ORIGINAL

The Effect of Laparoscopic Sleeve Gastrectomy on Obesity and Obesity-related Disease : the Results of 10 Initial Cases

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Abstract : *Introduction* : The number of patients who undergo laparoscopic sleeve gastrectomy (LSG) has been increasing. Department of Surgery, Tokushima University performed the first LSG in 2013. The aim of this study was to report the results of the initial ten cases who underwent a LSG. *Patients and methods* : Ten obese patients : five males and five females ; age range from thirty-three years to fifty-six years (mean age 42.2 years) ; mean body mass index (BMI) 50.3 ; five with diabetes ; nine with hypertension (HT) ; four with hyperlipidemia (HL) ; eight with sleep apnea syndrome (SAS) who underwent LSG were enrolled in this study. The data was analyzed retrospectively and included short- and long-term outcomes. *Results* : There were no post-operative complications in this study. The %EWL at three and six months and one year post-operative were 44.2%, 50.2% and 48.6% respectively. In three months post-operative the non-alcoholic fatty liver (NAFLD) and non-alcoholic steatohepatitis (NASH) had improved transaminase (AST/ALT), liver to spleen ratio in plain CT value. Improvements were also evident in the obesity-related diseases : diabetes 80% (4/5) ; HT 67% (6/9) ; HL 75% (3/4) ; and SAS 88% (7/8). *Conclusion* : LSG is a promising option for the treatment of morbid obesity and obesity-related diseases. J. Med. Invest. 66 : 289-292, August, 2019

***Keywords* :** *LSG, HT, HL, SAS, NASH*

INTRODUCTION

Metabolic syndrome (MS) is a disease characterized by obesity, diabetes, hypertension, and dyslipidemia. The incidence of MS has increased along with rapid economic development and an associated change in diet (1). Consequently, increased attention has been paid to the prevention of MS.

There is strong published evidence that bariatric surgery is an effective means to sustain long-term weight loss (2-4). Some reports have shown that bariatric surgery is superior to internal medicine in the treatment of MS (5). Especially, bariatric surgery is reported to achieve complete remission in obese patients with type 2 diabetes mellitus (T2DM) (6).

The authors previously reported that duodenal-jejunal bypass improved T2DM and liver steatosis by enhancing glucagon like peptide-1 (GLP-1) secretion through increasing serum bile acids and the proliferation of L cells in the ileum in vivo (7).

Three (3) main bariatric surgeries are performed worldwide : gastric banding ; Roux-en-Y gastric bypass (RYGB) ; and sleeve gastrectomy (SG).

The laparoscopic sleeve gastrectomy (LSG), initially used as the first stage of a more complex procedure (duodenal switch or gastric bypass) in patients with high surgical risk, has gained popularity in recent years due to reported good short-term results and its relatively lower technical difficulties (8, 9).

In Japan, the number of patients who have undergone a LSG has been increasing (10) since the Department of Surgery, Tokushima University performed the first LSGs in 2013. These initial ten (10) LSG cases are the focus of this study.

MATERIALS AND METHODS

Patient selection and data collection

Patients were included in this study based on the following indicators : a LSG at the Tokushima University Hospital ; aged between 18 years and 60 years ; a body mass index (BMI) of > 35 kg/m^{2} ; internal therapy of > 6 months ; and co-morbidity with : T2DM ; hypertension (HT) ; hyperlipidemia (HL) ; or sleep apnea syndrome (SAS).

The exclusion criteria were : known malignancies ; pregnancy ; and conditions associated with poor compliance (psychiatric illness).

The protocol for this research project was approved by a suitably constituted Ethics Committee of the Tokushima University Hospital.

From 2013 to 2017, ten (10) patients (5 males and 5 females ; age range from 33 years to 56 years (mean age 42.2 years) ; and a mean BMI of 50.3) were referred to the Tokushima University for treatment of morbid obesity. Co-morbidity included

Key words and acronyms
laparoscopic sleeve gastrectomy (LSG) ; Body Mass Index (BMI) ; type2 diabetes mellitus (T2DM) ; hypertension (HT) ; hyperlipidemia (HL) ; sleep apnea syndrome (SAS) ; percent excess weight loss (%EWL) ; non-alcoholic fatty liver (NAFLD) ; non-alcoholic steatohepatitis (NASH) ; Roux-en-Y gastric bypass (RYGB) ; glucagon-like peptide 1 (GLP-1) ; metabolic syndrome (MS) ; sleeve gastrectomy (SG) ; transaminase (AST/ALT) ; computed tomography (CT) ; bariatric surgery ; body weight (BW) ; vertical sleeve gastrectomy (VSG) ; hemoglobin A1c (HbA1c) ; farnesoid X receptor (FXR) ; duodenal-jejunal bypass (DJB)

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the following : five (5) patients with T2DM ; nine (9) patients with HT ; four (4) patients with HL ; and eight (8) patients with SAS (Table 1).

Data were collected retrospectively from medical records and supplemented with data and laboratory results.

Table 1. Patients' characteristics before LSG.

Factors	n = 10
Age (y.o.)	42.2 (33–56)
Gender : male/female	5/5
BW (kg)	138.8 (100.9–165.9)
BMI (kg/m^2)	50.3 (42.5–60.1)
Comorbidity	T2DM 5, HT 9, HL 4, SAS 8
HbA1c (%)	6.2 (4.9–8.4)

Technical description of a LSG

All surgical procedures were started laparoscopically. First, the greater curvature and the angle of His were dissected to staple the gastric fundus and greater curvature parallel to a gastric fiber, which was inserted in the stomach through the esophagus. Stapling (total five (5) to eight (8) times) was started from a distance of 5 cm to 8 cm from the pylorus on the greater curvature side toward the angle of His. This resulted in a tube-like stomach with a volume of approximately 100 mls made from the lesser curvature only. The staple line was reinforced by 3-0 PDS and vicryl continuous sutures.

Post-operative management

After the LSGs, the patients were started with water on day one (1) post-operative and a liquid diet on days four (4) and five (5) post-operative. A thrombosis prophylaxis was administered twice a day for a week.

After discharge, the patients were followed up once a month for two (2) months. At outpatient's clinic, the body weight (BW), blood test and plain CT of the patients were evaluated. For the purpose of the evaluation for fatty liver, the ratio of liver to spleen in plain CT was used. The ratio of liver to spleen in plain CT value > 1.0 indicated fatty liver.

Statistical analysis

The t-test was used for statistical analysis of the continuous variables. For all tests, $p < 0.05$ was interpreted as significant. The values for each continuous variable were expressed as a mean ± the standard deviation (SD).

RESULTS

An overview of the short-term outcomes after the LSGs is given in Table 2. The operation time was 233 ± 20.7 minutes and the blood loss was 11.7 ± 13.1 ml. The hospital stay after the LSGs was 30.8 ± 8.0 days and the weight loss during the hospital stay after the LSGs was 16.2 ± 5.8 kg. There were no post-operative complications after the LSGs.

Percent excess weight loss (%EWL) in three (3) months, six (6) months and one (1) year post-operative were : 44.2% (20.6 – 56.9) ; 50.2% (32.0 – 61.6) ; and 48.6% (35.5 – 62.6) respectively. Obesity related diseases were also improved at one (1) year post-operative : diabetes 80% (4/5) ; hypertension 67% (6/9) ; hyperlipidemia 75% (3/4) ; and SAS ; 88% (7/8). HbA1c at three (3) months post-operative was significantly lower than that recorded pre-operation (5.4 vs 6.2) (Table 3).

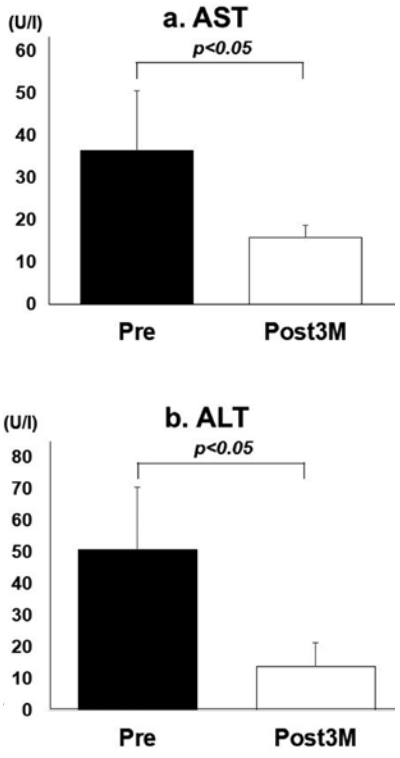
Table 2. Short-term outcome after LSG.

Factors	n = 10
Operation time (min.)	233 ± 20.7
Blood loss (ml)	11.7 ± 13.1
Postoperative complication (%)	0
Hospital stay after LSG (days)	30.8 ± 8.0
Weight loss during hospital stay (kg)	16.2 ± 5.8

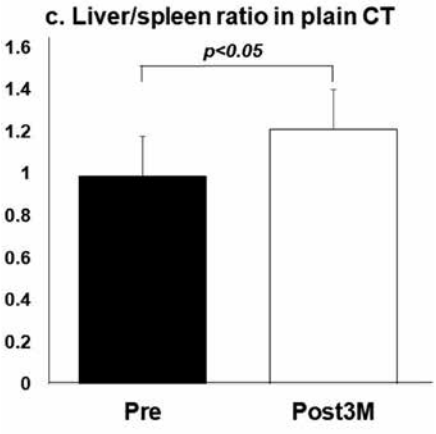
Table 3. Long-term outcome after LSG.

Factors	n = 10
%EWL in postoperative 3 months	44.2 (20.6–56.9)
%EWL in potoperative 6 months	50.2 (32.0–61.6)
%EWL in postoperative 1 year	48.6 (35.5–62.6)
Improvement of obesity-related disease	T2DM 80% (4/5)
	Hypertension 67% (6/9)
	Hyperlipidemia 75% (3/4)
	SAS 88% (7/8)
HbA1c (%) in postoperative 3 months	5.4 (4.8–6.5)

At three (3) months post-operative the LSGs had decreased the value of transaminase (AST/ALT) and increase the ratio of liver to spleen in plain CT value. Therefore, the LSGs contributed to the improvement of non-alcoholic fatty liver (NAFLD)/ non-alcoholic steatohepatitis (NASH) (Figures 1a ; 1b ; 1c and 1d).



Figures 1a and 1b : The comparison between the pre-operation and three (3) months post-operation levels of AST and ALT. The values for each continuous variable were expressed as a mean ± the standard deviation (SD). The t-test was used for statistical analysis of the continuous variables. For all tests, $p < 0.05$ was interpreted as significant.



Figures 1c : The comparison between the pre-operation and three (3) months post-operation in the value of liver to spleen in plain CT. The ratio of liver to spleen in plain CT value > 1.0 showed fatty liver. Values for each continuous variable were expressed as a mean ± the standard deviation (SD). The t-test was used for statistical analysis of the continuous variables. For all tests, $p < 0.05$ was interpreted as significant.

Figures 1d : The representative CT image in the pre-operation and three (3) months post-operation.

DISCUSSION

This study was designed to investigate the effect of a LSG on obesity and obesity-related disease in the Department of Surgery's initial ten (10) cases. The results showed not only BW loss but also improvements in T2DM, HT, HL, SAS and NAFLD/NASH.

SG surgery, in which 80% of the stomach is removed along the greater curvature but the intestinal anatomy is unaltered, is gaining in popularity. A LSG is considered a definitive procedure for the treatment of morbid obesity and T2DM. A LSG is increasingly used world-wide and represents the bariatric procedure in many countries (11-13). SG is successfully performed by laparoscopy in 99.7% of cases, with a high leak rate of 1.3%, a low leak rate of 0.5% and a mortality rate of 0.1% (14).

Zhang N, *et al*. reported that the remission rates of co-morbidity were observed in LSG for : sleep apnea (91.2) ; hyperlipidemia (63%) ; hypertension (38.8%) ; diabetes (58.6%) ; and musculoskeletal disease (66.7%) (15). Obesity is associated with NAFLD (16), and the resolution of NAFLD following bariatric surgery has been proven (17).

Regarding the resolution of diabetes and NASH following a LSG, a vertical sleeve gastrectomy (VSG) was reported to be as effective as RYGB for increasing secretion of GLP-1 and insulin as well as improving hepatic sensitivity to insulin. As well, these effects are independent of weight loss (18).

In the author's previous report, duodenal-jejunal bypass (DJB) improved T2DM and liver steatosis by enhancing GLP-1 secretion through increasing serum bile acids and the proliferation of L cells in the ileum in vivo (7). In addition, the authors have also reported that a DJB changed the composition of gut microbiota and these changes might be the factors that contributed to the effects of DJB (19). Ryan KK, *et al*. reported that bile acids and bile acid receptor, known as the farnesoid X receptor (FXR) was an important molecular underpinning for the beneficial effects of bariatric surgery (20). In this report, FXR in SG was associated with the change of gut microbiota. So, the important roles in SG might be the correlation among bile acids, GLP-1, FXR and gut microbiota.

In this study, the initial ten (10) cases who underwent LSGs were reported. LSG is a promising option for the treatment of morbid obesity and obesity-related disease.

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DISCLOSURES

Hideya Kashihara and the co-authors have no conflict of interest regarding this report.

All investigations on human subjects must include a statement that the subject gave informed consent and patient anonymity should be preserved.

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