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Original Article

How effective is laparoscopic redo-antireflux surgery?

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SUMMARY. ***Background:*** **The failure-rate after primary antireflux surgery ranges from 3 to 30%. Reasons for failures are multifactorial. The aim of this study is to gain insight into the complex reasons for, and management of, failure after antireflux surgery.** ***Methods:*** **Patients were selected for redo-surgery after a diagnostic workup consisting of history and physical examination, upper gastrointestinal endoscopy, quality-of-life assessment, screening for somatoform disorders, esophageal manometry, 24-hour-pH-impedance monitoring, and selective radiographic studies such as Barium-sandwich for esophageal passage and delayed gastric emptying. Perioperative and follow-up data were compiled between 2004 and 2017.** ***Results:*** **In total, 578 datasets were analyzed. The patient cohort undergoing a first redo-procedure ($n = 401$) consisted of 36 patients after in-house primary LF and 365 external referrals (mean age: 62.1 years [25–87]; mean BMI 26 [20–34]). The majority of patients underwent a repeated total or partial laparoscopic fundoplication. Major reasons for failure were migration and insufficient mobilization during the primary operation. With each increasing number of required redo-operations, the complexity of the redo-procedure itself increased, follow-up quality-of-life decreased (GIQLI: 106; 101; and 100), and complication rate increased (intraoperative: 6,4–10%; postoperative: 4,5–19%/first to third redo). After three redo-operations, resections were frequently necessary (morbidity: 42%).** ***Conclusions:*** **Providing a careful patient selection, primary redo-antireflux procedures have proven to be highly successful. It is often the final chance for a satisfying result may be achieved upon performing a second redo-procedure. A third revision may solve critical problems, such as severe pain and/or inadequate nutritional intake. When resection is required, quality of life cannot be entirely normalized.**

KEY WORDS: **antireflux surgery, gastroesophageal reflux (GERD), gastrointestinal motility, esophagitis, esophagogastrectomy, fundoplication.**

INTRODUCTION

Laparoscopic fundoplication (LF) remains a major therapeutic pillar in surgical treatment of patients with severe gastroesophageal reflux disease (GERD).[1–7] Unfortunately, some patients experience failure of primary LF.[1,6–9] This failure-rate, depending on the composition of the observed GERD-patient-cohort, ranges from 3 to 30%.[2–17] A variety of reasons for failure of the initial LF have been identified in the literature, including flawed patient selection, migration of the fundus due to limited quality of tissue and hence insufficient scaring required to maintain the corrected position, poor surgical technique or lacking experience of the surgical team, and poor patient education concerning vital postoperative behavioral aspects alongside lacking knowledge of physicians resulting in incorrect postoperative rates of recurrence.[2–22] Determining the contributing factors when diagnosing a failed LF is highly time consuming and requires experienced and detailed patient care.

The purpose of this study is to analyze patients with failures after primary LF and after redo-antireflux surgery with respect to their symptoms, quality of life (QL), underlying factors, choice of therapeutic concept, and subsequent problems. The aim of the study is to gain a broader insight into the complex issues surrounding LF-failures and their management.

MATERIAL AND METHODS

This study was performed at the AGAPLESION Markus Krankenhaus Frankfurt, Germany between 2004 and 2017. We have previously described our

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diagnostic and therapeutic concept in the management of GERD-patients.[5,22] GERD-patients were selected for redo-surgery after extensive diagnostic workup consisting of history and physical examination, upper gastrointestinal endoscopy, assessment of QL by the gastrointestinal quality of life index (GIQLI), screening for somatoform disorders, esophageal manometry, 24-hour-pH-impedance monitoring, and selective radiographic studies such as Barium-sandwich for esophageal passage and delayed gastric emptying (DGE).[5,7,20,22–24] Furthermore, it was important to obtain information about the primary procedure regarding diagnostic status, primary patient complaints, technical details, and the postoperative course. Each patient's recurrent or persisting symptoms were evaluated in order to be able to judge the validity of a true reflux-recurrence in order to determine whether the patient was potentially experiencing a new emerging problem or a persisting primary disorder which was not adequately resolved by the patient's primary LF. It is highly important to share information with patients to increase patient comprehension of the disease and previous operative failure.

The study was approved by the hospital institutional review board. All patients gave informed consent for study evaluation and diagnostic work-up and followed a defined study protocol. All procedures were performed in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1964 and later versions.

In this study, we primarily focus on those patients with recurrent GERD following surgical intervention. All included patients underwent LF during the time of investigation. Patients with GERD who received further conservative therapy, as well as patients suffering from other esophageal and gastric disorders, were excluded from the study. Documentation of all evaluated patient-data was performed as previously published.[22] The indication for antireflux redo-surgery was based on established guidelines by the EAES.[7] More severe symptoms, such as pain, dysphagia, or insufficient nutritional intake, were regarded as more immediate indications for redo-surgery.

All redo-patients received an antibiotic prophylaxis due to an increased risk of intraoperative perforation. The patients underwent general anesthesia and were positioned in a reverse-Trendelenburg position and a five-trocar technique was applied, and in all cases an ultrasonic energy-device was used. The technique applied in laparoscopic redo-fundoplication was based on the principles of anatomic reconstruction and on augmentation of the lower esophageal sphincter (LES) in order to gain a sufficient antireflux-effect. Dissection of the hiatus and esophagogastric junction (EGJ) along with sufficient mobilization of the posterior gastric fundus and the esophagus are important steps in anatomical reconstruction of the EGJ, and present a prerequisite for an effective functional result.

Therefore, the first operational step was laparoscopic adhesiolysis and dissection of anatomical landmarks at the hiatus and EGJ such as crurae, esophagus, vagal trunks, and, if necessary, the aorta, vena cava, and pulmonary lobes. During dissection, special care was taken to assess possible reasons for failure and to directly address these problems, especially with regard to mobilization of the esophagus to gain sufficient length. If not, a Collis-esophageal-lengthening procedure was considered, referring to fundic wedge-resection.[25] In borderline situations, an anterior gastropexy was added after the redo-fundoplication to reduce the risk of migration. In all doubtful cases, in which anatomy could not be clearly defined by laparoscopic view alone, an intraoperative endoscopy was performed to clearly identify the EGJ. The intraabdominal length of the LES was intraoperatively determined by measuring without tension the distance between the hiatal arch and the EGJ, which should be at least 2–3-cm long. If the distance was clearly shorter than 2 cm, a Collis-lengthening was performed.

Further care was taken to dissect and identify both vagal trunks to avoid lesions. Particularly after repeated redo-surgery, laparoscopic adhesiolysis could expose vagal trunks entering rigid, almost 'wooden-like' scar-tissue, sometimes irreversibly connected to the esophageal or gastric wall. This left the surgeon with limited choice of action and in some cases leading to obligatory major resection. Frequently these patients had a previous hiatal mesh-implant.

Following principles of antireflux surgery, at least 2–3 cm of tension-free esophageal LES-length must be positioned within the abdominal pressure compartment below the diaphragm during the repair.[22,26] A sufficient narrowing of the hiatal crurae without causing stenosis or kinking of the esophagus is vital. If necessary, a combined posterior and anterior suture-hiatoplasty was performed using nonabsorbable 0-size suture-material. Applying mesh could be helpful if narrowing of the hiatus was impossible due to rigidity of the tissue or crurae-destruction caused in previous procedures.

Short and floppy re-fundoplication was performed using the Nissen re-fundoplication (LNF).[26] In cases of impaired esophageal-motility (IEM), or severe preoperative dysphagia, a partial posterior Toupet re-hemifundoplication (THF) was applied. Care was taken to create tension-free symmetric full or partial fundoplication around a 54 French-bougie to allow for sufficient postoperative accommodation of the fundus. In more difficult cases, a partial or even major resection of the esophagus or stomach was necessary. Notably in redo-surgery, surgeons

Table 1 Overview on Redo-patient's preoperative characteristics

	1. Redo	2. Redo	3. Redo	Resections ($3^{rd}+4^{th}+5^{th}$ Redo)
n	401	90	31	45
Mean age (years)	62,5	61,4	58,6	66,4
Sex (m/f)	213/188	47/43	15/16	19/26
BMI median	26	26	25	24
	20–34	18–33	18–31	16–31
Years between primaryLF→Redo,	5,2	4,8	4,1	2,3
Prev. surgery→subsequent surgery	0,5–13	0,5–7	0,5–9	1–3
Preoperative chief-complaints(%):	59	53	42	31
Heartburn/regurgitation	12	22	29	38
Pain(thoracic/epigastric)	8	13	16	22
Dysphagia	5	11	13	4
Gas-related-symptoms				
Preop esophagitis(%)	90	83	81	80
Preop hiatal hernia(>0–1 cm)(%)	88	81	87	82
LES-incompetence % (tested: $n=388$)	81	83	84	89
Impaired esophageal Motility(%) (tested: $n=388$)	34	38	42	47
Pathologic esophageal acid exposure(%) (tested: $n=311$)	82	82	77	73
Delayed gastric emptying (%)	4 –	6	19	51

should be capable of performing major upper GI-resections, such as an esophagectomy if necessary, and whenever indicated be prepared to take such exceptional measures without hesitation.

For follow-up purposes, all patients received a letter containing standardized questions regarding their symptoms, QL, documentations of medical presentations in the meantime and a suggestion to present in hospital for further examination. If there was no response, a telephone interview was attempted. All available data were entered in a prospectively maintained database. For statistical comparison, either a *t*-test for unpaired samples was used or a Fisher's exact test was applied for group comparison.

RESULTS

A total of 578 datasets were evaluated. The characteristics of all patients with redo-antireflux surgery are summarized in Table 1. In 11 patients (1,9%), we performed laparoscopic myotomies for spastic motility disorders or achalasia as the primary diagnosis retrospectively proved to be false.

The cohort of patients undergoing their first redo-procedure ($n=401$) consisted of 36 patients after in-house primary LF and 365 external referrals (Table 1). The mean age of these patients was 62.1 years (25–87) and the mean BMI was 26 (20–34). In this first redo-cohort, chief-complaints were heartburn (53%), regurgitation (6%), thoracic or epigastric pain (12%), and dysphagia (8%). In Table 2, the overview of preoperative symptoms, both chief-complaints, and overall presence of symptoms is presented. In addition, gas-related symptoms were the most frequently presented symptom (73%), however with minor intensity.

Table 2 Overview on preoperative symptoms (chief complaints and overall presence of symptoms, prior to the first Redo-antireflux procedure)

Presence of chief/overall complaints: (%)	Chief:	Overall:
Heartburn	53	66
Regurgitation	6	47
Pain (thoracic, epigastric)	12	53
Dysphagia	13	47
Respiratory symptoms (cough, hoarseness)	5	15
Nausea, vomiting	6	35
Gas-related (belch, bloating, flatulence)	5	73

Table 3 Overview on preoperative grade of esophagitis, prior to the first Redo-antireflux procedure

Esophagitis ($n=401$))	*n*	%
Grade 0	43	11
Grade 1	101	25
Grade 2	207	52
Grade 3	29	7
Grade 4	21	5
(Barrett's esophagus)	(51)	(13%)

Respiratory symptoms were present in 5% as the chief-complaint and in 15% of the overall cohort. Mean duration of recurrent symptoms was 5,2 years.[1–13] QL was substantially reduced to a mean GIQLI of 83 (46–121). Tendency for somatoform disorders was present in 23% of patients.

Endoscopically, 89% of patients showed signs of esophagitis (Table 3). It must be emphasized that all patients were under PPI-treatment with insufficient therapeutic effect, resulting in persistent symptoms and reduced QL despite PPI therapy, often following dose escalation.

A recurrent hiatal hernia was present in 88%. In 81% of patients an LES-incompetence, as well

Table 4 perioperative data of first Redo-antireflux surgery

Investigated parameter	*n*	%
Previous procedures:($n=401$)	206	51
Nissen lap	6	1
Nissen open	26	6
Nissen-lap-mesh	139	35
Toupet	22	5
Toupet mesh	2	0,5
LINX		
Redo procedures($n=401$):	271	68
Lap Redo-Nissen	23	6
Lap-Redo-Nissen-pexy	2	0,5
Lap Redo-Collis Nissen	2	0,5
Open Redo-Nissen	(6)	19
(Nissen combined EPPD)	78	3
Lap Redo-Toupet	14	0,2
Lap Redo-Toupet-pexy	1	0
Lap-Redo-Collis-Toupet	0	1
Open Redo-Toupet	(4)	0,7
(Toupet combined EPPD)	5	0,5
Hill-Dor-pexy	3	(1%/2%)
Lap-Nissen-sleeve	2	
Roux-en-y distal gastric resection (primary open-access/total open)	(4/9)	
Conversions	5 1 spleen bleeding 4 massive adhesions	1,2
Intraoperative change to resection	0	
Intraoperative perforation	17	4,2%
Intraoperative spleen injury	7	1,7%
Necessity to convert for splenectomy	1	
Intraoperative vagal injury	3	0,7%
Postoperative proven gastroparesis	2	0,5%
Necessary revisional surgery within 4 weeks postoperatively:	11	2,7%
Postop bleeding	2	0,5%
Abscess/Leaks	6	1,5%
Early intrathoracic herniation	3	0,7%

as pathologic esophageal acid exposure (EAE; mean DeMeester-score 48.7), was determined. A total of 25 patients reported nausea and vomiting. Objective testing could confirm DGE in 10 patients with mild changes, 6 patients with fundic emptying problems, and 2 with full gastroparesis.

Most of the patients had undergone a previous LNF and modifications of such (58%) or THF and its modifications (40%; Table 4). Mesh had been applied for hiatal enforcement in 11% of these cases. Table 2 demonstrates our management of the first redo-procedures in this cohort of recurrent GERD-patients. The majority of patients underwent a redo-LNF or -THF and modifications of such (Table 4). Although 40% of the patients in our cohort had a primary Toupet procedure, only 21% of those patients received a redo-THF, whereas 76% underwent redo-LNF with modifications.

In around 10% of these patients, esophageal mobilization in the mediastinum was at the limit, therefore in 9% an additional gastropexy was performed. In 3 redo-patients, we were forced to combine a Collis-lengthening-procedure, of which 1 patient developed a failure after 3 years. DGE in 5 patients consequently led to resection and in another 10 patients Endoscopic pneumatic Pylorus dilations were necessary. In 2.7% of patients, severe postoperative complications occurred requiring revisions.

For a limited subgroup of patients ($n=97$), we prospectively documented intraoperative findings and our interpretation with regard to suspected reasons for failure in further detail (Table 5). Insufficient esophageal mobilization and/or fundic mobilization presented as major impact factors in 69 and 55%, respectively. The most frequent intraoperative observation after failure was migration of the proximal stomach into the mediastinum (71%), as well as remainders of the hernia sac in the mediastinum (59%). Based on our judgement, we documented an incorrect shape of the previous fundoplication in several cases. Upon adhesiolysis, we discovered an 'anatomical chaos' in ~20% of redo-patients, with postoperative severely altered major landmarks, including several posterior wrap-pull-throughs below the left gastric artery.

In patients undergoing multiple redo-operations (second, third redo-operations and resections; Table 1), we noticed a successive shortening of the time interval between each redo-operation. Another important observation was a change in symptomatic spectrum

Table 5 Intraoperative findings and interpretation regarding the possible causes for failure of previous primary antireflux-procedures as assessed on 97 consecutive patients

Intraoperative findings and interpretation	*n*	*%*
Severe limiting adhesions	41	42
Migration with wide or open hiatus	69	71
Slipped stomach above plication	26	27
Posterior fundic flap withdrawn	62	64
Fundoplication open	35	36
'asymmetric'	46	47
'too tight'	17	18
'too low'(low wrap position)	28	29
Hiatus too tight	8	8
Remainders of hernia sac	57	59
Previous circular mesh with stricture	9	9
Previous partial mesh with stricture	2	2
Previous mesh with penetration	2	2
Vagal damage	11	11
Intraoperative assessment and interpretation for reasons of failure:	67	69
Limited esophageal mobilization	53	55
Limited fundic mobilization	12	12
Too extensive division of greater curvature vessels	22	23
Anatomical chaos		

Table 6 Intraoperative management and data in patients undergoing Redo-antireflux surgery

	1. Redo	2. Redo	3. Redo	Resections ($3^{rd}+4^{th}+5^{th}$ Redo)
n	401	90	31	45
Nissen fundoplication and modified versions (%)	73	72	42	0
Partial fundoplication and modified versions (%)	26	24	48	7
Collis-esophageal-lengthening (%)	1	3	13	—
Resections (%)	1%	3	10	93
Intraoperative complications (%) (perforations, %)	6,4 (4,0)	4,4 (3,3)	10 (10)	13 —
Conversions (%)	1,2	1,1	10	open30pat conv.3(15)
Postoperative complications (%)	4,5	8	19	42
Postoperative mortality (%)	0	1	0	4,4
Postoperative revisions (%)	2,6	3,3	10	8,8

from the first to third redo, notably an increase in pain and dysphagia as chief-complaints with every operation. Table 6 provides an overview of the operative procedures applied and postoperative progress in the different cohorts. In the first redo-cohort, most patients' complaints could be resolved by a repeated redo-fundoplication. With increasing occurrence of failures, consequently more complex procedures became necessary such as esophageal lengthening (1–13% in 1.–3. redo) and more complications occurred (intraoperative: 6.4–10%; postoperative: 4.5–19% in first to third redo). Revision operations following a third redo-operation accounted for a higher rate of postoperative complications (morbidity: 42%; mortality: 4.4%).

A follow-up of the patient-cohort after the first redo-procedure ($n=288$) was performed on average 6.3 years after the procedure (Table 7). Reported symptoms had notably improved, demonstrated by a significantly increased GIQLI of 106 (67–141). The most burdensome chief-complaints were heartburn and regurgitation, as well as thoracic and epigastric pain and gas-related symptoms. There was a clear trend towards increased complaints in patients who had undergone multiple redo-operations (Table 7).

Symptom-analysis showed that patients prior to the first and second redo-procedures mostly suffered from reflux-recurrence, heartburn, and regurgitation, combined with pathologic EAE and esophagitis (Table 1). The more often redo-procedures are necessary, the more common it was for pain and dysphagia to emerge as chief-complaints (30–40%). A substantial number of patients after multiple operations suffer from DGE and require operative resections. Furthermore, repetitive revision procedures are associated with a significantly increased rate of intraoperative complications (>10%) and postoperative complications (>20%). From the 45 resections, there were 8 esophagectomies (morbidity (m): 4; 50%; mortality(mo): 1) 7 total gastrectomies (m: 3; 43%; mo: 1), 3 Merendino (m: 2; 67%; mo: 0), and 27 partial and atypical gastric resections (fundectomy, sleeve resection, others; m: 10; 37%; mo: 0).

Table 7 Overview on follow-up data after redo-antireflux surgery

	1. Redo	2. Redo	3. Redo	Resections $3^{rd} + 4^{th} + 5^{th}$ Redo
n	288	56	16	30
Follow-up mean years	6,5	8,4	6,8	5,9
Chief-complaints(%):	8	7	13	17
Heartburn/regurgitation	8	16	25	25
Pain(thoracic/epigastric)	2	11	13	15
Dysphagia	10	11	19	21
Gas-related symptoms				
Esophagitis(%)	7	9	29	22
Hiatal hernia(>0–1 cm)(%)	14	27	71	22
Pathologic esophageal acid exposure (score > 14,69)(%)	15	21	50	—
PPI intake occasionally(%)	34	29	31	33
PPI intake daily(%)	12	23	19	43

Table 8 Quality of life assessed by Gastrointestinal Quality of Life Index GIQLI

	n	GI-Symp	Emotional	Physical	Social	Therapy	GIQLI
Normal volunteers (Reference[23])	168	62	18,5	23,5	14,8	4	125
Maximum[23]		76	20	28	16	4	144
Preop 1. Redo cohort	401	46	10	14	10	3	83
Follow-up 1. Redo	288	56	15	17	14	4	106
Preop 2. Redo	90	40	12	10	8	3	73
Follow-up 2. Redo	56	55	13	17	12	4	101
Preop 3. Redo	31	39	11	10	7	3	70
Follow-up 3. Redo	16	57	13	15	12	3	100
Preop resections	45	37	9	9	7	2	64
Follow-up resections:	30	44	11	10	9	3	77
Roux-y		32	8	8	7	1	56
Merendino esophagectomy		46	11	12	11	3	84

Patients within the obtained follow-up cohorts provided information after a median of 6 years[1–14] after the procedures. Table 7 displays the persisting symptoms after a third redo-procedure, with an incidence of 20–30% of disabling symptoms, and indicates the unattainability of a satisfying level of symptom control. The necessity for PPI-intake rises above 70% in the resection-group.

Table 8 provides an overview on pre- and postoperative GIQLI of the different patient cohorts with first, second and third redo-procedures and resections. The first redo-procedure provided the last chance to normalize the GIQLI. Following second, third, or further redo operations, the additional procedures are able to solve severe problems, however, with few exceptions. Obtaining a normal GIQLI proved to be rather impossible. In any case, insignificant increases in GIQLI could be achieved by redo-procedures, usually on lower levels between GIQLI of 60–100. Interestingly, in patients with massive recurrence of reflux and combined DGE, a salvage esophagectomy was quite successful in improving the disastrous preoperative situation.

DISCUSSION

GERD-patients with more severe and/or progressive disease should be critically assessed and carefully selected for LF, since surgical treatment of such can be very successful.[1–9,22] Unfortunately, due to a multitude of reasons LF-failure may develop.[8,9,13–19] Limitation of failure-rates may be achieved through lessons from previously published experience.[8,9,13–22] The purpose of this study is to contribute to failure reduction by providing large volume data on reasons for failures and subsequent operative revisions.

Recurrent reflux symptoms play the major role (59%) in patient selection for primary redo-operations. It must be emphasized that the indication for the first redo-procedure is often recurrent reflux associated with excessive esophageal acid exposure and esophagitis despite ongoing PPI-therapy.

This is consistent with other reports, where heartburn and regurgitation are the major complaints in up to 64% of patients.[8,9,13–17] However, 25% of these patients also suffer from pain and dysphagia, which may limit QL and sufficient nutritional intake.[8,9,13–17]

Furthermore, the percentage of patients with preoperative pain and dysphagia increases with each redo-procedure.[8,9] In this study, 34% of patients have an IEM and a small group of patients suffer from associated DGE, requiring more specialized treatment and not merely another antireflux procedure.[8,9,22]

Laparoscopic redo-antireflux surgery may prove to be technically demanding, requiring critical patient selection and a highly experienced team to perform the surgery and cope with potential pitfalls throughout.[8,9,14–17,25] Analyses show that failures can be multifactorial.[8,9,14–17] Principal mistakes can be made by false patient selection, which was found to be the case in 1.9% within this cohort. This can be avoided by an extensive assessment prior to primary LF or redo-surgery.[7–9,14–17] This study shows that diagnostic errors can easily be detected prior to a second procedure providing a correct and detailed diagnostic management.[9,20]

The demanding skills required to resolve functional problems after primary operations are demonstrated by the broad spectrum of surgical procedures that were necessary. In the primary redo-cohort, 13% of cases required special techniques. In the second and third redo-cohort, this percentage increased to 28 and 41%, respectively. In 6–10% of patients, a difficult esophageal mobilization was required, and beyond that esophageal lengthening Collis-procedure was needed in 1–2%, which is consistent with previous reports in literature.[8,9,14–17,25] Gastroparesis may require gastric resections.[7,9] Intraoperative complications, such as perforations during dissection, occur more often than in primary antireflux-operations, with a potential frequency ranging up to 13%.[8,9,14–17]

A recent meta-analysis reported a conversion rate of 6% upon analyzing 27 different studies.[27] In our study, the conversion rate ranged from 1.2% in primary redo up to 10% in tertiary redo-operations. Major morbidity was between 4.5 and 19%, respectively for the number of redo's, which comparatively was stated as 4.98% in the meta-analysis.[27] In specialized centers, the morbidity rate was similar to our cohort's, between 2.0 and 13.8% for the first, second, and third redo.[8,14–17] Others have reported a morbidity up to 15.6%.[9]

Several reports have previously been published on the background of failures.[8,9,14–17] Insufficient mobilization of the esophagus appears to be a frequent problem in our study as well as others.[8,9,14–17,27] Persisting tension of the esophagus can be a direct cause of migration and dysfunction. A remaining part of the hernia sac in the mediastinum can severely impair accurate dissection during a redo-procedure and should therefore be avoided. It is evident from the literature that with increasing number of required redo-procedures there is an increase in complications, morbidity will arise, and it becomes less likely to achieve a satisfying result for the patient.

QL of these patients was severely reduced to levels of GIQLI scores of 64–83 in our study, as well as in previous literature.[14–17] The evolution of QL, before and after redo-procedures, supports the argument that normalization of GIQLI becomes less likely with each increasing redo-operation. It must be emphasized that regardless of starting point, GIQLI can be improved slightly, yet after multiple redo-procedures normalization is almost impossible. The latter emphasizes the importance of using this 'last chance' for substantial improvement by performing redo-operations in specialized centers.

CONCLUSION

Upon careful selection, primary redo-antireflux procedures can be successful. Usually, a second redo-procedure can be regarded as the 'last chance' to achieve a satisfying result, providing critical patient selection and adequate surgical performance. Further revisions may solve a critical problem, such as severe, chronic pain, and/or the insufficient nutritional intake. However, especially if resection is required, QL could potentially be elevated, but the impact will be limited. Therefore, patients with failures after antireflux surgery should be studied well and very carefully selected for redo-antireflux surgery. Even the first redo-antireflux surgery, and definitely multiple redo-cases, should be performed only in dedicated centers.

AUTHORS' CONTRIBUTIONS

KHF, WB, and GV provided substantial contributions to the study concept and design. KHF, WB, GV, and BB contributed substantially to the acquisition of data over the years. KHF, JAE, and AM made substantial contributions to the analysis and interpretation of the data. All authors made substantial contributions to the drafting of the manuscript and revising of the manuscript and the final approval of the manuscript to be published. All authors agree to be accountable for all aspects of the work and ensure its accuracy and its integrity.

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All authors declare that they do not have any conflicts of interest.

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