

# How does the extent of antral resection affect the residual gastric volume and excessive weight loss?



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## How does the extent of antral resection affect the residual gastric volume and excessive weight loss?

**AIM:** To identify the effect of the extent of antral resection on the residual gastric volume (RdGV) and excess weight loss (EWL) among patients who underwent laparoscopic sleeve gastrectomy (LSG) due to the obesity.

**MATERIAL AND METHODS:** The demographical data, operative details, postoperative morbidity, mortality and the percentages of EWL in the postoperative 3, 6 and 12 months of the patients who underwent LSG between January 2014 and August 2015 were analyzed. These patients were divided into three groups regarding the antral resection margin (ARM): Group 1 (n=80):  $ARM \leq 3\text{cm}$ ; Group 2 (n=35):  $3 < ARM < 6\text{cm}$ ; Group 3 (n=30):  $ARM \geq 6\text{cm}$ . The ARM was measured by using a ruler. RdGV measurement and leak test were performed by filling methylene blue through the bougie.

**RESULTS:** A total of 145 patients were included in the study. Demographic features were similar between three groups. The mean RdGV was significantly higher in Group 1, whereas RdGV was significantly higher in Group 3. The patients in Group 1 had significantly higher EWL% than Group 3 at 12 months postoperatively. The mean number of stapler used for gastric resection was significantly higher in Group 1. No significant complications such as hemorrhage, staple line leakage, abscess, etc. that required any interventional management were observed in all groups.

**CONCLUSIONS:** Enlargement of the antral resection margin (>6cm from pylorus) resulted in reduced operating cost and decelerated reach to optimal EWL% with similar postoperative outcomes.

**KEY WORDS:** Antral resection margin, Excess weight loss, Laparoscopic sleeve gastrectomy, Residual gastric volume, Surgical technique.

## Introduction

The development of bariatric surgical methods is the milestone for the treatment of obesity and obesity related health problems. Laparoscopic sleeve gastrectomy

(LSG), Roux-en-Y gastric bypass, biliopancreatic diversion, duodenal switch and the laparoscopic adjustable gastric band are the most widely accepted surgical procedures for the treatment of obesity. LSG has now become a first choice treatment option for most of the patients<sup>1,2</sup>. It has been as the first step in the bariatric surgery for high risk super-obese patients<sup>3</sup>. Laparoscopic sleeve gastrectomy has acceptable long-term weight loss results and other advantageous, when compared to other bariatric procedures<sup>4</sup>. As the long-term data showed permanent weight loss, improved medical comorbidities, long-term patient satisfaction, and improved quality of life after LSG, it has been accepted as stand-alone bariatric surgical procedure<sup>5</sup>. Since

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2013, LSG procedure has risen and become the most performed bariatric procedure for surgical treatment of obesity<sup>6</sup>.

Some mechanisms have been described for weight loss after sleeve gastrectomy. These well-known factors include the decreased plasma ghrelin level due to the fundectomy, reduced gastric expansion and volume, and subsequent rapid gastric emptying<sup>5,7</sup>. In particular, the effect of the remnant gastric volume is a continued debate. Although the basic steps of the surgical procedure are quite the same, there are varieties of surgical details of LSG such as the caliber of bougie, antral resection margin (ARM), and associated residual gastric volume (RdGV).

The aim of this study was to investigate the effect of the extent of antral resection on the residual gastric volume and the percentage of excess weight loss (EWL%, [(initial weight-current weight) / (initial weight-ideal weight)]\*100) among the patients who underwent LSG due to obesity.

## Material and Method

Between January 2014 and August 2015, 145 patients, Body Mass Index (BMI)>40 and <50 kg/m<sup>2</sup>, without the metabolic disease who underwent LSG procedure, were enrolled into the study. The institutional review board approved the study with a registration number of 729.

In all patients, a comprehensive preoperative evaluation including endoscopic evaluation to avoid any plausible peri-operative complication was performed<sup>8,9</sup>.

In this retrospectively designed study, patients were divided into three groups regarding ARM: Group 1 (n=80): ARM≤3cm; Group 2 (n=35): 3 <ARM < 6 cm; Group 3 (n=30): ARM ≥6cm.

Demographic and clinical features of the patients, surgical data, intraoperative measured RdGV, operative cost, postoperative morbidity and mortality, and the EWL% at

the 3, 6 and 12 months postoperatively were recorded. Apart from vessel sealer materials, trocars and other materials which were standardized for all operations were all the same in groups.

## SURGICAL PROCEDURE

Following Optical Trocar insertion, pneumoperitoneum was established, and other three working trocars and a Nathanson liver retractor were placed as illustrated in Fig. 1. The dissection started with the division of Leimer ligament. Anteriorly gastroesophageal fat pad was mobilized to guide the correct placement of stapler. The left crura were exposed completely up to its medial border. After then, stomach was separated from the gastrocolic and gastrosplenic ligament by EnSeal™5 mm (Ethicon Endo-Surgery, Cincinnati, OH, United States). Complete mobilization of the fundus (the division of both gastrocolic and gastrosplenic ligament and posterior gastric attachments) was achieved by detaching all attachments. After a 36F bougie was inserted towards proximal part of the pylorus measurement of ARM was done using a ruler, and a clip was placed as a marker. The creation of sleeve was performed with appropriate sized staplers, and the staple-line was reinforced with endo-clip. The bougie was pulled back to the esophagogastric junction; pylorus was compressed with laparoscopic intestinal clamp, methylene blue was injected through the bougie into the sleeve stomach. RdGV was noted as the volume of injected methylene blue producing sleeve-expansion (Fig. 2a). The 15 mm trocar site was closed with Endo-Close™(Covidien-Medtronic, Minneapolis, MN) and the resected gastric volume (RcGV) was measured by filling the specimen with tap water (Fig. 2b). Gastrograffin swallow fluoroscopy was performed on the first postoperative day, and clear-liquid diet was allowed in case of intact stapler line. On the second postoperative day, patients without any problem were discharged.



Fig. 1: Patient position(a), and arrangement of trocars (b,c).



Fig. 2: (a) Residual gastric volume; (b) Resected gastric volume and staplers used for resection (placed regarding the order of use).

## STATISTICAL ANALYSIS

All analyses were performed with the Statistical Product and Service Solutions (SPSS) software package (version 21.0, SPSS-IBM, Armonk, NY, USA) at the 95% confidence level and  $p < 0.05$  significance level. Data were obtained by review of the prospectively maintained database. Quantitative variables were reported as the mean and standard deviation (SD); qualitative variables were described as number and percentages. One-way analysis of variance (ANOVA) was used to determine whether there were any statistically significant differences between the means of three or more independent (unrelated) groups.

## Results

A total of 145 patients were included in the study. There was no statistically significant difference between three groups considering demographic features (Table I). The mean RcGVs was significantly higher in Group 1, whereas RdGV was significantly higher in Group 3, ( $p < 0.01$ ) (Table II).

TABLE I - Demographic features of the patients

Variables	Group 1 (n=80)	Group 2 (n=35)	Group 3 (n=30)	p value
F/M	59/21	26/9	22/8	NS
Age (year)(mean $\pm$ SD)	40.3 $\pm$ 4	38 $\pm$ 5	36 $\pm$ 3	NS
BMI (kg/m <sup>2</sup> )(mean $\pm$ SD)	46 $\pm$ 2	44 $\pm$ 4	45 $\pm$ 2	NS

F: female, M: male, BMI: body mass index, NS: non-significant

The mean number of stapler used for gastric resection was significantly higher in Group 1, ( $p < 0.01$ ) (Table II). Expected cost of the operation was also simultaneously increased in Group 1 (Table II). No major complications such as hemorrhage, staple line leakage, abscess, etc. that required any interventional management were observed in all groups.

The EWL% at the 3, 6 and 12 months postoperatively in all groups were shown in Table III. The patients in Group 1 had significantly higher EWL% than Group 3 at the 12 months postoperatively.

## Discussion

Laparoscopic sleeve gastrectomy is being a surgical intervention suggesting that it is more than a simple restrictive procedure because the mechanism of T2DM improvement is the weight-loss independent <sup>2</sup>. The mechanisms of weight loss after LSG are multifactorial; a combination of gastric restriction, hormonal factors (increased GLP-1 and decreased ghrelin level) <sup>9,10</sup>, and changes in gastric emptying (fastened) and eating habits are involved. However, it is still unclear that which factor plays the most important role <sup>5,12</sup>. In this study, we particularly focused on the characteristics of restriction process during laparoscopic sleeve gastrectomy.

Although it is well-known that LSG is not only a restrictive procedure but also effective regarding hormonal changes <sup>12</sup>, the efficacy of restriction volume on EWL% in the patients undergoing LSG remains disputed. This study evaluated different margins of antrum resection that could affect the RdGV and quality of restriction process, alike. As minor changes were encountered between groups, EWL% outcome appeared promising (75%) even in large ARM group despite its relatively low

TABLE II - Comparison of surgical data between groups.

Variables	Group 1, ≤3 cm (n=80)	Group 2, 3<ARM<6 cm (n=35)	Group 3, ≥6 cm (n=30)	p value
RcGV(cc), (mean ±SD)	1440±13	1412±21	1374±18	<0.01
RdGV(cc), (mean ±SD)	29.3±6	32.2±9	36.6±11	<0.01*
The number of stapler used(mean ±SD)	6.5±0.6	5.7±0.4	5.1±0.6	<0.01**
Operative cost (USD),(mean ±SD)	1239.9±45	1186.5±30.8	1146±41.2	<0.01

RcGV: resected gastric volume, RdGV: residual gastric volume; \*p values: Group 1 vs 2: NS, Group 1 vs 3: p<0.01, Group 2 vs 3: NS; \*\* p values: Group 1 vs 2: p<0.01, Group 1 vs 3: p<0.01, Group 2 vs 3: p<0.01

TABLE III - Comparison of EWL% between groups at 3, 6 and 12 mo postoperatively

Variables	Group 1, ≤3 cm (n=80)	Group 2, 3<ARM<6 cm (n=35)	Group 3, ≥6 cm (n=30)	p value
EWL% (3 mo) (mean ±SD)	43.2±6	42.8±5	40.4±4	0.195
EWL% (6 mo)(mean ±SD)	65±6	64.3±4	61.4±5	0.19
EWL% (12 mo)(mean ±SD)	81.2±5	79.2±5	75.6±5	<0.01

p values considering EWL% between groups: Group 1 vs 2: NS, Group 1 vs 3: p<0.15, Group 2 vs 3: NS

levels compared other two groups. This result could be related to concomitant factors. In a very recent study by Yormaz et al., acceptable EWL% despite decreased restriction was found associated with hormonal factors<sup>13</sup>.

There are various aspects of LSG procedure with no consensus and subsequent results and impacts. More surgeons perform the dissection >4 cm proximal to the pylorus, whereas others prefer to resect closer to the pylorus. Authors suggest that those with too close to the pylorus result in impaired antral pumping mechanism and the patient may have nausea and even higher rates of reflux<sup>13</sup>. In their prospective randomized study, Abdallah et al. reported similar findings in regards to comorbidities resolution in two groups in which gastric division was performed 2 cm and 6 cm from pylorus with no significant difference with regards to the post-operative complication, as well<sup>14</sup>. Although LSG has a restrictive role, antral preservation is suggested to maintain contractile function, promoting gastric emptying and thus reducing intraluminal pressure and potentially decreasing leakage, as well<sup>15-17</sup>. In our study, there was no difference with regards to the intraoperative and post-operative complications between groups. Study records did not specifically include reflux research. However, very few patients complained when questioned on any discomfort.

In fifth international consensus conference report, Gagner et al. noted the importance of learning curve for better results in weight loss. They particularly emphasized small details such as fundus dissection and stapling in close proximity of the gastroesophageal (GE) junction

but not the antral resection<sup>1</sup>. However, antrum issue still is a debate between bariatric surgeons. Obeidat et al. reported better-maintained weight loss in those with radical resection and its fortified restrictive effect<sup>18</sup>, whereas Jacobs et al. revealed no difference concerning weight loss and complications between groups of 4 cm versus 7 cm antral pouch<sup>19</sup>. In our study, although the RdGV and RcGV were significantly different between groups, EWL% was similar at 3 and 6 months postoperatively. At one-year follow-up, Group 1 was found with significantly higher EWL% values compared to Group 3. This was attributed to that antral preservation might result in deceleration to reach optimal EWL%. Likewise, Sahin et al. suggested that increasing the distance from pylorus was associated with better weight loss<sup>13</sup>. On the other hand, Fallatah et al. reported that antral resection margin should be selected on the basis of the patient characteristics such as gender, preoperative foregut conditions<sup>20</sup>.

Limitations of the study included the lack of prospective design of the study. The small size of the patient series and short-term follow-up are among the weakness of the study. Thirdly, plausible complications related to differences of antral resections such as reflux, gastrectomy disorders were not recorded in detail.

## Conclusions

In conclusions, research findings support an ongoing effort for improved standardization of techniques based

on current and past expert surgeon experience. The aim of this study was to investigate the role of the differences of antral resection margin on weight loss and postoperative morbidity. Enlargement of the antral resection (>6cm from pylorus) resulted in reduced operating cost and decelerated reach to optimal EWL% with similar postoperative outcomes. LSG with greater than 6 cm margin can be safe and provide promising results.

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