Pharyngeal Pouch (Zenker’s diverticulum) – a review

Simon Carr¹
MRCS DOHNS

Neeraj Sethi¹
MRCS DOHNS

Joseph Maung²
FRCS

Sanjai Sood¹
FRCS(ORL-HNS)

¹Bradford Royal Infirmary, Bradford
²Castlehill Hospital, Cottingham

Correspondence:
Sanjai Sood
Consultant Otolaryngologist-Head
and Neck Surgeon,
Bradford Royal Infirmary,
Duckworth Lane,
Bradford,
BD9 6RJ

Abstract
Pharyngeal pouches affect 2/100 000 of the population, usually occurring in the sixth and seventh decade. Typical symptoms include dysphagia, regurgitation, chronic cough, aspiration and weight loss. Despite several theories the aetiology remains unclear. The gold standard investigation is barium swallow. Treatment is surgical via either an open or endoscopic approach with endoscopic stapling being the most frequently employed procedure in the UK.

Keywords
Zenker diverticulum, Surgery, Endoscopy.

Introduction
The first anatomical description of a pharyngeal pouch was made by Ludlow in 1769, who described a preternatural dilatation formed in the pharynx.¹ It was made eponymous by Professor Friedrich Albert von Zenker in 1877.² In 1907 Killian later described the dehiscence in the posterior wall of the pharynx between the cricopharyngeus and thyropharyngeus muscles.³

The first reported successful resection of a pharyngeal pouch was by Wheeler in 1886.⁴ Since then, modification of the external resection technique has been described including diverticulectomy,⁵,⁶ diverticulopexy,⁷ diverticular inversion⁸ and cricopharyngeal myotomy.⁹

Endoscopic diverticulotomy was first described by Mosher in 1917,¹⁰ who introduced the principle of dividing the septum between the oesophagus and pouch. However his initial success was complicated by mediastinitis and death of his seventh patient. Dohlman¹¹ modified and repopularised the procedure in 1935 with the use of a specially designed double lipped hypopharyngoscope. He coagulated the septum between the oesophagus and pouch with insulated forceps and divided it using diathermy. Further modifications of the endoscopic method using the operating microscope and laser have been described by various authors.¹²,¹³ In 1993, endoscopic stapling diverticulotomy was introduced by Martin-Hirsch and Newbegin¹⁴ in the UK and by Collard et al in Belgium.¹⁵ This is now a well established method of treating pharyngeal pouches.

Anatomy
Essential to the understanding of pharyngeal pouch formation is the anatomy of Killian’s triangle (Figure 1).

The oblique fibres of the inferior constrictor (thyropharyngeus) muscle arise from the midline raphe forming the upper 2 sides of the triangle. The horizontal fibres of the cricopharyngeal muscle, which arises from the cricoid cartilage forms the base of the triangle. At this junction there is a natural weakness through which pharyngeal mucosa can herniate.³

Pathophysiology
The pathophysiology of this disorder remains unclear. It has been proposed that an anatomical predisposition to a large Killian’s dehiscence together with incoordination between the propulsive oblique fibres of the thyropharyngeus and the horizontal sphincteric fibres of the cricopharyngeus are the factors that contribute to the development of this posterior pulsion diverticulum (Figures 2 & 3).
Manometric studies have shown an abnormal sequence of premature oesophageal sphincter contractions prior to completion of the pharyngeal phase resulting in uncoordinated movement of the food bolus and hence a passage through the path of least resistance, which is Killian’s dehiscence.\textsuperscript{16} This is in contrast to a study by Cook \textit{et al.}\textsuperscript{17} who through controlled manometric and video radiographic studies, recorded marked increases in intra-bolus pressure and incomplete cricopharyngeus opening and concluded that this condition is due to a reduced opening rather than a lack of coordination. This theory has been refuted by van Overbeek\textsuperscript{18} in a study of 545 patients, he found no difference in intraluminal pressure between patients with a pouch and a control group. He postulated that the condition is not a result of differences in tonicity and contraction of muscles but rather a combination of anatomical predisposition and the loss of elasticity associated with age. There is also evidence that supports an association between cricopharyngeal spasm and gastro-oesophageal reflux.\textsuperscript{19}

However, one consistent finding in patients with a pouch is fibrosis in the cricopharyngeus muscle. This has been attributed to local ischaemia due to mechanical factors such as traction and compression of the upper oesophageal sphincter in its downward displacement in the presence of the pouch.\textsuperscript{20}

**Clinical Features**

It is an acquired condition with an incidence of 2/100,000. Most commonly patients are male and in their sixth and seventh decade.\textsuperscript{21} The common presenting symptoms are listed in Table 1.

Examination findings are few. Rarely a swelling may be palpated in the neck, which may gurgle on palpation (Boyce’s sign).\textsuperscript{22}

\begin{itemize}
  \item Dysphagia
  \item Regurgitation of undigested food
  \item Weight loss
  \item Mucus in the throat
  \item Halitosis
  \item Gurgling noises in the neck
  \item Coughing
  \item Repeated chest infections due to aspiration
\end{itemize}

**Table 1.** Common presenting symptoms of pharyngeal pouches.
The majority of pharyngeal pouches are benign, but there is a small risk of malignancy within a long-standing pouch. This is thought to be caused by chronic inflammation and chemical irritation of the mucosa within the pouch. This should be suspected if there is a sudden recurrence following treatment or an increase in the severity of symptoms such as pain, haemoptysis or marked regurgitation of food.\(^{21}\)

**Investigations**

The gold standard is barium swallow (Figure 4). Other investigations to consider are endoscopy, oesophageal manometry and scintigraphy, but these are primarily used for research purposes.

**Contrast study:** A barium swallow will illustrate the location of the opening of the diverticulum in relation to the cricopharyngeus muscle, the size of the pouch and the relationship of the sac to the cervical oesophagus. It will also outline the lower oesophagus to exclude any distal pathology to the pouch.\(^{25}\)

There are several radiological staging systems based on the findings at barium swallow (Table 2).\(^{24,25}\)

**Table 2. Radiological staging systems for pharyngeal pouch.**

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<td>Stage I: A small mucosal protrusion is present.</td>
<td>Small sacs are less than 1 vertebral body in length.</td>
<td>Stage 1: 2 - 3 mm thorn-like diverticulum seen during the resting phase of deglutition.</td>
<td>Small sacs are less than 2 cm in length.</td>
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<tr>
<td>Stage II: A definite sac is present, but the hypopharynx and oesophagus are in line.</td>
<td>Intermediate sacs are 1-3 vertebral bodies in length.</td>
<td>Stage 2: 7 - 8 mm clubshaped diverticulum, with horizontal or slightly caudal orientation, seen during the contraction phase of deglutition.</td>
<td>Intermediate sacs are 2-4 cm in length.</td>
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<tr>
<td>Stage III: The hypopharynx is in line with diverticulum, and the oesophagus is indented and pushed anteriorly.</td>
<td>Large sacs are greater than 3 vertebral bodies in length.</td>
<td>Stage 3: bagshaped diverticulum caudally oriented, without evidence of oesophageal compression.</td>
<td>Large sacs are greater than 4 cm in length.</td>
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**Oesophageal manometry (Figure 5):** Oesophageal disorders may secondarily affect pharyngeal and swallowing function. In these cases, manometry may be performed in order to evaluate the tone of the oesophageal sphincters (upper oesophageal sphincter hypertonia and the lower oesophageal sphincter hypotonia) and to monitor disease evolution and symptom progression.\(^{26}\)

**Treatment**

There are two main surgical approaches to the pharyngeal pouch: endoscopic or open (Table 3).

**Endoscopic vs open – patient selection**

There are patient and technical factors which will determine the procedure used:
1. Size of the pouch (small pouches may not be suitable for stapling due to technical difficulties).

2. Thickness of the bar between the pouch and oesophagus – if the bar is too thick it can make the endoscopic approach difficult.

3. Poor trans-oral accessibility to the pouch e.g. due to prominent teeth, cervical spine stiffness.

4. Risk of developing a carcinoma within the pouch that has not been excised or missing a carcinoma in the pouch.

5. Patient co-morbidities rendering them unfit for long general anaesthetic.

**Open surgery**
- Cricopharyngeus (c-p) myotomy alone
- Pouch excision with c-p myotomy
- Pouch inversion with c-p myotomy
- Pouch suspension with c-p myotomy
- Stapling - cutting devices

**Endoscopic surgery**
- **Division of partition wall**
  - Electrocautery
  - CO2 laser
  - Ktp laser
  - Stapling - linear cutting devices

**Endoscopic approach**

This is carried out trans-orally with the aim of dividing the muscular bar between the pouch and the oesophagus converting it into one cavity to allow transit of food. It is carried out using a double-bladed pharyngoscope (Figure 7). Various techniques have been described to divide the partition wall involving diathermy (Dohlman’s procedure), CO2 laser, KTP/532 laser or endoscopic stapling (Figures 8-11). A UK survey in 2004 found that endoscopic stapling was the most popular treatment method in the UK.30

Recently the Mayo clinic published their results of flexible endoscopic management using electrocautery
The advantages of the endoscopic approach are a shorter hospital as the patient returns to swallowing sooner, reduced perforation risk, lack of external scar and reduced risk of damaging the recurrent laryngeal nerve. The advantages of the endoscopic approach are a shorter hospital as the patient returns to swallowing sooner, reduced perforation risk, lack of external scar and reduced risk of damaging the recurrent laryngeal nerve. Revision surgery is also easier. Stapling provides further advantages over diathermy and laser because the staples seal the divided edges reducing the risk of fistula formation, mediastinitis and thermal damage to the recurrent laryngeal nerve.

There are, however, disadvantages with the endoscopic approach. Smaller pouches are difficult to treat as it is difficult to introduce the lower blade of the diverticuloscope into the pouch. A traumatic insertion of the pharyngoscope and excessive stapling are associated with a higher perforation risk. Some pouches cannot be treated endoscopically due to patient factors such as prominent teeth and stiff cervical spine and conversion rates to an open procedure range from 0-30%. Complication rates range from 0-15%, the main one being perforation. Recurrence rates are quoted as being between 0-32%. As no pathological specimen is provided, the pouch must be carefully examined with an oesophagosope or 30° Hopkins rod prior to surgery to exclude the presence of carcinoma.

Careful inspection of the divided bar after stapling is also mandatory to ensure that no perforation has been caused. If detected, there are two main ways to address it: open exploration and repair of the defect (depending on perforation size, fitness of the patient and experience of...
the surgeon) or nasogastric feeding until the perforation heals. A water soluble contrast swallow study can be used to confirm this. Micro lar yngoscopic repair has been described but only in a few patients.40

Patient satisfaction studies have been used to evaluate treatment methods. Wouters and Van Overbeek reported a 99% satisfaction rate after endoscopic diathermy or laser myotomy performed on 507 patients.16 Van Eeden et al reported that 88% of endoscopically treated patients showed symptomatic improvement compared to 70% who underwent an open procedure.41 There are a number of published retrospective studies demonstrating patient benefit from the endoscopic approach.19,33,41,42

Roth et al published their 10 year results of endoscopic stapling comparing single and multiple staple rows. They found a significantly increased rate of oesophageal perforation with multiple rows.43 However, as stated in their paper it is unclear to what extent the common wall has to be divided in order to achieve symptom resolution. Koay and Bates suggested that this decision is based on experience, but recommend being conservative in order to avoid perforation as there is evidence to suggest that residual or recurrent pouches can be treated endoscopically without any increase in morbidity or mortality.44 Several series comparing the results of the endoscopic surgery versus external approach for treatment of pharyngeal pouches have been published. However, a Cochrane review stated that there is a lack of evidence from high quality randomised controlled trials to demonstrate the effectiveness of endoscopic procedures compared to open procedures for a pharyngeal pouch.55 The National Institute for Health and Clinical Excellence has stated that endoscopic stapling is associated with a shorter hospital stay and more prompt recovery to normal swallowing function and with few complications.46

Carcinoma within the Pouch
Carcinoma arising in the pouch is an uncommon but real risk. The most recent data stated that 45 cases of carcinoma had been reported up to 2001.27 A study of over 1000 patients from the Mayo clinic in 1992 revealed an incidence of 0.5%47 and van Overbeek quoted an incidence of 0.3% from a series of 646 patients from 1994 to 2000.29 A barium study of a carcinoma within a pouch will usually show a filling defect in the lower two-thirds, which can be diagnosed preoperatively in 29.8%.48

Despite examination of the pouch with a Hopkins rod, there is still a chance of missing a carcinoma in situ or a small carcinoma within the pouch. For this reason some authors advocate an open approach for patients under 65 as it provides a pathological specimen although this is somewhat controversial and may not be universally accepted practice. In patients whose symptoms persist or recur, an endoscopic examination of the whole oesophagus is advisable to exclude distal pathology.21

Postoperative follow-up
Studies by Jaramillo and Ong reported persistent pouch but easy flow of the contrast into oesophagus in all patients of their series. They found the postoperative radiological appearance has no correlation to clinical symptoms and concluded that the barium swallow has no routine role in postoperative evaluation of patients after endoscopic stapling.33,49 Follow-up should be clinical and recurrence of the pouch suspected if symptoms recur.

Summary
Pharyngeal pouch is a pulsion diverticulum caused by a combination of an anatomical predisposition to a large Killian’s dehiscence and incoordination of pharyngeal musculature mainly between the cricopharyngeus and thyropharyngeus. In the UK, the treatment of choice is endoscopic stapling as it conveys many advantages over the open procedure, but the open approach still has an important role in certain cases. Malignancy within the pouch, although rare, should always be considered and thorough examination of the pouch should be performed.

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