
CASE REPORT

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BILATERAL VOCAL FOLD PARESIS AFTER ENDOSCOPIC STAPLING DIVERTICULOTOMY FOR ZENKER'S DIVERTICULUM

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Abstract: *Background.* Zenker's diverticulum may be treated with a variety of surgical techniques. Endoscopic methods, specifically endoscopic stapling diverticulotomy, have gained increasing acceptance because of shorter operative times, decreased morbidity, with shorter hospital stays and time to resumption of oral feedings.

Methods and Results. We report the occurrence of bilateral vocal fold paresis after endoscopic stapling diverticulotomy for Zenker's diverticulum, previously unreported in the literature. This complication likely resulted from traction on the recurrent laryngeal nerves secondary to unfavorable patient anatomy.

Conclusions. Endoscopic stapling diverticulotomy is a safe and effective treatment method for Zenker's diverticulum and remains our procedure of choice for most patients. However, inability to safely expose the diverticulum endoscopically results in a significant abandonment rate for attempted procedures and may result in significant postoperative complications. © 2004 Wiley Periodicals, Inc. *Head Neck* 26: 294–297, 2004

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Zenker's diverticulum is a pharyngoesophageal diverticulum resulting from protrusion of the pharyngeal mucosa through an area of muscular

weakness in the posterior pharyngoesophageal wall. This area of weakness, bounded by the inferior constrictor muscles of the pharynx and the cricopharyngeal muscle, has been termed Killian's dehiscence. Although the primary abnormality that leads to the development of Zenker's diverticulum remains an area of debate, abnormalities of the cricopharyngeus muscle seem to play an important role.

Zenker's diverticula typically are seen in the sixth to ninth decades of life with long-standing dysphagia, often of insidious onset. Men are affected two to three times more commonly than women. Retention of food in the diverticulum may result in regurgitation of undigested food. As the pouch enlarges, encroachment on the true esophageal lumen results in worsening symptoms of esophageal obstruction.

Although attempts at medical management have been made, such as botulinum toxin (Botox; Allergan Inc., Irvine, CA) injection, the management of Zenker's diverticulum remains surgical. The surgical correction of Zenker's diverticulum can be performed by either open or endoscopic approaches. Open diverticulectomy with cricopharyngeal myotomy has traditionally been consid-

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ered the “gold standard.” Diverticulopexy with cricopharyngeal myotomy has been advocated for high-risk patients.¹ Less commonly used open approaches include the two-stage operation with formation of a cervical esophagostomy and later closure, the inversion technique, and cricopharyngeal myotomy alone.

Recently, endoscopic approaches have been gaining popularity because of shorter operative times, hospital stays, and time to resumption of oral feedings. Mosher² provided the first description of the endoscopic approach in 1917, although he would later abandon this approach because of the incidence of postoperative complications, including mediastinitis. Dohlman and Mattson³ later popularized the endoscopic approach using diathermy and a bivalved esophageal speculum, now known as the Dohlman procedure. Collard et al⁴ subsequently introduced the endoscopic stapling technique in 1993, which is now the most widely used endoscopic method. Less commonly used endoscopic techniques include use of the carbon dioxide (CO₂) or KTP lasers and use of flexible endoscopy. Use of the endoscopic stapling technique is now widely accepted, with efficacy and safety similar to or superior to the open approach. As experience with this technique grows, optimum patient selection, technique, and incidence of postoperative complications will become clearer. We describe the occurrence of an unusual complication after endoscopic stapling diverticulotomy for Zenker’s diverticulum.

CASE REPORT

A 92-year-old man was referred to our institution for evaluation and treatment of a large Zenker’s diverticulum. The patient relayed a long-standing history of dysphagia with no clear date of onset. Over the year before his referral, he had generalized dysphagia for solids with immediate and delayed regurgitation of solid foods. His diet consisted entirely of liquids at the time of presentation, and he had a concomitant 20-pound weight loss. Despite the patient’s advanced age, he was found to be otherwise healthy and very functional in performing his activities of daily living. Review of the patient’s barium swallow examination confirmed the diagnosis of a large, 4-cm Zenker’s diverticulum, with some retained food particles within the pouch. The patient’s head and neck examination was generally unremarkable, with the exception of a visible inlet into the Zenker’s diverticulum seen on flexible laryngoscopy.

The patient was taken to the operating room for planned endoscopic stapling diverticulotomy. After induction of general anesthesia, the patient was placed in the standard Rose position for endoscopy. A direct laryngoscopy was performed using a small-caliber anterior commissure laryngoscope revealing a normal examination except for an approximately 3-cm mucosal bar separating a Zenker’s diverticulum from the esophageal lumen. Subsequent insertion of the Weerda diverticuloscope (Storz Medical AG, Kreuzlingen, Switzerland) was noted to be quite difficult secondary to cervical kyphosis and a large cervical osteophyte present just superior to the mucosal bar separating the diverticulum from the esophageal lumen. The difficulty arose in introducing the lower blade of the Weerda diverticuloscope into the diverticulum. To provide adequate exposure of the mucosal bar, the patient’s head position was changed from an extended to a flexed position. This maneuver allowed for more direct access to the neck of the diverticulum and more accurate placement of the lower blade of the Weerda diverticuloscope into the diverticulum and the upper blade down the native esophagus. The scope was then bivalved approximately 2.5 to 3.0 cm, exposing the entire depth of the diverticulum and party wall. An Ethicon endopath ETS 35-mm endoscopic stapling device (Ethicon EndoSurgery Cincinnati, OH) was then used to divide the diverticulum without difficulty. Inspection after this division showed the diverticulum to have been successfully decompressed into the native esophagus.

The procedure was then terminated, and the patient was transferred to the recovery room in stable condition. Initially the patient did well without significant complaints. However, approximately 1½ hours after the procedure, he and his family noted the onset of noisy breathing and increasing respiratory distress. Evaluation at that time noted biphasic stridor, and flexible laryngoscopy showed bilateral paramedian vocal folds. No movement of the vocal folds was appreciated at this initial evaluation. The patient was brought urgently back to the operating room, where a tracheotomy was performed without incident. Direct laryngoscopy was then performed, which showed bilateral vocal fold paresis, with normal passive motion of the vocal folds ruling out arytenoid subluxation and no evidence of subglottic disease or trauma.

Postoperatively, the patient had clinical evidence of aspiration on a bedside swallowing exam-

ination, and a three-phase swallowing examination revealed laryngeal penetration with mild aspiration when challenged with thick liquids, but a normal study with pureed material. There was no evidence of the preoperatively noted Zenker's diverticulum on this swallowing study. The patient's swallowing function rapidly improved and by postoperative day 5 he was tolerating a regular diet, which he had not been able to tolerate for years before the procedure. Repeat indirect laryngoscopy performed on postoperative day 8 showed nearly complete return of vocal fold function on the right, with a mobile but paretic left vocal fold. He was subsequently decannulated and discharged home on postoperative day 9. In subsequent follow-up, on postoperative day 14, the patient was doing well, tolerating a regular diet, and had complete return of vocal fold function.

DISCUSSION

The general trend in surgical management of Zenker's diverticulum has been toward less invasive approaches, generally with a coincident decrease in morbidity and mortality. Major complications of open diverticulectomy and cricopharyngeal myotomy include mediastinitis, bleeding, surgical emphysema, stricture formation, vocal cord paralysis, and death. Generally accepted complication rates from this approach include a morbidity of roughly 30%, with a 0% to 3% mortality rate.⁵ Subsequently, open diverticulopexy would gain favor, especially in high-risk patients, because of lower potential morbidity and decreased recovery time.¹

Although early attempts at endoscopic treatment were fraught with complications, recent refinements in available instruments have led to widespread acceptance of these techniques. Dohlman and Mattson³ described an endoscopic approach that uses division of the esophageal diverticular wall with a diathermic knife. In this series of more than 100 patients, there were no reported major complications. Bleeding was the most frequent complication after endoscopic treatment with either coagulation or CO₂ laser reported by Wouters and van Overbeek⁶ in their series of 544 patients. Subsequent reports have confirmed that bleeding represents the most frequent complication of these approaches and have also remarked on the occurrence of complications such as mediastinitis and transient unilateral vocal cord paresis.⁷

Endoscopic stapling diverticulotomy has been increasingly used as the treatment of choice for

Zenker's diverticulum. This seems to offer the advantage of shorter operative times and decreased morbidity. Theoretically, the endoscopic stapling devices should prevent significant bleeding or mediastinitis by sealing the diverticular esophageal wall as it is divided. The incidence of postoperative complications with this technique seems favorable compared with other techniques and is becoming more clearly defined as the use of this technique has increased. Indeed, abandonment of the procedure because of inability to adequately expose the diverticulum and insert the diverticuloscope seems to be the most frequent adverse event associated with attempts at endoscopic stapling diverticulotomy. The abandonment rate in reported series ranges from 5% to 30%.⁸⁻¹² Scher and Richtsmeier⁸ report a series of 36 patients, with significant complications including an accidental perforation of the esophagus with the stapling device, as well as a transient unilateral vocal fold paresis. This paresis was attributed to pressure on the posterior larynx by the Weerda diverticuloscope. Philippsen et al⁹ concluded that the endoscopic stapling technique should be the procedure of choice for most patients with Zenker's diverticulum after reviewing their experience with 14 patients. They report an abandonment rate of 20% with no postoperative complications. Smith et al¹⁰ report one case of mild postoperative bleeding that resolved spontaneously in their series of 16 patients. Raut and Primrose¹¹ describe one case of cervical abscess after a mucosal tear and one esophageal perforation in their series of 23 procedures. Other case reports have described esophageal leaks with specific stapler cartridges¹³ and delayed esophageal perforation.¹⁴

We report the occurrence of a transient bilateral vocal fold paresis after endoscopic stapling diverticulotomy for Zenker's diverticulum. This complication has not been previously reported in the literature. We believe this complication to have resulted from traction on the recurrent laryngeal nerves caused by the head position used to expose the diverticulum coupled with upward displacement of the larynx. Unilateral and bilateral vocal fold paresis as a complication of surgery unrelated to the neck are well described, with the focus of blame often falling on the endotracheal tube cuff. Hahn et al¹⁵ postulated that compression of the recurrent laryngeal nerve against the laryngeal wall could result in compression injury of recurrent laryngeal nerve endings. Subsequent detailed studies including careful cadaveric dissection have confirmed that the anterior (adductor) branch is at

particular risk as it travels medial to the thyroid cartilage and lateral to the arytenoids.^{16,17} Therefore, an endotracheal tube cuff inflated just distal to the true vocal cords could cause a compression injury to the recurrent laryngeal nerves intralaryngeally. The large degree of variability in the distribution of the anterior and posterior branches of the recurrent laryngeal nerve, as described by the Sunderland and Swaney,¹⁸ make identification of the site of injury on the basis of vocal fold position unreliable at best. In this case report, although impossible to discern the exact mechanism of injury to the recurrent laryngeal nerves, we believe that a traction injury occurred because of the unusual flexed head position that needed to be used to optimally expose the diverticulum. It was clearly noted that with the change of the head position during the procedure that the endotracheal tube was located well below the cords and approximately 2 cm above the carina, ruling out Hahn's described mechanism of injury. In addition, by bivalving the Weerda scope with the head in a flexed position, the larynx was not only lifted anteriorly but also rotated inferiorly. We believe this additional inferior rotation resulted in undue traction to both recurrent laryngeal nerves and resulted in the noted transient bilateral vocal fold paresis.

This complication highlights the importance of proper patient selection when electing an approach for management of Zenker's diverticulum. Inability to safely and easily expose the diverticulum in the standard position used in endoscopy should be considered a contraindication to the endoscopic stapling diverticulotomy. Complications such as this caused by difficulty with visualization, coupled with the relatively high abandonment rate in the literature, make it clear that the endoscopic stapling technique has not completely replaced other approaches for the management of Zenker's diverticulum. Nevertheless, the shorter operative times, decreased morbidity, and quicker recovery time continue to make the endoscopic stapling method our procedure of choice for most patients.

REFERENCE

1. Konowitz PM, Biller HF. Diverticulopexy and cricopharyngeal myotomy: treatment for the high-risk patient with a pharyngoesophageal (Zenker's) diverticulum. *Otolaryngol Head Neck Surg* 1989;100:146–153.
2. Mosher HP. Webs and pouches of the oesophagus, their diagnosis and treatment. *Surg Gynecol Obstet* 1917;25:175–187.
3. Dohlman G, Mattson O. The endoscopic operation for hypopharyngeal diverticula. *Arch Otolaryngol* 1960;71:744–752.
4. Collard JM, Otte JB, Kestens PJ. Endoscopic stapling technique of esophagodiverticulostomy for Zenker's diverticulum. *Ann Thorac Surg* 1993;56:573–576.
5. Cummings C, Frederickson J, Harker L, Krause C, Richardson M, Schuller D. *Otolaryngology, head and neck surgery*. St. Louis: Mosby-Year Book, Inc.; 1998. 3927 pp.
6. Wouters B, van Overbeek JJM. Endoscopic treatment of the hypopharyngeal (Zenker's) diverticulum. *Hepatogastroenterology* 1992;39:105–108.
7. Mattinger C, Hormann K. Endoscopic diverticulotomy of Zenker's diverticulum: management and complications. *Dysphagia* 2002;17:34–39.
8. Scher R, Richtsmeier W. Long-term experience with endoscopic staple-assisted esophagodiverticulostomy for Zenker's diverticulum. *Laryngoscope* 1998;108:200–205.
9. Philippsen L, Weisberger E, Whiteman T, Schmidt J. Endoscopic stapled diverticulotomy: treatment of choice for Zenker's diverticulum. *Laryngoscope* 2000;110:1283–1286.
10. Smith S, Genden E, Urken M. Endoscopic stapling technique for the treatment of Zenker diverticulum vs. Standard open-neck technique. *Arch Otolaryngol Head Neck Surg* 2002;128:141–144.
11. Raut V, Primrose W. Long-term results of endoscopic stapling diverticulotomy for pharyngeal pouches. *Otolaryngol Head Neck Surg* 2002;127:225–229.
12. Thaler E, Weber R, Goldberg A, Weinstein G. Feasibility and outcome of endoscopic staple-assisted esophagodiverticulostomy for Zenker's diverticulum. *Laryngoscope* 2001;111:1506–1508.
13. Richtsmeier W, Monzon J. Postendoscopic Zenker esophagodiverticulostomy leaks associated with a specific stapler cartridge. *Arch Otolaryngol Head Neck Surg* 2002;128:137–140.
14. Nix P. Delayed oesophageal perforation following endoscopic stapling of a pharyngeal pouch. *J Laryngol Otol* 2001;115:668–669.
15. Hahn FW Jr, Martin JT, Lillie JC. Vocal-cord paralysis with endotracheal intubation. *Arch Otolaryngol* 1970;92:226–229.
16. Cavo JW Jr. True vocal cord paralysis following intubation. *Laryngoscope* 1985;95:1352–1359.
17. Brandwein M, Abramson AL, Shikowitz M. Bilateral vocal cord paralysis following endotracheal intubation. *Arch Otolaryngol Head Neck Surg* 1986;112:877–882.
18. Sunderland S, Swaney W. The intraneural topography of the recurrent laryngeal nerve in man. *Anat Rec* 1952;114:411–426.