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## Original Works

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# Positive Short-term Outcomes of Laparoscopic Sleeve Gastrectomy (LSG) for the Treatment of Obesity and Its Associated Comorbidities in Japanese Patients

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**Abstract: Background:** Laparoscopic sleeve gastrectomy (LSG) is a new technique for severely obese patients that reportedly lowers rates of postoperative complications and death. This study was designed to determine short-term outcomes of LSG and associated complications in our institute.

**Methods:** From January 2009 to January 2013, 14 patients underwent LSG in our institution. Operation time and complications, as well as follow-up percentage of excess weight loss (%EWL) and improvement of comorbidities, were determined.

**Results:** All procedures were performed laparoscopically. The mean operation time was  $185.5 \pm 18.4$  minutes. No patient required reoperation due to an early complication. One year after surgery, these patients had a mean  $55.0\% \pm 11.8\%$  EWL. Comorbidities, including type 2 diabetes, sleep apnea, and hypertension, were markedly improved 6 months after surgery, and the effects were prolonged for more than 12 months. However, aggravation of diabetic renal failure after 11 months postoperatively, and a rebound of obesity with psychological disorders were observed after 30 months, respectively.

**Conclusions:** LSG showed good short-term outcomes as a restrictive procedure for weight loss and improvement of comorbidities. Longer follow-up and prospective comparative trials are needed to confirm the long-term outcomes of this novel procedure and to reach definitive conclusions. LSG can be safely performed, and intensive follow-up by many specialists may better maintain good postoperative control.

**Key Words:** Bariatric surgery, Obesity, LSG (Laparoscopic sleeve gastrectomy).

## Introduction

Obesity is a major health problem affecting over 1.7 billion people worldwide. It is associated with significant comorbid conditions and reduced life expectancy<sup>1-3</sup>. While the general treatment for obesity in Japan focuses on dietary, behavioral, and exercise therapy as well as drug treatment, surgical methods, called "metabolic surgery", were recently introduced<sup>4,5</sup>.

Bariatric surgery was first performed in Japan in 1982<sup>6</sup>. Although this bariatric restrictive procedure became eligible for insurance reimbursement, it was not widely performed. However, the increased number of obese individual in Japan, the greater social needs and expenses in response to obesity, and progress in laparoscopic surgical techniques have resulted in marked developments in the treatment of obesity. Laparoscopic sleeve gastrectomy (LSG) was approved in Japan for treatment of morbid obesity in 2008, but few reports have evaluated its effectiveness. This report describes the experience of our institute with metabolic surgery in patients with morbid obesity, and the effects of LSG on body weight loss and improvement of comorbidities during follow-up.

## Patients and Methods

Indications for surgery were according to the guidelines of The Japanese Society for Treatment of Obesity (JSTO). Patients were included if they were aged 31-49 years, had a body mass index (BMI)  $>35 \text{ kg/m}^2$  or  $>32 \text{ kg/m}^2$  with comorbidities, failed nonoperative treatment after a follow-up of 1 year, and participated in regular physical activity. Patients who met the inclusion criteria were invited to attend preoperative seminars conducted by our surgeons. All patients underwent multidisciplinary evaluations performed by internists, psychiatrists, and surgeons. Blood tests, abdominal ultrasonography, upper endoscopy, and body fat sequencing were performed preoperatively to establish a baseline. All patients provided written informed consent and acknowledged the purpose of the study, including the risks and benefits of the procedure. Fourteen patients were enrolled through the outpatient department of general surgery from January 2011 to January 2013 in a related hospital of the Kyoto Prefectural University of Medicine and were assigned to undergo LSG. Patient characteristics are shown in Table 1. One patient had a history of osteosis of posterior longitudinal ligament (OPLL).

Thirteen patients were followed up at 1, 3, 6, and 12 months postoperatively. One patient was followed up only for 6 months. Operative times, postoperative complications, percentage of excess weight loss (%EWL), and changes in comorbidities were analyzed.

## Surgical procedure

The patient was positioned in the modified beach chair position with both arms placed in abduction and the lower extremities kept straight. The surgeon and scopist stood to the right of the patient, and the assistant to the left. Fig. 1 shows an intraoperative picture of a patient undergoing LSG. Patients were placed in the modified beach chair position, securing the working space around the stomach in morbidly obesity patients (Fig. 2).

A closed pneumoperitoneum of 12 mm Hg was achieved. The first port was placed with Visiport<sup>TM</sup>. One 10 mm trocar was placed above the umbilicus for the laparoscope, and a second 10 mm trocar was placed on the anterior line at the midpoint of the xiphoid and umbilicus to pass the needle, for suturing and for the surgeon's right hand. A 5 mm trocar was placed below the xiphoid appendices

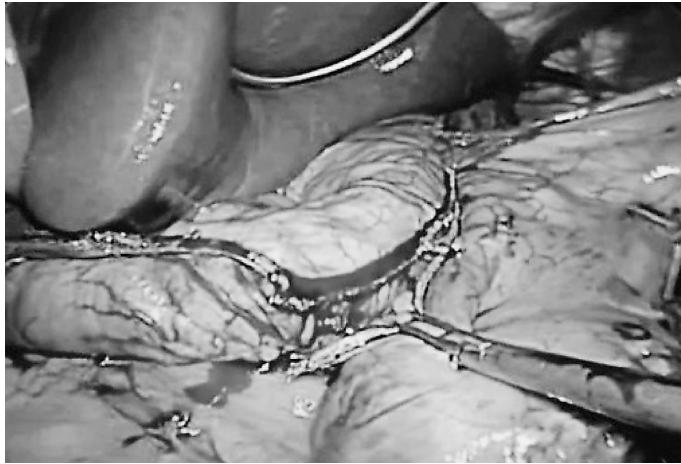


Fig. 1. Intraoperative finding of LSG.  
The stump of the sleeve gastrectomy is observed at the time of stapling.



Fig. 2. Patient position (modified beach chair position).  
Morbidly obese patients are placed in the modified beach chair position to secure the working space around the stomach.

for liver retraction; a second 5 mm trocar was placed on the right anterior axillary line, 2-3 cm subcostally for the surgeon's left hand; and a third 5 mm trocar was placed on the left midclavicular line 2-3 cm subcostally for the surgeon's assistant. Using an ultrasonic scalpel, the omentum and gastroepiploic vessels were dissected from the greater curvature, usually starting 5 cm from the pylorus and continuing up to the left crus of the diaphragm and the angle of His. The short gastric vessels, posterior gastric vein, and posterior gastric attachments were carefully divided. The endoscopist passed a 32F nasogastric tube or gastric fiberscope toward the pylorus. Under the guidance of

nasogastric tube, 5 to 6 times of endo-GIA 60-mm stapler were applied along the greater curvature of the stomach. The volume of the residual stomach was about 100 ml with the width of 3 to 4 cm. Row of 8-10 extramucosal interrupted stiches of 3-0 vicryl sutures was placed just below the angle of the His and continued distally to 4 cm of the pylorus.”

## Results

From January 2009 to April 2013, 14 patients were enrolled into this study, including 12 with hypertension and 11 with type 2 diabetes. All comorbidities were screened postoperatively. Clinicopathological factors of these 14 patients are summarized in Table 1. They ranged in age from 31 to 49 years old and had a BMI of 36.2 to 72 kg/m<sup>2</sup>. Comorbidities included hypertension, hyperlipidemia, and type 2 diabetes, and joint disease.

None of these patients experienced any surgical complications. Their mean %EWL was 55.0% ± 11.8% at 12 months. None required conversion due to massive bleeding. Comorbidities improved or resolved in most patients, including arterial hypertension (100%) and diabetes mellitus (91%) (Table 2).

Six months after surgery, comorbidities, including diabetes and hypertension, improved markedly in all patients. However, one patient, who had preoperative diabetic nephropathy, experienced an exacerbation of this condition, resulting in acute renal failure 11 months after LSG. Another patient

Table 1. Clinicopathological features of the patients who underwent LSG

| Characteristics                                 |                 |
|---|-----------------|
| Gender (Male/Female)                            | 10/4            |
| Median age (range), yr                          | 31–49 (39.4)    |
| Median BMI (range), kg/m <sup>2</sup>           | 36.2–72 (52.6)  |
| Mean ± SD operative time (min)                  | 185.57 ± 18.444 |
| Median blood loss (range), ml                   | 21–113 (64.3-)  |
| Comorbidity, n (%)                              |                 |
| Hypertension                                    | 12 (85.7%)      |
| Diabetes  | 11 (78.6%)      |
| Hyperlipidemia                                  | 9 (64.3%)       |
| Sleep apnea                                     | 2 (14.3%)       |
| Joint disease                                   | 2 (14.3%)       |
| Total   | 13/14 (92.9%)   |
| Major complications<br>(Bleeding, leakage etc.) | 0               |

experienced a rebound of obesity after 30 months when regular visits to the hospital were interrupted by mental stress.

Table 2. Summary of clinical outcomes after LSG

| Characteristics                  |                                      |
|----------------------------------|--------------------------------------|
| Mean ± SD                        | %EWL (range)                         |
| 3 months                         | 48.0 ± 12.5% (35-55%)                |
| 6 months                         | 51.1 ± 10.0% (47-55%)                |
| 12 months                        | 55.0 ± 11.8% (48-64%)                |
| Comorbidity, n (%)               |                                      |
| Hypertension                     | 12/12 (100%)                         |
| Diabetes                         | 10/11 (90.9%)                        |
| Hyperlipidemia                   | 9/9 (100%)                           |
| Sleep apnea                      | 2/2 (100%)                           |
| Joint disease                    | 2/2(100%)                            |
| Total                            | 13/14 (92.9%)                        |
| Complications (during follow-up) |                                      |
| Rebound                          | 1/14 (7%, 30 months postoperatively) |
| Diabetic renal failure           | 1/14 (7%, 11 months postoperatively) |

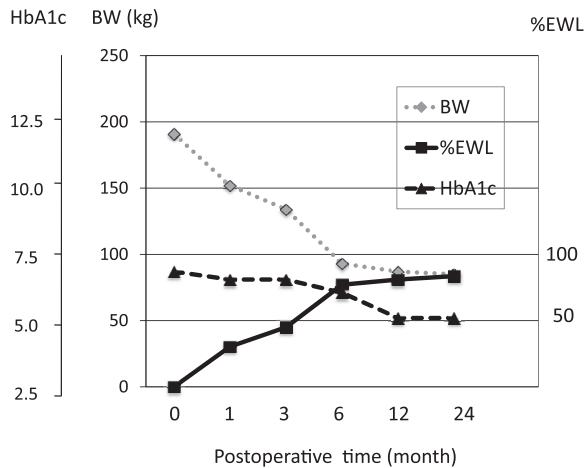


Fig. 3. Follow-up results after LSG. Chronological changes of body weight, %EWL, and HbA1c after surgery.

Typical data of changes over time in body weight, %EWL, and HbA1c after LSG are shown in Fig. 3.

## Discussion

LSG was first reported as part of the defective bariatric treatment known as duodenal switch<sup>7</sup>. LSG was accepted in 2008 as an advanced medical technique in Japan, and its use is gradually increasing. We introduced this procedure for metabolic surgery and have performed it safely and successfully in 14 patients. Although the follow-up period was short, we found that LGS could be performed safely, resulting in effective body weight loss and improvement of comorbidities, suggesting that this procedure is useful in Japanese patients as well as Europeans and Americans.

Many types of metabolic surgery involve Roux-en-Y bypass, during which the stomach is interpositioned<sup>4,5</sup>. As gastric cancer is frequent in Japan, screening of the residual stomach is necessary. Therefore, LSG may be preferable. Assessments of short-term outcomes of LSG found that the mean % EWL after 1 or more years exceeded 50%. Moreover, comorbidities, including type 2 diabetes, hypertension, and joint disease were improved in more than 90% of patients. These results are mostly in agreement with the data of an old overseas<sup>11-13</sup>. To date, few patients in Japan have undergone LSG; thus there are little follow-up data<sup>11</sup>. Long term follow-up is necessary to estimate its effect.

Staple line leakage and internal bleeding are reported to be major complications of LSG<sup>12</sup>. None of the patients in our series, however, experienced any intra- or postoperative complications. However, during follow-up, one patient each experienced diabetic renal failure and obesity rebound. Intensive follow-up by many medical professionals, including psychiatrists, physicians, counselors, nurses, and dietitians, may be needed to maintain good postoperative control and to prevent these complications.

To date, LSG methods have gradually been standardized<sup>13-15</sup>, but there is no general consensus about the techniques to use. The beach chair position may be optimal in ensuring adequate working space around the stomach of the patient. Space is secured when fat in the abdominal cavity moves to the rear with gravity; thus, this position may also be useful in overweight patients undergoing other types of upper abdominal surgery.

We are unable to identify studies on the economics of LSG, likely due to variations in the techniques used for bariatric surgery. LSG has been shown to improve comorbidities, contributing to decreased medical costs in morbidly obese patients<sup>16-21</sup>. We found that none of the 14 patients in this study required any of the medications prescribed before LSG, including insulin, anti-hypertensive agents, statins, and other lipid controlling agents. Moreover, all patients showed marked improvements in comorbidities.

In conclusion, we found that LSG resulted in an acceptable % EWL and good global outcomes in morbidly obese Japanese patients. Although LSG significantly improved comorbidities, its long-term metabolic effects are still unclear, and further studies in additional patients are needed.

**Conflict of interest statement:** Chouhei Sakakura and other co-authors have no conflicts of interest.

The authors indicated no potential conflict of interest.

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〈和文抄録〉

## 本邦における病的肥満及び併存疾患に対する 腹腔鏡下スリーブ状胃切除術の短期成績

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〈背景〉腹腔鏡下スリーブ状胃切除術 (LSG) は、欧米においては病的肥満患者に対する代謝手術として広く行われているが、本邦では未だ一般化されていない。本術式の日本人に対する有効性を検討した。

〈対象と方法〉2009年1月から2013年1月までに、肥満治療学会ステートメントの手術適応基準に準拠した14人に対して本術式を施行した。超過体重減少率 (%EWL), 併発疾患の改善効果などについて経時的に経過観察した。

〈結果〉いずれも腹腔鏡下手術にて施行しえた。手術時間は  $185.5 \pm 18.4$  分、術後合併症は認めなかった。術後1年後での %EWL は  $55.0 \pm 11.8\%$  で、2型糖尿病や高血圧や高脂血症などの併存疾患の著明な改善効果を認めた。内服薬やインシュリン皮下投与などは不要となり、その効果は術後12か月間以上持続した。しかし術後フォロー中に術前からの糖尿病性腎障害の増悪による人工透析移行 (術後30ヶ月) を1例、神経症増悪による通院困難とリバウンド (術後11ヶ月) を1例に認めた。

〈結論〉LSG は日本人の病的肥満患者に対しても安全に施行可能であり、代謝手術として有効であると考えられた。また術後の合併症やリバウンドを予防するためには、外科医のみならず精神科医や看護師やカウンセラーなどの多職種によるフォローアップが必要であると考えられた。

キーワード：減量手術, 肥満, LSG.