



Techniques and results of laparoscopic antireflux surgery in Germany

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Abstract

Background: This study aimed to evaluate the development and outcomes of laparoscopic antireflux surgery in Germany using a nationwide representative survey.

Methods: A written questionnaire including 34 detailed questions and 288 structured items about diagnostic and therapeutic approaches, number of procedures, complications, and mortality was sent to 546 randomly selected German surgeons (33% of the registered general surgeons) at the end of 2000.

Results: The response rate was 72%, and a total of 2,540 antireflux procedures were reported. According to the survey, 81% of all procedures were performed laparoscopically, and 0.1% were performed thoracoscopically. As reported, 65% were total funduplications, 31% were partial funduplications, and 4% were other procedures. Of the surgeons who had experience with laparoscopic antireflux techniques (29%), 71% preferred a 5-trocar technique, and 91% used the Harmonic Scalpel for dissection. There were significant technical variations among the surgical procedures (e.g., use and size of the bougie, length of the wrap, additional gastropexy, fixation of the wrap). The overall complication rate for laparoscopic fundoplication was 7.7% (5.7% surgical and 2% nonsurgical complications), including rates of 0.6% for esophageal perforations and 0.6% for splenic lesions. The conversion rate was 2.9%; the reoperation rate was 1.6%; and the overall hospital mortality rate was 0.13%. The authors observed a striking learning curve difference in complication rates between hospitals performing fewer than 10 laparoscopic antireflux techniques annually and those performing more than 10 funduplications per year (14% vs 5.1%, $p < 0.001$). Long-term dysphagia and interventions occasioned by dysphagia occurred significantly more often after total funduplications than after partial funduplications (6.6% vs 2.4%; $p < 0.001$). Similar findings were reported for

Nissen versus floppy Nissen procedures. The overall failure rate, however, was similar for both groups (Nissen 8.7%; partial 9%, difference not significant).

Conclusions: Until now, no unique laparoscopic antireflux technique has been accepted, and a number of different antireflux procedures with numerous modifications have been reported. The morbidity and mortality rates reported in this article compare very well with those in the literature, and 1-year-follow-up results are promising.

Key words: Antireflux surgery — Complications — Laparoscopic surgery — Multicenter study — National survey — Outcome

As in most Western countries, gastroesophageal reflux disease (GERD) is endemic in Germany, and minimally invasive surgery has become more and more important as a treatment option for this disease. Despite initial criticism, standardized laparoscopic procedures have been developed for most abdominal diseases requiring surgery, and special training schemes to keep complication rates low are available [21]. Laparoscopic antireflux procedures are widely accepted, and early results are reported by many surgeons. These results are published primarily by centers with high case numbers and good results, whereas the actual complication rates might be rather underestimated.

Because large randomized studies are not available, it appears necessary to evaluate large patient numbers retrospectively. This evaluation will be helpful for both patient information and quality control. The use of an anonymous questionnaire contributed to an honest report of negative results that otherwise would not be available for scientific evaluation.

We describe the results of an anonymous representative poll among German surgeons. These results describe the “German experience” with a nonselected

patient population and allow us to survey their approach to the treatment of GERD.

Materials and methods

Selection of surgeons

On the basis of address information for all German surgical departments, including private practitioners [4], a random selection of every third institution ($n = 546$) was asked to answer our survey. Departments and private practitioners obviously not trained in the treatment of GERD (e.g., orthopedic surgeons and vascular surgeons) were excluded before the survey.

Questionnaire

A total of 34 detailed questions required answers concerning 288 structured items. The questions asked for the actual use of diagnostic and therapeutic procedures and the exact number of procedures, as well as treatment-related early morbidity, hospital mortality, and 1-year follow-up data. To increase the validity of the answers, the questions were very detailed and exact. We were especially interested in evaluating the assumed large variation of surgical procedures performed.

The figures were classified by the responders as "counted" or "estimated." For the evaluation of complication, conversion, and mortality rates, and outcome, only "counted" data were considered. The data shown in the tables represent morbidity and mortality rates (%) for the different study groups.

Statistical analysis

Complications and outcome data were counted and presented as mean percentage rates referring to the corresponding total study population. For comparison of nonquantitative data, the χ^2 -test was used. Parametric data were tested using one-way analysis of variance (ANOVA) (SigmaStat for Windows 2.03; SPSS Inc., Chicago, USA). Data are presented as mean, median, and range of the different parameters for each responding hospital. Differences were considered as statistically significant at a p value less than 0.05.

Results

Responding surgeons

By the end of 2001, 71.8% ($n = 392$) of all the questionnaires had been returned, with 228 respondents answering that they do not perform antireflux surgery. Detailed data suitable for statistical evaluation were available from 120 hospitals. These institutions submitted detailed "counted" data regarding mortality and morbidity. The responses from 44 hospitals included only short answers regarding diagnostic and therapeutic strategies for GERD (Table 1).

Surgical procedures, hospital size, type of institution, and number of surgeons

The 392 hospitals included in our study performed 620,448 operations in 1999. These included 2,540 antireflux procedures were performed in 164 hospitals (Table 1). The hospitals performing laparoscopic antireflux

Table 1. Study design and responding surgeons

	<i>n</i>	%
Questionnaires mailed ^a	546	100.0
Responding surgeons	392	71.8
Not performing antireflux surgery	228	58.2
Complete questionnaires	120	30.6
Short responses	44	11.2
No. of surgical departments performing antireflux surgery ^b	164	41.8
University hospital	23/25	92.0
Academic hospital	60/80	75.0
Private/community hospital	81/237	34.2
Private practitioners/outpatient surgery centers	0/50	0.0
No. of operative procedures ^b	620,448	100.0
Antireflux procedures	2,540	0.4
Laparoscopic	2,053	80.8
Open	485	19.1
Thoracoscopic	2	0.1

^a 33% of the registered German general and visceral surgical hospitals including outpatient centers

^b Includes short responses

surgery usually are larger (84 ± 33 vs 58 ± 27 beds) and perform significantly more operations per year (2190 ± 1085 vs 1146 ± 686 ; $p < 0.001$). In 1999, 92% of the university hospitals (23/25) and 75% of the academic hospitals (60/80) were performing antireflux surgery, but only 34% (81/237) of the community and private nonacademic hospitals and none of the private practitioners were doing so (Table 1).

Surgery was performed laparoscopically in 2,053 cases (80.8%) in 113 hospitals (mean, 18.5 procedures per center and year; median, 7; range, 0–320), and using the open approach in 485 cases (19.1%) in 124 hospitals (mean, 3 procedures per center annually; median: 7; range: 0–20). One hospital performed two thoracoscopic antireflux procedures.

The surgical procedures chosen were reported for 1,909 cases. These procedures included 1,289 total funduplications (65%) (49% using modified Nissen-Rosetti, 9% using Nissen-Rosetti, 35% using floppy Nissen, 3% using Nissen, and 4% using other modifications), 620 partial funduplications (31%) (83% using posterior partial Toupet funduplications, 13% using anterior hemifunduplications [AHFP], 0.8% using posterior partial Guarner funduplications, 0.2% using Hill procedures, and 2.4% using other modifications), 81 other techniques (4%) (e.g., Lig. teres plasty, Vicryl-mesh, Lortat-Jacob procedure) (Fig. 1).

In 2000, 113 (29%) of the 392 responding hospitals had experience using laparoscopic surgery for GERD. Of these, 53% began to use this approach between 1998 and 2000, 34% between 1995 and 1997, and 13% before 1994. In addition, 18% of the hospitals actually not performing any antireflux surgery planned to start laparoscopic antireflux surgery in the near future. In 1999, 69 (61%) of the hospitals performing laparoscopic antireflux surgery had performed fewer than 11 laparoscopic funduplications; 14 (12%) reported 11 to

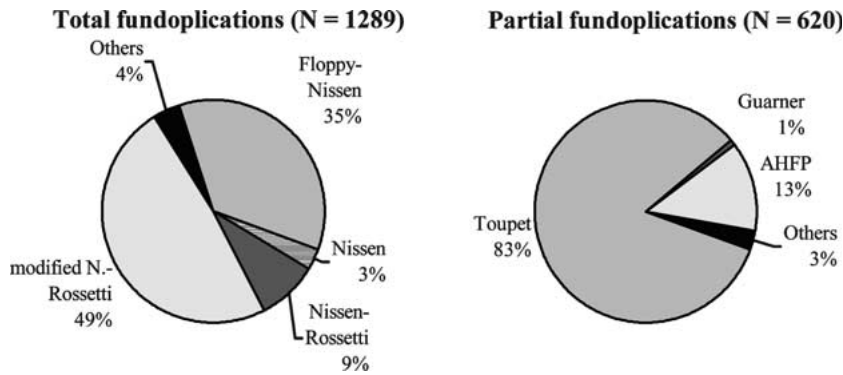


Fig. 1. Number and kinds of funduplications.

Table 2. Preoperative diagnostic procedures

Procedure	Obligatory (%)	Facultative (%)	Never (%)	Not specified (%)
Upper endoscopy	100	0	0	0
Biopsy GI junction	60	35	1	4
Biopsy stomach	27	53	5	15
Radiology (barium swallow)	61	25	4	11
Stationary esophageal manometry (360° fundoplication)	59	20	7	13
Stationary esophageal manometry (partial fundoplication)	47	16	11	27
24-h esophageal pH study	59	24	8	9
24-h gastric pH study	33	26	24	18
Photo-optic bilirubin assessment of the esophagus	4	24	47	25
Photo-optic bilirubin assessment of the stomach	0	19	54	27
Esophageal transit scintigraphy	0	13	61	26
Gastric emptying scintigraphy	0	14	59	27
Status of <i>Helicobacter pylori</i> infection	57	30	6	7

GI, gastrointestinal

20 laparoscopic funduplications; and 11 (10%) performed up to 50 procedures, 9% more than 50 funduplications. There was an average of 2.1 surgeons per hospital performing laparoscopic funduplications. As reported, 34% of the centers had only 1 qualified surgeon performing laparoscopic antireflux surgery; 56% had 2 or 3, qualified surgeons; and 10% had 4 or 5 qualified surgeons. The individual experience per surgeon was 9.7 laparoscopic antireflux procedures in 1999 (university hospitals, 8.1; nonuniversity hospitals, 10.4).

Preoperative diagnostic procedures

Preoperative upper gastrointestinal (GI) endoscopy was considered to be mandatory by all surgeons, and barium swallow by 61%. Esophageal function tests (manometry and 24-h pH study) were always used by 60%. Other tests such as the 24-h gastric pH study, photo-optic bilirubin assessment, and gastric emptying scintigraphy were used only optionally (Table 2).

Of all hospitals performing antireflux surgery, 25% performed endoscopies (23 university hospitals [70%] and 97 others [19%]), and 16% performed esophageal functional studies including manometry and pH studies (university hospitals, 57%; others, 7%) in their own departments.

Standard procedure

In the survey, 111 hospitals reported whether a standard antireflux procedure existed in their department or not. Whereas 85% reported an existing standard procedure, 15% did not have a standard procedure. The major reason for the choice of the standard procedure was "convincing own results" (67%), followed by "better standardization" and convincing reports in the literature (53%). Of all the hospitals, 26% mentioned that their procedure of choice would correspond to "expert opinion." Only 20% considered their procedures as "the one with fewer complications," and only 19% considered their choice to be "technically easier." As their method of choice, 64% chose a 360° procedure (Nissen, 16%; Nissen-Rossetti, 27%; Floppy-Nissen, 21%). Partial funduplications were standard in 10% of the hospitals (Toupet, 5%; AHFP, 5%). Both 360° fundoplication and a Toupet-procedure were reported as standard procedures by 9%. Other procedures such as Ligamentum teres plasty, implantation of a prolene mesh, and esophagofundopexy according to Lortat-Jacob were specified by 3%.

There was a striking difference regarding the choice of standard procedure between university and nonuniversity hospitals, with 22% of the universities performing partial funduplications (AHFP in 17%; Toupet in 6%) as the standard procedure. On the other hand, only

Conversion rate: 2.9% (N=36/1,614)

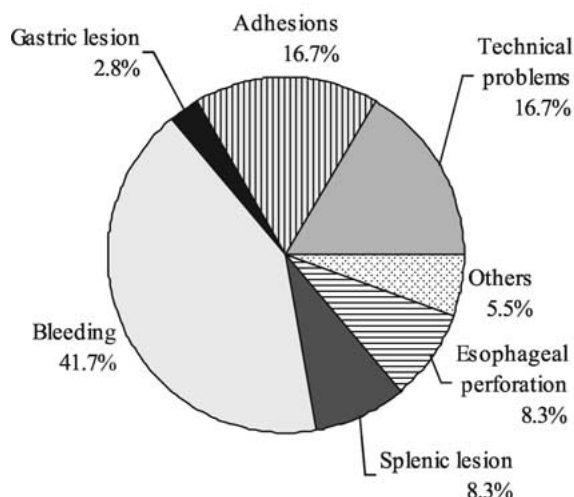


Fig. 2. Conversions from laparoscopic to open procedure, 1999.

partial funduplications were performed in 10% of the nonuniversity hospitals (AHFP in 3%; Toupet in 7%, difference not significant). According to the findings, 55% of the surgeons made their surgical decision according to the results of preoperative diagnostic findings, with 41% choosing a partial fundoplication in cases with esophageal motility dysfunction, 9% choosing a Nissen procedure, 3% choosing a gastropexy, and 4% not performing antireflux surgery for these patients or referring them to specialized centers. These questions were not answered by 41% of the surgeons, who had no experience in this field.

Open operation: primary choice and conversion

Laparoscopic surgery was the standard approach in 113 (69%) of the 164 hospitals, with 31% performing open surgery for GERD. In cases of recurrent disease, 46% chose laparoscopic surgery, whereas 49% used the open approach for these cases, and 4% chose the transthoracic approach (open, 2%; thoracoscopically, 2%), with 1% of the surgeons using the thoracoscopic or open abdominal approach. Almost half of the surgeons (49%) saw no indication for a primarily open approach and started every antireflux procedure laparoscopically. As a reason for a primary open approach, 32% defined prior abdominal operations. Further reasons included refunduplications (32%), giant hiatal hernias (8%), aged patients (4%), and others (12%).

The overall conversion rate was 2.9% (mean per center annually, 7%; median, 0; range, 0–100%). Figure 2 shows the reasons for conversion to open surgery. The most common causes were bleeding (41.7%) and technical problems (16.7%). Other reasons were adhesions (16.7%), esophageal perforations (8.3%), injuries to the spleen (8.3%), and injuries to the stomach wall (2.8%).

Table 3. General technical aspects

Procedures	Always (%)	Selective (%)	Never (%)	Not specified (%)
Dissection of the crura, esophageal mobilization	31	44	11	13
Hiatoplasty	65	24	2	9
Use of a bougie for calibration of the hiatus	46	15	24	15
Additional gastropexy	7	35	48	10
Intraoperative endoscopy	6	22	59	13

General technical aspects

Standard access

For laparoscopic fundoplication, 71% of all surgeons routinely used five trocars in 2000; 26% used four trocars; and 3% performed the procedures using a six- or three-trocar technique. For creation of the pneumoperitoneum, 69% used the Veress needle, and 31% used the open (Hassan) technique. The overwhelming majority (91%) routinely used the Harmonic Scalpel for dissection, with 5% using the electric scissors, and another 4% using the hook cautery.

Dissection of the crura and hiatoplasty, and intraoperative endoscopy

In 2000, dissection of the crura together with esophageal mobilization was mandatory in 31% of the hospitals. Another 44% performed this technique in selected cases, and 11% never used it (Table 3). A bougie was always used by 46%, used selectively by 15% and never used by 24% of the hospitals.

The great majority of the hospitals (94%) performed a posterior hiatoplasty, whereas 6% performed an anterior hiatoplasty. Intraoperative routine endoscopy was always performed by 6% and selectively used by 22% of the surgeons.

Technical details of the wrap (360° fundoplication, AHFP, Toupet)

With regard to the wrap construction, numerous technical variations in the antireflux procedures were observed (Table 4). Of the 120 hospitals (12.5%) that sent a completed questionnaire, 15 reported that they did not use a 360° procedure at all. Another 96 hospitals sent detailed information regarding the details of the 360° fundoplication used in their institution. The wrap length varied from 2 to 9 cm (2–3 cm, 53%; 3.5–6 cm, 39%; 6.5–9 cm, 8%). The number of sutures varied from 2 to 8 (2–3, 63%; 4, 25%; 5–8, 12%). In 81% of the hospitals, the wrap was fixed to the esophagus, with 16% also fixing the wrap to the crura. As reported, 73% of the surgeons used a bougie for calibration (small bougie [8–15 mm], 66%; large bougie [> 15 mm], 34%), and 27% did not use any bougie.

Table 4. Creation of the wrap: technical details

360° fundoplication (<i>n</i> = 96)		%
No. of sutures	2–3	63
	4	25
Length of the wrap (cm)	5–8	12
	2–3	53
	3.5–6	398
	6.5–9	8
Bougie for calibration	Yes	73
	No	27
Size of bougie (mm)	Small (8–15)	66
	Large (> 15)	34
Esophageal fixation of the wrap	Yes	81
	No	19
Additional crural fixation of the wrap	Yes	16
	No	84
Posterior partial fundoplication (Toupet) (<i>n</i> = 49)		
Desired size (°)	180	8
	180–270	55
	270	37
Fixation of the wrap	Both crurae	15
	Left crus	15
	Right crus	70
Anterior hemifundoplication (<i>n</i> = 15)		
Esophageal fixation of the wrap	Yes	87
	No	13
Additional fundopexy	Yes	20
	No	80

Similarly, we observed interhospital differences regarding the techniques used for partial fundoplications. Of 45 hospitals that sent detailed information regarding their Toupet procedure, 52% (62/120) reported that they did not use this procedure at all. The desired extension of their posterior partial fundoplication varied between 180° and 270° (180°, 8%; 180–270°, 55%; 270°, 37%). According to the survey, 15% of the hospitals used sutures between the wrap and both crura (university hospitals, 44%; nonuniversity hospitals, 8%), and another 15% used stitches only to the left. Still another 70% used stitches only to the right crus. No use was made of AHFP by 81% (97/120), and 13% of the hospitals performing this procedure did not include the esophagus in their fixation. In addition to the wrap fixation to the right crus, 27% of the surgeons also used sutures between the wrap and the anterior commissure, and 18% also used stitches to the left crus. An additional fundopexy was performed by 20% of the surgeons.

Additional gastropexy

Whereas 7% of the surgeons always completed the fundoplication with an additional gastropexy, 39% did so in selected cases. The most frequently performed gastropexy was a fundophrenicopexy (63%), and 18% performed an anterior corporepexy by suturing the stomach to the abdominal wall.

Complications, mortality, and reoperations

The overall complication rate after laparoscopic fundoplication was 7.7% (mean per center, 10.5%; median, 0%; range, 0–100%). The rate was 5.7% for

surgical complications (mean per center, 8.9%; median, 0%; range, 0–100%) and 2% for general complications (mean per center, 1.7%; median, 0%, range, 0–40%) (Table 5).

The most frequent surgical complications were lesions of the pleura and wound healing problems (respectively, 1.9% and 0.8% of the evaluated cases). Major complications such as esophageal perforations and lesions of the stomach wall were reported, respectively, in 0.6% and 0.5% of all cases. Furthermore, there were 0.4% intra- and postoperatively diagnosed bleeding complications, 0.6% involving injuries of the spleen and 0.1% involving other intraabdominal septic complications.

We were furthermore interested in evaluating whether a relationship between complication rates and the average experience of the hospital, expressed by the number of surgical procedures performed per year, would be detectable: Significant experience-related differences were found for hospitals performing up to 10 fundoplications per year (14%), as compared with hospitals performing more than 10 procedures per year (5.1%; $p < 0.001$). No further significant differences were found between hospitals performing more than 20, 30, or 40 fundoplications per year. Despite these findings, lesions of the pleura occurred most often in more experienced departments, with 27 of the 31 reported lesions occurring in hospitals performing more than 25 fundoplications per year ($p < 0.01$).

The overall reoperation rate after laparoscopic fundoplication was 1.6%, including a relaparotomy rate of 1.1% and a relaparoscopy rate of 0.5%.

Hospital mortality was reported to be 0.1%, which resulted from a pulmonary embolism after floppy Nissen fundoplication in one case and a nonspecified surgical complication after Toupet fundoplication in another case. Both lethal complications occurred in experienced university hospitals that performed more than 35 fundoplications per year. The mean postoperative hospital stay after laparoscopic fundoplication was 6.5 ± 2.4 days.

Technique-related outcome

Counted data suitable for outcome evaluation after antireflux procedures were available from 56 hospitals with a total of 2,059 cases. The minimum follow-up period for these patients was 1 year. In the survey, 46 hospitals reported follow-up results for patients who underwent surgery in 1999 and had follow-up data until the end of 2000. A total of 10 hospitals reported their cumulative results since initiation of laparoscopic antireflux surgery (median, 1995), with a minimum follow-up of 1 year.

Short-term dysphagia during the first month after surgery occurred in 39.1% of all the patients (median per center, 19.4; range, 0–100%), with no differences between 360° and partial fundoplications (Table 6). Dysphagia lasting 4 to 12 weeks occurred significantly more often after 360° fundoplications (8.2% vs 2.5%, respectively). Approximately 4.5% of all patients reported

Table 5. Laparoscopic antireflux surgery: complications

Cases evaluated	Total (<i>n</i> = 1,614)		Nissen (<i>n</i> = 1,062)	Toupet (<i>n</i> = 470)	AHFP (<i>n</i> = 82)
	<i>n</i>	%	%	%	%
Surgical complications	92	5.7	6.2	3.2	13.4
Bleeding (without spleen)	7	0.4	0.5	0.2	1.2
Injuries of the spleen	10	0.6	0.4	0.85	2.4
Esophageal perforation	9	0.6	0.6	0.4	1.2
Injuries of the stomach wall	8	0.5	0.6	0.2	1.2
Wound infections	13	0.8	0.85	0.0	4.9
Intraabdominal infections	2	0.1	0.2	0.0	0.0
Injuries of the pleura					
With thoracic drain	7	0.4	0.5	0.4	0.0
Without drain	24	1.5	1.8	0.6	2.4
Others (i.e., visceral, trocar injuries)	12	0.7	0.9	0.4	0.0
General, nonsurgical complications	32	2.0	2.5	1.1	0.0
Total	124	7.7	8.8	4.3	13.4

AHFP, anterior hemifundoplication

Table 6. Technique-dependent outcome

	Total (2,105 in 59 dpt) (<i>n</i>)	360° fundoplication (1,100 in 49 dpt) (<i>n</i>)	Partial fundoplication (502 in 18 dpt) (<i>n</i>)	<i>p</i>	Floppy-Nissen (403 in 13 dpt) (<i>n</i>)	Nonfloppy Nissen (604 in 28 dpt) (<i>n</i>)	<i>p</i>
Dysphagia	29.2	31.5	30.5	NS.	52.7	31.3	< 0.001
< 4 weeks							
4–12 weeks	10.0	8.2	2.5	< 0.001	10.8	8.3	NS.
> 12 weeks	4.5	6.6	2.4	< 0.001	3.6	6.6	0.10
Dysphagia-caused interventions	1.6	2.6	0.0	< 0.001	2.2	3.3	NS
Recurrence, symptomatic	3.8	3.3	3.2	NS.	1.4	4.5	< 0.005
Asymptomatic	5.5	5.4	5.8	NS.	0.9	9.0	< 0.001

dpt, departments; NS, not significant

dysphagia that lasted longer than 12 weeks. Again, a significant difference between 360° funduplications and partial funduplications was observed (6.6% vs 2.4%; $p < 0.001$). Even among the various 360° procedures, significant differences were observed (Table 6): Patients with short floppy Nissen had a long-term dysphagia rate of 3.6%, as compared with 6.6% after the original Nissen/Nissen–Rosetti procedure ($p = 0.10$). No significant differences were observed with regard to dysphagia in comparisons of Nissen and Nissen–Rosetti, use and size of the bougie, and hiatoplasty technique using the choices “never,” “always,” “selected cases.” Of the patients who underwent 360° fundoplication, 2.6% required intervention (dilation) because of dysphagia, which was not necessary after partial fundoplication ($p < 0.001$).

The overall failure rate was 9.3%, which included 3.8% symptomatic and 5.5% asymptomatic recurrences. There was no difference between partial and 360° funduplications in terms of recurrence rates. Nonetheless, recurrent disease was significantly reduced with short floppy Nissen (2.3%), as compared with the original Nissen/Nissen–Rosetti procedure (13.5%; $p < 0.001$).

Discussion

This study demonstrates the different procedures used for antireflux surgery in Germany. Although the introduction of laparoscopic cholecystectomy in Germany occurred very rapidly [19], the breakthrough for laparoscopic antireflux surgery did not develop before the end of the 1990s. Only 13% of the responding surgeons had started laparoscopic antireflux procedures by 1994. Since then, the number of hospitals offering laparoscopic surgery for GERD has increased dramatically. Of all the surgeons performing antireflux procedures, 34% started between 1995 and 1997, and 53% started between 1998 and 2000. In addition, an increasing number of patients undergoing surgery for GERD can be observed in Germany [14]. Similar findings are reported from other countries [20, 25, 27, 34].

Meanwhile, outpatient centers also have reported antireflux surgery, describing high case numbers and low morbidity and mortality rates [12]. Whereas most antireflux procedures in Germany were performed via laparotomy in 1995 [14], we observed 81% laparoscopic procedures in 1999. The experience of individual surgeons also increased during this period. One surgeon

actually was performing an average of 10 laparoscopic antireflux procedures in 1999.

Most surgeons obviously follow an algorithm in preoperative diagnostic testing. Although preoperative endoscopy is mandatory for all surgeons, functional studies such as esophageal manometry, 24-h pH-monitoring, and barium swallow are mandatory only for 60%. However, in comparison with an previous non-randomized study [14], this ratio has almost doubled. Modern methods of surgical education [21] and increasing numbers of consensus conferences [1–3, 10, 11, 13, 22] may have contributed to this development. Additional tests such as photo-optic bilirubin tests, 24-h gastric pH studies for assessing duodenoesophageal reflux, and gastric or esophageal emptying studies do not play a fundamental role in overall patient management in Germany. These findings are in agreement with the recommendations of the European Association for Endoscopic Surgery [10].

With case numbers increasing, an ongoing discussion regarding the procedure of choice with low rates of recurrent disease and few side effects has been initiated. The dangerous complications of Nissen fundoplication has resulted in various modifications of the original procedure, with exclusive or facultative use of partial wraps in a number of hospitals [17, 33–35]. This also was shown by the current study. Of the participating surgeons, 64% performed a 360° fundoplication as the standard procedure, whereas 10% chose a partial fundoplication as the standard operation. More than half of the surgeons, however, chose the different procedures in agreement with the results of preoperative functional tests. This so-called “tailored concept” is intended to minimize the risk of postoperative dysphagia through the use of a partial “weaker” wrap for patients with a weaker esophageal persistalsis. This concept is followed in a number of hospitals with promising results [17, 18, 33]. However, the randomized study addressing this issue by Rydberg et al. [24] failed to demonstrate any advantages of this concept.

An overall trend toward partial fundoplications has been described in another national report [34]. In 1995, 75% of all hospitals with a partial wrap as their standard procedure used the anterior hemifundoplication [14]. In 1999, only 45% of these hospitals still performed this procedure, most of them being university hospitals. The reasons for this development are beyond the scope of this study. Unfortunately, no randomized study exists that shows the advantage of one procedure over the others.

Considering the actual reported numbers of surgical procedures, it is surprising that more partial fundoplications were performed (31%) than would have been expected as a chosen standard procedure. As indicated by the case numbers, it appears that more experienced centers tend to perform increasing numbers of partial fundoplications. The observation that hospitals with lower case numbers mainly performed 360° fundoplications may be explained by different reasons. During the initial phase of laparoscopic surgery, most surgeons usually apply their experiences from open surgery. The decision to change a surgical procedure usually depends

on increasing experience with the laparoscopic approach and on higher case numbers. During recent years, the authors have observed in laparoscopic training sessions that German surgeons are trained mainly in 360° fundoplications. It may well be that most surgical “trend setters” in Germany favor this method. However, a previous study [14] shows by comparison that the ratio of partial fundoplications has not changed in Germany.

The authors were surprised by the findings that more than 50% of the responding surgeons never dissect the crura, or do so only in selected cases, and that almost 25% of the surgeons perform a hiatoplasty only selectively. Similar results are reported from Italy [35]. Only 46% always use a bougie to calibrate the tightness of the hiatus. These findings are in contrast to the recommendations of the European Association for Endoscopic Surgery [10] and the European Study Group for Antireflux Surgery (ESGARS) [13]. As reported, 7% always combine the fundoplication with an additional gastropexy, and another 35% use gastropexy selectively. The use of gastropexy may help to avoid a paraesophageal recurrence, which is a worrisome complication reported in up to 7% after laparoscopic Nissen procedures (see review in [29]).

Numerous differences in the technical details of wrap construction have been reported. It appears that especially during the Nissen procedure, no standards exist regarding the number of sutures, the length of the wrap, and the use and size of the bougie. With regard to the so-called “Toupet” fundoplication, fewer than 40% of the surgeons try to get a real 270° wrap, and only 15% fix the wrap to both crurae as described for the original Toupet procedure [26]. The other reported techniques are modifications of the Toupet fundoplication or similar posterior 180° fundoplication according to Guarner [15]. As for anterior hemifundoplication, the reported technique of various hospitals is closer to the 120° Watson procedure [28] than to a real anterior 180° hemifundoplication.

The technical variations described in this report compare well with the evaluation of the procedure used by the surgeons. Fewer than one-fourth of the participants reported that their technique was in agreement with expert opinion. Even fewer surgeons considered their technique as technically less demanding or reported fewer complications. Two-thirds of the surgeons, however, were satisfied with their results.

Despite these wide technical variations, the reported rates for overall mortality (0.1%) and complications (7.7%), including esophageal perforation (0.6%) as most serious complication, compare well with those in the literature. Complication rates for laparoscopic fundoplication in other regional or national surveys [6, 14], multicenter studies [7, 23, 35], and reviews of the literature [29, 30] range between 3.5% and 15%, with mortality rates between 0% and 0.5%. Complication rates for partial (Toupet and AHFP) and 360° fundoplication also are comparable.

The high number of surgical complications after AHFP is not in agreement with the literature [16, 17, 32]. This again must be discussed in light of the reported low case numbers. Of the 11 complications during

AHFP, including all major complications reported, 5 (1 esophageal perforation, 2 splenic lesions, 1 bleeding and 1 lesion of the stomach wall) occurred at one hospital with an overall complication rate of 83%. This is in agreement with the overall results showing that complication rates in less experienced centers (<10 funduplications per year) are three times higher than the rates in experienced centers. Moreover, minor complications such as pleural lesions have been reported primarily from experienced centers. In these centers, rates up to 6.3% for intraoperative pleural lesions were reported [17]. A recent review reported pleural lesion rates lower than 2% [29], which also is in agreement with our findings (1.9%). This complication occurs mainly because of injury to the left pleural membrane during retroesophageal dissection, and usually does not require therapeutic intervention. A thoracic drain was placed in only 25% of all patients in the current survey. Others, however, have reported the general use of a thoracic drain after intraoperative pleural lesions [17]. It appears that more experienced surgeons perform a wider mobilization of the esophagus, which would explain the higher incidence of pleural lesions at these centers.

The reoperation rate reported for this study (1.6%) compares favorably with that in the literature [29, 35]. Nonetheless, the risk depends on the length of the follow-up period. The DeMeesters group recently reported a surprisingly high reoperation rate of 3% for trocar hernias after laparoscopic reflux operations [5].

The reported 1-year follow-up results showing an overall recurrence rate of 9.3% and a long-term dysphagia rate of 4.5% are promising. Nonetheless, notable differences with regard to the outcome of the various methods have been observed. With comparable recurrence rates, significantly more long-term dysphagia and dysphagia requiring reintervention were observed after Nissen funduplications than after partial funduplications. This is in agreement with the randomized study addressing this issue reported by Watson et al. [31]. Until now, long-term results had not been published. Similar but statistically nonsignificant differences between floppy Nissen [8, 9] and nonfloppy Nissen were reported. Regarding the use and size of the bougie as well as the type of a hiatoplasty, no significant differences in outcome were observed. The latter also is in agreement with another randomized study [31].

All these observations require further studies within the framework of quality assurance programs that have been established in various German states (e.g., for laparoscopic cholecystectomy or inguinal hernia repair). The current study shows significant variations in the different procedures used for antireflux surgery, which is an important finding that must be considered when the outcome and long-term results of different surgical centers are compared.

The reliability of self-reported data may be uncertain, and we cannot rule out the possibility that the nonresponders had results no worse than those described in this report. On the other hand, a number of institutions with low patient numbers and considerably high complication rates also reported their poor results, with complication rates as high as 100%. In addition, a

completely anonymous data collection was warranted, and the majority of participating hospitals transmitted prospectively collected data within the framework of internal quality controls. We, therefore, are convinced that our study has high reliability.

Conclusion

This anonymous representative study allows for the estimation of overall risks in antireflux surgery, with special attention focused on the numerous techniques. It also includes the poor results of single institutions. This is important with regard to legal aspects. The study also allows the evaluation of diagnostic and technical trends as well as the estimation of their effects on complication rates. The overall complication and mortality rates are within the range reported in the literature. Data suggest that there is no place for the occasional laparoscopist in laparoscopic surgery for these advanced procedures. The best surgical technique for GERD, however, remains a subject of debate, and should be assessed with prospective randomized clinical studies.

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