincinnati, OH) to stop the bleeding. After 2 days, while the patient still was hospitalized, we noted subcutaneous emphysema involving the neck and the upper chest wall. Imaging included plain X-ray. Computed tomography (CT) demonstrated pneumomediastinum, and barium esophagogram showed leakage of contrast medium to the soft tissues of the neck. There were no signs of infection or hemodynamic instability. The leak was treated conservatively for 3 weeks with parenteral antibiotics. Enteral feeding was administered through a nasogastric tube, with complete resolution of the patient’s symptoms and a normal follow-up CT with oral contrast material. Follow-up evaluation over the past 2 years has shown complete resolution of the symptoms with no long-term sequela.

The patient who experienced severe esophageal edema was a 76-year-old woman. The procedure was aborted after multiple unsuccessful attempts to visualize the diverticulum due to severe spinal osteoarthritis. The patient was discharged the next day but rehospitalized 1 day later for severe dysphagia. Her endoscopy showed severe edema of the esophagus, and PEG insertion was performed. A few months later, she resumed regular oral feeding with no long-term sequela.

None of the patients experienced mediastinitis, pneumonia, pneumothorax, fistula, vocal cord injury, major bleeding, or worsening of symptoms, and transition to an external approach was not required. This series of patients had no treatment-associated mortality.

Table 1 Endoscopically stapled diverticulostomy (ESD) minor and major complications ($n = 55$)

	No. of patients	(%)
Minor complications		
Chipped teeth	2	
Oropharyngeal mucosal tears	2	
Subcutaneous emphysema	1	
Total	5	9.1
Major complications		
Esophageal perforation	1	
Severe esophageal edema	1	
Total	2	3.6

Discussion

Many surgical approaches for the treatment of Zenker’s diverticulum have been described including diverticulectomy, diverticulectomy, cricopharyngeal myotomy, diverticular invagination, and endoscopic diverticulectomy [8–10, 17–19]. For many years, patients with symptomatic Zenker’s diverticulum were treated by an open transcervical excision of the diverticular sac with or without cricopharyngeal myotomy. Despite the relatively high success rates, this technique was characterized by an unacceptable mortality rate (2%), a high complication rate (10–30%),

and protracted convalescence periods. The surgical management of Zenker's diverticulum has evolved significantly over the past two decades [17, 20, 21], with growing interest and experience in managing Zenker's diverticulum endoscopically.

The two most common endoscopic approaches are the CO₂ laser and the ESD, both proved to be superior over the traditional open techniques in most aspects [14]. In a recently published article, Miller et al. [16] showed that the endoscopic stapling technique has better efficacy and safety than the CO₂ laser technique.

The symptoms exhibited by our study population were the same as those reported in earlier series. However, the indication for ESD for two of our patients was reduced compliance with essential medical treatment because they could not swallow tablets or capsules. To the best of our knowledge, such an indication is not described elsewhere.

In contrast to the series of Scher [20], we did not use retraction sutures in the common wall routinely or in recurrent or complicated cases. We believe that the maneuvers involved in suturing in this region are potentially hazardous and outweigh the benefit of better exposure and easier stapling.

Four procedures were aborted due to inadequate exposure or inability to insert the stapler. Interestingly, three of these proceeded to an elective open procedure, and two involved major postoperative complications, namely, severe esophageal constriction necessitating permanent PEG insertion in one the patient and esophagocutaneous fistula in the other patient.

Review of the literature shows a mean recurrence rate of 5% (range, 0–19%) for the external approaches, 6.6% (range, 0–22%) for overall endoscopy, and 6% (range, 0–22%) for ESD. We defined recurrence as partial or complete return of symptoms that justifies revision ESD at any point in time after an ESD. At the long-term follow-up evaluation, only five patients fulfilled these criteria. In concurrence with the findings of Scher et al. [20], who demonstrated that the technical aspects and perioperative outcome for patients undergoing revision ESD are similar in all respects to primary ESD, all five patients underwent successful revision ESD at our hospital. To date, none of them have experienced recurrence. Hence, the success rate for the patients not aborted is 100%.

The mean operative time in our series was lower than in any other study, averaging 21.8 min (range, 5–45 min). We believe that this can be attributed to the collaboration between the two disciplines. Because most of our patients had comorbidities and were advanced in age (mean age, 66.5 years; range, 39–93 years), this difference in operative time may be of value.

The post-ESD complications were subdivided into major and minor complications. The major complications

included mediastinitis, pneumothorax, fistula formation, cervical abscess, major bleeding, aspiration pneumonia, and recurrent laryngeal nerve injury. The minor complications included dental injuries (most commonly chipped teeth), cervical subcutaneous emphysema, pharyngeal mucosal tears, and minor bleeding.

The reported major complication rate in the literature ranges from 0 to 38% (mean, 11.8%) for the open approaches [18, 22–29] and from 0 to 20% (mean, 5.5%) for the various endoscopic approaches [6, 8, 30–33]. The reported major complication rate for ESD is lower, averaging 2.6%.

The major complication rate in our study was 3.6%, which is relatively low. Furthermore, both major complications were relatively mild. The patient who experienced esophageal perforation had no signs of infection and required only conservative treatment. The patient who had severe esophageal edema resumed oral feeding 3 months afterward with no long-term sequela. Overall, none of our patients had any long term sequela.

Conclusions

We conclude that ESD offers patients with Zenker's diverticulum a short hospital stay, a low complication rate, decreased morbidity, rapid convalescence, and a high success rate. Our results are in concurrence with those of other series published since 1993, proving ESD to be superior to all other techniques, both external and endoscopic, for treating patients with Zenker's diverticulum. In view of our results and the literature, ESD should become the standard procedure for symptomatic Zenker's diverticulum.

References

1. Ludlow A (1769) A case of obstructed deglutition from a preternatural dilatation of and bag formed in the pharynx. *Med Obs Inq* 3:85–101
2. Zenker FA, von Ziemssen H (1878) Dilatations of the esophagus. *Cyclopedia Pract Med* 3:46–48
3. Mosher HP (1917) Webs and pouches of the esophagus: their diagnosis and treatment. *Surg Gynecol Obstet* 25:175–187
4. Dohlman G, Mattson O (1960) The endoscopic operation for hypopharyngeal diverticula. *Arch Otolaryngol Head Neck Surg* 71:744–752
5. Kneigt PP, de Jong PC, van der Schans EJ (1985) Endoscopic treatment of the hypopharyngeal diverticulum with the CO₂ laser. *Endoscopy* 17:205–206
6. Kuhn FA, Bent JP (1992) Zenker's diverticulotomy using the Ktp/532 laser. *Laryngoscope* 102:946–950
7. Von Doersten PG, Byl FM (1997) Endoscopic Zenker's diverticulotomy (Dohlman procedure): forty cases reviewed. *Otolaryngol Head Neck Surg* 116:209–212
8. Collard JM, Otte JB, Kestens PJ (1993) Endoscopic stapling technique of esophagodiverticulostomy for Zenker's diverticulum. *Ann Thorac Surg* 56:573–576

9. Scher RL, Richtsmeier WJ (1998) Long-term experience with endoscopic staple-assisted esophagodiverticulostomy for Zenker's diverticulum. *Laryngoscope* 108:200–205
10. Narne S, Cutrone C, Bonavina L, Chella B, Peracchia A (1999) Endoscopic diverticulotomy for the treatment of Zenker's diverticulum: results in 102 patients with staple-assisted endoscopy. *Ann Otol Rhinol Laryngol* 108:810–815
11. Baldwin DL, Toma AG (1998) Endoscopic stapled diverticulotomy: a real advance in the treatment of hypopharyngeal diverticulum. *Clin Otolaryngol Allied Sci* 23:244–247
12. Koay CB, Bates GJ (1996) Endoscopic stapling diverticulotomy for pharyngeal pouch. *Clin Otolaryngol Allied Sci* 21:371–376
13. Omote K, Feussner H, Stein HJ, Ungeheuer A, Siewert JR (1999) Endoscopic stapling diverticulostomy for Zenker's diverticulum. *Surg Endosc* 13:535–538
14. Smith SR, Genden EM, Urken ML (2002) Endoscopic stapling technique for the treatment of Zenker diverticulum vs standard open-neck technique: a direct comparison and charge analysis. *Arch Otolaryngol Head Neck Surg* 128:141–144
15. Chang CY, Payyapilli RJ, Scher RL (2003) Endoscopic staple diverticulostomy for Zenker's diverticulum: review of literature and experience in 159 consecutive cases. *Laryngoscope* 113:957–965
16. Miller FR, Bartley J, Otto RA (2006) The endoscopic management of Zenker diverticulum: CO₂ laser versus endoscopic stapling. *Laryngoscope* 116:1608–1611
17. Peracchia A, Bonavina L, Narne S, Segalin A, Antoniazzi L, Marotta G (1998) Minimally invasive surgery for Zenker's diverticulum: analysis of results in 95 consecutive patients. *Arch Surg* 133:695–700
18. Schmit PJ, Zuckerbraun L (1992) Treatment of Zenker's diverticulum by cricopharyngeus myotomy under local anesthesia. *Am Surg* 58:710–716
19. Laccourreye O, Menard M, Cauchois R et al (1994) Esophageal diverticulum: diverticulopexy versus diverticulectomy. *Laryngoscope* 104:889–892
20. Scher RL (2003) Endoscopic staple diverticulostomy for recurrent Zenker's diverticulum. *Laryngoscope* 113:63–67
21. Thaler ER, Weber RS, Goldberg AN, Weinstein GS (2001) Feasibility and outcome of endoscopic staple-assisted esophagodiverticulostomy for Zenker's diverticulum. *Laryngoscope* 111:1506–1508
22. Aggerholm K, Illum P (1990) Surgical treatment of Zenker's diverticulum. *J Laryngol Otol* 104:312–314
23. Barthlen W, Feussner H, Hannig CH, Holscher AH, Siewert JR (1990) Surgical therapy of Zenker's diverticulum: low risk and high efficiency. *Dysphagia* 5:13–19
24. Cerdan FO, Gonzalez EM, Garcia DH (1998) Diagnostic and treatment of Zenker's diverticulum: review of our series pharyngo-esophageal diverticula. *Hepatogastroenterology* 45:447–450
25. Payne WS (1992) The treatment of pharyngoesophageal diverticulum: the simple and complex. *Hepatogastroenterology* 39:109–114
26. Lindgren S, Ekberg O (1990) Cricopharyngeal myotomy in the treatment of dysphagia. *Clin Otolaryngol* 15:221–227
27. Louie H, Zuckerbraun L (1993) Staged Zenker's diverticulectomy with cervical esophagotomy and secondary esophagotomy closure for treatment of massive diverticulum in severely debilitated patients. *Am Surg* 59:842–845
28. Dorion D, Brown D, Gullane P (1994) Zenker's stapler diverticulectomy. *J Otolaryngol* 23:145–147
29. Laing MR, Murthy P, Cockburn SW (1995) Surgery for pharyngeal pouch: audit of management with short- and long-term follow up. *J R Coll Surg Edinb* 40:315–318
30. Ishioka S, Sakai P, Maluf Filho F, Melo JM (1995) Endoscopic incision of Zenker's diverticula. *Endoscopy* 27:433–437
31. Mulder CJ, den Hartog G, Robijn RJ, Thies JE (1995) Flexible endoscopic treatment of Zenker's diverticulum: a new approach. *Endoscopy* 27:438–442
32. Van Eeden S, Lloyd RV, Tranter RM (1999) Comparison of the endoscopic stapling technique with more established procedures for pharyngeal pouches: results and patient satisfaction survey. *J Laryngol Otol* 113:237–240
33. Zbaren P, Schar P, Tschopp L, Becker M, Hausler R (1999) Surgical treatment of Zenker's diverticulum: transcutaneous diverticulectomy versus microendoscopic myotomy of the cricopharyngeal muscle with CO₂ laser. *Otolaryngol Head Neck Surg* 121:482–487