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Pharyngo-oesophageal dysphagia: surgery based on clinical and manometric data

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Abstract High or pharyngo-oesophageal dysphagia (PD) is defined as difficulty in initiating the act of swallowing within 1s. It involves the mechanisms controlling the tongue, pharynx and upper oesophageal sphincter (UOS) and is associated with a wide variety of local, neurologic and muscular disorders, and can also occur after surgery in the area and in response to gastro-oesophageal reflux (GOR). Our study aims at defining the criteria for surgery in PD and to evaluate the clinical results of such treatment. Twenty-three patients who underwent surgery were evaluated with pharyngo-oesophageal motility and ambulatory 24-hr pH-metry. The following parameters were measured: 1) pharyngeal contraction amplitude, 2) duration, 3) repetitive pharyngeal contractions, 4) UOS tone, 5) percentage of UOS relaxation, 6) duration of relaxation, 7) UOS closing pressure, 8) UOS closing duration, 9) co-ordination of UOS closing pressure and upper oesophageal (UO) contractions. Preoperative manometry showed a variety of abnormalities in several of the parameters, such as prolonged pharyngeal contraction ("spasm"), unco-ordinated pharyngeal contractions and UOS relaxation, low amplitude pharyngeal contractions, unco-ordinated UOS closing tone and UO contractions and hypotonic UO. Surgery was directed at the specific abnormality in each patient taking into consideration the presence or absence of GOR. Seventeen patients (74%) had excellent results. Three other patients (13%), who had improved swallowing but who continued to have GOR complicated by some oesophageal dysmotility, oesophagitis and an oesophageal web, underwent subsequent anti-reflux surgery with relief of symptoms. In conclusion, pharyngo-oesophageal motility measurement is mandatory in PD, especially when a diverticulum is absent. Cricopharyngeal myotomy with or without diverticulectomy as indicated produces excellent results. Associated oesophageal problems have to be dealt with appropriately. [Eur J Cardio-thorac Surg (1996) 10: 365–371]

Key words High dysphagia · Zenker's diverticulum · Cricopharyngeal myotomy

High or pharyngo-oesophageal dysphagia (PD) is defined as difficulty in initiating the act of swallowing within 1 s [5]. Pharyngo-oesophageal dysphagia involves the mechanism controlling movements of the tongue, pharynx and upper oesophageal sphincter (UOS). It is associated with a wide variety of local, neurologic and muscular diseases, and can also develop after surgery to the laryngopharynx. It is commonly associated with gastro-oesophageal reflux (GOR) [1, 4, 5, 9]. The common complaints are difficulty in initiating swallow, nasal regurgitation, food sticking in the throat and cough during deglutition. It occurs in association with dysarthria and nasal speech. The development

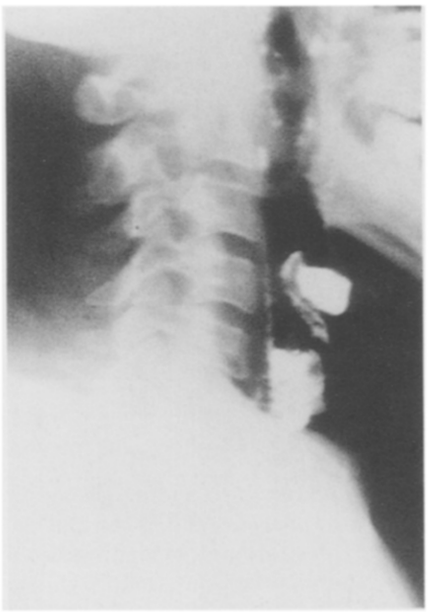

Fig. 1 Anterior indentation of barium-filled oesophagus above cricopharyngeal muscles with the pyriform fossa well filled above it

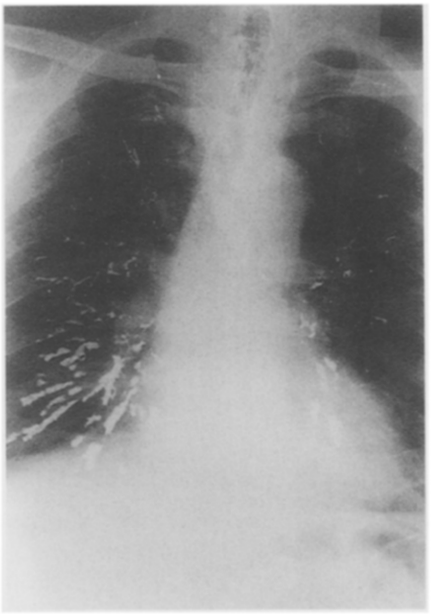

Fig. 2 Shows evidence of aspiration of all the barium into the bronchial tree in the same patient as in Fig. 1, resulting in recurrent episodes of pneumonitis

of symptoms can be dramatic with severe weight loss and recurrent episodes of aspiration pneumonitis [12] (Fig. 1 and 2). The surgical treatment, which consists of myotomy of the involved segment of pharyngo-oesophageal musculature, should be directed towards correcting the functional disorder as demonstrated on manometry [11].

The purpose of this study was to assess the clinical and laboratory criteria for surgery in patients suffering from PD and to evaluate the clinical results of surgical treatment based on the pathophysiology.

Material and methods

Twenty-four patients underwent surgical treatment for PD. All the patients underwent screening after barium swallow, manometry, pH-metry and upper gastro-intestinal endoscopy prior to surgery. Screening with barium swallow was performed in all patients using standard suspension, except in patients with chronic aspiration pneumonia in whom we prefer to use Gastrografin. The test was used to document the presence of Zenker's diverticulum, hiatal hernia, or other pathology. We have recently introduced video-roentgenography in order to study pharyngo-oesophageal deglutition using a frame-by-frame analysis. Pharyngo-oesophageal manometry was performed in the manner described recently by us [11]. A Gaeltec solid state, triple pressure sensor probe[1] with a diameter of 2.4 mm and with sensors 5 cm apart, offset by 120° was connected to a Roche polygraph[2] on which recordings were made. Having completed the manometry of the lower oesophagus using the station pull-through technique, pressures were then recorded with the proximal transducer in the pharynx, the middle sensor in the UOS zone and the distal one in the upper oesophagus (UO). The middle sensor, which was orientated anteroposteriorly, was selected for the analysis of the cricopharyngeal sphincter in an effort to minimize recording inconsistencies due to asymmetry of the sphincter, though we recognize that this does not entirely eliminate such errors. At least one dry and three wet swallows were recorded and evaluated for each subject. Several variables have been studied as shown in Table 1.

Twenty-four hour oesophageal pH-metry was performed, positioning an antimony electrode 5 cm transnasally above the proximal limit of the lower oesophageal sphincter (LOS) as measured by manometry. The pH of the oesophagus was sampled at 4-s intervals and the data stored in a Synectics digitrapper[3]. At the end of the 24 h the data were transferred to a personal computer and analysed using Synectics software. An episode of acid reflux was defined as a drop in the oesophageal pH to 4 or less.

Twenty age-matched subjects without oesophageal symptoms were also studied as a control group. All the values were expressed as the mean with standard deviation (SD). Endoscopy was performed using a flexible Olympus gastroscope[4] in order to complete the full investigation of the upper gastro-intenstinal tract, and to document the presence of reflux disease and of hiatal hernia, or of other concomitant disease. The larynx was always inspected carefully. Assessment of the results of surgery was based on clinical, radiological and, in the majority of patients, on laboratory criteria, and categorized as excellent, good and poor.

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Table 1 Manometric parameters measured preoperatively

Pharyngeal contraction amplitude
Pharyngeal contraction duration
Repetitive pharyngeal contractions
Upper oesophageal sphincter (UOS) resting tone
The percentage of UOS relaxation
Duration of UOS relaxation
UOS closing pressure amplitude
UOS closing pressure duration
Coordination between pharyngeal contraction and UOS relaxation
Upper oesophageal (UO) contraction amplitude
UO contraction duration
Coordination between UOS closing pressure and UO contraction

Table 2 Clinical data in the group of 24 patients with crico-pharyngeal dysphagia. Clincial data: 6 male, 8 female (aged 50–88, mean 77)

Symptoms	No.	Associated conditions	No.
Cough	13	Hiatal hernia	13
Weight loss	5	Zenker's diverticula	14
Heartburn	3	Motoneuron disease	1
Regurgitation	4	Pneumonia	6
Gurgling	2	Asthma	3
Halitosis	1	Schatzki ring	2
Nasal regurgitation	1	Oesophageal web	1
Odynophagia	1	Lower oesophageal stricture	1
Chest pain	1		

Table 3 Summary of manometric abnormalities recorded preoperatively in 24 patients

Parameters	No. of patients
Crico-oesophageal inco-ordination (Fig. 4)	11
Achalasia of UOS (Figs. 5 and 6)	4
Pharyngo-crico inco-ordination	3
Hypotonic oesophageal contraction	3
Both types of inco-ordination	2
Pharyngeal contraction amplitude < UOS resting tone	2
Pharyngeal contraction duration > UOS relaxation	1
Repetitive pharyngeal contractions without pharyngeal relaxation	1

Clinical data

There were 16 males and 8 females with a mean age of 77 years ranging from 50 to 88. Duration of symptoms ranged from 1 week–10 years. All patients presented with dysphagia. Thirteen patients presented with cough, five with weight loss, four with regurgitation and three with heartburn. Two patients experienced gurgling, one halitosis, one nasal regurgitation, one odynophagia and one chest pain. Associated conditions were Zenker's diverticula in 14, hiatal hernia in 13, pneumonia in 6, asthma in 3, Schatzki's ring in 2, oesophageal web in 1, motoneuron disease in 1 and, finally, oesophageal stricture in 1 (Table 2). Three patients had undergone other surgical treatment prior to the appearance of PD: the first patient had an oesophageal resection, the second surgery for a gastric ulcer (Billroth II) and the third for laryngeal tumour (laryngectomy). The manometric indications for myotomy are summarized in Table 3.

Thirteen patients underwent diverticulectomy and cricopharyngeal myotomy, whilst 11 had a myotomy without diverticulectomy. Three patients underwent a Belsey Mark IV repair at the same time as the myotomy in view of pathologic GOR not responding to medical regime.

Preoperative data

Endoscopy

Sixteen patients underwent successful endoscopy. In five patients it was not possible to pass the UOS (three with diverticulum and two without). Five patients had evidence of oesophagitis. Two patients had a narrowing of the lower oesophagus (one due to a Schatzki's ring and the other following oesophageal resection).

Barium swallow

Barium swallow showed the presence of pharyngeal pouch in 14 patients. Three patients inhaled barium into the bronchial tree (Figs. 1 and 2), one of these requiring bronchial lavage. Hiatal hernia was diagnosed in 13 patients. The radiogram of one patient who underwent laryngectomy for tumour showed a "mouse-tail" appearance of UOS. One patient with motoneuron disease showed an anterior indentation of the barium-filled oesophagus by a cricopharyngeal muscle bar (Fig. 1). In the same patient the video-roentgenography showed aspiration of all the contrast into the bronchial tree and that the sphincter never opened during the repetitive attempts of the pharyngeal muscle to push the bolus down.

Manometry

Pharynx: two patients showed pharyngeal contraction amplitude lower than UOS resting tone. One patient presented pharyngeal contraction of longer duration than UOS relaxation and, finally, four patients had repetitive pharyngeal contractions.

Upper oesophageal sphincter: four patients presented with incomplete relaxation of UOS (cricopharyngeal achalasia).

Sphincteric coordination: four patients presented a pharyngo-sphincteric inco-ordination, 11 patients presented a sphincter-oesophageal inco-ordination and two patients presented both.

Upper oesophagus: three patients presented hypotonic oesophageal contractions.

Operative technique

The technique of cricopharyngeal myotomy has been extensively described. Two important points have to be considered. Firstly, the operation can be performed under general or local anaesthesia [8]. We prefer general anaesthesia even if, in some circumstances, a local anaesthetic may be suitable. Secondly, the cervical incision can be performed in the left or in the right side of the neck depending on the surgeon's preference. Normally a right-handed surgeon would prefer to operate via the left side of the neck. The patient is in the supine position with the head turned to the right. A left cervical incision is performed along the anterior border of the sternocleidomastoid muscle. After incision of the deep cervical fascia in the same line, the pharynx and the cervical oesophageal region are exposed by retracting the carotid sheath laterally and the trachea and the larynx medially. Meticulous attention is exercised in order to preserve the descending branches of the cervical plexus of nerves. A better exposure is obtained by dividing the anterior belly of the omohyoid muscle, the middle thyroid vein and the inferior thyroid artery. Injury to the recurrent laryngeal nerve is avoided by limiting the anterior retraction of the trachea and the larynx.

When a diverticulum is present, a careful dissection is carried out to free its neck from the transverse fibres of the cricopharyngeus.

The extent of the myotomy of the pharyngo-oesophageal segment conforms to our recent description [11], and is determined by the manometric findings. The pouch, when present, is dealt with commensurate with its size. The inferior constrictor, cricopharyngeus and the muscles of the cervical oesophagus are dissected from the underlying mucosa. A muscle biopsy is performed at this stage.

In the absence of the diverticulum, the distance of the UOS from the nostril as measured at manometry is marked on a nasogastric catheter which is inserted through the nostril into the pharyngo-oesophageal lumen. The area of the cricopharyngeus is identified by palpation of the tip of the catheter through the mucosa. After completition of the myotomy and diverticulotomy or diverticulopexy, the integrity of the mucosa is checked with water in the operating field and insufflation of air into the oesophagus via the nasogastric tube. The cervical wound is closed with drainage of the retro-oesophageal space. Oral alimentation is permitted the following day and the patient is discharged home in 5–6 days when the drain has been removed and the wound healed.

Results

The follow-up was complete in 23 patients and ranged from 5 months to 25 years with a mean of 3 years. A postoperative death (4%) occurred from bilateral pneunomia in a patient with preoperative pneumonia. Two patients died in the long term from causes unrelated to the operation, but with excellent results of surgery. Seventeen had excellent results (71%). In three patients (12.5%) the results were good (Fig. 3). One had crico-pharyngeal achalasia associated with hypotonic peristalsis in the pharynx, the second was a patient with associated stricture in the lower oesophagus who recovered well from the PD but remained unsatisfied because of the dysphagia due to the stricture. The third patient, with motoneuron disease, had achalasia of the cricopharyngeus associated with repetitive contractions in the pharynx, and continued to have occasional dysphagia for liquids.

Unfortunately three patients (12.5%) had problems related to GOR. The first patient 1 year postoperatively went on to undergo an anti-reflux repair with myotomy of the lower oesophagus because of severe GOR and motility disorder of the oesophageal body. The second patient, with hiatal hernia and Schatzki's ring, developed oesophagitis grade II and stenosis which needed several dilatations. The third patient had an oesophageal web and was also dilated.

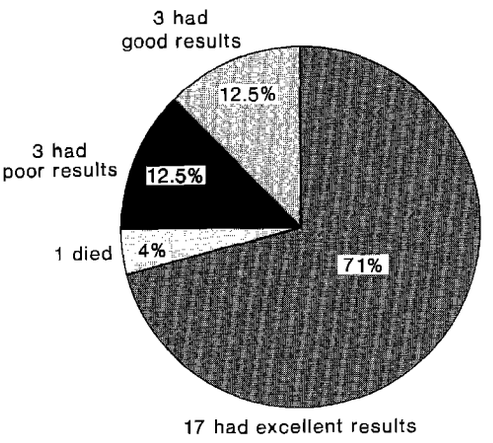

Fig. 3 Piechart of the results of surgical treatment as discussed in the text

Discussion

Pharyngo-oesophageal dysphagia is caused by a mechanical or functional disorder of this region. Several hypotheses have been proposed as causes of functional PD, for example pharyngeal disturbances [6], incomplete relaxation of the UOS [13], hypertensive UOS [5] and, finally, inco-ordination between pharyngeal contraction and UOS relaxation [7].

The diagnosis is always difficult. A careful analysis of the clinical history together with screeening of the oesophagus with contrast [10], manometry and 24-h pH-metry and endoscopy are necessary to define the pathophysiology and to decide the appropriate surgical treatment. We found manometry a most useful diagnostic test. Based on data in pharyngeal (presphincteric), sphincteric and oesophageal (postsphincteric) zones, we have classified the motility disturbances of the pharyngo-oesophageal segment, even if some patients have functional disturbances in two or three areas.

Pharyngeal motility disturbances can be due to three different abnormalities: a) hypotonic contraction, b) long duration contraction and c) repetitive contractions. Hypotonic contractions were present in two of our patients (one with achalasia of UOS and hypotonic UO contraction, and the second with an oesophageal stricture and hypotonic UO contraction). In these patients the myotomy gave good results because the pharyngeal contractions were able to overcome the resting tone of the myotomized sphincter and hypotonic UO. One patient had a long duration contraction in the pharynx which caused dysphagia because of an inco-ordination with UOS relaxation. The pharyngeal contraction appears when the sphincter is not open and ends when the sphincter is closed resulting in a pharyngosphincteric inco-ordination (Fig. 4). In this case the myotomy released the inco-ordination with good results (Fig. 5). Repetitive contractions in the pharynx were present in four patients. The origin of dysphagia in these patients can be explained on the basis of difficulties in pushing the bolus down through the UOS. One patient, with associated achalasia of UOS, long duration of closing tone and GOR, had excellent results after myotomy and hiatal hernia repair. In another patient, with chronic cough, aspiration pneumonia and achalasia, the video-roentgenography showed that the pharynx tried to push down the contrast through a closed sphincter resulting in aspiration of all the contrast. The myotomy resolved the dysphagia and the cough, even if occasional dysphagia for liquid was present. The third pa-

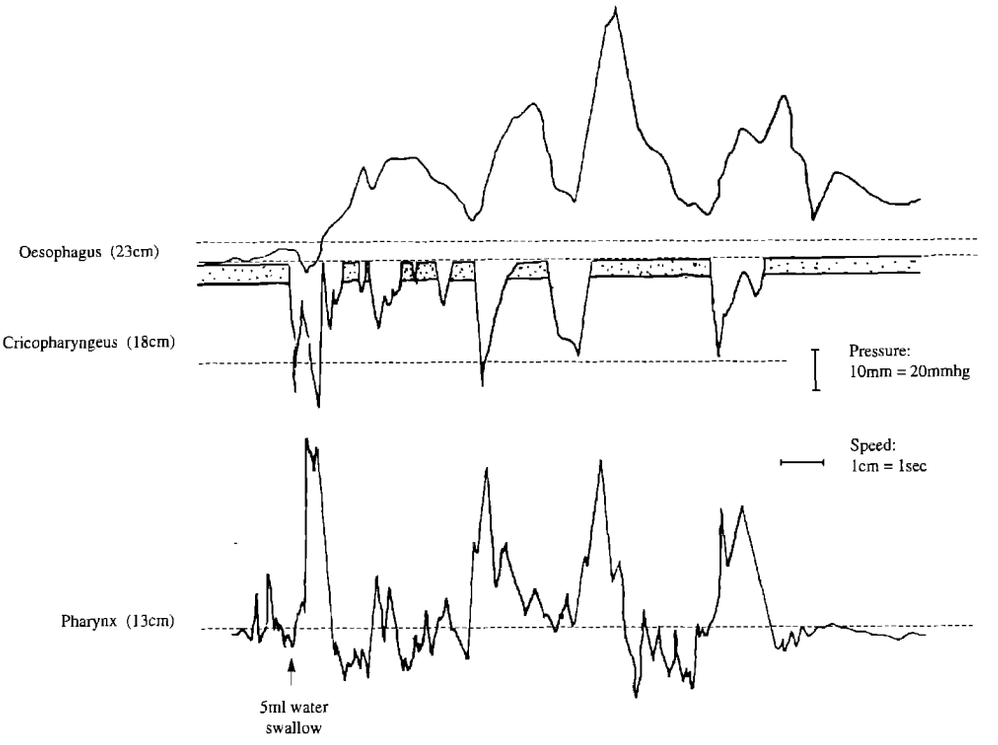

Fig. 4 Manometric tracing in a patient with Zenker's diverticulum 5 days after surgery, showing multiple attempts at deglutition almost amounting to pharyngeal spasm, the pharyngeal contraction occurring as the upper oesophageal sphincter is beginning to close (pharyngo-sphincteric inco-ordination)

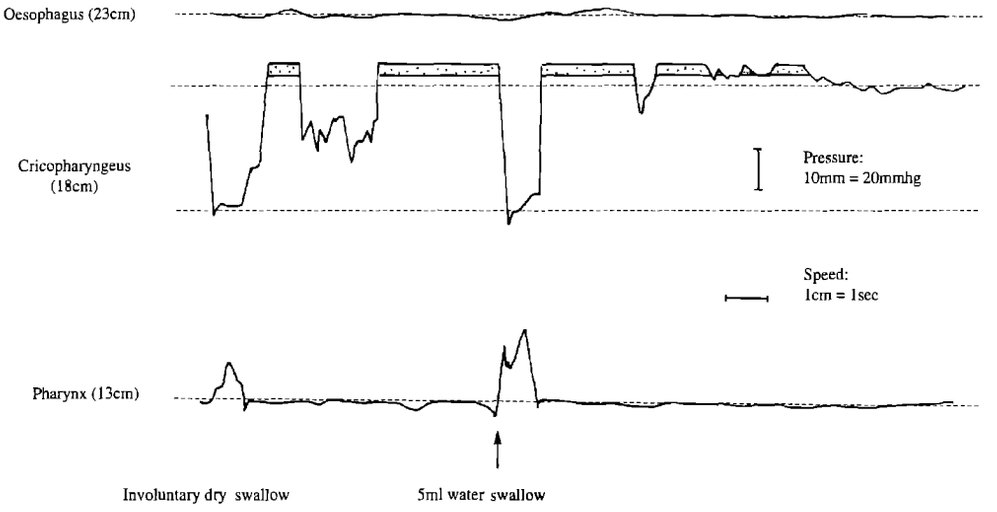

Fig. 5 Manometric tracing on the same patient as in Fig. 4 5 months after surgery showing pharyngeal waves of extended duration but of low amplitude with no suggestion of spasm. There appears to be no oesophageal response as the probe is located in the myotomized area

tient, with preoperative aspiration pneumonia, had a pharyngosphincteric and sphinctero-oesophageal inco-ordination. Unfortunately this patient developed severe respiratory complications and died. The fourth patient had associated motility disorders in the oesophageal body and undiagnosed GOR. The results of medical treatment were poor, and 2 years later the patient underwent longitudinal myotomy of the LOS and of the body of the oesophagus with a modified Belsey Mark IV procedure to relieve dysphagia and overcome reflux.

The *sphincteric* causes can be classified in: a) cricopharyngeal achalasia, b) high pressure of closing tone, c) longer duration of closing tone and d) association of b and c. We had five patients with achalasia of UOS who underwent myotomy of the pharyngo-oesophageal segment. One patient (Fig. 6 and 7) had a huge pharyngo-oesophageal pouch, the second had GOR, the third had undergone previous laryngectomy, the fourth had motoneuron disease and the last had a hypotonic oesophageal contraction. The first two patients had excellent results, the next two had good results only, because of the co-existence of other motility abnormalities. Unfortunately the last patient died because of absence of peristalsis in the UO, hypotonic LOS and free acid reflux into the mouth and inhalation.

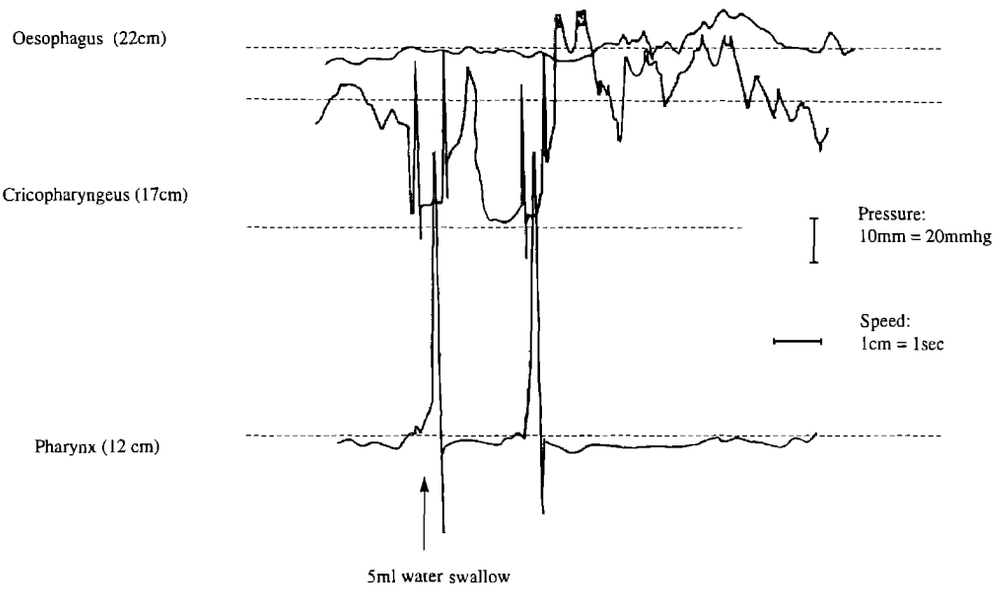

Fig. 6 Manometric tracing in a patient 9 days after surgery showing crico-pharyngeal spasm in response to an exaggerated pharyngeal contraction in patient with PD. There is no oesophageal wave at all as the swallow impulse has failed to reach it

Fig. 7 Manometric tracing in the same patient as in Fig. 6 5 months after a cricopharyngeal mytomy, diverticulectomy and an anti-reflux procedure. There is a co-ordinated swallow peristalsis although the oesophageal contaction is of low amplitude

High pressure and long duration of the closing tone of the UOS are often associated with simultaneous contraction in the UO. The high pressure and long duration can be interpreted as a "spasm" of the UOS due to persistent attempts at propulsion through a non-functional oesophagus or as a protection mechanism to prevent pharyngeal reflux of gastric contents [11] as Belsey pointed out in 1966 [1]. It is important to clarify that the hypertension is not related to the resting tone of UOS. We have demonstrated that 85% (12 out of 14) of the patients with Zenker's diverticulum had an associated motor abnormality between UOS closing tone and the UO contraction [11]. The results of surgical treatment in these patients were excellent in all except one, in whom a recurrence of diverticulum was seen twice. This was a patient with absence of peristalsis in the UO.

The *oesophageal* reasons for development of PD are: a) hypotonic contraction, b) long duration of UO contraction which leads to sphinctero-oesophageal incordination and c) simulatenous contractions in the UO. It has been demonstrated that hypotonic oesophageal contractions are associated with retrograde escape of barium. We found five patients with this abnormality, three of whom had Zenker's diverticula and the other two had simultaneous contractions in the pharynx. The results of surgical treatment in one patient were excellent, while in three others they were good. Unfortunately one other died. The motility study of the entire oesophagus is essential for a precise diagnosis of PD. If an oesophageal motor abnormality is present in the oesophageal body or in the LOS a different surgical approach may be preferred. One patient with undiagnosed

motility disorder in the lower oesophagus underwent a longitudinal myotomy and a modified Belsey Mark IV 1 year after a cricopharyngeal myotomy.

Patients with PD often have Zenker's diverticula of a variable size. We feel that the diverticulum should be excised if the diameter is greater then 5 cm. The proximal and distal extent of the myotomy depends on manometric data [11].

Gastro-oesophageal reflux is associated with PD and laryngeal symptoms and 24-h pH-metry is mandatory for this diagnosis. There has been a recent resurgence of interest in the development of PD and laryngeal symptoms associated with GOR [3, 6, 12].

Hypertensive UOS has been demonstrated in earlier reports [9]. The treatment of the GOR should start with postural, dietetic and medical regimes. If these fail we believe that an anti-reflux repair is necessary first, avoiding the myotomy of the pharyngo-oesophageal segment. Simultaneous anti-reflux repair and cricopharyngeal myotomy are indicated only if PD is associated with severe manometric abnormalities, weight loss or pulmonary symptoms. Recently it has been demonstrated that patients with PD and pulmonary aspiration secondary to GOR had impaired peristalsis in the entire oesophagus [12].

In this series we managed two patients with PD associated with oesophageal web or a Schatzki's ring, respectively. These patients are very difficult to treat by dilatation alone. Surgery relieves the discomfort due to PD, but the patients remain unsatisfied because of oesophageal dysphagia. We believe that, in the first instance, these patients should be treated with several bouginages without a myotomy. The next step should be directed to the understanding of the underlying cause of web or stricture. Iatrogenic PD has previously been reported [5]. Laryngectomy is one of the most common causes of iatrogenic PD because of the disruption of all the nerves implicated in the pharyngeal phase of swallowing. Manometric abnormalities following laryngectomy have been described by Duranceau [4], the most common being achalasia of UOS and hypotonic pharyngeal contractions. One of our patients who was known to have these features on manometry showed great improvement from cricopharyngeal myotomy even though swallowing was slow because of the absence of pharyngeal power.

Pharyngo-oesophageal dysphagia can also be due to muscular or neurologic disorders [2, 5]. In these patients the success rate of myotomy of UOS has been reported at 75% [5]. We treated one patient with motoneuron disease who developed PD for solids and liquids, weight loss and aspiration pneumonia. The manometric trace showed repetitive contractions in the pharynx and achalasia of the UOS. The record of video-roentgenography showed aspiration of all the barium into the bronchial tree. Extensive myotomy of the pharyngo-oesophageal segment enabled the patient to eat solids and semi-solids but he still continued to have difficulty with liquids.

In conclusion, in the presence of PD, especially in the absence of a diverticulum, a careful motility study of the pharyngo-oesophageal segment is mandatory in order to understand the underlying pathophysiology. Manometry of the entire oesophagus is necessary to diagnose concomitant functional diseases. Three different districts must be evaluated – pharyngeal (presphincteric), sphincteric and oesophageal (postsphincteric). The inco-ordination between UOS closing pressure and UO contraction (cricooesophageal) can explain some of the causes of dysphagia. The myotomy of the pharyngo-oesophageal segment, combined when necessary with diverticulectomy, gives excellent to good results in 83% of the patients (Fig. 3).

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