



## Prosthetic mesh repair of large and recurrent diaphragmatic hernias

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### Abstract

**Background:** Laparoscopic repair of large paraesophageal hernias (PEH) is associated with significant recurrence rates. Use of prosthetic mesh to complete tension-free repair of the hiatus has been suggested to decrease the recurrence rate.

**Methods:** Fifty-nine patients with large ( $n = 44$ ) or recurrent ( $n = 15$ ) PEH were operated on via the laparoscopic approach with the use of prosthetic mesh. Patients were followed with office visits and phone interviews. All patients were referred for barium studies. Data analysis included all patients, including conversions, on an intention-to-treat basis.

**Results:** Followup was completed in 56 (95%) patients. Mean followup time was 28.4 months. Forty patients (74%) had significant relief of all symptoms. Barium studies were performed in 45 patients (80.3%), including all symptomatic patients. Fifteen patients (33%) had a small sliding hernia, six (13.3%) had recurrent PEH, and four (8.8%) had narrowing of the gastroesophageal junction. Most patients with small hiatal hernias were symptomatic (60%). All responded to medical treatment.

**Conclusions:** Laparoscopic repair of large PEH with reinforcement mesh is feasible and safe with excellent short-term results. Long-term followup shows a low PEH recurrence requiring reoperation, but a significant number of patients develop symptomatic recurrent small hiatal hernias that can be managed nonoperatively.

**Key words:** Laparoscopic — Paraesophageal hernia — Mesh

Paraesophageal hernias (PEH) account for approximately 5% of all hiatal hernias [9]. This condition occurs mainly in elderly patients and if left untreated may cause complications such as gastric volvulus, strangulation, or gastrointestinal hemorrhage. Therefore, it is generally recommended that once diagnosis is made, elective repair be performed.

Several series have shown that open repair of PEH is associated with a recurrence rate of up to 10% [1, 4, 6]. Thanks to the experience gained with laparoscopy, most of which was acquired in treating gastroesophageal reflux disease, the laparoscopic approach became common practice in large PEH as well. Several series have shown this technique to be feasible and safe with excellent short-term results [16, 21]. However, the recurrence rate with the laparoscopic approach for large PEHs has been shown to be higher than in the open technique, ranging between 10.5% and 42% [8, 11, 12, 19, 22]. Most failures are caused by crural breakdown and migration of the wrap to the mediastinum [12, 19]. The use of a prosthetic mesh to complete a tension-free or buttressed repair of the hiatus has been suggested by several authors to decrease the recurrence rate [5, 7, 14, 20]. In this article we report the outcome of 59 patients with large PEHs (either primary or recurrent after previous failed repair) who underwent laparoscopic repair with prosthetic mesh placement.

### Patients and methods

We retrospectively reviewed the database of 170 patients with a diagnosis of PEH between October 1996 and October 2004 at our institution. All patients that underwent open or laparoscopic repair without the use of prosthetic mesh were excluded.

Study inclusion criteria were large or recurrent PEH, laparoscopic repair, and use of prosthetic reinforcement mesh for the repair of the hernia. Prosthetic reinforcement mesh was used only in patients who had large diaphragmatic hernias that required considerable tension to repair the defect. No mesh was used for patients with smaller hernias in which a tension-free repair could be achieved with primary repair, and

these patients were not included in this study. The size of the hiatal defect was not routinely measured because the decision to use the mesh was not based on size alone but rather on the surgeon's assessment of whether a safe, tension-free repair was feasible.

Information on presenting symptoms, preoperative workup, operative procedures, and postoperative course was extracted from the patients' files.

### Operative technique

After general anesthesia is induced, the patient is operated on while in the modified lithotomy position with the surgeon standing between the patient's legs. The procedure is carried out through four or five trocars. After the left lobe of the liver is retracted, the peritoneum is incised around the diaphragmatic defect and the dissection performed beyond the hernia sac, in an avascular plane between the sac and the mediastinum. No effort is made to reduce the sac content but rather the sac and its content are reduced en bloc. It is sometimes necessary to divide some of the short gastric vessels to give free access to the left crus, but this is not always necessary. After the sac is completely reduced, dissection in the mediastinum is performed to free the esophagus and ensure that the gastroesophageal junction is well below the diaphragm without tension. Occasionally, the pleura is opened during the dissection. This usually does not create a problem and is easily sutured when needed.

After the sac is reduced it is resected, taking care not to injure the vagal nerves. The esophagus is then encircled with nylon tape used for retraction. The repair is performed with interrupted nonabsorbable 00 braided sutures, dorsal and ventral to the esophagus, so as to place it approximately in its normal anatomical position. After the crura are approximated dorsally with several sutures, a precut mesh is placed around the distal esophagus and secured to the diaphragm using a hernia stapler or sutures, leaving a sufficient gap between the mesh and the esophagus. We used several meshes during the course of the study period. The first one was a polytetrafluoroethylene (PTFE) mesh that we stopped using because of reports that had appeared in the literature of mesh erosions, even though none of our patients developed this complication. We then used Gore-Tex mesh, which we found difficult to handle endoscopically. We recently started using a coated, preformed, polyester mesh (Pariatex mesh, Sofradim, Lyon, France) that is more easy to handle and less expensive.

A Nissen fundoplication is performed as part of the procedure in most cases. In some patients division of the short gastric vessels is not needed because the stomach, now reduced from the chest, is redundant enough to allow a "floppy" wrap. A 2–3-cm wrap is constructed and fixed by three stitches, with the upper one anchoring the wrap to the esophagus, taking care to spare the anterior vagus. No other procedure (e.g., anterior fundophrenopexy) is performed to further secure the stomach in the abdomen.

The repair of the diaphragm and the fundus is performed over a large nasogastric tube only. This is removed at the end of the procedure or shortly thereafter. Oral feeding is started the day after the operation, beginning with clear fluids and quickly proceeding to blended food, followed by a regular diet as tolerated.

### Followup data

Patients were followed up with office visits and phone interviews.

We do not routinely perform postoperative barium studies on asymptomatic patients. The patients included in this study, however, were all referred for barium studies regardless of symptomatology.

### Results

A total of 59 patients underwent LMRPEH between October 1996 and October 2004 in our institution. Two patients had died after the operation and one patient was lost to followup. The deaths of the two patients during the followup period were due to lung cancer and

**Table 1.** Presenting symptoms of patients with large and recurrent diaphragmatic hernias

Main symptom	No. patients (%)
Epigastric pain	61%
Heartburn	44%
Anemia	22%
Regurgitation	19%
Dysphagia	17%
Acute gastric volvulus	13%
Respiratory related symptoms	13%
Recurrent vomiting	7%
Early satiety	7%
Weight loss	4%

**Table 2.** Perioperative complications of laparoscopic mesh repair of large and recurrent diaphragmatic hernias

Complication	No. patients (%)
Pleural bleeding	2 (3.6%)
Esophageal perforation	1 (1.8%)
Pneumothorax	3 (5.5%)

acute myocardial infarction and occurred more than one year after the operation. Neither death was related to the procedure or to the PEH.

The mean age at presentation was 65.5 years (range = 26–82 years), and the female/male ratio was 1.19. The main presenting symptoms are outlined in Table 1. Mean duration of symptoms was 44 months [range = 0 (patients who presented with gastric volvulus without prior symptomatology) to 10 years]. Preoperative diagnosis of PEH was made with a barium study in 51 patients (91%), CT scan in 4 patients (7%), and chest X ray in 1 patient (1.8%). Upper endoscopy was performed in 41 patients (73%). Fifteen patients (27%) underwent a previous diaphragmatic hernia repair (all without use of prosthetic mesh) and presented with recurrence of symptoms and radiographically proved PEH.

Fundoplication was performed in 57 patients (96%), including Nissen fundoplication in 55 patients (93%), Toupet in 1 patient (1.8%), and Belsey in 1 patient (1.8%). Gastropexy was performed in one patient (1.8%). Mean hospital stay was 5.9 days (range = 2–70 days). Conversion to the open technique was required in four patients (7.1%). Perioperative complications occurred in six patients (11%) and are summarized in Table 2. Reoperation as a result of significant pleural bleeding was required in one patient.

Mean followup was 28.4 months (range = 6–92 months). Fifty-four patients (96.4%) were available for followup and 43 patients (77%) were available for followup for one year. Barium study was performed in 45 patients (80.3%), including all symptomatic patients. Nine asymptomatic patients preferred not to undergo the barium study. The incidence of postoperative symptoms is summarized in Table 3. Forty patients (74%) had significant relief of all symptoms; 25 of them were completely asymptomatic. In the remaining pa-

**Table 3.** Postoperative symptoms following laparoscopic mesh repair of large and recurrent diaphragmatic hernias

Symptom	No. patients (%)
Significant relief of all symptoms	40 (74%)
Totally asymptomatic	25 (46%)
Epigastric pain	13 (24%)
Heartburn	10 (18%)
Dysphagia	7 (13%)
Diarrhea	2 (3.6%)

tients the predominant symptoms included heartburn, epigastric pain, and dysphagia. Results of the barium studies and associated symptoms are summarized in Table 4. Twenty-five patients (55.5%) had an abnormal barium esophagram: 15 patients (33.3%) had a small type I sliding hernia, 6 patients (13.3%) had recurrent PEH, and 4 patients (8.8%) had narrowing of the gastroesophageal junction. Presenting symptoms of patients with recurrent PEH included recurrent vomiting (2 patients), recurrence of epigastric pain (3 patients), and heartburn (1 patient). Most patients with small hiatal hernias were symptomatic (60%); the most prominent symptoms were epigastric pain (40%) and heartburn (33%).

Operative complications, conversion rates, and PEH recurrence in patients who underwent first repairs compared with patients operated on for recurrent PEH are summarized in Table 5.

## Discussion

PEH is associated with a significant risk of life-threatening complications [18]. Therefore, it is generally agreed that PEH patients should undergo elective repair of PEH shortly after diagnosis is made. Recently it was debated whether asymptomatic patients should be treated. Open surgical repair of PEH is a highly effective procedure, with reported recurrence rates of up to 10% in most series [1, 4, 6]. Laparoscopic repair of PEH is a feasible and safe but technically demanding procedure. Several series have shown that the short-term results of laparoscopic repair of PEH are excellent [16, 21]; however, the incidence of hernia recurrence may be significantly higher than with the open approach, as high as 42% in one series [11]. One possible reason for the high recurrence rate may be the high tension that is formed when a wide crural gap is sutured. This hypothesis led some authors to recommend the use of prosthetic mesh to reinforce the hiatus and form a tension-free repair of the wide hiatal gap [5, 7, 14, 15, 20].

The short-term results following laparoscopic mesh repair of PEH in our series are excellent. After a mean followup time of 28.4 months, 74% of the patients have significant relief of all symptoms, and most of the remaining patients have mild to moderate symptoms typical of gastroesophageal reflux. The rate of demonstrated PEH recurrence in our study was relatively low, 11.2% (13.3% of patients that underwent barium studies

and 11.2% of all patients; all symptomatic patients underwent a barium study). However, in addition to the patients who had PEH recurrence, 42% of the patients who underwent barium studies also had either a small hiatal hernia (33%) or a gastroesophageal junction (GEJ) stricture (8.8%). Sixty percent of the patients with a small hiatal hernia and all of the patients with a GEJ stricture were symptomatic. However, the severity of the symptoms was mild to moderate and in most cases was well controlled with medication. Two patients required balloon dilatations of a strictured GEJ, and none of the patients with small sliding hernias required operation. We believe that because the indication for surgery in patients with PEH is to eliminate the chance of hernia incarceration, a potential fatal complication, patients with a small postoperative symptomatic sliding hernia may have a certain impact on the quality of life, but it is still an acceptable condition that has no potential for life-threatening complications.

The relatively high incidence of small postoperative sliding hiatal hernia following repair of large PEH has been reported previously [2, 11], and the clinical significance of these hernias is a controversial issue. Andujar et al. [2] reported a 20% rate of sliding hiatal hernia following laparoscopic repair of PEH without the use of mesh. These patients had similar postoperative symptom improvement compared with the group of patients without a sliding hernia. The patients remained asymptomatic on long-term followup as well, and the authors question whether the occurrence of such small hiatal hernias is an important clinical finding after a repair of large PEH. However, in our series most patients with small sliding hernias (60%) were symptomatic, with the most prominent complaints being heartburn and epigastric postprandial pain. This is certainly a disturbing finding because of the high incidence observed in our series (35%).

One of the main concerns regarding mesh placement is the possibility of mesh erosion into the esophagus or other abdominal viscera. There are several reports of this rare complication [3, 4, 17]. However, in our series no such complication occurred. Another concern when using prosthetic mesh is that in the event of postoperative intra-abdominal infection that involves the mesh, eradication of infection may require prolonged antibiotic treatment, multiple drainage procedures, and, in certain cases, even mesh removal, a procedure that may carry significant morbidity. This was evident in one of our patients with a postoperative esophageal leak that required approximately six months of antibiotic treatment and recurrent drainage procedures until resolution of infection was obtained. Fortunately, mesh removal was not necessary in this patient. We therefore generally do not use prosthetic mesh when contamination of the operative field by inadvertent perforation of esophagus has occurred.

Another concern when using mesh repair of PEH is the occurrence of postoperative dysphagia. Dysphagia is a main problem after antireflux procedures, with a reported incidence of 3%–24% after Nissen fundoplication [10, 13]. Usually the dysphagia is mild and resolves within several months. Granderath et al. [10] reported that patients with mesh repair of PEH had a higher rate

**Table 4.** Postoperative barium study and association with symptoms of 45 patients who underwent laparoscopic mesh repair of large and recurrent diaphragmatic hernias<sup>a</sup>

Barium study result	No. patients (%)	Mean time from surgery (months)	Asymptomatic	Symptomatic
Normal	20 (44%)	20.6	50%	50% Dysphagia (21%) Heartburn (15%) Epigastric pain (17%)
Recurrent PEH	6 (13.3%)	27.4	0	100% Heartburn (17%) Epigastric pain (50%) Vomiting (33%)
Small sliding hernia	15 (33.3%)	34.9	40%	60% Dysphagia (7%) Heartburn (33%) Epigastric pain (40%)
Stenosis at GE junction	4 (8.8%)	31.7	0	100% Dysphagia (100%)

<sup>a</sup> Some patients suffered from more than one symptom

**Table 5** Operative complications, conversions to laparotomy, and recurrences in patients operated on for recurrent diaphragmatic compared to primary repairs

	First repair (n = 40)	Recurrent hernia (n = 15)	p value
Conversion rate	1 (2.5%)	3 (20%)	0.057
Operative complications:	5 (12.5%)	6 (6.7%)	0.67
Pneumothorax	3 (7.5%)	0	
Hemorrhage	2 (5%)	0	
Esophageal perforation	0	1 (6.7%)	
Hospital stay	4.35	9.9	0.09
Patients with barium studies	32 (80%)	11 (73%)	0.71
Recurrence of PEH	5 (15.6%)	1 (9.1%)	0.67
Small hiatal hernia	13 (40.6%)	2 (18.2%)	0.61
Stricture	2 (6.3%)	2 (18.2%)	0.57

of postoperative dysphagia compared with the primary repair (4% vs. 16%), but one year after surgery both groups had similar dysphagia rates (4%). In our series the rate of persistent postoperative dysphagia one year or more following the operation was 13%, with two patients (3.6%) requiring endoscopic interventions.

The decision whether to use prosthetic mesh or perform a primary repair in each case was made by the operating surgeon. Currently, there are no objective parameters (such as gap size, patient characteristics, etc.) that predict recurrence. Prosthetic mesh was used according to the personal experience of the operating surgeon whenever the subjective assessment of the surgeon was that tension-free repair could not be performed without mesh placement. As experience was gained, a larger percentage of laparoscopic PEH repairs were performed with mesh. Mesh was not used in cases of small hiatal gaps and good-quality crurae that could be approximated without difficulty, and in the rare cases of esophageal perforation during sac dissection.

We used several mesh types over the years, including PTFE, polypropylene, and coated polyester (Parietex) mesh. The type of mesh used may have an impact on recurrence rate. Unfortunately, we could not extract the data of the specific mesh type used in each patient.

In conclusion, laparoscopic mesh repair of large PEH is a safe procedure with excellent short-term re-

sults. Symptomatic PEH recurrence requiring reoperation is uncommon, occurring in 11% of the cases. A significant number of patients (33%) have radiographically demonstrated small hiatal hernias that are usually symptomatic but can be managed nonoperatively. More long-term followup is required to more clearly determine the incidence of recurrence and the clinical significance of recurrent small hiatal hernias.

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