13 Some Laparoscopic Hiatal Hernia Repairs Fail – Impact of Mesh and Mesh Material in Crural Repair

J. F. Kukleta

Introduction

The breakdown of crural repair occurs in 6–40% of laparoscopic hiatal surgery [5, 17] and often leads to recurrence with intrathoracic wrap migration or para-oesophageal herniation. In order to prevent this complication, various surgeons attempt to reinforce the repair or patch the unsutured crural defect with prosthetic material.

Similarly to the problematic of intraperitoneal prosthetic repair of incisional hernias, the use of mesh in hiatal repair is still controversial. The impact of the surgical technique and the unique behaviour of specific mesh materials is recognized but far from being well investigated, understood and clearly standardized. Despite significant decrease in recurrence rate, some sporadic dangerous complications have been reported [9, 28]. One can assume that the numbers and complexity of these adverse events are strongly under-reported.

Method

Besides the review of the available literature published in English between 1995 and 2005, a personal communication of unpublished information to this rare topic from various experts is added. Not unexpectedly, sometimes the personal opinion of experienced laparoscopists differs from the trends imposed by the latest scientific papers.

Problem Analysis

Many causes of recurrence are suggested and discussed in the literature, but very few are supported by data, like surgeon's inexperience, postoperative vomiting, retention of the hernia sac and heavy lifting [1]. Although statistically not proven, chronic cough, smoking-related impairment of collagen synthesis and any other chronic increase of intra-abdominal pressure are logical promoting factors of recurrence.

Possible additional mechanisms directly related to laparoscopic procedure include no nasogatric tube in the early postoperative course, too early return to normal activities before the scar tissue is formed, less adhesions in laparoscopic surgery when compared to open technique.

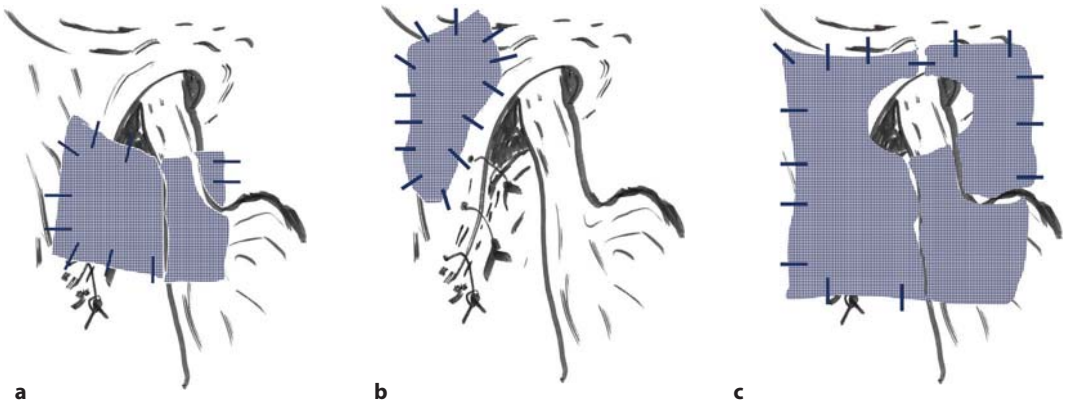
The early experience with laparoscopic repair of hiatal hernias of type II and III demonstrated higher recurrence rate than the open technique [2]. The individual learning curve, failure analysis and corrections of surgical technique, especially complete hernia sac removal from mediastinum or its excision, improved the durability of the repair [3, 4]. The significance of oesophageal shortening caused by chronic inflammation is still under debate. Due to fear of postoperative dysphagia, the crurorhaphy tends to become too loose rather than too tight, especially since the hiatal calibration with large bougies is being given up by many to avoid possible intra-operative perforation.

The principle cause of crural disruption is the tension: either the defect is too big, the repair too weak from the very start or it becomes insufficient due to acute or chronic increase of intra-abdominal pressure. The anatomical recurrence rate of non-reinforced crurorhaphy in type-II and -III hernias is after longer follow-up too high, but less than 50% of these patients are symptomatic.

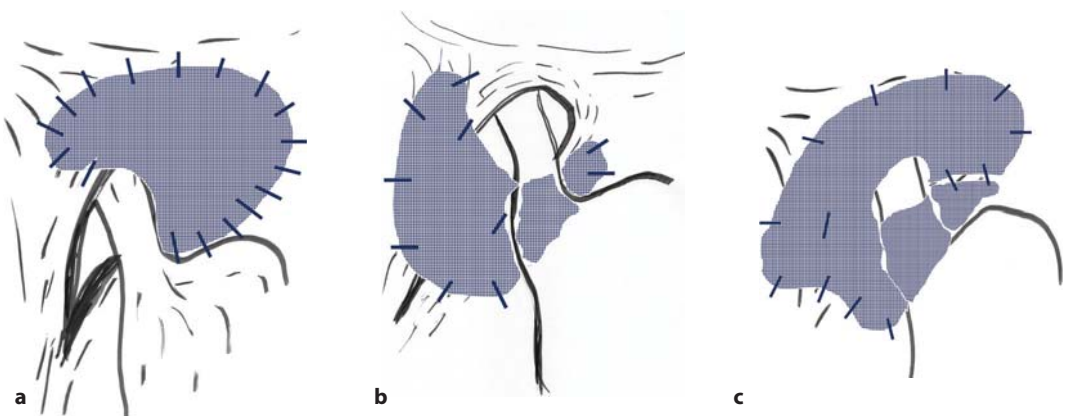
During the laparoscopy the diaphragm is distended and stretched. This effect makes the available tissue bites smaller and the repair weaker [1]. In redo surgery, the crural repair is even more difficult, because the disruption leads to a rigid defect and the crurorhaphy increases the tension even more. In large defects the posterior crural repair displaces the GE junction too far ventrally, potentially resulting in impaired transit. Although the diaphragm becomes thinner ventrally of the oesophagus, the anterior crural repair appears to be at least as good in the short term as posterior suturing as a method of narrowing the hiatus during laparoscopic Nissen fundoplication [13].

Results

As the use of prosthetic material is no longer taboo, many investigators use various materials under unequal conditions, and with different indications and additional technical modifications. Therefore a comparison of the methods and their outcome at this stage is nearly impossible (◘ Figs. 13.1 and 13.2).



◘ **Fig. 13.1. a** Reinforced posterior repair. **b** Relaxing incision. **c** Reinforced circular repair



◘ **Fig. 13.2. a** Patched anterior repair. **b** Patched posterior repair. **c** Patched circular repair

Most of the published experiences with the use of mesh in hiatal hernia are from small series with limited or rather short follow-up. Few comparative studies have demonstrated significant reduction of recurrence mesh vs. non-mesh, with a mesh-related complication rate close to zero [5, 8, 12]. The overall mesh complication reported is less than 2% [18].

Analysis of the complex issue of a prosthetic repair shows at least five important mesh related variables: the mesh material itself, its anchorage, its shape, position and function.

Function

Intraperitoneal onlay mesh can be used to reinforce the crural repair (not tension-free) [8, 9, 10, 11] or bridge/patch the enlarged hiatus without crural approximation, leaving the passage for the abdominal oesophagus free in different ways (true tension-free repair) [6, 7, 15].

Fixation

The mesh can be anchored to crura with sutures, tacks or staples. Sutures are more time consuming, staples and tacks can be more dangerous, inconstantly not deep enough and distort the mesh, depending on the material used. Cardiac tamponade was reported following tack fixation.

Position

Irrespective of the mesh purpose it can lie anteriorly [3, 6, 13] or posteriorly in relation to the oesophagus. Most authors are used to perform a posterior crural repair and therefore they buttress or patch posteriorly [7, 12]. The posterior total or partial fundic wrap protects the oesophagus from direct contact with the implant or at least from the transverse mesh edge.

Shape

A certain degree of creativity is still an important part of our profession. Numerous shapes were suggested: oesophagus totally encircling [19, 20] (A-shape, keyhole), partially encircling (U-shape, Arc de Triomphe-shape [3]) or not encircling triangular, rectangular, etc. (reinforcing, patching or covering the relaxation incision of the right crus).

Mesh Material

See ◘ Table 13.2.

Implant Site

The mesh-underlying tissue interface is similar, but not identical with the one in inguinofemoral or laparoscopic incisional hernia repair. The contact surface in hiatus is a thin muscle with a good blood supply with vital structures in the vicinity. The respiratory movements, the heartbeat and the oesophageal peristalsis make the region very difficult to be "just" stabilized.

Porosity

The macroporous meshes will induce and permit a complete tissue ingrowth. After maturation of collagen, a solid scar tissue is present thus incorporating the mesh. The meshed area of the hiatus oesophagei is in constant motion, therefore there must be a solid fixation guaranteed in the early postoperative period to prevent mesh dislocation and consecutive recurrence. The appreciated inflammatory reaction reinforces the interface, but bears an uncontrollable risk of oesophageal erosions or stenosis. The microporous meshes require better fixation. The biological meshes permit a complete ingrowth and cause a strong inflammatory reaction, which can lead to oesophageal stenosis.

Transparency

Transparent meshes add more security to mesh fixation, eliminate unrecognized bleeding when not blindly applying penetrating fixation and permit more generous suture bites.

Stiffness

The biggest disadvantage of polypropylene and polyester meshes is the loss of local elasticity due to fibrotic fixation, and the mesh margins may become sharp. The first may cause dysphagia due to impairment of peristalsis or stenosis, the latter erosions, migration or late oesophageal perforation. The resulting stiffness of the traditional "heavy" materials is not existent in lightweight meshes.

Table 13.1. Incomplete overview of prosthetic materials

Absorbable	Polyglactin 910	Vicryl
	Polyglycolic acid	Dexon
Non-absorbable	Polypropylene	Prolene, Marlex, Surgipro, Trelex, Parietene, Prolite, TiMesh
	Polyester	Mersilen, Parietex
	PTFE	Goretex, Dualmesh
	Composites	PP/e-PTFE Composix
		PP/RCO Proceed
		PP/Sepra Sepramesh
		PP/Polyglactin 910, Vypro, Vypro-2
		PP/Polyglecaprone Ultrapro
		PP/collagen film Parietene composite
		PE/collagen film Parietex composite
	PVDF/PE	Dynamesh
Biomaterials	Porcine SIS	Surgisis
	Porcine skin	Permacol
	Human skin	Alloderm

Less risk-bearing appears e-PTFE (without any objective proof), because it stays much softer and is less prone to adhesions, but is non-transparent and difficult in handling. Gryska reported no erosions (135 patients) after 10 years of experience [5].

Shrinkage

All mesh materials alter their extent after the primary scar tissue reaction is over. This "hot or overheated" issue in inguinofemoral hernia repair does not seem to be of clinical importance in mesh-supported hiatal repairs. The well-known pronounced shrinkage of the PTFE products or heavy polypropylene meshes could theoretically cause late dysphagias in patched repairs of large hiatal defects. The use of light-weight meshes as a consequence of the above fact has not yet been reported.

Infection Resistance

The incidence of infection of the prosthetic material in this specific location is so low, that it does not seem to be of significance as long as the digestive tract remains intact.

Mesh-Related Complications

In the early postoperative course a higher incidence of dysphagia of longer duration was reported [29].

The inflammatory reaction, which is a material-specific host response to a foreign body, can cause a material-specific morbidity even many years later. Erosions have been reported after 3 years with polypropylene [9], late oesophageal perforation with PTFE, Teflon pledget intrusion in oesophagus 9 years

after repair [28]. The adhesiogenic potential is in given localisation not of big concern as long as the oesophagus is not encircled, the direct contact of mesh and oesophagus can be avoided and materials, that turn to be stiff when fibrotic reaction takes place, are not used (heavy PP). Stiffness and wrinkles, that will become sharp edges are the main problem.

Discussion

For well-known reasons the information and knowledge being elaborated by studies even of a low level of evidence pass through many different filters, suffer from heterogeneity, difficulty of standardization and often from the impossibility to exclude the major variable factor in any clinical study – the personal experience of the surgeon. Unpublished opinion of opinion leaders is a different kind of information. It might be very subjective, it might not be scientifically correct, but it mostly reflects a personal attitude of a professional based on experience. To compare this personal information with the published literature, the author contacted 30 experienced surgeons by e-mail. More than 50% answered the simple question: what about a mesh in hiatal hernia repair and what is your preferred solution?

Mesh at All?

The vast majority would use the mesh very selectively. Some try to avoid prosthetic around oesophagus per principle, some reinforce the suture with pledgets or bicrural strips. Mesh as seldom as possible, most often only under difficult conditions in redos. The fear of erosion is understandable after a personally experienced disaster, but the general opinion seems to be overimpressed by few reported cases. If prosthetic material is used, the distance of the mesh margin to the oesophagus has to be warranted and encircling is not recommended (Table 13.1).

Table 13.2. Reports on materials used

Source	Material used
Frantzides [8]	Circular PTFE, PCR
Granderath [29]	Circular PP, PCR
Kamolz [12]	PCR + PP retrooesophageal strip
Casaccia [6]	Parietex composite, A-shape
Basso [7]	PP, retrooesophageal rectangular patch
Keidar [19]	Composix
Szold [20]	Parietex composite
Gryska [5]	PTFE retro-oesophageal, V-shape
Oelschlager [21]	Surgisis
Aregui	Surgisis, PCR, relaxing incision
Gagner	Surgisis
Jacobs	Surgisis
McKernan	Surgisis
Dallemagne	Pledgets, Surgisis
Filipi	PTFE, halfcircle
Himpens	PTFE, slit mesh
Bailey M	PP, bicrural strip, PCR
Giulianotti	Teflonpledgets, PTFE, semicon-cave, PCR

PP polypropylene, *PCR* posterior crural repair

What Material?

Most of the known materials did well in published reports (Table 13.2). The more personal experience with the use of mesh in hiatus, the more often the biomaterial Surgisis is proposed. The satisfaction with this product ranges from negative to very positive, from the danger of being too reactive (leads to stenosis and oesophageal-gastric resection) to a trend to reinforce even small sliding hernias to reduce the chance of rehernia-tion. The most frequently used material is still e-PTFE (according to the literature), being the best documented and having the longest follow-up.

Which Additional Manoeuvres?

As already analyzed [22], there is no available evidence on the use of additional "anti-re-herniation" surgical steps like fixation of the wrap on the crural repair or

gastropexy or gastrostomy. The importance of Collis oesophagus lengthening gastroplasty is unclear.

Routinely or Selective Approach?

Surgeons who can rely on their own results reinforce not only the redos or large type III, but even the small sliding hernias, to secure their good functional results, especially in long-term follow-up.

Is the Fear of Potential Mesh Complication Justified?

The indication for a surgical intervention in the case of large para-oesophageal hernia has often a prophylactic character due to its known natural course with possible serious complications. The minimally invasive solutions make the decision for a repair easier even in the elderly, but do not resolve the problem of recurrence. The vast majority of experienced laparoscopists are very reserved to foreign material in hiatus and would try to avoid it in primary repairs. Despite the fact that reported experience with biomaterials is of singular nature, more than half of the reviewed experts would advocate their use. The use of mesh in crural repair will have to stay selective until the mesh-related complications can be eliminated by improved materials.

Conclusion

The evidence of the most reports is low (II c–V). The very few existing comparative studies [7, 8, 12] have demonstrated the superiority of mesh repair.

The incidence of serious mesh-related complications is very low. Due to the fact that the reason for a breakdown of crural repair is multifactorial and the incidence of type-III hernias is low, there are no objective data available to justify the exclusive choice of one or another mesh material. Based on the reported information, the potential risk of visceral erosions, late fistulization and wound sepsis known from inguinal and incisional hernia repairs should not be transferred 1:1 to hiatal repair. However, the principles learned from experience should finally influence the operative strategy of crural repair: celebrating precise surgical technique and choosing light-weight or tissue-separating coated meshes. The objective value of biomaterials, although already very promising, must be demonstrated in more extensive studies.

References

1. Puri V, Kakarlapudi GV, Awad ZT, Filipi CJ (2004) Hiatal hernia recurrence. 8: 311–317
2. Hashemi M, Peters J, Demeester T, Huprich J, Queck M, Hagen J, Crookes P, Theisen J, Demeester JR, Sillin L, Bremner C (2000) Laparoscopic repair of large type III hiatal hernia: objective follow-up reveals high recurrence rate. J Am Coll Surgeons 190: 553–560
3. Leeder PC, Smith G, Dehn TC (2003) Laparoscopic management of large paraesophageal hiatal hernia. Surg Endosc 17:1372–1375
4. Edye MB, Canin-Endres J, Gattorno F, Salky BA (1998) Durability of laparoscopic repair of paraesophageal hernia. Ann Surg 4: 528–535
5. Gryska PV, Vernon JK (2005) Tension-free repair of hiatal hernia during laparoscopic fundoplication: a ten-year experience. Hernia 9(2):150–155
6. Casaccia M, Torelli P, Panaro F, Cavaliere D, Ventura A, Valente U (2002) Laparoscopic physiological hiatoplasty for hiatal hernia: new composite A-shaped mesh. Surg Endosc 16:1441–1445
7. Basso N, DeLeo A, Genco A, Rosato P, Rea S, Spaziani E, Privaera A (2002) 360° laparoscopic fundoplication with tension-free hiatoplasty in the treatment of symptomatic gastroesophageal reflux disease. Surg Endosc 14: 164–169
8. Frantzides C, Madan A, Carlson M, Stavropoulos G (2002) A prospective, randomized trial of laparoscopic polytetrafluoroethylene (PTFE) patch repair vs simple cruroplasty for large hiatal hernia. Arch Surg 137: 649–652
9. Carlson MA, Condon RE, Ludwig KA, Schulte WJ (1998) Management of intrathoracic stomach with polypropylene mesh prosthesis reinforced transabdominal hiatus hernia repair. J Am Coll Surg 187: 227–230
10. Morales-Conde S, Bellido J, Cadet I, Martin M (2002) Indications and management of prostheses to close the crura during laparoscopic repair of paraesophageal hernias. Surg Endosc 16: 284
11. Champion JK, Rock D (2003) Laparoscopic mesh cruroplasty for large paraesophageal hernias. Surg Endosc 17: 551–553
12. 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
13. Watson DI, Jamieson GG, Devitt PG, Kennedy JA, Ellis T, Ackroyd R, Lafullarde TO, Game PA (2001) A prospective randomized trial of laparoscopic Nissen fundoplication with anterior vs posterior hiatal repair. Arch Surg. 136: 745–751.
14. Granderath F, Kamolz T, Schweiger U, Pointer R (2003) Laparoscopic refundoplication with prosthetic hiatal closure after primary failed antireflux surgery. Arch Surg 138: 902–907
15. Paul MG, DeRosa RP, Petrucci PE, Palmer ML, Danovitch SH (1997) Laparoscopic tension-free repair of large paraesophageal hernias. Surg Endosc 11: 303–307
16. Targarona EM, Balague C, Martinez C, Garriga J, Trias M (2004) The massive hiatal hernia: dealing with the defect. Semin Laparosc Surg 11(3): 161–169

17. Targarona EM, Novell J, Vela S, et al. (2004) Mid-term analysis of safety and quality of life after the laparoscopic repair of paraesophageal hiatal hernia. Surg Endosc 18: 1045–1050
18. Targarona EM, Bendahan G, Balague C, Garriga J, Trias M (2004) Mesh in the hiatus – a controversial issue. Arch Surg 139: 1286–1296
19. Keidar A, Szold A (2003) Laparoscopic repair of paraoesophageal hernia with selective use of mesh. Surg Laparosc Endosc Percutan Tech 13: 149–154
20. Szold, Sagie B. Laparoscopic mesh repair of diaphragmatic hernias (2004) 26th Grepa congress in Prague
21. 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(1): 4–8
22. Draaisma WA, Gooszen HG, Tournoij E, Broeders IAMJ (2005) Controversies in paraesophageal hernia repair. Surg Endosc 19: 1300–1308
23. Carlson MA, Richards CG, Frantzides CT (1999) Laparoscopic prosthetic reinforcement of hiatal herniorrhaphy. Dig Surg 16: 407–410
24. Frantzides CT, Richards CG, Carlson MA (1999) Laparoscopic repair of large hiatal hernia with polytetrafluoroethylene. Surg Endosc 13: 906–908
25. Edelman DS (1995) Laparoscopic paraesophageal hernia repair with mesh. Surg Laparosc Endosc 5: 32–37
26. Champion JK, McKernan JB (1998) Prosthetic repair of diaphragmatic crural defects during laparoscopic fundoplication. Hernia 2: 511
27. Cadiere GB, Bruyns J, Himpens J, Vertruyen M (1996) Intrathoracic migration of the wrap after laparoscopic Nissen fundoplication. Surg Endosc 10: 187
28. Arendt T, Stuber E, Monig H, Fölsch UR, Katsoulis S (2000) Dysphagia due to transmural migration of surgical material into the esophagus nine years after Nissen fundoplication. Gastrointest Endosc. 51: 607–610
29. Granderath FA, Schweiger UM, Kamolz T, Asche KU, Pointner R (2005) Laparoscopic Nissen fundoplication with prosthetic hiatal closure reduces postoperative intrathoracic wrap herniation – Preliminary results of a prospective randomized functional and clinical study. Arch Surg 140: 40–48

Discussion

Carlsson: *Today I have heard a lot of anecdotal reports about the possible danger about the prosthetic oesophageal hiatus and in specific reference to a PTFE I have not been able to find published evidence of PTFE as a primary cause of erosion in the oesophagus. Now there are cases where there was a secondary problem, for example if a surgeon preparated the oesophagus and the stomach and then the PTFE was found in the preparation. Then this was called an erosion. But I have not been able to find a situation where PTFE eroded into the lumen primarily. I would encourage anyone in this room to report in published form these cases of a mesh erosion, so we can get this out of the table.*

Miserez: *I will not ask any questions about meshes, but in your second slice you mentioned the absence of an oesogastric tube postoperatively as a risk factor for an early recurrence. How long do you keep this tube in and on what evidence is this decision based?*

Kukleta: *We remove it before the patient wakes up in the laparoscopic repair. In the open repair, we have a longer ileus time so we keep it in. When the patients are fine they start eating and then they go. Probably they go very early they don't have an oesogastric tube after the operation. It is taken out in the recovery room.*

Franzidis: *This was an excellent presentation and what you show is that we are not in a perfect world. This is an imperfect world with problems, and we want to have a perfect operation and perfect prosthesis. I still believe that when the literature shows that you have a 30–50% rate of recurrence, then someone should come up with an alternative. Until then we have to accept the consequences. The reported erosion of PTFE or ePTFE is an anecdotal report. The same applies to dual mesh. Maybe these complications are under-reported or anecdotal. If the experts in the field would agree that this is a standardization of the technique we might avoid erosions. The advice is, that anybody embarking on this type of operation should be a very experienced laparoscopic surgeon and should have done his homework in the laboratory.*

Kukleta: *But certainly we end up with the technical details. This is an evolution of 10 years, and in 10 years you always add something to this, because it is difficult to stay with the same regime. If some people can reach these, we have to orient ourselves on those. That is my belief.*

Schumpelick: *There is something that I don't understand in this session. I hear that very small meshes fit, I hear that big meshes are used, I heard that you use different types of meshes, difficult localisations and you always mesh a reflux as a criterion that works. Are there any animal or anatomical or postmortem studies that show how the mesh really works? I think it is a bit like evidence level five. Everybody says I have good results, but how does it work? Some say better adhesions, some say it is better to have a patch on it; it is absolutely confusing for me. Are there better results in the literature than here?*

Kukleta: *We certainly have a problem with the incidence of these big hernias. They are not so numerous as inguinal hernias. If you have seen Dr. Pointners setup, there are very few papers that have enough numbers, just seven or eight studies with more than 100 cases. That is, why I cannot answer this.*

Ferzli: *Carlsson made a report about PTFE and you mentioned about the erosion. Phillip Chowbey mentioned the erosion of PTFE with a hiatal hernia into the oesophagus, and Eric DeMaria from Virginia reported one erosion of PTFE in the oesophagus. Just to clarify that.*

Pointner: *Prof. Schumpelick, thank you for your comments. In my opinion this is the important point. We don't know how large the hiatus really is. We have no anatomical studies, and today this was the first presentation I have seen, heard or found.*
Fuchs: *Most important was the pre-operative radiography; but this is an unreliable tool. Because you have patients where these 5 cm you do two times with a swab and they are down, and you have other patients where you are busy for half an hour clearing it. So it is not reliable. Probably it is much more reliable, as you suggested, to mesh the hiatus and then go on from there.*
Dutta: *I have two ideas. One is that mesh produces adhesions; the other is that mesh produces tension. I was fascinated by Dr. Pointner's report of using small mesh. I am thinking of the box a little bit and am wondering a little if that small mesh probably is reducing tension if it is causing adhesions. Has anyone thought about injecting a sclerosing agent into the crural to introduce adhesions?*
Kukleta: *But the muscle does this.*
Köckerling: *We can have our experimental experience with the different types of polypropylene meshes. I agree, obviously it is better to use light-weight polypropylene meshes. What we have learned in our experimental studies is that after 3 months, when we sacrifice the animals, this type of mesh behaves like nearly normal connecting tissue. It has no sharp edges, it does not fold due to shrinkage and other things, whereas the heavy-weight polypropylene meshes do that, they have sharp edges, they fold, they are stiff. From our point of view I would always prefer, if you use polypropylene mesh, then the light-weight mesh. Because it is like normal connective tissue.*

Concluding Remarks

Ferzli: *What we heard this evening is much more controversial than we thought. Now we are not able to say what is the best. Most speakers have repeated the significant points that are still unresolved. From the fixation to the wrap, the fixation of the oesophagus. I cannot go ahead and say we have a consensus. From what we have seen, we still have to go a long way. Hopefully the future will bring us some better answers.*
Fuchs: *If we look together at what to avoid, I think what we have learned this evening, or what we have discussed this afternoon, that we have here not one problem or not one disease. We have basically two, the reflux problem and the hiatal problem. In some patients, I would say in most patients, the reflux problem is foremost, but in some other patients it is maybe 10 to 20% it is the hiatus. The hiatal problems are really those that must have a higher priority. If I look at our experience of redos, there are some patients who come for the second or the third, fourth or even the fifth time. And if you come for several times, migration is still, of course, a problem. Also a spectrum of other reasons; we have to clarify, when mesh, for example, can help. To start with, you have to avoid that an operator who really has experience neither in laparoscopic surgery nor in the reflux disease or hernia repair, because that is really bad. Of course, you have to avoid the oesophageal perforation, destroying the crurals or injecting a sclerosing agent. This can be a real problem, because then you have nothing to put together. Too much tension on the suture, as we all know in the area of the body is a problem. Placing too many sutures and that is limiting, can be a problem. Placing too many sutures creates an angle that might have the effect of dysphagia. Or creating a stenosis is bad. Narrowing the hiatus insufficiently, even a gap, then the road is free for migration, and using insufficient crural alone for narrowing, as we have learned, is also a problem. So we need some material over the next 5 years to learn what size, what material we can use.*