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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 two 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 intra-operative 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 post-operative 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

Zenkers diverticulum; Zenkers; endoscopic; diverticulotomy; diverticulectomy; external

Introduction

Zenker's diverticulum (ZD) was first recognized by Friedrich Von Zenker in 1877¹. 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 80s³. 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 30-40% 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 two approaches to the treatment of this condition: endoscopic and external. 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^{4,5,6}. 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 in patient symptomatic relief^{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 re-operation. A retrospective review of 49 patients comparing the CO2 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 procedure⁹.

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)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, we sought in the current study to compare these two procedures in terms of in-hospital parameters, complications, return to normal diet, and rates of symptom recurrence.

Methods

This study was reviewed and approved by the IRB 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 Zenker's cricopharyngeal myotomy (ENDO group: 36) using either a stapler or CO2 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, pre-operative symptoms including dysphagia, regurgitation, cough or sensation of aspiration, and frank aspiration or pneumonia. Prior intervention for the ZD was also noted. The pre-operative 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 two 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 Zenkers 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 cricopharyngeal bar, the esophageal lumen and the diverticulum. If the articulating diverticuloscope could not be safely advanced, we then reintroduced the nonarticulating diverticuloscope and performed the endoscopic myotomy with the CO2 laser (this was done in 14 patients out of the 36 who underwent the endoscopic procedure).

Surgical intervention, either endoscopic (ENDO) with either stapler or CO2 laser, or external staple-assisted (EXT) was recorded. Any indication of perforation, whether noted intraoperatively or diagnosed postoperatively was recorded. Intraoperative time (in minutes) was measured. Post-operative hospital stay (in days), post-operative time to oral intake (in days), and any post-operative 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. $P < 0.05$ was taken as a statistically significant difference. This analysis ensured the similarity of our two groups prior to the surgical intervention, while indicating differences in postoperative outcomes.

Results

Of the 67 patients, 36 had the endoscopic Zenker's procedure (ENDO) performed, while 31 patients had the external GIA-stapler assisted diverticulectomy with cricopharyngeal myotomy (EXT) performed. Post-operative outcomes are summarized in Table 2.

Preoperative

Preoperative symptoms and demographic variables were similar between the two groups. Our patient population reflects the reported 2:1 ratio of male to female prevalence of ZD in the general population. 9 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 ($p=0.55$). Patients in both groups were also comparable in terms of age and pre-operative regurgitation, dysphagia, choking, and aspiration pneumonia. Nine (25%) of the ENDO group and 11 (35%) of the EXT treated patients had documented preoperative aspiration or aspiration pneumonia ($p=0.43$).

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 ($p < 0.0001$).

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 post-operative complications in the ENDO (11 patients, 31%) versus the EXT group (4 patients, 13%) with $p=0.08$. Specifically these included 2 episodes of urinary retention, 2 episodes of chest pain with negative cardiac enzymes and 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 Zenkers 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 ($p < 0.0001$). There was no difference in the days to oral diet between the two groups (1 day each).

Follow up

All patients had at least one 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 ($p=0.471$). 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 ($p=0.00011$). Of the patients with recurrence, 3/13 chose to have revision surgery. In addition, 9 patients who had undergone endoscopic diverticulotomy at outside institutions underwent one of the two 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 above in patients who cannot tolerate general anesthesia¹¹. 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 diverticulopexy, 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 (ENDO) using either a CO₂ laser or stapler with the external stapler assisted diverticulectomy with cricopharyngeal myotomy (EXT). Our patient population reflects the known 2:1 male to female prevalence of ZD and age distribution beyond the fifth decade. Further, the two groups of patients had similar prevalence of pre-operative 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 pre-operative 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 towards 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 intra-operative anesthesia-related complications for the EXT group despite the fact that the groups were matched for age. On the contrary, when we compared post-operative 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 two groups were not matched for co-morbidities, 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 post-operative day 1 and sent them home around post-operative day 1 (ENDO) or 2 (EXT). The decision to advance the diet on POD1 is based on our experience; we only used gastrograffin swallow imaging if the routine post-operative 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 2-4 weeks of their procedure. Only those patients with ongoing or future concerns were seen subsequently. The rates of recurrence after ENDO reported in the literature vary widely based upon how a recurrence was defined^{12,13}, as some papers see the endoscopic approach as a multi-step 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 symptom 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 two groups.

As noted above, because of the dead space at the end of the endoscopic stapler, this approach makes it more difficult 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 compare the efficacy of an endoscopic myotomy using a stapler vs. 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 two 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 patients to follow up should their dysphagia persist or recur. Because all of the patients were treated by the senior author (JS) who has been in the same academic practice for over 25 years, there is a reasonable chance that the patients would return to her in follow up should their symptoms recur. Clearly the group of patients with recurrences that we report in this study felt comfortable returning to our institution for care. And there is no reason to believe that only those patients with endoscopic recurrences would return for care.

Another limitation is that we do not have data on the size of each patient's diverticulum. In the past, most diagnoses of the diverticulum were made using 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 measurements 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 intra-operative time and a minimally longer hospital stay than the endoscopic approach, it provides similar days until initiation of an oral diet and a slightly lower (though not statistically significant) incidence of post-operative complications. Further, it is superior to the endoscopic approach when one considers its much lower rate of symptomatic recurrence and need for revision procedures.

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 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 experience in both techniques and using the model of shared decision making with the patient allows for two different viable options depending, in part, on patient preference.

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Table 1

Baseline Characteristics of Zenkers Patients

Pre-operative Characteristic	Endoscopic Procedure (N=36)	External Procedure (N=31)	P-value
Age-yr			.65
Median	68.5	66	
Interquartile Range	58.5-79	56-79	
Female	11 (31%)	10 (32%)	1
Male	25 (69%)	21 (68%)	1
Prior Zenker's surgery	4 (11%)	5 (16%)	.55
Pre-op regurgitation	29 (81%)	28 (90%)	.32
Pre-op dysphagia	36 (100%)	31 (100%)	
Pre-op choking or sensation of aspiration	10 (28%)	9 (29%)	1
Pre-op frank aspiration or pneumonia	9 (25%)	11 (35%)	.43

Table 2

Post-operative outcomes:

Post-operative variable	Endoscopic Procedure (N=36)	External Procedure (N=31)	P-value
Operative Time (mins)			<0.0001
Median	53	152	
Interquartile Range	35-84	126-188	
Perforation	3 (8.6%)	1 (3.2%)	.62
Aspiration	5 (15%)	3 (10%)	.71
Esophageal stenosis	1 (3%)	0	1
Other post-op complications	11 (31%)	4 (13%)	0.08
Length of stay (days)			<0.0001
Median	2	3	
Interquartile Range	2-3	3-4	
Days to PO			1
Median	1	1	
Interquartile Range	1-1	1-1	
Follow-up Time (months)			0.4701
Median	2	1	
Interquartile Range	1-17.5	1-3	
Recurrence	13 (39%)	0	0.00011
Revision	4 (13%)	0	.12