

Evaluation of the Different Transcervical Approaches for Zenker Diverticulum

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Otolaryngology—
 Head and Neck Surgery
 146(5) 725–729
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 DOI: 10.1177/0194599811435304
<http://otojournal.org>



No sponsorships or competing interests have been disclosed for this article.

Abstract

Objective. The aim of this study was to evaluate the results of open surgical techniques in the treatment of Zenker diverticulum.

Study Design. Case series with chart review.

Setting. Academic tertiary referral center.

Subjects and Methods. Fifty-four patients with Zenker diverticulum were treated using a transcervical approach. Three with a Brombart I diverticulum underwent a simple myotomy of the cricopharyngeal muscle. Myotomy was combined with a diverticulum inversion in 14 patients and myotomy with diverticulectomy was performed in 37 patients. The surgical procedures were compared with regard to mean anesthesia time, duration of hospitalization, overall complication rate and rate of serious complications, recurrence rate, and follow-up results.

Results. Hospitalization times were significantly shorter in the inversion group ($P = .024$). No statistically significant differences were observed between the transcervical modalities for any of the other variables investigated.

Conclusions. Inversion is an effective modality and is by definition less traumatic than traditional diverticulectomy. Although the size of the diverticulum appeared to be a helpful criterion, careful intraoperative evaluation is the key element in deciding which transcervical procedure should be used. In the authors' view, inversion always should be considered if the individual anatomy of the diverticulum sac (in terms of pharyngeal pouch size and intactness of the mucosa) allows it.

Keywords

Zenker diverticulum, surgery, diverticulectomy, diverticulum inversion

Received July 22, 2011; revised December 5, 2011; accepted December 16, 2011.

The endoscopically guided minimally invasive approach is now the treatment of choice for Zenker diverticulum (ZD) whenever possible, as it is safe

and cost-effective, with a low recurrence rate and a high level of acceptance by patients.¹ Possibly because of the enthusiasm over the value of the technique, there have been few recent reports in the literature exclusively discussing transcervical approaches. The last report describing inversion as a possible treatment for ZD was published 14 years ago.²

An open approach is chosen, either preoperatively or intraoperatively, when there is inadequate endoscopic exposure of the diverticulum and insufficient protection of the diverticulum sac by the dorsal esophageal wall (in patients with small diverticula without a clearly defined sill). Some recent reports in the literature have explicitly discussed the limitations of endoscopic exposure and the need to manage Zenker diverticulum using an open approach in 15% to 68% of cases.^{3,4} Cricopharyngeal myotomy, either alone or in combination with resection of the diverticulum sac, and closure of the hypopharyngeal wall (diverticulectomy), suspension (diverticulopexy), or inversion of the pharyngeal pouch are the recommended open surgical procedures.⁵ However, it should be emphasized that the key step in surgery for ZD appears to be a thorough and adequate cricopharyngeal myotomy.⁶

In the present study, diverticulectomy was compared with diverticulum inversion in relation to the mean anesthesia time, duration of hospitalization, incidence of complications, recurrence rate, and follow-up results.

Materials and Methods

The study was based on an analysis of the medical files and surgical charts for all patients who underwent primary open (transcervical) surgical treatment of ZD at a university tertiary referral center (Department of Otolaryngology, Head and Neck Surgery, University of Erlangen–Nuremberg, Germany) between 1992 and 2010. Relevant approval from

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the institutional review board of the hospital was obtained. From a total of 182 patients who underwent surgical treatment of ZD, 55 patients underwent a transcervical operation. One patient (1.8%) with squamous cell carcinoma arising from the mucosa of the excised diverticulum sac was excluded from the study, as the treatment followed a different protocol. The preoperative diagnosis was based on the patients' medical history, a full head and neck examination, and barium esophagogram.

The choice of surgical procedure depended on individual clinical criteria (patient's age and comorbidities, duration of symptoms, and likelihood of malignant degeneration), findings on the preoperative barium esophagogram (size and individual anatomy of the diverticulum sac, recognizable sill, and protection of the diverticulum), and an intraoperative evaluation.

All of the procedures were performed with the patient under general anesthesia. Endoscopy was initially carried out to allow inspection of the diverticulum mucosa and clearance of the sac, which was then packed with ribbon gauze. An incision was made on the left side of the neck, the sac including its neck was carefully dissected, and a transection of the cricopharyngeal muscle and proximal fibers of the esophageal muscle, with a minimum length of 3 to 4 cm, was performed. In cases of diverticulum inversion, the sac was inverted into the esophageal lumen using a 1-layer suture. During diverticulectomy, the diverticulum sac was resected and the esophageal defect was closed with a 2-layer suture. Diverticulopexy was not carried out in this group of patients. All patients included in the study received intravenous broad-spectrum antibiotics perioperatively, and antibiotic treatment was continued for 1 week.

Fifty-four patients were included in the analysis, consisting of 37 men (68.5%) and 17 women (31.5%). The male-to-female ratio was 2.1:1. The patients' mean age was 65.2 years (range, 40-85 years). The median follow-up period was 78 months (lower quartile: 48 months; upper quartile: 120 months).

The influence of the size of the diverticulum on the choice of surgical procedure was studied. The different surgical methods used—diverticulectomy and diverticulum inversion, both in combination with myotomy—were compared with regard to mean anesthesia time, duration of hospitalization, incidence of complications, recurrence rate, and follow-up. Recurrences were diagnosed when the patients reported new symptoms and a diverticulum sac was visible on a barium swallow at any time after the primary surgical intervention. Moreover, the influence of the age and the American Society of Anesthesiologists (ASA) physical status of the patients on the rate of complications was examined. Follow-up data were obtained using a questionnaire that was mailed to the 54 patients. In the questionnaires, the patients were asked to classify their current swallowing status as "normal," "considerably improved," or "not improved." The questionnaire also inquired about the patients' subjective perception of the success of the treatment. Any patients who failed to return the questionnaire were contacted by phone.

Table 1. Patients' Preoperative Symptoms

Symptom	Patients	
	n	%
Dysphagia	43	79.6
Regurgitation	35	64.8
Globus feeling	29	54.7
Cough	6	11.1
Halitosis	5	9.3
Weight loss	6	11.1
Mucous congestion	8	14.8
Heartburn	5	9.3
Aspiration	2	3.7
Reflux	2	3.7
Feeling of asphyxia	2	3.7
Vomiting	1	1.9
Pneumonia	1	1.9

Statistical analysis was carried out using the χ^2 test and the *t* test for independent samples. The Statistical Package for the Social Sciences program (SPSS) version 18 for Windows (SPSS Inc, Chicago, Illinois) was used for the analysis. A *P* value <.05 was considered statistically significant.

Results

The most frequent symptoms reported by the patients included in the study are listed in **Table 1**. The average duration of symptoms was 29.8 months (range, 1-166 months). Barium esophagography was performed preoperatively in all of the patients, and the diverticula were classified according to the Brombart scale⁷ (**Table 2**).

Among the 54 patients included in the study, 3 (5.5%) with a Brombart I diverticulum underwent a simple myotomy of the cricopharyngeal muscle, with a successful outcome. Because of the small number of patients, statistically meaningful analysis of simple myotomy was not possible in this series. Myotomy was combined with a diverticulum inversion in 14 patients (25.9%), and myotomy with diverticulectomy was performed in 37 patients (68.5%).

The mean anesthesia times were 153 minutes in the diverticulectomy group and 125 minutes in the diverticulum inversion group, with no statistically significant differences between the 2 approaches (*P* = .145). Analysis of our data revealed that modifications in anesthesia over the study period did not influence mean anesthesia times. The retrospective analysis showed that inversion was performed in 53.8% of small diverticula (Brombart I-II). With larger diverticula (Brombart III-IV), diverticulum inversion was only limited preferred (18.4%; **Table 2**).

Complications were observed in a total of 11 cases (20.3%), with no statistically significant differences between the surgical modalities (*P* = .437). Detailed information on postoperative complications is shown in **Table 3**. Serious

Table 2. Surgical Approaches Used Relative to the Brombart Stage of the Diverticulum

Brombart Stage	Diverticulectomy plus Myotomy	Diverticulum Inversion plus Myotomy	Simple Myotomy	Patients, n (%)
I	0	1	3	4 (7.4)
II	6	6	0	12 (22.2)
III	13	7	0	20 (37.0)
IV	18	0	0	18 (33.3)
Total	37	14	3	54

Table 3. Specific Postoperative Complications among the Study Patients

Complication	Patients, n (%)	Diverticulectomy plus Myotomy	Diverticulum Inversion plus Myotomy
Recurrent laryngeal nerve paralysis	6 (11.1)	5	1
Postoperative fever	2 (3.7)	2	0
Hemorrhage	3 (5.6)	3	0
Subcutaneous emphysema	2 (3.7)	2	0
Pharyngocutaneous fistula	2 (3.7)	2	0
Parapharyngeal abscess	0 (0)	0	0
Pneumonia	0 (0)	0	0
Mediastinitis	0 (0)	0	0

complications (pharyngocutaneous fistula, parapharyngeal abscess, mediastinitis, pneumonia, postoperative hemorrhage requiring surgical revision) were observed in 5 patients (all with diverticulectomy, 9.3%), with no statistically significant differences between the different surgical modalities ($P = .148$). The patients' age (≥ 70 years vs > 70 years) did not appear to influence either the rate of serious complications ($P = .849$) or the total complication rate ($P = .912$) significantly. All of the patients had ASA physical status grades I to III, and there were no patients with grade IV. ASA grades II and III appeared to be significantly associated with the rate of serious complications ($P = .015$).

Only 1 recurrence was observed, in a patient who had undergone diverticulectomy (1.9%), with no statistically significant differences between the surgical modalities ($P = .101$). The average hospitalization period was significantly shorter at 8.9 days in the diverticulum inversion group in comparison with 11 days in the diverticulectomy group ($P = .024$).

Feedback on the follow-up was obtained from a total of 45 of the 54 patients (86.5%). The mean follow-up period was 80 months (range, 6-144 months). No swallowing difficulties were reported by 86.7% of the patients at follow-up, and all but 1 (97.7%) considered that the surgery had been successful. No statistically significant differences were observed between diverticulum inversion and diverticulectomy in relation to swallowing status ($P = .433$) or the patients' perception of the success of the procedure ($P = .559$) at follow-up.

Discussion

The minimally invasive endoscopic approach for patients with ZD is now considered to be the treatment of choice for the condition, when possible.³ However, a review of the literature shows that the transcervical approach may be the only reliable treatment in up to 68% of ZD patients.^{3,4} Although numerous reports on the different transcervical approaches were published up to the early 1990s, only a few relevant studies have appeared in the more recent literature.² There also appears to be a lack of follow-up data for comparisons between these modalities with regard to postoperative swallowing status and the patients' perception of the success of the procedures. Moreover, no definitive criteria are available to help identify the most favorable transcervical approach in patients with ZD. Which open surgical modality should be chosen is therefore still a current issue of debate.

Myotomy appears to be centrally important in the treatment of all cases of ZD and may be sufficient in patients with small symptomatic diverticula⁸ (in which resection is associated with an increased risk of esophageal stenosis),⁵ although there is some risk of residual sacs or recurrences in up to 23% of cases.⁹ In the present study, none of the 3 patients (Brombart I) who underwent simple transcervical myotomy had recurrences, and they remained free of symptoms during the follow-up.

Diverticulopexy is another alternative favored by some authors.^{5,10-12} Although this technique leaves the esophageal mucosa intact, recurrences due to insufficiency of the

suspension suture have been reported in up to 7% of cases and fistulas or laryngeal nerve pareses in up to 12% and 11% of cases, respectively.⁵ The technique was not used in the present group of patients, and in the authors' view, it appears to be applicable only in patients with larger, mobile diverticulum sacs. In addition, the surgical trauma caused to the soft tissues of the neck with this method is comparable with that with the other transcervical techniques. After suspension of the sac, no further inspection of the diverticulum mucosa is possible for early detection of malignancy in these predominantly larger diverticula, in which the risk of malignant degeneration is reported to be higher.^{13,14} There is also a nonnegligible risk of recurrences due to insufficiency of the suspension sutures, and there appears to be a lack of information on the rate of malignancies developing in the suspended pharyngeal pouch.

Among the other transcervical modalities available, only diverticulectomy allows histopathological examination of the diverticulum sac.⁵ However, this technique is associated with a certain risk of pharyngocutaneous fistulas (up to 30%),¹⁵⁻¹⁹ recurrent nerve paralysis (transient or permanent, up to 9% of cases),²⁰ or esophageal stenosis.¹⁶ As a less traumatic method, diverticulum inversion is generally associated with a shorter hospital stay, a shorter time to the resumption of oral intake, and a lower complication rate (with fistulas in up to 5% of cases¹⁹ and recurrent laryngeal nerve paresis in up to 12%¹⁸). Fistulas associated with diverticulum inversion have been attributed to accidental injury to the pharyngeal wall either by the purse-string suture or by the scalpel or coagulation during myotomy.¹⁸ In addition, recurrence of the disease has also been reported.^{10,11,16,18,19,21} Also, residual intraluminal sacs after inversion of larger diverticula may lead to further symptoms of dysphagia during the early postoperative phase in rare cases.²² Interestingly, there is radiographic²¹ and video-fluoroscopic¹⁸ evidence showing that the inverted pouch atrophies in the early postoperative phase.

The results of the present series were comparable with the relevant literature, with a fistula developing in 2 cases (3.8%; both diverticulectomies) and (only temporary) recurrent laryngeal nerve paralysis in 11.5% of the cases. In connection with complications, it is a reasonable expectation that fistulas are far less likely to result from diverticulum inversion, which by definition does not disrupt the pharyngeal wall.¹⁶ There were no statistically significant differences between the surgical modalities in relation to the overall incidence of complications. No cases of mediastinitis were observed, a complication that has been reported in the literature in up to 9.5% of cases after transcervical treatment.¹¹

Recurrent diverticulum was observed in only 1 patient (after diverticulectomy) in the present study (1.9%), with no statistically significant differences between the surgical modalities investigated. This rate compares favorably with the rates reported in the relevant literature, in which recurrences are reported in 3% to 19% of cases with diverticulectomy^{20,23,24} and in 6% to 15% of cases with diverticulum inversion. However, it should be noted that the published

reports on diverticulum inversion include only small samples (<20 patients),¹⁹ so secure conclusions cannot be drawn. Nevertheless, these data suggest that these modalities can be successfully used in carefully selected patients.

A comprehensive review of the relevant literature showed that there is a lack of data regarding patients' swallowing status after transcervical surgery for ZD. In the present series, almost 87% of the patients reported no swallowing difficulties in the follow-up, and all but 1 considered that the diverticulum surgery had been successful. The low rate of serious complications, the exceptionally low rate of recurrences, and the high degree of patient satisfaction during the follow-up confirm that both of the surgical modalities examined can provide an effective and safe cure for this disease, irrespective of the technique used.

An important point that emerged from the review of the relevant literature was that there is a lack of objective criteria for deciding which type of transcervical surgery to use. Interestingly, the size of the diverticulum appears to influence the choice of treatment. Freeland and Bates,²¹ Morton and Bartley,¹⁸ and Nguyen and Urquhart² recommended diverticulum inversion with myotomy only in patients with a small or medium-sized (up to 4 cm) diverticulum sac. Similarly, Leporrier et al²⁵ stated that they preferred diverticulectomy in patients with a ZD larger than 6 cm and in younger patients, in view of the risk of malignant transformation. In our own personal experience (**Table 2**), diverticulum inversion may be preferable in small or medium-sized diverticula. Of course, this modality should be avoided in cases of inadequate endoscopic evaluation of the mucosa of the diverticulum sac.

Furthermore, Konowitz and Biller¹⁰ and Leporrier et al²⁵ suggested that a less invasive modality (diverticulopexy with myotomy) should be performed in elderly patients with concurrent illnesses or a history of postsurgical complications. In the present study, patients older than 70 years did not appear to have higher complication rates, despite the fact that they underwent diverticulectomy in 82% of cases. On the other hand, higher ASA grades correlated significantly with the rate of serious complications ($P = .015$). Our results, in accordance with the relevant published data, suggest that less invasive techniques should be considered in patients with greater preoperative morbidity or higher ASA grades, provided that the individual anatomy of the diverticulum sac (in terms of pouch size and mucosa intactness) allows this.

In our opinion, considering these parameters is crucial in order to choose the best surgical modality in each case. Nevertheless, it should be mentioned that the personal preferences of the surgeon play an important role in this issue and thereby suggest selection bias in the findings of our analysis and similar studies.

Conclusion

The key step in surgery for ZD appears to be a thorough and complete cricopharyngeal myotomy, and this may be the only treatment necessary in small symptomatic diverticula. Diverticulum inversion appears to be, by definition, less a

traumatic modality than traditional diverticulectomy. However, careful patient selection and evaluation of the intraoperative findings are of paramount importance. Particularly in patients with long-standing pharyngeal pouches, which in theory have a higher risk of malignant degeneration,^{13,14,26} a careful direct esophagoscopy at the beginning of the operation is of vital importance to rule out suspicious lesions on the diverticulum mucosa. Factors such as patient morbidity and the size of the diverticulum should also be taken into account and may influence the treatment decision in favor of a less invasive procedure. In principle, head and neck surgeons need to be familiar with all transcervical techniques and should not hesitate to convert an intended inversion procedure to a resection when this is indicated.

Author Contributions

Konstantinos Mantsopoulos, conception and design of the study, acquisition of data, analysis and interpretation of data, critical revision for important intellectual content, final approval of the version to be published; **Georgios Psychogios**, conception and design of the study, critical revision, final approval of the version to be published; **Julian Künzel**, acquisition of data, interpretation of data, critical revision, final approval of the version to be published; **Johannes Zenk**, conception and design of the study, acquisition of data, critical revision, final approval of the version to be published; **Heinrich Iro**, conception and design of the study, acquisition of data, critical revision, final approval of the version to be published; **Michael Koch**, conception and design, interpretation of data, critical revision, final approval of the version to be published.

Disclosures

Competing interests: None.

Sponsorships: None.

Funding source: None.

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