Laparoscopic management of large hiatus hernia with mesh cruroplasty

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Received: 29 September 2008 / Accepted: 4 November 2008

Abstract

Purpose Laparoscopy has become the standard surgical approach to surgery for gastroesophageal reflux disease (GERD) and hiatal hernia repair with excellent long-term results and high patient satisfaction. However several studies have shown that hiatal hernia repair, especially large hiatus are associated with high recurrence rate. Mesh reinforcement has been proposed for repair of large hiatus hernia. The objective of this study was to evaluate the role of mesh cruroplasty in management of large hiatus hernia (> 5 cm).

Methods Between February 2002 to December 2007, 73 patients (28 men and 45 women) who underwent laparoscopic hiatal hernia repair with mesh cruroplasty were included in our study. Mesh reinforcement (cruroplasty) was used for repair of large hiatus hernia (>5 cms hernial defect). Mean age was 50.4 years (range 30–72 years). Follow up included barium swallow of patients at 3 months and yearly thereafter.

Results Seventy-three patients underwent mesh cruroplasty for large hiatus hernia. We were able to adequately mobilise the oesophagus to achieve an intra-abdominal length of at least 3 cm in all patients. Intraoperative complication

rate was 8.21% (6/73), intraoperative complications included pleural tear, bleeding from splenic capsule laceration and short gastric vessels. Postoperative complication rate was 4.1% (3/73), which included complete dysphagia, atelactasis and pneumonia. Mean duration of hospitalisation was 3.5 days (range 3–9 days). Five patients (5/73) were lost to follow up. Four patients (5.8%) developed recurrence on routine follow up. No mesh related complications were noted on long-term follow up period. Mean follow up period was 3.2 years (range 5 months–6 years).

Conclusion Our data supports the use of mesh in hiatal hernia repair, especially in large hiatus hernia as it leads to low recurrence rates. Longer follow up and more randomised controlled trials are needed to establish laparoscopic mesh cruroplasty as standard technique for large hiatal hernia repair.

Keywords Hiatal hernia repair · Mesh reinforcement · Large hiatus hernia · Mesh cruroplasty · Recurrence

Introduction

Laparoscopic oesophageal surgery has gained popularity due to the unprecedented view of the oesophageal hiatus hernias and ease of access to the surgical site offered by the minimal access approach. Numerous series have demonstrated the safety and efficacy of approaching gastroesophageal reflux disease (GERD) and hiatus hernia repair by the laparoscopic approach [1, 2]. Despite increasing experience with laparoscopic hiatal hernia repair, authors continue to report recurrence rate of up to 43% with sutured cruroplasty [3, 4]. This compares laparoscopic hiatal hernia repair poorly to open repair as it is well documented that open hiatal hernia repair with addition of Stamm gastrostomy is associated with very low recurrence rate [5, 6]. Addition-

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ally, intrathoracic wrap migration rates up to 26% have been reported for patients undergoing laparoscopic fundoplication with primary sutured hiatal hernia repair [7].

Several technical details have been considered to minimise these high recurrence rates like excision of sac with complete detachment of sac from hiatus and mediastinum, adequate mobilisation of oesophagus with minimum of 3 cm of intra-abdominal oesophagus, use of mesh cruroplasty in patient with large hiatus hernia. The concept of using prosthetic materials is to achieve a tension free hiatal repair. The mesh may be used to close the gap between two widely spaced crura or to reinforce a suture cruroplasty.

The aim of the present study was to evaluate the effect of mesh reinforcement in laparoscopic hiatal hernia repair on recurrence rate and the side effects during long-term follow up.

Patients and methods

Patients

A total of 73 patients (28 men and 45 women) underwent laparoscopic mesh cruroplasty for large hiatus hernia (> 5 cm hernial defect) between February 2002 to December 2007 at Sir Ganga Ram Hospital, New Delhi, India, a tertiary referral centre for minimal access and bariatric surgery. It was a prospective cohort study. Mean age was 50.4 yrs (range 30–72 yrs). Out of these 73 patients, five patients had sliding hernia and 33 patients had paraoesophageal hernia and 35 patients had both sliding and paraoesophageal hernia.

Symptoms

Symptoms in patients with hiatus hernia vary greatly. The most common symptoms were heart burn (57.5%), regurgitation (49.3%) and epigastric pain (20.5%). Other symptoms included bleeding, dysphagia, recurrent aspiration as shown in Table 1.

Table 1 Symptoms of patients with large hiatus hernia

Symptoms	Number	Percentage (%)
Heart burn	42/73	57.5%
Regurgitation	36/73	49.3%
Epigastric pain	15/73	20.5%
Bleeding	7/73	9.5%
Dysphagia	5/73	6.8%
Aspiration	5/73	6.8%
Volvulus	3/73	4.1%

Preoperative investigation

Preoperative evaluation included a chest X-ray, upper gastrointestinal endoscopy, and barium swallow for all patients. Manometry and 24-hour pH monitoring were performed selectively. They were performed in those patients in whom symptoms did not correlate with endoscopic and radiological findings and patients who had mainly atypical symptoms. Manometry and 24-hour pH monitoring was performed in only 5 patients and results are shown in Table 2. Fluoroscopic evaluation provided a crude measure of oesophageal motility. The presence or absence of dysphagia was considered another reasonably sound predictor of whether the patient will tolerate complete wrap (Nissen fundoplication). Partial fundoplication is performed only in patient with history of dysphagia and age >65.

Indications for surgery

Sliding hernia Symptomatic patients (with GERD)

Paraoesophageal hernia All patients were advised surgery to avoid potential risk of life threatening complications such as incarceration, volvulus, perforation and bleeding.

Surgical technique

Our aims of surgery

Reduction of contents

Excision of sac

To achieve minimum of 3 cm intra-abdominal length of oesophagus

Division of short gastric vessels to mobilize gastric fundus

Prosthetic repair of crural gap in hiatus more than 5 cm wide

Short, floppy 360 degree wrap or partial wrap.

The procedure is performed under general anaesthesia with endotracheal intubation. Patient is placed in Reversed Trendelenburg position with knees slightly flexed. Surgeon stands between the legs; the camera assistant is positioned to the right of the patient and assistant surgeon to the left of the patient (Fig. 1).

The camera port (10 mm) is made above the umbilicus one-third the distance between the umbilicus and the epigastrium towards left of midline. Additional three 5 mm and one 10 mm ports are placed as shown in (Fig. 2). The 5 mm port in the epigastrium is used to retract the left lobe of liver using Nathanson's liver retractor. The 5 mm port in the right midclavicular line and the 10 mm port in the left midclavicular line are the surgeon's left and right hand working ports respectively.

Using atraumatic bowel graspers, the stomach is grasped and retracted and the contents from the hernial sac are

reduced (Fig. 3). Right diaphragmatic crus is identified after dividing the gastro hepatic ligament (Fig. 4).

Ultrasonic coagulating shears is used to divide peritoneum at the anterolateral edge of hiatus. The natural tissue plane that exists between the peritoneal and pleural lay-

ers of the hernial sac is developed and the sac separated completely. Once the complete dissection of sac has been performed, the sac is excised close to its attachment to the gastroesophageal junction and removed so that it does not interfere with subsequent repair. Circumferential oesopha-

Table 2 Results of 24-hour pH monitoring and manometry

Patients	Manometry			24-hour pH monitoring			
	LES pressure mm Hg	Body amplitude mm Hg	Transmitted contractions	Total time pH <4.0	Mean duration	No. of reflux	Longest reflux
1	14	63	All normal	406 min	2.4 min	169	15 min
2	12	86	All normal	382 min	3.57 min	107	6 min
3	23	64	All normal	0	0	0	0
4	22	70	All normal	0	0	0	0
5	9	79	All normal	530 min	1.99 min	266	26 min

Fig. 1 OT lay out

Fig. 2 Port positions

Fig. 3 Stomach being reduced from mediastinum using bowel grasper

Fig. 4 Gastro hepatic ligament is being divided to visualize right crus

geal mobilisation is done using ultrasonic shears so as to have a minimum of 3 cm length of intra-abdominal oesophagus around which the fundal wrap is created. In our experience it has been possible to mobilise the oesophagus to achieve an intra-abdominal length of 3 cm in all patients.

Short gastric vessels are divided to mobilise the gastric fundus using ultrasonic coagulating shears until the left crus is identified. This helps us in creating loose, floppy fundoplication.

The retrooesophageal window is enlarged and oesophagus retracted to the patient's left with a sling made by a penrose drain.

Size of the hiatus is then assessed (in the anterior – posterior plane) (Fig. 5).

If size of hiatus is more than 5 cm, a mesh repair is performed either to reinforce a sutured repair or to bridge the gap between the widely spaced crura.

Before placement of mesh we prefer to approximate the crura posteriorly as much as it can be achieved without tension. In our initial practice we used polypropylene mesh (Prolene; Ethicon, Inc., Somerville, NJ, USA). Later we started using lightweight meshes and Crurasoft (C. R. Bard, Murray Hill, NJ, USA). The Crurasoft is a V shaped mesh conforming to the hiatal anatomy. The mesh is fixed using 2–0 ethibond (Ethicon, Inc., Somerville, NJ, USA) sutures (Fig. 6) with its margins overlapping the crural margin by 2–3 cm.

We perform Nissen fundoplication in most patients wherein the gastric fundus is wrapped around the lower oesophagus to create a tension free wrap. Two gastro gastric seromuscular sutures are placed that include a seromuscular bite on the oesophageal wall to ensure correct positioning of the fundoplication and prevent slippage (Fig. 7). Toupet partial fundoplication (posterior oesophageal wrap) is performed only inpatients with history of dysphagia and age >65 years.

Fig. 5 Size of hiatus is assessed in anterior – posterior plane

Postoperative management

Postoperatively patients are kept on a liquid diet till 72 hours followed by a soft diet. Follow-up evaluation was at 7 days, 3 months and 1 year after surgery. Barium swallow was performed at 3 months and yearly thereafter.

Surgical outcome

Preoperative data were collected retrospectively. Long-term follow-up assessment was prospectively performed for 68 patients (93%) using a standardised questionnaire by clinical examination. Hiatal hernia recurrence was assessed using barium swallow. The mean follow up period was 3.2 years (range 0.5–6 years)

Fig. 6 2–0 Ethibond suture being used to fixed crura soft mesh near right crus

Fig. 7 Gastro gastric suture being taken by 2–0 Ethibond for fundal wrap

Results

There was no conversion to open surgery. Operative details are shown in Table 3. Intra-operative complication rate was 6 (8.2%) as shown in Table 4. Three (4.14%) patients had a pleural tear, which was managed by positive pressure ventilation during carbon dioxide desufflation to ensure lung expansion. There were no postoperative sequelae. Two (2.7%) patients had bleeding from short gastric vessels, which was managed by application of clips and in one (1.36%) patient there was splenic capsule laceration, which was managed by compression with gauge packing alone. In all patients an adequate intra-abdominal length of oesophagus of at least 3 cms was achieved by mobilising the oesophagus. Postoperatively morbidity rate was 4.1 % (3/73) as shown in Table 5. One (1.36%) of our patients developed complete dysphagia (inability to swallow saliva). All these patients were managed conservatively with i.v. fluids and restricting oral intake. One (1.36%) patient developed atelectasis and one (1.36%) had pneumonia which responded to intravenous antibiotics and chest physiotherapy. There was no mortality. Mean duration of hospitalisation was 3.5 days (range 3–9 days).

Post operatively at 3 months follow up dysphagia rate was 14.7 % (10 out of 68). However, the dysphagia rate at 1 year follow up improved and was 4.4% (3/68).

Table 3 Operative details

Operative details	
Operating time	Mean 151 min (range 100–190 min)
Defect size	Mean 7.2 cm (range 5–10 cm)
Type of mesh used	
Polypropylene	27 patients
Crurasoft	26 patients
Ultrapro	20 patients

Table 4 Intraoperative complications

Intraoperative complications	Number	Percentage (%)
Pleural tear	3/73	4.1%
Bleeding	2/73	2.7%
Splenic injury	1/73	1.36%

Table 5 Postoperative complications

Postoperative complications	Number	Percentage (%)
Complete dysphagia	1/73	1.36%
Atelactasis	1/73	1.36%
Pneumonia	1/73	1.36%
Dysphagia at 1 year	3/68	4.4%
Recurrence	4/68	5.8%

During follow up of mesh cruroplasty patients, the recurrence rate was 5.8% (4 out of 68) (Fig. 8). All these patients had small sliding hernia on radiological evaluation. These patients were asymptomatic and are being regularly followed up. No mesh related complications were observed.

Discussion

Over the past 50 years, we have witnessed a paradigm shift in the surgical repair of both inguinal and ventral hernias. Several randomised data show a clear superiority of tension free mesh hernia repairs for both inguinal and ventral hernias [8–10]. Creating a tension free, primary sutured repair of the diaphragmatic hiatus is difficult. It is a dynamic area due to diaphragmatic excursions with constant motion, even at rest. The goal for repair of the hiatus nevertheless should be the creation of a tension-free repair. A high recurrence rate after laparoscopic primary sutured cruroplasty, especially for large hiatus hernia (3, 4), is suggestive that suture repair alone does not provide an optimal tension-free repair. Our own experience demonstrated a higher recurrence rate in patients with sutured cruroplasty compared to mesh cruroplasty (14.9% vs 5.8%).

As with hernia repair in other areas, there is no consensus on the best prosthetic material to use in the procedure. The most commonly used mesh is polypropylene (Prolene; Ethicon, Inc., Somerville, NJ, USA) [11–13]. Several different types of polytetrafluoroethylene (PTFE) and composite materials have been used including dual mesh (W.L Gore and associates, Inc., Flagstaff, AZ, USA) [14] and a simple PTFE patch [15, 16]. Porcine small intestinal mucosa (Surgisis; Cook surgical, Bloomington, IN, USA), which provides scaffolding for natural tissue ingrowth, also is used [17]. In our initial 27 cases we used prolene mesh (Prolene; Ethicon, Inc., Somerville, NJ, USA) because it is readily available, inexpensive, malleable, and easy to handle. There has been concern about the use of polypropylene mesh because it causes dense fibrosis. As a result, we started using lightweight; large pore meshes, Ultrapro (Ethicon, Inc., Somerville, NJ, USA),

Fig. 8 Recurrence rate in patients in mesh cruroplasty group

and Crura soft (C. R. Bard, Murray Hill, NJ, USA) because they are tissue friendly and known to cause less fibrosis.

The meshes for hiatal reinforcement are available in variable shapes like V-shape, U-shape or complete circular mesh [Fig. 9]. There has been some concern about the use of a circular mesh, due to its potential to cause circumferential fibrosis around the oesophagus, resulting in dysphagia. Our preference is a V-shape mesh (Crura soft) for closing the oesophageal hiatus.

The technique for placement of prosthetic materials can be either posterior, anterior onlay or interposition repair when reapproximation of the hiatus is possible (Fig. 10). Most surgeons prefer primary sutured repair of the hiatus followed by an onlay of prosthetic materials. The overall theme remains that hiatal hernia repair should be made as tension free as possible, whether this is via an onlay repair or an interposition repair. Our preference is to perform an onlay repair for large hiatus hernias (>5 cm).

The mesh is fixed at the hiatus using sutures, tacks and recently fibrin sealant. The topographic vicinity of the heart and other major anatomical structures (liver, inferior vena

cava) and the fact that the diaphragm is very thin in this area makes suturing technically very difficult and requires a high level of expertise. An easier alternative is to apply tacks, but it has resulted in fatal complications including death by cardiac tamponade [18]. The use of fibrin sealant for mesh fixation was reported by Katkhouda et al in an animal experiment [19]. These authors were able to show that fixation with fibrin sealant is mechanically equivalent to stapler fixation. In a number of clinical studies, both its efficiency and also a reduction in postoperative complication have been shown in inguinal hernia repair [20, 21]. The use of fibrin sealant is now also being described for hiatus hernia repair. As protocol we prefer sutures to fix the mesh but have on occasion used fibrin sealant and found it a safe and effective adhesive.

Higher rates of dysphagia have been reported in patients with mesh cruroplasty [22, 23] and there have been case reports of patient being re-operated for mesh-induced fibrosis [24, 25]. In most studies the early results have shown a higher rate of dysphagia in patients of mesh cruroplasty but this rate became comparable at 1 year follow up. In our study also dysphagia rate was comparable at 1-year follow up (3.8% vs 4.3%).

Other major concern of using mesh at hiatus is erosion of mesh into oesophagus or stomach. Erosion of mesh is very rare and has been reported only as a case report [26, 27]. In our experience too there was no mesh related complication.

In conclusion, repair of a large hiatal defect (>5 cm) with mesh reinforcement is safe, feasible and leads to low recurrence rates.

Fig. 9 Various shapes of mesh

Fig. 10 Techniques of mesh cruroplasty

References

1. Arnaud JP, Pessaux P, Ghavami B, Flaments JB, Trebuchet G, Meyer C, Hutten N, Champauck G (2000) Laparoscopic fundoplication for gastroesophageal reflux: multicenter study of 1470 cases. *Surg Endosc* 14:1024–1027
2. Huntington TR (1997) Short-term outcomes of laparoscopic paraesophageal hernia repair: a case of 58 consecutive patients. *Surg Endosc* 11:894–893
3. Hashemi M, Peters JH, Deemeester TR, Huprich JE, Quek M, Hagen JA, Crookes PF, Theisen I, De Meester SR, Sillin F, Bremner CG (2000) Laparoscopic repair of large type III hiatal hernia: objective follow up reveals high recurrence rate. *J Am Coll Surg* 190:553–561
4. Wiechmann RJ, Ferguson MK, Nauheim KS, McKesey P, Hazelrigg SJ, Santucci TS, Macherey RS, Landreneau RJ (2001) laparoscopic management of giant paraesophageal hernia. *Ann Thoracic Surg* 71:1080–1087
5. Schauer PR, Ikramuddin S, McLaughlin RH, Graham TO, Slivka A, Lee KK, Schraut WH, Luketich JD (1998) Comparison of Laparoscopic versus open repair of paraesophageal hernia. *Surg* 176:659–665
6. Wichterman K, Geha AS, Cahow CE, Raue AE (1979) Paraesophageal hiatus hernia with intrathoracic stomach and colon: the case for early repair. *Surgery* 86:497–506

7. Granderath FA, Schweiger UM, Kamoiz T, Ashe KU, Pointner R (2006) Laparoscopic Nissen Fundoplication with prosthetic hiatal closure reduces postoperative Intrathoracic wrap herniation. *Arch Surg* 140:40–48
8. Burger JW, Luijendijk RW, Hop WC, Halm JA, Verdaasdonk EG, Jeekel J (2004) Long-term follow up of a randomized controlled trial of suture versus mesh repair of incisional hernia. *Ann Surg* 240:578–585
9. Lichtenstein IL, Shulman AG, Amid PK, Montlior MM (1989) The tension-free hernioplasty. *Am J Surg* 157:188–193
10. Vrijland WW, van den Tol MP, Luijendijk RW, Hop WC, Busschback JJ, de Lange DC, van Geldere D, Rottier AB, Vegt PA, IJzermans JN, Jeekel J (2002) Randomized clinical trial of nonmesh versus mesh repair of primary inguinal hernia. *Br J Surg* 89:293–297
11. Basso N, De leo A, Genco A, Rosato P, Rea S, Spaziani E, Primavera A (2000) 360° laparoscopic fundoplication with tension-free hiatoplasty in the treatment of symptomatic gastroesophageal reflux disease. *Surg Endosc* 14:164–169
12. Basso N, Rosato P, De Leo A, Genco A, Rea S, Neri Y (1999) “Tension-free” hiatoplasty, gastrophrenic anchorage and 360° fundoplication in the laparoscopic treatment of paraesophageal hernia. *Surg Laparosc Endosc* 9:257–262
13. Hawasli A, Zonca S (1998) Laparoscopic repair of paraesophageal hiatal hernia. *Am Surg* 64:703–710
14. Frantzides CT, Madan AK, Carlson MA (2002). A prospective randomized trial of laparoscopic polytetrafluoroethylene (PTFE) patch repair vs. simple cruroplasty for large hiatal hernia. *Arch Surg* 137:649–652
15. Athanasakis H, Tzortzinis A, Tsiaoussis J (2001) Laparoscopic repair of paraesophageal hernia. *Endoscopy* 33: 590–594
16. Carlson MA, Richards CG, Frantzides CT (1999) Laparoscopic reinforcement of hiatal herniorrhaphy. *Diag Surg* 16:407–410
17. Oelschlager BK, Barreca M, Chang L, Pellegrini CA (2003) The use of small intestine submucosa in the repair of paraesophageal hernias: initial observations of a new technique. *Am J Surg* 186:4–8
18. Kemppainen E, Kiviluoto T (2000) Fatal cardiac tamponade after emergency tension-free repair of a large paraesophageal hernia. *Surg Endosc* 14:593
19. Katkhouda N, Mavor E, Friedlander MH, Mason RJ, Kiyabu M, Grant SW, Achanta K, Kirkman EL, Narayanan K, Essani R (2001) Use of Fibrin Sealant for Prosthetic Mesh Fixation in Laparoscopic Extraperitoneal Inguinal Hernia Repair. *Ann Surg* 233:18–25
20. Lau H (2005) Fibrin Sealant Versus Mechanical Stapling for Mesh Fixation During Endoscopic Extraperitoneal Inguinal Hernioplasty. *Ann Surg* 242:670–675
21. Novik B, Hagedorn S, Mork UB, Dahlin K, Skullman S, Dalenback J (2006) Fibrin glue for securing the mesh in laparoscopic totally extraperitoneal inguinal hernia repair. *Surg Endosc* 20:462–467
22. Granderath FA, Schweiger UM, Kamolz T, et al. (2002) Laparoscopic antireflux surgery with routine mesh-hioplasty in the treatment of gastroesophageal reflux disease. *J Gastrointestinal* 6:347–353
23. Kamolz T, Granderath FA, Bammer T, Pasiut M, Pointner R (2002) Dysphagia and quality of life after laparoscopic Nissen fundoplication in patients with and without prosthetic reinforcement of the hiatal crura. *Surg Endosc* 16: 572–577
24. Edelman DS (1995) laparoscopic paraesophageal hernia repair with mesh. *Surg Laparosc Endosc* 5:32–37
25. Trus TL, Bax T, Richardson WS, Branum GD, Mauren SJ, Swanstrom LL, Hunter JG (1997) Complications of laparoscopic paraesophageal hernia repair. *J Gastrointest Surg* 1: 221–228
26. Carlson MA, Condon RE, Ludwig KA (1998) Management of intrathoracic with polypropylene mesh prosthesis reinforced transabdominal hiatus hernia repair. *J Am Coll Surg* 187:227–230
27. Schauer PR, Ikramudin S, McLaughlin RH, Graham TO, Slivka A, Lee KK, Schrayt WH, Luketich JD (1998) Comparison of laparoscopic versus open repair of paraesophageal hernia. *Am J Surg* 176:659–665