



به نام خدای بخشناينده مهربان

In the name of Allah, the Beneficent, the Merciful.

Anastomotic Leak Following Gastric Bypass



Book Review

Complications in Bariatric Surgery

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Editors

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Introduction

- Obesity represents a major public health-care problem
- The WHO estimates that 13% of the world's adult population suffers with obesity [1]
- Bariatric surgery is considered to be the most effective option for its treatment and related comorbidities
- Over the past decades, the Roux-en-Y gastric bypass (RYGB) has been proven to be very effective due to the favorable metabolic effect provided
- Currently, RYGB is the **second most common** bariatric procedure performed worldwide (36.9%) following sleeve gastrectomy (45.9%)
- Nonetheless, this procedure may be technically challenging because it requires operating in two different abdominal quadrants within the characteristic body habitus of a patient with morbid obesity, where advanced surgical skills are crucial for appropriate intestinal reconstruction

Introduction

- Despite the **low morbidity and mortality** rates associated with RYGB, several perioperative **complications** may arise **including**:
 - bleeding,
 - infection,
 - port site herniation,
 - marginal ulceration,
 - anastomotic leaks, and
 - anastomotic strictures
- ❖ Among these conditions, **anastomotic leak** is the most serious and feared complication following the procedure

Introduction

- Postoperative anastomotic leak incidence is variable, ranging from 1% to 5.6% , but is associated with high morbidity and mortality rates (30%)
- Moreover, a leak rate of 1.5% at a high-volume bariatric center would be considered at the higher end of leak rates
- The presence of anastomotic leaks represents a devastating complication for the patient, leading to significant morbidity and mortality, extended length of hospital stay, additional diagnostic studies, and potential reoperation

Introduction



- The clinical presentation may be subtle or even delayed, requiring a high index of **suspicion** and attention during the postoperative course
- An early diagnosis is *crucial* for the management of leaks and can significantly reduce the risk of further complications
- The most effective strategy consists in adapting the therapeutic options to the time of presentation and to the patient's hemodynamic status
- **The key features of the management are based on medical support, appropriate drainage of the leak, and repairing the underlying defect**

Etiology and Classification

- Anastomotic leaks are defined by Brethauer et al. as
- ❑ **“The egress of gastrointestinal contents through a suture or staple line into a cavity.”**
- ✓ The pathogenesis of leak depends on mechanical and/or ischemic factors disrupting the normal acute healing process , in addition to an increasing intraluminal pressure that exceeds the strength of the anastomotic staple line
- ✓ These factors are divided into **techniquerelated factors**, such as tissue tension or types of anastomosis reinforcement , and **patient-related factors**
- ✓ Nguyen et al. found that factors associated with higher rates of complications following gastric bypass were: age greater than 50 and male gender
- ✓ Likewise, Livingston et al. reported in their study that BMI ≥ 50 kg/m², male gender, and previous bariatric operations were independent factors for the development of leaks after RYGB

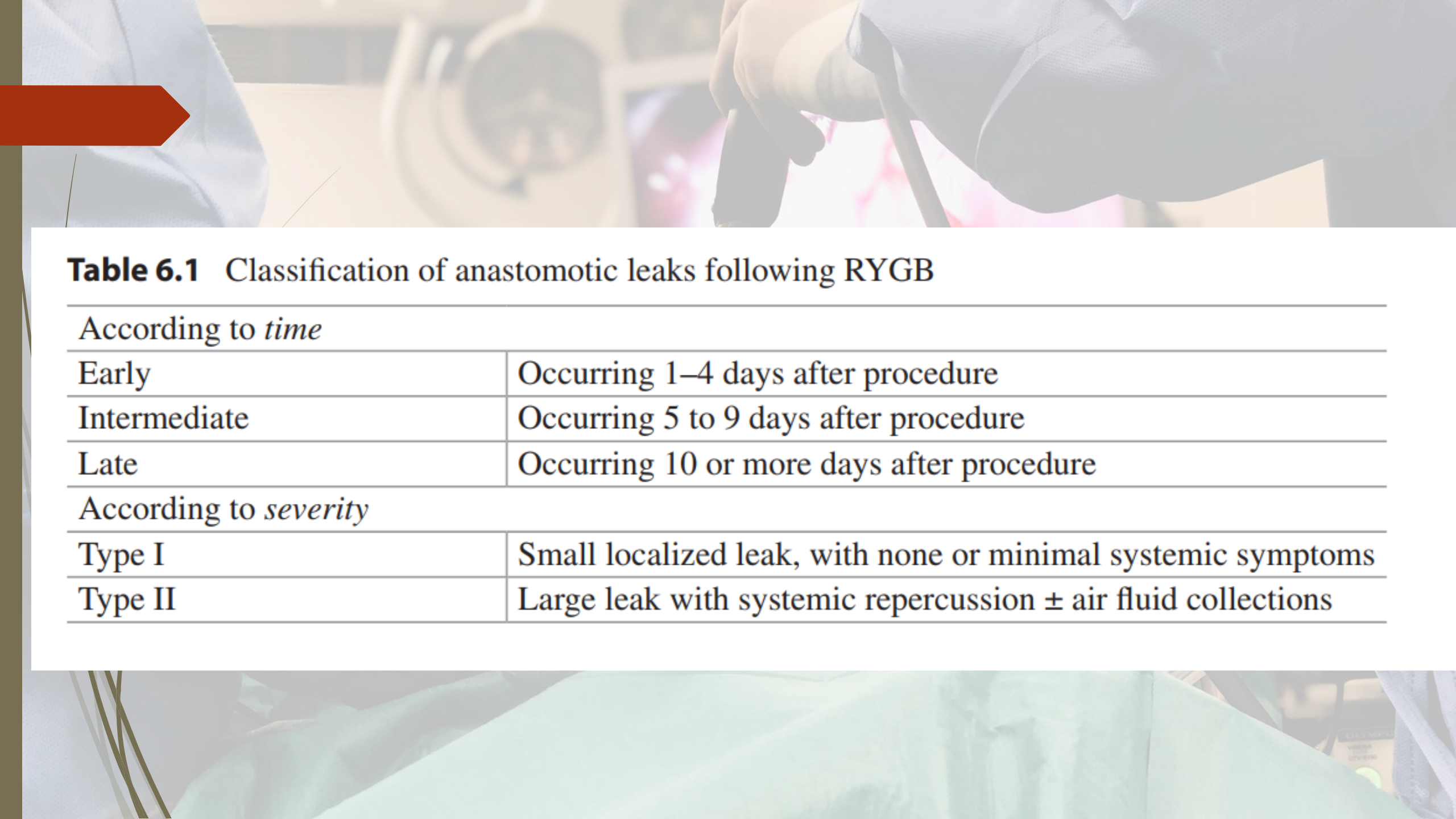


Table 6.1 Classification of anastomotic leaks following RYGB

According to <i>time</i>	
Early	Occurring 1–4 days after procedure
Intermediate	Occurring 5 to 9 days after procedure
Late	Occurring 10 or more days after procedure
According to <i>severity</i>	
Type I	Small localized leak, with none or minimal systemic symptoms
Type II	Large leak with systemic repercussion \pm air fluid collections

Etiology and Classification

- The post-RYGB anastomotic leak classification depends on the time of presentation of the leak, its severity (Table 6.1), and its location (Fig. 6.1)
- Leaks developing within 5 days are mostly related to technical properties of the procedure, whereas leaks occurring after 5 days post-procedure are usually resulting from localized ischemia or infection
- Csendes et al. found intermediate leaks to be the most frequent type (46.7%) followed by early leaks (28.3%) and late leaks (25%).
- Additionally, they reported 80% of the anastomotic leaks as clinically severe

Fig. 6.1 Location of leaks following gastric bypass.
(a) Gastrojejunal anastomosis. (b) Gastric pouch staple line. c Gastric remnant staple line. (d) Jejunoj jejunal anastomosis. (e) Jejunal stump

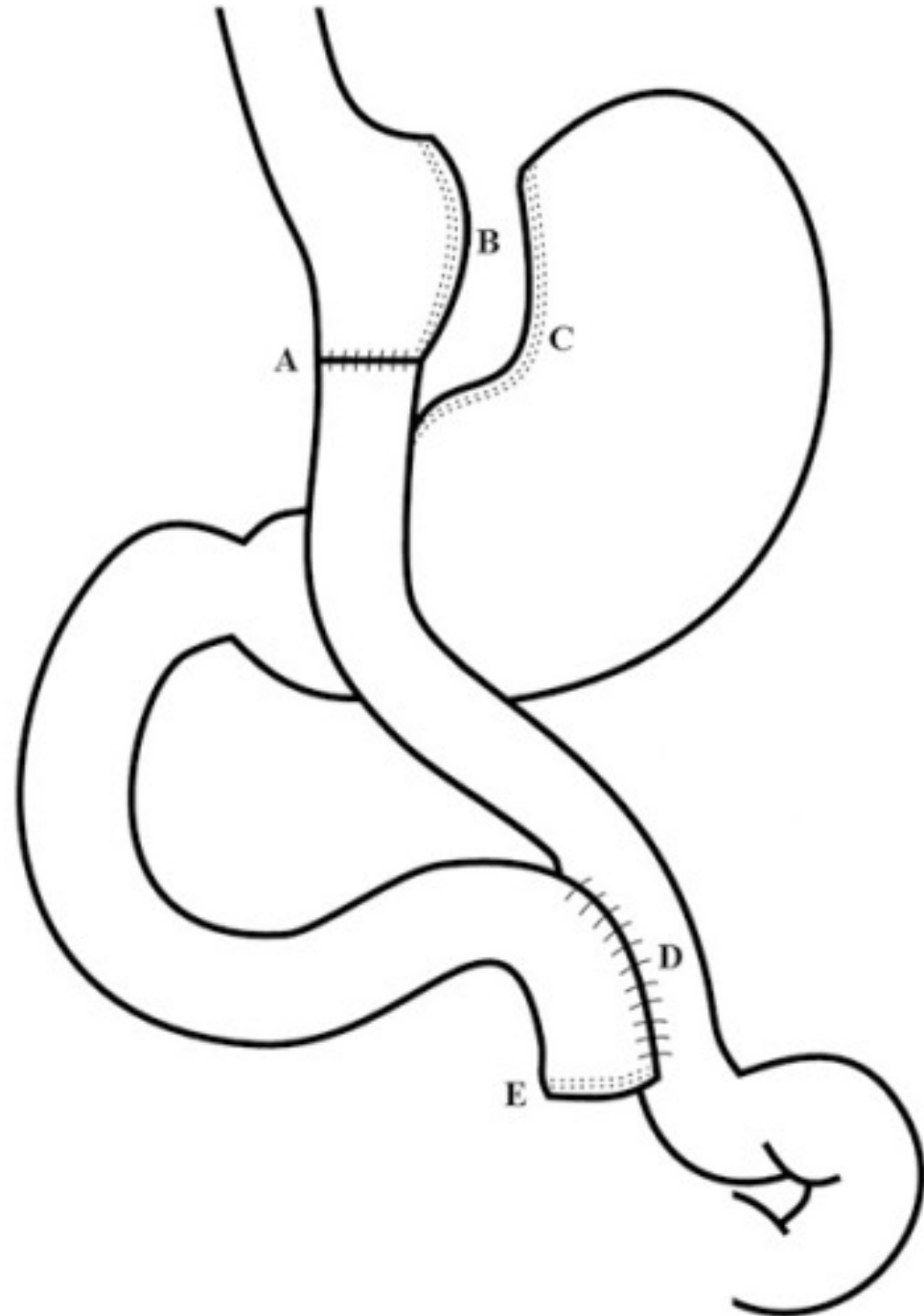


Table 6.2 Location of anastomotic leaks following RYGB

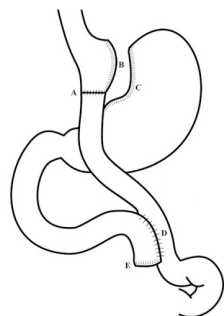
Site	Percentage
Gastrojejunostomy	53.3%
Gastric pouch staple line	18.3%
Jejunal stump	15%
Jejunojejunostomy	5.5%
Gastric remnant staple line	1.7%

Created with data from Csendes et al. [6]

Etiology and Classification

- Regarding the location of a leak, the **most common** site is at the gastrojejunal anastomosis (GJ), followed by leaks located at the gastric pouch staple line; jejunal stump; jejunojejunostomy (JJ), which is associated with greater mortality rates; and gastric remnant staple line (Table 6.2)

Fig. 6.1 Location of leaks following gastric bypass.
(a) Gastrojejunal anastomosis. (b) Gastric pouch staple line. (c) Gastric remnant staple line. (d) Jejunojejunal anastomosis. (e) Jejunal stump



Prevention

- The **best way** to manage anastomotic leaks is to prevent its development
- Multiple intraoperative methods are designed to decrease the incidence of leaks including, but not limited to, staple-line reinforcement with synthetic materials such as fibrin glue or other tissue sealants; however, studies report variable outcomes regarding the efficacy of these approaches
- Varban et al. , in their multicentric study of anastomotic leaks following RYGB, found **no association** between the type of anastomosis (hand-sewn, circular or linear stapler) and the development of leaks

Prevention

- Conversely, they found a significant relationship between the use of a **fibrin sealant** and lower leaks rate, whereas the use of buttressing material was found to be significantly related with higher rates
- **Diagnostic tests** such as the **methylene blue test** or the **air-leak test** may be beneficial in identifying leaks intraoperatively and allowing them to be repaired immediately during the procedure
- **However, these tests will not predict the future development of a leak**

Prevention

- Another important factor related to decreasing anastomotic leak rates is the **surgeon's experience**
- Schauer et al. studied the learning curve of a single surgeon over 100 laparoscopic RYGB cases concluding that there is a significant relationship between greater operative performance and lower overall complication rate
- Although the incidence of staple-line leaks decreased with greater surgeon's experience, the reduction did not reach statistical significance
- Conversely, DeMaria et al. studied 281 cases of laparoscopic RYGB and found a reduction in the rate of leaks on the latter phase of their series
- → → **They concluded that the learning curve is clearly associated with the rates of complications**

Early Diagnosis and Intervention

- An early diagnosis is essential to significantly reduce the morbidity and mortality rates associated with postoperative leaks
- This condition may be challenging to diagnose and may rapidly progress to systemic illness; therefore, surgeons need to **suspect** and treat leaks in a timely manner
- An appropriate evaluation of clinical signs and symptoms during the postoperative course is the key to an early diagnosis
- Even minimal symptoms should be investigated for leaks, since its early identification is vital to achieving an optimal outcome
- **Post-procedural tachycardia, abdominal pain, fever, or persistent hiccups are the most common symptoms**
- **Tachycardia** is the earliest indicator of hemodynamically instability

Early Diagnosis and Intervention

- A heart rate greater than 120 should prompt an investigation, **even** if the patient looks and feels well
- A pulse rate over 90 beats per minute on postoperative day 1 distinguishes between patient with and without leaks with a sensitivity of 100% and a specificity of 87%
- Furthermore, the combination of tachycardia, tachypnea, and fever has a **high positive predictive value** for the presence of leaks
- A delay in diagnosis (>24 h) is associated with unfavorable outcomes

Early Diagnosis and Intervention

- **Imaging studies** are useful for the early detection of leaks
- Upper gastrointestinal series (**UGIS**) with soluble contrast assists evaluating the integrity of the gastrojejunostomy and jejunojejunostomy
- A routine UGIS has a positive predictive value of 67% and a negative predictive value of 99% for anastomotic leak detection
- Additionally, this study provides useful information about the intestinal anatomy or alterations such as abnormal dilation of the remnant or other causes of bowel obstruction

Early Diagnosis and Intervention

- **A contrast-enhanced abdominal CT** scan has higher sensitivity and specificity than UGSI and is superior at detecting whether a leak appears contained or is communicating with the abdominal cavity
- A CT scan is also helpful at detecting abscess, collections, hernias, or any other pathological conditions after RYGB
- Although typically accurate, radiologic studies have limitations and can sometimes delay accurate diagnosis and therapy
- Gonzalez et al. reported a false-negative rate of 30% in patients with leaks undergoing combined diagnostic UGIS and CT scan

Management

- The management of anastomotic leaks needs a multidisciplinary approach based on the **severity** and **location** of the leak, as well as the **hemodynamic status** of the patient
- Surgical management is the keystone of the treatment and should be considered in the early postoperative period and in every **unstable patient**
- Operative management consists in adequate drainage of the leak to decontaminating the abdominal cavity and preventing future complications, followed by addressing the defect responsible for the leakage
- Nonoperative management may be considered in selected patient based on *hemodynamic stability*

Management



- **Endoscopy** plays a valuable role in the diagnosis and treatment of gastrointestinal leaks after bariatric surgery
- It is commonly used to delineate the gastric anatomy and to rule out the presence of distal strictures that may be contributing to the development of a leak and its failure to heal
- It is also an excellent tool for multiple therapeutic interventions aimed to treating a leak (Table 6.3)
- Schiesser et al compared the outcomes of a group of patients treated with reoperation and drain placement versus the outcomes of a group of patients treated with endoscopy using different approaches such as stent placing, over-the-scope clip application, and percutaneous drains
- →→ The rate of **leak resolution** among the groups was 88% versus 100%, respectively

Table 6.3 Outcomes of post-RYGB managed endoscopically

Study	No. of subjects	Resolution rate (%)	Therapeutic option used
Kowalski et al.	5	100%	Fibrin sealant injection
Victorzon et al.	6	100%	Fibrin sealant injection
Shehab et al.	12	100%	OTSC
Salinas et al.	17	94%	SEMS
Freedman et al.	35	86%	Sent (not specified)
Maluf-Filho et al.	25	80%	Fibrin sealant injection

Created with data from Joo [25]

OTSC over-the-scope clip, *SEMS* self-expandable metal stent

Management

- Recently developed techniques, such as the use of vacuum-assisted endoscopic drainage, demonstrated promising rates of leak resolution ranging from 85% to 100%
- Several endoluminal therapies can be used for the management of a leak
- Early drainage, early endoscopic intervention, and early correction of distal strictures are of great significance
- This process often includes placement of endoscopic clips, fibrin glue, absorbable fistula plugs, and endoluminal stenting
- Chang et al. studied the outcomes of endoscopically placed stents for the management of postoperative anastomotic complications after foregut surgery
- Regarding the management of leaks following RYGB, they achieved 100% resolution of GJ and gastric pouch staple-line leaks, **finally suggesting that managing these complications by endoscopy is very effective**

Management

- **Medical support or conservative management** includes :
 - nil per os status,
 - broadspectrum antibiotics, and
 - percutaneous access to the gastric remnant for decompression and feeding, as well as percutaneous drainage of collections
- **Sepsis control** revolves around defining the leak and managing potential collections, either through a percutaneous approach or operative intervention

Management

- **Nutritional support** is essential and can be achieved in several different ways
- Patients undergoing endoscopic intervention can either restore oral intake after exclusion of the leak or have reliable **enteral access** placed at the time of the endoscopy, either by nasojejunal route or endoscopic tube placement

Management

- Csendes et al. reported in their study that 65% of anastomotic leaks were successfully managed by conservative treatment
- **Surgical intervention** was performed in 9% of the localized leaks **(type I)** and in 42% of the clinically severe/disseminated leaks **(type II)**
- They concluded that early surgical intervention is necessary when dealing with type II leaks localized at the JJ or GJ anastomosis
- On the other hand, when a leak develops several-day post-procedure, even if it is a type II anastomotic leak, it can be managed conservatively

Management

- Jacobsen et al. studied 6000 patients post-laparoscopic RYGB and reported 64 patients complicated with anastomotic leaks (corresponding to 1.1% of the population)
- Two thirds of those patients were considered to have leaks categorized as **IIIB** or more (according to the Clavien-Dindo classification) and were managed successfully with reoperation
- An interesting fact of this study was that 62% of those patients were diagnosed based only their clinical status (tachycardia, fever, abdominal pain)

Management

- The management of anastomotic leaks must be tailored to the severity and the time of presentation
- **Follow-up imaging** studies are necessary to assessing the progress or resolution of leaks

Conclusion

- Anastomotic leaks following Roux-en-Y gastric bypass represent a serious complication in bariatric patients leading to significant morbidity and mortality
- **Early diagnosis** is fundamental in their management
- Furthermore, anastomotic leaks are predictable based on clinical symptoms in the postoperative period
- Therefore, physicians should evaluate any postoperative **tachycardia, tachypnea, or fever** which can be the only parameters leading to an accurate diagnosis

Conclusion

- If diagnostic tests are inconclusive but clinical suspicion is high, the patient should return to the operating room early
- A delay in diagnosis and treatment is associated with adverse outcomes
- If a patient is diagnosed with a contained leak on UGIS or CT scan and is hemodynamically stable, conservative management with bowel rest, antibiotics, and percutaneous drainage may be appropriate
- Endoscopy must be considered as a therapeutic approach, since less invasive interventions with optimal outcomes are currently being highly demanded by the bariatric population



Single-Anastomosis Sleeve Jejunal (SAS-J) Bypass as Revisional Surgery After Primary Restrictive Bariatric Procedures

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Abstract

Purpose Single-anastomosis sleeve jejunal (SAS-J) bypass is the modification of a single-anastomosis sleeve ileal (SASI) bypass with a short biliary limb. SAS-J bypass is reported to be a good primary bariatric procedure. This study aimed to evaluate the results of SAS-J bypass as a revisional surgery after failed primary restrictive bariatric procedures.

Material and Methods This was a prospective cohort study including 43 patients who underwent SAS-J bypass as a revisional surgery for weight regain after laparoscopic sleeve gastrectomy (LSG), laparoscopic adjustable gastric band (LAGB), or laparoscopic gastric plication.

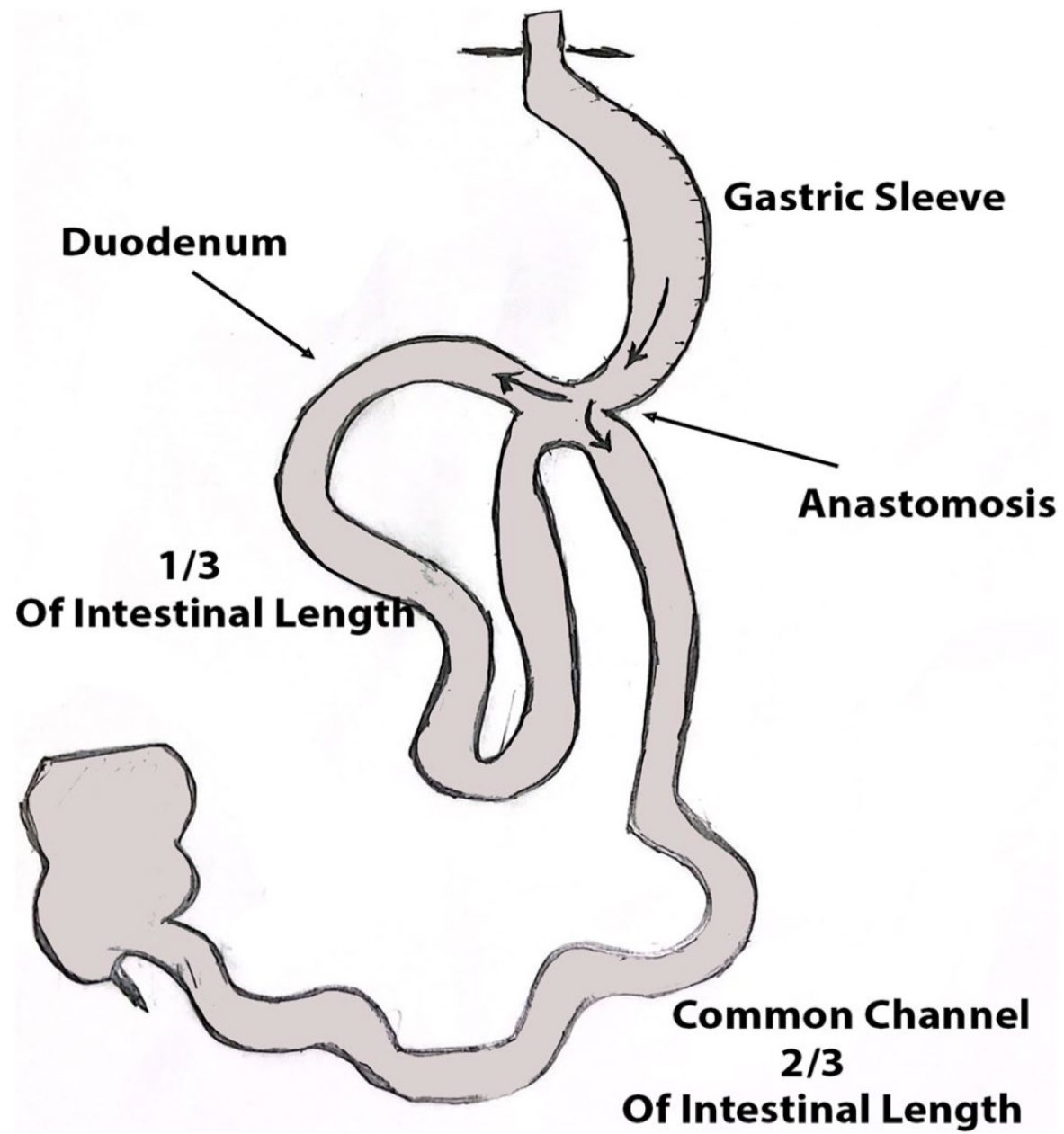
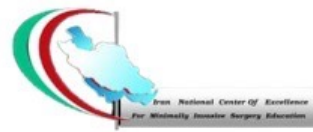


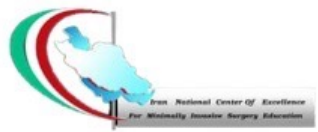
Fig. 1 Schematic demonstration of SAS-J bypass

Single-Anastomosis Sleeve Jejunal (SAS-J) Bypass as Revisional Surgery After Primary Restrictive Bariatric Procedures



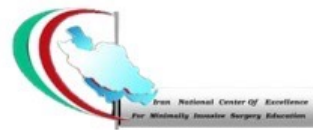
- **The definition** of weight regain has not yet been established in the literature, but around one-third of studies define it as a BMI of ≥ 35 kg/m² or EWL of $\leq 50\%$
- The reported failure rates after LSG, VBG, and LAGB are up to 30–60%
- **Revisional procedures** have moderate efficacy for weight loss, with a higher complication rate and longer length of stay compared to primary bariatric interventions

Single-Anastomosis Sleeve Jejunal (SAS-J) Bypass as Revisional Surgery After Primary Restrictive Bariatric Procedures



- ➔ **SAS-J bypass** is effective as a primary bariatric procedure, with many advantages, including its relative simplicity, less malnutrition compared to other malabsorptive procedures, and easy screening of the upper GIT and biliary tree

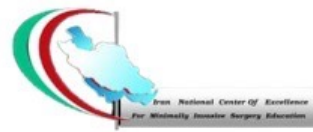
Single-Anastomosis Sleeve Jejunal (SAS-J) Bypass as Revisional Surgery After Primary Restrictive Bariatric Procedures



➤ Materials and Methods

- This was a prospective cohort study of 43 patients who underwent SAS-J bypass as a revisional procedure after weight regain or failure of LSG, gastric plication, or LAGB between January 2018 and January 2021
- Of the total number, 5 cases were operated in our center, and the other 38 were operated in other centers
- Failure was considered when EWL was $< 50\%$, BMI remained ≥ 35 kg/m², or control of obesity-related comorbidities was not satisfactory
- Weight regain was defined as an increase in BMI to > 35 kg/m² after successful weight loss

Single-Anastomosis Sleeve Jejunal (SAS-J) Bypass as Revisional Surgery After Primary Restrictive Bariatric Procedures



➤ Materials and Methods

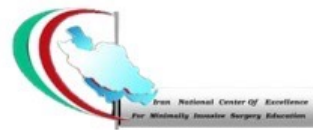
- In this study, all patients asked for revisional surgery, mainly for weight regain after initial satisfactory weight loss \pm comorbidities (as shown in Table 1)
- Weight regain was due to patient noncompliance with lifestyle change and follow-up
- All patients had a psychological consultation
- They were informed that lifestyle change is the mainstay of long-term results and consented to this
- The primary operations were done at least 5 years before the revisional operation
- All patients had at least one trial of a weight-loss diet for 3–6 months with a nutritionist

Table 1 Indications for the revisional surgery

Indication for surgery	1ry procedure		
	LSG (No. = 32)	LAGB (No. = 9)	Gastric plication (No. = 2)
Weight regain	32	9	2
+DM	3	1	1
+HPN	4	1	0
+SAS	2	0	1
+GERD	9	6	0
+Hyperlipidemia	11	6	1

DM diabetes mellitus, *HPN* hypertension, *SAS* sleep apnea syndrome, *GERD* gastroesophageal reflux disease

Single-Anastomosis Sleeve Jejunal (SAS-J) Bypass as Revisional Surgery After Primary Restrictive Bariatric Procedures



- **Surgical Technique**
- The patient was placed in the French position with a steep reverse-Trendelenburg position
- The surgeon stood between the patient's legs
- All patients were operated on under general anesthesia with endotracheal intubation
- The camera port was inserted cautiously using an optical trocar, and the other working ports were entered under direct vision

SAS-J Bypass After LAGB

- Dissection of adhesions was done cautiously
- If the adjustable band was present, it was removed first, together with its capsule or at least the anterior side of the capsule
- After complete dissection of all adhesions to free the stomach from the liver anteriorly, we began with the division of the greater omentum from the stomach and continued division upward to the left crus of the diaphragm
- The crus was completely cleared from any adhesions
- The stomach was completely freed posteriorly by dissecting any adhesions between it and the pancreas

SAS-J Bypass After LAGB

- The dissection continued downward toward the pylorus
- A 36 French calibration tube was used for the proper sleeve
- The stapling was initiated 6 cm from the pyloric ring and continued using suitable reload colors according to the stomach thickness
- Stapling was continued until it completely divided the stomach
- We routinely **oversewed the staple line** using a running 3–0 Prolene suture
- The sleeved stomach was **routinely fixed to the crus** of the diaphragm, to prevent later migration of the stomach into the chest and decrease the incidence of reflux, and also **fixed to the peripancreatic fascia** to prevent its twisting
- Division of ligaments that fix the stomach during LSG may lead to gastric torsion and postoperative emptying disorders
- Gastric volvulus has been already reported after LSG

SAS-J Bypass After LAGB

- The duodenojejunal (DJ) junction was then identified, and we measured the total intestinal length from the DJ by the number of counts instead of using a measure
- We then took nearly **one third of the total** count from the DJ junction (for example, if the total intestinal count was 100, the anastomosis was done at 33 counts from the DJ)
- This process standardized the procedure to a percentage rather than a fixed length (see Fig. 1), since the common limb may be short in some and longer in others
- Some patients have a much smaller or much longer total bowel length
- The jejunum was fixed at the desired length with an orientation stitch to the pylorus.

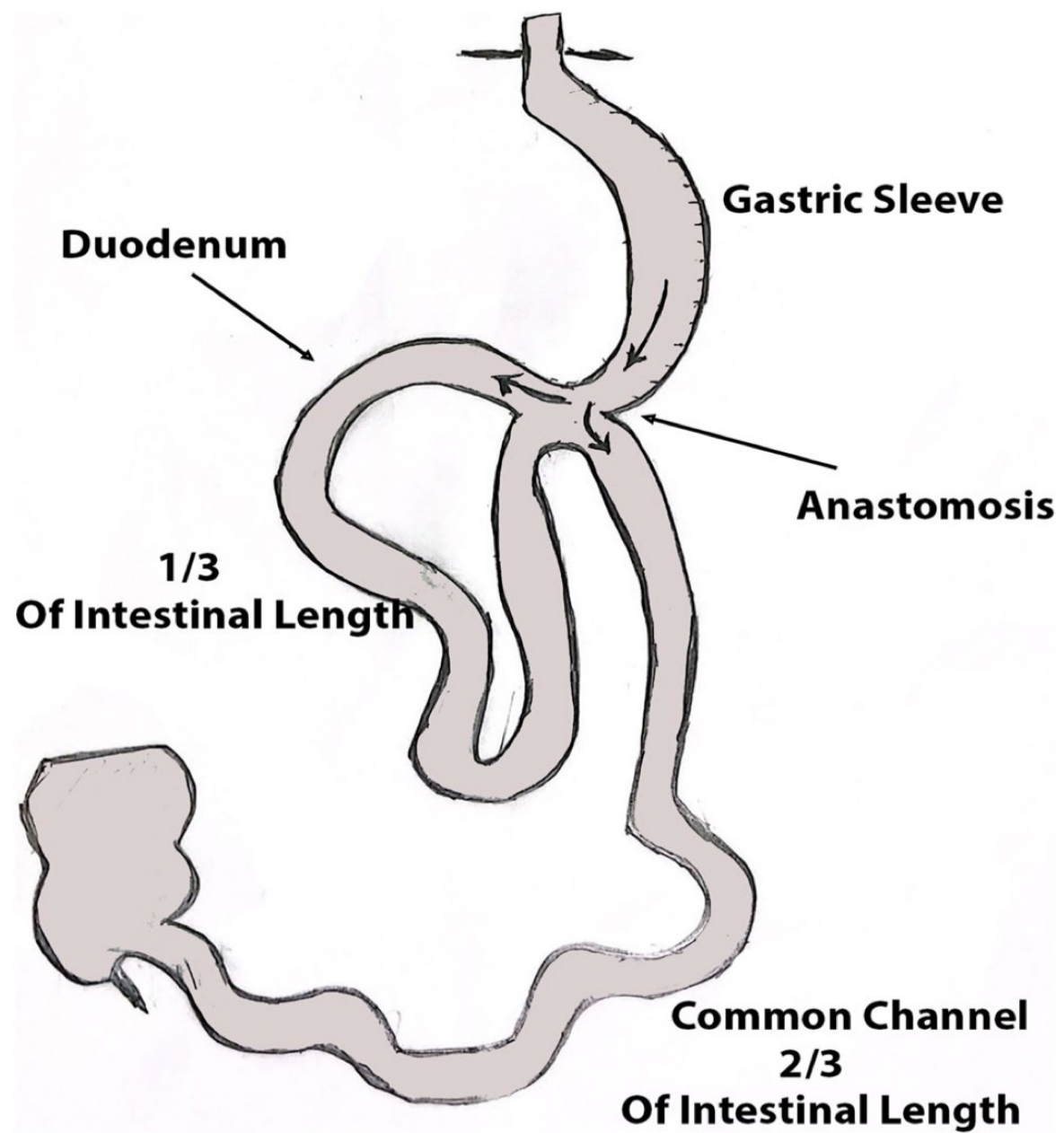


Fig. 1 Schematic demonstration of SAS-J bypass

SAS-J Bypass After LAGB

- The anastomosis between the jejunum and sleeved stomach was performed at the dissected inferior border of the sleeved stomach, using a 45-blue reload at around 1–2 cm from the pyloric ring, to make an approximately 40-mm stoma
- Early in our practice of SAS-J, we noticed unsatisfactory weight loss using 30 reload
- The defect in the gastro-jejunal anastomosis was then closed with a two-layer running suture
- Finally, another orientation stitch was made at the left side of the anastomosis between the jejunum and the staple line of the stomach
- The aim of these two orientation stitches was as follows: (1) to minimize tension on the anastomosis, (2) to make the anastomosis and the jejunal loop anatomically oriented without twisting, and (3) as an anti-reflux measure by the left stitch
- Finally, a **methylene blue leak test** was performed.

Results

Preoperative Data

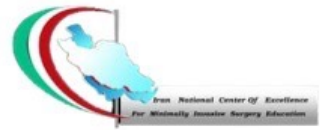
- This study included 43 patients who underwent SAS-J bypass as a revisional procedure after failed LAGB, LSG, or gastric plication between January 2018 and January 2021
- Of the patients, 32 (74.4%) had a failed sleeve, 9 (20.9%) had a failed LAGB, and 2 (4.7%) had a failed gastric plication
- In all cases, weight regain was the main cause of revision (Table 1)
- Thirty-five (81.4%) patients were female, and 8 (18.6%) were male
- The mean BMI was 46.3 kg/m^2 , and the mean age was 41 years
- T2DM was present in 5 patients (11.6%), hypertension in 5 (11.6%), gallstones in 2 (4.7%), OSAS in 3 (7%), GERD in 15 (35%), and hyperlipidemia in 18 (42%; see Table 2)

Table 2 Preoperative characteristics of all patients

Variables		Value (total number = 43)
Age		41 ± 6
Sex	F	35 (81.4%)
	M	8 (18.6%)
Primary procedure	LSG	32 (74.4%)
	LAGB	9 (20.9%)
	Gastric plication	2 (4.7%)
Weight		126 ± 13
Height in meter		1.66 ± 0.06
BMI		46 ± 3
Comorbidities	Diabetes	5 (11.6%)
	Hypertension	5 (11.6%)
	GERD	15 (35%)
	Hyperlipidemia	18 (42%)
	Sleep apnea	3 (7%)
Gallstone		2 (4.7%)

F female, *M* male

Operative and Early Postoperative Results



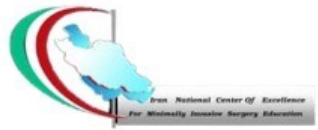
- Preoperative gallstones were present in 2 (4.7%) patients, who underwent cholecystectomy in the same session with no complications
- The mean operative time was 104 min, with almost all cases discharged the next day
- Intra-abdominal bleeding occurred in 1 case (2.3%); laparoscopic exploration revealed only a large peri-gastric hematoma, and evacuation was performed without locating an apparent source of the bleeding
- Intraluminal bleeding occurred in 3 cases (7%); these patients presented with rectal bleeding on the second postoperative day
- The bleeding was managed by conservative treatment
- **No case (0%) developed a leak (Table 3)**

Table 3 Intraoperative variables and complications

Variables		Value (total number=43)	
Associated lap chole		2 (4.7%)	
Operative time		104 ± 23	
Return to work		10 ± 2 days	
Complications		Incidence	Grade
Early	Leakage	0 (0%)	III
	Intra-abdominal bleeding	1 (2.3%)	III
	Intramural bleeding	3 (7%)	III
Late	Biliary gastritis	4 (9.3%)	I
	Dumping	4 (9.3%)	I
	Iron deficiency	3 (7%)	I
Total		15 (34.8%)	

NB: Complication grading is according to Clavien-Dindo

Short-term Effect on BMI and Comorbidities



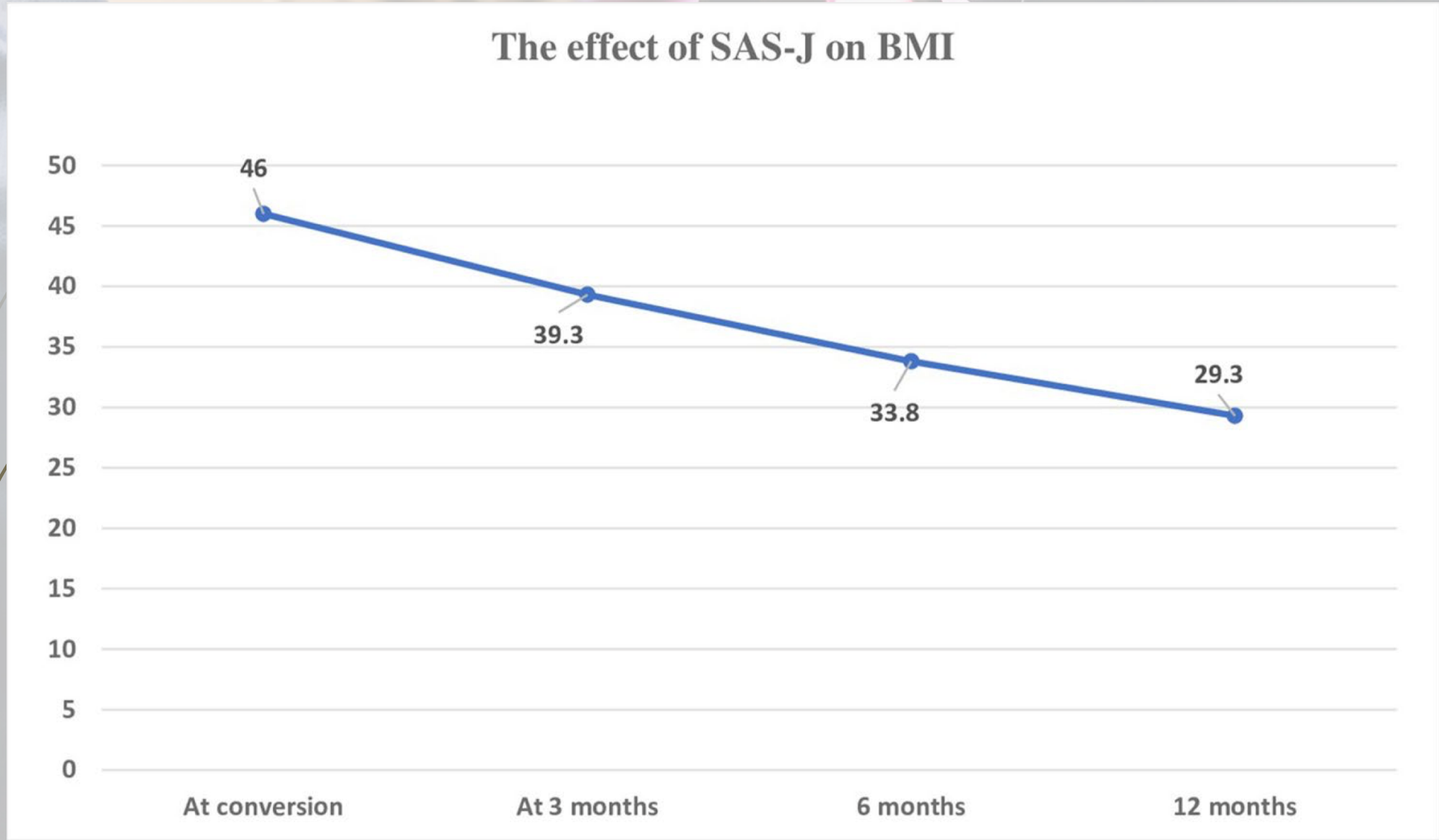
- The mean %TWL was 30% and the mean %EWL reached 76.5% for all included patients after 1 year, the minimum follow-up period (Fig. 2)
- In 27 patients who completed 2 years of follow-up, the %EWL reached 77.6%, and the %TWL was 32.7%
- T2DM remission occurred in all diabetic patients within 3 months of surgery, hypertension remitted in 80%, hyperlipidemia remitted in 83.3%, and OSAS improved in all cases at 1 year of follow-up
- GERD symptoms were improved in 86.7% of patients (Tables 4 and 5).

Table 4 The effect of SAS-J bypass on weight loss

	At time of conversion No. = 43	3 months postoperative No. = 43	6 months postoperative No. = 43	12 months postopera- tive No. = 43
BMI	46 ± 3	39.3 ± 1.5	33.8 ± 1	29.3 ± 2
%TWL	-	9 ± 1	20.5 ± 3	30 ± 5.8
%EWL	-	17.2 ± 4	55.3 ± 3	$76.5\% \pm 9\%$

Each *p* value was calculated by paired *t*-test. We compared each value with just before follow-up values

Fig. 2 The effect of SAS-J bypass on BMI



The effect of SAS-J bypass on comorbidities

	Preoperative No.=43	At 3 months No.=43	6 months No.=43	12 months No.=43	% of improvement	<i>p</i> value
Diabetes	5/43 (11.6%)	0	0	0	100%	< 0.02
Hypertension	5/43 (11.6%)	1	1	1	80%	< 0.09
Hyperlipidemia	18 /43(42%)	16	6	3	83.3%	< 0.001
Sleep apnea	3/43 (7%)	2	0	0	100%	< 0.07
GERD	15/43(35%)	2	2	2	86.7%	< 0.001

p value is significant when $\leq 0.05\%$. Each *p* value was calculated by chi-square test. We compared each the preoperative incidence with the incidence at 1-year follow-up

Conclusion

- ➡ **SAS-J bypass** is effective as a salvage surgery after failed restrictive bariatric procedures, but long-term follow-up is needed.

thank
you