11 Endoscopic and Surgical Management of Zenker's Diverticulum: New Approaches

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11.1 Introduction

Zenker's diverticulum (ZD) is a posterior pharyngoesophageal pouch that forms through pulsion forces in an area of relative hypopharyngeal wall weakness between the oblique fibers of the inferior pharyngeal constrictor and the horizontal fibers of the cricopharyngeus (CP) muscles [1]. Poor upper esophageal sphincter (UES) compliance has been regarded as the main pathophysiologic mechanism. This dysfunction creates a high-pressure zone eventuating in increased pulsion forces and subsequent ZD formation. This entity most commonly presents in the elderly and can be associated with a plethora of potential symptoms, of which dysphagia is most common.

11.2 Pathophysiology

Although a complete understanding of the pathogenesis of ZD has not yet been reached, it is generally accepted that ZD is likely to be a multifactorial disorder. The noncompliant cricopharyngeal muscle shows structural changes in terms of histological reduction in muscle component combined with qualitative fiber alterations,

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increase in fibrotic tissue, and significant increase of the collagen to elastin ratio. The aging process might play a role because of the loss of tissue elasticity and the decrease in muscle tone [1].

The hypothesized mechanisms relate to increased intraluminal pressure leading to an outpouching in the triangle of Killian, an area of relative wall weakness located posteriorly in the hypopharynx between two strong muscles, the CP and the inferior pharyngeal constrictor. This posterior pouch includes only mucosa and submucosa, so that ZD should be considered as a pseudodiverticulum.

The forces that determine this dehiscence are less clear. Accurate manometric measurements are difficult to achieve. The most likely mechanism proposed is decreased compliance of the UES with failure to open completely and a subsequent increase in the hypopharyngeal pressure gradient. It should be noted that this change in compliance is not equivalent to a change in UES pressure, which has been inconsistently shown.

Other contributing factors include an increase in intrabolus pressure due to the stiffness of the CP and hypopharynx. Finally, some investigators have also variably demonstrated incoordination of pharyngeal contraction and UES opening.

11.3 Symptoms and Diagnosis

Zenker's diverticula typically present in middle-aged adults and elderly individuals, especially during the seventh and eighth decades of life. It occurs predominately in men, and the overall prevalence of ZD among the general population is believed to be between 0.01 and 0.11 % [1]. The incidence varies based on region, being more common in Northern than Southern Europe. It has been described more frequently in the United States, Canada, and Australia than in Japan and Indonesia. It is unclear if these differences in prevalence reflect differences in longevity or anatomical differences between geographic areas. However, although Zenker's diverticula are the most common type that cause symptoms, its incidence and prevalence may be underestimated as many diverticula may remain clinically silent and many elderly patients with small pouches and minimal symptoms may not seek medical advice.

The vast majority of patients complain of dysphagia and regurgitation. Cervical borborygmus is almost pathognomonic of ZD. As dysphagia increases, symptoms become more severe with resultant weight loss and malnutrition. Hoarseness, cough, and aspiration pneumonia have also been described. Regurgitation of undigested foods and halitosis may occur because of stasis of food in the pouch.

In most cases, the diagnosis of ZD is suspected based on clinical symptoms and confirmed by contrast esophagography.

11.4 Surgical Treatment

Many experts still consider open surgery as the standard management of symptomatic ZD. However, clinically relevant adverse events are associated with open diverticulectomy, including mediastinitis, recurrent laryngeal nerve injury, esophageal stricture, fistula, esophageal perforation, hematoma, wound infection, pneumonia, and even death, with an 11 % median incidence of major morbidity [1].

In a pilot study, we showed for the first time the feasibility of a robot-assisted left transaxillary approach for the surgical management of ZD [2]. The patient was placed supine under general anesthesia. Similarly to transaxillary robotic thyroidectomy, the neck was slightly extended, and the left arm was raised and fixed to obtain the shortest distance from the axilla to the anterior neck. Under direct vision, a 4–5 cm skin incision was made in the left axilla, and the subplatysmal skin flap from the axilla to the anterior neck area was dissected over the anterior surface of the pectoralis major muscle using the Johann grasper or a monopolar electrical cautery. Next, to maintain adequate working space, an external retractor was inserted through the skin incision in the axilla. A suction tube was connected in order to avoid field fogging. The myocutaneous flap was raised until the sternal and clavicular heads of the sternocleidomastoideus muscle were visualized; then the dissection continued through the two sternocleidomastoideus branches. Next, the external retractor placed beneath the strap muscle was replaced with a larger one to obtain an adequate working space. Robotic docking was then performed. Four robotic arms were used during the operation, all through the axillary incision. The dual-channel endoscope was placed on the central arm, and the Harmonic curved shears together with the Maryland dissector were placed on the right side of the scope. ProGrasp forceps were inserted on the left side of the scope. All vessel dissections were performed using the Harmonic curved shears. Under robotic guidance, the thyroid was drawn medially by the ProGrasp forceps in order to identify and spare the inferior thyroid artery and the inferior laryngeal nerve. It was necessary to cut the middle thyroid vein in all cases and the omohyoid muscle in two cases. The prevertebral fascia was identified and the diverticulum isolated. Under endoscopic control, the loose connective tissue surrounding the pouch was dissected to identify the neck of the diverticulum on the posterior pharyngeal wall (Fig. 11.1). The neck was fully exposed by tractioning the diverticulum to the left with the Maryland dissector (Fig. 11.2). A complete myotomy was then performed with a robotic monopolar hook allowing dissection and resection: the myotomy included the cricopharyngeal muscle and the first 5 cm of the circular layer of the cervical esophagus. Then a surgical linear stapler (Endopath RTS-FLEX Endoscopic Articulating Linear Cutter 35 mm; Ethicon Endo-Surgery, LLC) with a blue cartridge was inserted through the axilla and applied to the neck of the diverticulum (Fig. 11.3). The complete diverticulum removal was endoscopically confirmed. Intravenous

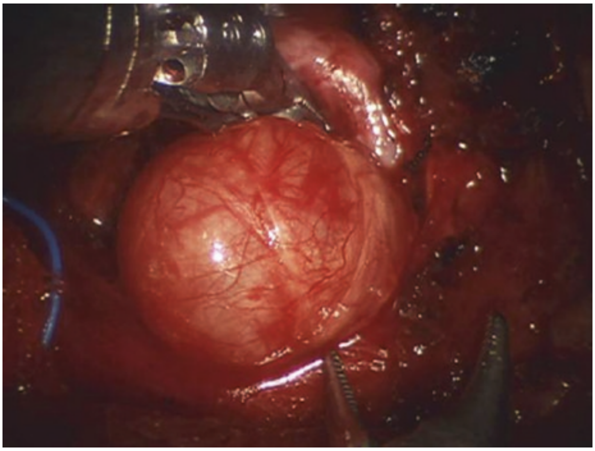

Fig. 11.1 Isolation and exposition of the diverticulum under endoscopic control

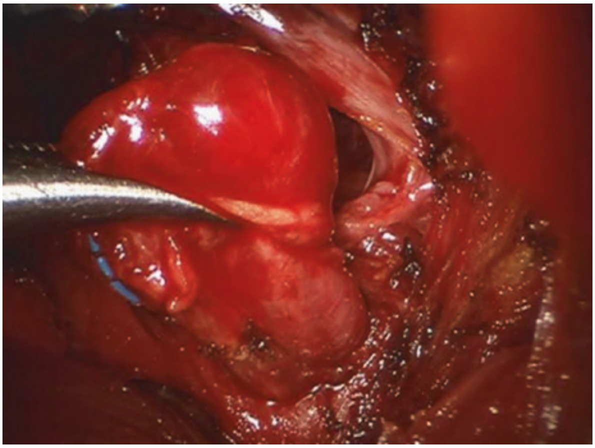

Fig. 11.2 The neck has been isolated and the diverticulum is fully exposed

broad-spectrum antibiotics were administered for 72 h after intervention. The advantages afforded by robotic technology could contribute to prevent both transient and definitive palsy of the recurrent laryngeal nerve and to render the crico-pharyngeal myotomy safer with sparing of the esophageal mucosa. In our preliminary series, no relevant complication was registered. These preliminary results are encouraging, but we acknowledge that the robot-assisted transaxillary Zenker's diverticulectomy is a technically demanding procedure. Skill in thyroid and robotic surgery is required, as well as in esophageal surgery. Enthusiasm must be tempered by caution, and our results need to be confirmed in larger patient cohorts.

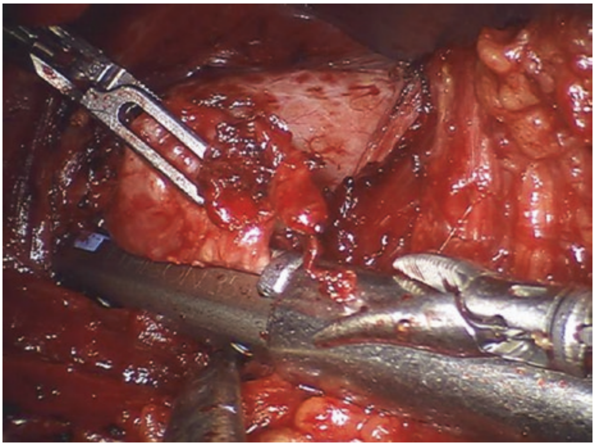

Fig. 11.3 The surgical linear stapler has been applied to the neck of the diverticulum

11.5 Endoscopic Treatment

The open surgical approach is associated with adverse events, including fistulae and infection. A transoral approach lessens these risks by avoiding an incision. In experienced hands, flexible or rigid endoscopic diverticulotomy is currently considered as a first-choice option in the management of ZD because it gives symptom relief comparable to open surgical diverticulectomy with less morbidity, shorter hospital stay, and, in the case of a flexible endoscopic approach, without the need of general anesthesia.

Rigid endoscopic diverticulectomy is carried out by dividing the common wall with a rigid diverticuloscope. The methods adopted to divide the common wall have evolved from electrocautery to carbon dioxide laser therapy to the now more commonly performed stapling [1].

Flexible endoscopy shares the same principles as rigid endoscopy: it consists of dividing the septum thus creating a common cavity. However, the technique still needs to be standardized because a variety of different modalities and endoscopic devices have been used, including freehand cut, guidewire-assisted and diverticuloscope-assisted myotomy, argon plasma coagulation, monopolar forceps, and needle knife for cutting the septum [3–10]. In this line, three different needles have been used: a standard needle knife [5], the hook knife [6] (Fig. 11.4), and most recently the IT knife 2 [7] (Fig. 11.5). Flexible endoscopic treatment of ZD can be performed in deep sedation with propofol or under general anesthesia and endotracheal intubation according to local practice. Antibiotic prophylaxis is recommended in high-risk patients. A soft diverticuloscope (ZD overtube; Cook Endoscopy, Winston – Salem, North Carolina, USA) (Fig. 11.6) permits to expose, stretch, and fix the septum (Fig. 11.7). It has two distal flaps of 40 and 30 mm that protect the anterior esophageal and posterior diverticular wall, respectively. The

Fig. 11.4 The hook knife (Olympus Co., Ltd)

Fig. 11.5 IT knife 2 (Olympus Co., Ltd.)

Fig. 11.6 Diverticuloscope (ZD overtube; Cook Endoscopy)

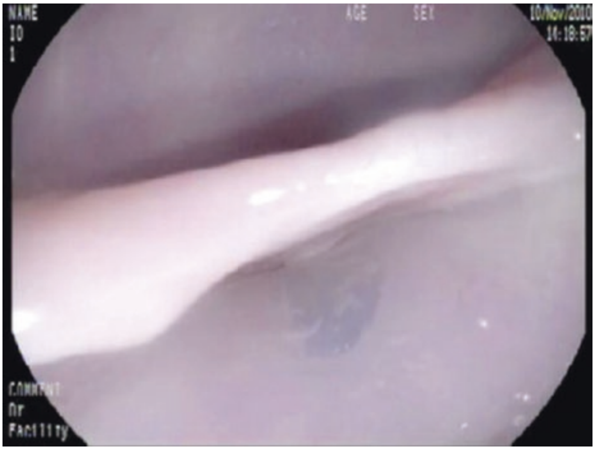

Fig. 11.7 Septum exposure with diverticuloscope

overtube is advanced over the endoscope up to a black marker indicating the average distance between the septum and teeth line. Under endoscopic vision, the septum is displayed [5]. Once the septum is properly exposed, different cutting methods can be applied. Myotomy can be done using standard needle knife, monopolar forceps, argon plasma coagulation, hook knife, or, most recently, IT knife 2 [3–10]. IT knife 2 seems to guarantee a more precise cut compared with other devices, allowing a more stable position by putting the insulated rounded tip on the septum of the diverticulum and cutting it toward a caudal direction (Figs. 11.8 and 11.9). In our study [7], 21 procedures in 19 patients were performed registering two dysphagia recurrences (in the first two cases) and no complications.

Fig. 11.8 Cut of the septum with IT knife 2

Fig. 11.9 Completion of myotomy

Conclusions

The flexible endoscopic procedure is simpler and less costly than the surgical procedure, particularly when the robotic option is considered, and the median hospital stay is shorter (3 days vs. 7 days at our institution). However, for large-size (>6 cm) diverticula, we still regard the surgical option as more effective and still preferable, unless the patient is unfit for surgery.

In conclusion, flexible endoscopic treatment of ZD seems/appears effective and safe, the choice between different options depending on local expertise and availability of advanced techniques.

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