Original article

Functional results after extended myotomy for diffuse oesophageal spasm

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Background: The role of surgery in the management of patients with diffuse oesophageal spasm (DOS) remains controversial. The aim of this study was to assess functional results after extended myotomy for DOS.

Methods: This prospective study evaluated 20 patients who had extended myotomy (14 cm on the oesophagus and 2 cm below the oesophagogastric junction) with anterior fundoplication via a laparotomy for severe DOS. Median follow-up was 50 (range 6–84) months. Functional data were assessed by means of dysphagia (range 0–3), chest pain (range 0–3) and overall clinical (range 0–12, including dysphagia, chest pain, regurgitation, gastro-oesophageal reflux) scores.

Results: All patients had severe DOS. The median preoperative overall clinical score was 6 (range 3–8) with a dysphagia score of at least 2. Median postoperative functional scores were significantly lower than preoperative values (overall clinical score 1 *versus* 6, dysphagia score 0 *versus* 3, chest pain score 0 *versus* 2). At final follow-up, good or excellent results were obtained for overall clinical score in 16 patients, for dysphagia score in 18 and for chest pain score in all 20 patients. Postoperative gastro-oesophageal reflux was noted in two of the 20 patients.

Conclusion: Extended myotomy with anterior fundoplication is an effective treatment for severe DOS. Medium-term postoperative functional results were excellent, especially in terms of dysphagia and chest pain.

Introduction

Primary oesophageal motility disorders, mainly characterized by dysphagia and chest pain, are diagnosed routinely from manometric data. Achalasia is the commonest motility disorder and is correlated with specific histological anomalies[1]. Diffuse oesophageal spasm (DOS) is rare and reported to be five times less frequent than achalasia[2]. According to the definition by Richter and colleagues[3], DOS is characterized by intermittent peristalsis and simultaneous contractions in 20 per cent or more of wet swallows[4,5]. Some authors have found correlations between contraction amplitudes, frequently exceeding 30 mmHg, and symptomatic events[1,6]. Patients have subsequently been separated into two distinct subgroups: those with chest pain and high contraction amplitudes and others

with dysphagia and lower contraction amplitudes. Radiological findings vary but may show segmental contractions sometimes associated with oesophageal diverticula.

The first-line treatment for DOS is still under debate. Many patients with chest pain respond to reassurance or medical treatments such as calcium-channel blockers[7], long-acting nitrates[8], anticholinergics[9] and even antidepressant medication[10]. Pneumatic dilatation[11] or injection of *Clostridium botulinum* toxin[12] may help patients with severe dysphagia and symptoms of delayed emptying. Although the risk for oesophageal perforation following pneumatic dilatation in patients with DOS has not been evaluated, a higher risk for oesophageal perforation has been shown in patients with achalasia when high pressures (more than 70 cmH$_2$O) are used[13]. If chest pain and

dysphagia do not respond to endoscopic treatment, surgical extended myotomy might help, but the position and length of the myotomy, the surgical approach (thoracic or abdominal) and benefit of an antireflux procedure are controversial[14–17]. Furthermore, incomplete symptom relief associated with early recurrence has been reported after extended myotomy for DOS, making some surgeons reluctant to operate[18]. The aim of this study was to assess medium-term functional results after extended myotomy with an anterior fundoplication for severe DOS.

Methods

All patients with severe DOS or unsuccessful endoscopic treatment for DOS had elective surgery at Cochin University Hospital between 1998 and 2004. The surgical procedure was agreed by both medical and surgical teams for patients with severe DOS associated with quality of life impairment or a dysphagia score of at least 2: primary surgery was proposed in patients with a lower oesophageal sphincter (LOS) pressure above 70 cmH$_2$O whereas secondary surgery was chosen after failure of endoscopic treatment in patients with slightly increased LOS pressure (less than 70 cmH$_2$O). Characteristics of the 20 consecutive patients included in this prospective study appear in *Table 1*. Nine patients had a history of abdominal surgery unrelated to oesophageal or gastric surgery.

All patients had barium swallow, endoscopy and oesophageal manometry. Symptoms suggestive of DOS were dysphagia, chest pain and regurgitation (*Table 1*). DOS was diagnosed manometrically when intermittent simultaneous contractions were detected (20 per cent or more of wet swallows)[5] intermixed with normal peristalsis[4].

Table 1 Characteristics and preoperative symptoms of 20 patients with diffuse oesophageal spasm

Age (years)*	61·5 (29–80)
ASA score	
I	18
II and III	2
Sex ratio (F : M)	13 : 7
Weight (kg)*	69·5 (41–85)
Height (cm)*	168·5 (156–178)
Duration of symptoms (months)*	48 (6–240)
Weight loss in the previous 3 months (kg)*	7 (0–25)
Preoperative medical treatment	7
Preoperative endoscopic treatment	8
Dysphagia	20
Chest pain	14
Dysphagia and chest pain	14
Regurgitation	16
Gastro-oesophageal reflux	0

*Values are median (range). ASA, American Society of Anesthesiologists.

The surgical procedure consisted of an extended modified Heller myotomy[19] associated with muscular crural closure and anterior fundoplication (Dor procedure)[20]. This procedure was performed via a supraumbilical midline incision by one surgeon. After section of the anterior cardial vessels and location of the vagal trunks, the oesophagogastric junction was mobilized with complete oesophageal dissection. The thoracic oesophagus was dissected, reaching the posterior mediastinum at the level of the inferior pulmonary veins. To facilitate the myotomy, a 36-Fr Faucher tube (Vygon, Ecouen, France) was introduced into the oesophagus and then replaced by a nasogastric suction tube before completion of the fundoplication. The myotomy extended upwards for 12–16 cm above the cardia and downwards for 2 cm below the oesophagogastric junction. A methylene blue test was carried out to check for mucosal tears. The oesophageal hiatus was then partially closed posterior to the oesophagus using separate non-absorbable stitches (Ethibond® 2/0; Ethicon, Issy les Moulineaux, France). An anterior fundoplication was performed and sutured to the right hiatal crus and the right edge of the myotomy using separate non-absorbable stitches (Ethibond® 3/0). The fundoplication covered the intra-abdominal part of the myotomy. No surgical treatment of oesophageal diverticula was undertaken.

Functional variables (dysphagia, chest pain, regurgitation, gastro-oesophageal reflux and weight variation) were recorded. Functional scores were obtained after separate evaluations by gastroenterological and surgical teams. In case of discrepancy, a mean score was recorded. The patients were evaluated before surgery, then 1, 3, 6 and 12 months afterwards and annually thereafter.

An overall clinical score based on four clinical symptoms (dysphagia, chest pain, regurgitation and gastro-oesophageal reflux) derived from the Eckardt score[21] and originally devised for achalasia was used for functional assessment of patients. The results were considered to be excellent (score 0), satisfactory (score 1 or 2, with two different symptoms), fair (score 2 or 3) or poor (score more than 3, or any patient requiring reoperation or postoperative pneumatic dilatation). Dysphagia and chest pain were also assessed separately, and the results were considered to be excellent (none, score 0), satisfactory (weekly, score 1), fair (daily, score 2) or poor (each meal, score 3). Perioperative data (duration of surgery, morbidity, intraoperative mucosal tear, length of hospital stay, time to resumption of oral feeding) were collected.

A barium swallow was performed in all patients 1 month after surgery (*Fig. 1b*). Protocol-driven postoperative workup, including oesophageal manometry, endoscopy, 24-h pH monitoring and barium swallow, was undertaken in

any patient with an overall clinical score of 2 or more or any symptom of gastro-oesophageal reflux at 3 months. Postoperative follow-up refers to the time between surgery and last functional evaluation. No patient was lost to follow-up.

Statistical analysis

Results are expressed as median (range). Quantitative variables were compared using Wilcoxon paired rank sum test. $P < 0.050$ was considered significant. Functional results were assessed on an intention-to-treat basis.

Results

Manometric data appear in *Table 2*. Barium swallow revealed 'rosary bead oesophagus' (segmental contractions) in 13 patients (*Fig. 1a*), cardiospasm in eight (dilated oesophagus with bird-beak appearance of the oesophagogastric junction), epiphrenic diverticulum in four, midthoracic diverticulum in two and a normal oesophagus in one. Endoscopic ultrasonography (EUS) was performed in 11 of 20 patients with atypical clinical or manometric features. EUS was normal in six patients and showed muscular thickening in the distal oesophagus in five.

Previous medical treatment with calcium-channel blockers, long-acting nitrates or both had failed in six patients. Endoscopic treatment had failed in eight, including *Clostridium botulinum* toxin injection in two, one to three pneumatic dilatations in five patients, and both treatments in one patient.

Median duration of operation was 120 (range 60–210) min. There were no inadvertent intraoperative mucosal tears. The median postoperative hospital stay was 8 (range 5–30) days and median time to resumption of oral intake was 2 (range 1–8) days. One patient developed delayed gastric emptying which markedly delayed resumption of oral feeding. Two patients had asymptomatic pleural effusion with no need for drainage. The clinically relevant morbidity rate was 5 per cent. There were no postoperative deaths.

Functional scores from before and after surgery appear in *Table 3*. Overall median follow-up was 50 (range 6–84)

Table 2 Preoperative manometric data in 20 patients with diffuse oesophageal spasm

LOS pressure (cmH$_2$O)	41·5 (16–120)
LOS relaxation (%)	71·5 (15–90)
Peristalsis (%)	40 (0–100)
Contraction amplitude (cmH$_2$O)	102·5 (35–304)

Values are median (range). LOS, lower oesophageal sphincter.
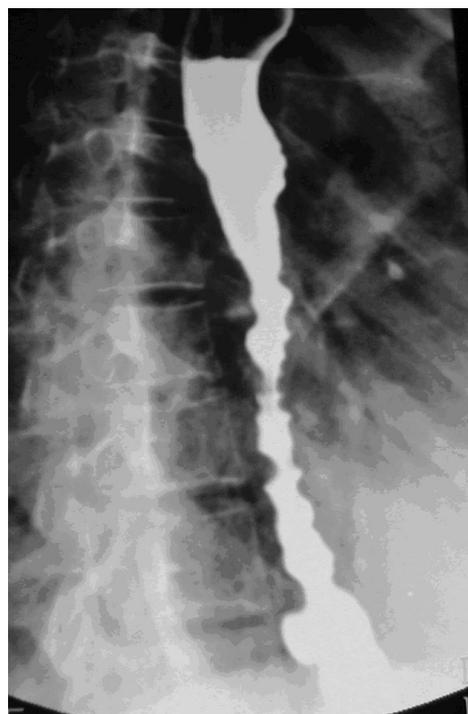
a Before operation

b After operation

Fig. 1 Barium swallow **a** before operation and **b** 1 month after operation in the same patient

Table 3 Functional scores before operation and at the end of the follow-up in 20 patients who had surgery for diffuse oesophageal spasm

	Preoperative (n = 20)	Postoperative (n = 20)	P*
Overall clinical score	6 (3–8)	1 (0–6)	< 0·01
Dysphagia score	3 (2–3)	0 (0–3)	< 0·01
Chest pain score	2 (0–3)	0 (0–1)	< 0·01

Values are median (range). *Wilcoxon paired rank sum test.

Table 4 Outcome after operation for diffuse oesophageal spasm

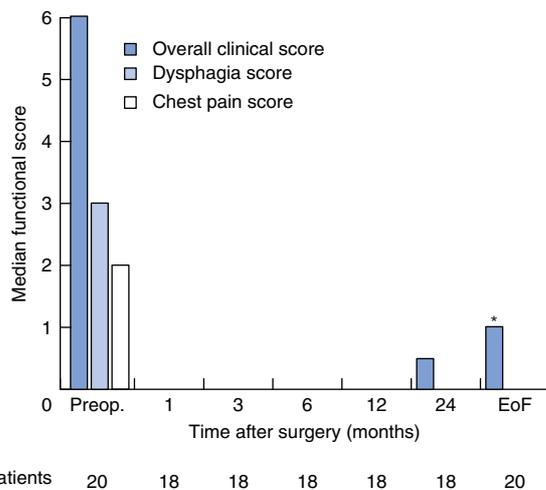|	Satisfactory or excellent result				
	3 months	6 months	12 months	24 months	36 months
Overall clinical score	16 of 20	16 of 18	16 of 18	15 of 18	12 of 16
Dysphagia score	19 of 20	17 of 18	17 of 18	16 of 18	14 of 16
Chest pain score	20 of 20	18 of 18	18 of 18	18 of 18	16 of 16

Fig. 2 Changes in median functional scores with time in 20 patients who had surgery for diffuse oesophageal spasm. EoF, end of follow-up

months. Median regain of weight at 6-month follow-up was 2·5 (range 0–9) kg. At the end of the follow-up period, global excellent or satisfactory results were found in 16 of 20 patients when assessed on the overall clinical score, in 18 of 20 on the dysphagia score and in all 20 on the chest pain score. Of the four patients with incomplete symptom relief who underwent a complete postoperative work-up, median LOS pressures were 18

(range 11–23) cmH$_2$O. Barium swallow and endoscopy showed no signs of fundoplication failure or gastric outlet obstruction. In two patients, 24-h pH monitoring disclosed postoperative gastro-oesophageal reflux, as suggested by clinical symptoms. Functional results seemed to be stable with time, when assessed by overall clinical score and dysphagia score (*Table 4, Fig. 2*).

Discussion

In this study, extended myotomy with anterior fundoplication achieved excellent results in a high proportion of patients with severe DOS when assessed on overall clinical scores as well as dysphagia and chest pain scores.

Surgical treatment for DOS is palliative and consists of an extended myotomy designed to eradicate the oesophageal spasm responsible for dysphagia and chest pain. The surgical technique was first reported by Lortat-Jacob[22] in 1950, but some debate remains about the length and level of the myotomy, the thoracic or abdominal approach, whether to include the LOS and the need for an antireflux procedure[17]. Variable success from small surgical series have led most gastroenterologists to consider surgical treatment only for patients with incapacitating symptoms[15]. The aim of the present study was to evaluate functional results after extended myotomy (up to the level of the interior pulmonary veins) with partial anterior fundoplication for DOS by means of a clinical score.

Total oesophageal myotomy has been advocated for the treatment of DOS[23]. In a series of 34 patients with a 5-year follow-up, complete relief of chest pain in all but one patient and satisfactory postoperative results in 94 per cent[15] of cases were reported. Others have recommended correlation of the myotomy extent with preoperative manometric data[17]. The precise extent of the myotomy was not detailed in other studies, except for the small number of total oesophageal myotomies, one of 11 patients in one study[16] and one of 40 in another[24]. Total thoracic oesophageal myotomy seems difficult to justify as morbidity is increased by the thoracic approach while functional results are not improved compared to those reported after extended transabdominal myotomy[15,16,24].

Recent data suggest that DOS is not a diffuse spastic disorder but represents a distal oesophageal dysfunction, which could explain the efficiency of a distal myotomy[25,26]. Nastos and colleagues[25] reported a better functional outcome in patients with an epiphrenic diverticulum, possibly related to a more limited distal oesophageal disorder.

The functional results observed in the present series appeared better than those previously reported after

the same surgical technique performed via a thoracic approach[25]. These encouraging results might be biased by the use of a scoring system principally based on symptom frequency rather than intensity. The present study defined DOS using two subgroups of patients (those with chest pain and high pressure and those with dysphagia and low pressure) according to the definitions of Richter[1] and Srinivasan and colleagues[6]. This may also have influenced results, as some authors do not consider patients with low-amplitude contractions as having DOS[25,26]. The present results do, however, support the view that an extended myotomy (including the LOS) is an adequate procedure for the treatment of severe symptomatic DOS[25]. The systematic inclusion of the LOS seems warranted by the potential after-effects of myotomy, even in the setting of normal LOS pressure[27]. Myotomy preserving the LOS may result in postoperative dysphagia due to induced aperistalsis[27], with a reported incidence of 27·2 per cent[16].

Inclusion of the LOS in the myotomy increases the risk of postoperative gastro-oesophageal reflux. Ellis and co-workers[17] reported symptomatic reflux in 7·5 per cent of patients after myotomy via a thoracic approach, a rate similar to this series. They, like others, recommend an antireflux procedure in association with crural closure to prevent gastro-oesophageal reflux. The use of an anterior fundoplication prevents adhesion between the myotomy and the left liver[28,29] and may minimize the risk of an oesophageal tear in the rare instance of late reoperative surgery (6 per cent)[30]. Data from randomized clinical trials comparing anterior and Nissen fundoplication for reflux disease have reported similar functional results, although incapacitating dysphagia is less frequent after partial fundoplication[31,32]. This may be important in the setting of motility disorders.

Extended myotomy including the LOS associated with anterior fundoplication resulted in excellent medium-term results for the treatment of severe DOS. Larger series are needed with longer follow-up to confirm the durability of this operation.

Acknowledgements

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