

Reoperative Bariatric Surgery

Weekly book review of ASMBS

Chapter #24

Chapter Objectives

1. Describe the importance of preoperative testing.
 2. Understand the different indications for reoperative surgery.
 3. Describe the different types of reoperative bariatric procedures.
 4. Understand the morbidity and outcome of reoperative surgery.
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Introduction

- ▶ **(ASMBS)** has estimated that 228,000 BS were performed in 2017 in the U.S. This is a 13-fold increase compared to 1992
- ▶ number of **revisional bariatric** procedures has progressively increased as well.
- ▶ reoperations **after any bariatric** procedure is estimated to be between 5% and 54%
- ▶ the incidence of revisions after any BS in US 14.14%

Cont..

- ▶ Restrictive operations **AGB, VBG** have the highest rates of reoperation in the literature (up to 60%)
 - ▶ Combined malabsorptive and restrictive procedures such as RYGB have a reoperation rate of between 2.1% and 20%
 - ▶ **LSG Reoperation** rates range is between 3.3% and 34%
 - ▶ **BPD and BPD-DS** have the lowest rates of reoperation (5%)
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Cont...

- ▶ Indications for reoperations in **BS** related to failure of **WL/WR** or complications can be **acute, early, late, or chronic**
 - ▶ With high **morbidity and mortality** is reoperative **BS**
 - ▶ it is necessary for **bariatric surgeons** to familiarize themselves with the different surgical scenarios
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Reoperative Bariatric Surgery: Classification

- ▶ different re-interventions after BS can be classified
 - (1) indications
 - (2) procedure types
 - (3) outcomes
- ▶ The main reasons Indications for reoperation can be categorized
 - failures of BS as WL or WR
 - complications acute early/late and chronic

Cont...

- ▶ Procedure Types can be classified into
 - Revisions (just modification not alter basic anatomy of primary procedure)
 - conversions (anatomy of the primary operation is changed into a different type of operation)
 - reversals(to reestablish the original anatomy as closely as possible)
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Table 24.1 Classification of reoperative bariatric surgery

Indications	Failures	Weight regain	Technical compliance
		Failure of weight loss	Metabolic
		Recurrence of comorbidities	
	Complications	Time of onset	Acute (<7 days)
			Early (7 days–6 weeks)
			Late (6 s–12 weeks)
Chronic (>1 week) (see Table 24.2)			
Type	Surgical or anatomical		
	Nutritional or metabolic		

Types of procedures	Revisions	Maintain basic anatomy of primary procedure	
	Conversions	Anatomy changed to different operations	
	Reversal	Restore original anatomy	
Outcomes	Type of primary	Restrictive versus malabsorptive	
	Type of reoperation	See Table 24.3	
	Indications	Failures	
		Complications	
	Surgeon's experience		
	Approach	Open	
Laparoscopic			

Table 24.2 Chronic complications of common bariatric operations

	LAGB	VBG	RYGB	BPD-DS	JIB	Loop GB	SG
G-G fistula	–	+	+	–	–	+	–
Ulcer	+	+	+	–	–	+	–
Anastomotic stricture	–	–	+	–	–	+	–
Gastric outlet obstruction	+	+	+	+	–	+	+
Foreign body erosion	+	+	+ ^a	–	–	–	–
Symptomatic GERD	+	+	+	+	–	+	+
Bowel obstruction	+ ^b	–	+	+	+	±	–
Malnutrition	+ ^c	+ ^c	+	+	+	+	+

LAGB laparoscopic adjustable gastric banding, *VBG* vertical banded gastroplasty, *RYGB* Roux-en-Y gastric bypass, *BPD-DS* biliopancreatic diversion with duodenal switch, *JIB* jejunioileal bypass, *Loop GB* loop gastric bypass, *SG* laparoscopic sleeve gastrectomy

^aIn case of banded gastrojejunostomy

^bFrom intraabdominal tubing

^cWhen gastric outlet obstruction or dysphagia is present

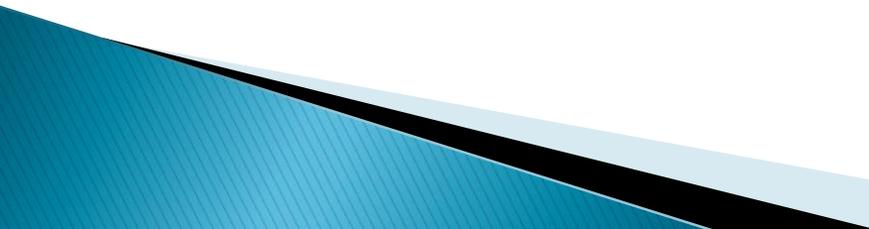
Outcomes

- ▶ **current incidence of reoperative bariatric procedures is roughly high 50%**
 - ▶ **Most studies report higher perioperative morbidity (10–50%) and mortality (2.7–8.3%) following reoperative procedures compared to primary ones**
 - ▶ **the morbidity and mortality are even higher in reoperative procedure**
- 

The outcomes differ based on the following criteria

- ▶ Indication for reoperation
 - ▶ type of primary operation
 - ▶ type of re-intervention,
 - ▶ approach (laparoscopic versus open)
 - ▶ surgeon experience
- 

Type of Primary Procedure

- ▶ Patients undergoing reoperative BS have a broad basis for justifying said procedures
 - Mechanical
 - physiological
 - behavioral factors are determinants for weight regain or long-term weight loss failure
 - ▶ primary operation can influence the weight loss of the secondary reoperative procedure
- 

Type of Re-intervention

- ▶ divided into LAGB related and non-LAGB related
 - the contemporary primary revisional procedures are band revisions
 - RYGB revisions
 - sleeve revisions
- ▶ mortality rate after reoperative bariatric surgery is nearly 2%
- ▶ primary bariatric mortality outcomes of 0.1% and 1.1%

Cont...

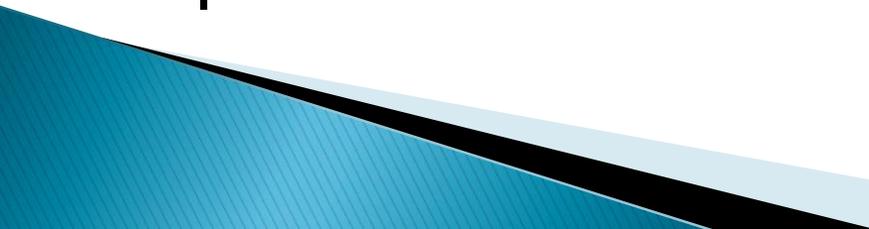
- ▶ **revisional surgeries**, rates range from 0% to 39.3%
 - ▶ **conversion rates** range from 0% to 47.6%
 - ▶ **Conversion to RYGB** have greater risk of complications compared to primary RYGB
 - ▶ **Several reviews** published in the literature suggest that reoperative surgery has higher complication rates than primary bariatric procedures
- 

Table 24.3 Types of reoperations

LAGB related	Revision	Band	Repositioning
			Replacement
		Port-tubing complex	Repositioning
			Reattaching
	Replacement		
	Conversion	RYGB	
		BPD-DS	
		SG	
	Removal		
	Non-LAGB related	Revision	RYGB
Remnant gastrectomy			
Redo GJ			
Redo J-J			
Distal RYGB			
BPD-DS		Re-SG	
		Limb shortening	
SG		Re-SG	

Conversion	RYGB	BPD-DS
		SG
	VBG	RYGB
		BPD-DS
		SG
SG	RYGB	
	BPD-DS	
Loop GB	RYGB	
Reversal	RYGB	
	BPD-DS	
	VBG	Ring removal ± gastrogastrostomy
	JIB	

LAGB laparoscopic adjustable gastric banding, *VBG* vertical banded gastroplasty, *RYGB* Roux-en-Y gastric bypass, *BPD-DS* biliopancreatic diversion with duodenal switch, *JIB* jejunoileal bypass, *Loop GB* loop gastric bypass, *SG* laparoscopic sleeve gastrectomy, *GB* gastric bypass

Surgeon Experience

- ▶ **surgeon experience** has been well correlated to outcomes in BS
- ▶ decreased **perioperative** mortality after BS in the hands of experienced surgeons
- ▶ surgeon and hospital volumes were **associated with better** outcomes In postoperative mortality and 30-day mortality rates

Cont...

- ▶ Of the roughly 20,000 bariatric surgeries performed, **45.7%** involved residents, while **36.7%** involved senior-level residents, **with poor outcomes** with higher rates of postoperative complications

Preoperative Evaluation

- ▶ a comprehensive preoperative evaluation is necessary
 - identify and promptly manage potential risk factors before surgery
 - should be performed hand in hand with a broad review of the patient's nutritional, behavioral, and medical background
 - multidisciplinary management allow satisfactory results

Cont...

- ▶ A retrospective analysis of prospectively collected data of **1225 patients** undergoing LRYGB and SG evaluated the preoperative findings of **gastrointestinal endoscopy**, radiographic gastrointestinal series, and esophageal manometry
- ▶ **Gallstones in 21%**, hiatal hernias in 27.6%, **C gastritis in 18.8%**, reflux esophagitis in 19.2%, **H-pylori-positive gastritis in 13.3%** patients,

Imaging and Functional Studies

- ▶ assessment of the GI tract prior to each reoperation
 - ▶ **UGI** contrast study s the best radiologic examination to obtain an anatomic road map
 - ▶ **CXR, DVT** clinical and imaging diagnostic evaluation
 - ▶ upper GI series or **endoscopy**
 - ▶ **Abdominal** sonography
- 

Dietary and Nutritional Assessment and Counseling

- ▶ All candidates for bariatric surgery should undergo evaluation of their ability to incorporate nutritional and behavioral modifications before and after the procedure
- ▶ ASMBS suggested guidelines is: optimizing weight loss, changes in dietary habits
 - Proper nutrition, postoperative bariatric diet.
 - Educate patients with protocol-based meal plans
 - Counseling patients to eat three small meals
 - Determine on an individualized basis appropriate protein intake
 - Considerate risks of micronutrient deficiency

Psychological Assessment and Counseling

- ▶ The endpoint of the **psychological** assessment is to determine if the patients are suitable candidates to modify necessary lifestyle to ensure short- and long-term outcomes
 - ▶ It is important then to avoid **underestimating** presurgical psychological assessment mainly because of risk behaviors
 - ▶ specific **psychological** conditions have to be identified and treated
- 

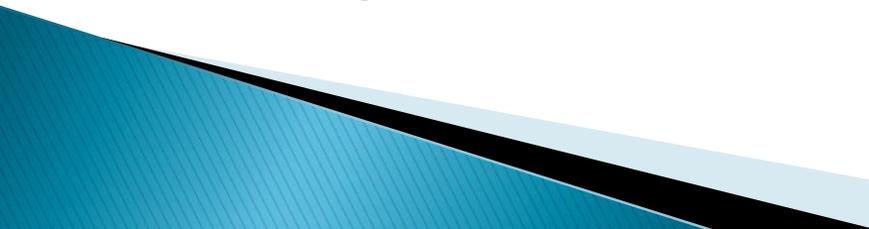
Preoperative Testing and Clearances

- ▶ According to the ASMBS following elements of medical clearance for BS
 - Optimize glycemia
 - should have screening TSH levels
 - EKG, CXR, H-pylori, Psychosocial-behavioral evaluation
 - micronutrient serum levels (albumin)
 - Pulmonary evaluation
 - Cardiac evaluation
 - malnutrition or hypovitaminosis
 - anasarca, hair loss, neurologic abnormalities

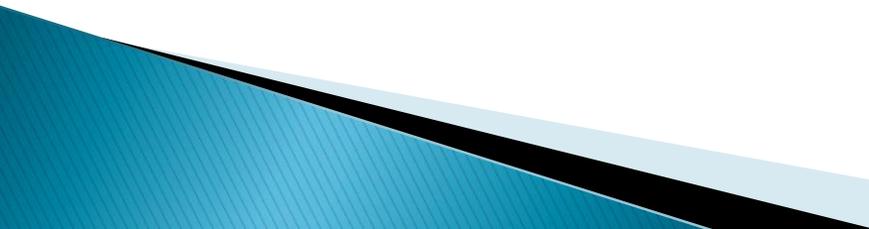
Approach

- ▶ **Reoperations categorize in:**
 1. **Reoperations after gastric banding**
 2. **Reoperations after non-gastric banding**
 - (a) Emergent procedures
 - (b) Revisions
 - (c) Conversions
 - (d) Reversals (not for weight regain)

Technical Aspects

- ▶ first challenge in reoperative BS consists of **accessing the abdominal cavity**
 - ▶ **midline laparotomy** and/or repair of an incisional **hernia with mesh**
 - ▶ The most commonly used technique is the open **Hasson** technique via the midline incision or, alternatively **LUQ optical trocar** entry
 - ▶ next step is mainly to **lyse adhesions** to allow recognition of critical anatomy
- 

Cont...

- ▶ **adhesions** between the left lobe of the liver and the stomach or gastric pouch is challenging
 - ▶ perform a **safe dissection** identify caudate lobe of the liver, the left gastric artery, and the right crus of the diaphragm
 - ▶ **vena cava, esophagus** and aorta should be anatomically identify
 - ▶ **intraoperative endoscopy** or calibration tubes facilitates the identification
- 

Cont...

- ▶ **multiple staple** lines and scarred predisposes to postoperative ischemia and leaks
- ▶ **oversewing** or reinforcement is recommended
- ▶ **reinforcing** the suture line decreases the leak rate after bariatric surgery SG in particular
- ▶ after **reoperative** surgery leak test with air or methylene blueshould be utilized
- ▶ the **benefit of a remnant gastrostomy** should be considered in every reoperative case of gastric bypass

RYGB

- ▶ the number of **RYGBs** has increased exponentially
- ▶ reoperation after RYGB can be due to failure of **WL**, **WR** or secondary to complications
- ▶ Based on the previously mentioned criteria for weight loss, **RYGB fails in between 15% and 33%** of the cases
- ▶ Of the failures, only up to **20%** will present for a second operation

Cont..

- ▶ **Revisions:** The reasons for revision of a RYGB are determined by the acuity of the problem
 - Acute complications include gastrointestinal leaks, obstruction, stricture, and bleeding
 - chronic complications include marginal ulcers, fistulae, and obstruction
- ▶ **Some surgeons** assume that a small pouch (25–30 cc) would determine restriction and affect weight loss maintenance
- ▶ **Trimming** of the pouch should always proceed with a calibration tube
- ▶ **Oversewing** the staple line reduces the chance of bleeding and leak

Cont...

- ▶ **Conversion:** Conversion from RYGB to another procedure might be indicated in the case of failure of weight loss
 - ▶ Typically **RYGB is converted** to BPD–DS
 - ▶ the revision of **proximal–to–distal RYGB** showed significant improvement in weight loss and resolution of comorbidities at 3 years
- 

Loop Gastric Bypass

- ▶ a long narrow gastric tube results in a tension-free gastrojejunostomy
- ▶ avoidance of a Roux reconstruction will decrease the chance of developing internal hernias and mesenteric hematomas
- ▶ the presence of an afferent limb can predispose to the development of marginal ulcers, strictures, and bile gastritis
 - mortality rate of 0.1%
 - 0.8% reoperation rate
- ▶ The procedure of choice is conversion to a traditional RYGB

Biliopancreatic Diversion with Duodenal Switch (BPD-DS)

- ▶ BPD-DS has the lowest **reoperation rate** among the bariatric procedures (5%)
- ▶ weight regain is less **common after BPD-DS**
- ▶ rare cases of weight regain after BPD-DS
- ▶ **revision** should focus on shortening of the common channel or the sleeve volume should be reduced

Vertical Banded Gastroplasty (VBG)

- ▶ the **VBG** is the one that gained the most popularity
- ▶ Indication for reoperation is
 - gastro-gastric fistula
 - **Dysphagia** and esophageal reflux symptoms secondary to gastric outlet obstruction
 - **obstruction is commonly** caused by the different degrees of erosion of the foreign body (silastic band or mesh)

Conversion VGB

- ▶ In gastro-gastric fistula, gastric outlet obstruction, weight regain **VGB conversion to RYGB, BPD-DS, or SG** might be warranted
 - After identification and removal of the gastric ring
 - retrogastric and angle of His dissections are the most challenging steps
 - In the case of **weight loss failure** after VGB, conversion to **RYGB** is the most appropriate reoperation approach
- ▶ conversion from **VGB to SG**, reports leak rate of 14%
- ▶ conversion to **BPD-DS** has a leak rate of 22%



Analysis of the Factors Contributing to Bariatric Success After Laparoscopic Redo Bariatric Procedures: Results from Multicenter Polish Revision Obesity Surgery Study (PROSS)

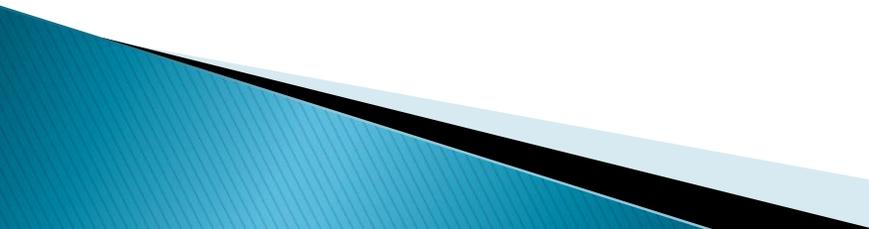
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Introduction

- ▶ **BS is effective** and approved method of treatment of clinically severe obesity, however, we must recognize its limitations and realize that some patients, due to various reasons, will require redo bariatric surgeries
- ▶ **Majority of bariatric patients** manages to achieve satisfactory weight loss $> 50\%$ EWL, but approximately 15–20% do not achieve or sustain this goal
- ▶ **More indications** for RBS include GERD and other complications of PBS such as marginal ulcers, malnourishment, and fistulas
- ▶ **Prevalence of GERD** increases after SG

Cont...

- ▶ **RBS represent** around 7% of the total bariatric procedures in the world
 - ▶ **In some countries**, including the USA, RBS are nowadays the third most common bariatric surgeries in total
 - ▶ **As the number** of bariatric surgeries performed continuously increases worldwide , it is safe to assume that demand for RBS will also grow
 - ▶ **Indications for RBS** are not clearly defined. Moreover, these procedures are technically more challenging and associated with higher morbidity rate , thus, patients that are considered for RBS require individual evaluation of potential benefits and risks
- 

Statistical Analysis

- ▶ **multivariate analysis** to obtain significant, independent risk factors and to calculate the odds ratio OR with 95% confidence interval (CI). P values ≤ 0.05 were considered statistically significant

Fig. 1 Flowchart of patients in the study

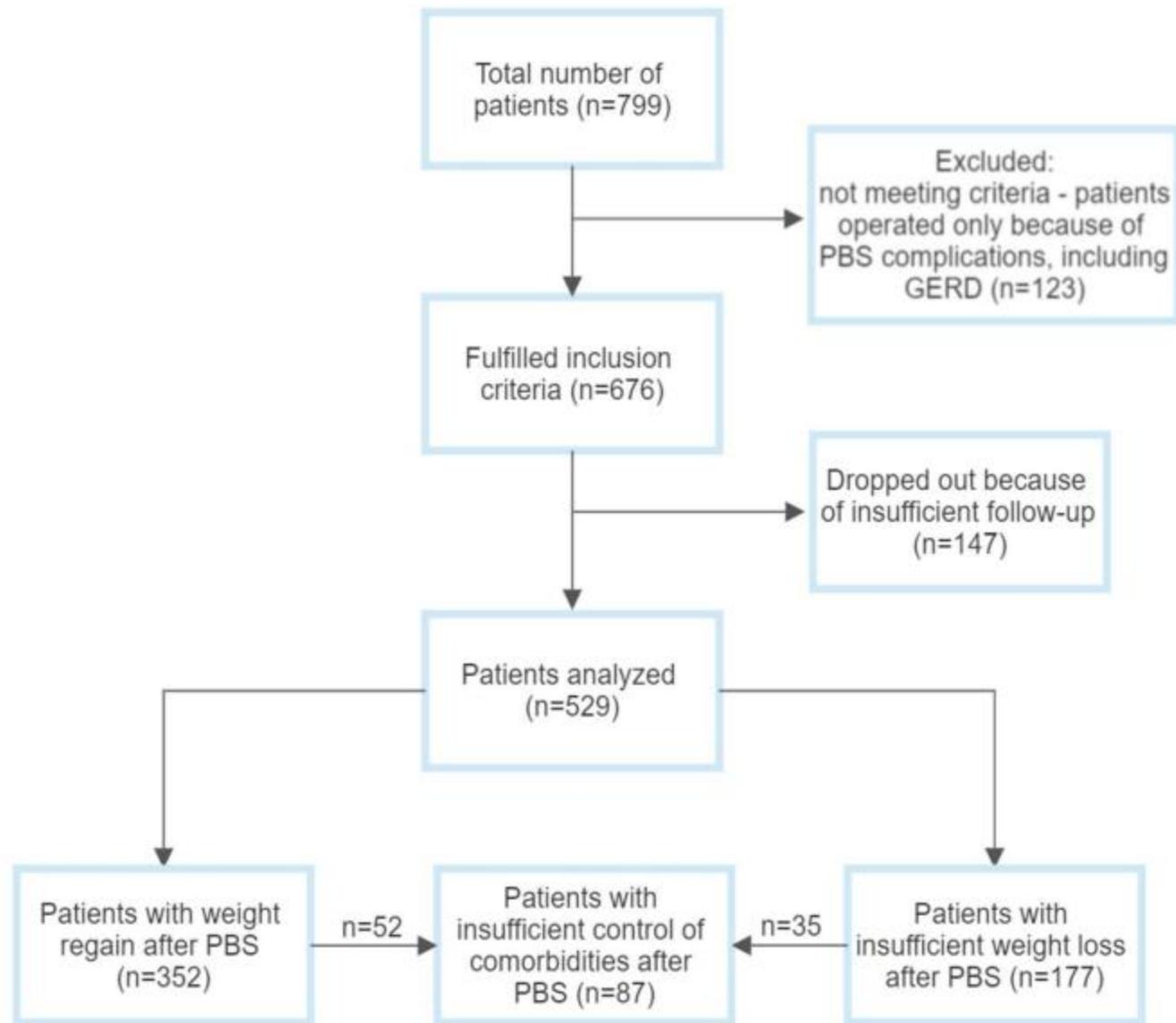
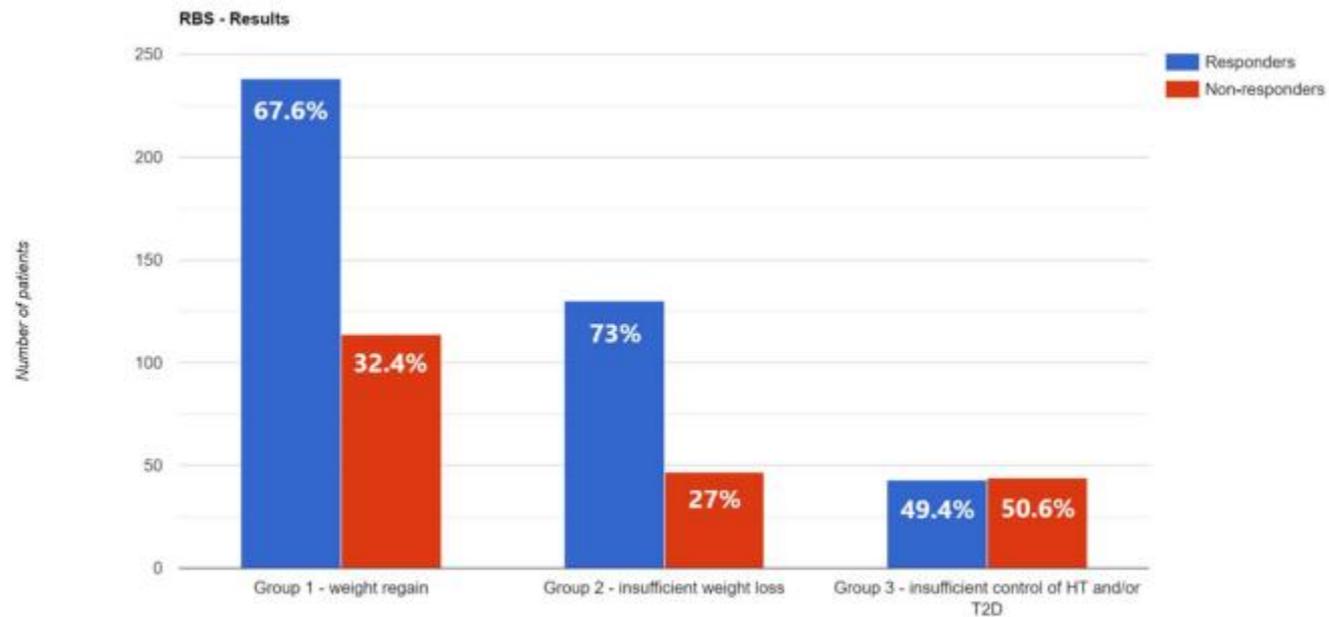
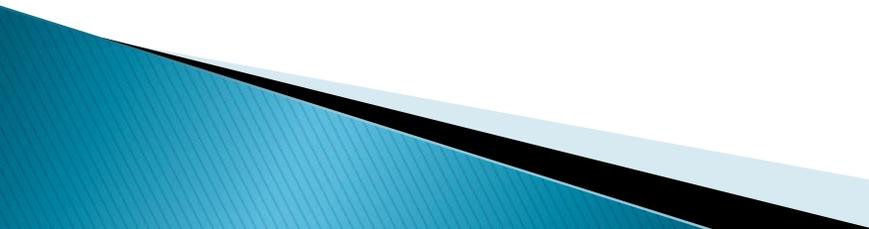


Fig. 2 Graphic presentation of study groups' response/non-response ratio



Group 1: Patients with Weight Regain After Primary Procedure

- ▶ **In this study group**, 238 of 352 patients (67.6%) exceeded 50% EWL after redo bariatric surgery
 - ▶ **Patients from responsive and patients from non-responsive subgroups** did not statistically differ in sex, age, maximal BMI, BMI before primary procedure, duration of obesity, smoking, alcohol consumption, NSAID), or anticoagulation intake
 - ▶ **Associated medical conditions** such as hypertension, type 2 diabetes mellitus, asthma, OSA, and COPD also did not differ both subgroups.
- 

Cont...

- ▶ Active smokers did not **undergo bariatric surgery**—**all** smoking patients included in the study were advised to quit smoking tobacco at least 6 weeks before the surgery and to continue not smoking after the surgery
 - ▶ **Prior gastric balloon** treatment and type of primary procedure were not contributing factor in achieving satisfying weight loss after redo-surgery, as well as time interval between primary and redo-surgery
- 

Table 1 General characteristics with primary bariatric treatment and qualification for RBS details: group 1 (patients with weight regain after primary procedure)

	Group 1: non-responders (<50% EWL)	Group 1: responders (≥50% EWL)	<i>p</i> value
<i>n</i> (%)	114 (32.4%)	238 (67.6%)	n/a
Male/female, <i>n</i> (%)	33/81 (28.6%/71.5%)	52/186 (21.9%/78.2%)	0.145
Median age, years (IQR)	36 (31–43)	38 (31–44)	0.163
Median maximal BMI, kg/m ² (IQR)	47.2 (42.5–52.1)	46.5 (42.2–52.6)	0.444
Median BMI before primary procedure, kg/m ² (IQR)	46.2 (41.5–50.5)	45.0 (40.5–50.2)	0.335
Duration of obesity, <i>n</i> (%)			
< 5 years	3 (2.6%)	10 (4.2%)	0.828
5–15 years	55 (48.2%)	110 (46.2%)	
> 15 years	56 (49.2%)	118 (49.6%)	
Smoking, <i>n</i> (%)	14 (12.3%)	29 (12.2%)	0.896
Alcohol consumption, <i>n</i> (%)	31 (27.2%)	70 (29.4%)	0.696
NSAID or anticoagulation > once a week, <i>n</i> (%)	12 (10.5%)	18 (7.6%)	0.383
Type 2 diabetes mellitus, <i>n</i> (%)	19 (16.7%)	50 (21.0%)	0.337
Hypertension, <i>n</i> (%)	43 (37.7%)	87 (36.6%)	0.832
Asthma, obstructive sleep apnea, chronic obstructive pulmonary disease, <i>n</i> (%)	6 (5.3%)	14 (5.9%)	0.814
Prior gastric balloon treatment, <i>n</i> (%)	6 (5.3%)	22 (9.24%)	0.280
Type of primary procedure, <i>n</i> (%)			0.125
LSG	65 (57.0%)	152 (63.9%)	
RYGB	3 (2.6%)	1 (0.4%)	
VBG	9 (7.9%)	18 (7.6%)	
OAGB	1 (0.9%)	0	
AGB	36 (31.6%)	63 (26.5%)	
GP	0	4 (1.7%)	
Median lowest BMI after primary procedure, kg/m ² (IQR)	33.8 (28.9–38.5)	30.8 (27.5–35.6)	< 0.001
Median interval between primary procedure and RBS, years (IQR)	5 (3–8)	5 (3–7)	0.528
Remission of type 2 diabetes mellitus, <i>n</i> (%)	3 (15.8%)	14 (28.0%)	0.359
Remission of hypertension, <i>n</i> (%)	6 (14.0%)	12 (13.0%)	0.899
Treatment continued in center that performed primary procedure, <i>n</i> (%)	62 (54.4%)	156 (66.1%)	0.034
BMI pre-RBS, kg/m ² (IQR)	43.1 (39.7–48.3)	39.1 (34.6–43.5)	< 0.001
Median difference in BMI pre-RBS and lowest after primary procedure, kg/m ² (IQR)	9.9 (6.0–14.1)	7.4 (4.3–10.8)	< 0.001
Median %TWL after PBS (with lowest weight achieved after PBS) (IQR)	29.9 (21.7 (36.5–15.4)	32.5 (27.2–40.6)	0.002
Median %TWL after PBS (with weight before RBS) (IQR)	6.4 (0.7–13.3)	15.7 (7.7–23.4)	< 0.001

Significant *p*-values (below 0.05) are bolded

%EWL, percentage of excess weight loss; IQR, inter-quartile range; BMI, body mass index; NSAID, non-steroid anti-inflammatory drugs; LSG, laparoscopic sleeve gastrectomy; RYGB, Roux-en-Y gastric bypass; VBG, vertical banded gastroplasty; OAGB, one anastomosis gastric bypass; AGB, adjustable gastric banding; GP, gastric plication; RBS, redo bariatric surgery; %TWL, percentage of total weight loss; PBS, primary bariatric surgery

Table 3 Multivariate logistic regression model: group 1 (patients with weight regain after primary procedure)

	OR	95% CI	<i>p</i> value
Treatment continued in center that performed primary procedure	1.27	0.78–2.06	0.330
Difference in BMI pre-RBS and lowest after primary procedure > 10.6	2.33	1.43–3.80	0.001

Significant *p*-values (below 0.05) are bolded

OR, odds ratio; *95% CI*, 95% confidence interval; *BMI*, body mass index; *RBS*, redo bariatric surgery

Group 2: Patients with Insufficient Weight Loss After Primary Procedure

- ▶ In this **study group**, 130 of 177 patients (73.4%) exceeded, 50% EWL after redo bariatric surgery
- ▶ Patients did **not significantly differ** in terms of sex, age, duration of obesity, smoking, alcohol consumption, NSAID or anticoagulation intake, type 2 diabetes, hypertension, and pulmonary conditions

Table 2 RBS: group 1 (patients with weight regain after primary procedure)

	Group 1: non-responders ($< 50\%$ EWL)	Group 1: responders ($\geq 50\%$ EWL)	<i>p</i> value
<i>n</i> (%)	114 (32.4%)	238 (67.6%)	n/a
Median BMI after RBS, kg/m ² (IQR)	38.4 (34.7–41.9)	29.9 (27.4–33.0)	< 0.001
Type of RBS			0.510
LSG/re-SG	24 (21.1%)	46 (19.3%)	
Others (BPD-DS, SAGI, SASI)	2 (1.8%)	9 (3.8%)	
RYGB	49 (43.0%)	89 (37.4%)	
OAGB	39 (34.2%)	94 (39.5%)	
Remission of type 2 diabetes mellitus, <i>n</i> (%)	1 (5.3%)	22 (44.0%)	< 0.001
Remission of hypertension, <i>n</i> (%)	8 (18.6%)	23 (26.4%)	0.280
Postoperative morbidity, <i>n</i> (%)	22 (19.3%)	52 (21.9%)	0.583
Median %TWL after RBS (IQR)	19.5 (12.9–24.6)	34.8 (30.8–41.2)	< 0.001

Significant *p*-values (below 0.05) are bolded

%EWL, percentage of excess weight loss; RBS, redo bariatric procedure; LSG, laparoscopic sleeve gastrectomy; re-SG, redo sleeve gastrectomy; BPS-DS, biliopancreatic diversion with duodenal switch; SAGI, single anastomosis gastro-ileal bypass; SASI, single anastomosis sleeve-ileal bypass; RYGB, Roux-en-Y gastric bypass; OAGB, one-anastomosis gastric bypass; %TWL, percentage total weight loss

Table 4 General characteristics with primary bariatric treatment and qualification for RBS details: – group 2 (patients with insufficient weight loss after primary procedure)

	Group 2: non-responders (<50% EWL)	Group 2: responders (≥50% EWL)	<i>p</i> value
<i>n</i> (%)	47 (37%)	130 (73%)	n/a
Male/female, <i>n</i> (%)	13/34 (28%/72%)	36/94 (28%/72%)	0.997
Median age, years (IQR)	38 (31–47)	40 (34–51)	0.053
Median maximal BMI, kg/m ² (IQR)	44.6 (40.5–50.0)	50.1 (44.9–54.5)	<0.001
Median BMI before primary procedure, kg/m ² (IQR)	44.3 (40.2–47.4)	46.2 (42.2–50.4)	0.026
Duration of obesity, <i>n</i> (%)			
< 5 years	3 (6.4%)	6 (4.6%)	0.183
5–15 years	15 (31.9%)	62 (47.7%)	
> 15 years	29 (61.7%)	62 (47.7%)	
Smoking, <i>n</i> (%)	11 (23.4%)	16 (12.3%)	0.205
Alcohol consumption, <i>n</i> (%)	11 (23.4%)	43 (33.1%)	0.377
NSAID or anticoagulation > once a week, <i>n</i> (%)	6 (12.8%)	22 (16.9%)	0.858
Type 2 diabetes mellitus, <i>n</i> (%)	9 (19.2%)	44 (33.9%)	0.089
Hypertension, <i>n</i> (%)	24 (51.1%)	74 (56.9%)	0.489
Asthma, obstructive sleep apnea, chronic obstructive pulmonary disease, <i>n</i> (%)	3 (6.4%)	14 (10.8%)	0.382

Type of primary procedure, <i>n</i> (%)			0.004
LSG	24 (51.1%)	101 (77.7%)	
RYGB	2 (4.3%)	1 (0.8%)	
VBG	2 (4.3%)	1 (0.8%)	
OAGB	0	3 (2.3%)	
AGB	19 (40.4%)	23 (17.7%)	
GP	0	1 (0.8%)	
Median lowest BMI after primary procedure, kg/m ² (IQR)	38.7 (36.2–40.8)	37.1 (33.5–42.0)	0.260
Median interval between primary procedure and RBS, years (IQR)	4 (3–7)	2 (1–3)	< 0.001
Remission of type 2 diabetes mellitus, <i>n</i> (%)	0	11 (25.0%)	n/a
Remission of hypertension, <i>n</i> (%)	2 (8.3%)	13 (17.6%)	0.508
Treatment continued in center that performed primary procedure, <i>n</i> (%)	33 (70.2%)	110 (84.6%)	0.032
BMI pre-RBS, kg/m ² (IQR)	42.1 (37.8–45.0)	38.6 (34.3–42.5)	0.002
Median difference in BMI pre-RBS and lowest after primary procedure, kg/m ² (IQR)	0.8 (0–4.7)	0 (0–1.8)	0.022
Median %TWL after PBS (with lowest weight achieved after PBS) (IQR)	11.9 (9–24.4)	24.6 (17.4–30.8)	< 0.001
Median %TWL after PBS (with weight before RBS) (IQR)	6.8 (0.8–11.61)	21.7 (14.1–30.0)	< 0.001

Significant *p*-values (below 0.05) are bolded

%EWL, percentage of excess weight loss; IQR, inter-quartile range; BMI, body mass index; NSAID, non-steroid anti-inflammatory drugs; LSG, laparoscopic sleeve gastrectomy; RYGB, Roux-en-Y gastric bypass; VBG, vertical banded gastroplasty; OAGB, one anastomosis gastric bypass; AGB, adjustable gastric banding; GP, gastric plication; RBS, redo bariatric surgery; %TWL, percentage of total weight loss; PBS, primary bariatric surgery

Table 5 RBS: group 2 (patients with insufficient weight loss after primary procedure)

	Group 2: non-responders (<50% EWL)	Group 2: responders (≥50% EWL)	<i>p</i> value
<i>n</i> (%)	47	130	n/a
Median BMI after RBS, kg/m ² (IQR)	37.0 (34.1–41.3)	30.5 (27.8–33.9)	< 0.001
Type of RBS			< 0.001
LSG/re-SG	11 (23.4%)	13 (10.0%)	
Others (Fobi-pouch operation, gastric pouch reduction after RYGB, BPD-DS, SAGI)	3 (6.4%)	1 (0.8%)	
RYGB	17 (36.2%)	22 (16.9%)	
OAGB	16 (34.0%)	94 (72.3%)	
Remission of type 2 diabetes mellitus, <i>n</i> (%)	3 (33.3%)	25 (56.8%)	0.021
Remission of hypertension, <i>n</i> (%)	3 (12.5%)	27 (36.5%)	0.037
Postoperative morbidity, <i>n</i> (%)	2 (4.3%)	32 (24.6%)	0.002
Median %TWL after RBS (IQR)	18.2 (10.9–21.6)	38.7 (32.1–43.1)	< 0.001

Significant *p*-values (below 0.05) are bolded

%EWL, percentage of excess weight loss; *BMI*, body mass index; *RBS*, redo bariatric procedure; *LSG*, laparoscopic sleeve gastrectomy; *re-SG*, redo sleeve gastrectomy; *RYGB*, Roux-en-Y gastric bypass; *OAGB*, one-anastomosis gastric bypass; *BPS-DS*, biliopancreatic diversion with duodenal switch; *SAGI*, single anastomosis gastro-ileal bypass; *%TWL*, percentage total weight loss

Table 6 Multivariate logistic regression analysis for factors contributing to bariatric success: group 2 (patients with insufficient weight loss after primary procedure)

	OR	95% CI	<i>p</i> value
Age	1.01	0.98–1.05	0.498
Maximal BMI	1.03	0.98–1.05	0.560
Primary bariatric procedure			
LSG	1.00		
RYGB	0.99	0.05–20.9	0.999
VBG	1.54	0.06–41.22	0.796
OAGB	n/a		
AGB	2.03	0.59–6.92	0.259
GP	n/a		
Treatment continued in primary bariatric center	0.66	0.20–2.13	0.486
Median interval between primary procedure and RBS	0.88	0.74–1.06	0.177
Difference in BMI pre-RBS and lowest after primary procedure	0.76	0.64–0.89	0.001
Types of RBS			
LSG/re-SG	1.00		
Others (Fobi-pouch operation, gastric pouch reduction after RYGB, BPD-DS, SAGI)	0.12	0.001–9.61	0.339
RYGB	0.76	0.20–2.86	0.686
OAGB	2.80	0.67–11.64	0.157

Significant *p*-values (below 0.05) are bolded

OR, odds ratio; *95% CI*, 95% confidence interval; *BMI*, body mass index; *LSG*, laparoscopic sleeve gastrectomy; *RYGB*, Roux-en-Y gastric bypass; *VBG*, vertical banded gastroplasty; *OAGB*, one anastomosis gastric bypass; *AGB*, adjustable gastric banding; *GP*, gastric plication; *RBS*, redo bariatric surgery; *LSG*, laparoscopic sleeve gastrectomy; *Re-SG*, redo sleeve gastrectomy; *BPD-DS*, biliopancreatic diversion with duodenal switch; *SAGI*, single anastomosis gastro-ileal bypass

Group 3: Patients with Insufficient Control of Obesity-Related Diseases After Primary Procedure

- ▶ In this **study group**, 44 of 87 (50.6%) patients did not achieve remission of type 2 diabetes and/or hypertension after RBS and 43 of 87 (49.4%) did. General characteristics are presented
- ▶ Overall, there were **28 patients in remission of T2D** and 26 patients in remission of HTN
- ▶ **Patients did not significantly** differ in terms of sex, age, median maximal BMI, median BMI before primary procedure, smoking, alcohol consumption, NSAID or anticoagulation intake, type2 diabetes hypertension, and pulmonary conditions

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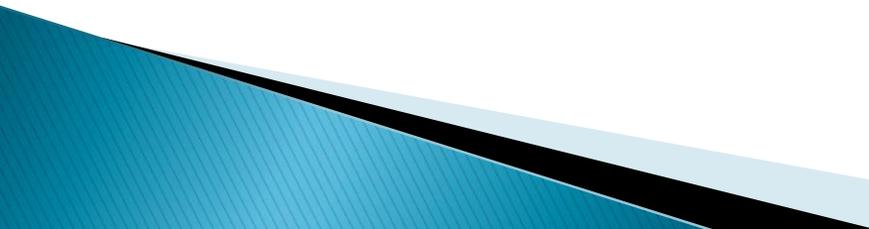
- ▶ Duration of **obesity** was significantly longer in non-responsive group: 29 of 44 patients (65.9%) were obese for more than 15 years compared to 11 of 43 patients (25.6%) in responsive group
 - ▶ **Prior gastric balloon** treatment did not differ groups
 - ▶ There were no significant differences in types of primary bariatric **procedures with LSG** being the most common in both groups
 - ▶ **Subgroups differed** in median interval between primary procedure and RBS
 - ▶ Subgroups differed in median interval between primary procedure and RBS
- 

Table 7 General characteristics with primary bariatric treatment and qualification for RBS details – group 3 (patients with insufficient control of obesity-related diseases after primary procedure)

	Group 3: non-responders	Group 3: responders (remission of HT and/ or T2D)	<i>p</i> value
<i>n</i> (%)	44 (50.6%)	43 (49.4%)	n/a
Male/female, <i>n</i> (%)	17/27 (39%/61%)	11/32 (26%/74%)	0.193
Median age, years (IQR)	44 (36–53)	42 (35–50)	0.372
Median maximal BMI, kg/m ² (IQR)	51.3 (46.3–57.1)	51.2 (46.5–54.2)	0.586
Median BMI before primary procedure, kg/m ² (IQR)	48.3 (43.3–53.6)	47.0 (41.5–51.3)	0.174
Duration of obesity, <i>n</i> (%)			
<5 years	3 (6.8%)	4 (9.3%)	0.001
5–15 years	12 (27.3%)	28 (65.1%)	
> 15 years	29 (65.9%)	11 (25.6%)	
Smoking, <i>n</i> (%)	3 (6.8%)	6 (14.0%)	0.245
Alcohol consumption, <i>n</i> (%)	17 (40.5%)	11 (30.6%)	0.363
NSAID or anticoagulation > once a week, <i>n</i> (%)	6 (13.6%)	10 (23.3%)	0.160
Type 2 diabetes mellitus, <i>n</i> (%)	25 (56.8%)	31 (72.1%)	0.137
Hypertension, <i>n</i> (%)	37 (84.1%)	36 (83.7%)	0.963
Asthma, obstructive sleep apnea, chronic obstructive pulmonary disease, <i>n</i> (%)	4 (9.1%)	7 (16.28%)	0.352
Prior gastric balloon treatment, <i>n</i> (%)	4 (9.1%)	5 (11.6%)	0.739

Type of primary procedure, <i>n</i> (%)			0.648
LSG	32 (72.7%)	35 (81.4%)	
RYGB	2 (4.6%)	1 (2.3%)	
VBG	2 (4.6%)	1 (2.3%)	
OAGB	0	1 (2.3%)	
AGB	8 (18.2%)	5 (11.6%)	
Median lowest BMI after primary procedure, kg/m ² (IQR)	37.5 (34.1–42.0)	34.9 (30.7–41.1)	0.066
Median interval between primary procedure and RBS, years (IQR)	4 (2.5–6)	3 (1–4)	0.004
Remission of type 2 diabetes mellitus, <i>n</i> (%)	1 (4.0%)	6 (19.4%)	0.117
Remission of hypertension, <i>n</i> (%)	0	5 (13.9%)	n/a
Treatment continued in center that performed primary procedure, <i>n</i> (%)	33 (75.0%)	30 (69.8%)	0.585
BMI pre-RBS, kg/m ² (IQR)	43.9 (39.5–49.0)	41.1 (34.4–45.3)	0.011
Median difference in BMI pre-RBS and lowest after primary procedure, kg/m ² (IQR)	6.0 (1.9–10.5)	1.3 (0–9.4)	0.052
Median %TWL after PBS (with lowest weight achieved after PBS) (IQR)	26.8 (18.9–33.1)	29.1 (21.3–38.2)	0.106
Median %TWL after PBS (with weight before RBS) (IQR)	12.0 (6.2–21.0)	20.9 (15.5–27.7)	0.002

Significant *p*-values (below 0.05) are bolded

HT, hypertension; *T2D*, type 2 diabetes; *IQR*, inter-quartile range; *BMI*, body mass index; *NSAID*, non-steroid anti-inflammatory drugs; *LSG*, laparoscopic sleeve gastrectomy; *RYGB*, Roux-en-Y gastric bypass; *VBG*, vertical banded gastroplasty; *OAGB*, one anastomosis gastric bypass; *AGB*, adjustable gastric banding; *RBS*, redo bariatric surgery; *%TWL*, percentage of total weight loss; *PBS*, primary bariatric surgery

Table 8 RBS: group 3 (patients with insufficient control of obesity-related diseases after primary procedure)

	Group 3: non-responders	Group 3: responders (remission of HT and/or T2D)	<i>p</i> value
n (%)	44 (50.6%)	43 (49.4%)	n/a
Median BMI after RBS, kg/m ² (IQR)	35.1 (32.3–40.4)	30.7 (27.2–37.1)	< 0.001
Type of RBS			0.001
LSG/re-SG	15 (34.1%)	3 (7.0%)	
Others (SASI, reduction of gastric pouch after RYGB)	3 (6.8%)	2 (4.7%)	
RYGB	10 (22.7%)	5 (11.6%)	
OAGB	16 (36.4%)	33 (76.7%)	
Remission of type 2 diabetes mellitus, <i>n</i> (%)	0	28 (90.3%)	< 0.001
Remission of hypertension, <i>n</i> (%)	0	26 (72.2%)	< 0.001
Postoperative morbidity, <i>n</i> (%)	9 (20.5%)	9 (20.9%)	0.956
Median %TWL after RBS (IQR)	29.2 (24.4–35.6)	39.1 (33.5–43.6)	< 0.001

Significant *p*-values (below 0.05) are bolded

HT, hypertension; *T2D*, type 2 diabetes; *BMI*, body mass index; *RBS*, redo bariatric procedure; *LSG*, laparoscopic sleeve gastrectomy; *re-SG*, redo sleeve gastrectomy; *SASI*, single anastomosis sleeve-ileal bypass; *RYGB*, Roux-en-Y gastric bypass; *OAGB*, one-anastomosis gastric bypass; *%TWL*, percentage of total weight loss

Table 9 Multivariate logistic regression analysis for factors contributing to bariatric success: group 3 (patients with insufficient control of obesity-related diseases after primary procedure)

	OR	95% CI	<i>p</i> value
BMI pre-RBS > 45.5 kg/m ²	0.48	0.15–1.49	0.201
Types of RBS			
LSG/re-SG	1.00		
Others (SASI, reduction of gastric pouch after RYGB)	2.81	0.31–25.78	0.362
RYGB	2.19	0.41–11.63	0.356
OAGB	7.23	1.67–31.33	0.008

Significant *p*-values (below 0.05) are bolded

OR, odds ratio; *95% CI*, 95% confidence interval; *BMI*, body mass index; *RBS*, redo bariatric surgery; *LSG*, laparoscopic sleeve gastrectomy; *Re-SG*, redo sleeve gastrectomy; *SASI*, single anastomosis sleeve-ileal bypass; *RYGB*, Roux-en-Y gastric bypass; *OAGB*, one anastomosis gastric bypass

Table 10 Efficacy results' comparison in relation to the type of redo-surgery in 3 groups

Group 1 (n = 352)		Group 2 (n = 177)		Group 3 (n = 87)	
Non-responders (n = 114)	Responders (n = 238)	Non-responders (n = 47)	Responders (n = 130)	Non-responders (n = 44)	Responders (n = 43)
LSG/re-SG (n = 70)		LSG/re-SG (n = 24)		LSG/re-SG (n = 18)	
24 (34.3%)	46 (65.7%)	11 (45.8%)	13 (54.2%)	15 (83.3%)	3 (16.7%)
RYGB (n = 138)		RYGB (n = 39)		RYGB (n = 15)	
49 (35.5%)	89 (64.5%)	17 (43.6%)	22 (56.4%)	10 (66.7%)	5 (33.3%)
OAGB (n = 133)		OAGB (n = 110)		OAGB (n = 49)	
39 (29.3%)	94 (70.7%)	16 (14.5%)	94 (85.5%)	16 (32.7%)	33 (67.3%)
Others (n = 11) (BPD-DS, SAGI, SASI)		Others (n = 4) (Fobi-pouch operation, gastric pouch reduction after RYGB, BPD-DS, SAGI)		Others (n = 5) (SASI, reduction of gastric pouch after RYGB)	
2 (18.2%)	9 (81.8%)	3 (75%)	1 (25%)	3 (60%)	2 (40%)

Definitions of response: > 50% EWL for groups 1 and 2, remission of T2D and/or HT for group 3

RBS, redo bariatric procedure; *LSG*, laparoscopic sleeve gastrectomy; *re-SG*, redo sleeve gastrectomy; *RYGB*, Roux-en-Y gastric bypass; *OAGB*, one-anastomosis gastric bypass; *BPD-DS*, biliopancreatic diversion with duodenal switch; *SAGI*, single anastomosis gastric-ileal bypass; *SASI*, single anastomosis sleeve-ileal bypass; %*EWL*, percentage of excess weight loss; *T2D*, type 2 diabetes; *HT*, hypertension

Conclusion

- ▶ **Redo bariatric surgery** is an effective form of treatment in patients who did not achieve good results after primary bariatric operations. **67.6% of patients after PBS** with weight regain (obesity recurrence) exceeded **50% EWL after RBS**. In three-quarters of patients (**73.7%**) who did not achieve **satisfactory weight** loss after PBS to begin with, RBS was successful treatment leading to **> 50% EWL**. Half of all patients (**49.4%**) that underwent RBS because of **insufficient control** of hypertension and/or type 2 diabetes experienced remission of at least one of these conditions.

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- ▶ Greater BMI difference between the time of RBS and lowest after PBS was associated with smaller chance of success in patients that underwent RBS because of weight regain or insufficient weight loss. In group that underwent RBS because of insufficient control of obesity-related diseases, OAGB as RBS was associated with greater chance of success