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Does Gastric Dilatation Limit the Success of Sleeve Gastrectomy as a Sole Operation for Morbid Obesity?

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Background: Sleeve gastrectomy as the sole bariatric operation has been reported for high-risk super-obese patients or as first-step followed by Roux-en-Y gastric bypass (RYGBP) or duodenal switch (DS) in super-super obese patients. The efficacy of laparoscopic sleeve gastrectomy (LSG) for morbidly obese patients with a BMI of <50 kg/m² and the incidence of gastric dilatation following LSG have not yet been investigated.

Methods: 23 patients (15 morbidly obese, 8 super-obese) were studied prospectively for weight loss following LSG. The incidence of sleeve dilatation was assessed by upper GI contrast studies in patients with a follow-up of >12 months.

Results: Patients who underwent LSG achieved a mean excess weight loss (EWL) at 6 and 12 months postoperatively of 46% and 56%, respectively. No significant differences were observed in %EWL comparing obese and super-obese patients. At a mean follow-up of 20 months, dilatation of the gastric sleeve was found in 1 patient and weight regain after initial successful weight loss in 3 of the 23 patients.

Conclusion: LSG has been highly effective for weight reduction for morbid obesity even as the sole bariatric operation. Gastric dilatation was found in only 1 patient in this short-term follow-up. Weight regain following LSG may require conversion to RYGBP or DS. Follow-up will be necessary to evaluate long-term results.

Key words: Morbid obesity, sleeve gastrectomy, gastric dilatation, weight regain, gastric bypass, duodenal switch

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Introduction

Restrictive and malabsorptive bariatric operations such as laparoscopic adjustable gastric banding (LAGB), laparoscopic Roux-en-Y gastric bypass (LRYGBP) and biliopancreatic diversion with duodenal switch (BPD-DS) have proven to be effective in long-term weight reduction for morbidly obese patients.[1-11]

In laparoscopic sleeve gastrectomy (LSG) the stomach is reduced to a narrow tube. This strictly restrictive procedure can be seen as further development of the vertical banded gastroplasty (VBG)[12-15] or the Magenstrasse and Mill procedure (M&M),[16,17] as a non-banded vertical gastroplasty. LSG as a part of another bariatric operation was originally established in the BPD-DS described by Hess.[18]

LSG has been described as the first step of a two-stage LRYGBP or BPD-DS in super-super obese patients,[19] as well as the sole bariatric procedure for high-risk super-obese patients.[20,21] In one series, LSG was compared to intragastric balloon as a first-step procedure for super-obese patients,[22] and LSG was found to be more effective. In these studies, only patients with a BMI >50 kg/m² were included. LSG performed in non-super-obese, but rather morbidly obese, patients has not been reported thus far.

The success of this restrictive bariatric operation may be limited by dilatation of the remaining gastric tube at longer follow-up, thus diminishing the restrictive effect. The aim of this study was to determine the effects of LSG as the sole operation on

postoperative weight loss in morbidly obese and super-obese patients, and to assess the incidence and impact of gastric dilatation following this operation.

Materials and Methods

A total of 23 patients (17 female, six male), with mean BMI 48.5 ± 6.9 kg/m^2 and fulfilling the NIH recommendations for bariatric surgery,[23] were included in this prospective study. Eight of these patients had a BMI >50 kg/m^2 and were therefore classed as super-obese. In all but one patient, LSG was the first bariatric procedure; the one patient underwent LSG after band migration following LAGB. Sweet-eaters or binge eaters were excluded from the operation. In one patient, LSG was performed 13 years after a liver transplantation.

Preoperative evaluation was similar to other bariatric procedures, including abdominal ultrasound, chest X-ray, blood tests, pulmonary function, EKG, and endocrinological and psychological work-up.

Surgical Method of LSG

The greater curvature, including the complete fundus together with the major part of the corpus and antrum, was resected from the antrum starting opposite of the nerve of Latarjet, to the angle of His. The stomach was therefore reduced to a narrow gastric tube at the lesser curvature over a 48-Fr bougie, which was used to avoid stenosis. As the integrity of the vagal nerve remained preserved in the sleeve gastrectomy, no pyloroplasty was performed. In contrast to other published series,[24,25] the staple-line was not buttressed but instead was oversewn using a running suture to prevent bleeding and leakage. Routine testing for leakage was not done intraoperatively.

A water-soluble contrast swallow was routinely performed on the 1st postoperative day to rule out gastric leakage, and thereafter a semi-liquid diet was started for the next 4 weeks.

Patients were advised to take an oral multivitamin supplement daily. Follow-up examinations included blood samples to assess the incidence of vitamin B_{12}, folate and iron deficiency. In patients with a follow-up of >1 year, upper GI contrast study was performed to rule out dilatation of the gastric tube. Sleeve dilatation was defined as broadening of the gastric tube to >4 cm.

Weight loss is expressed as percentage of excess weight loss (EWL), based on the Metropolitan Life Tables;[26] super-obesity was defined as BMI >50 kg/m^2.

Statistical Analysis

Results are expressed as mean ± standard deviation. A *P*-value <0.05 was considered to be significant. Differences in weight loss comparing obese and super-obese patients were analyzed using the Mann-Whitney-U test.[27] Statistical analysis was performed using the SSPS statistical package, version 11.5 (SSPS, Inc.).

Results

BMI at time of surgery was 48.5 ± 6.9 kg/m^2 (range 40-73), with the proportion of super-obese patients 35% (8/23). Mean weight was 129 ± 20.1 kg (range 110-187) (Table 1).

Median follow-up for all patients was 20 months (range 5 to 29), achieving a mean postoperatively EWL at 1, 6, and 12 months of 21%, 46% and 56% (Table 2, Figure 1). In the 15 patients beyond 18 months, mean EWL was 57% at 18 months following LSG.

Comparing %EWL in super-obese and morbidly obese patients, no significant differences were found at 1 (*P*=0.683) and 6 (*P*=0.754) months and 1 year (*P*=0.360) follow-up respectively (Table 2). Scheduled blood tests revealed no iron, vitamin B_{12} or folate deficiency in any patient.

Table 1. Demographics of the study population

N	23	
Sex (F/M)	17/6	
Age (years)	41.2 ± 12.8	(21 – 69)
Body weight (kg)	129 ± 20.1	(110 – 187)
BMI (kg/m^2)	48.5 ± 6.9	(40 – 73)
Super-obese	8 (35%)	

Table 2. Weight loss following LSG

Follow-up (months)	1	6	12
All patients (n)	23	23	18
Mean weight (kg)	119±17	102±20	95±22
EWL (%)	21±6	46±13	56±18
Morbidly obese (n)	15	15	12
EWL (%)	21±6	47±14	53±20
Super-obese (n)	8	8	6
EWL (%)	20±7	45±12	62±12

In two patients, the LSG was converted to a LRYGBP: One patient underwent re-operation because of severe gastro-esophageal reflux at 15 months postoperatively, having achieved an EWL of 98%. The other patient presented with an EWL of only 18% at 1 year and complete weight regain at 2 years postoperatively. Therefore, he underwent conversion to LRYGBP.

Partial weight regain was observed in three patients within a median follow-up of 20 months, including in one patient with an uneventful pregnancy and delivery.

Having reached a follow-up of >1 year, 14 patients (78%) underwent upper GI series to rule out dilatation of the gastric tube. According to our definition, contrast swallow revealed gastric dilatation in only one patient (Figure 2). Despite radiographic gastric dilatation, she achieved an EWL of 59% at 12 months follow-up, and has remained weight stable at 30 months postoperatively now, and still has early satiety. This indicates, that gastric dilatation does not necessarily lead to weight regain, at least during short-term follow-up.

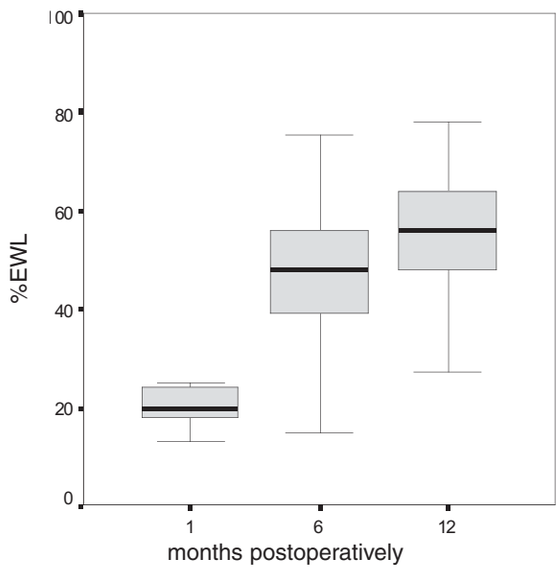

Figure 1. %EWL of 23 patients in early follow-up after LSG.

Discussion

In this study of 23 patients, LSG was quite effective in weight reduction, not only in super-obese but also in morbidly obese patients with BMI <50 kg/m^2. Dilatation of the gastric sleeve was diagnosed at 1-year follow-up in only one of the eligible 14 patients, but has not led to weight regain in that patient. Conversion to RYGBP following LSG was performed for inadequate weight loss which had been followed by complete weight regain in one patient, and for severe gastro-esophageal reflux in another patient.

Sleeve gastrectomy as a strictly restrictive bariatric procedure can be seen as a further development of the VBG and the Magenstrasse and Mill (M&M) procedure. Following the M&M procedure performed by open surgery, a mean EWL of 58% was reported at 12 months in a series of 100 patients,[16] while following the VBG, an EWL of 44% to 69% was achieved 1 year following surgery.[14,28-30]

Figure 2. Gastric dilatation at 18 months following LSG.

LSG may have some advantages compared to established bariatric procedures. In contrast to LAGB, no foreign material is implanted, avoiding complications such as band migration.[9,31,32] Compared to RYGBP or BPD-DS, the complete upper GI tract remains accessible to endoscopy after LSG. Furthermore, LSG does not alter absorption of orally-administered drugs, which may transpire after RYGBP or BPD-DS. After VBG, a high rate of re-operation of 14% to 43% has been reported[30,33-36] for staple-line disruption or stenosis of the banded stoma with inadequate weight loss or food intolerance.

The weight loss results of sleeve gastrectomy alone have been reported in super-obese patients (Table 3). Recently, Baltasar et al[37] reported 31 patients undergoing LSG, mainly for very high BMI or risk, but results were very early. A very recent report of LSG in 60 morbidly obese Koreans found 83% EWL at 12 months, with only one patient requiring a second operation (duodenal switch);[38] however, Asians have a high incidence of central obesity and co-morbidities at a lower BMI, and their diet is high in carbohydrate bulk (sticky rice).

Regan et al[19] reported LSG as an interim procedure followed by RYGBP in super-super obese patients. In that series, 7 patients achieved a primary mean EWL of 33% after a mean period of 11 months, and the mean BMI was reduced from 63 to 50 kg/m^2. In a second step, the sleeve gastrectomy was converted to an RYGBP. Nguyen et al[39] have also reported this approach in the super-obese.

In the series reported by Almogy et al,[20] sleeve gastrectomy was performed by laparotomy in 21 high-risk super-obese patients not eligible for BPD-DS due to risk, hemodynamic instability or liver cirrhosis discovered at operation. These patients achieved a mean EWL of 45% at 12 months postoperatively.

Table 3. Sleeve gastrectomy: review of literature

Author	Patients (n)	Preop BMI (range)	Mean EWL*
Regan[19]	7	58-71	33% at 11 months
Almogy[20]	21	53-72	45% at 12 months
Mognol[21]	10	61-80	51% at 12 months
Milone[22]	20	60-85	35% at 6 months

*EWL = excess weight loss, based on Metropolitan Life Tables.

Comparing LSG and intragastric balloon as a first-step procedure for super-obesity, Milone et al in Gagner's group[22] found sleeve gastrectomy to be more effective with an EWL of 35% after 6 months.

Mognol et al[21] presented the initial results of LSG in 10 super-super-obese patients (BMI >60), achieving a mean EWL of 51% at 1 year postoperatively.

In our series, a mean EWL of 46% was achieved after only 6 months, while the mean BMI was reduced from 48 to 36 kg/m^2. Because of these good results in weight loss, conversion to LRYGBP was not a consideration. Sleeve gastrectomy can therefore serve not only as an initial tool for an intended malabsorptive procedure but also as a sole bariatric operation.

The persisting weight reduction can be explained by the extent of gastrectomy, because we resected the complete gastric fundus, reducing the gastric volume to a narrow lesser curvature tube over a 48-Fr bougie. Thus, a smaller diameter of the gastric sleeve is achieved compared with other series, resulting in a higher degree of restriction.

This series reports weight loss after LSG not only in super-obese patients but also in 15 patients with a BMI of <50 kg/m^2. Comparing %EWL in super-obese and morbidly obese patients, no significant differences were found at 1 and 6 months and at 1 year follow-up (Table 2). We recommend LSG for selected patients with a BMI <50.

As an example, LSG was performed in one patient 13 years following liver transplantation. The patient was on Cyclosporine (Sandimmun Neoral®) as immunosuppressive medication. As reliable oral absorption of immunosuppressive drugs is essential following organ transplantation, LSG and not RYGBP was performed. Following LSG the drug dosage did not have to be adjusted to achieve stable blood trough levels of Cyclosporine. As LSG is a safe procedure in patients depending on oral immunosuppressive medication, another immunosuppressed patient on Mycophenolat Mofetil (Cellcept®) medication for systemic lupus erythematosus is currently on the waiting list for LSG.

As reported recently,[40] LSG leads to stable decreased plasma levels of the hunger-regulating hormone "ghrelin". In one patient in that series, who presented with complete weight regain after initial weight loss of 17 kg in 3 months, ghrelin did not decrease in the postoperative period. At conversion to RYGBP at 24 months following LSG, a remnant

part of the gastric fundus, unrecognized due to axial diaphragmal hernia, was found intraoperatively. As the fundus is known to be the main location of ghrelin-producing cells, any remnant of the fundus might prevent decrease in plasma ghrelin levels postoperatively. In this patient weight regain could have been influenced by the increased ghrelin levels, which were also observed in patients following LAGB[41] which is another restrictive bariatric procedure but retains the fundus. This emphasizes the importance of complete resection of the gastric fundus in LSG.

Little is known about possible long-term complications of sleeve gastrectomy. Gastric dilatation has been reported for sleeve gastrectomy as part of BPD-DS.[42] In that case report, the patient presented with weight regain after successful weight reduction of 80% EWL at 32 months postoperatively. Upper GI series showed a dilated gastric sleeve. Reoperative LSG was performed using a 60-Fr bougie calibration.

Our study is the first on the incidence of gastric dilatation following LSG. Dilatation was diagnosed by upper GI contrast studies in the patients with follow-up >12 months. Weight regain was not a mandatory consequence of gastric dilatation, as the only patient presenting with gastric dilation achieved an EWL of 59% at 12 months and has remained weight stable so far.

EWL in this series of 23 patients was comparable to RYGBP, which confirms the effectiveness of LSG in high-risk patients.[20] In the short-term follow-up of this series, gastric dilatation may not be a limiting factor for sleeve gastrectomy as a single bariatric operation. However, patients should be informed about possible dilatation and that a second-stage operation could become necessary if there is inadequate weight loss or weight regain.

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