

CIRUGÍA ESPAÑOLA

www.elsevier.es/cirugia



Review article

Epiphrenic diverticula: when and how to operate?

David Ruiz de Angulo Martín,* M. Ángeles Ortiz Escandell, Luisa F. Martínez de Haro, Vicente Munítiz Ruiz, and Pascual Parrilla Paricio

Unidad de Cirugía Esofágica, Hospital Universitario Virgen de la Arrixaca, El Palmar, Murcia, Spain

ARTICLE INFORMATION

Article history:

Received September 3, 2008

Accepted October 7, 2008

On-line March 26, 2009

Keywords:

Epiphrenic diverticulum

Surgical treatment

Thoracoscopic surgery

Laparoscopic surgery

A B S T R A C T

The majority of epiphrenic diverticula arise due to a peristaltic mechanism caused by an oesophageal motor disturbance that establishes a barrier effect and causes mucosal and submucosal herniation through a weak point in the muscular layer. Intraluminal oesophageal manometry and video-radiology are important in assessing these patients, since they define the characteristics of the functional disorder, as well as the true relationship between the symptoms of the patient and the diverticulum.

Surgical treatment is indicated in symptomatic patients, more so if there are respiratory complications. Left posterolateral thoracotomy followed by diverticulotomy, oesophageal cardiomyotomy, and anti-reflux have been considered the surgery technique of choice. Oesophageal myotomy must go beyond, in a proximal direction, the neck of the diverticulum, and, in a distal direction, must progress 1–2 cm into the gastric wall. The laparoscopic approach has won many followers since it has been shown to be both safe and effective as open surgery, adding to the advantages of minimally invasive surgery.

© 2008 AEC. Published by Elsevier España, S.L. All rights reserved.

Divertículos epifrénicos: ¿cuándo y cómo operar?

R E S U M E N

Palabras clave:

Divertículo epifrénico

Tratamiento quirúrgico

Cirugía toracoscópica

Cirugía laparoscópica

La mayoría de los divertículos epifrénicos surgen por un mecanismo de pulsión debido a un trastorno motor esofágico que determina un efecto barrera y ocasiona la herniación mucosa y submucosa a través de un punto débil de la capa muscular. La manometría intraluminal esofágica y la videoradiología resultan importantes en la valoración de estos pacientes ya que definen las características del trastorno funcional, así como la verdadera relación entre los síntomas del paciente y el divertículo.

El tratamiento quirúrgico está indicado en los sujetos sintomáticos, más aún si se han producido complicaciones respiratorias. La toracotomía posterolateral izquierda, seguida de diverticulectomía, cardiomiectomía esofágica y antirreflujo, ha sido considerada la técnica quirúrgica de elección. La miotomía esofágica debe sobrepasar, en sentido proximal,

*Author for correspondence.

E-mail address: druizdeangulo@hotmail.com (D. Ruiz de Angulo Martín).

el cuello del divertículo y, en sentido distal, debe progresar 1–2 cm en la pared gástrica. El abordaje laparoscópico ha ganado numerosos adeptos, pues se ha mostrado tan seguro y eficaz como la vía abierta y suma las ventajas de la cirugía mínimamente invasiva

© 2008 AEC. Publicado por Elsevier España, S.L. Todos los derechos reservados.

Introduction

Oesophageal diverticula are caecal pouch shaped evaginations that are covered by the oesophageal mucosa and they connect with the primary lumen. The epiphrenic diverticula, located in the last 10 cm of the oesophagus, represent less than 10% of the total.¹ The controversial points regarding this pathology continue to be surgical indication, the type of approach and the technique to be used. The answer to the greater part of these questions requires a precise understanding of the relevant physiopathology. The scarcity of diagnosed cases, 126 patients in existing literature from all over the world in 1952,² and the absence of randomized prospective studies suggest that one should not be dogmatic with this topic. Keeping in mind that the majority of the reviewed studies do not surpass level 2 scientific investigation (SIGN),³ we will try to answer some questions about this infrequent illness.

History

In 1804, the symptoms caused by the epiphrenic diverticulum were first described by DeGuise.^{4,5}

He also described their anatomical characteristics thanks to the findings of an autopsy performed on a patient that died from malnutrition secondary to oesophageal obstruction that had caused said diverticulum. Mondiere,⁶ in 1833, revealed his belief in the pulsion mechanism as a cause of this illness. In 1898, Reitzenstein showed unedited radiological images of an oesophageal diverticulum,⁷ while Reeves, in 1855, invented the term “epiphrenic diverticulum.”⁴ The first intervention carried out successfully took place in 1921 and was performed by Clairmont.⁸ Kay, in 1953, and Effer, in 1959, confirmed the presence of a hypertrophy of the circular muscle layer in the distal oesophagus of these patients.¹

Epidemiology

The true prevalence of epiphrenic diverticula is unknown, as the majority does not produce symptoms. Some authors even report percentages greater than 80% of asymptomatic individuals or those that only present light symptoms.^{9,10} Many of them are incidental findings when performing a barium transit test for another reason.⁹ On other occasions they appear as false positives in scans carried out to detect tumour metastases^{11,12} due to the fact that the radio-marked capsule remains trapped in the pouch.

It seems that there may be a slight predominance in males, although we have found contrasting data. They are usually

found in people older than 60 and the size is variable, from pouches smaller than 5cm to large formations greater than 10 cm.^{13,15} In series with long-term follow-up, a size stabilisation is observed in many cases.^{16,17} Diverticula located on the right side are predominant, as the adjacent mediastinic structures protect the left side of the oesophagus.¹⁶ Normally they appear alone, but cases have been reported of various epiphrenic diverticula in the same patient.^{18,19}

Aetiology

Following the hypotheses of Vinson,²⁰ we consider today that the majority of these diverticula come from the pulsion mechanism, from functional syndromes that affect the motility of the oesophageal body and the relaxation of the inferior oesophageal sphincter (IOS).²¹ Achalasia of the cardia is the pathology that is most frequently related with the epiphrenic diverticulum,^{22,23} although other alterations have been detected, such as diffuse oesophageal spasm, symptomatic oesophageal peristalsis, and hypertension of the inferior oesophageal sphincter (Table 1). However, the low incidence of epiphrenic diverticula in patients with achalasia (9%-15%),²⁴ as well as the absence of pressive differences between the patients with motility disorders with and without epiphrenic diverticulum,¹⁸ forces us to think of the coexistence of other aetiological factors.

Some diverticula have been related with peptic stenosis,^{18,25} tumours,^{26,27} and certain surgical procedures, such as the insertion of a gastric band²⁸ and oesophageal myotomy. All of these circumstances weaken the oesophageal wall or lead to a considerable increase of the intraluminal pressure from distal obstruction, which favours its formation. In theory, they are false diverticula consisting of mucosa and submucosa that penetrate the oesophageal circular and longitudinal muscle layers.¹⁶ Certain epiphrenic diverticula are caused by a congenital alteration that takes place during embryonic or foetal development.^{29,31} They are caused by traction in very few cases that is caused by mediastinic tuberculosis adenopathies³² or neoplasia.³³

Clinical manifestations

Dysphagia and regurgitations are the most frequent clinical manifestations and may cause weight loss in certain individuals.³⁴ Other patients report thoracic pain, chronic coughing, pyrosis, halitosis, dyspnoea,³⁵ and symptoms that are secondary to respiratory complications. Haematemesis, has been described as an exception, from bleeding within the

Table 1 – Prevalence of oesophageal movement disorders in patients with epiphrenic diverticula

Author	Year	No.	Manometry, n ^a /n _{total}	Movement disorders, ^b %	Diagnosis					
					AC	DIOS	SOP	IOS	IMD	Normal
Debas et al ¹⁸	1980	65	36/65	75	13	NS	0	NS	10	15
Streitz et al ²²	1992	16	9/12	62	4	3	0	1	1	3
Altorki et al ³⁴	1993	20	8/15	60	7	2	0	1	2	3
Benacci et al ⁹	1993	33	20/33	58	8	3	0	1	7	1
Eubanks et al ²³	1999	5	1/2	20	0	0	1	0	0	1
Nehra et al ¹⁹	2002	21	21/21	100	9	5	2	3	2	0
Matthews et al ⁴⁹	2003	5	5/5	60	0	0	1	0	2	2
Del Genio et al ⁷²	2004	13	13/13	100	6	0	1	3	3	0
Tedesco et al ⁶¹	2005	21	21/21	94	2	5	5	0	5	4
Reznik et al ⁵⁹	2007	44	38/38	73	18	2	2	1	7	8

AC indicates achalasia of the cardia; DIOS, diffuse idiopathic oesophageal spasm; SOP, symptomatic oesophageal peristalsis; IMD, intermediate movement disorder; NS, not specified.

^aComplete manometry: studies the inferior and superior oesophageal sphincters and the oesophageal body.

^bPercentage compared to the total number of patients. Includes radiological diagnosis.

diverticulum,^{5,36,37} hypo-persistent,³⁸ and cardiac arrhythmias triggered by atrial compression during meals.³⁹

Many authors closely relate the diverticulum with regurgitations, while the subjacent movement disorders would justify the dysphagia and thoracic pain^{9,6,18,34,40}

Indications for surgical treatment

Today there is a consensus to operate on those patients with severe oesophageal symptoms or those whose condition has worsened clinically with a considerable increase in the size of the diverticulum. Individuals with respiratory manifestations of any magnitude, and especially those that present a large pouch, are also surgically indicated. Similarly, the neoplastic degeneration of the oesophageal mucosa within the diverticulum⁴¹⁻⁴⁴ requires surgery. Indeed, certain aspects should be clarified.

Oesophageal symptoms derived from the diverticulum are non-distinguishable from those that are secondary to subjacent movement disorders, which makes it difficult to evaluate how much one depends on the other.⁴⁵ The fact that the intensity of the symptoms may be proportional to the size of the diverticulum is also in question. In this respect, Fasano et al⁴⁶ find a correlation between the dimensions of the diverticulum and the presence of symptoms. In the same direction, Motoyama et al⁴⁷ show the case of a patient with an epiphrenic diverticulum, discovered years before, where the accelerated growth of the pouch considerably increased clinical alterations. On the other hand, various authors argue that the dysphagia and regurgitations that the patients experience do not depend on the size of the diverticulum¹³ and are secondary to the concomitant contractile alterations.^{18,45,48,50} To support this, Hiebert declared that when indicating surgical treatment,

the intensity of the symptoms should have priority over the length of the diverticulum, as one does not entail the other.⁵¹ In order to find an answer to this question, it is important to carry out radiological tests that allow us to visualize the swallowing dynamics and the progression of the contrast.

Consequently, Jordan et al¹⁷ point out that the clinic due to the diverticulum depends on the differential pressure between the diverticulum and the oesophagus and also the oesophageal height where its content is drained. Those whose opening is higher will have a greater probability of provoking regurgitations and respiratory manifestations. Using video-radiology, they observe that regurgitation increases in the prone position and it decreases with Valsalva manoeuvres. At the same time, they prove a constant flow of barium between the oesophagus and the diverticulum so that if the inferior oesophageal sphincter adequately relaxes, the advancing of the content to the stomach is favoured, without causing any problems.

Furthermore, 20%-30% of the symptomatic individuals presented repeated pneumonias, pulmonary abscesses, and pneumonitis from aspiration.¹⁹ These circumstances can lead to death before carrying out surgical treatment, and even in anaesthetic induction.⁵² Indeed, Altorki et al³⁴ claim that elective surgery should be performed in all individuals with epiphrenic diverticula to avoid respiratory events that put the patient's life in danger. Almost half of the 20 individuals that make up their series presented pulmonary complications in the moment of diagnosis and in 3 of them the respiratory symptoms were the only manifestations of the illness.

But surgery is not risk free. Some authors believe that surgical treatment should be reserved for those individuals with severe symptoms,^{9,53} as the intervention entails a morbidity and a mortality that are not insignificant in the published series (Table 2).

Table 2 – Techniques, approach, complications, and results of the surgical treatment of the epiphrenic diverticulum

Author, year	No.	Surgical treatment	Approach			Technique				Morbidity (surgical)	Mortality	Results, excellent-good ^a
			TT	TC	LT	LC	DE	DP	M	A	O	
Altorki et al. ³⁴ 1993	20	17	17	-	-	-	14	1	17	17	-	13/14 (93%) [84]
Benacci et al. ⁹ 1993	112	33	33	-	-	-	29	-	23	6	3	22/29 (76%) [84]
Hudspeth et al. ²⁵ 1993	18	9	9	-	-	-	9	-	8	-	-	9/9 (100%) (36)
Vecchio et al. ⁷⁰ 1997	15	15	11	-	4	-	10	-	15	13	-	13/15 (87%) (60)
Myers et al. ⁸⁹ 1998	3	3	-	-	1	2	3	-	3	2	-	3/3 (100%) (NS)
Rosati et al. ⁷¹ 1998	4	4	-	-	-	4	4	-	4	4	-	4/4 (100%) (21)
Jordan et al. ¹⁷ 1999	25	19	15	-	4	-	15	3	9	6	2	9/10 (90%) (81)
Nehra et al. ¹⁹ 2002	21	18	17	-	1	-	13	4	17	17	1	15/17 (88%) [24]
Matthews et al. ⁴⁹ 2003	5	5	-	1	-	4	5	-	5	4	-	5/5 (100%) (16)
Klaus et al. ⁴⁰ 2003	17	11	-	1	-	10	6	-	7	10	-	7/8 (87%) (26)
Fraji et al. ⁸⁵ 2003	6	6	-	-	-	6	6	-	6	6	-	6/6 (100%) (9)
Del Genio et al. ⁷² 2004	13	13	-	-	-	13	13	-	13	13	-	11/12 (92%) (58)
Tedesco et al. ⁶¹ 2005	21	7	-	-	-	7	7	-	7	7	-	7/7 (100%) [60]

A indicates anti-reflux; DE, diverticulectomy; DP, diverticulopexy; LC, laparoscopy; LT, laparotomy; M, myotomy; NS, non-specified; O, others; TC, thoracoscopy; TT, thoracotomy.

^aThe data are presented from [median] or (average) of follow-up in months.

Surgical technique

What technique should we use?

The standard for the majority of authors combines diverticulectomy, oesophageal cardiomyotomy, and anti-reflux techniques. Other options found in existing literature are the isolated diverticulectomy, the diverticulectomy with myotomy without anti-reflux, myotomy with or without anti-reflux, and oesophagectomy. We will analyse the advantages and disadvantages of these variables.

Müller et al,⁵⁴ based on his experience with 4 cases, claims that in high risk people, the option exists to exclusively perform a myotomy and a fundoplication. Montesani et al⁵⁵ support the same idea, due to the good results obtained in 2 patients with this technique. The success in the abovementioned cases possibly radiates from the little clinical relevance that the diverticulum had in said individuals. Indeed, their 2 patients presented pyrosis with positive pH-metres, for which we suppose that the manifestations referred to were due to the gastroesophageal reflux and the concomitant movement disorder more than to the diverticulum in itself.

On the opposite end, the performance of an isolated diverticulectomy is found.^{29,56} Duda et al³³ point out the good clinical and radiological results obtained with this intervention in 11 patients. They conclude that there should be other aetiopathogenic mechanisms aside from the movement disorders or functional alterations of the inferior oesophageal sphincter. However, the manometry was only performed on one third of the patients, and thus we cannot know the exact prevalence of oesophageal movement disorders in their series. However, other authors report poor results when carrying out the diverticulectomy alone without other surgical gestures.^{16,21} This appears to be logical, as when not acting on the alleged cause, the relapse of the diverticulum,^{10,45,57} the early dehiscence of the sutures⁴⁰ or the formation of oesophagobroncheal fistulae⁵⁸ are favoured.

The oesophagectomy is a very aggressive intervention to treat a benign affection like this one. Nonetheless, in some cases, the failure of other techniques may require a oesophagectomy as a definitive solution.⁵⁹

Systematic or selective myotomy?

Some authors advocate for the systematic use of the myotomy,^{48,60} while others limit its practice to patients with obvious manometric disorders.^{25,33} Streitz et al²² defend the use of the selective myotomy as they observe, in 2 of their patients with normal manometries, oesophageal stenosis from reflux after the myotomy without fundoplication. They believe it is incorrect to section a healthy sphincter to later create a substituting antireflux mechanism.

They also base themselves on the good results obtained in certain patients with normal manometries to which a diverticulectomy without myotomy was performed.

As a result, the largest problem to back up the use of the myotomy is to identify the movement anomalies, which is not always easy. The barium transit test shows radiological

alterations (tertiary waves, spiral type images) that suggest a movement disorder in patients with normal or incomplete manometries.⁶¹ In turn, Nehra et al¹⁹ confirm functional disorders in 100% of the patients thanks to the use of the ambulatory manometry. This test registers the oesophageal motility during 24 h and it is especially useful to demonstrate functional disorders during meals. This study in a patient with a normal stationary manometry is diagnosed with an intermediate movement disorder thanks to the ambulatory test. They also use an endoscopy to introduce the manometry catheter in the stomach, which allows them to evaluate the characteristics of the inferior oesophageal sphincter in all individuals (Table 1).

From a technical point of view, the myotomy should respect the integrity of the vagus nerves, as cutting them would cause added morbidity.⁶² It is performed on the opposite side of the diverticulum if it is going to be removed, and in the same side, if it is going to be attached to the prevertebral fascia. We will advance from the distal end between 1.5 and 2 cm into the gastric wall. Regarding the proximal limit, all studies coincide that it should include the neck of the diverticulum. Evander et al⁴⁸ advance in the proximal direction to the level where the movement disorders begin as indicated in the manometry.

However, there is no research that evaluates the results of the surgery regarding the proximal extension of the myotomy.

Diverticulectomy or diverticulopexy?

There is not enough scientific evidence to specifically recommend either of the 2 procedures. The most used therapeutic option among surgeons is the excision of the pouch, and the pexy to the prevertebral fascia is conserved in those that present a wide neck^{19,48} and that offer, because of their characteristics, said technical possibility. The invagination of small diverticula of the oesophageal opening with good results⁴⁰ has also been described.

Belsey⁶³ confirms that the pexy of a large diverticulum is a safe procedure that is capable of eliminating the stasis of food in its interior if the difficulty to empty itself is due to the downward position of said diverticulum. We have not observed morbidity-mortality associated directly to the diverticulopexy, while the diverticulectomy entails the possibility of the dehiscence of the suture, relapse of the diverticulum, and oesophageal stenosis.⁶² The use of the diverticulopexy in poorly-nourished patients seems logical, as it would avoid the complications of the possible failures of the sutures. In addition, the section and the mechanical stapling of diverticula with wide necks presents a greater risk of dehiscence, as it usually requires more than one load. The crossed stitch between the different lines of staples are the weakest areas and thus the use of pistols with a sufficient length is recommended to complete the excision with only one shot.⁵⁹

In addition, the possibility of the malignancy of the oesophageal mucosa in the interior of the diverticular pouch,^{64,67} has been recognized for many years, leading to the need to remove it. The chronic inflammation caused by retaining foods could explain this infrequent neoplastic degeneration.⁶⁸ The majority of the oesophageal tumours

that are found in the diverticulum have a poor prognosis due to the fact that the absence of muscular layers favours a fast lymphatic dissemination. In addition, the diagnosis takes time as the early intra-diverticular growth does not initially cause dysphagia. Honda et al⁶⁴ report the paradoxical case of a carcinoma in situ detected in an early stage and treated with a diverticulectomy. The oesophagoscopy, proscribed a few years ago in a preoperative study of these patients because of the risk of iatrogenic perforation,²⁹ allows for the identification of mucosal lesions and, therefore, the correct planning of surgery.⁶⁹ Renz et al⁵⁶ recommend the use of the diverticulectomy in patients with illnesses that require strict pharmacologic treatment, as the diverticulum can act as a reservoir and alter the pharmaco-dynamics of the medications. The cases where the clinical progression has moved parallel to the growth of the pouch could greatly benefit from the diverticulectomy.

Is the systematic association of an anti-reflux technique necessary?

Although the majority of authors currently associate an anti-reflux technique, this issue continues to be questioned. Hudspeth et al²⁵ prolong the muscular section 1 cm to the gastric variant, without performing a fundoplication. They report excellent clinical results in all patients, although they do not specify if they interrogate them about reflux symptoms. We believe it is necessary to complete the intervention with an anti-reflux technique if the myotomy is extended 1.5-2 cm in the gastric wall. The muscular section of the gastroesophageal union, together with the decrease in the oesophageal clearance capacity, supports this idea. Indeed, Vecchio et al⁷⁰ report peptic oesophagitis in 2 patients with myotomy without anti-reflux. Another reason for the use of an anti-reflux technique is that some individuals simultaneously present an hiatus hernia and oesophagitis of various degrees, including Barrett's oesophagus.^{9,71} No cause-effect relationship has been demonstrated between the hiatus hernia and epiphrenic diverticula, but they are anatomical alterations that can co-exist with a pathological acid reflux that we can observe with a 24 h ambulatory pH-metre. In addition, the abdominal treatment entails the sectioning of the phrenoesophageal membrane, "de-inserting" the oesophagus from the diaphragm, which favours the reflux of the gastric content to the oesophagus. Matthews et al⁴⁹ recommend not to combine the fundoplication if the integrity of said ligament is maintained.

Which is the ideal anti-reflux mechanism in these cases?

Although the successful practice of the Fundoplication by Nissen^{70,72} has been described in these patients, the majority of authors prefer partial techniques,^{60,73} including Dor^{61,74-76} as well as Toupet.^{49,77,78} These entail less risk of postoperative dysphagia, and less so if they are preceded by a myotomy. The creation of a valvular mechanism of higher pressure may lead to the dehiscence of the sutures after a diverticulectomy. To avoid this, del Genio et al⁷² carry out a manometric evaluation of the inferior oesophageal sphincter in surgery once the 360° anti-reflux is finished, so that if any pressure >40 mm Hg is detected, they repeat the fundoplication in a looser manner. Some surgeons that treat diverticula with the thoracotomy

prefer to use a modified Belsey Mark IV technique,^{19,34} obtaining satisfactory results. However, Studies with pH-metre follow-ups are needed long term which allow for greater asseverations.

What treatment to use

Thoracic access?

The left posterior-lateral thoracotomy was chosen by the majority of surgeons until the late 1990's. Its advantages include the comfortable exposure of the diverticula and the low level of difficulty to perform an adequate intervention without altering the surrounding anatomy. The intervention is easy to complete with a myotomy as wide as needed and an anti-reflux technique. In spite of the fact that the majority of diverticula are found in the right wall of the oesophagus, the left entry allows for the dissection and excision without any problems or difficulties.³⁴ However, diverticulectomies by means of a right thoracotomy have also been performed correctly. The excellent-good results surpass 80% (Table 2), with a surgical morbidity comparable to any other access.

The introduction of the minimally invasive techniques brought with them the description of the first cases intervened by thoracoscopy.⁷⁹⁻⁸¹ We have found a greater morbidity with the thoroscopic intervention, possibly due to the technical difficulty of sectioning the neck of the diverticulum and, especially, for the combination of a sufficient myotomy and an effective anti-reflux technique. Indeed, Bonavina et al⁵⁸ suggest the possibility of carrying out a double technique, thoracoscopy for dissection and exeresis of the diverticulum, and laparoscopy to perform the fundoplication, after a myotomy. In spite of the introduction of mobile endostaplers, the practice of an anti-reflux by means of a thoracoscopy still seems to be especially complicated. Consequently, Champion⁸² does not recommend the use of a Belsey type fundoplication by thoracoscopy, as it entails a high morbidity in his series of 21 patients. As an advantage of the thoroscopic technique compared to the laparoscopy, van der Peet et al⁸³ point out the good visualization of the diverticular pouch and the adjacent structures, which permits its safe removal without damaging the vagus nerves.

Therefore, the thoracoscopy is especially indicated in the treatment of diverticula located in the middle oesophagus that do not have an associated movement disorder or gastroesophageal reflux, and that only need a diverticulectomy.

It can also be used to complete the dissection and excision of diverticula initially treated from the abdomen. Video-assisted thoracic surgery significantly reduces postoperative pain and analgesic requirements,⁸³ but that is not enough reason to systematically recommend for the treatment of the epiphrenic diverticulum.

Abdominal access?

The abdominal technique for epiphrenic diverticula is gaining importance in the last few years thanks to the incorporation

of the laparoscopy. It is especially indicated when the thoracotomy, because of previous surgery or an important alteration of the lung capacity of the patient, entails a high risk.⁸⁴ Its principal disadvantage is the difficulty to dissect large diverticula which require the sectioning of the diaphragm, altering the anatomy of the region. Under these circumstances, the diverticulectomy as well as the diverticulopexy may be technically difficult. Nonetheless, the results are satisfactory without observing great rates of morbidity-mortality.

In turn, the laparoscopic technique, thanks to the 30°-45° optics, allows for greater comfort when working in this area. The growing familiarity of the surgeons with the laparoscopic technique in the oesophageal hiatus has increased the procedures that can be carried out safely by means of this approach. However, those that do not agree, argue about the difficulty entailed in the dissection of the superior edge of the diverticula⁸⁵ and extension of the myotomy in the proximal direction to the correct height. Surgeons that use it praise the fact that they can finish the intervention with an adequate myotomy, diaphragmatic pillar repair and a fundoplication.⁸⁴ It is also possible to successfully treat large sized⁸⁶ and perforated diverticula, as Tinoco et al⁸⁷ demonstrate in a clinical case. Likewise, the entry angle of the lineal endostapler, parallel to the oesophagus, is the best to section the neck of the pouch. In addition, they use the intraoperative endoscopy as a complementary tool to corroborate the integrity of the oesophageal mucosa.⁸⁸ This enables the surgeon to identify and suture the produced perforations, if present, in the same intervention.⁸⁵ The intraoperative endoscopy as well as the use of guides avoid iatrogenic oesophageal narrowing that we produce if we excessively tighten the endoGIA to the neck of the diverticulum. As the guide moves through the oesophagus, it should always be supervised with direct vision, so that it is not introduced into the diverticulum where it could accidentally perforate it.²³

Abdominal technique of epiphrenic diverticula must be done with special care and precaution as to not damage the mediastinic pleura, as, occasionally, the adherences between these and the diverticulum are strong due to inflammatory phenomena. The opening of the pleural cavity causes a pneumothorax that, associated to a pneumoperitoneum if the surgery is laparoscopic, may require the use of a pleural drain system.⁸⁹

The duration of the intervention varies depending on the manoeuvres used and the skill level of the surgeon. Laparoscopic surgery times oscillate between 90 min⁹⁰ and 441 min,⁴⁷ but we cannot compare it with other types of surgery as we have no data.

The hospital stay of the patients that have undergone laparoscopic surgery is short, only presenting longer stays in some cases 24-48 h after the operation. Unlike open surgery, the analgesic requirements are minimal and patients can go back to everyday affairs very soon.⁹¹ The discomfort in the area of the incision from the thoracotomy and the laparotomy, described by some authors, does not appear after laparoscopic surgery. The results obtained from the laparoscopic excision of the pouch are satisfactory short, middle^{74,92,93} and long term^{61,94} (Table 2).

Other treatments

The majority of the reviewed studies do not describe conservative medical treatment in these patients. Michael et al⁹⁵ list all of the existing therapeutic possibilities, highlighting the lack of studies on the cost-effectiveness of each treatment. They confirm that the combination of medications with endoscopic therapy has a limited role, with 26% of the patients that respond to these measures (muscle relaxers, antidepressants, antisepters, pneumatic endoscopic dilatation, endoscopic injection of botulinum toxin). In spite of everything, it has been confirmed that high-risk patients (ASA III-IV) with an epiphrenic diverticulum associated with achalasia of the cardia temporarily improve after endoscopic dilatation or an injection of botulinum toxin.⁹⁶

Conclusions

Surgical indication in patients with an epiphrenic diverticulum should begin with a complete clinical history that allows us to understand the magnitude and the duration of symptoms. The corresponding complementary tests, among which the intraluminal oesophageal manometry and the videoradiology stand out, will establish a correlation between the clinic, the characteristics of the diverticulum and the associated movement disorder. The most practiced intervention is the diverticulectomy combined with an oesophageal cardiomyotomy and a partial fundoplication, as other varieties present greater morbidity-mortality. The ideal approach is whichever method that we are able to carry out the surgery correctly. The laparoscopic technique that should be performed by surgeons that are experts in gastroesophageal endoscopic surgery has gained numerous followers due to the good results obtained.

REFERENCES

- Borrie J, Wilson RL. Oesophageal diverticula: principles of management and appraisal of classification. *Thorax*. 1980;35:759-67.
- Goodman HI, Parnes IH. Epiphrenic diverticula of the esophagus. *J Thorac Cardiovasc Surg*. 1952;23:145-59.
- Harbour R, Miller J. A new system for grading recommendations in evidence based guidelines. *BMJ*. 2001;323:334-6.
- Harrington SW. The surgical treatment of pulsion diverticula of the thoracic esophagus. *Ann Surg*. 1949;129:606-18.
- Hoxie DA, Dillon MC, Tuckson WB, DeSai RM. Profuse bleeding in epiphrenic diverticula: an unusual finding. *J Natl Med Assoc*. 1995;87:373-5.
- Mondiere JT. Notes sur quelques maladies de l'oesophage. *Arch Gen Med Paris*. 1833;3:28-65.
- Thomas ML, Anthony AA, Fosh BG, Finch JG, Maddern GJ. Oesophageal diverticula. *Br J Surg*. 2001;88:629-42.
- Schachner A, Reiss R. Giant epiphrenic diverticulum of the esophagus. *Int Surg*. 1973;58:269-70.
- Benacci JC, Deschamps C, Trastek VF, Allen MS, Daly RC, Pairero PC. Epiphrenic diverticulum: results of surgical treatment. *Ann Thorac Surg*. 1993;55:1109-14.
- Mulder DG, Rosenkranz E, DenBesten L. Management of huge epiphrenic esophageal diverticula. *Am J Surg*. 1989;157:303-7.
- Nguyen BD, Roarke MC. Epiphrenic diverticulum: potential pitfall in thyroid cancer iodine-131 scintigraphy. *Clin Nucl Med*. 2005;30:631-2.
- Song HC, Kim SM, Heo YJ, Bom HS. Retention of iodine-131 in a thoracic esophageal diverticulum mimicking metastatic thyroid cancer. *Clin Nucl Med*. 2002;27:896-7.
- Conrad C, Nissen F. Giant epiphrenic diverticula. *Eur J Radiol*. 1982;2:48-9.
- Parikh HK, Deshpande RK, Desai PB. Epiphrenic diverticulum of the esophagus. *Indian J Gastroenterol*. 1991;10:150-1.
- Lavini C, Morandi U, Salcito D, Smerieri A, Fontana G, Lodi R. Epiphrenic megadiverticula: clinical and therapeutic considerations. Case contributions. *Ann Ital Chir*. 1983;55:211-9.
- Bruggemann LL, Seaman WB. Epiphrenic diverticula. An analysis of 80 cases. *Am J Roentgenol Radium Ther Nucl Med*. 1973;119:266-76.
- Jordan Jr PH, Kinner BM. New look at epiphrenic diverticula. *World J Surg*. 1999;23:147-52.
- Debas HT, Payne WS, Cameron AJ, Carlson HC. Physiopathology of lower esophageal diverticulum and its implications for treatment. *Surg Gynecol Obstet*. 1980;151:593-600.
- Nehra D, Lord RV, DeMeester TR, Theisen J, Peters JH, Crookes PF, et al. Physiologic basis for the treatment of epiphrenic diverticulum. *Ann Surg*. 2002;235:346-54.
- Vinson PP. Diverticula of the thoracic portion of the esophagus: report of forty-two cases. *Arch Otolaryngol*. 1934;19:508-13.
- Rivkin L, Bremner CG, Bremner CH. Pathophysiology of mid-oesophageal and epiphrenic diverticula of the oesophagus. *S Afr Med J*. 1984;66:127-9.
- Streitz Jr JM, Glick ME, Ellis Jr FH. Selective use of myotomy for treatment of epiphrenic diverticula. Manometric and clinical analysis. *Arch Surg*. 1992;127:585-7.
- Eubanks TR, Pellegrini CA. Minimally invasive treatment of esophageal diverticula. *Semin Thorac Cardiovasc Surg*. 1999;11:363-7.
- Ott DJ, Hodge RG, Chen MY, Wu WC, Gelfand DW. Achalasia associated with esophageal diverticula. Prevalence and potential implications. *J Clin Gastroenterol*. 1994;18:343-6.
- Hudspeth DA, Thorne MT, Conroy R, Pennell TC. Management of epiphrenic esophageal diverticula. A fifteen-year experience. *Am Surg*. 1993;59:40-2.
- Fegiz G, Paolini A, de Marchi C, Tosato F. Surgical management of esophageal diverticula. *World J Surg*. 1984;8:757-65.
- Hamilton S. Esophageal leiomyoma arising in an epiphrenic diverticulum. *Eur J Radiol*. 1988;8:118-9.
- Stroh C, Hohmann U, Meyer F, Manger T. Epiphrenic esophageal diverticulum after laparoscopic placement of an adjustable gastric band. *Obes Surg*. 2006;16:372-4.
- Jalundhwa JM, Shah RC. Epiphrenic esophageal diverticulum. *Chest*. 1970;57:97-9.
- Baker ME, Zuccaro Jr G, Achkar E, Rice TW. Esophageal diverticula: patient assessment. *Semin Thorac Cardiovasc Surg*. 1999;11:326-36.
- Mendl K, Evans CJ. Congenital and acquired epiphrenic diverticula of the oesophagus. *Br J Radiol*. 1962;35:53-8.
- Kaman L, Kundel B, Sinha SK, Singh R. True epiphrenic

- diverticulum of esophagus secondary to tubercular adenitis. *Indian J Gastroenterol.* 2003;22:65-6.
33. Duda M, Sery Z, Vojacek K, Rocek V, Rehulka M. Etiopathogenesis and classification of esophageal diverticula. *Int Surg.* 1985;70:291-5.
 34. Altorki NK, Sunagawa M, Skinner DB. Thoracic esophageal diverticula. Why is operation necessary? *J Thorac Cardiovasc Surg.* 1993;105:260-4.
 35. Clark SC, Norton SA, Jeyasingham K, Ridley PD. Oesophageal epiphrenic diverticulum: an unusual presentation and review. *Ann R Coll Surg Engl.* 1995;77:342-5.
 36. Witter JA, Lookanoff VA. Massive hemorrhage as the first manifestation of diverticulum of the lower thoracic esophagus. *Surgery.* 1951;29:895-901.
 37. Abul-Khair MH, Khalil A, Mohsen A. Bleeding from an epiphrenic oesophageal diverticulum. *Eur J Surg.* 1992;158:377-8.
 38. García JB, Bengochea JB, Wooler GH. Epiphrenic diverticula of the esophagus. Certain considerations about its surgical treatment. *J Thorac Cardiovasc Surg.* 1972;63:114-7.
 39. Galea JL, Manche A, Goiti JJ. An unusual case of supraventricular arrhythmia. *Eur J Cardiothorac Surg.* 1995;9:221-2.
 40. Klaus A, Hinder RA, Swain J, Achem SR. Management of epiphrenic diverticula. *J Gastrointest Surg.* 2003;7:906-11.
 41. Shah SM, Desai HG. Carcinoma in an oesophageal diverticulum. *J Assoc Physicians India.* 1992;40:119-20.
 42. Shin MS. Primary carcinoma arising in the epiphrenic esophageal diverticulum. *South Med J.* 1971;64:1022-4.
 43. Saldana JA, Cone RO, Hopens TA, Bannayan GA. Carcinoma arising in an epiphrenic esophageal diverticulum. *Gastrointest Radiol.* 1982;7:15-8.
 44. Philippakis M, Karkanas GG, Sakorafas GH. Carcinoma within an epiphrenic esophageal diverticulum. Case report. *Eur J Surg.* 1991;157:617-8.
 45. Fernando HC, Luketich JD, Samphire J, Alvelo-Rivera M, Christie NA, Buenaventura PO, et al. Minimally invasive operation for esophageal diverticula. *Ann Thorac Surg.* 2005;80:2076-80.
 46. Fasano NC, Levine MS, Rubesin SE, Redfern RO, Laufer I. Epiphrenic diverticulum: clinical and radiographic findings in 27 patients. *Dysphagia.* 2003;18:9-15.
 47. Motoyama S, Maruyama K, Okuyama M, Sasaki K, Sato Y, Ogawa J. Laparoscopic long esophagomyotomy with Dor's fundoplication using a transhiatal approach for an epiphrenic esophageal diverticulum. *Surg Today.* 2006;36:758-60.
 48. Evander A, Little AG, Ferguson MK, Skinner DB. Diverticula of the mid- and lower esophagus: pathogenesis and surgical treatment. *World J Surg.* 1986;10:820-8.
 49. Matthews BD, Nelms CD, Lohr CE, Harold KL, Kercher KW, Heniford BT. Minimally invasive management of epiphrenic esophageal diverticula. *Am Surg.* 2003;69:465-70.
 50. Orringer MB. Epiphrenic diverticula: fact and fable. *Ann Thorac Surg.* 1993;55:1067-8.
 51. Lerut T. Esophageal diverticula. In: Pearson FG, Deslauriers J, Ginsberg RJ, Hiebert CA, McKneally MF, Urschel HC, editors. *Esophageal surgery.* New York: Churchill Livingstone; 1995. p. 417-24.
 52. Allen TH, Clagett OT. Changing concepts in the surgical treatment of pulsion diverticula of the lower esophagus. *J Thorac Cardiovasc Surg.* 1965;50:455-62.
 53. Habein Jr HC, Moersch HJ, Kirklin JW. Diverticula of the lower part of the esophagus: a clinical study of one hundred forty-nine nonsurgical cases. *AMA Arch Intern Med.* 1956;97:768-77.
 54. Müller A, Halbfass HJ. [Laparoscopic esophagotomy without diverticular resection for treating epiphrenic diverticulum in hypertonic lower esophageal sphincter]. *Chirurg.* 2004;75:302-6.
 55. Montesani C, d'Amato A, Citone G, Procaccianti F, Narilli P, Ribotta G. Surgical treatment of epiphrenic diverticula of the esophagus: is diverticulectomy always necessary? A report of two cases. *Ital J Surg Sci.* 1985;15:69-73.
 56. Renz EM, Parker MV, Hetz SP. Laparoscopic repair of a large symptomatic epiphrenic esophageal diverticulum. *Curr Surg.* 2002;59:190-3.
 57. Habein Jr HC, Kirklin J, Clagett O, Moersch H. Surgical treatment of lower esophageal pulsion diverticula. *AMA Arch Surg.* 1956;72:1018-24.
 58. Bonavina L, Reitano M, Incabone R, Cappelletti M. Esophago-bronchial fistula after thoracoscopic resection of an epiphrenic diverticulum. *Dis Esophagus.* 1999;12:324-5.
 59. Reznik SI, Rice TW, Murthy SC, Mason DP, Apperson-Hansen C, Blackstone EH. Assessment of a pathophysiology-directed treatment for symptomatic epiphrenic diverticulum. *Dis Esophagus.* 2007;20:320-7.
 60. Fekete F, Vonns C. Surgical management of esophageal thoracic diverticula. *Hepatogastroenterology.* 1992;39:97-9.
 61. Tedesco P, Fisichella PM, Way LW, Patti MG. Cause and treatment of epiphrenic diverticula. *Am J Surg.* 2005;190:891-4.
 62. Giuli R, Estenne B, Richard CA, Lortat-Jacob JL. Les diverticules de l'oesophage. A propos de 221 cas. *Ann Chir.* 1974;28:435-43.
 63. Belsey R. Functional disease of the esophagus. *J Thorac Cardiovasc Surg.* 1966;52:164-88.
 64. Honda H, Kume K, Tashiro M, Sugihara Y, Yamasaki T, Narita R, et al. Early stage esophageal carcinoma in an epiphrenic diverticulum. *Gastrointest Endosc.* 2003;57:980-2.
 65. Schultz SC, Byrne DM, de Cunzio P, Byrne WB. Carcinoma arising within epiphrenic diverticula. A report of two cases and review of the literature. *J Cardiovasc Surg.* 1996;37:649-51.
 66. Thomas RC. Carcinoma in epiphrenic diverticula. *Ann Thorac Surg.* 1968;6:85-7.
 67. Guerra JM, Zuñil M, García I, Moreno E. Epiphrenic diverticula, esophageal carcinoma and esophagopleural fistula. *Hepatogastroenterology.* 2001;48:718-9.
 68. Gawande AS, Batiuchok W, Barman AA, Mule JE. Carcinoma within lower esophageal (epiphrenic) diverticulum. *NY State J Med.* 1972;72:1749-51.
 69. Lai ST, Hsu CP. Carcinoma arising from an epiphrenic diverticulum: a frequently misdiagnosed disease. *Ann Thorac Cardiovasc Surg.* 2007;13:110-3.
 70. Vecchio R, Mosca F, Ciaccio G, Ferrara M, Di Franco F, Latteri S. The physiopathological and therapeutic aspects of esophageal diverticula. *Minerva Chir.* 1997;52:329-35.
 71. Rosati R, Fumagalli U, Bona S, Bonavina L, Peracchia A. Diverticulectomy, myotomy, and fundoplication through laparoscopy: a new option to treat epiphrenic esophageal diverticula? *Ann Surg.* 1998;227:174-8.
 72. del Genio A, Rossetti G, Maffetone V, Renzi A, Bruscianno L, Limongelli P, et al. Laparoscopic approach in the treatment of epiphrenic diverticula: long-term results. *Surg Endosc.* 2004;18:741-5.
 73. Allen MS. Treatment of epiphrenic diverticula. *Semin Thorac Cardiovasc Surg.* 1999;11:358-62.
 74. Ceretti AP, Carzaniga P. Laparoscopic management of oesophageal epiphrenic diverticulum: a case report. *Chir Ital.* 2005;57:261-6.

75. Lukovich P, Nehez L, Kupcsulik P. Laparoscopic transhiatal resection of epiphrenic diverticulum of the esophagus. *Orv Hetil.* 2006;147:2187-9.
76. Chiappalone S, Russo B, Masella C, Fontana B, Virgilio D. The epiphrenic esophageal diverticulum. Its transhiatal laparoscopic treatment. *Minerva Chir.* 1999;54:631-4.
77. Valentini M, Pera M, Vidal O, Lacima G, Belda J, de Lacy AM. Incomplete esophageal myotomy and early recurrence of an epiphrenic diverticulum. *Dis Esophagus.* 2005;18:64-6.
78. Pitchford TJ, Price PD. Laparoscopic Heller myotomy with epiphrenic diverticulectomy. *JSLs.* 2003;7:165-9.
79. Peracchia A, Bonavina L, Rosati R, Bona S. Thoracoscopic resection of epiphrenic esophageal diverticula. In: Peters J, DeMeester TR, editors. Minimally invasive surgery of the foregut. St. Louis: QMP; 1994. p. 110-6.
80. Ohgami M, Ando N, Ozawa S, Kitajima M. Thoracoscopic surgery for benign esophageal disease. *Rinsho Kyobu Geka.* 1994;14:30-6.
81. Saw EC, McDonald TP, Kam NT. Video-assisted thoracoscopic resection of an epiphrenic diverticulum with esophagomyotomy and partial fundoplication. *Surg Laparosc Endosc.* 1998;8:145-8.
82. Champion JK. Thoracoscopic Belsey fundoplication with 5-year outcomes. *Surg Endosc.* 2003;17:1212-5.
83. van der Peet DL, Klinkenberg-Knol EC, Berends FJ, Cuesta MA. Epiphrenic diverticula: minimal invasive approach and repair in five patients. *Dis Esophagus.* 2001;14:60-2.
84. Neoral C, Aujesky R, Bohanes T, Klein J, Kral V. Laparoscopic transhiatal resection of epiphrenic diverticulum. *Dis Esophagus.* 2002;15:323-5.
85. Fraiji E, Bloomston M, Carey L, Zervos E, Goldin S, Banasiak M, et al. Laparoscopic management of symptomatic achalasia associated with epiphrenic diverticulum. *Surg Endosc.* 2003;17:1600-3.
86. Granderath FA, Pointner R. Laparoscopic transhiatal resection of giant epiphrenic esophageal diverticulum. *Dis Esophagus.* 2007;20:353-7.
87. Tinoco RC, Tinoco AC, El-Kadre L. Perforated epiphrenic diverticulum treated by video laparoscopy. *Surg Endosc.* 1999;13:270.
88. Bloomston M, Brady P, Rosemurgy AS. Videoscopic Heller myotomy for achalasia-results beyond short-term follow-up. *JSLs.* 2002;6:133-8.
89. Myers BS, Dempsey DT. Laparoscopic resection of esophageal epiphrenic diverticulum. *J Laparoendosc Adv Surg Tech.* 1998;8:201-7.
90. Ipek T, Eyuboglu E. Laparoscopic resection of an esophageal epiphrenic diverticulum. *Acta Chir Belg.* 2002;102:270-3.
91. Lazar G, Szentpali K, Paszt A. Minimally invasive surgical treatment for mild-esophageal and epiphrenic diverticula. *Magy Seb.* 2005;58:352-6.
92. Chami Z, Fabre JM, Navarro F, Domergue J. Abdominal laparoscopic approach for thoracic epiphrenic diverticulum. *Surg Endosc.* 1999;13:164-5.
93. Rosati R, Fumagalli U, Bona S, Zago M, Celotti S, Bisagni P, et al. Laparoscopic treatment of epiphrenic diverticula. *J Laparoendosc Adv Surg Tech A.* 2001;11:371-5.
94. Feo CV, Sortini D, Liboni A. Esophageal achalasia with epiphrenic diverticulum with laparoscopic approach: a 6-year follow-up. *Dig Surg.* 2006;23:27.
95. Michael H, Fisher RS. Treatment of epiphrenic and Mid-esophageal diverticula. *Curr Treat Options Gastroenterol.* 2004;7:41-52.
96. Wehrmann T, Kokabpick H, Jacobi V, Seifert H, Lembcke B, Caspary WF. Long-term results of endoscopic injection of botulinum toxin in elderly achalasia patients with tortuous megaesophagus or epiphrenic diverticulum. *Endoscopy.* 1999;31:352-8.