Diagnosis and Evaluation of Hypopharyngeal Diverticula

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David Myssiorek and Laurie Wennerholm

Introduction

Hypopharyngeal diverticula are uncommon. Their incidence has been estimated to be 2/100,000 in the United States [1]. They tend to be more prevalent in men with a male to female estimated ratio of 1.5–1 [2]. There appears to be a different incidence geographically as well. Northern Europeans are more prone to Zenker diverticula (ZD) than southern Europeans. Compared to the United States, Canada, and Australia, the incidence is much lower in Japan and Indonesia [3]. While the most common presentation is during the seventh to eighth decades, ZD have been found throughout adulthood. Perhaps there may be genetic contributions as there have been reports of hypopharyngeal diverticula occurring in families [4, 5].

As covered elsewhere in this book, there are two types of diverticula of the hypopharynx: pulsion and traction. Traction diverticula were associated with tuberculosis and retropharyngeal adenopathy in the past but more recently have been most commonly associated with anterior surgical approaches for cervical spine disease [6]. Adhesion of the posterior pharynx to the cervical spine hardware can lead to development of a diverticulum. In extreme cases, the hardware and screws can be found within the traction sac (Fig. 3.1). Since they are traction diverticula, they are represented by all three layers of the posterior wall of the hypopharynx. While less common, they must be suspected during the evaluation of any hypopharyngeal diverticulum.

D. Myssiorek (✉)
Jacobi Medical Center, Bronx, NY, USA

Department of Otolaryngology, Albert Einstein College of Medicine, Bronx, NY, USA

L. Wennerholm
Speech Pathology and Swallowing Center for Cancer Care, White Plains Hospital/Montefiore Health System, White Plains, NY, USA
e-mail: Lwennerhol@wphospital.org

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Fig. 3.1 Traction diverticulum secondary to surgery for cervical spine injury

History

All hypopharyngeal diverticula present similarly. The patient most commonly presents with dysphagia. Some patients may be referred for an incidental finding of a diverticulum found during a flexible esophagoscopy performed for other causes. Computed tomographic imaging for unassociated pathology may detect a diverticulum. In obtaining a history, the patient's age, sex, and heredity may raise the suspicion of a hypopharyngeal diverticulum.

Regurgitation of undigested food is the sine qua non for Zenker diverticulum. Gurgling is a prominent complaint and can sometimes be heard while the patient sleeps. Other symptoms include weight loss, excessive throat mucus and throat clearing, coughing, and halitosis. Symptoms may be of recent onset or be present for years. A history of previous cervical surgery or transmural infections of the esophagus is easily obtained. Prior surgery of the thyroid and parathyroid glands, carotid arterial system or larynx should be sought. These will impact potential open approaches to a diverticulum. Currently it is unclear if gastroesophageal reflux is causal with regard to hypopharyngeal diverticula, but patients should be questioned about this possibility as it could certainly impact posttreatment symptom relief.

Physical Examination

A routine physical examination of the head and neck should be performed. Attention to dentition, jaw excursion, and any other obstructions in the oral cavity or oropharynx needs to be recorded. Loose or broken teeth require addressing

especially when considering endoscopic treatment of ZD. If the patient is to undergo transoral treatment of their diverticulum, some dentists can create a custom-fitting dental guard. The benefit of this device is that it can be used to protect the upper teeth from excessive force from the endoscope. It will usually have a lower profile than the dental guards available in most operating theaters.

Reduced jaw excursions may make transoral treatment difficult to impossible. Certain patients with stocky necks do not have jaw excursion wide enough to admit a rigid laryngoscope but may admit a flexible scope. Therefore, examination of the jaw and neck is essential to determining operability of some patients. Neck range of motion requires examination. Severely kyphotic patients will not permit placement of rigid endoscopes for transoral treatment (Fig. 3.2). This condition is not correctable with anesthetic relaxation.

Visualization of the hypopharynx should be performed but rarely adds to the diagnosis. However, vocal fold mobility is assessed which is particularly important if an open procedure is entertained. Frequently, mucus pooling in the hypopharynx is visualized. This may clear with swallowing, but then quickly reappears due to collection in the diverticulum. Rarely, the orifice of the diverticulum can be visualized in an office setting, especially with non-Zenker diverticula, since the diverticular opening is inferior to the cricopharyngeal muscle.

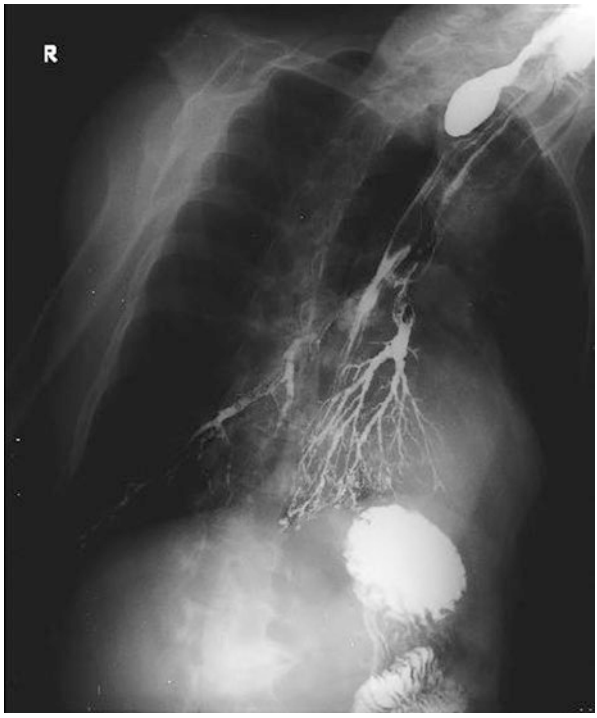

Fig. 3.2 Kyphotic patient with a Zenker diverticulum

Diagnosis

Radiologic Imaging

Establishment of the diagnosis of a hypopharyngeal diverticulum is confirmed with radiologic imaging. The gold standard is a barium esophagram with cine-esophagography (Fig. 3.3). Some patients aspirate during these studies (Fig. 3.4). For this reason, barium is preferred over water-soluble agents such as gastrografin. Gastrografin is caustic to lung tissue and should be avoided. The diverticulum is identified, its size is determined, and the size of the diverticular opening is assessed. It is critical to determine the position of the diverticulum in the event that an open

Fig. 3.3 Esophagram of large Zenker diverticulum, sagittal or lateral view

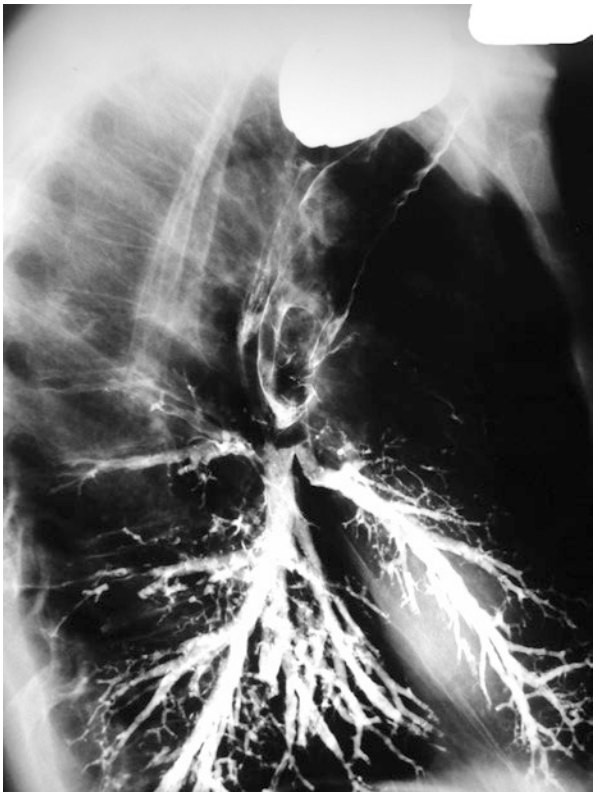

Fig. 3.4 Esophagram revealing aspiration of contrast

procedure is elected. Approximately 10% of ZD present on the right side (Fig. 3.5). More importantly, the relationship of the cricopharyngeal muscle relative to the neck of the diverticulum is essential. If the cricopharyngeal muscle is above the neck of the diverticulum, then it is not a ZD (Fig. 3.6a, b). A diverticulum that localizes below the cricopharyngeal muscle should be examined in the AP and lateral projection. In the AP projection, the diverticulum may be seen lateral to the esophagus which would be consistent with a Killian-Jamieson diverticulum. If it is imaged well in the lateral projection, and below the cricopharyngeal muscle, it is a rare Laimer diverticulum. This obviously would impact treatment and is covered elsewhere in this book.

A classic ZD will be found at the midline, at the pharyngoesophageal junction (Fig. 3.7). The classic view is the lateral view which will demonstrate the sac at approximately the level of the fifth and sixth cervical vertebrae. Cine-esophagography will reveal a narrow esophagus immediately anterior to and below the opening of the ZD. As the diverticula expand, they lateralize to the left approximately 90% of the time. Uncommonly, a large diverticulum will sequester the entire bolus of barium preventing evaluation of the esophagus unless more

Fig. 3.5 Esophagram, AP view of a Zenker diverticulum presenting on the right side

barium is delivered. Smaller diverticula may not be imaged adequately if they are superimposed on the esophageal barium bolus. An experienced radiologist will rotate the patient slightly to an oblique plane to better visualize small diverticula. Although rare, cancers found in ZD can present as an irregularity of the sac lumen on the lateral projection. Most institutions perform videofluoroscopy making review of the study easier. Downstream observation of the study may show other intrinsic abnormalities of the esophagus including dysmotility and distal strictures.

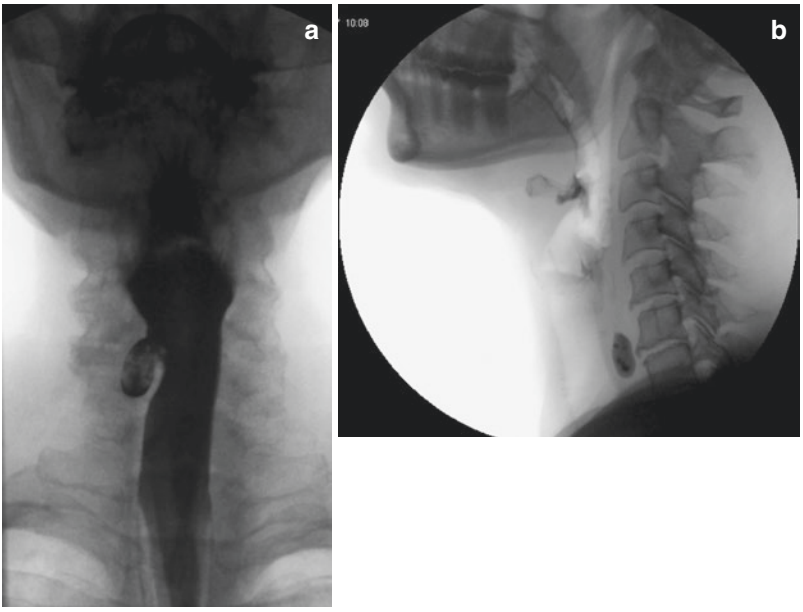

Fig. 3.6 (**a**) Reverse barium esophagram of a Killian-Jamieson diverticulum presenting laterally. (**b**) Sagittal view of same patient

Fig. 3.7 Esophagram of a classic Zenker diverticulum

Fig. 3.8 Computed tomogram of a Zenker diverticulum filled with gas and debris. The esophagus is outlined between the diverticulum and the posterior trachea

Computed tomographic scanning (CT) is not usually used for diagnosis of ZD but may be useful for KJD. Asymptomatic patients being imaged for other entities of the thorax and neck may incidentally identify a ZD. The diverticulum will contain particulate matter and gas. It localizes between the spine and the esophagus (Fig. 3.8). Since the trachea and larynx are anterior to the esophagus, the esophagus can be visualized between two air-filled cavities. This air contrast can show a thickened upper esophagus indenting the trachea and suggesting the thickness of the upper esophageal sphincter. If there is evidence of cancer in the sac, CT scanning will help delineate local involvement and adenopathy.

Ultrasound has been used to detect ZD, although it is not currently recommended for routine clinical assessment. Ultrasound contrast agent is ingested by the patient, and the patient is scanned. At this time, oral use of SonoVue (Bracco, Milan, Italy) is off label. As expected, the diverticulum appears posterior to the hypopharynx and esophagus and retains contrast for greater than 3 min [7]. The procedure can be performed without the need for a radiology suite, and the patient is not exposed to radiation. However, the study does not offer the detail of a barium study and cannot visualize the position of a diverticulum relative to the cricopharyngeal muscle. The images are not as easily interpreted during operative treatment of hypopharyngeal diverticula.

Scintigraphy of ZD has been employed. Scintigraphy has been used to evaluate esophageal motility issues. Valenza et al. compared scintigraphic identification of ZD to barium studies [8]. Technetium-99m colloid was swallowed as a bolus, and the patient was imaged. Ninety-four percent of the patients studied were correctly identified. The authors claimed that the study was less costly, exposed the patient to less radiation, and was better tolerated by elderly patients than either barium studies or manometry. However, the images offer less detail and are difficult to interpret with regard to the other hypopharyngeal diverticula.

The authors highly recommend bringing the images of the barium radiographic study to the operating theater in all cases of operative management. Sidedness of the

sac and the size of the diverticular orifice compared to the esophageal inlet are critical when endoscopically approaching these diverticula for treatment.

Manometry

Esophageal manometry is an important tool in evaluating esophageal motility. It does have limited application in evaluating hypopharyngeal diverticula [9]. In a study by Broll et al., after myotomy and sac excision of ZD, preoperative manometric pressure was decreased [10]. Ishioka et al. studied five patients with ZD evaluated manometrically before and after endoscopic treatment [11]. The mean pressure of the upper esophageal sphincter preoperatively was 54.6 cm water with a length of 3 cm. Post-diverticulotomy, that pressure decreased to 26.8 cm of water [12]. In another study, following transoral treatment of ZD, 30 patients had a significant drop in mean resting pressure of the cricopharyngeal muscle [13]. From a starting pressure of 16.23 mmHg, on average it fell to 9.26 mmHg. The intrabolus pressure at the cricopharyngeal muscle decreased from 22.48 to 10.16 mmHg.

While these studies add to our knowledge of the pathophysiology of ZD and our ability to predict outcomes, they do not add to the diagnostic evaluation of hypopharyngeal diverticula. Therefore, they are not currently recommended in the evaluation of these diverticula.

Diverticula and the Speech-Language Pathologist

In the 1980s the speech-language pathologist (SLP) became one of the main professionals responsible for the evaluation and treatment of dysphagia, specifically oropharyngeal dysphagia [14]. Since then, for decades, the SLP has worked in conjunction with the otolaryngologist and gastroenterologist to determine the nature and location of the swallowing deficit.

The two most common methods for the SLP to use to visualize the swallow are the modified barium swallow study (MBSS) and the fiber-optic endoscopic evaluation of swallow (FEES). The MBSS was created by Jeri Logemann and her colleagues by "flipping up" the image of an esophagram to view the oropharyngeal swallow and the cervical esophagus [12]. The test is performed in real time and differs from the barium swallow in that it is not a series of still images.

The FEES was created by Susan Langmore [14] to improve portability of formal swallowing evaluations using a flexible laryngoscope to view the endolarynx and its surrounding tissues. The SLP endoscopist views the path of the bolus and patterns of residue, while the patient is swallowing green- or blue-dyed food stuffs. Together with the patients' symptoms, imaging like the MBS and FEES reveals a variety of oral, pharyngeal, and esophageal phase disorders. There are specific findings on each exam that aid in the diagnosis of the ZD, such as residual bolus in the vallecula signalling deficits in tongue base to posterior pharyngeal wall contact.

Early symptomatology may be vague and nonspecific, "Something sticks in my throat." This is consistent with a symptom that accompanies many pharyngeal or esophageal issues from reflux to pharyngeal and esophageal dysfunction. A

cricopharyngeal bar may obstruct flow of pills during swallowing and may be a sign of an early ZD. As the pouch becomes larger, the patient may complain that food sticks in the throat and it may be regurgitated (especially if the patient bends at the waist) [15]. In addition, the patient may complain of dysgeusia, an intermittent bad taste in the mouth as well as halitosis.

MBSS or videofluoroscopic evaluation of the swallow can provide extremely useful information about the size and impact of a ZD on swallowing physiology [16, 17]. On MBSS, in the lateral plane, the oropharyngeal swallow may be intact, with a bolus collection that forms a barium-filled pouch in the region of the hypopharynx/cricopharyngeus. Depending upon the size of the pouch and depth, the pouch may empty after the swallow and then fill again during the next swallow. In fact, according to Sydow et al., most material that accumulates will exit upward through the defect's inlet and reenter the hypopharynx eliciting a secondary swallow [18]. If the pouch becomes filled to capacity, it will be partially or completely aspirated after the swallow.

ZD are not common reasons for most patients' dysphagia. With prevalence between 0.01 and 0.11%, less experienced SLPs may not connect the clinical signs and reported symptoms with imaging findings to reveal the defect. One reason is the inferior location of the pouch. The laryngopharynx contracts and raises two to three vertebral levels of height during the swallow and then falls within 1–2 s [19]. Since the ZD is at the level or below the CP, the pouch may not be easily viewed. Placing a patient in a lateral oblique view to eliminate shoulder obstruction can significantly improve the view and reveal the ZD [15].

Another hallmark sign that a ZD may be present on an MBSS is a pattern of post swallow "refilling" of the distal pharynx in the absence of retention in the proximal pharynx. For example, a patient who has delayed post-swallow leakage of material from the valleculae to the pyriform sinuses may have reduced tongue base retraction and clearance of the valleculae on swallow offset. However, the patient with a ZD would have no such pattern of top to bottom spillage. According to Coyle, the SLP may focus too closely on the airway and miss aspiration originating from an inferior and lateral source, that being a ZD [15]. One final sign of a possible ZD on videofluoroscopic swallow evaluation is post-swallow aspiration that does not have a clear origin.

Vaezi indicated that endoscopy will not contribute to diagnosis of diverticulum and may place a patient at risk for perforation of the pouch [16]. In addition, Perie and colleagues noted that direct viewing of the diverticulum is difficult on endoscopy in that the structures are collapsed upon each other at rest and in swallowing [20]. The pouch may reside lower than the endoscope allows. However, in their study, a group of 12 patients demonstrated a manifestation of a ZD on endoscopy that aided in differential diagnosis. Patients were seen for FEES and viewed while ingesting a cream bolus. Authors described the "sign of the rising tide" as a manifestation of a ZD during which the bolus completely clears the pharynx and several seconds later reappears. Authors confirmed the diagnosis via the standard fluoroscopic study. Of note, this was found to be a specific sign for ZD, and it was not present after surgical diverticulectomy.

Unlike oral and pharyngeal phase swallowing disorders that result from stroke or head and neck cancer, muscular strengthening exercises may not be appropriate in cases of diverticula, and they oftentimes require surgical intervention. However, consistency modification, postures, and maneuvers that can be outlined by an SLP as well as counseling can reduce a patient's aspiration risk and improve feeding quality [15, 21]. In their study, Holmes and colleagues found that SLPs were able to reduce risk of aspiration in patients with diverticula using liquid or solid modification and swallowing strategies. Coyle outlined the use of head rotation and increased bolus volume as behavioral techniques to improve clearance of the ZD, thereby reducing the residual in the pouch and the risk of large-volume aspiration. Typically, in head rotation, the patient is cued to turn the head to the damaged hemipharynx to divert the bolus down the stronger hemipharynx [22]. Another outcome of head rotation as determined by manometry is that it lowers the resting pressure of the UES and delays UES closing. In head rotation, the patient benefits from reduced resistance to bolus flow from the upper sphincter as well as a lengthier duration of esophageal opening [23]. These combined effects can enhance pharyngoesophageal clearance and aid in the behavioral emptying of a ZD. There are occasions when the patient may actually benefit from a head rotation to the stronger side. Coyle suggests trialing head rotation in both directions to assess benefit. Improvement would be determined by the height of the post-swallow residue within the pouch as compared to the pouch height. The higher the contrast level, the greater the risk for post-swallow aspiration. In addition to postural changes like head rotation and airway protection strategies, cued or deliberate cough and re-swallow can assist in providing greater clearance of a penetrant or aspirant. In practice, improving a patient's understanding of his/her need to cough and re-swallow can improve safety if this strategy is integrated into feeding tasks. Therefore, in select cases, behavioral interventions can be used in the treatment of ZD. This is particularly important if the patient is not appropriate for surgery. In these cases, the role of the SLP in the management of a patient with ZD becomes magnified, and he/she must have the tools to optimize function via traditional, behavioral techniques that, when used in combination, may have an impact on health status of the patient and his/her quality of life.

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