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What is This?
A Comparative Study of Outcomes for Endoscopic Diverticulotomy versus External Diverticulectomy

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Abstract
Objectives. Current literature on the treatment of Zenker’s diverticulum (ZD) favors the use of various endoscopic procedures over external surgical techniques for patients, arguing that endoscopic approaches reduce intraoperative time and anesthesia, length of hospital stay, and days until oral diet is restarted. However, such techniques often have higher symptomatic recurrence rates and require further interventions. Because of our experience with both endoscopic diverticulotomy (ENDO) and external diverticulectomy (EXT) using the GIA-stapler, we sought to compare these 2 procedures in terms of in-hospital parameters, complications, return to normal diet, and rates of symptom recurrence.

Study Design. Case series with chart review.

Setting. Academic tertiary care hospital.

Subjects. Patients with Zenker’s diverticulum who underwent surgical repair.

Methods. Retrospective analysis of 67 patients seen at Brigham and Women’s Hospital between 1990 and 2012 with Zenker’s diverticulum who underwent either an endoscopic Zenker’s procedure (36) or an external stapler-assisted diverticulectomy with cricopharyngeal myotomy (31).

Results. Although the external stapler-assisted procedure for ZD does carry a longer intraoperative time and a slightly longer hospital stay than the endoscopic approach, it provides similar days until initiation of an oral diet and a similar incidence of postoperative complications. Further, it is superior to the endoscopic approach when one considers its much lower rate of symptomatic recurrence and need for revision procedures.

Conclusion. We argue that the external stapler-assisted diverticulectomy with cricopharyngeal myotomy should be considered as a viable treatment in patients who need definitive, single-session treatment for ZD, especially to prevent life-threatening aspiration pneumonia.

Keywords
Zenker’s diverticulum, Zenker’s, endoscopic, diverticulotomy, diverticulectomy, external

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Introduction
Zenker’s diverticulum (ZD) was first recognized by Friedrich Von Zenker in 1877.1 The incidence of ZD in the general population is 0.01% to 0.11%2 and occurs more frequently in men in their 70s and 80s.3 These patients experience dysphagia as food becomes lodged in the diverticulum. This leads to the subsequent risks of regurgitation, chronic cough, and pulmonary aspiration. The latter complication is the most serious consequence of Zenker’s, which occurs in the elderly population least able to recover from recurrent pneumonias. Up to 30% to 40% of ZD patients have chronic cough with recurrent aspiration. The chronic dysphagia symptoms also have a negative impact on patients’ quality of life.

There are 2 approaches to the treatment of this condition: endoscopic (END) and external (EXT). There has been debate about which of these approaches is best for patients as each carries different risks and benefits. Currently many studies conclude that ENDO should be the gold standard for treating ZD primarily based on its shorter initial intraoperative time, hospital stay, and time to PO intake.4-6 Several studies comparing the endoscopic stapler approach with the external approach found that the external approach was associated with longer operative times and post-hospital...
stays, but found no difference in time to oral liquids or patient symptomatic relief.\textsuperscript{7,8}

The endoscopic approach has been associated with a higher rate of complications as well as persistence or recurrence of symptoms and need for a reoperation. A retrospective review of 49 patients comparing the CO\textsubscript{2} laser endoscopic diverticulotomy with the traditional EXT also found that the operative time was shorter for ENDO, but found no significant difference in length of hospital stay and found that the endoscopic approach may have a higher persistence rate than the open procedure.\textsuperscript{9}

Crescenzo et al studied EXT and confirmed the definitive nature of the procedure, noting that none of the 27 patients with preoperative diverticulum reflux had problems with aspiration after correction (median follow-up 39.6 months).\textsuperscript{10} They concluded that EXT is in fact justified and safe in the elderly population.

Because of our experience with both ENDO and EXT using the GIA-stapler, in the current study we sought to compare these 2 procedures in terms of in-hospital parameters, complications, return to normal diet, and rates of symptom recurrence.

\textbf{Methods}

This study was reviewed and approved by the Institutional Review Board at the Brigham and Women’s Hospital, the Partners Human Research Committee.

In this study, we retrospectively analyzed 67 patients seen at Brigham and Women’s Hospital consecutively between 1990 and 2012 with a documented diagnosis of Zenker’s diverticulum who underwent either an endoscopic diverticulectomy with cricopharyngeal myotomy (ENDO group: 36) using either a stapler or CO\textsubscript{2} laser or an external stapler-assisted diverticulectomy with cricopharyngeal myotomy (EXT group: 31). We excluded patients operated on by other members of the division. Demographic information collected included age at time of surgical intervention, sex, and preoperative symptoms including dysphagia, regurgitation, cough or sensation of aspiration, and frank aspiration or pneumonia. Prior intervention for the ZD was also noted. The preoperative variables for each group are in Table 1. The decision as to which procedure to perform was based on a number of factors including any history of aspiration pneumonia, the relative size of the diverticulum, the patients’ willingness to tolerate the increased risk of recurrent symptoms after an endoscopic approach, and the more invasive nature of the external approach. The choice was ultimately driven by patient preference when the risks and benefits of each of the 2 procedures were detailed.

Our operative approach on all patients began with passage of the nonarticulating diverticuloscope. When the external approach was planned, the scope was passed in order to intubate the esophagus with an endotracheal tube and to pack the Zenker’s diverticulum. When the endoscopic approach was planned, the nonarticulating scope was first passed in order to most easily visualize the cricopharyngeal bar, esophageal lumen, and the diverticulum. This scope was then withdrawn and the articulating diverticuloscope was introduced and advanced to expose the same structures in order to perform an endoscopic stapler-assisted myotomy. If the articulating diverticuloscope could not be safely advanced, we then reintroduced the nonarticulating diverticuloscope and performed the endoscopic myotomy with the CO\textsubscript{2} laser (this was done in 14 patients out of the 36 who underwent the endoscopic procedure).

Surgical intervention, either endoscopic with either stapler or CO\textsubscript{2} laser or external staple-assisted, was recorded. Any indication of perforation, whether noted intraoperatively or diagnosed postoperatively, was recorded. Intraoperative time (in minutes) was measured. Postoperative hospital stay (in days), postoperative time to oral intake (in days), and any postoperative complications were also recorded from discharge summaries. From postoperative follow-up records we recorded any recurrence or persistence of symptoms, aspiration, need for further interventions, and any need for a revision. Averages are reported and Fisher’s exact test was used to compare the discrete variables. Median and interquartile ranges were reported and Wilcoxon rank sum test was used.
to compare the continuous variables. \( P < .05 \) was taken as a statistically significant difference. This analysis ensured the similarity of our 2 groups prior to the surgical intervention while indicating differences in postoperative outcomes.

**Results**

Of the 67 patients, 36 had the endoscopic Zenker’s procedure performed, while 31 patients had the external GIA-stapler assisted diverticulectomy with cricopharyngeal myotomy performed. Postoperative outcomes are summarized in Table 2.

**Preoperative**

Preoperative symptoms and demographic variables were similar between the 2 groups. Our patient population reflects the reported 2:1 ratio of male to female prevalence of ZD in the general population. Nine patients had a prior Zenker’s repair at an outside institution and came to see us for persistent dysphagia. Of these, we treated 4 (11% of all patients) endoscopically and 5 (16% of all patients) with the external approach (\( P = .55 \)). Patients in both groups were also comparable in terms of age and preoperative regurgitation, dysphagia, choking, and aspiration pneumonia. Nine (25%) of the ENDO patients and 11 (35%) of the EXT treated patients had documented preoperative aspiration or aspiration pneumonia (\( P = .43 \)).

**Operative**

The median endoscopic operative time was 53 minutes (IQR, 35-84) while that of the external operative time was 152 minutes (IQR, 126-188), a statistically significant difference (\( P < .0001 \)).

**Complications**

There was a nonsignificantly higher rate of complications in the endoscopic group than in the external group. The difference between the incidence of perforation in the ENDO (3 patients, 8.6%) and EXT (1 patient, 3.2%) was not statistically significant (\( P = .62 \)), nor was the difference between the rates of other postoperative complications in the ENDO (11 patients, 31%) versus the EXT group (4 patients, 13%), with \( P = .08 \). Specifically these included 2 episodes of urinary retention, 2 episodes of chest pain with negative cardiac enzymes and chest x-ray (CXR), 1 episode of diarrhea, 1 episode of bradycardia, 1 episode of atrial fibrillation, 1 episode of self-resolving fever, 1 episode of abdominal pain, and 1 episode of bronchospasm in the ENDO group. The EXT group postoperative complications included 1 episode of urinary retention, 1 loose tooth (likely caused by the diverticuloscope used to visualize the esophageal lumen and Zenker’s diverticulum), 1 episode of chest pain with negative cardiac enzymes and EKG, and 1 episode of a CXR suspicious for pneumonia. There were no incidents of vocal cord paresis/paralysis in either group.

**Length of Stay**

The median length of hospital stay was 2 days (IQR, 2-3) for the ENDO group and 3 (IQR, 3-4) for the EXT group (\( P < .0001 \)). There was no difference in the days to oral diet between the 2 groups (1 day each).

**Follow-up**

All patients had at least 1 follow-up visit in outpatient clinic. The median length of follow-up was 2 months (IQR,
1-17.5) for ENDO and 1 month (IQR, 1-3) for EXT, with no statistically significant difference (P = .471). It should be noted that patients were only scheduled for a single postoperative visit. If there were no concerns on this visit, the patients were encouraged to follow up if they had any recurrence of symptoms or any other problems in the future.

Recurrence

Any persistence or recurrence of dysphagia symptoms, frank aspiration, or revision procedure was recorded. We do not routinely obtain postoperative swallowing studies on our patients because our follow-up treatment decisions are based initially on symptoms; we image those patients whose symptoms have recurred, however mildly. The rate of recurrent symptoms in those patients on whom we initially operated was significantly higher in the endoscopic group at 39% (13 patients) compared with 0 recurrences in the external group (P = .00011). Of the patients with recurrence, 3 of 13 chose to have revision surgery. In addition, 9 patients who had undergone endoscopic diverticulectomy at outside institutions underwent 1 of the 2 Zenker’s approaches at our institution.

Discussion

There are various techniques reported with both the endoscopic and external approaches. The endoscopic techniques include using the rigid endoscope to allow the passage of either an endoscopic stapler, needle-knife, carbon-dioxide laser, or argon beam laser to perform a cricopharyngeal myotomy. A flexible endoscope has also been used by gastroenterologists to perform the myotomy with the techniques listed previously in patients who cannot tolerate general anesthesia. Much of the more recent literature regarding endoscopic myotomy describes using the stapler. The endoscopic stapling technique has the advantage of shorter intraoperative time and ease of usage when compared with the laser approach. On the other hand, the stapler requires using the articulating diverticuloscope that can be more difficult to pass. In addition, the stapling myotomy is necessarily less complete than with the laser as the stapler limits the extent of the cut. We chose to convert immediately from a planned endoscopic stapling approach to either an endoscopic laser or external approach, depending on the anatomy and exposure visualized intraoperatively.

The external techniques include diverticulectomy, diverticulectomy, and external cricopharyngeal myotomy. Current literature on the treatment of Zenker’s diverticulum heavily favors the use of various endoscopic procedures over the external approach, as the endoscopic procedures reduce intraoperative time and length of hospital stay. However, higher rates of symptomatic persistence and recurrence as well as subsequent revision procedures are seen with the endoscopic techniques.

Our current study compared the endoscopic technique using either a CO2 laser or stapler with the external stapler assisted diverticulectomy with cricopharyngeal myotomy. Our patient population reflects the known 2:1 male to female prevalence of ZD and age distribution beyond the fifth decade. Further, the 2 groups of patients had similar prevalence of preoperative symptoms of their ZD, including regurgitation, difficulty with bolus propulsion, aspiration sensation (noted as either coughing, choking, or the subjective sensation of aspiration), and documented aspiration pneumonia. There was an insignificantly higher incidence of preoperative aspiration in the EXT group; this may reflect our bias for performing the more definitive external stapler-assisted surgery on patients at highest risk for recurrent aspiration pneumonia.

A larger number of patients who were treated with the EXT technique had undergone prior procedures for ZD at outside facilities. Though this was not statistically significant, it may reflect patient bias toward a definitive procedure in those who failed a prior ZD repair.

As seen in prior literature, the intraoperative time was significantly longer for the EXT group than the ENDO group. However, this did not result in more post- or intraoperative anesthesia-related complications for the EXT group despite the fact that the groups were matched for age. On the contrary, when we compared postoperative complications that could be caused by extended anesthesia, such as urinary retention, GI disturbance/diarrhea, cardiac issues, and pulmonary atelectasis/congestion, the endoscopically treated group had a similar rate of complications to the externally treated group. Because the 2 groups were not matched for comorbidities, we cannot conclude that in general ENDO is riskier for post-anesthetic complications, but we can certainly say that in our series the external approach did not place our patients at increased risk for post-anesthesia complications.

There were 3 patients (8.6%) with perforation in the ENDO group and 1 patient (3.2%) in the EXT group; this was not a statistically significant difference.

Unlike the previously published literature comparing endoscopic versus external surgical procedures for ZD, we found no difference in days until initiation of an oral diet in those patients who did not have a perforation. We routinely started advancing the diets of both our external stapler-assisted and endoscopically treated patients on postoperative day 1 (POD1) and sent them home around postoperative day 1 (ENDO) or 2 (EXT). The decision to advance the diet on POD1 is based on our experience; we only used gastrografin swallow imaging if the routine postoperative CXR showed evidence of air leak and/or there were clinical signs of perforation. The shortened hospital stay of the EXT patients as compared to that reported in the literature may reflect the use of the GIA-stapler, which obviates the need for sutured pharyngotomy closure, thus decreasing the likelihood of a leak. Hence, we felt comfortable starting our patients on an oral diet earlier, which resulted in expedited hospital discharges.

Follow-up time was similar for both our endoscopically and externally stapler-assisted treated groups. This requires some explanation: all patients were seen by the senior author within 2 to 4 weeks of their procedure. Only those
patients with ongoing or future concerns were seen subse-
sequently. The rates reported in the literature of recurrence
after ENDO vary widely based on how a recurrence was
defined, as some papers see the endoscopic approach as
a multistep procedure requiring several “sessions” before
the initial treatment is complete. In our study, the overall
rate of symptomatic persistence or recurrence in the ENDO
groups was 39%, while none of our EXT patients had symp-
tom recurrence. Three of the endoscopic patients whose
symptoms recurred elected to undergo revision surgery.
There was no difference in the immediate postoperative
incidence of aspiration between the 2 groups.

As noted previously, because of the dead space at the end
of the endoscopic stapler, this approach makes it more dif-
ficult to perform a complete myotomy and may result in a
higher persistence or recurrence rate. Another constraint of
the stapler is that passage of the stapler requires use of the
articulating diverticuloscope that is more difficult to advance
in many patients. It is beyond the scope of this paper to com-
pare the efficacy of an endoscopic myotomy using a stapler
versus a CO2 laser, especially in view of the fact that when
we planned on an endoscopic approach, we intended to use a
stapler and only converted to a laser if the anatomy precluded
the stapling approach. A comparison of the 2 endoscopic
techniques would be a fruitful area to explore in the future.

We recognize some limitations of this study. One is that
we did not contact patients to assess long-term results; we
are relying on patient follow up should their dysphagia per-
sist or recur. Because all of the patients were treated by the
senior author (JS) who has been in the same academic prac-
tice for over 25 years, there is a reasonable chance that the
patients would return to her in follow-up should their symp-
toms recur. Clearly the group of patients with recurrences
that we report in this study felt comfortable returning to our
institution for care. There is no reason to believe that only
those patients with endoscopic recurrences would return for
care.

Another limitation is an absence of data on the size of
each patient’s diverticulum. In the past, most diagnoses of
the diverticulum used a standard barium swallow where the
size of the diverticulum could be measured by the radiologist.
Currently, most patients are evaluated using a swallowing
video fluoroscopy (VF). Because the camera distance from
the patients in VF is variable, it is more difficult to make
accurate comparisons of diverticular size so these measure-
ments are rarely reported by the radiologist. In addition, we
recognize that because the groups were not randomized, there
is always a possibility for selection bias.

Conclusion

Although the external stapler-assisted procedure for ZD does
carry a longer intraoperative time and a minimally longer
hospital stay than the endoscopic approach, it provides simi-
lar days until initiation of an oral diet and a slightly lower
(though not statistically significant) incidence of postopera-
tive complications. Further, it is superior to the endoscopic
approach when one considers its much lower rate of sympto-
matic recurrence and need for revision procedures.

We argue that the external stapler-assisted diverticulect-
yomy with cricopharyngeal myotomy should be considered as
a viable treatment in patients who need definitive, single-
session treatment for ZD to prevent life-threatening aspiration
pneumonia. We believe the external approach allows for comparable recovery time to the endoscopic procedures while
providing a definitive treatment. The endoscopic approach is
also an excellent procedure in selected patients. Having experi-
ence in both techniques and using the model of shared deci-
sion making with the patient allows for choice between 2
viable options depending, in part, on patient preference.

Author Contributions

Sarrah Shahawy, data analysis and interpretation, draft article,
final approval; Agnieszka M. Janisiewicz, data analysis and inter-
pretation, draft and final approval; Don Anninger, data acquisition,
article revision and final approval; Jo Shapiro, study, design, data
acquisition and integration, article revision, final approval.

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References

1. Zenker FA, von Ziemssen H. Diseases of the esophagus. In:
von Zeimssen H ed., Handbuch der Speziellen Pathologie an
2. Watemberg S, Landau O, Avrahami R. Zenker’s diverticulum:
3. Maran AGD, Wilson JA, Al Muhanna AH. Pharyngeal diverti-
4. Chang CY, Payyapilli RJ, Scher RL. Endoscopic staple diverti-
culostomy for Zenker’s diverticulum: review of literature and ex-
perience in 159 consecutive cases. Laryngoscope. 2003;133:
957-965.
5. Lang RA, Spelser FW, Winter H, Jauch KW, Hutt TP. Transoral
diverticulostomy with a modified endo-GIA stapler:
results after 4 years of experience. Surg Endosc. 2007;21:532-
536.
6. Wirth D, Kern B, Guenin MO, et al. Outcome and quality of
life after open surgery versus endoscopic stapler-assisted eso-
phagodiverticulostomy for Zenker’s diverticulum. Dis Esophagus.
versus external transcervical approach for the treatment of


