Outcome of pouch reduction for dilated stomach in patients with weight loss failure after laparoscopic sleeve gastrectomy

Karim W. Shawky, Alaa A.S. Mostafa, Bassem H. El-Shayeb, Fady Makram

Department of General Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt

Correspondence to Karim W. Shawky, MD, Heliopolis, Cairo, Egypt.
Tel: +20 121 131 1307;
e-mail: karim.wa7id@gmail.com

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Background
Revisional surgery is increasing after different bariatric surgeries, especially after laparoscopic sleeve gastrectomy (LSG), where laparoscopic re-sleeve gastrectomy is a proposed option as one of the revisional surgeries. The aim of this study was to evaluate the outcome of weight loss results in patients who underwent revisional re-sleeve gastrectomy after LSG for weight loss failure with dilated stomach.

Patients and methods
This was a cohort prospective study conducted on 40 patients who underwent LSG and failed to lose weight effectively or experienced weight regain with either dilated stomach only or associated with presence of retained fundus and then were subjected to re-sleeve gastrectomy and were followed up for one year with correlation to their weight loss results. This study was conducted at the Bariatric Surgery Unit of Ain Shams University Hospitals starting from October 2020 till the end of October 2022.

Results
This study results concerning group A, which underwent re-sleeve gastrectomy after initial LSG with dilated stomach and associated with retained fundus, showed % of excess weight loss in the range of 5.3–18.3%, 9–58.4%, and 13.2–94.2% in 1, 6, and 12 months postoperatively, respectively. However, group B, which underwent re-sleeve gastrectomy after initial LSG with homogenously dilated stomach only, showed % of excess weight loss in the range of 7.2–20.7%, 8.9–56.7%, and 10.6–95.6% at 1, 6, and 12 months postoperatively, respectively. This study results concerning group A showed initial BMI and follow-up BMI in the range of 36.6–48.3, 34.9–45.6, 30.2–42.6, and 25.1–41.7 initially and in 1, 6, and 12 months postoperatively, respectively, whereas group B showed initial BMI and follow-up BMI in the range of 37.6–47.3, 35.1–45.3, 30.3–45, and 24.8–44.9 initially and at 1, 6, and 12 months postoperatively, respectively.

Conclusion
Re-sleeve gastrectomy is a safe and good surgical option for patients who underwent LSG and failed to lose weight effectively or experienced weight regain with either dilated stomach only or associated with presence of retained fundus, resulting in significant weight loss results after 1-year follow-up, without significant differences between the two groups.

Keywords:
dilated stomach, laparoscopic re-sleeve gastrectomy, weight loss failure

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Introduction

Obesity, defined as a BMI of $>30\,kg/m^2$, has become an epidemic with an enormous burden on public health [1]. Bariatric surgery has been demonstrated to be the most effective therapy for achieving sustained weight loss and managing obesity-related complications such as type II diabetes mellitus, hypertension, dyslipidemia, and cardiovascular diseases [2].

Laparoscopic sleeve gastrectomy (LSG) is currently the most common bariatric surgery, because of its excellent weight loss success at short-term follow-ups and its relative technical ease. As the number of LSG procedures increases, the significant issue of weight loss failure is becoming more prevalent [3].

The technique comprises removal of the greater curvature of the stomach from the antrum to the angle of His, with a resection line parallel to the lesser curvature, so as to create a long tubular gastric remnant. The mechanism of action of the LSG operation is believed to involve a combination of

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gastric restriction, hormonal effects concerning ghrelin hormone, which is mainly produced at the gastric fundus, and changes in eating habits [4].

The reduction of gastric volume, which inhibits food intake, is considered one of the main mechanisms of action of LSG. Therefore, the residual gastric volume is essential to achieve optimal weight loss results [5].

The target of LSG is to achieve an excess weight loss (EWL) greater than or equal to 50% within 2 years, associated with resolution of obesity-related comorbidities [3].

However, in up to 30% of the cases, a revision surgery is required for reasons that include insufficient weight loss or weight regain [6].

Insufficient weight loss represents an EWL of less than 50% at 2 years from surgery, whereas weight regain is defined as gaining 10 kg or 25% of EWL from nadir [7].

The potential explanation for LSG failure may be eventually identified as incomplete removal of the gastric fundus, too large gastric pouch calibrated over a too big orogastric bougie, and the dilatation of the gastric tube with consequent increase in the gastric capacity [5].

Re-LSG could be applied when the fundus is too large or when the gastric tube is dilated after the original LSG. On the long term, this dilatation may be responsible for weight loss insufficiency or weight regain [8].

Patients and methods

Type of the study

This was a cohort prospective study conducted on patients who underwent LSG.

Study population

Inclusion criteria

Patients were included in the study if they met the NIH criteria for weight loss surgery, with previous LSG operation more than 2 years ago and then failed to lose weight effectively, represented as an EWL of less than 50% at 2 years from surgery or experienced weight regain represented as gaining 10 kg or 25% of EWL from nadir with either dilated stomach only by computed tomography (CT) scan volumetry greater than 250 ml or associated with presence of retained fundus; loss of satiety despite intensified nutritional regimen and physiotherapeutic treatment; and patients who were fit for anesthesia without complications (American Society of Anesthesiologists 1 or 2).

Exclusion criteria

Patients were excluded from the study if they did not meet any of the aforementioned criteria, had other causes for weight regain, or patients for whom anesthesia was risky (American Society of Anesthesiologists 3 or above).

Study duration

Data of patients were collected prospectively starting from October 2020 till the end of October 2022.

Sample size

The required sample size was estimated to be 40 patients who underwent LSG and failed to lose weight effectively or experienced weight regain with either dilated stomach only or associated with presence of retained fundus and then were subjected to re-sleeve gastrectomy with strict follow-up till the end of October 2022.

Study tools and procedures

All patients included in the study were candidates for the following.

Clinical assessment

Detailed medical, surgical, and family history; careful analysis of symptoms like heartburn and dysphagial careful assessment of height, weight, and BMI; assessment of satisfaction level postoperatively; and general examination.

Investigations

Routine laboratory investigations such as complete blood count, liver profile, kidney profile and coagulation profile, pelviabdominal ultrasound, pulmonary function tests, echocardiography, ECG, upper gastrointestinal tract endoscopy, and CT scan volumetry.

Intervention

A total of 40 patients were subjected to laparoscopic re-sleeve gastrectomy.

Procedure

Access to the abdomen was safely granted by transparent port technique (visi-port) and then insufflation of the abdomen was done using CO_2 gas to an intra-abdominal pressure of 14 mm Hg. Four ports were placed, and the 'S-shaped' retractor was used to retract the liver. The first step of the

procedure consisted of dissecting the adhesions between the residual gastric pouch, the liver, the anterior surface of the pancreas, and the omentum by Harmonic scalpel, and then a 36-French bougie was inserted (Figs 1 and 2). Gastric resection was initiated at 4 cm proximal to the pylorus by using the 'GIA' endoscopic Ethicon stapler (Johnson & Johnson Medical Devices Company, An American multinational corporation founded in 1886) with black cartridges along the bougie until reaching the angle of His (Fig. 3) followed by instillation of methylene blue by the anesthesiologist through the bougie was used to exclude leakage from the suture line. The excised part of the stomach was extracted outside the abdomen, and then adequate hemostasis was done (Figs 4 and 5).

Follow-up

All patients were followed up by body weight, BMI, and % of EWL 1, 6, and 12 months postoperatively.

Study setting

The required sample size was estimated to be 40 patients who underwent LSG and failed to lose weight effectively or experienced weight regain with either dilated stomach only or associated with presence of retained fundus and was subjected to re-sleeve gastrectomy then strict follow-up till the end of October 2022. This study was conducted at the bariatric surgery unit of Ain Shams University Hospitals starting from October 2020 till the end of October 2022.

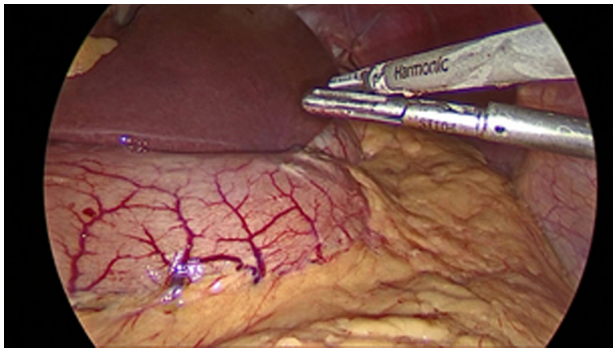
Ethical considerations

Patients' names, address, and phone numbers were not enlisted in the data gathering forms or in the database. Instead, a hospital ID was used. Access to hospital files was granted by a written permission from hospital management authorities. Forms, databases, and the sensitive information they held were private, and their access was only limited to the investigators. Approval of the Ethical Committee and written informed consent from all participants were obtained.

Data collection

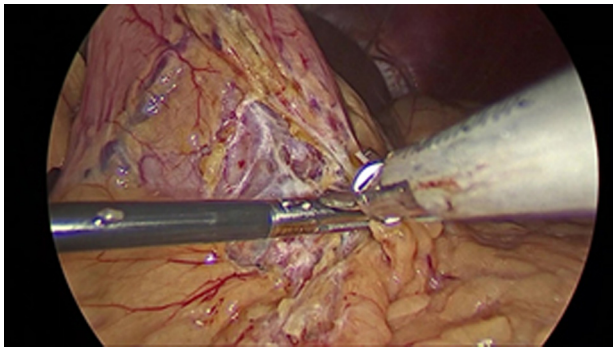
The following data were collected: patients' sex, age, medical comorbidities, initial BMI before revisional surgery, indication for surgery (either failed to lose

Figure 1



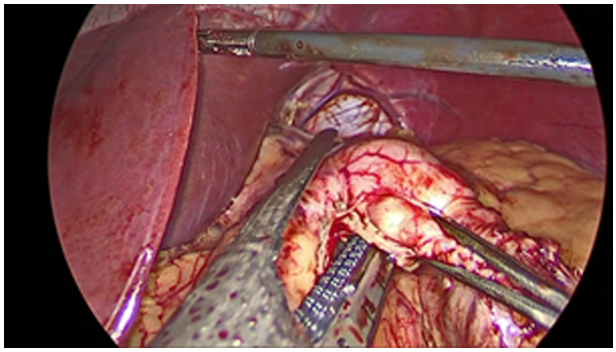
Insertion of ports and dilated stomach.

Figure 2



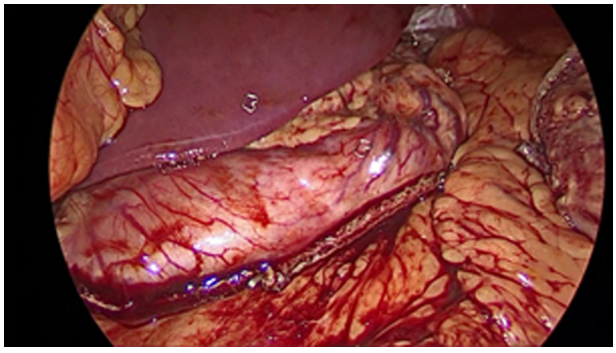
Adhesolysis of the gastric posterior wall by a harmonic scalpel.

Figure 3



Gastric stapling using 'GIA' endoscopic Ethicon stapler.

Figure 4



Methylene blue test and hemostasis.

weight effectively or experienced weight regain), follow-up body weight, BMI, and % of EWL after 1, 6, and 12 months after re-sleeve gastrectomy.

Figure 5

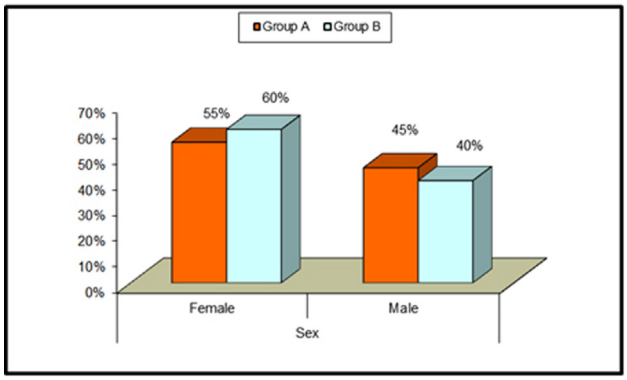
Excised part of the stomach with a retained fundus.

Results

Table 1 shows a comparison between age and sex of the two groups, and results between them were nonsignificant, where group A showed a mean age of 30.10 years, ranging 21–42 years old, whereas group B showed a mean age of 30.10 years, ranging 20–41 years old. Concerning sex, group A was ~45% males and 55% females, whereas group B was 40% males and 60% females (Fig. 6).

Table 2 shows a comparison of the medical comorbidities % between the two groups, where in group A, 75% had medical comorbidities, 25% had sleep apnea, 35% were diabetic, 25% were hypertensive, 5% had osteoarthritis, and 5% had ischemic heart

Figure 6



Correlation in gender in the two study groups.

Table 1 Correlation between age and sex in the two study groups

	Group A *N*=20	Group B *N*=20	Test value	*P* value	Significance
Age					
Mean±SD	30.10±5.88	30.10±5.96	0.000•	1.000	NS
Range	21–42	20–41			
Sex [*n* (%)]					
Female	11 (55.0)	12 (60.0)	0.102*	0.749	NS
Male	9 (45.0)	8 (40.0)			

*χ^2-test. •Independent *t*-test. $P>0.05$: nonsignificant. $P<0.05$: significant. $P<0.01$: highly significant.

Table 2 Correlation between different medical comorbidities in the two study groups

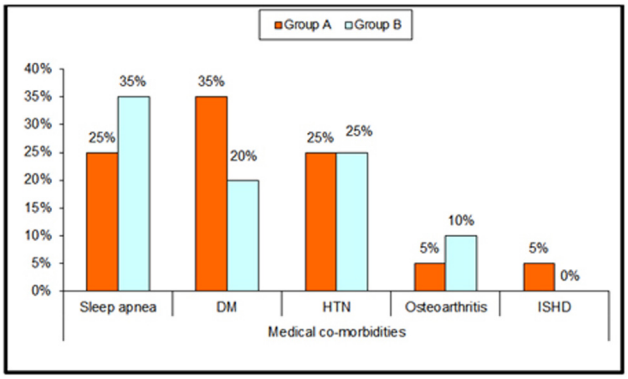
Medical comorbidities	Group A [*n* (%)] *N*=20	Group B [*n* (%)] *N*=20	Test value	*P* value	Significance
No	5 (25.0)	5 (25.0)	0.000*	1.000	NS
Yes	15 (75.0)	15 (75.0)			
Sleep apnea	5 (25.0)	7 (35.0)	0.476*	0.490	NS
DM	7 (35.0)	4 (20.0)	1.129*	0.288	NS
HTN	5 (25.0)	5 (25.0)	0.000*	1.000	NS
Osteoarthritis	1 (5.0)	2 (10.0)	0.360*	0.548	NS
ISHD	1 (5.0)	0	1.026*	0.311	NS

DM, diabetes mellitus; HTN, hypertension; ISHD, Ischemic heart disease. *χ^2-test. $P>0.05$: nonsignificant. $P<0.05$: significant. $P<0.01$: highly significant.

disease, whereas in group B, 75% had medical comorbidities, 35% had sleep apnea, 20% were diabetic, 25% were hypertensive, 10% had osteoarthritis, and no one had ischemic heart disease, with no significant difference in medical comorbidities in comparison between the two groups (Fig. 7).

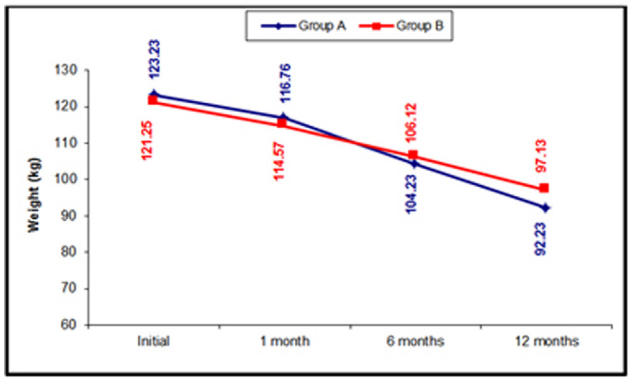
Table 3 shows a comparison in weight per kg and follow-up of the two groups for weight through 1, 6,

Figure 7



Correlation between different medical comorbidities in the two study groups.

Figure 8



Correlation between weight (kg) preoperatively and during follow-up in the two study groups.

Table 3 Correlation between weight (kg) preoperatively and postoperatively in the two study groups

Weight (kg)	Group A *N*=20	Group B *N*=20	Test value	*P* value	Significance
Initial					
Mean±SD	123.23±10.81	121.25±9.50	0.617•	0.541	NS
Range	105.7–139.5	108.7–136.8			
1 month					
Mean±SD	116.76±9.97	114.57±9.56	0.709•	0.483	NS
Range	101–131.9	101.3–131			
6 months					
Mean±SD	104.23±9.68	106.12±12.87	–0.524•	0.604	NS
Range	87.2–123	87.5–130			
12 months					
Mean±SD	92.23±11.46	97.13±18.85	–0.993•	0.327	NS
Range	72.4–120.6	71.7–129.7			

•Independent *t*-test. $P>0.05$: nonsignificant. $P<0.05$: significant. $P<0.01$: highly significant.

Table 4 Correlation between BMI preoperatively and during follow-up in the two study groups

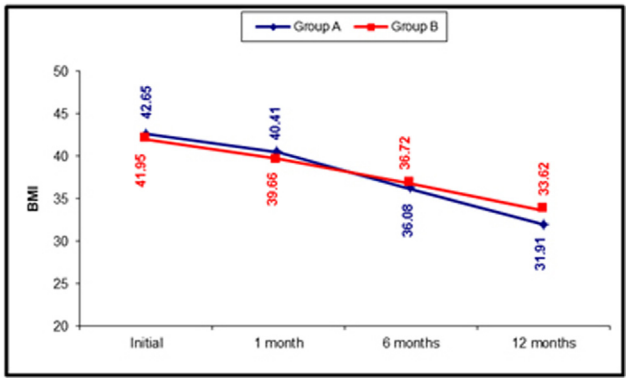
BMI	Group A *N*=20	Group B *N*=20	Test value	*P* value	Significance
Initial					
Mean±SD	42.65±3.74	41.95±3.28	0.634•	0.530	NS
Range	36.6–48.3	37.6–47.3			
1 month					
Mean±SD	40.41±3.44	39.66±3.31	0.707•	0.484	NS
Range	34.9–45.6	35.1–45.3			
6 months					
Mean±SD	36.08±3.35	36.72±4.45	–0.513•	0.611	NS
Range	30.2–42.6	30.3–45			
12 months					
Mean±SD	31.91±3.96	33.62±6.52	–0.999•	0.324	NS
Range	25.1–41.7	24.8–44.9			

•Independent *t*-test. $P>0.05$: nonsignificant. $P<0.05$: significant. $P<0.01$: highly significant.

and 12 months, where preoperatively group A had a weight ranging from 105.7 to 139.5 years, with a mean ±SD of 123.23±10.81 kg, whereas group B weight ranged from 108.7 to 136.8 kg, with a mean±SD of 121.25±9.50 kg. During follow-up at 1, 6, and 12 months, group A had a range of 101–131.9 kg, 87.2–123 kg, and 72.4–120.6 kg, respectively, whereas in group B was 108.7–136.8 kg, 101.3–131 kg, and 71.7–129.7 kg, respectively, with no significant difference in weight reduction in comparison between the two groups (Fig. 8).

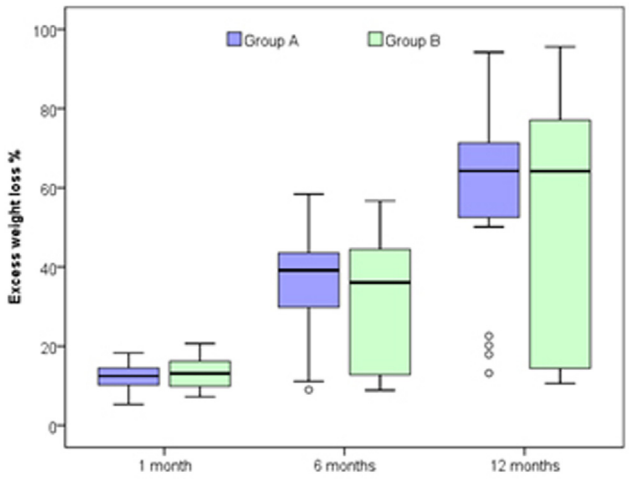
Table 4 shows a comparison in BMI preoperatively and follow-up of the two groups at 1, 6, and 12 months postoperatively, where preoperatively group A had a BMI ranging from 36.6 to 48.3, with a mean±SD of

Figure 9



Correlation between BMI preoperatively and during follow-up in the two study groups.

Figure 10



Correlation between % of excess weight loss postoperatively during follow-up in the two study groups.

Table 5 Correlation between % of excess weight loss postoperatively during follow-up in the two study groups

% of excess weight loss	Group A *N*=20	Group B *N*=20	Test value	*P* value	Significance
1 month					
Median (IQR)	12.45 (10.2–14.5)	13.1 (9.9–16.2)	−0.785≠	0.433	NS
Range	5.3–18.3	7.2–20.7			
6 months					
Median (IQR)	39.16 (29.8–43.53)	36.05 (12.8–44.45)	−0.582≠	0.561	NS
Range	9–58.4	8.9–56.7			
12 months					
Median (IQR)	64.25 (52.5–71.3)	64.2 (14.4–77.05)	−0.568≠	0.570	NS
Range	13.2–94.2	10.6–95.6			

IQR, interquartile range. ≠Mann–Whitney test. *P*>0.05: nonsignificant. *P*<0.05: significant. *P*<0.01: highly significant.

Table 6 Correlation between BMI decrease during follow-up in the two study groups

BMI decrease	Group A *N*=20	Group B *N*=20	Test value	*P* value	Significance
1 month					
Median (IQR)	2.45 (1.75–2.7)	2.4 (1.7–2.75)	−0.054≠	0.957	NS
Range	0.9–3.3	1.3–3.3			
6 months					
Median (IQR)	7.45 (5.85–8.5)	6 (2.25–8)	−1.286≠	0.198	NS
Range	1.4–9.2	1.8–9			
12 months					
Median (IQR)	12.55 (10.35–13.5)	11.1 (2.55–13.25)	−1.029≠	0.304	NS
Range	2.3–15	2.3–14.9			

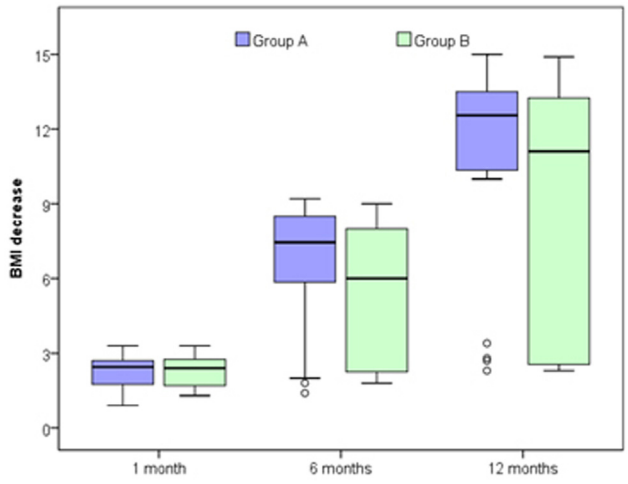
IQR, interquartile range. ≠Mann–Whitney test. *P*>0.05: nonsignificant. *P*<0.05: significant. *P*<0.01: highly significant.

42.65±3.74, whereas in group B, BMI ranged from 37.6 to 47.3 with a mean±SD of 41.95±3.28. During follow-up at 1, 6, and 12 months, group A had a BMI in the range of 34.9–45.6, 30.2–42.6, and 25.1–41.7, respectively, whereas in group B was 35.1–45.3, 30.3–45, and 24.8–44.9, respectively, with no significant difference in BMI reduction in comparison between the two groups (Fig. 9).

Table 5 shows a comparison in % of EWL at follow-up of the two groups at 1, 6, and 12 months, group A had a range of 5.3–18.3%, 9–58.4%, and 13.2–94.2%, respectively, whereas in group B was 7.2–20.7%, 8.9–56.7%, and 10.6–95.6%, respectively, with no significant difference in % of EWL on comparison between the two groups (Fig. 10).

Table 6 shows a comparison in BMI decrease between the two groups at postoperative follow-up periods of 1, 6, and 12 months, where during follow-up, group A had a BMI decrease in the range of 0.9–3.3, 1.4–9.2, and 2.3–15, respectively, whereas in group B was 1.3–3.3, 1.8–9, and 2.3–14.9, respectively, with no significant difference in BMI decrease in comparison between the two groups (Fig. 11).

Figure 11



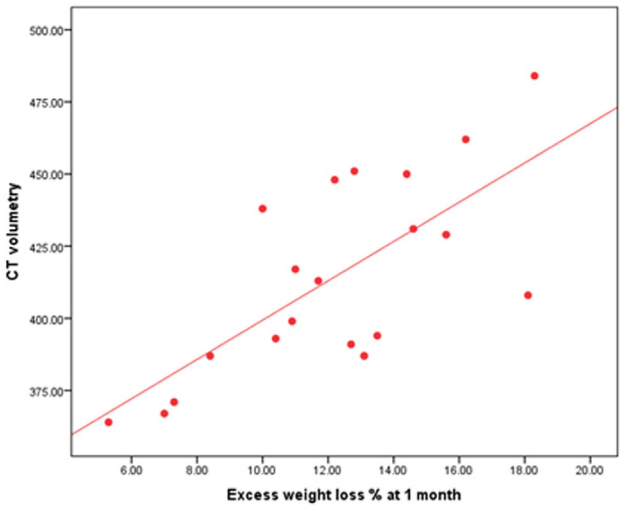
Correlation between BMI decrease during follow-up in the two study groups.

Table 7 shows a correlation between the preoperative CT volumetry and % of EWL during follow-up in the two study groups through 1, 6, and 12 months, where during follow-up, group A shows highly significant results in increased % of EWL in correlation to increased gastric volume, whereas group B showed significant results (Figs 12–17).

Discussion

Our study results concerning group A, which underwent re-sleeve gastrectomy after initial LSG with dilated stomach associated with retained fundus, including 11 female and nine male patients, showed a weight loss in the range of 2.6–9.4 kg, 4.1–26.5 kg, and 6.6–43.4 kg at 1, 6, and 12 months postoperatively, respectively, whereas group B, which underwent re-sleeve gastrectomy after initial LSG with homogenously dilated stomach only, including 12 female and eight male patients, showed weight loss in the range of 3.7–9.7 kg, 5.2–26.1 kg, and 6.7–43.2 kg at 1, 6, and 12 months postoperatively, respectively, with a nonsignificant result comparing the two groups with each other.

Figure 12



Correlation between % of excess weight loss postoperatively during 1-month follow-up and computed tomography volumetry preoperatively in group A.

Table 7 Correlation between the preoperative CT volumetry and % of EWL during follow-up in the two study groups.

	CT volumetry			
	Group A		Group B	
	r	*P* value	*r*	*P* value
Excess weight loss % 1 month	0.672**	0.001	0.481*	0.032
Excess weight loss % 6 months	0.855**	0.000	0.544*	0.013
Excess weight loss % 12 months	0.873**	0.000	0.488*	0.029

CT, computed tomography; EWL, excess weight loss. Spearman correlation coefficient. $P>0.05$: nonsignificant. $P<0.05$: significant. $P<0.01$: highly significant.

Our study results concerning group A showed % of EWL in the range of 5.3–18.3%, 9–58.4%, and 13.2–94.2% at 1, 6, and 12 months postoperatively, respectively, with a mean % of EWL 12.45%, 39.16%, and 64.25% at 1, 6, and 12 months postoperatively, respectively, whereas group B showed % of EWL in the range of 7.2–20.7%, 8.9–56.7%, and 10.6–95.6% at 1 month, 6 months, and 12 months postoperatively, respectively, with a mean % of EWL of 13.1, 36.05, and 64.2% at 1, 6, and 12 months postoperatively, respectively, which was a nonsignificant result comparing the two groups with each other.

Patrick and colleagues stated that re-sleeve gastrectomy is a feasible and safe surgical approach for weight regain after LSG and is best applied when the gastric pouch is too large or when the gastric tube is dilated after the original LSG. The study was conducted on 36 patients who underwent re-sleeve gastrectomy for progressive weight regain or insufficient weight loss. The 36 patients (34 women and two men, with a mean age of 41.3 years) were found to have mean % of EWL of 58.5% [9].

Figure 13

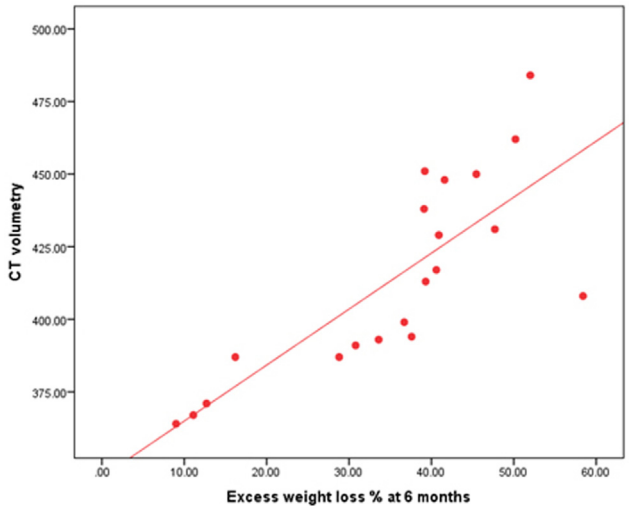
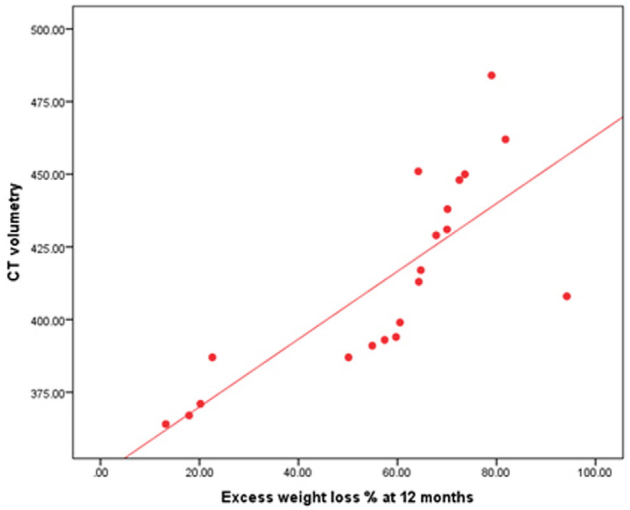


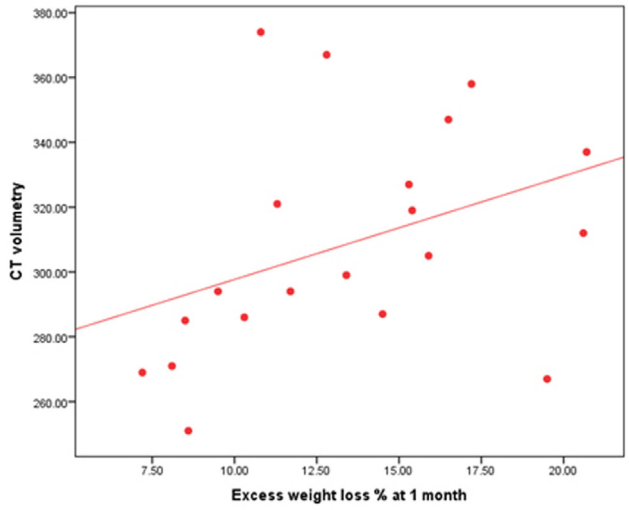
Figure 13Correlation between % of excess weight loss postoperatively during 6-month follow-up and computed tomography volumetry preoperatively in group A.

Figure 14



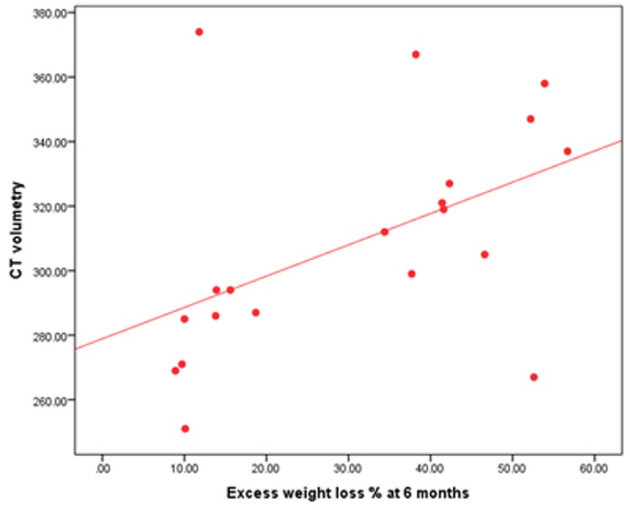
Correlation between % of excess weight loss postoperatively during 12-month follow-up and computed tomography volumetry preoperatively in group A.

Figure 15



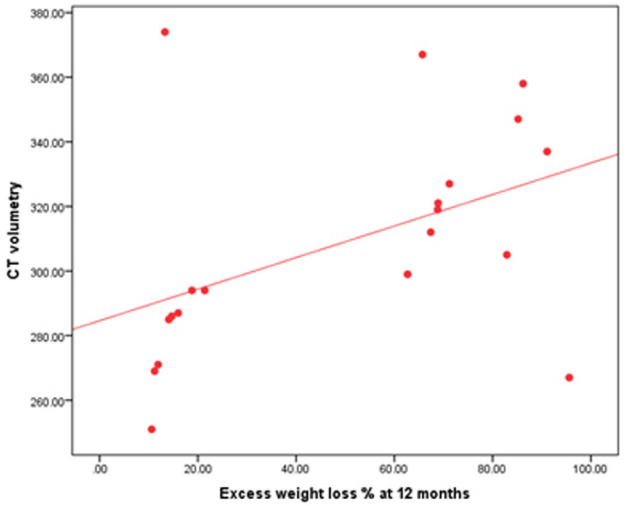
Correlation between % of excess weight loss postoperatively during 1-month follow-up and computed tomography volumetry preoperatively in group B.

Figure 16



Correlation between % of excess weight loss postoperatively during 6-month follow-up and computed tomography volumetry preoperatively in group B.

Figure 17



Correlation between % of excess weight loss postoperatively during 12-month follow-up and computed tomography volumetry preoperatively in group B.

Antonio and colleagues concluded that revision of LSG for insufficient weight loss or weight regain with persistence of gastric fundus is technically feasible and leads to good results. In their study, 13 patients underwent re-sleeve gastrectomy procedure for progressive weight regain or insufficient weight loss and showed % of EWL of 50.3% at 1 month, 47.9% at 6 months, and 71.4% at 12 months [10].

Bayrak and colleagues found that re-sleeve gastrectomy is a safe procedure which showed significant improvement in weight loss and appears to be a beneficial method of correcting post-LSG weight regain or insufficient weight loss with persistent gastric fundus or uniform dilatation, where a total of 21 patients who underwent re-sleeve gastrectomy after LSG were seven males and 14 female patients. The results of % of EWL were 19.96% at 1 month, 68.20% at 6 months, 86.82% at 12 months, postoperatively [11].

Rebibo and colleagues conducted a retrospective study that included 15 patients who underwent re-sleeve gastrectomy after failure of first-line LSG and found that the % of EWL at 12 months was 65.95±20.2%, concluding that revision of LSG with re-sleeve gastrectomy is technically feasible based on gastric volumetry data suggestive of dilatation of the stomach or a nonoptimal diameter of the greater curvature [12].

Saliba and colleagues stated that re-sleeve gastrectomy is a promising option for failed weight loss after LSG in patients who demonstrate the presence of a large residual fundus. In their study, six patients underwent a re-sleeve gastrectomy and registered a mean % of EWL of 64%, with range from 48 to 75% [13].

Marius *et al.* [14] conducted a study on 61 patients who underwent re-sleeve gastrectomy after failure of primary LSG due to an upper gastric pouch dilation or a huge unresected fundus, and the results showed mean % of EWL of 62.7% after 12 months, concluding that re-sleeve gastrectomy is a feasible and well-tolerated surgical approach for patients experiencing post-LSG weight regain and is best applied when the gastric pouch is too large after the original LSG.

Simona and colleagues found that re-sleeve gastrectomy is indicated as a revisional surgery procedure for cases with gastric tube dilatation. The study was conducted on 27 patients who underwent re-sleeve gastrectomy after LSG and showed that % of EWL was 83.88% at 6 months and 94.45% at 1 year of follow-up [15].

Our study results concerning group A showing initial BMI and follow-up BMI in the range of 36.6–48.3, 34.9–45.6, 30.2–42.6, and 25.1–41.7 initially and at 1, 6, and 12 months postoperatively, respectively, with a mean of 42.65, 40.41, 36.08, and 31.91 initially and at 1, 6, and 12 months postoperatively, respectively, whereas group B showed initial BMI and follow-up BMI in the range of 37.6–47.3, 35.1–45.3, 30.3–45, and 24.8–44.9 initially and at 1, 6, and 12 months postoperatively, respectively, with a mean of 41.95, 39.66, 36.72, and 33.62 initially and at 1, 6, and 12 months postoperatively, respectively, which was a nonsignificant result comparing the two groups with each other.

Patrick and colleagues conducted a study on 36 patients who underwent re-sleeve gastrectomy for progressive weight regain or insufficient weight loss. The 36 patients (34 women and two men with mean age 41.3 years) with a mean BMI of 39.9 underwent re-sleeve gastrectomy. The mean BMI decreased to 29.2 (range: 20.24–37.5), concluding that re-sleeve gastrectomy is a feasible and safe surgical approach for weight regain after LSG and is best applied when the gastric pouch is too large or when the gastric tube is dilated after the original LSG [9].

Antonio and colleagues stated that revision of LSG for insufficient weight loss or weight regain with persistence of gastric fundus is technically feasible and leads to good results. In their study, 13 patients underwent re-sleeve gastrectomy for progressive

weight regain or insufficient weight loss and showed a mean BMI of 32.3 kg/m^2 at 1 month, 32 kg/m^2 at 6 months, and 27.5 kg/m^2 at 12 months [10].

Bayrak and colleagues concluded that re-sleeve gastrectomy is a safe procedure which showed significant improvement in weight loss and appears to be a beneficial method of correcting post-LSG weight regain or insufficient weight loss with persistent gastric fundus or uniform dilatation. The study was performed on 21 patients who underwent re-sleeve gastrectomy after LSG due to inadequate weight loss or a regain in weight. A total of seven patients were males and 14 were females. The results showed that the mean BMI was 42.1 kg/m^2 at 1 month, 30.1 kg/m^2 at 6 months, and 24.5 kg/m^2 at 12 months postoperatively [11].

Rebibo and colleagues stated that revision of LSG with re-sleeve gastrectomy is technically feasible based on gastric volumetry data suggestive of dilatation of the stomach or a nonoptimal diameter of the greater curvature. A retrospective study included 15 patients who underwent re-sleeve gastrectomy after failure of first-line LSG and found the mean BMI was 39.4 kg/m^2 at 1 month, 35.7 kg/m^2 at 6 months, and 33.2 kg/m^2 at 12 months [12].

Marius and colleagues conducted a study on 61 patients who underwent re-sleeve gastrectomy after failure of primary LSG due to an upper gastric pouch dilation or a huge unresected fundus. The mean BMI was 29.8 kg/m^2 (range: 20.2–41) after 12 months, suggesting that re-sleeve gastrectomy is a feasible and well-tolerated surgical approach for patients experiencing post-LSG weight regain and is best applied when the gastric pouch is too large after the original LSG [14].

Simona and colleagues stated that re-sleeve gastrectomy is indicated as a revisional surgery procedure for cases with gastric tube dilatation. A study was performed on 27 patients who underwent re-sleeve gastrectomy after LSG and showed that the mean BMI was 28.39±5.32 kg/m^2 at 6 months revealed and 27.23±5.23 kg/m^2 at 1 year of follow-up [15].

Conclusion

Re-sleeve gastrectomy is a safe and good surgical option for patients underwent LSG and failed to lose weight effectively or experienced weight regain with either dilated stomach only or associated with presence of retained fundus, resulting in significant weight loss results but without a significant difference between the two groups. More accurate results could be attained with a greater number of candidate patients and considering the dietary habits of the patients.

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Conflicts of interest

There are no conflicts of interest.

References

1 Roditis ML, Parlapani ES, Tzotzas T, Hassapidou M, Krassas GE. Epidemiology and predisposing factors of obesity in Greece: from the Second World War until today. J Pediatr Endocrinol Metab 2009; 22:389–405.

2 Sjöström L, Peltonen M, Jacobson P, Sjöström CD, Karason K, Wedel H, *et al.* Bariatric surgery and long-term cardiovascular events. JAMA 2012; 307:56–65.

3 Arman GA, Himpens J, Dhaenens J, Ballet T, Vilallonga R, Leman G. Long-term (11+years) outcomes in weight, patient satisfaction, comorbidities, and gastroesophageal reflux treatment after laparoscopic sleeve gastrectomy. Surg Obes Relat Dis 2016; 12:1778–1786.

4 Buchwald H, Avidor Y, Braunwald E, Jensen MD, Pories W, Fahrbach K, Schoelles K. Bariatric surgery: a systematic review and meta-analysis. JAMA 2004; 292:1724–1737.

5 Iannelli A, Dainese R, Piche T, Facchiano E, Gugenheim J. Laparoscopic sleeve gastrectomy for morbid obesity. World J Gastroenterol 2008; 14:821–827.

6 Silecchia G, De Angelis F, Rizzello M, Albanese A, Longo F, Foletto M. Residual fundus or neofundus after laparoscopic sleeve gastrectomy: is fundectomy safe and effective as revision surgery? Surg Endosc 2015; 29:2899–2903.

7 Nedelcu M, Khwaja HA, Rogula TG. Weight regain after bariatric surgery-how should it be defined? Surg Obes Relat Dis 2016; 12:1129–1130.

8 Iannelli A, Schneck AS, Noel P, Amor IB, Krawczykowski D, Gugenheim J. Re-sleeve gastrectomy for failed laparo- scopic sleeve gastrectomy: a feasibility study. Obes Surg 2011; 21:832–835.

9 Noel P, Nedelcu M, Nocca D, Schneck A-S, Gugenheim J, Iannelli A, Gagner M. Revised sleeve gastrectomy: another option for weight loss failure after sleeve gastrectomy. Surg Endosc 2013;28:1096–1102.

10 Iannelli A, Schneck AS, Noel P, Amor IB, Krawczykowski D, Gugenheim J. Re-sleeve gastrectomy for failed laparoscopic sleeve gastrectomy: a feasibility study. Obes Surg 2011; 21:832–835.

11 Mehmet B, Yasemin A. Re-sleeve gastrectomy for failed primary laparoscopic sleeve gastrectomy. J Coll Phys Surg Pak 2019; 29:62–65.

12 Rebibo L, Fuks D, Verhaeghe P, Deguines J-B, Dhahri A, Regimbeau J-M. Repeat sleeve gastrectomy compared with primary sleeve gastrectomy: a single-center, matched case study. Obes Surg 2012; 22:1909–1915.

13 Saliba C, El Rayes J, Diab S, Nicolas G, Wakim R. Weight regain after sleeve gastrectomy: a look at the benefits of re-sleeve. Cureus 2018; 10: e3450.

14 Nedelcu M, Noel P, Iannelli A, Gagner M. Revised sleeve gastrectomy (re-sleeve). Surg Obes Relat Dis 2015; 11:1282–1288.

15 Simona F, Ionut H, Catalin C. Re-sleeve gastrectomy – an efficient revisional bariatric procedure: 3 years results. Chirurgia (Bucur) 2019; 114:809–823.