Prospective comparative study between laparoscopic Roux-en-Y gastric bypass and sleeve gastrectomy in the management of morbid obesity and its comorbidities

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Background
Laparoscopic Roux-en-Y gastric bypass (LRYGB) is one of the most widely used bariatric procedures today, and laparoscopic sleeve gastrectomy (LSG) as a single-stage procedure for the treatment of morbid obesity is becoming increasingly popular.

Objective
The aim of this study was to compare the results between LRYGB and LSG in the management of morbid obesity and its comorbidities.

Methods
Between January 2010 and January 2015, 434 morbid obese patients were randomized, operated upon, and followed up for 2 years in Al Ahli Hospital, Doha, Qatar. A total of 214 patients underwent LSG, and 220 patients underwent LRYGB. The mean BMI of all patients was 44 ± 10.8 kg/m^2; their mean age was 43 ± 4.9 years; and 72% of them were female. Patients were followed up at 3, 6, and 9 months and at 1 and 2 years. Operative time, length of hospital stay, weight loss, comorbidity improvement or resolution, postoperative complications, reinterventions and mortality were evaluated.

Results
Age, sex, BMI, and comorbidities were equal in both groups. The mean operative time for LSG was 86.9 ± 51.6 min and that for LRYGB was 108.4 ± 41.8 min. The conversion rate was 0.9% in both groups. Minor complications occurred more often in LRYGB than in LSG (17.2 vs. 8.4%). However, the difference in major complications did not reach statistical significance (4.5% for LRYGB vs. 1.4% for LSG). One-year excessive BMI loss was similar between the two groups (71.8 ± 21.9% for LSG and 77.2 ± 21.3% for LRYGB). The comorbidities were significantly improved after both procedures, except for gastroesophageal reflux disease, which showed a higher resolution rate after LRYGB.

Conclusion
Two years after surgery, both procedures were almost equally efficient regarding weight loss and improvement of comorbidities, except gastroesophageal reflux disease. LSG was associated with shorter operation time and fewer complications compared with LRYGB. Long-term follow-up data are needed to confirm these results.

Keywords:
gastric bypass, morbid obesity, sleeve gastrectomy

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Introduction

Severe obesity is one of the major problems in the world and is associated with several comorbidities and disabling diseases [e.g. cardiovascular disease, metabolic syndrome, type 2 diabetes mellitus (T2DM), infertility, certain tumor types, and increased mortality] [1–3]. Bariatric surgery is the most effective treatment for morbid obesity and, depending on the type of operation, is also very effective in the resolution of diabetes. This effect usually occurs even before the start of weight loss owing to changes in the gut hormones and the patient's diet [4].

A variety of surgical procedures are available and, currently, it is difficult to identify the most effective option based on patient characteristics and comorbidities. Furthermore, little is known regarding the effect of the various surgical procedures on glycemic control and T2DM remission [5–7]. Laparoscopic Roux-en-Y gastric bypass (LRYGB) is currently the preferred bariatric operation, involves two surgical alterations: restriction of the gastric volume and diversion of the ingested nutrients away from the proximal small intestine [8]. In contrast, laparoscopic sleeve gastrectomy (LSG) preserves the integrity of the

pylorus and does not include the intestinal bypass. LSG is the restrictive part of the biliopancreatic diversion and was initially applied as an isolated operation for super obese patients with severe comorbidities as a staged concept [9].

The promising short-term results of LSG have somewhat altered the paradigm for LSG from a two-stage procedure to a stand-alone definitive bariatric procedure [10]. LSG is perceived to be less invasive, technically simpler, and easier to perform compared with LRYGB. The possible long-term benefits of LSG include an intact gastrointestinal tract, the absence of internal hernias, and the lack of malabsorption requiring lifelong follow-up of nutritional status [11]. LSG could thus become the procedure of choice in treating morbid obesity provided that the long-term results of LSG are comparable with LRYGB regarding weight loss, the resolution of comorbidities, and improvement in the quality of life [12]. In 2012, the American Society for Metabolic and Bariatric Surgery published a revised position statement, which proposed that LSG is a valid alternative operation technique to LRYGB [13].

Methods

The current study was carried out in Al Ahli Hospital, Doha, Qatar, between January 2010 and January 2015. It included 434 morbid obese patients who were randomized and divided into two groups: the LSG group (n = 214) and the LRYGB group (n = 220). The procedure was explained in detail to all patients, including possible complications and postoperative dietary plan. An IRB form and written consent forms were obtained from all patients for the surgery and consent to share in this study. All patients were evaluated preoperatively by a bariatric surgeon, nutritionist, endocrinologist, and a psychiatrist. Upper gastrointestinal endoscopy, barium meal study, and abdominal ultrasound were routinely performed for all cases.

The inclusion criteria for the study were as follows: (a) BMI of at least 40 or BMI of at least 35 with a significant comorbidity associated with morbid obesity (T2DM, hypertension, obstructive sleep apnea, dyslipidemia, and arthritis); (b) age 18–60 years; and (c) previous failed adequate diet and exercise program. The exclusion criteria included BMI greater than 60, significant psychiatric disorder, active alcohol or substance abuse, active gastric ulcer disease, severe gastroesophageal reflux disease (GERD) with a large hiatal hernia, and previous bariatric surgery. Both study groups were similar regarding age, sex, BMI, and comorbidities. The primary endpoint of the study was weight loss. The secondary endpoints assessed the improvement of obesity-related comorbidities, and the overall morbidity and mortality of the procedures.

Surgical technique

Laparoscopic sleeve gastrectomy

A 36 Fr bougie was used along the lesser curvature for calibration of the gastric tube; longitudinal resection of the stomach was done from ~ 4 to 6 cm orally of the pylorus to the angle of His. No buttress material was used, and oversuturing of the staple line was only over the bleeding points (Fig. 1a and b).

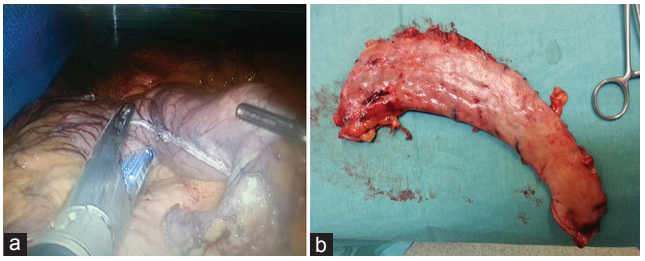
Laparoscopic Roux-en-Y gastric bypass

An antecolic and antegastric Roux-en-Y gastric bypass was performed with a 150 cm alimentary limb with either a linearly stapled or circularly stapled (25 mm) gastrojejunostomy according to the preference of the surgeon. A 50-cm-long biliopancreatic limb was chosen (Fig. 2).

In both procedures intraoperative methylene blue leak test was routinely performed, and a wide bore drain was applied near the staple line or anastomosis.

The postoperative follow-up of the patients was in the outpatient clinic at 3-month intervals for the first year and then after 2 years. All the data concerning weight loss, state of obesity-related comorbidities, and possible complications were thoroughly recorded. Postoperatively obesity-related comorbidities were classified as 'persisting' (medication is the same as preoperatively), 'improved' (reduction in medication), or 'resolved' (no more need for medication) after the endocrinologist's visit. Postoperative complications were classified as major or minor; morbidity resulting in death or a reoperation, a hospital stay exceeding 7 days, or a need for blood transfusions of four or more units constituted a major complication. All other postoperative problems were evaluated as minor complications.

Figure 1



(a) Resection of the outer part of the stomach using endo-GI stapler during sleeve gastrectomy. (b) Excised part of the stomach after sleeve gastrectomy. GI, gastrointestinal.

Statistical analysis

Data analysis was performed using SPSS for Windows (SPSS Inc., Chicago, Illlinois, USA). Values were reported as mean ± SD. Descriptive statistics were used for demographic variables such as age, weight, and BMI. A *P* value of less than 0.05 was considered statistically significant.

Results

This study included 434 patients. Their BMI ranged between 35 and 60 kg/m^2. They were randomized into two groups: the LSG group (214 patients) and the LRYGB group (220 patients). All of the patients completed the first-year follow-up (100%), but only 224 patients completed the second-year follow-up (109 from LSG group and 115 from LRYGB group).

There was no statistical difference between the two groups regarding age, sex, BMI, and rate of comorbidities associated with obesity (Table 1).

All procedures were completed laparoscopically, except four that were converted to open surgery. Two of them were in the LRYGB group because of excess intra-abdominal fat and large liver size. The other two cases were in the LSG group because of intraoperative bleeding that could not be controlled laparoscopically. Thus, conversion rate was similar in both groups (0.9%).

The mean operative time for LRYGB was 108.4 ± 41.8 min, higher than that for LSG, which was 86.9 ± 51.6 min (P = 0.003). The mean hospital stay was 6 days in the LRYGB group and 5 days in the LSG group.

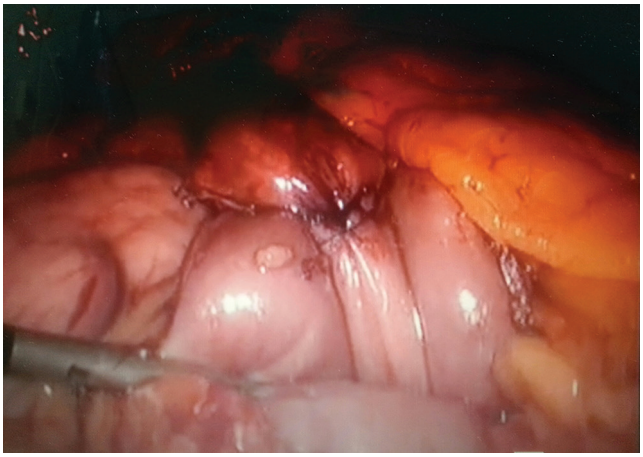
The postoperative complications were classified into minor and major as discussed in the methods. Major complications that required reoperation were 10 cases in the LRYGB group (4.5%) versus three cases in the LSG group (1.4%; P = 0.21). The reasons for reoperation in the LRYGB group (10 cases) were two leakages at the gastrojejunostomy, two obstructions at the biliopancreatic limb, four intra-abdominal abscesses, and two pleural empyemas. And the reasons for reoperation in the LSG group (three cases) were two leakages from the staple line and one left subphrenic abscess.

One patient in the LRYGB group developed leakage from the gastrojejunostomy, which was reoperated and complicated by aspiration pneumonia followed by acute respiratory distress syndrome and multiorgan failure and finally death. Table 2 demonstrates the postoperative complications, reoperation, and mortality.

There was no significant statistical difference between the two groups with respect to weight loss and excess body mass index loss (EBMIL) during the follow-up period. We noticed that most of the weight loss and EBMIL occurred during the first year in both groups, and then there was a tendency toward a lower weight loss and EBMIL and even weight regain in the LSG group than in the LRYGB group at the end of the second year (Tables 3–5).

There was marked improvement in comorbidities in both groups 1 year after surgery. There was no significant statistical difference between the LSG group and the LRYGB group regarding the remission of comorbidities or improvement rate, except for the remission of GERD. Patients undergoing LSG experienced a slightly higher rate of new-onset

Figure 2



Gastrojejunostomy (pouch-jejunostomy) during Roux-en-Y gastric bypass.

Table 1 Patient demographics and comorbidities

Items	LSG	LRYGB	*P*
Preoperative BMI	43.9±4.9	44.4±5.4	NS
First year after surgery	30.8±5.1	30.1±4.9	NS
Second year after surgery	31.3±4.5	30.3±5.2	NS

LRYGB, laparoscopic Roux-en-Y gastric bypass; LSG, laparoscopic sleeve gastrectomy; NS, nonsignificant.

Table 2 Postoperative complications, reoperation, and mortality

Comorbidities	LSG (*n*=214) (%)		LRYGB (*n*=220) (%)		*P*
	Cured	Improved	Cured	Improved	
Hypertension	31.8	57.2	32.2	62.8	NS
T2DM	58.1	40.9	68.4	27.6	NS
Dyslipidemia	25.8	59.2	46.3	49.7	NS
OSAS	51.1	43.9	32.5	66.5	NS
Joint pain	21.6	67.4	16.3	71.7	NS
GERD	14.2	35.8	24.7	50.3	S

GERD, gastroesophageal reflux disease; LRYGB, laparoscopic Roux-en-Y gastric bypass; LSG, laparoscopic sleeve gastrectomy; NS, nonsignificant; OSAS, obstructive sleep apnea syndrome; S, significant; T2DM, type 2 diabetes mellitus.

GERD (13.5 vs. 3.9%; $P = 0.12$), and among those who already presented with GERD before the operation the rate of improvement was significantly lower than among those who underwent LRYGB (50 vs. 75%; $P = 0.008$). Table 6 demonstrates the percentage of patients who were cured or showed improvement in their comorbidities.

Discussion

The positive effects of bariatric surgery on weight loss and obesity-related comorbidities are no longer doubted. In addition, these procedures can also be performed safely with low mortality and morbidity [14]. There are few randomized controlled trials comparing the two most commonly performed bariatric procedures – that is, LRYGB and LSG – with regard to actual weight loss and/or improvement in obesity-related comorbidities in the mid and long term [15].

My study included 434 patients with BMI 35–60 kg/m^2, which matches with most of the similar studies that was conducted on the same BMI group [16–19]. However, Yang *et al.* [20] conducted a similar study on a lower BMI group (28–35 kg/m^2) comparing both procedures in the treatment of Chinese T2DM.

The follow-up period in my study was 2 years. All of the patients completed the first-year follow-up but only 224 patients completed the second-year follow-up during data analysis, which could be considered a weak point in the study. Helmiö *et al.* [19] completed their study within 6 months' follow-up. Albeladi *et al.* [21] followed up their study group for 18 months, and Vidal *et al.* [22] completed 4 years of follow-up in their study.

I found that the mean operative time for LSG was significantly shorter than that for LRYGB ($P = 0.003$), and also the mean hospital stay was shorter in the LSG group than in the LRYGB group (5 vs. 6 days). The same results were obtained by different similar studies [15,20,23].

I noticed higher rates of minor and major postoperative complications in the LRYGB group than in the LSG group but the difference was not statistically significant (17.3 vs. 8.4% and 4.5 vs. 1.4%, respectively). This result matches with the study by Leyba *et al.* [24], whereas Boza *et al.* [25] found that the rate of early complications was significantly higher in the LRYGB group than in the LSG group ($P < 0.001$).

My results showed that most of the weight loss and BMIL occurred during the first year in both groups, and then there was a tendency toward a lower weight loss and EBMIL and even weight regain in the LSG group than in the LRYGB group at the second year but the differences were not statistically significant. A systematic review revealed that the EWL after 24 months is not statistically different between RYGB and SG [26]. There are reports from nonrandomized trials on tendency for weight regain after LSG at 3–5 years following surgery [27,28]. However, this is a general phenomenon following bariatric surgery, and it is not specifically related only to LSG. In contrast,

Table 3 Changes in the body weight (mean±SE)

Items	LSG (*n*=214)	LRYGB (*n*=220)	*P*
Minor complications			
Dysphagia	8	6	
Wound infection	2	6	
Atelectasis, pleural effusion	8	26	
Total (*n* (%))	18 (8.4)	38 (17.3)	NS
Major complications			
Leakage	2	2	
Obstruction	0	2	
Intra-abdominal infection	1	4	
Empyema	0	2	
Total (*n* (%))	3 (1.4)	10 (4.5)	NS
Mortality	0	1	NS

LRYGB, laparoscopic Roux-en-Y gastric bypass; LSG, laparoscopic sleeve gastrectomy; NS, nonsignificant.

Table 4 Changes in BMI (mean±SE)

Items	LSG	LRYGB	*P*
Preoperative body weight	124.1±18.7	125.3±20.2	NS
First year after surgery	87.3±17.2	85.2±17.1	NS
Second year after surgery	89.1±17.6	84.8±18.2	NS

LRYGB, laparoscopic Roux-en-Y gastric bypass; LSG, laparoscopic sleeve gastrectomy; NS, nonsignificant.

Table 5 Excess body mass index loss (mean±SE (%))

Items	LSG (*n*=214)	LRYGB (*n*=220)	*P*
Age (mean±SD) (years)	43.4±10.8	42.4±11.3	NS
Male (*n* (%))	60 (28)	62 (28)	NS
Female (*n* (%))	154 (72)	158 (72)	NS
Weight (mean±SD) (kg)	124.1±18.7	125.3±20.2	NS
BMI±SD (kg/m^2)	43.9±4.9	44.4±5.4	NS
Hypertension (%)	62.8	59.3	NS
T2DM (%)	23.9	25.8	NS
Dyslipidemia (%)	67.3	51.2	NS
OSAS (%)	47.8	42.3	NS
Joint pain (%)	61.2	67.7	NS
GERD (%)	43.7	45.9	NS

GERD, gastroesophageal reflux disease; LRYGB, laparoscopic Roux-en-Y gastric bypass; LSG, laparoscopic sleeve gastrectomy; NS, nonsignificant; OSAS, obstructive sleep apnea syndrome; T2DM, type 2 diabetes mellitus.

Table 6 Percentage of cure and improvement in comorbidities in both groups 1 year after operation

Items (%)	LSG	LRYGB	*P*
First year after surgery	71.8±21.9	77.2±21.3	NS
Second year after surgery	69.3±21.2	76.9±20.8	NS

LRYGB, laparoscopic Roux-en-Y gastric bypass; LSG, laparoscopic sleeve gastrectomy; NS, nonsignificant.

Boza *et al.* [10] have reported excellent results of 1000 consecutive LSG procedures with a mean EWL of 84.5% at 3-year follow-up and with minimal weight regain after the first postoperative year.

The technical aspects of LSG somewhat lack standardization. The use of a smaller bougie size as calibration during the operation has been reported to be associated with a better weight loss and resolution of comorbidities, but on the contrary also with a higher leak rate [29,30]. Similarly, the preservation of the antrum and the use of reinforced staple lines have been controversial issues. An expert panel consensus statement on best practice guidelines for LSG was published addressing several of these technical issues as well as indications and contraindications for LSG and also evaluating both management and prevention of complications [31]. In my study, all the sleeves were created narrow, using a 36 Fr bougie. The distal resection was started 4–6 cm proximal to the pylorus, and the staple lines were oversutured only at the bleeding points.

From the obesity-related comorbidities, I observed the rate of cure and improvement of hypertension, T2DM, dyslipidemia, obstructive sleep apnea syndrome, joint pain, and GERD. There was marked improvement in comorbidities in both groups 1 year after surgery. There was no significant statistical difference between the LSG group and the LRYGB group regarding the remission of comorbidities or improvement rate except for the remission of GERD. The same results were obtained from different studies on the same subject, even with a lower BMI group, especially the rapid improvement in T2DM after both procedures [20,23,32,33].

In the past, there has been skepticism regarding LSG and GERD, because the anatomical structure of the angle of His is no longer intact after LSG. Furthermore, there is still a large proportion of remaining parietal cells. Accordingly, the new-onset rate of GERD has been reported to be as high as 21% after LSG [28]. In line with this, I observed a significantly lower rate of GERD remission and a clear trend of new-onset GERD after LSG compared with LRYGB. Prachand and Alverdy [34] also concluded that the incidence of GERD seems to be more frequent after LSG, whereas LRYGB is considered a therapeutic option in patients with GERD. Nevertheless, the course of GERD after LSG is controversial, and definite evidence supporting either side does not exist [35–37].

Conclusion

LSG and LRYGB are equally efficient regarding weight loss and improvement of comorbidities except GERD in the mid term. Moreover, LSG has shorter operative time than LRYGB, with fewer postoperative complications. Therefore, I believe that LSG is a valuable surgical alternative for selected patients with morbid obesity. On the other hand, patients with preexisting GERD are at risk for deterioration after LSG and should rather undergo LRYGB. Long-term follow-up data are needed to confirm these results.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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