Laparoscopic Sleeve Gastrectomy (LSG) In Morbid Obesity: Review

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ABSTRACT:

Following the "Magenstrasse" and Mill procedure (M&M), the sleeve gastrectomy was introduced into the spectrum of laparoscopic bariatric surgery. The background for the introduction of this procedure was the high mortality rate (6%) of laparoscopic biliary-pancreatic diversion-duodenal switch operation in super patients (BMI >60 kg/m2). Later the LSG as a sole bariatric operation or as an initial step procedure followed by Roux-en-Y gastric bypass (RYGBP) was used for super-super-obese patients.

Being a relatively newly introduced procedure in the menu of obesity surgery, there is a lack of standardization of the technique and hence diversions between the results of the published series. Fifteen recent (2006- 2008) articles about the laparoscopic sleeve gastrectomy and its related issues had been deliberately reviewed and analyzed in a trial to through a light on this newly adopted technique in the field of bariatric surgery. The technique adopted is still lacking true standardization in many of its steps e.g. type of the stapler to be used, size of the bougie and hence the proposed size of the pouch left on the lesser curve as well as the technique of reinforcement of the staple line. The 15 reviewed studies included 707 patients and the indications included nearly the whole grades of morbidly obese patients with or without severe comorbidities. The mean %EWL was 40% after a mean of 14 months follow up. Medical comorbidities showed marked improvement to complete resolution in high percentage of cases. The overall major complication rate was 0.14% and this included gastric staple line leak, stenosis of the pouch and renal failure. GERD seems to be common sequelae after LSG but in most cases resolved spontaneously. The short-term results are very encouraging but long- term results are still awaited to give this newly adopted technique its true grading in the field of bariatric surgery.

Key words: laparoscopic sleeve gastrectomy, bariatric surgery, sleeve gastrectomy.

INTRODUCTION:

In 2006, the number of overweight and obese people in the world overtook the number of malnourished. Bariatric surgery is the only available treatment for patients with severe obesity. Current surgical techniques could be broadly classified as restrictive procedures, malabsorptive procedures or a combination of the two3.The sleeve gastrectomy was introduced into the menu of laparoscopic bariatric surgical operations after the "Magenstrasse" and Mill technique (M&M)4. Gagner and his coworkers5 published the early results of laparoscopic sleeve gastrectomy (LSG) as an initial-step procedure before laparoscopic biliopancreatic diversion with duodenal switch (LBPD-DS) in super-obese patients to avoid high mortality rate (6%) of LBPD-DS in patients with BMI >60 kg/m2. Recently the LSG as a sole bariatric surgical operation or as an initial-step procedure followed by Roux-en-Y gastric bypass (RYGBP) or DPB-DS was used for super-super-obese patients. In the last few years, the number of surgeons reporting the use of the LSG as the only bariatric surgical operation is increasing. Being short-

lived bariatric surgery technique, many issues within this technique are not yet universally standardized and debatable issues are still too many. These debatable issues include the nomenclature of the technique; is it sleeve gastrectomy or vertical gastrectomy or vertical sleeve gastrectomy or greater curvature gastrectomy or parietal gastrectomy or vertical gastroplasty?, should it be used confidently as a single-stage bariatric surgical operation or as initial step to more complicated techniques?, if used as a single–stage procedure, should it be preceded by intragastric balloon in high-risk and super super obese patients?, how long should be the preserved pylorus and is it must to be preserved?, what is the size of the gastric bougie which should be used, hence the size of the remaining gastric pouch?, should the size of the constructed pouch be changed with the degree of obesity indicated it?, is the reinforcement of the staple line must and how could it be undertaken?.

AIM:

The aim of this study is to review the current literature about the laparoscopic sleeve gastrectomy in a trial to clarify the previously mentioned debatable issues.

METHODS:

Google, Springer Link and High Wire Press search engines had been went through using the following key words: laparoscopic sleeve gastrectomy, sleeve gastrectomy, morbid obesity, bariatric surgery, restrictive operations, laparoscopic gastric bypass, laparoscopic gastric banding and vertical gastric banding. A 15 recent (>2005) articles had been deliberately reviewed; analyzed results of the research are tabulated and statistically analyzed using SSPS program for windows. This review will concentrate upon the following main points: technique, % weight loss, impact on associated comorbidity and complications.

RESULTS:

Technique:

Like most of the bariatric surgery operations, currently there are multiple variations in the technique for the LSG. Some of these variations are: the size of bougie (determines the size of the pouch) beside which the Endo GIA Staplers are placed to divide the stomach, the level at which the surgeons start the division in the central area. Many surgeons leave most of the antrum for its pumping, emptying action and also to avoid the possibility of leak from this thick-walled tough area1, 2, 3 and thirdly, to reinforce or not reinforce this long staple line.

Five or six trocars are used for SG and the surgeon standing between the patient's legs. An open technique could be used for the first trocar, establishing a pneumoperitoneum of 15 mm Hg. Then, two right trocars, a left trocar, and a midline trocar are inserted. The right subcostal trocar is used to insert the fan retractor for the liver. The camera should be placed high between the umbilicus and xiphoid. Initial decompression of the stomach with NGT is preferrable. Some surgeons commence the laparoscopic sleeve gastrectomy with an opening through the gastrocolic ligament to lesser sac, and firstly cut–staple the vertical channel along the bougie. Gagner5 firstly mobilizes the greater curvature outside the epiploic arcade, near to the gastric wall, which will be removed. With the patient in slight reverse Trendelenberg' position, the posterior stomach wall is visualized and fine adhesions to the pancreas are divided and the lesser sac totally freed using harmonic scalpel, ligasure, or coagulation hook. The left side of the GE junction should be

cleared off fat to avoid later compromise of the stapling during creation of the sleeve. Left crus should be exposed completely.

Majority of surgeons start the dissection 5–10 cm proximal to the pylorus, but some surgeons in Europe start the dissection closer to the pylorus. If the dissection starts too close to the pylorus, the antrum will not empty properly and its pumping mechanism will be defective, and postoperative nausea may occur. The linear Endo GIA stapler is generally introduced through a right trocar towards the left shoulder, with or without buttressing material, and leaves about 1 cm of fat pad along the lesser curvature (~3 cm width). This assures adequate blood supply on the lesser curvature for the sleeve. Gagner5 starts transecting the stomach 6 cm proximal to the pylorus and then the anesthesiologist inserts a 36–40-Fr bougie down to pylorus, if the SG is intended as the sole operation but if as a preliminary step before duodenal switch, a 60-Fr bougie is used. Kueper, et al consider a 34 fr bougie which results in a pouch of 100 ml is a standard7. The sleeve is started at the lower end of the crow's foot. The procedure requires five to six firings of the linear cutting stapler (60 cm long, 4.8-mm staple-height, and green cartridge) to divide the entire stomach. It is important to remove all fundus to avoid regain of weight. The vagus nerves anteriorly and posteriorly are preserved for normal gastric emptying.

The resected greater curvature could be extracted in a bag (via epigastric or right paramedian trocar-site after being dilated to two-finger diameter. The typical specimen has the shape of a comma with the fundus at the top. In dividing the stomach, most surgeons have been oversewing the staple-line by continuous or interrupted absorbable sutures to prevent bleeding and leaks5, 6. Gagner5 and Gumbs7 reinforce each crossing-overlapping site from the stapler with an absorbable monofilament figure-of-eight suture after removing the bougie. Assalia et al2007 reinforced the staple line of SG with bovine pericardium in an experimental study in a trial to minimize the incidence of leakage and staple line failure8.

Intraoperative testing through an 18-Fr Argyle tube with diluted methylene blue or air under saline using a gastroscope, with concurrent compression of prepyloric area is a complementary step. A Gastrografin® swallow is ordered by many surgeons on the second postoperative day, or others perform this study only if there is a problem. A liquid diet may be commenced on the first postoperative day.

WEIGHT LOSS:

"Durable" weight loss is the one most important gain of bariatric surgery operations, and it is the parameter by which success or failure of weight-reducing techniques is measured. Success of treatment has been defined as weight loss >50% of excess weight, maintaining or even losing further after surgery8.

Table 1: outcome of published series on sleeve gastrectomy:

s	author	No.of pts.	Average Preop. BMI	Bougie (Fr.)	F.U. (Months)	%WT. LOSS
1	Weimer,etal3 (2007)	A=25	61.6	NR	60	62% at 12ms. C>B>A significantly
		B=32	60.8	44	60	
		C=63	60.3	32	60	

2	Strekas9 (2008)	93	46.86± 6.48	36	12.51±4.15	58.32± 16.54%,
3	*Dapri et al10 (2007)*	A=20	42.5	34	12	48.3%
		B=20	47	34	12	49.5%
4	Lee et al11 (2007)	216	49±11	32		
5	Melissas, et al12 (2007)	23	47.2±4.8	34	12	33.1%
6	**Hamoui13**	118	55		24	47.3%
7	Langer, et al14 (2006) (sleeve dilatation)	23	48.5 ± 6.9	48	12	56%
8	Quesada15 (2008)	15	54	38	6	44%
9	**Baltasar16 (2006) (re-sleeve)**	2	46, 42			
10	Cottam et al17 2006) (initial, high-risk)	126	65.3±0.8	48	12	46%
11	Vidal et al18 (2007) (effect of LSG on DM)	35		48		NR
12	Silecchia, et al19 (2006)	41;superobese ≥2major comorbidities	57.3±6.5	48	22.2± 7.1	NR
13	DePaula; et al 20 (2008)(effect of LSG AS INITIAL TO 2 DIFF. PROCEDURES ON DM WITH BMI≤35	39	23.4 to 34.9	NR	7	22%
14	Madhala,ET AL21 (2008)(technique)	25	44 ± 2	50	4	22.7%
15	Till, et al22 (2008) (LSG in morbid obese children)	4 (≤14.5 ys.)	48.4	40	12	23%
total		707	MEAN=57.76	MEAN=43.7Fr.	Mean=14.5months	Mean= 40%

Table 2: main complications of LSG in the reviewed published series:

s	author	No.of pts.	Main complications	recommendations
1	Weimer3 (2007)	120	Reflux symptoms, severe esophagitis	
2	Strekas9 (2008	93	4 cases of gastric leak, 3 managed conservatively	more suitable for intermediate morbidly obese patients with BMI between 40–50 kg/m
3	*Dapri et al10 (2007)*	20+20	1 leak in gp. a late 1 stenosis in B	better mobilize the stomach then resect it
4	Lee et al11 (2007)	23	2 leaks	Recommended for BMI< 50 KG/M2
5	Melissas et al12 (2007)	23	8 GERD; only one persisted	The term restrictive may not be applicable to the lsg
6	**Hamoui, et al**13 (2006)	118	one death due to gastric leakage	Out of118 superobese patients, only 6 requested second stage duodenal switch.
7	Langer, et al14 (2006)	23	One severe GERD ONE RF AILURE	Sleeve dilatation doesn't necessarily lead to weight gain
8	Quesada15 (2008)	15	-	LSG is best option in the presence of adhesions
9	Baltasar16 (2006)	2	-	Re-LSG is achievable with minimal complication
10	Cottam Etal17(2006) (initial, high-risk)	126 (+9.3 comorbidities in each; mean)	-	Only 36 pts. (39%) Were in need of the second stage. LSG is a good initial op. in those severely comorbid patients.
11	Vidal et al18 (2007) (effect of LSG on DM)	35	-	DM resolved in 51.3% 4 months after LSG.
12	Silecchia, et al19 (2006)	41 Superobese ≥2major comorbidities	1leakage,1bleeding, 1 transient renal failure	After 12 months, 57.8% of the patients were co-morbidity-free
13	DePaula; et al20 (2008)	39	2 leakage, 2 renal failure	5O%resolution of DM after 7 months.
14	Madhala,et al21 (2007)	25	-	

15	Till, et al22 (2008) (LSG in morbid obese children)	4 (≤14.5 ys.)	-	Comorbidities improved significantly
TOTAL		707	11 gastric leaks,1DEATH, 4RF,1 stenosis,=17; 2.4%	

The percentage weight loss after LSG in 707 morbidly obese patients included in the reviewed series is 40% (a mean) after a mean follow up of 14 months (table1).

Effect on associated comorbidities:

Laparoscopic sleeve gastrectomy had been carried out for superobese patients with multiple severe comorbidities and in at least 50% of the patients; there was marked improvement of the comorbidities specially DM which resolved in in 50% to 57% of cases in 3 studies17-19.

Complications:

In the reviewed series (n= 707), there are 17 major complications with an incidence of 2.4%. One should consider the heterogeneity of the patient's population where those with high –risk and multiple severe comorbidities are included. One death due to gastric leakage reported with 11 gastric leakage, 4 renal failures and 1 stenosis. GERD occurs in too many cases but most of the patients improve gradually on conservative management. Bleeding from the suture line reported rarely and could be managed conservatively in most of the cases.

LSG as initial step for super super obese and high-risk patients:

In two studies LSG was used as a planned initial step for entertained other major final technique due to super super obesity with poor general condition in an attempt to minimize the risk in this subgroup of patients. During the post-LSG follow-up, the authors found the second stage operation is only needed in 5% in one study12 and 39% in the other16 (table 2).

Re-sleeve gastrectomy:

Baltasar21 found it easy to do re-sleeve gastrectomy in two of his patients who fail to maintain long- lasting weight loss.

LSG in morbidly obese children:

Till et al 27 carried-out LSG in 4 morbidly obese patients with multiple comorbidities. Marked improvements in their comorbidities and 23% percentage weight loss had been achieved after 12 months follow-up.

Discussion:

The world-wide population continues to suffer from increasing obesity1, 2. This obesity and related co-morbidities are responsible for 2.5 million deaths annually worldwide23. Bariatric surgery is the only available treatment for patients with severe obesity3. Surgeons have begun devising safer methods for the management of these patients. If less invasive procedures could be done as the first part of a two-staged surgical regimen, complications and mortality could be kept to a *minimum24, 25*. Pure-gastric-restriction procedures represent the least invasive techniques for the management of morbid obesity26 LSG produces weight loss by a double mechanism: 1) early satiety as described by Marceau27 and 2) reduction of the ghrelin levels28, 29. Initially, SG had been used as the first step of a more complicated and demanding but meanwhile very effective biliary pancreatic diversion-duodenal switch procedure in the management of superobese patients in a trial to minimize the complication rate19. As experience with this procedure has been gained, many surgeons have begun using SG as single surgical procedure for the management of morbid obesity3,9-12. Lack for the need of foreign material, maintenance of gastric empting and low incidence of nutritional deficiencies are inherent attributes in SG which lead to excellent patient tolerance of the technique30-31.

SG is essentially a modification of the M&M procedure and has gained popularity in the laparoscopic era because of the ease of performing SG via minimally invasive techniques and the experience from this M&M procedure has greatly assisted in understanding the optimal creation of the gastric sleeve 32. In our review, the mean size of the currently used bougie during creation of the gastric tube from the lesser curve is 43.7fr. And this relatively small -sized bougie together with the more gained experience of the surgeons may explain the good results and less complication rate in the reviewed recent studies in our review.
SG has been found to have a mean of 40 %EWL at a mean follow-up of 14 months in this review; however longer-term follow-up is needed to see the effects of gastric dilation over time as advised by Gumbs, et al33. Resleeve gastrectomy was achievable safe procedure in this review with minimal complication rate9. According to Baltasar34 and Bernate, et al35 LSG is also a good operation for patients with complicated lap gastric banding such as inadequate weight loss, band erosion, or poor quality of life.
The long staple line in LSG makes it liable for bleeding and leakage; hence the reinforcement of the staple line became the standard practice in the recent literature. This maneuver is usually carried-out by running or interrupted stitches. Recently, experimental works on the use of some glues or bovine pericardium are reported and may prove efficacy and safety in the near future14. Resolution or at least improvement of medical comorbidities after LSG had been proved in this review through four studies23-25,27 and meanwhile the majority of cases who had undergone LSG as a first step before more complicated and demanding techniques exhibited so satisfactory results that the second procedure was not any more indicated18,22. There 16 major complications in the 707 patients of the reviewed studies giving overall incidence of 0.14% reflecting the safety of the technique in this high –risk category of patients.

Conclusion:

The early results of LSG are very encouraging but long term results will be the true proof for the efficacy and safety of this neoborn procedure in the field of bariatric surgery. International consensus summit by the experts in the field of bariatric surgery should be held for more clarification and standardization of many vague points in LSG.

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