Original Article

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Clinical and Endoscopic Outcomes of De Meester Switch in Duodenogastric Alkaline Reflux Disease: A Retrospective Analysis with Mid-Term Follow-up

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Abstract

Aim: By presenting endoscopic, symptomatic, and quality-of-life outcomes with mid-term follow-up, this study aims to contribute to the limited body of evidence regarding the results of the De Meester Switch method for duodenogastric alkaline reflux disease (DGAR-D).

Methods: Between 2017 and 2023, laparoscopic De Meester Switch surgery was performed on 30 patients with DGAR-D symptoms for over three years. The total bilirubin (TB) and direct bilirubin (DB) levels were measured in the gastric reflux content and serum at baseline and the last follow-up. In addition, the patient's baseline and postoperative DGAR-D symptoms were evaluated in the sixth, twelfth, and last follow-up months. The Reflux Disease Questionnaire (RDQ) was used retrospectively to assess the patient's quality of life.

Results: Before surgery, most patients experienced nausea (76.6%), epigastric pain (80%), bloating (90%), heartburn (76.6%), bilious vomiting (56.6%), and sore throat (53.3%). Moreover, 93.3% of those who endured these symptoms for 3-12 years found no relief with medical treatment. Post-surgery, all symptoms significantly decreased ($p<0.001$). At a 34-month follow-up, some experienced persistent nausea and bloating (13.3%), epigastric pain (20%), heartburn, and sore throat (6.6%). However, bilious vomiting and biliary intestinal fluid stasis resolved entirely (100%). Preoperative gastric aspirate TB and DB levels were 2.4 and 2.1 mg/dL, respectively, reducing to 0.4 and 0.2 mg/dL postoperatively. The RDQ score significantly decreased from 82.21±3.10 to 31.13±3.09 at the last follow-up, with no observed mortality.

Conclusion: The De Meester Switch can prevent the reflux of bilious duodenal contents into the stomach in patients with DGAR-D and significantly reduce complaints. This treatment is safe and effective when applied laparoscopically.

Keywords: Duodenogastric reflux, bile reflux, gastroesophageal reflux disease (GERD), dyspepsia

Introduction

Duodenogastric alkaline reflux (DGAR) is characterized by the retrograde flow of bile and pancreatic secretions into the stomach and esophagus. This condition is often associated with symptoms such as epigastric pain, bloating, nausea, and bile vomiting, and in more severe cases, may lead to bile-induced gastritis or contribute to gastroesophageal reflux disease (GERD) (1). Despite its clinical impact, DGAR remains a relatively underrecognized and underdiagnosed entity, with no established consensus on diagnostic criteria or optimal management strategies (2).

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Gastroesophageal reflux disease can be particularly debilitating in patients who suffer from persistent symptoms despite acid-suppressive therapy. While medical options such as prokinetics and bile acid binders may provide some relief, they often fail in cases of severe bile reflux (3). Surgical diversion of bile away from the stomach represents a physiologically rational approach, aiming to eliminate duodenal refluxate from the gastric reservoir and alleviate mucosal injury. This concept was first introduced in 1987 by MD. Tom R. DeMeester, who described the "DeMeester Switch" procedure as a bile diversion technique for medically refractory reflux disease (4). Based on our clinical experience with patients who underwent De Meester Switch surgery for intractable bile reflux, we retrospectively examined whether this surgical technique could provide symptom relief and endoscopic improvement.

Although no prospective hypothesis was formulated at the outset, the present study was conducted to retrospectively evaluate the outcomes of bile diversion surgery in patients with confirmed duodenogastric bile reflux who remained symptomatic despite medical therapy. By presenting endoscopic, symptomatic, and quality-of-life outcomes with mid-term follow-up, this study aims to contribute to the limited body of evidence regarding surgical treatment options for this challenging condition.

Materials and Methods

Compliance with Ethical Standards

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Trakya University Faculty of Medicine Non-Interventional Scientific Research Ethics Committee (approval no.: 01/06, date: 09.01.2023). Informed consent was obtained from all individual participants included in the study. Data were collected retrospectively and anonymized prior to analysis to ensure patient confidentiality.

Study Design

The study included 30 patients who underwent surgery between June 2017 and September 2023, all of whom had been symptomatic for more than three years. Endoscopic evaluations revealed severe bile loculations in their stomachs (Figure 1), indicative of DGAR-disease

Figure 1. A typical "Bile Lake" formation in a patient with duodenogastric alkaline reflux disease

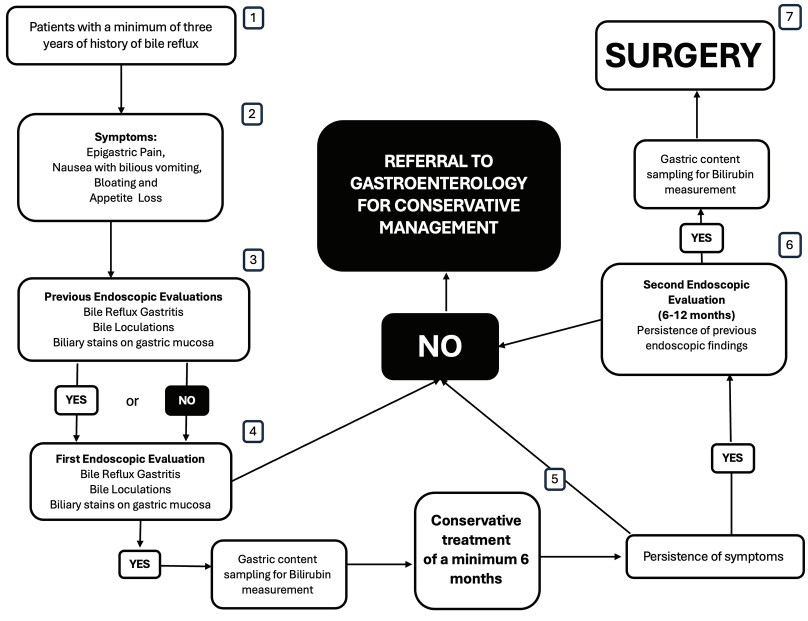

Figure 2. The flowchart diagram of the diagnosis of the patients

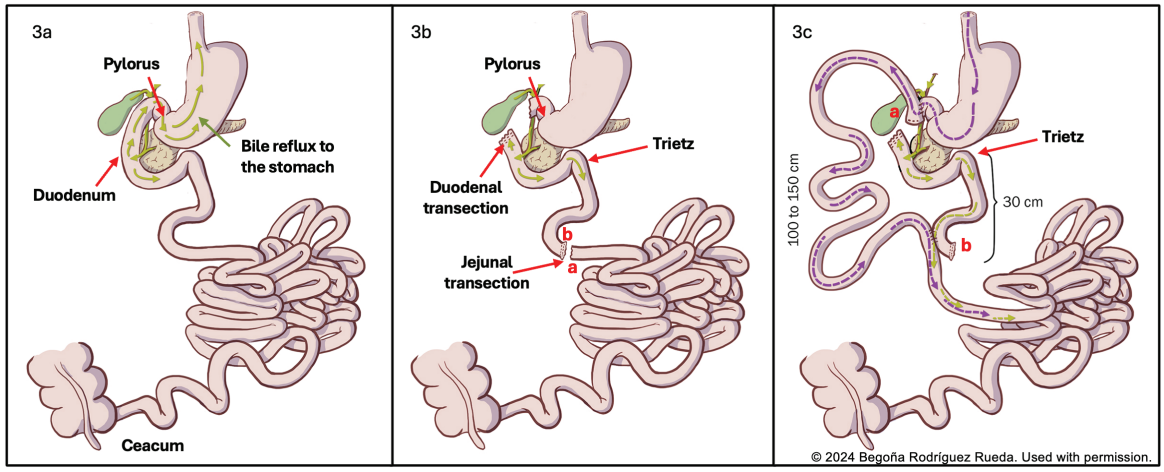

Figure 3. The steps of surgical technique. The duodenum is transected 2-3 cm away from the pylorus, and the proximal jejunum is divided at 30 cm to the Treitz ligament. A hand-sewn duodenojejunal anastomosis is performed between the distal tip of the jejunum (b) and the post-pyloric duodenum. The tip of the biliopancreatic loop (a) is anastomosed to the alimentary limb at 100-150 cm distal to the duodenojejunostomy in a side-to-side fashion with a vascular stapler

(DGAR-D). Despite prior medical and nutritional support, the patients required 6-12 months of monitoring with dietary adjustments and medical therapy, with two endoscopies per patient. Total bilirubin (TB) and direct bilirubin (DB) levels were measured in gastric aspirates and blood samples. Surgery was considered if severe bile stasis persisted in subsequent endoscopies. All patients were regularly monitored postoperatively, with an endoscopic follow-up at 6-18 months. Results were evaluated retrospectively. The flowchart for the diagnosis of patients is given in Figure 2.

Surgical Technique

The procedure was laparoscopic and performed under general anesthesia. Patients were placed supine, and their legs were split in the French position. Four ports were used for surgery. The duodenum was dissected and isolated until the gastroduodenal artery was seen near the pancreatic head. The duodenal transection was done with 2.5 mm vascular white cartridges. The stump was not buried with sutures. The jejunum was measured from the non-stretched anti-mesenteric wall and transected with 2.5 mm vascular white cartridges at 30 cm from the Treitz ligament. The distal tip of the jejunal loop (the Roux limb) was pulled up in an antecolic fashion, and a laparoscopic hand-sewn duodenojejunostomy was performed intracorporeally. The integrity of the anastomosis was checked by filling the distal stomach with a blue dye solution while clamping the proximal stomach and the jejunal loop distal to the anastomosis. The proximal tip of the transected jejunum (the biliopancreatic limb) was anastomosed to the Roux limb with a 2.5 mm vascular white cartridge at 100 cm distal to duodeno-jejunostomy. Mesenteric defects were closed by placing separate stitches with non-absorbable monofilament sutures. One suction drain was placed under the duodeno-jejunostomy, extending to the transected duodenal stump. All port sides were closed with non-absorbable sutures (the steps are demonstrated in Figure 3).

Reflux Disease Questionnaire

Reflux Disease Questionnaire (RDQ) is a questionnaire consisting of 12 questions, developed by Shaw et al. (5). Hançerlioğlu and Bor (6) conducted a Turkish reliability and validity study of the survey. Cronbach's alpha of the survey was found to be 0.92. Half of the questions were related to the severity of symptoms, while the other half pertained to their frequency, with both measured on a 6-point scale (from no occurrence to daily/severe). As the score increases, so does the severity of the disease.

Statistical Analysis

Statistical analysis was performed using SPSS 20 software. The Shapiro-Wilk test was used to evaluate the suitability of the measured data for a normal distribution. Mean, standard error, minimum, and maximum values of continuous variables and frequency and percentage values of categorical variables were given. The Wilcoxon test was applied to compare continuous data. The Cochran Q test was used to compare categorical data. The McNemar test was applied for pairwise comparisons. For statistical analysis results, a p-value of less than 0.05 was considered significant.

Results

Demographic and baseline clinical data are summarized in Table 1. The cohort consisted of 22 female and 8 male

patients with a mean age of 40.9 years. The average duration of symptoms was 6 years, and the mean follow-up time was 34.3 months. Two patients (6.7%) experienced postoperative complications requiring surgical revision.

The Wilcoxon test demonstrated statistically significant reductions in RDQ scores (p<0.001), reflux TB (p<0.001), and reflux DB (p<0.001) levels following surgery. Serum DB levels showed a significant postoperative increase (p=0.017), while changes in serum TB were not statistically significant (Table 2).

Symptom resolution was assessed across multiple timepoints using the Cochran Q and McNemar tests. Significant improvements were observed postoperatively in nausea, bilious vomiting, epigastric pain, bloating, heartburn, sore throat, and unresponsiveness to medical treatment (all p<0.001). Additionally, bile lakes, which were present in all patients preoperatively, were no longer detected at the final endoscopic follow-up (p<0.001) (Table 3).

Table 1. Demographic data of the patients		
Variables		**Mean±SD (Minimum-Maximum)**
Age, year		40.86±13.05 (19-63)
Average duration of symptoms		6.30±2.18 (3-12)
Average last follow-up time, month		34.33±24.47 (5-79)
Average endoscopy time after surgery, month		7.73±4.09 (3-18)
Surgery duration, minutes		104.46±26.88 (68-189)
Stay at hospital, day		4.10±1.02 (3-7)
Irritable bowel syndrome		**n (%)**
	No	24 (80%)
	Yes	6 (20%)
Small intestine bacterial overgrowth		
	No	29 (96.7%)
	Yes	1 (3.3%)
Complication		
	No	28 (93.3%)
	Yes	2 (6.7%)
Previous cholecystectomy		
	No	11 (36.7%)
	Yes	19 (63.3%)
Simultaneous surgery		
	No	19 (63.3%)
	Cholecystectomy	10 (33.4%)
	Nissen fundoplication	1 (3.3%)
Second surgery		
	No	30 (93.3%)
	Yes	2 (6.7%)
SD: Standard deviation		

Table 2. Comparison of some parameters of the patients before and after the operation				
	Preop	**Postop**	**z**	**p-value**
RDQ	82.21±3.10 (30.5-100)	31.13±3.09 (16.7-76.4)	**-4,782**	**<0.001**
Serum total bilirubin	0.55±0.30 (0.3-2.0)	0.55±0.13 (0.4-0.9)	-0.913	0.361
Serum direct bilirubin	0.20±0.17 (0.1-1)	0.25±0.09 (0.1-0.5)	**-2,384**	**0.017**
Reflux total bilirubin	2.41±0.50 (1.3-3.7)	0.39±0.14 (02.-0.7)	**-4.,786**	**<0.001**
Reflux direct bilirubin	2.09±0.49 (0.9-3.1)	0.15±0.08 (0-0.4)	**-4,786**	**<0.001**
z: Wilcoxon test RDQ: Reflux Disease Questionnaire				

Discussion

In this study, we performed our modified De Meester Switch method on 30 patients diagnosed with DGAR-D. A significant decrease in DGAR-D symptoms was observed from the sixth month after surgery. All patients had control endoscopies within the first 18 months after surgery, and no biliary intestinal content was present in any of the patients.

Table 3. Comparison of different parameters of patients before and after surgery

	No	Yes	df	Cohran's Q value	p-value
Nausea					
Baseline	7 (23.3%)	23 (76.7%)	3	**46,800**	**<0.001***
Sixth month	22(73.3%)	8 (26.7%)			
Twelfth month	25 (83.3%)	5 (16.7%)			
Last follow-up	26 (86.7%)	4 (13.3%)			
Bilious vomiting					
Baseline	13 (43.3%)	17 (56.7%)	3	**51,000**	**<0.001***
Sixth month	30 (100%)	0 (0%)			
Twelfth month	30 (100%)	0 (0%)			
Last follow-up	30 (100%)	0 (0%)			
Epigastric pain					
Baseline	6 (20%)	24 (80%)	3	**39,563**	**<0.001***
Sixth month	22 (73.3%)	8 (26.7%)			
Twelfth month	22 (73.3%)	8 (26.7%)			
Last follow-up	24 (80%)	6 (20%)			
Bloating					
Baseline	3 (10%)	27 (90%)	3	**53,415**	**<0.001***
Sixth month	25 (83.3%)	5 (16.7%)			
Twelfth month	26 (86.7%)	4 (13.3%)			
Last follow-up	26 (86.7%)	4 (13.3%)			
Unresponsiveness to medical treatment					
Baseline	2 (6.7%)	28 (93.3%)	3	**58,443**	**<0.001***
Sixth month	23 (76.7%)	7 (23.3%)			
Twelfth month	23 (76.7%)	7 (23.3%)			
Last follow-up	27 (90%)	3 (10%)			
Heartburn					
Baseline	7 (23.3%)	23 (76.7%)	3	**54,000**	**<0.001***
Sixth month	25 (83.3%)	5 (16.7%)			
Twelfth month	28 (93.3%)	2(6.7%)			
Last follow-up	28 (93.3%)	2 (6.7%)			
Sore throat					
Baseline	14 (46.7%)	16 (53.3%)	3	**32,872**	**<0.001***
Sixth month	26 (86.7%)	4 (13.3%)			
Twelfth month	27 (90%)	3 (10%)			
Last follow-up	28 (93.3%)	2 (6.7%)			
Bile lakes				**X^2**	**p-value**
Baseline	0 (0%)	30 (100%)		**28,033**	**<0.001¥**
Last follow-up	30 (100%)	0 (0%)			

*Cochran Q test, ¥McNemar test

Bile can cause severe mucosal damage when in contact with gastric, esophageal, and even laryngopharyngeal regions, and has been implicated in various diseases such as gastric polyps, chronic atrophic gastritis, peptic ulcers, pernicious anemia, erosive esophagitis, Barrett's esophagitis (dysplasia), post-cholecystectomy syndrome/ reflux, and gastricr (1,7). A recent study found a strong correlation between the quality-of-life (QoL) reflux symptom score and salivary bile salts in patients with laryngopharyngeal reflux disease-related chronic cough. Patients with chronic cough exhibited more severe symptoms than those without, and salivary elastase and bile salts were identified as potential predictors of clinical findings (8).

The clinical presentation of DGAR-D is similar to that of GERD. However, the efficacy of lifestyle modification and medical treatment is controversial in the literature for DGAR. Proton pump inhibitors (PPIs) were compared in symptomatic and asymptomatic GERD patients who had accompanying DGAR, and no statistical significance was found for the healing effect of PPI (9). Five out of 223 DGAR patients who did not respond to PPI treatments were found to have bile lakes in their stomach (10).

Ursodeoxycholic acid therapy was shown to reduce biliary reflux significantly and associated gastritis after distal gastrectomy with Billroth-I reconstruction by approximately 50% at 12 months postoperatively, compared to placebo (11). However, there has been no established consensus or treatment algorithm for DGAR.

The patients in our study had severe symptoms, with 76.6% experiencing nausea, 80% experiencing epigastric pain, 90% experiencing bloating, 76.6% experiencing heartburn, 56.6% experiencing bilious vomiting, and 53.3% experiencing sore throat. In addition, it was found that 93.3% of the patients, who had been suffering from these symptoms for 3-12 years, did not respond to medical treatment.

Elhak et al. (12) achieved a significant control rate of symptoms in patients with DGAR-associated distal esophagitis via medical treatment, up to 70.8%. However, while the presence of bile in the stomach of these patients was detected via an impedance pH meter and spectrophotometric analysis with Bilitec 2000, there was no observable bile stasis in endoscopy, and the high response rate to medical therapy was attributed to the absence of bile lakes in the patients' stomachs (12). In our study, bile lakes were detected during endoscopy in all patients, and the high rate of non-response to medical treatment, over 93 percent, may be related to their presence in these patients.

Unresponsiveness to medical treatment is the main indication for surgical treatment. However, the diagnosis and symptomatology of the disease, and when and what type of surgery to perform, are still controversial. There is no consensus on any of these aspects concerning DAGR-D. Having a history of more than one year of symptoms and unresponsiveness to medical and nutritional treatments is fundamental for most studies in the literature. Truncal vagotomy, antrectomy, and Roux-en-Y gastro-jejunostomy are the most preferred surgical methods to treat alkaline reflux.

This is mainly related to the familiarity of most surgeons with the technique and the simplicity of the procedure compared to the duodenal switch. The De Meester Switch, when performed laparoscopically, is a technically complicated procedure, requiring the dissection and transection of the duodenum in precarious anatomical areas and advanced skills to perform an intracorporal anastomosis. However, it is more physiological to preserve the integrity of the stomach and pylorus rather than gastrectomy with Roux-n-Y gastrojejunostomy. The choosing Nissen fundoplication for GER with accompanying biliary reflux may overlook the significant pathology underlying most symptoms. The surgeon involved in this study had completed more than 500 variations of switch surgeries.

The candidates for surgery in this study were not the patients with trace amounts of biliary presence in the stomach that can be detected only by the impedance-pH meter. Rather, they had persistent and severe bile lakes consistently observed on serial endoscopic examinations over a prolonged period, specifically for at least three years, within a mean symptom duration of six years (range: 3-12 years).

All procedures were completed laparoscopically without any mortality. Only two patients were re-operated on for surgery-related complications. Both underwent antrectomy and Roux-en-Y gastrojejunostomy. Our study showed that the rate of postoperative symptoms in patients decreased significantly compared to the preoperative period. All patients had endoscopic evaluation at least once after surgery, and no bile was observed in any follow-up endoscopies. Although there was an absence of bile in postoperative endoscopies and a statistically significant decrease in unresponsiveness to medical treatments (99.3% in pre-op and 23.3% in postoperative 6 and 12 months), it is essential to observe that despite a complete diversion of bile from the stomach, still one out of five patients had no relief of symptoms in our cohort. Klingler et al. (13) reported a significant reduction in clinical symptoms in 94% of 32 patients with De Meester Switch for primary DGAR. del Genio et al. (14) reported total relief of symptoms in two cases after the De Meester Switch. Both patients had severe bile lakes in the stomach, which completely resolved after surgical treatment. Strignano et

al. (15) reported that after the duodenal switch procedure, 44 of 48 patients were satisfied with the surgery, while four were dissatisfied. Dumping syndrome occurred in one of these four patients, the complaints did not improve in two, and a recurrence was observed in another after a long follow-up. In the patient with recurrence, the 60 cm Roux-en-Y jejunal loop was extended to 110 cm, and symptomatic improvement was achieved. The reason some of the symptoms persisted in some patients in our study may be related to the longer duration of DGAR-D and the severe clinical symptoms of our patients due to the selection criteria for surgery.

In patients included in this study, the gastric contents obtained from aspiration, with bile seen during endoscopy, revealed TB levels of 2.4 mg/dL and DB of 2.1 mg/dL. Chen et al.'s (16) study determined that gastric bile acid levels of DGR patients were significantly higher than control values (TB; 5.49 vs. 1.63; DB; 5.43 vs. 1.87). Although the bilirubin levels in the gastric contents detected in our study were significantly higher than those in simultaneously collected serum samples, they were observed to be lower than data reported in other studies. A study investigating bile reflux in patients undergoing one anastomosis gastric bypass (OAGB) reported bilirubin levels in gastric contents up to 27 mg/dL (17). However, normal levels were also reported in some patients. Another study reported higher bilirubin levels in gastric aspirate (7 and 11.3 mg/dL) than in the duodenum (<5 mg/dL) when an underlying intestinal obstruction was present (18). In our study, lower bilirubin levels, compared to patients with OAGB, may have been due to our patients' preservation of gastric integrity and residual bile in the stomach. In individuals with primary DGAR, bile may remain in the stomach longer, increasing the likelihood of dilution with gastric and salivary secretions. In patients with OAGB, however, the reduced gastric volume (between 50-100 cc) may prevent bile retention in the stomach. This led to a higher probability of sampled bile quickly refluxing from the intestines to the stomach. Additionally, decreased gastric secretion in the reduced stomach may explain a more concentrated bile content in the stomach. Although the bilirubin levels in gastric aspirate were lower in our study group compared to other studies, they returned to normal levels after surgery.

Our study retrospectively evaluated patients' preoperative complaints using the RDQ during the final follow-up period (average 34 months). Simultaneously, we administered the same questionnaire again to assess their complaints. Our results showed a statistically significant decrease in the RDQ score after surgery, thus being associated with a significant increase in their quality of life. Given the retrospective nature of our study, one methodological constraint is the post hoc administration of the RDQ, which introduces a potential for recall bias. Patients were asked to evaluate their preoperative symptom burden an average of more than two years after their surgery, which may have affected the accuracy of recollection, particularly for subjective symptoms such as pain, bloating, and heartburn. While recall bias is a recognized issue in retrospective quality-of-life research, mainly when current health status influences perceptions of past symptoms (19), the RDQ - a validated and reliable instrument (5,6) - still provided a structured and standardized means of capturing symptomatic change. Prospective symptom tracking with pre- and post-operative RDQ administration would be ideal for future studies to quantify treatment efficacy and minimize bias with greater precision.

Study Limitations

Our study has several limitations. First, the study was conducted retrospectively and included a relatively small number of patients, which may limit the statistical power and generalizability of the results. Not all patients had long-term follow-ups beyond 18 months, thus preventing comprehensive long-term evaluation of outcomes.

The absence of a control group further limits our ability to directly compare outcomes with other treatment modalities or the disease's natural course. This limitation is inherent to the study's retrospective design; patients were operated on based on clinical indications, without the intention to conduct a prospective trial. For the same reason, preoperative RDQ assessments were not routinely performed before surgery but were administered retrospectively. This approach introduces a potential for recall bias, as patients may not accurately recall the frequency and severity of symptoms experienced before surgery.

Lastly, although bile lakes in the stomach were demonstrated and sampled endoscopically in all patients and bilirubin levels were measured to confirm the presence of bile, we could not use Bilitec 2000 spectrophotometry or hepatobiliary scintigraphy to further evaluate bile reflux due to the limited availability of these technologies in our country.

Despite these limitations, the strength of our study is that the cohort of patients had severe symptoms with long durations, the patients' endoscopic diagnoses were well-defined with the presence of bile lakes in all patients, and the valid and reliable RDQ was used to evaluate their quality of life. Another strength of our study is its contribution to literature, as there are scarce reports of the De Meester Switch procedure for DGAR. Our study provides significant efficacy in preventing bile reflux, alleviating symptoms of the patients, and increasing QoL.

Conclusion

Our study determined that the modified De Meester Switch Surgery significantly reduced the symptoms and improved the patients' quality of life with DGAR-D. Laparoscopic application of the De Meester Switch Surgery is a highly complicated procedure and may lead to severe complications. However, it can be performed safely by experienced surgical teams. Switch surgery has significant physiological advantages over gastrectomy and Roux-en-Y gastrojejunostomy, especially in preventing dumping syndrome by preserving the stomach and the pylorus valve.

Ethics

Ethics Committee Approval: Ethical approval was obtained from the Trakya University Faculty of Medicine Non-Interventional Scientific Research Ethics Committee (approval no.: 01/06, date: 09.01.2023).

Informed Consent: Informed consent was obtained from all individual participants included in the study.

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Footnotes

Authorship Contributions

Surgical and Medical Practices: T.D., Z.T., S.U., Concept: T.D., S.U., Design: T.D., S.U., Data Collection or Processing: T.D., Z.T., Analysis or Interpretation: T.D., Z.T., S.U., Literature Search: T.D., Z.T., Writing: T.D., Z.T., S.U.

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