Reoperative bariatric surgery: a single-center experience

Ahmed A. Elgeidie, Khalid Marzouk, Helmy Ezzat, Mohamed Attia

Department of General Surgery, Gastroenterology Center, Mansoura University, Mansoura, Egypt

Correspondence to Mohamed Attia, MD, Department of General Surgery, Hepatobiliary and Pancreatic Surgery, Gastroenterology Surgical Center, Mansoura University, Mansoura 35516, Egypt
Tel: +20 100 842 0576;
e-mail: dr_mohamedattia410@hotmail.com

Received: 03 July 2022
Revised: 25 July 2022
Accepted: 24 July 2022
Published: 05 April 2023

The Egyptian Journal of Surgery 2023, 41:1047–1070

Background
It is well known that bariatric surgery is effective in the long-term management of weight loss and comorbidity improvement. The frequency of revision procedures is increasing, although they are known to be less effective and are associated with complications.
Patients and methods
This study was conducted at the Gastrointestinal Surgery Center of Mansoura University, Egypt, aiming to evaluate the indications, efficacy, and safety of reoperative bariatric surgery. We retrospectively reviewed the data of all patients who underwent reoperation for a bariatric-related cause during the duration between December 2012 and October 2021. A total of 90 reoperative bariatric surgeries were done during the study period. Patients had undergone revisional surgery for either insufficient weight loss or refractory complications such as gastroesophageal reflux.
Results
When comparing insufficient weight loss group and refractory complication group r, our results showed the following finding: a significant difference was noted between the two groups regarding age, the interval between both operations, weight and BMI at both primary and redo operations, ΔBMI and % excess weight loss at reoperation, the laparoscopic approach of both primary and reoperation, postoperative hospital stay, and physical and mental quality of life. The most commonly failed primary operation was sleeve gastrectomy (SG). The most frequent primary operation in the leakage group was SG. The second most common failed primary operation was vertical band gastroplasty. Mini-gastric bypass was the most common primary operation in the malnutrition group (80%), vertical band gastroplasty was the most common primary operation in the stricture group (57%), and SG was the only primary operation in the gastroesophageal reflux group (100%).
Conclusion
Reoperative procedure should be based on the primary operation, the patient's anatomy, the patient's weight and comorbidities, and the experience of the surgeon.

Keywords:
bariatric surgery, BMI, gastroesophageal reflux, insufficient weight loss, mini-gastric bypass, refractory complications, sleeve gastrectomy

Egyptian J Surgery 2023, 41:1047–1070

1110-1121

Introduction

Obesity has become one of the most important public health problems worldwide. Bariatric surgery has become more prevalent owing to the worldwide obesity epidemic, and several studies have demonstrated that it is the most effective therapy for achieving sustained weight loss and managing obesity-related comorbidities [1].

In 2016, 685 874 bariatric surgeries were performed worldwide [2]. With the increase in the volume of bariatric surgeries, there has been an increase in the need for revision surgeries. Revisional surgery is the fastest growing area in bariatric surgery, constituting 13.6% of all procedures performed since 2015. This reflects a rising need to treat adverse sequelae of primary bariatric procedures. Despite the increase in revisions, their safety and efficacy remain controversial [3].

Insufficient weight loss (IWL) and complications such as gastroesophageal reflux disease (GERD) following primary surgery are two major indications for revision surgery [4].

Studies have shown that weight regain after bariatric surgery ranges from 5 to 39%, depending on the type of surgery and patient compliance. The proportion of patients needing revision after weight loss surgery can approach 25% and might reach 60% for certain procedures [5].

As with other surgical specialties, reoperative bariatric surgery is more challenging than primary procedures

and is associated with a higher rate of 30-day adverse events [6].

However, when reoperative surgery is performed by experienced surgeons who have performed a variety of revisional procedures, risk and complication rates are acceptable [7].

Reoperative surgeries are classified as conversions, corrections, or reversals, as defined by the American Society for Metabolic and Bariatric Surgery [7]. Conversions are changes to a different type of bariatric procedure, corrections are the treatment of complications or improvements to the primary surgical procedure, and reversals are operations to restore normal gastrointestinal anatomy.

Patients and methods

Study design

This was a retrospective cohort study.

Setting

This study involved patients who underwent reoperative bariatric surgery owing to inadequate weight loss (IWL) or refractory complications (RC) such as leakage, malnutrition, stricture, intractable GERD, bleeding, intestinal obstruction, or mesenteric vascular occlusion from December 2012 to October 2021 in the gastrointestinal surgery center of Mansoura University. Data from a prospectively maintained database were thoroughly reviewed, and all patients who met our inclusion and exclusion criteria were enrolled in the study with a minimum follow-up period of 3 months. The study received approval from the Mansoura Faculty of Medicine Institutional Research Board.

Exclusion criteria

(1) Patients underwent reoperations for reasons other than IWL or RC such as incisional hernia (elective) or cholecystectomy.
(2) Presence of uncontrolled mental disorder; active eating disorder such as bulimia nervosa, binge-eating disorder, and compulsive overeating; or uncontrolled endocrine disorder (e.g. hypothyroidism).
(3) Patients unfit for surgery were also excluded.

Definitions

(1) Reoperation is an operation to correct a condition not corrected by a previous operation or to correct the complications of a previous operation [8].
(2) IWL is a percent excess weight loss (%EWL) of 50% or less at 1 year after the primary surgery, and this was the criteria under which revision surgery was recommended to the IWL patients [9].
(3) Good weight loss is a %EWL of more than 50% at 1 year after the primary surgery.
(4) Significant weight regain is weight gain of more than 10 kg, weight gain of 25% of weight loss, recurrence of weight loss status to less than 50% EBWL, BMI status more than 35 kg/m^2 for class III obesity, or BMI more than 40 kg/m^2 for patients with super obesity and super-super obesity [10,11].
(5) %EWL: [(initial weight−postoperative weight)/(initial weight−ideal weight)×100].
(6) Total absolute weight loss (TWL in kg) and percent total weight loss (%TWL): [(initial weight−postoperative weight)/(initial weight)×100].
(7) BMI: weight (kg)/height(m^2).
(8) Change in BMI (ΔBMI): initial BMI−final BMI.
(9) Percent excess BMI loss: [(initial BMI−postoperative BMI)/(initial BMI−25)×100].
(10) Leakage is the extravasation of dye or gastrointestinal secretions through the abdominal drain, positive clinical signs, and laboratory markers of inflammation and sepsis with radiological evidence of contrast extravasation and/or surgical site collection [12].

Refractory GERD is the presence of persistent troublesome GERD symptoms and objective evidence of GERD despite optimized proton pump inhibitors (PPI) therapy (double-dose PPI therapy over at least 8 weeks) [13].

Patients were classified as follows:

(1) According to the indication for reoperation: patients were divided into seven subgroups under two major groups of IWL and RC:
    (a) IWL: group 1.
    (b) RC: groups 2–7.
        (1) Group 2: leakage.
        (2) Group 3: malnutrition.
        (3) Group 4: stricture.
        (4) Group 5: intractable GERD.
        (5) Group 6: bleeding.
        (6) Group 7: others (intestinal obstruction and MVO).

Patients who presented with both RC-related symptoms and IWL were assigned to the IWL group.

(1) According to the type of the reoperation:
Patients were divided into three groups:
   (a) Conversion group: conversion is to anatomically change the bariatric procedure to a different type such as conversion of sleeve gastrectomy (SG) to mini-gastric bypass (MGB).
   (b) Correction group (revision): corrections are the treatment of complications or improvements to the primary surgical procedure such as resleeve or the operative repair of leaks and fistulas.
   (c) Reversal group: reversals are operations to restore the original anatomy such as reversal of MGB to normal anatomy.

Preoperative workup

Detailed history including dietary history, full clinical examination, and proper investigations were done for each case as follows:

(1) IWL group: all patients with IWL were required to follow 1–3 months of a physician-guided medical weight loss regimen in addition to specialist dietician evaluation. A preoperative oral gastrografin (OGG) study and diagnostic upper endoscopy were performed to determine anatomy. Computed tomography (CT) volumetric study and 24-h pH monitoring study were done in selected cases.
(2) GERD group: patients were prescribed nonoperative therapies including optimized PPI therapy, prokinetics, cytoprotective medication, dietary modification which failed then they underwent oral contrast study, upper endoscopy, and 24-h pH monitoring study.
(3) Stricture groups: patients were prescribed PPI, prokinetics, and dietary modification for a shorter period than GERD group and then they underwent oral contrast study and upper endoscopy, as well as 24-h pH monitoring for selected cases. Some cases had single or multiple sessions of endoscopic dilatation that ultimately failed.
(4) Malnutrition group: basic laboratory tests were done to detect anemia and deficiency of albumin and micronutrients such as ferritin, calcium, and vitamin D, and treatment of deficiencies was done, especially for malabsorptive operative procedures.
(5) Leakage group: patients who are not critically ill underwent CT abdomen and pelvis with oral contrast study.

Preoperative patient education was done to re-emphasize important events of the perioperative period, expected postoperative course, and instructions for postoperative activity and diet.

Deep venous thrombosis (DVT) prophylaxis precautions were done preoperatively and postoperatively in the form of low-molecular-weight heparin subcutaneously 12 h before operation and at appropriate intervals thereafter in addition to wearing above-knee elastic stockings during and after the surgery till complete ambulation and discharge of the patient.

Postoperative complications

Postoperative complications were categorized into minor versus major and early (≤30 days) versus late (> 30 days) according to the American Society of Metabolic and Bariatric Surgery (ASMBS) standardized reporting criteria [14].

Late postoperative follow-up

The late postoperative follow-up was done through contacting all patients and asking them to fill a questionnaire covering these items:

(1) Quality-of-life assessment using the Arabic translation of RAND 36-Item Health Survey (Version 1.0).
(2) Change in weight.
(3) Symptoms of complications.
Quality-of-life assessment: quality of life was assessed using the Arabic translation of RAND 36-Item Health Short Form survey (SF-36) (version 1.0) [15].

The primary outcome was to evaluate efficacy and safety of reoperative bariatric surgery. The secondary outcomes were the complications developed and the effect on quality of life.

Statistical analysis

(1) Data were entered and analyzed using IBM-SPSS software (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0.IBM Corp., Armonk, New York, USA).
(2) Data expression:
   (1) Qualitative data were expressed as frequency and percentage.
   (2) Quantitative data were initially tested for normality using Shapiro–Wilk's test with data being normally distributed if *P* value more than 0.050. Presence of outliers was examined for by inspecting the boxplots.

(3) Quantitative data were expressed as mean±SD if normally distributed with no significant outliers or median and interquartile range if not. Interquartile range equals 75th percentile minus 25th percentile.
(4) Data comparison:
   (a) Qualitative data: categorical data were compared by χ^2 test for large sample sizes of cells (expected count ≥5 in all cells) or Fisher's exact test for smaller sample sizes (expected count <5 in at least one of the cells).
   (b) Quantitative data between two groups: independent samples *t* test was used if data were normally distributed in both groups with no significant outliers, whereas the nonparametric alternative Mann–Whitney *U* test was used if not.
   (c) Paired quantitative data: paired samples *t* test was used if data were normally distributed in both groups with no significant outliers. The nonparametric alternative Wilcoxon signed-rank test was used if not.

(5) Correlation tests: Pearson's correlation test was used to assess the direction and strength of association between two quantitative variables if data were normally distributed with no significant outliers. Otherwise, Spearman's correlation test was used.
(6) Significance level: for any of the used tests, results were considered as statistically significant if *P* value was less than or equal to 0.050.
(7) Charts: appropriate charts were used to graphically present the results whenever needed including boxplots.

Results

A total of 74 patients underwent 90 reoperative bariatric surgeries in the gastrointestinal surgery center of Mansoura University in the duration between December 2012 and October 2021, accounting for 10.45% of the total 861 bariatric surgeries performed. Numbers and different bariatric surgeries performed are illustrated in Fig. 1.

Patients in this study were divided into two major categories according to the indication for reoperation: IWL group, which included 32 (43.2%) patients, and RC group, which included 42 (56.8%) patients. It was further subclassified into six groups according to the definite complication, as illustrated in Table 1.

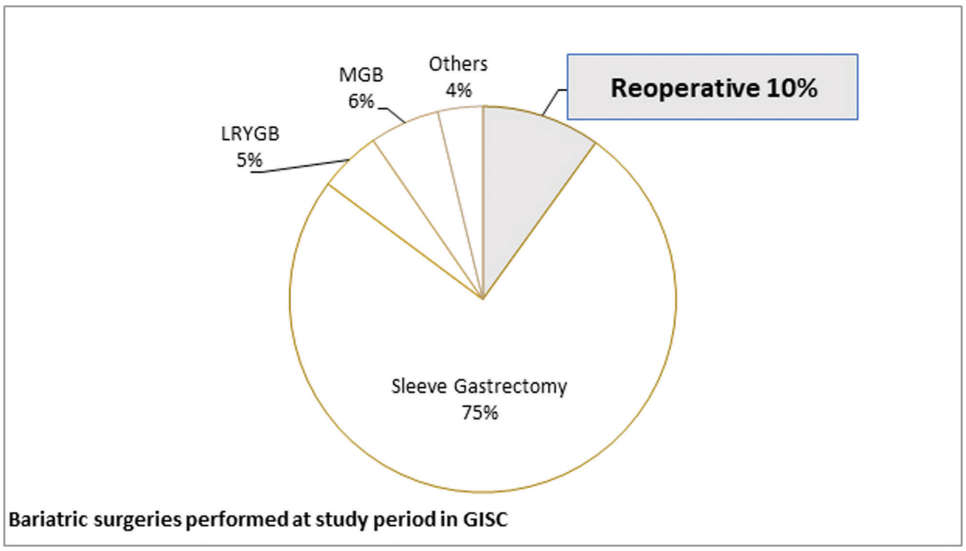
Regarding demographic data, generally, a significant difference was detected between the two groups regarding age, interval between both operations, weight and BMI at both primary and redo operations, ΔBMI and %EWL at reoperation, laparoscopic approach of both primary and reoperation, postoperative hospital stay, and physical and mental quality of life, as illustrated in Table 2.

Patients in this study were divided into seven main groups according to the major indication for reoperation as discussed before in Table 5. Each group is discussed individually.

Group 1: insufficient weight loss (*n*=32)

IWL group included 32 (43.2%) patients who presented with IWL (%EWL of 50% or less at 1 year after the primary surgery). Different types of reoperations were

Figure 1



Bariatric surgeries performed between December 2012 and October 2021 in GISC. GISC, gastrointestinal surgery center.

performed depending on the type of primary surgery, as shown in Fig. 2.

Perioperative demographics data for IWL group are illustrated in Table 3.

After taking a thorough dietary history, it was obvious that it was nearly the same story from patient to patient; those with maladaptive eating prefer foods that disintegrate easily. For example, in our practice, we noted that chipsy and carbonated soft drinks were foods nearly universally (74.8%) consumed by these patients. Sweets were also common (68%). Healthy foods such as fresh vegetables, fruits, and meats were not well tolerated (64.1%) and therefore were slowly eliminated from the diet. For all patients with IWL, nutritional consultation with a bariatric-specialized registered dietician at our center was done to ensure that redo surgery was mandatory.

Preoperative oral contrast study and upper endoscopy were done in all cases and are summarized in Table 4.

Table 1 Study groups

	Group	Indication	*n* (%) (total=74)
IWL	Group 1	IWL	32 (43.2)
RC	Group 2	Leakage	15 (20.2)
	Group 3	Malnutrition	5 (6.7)
	Group 4	Stricture	7 (9.4)
	Group 5	GERD	4 (5.4)
	Group 6	Bleeding	9 (12.2)
	Group 7	Others	2 (2.7)

GERD, gastroesophageal reflux; IWL, insufficient weight loss; RC, refractory complication.

Revisional outcome for insufficient weight loss group

A total of 21 (65.6%) patients appeared at follow-up, and they were divided into three subgroups according to the interval since reoperation:

(1) Subgroup 1: less than 3 years (12 patients).
(2) Subgroup 2: 3–5 years (three patients).
(3) Subgroup 3: more than 5 years (six patients).

On comparing weight parameters at the time of reoperation and at the last follow-up in each group, the results were statistically significant regarding BMI and BMI units lost in subgroup 1, whereas all weight parameters were statistically insignificant in subgroups 2 and 3 perhaps owing to the small sample size in these two subgroups (Table 5).

Group 2: leakage (*n*=15)

A total of 15 (20.2%) patients were explored for leakage after bariatric procedures. Details of surgical exploration and their outcomes are shown in Fig. 3.

Patient clinical and demographic data are summarized in Table 6.

Postsleeve gastrectomy leakage

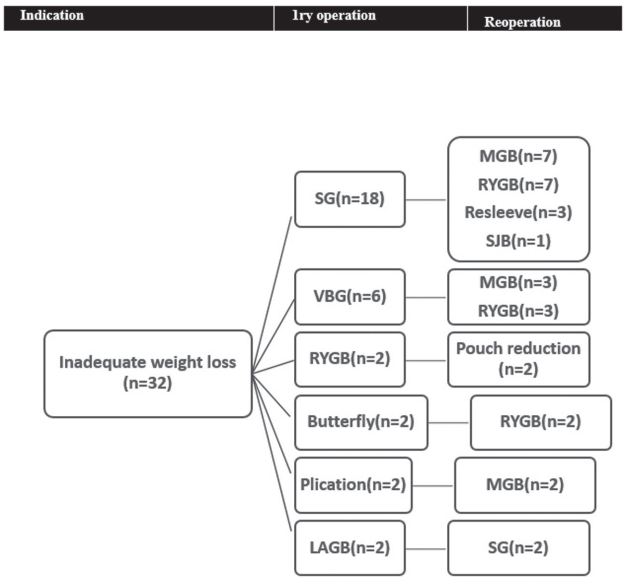
SG was the primary operation in 12 (80%) patients, where 10 cases presented at 7–25 postoperative days, whereas only two presented at first and fourth postoperative day. A total of 11 (91.6%) cases were presented by abdominal sepsis and only one (8.4%) presented by gastric contents in the abdominal drain in the first postoperative day. Management decision

Table 2 Demographic and weight characteristics in insufficient weight loss and refractory complication groups

	IWL (*N*=32) [*n* (%) or mean±SD]	RC (*N*=42) [*n* (%) or mean±SD]	*P* value
Age at revision (years)	40.71±8	40.19±11.8	**0.02**
Female sex	24(75)	34(80.9)	0.6
Referred cases	19(59.4)	19(45.3)	0.3
Interval between primary and reoperation	5.2±4.5 (years)	287±456 (days)	**0.001**
Weight at primary surgery (kg)	148.77±24.8	139.9±29.7	0.2
BMI at primary surgery (kg/m^2)	55.29±8.44	51.1±9.2	**0.05**
Primary Laparoscopic approach	19(59.4)	35(83.3)	**0.05**
Weight at reoperation (kg)	135.55±29	115.1±45.3	**0.03**
BMI at reoperation (kg/m^2)	49.8±10	38.6±17	**0.002**
Reoperation Laparoscopic approach	29(90.6)	33(56.8)	**0.004**
ΔWT at reoperation (kg)	14.38±21.2	21.22±33	0.3
ΔBMI at reoperation (kg/m^2)	5.6±7.7	12.5±14.3	**0.02**
%EWL at reoperation	22±32	49±60	**0.04**
Operation time (h)	2.8±1	2.68±1	0.5
Postoperative hospital stay	3.19±2	14.4±17.8	**0.001**
Physical health score at last follow-up according to SF-36 QOL Survey (0–100)	47.67±22.6	45±26	**0.027**
Mental health score at last follow-up according to SF-36 QOL survey (0–100)	47.26±25.7	43.8±29.6	**0.009**

EWL, excess weight loss; IWL, insufficient weight loss; RC, refractory complication; SF-36, 36-Item Health Short Form survey.

Figure 2



Types of primary operation and reoperation performed in the IWL group. IWL, insufficient weight loss.

Table 3 Demographic data for the insufficient weight loss group

Variables	IWL (*N*=32) [*n* (%) or mean±SD]
Age at revision (years)	40.71 ± 8
Female sex	25 (77)
Referred cases	18 (56.2)
Interval between primary and reoperation (years)	5.2 ± 4.5
BMI at primary surgery (kg/m^2)	55.3± 8.4
BMI at reoperation (kg/m^2)	49.8 ± 10
ΔBMI at reoperation (kg/m^2)	5.6 ± 7.7
%EWL at reoperation	22 ± 32

EWL, excess weight loss; IWL, insufficient weight loss.

Table 4 Preoperative workup findings in the insufficient weight loss group based on upper endoscopy and oral gastrografin studies

Primary operation	Findings	Number
SG	Reflux	10
	Residual fundus	5
	Large sleeve	2
	Stricture	2
	Not performed	1
	Normal	1
LAGB	Band erosion	1
	normal	1
VBG	No apparent previous operation	3
	Stricture	2
	Fistula	1
	Not performed	1
RYGB	Large pouch	1
	Normal	1

RYGB, Roux-en-Y gastric bypass; SG, sleeve gastrectomy; VBG, vertical band gastroplasty.

was based on clinical and radiological findings in 10 (86.6%) cases and on clinical presentation only in two (13.3%) cases. Leakage location was the upper stapler near the cardioesophageal junction (CEJ) in all cases (P<0.05), and the mean leakage size was about 1.4 ± 0.7 cm.

Surgical drainage and endoscopic mega stent was the treatment strategy in 10 (83.3%) cases, whereas the other two (16.7%) cases had drainage without stenting. Stent fixation by surgical suture was done in a single case (6.7%). The median duration of stents was 3.4 weeks (range, 3–8 weeks). The success rate of endoscopic mega stents combined with surgical drainage was 60%, whereas it was 40% when leak persisted. Adverse events related to endoscopic stenting combined with surgery are summarized in Table 7.

Outcomes of surgical management of leakage

Long-term success rate was 86.6%, as two (13.3%) patients died in this group after exploration as a sequela of leakage-induced septic shock and multiorgan failure. Ten (66.6%) patients needed more than one reoperation. Four (26.6%) cases presented with postleakage stricture at long-term follow-up, which resolved completely by endoscopic savary dilatation, either single (n=1) or multiple sessions (n=3). %EWL at leakage group was 99 ± 64, which is statistically significant (P<0.05) compared with the other RC group. Outcomes of management of leakage are summarized in Table 8.

Group 3: malnutrition (n=5)

Five (6.8%) patients had corrective operations for malnutrition after bariatric procedures (Fig. 4). Patients' demographic data are summarized in Table 9.

Clinical presentations of cases that underwent operations for malnutrition after bariatric surgery, complications, associations, and laboratory data are summarized in Tables 10 and 11.

Regarding outcomes of management of malnutrition, the overall % of deficient weight gained from time of reoperative surgery to last follow-up was 238.1 ± 149% and overall %EWL from time of primary surgery to last follow-up was 63.6 ± 27.7%, which is considered successful restoration of the normal weight loss course. Physical and mental health scores at last follow-up according to SF-36 QOL survey were 74.8 ± 26.4 and 75.5 ± 12.3, respectively, which is the highest score among all groups. Follow-up weight parameters are illustrated in Table 12.

Group 4: stricture (n=7)

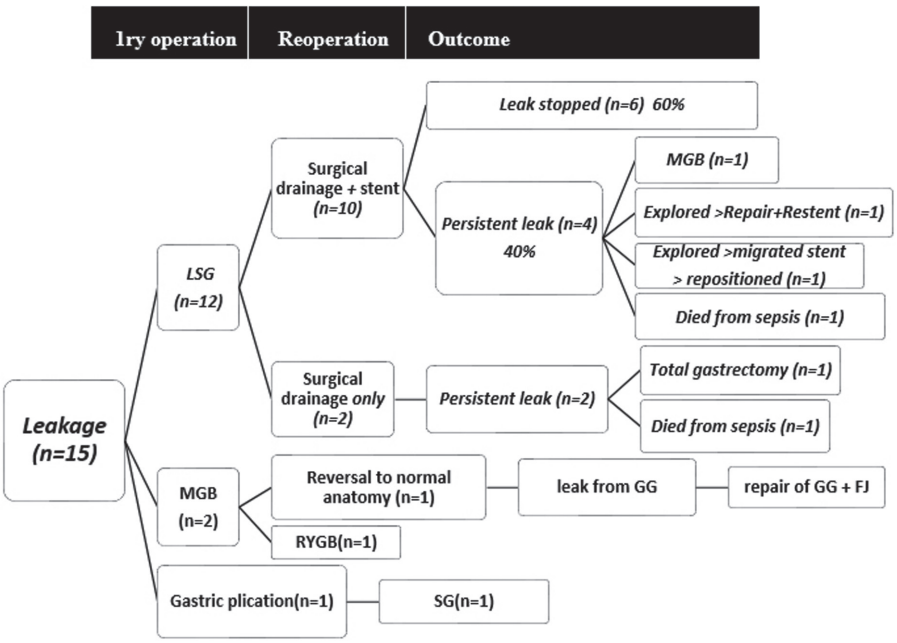
Seven (9.5%) patients underwent redo bariatric operations for radiologically and/or endoscopically

Table 5 Weight parameters at the time of reoperation and at the last follow-up in each insufficient weight loss subgroup

Subgroup 1: less than 3 years (12 patients)			
Variables	At reoperation	At follow-up	*P* value
BMI	51.4 ± 9.6 (40.8–69.8)	39.2 ± 8.5 (26.9–57.8)	**0.03**
BMI units lost	5 ± 6.7 (–3.7 to 16.5)	12.2 ± 8.2 (2.3–30.1)	**0.03**
%EWL	16.2 ± 18.5 (–10.9 to 45.6)	56.3 ± 20.2 (21.3–90)	0.96
%TWL	8.8 ± 10.7 (–6.3 to 25.4)	30.5 ± 10.4 (13.3–45)	0.92
Subgroup 2: 3–5 years (3 patients)			
BMI	56.6 ± 13.1 (43.3–69.5)	44.3 ± 9.3 (38.8–55)	0.36
BMI units lost	0.4 ± 9.8 (–10 to 9.4)	12.3 ± 7.3 (4.1–18.3)	0.57
%EWL	3.3 ± 31.5 (–29.1 to 34)	40.4 ± 24.3 (12.9–59)	0.43
%TWL	1.3 ± 17.4 (–16.9 to 17.9)	22.4 ± 13.6 (7.5–34)	0.48
Subgroup 3: more than 5 years (6 patients)			
BMI	43 ± 7 (35.4–53.4)	37.8 ± 10 (25.4–47.7)	0.11
BMI units lost	8.2 ± 8.4 (0–24.4)	5.2 ± 7 (–6.5 to 12.5)	0.14
%EWL	29.4 ± 20.9 (0–60)	55.6 ± 34 (13–97.9)	0.36
%TWL	15 ± 12.4 (0–37.1)	26.5 ± 13.6 (6.7–40.9)	0.40

EWL, excess weight loss; TWL, total weight loss.

Figure 3



Details of surgical exploration and outcomes for the leakage group.

Table 6 Preoperative data for leakage group

Variables	15 patients [*n* (%) or mean±SD]
Age (years)	42.29 ± 12.69
Female sex	10 (66.6)
BMI at primary surgery (kg/m^2)	51.26 ± 6.5
Referred cases	7(46.6)

proven stricture causing persistent vomiting not responding to intensive medical treatment. Different types of the primary and redo operations done in this group are illustrated in Fig. 5.

Clinical and demographic data of stricture group are summarized in Table 13.

All cases underwent upper endoscopy and oral contrast study. Results are summarized in Table 14.

Regarding the site of stenosis in the SG group, it was in the mid body, whereas it was in the pouch outlet in the vertical band gastroplasty (VBG) group, as shown in Table 15.

Pneumatic balloon dilatation (PBD) was tried in five (71.4%) cases before going for surgery, and details of PBD are shown in Table 16.

Outcomes for surgical management of stricture are illustrated in Table 17.

Table 7 Adverse events related to endoscopic stenting combined with surgery for management of post-sleeve gastrectomy leakage according to the lexicon by American Society for Gastrointestinal Endoscopy

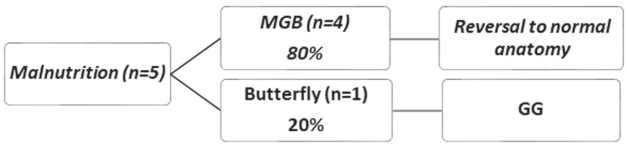
None [*n* (%)]	2 (20)
Mild [*n* (%)]	
Intolerance requiring hospitalization (≤3 days)	1 (10)
Aspiration requiring medical consultation	1 (10)
Reflux	7 (70)
Moderate [*n* (%)]	
Intolerance requiring hospitalization (4–10 days)	2 (20)
Intolerance managed by endoscopic removal	1 (10)
Migration managed by endoscopic reposition	1 (10)
Migration managed by endoscopic exchange	1 (10)
Endoscopically manageable postremoval stricture	2 (20)
Severe [*n* (%)]	
Intolerance requiring hospitalization (> 10 days)	2 (20)
Spill over managed by 2nd reoperation (feeding tube)	4 (40)
Fatal	1(10)

Table 8 Outcomes of surgical management of leakage

Variables	Results [*n* (%)]
Success	13 (86.6)
Mortality	2 (13.3)
Postleakage stricture	4 (26.6)
Poststent insertion	2
Without previous stent	2
Successful endoscopic management by savary dilatation	4
Patients at follow-up	5 (35.7)
<3 years	3
>5 years	2
BMI at last follow-up (kg/m^2)	24.5 ± 17
Overall %EWL from time of 1ry surgery to last follow-up	99 ± 64
Physical health score at last follow-up according to SF-36 QOL Survey (0–100)	49.2 ± 21.35
Mental health score at last follow-up according to SF-36 QOL Survey (0–100)	22.24 ± 7.4

EWL, excess weight loss; SF-36, 36-Item Health Short Form survey.

Figure 4



Corrective operations done for malnutrition after bariatric procedures.

Group 5: gastroesophageal reflux (*n*=4)

Four (5.4%) patients had corrective operations for refractory GERD after bariatric procedures (Fig. 6). All patients had presence of persistent troublesome GERD symptoms and objective evidence of GERD despite double-dose PPI therapy over at least 8 weeks.

Patient clinical and demographic data are summarized in Table 18.

Table 9 Demographic data of malnutrition group

Variables	(*N*=5) [*n* (%) or mean±SD]
Age at revision (years)	47 ± 16.4
Female sex	5 (100)
Referred cases	4(80)
Interval between primary and reoperation (range by years)	(1–3.3)
Socioeconomic status (according to the modified Fahmy and El-Sherbini scoring system)(16)	High (0/5)
	Medium (1/5)
	Low (4/5)
Compliance to supplements, diet and follow-up	Supplements (4/5)
	Diet (3/5)
	Follow-up (4/5)
BMI at primary surgery (kg/m^2)	40.39 ± 6.34
BMI at reoperation (kg/m^2)	21.65 ± 7.77
%EWL at reoperation	142.39 ± 64.3

EWL, excess weight loss.

Table 10 Clinical presentation of malnutrition group

Clinical presentation	Excessive weight loss (5/5)
	Generalized anasarca (1/5)
	Lower limb edema (1/5)
	Physical weakness (5/5)

Table 11 Laboratory data and associated complications of malnutrition group

Laboratory data	Albumin (mg/dl) mean 3.2 (range, 1.9–3.7)
	Anemia (4/5)
	↓ Vitamin D (2/5)
	↓ Ionized±total calcium (3/5)
Associated complications	Cirrhotic liver (1/5)
	Drowsiness (1/5)
	Steatorrhea (1/5)
	Recurrent respiratory infection (2/5)
	Psychological depression (5/5)
	(*N*=7) [*n* (%) or mean±SD]
	Fatty liver (3/5)

All cases underwent upper endoscopy, oral contrast study, and 24-h-pH monitoring. Regarding the long-term outcomes of management of GERD, three out of four cases were still complaining of GERD symptoms at last follow-up. One case was completely responding to 40 mg PPI/day, whereas the other two cases had only partial response. Physical and mental health scores at last follow-up according to SF-36 QOL survey were 22.6 ± 15 and 24 ± 23.9, respectively, which are the lowest score among all groups (P<0.05). Follow-up parameters are illustrated in Table 19.

Group 6: bleeding (*n*=9)

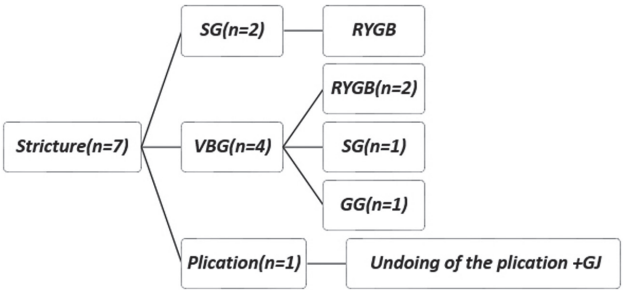
Nine (12.2%) patients were explored for bleeding after bariatric procedures (Fig. 7).

Table 12 Follow-up weight parameters in malnutrition group

Follow-up parameters	*N*=5 [*n* (%) or mean±SD]
Patients at follow-up	4 (80)
<3 years	1
>5 years	3
Weight at last follow-up (kg)	89.5±13.2
BMI at last follow-up (kg/m^2)	30.7±5.56
ΔWT at last follow-up from time of reoperation (kg)	35.75±10.9
ΔWT at last follow-up from time of 1ry surgery (kg)	22.25±7.18
ΔBMI at last follow-up from time of reoperation (kg/m^2)	12.34±4.28
Overall % of deficient weight gained from time of reoperative surgery to last follow-up	238.11±149
Overall %EWL from time of 1ry surgery to last follow-up	63.66±27.7

EWL, excess weight loss.

Figure 5



Types of the primary and redo-operation done in the stricture group.

Table 13 Clinical and demographic data of stricture group

Variables	*N*=7 [*n* (%) or mean±SD]
Age at revision (years)	41.14±9.3
Female sex	6(85.7)
Referred cases	6(85.7)
Interval between primary and reoperation (years)	4.7±6.7
BMI at primary surgery (kg/m^2)	50.84±11.97
BMI at reoperation (kg/m^2)	32±10.57
%EWL at reoperation	66.8±63

EWL, excess weight loss.

Patients' preoperative clinical and demographic data are summarized in Table 20.

Preoperative risk factors for bleeding included previous abdominal surgeries, associated morbidities, and coagulation profile, which are summarized in Table 21.

Patients' preoperative hemoglobin level, early signs of bleeding, vital signs before exploration, and need for blood transfusion are illustrated in Table 22.

Complications after reoperative bariatric surgery

A total of 22 reoperative cases had complications in the first 30 days of the postoperative period (24.4%,

Table 14 upper endoscopy and oral contrast study before redo operation at stricture group

Upper endoscopy findings	Oral contrast study findings	*N*=7
Stricture	Stricture	2
Normal	Stricture	2
Stricture	Normal	3

Table 15 Site of stenosis

Mid body (cases post-SG)	2
Pouch outlet (cases post-VBG)	4
Gastric plicated ridge into the antrum (case post plication)	1

SG, sleeve gastrectomy; VBG, vertical band gastroplasty.

Table 16 Pneumatic balloon dilatation used in stricture group

Primary surgery	
SG	2
VBG	3
Number of sessions of PBD/patient (range)	1 (1–3)
Duration between index surgery and PBD by months	13±10
Outcome of PBD	
Partial improvement	2
No improvement	3

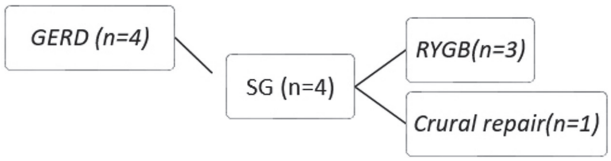
PBD, pneumatic balloon dilatation; SG, sleeve gastrectomy; VBG, vertical band gastroplasty.

Table 17 Follow up of patients in stricture group

Patients at follow-up	5 (71.4%)
< 3 years	3
3–5 years	2
BMI at last follow-up (kg/m^2)	34.6±2.8
Patients reported relief of symptoms of gastric outlet obstruction	4/5
Physical health score at last follow-up according to SF-36 QOL Survey (0–100)	40.2±24
Mental health score at last follow-up according to SF-36 QOL Survey (0–100)	50.25±35.2

SF-36, 36-Item Health Short Form survey.

Figure 6



Corrective operations done for refractory GERD after bariatric procedures. GERD, gastroesophageal reflux.

Table 18 Preoperative data for refractory gastroesophageal reflux group

Variables	*N*=4 [*n* (%) or mean±SD]
Age at revision (years)	42.8±10.7
Female sex	4 (100)
Referred cases	1 (25)
Interval between primary and reoperation (years)	2.4±0.8
BMI at primary surgery (kg/m^2)	50.2±5.7
BMI at reoperation (kg/m^2)	34.37±35
ΔBMI at reoperation (kg/m^2)	15.8±3.9
%EWL at reoperation	63±11.6

EWL, excess weight loss.

22/90 reoperations), whereas 10 (11.1%) reoperations had late complications. Overall major and minor complications occurred in 17.5 and 25.6% of patients, respectively. Patients experiencing any complication following revision for IWL or RC are described in detail in Tables 4 and 5, respectively. The most frequent complications included anastomotic leakage (7.7%), surgical wound infection (2.2%), surgical wound hematoma (2.2%) and GERD (4.4%), incisional hernia (6.6%), stricture (3.3%), and intestinal obstruction (2.2%). The reoperation rate was 21.6% (16/74 patients, including one IWL and 15 RC; $P<0.05$): 12 due to small anastomotic leaks ($P<0.05$), two due to intestinal obstruction, one due to staple line bleeding, and one due to mesenteric vascular occlusion (MVO) missed during first reoperation.

Table 19 Follow-up parameters of gastroesophageal reflux group

Follow-up variables	*N*=4 [*n* (%) or mean±SD]
Patients at follow-up	4 (100)
< 3 years	1
3–5 years	1
>5 years	2
Presence of GERD symptoms	3/4
Complete response to 40 mg PPI/day	1
Only partial response to 40 mg PPI/day	2
BMI at last follow-up (kg/m^2)	33.59 ± 5.9
ΔBMI at last follow-up from time of reoperation (kg/m^2)	0.47 ± 3.73
Overall %EWL from time of reoperative surgery to last follow-up	7.8 ± 36.3
Overall %EWL from time of 1ry surgery to last follow-up	67.42 ± 15.67
Physical health score at last follow-up according to SF-36 QOL survey (0–100)	22.6 ± 15
Mental health score at last follow-up according to SF-36 QOL Survey (0–100)	24 ± 23.9

EWL, excess weight loss; GERD, gastroesophageal reflux; PPI, proton pump inhibitors; SF-36, 36-Item Health Short Form survey.

The mortality rate was 5.4% (four out of 74 patients, including one IWL and three RC): two cases due to leakage-related-sepsis and two due to major thromboembolic events in early postoperative period, namely, MVO and pulmonary embolism.

Complications following reoperation for insufficient weight loss

Patients who developed complications following revision for IWL are described in detail in Table 23. Two major complications occurred in a single case of Roux-en-Y gastric bypass (RYGB) that underwent pouch reduction and then developed leakage owing to kink near GJ causing obstruction which needed GJ revision. Thereafter, high-output intestinal fistula developed (>500/day), and unfortunately, the patient death suddenly in the ward on fourth postoperative day.

Complications following reoperation for refractory complication

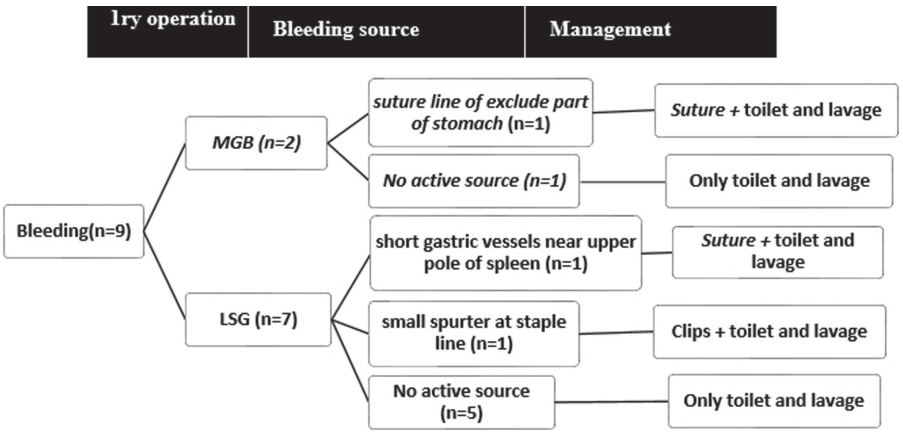
As shown in Tables 24 and 25, 19 cases developed minor complications (10 early and nine late), whereas major complications occurred in 14 cases (13 early and one late) (Fig. 8).

Discussion

With the rising prevalence of obesity, there has been a steady rise in the number of bariatric surgeries performed worldwide. As expected, there has also been an increase in the number of revisional surgeries performed to manage acute and chronic postoperative complications. In the United States, ~9480 revisional bariatric surgeries were performed in 2011, which increased to 38 971 in 2018 [16].

So, the frequency of revision procedures is increasing, although they are known to be less effective and are associated with complications [17–19].

Figure 7



Operations done for bleeding after bariatric procedures.

There was a female predominance (74%) in the current study, and this is in accordance with previous reports [20,21]. This is explained by the higher number of females undergoing the initial bariatric operations. Another factor is that women lose less weight compared with men [22]. Therefore, it is unclear whether men obtained fewer reoperations because of satisfactory results or if they were more reluctant to seek a reoperation compared with women, as may be the case with initial bariatric operations.

In this study, the mean age was 40.4±10.3 years, which was slightly lower than that reported in other studies, such as 45.5±1.5 years by Vallois *et al.* [23] and 44.2±11 by Keren *et al.* [24]. We had only two (2.7%) elderly patients (>60 years), which is much less than other studies. Elderly patients comprised 12% of the reoperative group of patients in the study by Sudan *et al.* [21].

On the contrary, we had only one (1.3%) case of reoperation in adolescents (<19 years), but multiple studies have shown much higher numbers [25]. In our study, the interval between primary and reoperation was 5.2±4.5 years for IWL, which is near to the literature [3,26]. However, Park *et al.* [1] reported only a 3-year interval. This heterogenicity of results could be explained by the different definitions for IWL relied upon by these studies. Another factor is that some countries' health insurance systems require a certain time interval to pass from primary operation to go for another one.

Regarding postoperative hospital stay in the IWL group, we reported 3.19±2 days, which is not significantly different from the results of many studies on this type of reoperations. For example, Qiu *et al.* [3] reported a median length of only 2 days, whereas Keren *et al.* [24] and Park *et al.* [1] reported a length of hospital stay of 3 days.

A total of 38 (51.4%) patients were referred to our institution from outside clinics. As the operative data of most referred cases were not known to us, we had to do full evaluation by upper endoscopy, OGG, and CT volumetry if indicated.

Many of the referred cases (34%) underwent unrecognized primary procedures such as VBG and butterfly or had anatomical causes of failure such as presence of a large sleeve with retained gastric fundus. So, bariatric surgery should be limited to specialized centers that offer a multidisciplinary team. We also recommend that the medical syndicate should have a role in organizing local bariatric practice regarding these types of procedures.

The search for the ideal bariatric procedure is a dynamic process, and easy reversibility is a criterion of an ideal one [27].

Regarding primary surgery in the IWL group, the main bulk was for restrictive procedures (75%) (SG, 18 cases, and VBG, 6 cases), whereas RYGB, butterfly, plication, and LAGB represented 25% (eight cases, two for each type).

The reported percentage of patients with weight regain after SG ranged from 5.7% at 2 years to 75.6% at 6 years [28]. So, weight regain after SG is common, and it is due to either an inappropriately performed

Table 20 3 Clinical and demographic data of bleeding group

Variables	*N*=9 [*n* (%)]
Age (years)	35.3±8.5
Male sex	6
BMI (kg/m^2)	58.6+8.8
BMI> 50 (kg/m^2)	6
Interval between primary and reoperation	1±0.4 day

Table 21 Preoperative risk factors for bleeding

Variables	*N*=9 [*n* (%)]
Previous upper abdominal surgery (cholecystectomy)	2
Associated morbidities	
Liver disease	1
Hypertension	4
Diabetes mellitus	0
Coagulation profile	
Preoperative anticoagulant use	4
Preoperative INR [mean (SD)]	1±0.05
Preoperative platelet count [mean (SD)]	289±90

Table 22 Signs of bleeding group and blood transfusion

Variables	*N*=9 [*n* (%) or mean (SD)]
Blood hemoglobin	
Hb at exploration	9.5±1.3
ΔHb	4.2±1
Earliest bleeding sign detected	
Shock: tachycardia, hypotension, or tachypnea	5
Bloody drain	2
Hb drop	2
More than one sign	7
Vital signs before exploration	
Tachycardia (HR: 100–120 bpm)	9 (100)
Severe tachycardia (HR>120 bpm)	6
SBP< 90 [*n* (%)]	5
Blood transfusion	
Patients needed blood transfusion	8 (88.9)
Number of units per patient	3 (2–5)

SBP, systolic blood pressure.

Table 23 Complications following revision for insufficient weight loss

Reoperative procedure	Type		Complication	Management	Outcome
LSG conversion to RYGB			Pain		
LSG conversion to SJB		Early	GERD	PPI±prokinetics	Resolution
LSG conversion to MGB	Minor				
Resleeve		Late	Stricture	Endoscopic dilatation	
VBG conversion to MGB			Incisional hernia	Conservative	Still present
RYGB pouch reduction (one case developed 2 major complications)	Major	Early	Intestinal obstruction caused leakage from GJ	Exploration	Intestinal leak which continued till death
	Major	Early	mostly Pulmonary embolism	Cause of death could not be confirmed	Sudden death

GERD, gastroesophageal reflux; MBG, mini-gastric bypass; PPI, proton pump inhibitors; RYGB, Roux-en-Y gastric bypass; VBG, vertical band gastroplasty.

Table 24 Minor complications following reoperation for refractory complication

Reoperative procedure	Type	Complication	Management	Outcome
Exploration for leakage post-SG	Early	Wound infection	Antibiotics+wound care	Resolution
Excision of intestinal fistula		Wound hematoma	Incision+drainage	Resolution
Reversal of MGB		Wound hematoma	Incision+drainage	Resolution
Repair of gastric fistula		Stricture	Endoscopic dilatation	Resolution
LSG conversion to RYGB		Pain	PPI+prokinetics	Resolution
Crural repair after LSG		GERD	PPI±prokinetics	Still present
GG for VBG				Resolution
LSG conversion to SJB				
LSG conversion to MGB				
VBG conversion to RYGB		Dumping syndrome	Dietary instructions+medical treatment	Resolution
Repair of gastric fistula	Late	Wound infection	Antibiotics+wound care	Resolution
Excision of intestinal fistula		Wound dehiscence	Topical silver nitrate	Resolution
Repair of gastric fistula		Stricture	Endoscopic dilatation	Resolution
Resleeve				
Reversal of MGB		Incisional hernia	Hernioplasty	Resolution
Exploration for leakage post-SG				
Repair of gastric fistula				
LSG conversion to RYGB			Conservative	still present
VBG conversion to MGB				

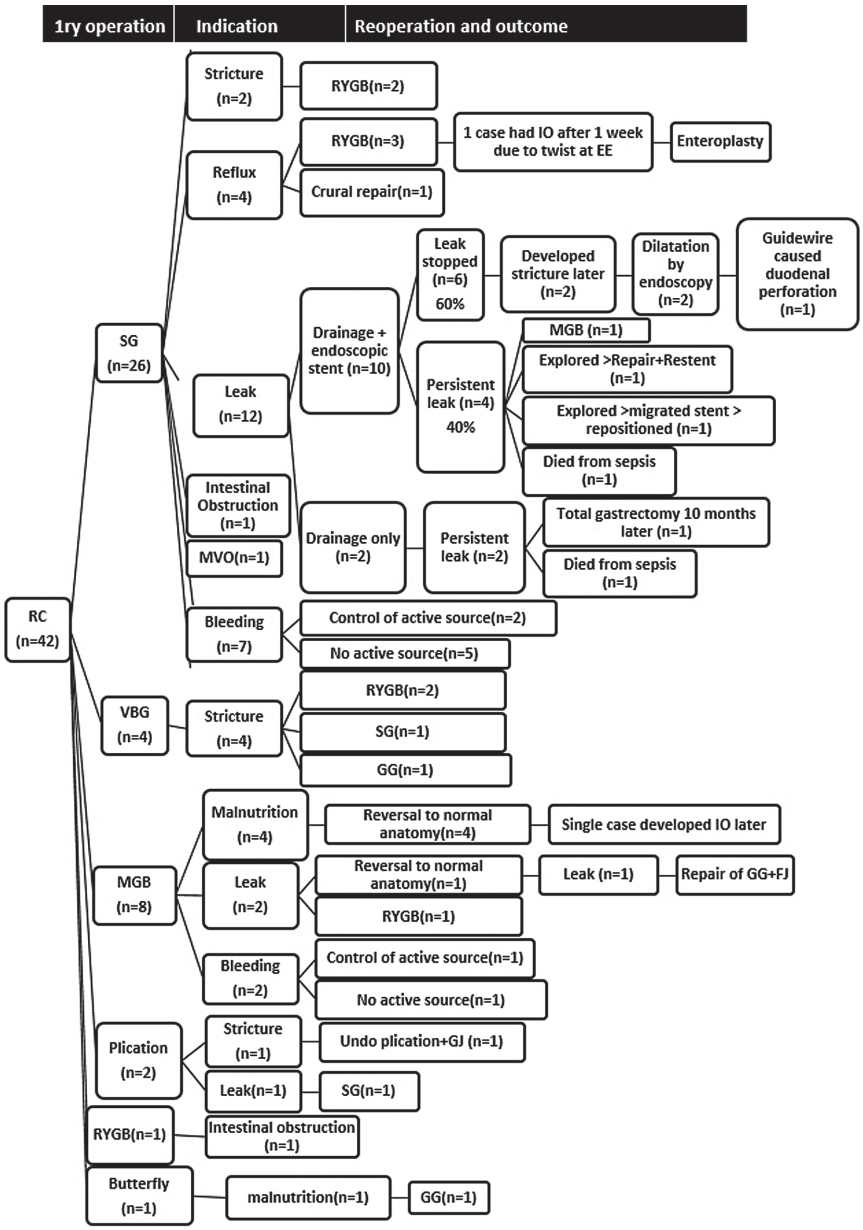
GERD, gastroesophageal reflux; MBG, mini-gastric bypass; PPI, proton pump inhibitors; RYGB, Roux-en-Y gastric bypass; SG, sleeve gastrectomy; VBG, vertical band gastroplasty.

Table 25 Major complications following reoperation for refractory complication

Reoperative procedure	Type	Complication	Management	Outcome
GJ revision	Early	Thromboembolic	Conservative	Death
Perforation by endoscopic guide wire for stricture after megastent for gastric fistula		Perforation	TPN+drainage	Resolution
Missed diagnosis of MVO at 1st exploration		MVO	Exploration+resection anastomosis of gangrenous bowel	Death
LSG conversion to RYGB		Intestinal obstruction	Laparoscopic adhesiolysis	Resolution
Diagnostic laparoscopy for MGB internal hemorrhage		Collection	US-guided tube drainage	Resolution
Repair of gastric fistula		Anastomotic leakage	TPN+drainage	Resolution
Repair of gastric fistula				Resolution
Repair of gastric fistula				Resolution
Repair of gastric fistula				Resolution
Exploration for leakage after sleeve				Resolution
Exploration for leakage after sleeve				Death
Reversal of MGB			Laparoscopic repair	Resolution
Reversal of MGB	Late	Intestinal obstruction	Laparoscopic adhesiolysis	Resolution
VBG conversion to SG		Stricture and relative twist	Adhesiolysis with fixation of sleeve	Resolution

MBG, mini-gastric bypass; RYGB, Roux-en-Y gastric bypass; SG, sleeve gastrectomy; VBG, vertical band gastroplasty.

Figure 8



Reoperative outcomes in the RC group. RC, refractory complication.

operation (leaving behind a large sleeve, retained antrum, or retained fundus) or inadequate follow-up with a maladaptive eating behavior [29–31].

In the current study, 9 of 18 patients whose primary operation was SG had residual fundus or large sleeve apparent by preoperative UGIE. It is difficult to understand how an initially 'large' sleeve or primary dilation is a cause of weight regain rather than IWL, but the answer may lie in the fact that this often results from an incompletely excised fundus, the most distensible part of the stomach, which may then increasingly distend and release larger amounts of ghrelin. It does seem logical, however, that progressive sleeve dilatation or secondary dilatation would contribute to weight regain [29].

Another issue for IWL after SG is the retained antrum. In this study, the antrum was divided at 4.9 ± 1.2 cm from the pylorus. Obeidat and colleagues compared weigh regain between a group of 54 patients who had the antrum divided at 6 cm from the pylorus and a group of 56 patients whose antrum was divided at 2 cm. At 2 years following surgery, 12 (22%) patients with a 6-cm remnant antrum had regained weight (defined as at least 10 kg from primary weight) compared with only two (4%) patients with a 2-cm antral remnant (P=0.003) [32].

Concerning the bougie size in SG, the mean bougie size used in this study was 34.3 ± 0.9 F. However, Abd Ellatif and colleagues analyzed the data from 1395 individuals and reported that weight regain occurred

in 29 (3.5%) people in the group using a larger bougie size (44 F) and eight (1.4%) people in the group using a smaller bougie size (36 F). This difference was statistically significant, suggesting that a smaller bougie may be a protective factor against post-SG weight regain [33].

Regarding VBG, the basic concept of restriction is obtained by a lesser curvature-based gastric tube, with a restricted outlet supported by an extrinsic implant. Because of the nondivided nature of the gastric tube, the major reason for weight regain is the recanalization of the vertical staple line, resulting in gastro-gastric fistula [34,35]. In the current study, four of six patients showed that their preoperative UGIE and OGG confirmed complete obliteration of the vertical staple line with normally apparent stomach and one had apparent fistula by UGIE.

Weight regain after RYGB can occur owing to pouch dilatation, increase in stoma size, and gastro-gastric fistula [36], as well as long Roux limb [37].

Pouch dilatation is considered, if the pouch is more than 6 cm long or more than 5 cm wide [36,31]. However, these measurements are empirical, and little scientific evidence exists to support them. Topart and colleagues estimated the pouch size after barium swallow in 107 patients on an average 3 years after the operation and found no correlation between the pouch size and %EWL. Patients who had large pouches (>50 mL) had similar weight loss to those who had normal-sized pouches (68 vs. 66% EWL, respectively). Even in patients with pouches more than 100 ml in size, the weight loss was comparable to those with smaller pouches [26,38].

Another important anatomic change that has been shown to reduce the effectiveness of the RYGB is the presence of a gastro-gastric fistula with an incidence ranging between 1.5 and 6% [39]. Gastro-gastric fistulas may reduce both the restrictive and malabsorptive components of RYGB by allowing food to travel through alternative routes and thus not passing through the surgically created gastric pouch, gastrojejunostomy, and bypassed intestine.

In general, long-term follow-up is important in preventing weight regain. Sarela *et al.* [40] proposed that the lifelong follow-up provided by the National Health Service in the UK is responsible for less weight regain in the long term. This study included 32 patients with IWL. Approximately 84.4% (27 patients) stated they missed their follow-up at a certain period owing to different causes. Another study by Lombardo and colleagues specifically investigated whether or not more frequent follow-up visits prevent weight regain. In their series of 71 patients, including 43 patients who had undergone SG with a baseline BMI of 49.8 kg/m^2, they compared a group of patients who had follow-up visits at 9, 12, 15, 18, 24, 30, and 36 months with a group that had follow-up at only 12, 18, 24, and 36 months. They concluded that more follow-up visits may help reduce weight regain based on significant differences between the groups with respect to change in body weight, change in BMI, and change in %EWL [41].

The type of reoperation for IWL depends on the index operation and the associated complications such as intractable GERD. In the current study, SG was converted to MGB (seven cases), RYGB (seven cases), resleeve (three cases), and sleeve jejenal bypass (SJB) (one case).

The current literature confirms the safety and long-term effectiveness of MGB as a revisional surgery for failed gastric-restrictive procedures [42–45].

Although IWL was the principal reason for conversion, BPL length was found to represent a crucial technical point regarding revisional surgery. In our study, the biliopancreatic limb length in MGB was 1.9 ± 0.3 meter. The optimal limb length in primary and revisional MGB is still a matter for debate, so there is variation in the literature. BPL varied from 150 to 350 cm [46]. In many studies, the most common BPL length in MGB was 200 cm. Meanwhile, some studies used 150-cm BPL lengths (and increased them by 10 cm for each BMI point above 40) [43,44,47–52].

Regarding weight loss in the current study, the final %EWL in eight patients who converted from SG to MGB was 58 ± 21% after 3–5 years, which is near to 77% reported by Debs *et al.* [50] after 5 years, 64% reported by Chiappetta *et al.* [44] after 1 year, and 58.9% reported by Ohta *et al.* [53] after 1 year.

In our study, 12 cases of SG were converted to RYGB for a variety of indications: eight for IWL, three for GERD, two for stricture, and one for leak. This variability of indications was reported by many authors like IWL [54–56], GERD [54–57], stenosis [58], leak [59,60], dysphagia [55], and gastric outlet obstruction [61]. RYGB was indeed the commonest conversion choice for revisions after SG in a recent systematic review [62].

GERD incidence after SG was 23% and prevalence was 19% as reported by a recent large systematic review in 10 718 patients [63]. In addition, there have been some

reports of Barrett's esophagus after SG [64,65]. Many patients fail to respond to conservative management, such as PPIs, warranting further intervention, and here, the role of RYGB should be discussed. In a recent meta-analysis covering 556 patients from 17 studies who underwent RYGB after SG, the indication for conversion due to GERD was 30.4% [66]. This is near to the 25% rate of the current study. In these cases, the alimentary limb length should be at least between 60 and 70 cm to prevent any bile reflux into the sleeve-like gastric pouch [67]. In our study, the alimentary limb was 1 m in the three cases, which is on the safe side to prevent biliary gastritis.

Our study shows that although RYGB results in some more weight loss, it is unremarkable. The final %EWL of 26 ± 33 at an average of 3 years in eight patients who were converted from SG to RYGB is less than the %EWL reported in many studies with primary RYGB, which is about 56% as reported by Kothari *et al*. [68], 70% as reported by Carbajo *et al*. [47] after following up 1200 patients, and 84.3% after 11 years as reported by Sheikh *et al*. [69]. So, weight loss appears to be less than what we would generally expect with primary RYGB, and this was similar to what others have reported in this type of reoperation [11,54,56,57].

On comparing %EWL between MGB and RYGB as two important options for failed SG (58 ± 21 for MGB vs. 26 ± 33 for RYGB), there was a statistically significant difference (P<0.05), which is also in accordance with the literature. Ruiz-Tovar *et al*. [70] reported %EWL of MGB vs RYGB after 1 year (100.4 vs. 81.2; P<0.05), after 2 years (104.3 vs. 87.2; P<0.05), and after 5 years (97.9 vs. 77.1; P<0.05), all being statistically significant. Lee *et al*. [71] reported %EWL of MGB versus RYGB after 1 year (64.9 vs. 58.7; P<0.05) and after 2 years (64.4 vs. 59.2; P<0.05), which was statistically significant. A recent study by Robert *et al*. [72] reported %EWL of MGB versus RYGB (87.9 vs. 85.8) after 1 year, reporting that MGB may not be inferior to RYGB in terms of EWL (P noninferiority=0.0024). The explanation for this is that they used a 200-cm biliopancreatic limb in the MGB group and a 150-cm alimentary limb and 50-cm biliopancreatic limb in the RYGB group, which is different from other studies using a shorter alimentary limb and a longer BPL.

Regarding the safety of RYGB following SG, no deaths were reported in this study. One case developed intestinal obstruction, which required laparoscopic exploration to relieve a twist near GJ. Another case developed early abdominal pain after discharge, which required readmission and improved with PPI and prokinetics. From a recent meta-analysis, the pooled serious adverse event rate within 30 days was 16.4%, whereas the pooled adverse event rate after 30 days was 11.4%. The median reoperation rate for complications after conversion was 6.7% [66].

Generally on comparing MGB and RYGB, MGB was found to be technically easier (mean operative time: 120 vs. 174 min; P<0.05), better regarding weight loss (%EWL: 58 ± 21 vs. 26 ± 33; P<0.05), and with less complications rate as an option for IWL after SG. Nearly the same results were reported by Cardoso and Nocca [67].

In this study, there were three cases of re-SG in the IWL group. The three cases achieved EWL of 13.4, 47.5, and 63% at more than 5 years, more than 5 years, and less than 3 years, respectively. This indicates that it was not effective in two patients. Cardoso and Nocca [67] reported IWL in 42% of patients at 5-year follow-up. However, AlSabah *et al.* [73] reported median EWL of 57% after 1-year follow-up.

The negative effects of resleeve in the form of the risk of leakage, the high-pressure system, and the absence of an additional malabsorptive effect must be kept in mind when choosing this type of revisional surgery [44].

Noel and colleagues reported that resleeve remains effective in most patients at 5 years postoperative with good success rate especially for the nonsuper-obese patients and for primary or localized dilatation. For patients with a global dilatation of the SG, the procedure of re-SG should be avoided [74]. Further prospective clinical trials are required to compare the outcomes of re-SG with those of RYGB, OAGB, or SADI for weight loss failure after LSG.

In our study, we had 10 cases of reoperation after VBG. VGB has been progressively abandoned in the bariatric community both for a high long-term failure rate and a disappointingly high complication rate. The options for revision are variable including mainly RYGB and MGB. In our study, we had three cases of IWL and two cases of stricture after VBG that were converted to RYGB. In other studies, RYBG was the revisional surgery of choice after failed VBG, as it can achieve good results in weight loss and can permit corrections of comorbidities [75]. However, revisional LRYGB is a technically difficult procedure and is associated with higher morbidities and mortalities [76–79]. In our study, other than a single case that had dumping symptoms and necessitated readmission, we had no major complications following VBG conversion to

RYGB. On the contrary, the three cases had acceptable %EWL at the last follow-up. They achieved %EWL of 80, 57, and 49% at 3–5 years of follow-up. Low number of cases can be the reason for low complications.

We had three cases of IWL after failed VBG that were converted to MGB. MGB offers major benefits, with quite satisfactory results, over most alternative procedures. In a recent large meta-analysis comparing MGB and RYGB, nearly equal results were found in terms of perioperative complications, so it was recommended that MGB is a simpler and more effective technique [80]. Another recent study described MGB as a promising revisional procedure for patients with failed VBG with technically feasibility, good safety, low rate of major postoperative complications, and efficient weight loss [81].

In our study, the mean operative time and mean postoperative hospital stay for VBG converted to MGB were 168 min and 2.3 days respectively in comparison to cases converted into RYGB where the mean operative time and mean postoperative hospital stay were 180 min and 2.3 days (P>0.05), respectively. In another study, these variables were significantly shorter (145 min and 4.7 days for MGB, whereas 185 min and 6.2 days for RYGB; P<0.05) [82].

In our study, at 3–5 years of follow-up, %EWL after VBG was converted to RYGB was 61 ± 13%, whereas after VBG was converted to MGB was 73 ± 8% (P>0.05). This was reported by Salama and Sabry [82] after 1-year follow-up, indicating that that there was no significant difference, as both procedures have similar weight loss efficiencies.

There were no significant complications recorded after this conversion procedure in our study. However, other studies reported a significant decrease in the rate of complications after MGB in comparison with RYGB, which was 2.5 and 9.5%, respectively [82]. This difference may be owing to the small sample size or the fact that these types of redo surgeries at our center are done by senior bariatric surgeons with good experience. Important to notice is that not all cases with failed VBG can be converted into MGB and sometimes we have to do RYGB. The decision should be taken intraoperatively depending mainly on the actual intraoperative pouch length.

In our study, we had two cases of weight regain after failed RYGB who were corrected by resizing of the gastric pouch. There are different methods to combat WR after RYGB as illustrated by Felsenreich and colleagues, including (a) pouch resizing, (b) pouch banding, (c) pouch resizing plus pouch banding, and (d) common limb shortening (i.e. distalization). They compared the four groups regarding weight loss and complications developed and concluded the follows: (a) no significant differences concerning additional weight loss among the four methods; (b) no risk of malnutrition with pouch resizing, but there is with bypass distalization; and (c) pouch banding (+/– resizing) poses a high risk of dysphagia [83].

We had only two cases in our series whose primary operation was LAGB, and both were converted to SG. This small number compared with the literature is due to the low prevalence of LAGB in our locality compared with Europe and USA, where it was one of the most performed bariatric operation [84–86].

Conversion of LAGB to SG seems to be safer than RYGB [87,88]. The same was reported in a study of 32 RYGB and 72 SG patients who were converted from AGB, and the results were 9.3 versus 2.8% for reoperation rate and 18.8 versus 12.5% for complication rates (P>0.05) [89]. Similarly, Moon and colleagues reported on their experience with 54 patients undergoing conversion and found higher reoperation (10 vs. 8.3%) and hospital readmission (17.5 vs. 8.3%) with RYGB compared with SG [90]. On the contrary, a meta-analysis included 1370 patients, and 30-day morbidity for single-stage conversion was 10.9% for SG and 8.3% for RYGB [91]. It is possible that over time, with increase in the proportion of patients who present for ABG conversions, further experience has led to improved outcomes after RYGB.

RYGB is the best option to convert failed LAGB based on experience of more than 12 000 cases [92].

Gastrointestinal leak remains one of the most dreaded complications in bariatric surgery [93], with a current reported rate of 0.3–0.4% [94]. We had 14 cases of leakage: 11 post-SG, two post-MGB, and one postgastric plication.

In 10 of 11 cases after SG, the location of the leakage was near the CEJ, which represents an anatomical area of weakness for any sutures. This was stated in the literature, which is due to the thinner fundic wall and less vascularization than the rest of the stomach. In addition, this area under the cardia is more sensitive to technical failure or to any increase in intragastric pressure [95,92]. When technical factor is the cause, the leakage tends to appear in the first 2 days of the postoperative period, whereas when ischemic factor is the cause, the leakage tends to appear 5–6 days postoperatively [95]. It was reported that postsleeve

fistulas are the most difficult to heal in comparison with those after RYGB owing to the high pressure within the stomach after SG.

The surgical option is considered to be indicated primarily when a leak appears in the immediate postoperative period and/or in patients in poor condition to tolerate them, whereas nonoperative management is indicated in cases in which the leak arises late and patients are in good general condition of health.

The use of endoscopic therapy and stenting for the management of leaks was first reported in 2006 [96]. Theoretically, endoscopic stenting is a minimally invasive technique with early ambulation, enteral feeding, more patient comfort, shorter hospital stay, and less cost. In the current study, half of the cases (n=7) were treated with combined surgical management and stents. Three (42%) cases out of the seven had symptoms of stent intolerance such as severe retrosternal heaviness, persistent hiccough and eructation, acid and biliary reflux, and intractable vomiting.

PPIs, antiemetics, stepladder analgesics, antispasmodics, calcium channel blockers, and tranquilizers can be used to relieve intolerance. Patient and family counseling and assurance can help improve patient tolerance. The prevalence of intolerance not responding to medical treatment and mandating stent removal reached up to 10–20% in some reports [97,98]. Stent migration is a costly complication associated with delayed healing and more endoscopic interventions with an estimated prevalence of 10–60% [99,100]. We had two cases of stent migration that were managed endoscopically.

Five out of the seven cases had spillover, after which three cases had to stop oral intake and to use the feeding jejunostomy tube. After stent removal, two cases developed stricture, which needed endoscopic dilatation. So, stent is a double-edged weapon, with its well established hazards.

Modifications were introduced such as endoscopic suturing, which have allowed for stents to be secured, thereby minimizing migration [101]. In this study, only one case had stent fixation by surgical suture. A new generation of specifically designed longer endoscopic stents represented a new starting point in the endoscopic management of leaks after LSG, but their clinical tolerance remained poor, imposing frequent endoscopic control and restricting their use [102,103].

Later, a new trend was adopted to use the pigtails instead stenting as a first intention of endoscopic treatment with a better quality of life for patients [104–106]. Pigtail drain was initially described by Pequignot *et al.* [105] in post-SG leaks. They claim it to be efficacious, better tolerated, requiring fewer procedures per patient, and with shorter healing time than the covered SEMS.

In our series, the only patient who experienced a chronic fistula necessitating a total gastrectomy 10 months after initial bariatric surgery was a patient who presented with leakage 14 days after SG for which UGIE was done and an internal pigtail drain was placed. The patient developed acute abdomen next day owing to pneumoperitoneum with rapid deterioration which required laparoscopic exploration. Vital signs improved with insertion of the first port and deflation of abdomen. Toilet and lavage plus feeding jejunostomy were done. The patient was discharge on the fifth postoperative day on feeding from a jejunostomy tube. On follow-up visits, the patient had 10 sets of UGIE in which pigtail was inserted and frequently replaced plus dilatation of a stricture at mid body of the sleeve. Ultimately, the leak did not stop and the patient had total gastrectomy later.

Gastric leak following LSG management must be tailored to meet several criteria: the type of leak (acute or chronic), the size of the fistulous site, and the presence of stenosis (functional or mechanical). The decision to use a specific endoscopic approach must be based on endoscopic findings [67].

Pigtail stent simultaneously drains the infected collection and acts as a foreign body, thus promoting the re-epithelialization of the mucosa defect. A systematic evaluation between 4 and 6 weeks after pig tail placement should be considered to reactivate the pigtail effect. More importantly, the replacement of the pigtail will cause additional trauma and will stimulate the formation of granulation tissue [67].

Pigtail placement should be indicated only for patients who will adhere to strict follow-up endoscopy every 7–10 days with the risk of repeated general anesthesia, so each patient should be selected wisely.

In this study, there was a single case of leakage after gastric plication that underwent SG with good outcome. Leakage from the plication line and gastric perforation following LGP were reported by multiple studies reported [107–111]. LGP is still being performed owing to its purported financial advantage over SG. A recent meta-analysis comparing 2668 patients who underwent LGP and 574 patients who underwent LSG concluded that LGP had higher rates of complications and reoperation, and less %EWL

compared with LSG. Despite modest initial cost benefit of LGP, when considering costs associated with the complications and reoperations, LSG is superior to LGP in outcome and cost-effectiveness [112].

Stenosis below the leak was documented in one case in our series with no history of stenting, for which endoscopic dilation was needed, and this may be the cause for leakage as a result of increased intraluminal pressure as described in many studies [95,113,114].

In our study, we had five cases that underwent reoperation owing to malnutrition: four of them were post-MGB cases and one was post-butterfly procedure case. This is in accordance with other studies, which reported that the most common cause (40–60%) for revision after MGB is malnutrition [115–118].

All of them are females. This can be explained by the fact that adolescents and women in reproductive age are the most vulnerable groups at risk of nutritional deficiencies [119], yet this is typical of patients seeking bariatric surgery. This female predominance undergoing reoperation for malnutritional causes was described in many studies [115,117].

Suspicion of risk of malnutrition in obese patients is a clinical challenge. This is more difficult after bariatric surgery as the reduced food intake is considered a success [120]. Malnutrition can be assessed clinically and also by some laboratory tests. In the current study, all patients presented with physical weakness, one patient presented with generalized anasarca, and one patient presented with lower limb edema. On assessing associated complications, two patients reported recurrent respiratory tract infection, one patient reported recurrent drowsiness, and all patients reported psychological depression. These variable presenting symptoms were described in many studies.

Several studies have assessed the incidence of hypoalbuminemia after bariatric surgery and most used albumin cutoff levels of 3–3.5 mg/dl [121]. In our study, the mean albumin level was 3.2 mg/dl (range, 1.9–3.7).

Most reports attribute malnutrition to excess length of the BPL in MGB. Many policies are recommended to avoid this complication, including measurement of the whole bowel length, bypass of a fixed percentage of bowel length, tailoring the BPL according to BMI, and adherence to a maximum of 150–200 cm length of BPL [122]. With biliopancreatic limb length of 200 cm, the incidence of malnutrition is 2–3% but is rapidly increasing with longer limb length. With a biliopancreatic limb length of 150 cm, the risk for malnutrition is very low [67].

In this series, two patients who presented with malnutrition had a BPL length of 200 cm and three had PBL of about 300 cm. Similarly many studies reported length of BPL of 150–300 cm based on BMI.

Ahuja *et al.* [123] published a comparative study. A total of 101 patients who underwent MGB were divided into three groups of 150, 180, and 250 cm depending on the length of BPL bypassed. The nutritional parameters (vitamin D3, vitamin B12, serum iron, serum ferritin, total protein, serum albumin, and serum globulin), anthropometric measurements (weight and BMI), and comorbidity resolution (type 2 diabetes mellitus and hypertension) were compared among the three groups at 1-year follow-up. There was a statistically significant difference in the number of patients having deficiencies in all of the nutritional parameters, except globulin, between 150 and 250-cm groups ($P<0.05$). On comparing 180 and 250-cm groups, a statistically significant difference was present in vitamin D3, vitamin B12, and total protein ($P<0.05$) only. The difference was statistically insignificant among the three groups based on type 2 diabetes mellitus, hypertension resolution, and %EWL, but TWL between 150 and180 cm and between 150 and 250 cm showed significant difference. The authors concluded a 150-cm BPL length is adequate with very minimal nutritional complications and good results. A 180-cm BPL can be used in super obese, whereas a 250-cm BPL should be used with utmost care as it results in significant nutritional deficiencies. The same consequences have been expected after secondary MGB after SG [123].

In the current study, one case reported long history of steatorrhea. Socioeconomic and financial status play a role that cannot be ignored in compliance to supplementations, healthy high-protein diet, readmissions, good hygienic standards, intensive nutritional therapy, and even in the coverage of reversal surgery [115]. In our study, 80% of patients had a low socioeconomic status and 20% had a medium socioeconomic status according to the modified Fahmy *et al.* [124] scoring system. So, if a patient cannot afford postoperative supplementations, the decision to do a bypass as a primary operation will be hazardous,

Gastric stricture (GS) is a well-recognized complication after SG with a negative effect on patients' nutritional status and quality of life. Vigorous debate exists concerning many aspects of its management [125–127]. The reported prevalence of stricture after SG is

0.1–4%; however, the actual prevalence in the community is expected to be more [125,128].

The timing of the presentation of obstructive gastric symptoms (OGSs) is crucial in the management plan [129]. The presentation can occur months to years after SG [127]. This time lag between index surgery and management usually occurs owing the attempt by patients to adjust to symptoms or seek conservative measures before the endoscopic intervention. The two cases with GS presented with OGS after 8–10 months following SG.

Many studies reported a high success rate (88–100%) after a long interval to endoscopic dilatation (5–24 months) [130–132].

Few studies recommended early laparoscopic exploration to evacuate hematomas, cut encroaching sutures, or perform gastropexy [133,134]. However, early surgical intervention is not simple, and the stricture in some cases may be transitory owing to edema or hematoma, which will resolve spontaneously [130].

Early OGSs should be managed by patient education, behavioral training, intravenous fluids, steroids, and anti-reflux therapy [135]. A recent study reported a success rate of 68.8% (11/16 patients) for medical treatment in the resolution of OGSs [134]. PBD using Achalasia balloon is the mainstay of treatment for GS not responding to medical treatment [135]. Many of the technical details are controversial, including balloon size, duration, and the number of sessions. However, early PBD is not recommended, as it may lead to the dehiscence of the staple line [134].

Recent studies present new endoscopic techniques for the management of GS such as gastric peroral endoscopic myotomy and tunneling stricturotomy [136,137]. However, the most used technique with an accepted outcome after the failure of PBD is endoscopic stenting owing to its less invasive nature with special emphasis on the possible complications of intolerance, migration, and postremoval stricture. Reoperation was recommended in cases associated with weight regain after failure of endoscopic stenting, and the operation of choice is RYGB [125,135].

However, the feasibility of RYGB is decreased dramatically after questionable surgical interventions owing to extensive adhesions and distorted anatomy. In some cases, beginning with questionable techniques ended up with total gastrectomy or even a patient with permanent feeding jejunostomy [130].

Alternative surgical techniques include seromyotomy, adhesiolysis with or without gastropexy, stricturoplasty, median gastrectomy, and circular gastro-gastrostomy. These procedure are technically demanding and associated with high morbidity and failure rate [138–140].

In the current study, we had seven cases with GS: four after VBG, two after SG, and one after GP. The mean time of presentation after index surgery was 11 months for SG, 4.6 year for GP, and 6.8 years for VBG. The first session of PBD did not improve symptoms, so the decision was to do directly RYGB.

Gastric outlet obstruction is a significant complication following VBG, with outlet stenosis rates ranging between 10 and 20% of VBG patients [141–143]. Although weight regain is the most common indication for revisional surgery, studies report that more than 30% of patients being revised from VBG in the literature were as a consequence of symptomatic outlet stenosis [3,12,141,144]. In our study, we had four cases of stricture after VBG.

For gastric stenosis after VBG, nonsurgical modalities including endoscopic dilatation are often unsuccessful [141]. Poor response to initial endoscopic dilation is an important prognostic indicator for surgical management of outlet stenosis [145,124]. Two cases in our study with stenosis after VBG underwent endoscopic dilatation with poor response, which eventually needed surgery.

Surgical revision management options include conversion to RYGB, VBG reversal by GG, and stoma revision [146]. In the current study, two cases were converted to RYGB: one of them was admitted multiple times owing to dumping syndrome, which was managed conservatively by dietary instructions and medical treatment. A single female case was reversed by doing GG, and during follow-up, she had severe GERD symptoms, which responded to medical treatment.

We had only one case that was converted to SG, although this is not commonly recommended in the literature, as the belief was that a previously failed restrictive procedure is a relative contra-indication to a repeated restrictive procedure [147]. In addition, there is a theoretical risk of increased leak rates from creating high intraluminal gastric pressures near a potential area of weakness at the site of the mesh or ring [141]. This case was discharged on the fourth postoperative day on oral fluids but developed vomiting, which required admission. OGG showed no evacuation of

contrast. The patient was discharged on her request and experienced frequent vomiting for 3 years till she had second reoperation by a senior consultant outside our center, where adhesiolysis and fixation of the sleeve was done. The patient showed excellent oral tolerance afterward.

SG is a well-known procedure with high postoperative prevalence of GERD [148–150]. In a recent study, the development of GERD appeared to be related to the sleeve stenosis and de novo hiatal hernia that occurred after primary SG [4]. At our study, we had four patients who presented with persistent GERD that proved to be intractable, that is, GERD that was nonresponsive or inadequately responsive to potent PPI therapy and all had SG as the index operation. The reoperation of choice for three of them was RYGB, which was confirmed in many studies to be effective in controlling GERD symptoms without any need for medication in 80% of the patients [54,56,57,151].

There have been many studies regarding diagnosis of GERD after SG [27–29,152–154]. However, it is difficult to evaluate which diagnostic test or tests (endoscopy, pH study, manometry, radiology, or histology) should be applied because the criteria used to diagnose GERD have differed. In our center, we usually perform endoscopy and radiology to evaluate the severity of GERD, but we regard patients' clinical history as an important evidence. This was evident in our study as only one (25%) patient had GERD in both UGIE and OGG, whereas the remaining three had GERD in one investigation only.

In the current study, all of the patients who had reoperation for GERD had achieved acceptable weight loss after their index SG at the time of presentation (%EWL at reoperation 63 ± 11.6). So, RYGB is an ideal option, as it results in minimal further weight loss, which is an added advantage, as these patients usually do not seek much further weight loss [155]. Again, this point raises doubts about the efficacy of such conversions for those converted for IWL which was previously discussed.

One of the complications of bariatric surgery is postoperative bleeding. In the literature, the reported reoperation rate ranges from 0.8 to 2.5% compared with 1% in our study, which is relatively low [156–159].

Postoperative bleeding is often self-limiting; however, occasionally it can lead to significant morbidity or mortality. In our center, we explored nine cases of reactive bleeding with no reported morbidities or mortalities.

Evidence has been found that postoperative hemoglobin and heart rate were associated with bleeding, but not systolic blood pressure (SBP) or patient characteristics [160]. In our study, tachycardia (heart rate >100) was found in all patients, so it is a good negative sign. However, low SBP less than 90 was found in five out of nine case with active hemorrhage. This could be explained by the normal physiological sequence of hypovolemic shock, which starts by tachycardia followed by lowering of SBP.

Our results show that 66.6% of cases had no active bleeding identified on reoperation, whereas only 33.3% had a definite active source of bleeding. However, exploration help in the evacuation of a hematoma may alleviate symptoms. This was shown in a recent study [161]. Moreover, in patients with intraluminal bleeding, surgical exploration help in identifying a dilated biliary limb or gastric remnant due to clots obstructing it, which may result in a staple line leak [157].

Endoscopic management is another viable option, which has been described in the management of early postoperative gastrointestinal hemorrhage, using epinephrine injection and cautery [157,162]. However, if the bleeding is more distal or if there is an intra-abdominal source as well, then the endoscopy might be less helpful. An ideal, 'hybrid' option is the combination of upper endoscopy with simultaneous laparoscopy [161]. However, this approach is not the standard practice in our institution, as laparoscopy is usually efficient and bleeding in most cases is extraluminal.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patients have given their consent for their images and other clinical information to be reported in the journal. The patient understands that his name and initials will not be published and due efforts will be made to conceal her identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Park JY, Song D, Kim YJ. Causes and outcomes of revisional bariatric surgery: initial experience at a single center. Ann Surg Treat Res 2014; 86:295–301.

2 Angrisani L, Santonicola A, Iovino P, Vitiello A, Higa K, Himpens J, *et al*. IFSO worldwide survey 2016: primary, endoluminal, and revisional procedures. Obes Surg 2018; 28:3783–3794.

3 Qiu J, Lundberg PW, Javier Birriel T, Claros L, Stoltzfus J, El Chaar M. Revisional bariatric surgery for weight regain and refractory complications

in a single MBSAQIP Accredited Center: what are we dealing with?. Obes Surg 2018; 28:2789–2795.

4 Amiki M, Seki Y, Kasama K, Hashimoto K, Kitagawa M, Umezawa A, *et al*. Revisional bariatric surgery for insufficient weight loss and gastroesophageal reflux disease: our 12-year experience. Obes Surg 2020; 30:1671–1678.

5 Keren D, Romano-Zelekha O, Rainis T, Sakran N. Revisional bariatric surgery in Israel: findings from the Israeli Bariatric Surgery Registry. 2019 Available at: https://doi.org/10.1007/s11695-019-04018-9. [Accessed date 24 June 2019]

6 Inabnet 3rdWB, Belle SH, Bessler M, Courcoulas A, Dellinger P, Garcia L, *et al*. Comparison of 30-day outcomes after non-LapBand primary and revisional bariatric surgical procedures from the Longitudinal Assessment of Bariatric Surgery study. Surg Obes Relat Dis 2010; 6:22–30.

7 Brethauer SA, Kothari S, Sudan R, Williams B, English WJ, Brengman M, *et al*. Systematic review on reoperative bariatric surgery: American society for metabolic and bariatric surgery revision task force. Surg Obes Relat Dis 2014; 10:952–972.

8 merriam-webster. No Title [Internet]. 2022. Available at: https://www.merriam-webster.com/. [Accessed date 24 June 2022].

9 Al-Khyatt W, Ryall R, Leeder P, Ahmed J, Awad S. Predictors of inadequate weight loss after laparoscopic gastric bypass for morbid obesity. Obes Surg 2017; 27:1446–1452.

10 Baig SJ, Priya P, Mahawar KK, Shah S. Weight regain after bariatric surgery—a multicentre study of 9617 patients from indian bariatric surgery outcome reporting group. Obes Surg 2019; 29:1583–1592.

11 Carmeli I, Golomb I, Sadot E, Kashtan H, Keidar A. Laparoscopic conversion of sleeve gastrectomy to a biliopancreatic diversion with duodenal switch or a Roux-en-Y gastric bypass due to weight loss failure: our algorithm. Surg Obes Relat Dis 2015; 11:79–85.

12 Kiriakopoulos A, Kounatidis N, Menenakos I, Kostrova M, Zografos K, Menenakos E. Non-stenting treatment versus endoscopic stent placement in staple line leaks after laparoscopic sleeve gastrectomy. Langenbeck's Arch Surg 2022; 2022:25.

13 Yadlapati R, DeLay K. Proton pump inhibitor-refractory gastroesophageal reflux disease. Med Clin North Am 2019; 103:15–27.

14 Brethauer SA, Kim J, el Chaar M, Papasavas P, Eisenberg D, Rogers A, *et al*. Standardized outcomes reporting in metabolic and bariatric surgery. Surg Obes Relat Dis 2015; 11:489–506.

15 Al Abdulmohsin SA, Coons S, Draugalis JR, Hays RD. Translation of the RAND 36-ITEM Health Survey 1.0 (aka SF-36) into Arabic [Internet]. Santa Monica, CA: RAND Corporation PP – Santa Monica, CA; 1997.

16 English WJ, DeMaria EJ, Hutter MM, Kothari SN, Mattar SG, Brethauer SA, *et al*. American Society for Metabolic and Bariatric Surgery 2018 estimate of metabolic and bariatric procedures performed in the United States. Surg Obes Relat Dis 2020; 4:457–463.

17 Mor A, Keenan E, Portenier D, Torquati A. Case-matched analysis comparing outcomes of revisional versus primary laparoscopic Roux-en-Y gastric bypass. Surg Endosc 2013; 27:548–552.

18 Jennings NA, Boyle M, Mahawar K, Balupuri S, Small PK. Revisional laparoscopic Roux-en-Y gastric bypass following failed laparoscopic adjustable gastric banding. 2013. 2018; 14:52–57. doi: 10.4103/jmas.JMAS_11_17.

19 Radtka JF, Puleo FJ, Wang L, Cooney RN. Revisional bariatric surgery: who, what, where, and when?. Surg Obes Relat Dis 2010; 6:635–642.

20 Mahawar KK, Graham Y, Carr WRJ, Jennings N, Schroeder N, Balupuri S, *et al*. Revisional Roux-en-Y gastric bypass and sleeve gastrectomy: a systematic review of comparative outcomes with respective primary procedures. Obes Surg 2015; 25:1271–1280.

21 Sudan R, Nguyen NT, Hutter MM, Brethauer SA, Ponce J, Morton JM. 2014 SSAT plenary presentation. 2014;19.

22 Mor A, Sharp L, Portenier D, Sudan R, Torquati A. Weight loss at first postoperative visit predicts long-term outcome of Roux-en-Y gastric bypass using Duke weight loss surgery chart. Surg Obes Relat Dis 2012; 8:556–560.

23 Vallois A, Menahem B, Le Roux Y, Lee Bion A, Meunier H, Gautier T, *et al*. Revisional Roux-en-Y gastric bypass: a safe surgical opportunity? Results of a case-matched study. Obes Surg 2019; 29:903–910.

24 Keren D, Romano-Zelekha O, Rainis T, Sakran N. Revisional bariatric surgery in israel: findings from the Israeli Bariatric Surgery Registry. Obes Surg 2019; 29:3514–3522.

25 Ogle SB, Dewberry LC, Jenkins TM, Inge TH, Kelsey M, Bruzoni M, *et al*. Outcomes of bariatric surgery in older versus younger adolescents. Pediatrics 2021; 147:2020024182.

26 Super J, Charalampakis V, Tahrani AA, Kumar S, Bankenahally R, Raghuraman G, *et al*. Safety and feasibility of revisional bariatric surgery following Laparoscopic Adjustable Gastric Band – outcomes from a large UK private practice. Obes Res Clin Pract 2021; 15:381–386.

27 Mahawar KK, Jennings N, Brown J, Gupta A, Balupuri S, Small PK. 'Mini' gastric bypass: systematic review of a controversial procedure. Obes Surg 2013; 23:1890–1898.

28 Lauti M, Kularatna M, Hill AG, MacCormick AD. Weight regain following sleeve gastrectomy—a systematic review. Obes Surg 2016; 26:1326–1334.

29 Noel P, Nedelcu M, Nocca D, Schneck A-S., Gugenheim J, Iannelli A, *et al*. Revised sleeve gastrectomy: another option for weight loss failure after sleeve gastrectomy. Surg Endosc 2014; 28:1096–1102.

30 Braghetto I, Csendes A, Lanzarini E, Papapietro K, Cárcamo C, Molina JC. Is laparoscopic sleeve gastrectomy an acceptable primary bariatric procedure in obese patients? Early and 5-year postoperative results. Surg Laparosc Endosc Percutan Tech 2012; 22:479–486.

31 Bhandari M, Khurana M, Fobi MAL. Weight regain after bariatric metabolic surgery. Manag Nutr Metab Complicat Bariatr Surg 2021; 313–327

32 Obeidat F, Shanti H, Mismar A, Albsoul N, Al-Qudah M. The magnitude of antral resection in laparoscopic sleeve gastrectomy and its relationship to excess weight loss. Obes Surg 2015; 25:1928–1932.

33 Abd Ellatif ME, Abdallah E, Askar W, Thabet W, Aboushady M, Abbas AE, *et al*. Long term predictors of success after laparoscopic sleeve gastrectomy. Int J Surg 2014; 12:504–508.

34 Denneval A, Chalumeau C, Iceta S, Pelascini E, Disse E, Robert M. Revision of Mason's procedure (vertical banded gastroplasty) to Roux-en-Y gastric bypass: role of an associated fundectomy in weight loss outcomes. Surg Obes Relat Dis 2021; 17:870–877.

35 Athanasiadis DI, Monfared S, Choi JN, Selzer D, Banerjee A, Stefanidis D. Vertical banded gastroplasty revision to gastric bypass leads to effective weight loss and comorbidity and dysphagia symptom resolution. Obes Surg 2020; 30:3453–3458.

36 Brethauer SA, Nfonsam V, Sherman V, Udomsawaengsup S, Schauer PR, Chand B. Endoscopy and upper gastrointestinal contrast studies are complementary in evaluation of weight regain after bariatric surgery. Surg Obes Relat Dis 2006; 2:643–648.

37 Stefanidis D, Kuwada TS, Gersin KS. The importance of the length of the limbs for gastric bypass patients—an evidence-based review. Obes Surg 2011; 21:119–124.

38 Topart P, Becouarn G, Ritz P. Pouch size after gastric bypass does not correlate with weight loss outcome. Obes Surg 2011; 21:1350–1354.

39 Cucchi SGD, Pories WJ, MacDonald KG, Morgan EJ. Gastrogastric fistulas a complication of divided gastric bypass surgery. Ann Surg 1995; 221:387–391.

40 Sarela AI, Dexter SPL, O'Kane M, Menon A, McMahon MJ. Long-term follow-up after laparoscopic sleeve gastrectomy: 8-9-year results. Surg Obes Relat Dis 2012; 8:679–684.

41 Lombardo M, Bellia A, Mattiuzzo F, Franchi A, Ferri C, Elvira P, *et al*. Frequent follow-up visits reduce weight regain in long-term management after bariatric surgery. Bariatr Surg Pract Patient Care 2015; 10:119–125.

42 Cavin J-B., Voitellier E, Cluzeaud F, Kapel N, Marmuse J-P, Chevallier J-M, *et al*. Malabsorption and intestinal adaptation after one anastomosis gastric bypass compared with Roux-en-Y gastric bypass in rats. Am J Physiol Liver Physiol 2016; 311:G492–G500.

43 Bruzzi M, Voron T, Zinzindohoue F, Berger A, Douard R, Chevallier J-M. Revisional single-anastomosis gastric bypass for a failed restrictive procedure: 5-year results. Surg Obes Relat Dis 2016; 12:240–245.

44 Chiappetta S, Stier C, Scheffel O, Squillante S, Weiner RA. Mini/one anastomosis gastric bypass versus Roux-en-Y gastric bypass as a second step procedure after sleeve gastrectomy—a retrospective cohort study. Obes Surg 2019; 29:819–827.

45 Disse E, Pasquer A, Espalieu P, Poncet G, Gouillat C, Robert M. Greater weight loss with the omega loop bypass compared to the Roux-en-Y gastric bypass: a comparative study. Obes Surg 2014; 24:841–846.

46 Kermansaravi M, Shahab Shahmiri S, Amir Davarpanahjazi H, Valizadeh R, *et al*. One anastomosis/mini-gastric bypass (OAGB/MGB) as revisional surgery following primary restrictive bariatric procedures: a systematic review and meta-analysis. 2020; Available at: https://doi.org/10.1007/s11695-020-05079-x. [Accessed date 24 June 2020].

47 Carbajo MA, Luque-de-León E, Jiménez JM, Ortiz-de-Solórzano J, Pérez-Miranda M, Castro-Alija MJ. Laparoscopic one-anastomosis gastric bypass: technique, results, and long-term follow-up in 1200 patients. Obes Surg 2017; 27:1153–1167.

48 AlSabah S, Al Haddad E, Al-Subaie S, Ekrouf S, Alenezi K, Almulla A, *et al*. Short-term results of revisional single-anastomosis gastric bypass after sleeve gastrectomy for weight regain. Obes Surg 2018; 28:2197–2202.

49 Bhandari M, Humes T, Kosta S, Bhandari M, Mathur W, Salvi P, *et al*. Revision operation to one-anastomosis gastric bypass for failed sleeve gastrectomy. Surg Obes Relat Dis 2019; 15:2033–2037.

50 Debs T, Petrucciani N, Kassir R, Juglard G, Gugenheim J, Iannelli A, *et al*. Laparoscopic conversion of sleeve gastrectomy to one anastomosis gastric bypass for weight loss failure: mid-term results. Obes Surg 2020; 30:2259–2265.

51 Keleidari B, Mahmoudieh M, Shahabi S, Sheikhbahaei E, Rezaei M, Sayadi M, *et al*. Reversing one-anastomosis gastric bypass surgery due to severe and refractory hypoalbuminemia. World J Surg 2020; 44:1200–1208.

52 Mahmoudieh M, Keleidari B, Afshin N, Sayadi Shahraki M, Shahabi Shahmiri S, Sheikhbahaei E, *et al*. The early results of the laparoscopic mini-gastric bypass/one anastomosis gastric bypass on patients with different body mass index. J Obes 2020; 2020:7572153.

53 Ohta M, Seki Y, Wong SKH, Wang C, Huang CK, Aly A, *et al*. Bariatric/metabolic surgery in the Asia-Pacific region: APMBSS 2018 Survey. Obes Surg 2019; 29:534–541.

54 Gautier T, Sarcher T, Contival N, Le Roux Y, Alves A. Indications and mid-term results of conversion from sleeve gastrectomy to Roux-en-Y gastric bypass. Obes Surg 2013; 23:212–215.

55 Homan J, Betzel B, Aarts EO, Van Laarhoven KJHM, Janssen IMC, Berends FJ. Secondary surgery after sleeve gastrectomy: Roux-en-Y gastric bypass or biliopancreatic diversion with duodenal switch. Surg Obes Relat Dis 2015; 11:771–777.

56 Langer FB, Bohdjalian A, Shakeri-Leidenmühler S, Schoppmann SF, Zacherl J, Prager G. Conversion from sleeve gastrectomy to Roux-en-Y gastric bypass—indications and outcome. Obes Surg 2010; 20:835–840.

57 Abdemur A, Han SM, Lo Menzo E, Szomstein S, Rosenthal R. Reasons and outcomes of conversion of laparoscopic sleeve gastrectomy to Roux-en-Y gastric bypass for nonresponders. Surg Obes Relat Dis 2016; 12:113–118.

58 Parikh A, Alley JB, Peterson RM, Harnisch MC, Pfluke JM, Tapper DM, *et al*. Management options for symptomatic stenosis after laparoscopic vertical sleeve gastrectomy in the morbidly obese. Surg Endosc 2012; 26:738–746.

59 Nepogodiev D, Omar OM, Glasbey JC, Li E, Simoes JFF, Abbott TEF, *et al*. Elective surgery cancellations due to the COVID-19 pandemic: global predictive modelling to inform surgical recovery plans. Br J Surg 2020; 107:1440–1449.

60 Moon RC, Shah N, Teixeira AF, Jawad MA. Management of staple line leaks following sleeve gastrectomy. Surg Obes Relat Dis 2015; 11:54–59.

61 Bellorin O, Lieb J, Szomstein S, Rosenthal RJ. Laparoscopic conversion of sleeve gastrectomy to Roux-en-Y gastric bypass for acute gastric outlet obstruction after laparoscopic sleeve gastrectomy for morbid obesity. Surg Obes Relat Dis 2010; 6:566–568.

62 Cheung D, Switzer NJ, Gill RS, Shi X, Karmali S. Revisional bariatric surgery following failed primary laparoscopic sleeve gastrectomy: a systematic review. Obes Surg 2014; 24:1757–1763.

63 Yeung KTD, Penney N, Ashrafian L, Darzi A, Ashrafian H. Does sleeve gastrectomy expose the distal esophagus to severe reflux?. Ann Surg 2020; 271:257–265.

64 El Khoury L, Benvenga R, Romero R, Cohen R, Roussel J, Catheline J-M. Esophageal adenocarcinoma in Barrett's esophagus after sleeve gastrectomy: case report and literature review. Int J Surg Case Rep 2018; 52:132–136.

65 Sebastianelli L, Benois M, Vanbiervliet G, Bailly L, Robert M, Turrin N, *et al*. Systematic endoscopy 5 years after sleeve gastrectomy results in a high rate of barrett's esophagus: results of a multicenter study. Obes Surg 2019; 29:1462–1469.

66 Matar R, Monzer N, Jaruvongvanich V, Abusaleh R, Vargas EJ, Maselli DB, *et al*. Indications and outcomes of conversion of sleeve gastrectomy to roux-en-y gastric bypass: a systematic review and a meta-analysis. Obes Surg 2021; 31:3936–3946.

67 Cardoso MGAR, Nocca MPPND, Editors. The perfect sleeve gastrectomy. in: the perfect sleeve gastrectomy. 1st ed. Springer International Publishing 2020.

68 Kothari SN, Borgert AJ, Kallies KJ, Baker MT, Grover BT. Long-term (>10-year) outcomes after laparoscopic Roux-en-Y gastric bypass. Surg Obes Relat Dis 2017; 13:972–978.

69 Sheikh L, Pearless LA, Booth MW. Laparoscopic silastic ring mini-gastric bypass (SR-MGBP): up to 11-year results from a single centre. Obes Surg [Internet] 2017; 27:2229–2234.

70 Ruiz-Tovar J, Carbajo MA, Jimenez JM, Castro MJ, Gonzalez G, Ortiz-de-Solorzano J, *et al*. Long-term follow-up after sleeve gastrectomy versus Roux-en-Y gastric bypass versus one-anastomosis gastric bypass: a prospective randomized comparative study of weight loss and remission of comorbidities. Surg Endosc 2019; 33:401–410.

71 Lee W-J., Yu P-J., Wang W, Chen T-C., Wei P-L., Huang M-T. Laparoscopic Roux-en-Y versus mini-gastric bypass for the treatment of morbid obesity. Ann Surg 2005; 242:20–28.

72 Robert M, Espalieu P, Pelascini E, Caiazzo R, Sterkers A, Khamphommala L, *et al*. Efficacy and safety of one anastomosis gastric bypass versus Roux-en-Y gastric bypass for obesity (YOMEGA): a multicentre, randomised, open-label, non-inferiority trial. Lancet 2019; 393:1299–1309.

73 AlSabah S, Alsharqawi N, Almulla A, Akrof S, Alenezi K, Buhaimed W, *et al*. Approach to poor weight loss after laparoscopic sleeve gastrectomy: re-sleeve vs. gastric bypass. Obes Surg 2016; 26:2302–2307.

74 Noel P, dbali IE, Nedelcu M. Revisional surgery: sleeve to resleeve. Laparosc Sleeve Gastrectomy [Internet] 2021; 2021:551–557.

75 Khaitan L, Van Sickle K, Gonzalez R, Lin E, Ramshaw B, Daniel Smith C. Laparoscopic Revision of Bariatric Procedures: Is It Feasible? 2005; 71:6–10; discussion 10-2

76 Ortega J, Sala C, Flor B, Jiménez E, Escudero MD, Martinez-Valls J, *et al*. Vertical banded gastroplasty converted to Roux-en-Y gastric bypass: little impact on nutritional status after 5-year follow-up. Obes Surg 2004; 14:638–643.

77 Suter M, Giusti V, Héraief E, Calmes JM. Band erosion after laparoscopic gastric banding: occurrence and results after conversion to Roux-en-Y gastric bypass. Obes Surg 2004; 14:381–386.

78 Gonzalez R, Gallagher SF, Haines K, Murr MM. Operative technique for converting a failed vertical banded gastroplasty to Roux-en-Y gastric bypass. J Am Coll Surg 2005; 201:366–374.

79 Gagné DJ, Dovec E, Urbandt JE. Laparoscopic revision of vertical banded gastroplasty to Roux-en-Y gastric bypass: outcomes of 105 patients. Surg Obes Relat Dis 2011; 7:493–499.

80 Velotti N, Vitiello A, Berardi G, Di Lauro K, Musella M. Roux-en-Y gastric bypass versus one anastomosis-mini gastric bypass as a rescue procedure following failed restrictive bariatric surgery. A systematic review of literature with metanalysis. Updates Surg 2021; 73:639–647

81 Mohamed R, Abdelaziz M, Khalil M, Gowied M. outcome of mini gastric bypass after failed vertical band gastroplasty in treatment of morbid obese patients. Ain Shams Med J 2021; 72:517–532.

82 Salama TMS, Sabry K. Redo surgery after failed open VBG: laparoscopic minigastric bypass versus laparoscopic roux en y gastric bypass – which is better? Minim Invasive Surg 2016; 2016:8737519.

83 Felsenreich DM, Langer FB, Bichler C, Kristo I, Jedamzik J, Eilenberg M, *et al*. Surgical therapy of weight regain after Roux-en-Y gastric bypass. Surg Obes Relat Dis 2019; 15:1719–1728.

84 Colquitt JL, Picot J, Loveman E, Clegg AJ. Surgery for obesity. In: Colquitt JL, editor. Cochrane Database of Systematic Reviews [Internet]. Chichester, UK: John Wiley BT & Sons, Ltd 2009.

85 Birkmeyer NJO, Dimick JB, Share D, Hawasli A, English WJ, Genaw J, *et al*. Hospital complication rates with bariatric surgery in Michigan. JAMA 2010; 304:435–442.

86 Brethauer SA, Hammel JP, Schauer PR. Systematic review of sleeve gastrectomy as staging and primary bariatric procedure. Surg Obes Relat Dis 2009; 5:469–475.

87 Spaniolas K, Yang J, Zhu C, Maria A, Bates AT, Docimo S, *et al*. Conversion of adjustable gastric banding to stapling bariatric procedures. Ann Surg 2021; 273:542–547.

88 Spaniolas K, Bates AT, Docimo S, Obeid NR, Talamini MA, Pryor AD. Single stage conversion from adjustable gastric banding to sleeve gastrectomy or Roux-en-Y gastric bypass: an analysis of 4875 patients. Surg Obes Relat Dis 2017; 13:1880–1884.

89 Yeung L, Durkan B, Barrett A, Kraft C, Vu K, Phillips E, *et al*. Single-stage revision from gastric band to gastric bypass or sleeve gastrectomy: 6 - and 12-month outcomes. Surg Endosc 2016; 30:2244–2250.

90 Moon RC, Teixeira AF, Jawad MA. Conversion of failed laparoscopic adjustable gastric banding: sleeve gastrectomy or Roux-en-Y gastric bypass?. Surg Obes Relat Dis 2013; 9:901–907.

91 Dang JT, Switzer NJ, Wu J, Gill RS, Shi X, Thereaux J, *et al*. Gastric band removal in revisional bariatric surgery, one-step versus two-step: a systematic review and meta-analysis. Obes Surg 2016; 26:866–873.

92 Rosenthal RJ. International Sleeve Gastrectomy Expert Panel Consensus Statement: best practice guidelines based on experience of >12,000 cases. Surg Obes Relat Dis 2012; 8:8–19.

93 Hamed H, Said M, Elghadban H, Elgeidie A. Outcome and adverse events of endoscopic bariatric stents for management of leakage after bariatric surgery. Obes Surg 2020; 30:982–991.

94 Jung JJ, Jackson T, Gordon L, Hutter MM. Intraoperative leak test is associated with lower postoperative bleed rate in primary sleeve gastrectomy: a propensity matched analysis of primary and revision bariatric surgery using the MBSAQIP database. Surg Endosc 2022; 36:753–763.

95 Balagué C, Ruiz de Adana JC, Ibarzabal A, Del Castillo D, Puche JJ, Vilallonga R. Insights into the treatment of postsleeve gastrectomy leak: analysis of the results of 105 cases on a national register. Surg Obes Relat Dis 2021; 17:36–43.

96 Fukumoto R, Orlina J, McGinty J, Teixeira J. Use of Polyflex Stents in treatment of acute esophageal and gastric leaks after bariatric surgery. Surg Obes Relat Dis 2007; 3:68–72.

97 Shehab H, Abdallah E, Gawdat K, Elattar I. Large bariatric-specific stents and over-the-scope clips in the management of post-bariatric surgery leaks. Obes Surg 2018; 28:15–24.

98 Chang J, Sharma G, Boules M, Brethauer S, Rodriguez J, Kroh MD. Endoscopic stents in the management of anastomotic complications after foregut surgery: new applications and techniques. Surg Obes Relat Dis 2016; 12:1373–1381.

99 Okazaki O, Bernardo WM, Brunaldi VO, Junior CC, de C, Minata MK, *et al*. Efficacy and safety of stents in the treatment of fistula after bariatric surgery: a systematic review and meta-analysis. Obes Surg [Internet] 2018; 28:1788–1796.

100 Wilcox VT, Huang AY, Tariq N, Dunkin BJ. Endoscopic suture fixation of self-expanding metallic stents with and without submucosal injection. Surg Endosc [Internet] 2015; 29:24–29.

101 Krishnan V, Hutchings K, Godwin A, Wong JT, Teixeira J. Long-term outcomes following endoscopic stenting in the management of leaks after foregut and bariatric surgery. Surg Endosc 2019; 33:2691–2695.

102 Garofalo F, Noreau-Nguyen M, Denis R, Atlas H, Garneau P, Pescarus R. Evolution of endoscopic treatment of sleeve gastrectomy leaks: from partial covered to long, fully covered stents. Surg Obes Relat Dis 2017; 13:925–932.

103 D Moura EMMN. Outcomes of a novel bariatric stent in the management of sleeve gastrectomy leaks: a multicenter study. Surg Obes Relat Dis 2019; 15:124151.

104 Giuliani A, Romano L, Marchese M, Necozione S, Cianca G, Schietroma M, *et al*. Gastric leak after laparoscopic sleeve gastrectomy: management with endoscopic double pigtail drainage. A systemativ review. Surg Obes Relat Dis 2019; 15:1014–1019.

105 Pequignot A, Fuks D, Verhaeghe P, Dhahri A, Brehant O, Bartoli E, *et al*. Is there a place for pigtail drains in the management of gastric leaks after laparoscopic sleeve gastrectomy?. Obes Surg [Internet] 2012; 22:712–720.

106 Donatelli G, Dumont JL, Cereatti F, Ferretti S, Vergeau BM, Tuszynski T, *et al*. Treatment of leaks following sleeve gastrectomy by endoscopic internal drainage (EID). Obes Surg 2015; 25:1293–1301.

107 Atlas H, Yazbek T, Garneau PY, Safa N, Denis R. Is there a future for laparoscopic gastric greater curvature plication (LGGCP)? A review of 44 patients. Obes Surg 2013; 23:1397–1403.

108 M Buzga PHZSPZ. Laparoscopic gastric plication and its effect on saccharide and lipid metabolism: a 12-month prospective study. Wideochir Inne Tech Maloinwazyjne 2015; 10:398–405.

109 Doležalova-Kormanova K, Buchwald JN, Skochova D, Pichlerova D, McGlennon TW, Fried M. Five-year outcomes: laparoscopic greater curvature plication for treatment of morbid obesity. Obes Surg 2017; 27:2818–2828.

110 Talebpour M, Motamedi SMK, Talebpour A, Vahidi H. Twelve year experience of laparoscopic gastric plication in morbid obesity: development of the technique and patient outcomes. Ann Surg Innov Res 2012; 6:7.

111 Skrekas G, Antiochos K, Stafyla VK. Laparoscopic gastric greater curvature plication: results and complications in a series of 135 patients. Obes Surg 2011; 21:1657–1663.

112 Suarez DF, Gangemi A. How Bad Is 'Bad'? A cost consideration and review of laparoscopic gastric plication versus laparoscopic sleeve gastrectomy. Obes Surg 2021; 31:307–316.

113 Csendes A, Braghetto I, León P, Burgos AM. Management of leaks after laparoscopic sleeve gastrectomy in patients with obesity. J Gastrointest Surg [Internet] 2010; 14:1343–1348.

114 Yehoshua RT, Eidelman LA, Stein M, Fichman S, Mazor A, Chen J, *et al*. Laparoscopic sleeve gastrectomy—volume and pressure assessment. Obes Surg 2008; 18:1083.

115 Elgeidie A, Abou El-Magd E, Elghadban H, Abdelgawad M, Hamed H. Protein Energy malnutrition after one-anastomosis gastric bypass with a biliopancreatic limb ≤200 cm: a case series. J Laparoendosc Adv Surg Tech 2020; 30:1320–1328.

116 Genser L, Soprani A, Tabbara M, Siksik J-M., Cady J, Carandina S. Laparoscopic reversal of mini-gastric bypass to original anatomy for severe postoperative malnutrition. Langenbeck's Arch Surg [Internet] 2017; 402:1263–1270.

117 Khalaj A, Kalantar Motamedi MA, Mousapour P, Valizadeh M, Barzin M. Protein-calorie malnutrition requiring revisional surgery after one-anastomosis-mini-gastric bypass (OAGB-MGB): case series from the Tehran Obesity Treatment Study (TOTS). Obes Surg 2019; 29:1714–1720.

118 Alkhalifah N, Lee W-J., Hai TC, Ser K-H, Chen J-C, Wu C-C. 15-year experience of laparoscopic single anastomosis (mini-)gastric bypass: comparison with other bariatric procedures. Surg Endosc [Internet] 2018; 32:3024–3031.

119 Alvarez-Leite J. Nutrient deficiencies secondary to bariatric surgery. Curr Opin Clin Nutr Metab Care 2004; 7:569–575.

120 Admiraal WM, Celik F, Gerdes VE, Dallal RM, Hoekstra JB, Holleman F. Ethnic differences in weight loss and diabetes remission after bariatric surgery. Diabetes Care 2012; 35:1951–1958.

121 Kuin C, den Ouden F, Brandts H, Deden L, Hazebroek E, van Borren M, *et al*. Treatment of severe protein malnutrition after bariatric surgery. Obes Surg 2019; 29:3095–3102.

122 Dang H, Arias E, Szomstein S, Rosenthal R. Laparoscopic conversion of distal mini-gastric bypass to proximal Roux-en-Y gastric bypass for malnutrition: case report and review of the literature. Surg Obes Relat Dis 2009; 5:383–386.

123 Ahuja A, Tantia O, Goyal G, Chaudhuri T, Khanna S, Poddar A, *et al*. MGB-OAGB: effect of biliopancreatic limb length on nutritional deficiency, weight loss, and comorbidity resolution. Obes Surg [Internet] 2018; 28:3439–3445.

124 Fahmy SI, Nofal LM, Shehata SF, El Kady HM, Ibrahim HK. Updating indicators for scaling the socioeconomic level of families for health research. J Egypt Public Health Assoc 2015; 90:1–7.

125 Chang SH, Popov VB, Thompson CC. Endoscopic balloon dilation for treatment of sleeve gastrectomy stenosis: a systematic review and meta-analysis. Gastrointest Endosc 2020; 91:989–1002.

126 Deslauriers V, Beauchamp A, Garofalo F, Atlas H, Denis R, Garneau P, *et al*. Endoscopic management of post-laparoscopic sleeve gastrectomy stenosis. Surg Endosc 2018; 32:601–609.

127 Brunaldi VO, Galvao Neto M, Zundel N, Abu Dayyeh BK. Isolated sleeve gastrectomy stricture: a systematic review on reporting, workup, and treatment. Surg Obes Relat Dis 2020; 16:955–966.

128 Aryaie AH, Singer JL, Fayezizadeh M, Lash J, Marks JM. Efficacy of endoscopic management of leak after foregut surgery with endoscopic covered self-expanding metal stents (SEMS). Surg Endosc 2017; 31:612–617.

129 Manos T, Nedelcu M, Cotirlet A, Eddbali I, Gagner M, Noel P. How to treat stenosis after sleeve gastrectomy? Surg Obes Relat Dis 2017; 13:150–154.

130 Dhorepatil AS, Cottam D, Surve A, Medlin W, Zaveri H, Richards C, *et al*. Is pneumatic balloon dilation safe and effective primary modality of treatment for post-sleeve gastrectomy strictures? A retrospective study. BMC Surg 2018; 18:52–58.

131 Ogra R, Kini GP. Evolving endoscopic management options for symptomatic stenosis post-laparoscopic sleeve gastrectomy for morbid obesity: experience at a large bariatric surgery unit in New Zealand. Obes Surg 2015; 25:242–248.

132 Agnihotri A, Barola S, Hill C, Neto MG, Campos J, Singh VK, *et al*. An algorithmic approach to the management of gastric stenosis following laparoscopic sleeve gastrectomy. Obes Surg 2017; 27:2628–2636.

133 Zundel N, Hernandez JD, Neto MG, Campos J. Strictures after laparoscopic sleeve gastrectomy. Surg Laparosc Endosc Percutan Tech 2010; 20:154–158.

134 Binda A, Jaworski P, Tarnowski W. Stenosis after sleeve gastrectomy: cause, diagnosis, and management strategy. Pol Przegl Chir 2013; 85:730–736.

135 Hamed H, Elghadban H, Ezzat H, Attia M, Sanad A, El Sorogy M. Gastric stenosis after sleeve gastrectomy: an algorithm for management. Obes Surg 2020; 30:4785–4793.

136 De Moura EGH, de Moura DTH, Sakai CM, Sagae V, Neto ACM, Thompson CC. Endoscopic tunneled stricturotomy with full-thickness dissection in the management of a sleeve gastrectomy stenosis. Obes Surg 2019; 29:2711–2712.

137 Farha J, Fayad L, Kadhim A, Şimşek C, Badurdeen DS, Ichkhanian Y, *et al*. Gastric per-oral endoscopic myotomy (G-POEM) for the treatment of gastric stenosis post-laparoscopic sleeve gastrectomy (LSG). Obes Surg 2019; 29:2350–2354.

138 Vilallonga R, Himpens J, Van De Vrande S. Laparoscopic management of persistent strictures after laparoscopic sleeve gastrectomy. Obes Surg 2013; 23:1655–1661.

139 Turcu F, Balahura C, Doras I, Constantin A, Copaescu C. Symptomatic stenosis after laparoscopic sleeve gastrectomy – incidence and management in a high-volume bariatric surgery center. Chirurgia (Bucur) 2018; 113:826–836.

140 Kalaiselvan R, Ammori BJ. Laparoscopic median gastrectomy for stenosis following sleeve gastrectomy. Surg Obes Relat Dis 2015; 11:474–477.

141 Vasas P, Dillemans B, Van Cauwenberge S, De Visschere M, Vercauteren C. Short- and long-term outcomes of vertical banded gastroplasty converted to Roux-en-Y gastric bypass. Obes Surg [Internet] 2013; 23:241–248.

142 Suter M, Jayet C, Jayet A. Vertical banded gastroplasty: long-term results comparing three different techniques. Obes Surg 2000; 10:41–46.

143 van Wezenbeek MR, Smulders JF, de Zoete JPJGM, Luyer MD, van Montfort G, Nienhuijs SW. Long-term results of primary vertical banded gastroplasty. Obes Surg [Internet] 2015; 25:1425–1430.

144 Foletto M, Prevedello L, Bernante P, Luca B, Vettor R, Francini-Pesenti F, *et al*. Sleeve gastrectomy as revisional procedure for failed gastric banding or gastroplasty. Surg Obes Relat Dis 2010; 6:146–151.

145 Holt PD, de Lange EE, Shaffer HA. Strictures after gastric surgery: treatment with fluoroscopically guided balloon dilatation. Am J Roentgenol 1995; 164:895–899.

146 Thoreson R, Cullen JJ. Indications and Results of Reversal of Vertical Banded Gastroplasty (VBG). J Gastrointest Surg [Internet] 2008; 12:2032–2036. Available from: http://link.springer.com/10.1007/s11605-008-0658-9

147 Elazary R, Hazzan D, Appelbaum L, Rivkind AI, Keidar A. Feasibility of sleeve gastrectomy as a revision operation for failed silastic ring vertical gastroplasty. Obes Surg [Internet] 2009; 19:645–649.

148 Carter PR, Leblanc KA, Hausmann MG, Kleinpeter KP, Debarros SN, Jones SM. Association between gastroesophageal reflux disease and laparoscopic sleeve gastrectomy. Surg Obes Relat Dis 2011; 7:569–572.

149 DuPree CE, Blair K, Steele SR, Martin MJ. Laparoscopic sleeve gastrectomy in patients with preexisting gastroesophageal reflux disease: a national analysis. JAMA Surg 2014; 149:328–334.

150 Nocca D, Loureiro M, Skalli EM, Nedelcu M, Jaussent A, Deloze M, *et al*. Five-year results of laparoscopic sleeve gastrectomy for the treatment of severe obesity. Surg Endosc 2017; 31:3251–3257.

151 Van Rutte PWJ, Smulders JF, De Zoete JP, Nienhuijs SW. Indications and short-term outcomes of revisional surgery after failed or complicated sleeve gastrectomy. Obes Surg 2012; 22:1903–1908.

152 Mandeville Y, Van Looveren R, Vancoillie PJ, Verbeke X, Vandendriessche K, Vuylsteke P, *et al*. Moderating the enthusiasm of sleeve gastrectomy: up to fifty percent of reflux symptoms after ten years in a consecutive series of one hundred laparoscopic sleeve gastrectomies. Obes Surg 2017; 27:1797–1803.

153 Burgerhart JS, Schotborgh CAI, Schoon EJ, Smulders JF, Van De Meeberg PC, Siersema PD, *et al*. Effect of sleeve gastrectomy on gastroesophageal reflux. Obes Surg 2014; 9:1436–1441.

154 Mion F, Tolone S, Garros A, Savarino E, Pelascini E, Robert M, *et al*. High-resolution impedance manometry after sleeve gastrectomy: increased intragastric pressure and reflux are frequent events. Obes Surg 2016; 10:2449–2456.

155 Parmar CD, Mahawar KK, Boyle M, Schroeder N, Balupuri S, Small PK. Conversion of sleeve gastrectomy to Roux-en-Y gastric bypass is effective for gastro-oesophageal reflux disease but not for further weight loss. Obes Surg 2017; 27:1651–1658.

156 Bellorin O, Abdemur A, Sucandy I, Szomstein S, Rosenthal RJ. Understanding the significance, reasons and patterns of abnormal vital signs after gastric bypass for morbid obesity. Obes Surg 2011; 21:707–713.

157 Dick A, Byrne TK, Baker M, Budak A, Morgan K. Gastrointestinal bleeding after gastric bypass surgery: nuisance or catastrophe?. Surg Obes Relat Dis 2010; 6:643–647.

158 Kitahama S, Smith MD, Rosencrantz DR, Patterson EJ. Is bariatric surgery safe in patients who refuse blood transfusion? Surg Obes Relat Dis 2013; 9:390–394.

159 Augustin T, Aminian A, Romero-Talamás H, Rogula T, Schauer PR, Brethauer SA. Reoperative surgery for management of early complications after gastric bypass. Obes Surg 2016; 26:345–349.

160 Cologne KG, Keller DS, Liwanag L, Devaraj B, Senagore AJ. Use of the American College of Surgeons NSQIP surgical risk calculator for laparoscopic colectomy: how good is it and how can we improve it?. J Am Coll Surg 2015; 220:281–286.

161 Fecso AB, Samuel T, Elnahas A, Sockalingam S, Jackson T, Quereshy F, *et al*. Clinical indicators of postoperative bleeding in bariatric surgery. Surg Laparosc Endosc Percutaneous Tech 2018; 28:52–55.

162 Fernández-Esparrach G, Bordas JM, Pellisé M, Gimeno-García AZ, Lacy A, Delgado S, *et al*. Endoscopic management of early GI hemorrhage after laparoscopic gastric bypass. Gastrointest Endosc 2008; 67:552–555.