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Dysphagia Characteristics in Zenker's Diverticulum

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Abstract

Objectives. To evaluate dysphagia characteristics in patients with Zenker's diverticulum (ZD).

Study Design. Case series with chart review.

Setting. Outpatient tertiary care dysphagia clinic.

Subjects and Methods. All ZD cases surgically treated over a 6-year period were identified and reviewed for dysphagia history and dysphagia characteristics on initial presentation using fiber-optic endoscopic evaluation of swallowing (FEES). Dysphagia symptoms and swallowing abnormalities were compared across groups based on diverticulum size (small $<$1 cm, medium 1-3 cm, and large $>$3 cm).

Results. Forty-six patients underwent a total of 52 procedures during the study period. ZD size was available in 49 cases (6 small, 26 medium, 17 large). Regurgitation symptoms were less frequent in patients with small (17%) compared with medium (68%) or large diverticula (76%; P = .03). Postswallow hypopharyngeal reflux (PSHR) was less frequent in patients with small (17%) compared with medium (91%) and large diverticula (87%; $P < .01$). PSHR was present on all FEES available for patients who presented with a recurrent or residual ZD (n = 7). In all cases, PSHR resolved after successful treatment of ZD. Pharyngeal residue indicating possible weakness was present in 24% of all patients at initial presentation.

Conclusions. Preoperative assessment of dysphagia characteristics in ZD patients reveals that PSHR is predictive of a ZD larger than 1 cm and may be useful in surgical planning. PSHR is also helpful in identifying patients with recurrent or residual symptomatic ZD following surgical treatment. Pharyngeal weakness is present in a subset of ZD patients.

Keywords

esophageal diverticulum, Zenker's diverticulum, swallowing, postswallow hypopharyngeal reflux, dysphagia

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Zenker's diverticulum (ZD) is an uncommon but highly treatable cause of dysphagia. It is more prevalent in men than in women and typically presents in the seventh and eighth decades of life.[1-3] ZD is a pulsion diverticulum through a dehiscence at Killian's triangle between the oblique and transverse fibers of the inferior pharyngeal constrictor.[4] The transverse fibers are also called the cricopharyngeus (CP), which is the primary muscle comprising the upper esophageal sphincter (UES). Dysphagia and regurgitation are the most common symptoms of ZD, with an incidence of 80% to 100% and 57% to 78%, respectively.[1-3] The definitive diagnosis of ZD is made with a radiologic study demonstrating the diverticulum in the appropriate location filled with contrast material.[2,3,5] ZD is treated surgically, and several techniques have been described.[6-8]

While surgical treatment of ZD has gained much attention, little has been written about the dysphagia characteristics and endoscopic findings relating to diagnosis and treatment of ZD. Maran et al[1] reported 59 patients with ZD and stated that ''other than three patients with clinical evidence of pooling of secretions on laryngoscopy, the physical examination contributed little information.'' In contrast, Ongkasuwan et al[9] reported 23 patients with ZD and found greater pooling of secretions on the left pyriform sinus compared with the right with a sensitivity of 52% and a specificity of 97%. However, both studies were limited in scope and did not report other abnormal endoscopic findings or dysphagia characteristics.

Regurgitation, a common symptom of ZD, can be assessed on endoscopic examination. Langmore et al[10] first described fiber-optic endoscopic evaluation of swallowing (FEES) in 1988, but its utility for ZD was not realized until 1998 by Richardson and Bastian.[11] They endoscopically visualized regurgitation of swallowed material in the

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hypopharynx and called the finding postswallow hypopharyngeal reflux (PSHR). They found PSHR to be 85% sensitive and 86% specific for ZD. Limitations, however, included a small sample size, no evaluation of other FEES findings, and no correlation between FEES findings and symptoms or diverticulum size.

While imaging is the mainstay of diagnosing ZD, the utility of history, physical examination, and office procedures routinely performed by otolaryngologists, such as FEES and transnasal esophagoscopy (TNE), should not be ignored. A better understanding of how patient symptoms and office endoscopic findings correlate with ZD diagnosis and response to treatment will improve clinical acumen in diagnosis, treatment planning, and preoperative counseling. Thus, this study aims to describe the presenting symptoms and dysphagia characteristics (such as PSHR, aspiration, and pharyngeal weakness) in patients treated for ZD over a 6-year period. We correlate the preoperative findings with intraoperative findings such as diverticulum size and provide insight as to how office-based swallow evaluation assists with management decisions in patients with ZD.

Materials and Methods

Approval for this retrospective review was obtained from the University of California, Los Angeles, Institutional Review Board. Hospital records were examined to identify patients treated for ZD from January 2006 through April 2012 by a single surgeon (D.K.C.). Hospital and clinic records including history, physical examination, dysphagia clinic notes, operative notes, and findings on instrumental and radiologic swallow evaluations including FEES, TNE, modified barium swallow study (MBSS), and esophagram were reviewed.

The history included assessment of symptoms of solid or liquid dysphagia, cough, regurgitation, globus, aspiration, weight loss, and supplemental nutrition. A pre- and postoperative Functional Outcome Swallowing Scale (FOSS) score was determined based on the dysphagia clinic records. The methodology to calculate FOSS score was as described by Salassa.[12] FOSS is a 6-point scale based on dysphagia symptoms, physiologic function, diet, and ability to compensate. We also documented those patients presenting for recurrent or residual ZD and the prior treatment method.

FEES were performed according to a standard protocol previously described.[13] All FEES and TNE examinations were performed by the senior author (D.K.C.), recorded with a Kay-Pentax (Lincoln Park, NJ) EPK1000 digital video processor connected to a personal computer for data storage and display. FEES and TNE findings were documented on standardized forms in the chart, documenting swallow abnormalities such as pooling of secretions, oral phase abnormalities, pharyngeal residue in the vallecula or hypopharynx (indicating pharyngeal weakness or cricopharyngeal obstruction), aspiration, and PSHR.

Spontaneous PSHR is sought by observing the hypopharynx for regurgitation after the food bolus disappears into the esophagus during FEES (**Figure 1**). For patients with pyriform sinus pooling and thus suspected ZD, additional maneuvers that provoke PSHR include having the patient phonate a sustained /e/ or massaging the anterior neck beneath the cricoid. A postoperative FEES was not initially routinely performed; however, over time, it was recognized that postoperative FEES assisted in patient management. Specifically, if the patient complained of dysphagia and PSHR was found, this indicated a recurrence requiring treatment. Therefore, a postoperative FEES is now performed on all patients to document swallow outcomes and to decide on further interventions. Specific abnormalities sought on FEES included pooling of secretions, pharyngeal residue, aspiration, and PSHR. TNE, if performed, followed FEES and was performed in a standard fashion as previously described.[14] TNE was performed preoperatively if ZD was suspected based on history and FEES but an esophagram was not available and in patients with recurrent ZD to assess diverticulum size and extent of food collection in the pouch.

Figure 1. An image from a fiber-optic endoscopic evaluation of swallowing of postswallow hypopharyngeal reflux showing the reappearance of the swallowed material following clearance into the esophagus with the swallow.

The operative reports were examined to determine method of treatment and ZD size. Operations included open diverticulectomy with cricopharyngeal myotomy or endoscopic staple or CO_2 laser diverticulotomy. ZD size was measured intraoperatively as the distance from the apex of the pouch to the superior edge of the common cricopharyngeal wall. Size was stratified into 3 groups: small (<1 cm), medium (1-3 cm), and large (>3 cm). Presenting symptoms, FOSS scores, and FEES findings (pre- and postoperative) were compared across the 3 groups of diverticulum size.

Logistic regression analysis was used to evaluate the association between presenting symptoms (dependent variable) and diverticular size (independent variable). Logistic regression analysis was also used to assess association between dysphagia characteristics (dependent variable)—specifically PSHR, aspiration, pooling of secretions, and pharyngeal residue—and diverticular size (independent variable). Statistical analyses were performed using XLSTAT 2007 (Addinsoft, Paris, France) with a $P < .05$ considered significant.

Table 1. Presenting Symptoms and Zenker's Diverticulum Size

	Small		Medium		Large		All	
	%	n	%	n	%	n	%	n
Solid dysphagia	83.3	5	100.0	26	100.0	17	98.1	51
Liquid dysphagia	16.7	1	34.6	9	23.5	4	30.8	16
Regurgitation	16.7	1	68.0	17	68.0	17	64.7	33
Aspiration	16.7	1	19.2	5	5.9	1	13.5	7
Globus	33.3	2	11.5	3	0.0	0	9.6	5
Chronic cough	83.3	5	42.3	11	41.2	7	46.2	24
Weight loss	16.7	1	30.8	8	29.4	5	28.8	15
Gastrostomy tube or total parenteral nutrition	0.0	0	0.0	0	11.8	2	3.8	2

Results

Forty-six patients who underwent 52 total operations for ZD were identified during the 6-year study period. Two patients with a medium-sized ZD underwent 2 revision procedures due to recurrences. One patient with a medium-sized ZD and 1 patient with a large ZD underwent 1 revision procedure for a recurrence.

ZD size was available in 49 cases with 6 small (<1 cm), 26 medium (1-3 cm), and 17 large (>3 cm) diverticula. The distribution of presenting symptoms across size groups is presented in **Table 1**. Solid dysphagia was more common than liquid dysphagia and was present in all patients except 1 with a small ZD who presented with nighttime cough and globus. Regurgitation was less frequent in patients with small (17%) compared with medium-sized (68%) or large diverticula (76%; $P = .029$). Globus was more commonly seen in small (33%) or medium-sized (12%) ZD when compared with large ZD (0%). Only 2 patients required supplemental nutrition, 1 receiving total parenteral nutrition and 1 gastrostomy tube dependent, both of whom had large ZD and severe pharyngeal weakness. FOSS scores across ZD size are presented in **Figure 2**. The most common FOSS score was II, and only patients with large ZD had FOSS scores greater than III.

Preoperative and postoperative FEES were performed for 46 and 36 cases, respectively, and FEES findings are presented in **Table 2**. Preoperative hypopharyngeal pooling of secretions was more common in medium-sized (77%) and large (93%) diverticula when compared with small diverticula (33%; $P = .018$). For all patients with ZD, pooling of secretions predicted a ZD >1 cm with a sensitivity of 84%, specificity of 67%, positive predictive value of 94%, and negative predictive value of 40%. An even stronger statistical significance was found with PSHR on initial FEES, which was less frequent in patients with small (17%) compared with medium-sized (91%) and large diverticula (87%; $P = .001$). For all patients with ZD, preoperative PSHR predicted a ZD >1 cm with a sensitivity of 89%, specificity of 83%, positive predictive value of 97%, and negative predictive value of 55%. Two patients with medium-sized ZD had evidence of PSHR on initial postoperative FEES. In 3 additional cases, patients developed PSHR on subsequent FEES. All of these patients complained of dysphagia; were found to have either residual or recurrent ZD on TNE, MBSS, or esophagram; and were managed with further surgery. All of those treated for recurrence who underwent postoperative FEES had no PSHR after successful treatment of ZD. Aspiration on FEES was seen only in patients with medium-sized or large ZD and resolved postoperatively in all but 1 patient who also had severe pharyngeal weakness. Results of logistic regression modeling of the preoperative FEES findings and symptoms found to be statistically significant are presented in **Table 3**.

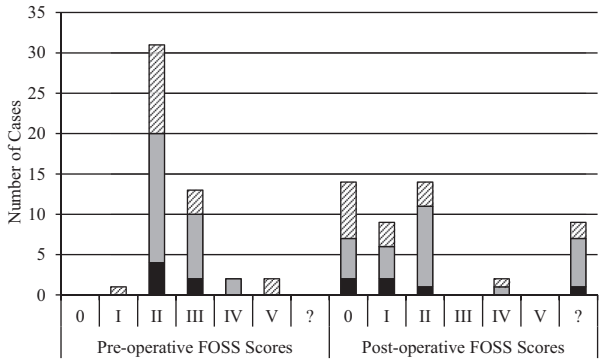

Figure 2. Pre- and postoperative Functional Outcome Swallowing Scale (FOSS) score distribution of Zenker's diverticulum size. Zenker's diverticulum size: ■ small (<1 cm), ■ medium (1-3 cm), ▨ large (>3 cm). ? = uknown FOSS score.

Twenty-four percent (n = 11) of patients had pharyngeal residue on initial FEES. This finding was not associated with ZD size ($P = .53$) but was associated with higher preoperative FOSS scores ($P < .0001$) and higher postoperative FOSS scores ($P = .006$). Eight of these patients had postoperative FEES, and of these, 6 continued to have pharyngeal residue on examination. Two additional patients with medium-sized ZD had a new finding of mild pharyngeal residue after surgery.

Table 2. FEES Findings and Zenker's Diverticulum Size

	Hypopharyngeal Pooling		PSHR		Pharyngeal Residue		Aspiration	
Zenker's Diverticulum Size	%	n	%	n	%	n	%	n
Preoperative FEES findings								
Small (<1 cm)	33.33	2	16.67	1	16.67	1	0.00	0
Medium (1-3 cm)	77.27	17	90.91	20	18.18	4	18.18	4
Large (>3 cm)	93.33	14	86.67	13	33.33	5	26.67	4
All cases	78.26	36	80.43	37	23.91	11	19.57	9
Postoperative FEES findings								
Small (<1 cm)	0.00	0	0.00	0	25.00	1	0.00	0
Medium (1-3 cm)	11.76	2	11.76	2	29.41	5	5.88	1
Large (>3 cm)	0.00	0	0.00	0	15.38	2	0.00	0
All cases	5.56	2	5.56	2	22.22	8	2.78	1

Abbreviations: FEES, fiber-optic endoscopic evaluation of swallowing; PSHR, postswallow hypopharyngeal reflux.

Table 3. Logistic Regression Modeling of Significant Variables

				95% CI			
	Coefficient	Standard Error	Odds Ratio	Lower	Upper	*P* Value	R^2 (Nagelkerke)
Preoperative pooling						0.018	0.259
Small (>1 cm)	Reference						
Medium (1-3 cm)	1.917	1.004	6.800	0.950	48.692		
Large (>3 cm)	3.332	1.350	28.000	1.988	394.405		
Preoperative PSHR						0.001	0.421
Small (>1 cm)	Reference						
Medium (1-3 cm)	3.912	1.323	50.000	3.741	668.350		
Large (>3 cm)	3.481	1.333	32.500	2.384	443.145		
Regurgitation						0.029	0.189
Small (>1 cm)	Reference						
Medium (1-3 cm)	2.363	1.176	10.625	1.059	106.573		
Large (>3 cm)	2.788	1.236	16.250	1.442	183.093		
Globus						0.014	0.331
Small (>1 cm)	Reference						
Medium (1-3 cm)	–1.317	1.033	0.268	0.035	2.029		
Large (>3 cm)	–2.968	1.704	0.051	0.002	1.451		

Abbreviations: CI, confidence interval; PSHR, postswallow hypopharyngeal reflux.

Nine cases in this series were for recurrent or residual diverticula, and several surgical approaches were used: 4 endoscopic staple diverticulotomies, 2 endoscopic laser diverticulotomies, and 3 open diverticulectomies. Of these, 5 had prior operations by outside physicians and 4 by the senior author (D.K.C.). The mean and median times to recurrence were 35 and 36 months, respectively. The mean number of prior operations was 1.22. Preoperative FEES were performed for 7 of these revision cases, and PSHR and pooling of secretions were present on all 7. Postoperatively, 1 of these patients had PSHR on FEES due to residual ZD, requiring another revision surgery. Following the second revision, the PSHR and the dysphagia complaints resolved. The postoperative FEES for the remaining 6 patients showed no PSHR.

Discussion

Traditionally, otolaryngologists have relied on radiologic assessments to diagnose ZD. However, the utility of the history and office-based physical examination must not be neglected in diagnosing and managing these patients. This study demonstrates that otolaryngologists can use the history and FEES not only to confirm the suspicion of ZD diagnosis but also to provide information about ZD size and guide postoperative management.

Prior work has found PSHR to be a reliable diagnostic sign of ZD. In their study of 34 patients, Richardson and Bastian[11] found the sensitivity and specificity of PSHR for ZD to be 85% and 86%, respectively. A second study by

Périé et al[15] described PSHR on FEES as ''the sign of the rising tide.'' They reported on 12 patients with ZD and found that 11 of the 12 had hypopharyngeal pooling of secretions, but all 12 exhibited PSHR. In addition, none of their 20 control patients with UES dysfunction displayed PSHR. After surgical treatment of the ZD, 6 of the 7 patients with postoperative FEES had no PSHR. The 1 patient with postoperative PSHR was also symptomatic with intermittent regurgitation. We too have found persistent or recurrent PSHR after ZD surgery a sign of symptomatic ZD and use this to recommend further surgery in symptomatic patients.

Patients with ZD can also present with aspiration and pharyngeal weakness, but this has rarely been reported. Périé et al[15] reported aspiration on FEES in 6 patients and evidence of pharyngeal weakness in 1 patient, but they did not mention if these signs resolved after treatment. In our series, usually aspiration resolved while pharyngeal weakness persisted. Our findings were very similar to those of Périé et al,[5] with the added benefit of a larger sample size, increased number of postoperative examinations, and the ability to correlate our findings with diverticulum size and preoperative symptoms. The 2 prior studies were published before the emergence of office-based esophagoscopy and routine use of FEES in outpatient clinics. Despite FEES' expanded application, PSHR has been neglected in the literature in the 13 years since these initial studies.

In 2011, Ongkasuwan et al[9] reported 23 patients with ZD and 73 control patients. They identified pooling of secretions in the pyriform sinus on the left greater than right as predictive of a ZD with a sensitivity of 52% and a specificity of 97%. In patients with ZD >4 cm, equivalent hypopharyngeal secretions (left = right) were more likely. Our results showed that hypopharyngeal pooling was significantly more common in patients with medium-sized and large ZD compared with those with small ZD. With this in mind, left greater than right hypopharyngeal pooling may be useful in identifying patients with smaller ZD, and PSHR may be used to identify patients with larger ZD and equivalent hypopharyngeal pooling.

After diagnosis, the surgeon must choose how to appropriately treat the ZD. Diverticula of different sizes are often managed differently based on surgeons' preferences. In 2008, Rizzetto et al[5] suggested that endoscopic staple diverticulotomy is best for patients with a medium-sized ZD, but open surgery should be offered for those with small or large ZD. Small diverticula specifically challenge the endoscopic stapling technique as the stapler cannot transect all of the offending CP fibers. Knowing the ZD size preoperatively assists the surgeon in planning for the correct amount of surgical time (open versus endoscopic), having the necessary equipment available (stapling device versus laser), and appropriately counseling patients on the likely approach (open or endoscopic) and likely length of admission. We found the presence of pooling of secretions as well as PSHR more commonly in medium-sized or large ZD and use this information in preoperative planning. In our dysphagia clinic, if an esophagram or MBSS is not available or if the diagnosis is unclear, we perform a TNE to further characterize and measure the ZD size. On TNE, the tip of the scope will fall into the ZD pouch first, and then the scope has to be slightly retracted and the tip angled anteriorly as the patient swallows to guide the scope into the esophagus. In the setting of a noncompliant UES, care must be taken to avoid the theoretical risk of esophageal perforation at the diverticulum while attempting to pass the scope. Confirmation of the ZD on TNE allows immediate operative counseling and planning.

While esophagram or MBSS are used for ZD diagnosis, they are less helpful postoperatively. It is documented that following surgical treatment of ZD, a residual diverticulum is often seen on imaging.[5,16-18] Witterick et al[16] examined the correlation between radiographic and symptomatic findings after ZD. In their series of 18 patients, 7 asymptomatic patients were radiologically diagnosed with a residual ZD. Similarly, Sydow et al[18] found that following surgical treatment of ZD, 25% of their 16 patients had a remnant diverticulum with an average size of 2.3 cm. Most recently, Rizetto et al[5] reported that all of their postoperative ZD patients who underwent MBSS had a posterior pouch on the examination. This shortcoming of MBSS and esophagram gains significance when evaluating a patient with dysphagia symptoms previously treated for ZD. In our study, 17% of cases were for recurrent ZD. PSHR was found on follow-up FEES on all recurrences and none of those without recurrence. This finding simplified the decision to perform revision surgery. In addition, after successful revision surgery, none of these patients displayed PSHR. Given the limitations of postoperative radiologic examinations, we advocate FEES as more ideal in evaluating patients with recurrent symptoms after previous surgery for ZD.

Twenty-four percent of our patients with ZD had pharyngeal residue, indicating either weakness or CP obstruction; thus, it is reasonable to consider CP dysfunction in the pathophysiology of pharyngeal weakness. In a case-control study, Belafsky et al[19] performed fluoroscopic swallow studies to evaluate pharyngeal dilation and weakness proximal to cricopharyngeal obstruction. They concluded that the longer the obstruction is present, the worse the weakness and dilation become, resulting in possibly irreversible changes. In our series, the residue did not resolve initially for most cases; thus, our results are consistent with this hypothesis. However, long-term data on pharyngeal weakness are unclear as most of our patients did not follow up after their first postoperative examination unless they had continued or recurrent dysphagia.

Conclusions

Dysphagia with PSHR on FEES is predictive of a ZD larger than 1 cm and may be useful in preoperative planning. PSHR is also helpful in identifying patients with recurrent or residual symptomatic ZD following surgical treatment. Pharyngeal weakness is present in a subset of ZD patients and may not resolve initially after treatment of the ZD.

Author Contributions

Jennifer L. Bergeron, conception and design, acquisition and analysis of data, drafting of article, final approval; **Jennifer L. Long**, conception and design, drafting of article, final approval; **Dinesh K. Chhetri**, conception and design, drafting of article, final approval.

Disclosures

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