12 Change of Technique: With or Without Mesh?

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Introduction

Despite increasing experience with laparoscopic sliding or para-oesophageal hernia repair, authors are continuing to report recurrence rates between 30 and 40% with simple primary suture repair of the hiatus [1–3]. This high recurrence rate is also documented for the open approach in long-term follow-up series [4]. As there is a paradigm shift in the repair of inguinal and ventral hernias, discussion arises also for the hiatus, whether to close it by simple suture technique, tension-free, or by the use of meshes. The experience during the past 10 years suggests that the most important technical steps for maintaining the stomach in place in the abdomen are visceral reduction and sac excision, fundoplication and crural closure [5]. Whereas there is wide agreement concerning sac excision and fundoplication, controversy exists about the technique to close the crura. There are no exact data available as to why hiatal hernias recur. The tension on the crura, the diameter of the hiatus, the anatomy of the pillars and the intra-abdominal pressure of the patient are suggested as the main reasons for the failure of hiatal repair. As simple sutures seem to be unable to restore the hiatal anatomy for a long time and cannot provide a tension-free repair, attention is being paid by a few surgeons to the use of prosthetic material for repair or re-inforcement of the hiatus. There are only two randomized trials [6, 7] comparing simple suture techniques to mesh techniques, demonstrating extremely low recurrence rates for the mesh techniques compared to simple sutures. The concept of using prosthetic meshes is based on the lessening of tension on the hiatal crura or the reinforcement of simple sutured crura to prevent postoperative hiatal disruption. Since the first description of prosthetic hiatal closure by Kuster and Gilroy [8] in 1993, a number of techniques has been published. There has been debate regarding the shape, material and the placement of the mesh, and especially whether a prosthetic hiatal reinforcement has to be tension-free. Additionally, there is no agreement regarding the question of selective versus routine use of mesh. Some authors recommend the routine use of prosthetic mesh in order to prevent tension on the hiatal crura and therefore decrease hiatal hernia recurrence. Other authors use mesh selectively – for example in patients in whom a sufficient tension-free hiatal closure cannot be achieved with simple sutures. For some authors, the indication for reinforcement of the hiatal crura with prosthetic material depends on the size of the hiatal defect.

Methods

1. A search of electronic databases was performed to identify available articles regarding prosthetic hiatal closure for hiatal hernia repair. Feasibility, safety and complications related to the use of meshes for hiatal closure as well as recurrence rates were reviewed and compared.
2. Additionally, our own patient material was followed up:

- Thirty-three patients presenting with recurrent large hiatal hernia underwent prosthetic hiatal closure with a circular polypropylene mesh. The mesh was cut from a larger sheet of mesh, cutting a circular defect of 3 cm as a keyhole in the centre. The patch was applied as an onlay to the suture diaphragmatic repair and was anchored in place with a laparoscopic hernia stapler. Out of 33 patients, who were all controlled radiologically by barium X-ray, 24 patients had a follow-up time of 60 months or more.
- Between 11/2003 and 02/2005 in 15 patients with a large hiatal hernia without any possibility of approximating the crura by simple sutures, a tension-free procedure, using a composite PTFE mesh (BARD Crurasoft) was performed. This special V-shaped mesh was fixed with interrupted sutures on the edges of the mesh and secured with staples on the lateral side of the mesh. An X-ray control was performed in all these patients in December 2005.
- Between 10/2003 and 12/2005 a mesh onlay procedure was performed in 20 patients with a large hiatal hernia and weak crura using a dual mesh (Parietex). This mesh has a three dimensional weave of polyester on one side with a hydrophilic collagen material on the other. With the specially designed U-shape of the mesh it can specifically be used as an additional reinforcement of primary sutured hiatal crura and is secured to the diaphragm with a hernia stapler. In all these patients an X-ray control was performed in December 2005.

12

Results

Review of the Literature

Kuster and Gilroy [8] were the first to report on tension-free anterior repair of a hiatal defect. In six patients with large para-oesophageal hernias, a non-absorbable polyester fibre mesh was placed on the hiatus as an anterior onlay patch, overlapping the hiatal crura approximately 2 cm in all directions and securing the crural edges with staples. No intra-operative or postoperative mesh-related complications occurred during a follow-up period of 8–22 months and X-ray showed no evidence of postoperative hernia recurrence. A similar technique was used by Paul [9] with a 5×10 cm PTFE mesh in three patients, showing no complications and no hernia recurrences for a mean follow-up period of 10 months.

In a series of 65 patients who underwent simple sutured hiatal closure, Basso et al. [10] experienced a hiatal hernia recurrence rate of 13.8% during a mean follow-up of 48.3 months. After reviewing the video tapes of these patients, it became clear that the crural sutures were under tension leading to hiatal disruption and intrathoracic migration of the fundic wrap. Due to these findings, Basso et al. began using a 3×4-cm polypropylene mesh for posterior hiatal reinforcement. The mesh was secured with staples as a tension-free hiatoplasty. This technique was used in a subsequent group of 67 patients who underwent Nissen fundoplication for GERD. During a mean follow-up of 22.5 months, there were no complications related to the prosthetic mesh and no hiatal hernia recurrence.

Champion et al. [11] preferred a prosthetic reinforcement of primarily sutured crura. After placing interrupted permanent sutures posteriorly to the esophagus, a 3×5-cm polypropylene mesh was placed as an onlay prostheses and then fixed with a hernia stapler along the crural edges. This technique was performed in 52 consecutive patients with symptomatic GERD and a large hiatal hernia. During a mean postoperative follow-up of 25 months, only one patient developed a postoperative intrathoracic wrap migration. No mesh migrations or visceral erosion occurred in this series of patients.

Keidar and Szold [12] used a circular mesh with a shape similar to that used by Frantzides and Carlson. Out of a sample of 33 patients, 10 patients with large para-oesophageal hernias underwent laparoscopic prosthetic hiatal repair. The simple cruroplasty was then reinforced with a polypropylene mesh. The mesh was precut to an oval sheet, placed around the esophagus and fixed to the diaphragm using a hernia stapler. During a follow-up of 46–76 months, the satisfaction score was good to excellent for the majority of patients. Only one of the mesh-repaired patients developed a hiatal hernia recurrence compared to four patients who underwent repair without mesh. No complications related to the use of the mesh were seen in this study. To increase the theoretical safety of the procedure, they began using a preformed composite mesh with polyester on one side and a hydrophilic collagen material on the other. In any diaphragmatic hernia measuring 4 cm or larger, a loose primary repair was performed and reinforced with the precut Parietex mesh. The mesh was anchored with hernia tacks at two or three points. During a period of 7 years, a total of 238 patients had a diaphragmatic hernia repair. Of these, a mesh was used in 55 patients (23%). Twenty patients were operated on for a recurrent diaphragmatic hernia and in 33 a mesh was used for repair

of a defect larger than 4 cm. During a follow-up of 58 months, there were two symptomatic hernias (3.6%) that necessitated a second repair. In addition, in four patients (7%) a small, so-called sliding hernia was diagnosed that necessitated no intervention. There were no long-term complications that could be related to the use of the mesh.

Encouraged by a series of Condon [13] with 44 patients of open mesh repair with a polypropylene onlay to the diaphragm showing a clinical recurrence rate of zero during a 15-year period, Frantzides and Carlson [14] were the first to address the problem of an unacceptably high recurrence rate of the sutured hiatal herniorrhaphy by using a mesh-reinforced cruraplasty with a minimally invasive approach. They hypothesized that the benefit from mesh placement would most likely be seen in patients with a large hiatal defect; 72 patients with GERD and large defect hiatal hernia were enrolled in a trial randomizing the subjects between simple posterior cruroplasty with or without PTFE onlay re-inforcement followed by performing a floppy Nissen fundoplication. After a mean follow-up of 3.3 years the recurrence rate in the cruroplasty onlay group was 22% (8/36) and the rate in the cruroplasty plus PTFE group was zero. There were no mesh-related complications. The PTFE patch was cut from a larger sheet of mesh with a 3.5-cm circular defect as a keyhole in the centre of the mesh to accommodate the esophagus.

Results of Own Patient Material

1. All 33 patients with a recurrent hiatal hernia who were treated with a circular polypropylene mesh underwent X-ray-control in December 2005. A recurrent hiatal hernia was seen in two patients (6%); 24 patients had a follow-up time of 5 years or more. The recurrences occurred in one patient after 1 year, in the other after 4 years.
2. All 15 patients in whom a tension-free procedure due to giant hiatal hernia was performed were controlled by radiological barium swallow in December 2005. Before December a re-operation had to be performed in three of them (20%): in one of them because of increasing dysphagia caused by a suggested impression of the mesh leading to an erosion of the esophagus. Two patients had to be operated on because of recurrences, one complete and one partial recurrence (recurrence rate 13.3%). The performed X-ray-control showed no further recurrences.
3. In all 20 patients with large hiatal hernias and treated by a mesh onlay procedure an X-ray control was performed in December 2005. One patient had experienced an accident with a sternum fracture a few months before and had to be reoperated on. No recurrences were found in this group of patients.

Complications

The use of prosthetic materials in surgery for large hiatal hernia repair is accompanied by a low incidence of foreign-body complications. Visceral erosions, foreign-body migrations or gastro-oesophageal fistulas after surgery are reported. The focus is on the possibility of erosion or migration of the mesh into the esophagus or stomach as well as complications due to severe mesh adhesions or the development of fibrotic strictures on the hiatal area. Beneath these complications (◘ Table 12.1), there has been one fatal complication described by Kemppainen [15] not primarily related to the use of a mesh but to the use of a hernia stapler: after fixation of the mesh to the diaphragm, the patient developed a cardiac temponade caused by a stapler laceration of a coronary vein.

Discussion

The incidence of 30–50% of anatomical recurrences following simple sutured cruroplasty for both the open and laparoscopic approach is unacceptably high. Condon [13] was the first to show that the recurrence rates for the open approach could be minimized by using meshes. Especially Frantzides and Carlson were encouraged by these results, leading to their well-known randomized trial with 72 patients [6]. There are only a few comparative studies and trials of laparoscopic hiatal closure with simple sutures versus mesh hiatoplasty. All of them have shown that patients with a prosthetic hiatal closure have a lower rate of postoperative hiatal hernia recurrence in comparison to patients with simple hiatal repair (◘ Table 12.2). There is debate not only whether to use prosthetics but also when to employ them. Champion [11] prospectively measured the hiatal diameter in 476 primary laparoscopic antireflux procedures with simple posterior suture closure of the hiatus, and demonstrated a recurrence rate of 0.9% if the initial crural diameter was <4.5 cm and a 10.6% recurrence risk if the diameter was >4.5 cm. The difference was highly significant. Since Frantzides and Carlson had an impressive difference in outcome between the control and mesh groups, they felt justified in broadening the indication for mesh usage and decreased their threshold

Table 12.1. Complications of prosthetic crural closure

Author	Type	Complications	Re-operation
	Prolene	Esophageal stenosis due to mesh-induced fibrosis	Laparoscopic revision
Trus [22]	–	Mesh-induced esophageal scarification	Relaparotomy with esophageal myotomy
Carlson [14]	Prolene	Esophageal mesh erosion	Transhiatal esophagectomy
Kempainen [16]	PTFE	Cardiac tamponade secondary to mesh fixation by tacks	
v. d. Peet [23]	Polyester	Hiatal fibrosis	Relaparotomy with mesh removal
Casabella [24]	–	Fibrotic hiatal damage/esophageal mesh ersion	Relaparotomy with distal esophagectomy
Coluccio [25]	PTFE	Penetration of the cardial lumen	Relaparotomy with distal esophagectomy
Zilberstein [26]	Dacron	Esophageal mesh migration	Laparoscopic mesh removal

for mesh usage to hiatal defects whose diameter is 5 or 6 cm. The original indication for the utilization of PTFE reinforcement during hiatal hernioraphy was a defect size of more than 8 cm.

As documented in various papers before, in our own patient material on the symptoms of GERD with hiatal hernia, we experienced a significantly higher recurrence rate with simple suture herniorraphy compared to patients with mesh usage [7, 16]. The evaluation of our database led us to attempt different methods of crural closure, depending on the size of the hiatal defect, by measuring the hiatal surface area (HSA). This HSA (Fig. 12.1) can be calculated with the length of the crura measured in centimetres beginning at the crural commissure up to the edge where the pars flaccida begins and the circuit between the both crural edges is measured. The HSA corresponds to the space of any hernia ring in square centimetres. This proceeding is equivalent to the way of fixing the threshold for mesh usage as Frantzides or Champion do. Patients with an HSA of <4 cm² undergo crural closure by simple interrupted non-absorbable sutures. Patients with an HSA >4 cm² with strong crura undergo simple sutured crural closure and additional application of a 1×3-cm polypropylene mesh which is cut out of a 10×15-cm mesh, which is usually taken for laparoscopic inguinal hernia repair. Patients with an HSA >4 cm² with weak crura or narrow crura undergo primary simple sutured crural closure and additional reinforcement with a composite mesh. Basically in all patients with extra large hiatal hernias with a HSA over 8 cm², the crural closure is performed without simple sutures in a tension-free technique. After hiatal dissection, a special v-shaped mesh with porous PTFE is positioned on the crura as a tension-free posterior onlay. By thus tailoring the method of crural closure to the size of HSA, the recurrence rates with a follow-up of more than 2 years are very low. In all patients with large hiatal defects undergoing laparoscopic redo-surgery after failed primary hiatoplasty, the crura were approximated by simple non-absorbable sutures and the hiatus reinforced with a circular polypropylene mesh [17]. Out of 33 patients with recurrent hiatal hernia with a circular polypropylene mesh, only two patients (6%) experienced recurrences in a follow-up of more than 5 years. Although this follow-up is short compared to the 20-year survey of Philip Allison [4], it has to be taken into consideration that these patients are of higher risk for experiencing recurrences, as they all had large hiatal defects, weak crura and most of them were obese. None of the papers, including our own dealing with [19] mesh usage, reported about mesh erosion or mesh migration into the esophagus or stomach. In contrast to only a few reported prosthetic erosions and

Table 12.2. Prosthetic hiatal closure

Author	Patients (no.)		Mesh	Follow-up (months)	Recurrences Hernia	
	Mesh	Non-mesh			Mesh	Non-mesh
Carlson [14]	44		Prolene	52	0	
Frantzides [15]	17	18	PTFE	36	0	3
Basso [11]	67	65	Prolene	22,5	0	9
Frantzides [6]	36	36	PTFE	6–72	0	8
Champion [12]	52		Prolene	7–60	1	
Keidar [13]	10	23	Prolene	46–76	1	4
Szold [20]	55	183	Parietex	58	2	NA
Gryska [19]	135		PTFE	64	1	

migrations associated with mesh at the hiatus, there are no complications in larger series with prosthetic mesh closure. Especially Gryska and Vernon [18] examined the safety and efficacy of a tension-free crural repair with a PTFE mesh in 135 patients with a mean follow-up of 64 months. They reported one reherniation but no migrations or erosions in that huge number of patients.

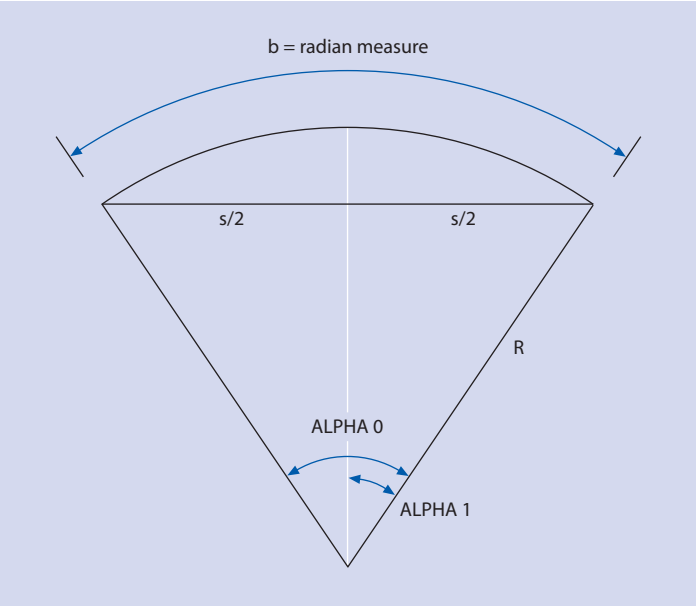

Fig. 12.1. Hiatal surface area (HSA)

With the paradigm shift in the repair of inguinal and ventral hernias to tension-free and mesh-inforced procedures, the unacceptably high recurrence rate of primary sutured repair of diaphragmatic hernias came under discussion. As with any other hernia, the goal for repair of the hiatus should be the creation of a tension-free repair. The diaphragm is a dynamic area with constant motion, even when at rest, and that may explain why the repair of the diaphragmatic hiatus is so difficult, with recurrence rates up to 50%. Of all the trials yet published comparing primary suture repair to mesh repair in hiatal hernia surgery, an advantage for the mesh group was documented with significantly lower recurrence rates. Although it seems to be evident that mesh usage is superior to simple suture repair, a lot of questions are unresolved: the technique for placement of meshes varies; there is also no agreement as to which mesh should be used, including the problem of tension-free or non-tension-free repair. Above all, it remains unclear how a recurrence is defined and what the indications for re-operations are.

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Discussion

Fuchs: *From the very few cases I have done, in two patient relaparoscopies where previously mesh was put in similarly to this technique. What I could see was that the hiatus in that posterior reach was very firm and scary. The mesh was incorporated, it was hard to see that it was a mesh, the colour had changed to the colour of the muscle infect. But you could still feel it, when you touched it.*

Pointner: *In those patients, we don't see complete wrap migration intrathoracically.*

Ferzli: *Do you know any case, or any situation while you are doing the dissection and are planning to put a mesh and you have an iatrogenic injury of the oesophagus or the stomach? Would you go ahead and put a mesh; have you had iatrogenic injury in this series that you have repaired and put a mesh?*

Pointner: *In a few cases I had an injury of the stomach and I put a mesh in and left it in, that is no problem. I have never had an injury of the oesophagus.*

Fuchs: *I would like to confirm this from doing a Collis together with a mesh. I have a suture line to the stomach and this has been no problem.*

Schippers: *Do we not have to learn how to fix the mesh? As I realized you changed suturing, you had tackers, you mentioned one patient dying after spiral tackers; during the coffee break I heard about two patients dying after spiral tackers.*

Pointner: *You are completely right.*

Köckerling: *Why do you use the circumferential mesh design in the recurrences, and in the primary case just the small 1- to 3-centimetre piece?*

Pointner: *Because the recurrences had larger hernias, and the other ones were just prospective, randomized only non-mesh versus mesh, independent of which hernia they had.*

Fuchs: *Without the study, would you still do this, or would you use different sizes of mesh adapted to the anatomical problems?*

Pointner: *I do not know if I would do it without the studies. But we are working now according to the hiatal surface area.*