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Original article

## Resected gastric volume has no influence on early weight loss after laparoscopic sleeve gastrectomy

Xiao Du, M.D.<sup>a</sup>, Rong Luo, M.D.<sup>b</sup>, Yan-yu Chen, M.D.<sup>b</sup>, Bo-qiang Peng, M.D.<sup>b</sup>,  
Jian-kun Hu, M.D.<sup>a</sup>, Zhong Cheng, M.D.<sup>a,\*</sup>

<sup>a</sup>Department of Gastrointestinal Surgery, Laboratory of Bariatric and Metabolic Surgery, West China Hospital, Sichuan University, Chengdu, P. R. China

<sup>b</sup>Gastrointestinal Tract Reconstruction and Metabolic Surgery Association, West China Medical School, West China Hospital, Sichuan University, Chengdu, P. R. China

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### Abstract

**Background:** Laparoscopic sleeve gastrectomy (LSG) has become a popular procedure for treatment of obesity, but it is still undecided whether resected gastric volume (RGV) is related to weight loss after LSG.

**Objective:** The aim of this study was to investigate the influence of RGV and other factors on weight loss at 1 year after LSG in a Chinese population.

**Setting:** University Hospital, China.

**Methods:** A total of 53 patients who underwent LSG between August 2015 and July 2016 were enrolled. The LSG procedure and RGV measurement were performed using standardized techniques. Patients were followed-up every 3 months in the first year and 6 monthly after that. Correlations between the percentage of excess weight loss at 1 year (%EWL-1 yr) and RGV and other parameters were evaluated.

**Results:** All patients completed at least 1 year of follow-up. No major complications or cases of underweight were seen. Mean body mass index (BMI) at 1 year after LSG was significantly lower than the baseline BMI ( $31.1 \pm 3.8 \text{ kg/m}^2$  versus  $39.0 \pm 6.6 \text{ kg/m}^2$ ;  $P < .001$ ). Mean %EWL-1 yr was 58.8%, and mean RGV was  $862.6 \pm 209.5 \text{ mL}$ . No correlation was observed between %EWL-1 yr and RGV ( $r = -0.071$ ;  $P = .613$ ). The %EWL-1 yr was correlated with preoperative weight, BMI, RGV/weight, and RGV/BMI. RGV was positively correlated with preoperative weight and BMI. Patients who achieved satisfactory weight loss (%EWL  $\geq 50\%$ ) had significantly lower baseline BMI, and higher RGV/weight and RGV/BMI, than those who had inadequate weight loss. However, RGV was not significantly different between the 2 groups.

**Conclusions:** Weight loss effect at 1 year after LSG was not associated with RGV in this Chinese population. RGV was influenced by the weight and BMI. (Surg Obes Relat Dis 2017;■:00–00.) © 2017 American Society for Metabolic and Bariatric Surgery. All rights reserved.

### Keywords:

Bariatric surgery; Sleeve gastrectomy; Resected gastric volume; Weight loss; Body mass index

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\*Correspondence: Zhong Cheng, M.D., Department of Gastrointestinal Surgery, Laboratory of Bariatric and Metabolic Surgery, West China Hospital, Sichuan University, No. 37, Guo Xue Xiang, Chengdu, 610041, P. R. China.

E-mail: zhongcheng1963@126.com

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Bariatric surgery has been proven to be the most effective and safest treatment for inducing durable weight loss and improving co-morbidities in morbidly obese individuals [1–3]. It can be broadly classified as restrictive procedures, malabsorptive procedures, or a combination of the 2. One type of restrictive procedure is laparoscopic sleeve gastrectomy (LSG), which was first described by Gagner as the

initial step of a 2-stage bariatric procedure—either biliopancreatic diversion or laparoscopic Roux-en-Y gastric bypass—for treatment of high-risk, super-super obese patients [4]. The advantages of LSG include: (1) no intestinal bypass (thus avoiding gastrointestinal anastomoses, metabolic derangements, and internal hernias), (2) short operating time, and (3) no implantation of a foreign body. LSG also has a favorable complication profile, which makes it an especially attractive procedure for high-risk patients [5]. The popularity of LSG has soared over the recent years, and it has become the most commonly performed stand-alone bariatric surgery. According to the latest global survey, LSG accounts for 45.9% of the bariatric surgeries performed worldwide [6].

However, the LSG technique is not fully standardized, and there are still many controversial technical issues. In addition, just like any other bariatric surgery, LSG can sometimes fail. The failure rate is estimated at 10% to 30% [7]. Weight loss after LSG is multifactorial, but volume restriction appears to be the key factor [8–10]. Whether failure after LSG is because this restrictive bariatric procedure is not restrictive enough still remains unclear. The resected gastric volume (RGV) and residual gastric volume are 2 important indices that reflect the restriction of LSG. But the stomach is a highly elastic organ with unceasing contraction, and accurate measurement of the residual gastric volume is therefore difficult to achieve [11]. RGV measurement, however, is direct and relatively easy to carry out.

There have been no studies from China on the relationship between RGV or residual gastric volume and weight loss outcome, and the results of studies from other countries have been inconsistent. However, many authors have reported positive correlation between RGV and baseline body mass index (BMI) or weight. We wished to investigate whether variables, such as RGV/weight, RGV/BMI, and RGV/waist circumference, which eliminate the influence of baseline characteristics, could more precisely reflect the degree of gastric volume restriction and predict the outcome after LSG. Therefore, this prospective study was designed to assess the relationship of RGV and these new parameters (RGV/weight, RGV/BMI, and RGV/waist circumference) with weight loss effect at 1 year after LSG in Chinese obese patients.

## Methods

### Patients

Between August 2015 and July 2016, 53 morbidly obese patients were consecutively enrolled in this prospective study. The inclusion criteria were according to the guidelines of the Chinese Society for Metabolic and Bariatric Surgery, (i.e., age between 16 and 60 years, and BMI > 32 kg/m<sup>2</sup>, or BMI > 27.5 kg/m<sup>2</sup> plus a major co-morbid

disorder). Patients with diabetes were eligible for inclusion if the disease was at an early stage (i.e., course < 5 yr and fasting C peptide normal or elevated; otherwise, laparoscopic Roux-en-Y gastric bypass was performed). Exclusion criteria were (1) history of unstable psychiatric illness or alcohol or drug abuse, (2) confirmed or suspected malignancy, (3) severe gastroesophageal reflux disease or Barrett esophagus or large hiatal hernia, or (4) obvious contraindications to surgery.

The advantages and possible complications of LSG were explained to each patient, and the need for change in lifestyle and life-long follow-up after surgery was emphasized. Written informed consent was obtained from all participating patients. The Research and Ethics Committee of West China Hospital approved the study.

### Surgical techniques

The same surgeon (CZ) performed the operation in all patients, employing a strictly standardized LSG procedure and the 4-trocar technique. The surgical team had performed > 200 LSG procedures before this study. During surgery, 4 key steps were emphasized and standardized:

1. Complete dissection of the greater curve began 4 cm from the pylorus of stomach. The distance was marked out using a premeasured tape;
2. The left crus of the diaphragm was completely dissected and clearly visualized. The angle of His was fully mobilized;
3. A 34-Fr bougie was used in all patients; stapling was performed as close as possible to the tube, and tube freedom was confirmed before each firing; and
4. Last firing was .6 to .8 cm away from the angle of His to ensure that the gastric fundus was fully removed. Reinforcement of the staple line was not routinely performed.

Measurement of the RGV was standardized. A small hole (.2 × .2 cm<sup>2</sup>) was made at the antral end, and the resected stomach was suspended vertically by 2 Allis forceps. Then, using a 50-mL syringe, saline was injected slowly into the resected stomach until it overflowed from the hole; the total amount of saline injected was recorded (Fig. 1).

### Follow-up

Patients were followed-up every 3 months in the first year and 6 monthly after that. At each follow-up visit, the percentage of excess weight loss (%EWL), current BMI and waist circumference, the status of co-morbidities, and complications were recorded. The %EWL was the major index for assessing the success of the procedure. Standard BMI was defined as 25 kg/m<sup>2</sup> for males and 24 kg/m<sup>2</sup> for females. The procedure was considered inadequate if

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