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Laparoscopic fundoplication: When, how and what to do if it fails?

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Laparoskopische Fundoplikatio: Indikation und Management von Komplikationen

Zusammenfassung. *Grundlagen:* Sowohl die Gesamtzahl an Komplikationen nach antirefluxchirurgischen Eingriffen als auch der Prozentanteil an Patienten mit Problemen nach Fundoplikatio nimmt mit der Dauer des Überwachungszeitraumes zu. Therapeutische Schritte hängen einerseits von den Symptomen, damit von der Art und Intensität der Einschränkung der Lebensqualität des Patienten ab, andererseits von der dieser Problematik zugrunde liegenden morphologischen Veränderung.

Methodik: Es wird eine Übersicht über mögliche postoperative Symptome und deren Evaluierung gegeben, eine Korrelation zu morphologischen Befunden hergestellt und sich daraus ergebende Therapieoptionen aufgezeigt. Darüberhinaus werden die Symptome, morphologischen Veränderungen und deren therapeutische Konsequenzen anhand von 259 eigenen laparoskopischen Re-Eingriffen analysiert.

Ergebnisse: Die häufigsten Probleme postoperativer Störungen nach Fundoplikatio sind anhaltendes oder wiederum aufgetretenes Sodbrennen, Dysphagie oder die Kombination beider. Im eigenen Krankengut traten diese Symptome vor der Erstrevision bei 201 Patienten 50 mal (Dysphagie), 72 mal (Sodbrennen) und 79 mal (Kombination beider Symptome) auf. Die häufigste morphologische Ursache für Komplikationen ist das sog. „Slippen" des Fundoplikats, das im eigenen Krankengut vor dem ersten Re-Engriff bei 141 Patienten, vor allen wiederholten Re-Eingriffen zusammen 194 mal vorgefunden wurde und damit 70,1% bzw. 74,6% aller Komplikationen betrifft. Sogenannte „Side effects" wie Blähungen oder unkontrollierte Darmtätigkeit treten gerne mit oben genannten Komplikationen auf, sind jedoch zumindest zum Teil mit einem Revisionseingriff reversibel.

Schlussfolgerungen: Die Therapie postoperativer Komplikationen hängt immer von der Schwere der Symptome, das heißt, der Beeinträchtigung der Lebensqualität des Patienten ab. Liegt der Symptomatik ein morphologischer Fehler zugrunde, sollte eine Re-Fundoplikatio in Erwägung gezogen werden. Die Lebensqualität nimmt durch eine Re-Fundoplikatio deutlich zu, auch unerwünschte Nebenwirkungen sind in hohem Maße verbesserbar.

Schlüsselwörter: Komplikationen und Nebenwirkungen nach Fundoplikatio; Re-Fundoplikatio; Symptome und Lebensqualität nach Fundoplikatio.Symptome, Komplikationen vor Re-Fundoplikatio.

Summary. *Background:* The number of complications following surgical antireflux procedures as well as the percentage of patients with problems after fundoplication increases with the time of surveillance. The therapy of those problems depends on the symptoms and an impaired quality of life of the patients and on the underlying morphologic failure which is responsible for those symptoms.

Methods: An overview of postoperative symptoms, diagnostic procedures and a correlation to morphologic changes and therapeutic options is given. Furthermore the symptoms, morphologic changes and therapeutic consequences of 259 redo-procedures of the own patient material are analyzed.

Results: The most frequent postoperative problems following fundoplication are ongoing or recurrent heartburn, dysphagia or the combination of both. Reviewing the own patient material those symptoms were present before the first redo 50 times for dysphagia, in 72 cases for heartburn and in 79 cases for the combination of both. The most frequent morphologic failure was the so-called ''slipping'' of the fundoplication intrathoracically (wrap migration). In the own patient material the so-called ''slipping'' was present in 141 patients (70.1%) before

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the first redo procedure and in 194 patients (74.6%) of all redo procedures. The so-called ''side effects'' like ''gas-bloat'' or ''bowl dysfunction'' do have a high correlation to the above-mentioned complications. Following redo fundoplication these ''side-effects'' have a high tendency of reversibility.

Conclusions: The therapy of postoperative complications depends on the severity of symptoms and the impairment of patients' quality of life. In terms of symptom relation to postoperative morphologic changes a refundoplication is advocated. Quality of life increases after refundoplication, and the number of ''side-effects'' decreases.

Keywords: Fundoplication, side-effects, refundoplication, symptoms, quality of life, complications.

Introduction

The progress of laparoscopic surgery and the more profound understanding of the pathophysiological conditions leading to gastroesophageal reflux disease have resulted in a revival of antireflux surgery. Since 1991 the laparoscopic Nissen and Toupet fundoplication and their modifications have emerged as the surgical alternatives for the treatment of GERD [1]. The reduced morbidity and an approximately 0% mortality rate in combination with excellent outcomes following laparoscopic approaches have encouraged surgeons to a more liberal indication to surgery and have also raised patients' expectations for a perfect outcome. Therefore, it is no surprise that the rates of laparoscopic antireflux surgery grew steadily in the 1990s with a peak in 1999. Since then the utilization of antireflux surgery declined dramatically. Whether questions about the long-term effectiveness of surgery in terms of alleviating reflux symptoms and keeping patients off medications or reported side effects or the better availability of protum pump inhibitors have dampend the enthusiasm for antireflux surgery is still unclear. Whether justified or not, it is evident that fewer patients with GERD are undergoing surgical intervention now [2].

Surgeons operating on patients with gastroesophageal reflux aim to offer a risk free procedure, long-term control of reflux in all patients and no short- or long-term side effects. Even though a good or excellent outcome is achieved for the majority of patients, a small number of them have a less than satisfactory result, either because of recurrent reflux, dysphagia, other complications or ''side effects''. In a few of them the indication for operation was not correct. The most frequent so-called ''side-effects'' of antireflux surgery are gasbloat, bowel dysfunction including flatulence and epigastric pain.

Reviewing the literature, 5–20% of all patients who underwent antireflux procedures have to be treated again because of new onset or persistent reflux symptoms [3]. Depending on the type and definition, failure after open antireflux surgery occurs in up to 30% of patients [4]. Published series with short-, middle- and even long-term follow-up of laparoscopic fundoplication have shown failure rates in up to 25% of cases, too [5, 6]. The main anatomical factors causing the above-mentioned symptoms and leading to repeat surgery are a slipped or misplaced fundoplication in combination with a rupture of the hiatal closure. Those failures are found in about 70% of redo procedures [5, 7, 8]. A wrap disruption or an excessively tight wrap is found comparatively seldom. Although repeat surgery after primary failed antireflux surgery has traditionally been performed by the open technique, the growing experience in minimally invasive techniques has increased the number of laparoscopic reinterventions after failed antireflux surgery. Recent studies have shown that the laparoscopic approach to repeat surgery can be performed safely with good to excellent results when performed by an experienced surgeon [9, 10].

Although there is no exact definition, what the so-called failed fundoplication really is, there exists general agreement among surgeons that antireflux surgery is failed, if the patient is not able to swallow undisturbed, reports about epigastric pain or shows the same symptoms of reflux disease which were the initial reasons for primary antireflux surgery. In addition to persisting or new onset symptoms the quality of life in these patients must typically be lower than before primary surgery [11]. Whenever a clinical problem after laparoscopic fundoplication occurs, the management strategy will be either conservative management, endoscopy and dilatation, or repeat surgery.

Symptoms occurring after antireflux surgery and treatment options

Except the typical signs of perforation or leakage which require urgent reoperation, adverse symptoms in the first days following fundoplication are almost the same than those affecting patients' quality of life months or years later. The main problems are dysphagia, continuing or recurrent heartburn or a pressure in the hiatal region. Approximately 50% of patients experience dysphagia immediately after operation but this symptom usually resolves spontaneously within 2–3 months [12, 13]. In the case of complete inability to swallow even saliva, a swallow X-ray using a soluble contrast should be performed. If no contrast passes into the stomach or the passage is very slow, a trial of dilatation therapy is recommended. If the X-ray during pneumatic dilatation shows the so-called ''sandglass-phenomenon'' as the typical sign of a too tight hiatus [14], early reoperation is advocated. Only a small number of patients experience postoperative dysphagia which is persistent and sufficiently severe. If nutrition is adequately maintained, then waiting for a few months before considering surgical revision should be encouraged. If nutrition is not adequate and the patient continues to loose weight, then a reoperation should be planned.

The most frequent blame with regard to fundoplication is the continuing use of PPI's following antireflux surgery. Especially for patients who complain of persistent heartburn, it is important to verify specifically the symptom that has not been relieved by fundoplication. There are differences in the understanding of the mean-

ing of the German word ''Sodbrennen'' as well as of the term ''heartburn''. Patients may use it to describe a variety of symptoms that are related only indirectly to gastroesophageal reflux, although – in contrast to the German word ''Sodbrennen'' – the term heartburn indicates that the region of pain must be somewhere around the heart [15]. GERD is frequently associated with functional symptoms that may not be due to reflux of gastric contents [16]. As documented by Spechler et al. [17] years ago and confirmed by Ronald Hinder et al. [18], approximately 50% of the medically treated patients complained of abdominal distention and fullness. Those symptoms are more likely to be epiphenomena unrelated to GERD or manifestations of gut motility disorder that predisposes to GERD rather than complaints caused directly by gastroesophageal reflux. As symptoms that are not primarily due to reflux are unlikely to be relieved by antireflux surgery, the surgeon has to be aware of the selection of the ''right'' patient for antireflux surgery.

Most patients are free of symptoms for months or years, but may report about new onset dysphagia alone or in combination with recurrent reflux, beginning months or years after fundoplication. Recurrent reflux as a single symptom following laparoscopic fundoplication has been reported for the long-term follow-up to be between 5 and 10% [19, 20]. This happens if the original fundoplication unravels. Therapy of choice in these patients is the generous employment of PPI's as long as their quality of life is not disturbed. With a decrease of the quality of life score to or under the value that the patient experienced preoperatively and that was the reason for indication for surgery, refundoplication is advocated.

If the gastroesophageal junction migrates proximally through an intact fundoplication, so that the fundoplication sits around the cardia rather than the lower esophagus (as we call ''telescope-phenomenon'') or if the intact fundoplication migrates from the abdominal cavity through the hiatal crura intrathoracically (as we call ''slipped-fundoplication''), patients may experience reflux and dysphagia in combination. The incidence of those recurrences increases during long-term follow-up [21] with failure rates of up to 50% reported at 20 years later following open surgical procedures [22, 23]. The most common cause of problems beginning years after primary fundoplication is the hiatal disruption, leading to a proximal migration of the total fundoplication. The therapy of choice in this group of patients is a conservative management by PPI's as long as their predominant problem is recurrent heartburn and their quality of life is not impaired. As soon as they are affected adversely by heartburn or further side effects, regurgitation or dysphagia, redo surgery is advocated.

Whereas in almost all cases of early or late dysphagia, persistent or recurrent reflux or the combination of both symptoms the underlying mechanical reason for the failure can be detected by a strategy of exact examination, in the case of ''wind-related'' side effects or problems it is often not clear what the actual cause for these symptoms is. ''Wind-related'' problems include flatulance, inability to belch and abdominal bloating. The occurrence of these symptoms which are itself poorly defined must be compared with their preoperative incidence [18, 24, 25]. Interestingly no specific definition is provided in any publication for the sensation of bloating. The cause of that syndrome is as unclear as the cause for flatulance, early satiety or abdominal distention. Possible proposed mechanisms are the inability of the gastroesophageal junction to relax after surgery [26], as well as aerophagia, a frequent habit of patients with GERD [27] and an impairment of meal induced receptive relaxation and accomodation of the stomach including disturbed gastric emptying [28]. As the actual cause of the so-called ''gas-bloat syndrome'' is not clear, the treatment of these side effects is difficult and for most patients dissatisfying. Although there are no published data describing the outcome of surgical revision primarily for troublesome side effects, patients may benefit from an attempt to change the proposed mechanisms by reoperation.

Own experience

Patients and methods

Between December 1993 and April 2008, 1,235 patients underwent a laparoscopic fundoplication at the surgical unit of the hospital of Zell am See due to symptomatic gastroesophageal reflux. In addition 259 laparoscopic redo procedures in 213 patients were performed in the same period. Of those, the primary operation was performed laparoscopically in 177 patients and in 36 patients by open surgery. Of the own patient material 117 patients had to undergo a redo procedure one or more times, 96 patients have been operated elsewhere primarily and were treated laparoscopically one or more times too. The indication for laparoscopic refundoplication depended on an excessive decrease of the ''gastrointestinal quality of life index (GIQLI)'' [29], as well as on the verification of

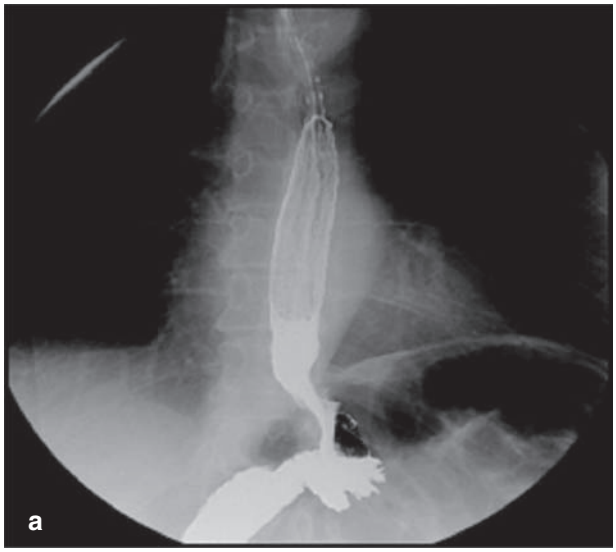

Fig. 1a: Barium swallow cinematography in a patient presenting with dysphagia: The X-ray shows a support-level of contrast in the esophagus caused by a partially slipped left limb of the Toupet-fundoplication leading to a stenosis at the hiatal region

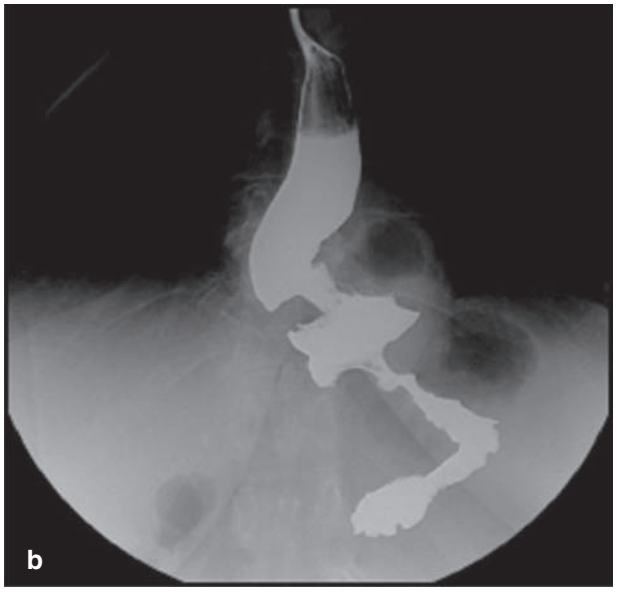

Fig. 1b: Barium swallow cinematography in a patient presenting with recurrent heartburn: The X-ray shows a migration of the complete Nissen-fundoplication intrathoracically

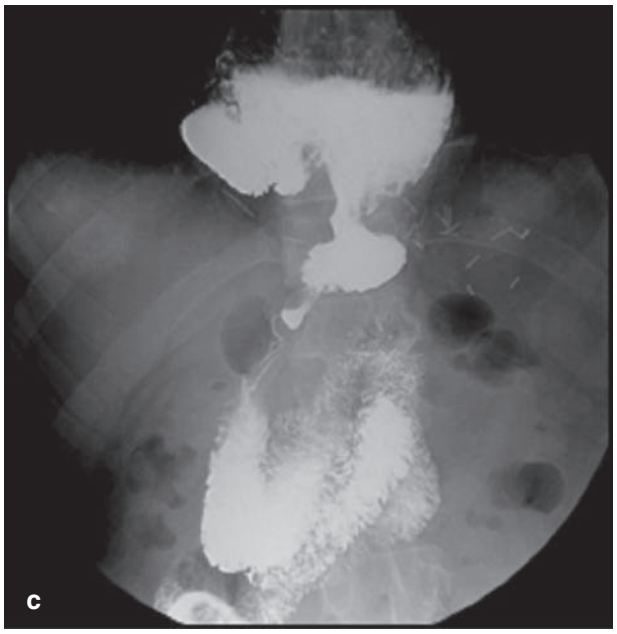

Fig. 1c: Barium swallow cinematography in a patient presenting with dysphagia and recurrent heartburn: The X-ray shows the wrap, the whole fundus and a part of the corpus ventriculi placed intrathoracically leading to a stenosis at the hiatal region

recurrent reflux, dysphagia or the combination of both symptoms. These three leading symptoms have been evaluated prospectively together with the so-called ''side effects'' like epigastric pain, gasbloat (abdominal distention or fulness) and bowl dysfunction (obstipation, flatulence, and diarrhea). In addition to a detailed anamnesis the preoperative examination for the indication to redo surgery included an endoscopy, a manometry, a 24-h-pH investigation as well as a barium swallow cinematography (Fig. 1a–c). According to their radiologic findings, patients with signs of obstruction at or above the gastroesophageal junction suspicious of a too tight wrap or crural stenosis were allotted to pneumatic dilatation. The pneumatic dilatation was performed in general anaesthesia using X-ray documentation for verifying the sign and kind of the stenosis. This procedure [14], the technique of laparoscopic fundoplication, as well as the technique of the redo procedures, is standardized and described elsewhere [30, 31]. The disease-related quality of life for the patients in the present series was investigated with the Gastrointestinal Quality of Life Index (GIQLI), developed by Eypasch et al. [29]. The GIQLI is a well-established instrument that has been used in previous studies for standardized quality of life evaluation in gastroesophageal reflux disease patients. Using 36 single items, a general quality of life can be assessed. This general score is graded from 0 to 144 points. The higher the value, the better the patients.

Statistics were not applied.

Results

In 213 patients 259 redo procedures were performed (Table 1). The conversion rate to open surgery was 0.8% (2 patients). There were no early redo procedures and no mortality. Before the first redo 50 patients suffered from

Tab. 1: Number and percentage of patients submitted to the first and all following redo's

	Primary fundoplications (own) 1.235 pts		Pts submitted from elsewhere (96 pts)	
	↓	117 (9.5%)	+	84
First redo:	201			
	↓	31 (16.3%)	+	8
Second redo:	39			
	↓	10 (25.6%)	+	4
Third redo:	14			
	↓	5 (35.7%)		
Fourth redo:	5			
	259			96

Note: 259 Redo's in 213 patients (1.4.2008) (117 own, 96 submitted from elsewhere).

Tab. 2: Leading symptom before refundoplication (1.4.2008)

Symptom	Before the 1. Re- ($n = 201$)	Before all Re- ($n = 259$)
Heartburn, Regurgitation	72	92
Dysphagia	50	59
Heartburn, Regurgitation, Dysphagia	79	108

Tab. 3: Morphologic changes before refundoplication (1 *AX*)

Morphologic failure	Before the 1. Re-	Before all Re-
''Telescope''	21	21
''Slipping''	141	194
Too tight hiatus, wrap, scar tissue	28	33
''Wrap disruption''	11	11

dysphagia, 72 from recurrent reflux and 79 from dysphagia and reflux in combination. Adding the symptoms of patients before all redos, the number of patients with dysphagia, recurrent reflux and the combination of both are shown in Table 2. The morphologic changes leading to the redos are listed in Table 3, showing the so-called ''telescope-phenomenon'' in 21 patients and a disruption of the wrap in 11 patients before the first redo as well as before all redos. A too tight hiatus or excessive scar tissue or a too tight wrap was found in 28 patients before the first redo; in 5 further patients excessive scar was the reason for a further revision. In 141 patients the underlying reason for their symptoms before the first redo were a partial or complete migration of the wrap from intraabdominal to intrathoracical that means the occurence or reoccurrence of a hiatal hernia. Adding the numbers of wrap migration of the further redos to the first redos, this morphologic change was found in 194 patients (Table 3).

The morphologic changes are associated with typical symptoms like recurrent reflux, dysphagia or the combination of both. For the morphologic change of a ''slipping fundoplication'' the ''side-effects'' of epigastric pain, bloating or bowl dysfunction are assigned to the leading symptoms. As shown in Table 4 the most common side effect is epigastric pain, followed by ''bloating''. For all the 25 patients, in whome the leading symptom of the morphologic failure of a slippage is dysphagia, this symptom is associated with epigastric pain and gasbloat. Only in 3 of the 24 patients these side effects were present before the primary operation. 41 of the 57 patients, suffering from recurrent reflux and dysphagia experience side effects; 13 of those had these side effects preoperatively, too and 29 patients out of those 59 with recurrent reflux reported about side effects, 16 of them preoperatively. The numbers of the ''side-effects'' related to the leading symptom of the morphologic failure of a ''slipping'' 3 months postoperatively are shown in Table 4, too. The ''side-effects'' are divided into halves 3 months after the first redo fundoplication, although the number is twice as high as before the primary surgery.

The evaluation of quality of life could be obtained completely in all 213 patients before and three months after all 259 redo procedures. Before laparoscopic refundoplication quality of life for all patients was considerably impaired, with a mean general score of 85.5 which is significantly lower than in healthy controls (122.6). The general score improved significantly at 3 months follow up to a mean score of 118.8 with a slight decline at the one year follow up (117.4), which is available for 128 patients (60%).

Among the complete patient population of 1,235 patients 22 (1.9%) were dissatisfied, 16 of them were treated conservatively including 4 patients, in whome a pneumatic dilatation was attempted. 6 of them underwent redo surgery, in 3 of them the wrap was dissolved on their own request.

Tab. 4: Correlation of the leading ''side effects'' to the leading symptom in patients with a ''slipping fundoplication''

		Rec. Reflux Regurgitation	Dysphagia	Dysphagia Re-Reflux Regurgitation
''Slipping''	141	59	25	57
Epigastric pain (before/new) 3 Mo p.o. (new)	45 (12/33) 16 (= +4)	8 (5/3) 6 (= +1)	16 (1/15) 2 (= +1)	21 (6/15) 8 (= +2)
''Gasbloat'' (before/new) 3 Mo p.o. (new)	33 (15/18) 19 (= +4)	12 (8/4) 9 (= +1)	9 (2/7) 4 (= +2)	12 (5/7) 6 (= +1)
Bowl dysfunction (before/new) 3 Mo p.o. (new)	17 (5/12) 10 (= +5)	9 (3/6) 5 (= +2)	0 (0/0) 1 (= +1)	8 (2/6) 4 (= +2)
''Side effects'' (before/new) 3 Mo p.o. (new)	95 (32/63) 45 (= +13)	29 (16/13) 20 (= +4)	25 (3/22) 7 (= +4)	41 (13/28) 18 (= +5)

Note: Different ''side-effects'' as epigastric pain, gasbloat and bowl dysfunction are assigned to the three leading symptoms (rec. reflux, dysphagia, combination of both) of 141 patients with the morphologic failure of a ''slipping fundoplication''. The figure in parenthesis indicates the number of patients before the first fundoplication and the new symptoms after fundoplication. The following line indicates the number of patients suffering from those symptoms 3 months after the redo procedure.

Discussion

Success and failure rates primarily depend on a precise indication to surgery and on the frequency how offen the procedure is performed in the institution and by a single surgeon [32–34]. A precise indication does not only include an upper GI-endoscopy or pH-values, but also has to clarify whether patients complaints are due to gastroesophageal reflux or not. In this purpose the most important point in the evaluation of a patient for antireflux surgery is a detailed anamnesis and history. As comorbidities like aerophagia, anxiety disorders or major depression do influence the outcome of surgery adversely [27, 35, 36], the history has to check not only objektively measurable facts. Subjective, patient related characteristics like the above mentioned comorbidities or the absence of compliance to medical therapy may also simulate a so called ''failed fundoplication'' [37]. Especially those patients are not satisfied, rate their surgical outcome as bad and experience a lower quality of life compared to ''normal'' reflux patients. It is no surprise that expectations of patients in a better quality of life, which were not fulfilled, result in a so called ''failed fundoplication''. Unfortunately, there is a lack of standardized definition for failed antireflux surgery. Fundoplications can ''fail'' in any number of ways. For example, surgery can fail to control the primary GERD manifestation for which the operation was prescribed. But is it a failure or an incomplete success, if a symptom is still present, only improved to the point that it is more tolerable or more readily controlled with medication? If the definition of failure includes the appearance of new symptoms such as dysphagia, bloating, diarrhea, is it a failure, if the operation has eliminated the primary complaint? The goal of treatment – conservative, endoscopic or surgical – is to eliminate or diminish patients' complaints and increase their quality of life. Therefore the patients' discription and view of the kind, intensity and beginning of new or recurrent symptoms especially before as well as after the primary antireflux procedure are essential for a further analysis. Aim of this patient related diagnostic procedure is to clarify possible morphologic changes that are responsible for the above mentioned symptoms. Those morphologic changes may be results of technical or surgical failures. They should end in refundoplication, if special conditions are fulfilled: a conservative treatment can neither ameliorate the symptoms nor increase patient's quality of life. Thus patients suffering from recurrent reflux following antireflux surgery are treated with PPI's as long as they are not operated on. In case of dysphagia, pneumatic dilatation is a useful tool to identify the morphologic reason for this complication, as both, the type and placement of the fundic wrap or a mechanical obstruction of the hiatal crura may cause dysphagia – not only in the early postoperative period. Whereas a functionally tight fundoplication can be treated successfully by pneumatic dilatation, a narrow diaphragmatic hiatus or excessive perihiatal scar tissue causing persistent dysphagia are reasons for reoperation.

The fact that we almost have reached the 10%-margin concerning the patients for a second surgical intervention is underlined by Strate et al. [5]. In their complete 2-year-follow up of exact 200 patients 19 had to undergo refundoplication. Using a very detailed and patient-related questionnaire, a symptom score and quality of life index, the intensity of the symptoms and the impairment of their daily life seems to be more pronounced compared to a telephone survey as it is used in other follow up studies [6, 7, 38]. Thus it is no surprise that the complaints of dysphagia and of recurrent reflux symptoms in combination with a decreased quality of life score result in a higher percentage of refundoplication. Additionally the quality of life of patients referred to redo fundoplication is extremely bad [11].

These findings are in accordance with our results of 9.5% of patients out of 1,235 primary fundoplications fulfilling the criteria for refundoplication. As shown in Table 4 the low quality of life score of patients suffering from a ''slipping fundoplication'' is not only caused by the leading symptoms such as dysphagia or recurrent reflux, but dependent on so called ''side effects'' like bloating, epigastric pressure or bowl dysfunction, too. In accordance with the findings of Klaus et al. [18] we noticed that about half of the patients presenting with ''side-effects'' after fundoplication reported about these symptoms preoperatively. After redofundoplication due to a ''slipping'' the rate of those ''side-effects'' decreases almost to the value of the pre-existing symptoms. Following laparoscopic antireflux surgery, gastric emptying and postprandial gastric relaxation may alter and propably be responsible for different side-effects'' [25, 28]. In our patients with a ''slipping'' of the wrap, either complete or incomplete, those side effects were reversible in a high percentage after redo surgery. This reversibility may contribute to a change or decrease of the pressure on the gastric fundus after refundoplication, when the intrathoracically slipped wrap is freed a drawn back into the abdominal cavity. The loss of impairing symptoms and the decrease of ''side-effects'' result in a similiar high quality of life score after refuncoplication as after the primary intervention [11]. Therefore a liberal indication is recommended for redo surgery. Certainly it has to be guaranteed that the symptoms of recurrent reflux, dysphagia and different side effects correspond to morphologic failures. Following this draft of a more liberal indication to redo fundoplication the ratio of dysphagia and patients on PPI becomes extremely low. On the other hand only 6% of patients following redo fundoplication are unsatisfied and 94% of the patients would undergo surgery again, if necessary. The relatively high quality of life score and the high patient satisfaction after refundoplication [11] is one of the reasons for repeat redo's, since a better alternative to this procedure is not yet available. This proceeding is in accordance with Smith and Hunter [7] showing an increase of the percentage of the redo's from the second to the third and fourth one. Whereas the number of a ''telescope-phenomenon'' or wrap disruption remains the same after the first redo and after all redos (21/telescope and 11/wrap disruption) almost all further second, third or fourth interventions are caused by a slipping of the wrap intrathoracically (Table 3).

As shown in Table 3 the sole reason for repeat redo's is a problem at or of the hiatus: hardly often because of a

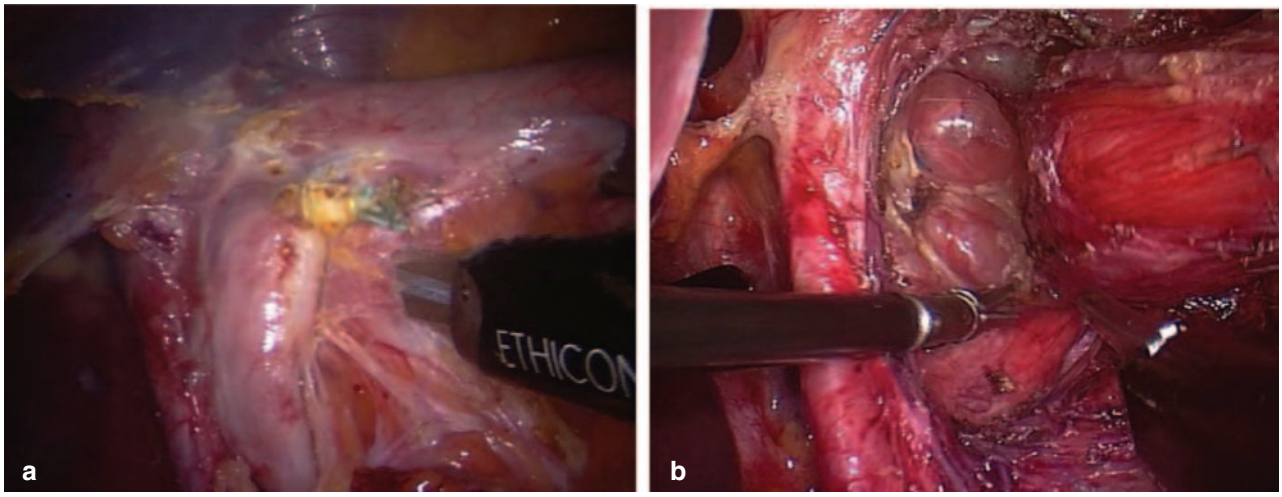

Fig. 2a and b: Exposure of the crura and breakdown of the wrap

too tight sutured hiatus or excessive scar tissue. The most frequent reason for repeat redo's is a slipping of the wrap intrathoracically caused by a hiatal disruption or crura that were sutured too loose as it is in case of failures after primary fundoplication. In general a careful redo surgery with a breakdown of the wrap (Fig. 2) unravelling the hiatal sutures and excision of scar tissue meets the requirements for a completely new hiatal closure and fundoplication.

In accordance with others [5, 7] the main anatomic failure after primary fundoplication in our own series is a slipping of the wrap intrathoracically resulting in recurrent heartburn, regurgitation and/or dysphagia. In a large review of more than 10,000 laparoscopic antireflux procedures it was documented that postoperative intrathoracic wrap herniation was the most common intraoperative finding during redo surgery for a failed antireflux procedure [39]. Before the first redo 70.1% of our patients present with the failure of a transdiaphragmatic wrap herniation, too. This high percentage should emphasize the importance of the crural closure. Independent whether a hiatal hernia is present or not, it has been shown that hiatal closure has become the crucial point in laparoscopic antireflux surgery [9]. In addition there is an increasing debate about the definition of a hiatal hernia and its clinical consequence [8]. As in case of groin hernia surgery the most important point for a repair is the size of the surface but not the contents of the hernia sac. Thus all the current definitions of type I, II, III or IV hernias are misleading, since they contribute to the contents of the hernia sac but give no information about the size of the hiatal surface area. This hiatal surface area can be calculated by measuring the crura and the diameter of the opening [40] (Fig. 3). Nevertheless it is interesting to observe that only a few square centimetres account for a small or a large hiatal hernia. This problem and its clinical revelance should be a topic for further investigations. Nevertheless crural closure has become a relevant problem in laparoscopic antireflux surgery as well as during laparoscopic paraesophageal hernia repair. To solve this problem the

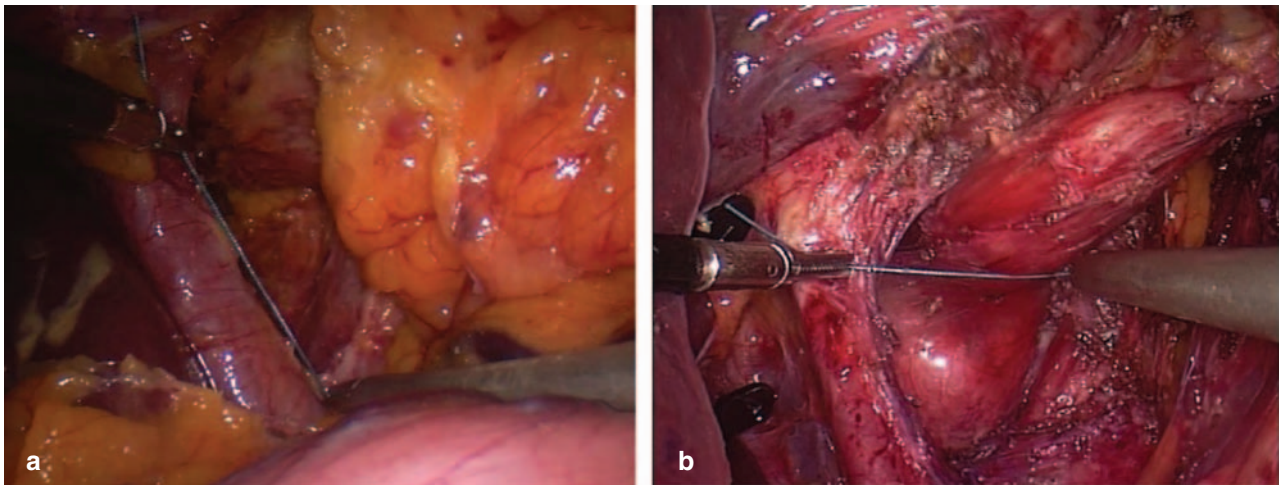

Fig. 3a and b: The hiatal surface is calculated by measuring the length of the crura and the diameter of the opening

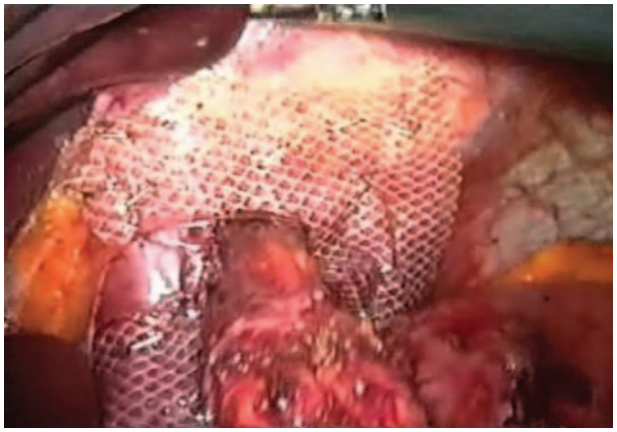

Fig. 4: The crura have been approximated with interrupted nonabsorbable sutures and then reinforced by this composite mesh. It is positioned in an U-shaped form around the hiatus lying on the left crus and keeping the right crus free

use of prosthetic material for crural closure has been advocated. Although there is evidence and general agreement among surgeons that the use of prosthetic material prevents against slipping [30, 41, 42], there is still debate regarding the shape of the mesh, the material of the mesh, the position and placement of the mesh, and especially whether a prosthetic hiatal reinforcement has to be tension-free. Whereas some authors recommend the routine use of meshes in order to prevent tension on the hiatus, the indication for reinforcement of the hiatal crura with prosthetic material in our patient material depends on the size of the hiatal defect. As shown [43], the long-term results of laparoscopic revisional fundoplication with the use of a circular mesh prothesis, even one composed of polypropylene are excellent and do have a low recurrence rate of only 6%. Although we have not seen any complications with the use of polypropylene meshes until now, the fear of reported problems was motivation to try a composite mesh with a three dimensional weave of polyester on the one side and a hydrophilic collagen material on the other side. As we did in case of polypropylene meshes, the failed hiatal repair was primarily approximated with interrupted nonabsorbable sutures and then reinforced with this composite mesh (Fig. 4). The results with the use of this mesh seem to be comparable to those of former employed meshes, even if the observation period is not long enough.

Unfortunately a small risk of adverse outcomes following laparoscopic fundoplication remains. A careful history will help to dishinguisch an operation that failed for technical reasons from a failure of preoperative diagnosis and consistent wrong indication to surgery. The most frequent technical failure is a new or recurrent hiatal hernia, resulting in a partial or complete slipping of the wrap intrathoracically. This slipping may produce different symptoms: heartburn, or dysphagia or the combination of both. In case of new onset or recurrent reflux a conservative management of the patient is indicated. Whenever the quality of life is affected adversely by heartburn alone or concomintant ''side-effects'', redo fundoplication is advocated. If dysphagia is the dominant symptom, a trial of pneumatic dilatation is warranted. The verification of a problem of or at the hiatus should result in revisional surgery.

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