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Efficiency and risks of laparoscopic conversion of omega anastomosis gastric bypass to Roux-en-Y gastric bypass

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Abstract

Background There is a paucity on literature data related to conversion of Omega anastomosis gastric bypass (OAGB) to Roux-en-Y gastric bypass (RYGB).

Methods This is a retrospective study. Records of all patients who underwent this conversion were analyzed. Additionally, patients were contacted to answer a questionnaire on their current clinical condition.

Results Twenty-eight patients underwent laparoscopic conversion between September 2007 and June 2016. Indications were peritonitis in 7 patients (leaks after OAGB in 5, perforated marginal ulcer (MU) and blow-out remnant with concomitant leak in one patient each), anastomotic bleeding in one, bile reflux in 6, recalcitrant MU in 4, afferent loop syndrome in 6, postprandial vomiting in 2 (related to anastomotic stenosis and perianastomotic diverticulum, one each), and malnutrition and hypoglycemia both in 1. Thirty-day mortality was zero, complication rate (Clavien–Dindo grade III or more) 5% (($N=1/20$), abscess) when conversion was elective and 50.0% (($N=4/8$), all persisting leaks) when conversion was urgent. All 4 leaks persisting after conversion were successfully treated by endoscopic stenting, despite stent migration in 2 patients. Follow-up was available in 92.9%, for a mean time of 64.5 ± 30.1 months. Successful symptom relief (Likert score 4 or more) was noted for bile reflux and postprandial vomiting. Additionally, malnutrition was corrected.

Conclusions When indicated, conversion of OAGB to RYGB is a safe treatment strategy. In case conversion is performed for leak after OAGB, persisting subclinical leaks are frequent but can be efficiently addressed by endoscopic stenting.

Keywords Omega anastomosis gastric bypass · Conversion · Outcome · Endoscopic stenting

Robert Rutledge was the first to report on Omega (or one-) anastomosis gastric bypass (OAGB) as a bariatric procedure (1997) [1]. In 2014, OAGB accounted for 1.8% of the bariatric procedures worldwide [2]. Despite reports on excellent mid-term metabolic outcomes and 20 years of experience by now, there is no significant worldwide increase in numbers for this procedure [3–5]. OAGB is still perceived as controversial, because of the alleged predisposition for gastric and esophageal cancer, biliary reflux and gastritis, persistent marginal ulcers (MU), and malnutrition [6, 7].

Nevertheless, OAGB has been included in our department's armamentarium in 2007 and last year accounted for 40% of our primary bariatric procedures, besides Roux-en-Y gastric bypass (RYGB) (30%), and sleeve gastrectomy (30%).

We were seduced by the simplicity of the OAGB procedure and hypothesized that in case patients did experience a side effect, conversion to RYGB would be straightforward and salutary.

In order to evaluate this hypothesis, we present here our experience with the conversion of OAGB to RYGB, with focus on the perioperative morbidity and the management of leaks persisting after this conversion.

Materials and methods

A retrospective chart analysis was conducted of all patients who underwent conversion from OAGB to RYGB. At our follow-up point (2017), we contacted all selected patients

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to reassess the condition that had demanded the conversion, and to check for possible reinterventions that might have been required in relation to the conversion. All patients were interviewed by telephone at our follow-up point and asked to score their symptom control on a 5-point Likert scale [8].

Our study was approved by the ethical committee of our hospital (nr B012201732939) and all patients consented in including their anonymized data in the study.

Patients had been selected for OAGB based on our bariatric algorithm (Online Appendix) and on the proceedings of the multidisciplinary consultation.

A long (> 10 cm) and narrow 30-ml gastric pouch was created and anastomosed end-to-side to the small bowel by semi-mechanical technique. The afferent limb was made some 200 cm long, provided the remaining (efferent) limb had a length of at least 300 cm. The Petersen defect was closed systematically. Early in our experience in selected patients we added a Nissen-Rossetti-type fundoplication using the remnant fundus, in an effort to prevent reflux and to reinforce the hiatal repair when performed.

Technique of conversion to RYGB

Depending on the peroperative findings and indication, we used three different techniques, in growing order of complexity (Fig. 1):

a. Lonroth technique (keeping the anastomosis): section of the small bowel (afferent limb) just proximal to the gastro-enteral anastomosis (GE), reanastomosing the small bowel to the efferent limb 60 cm distal to the GE.
b. Separation of the anastomosis (without small bowel resection): transection of the anastomosis flush with the staple line, with care to avoid lumen stenosis, shortening of the gastric pouch, new GE proximal on the small bowel to the previous anastomosis, and completion of the Roux-en-Y.
c. Resection of the entire anastomosis: section of the gastric side to create a shorter gastric pouch and section of the afferent and efferent bowel side, removal of the isolated specimen, restoration of bowel continuity, new GE and completion of the Roux-en-Y.

The previously closed Petersen defects were checked, the newly created mesenteric defects systematically closed, and a drain placed in the vicinity of the GE.

If present, the Nissen-Rossetti fundoplication was taken down and, when no overt sepsis was present, a polar remnant gastrectomy was performed.

Indications for conversion

Were considered an indication for conversion of OAGB to RYGB:

1. Early conversions:
   - all postoperative leaks after OAGB with ongoing sepsis despite maximal conservative therapy (i.e., antibiotics, resuscitation)
   - anastomotic bleeding with hemodynamic instability.
2. Late conversions:
   - clinically severe reflux, i.e., frequent (more than once weekly) self-reported bile vomiting, or gastroesophageal reflux suffered at least daily and proven to be bilious on endoscopy; symptoms persist despite conservative treatment including prokinetics and elevation of the bedhead
   - endoscopically proven MU, persisting despite at least 3 months of conservative measures consisting of high-dose Proton Pump Inhibitors (PPI) and other oral antacid medications. Possible causative factors such as gastrogastric fistula had to have been ruled out.
   - Afferent loop syndrome: severe gastrointestinal symptoms such as bloating experienced as invalidating abdominal distension and diarrhea that remain unresponsive to conservative measures including strict dietary guidelines, trial with antibiotic therapy and digestive enzymes.
   - malnutrition, i.e., protein malnutrition with plasma protein under 5 g/dl, unresponsive to dietary measures
   - neuroglycopenia, i.e., hypoglycemia in the context of the Whipple triad (symptomatic hypoglycemia resolving by normalization of plasma glucose levels), in the absence of insulin producing foci.

Endpoints

The primary endpoint of this study was the early and late morbidity of converting OAGB to RYGB. To quantify morbidity, the standardized Clavien–Dindo Classification system was used [9]. Complications graded III or over were registered. Special attention was paid to the incidence and treatment of post-conversion (persisting) leaks. Leaks were assessed by upper gastrointestinal tract contrast radiography and/or by methylene blue test when an intra-abdominal drain was still in place.

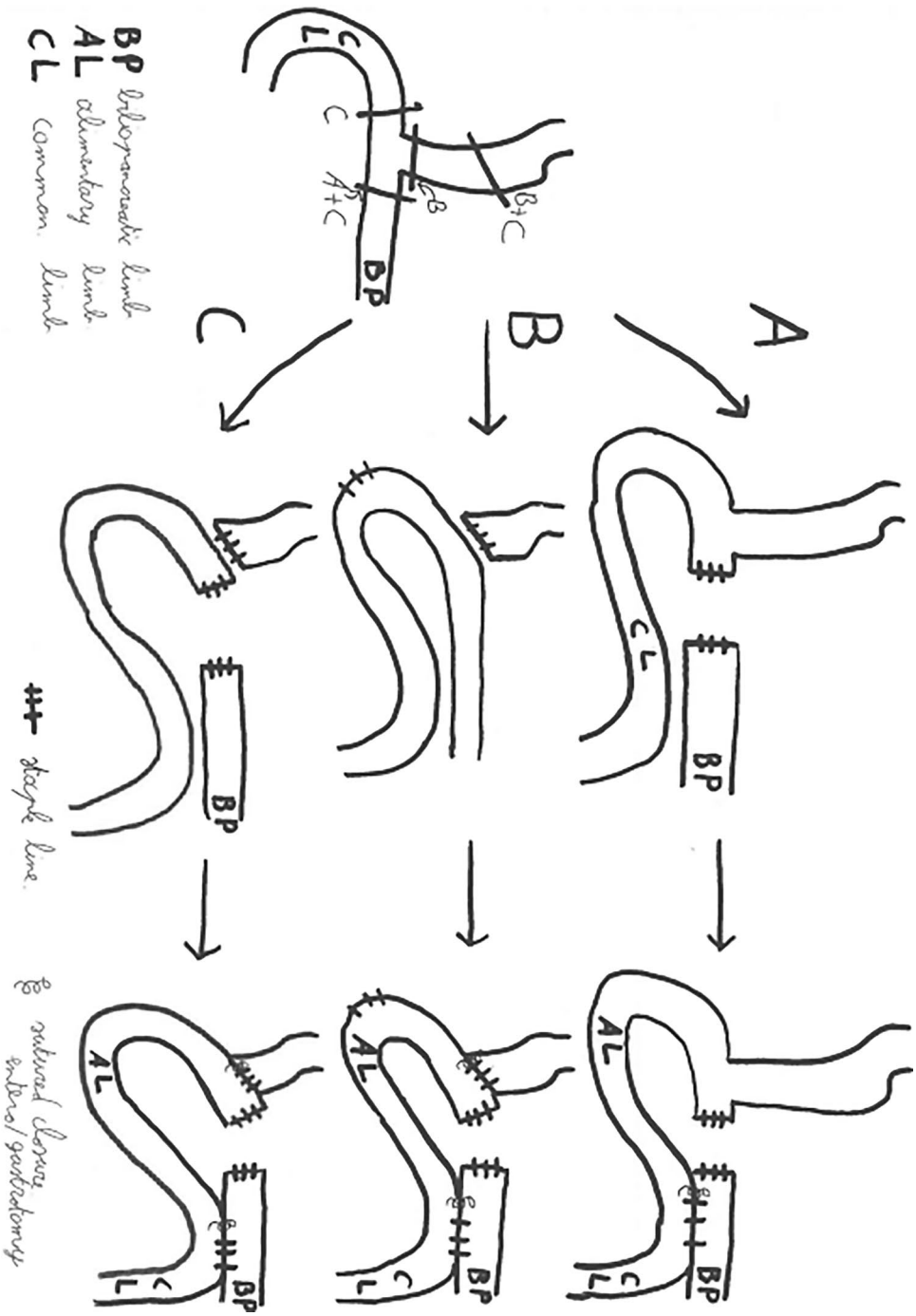

Fig. 1 Overview of three conversion techniques. Technique A: Lonroth technique, B: separation of the anastomosis, C: resection of the entire anastomosis

Secondary endpoint was the efficiency of the conversion in addressing the condition that had required the conversion after OAGB.

Statistics

Quantitative data are expressed as mean + standard deviation when normally distributed and as median + interquartile t-range (IQR) when distribution was not Gaussian.

Results

Of the 526 patients with obesity who underwent an OAGB at our institution between September 2007 and June 2016, 28 (5.3%) underwent conversion to a RYGB construction at our department: 7 for an early and 21 for a late postoperative complication. The latter group included 1 MU perforation, and hence in total 8 patients required urgent treatment (Fig. 2). All conversions were completed laparoscopically. An overview of relevant patients'

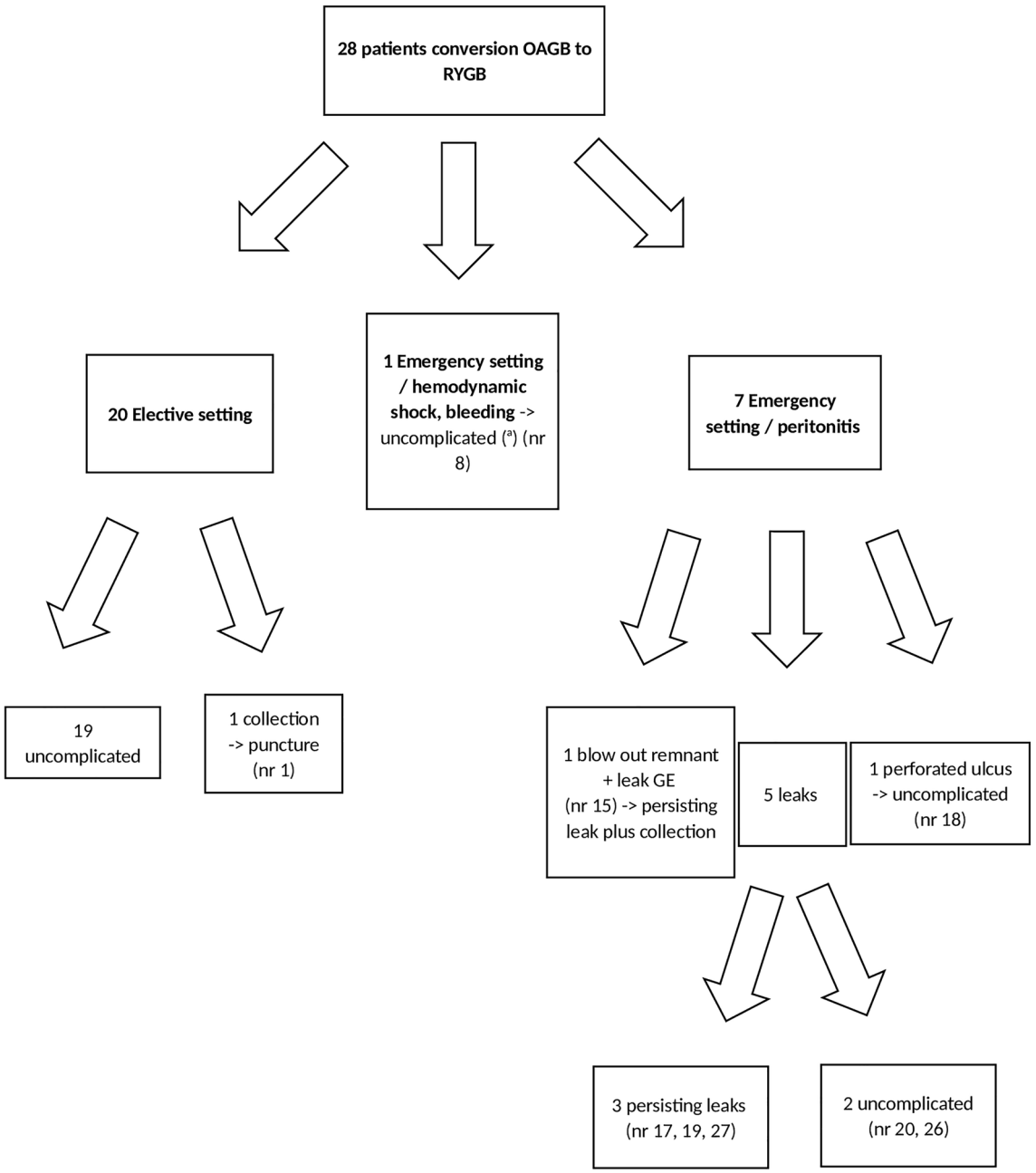

Fig. 2 Overview of an early postoperative outcome elective and emergency conversion of OAGB to RYGB. *OAGB* Omega anastomosis gastric bypass, *RYGB* Roux-en-Y gastric bypass, *GE* gastro-enteral anastomosis, [a]intensive care unit stay for 9 days because of severe hemodynamic shock after OAGB without conversion-related complications

characteristics, operative details of the OAGB, and conversion procedure and indications are reported in Table 1.

Of note, in 3 of 6 patients with an afferent loop syndrome a "Nissen-Rossetti-type" fundoplication had been performed during the primary OAGB procedure.

Table 2 provides the operative details of the conversion procedure. Eighteen patients (64.3%) benefited from the Lonroth technique (technique A), including the 5 individuals who suffered an acute leak shortly after OAGB, i.e., on postoperative day 1, 2, 6, 7, and 8, respectively.

No post-conversion mortality was noted. The overall 30-day postoperative complication rate was 5/28 (17.9%), including 4 persisting leaks for the 8 patients who had undergone the conversion as an emergency (50%). The fifth suffered an abscess after elective conversion for therapy resistant MU and was an active smoker at time of conversion.

Table 1 Patients' characteristics, procedural details, and indications

Female (*n*) (%)	25 (89.3%)
Mean age at time conversion (years)	39.5 ± 13.1
Comorbidities before OAGB	
AHT (*n*)	7
Diabetes (*n*)	4
CPAP (*n*)	1
Previous bariatric surgery before OAGB (*n*)	1 (LGB)
Additional surgery during OAGB	
Nissen-Rossetti (*n*)	10
Hiatoplasty only (*n*)	4
Mean BMI before conversion (kg/m^2)	28.7 ± 7.8
Median time between OAGB and conversion (months)	8.0 (IQR 2.3–18.3)
Smoking time conversion (*n*) (%)	4 (14.3)
Technique OAGB (*n* = 28) (Fig. 1)	
Lonroth (A) (*n*)	18
Separation of the anastomosis (B) (*n*)	4
Resection of anastomosis (C) (*n*)	6
Main indication conversion (*n* = 28)	
Peritonitis	7
Early postoperative after OAGB (30 days)	
Leaks (*n*)	5
Blow-out remnant (*n*)	1
Late	
Perforated MU	1
Early postoperative anastomotic bleeding (*n*)	1
Bile reflux	6
Recalcitrant MU	4
Afferent loop syndrome	6
Postprandial vomiting	2
Anastomotic stenosis (seven unsuccessful dilatations)	1
Perianastomotic diverticulum	1
Malnutrition	1
Hypoglycemia	1

N number of patients, *OAGB* Omega anastomosis gastric bypass, *AHT* arterial hypertension, *CPAP* continuous positive airway pressure, *LGB* laparoscopic gastric banding, *BMI* body mass index, *MU* marginal ulcer, *IQR* interquartile range

Additionally, one patient was affected by a severe hemodynamic shock after OAGB related to biliary limb bleeding for which urgent conversion and prolonged intensive care unit (ICU) stay was needed without observing conversion-related complications. The remaining 19 of the 20 patients (95%) who underwent elective conversion benefited from an uncomplicated early postoperative course (Fig. 2).

The persisting leaks occurring after conversion were treated by mantling the defect with a partially covered self-expandable metallic stent (SEMS) (Ultraflex°, Boston Scientific, Natick MA), which was kept in situ for between 2 and 6 weeks, followed by the insertion of a plastic stent before extraction 1 week later (Polyflex°, Boston Scientific, Natick MA) (Fig. 3). This stenting strategy proved successful in all 4 patients, with resolution of the leak. However, 2 patients (50%) required an additional endoscopic stenting procedure because of stent migration.

Follow-up was available in 26 patients (92.9%) after a mean time of 64.5 ± 30.1 months; one patient could not be traced, and one other individual preferred not to participate.

The evolution of the condition that had led to conversion was assessed at our follow-up point and is summarized in Table 3. In particular, for the individuals suffering from bile reflux, postprandial vomiting or MU outcome was good (Likert score of 4 or 5), except in one patient who peroperatively appeared to suffer a MU that had perforated toward the pancreas. The patient operated on for malnutrition regained 11.9 points of BMI, and total protein rose to 6.7 g/dl at follow-up.

Table 2 Detailed overview of patients' characteristics, procedures, complications, and hospital stay

	Main indication	Gender	Age (years)	Smoking at time OAGB	BMI[a]	Additional surgery at OAGB	Additional surgery at conversion	Anastomosis[b]	Early Complications (30 days)	Hospital stay after conversion (days)
1	MU + GG fistula	F	33	Yes	21.3	/	Resection remnant	C	Perihepatic collection + douglas -> puncture	15
2	Postprandial vomiting/ perianastomotic diverticulum	F	19	No	23.9	/	Resection diverticulum	B	/	4
3	MU + dysphagia (paraesophageal)	F	50	No	28.0	Nissen, hiatoplasty, CCE	Resection remnant + reshaping pouch	B	/	4
4	Afferent loop syndrome	F	28	No	24.9	/	/	A	/	3
5	Hypoglycemia	F	29	No	27.6	/	Gastrostomy + CCE	A	/	5
6	Cachexia (twist efferent)	F	58	Yes	15.8	Hiatoplasty, gastrostomy	/	C	/	5
7	Afferent loop syndrome	F	22	No	23.4	/	/	B	/	4
8	Bleeding biliary limb	F	33	No	30.0	/	Peroperative shock -> no RY	B	/	9, ICU
9	MU (perforated toward pancreas + GG fistula)	F	38	No	23.6	/	Resection remnant	A	/	4
10	MU	F	23	No	26.4	Umbilical hernia repair	Resection remnant	C	/	5
11	Bile reflux + cachexia	F	49	No	18.9	/	Resection remnant	C	/	5
12	Bile reflux	F	22	No	23.7	Hiatoplasty	/	A	/	4
13	Afferent loop syndrome	F	43	No	18.6	Nissen, hiatoplasty	Resection remnant + CCE	A	/	4
14	Afferent loop syndrome	F	67	No	24.1	Nissen, hiatoplasty, CCE	Resection remnant + hiatoplasty	A	/	5
15	Blow-out remnant	F	34	Yes	43.0	Nissen, hiatoplasty	Resection remnant + jejunostomy + draining leak GE	A	Leak -> puncture + stenting GE	60, ICU
16	Bile reflux	M	46	No	29.0	Nissen, hiatoplasty	Resection remnant	A	/	3
17	Leak	F	44	Yes	45.0	/	Gastrostomy	A	Leak -> puncture + stenting GE	60
18	Perforated MU + GG fistula	F	38	No	25.3	Nissen, hiatoplasty, CCE	Resection remnant	C	/	4
19	Leak	M	43	Yes	38.0	Nissen	Gastrostomy	A	Leak -> stenting GE	15
20	Leak	F	58	No	38.0	Hiatoplasty	Gastrostomy	A	/	10
21	Bile reflux	F	49	No	35.1	CCE	/	A	/	3
22	Afferent loop syndrome	F	56	No	32.4	Nissen, hiatoplasty, CCE	Resection remnant	A	/	3
23	Postprandial vomiting/ anastomotic stenosis + GG fistula	F	29	No	19.2	Nissen, hiatoplasty	Resection remnant + hiatoplasty	C	/	7
24	Afferent loop syndrome	F	28	Yes	35.3	/	/	A	/	4

Table 2 (continued)

	Main indication	Gender	Age (years)	Smoking at time OAGB	BMI[a]	Additional surgery at OAGB	Additional surgery at conversion	Anastomosis[b]	Early Complications (30 days)	Hospital stay after conversion (days)
25	Bile reflux	M	46	No	26.5	Nissen, hiatoplasty	Resection remnant + hiatoplasty	A	/	4
26	Leak	F	59	No	41.2	/	Gastrostomy	A	/	8
27	Leak	F	36	No	37.2	Hiatoplasty	Jejunostomy	A	Leak -> puncture + stenting GE	17
28	Bile reflux	F	26	Yes	27.6	/	/	A	/	3

M male, *F* female, *BMI* body mass index (kg/m^2), *OAGB* omega anastomosis gastric bypass, *GG* gastrogastric, *CCE* cholecystectomy, *GE* gastro-enteral anastomosis, *EE* entero-enteral anastomosis, *RY* roux-en-Y, *ICU* intensive care unit, *MU* marginal ulcer

[a]BMI at time conversion

[b]Technique of anastomosis: A = Lonroth, B = Separation of the anastomosis, C = resection of the anastomosis

Table 4 lists patients' additional postoperative abdominal interventions after conversion.

Discussion

This study evaluated the safety of our conversion strategy from OAGB to RYGB, including our approach to possible postoperative complications after conversion. Conversion from OAGB to RYGB was performed either as an urgent salvage strategy or as an elective corrective procedure.

All but one (i.e., 7 of 8) urgent conversions were performed for a complication (i.e., 5 leaks, 1 blow-out of the remnant, and 1 bleeding) shortly after OAGB in a hemodynamically unstable patient. The eighth urgent conversion was performed in a patient suffering a perforated MU occurring 4 months after OAGB. Conversion to RYGB results in diverting the caustic biliopancreatic juices away from the defective anastomosis. In our experience, urgent conversion to RYGB did provide eventual sepsis control in all 6 patients thus treated. In comparison, Poghosyan and Beaupel et al. noted an uncomplicated conversion to RYGB in the treatment of similar leaks in 2/3 (need for additional stenting in just one) and 2/2 patients [10, 11]. Along the same lines, Genser et al. reported ongoing leaks after their technique of revision, consisting of peritoneal wash-out with suturing of the defect and omentoplasty, in 2/4 patients with need for a second laparoscopic drainage in one patient [12].

In our experience, persisting leaks after conversion could successfully be managed thanks to stenting and percutaneous puncture of collections. Nevertheless, we did observe stent migration in two patients. Stent migration, along with stent intolerance, is a well-documented issue, but this complication does not seem to prevent the growing success of stent treatment for leaks after foregut surgery [13–17]. To minimize the risk of migration and allow early oral feeding, we advise partially covered self-expanding metallic stents [18]. We preconize a two-step removal strategy by introducing a plastic stent initially because of fear of complications in the one-step procedure (e.g., inversion technique) [19].

When conversion was performed electively, early postoperative outcome was excellent (uneventful postoperative course in 19/20 patients). Our numbers compared favorably with Poghosyan et al. who reported a surgical complication rate of 40.0% after conversion for late complications after OAGB [10]. Actually, the only patient who suffered a complication after elective conversion appeared to be a smoker, which constitutes a known risk factor for complications after bariatric surgery [20].

The chronic conditions that in our opinion justified elective conversion included bile reflux, MU, afferent loop syndrome, postprandial vomiting (anastomotic

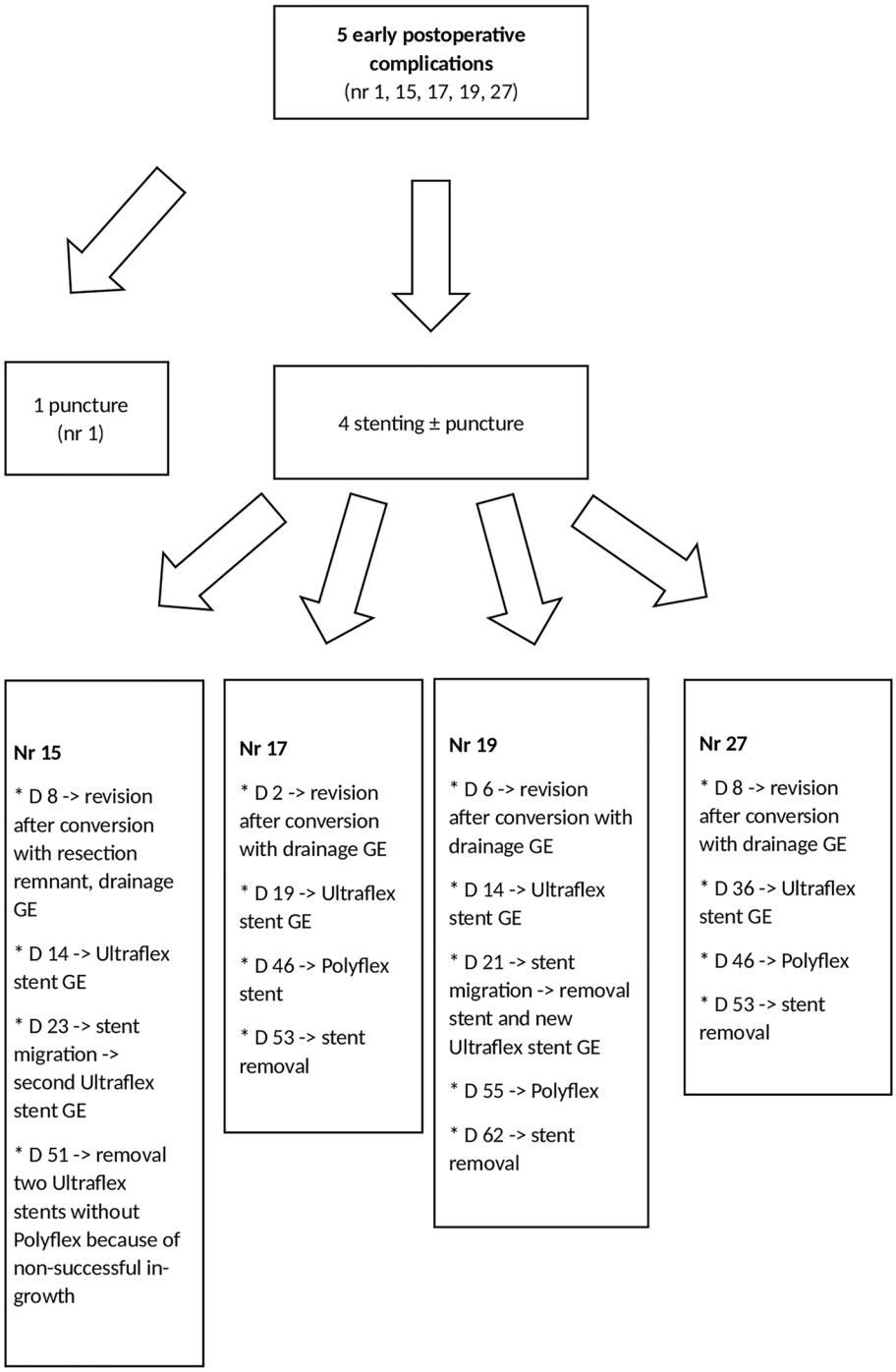

Fig. 3 Management strategy of complications after conversion of OAGB to RYGB. *OAGB* Omega anastomosis gastric bypass, *RYGB* Roux-en-Y gastric bypass, *D* day, *GE* gastroenteral anastomosis

stenosis–perianastomotic diverticulum), malnutrition, and hypoglycemic syndrome.

Bile reflux is a rare but disabling, long-term complication after OAGB. The incidence appears to be less than 1% as reported by Musella et al. [6, 21]. Despite meticulous care in creating a narrow and long gastric tube, in our experience 1.1% (6 patients) needed conversion because of this condition. Our preferred treatment strategy is conversion by using a Lonroth technique, rather than a Braun jejunojejunostomy as described by Johnson et al. [22]. The Lonroth technique was effective in controlling bile reflux in all 4 patients available for follow-up. Poghosyan et al. reported a same efficiency of this procedure in three converted patients [10].

The incidence of MU after OAGB is reported to be around 5.6%, comparable to RYGB [7, 23, 24]. Treatment with high dose of PPI and elimination of risk factors seems to be efficient, translated in the low incidence of MU-related complications [3]. In the rare cases of treatment recalcitrant

Table 3 Postoperative outcome after conversion

Early postoperative outcome	
Complications conversion (Clavien–Dindo classification [8]) (*n*)	5
Grade III	4
Grade IV	1
Mean postoperative hospital stay (days)	
Uneventful course (*n* = 23)	4.7 ± 1.9
Patients with early postoperative complication (*n* = 5)	33.4 ± 24.3
Evolution of complications OAGB at follow-up[a]	
Bile reflux (*n* = 6)	4-5-5-5-?-?
Marginal ulcer (*n* = 5)	3-4-4-5-5
Afferent loop syndrome (*n* = 6)	2-3-4-4-5-5
Postprandial vomiting (*n* = 2)	
Anastomotic stenosis (*n* = 1)	5
Pouch diverticulum (*n* = 1)	4
Malnutrition (*n* = 1)	BMI 15.8 -> 27.7
Hypoglycemia (*n* = 1)[b]	

N number of patients, *OAGB* Omega anastomosis gastric bypass, *BMI* body mass index

[a]Score on Likert scale [9]

[b]During follow-up reversal of Roux-en-Y gastric bypass

Table 4 Abdominal interventions after conversion

- Invagination EE (patient 4)
- Reversal with sleeve gastrectomy (patient 5)
- Incisional hernia repair (patient 6, 11, 25)
- Laparoscopic adhesiolysis—obstruction (patient 9)
- Laparoscopic gastrostomy—cachexia (patient 11, 28)
- Exploratory laparoscopy—persistent severe pain with resection of candy cane and CCE (patient 24)
- CCE (patient 28)

EE entero-enteral anastomosis, *CCE* cholecystectomy

or complicated (perforated) MU, we prefer to convert to RYGB and proceed with shortening of the gastric pouch, resection of the anastomosis, and performance of a new semi-stapled anastomosis without vagotomy (technique C). This approach that includes shortening of the stomach pouch is based on the findings of Edholm et al. indicating that the relative risk of marginal ulcer increases by 14% for each additional cm length [25]. Additionally, anatomical abnormalities must be corrected as encountered during the conversion procedure [26, 27].

Bloating associated with diarrhea may be an expression of the afferent loop syndrome, a known complication after the Billroth II procedure. This condition is caused by inadequate evacuation of digestive juices from the biliopancreatic limb resulting in bacterial overgrowth and a clinical presentation of bloating [28]. Obviously, anatomic factors that facilitate stasis should be addressed during re-exploration, and hence the consent form for conversion for bloating/afferent loop syndrome and postprandial vomiting should mention the authorization to fully explore and correct any unexpected (sub)obstructive anatomical flaws such as the perianastomotic diverticulum that had gone undetected in our patient. Additionally, by systematically taking down the Nissen-Rossetti construction—if present—during the conversion procedure, we corrected this possible aggravating factor in the context of the afferent loop syndrome/bloating. After noticing effectiveness of this strategy in addressing bloating in OAGB patients, we avoided all Nissen-Rossetti constructions during primary OAGB in our subsequent cases.

Severe malnutrition is a feared long-term complication after OAGB [7]. Both the length of the common (which should be at least 300 cm) and biliopancreatic limb (maximum 150–200 cm) are crucial in terms of nutrient absorption, and the limb lengths should be corrected during the conversion procedure [3]. With limb length correction during the conversion procedure, the patient in our series gained 11.9 points of BMI after a follow-up period of 24 months. Poghosyan et al. reported a similar efficiency to address malnutrition after OAGB, with resolution (BMI > 18.5) in all 7 patients two years after conversion [10].

Concerning the one case of conversion to RYGB for hypoglycemia, this was based on the patient's initial refusal to have the bypass construction reversed. By converting to RYGB, we aimed at constructing a bile-deprived (Roux) limb, where activation of the SGLT1 cotransporter does not occur and, consequently, active glucose absorption is impaired [29]. As a result, insulin hypersecretion and subsequent reactive hypoglycemia should be tapered [30]. The patient continued to experience invalidating hypoglycemic events, which was the reason to finally reverse her bypass anatomy on her request.

Limitations of our study are the retrospective character as well as the small sample size that are both sources of bias. In addition, we must regret the lack of objective endoscopic data at our follow-up point for the specific conditions bile reflux and MU.

Additional data analysis after OAGB is necessary to come to a standardization in the management of associated complications. In the meantime, as a rule, the less predictable outcome of the revisional procedure must be carefully discussed with the patient, as well as the higher postoperative morbidity compared to primary bariatric procedures [31].

In patients presenting with a complication after OAGB, conversion to a Roux-en-Y construction is a safe treatment option in the elective setting. Additionally, it is efficient in addressing early complications after OAGB, but at the expense of a high incidence of persistent leaks. Those can, however, be successfully approached by endoscopic stenting.

Compliance with ethical standards

Disclosures Dr. Himpens is a consultant with Ethicon Endosurgery and with Covidien (Medtronic). Dr. Bolckmans and Dr. Arman have no conflicts of interest or financial ties to disclose.

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