Flexible Endoscopic Zenker’s Diverticulotomy with an Articulating Bipolar Energy Sealer

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Abstract
The surgical management of Zenker’s diverticula is performed through open or endoscopic approaches. The purpose of this report is to review our early experience with flexible endoscopic diverticulotomy with an articulating bipolar energy sealer for cricopharyngeal and diverticular wall division in a series of 5 patients where transoral rigid access was not possible. In addition to technical details, safety and efficacy data are included. The average diverticulum size was 2.5 cm. All patients reported symptom resolution, and there were no surgical complications. Liquid diet was initiated on postoperative day 1 for all patients and solids on day 11.8 ± 14.4 (mean ± SD) per protocol. Results demonstrate that treatment of Zenker’s diverticula can safely and successfully be performed with flexible endoscopic visualization and utilization of an articulating bipolar energy sealer to perform diverticulotomy in a population of patients where transoral diverticulotomy would not otherwise be feasible due to anatomic constraints. Early results support obtaining further experience to study this technology as an alternative to open surgery, especially when visualization and access are suboptimal with rigid endoscopy.

Keywords
Zenker’s diverticulum, endoscopy, dysphagia, technology

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In recent years, there has been discussion regarding optimal management of Zenker’s diverticula. Traditional approaches, such as transoral rigid diverticulotomy and transcervical open diverticulectomy, can provide good outcomes with low risk profiles; however, each has limitations. Transoral rigid diverticulotomy may be limited by anatomic access and open diverticulectomy by low laryngeal anatomy, risk profile, or patient preference. When neither approach is ideal, flexible endoscopic diverticulotomy (FED) may be considered an alternative. Here we present the first described use of the Articulating Enseal G2 Tissue Sealer (Ethicon Endo-Surgery, Blue Ash, Ohio) in FED.

Methods
A retrospective review was performed of patients who underwent FED between 2012 and 2018. Approval was granted by the Institutional Review Board at University of California, San Diego. All patients underwent preoperative barium swallow. Cases were performed under general anesthesia. Initially, all patients underwent rigid transoral endoscopy. In patients where exposure was inadequate and who were poor open surgical candidates or refused open surgery, a flexible approach was utilized.

A flexible channeled endoscope (Olympus GIF-Q180) was utilized to visualize the pharyngoesophageal segment. The endoscope was withdrawn and passed through a Gardus 25-cm overtube (US Endoscopy, Mentor, Ohio), which was...
modified by replacing the cap with a latex glove secured by a rubber band to create a diaphragm (Figure 1).

The articulating bipolar energy sealer (ABES) was inserted adjacent to the endoscope, both through perforations in the glove. The overtube was maintained just proximal to the cricopharyngeus (CP) throughout the procedure (Figure 2). The ABES was advanced under endoscopic guidance; the articulation was adjusted to best access the bar; and the jaws were closed over the mid-CP, at which point the device was activated and the blade advanced by the surgeon. The jaws were subsequently advanced along the CP and esophageal-diverticular wall (Figure 3), with sequential inspection and division of the party wall, until continuity between the pouch and cervical esophagus was achieved (Figure 4). The device was typically fired 2 to 5 times depending on size of the diverticula.

Results

Four of 5 patients were male, and the mean ± SD age was 68.0 ± 14.2 years. The average diverticulum size was 2.5 cm (Supplemental Table S1, available in the online version of the article). All cases resulted in division of the CP without major complications. There were no mortalities, readmissions, leaks, or reoperations. Two patients experienced urinary retention, and 1 complained of worsening reflux. Liquid diet was resumed on postoperative day 1 and solids on day 11.8 ± 14.4. All patients were discharged on postoperative day 1. Average follow-up was 56.2 ± 48.1 days. All patients reported subjective improvement or resolution of symptoms at clinical follow-up.

Discussion

FED is not novel. In 1995, Ishioka et al presented a series of 42 subjects undergoing endoscopic incision of the diverticular septum with an electrocautery knife. Complications were few, and recurrence was 7.1%, with an average follow-up of 38 months. The past 20 years have seen a variety of technologies used with flexible instrumentation. Meta-analysis of 813 patients undergoing FED with various energy devices suggested success rates of 91%, adverse events of 11.3%, and recurrence of 11%. In a systematic review by Crawley et al comparing transoral rigid and flexible endoscopic approaches, both approaches had few adverse events, with somewhat higher recurrence rates in the flexible group.

There is little published experience with bipolar energy sealer use in Zenker’s diverticula. Andersen et al described use of the Ligasure (Medtronic, Dublin, Ireland), an alternative bipolar energy sealer, for use in transoral rigid diverticulotomy. Ligasure use with FED was reported in 8 patients, with only 1 recurrence and a single complication of mild hematemesis.

In the present study, ABES was used to safely complete diverticulotomy in a single stage. The 5-mm low-profile rotatable shaft and 110° articulating neck of the device allow for improved access to the diverticulum when placed through the modified overtube. Additionally, ABES allows for targeted energy delivery with minimal collateral thermal injury. Unlike the stapler, the active zone of the instrument extends the entire 20-mm jaw length, allowing for complete diverticulotomy, quick refiring, and no need for reloading. The cost is competitive with other devices, and it does not require any additional personnel, as would be typical for a laser. Also, given its use in general surgery, ABES is stocked in most operating rooms.

Conclusion

Based on early experience, FED with ABES is safe and promises to be useful in situations where rigid visualization is
inadequate or candidacy for open surgery is poor. While availability of postoperative data was limited in this group, good functional outcomes were universal. Further study is warranted to address questions of functional swallow outcomes, rates of recurrence, and relative cost-effectiveness.

**Author Contributions**

**Philip A. Weissbrod**, conception, data acquisition, interpretation, drafting/revising, final approval, accountable; **Aria Jafari**, conception, data acquisition, interpretation, drafting/revising, final approval, accountable; **Shanglei Liu**, conception, data acquisition, interpretation, drafting/revising, final approval, accountable; **Santiago Horgan**, conception, data acquisition, interpretation, drafting/revising, final approval, accountable; **Robert A. Weisman**, conception, data acquisition, interpretation, revising, final approval, accountable.

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**Supplemental Material**

Additional supporting information is available in the online version of the article.

**References**