

Laparoscopic sleeve gastrectomy: an innovative new tool in the battle against the obesity epidemic in Canada

Shahzeer Karmali, MD*
Philip Schauer, MD†
Daniel Birch, MD*
Arya M. Sharma, MD*
Vadim Sherman, MD‡

From the *Centre for Advancement of Minimally Invasive Surgery and the Weight Wise Bariatric Centre, University of Alberta, Edmonton, Alta., the †Cleveland Clinic Bariatric and Metabolic Institute, Cleveland Clinic, Cleveland, Ohio, and the ‡Baylor College of Medicine Comprehensive Bariatric Surgery Program, Baylor College of Medicine, Houston, Tex.

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Correspondence to:

Dr. S. Karmali
10240 Kingsway Ave., Rm. 405 CSC
Edmonton AB T5H 3V9
fax 780 735-6652
shahzeer@ualberta.ca

Obesity can be considered to be one of the most important chronic diseases facing Canadians of all ages. Whereas patients with a very high body mass index may have the most to gain from procedures such as Roux-en-Y gastric bypass or biliopancreatic diversion/duodenal switch, the increased risk of postoperative complications often makes them poor surgical candidates. As a result, several “bridging” procedures have been proposed to impart clinically effective weight loss and reduce the risk of complications and improve outcomes in the definitive weight-loss procedure. In this article, we provide a review of the evidence in support of laparoscopic sleeve gastrectomy as an innovative new surgical procedure used as a bridging procedure in patients with severe obesity and discuss new findings for its possible role as a definitive procedure for some individuals with less severe obesity. Finally, we comment on a possible approach to introduce this innovative new procedure to Canadian bariatric centres.

On peut considérer l'obésité comme l'une des plus importantes maladies chroniques auxquelles les Canadiens de tous âges font face. Si les Canadiens dont l'indice de masse corporelle est très élevé sont ceux qui pourraient le plus bénéficier des avantages d'interventions telles que la dérivation gastrique Roux en Y ou la diversion biliopancréatique avec commutation duodénale, en fait, le risque accru de complications opératoires fait d'eux de mauvais candidats à la chirurgie. C'est pourquoi on a proposé plusieurs solutions de transition pour obtenir une perte de poids cliniquement efficace et ainsi réduire le risque de complications et améliorer l'issue de l'intervention bariatrique définitive le temps venu. Dans le présent article, nous présentons un aperçu des preuves favorables à la gastrectomie laparoscopique en manchon comme intervention chirurgicale novatrice en guise de solution intermédiaire chez les patients atteints d'obésité morbide et nous présentons les résultats récents qui témoignent de son rôle possible à titre d'intervention définitive dans certains cas d'obésité moins prononcée. En terminant, nous commentons une démarche envisageable pour faire adopter cette intervention novatrice dans les centres bariatriques canadiens.

According to the most recent estimates from the 2004 Canadian Community Health Survey, 59% of the adult population is overweight (i.e., body mass index [BMI] ≥ 25) and 1 in 4 (23%) is obese (i.e., BMI ≥ 30).¹ Even more alarming is the problem of obesity among children and adolescents in Canada. In 2004, 1 in 4 (26%) Canadian children and adolescents aged 2–17 years was overweight. The obesity rate has increased dramatically in the last 15 years: from 2% to 10% among boys and from 2% to 9% among girls.^{2,3} There is compelling evidence that overweight people are at increased risk of a variety of health problems, including type 2 diabetes, hypertension, dyslipidemia, coronary artery disease, stroke, osteoarthritis and certain forms of cancer. Moreover, it has been recently estimated that 1 in 10 premature deaths among Canadian adults 20–64 is directly attributable to obesity.⁴ In addition to affecting personal health, the increased health risks translate into an increased burden on the health care system. The cost of obesity in Canada has been conservatively estimated to be \$2 billion per year, or 2.4% of total health care expenditures in 1997.⁵ Thus, the continuing epidemic of obesity in Canada is exacting a high toll on the health of the population.⁴ Obesity can therefore be considered to be one of the most important chronic diseases facing Canadians of all ages.

The limited long-term success of behavioural and drug therapies in patients

with severe obesity has led to a renewed interest in bariatric (obesity) surgery in Canada.⁶ Further, the 2006 *Canadian Clinical Practice Guidelines on the Management and Prevention of Obesity in Adults and Children*⁴ recommended bariatric surgery as a choice in adults with clinically severe obesity (BMI ≥ 40 or ≥ 35 with severe comorbid disease) when lifestyle intervention is inadequate to achieve healthy weight goals. Interestingly, there has been a 14-fold increase in the number of bariatric surgeries in Canada in the last 2 years,^{7,8} and on July 22, 2008, the Ontario health minister announced a \$75 million initiative to increase Ontario's capacity for bariatric surgery several-fold within 2 years.⁹

The vast majority of patients undergoing bariatric surgery are middle-aged women who have no pre-existing cardiovascular disease or risk factors. This "preselection" of low-risk surgical candidates results in very low rates of in-hospital morbidity and mortality but may not fully address

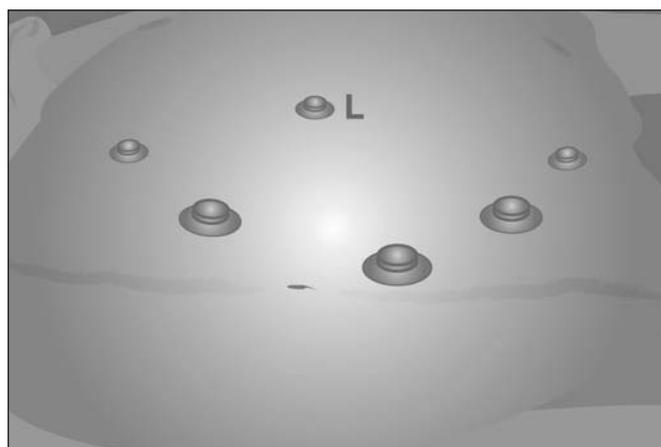


Fig. 1. Port setup for laparoscopic sleeve gastrectomy.

the subset of obese patients who are at highest risk of death from their disease. This is particularly true for severely obese patients, that is, those with a body mass index (BMI) over 60, who have an increased number of comorbid conditions and thus a significantly increased operative risk.¹⁰

Whereas patients with a very high BMI (> 60) may have the most to gain from procedures such as Roux-en-Y gastric bypass (RYGB) or biliopancreatic diversion with duodenal switch (BPD-DS), the increased risk of postoperative complications often renders them poor surgical candidates.¹⁰ As a result, several "bridging" procedures have been proposed to impart clinically effective weight loss and reduce the risk of complications and improve outcomes in the definitive weight-loss procedure. These include endoscopically placed intragastric balloons, laparoscopic adjustable gastric banding (LAGB) and laparoscopic sleeve gastrectomy (LSG). Following initial weight loss and overall improvement, these interventions can be followed by conversion or completion to RYGB or BPD-DS.

In this review, we focus on the role of LSG as a bridging procedure in patients with severe obesity and discuss new findings indicating that this may be a definitive procedure in some individuals with less severe obesity. Finally, we comment on a possible approach to introduce this innovative new procedure to Canadian bariatric centres.

LAPAROSCOPIC SLEEVE GASTRECTOMY TECHNIQUE

Although there are minor variations of the LSG procedure, in general 75%–80% of the greater curvature is excised, leaving a narrow stomach tube. Port placement is similar to RYGB (Fig. 1). The key phases of the procedure are summarized in Table 1. A point on the greater curve,

Table 1. Summary of the steps of laparoscopic sleeve gastrectomy

Phase	Goals	Pearls and pitfalls
Access or port placement	Safe access; optimize ports for stapling	<ul style="list-style-type: none"> • Veress needle (left upper quadrant) • Require 3 \times 10- or 12-mm ports to facilitate stapling and camera visualization
Identification of the distal point of transection on the stomach	Avoid pylorus/distal antrum	<ul style="list-style-type: none"> • Most surgeons commence dissection 5–10 cm proximal to the pylorus • If dissection is too close to the pylorus, the thick area can crack and become predisposed to leaks and/or the antral pumping mechanism will be affected
Mobilization of the greater curvature	Full mobilization of the greater curvature and posterior aspect of stomach (division of retrogastric adhesions)	<ul style="list-style-type: none"> • Mobilize the greater curvature inside the epiploic arcade, close to the gastric wall, which will be removed; this reduces the specimen size • Lack of adequate retrogastric mobilization increases the risk of leaving a large posterior stomach
Bougie insertion	Size the pouch to an adequate size (32–60 French bougie may be used)	<ul style="list-style-type: none"> • Ensure that the bougie lies on the lesser curve and that it is distal to the point of transection
Staple transection	Creation of a uniform gastric tube	<ul style="list-style-type: none"> • Ensure good lateral traction on the stomach by the assistant and good visualization anteriorly and posteriorly to ensure that a large posterior stomach is not left behind • Do not include the esophagus in the transection (direct the last staple fire away from esophagus) because the tissue is too thin for the cartridge load, and high gastric leaks are very difficult to manage
Staple line reinforcement	Reduce leaks and bleeding from the staple line	<ul style="list-style-type: none"> • Buttressing material is used on all staple loads • Reinforce crossing/overlapping staple lines with an absorbable monofilament figure-of-8 suture and place sutures at the start point and end points of the transection
Staple line testing/ drain placement	Identify leaks	<ul style="list-style-type: none"> • Intraoperative leak testing with air (gastroscope) and methylene blue dye • Place a Blake drain along the staple line

on the antrum, is chosen as the starting point. This has previously been described as ranging from 2 to 10 cm from the pylorus. The lesser sac is entered by opening the gastrocolic ligament. The short gastric vessels and the greater curvature ligaments (gastrosplenic and gastrocolic) are then divided with ultrasonic dissection to the left crus. A 32–60 French bougie is then passed transorally into the pylorus, placed against the lesser curvature. Technically, there appears to be no short-term weight loss difference in the choice of dilator size to create the lesser curve conduit.¹¹ A laparoscopic stapler with a green cartridge (4.8 mm closed staple height) is introduced and is fired consecutively along the length of the bougie until the angle of His is reached (Fig. 2). At this point, about 75%–80% of the stomach has been separated (Fig. 3). The specimen (Fig. 4) is removed by enlarging one of the 12-mm ports. A drain is then placed alongside the staple line.

Although the procedure does not involve anastomoses, the length of the staple line still renders the patient at risk for bleeding or leakage. Several authors have described oversewing the long staple line, whereas others have used buttressed staples (i.e., Gore Seamguard Bioabsorbable Staple Line Reinforcement) or fibrin glue as a sealant.¹³ The potential benefits of an absorbable polyglyconate polymer staple line buttress were demonstrated in a randomized study involving patients undergoing LSG with or without BPD-DS.¹³ Ten patients were randomly assigned to a control group and underwent LSG in the conventional fashion. The other 10 patients underwent LSG in which the absorbable polymer membrane was integrated into the length of the

gastric staple line. Although the number of patients was small, the investigators were able to demonstrate significantly less intraoperative blood loss in the buttressed staple line group (120 mL v. 210 mL, $p < 0.05$). Furthermore, 2 staple line hemorrhages occurred in the control group after operation, but none occurred in the buttressed staple line group. No staple line leaks occurred. A video of LSG is available for review at www.capitalhealth.ca/CAMIS.

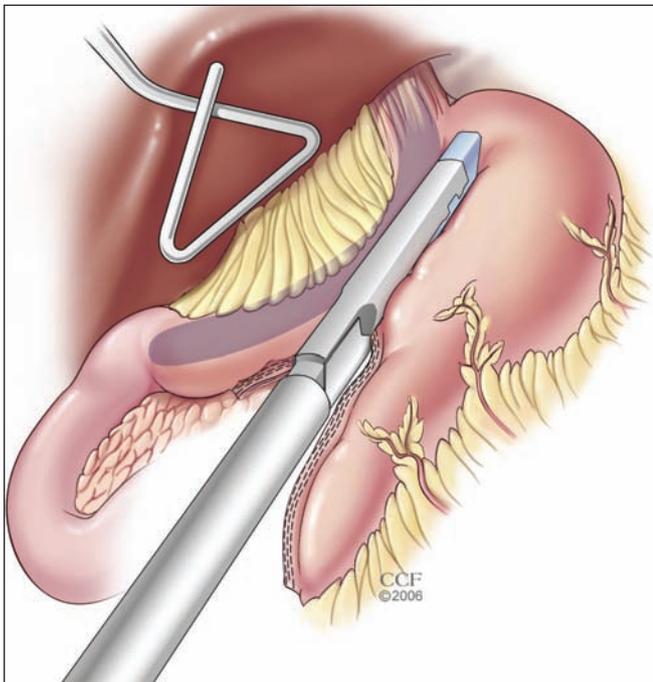


Fig. 2. A stapler is fired successively along the length of an intragastric bougie. From Sherman et al.¹² Reprinted with the permission of The Cleveland Clinic Center for Medical Art & Photography.

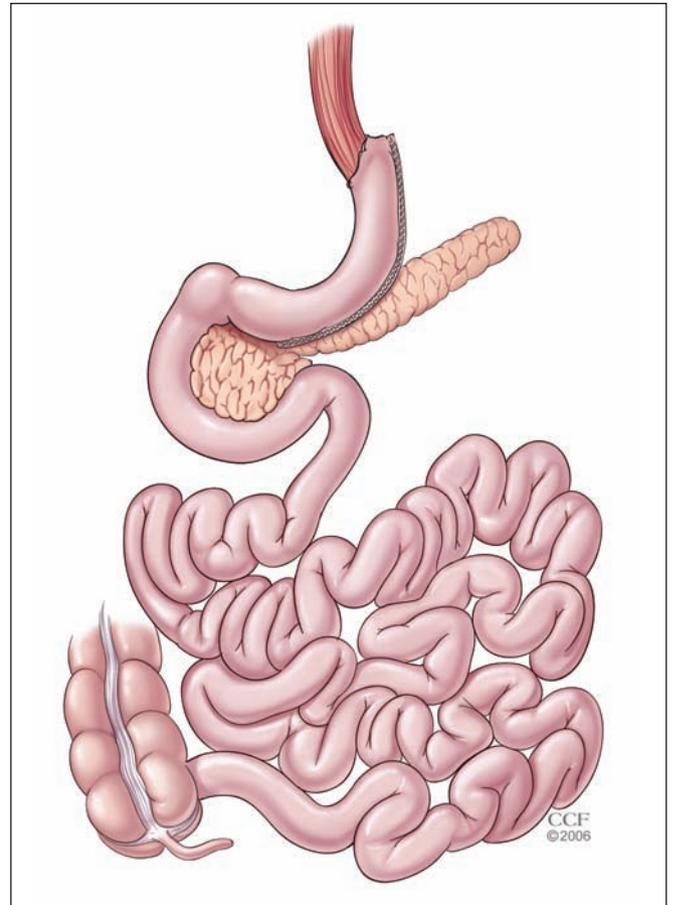


Fig. 3. Completed sleeve gastrectomy demonstrating a tubularized stomach. From Sherman et al.¹² Reprinted with the permission of The Cleveland Clinic Center for Medical Art & Photography.



Fig. 4. Specimen after laparoscopic sleeve gastrectomy.

MECHANISM OF ACTION OF LSG

Laparoscopic sleeve gastrectomy is putatively a purely restrictive operation that reduces the size of the gastric reservoir to 60–100 mL, permitting the intake of only small amounts of food and imparting a feeling of satiety earlier during a meal. More recently, however, it has been suggested that attenuation of endogenous ghrelin levels may also contribute to the success of LSG.¹⁴ Ghrelin, which is thought to be a hunger-regulating peptide hormone, is mainly produced in the fundus of the stomach. By resecting the fundus in LSG, the majority of ghrelin-producing cells are removed, thus reducing plasma ghrelin levels and subsequently hunger.

In a prospective study of 20 patients, the effects of LSG on immediate and 6-month postoperative ghrelin levels were compared with those of LAGB.¹⁵ The patients were randomly assigned to undergo either LSG or LAGB. Groups were comparable at baseline, with an overall mean BMI of 45 (standard deviation [SD] 4.7). Patients who underwent LSG achieved a higher excess weight loss at 1 and 6 months after operation compared with the LAGB group. The LSG patients also showed a significant decrease in plasma ghrelin levels on day 1 compared with preoperative levels, which remained low through 6 months. In contrast, in patients who underwent LAGB, plasma ghrelin levels did not change perioperatively and were found to significantly increase at 1 month. These observations suggest that although both procedures are purely restrictive in nature, the superior short-term weight loss experienced by LSG patients may in part be attributed to the lower ghrelin levels, which attenuate hunger as a compensatory mechanism.

Similarly, in a prospective double-blind study of 32 patients, LSG resulted in a marked reduction in fasting ghrelin levels and significant suppression after a meal, which was not seen after RYGB.¹⁴ Furthermore, appetite was also reduced to a greater extent after LSG.¹⁴ Thus, although reduction in ghrelin secretion may contribute to the mechanism of early weight loss in LSG, larger studies with longer follow-up will be required to fully elucidate the role of this putative mechanism.

SAFETY AND EFFICACY OF LSG

Early safety and efficacy of LSG was examined prospectively by Mognol and colleagues¹⁶ in 10 patients (mean BMI 64, range 61–80, average age 42.7 yr). Patients had an average of 3.4 comorbidities, including hypertension (50%) and sleep apnea (90%). Mean operative time was 120 (range 90–150) minutes and the average length of stay in hospital was 7.2 days. No early mortalities or complications were reported. At 1-year after LSG, an excess weight loss of 51% and a BMI decrease to 41 was reported in the 30% of patients who completed follow-up.

Similar results were demonstrated in a retrospective study by Baltasar and colleagues¹⁷ involving 31 patients who had undergone LSG for various reasons. Seven patients were super-super obese (mean BMI 65, range 61–74) and underwent LSG as a first stage toward completion BPD-DS. Another 23 patients had significant comorbidities or intraoperative findings that did not make full BPD-DS advisable. One patient was converted from LAGB to LSG owing to severe symptoms from the initial procedure. There were no instances of deep vein thrombosis or pulmonary embolism, leak or pneumonia. However, there were 2 instances of trocar-related intra-abdominal bleeding, with one leading to death. Mean excess weight loss ranged from 56.1% (at 4–27 months) in the super-obese patients to 62.3% (3–27 months follow-up) in the lower BMI patients with significant comorbidities. The longest published follow-up was performed by Himpens and colleagues¹⁸ who published a prospective randomized study involving 40 patients undergoing LSG. With a median initial BMI of 39 (range 30 to 53), their 3-year follow-up data found a median weight loss of 29.5 kg (range 1 to 48), median BMI decrease of 27.5 kg/m² (range 0 to 48) and a median percent of excess weight loss of 66% (range –3.1 to 152.4) after LSG.

COMPARISON TO OTHER MODALITIES

There is no consensus about the most appropriate bariatric procedure for high-risk or super-obese patients. Besides LSG, options include LAGB and placement of an endoscopic intragastric balloon. Gagner's group¹⁹ compared LSG to the BioEnterics Intragastric Balloon (BIB) as a first-stage procedure for effective initial weight loss before definitive weight loss surgery. Numerous intragastric balloons have been tested but abandoned owing to various complications such as erosion, ulcers and intestinal obstruction. However, BIB has become accepted as a viable option for weight loss outside the United States.²⁰ The balloon is placed endoscopically and reduces the volume of the stomach, thereby acting as a restrictive procedure.

Milone and colleagues¹⁹ retrospectively compared their experience with 20 LSG patients (BMI > 50) to that of 57 BIB historical controls with similar BMI described in 2 studies.¹⁹ At 6 months, the LSG group experienced a greater excess weight loss than did those in the 2 BIB groups (34.9% v. 26.1% and 21%). Baseline BMI and weight were equivalent between the LSG and BIB patients, but the LSG patients experienced a 15.9 decrease in mean BMI versus 9.4 and 6.4 in the BIB patients. Each patient in the LSG and BIB group had improvement in comorbidities such as hypertension, osteoarthritis and sleep apnea. Among the 20 LSG patients, the only complication was a trocar site infection. However, 4 (7%) patients in the BIB group required removal of the balloon and 1 patient spontaneously eliminated the balloon in their stool. Other

noted complications included severe vomiting and dehydration in 2 patients. Thus, although both procedures had positive results as a bridging procedure in the super-super-obese, LSG not only produced significantly more weight loss but also had fewer complications in this limited study.

Only a single prospective trial has compared LSG to LAGB. Median weight loss after 1 year was 14 kg (range -5 to 38) for LAGB and 26 kg (range 0 to 46) for LSG ($p < 0.0001$) and after 3 years was 17 kg (range 0 to 40) for LAGB and 29.5 kg (range 1 to 48) for LSG ($p < 0.0001$). The median percent of excess weight loss at 1 year was 41.4% (range -11.8 to 130.5) after LAGB and 57.7% (range 0 to 125.5) after LSG ($p = 0.0004$) and at 3 years was 48% (range 0 to 124.8) after LAGB and 66% (range -3.1 to 152.4) after LSG ($p = 0.0025$). Loss of feeling of hunger after 1 year was reported in 42.5% of patients with LAGB and in 75% of patients with LSG ($p = 0.003$) and after 3 years in 2.9% of patients with LAGB and 46.7% of patients with LSG ($p < 0.0001$).¹⁸

ROLE OF LSG AS A STAGED PROCEDURE

In a retrospective analysis of 7 patients who underwent LSG followed by RYGB, Pomp's group²¹ demonstrated the efficacy and safety of a 2-stage approach to surgical weight loss in high-risk super-super-obese patients. These patients had an average age of 43 and preoperative mean BMI of 63 (range 58–71). Mean operative time for stage I was 124 minutes and 158 minutes for stage II, with a length of stay of 2.7 days, averaged over all 14 procedures. Following stage I, there were 3 complications in 2 patients (42.9%), which included postoperative bleeding, a urinary tract infection and port-site hernia (discovered at stage II). Following stage II, there were 2 complications (28.6%), which included a gastrojejunal stricture and a temporary upper extremity neurapraxia. There were no deaths. The second stage was performed within a mean of 11 (range 4–22) months and BMI had decreased to 50 with average excess weight loss of 33%. Although follow-up after completion of RYGB was short (average 2.5 mo), patients continued to lose weight, with an average excess weight loss of 46%. Improvement or resolution of comorbidities was not reported.

The largest study of LSG to date involved 126 patients who underwent LSG as a first stage en route to completion RYGB.²² In the majority of the procedures (> 90%), LSG had been planned preoperatively because of high BMI or severe comorbid conditions. The remainder of the patients were chosen after intraoperative abdominal evaluation revealed unfavourable anatomy. The group of patients had a preoperative BMI of 65.4 (SD 9, range 45–91) and numerous comorbid conditions, with an average number of around 9. About 42% were classified as American Society of Anesthesiologists (ASA) III and 52% were ASA IV. Of the 126 patients, 36 patients proceeded to stage II completion

RYGB about 1 year after LSG (range 4–22 mo). At the time of the second stage, the mean number of comorbid conditions had decreased to 6.4 (SD 3), and the percentage of patients with ASA III or IV was 44%, compared with 94% before stage I. Body mass index had also been reduced significantly to 49.5 (SD 8). At stage II completion RYGB, the mean operative time for the 36 patients was 229 (SD 65) minutes and mean length of stay was 3 days. There were no deaths after LSG or completion RYGB. The complication rate after stage I was 14%, including 5 strictures, 2 leaks, 2 pulmonary embolisms and 4 cases of transient renal insufficiency, as well as 5 patients requiring more than 24 hours ventilatory support.

Despite the relatively high complication rate, the majority of complications were self-limited. Clearly, the marked improvement in the medical comorbidities following the initial procedure reduced the operative risk in patients undergoing stage II. All patients with diabetes and the vast majority of patients with sleep apnea showed improvement of their comorbidity before undergoing completion RYGB. As well, all cases of peripheral edema resolved and patients with degenerative joint disease showed significant improvement in activity levels before stage II, facilitating early ambulation after the procedure. Of the 36 patients, 6 experienced complications (17%), which included 3 postoperative bleeds, 1 leak, 1 acute cholecystitis and 1 marginal ulcer. Although 6-month follow-up after completion RYGB was limited to 20 patients at the time of publication, patients continued to lose weight (excess weight loss 55%) and most had either resolution or improvement in their major medical comorbidities.

In 2008, a retrospective review of 164 patients who underwent LSG from 2004 to 2007 at the Cleveland Clinic Florida was published.²³ In this study, 1-stage LSG was performed in 148 patients. The rate of major complications was 2.9% (4/149), including 1 leak (0.7%), 1 case of hemorrhage (0.7%), 1 case of postoperative abscess (0.7%) and 1 case of sleeve stricture that required endoscopic dilation (0.7%). One late complication of choledocholithiasis and bile duct stricture required a Whipple procedure. Laparoscopic sleeve gastrectomy was used as revisional surgery in 16 patients (9%). One of these patients had a leak and an abscess (7.1%) that required reoperation. One case was aborted, and 2 cases were converted to an open procedure because of dense adhesions. No patients died in either group.²³

ROLE OF LSG AS A DEFINITIVE BARIATRIC PROCEDURE

The feasibility of LSG as a definitive bariatric surgery was examined in a Korean study.²⁴ The lower prevalence of severe obesity in this country is reflected in the demographics of this low-risk population (mean BMI 37.2, range 30–56, mean age 30, range 16–62 yr). Although 130 patients underwent LSG, 1-year follow up data were reported for only 60 (46%) patients. Whereas excess

weight loss was 83.3%, BMI decreased to 28. Preoperatively, there were an average of 2.1 comorbidities in the 60 patients, most of which resolved or improved by 6 months. There was 100% resolution of fatty liver, sleep apnea, diabetes and asthma at 6 months and 100% resolution of joint pain, reflux esophagitis and amenorrhea at 1 year. Hypertension was resolved in 93% at 1 year and was improved in the remaining 7%. Dyslipidemia was the only comorbidity that was not fully improved at 1 year (65% resolution and 10% improvement). In the 130 initial patients, there was 1 leak, 1 case of delayed bleeding, 1 case of prolonged vomiting and 2 cases of atelectasis. There were no deaths. Given the low BMI of this population, it is perhaps not unexpected that weight loss plateaued in most patients at 1 year. Nevertheless, 5 of the 60 patients were subsequently required a secondary weight loss procedure because of inadequate weight loss.

Laparoscopic sleeve gastrectomy as a sole weight loss procedure was also examined by Langer and colleagues.²⁵ The aim of their study was to evaluate the effectiveness of LSG in patients with a lower BMI. Of the 23 patients prospectively studied, 8 patients had a preoperative BMI greater than 50 (mean BMI of the entire group was 48.5). At 6 months, mean excess weight loss among all 23 patients was 46%, and it was 56% at 1 year. There was no significant difference in percent excess weight loss between patients with an initial BMI less than 50 and those with a BMI greater than 50. Two patients required conversion to RYGB: one patient for failure to lose weight and the second for severe gastroesophageal reflux. Partial weight regain was observed in an additional 3 patients within a median follow-up of 20 months. All patients underwent a contrast study on postoperative day 1, and 14 patients underwent a follow-up contrast study at 1 year. Only 1 patient had dilatation of the stomach (width of gastric tube > 4 cm), but this patient had experienced an adequate excess weight loss of 59% and continued to experience early satiety. Weight loss from LSG was demonstrated to be very effective and even comparable to that of RYGB; however, follow-up was limited to about 1 year, when long-term durability of the sleeve gastrectomy becomes an issue.

Short-term data have been published demonstrating a beneficial effect of LSG on metabolic syndrome. A 4-month prospective study by Vidal and colleagues²⁶ involving 35 severely obese patients with type 2 diabetes mellitus undergoing LSG and 50 patients undergoing RYGB demonstrated a resolution of diabetes in 51.4% and 62.0% of the LSG and RYGB patients, respectively ($p = 0.332$). Nevertheless, more data are required to fully understand the role of LSG in the resolution of comorbidities.

A recent survey conducted at the First International Consensus Summit for Sleeve Gastrectomy asked "Is LSG indicated as a primary procedure in patients with a BMI > 40 or BMI > 35 with comorbidities?" Of the respondents, 58% completely agreed, 19% somewhat agreed, 8% had

no opinion, 14% somewhat disagreed and 0% completely disagreed.²⁷

CONCLUSION

First used as a "bridging" procedure in prohibitively high-risk patients with severe obesity, LSG has now been shown to result in adequate early weight loss and may be considered as a definitive bariatric surgical management option. Nonetheless, long-term (> 5 yr) weight loss and comorbidity resolution data for sleeve gastrectomy have yet to be reported.²⁸ Furthermore, with a major complication rate ranging from 2.9%–14%, LSG for morbid obesity remains a major technical undertaking.^{22,23}

With a 4-fold increase in the prevalence of grade 2 and 3 obesity in Canada,²⁹ we are still struggling with optimal management of this complex metabolic disease. Furthermore, within Canada there are few dedicated bariatric surgeons or regionally/provincially supported centres specializing in bariatric surgery with multidisciplinary, longitudinal follow-up. In its position statement on LSG, the American Society for Metabolic and Bariatric Surgery suggests that surgeons performing sleeve gastrectomy prospectively collect and report outcome data for this procedure in the scientific literature. In addition, it is suggested that surgeons performing sleeve gastrectomy inform patients about the lack of published evidence for sustained weight loss beyond 3 years and provide them with information about alternative procedures with published long-term (≥ 5 yr) data confirming sustained weight loss and comorbidity resolution.²⁸ At the Centre for Advancement of Minimally Invasive Surgery, we have obtained institutional review and approval for a prospective case series of LSG in bariatric surgical patients. All morbidly obese patients who are being considered for bariatric surgery will be offered 3 surgical options: LSG, RYGB or LAGB. Detailed information about these 3 procedures will be discussed with patients, and the decision about the procedure of choice will be a joint decision between the operating surgeon and patient. Measured outcomes will include percentage of initial and excess weight loss, BMI, operative time, mean length of hospital stay, complications and improvement of comorbidities. Our institutionally approved protocol is available for review at www.capitalhealth.ca/CAMIS.

We urge all Canadian centres with an interest in the surgical management of bariatric patients to consider joining us in this study to define the outcomes of LSG in the Canadian bariatric surgical population. We believe that a multicentre registry will help clarify the indications, safety and efficacy of LSG as well as lay the groundwork for future robust prospective trials comparing LSG with LAGB and RYGB.

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References

- Shields M. Measured obesity: overweight Canadian children and adolescents. *Nutrition: findings from the Canadian Community Health Survey* 2005;1:1-34. Cat. No. 82-620-MWE2005001. Available: www.statcan.ca/english/research/82-620-MIE/2005001/pdf/cobesity.pdf (accessed 2010 Feb. 1).
- Tremblay MS, Katzmarzyk P, Wilms J. Temporal trends in overweight and obesity in Canada, 1981-1996. *Int J Obes Relat Metab Disord* 2002;26:538-43.
- Canning PM, Courage ML, Frizzell LM. Prevalence of overweight and obesity in a provincial population of Canadian preschool children. *CMAJ* 2004;171:240-2.
- Lau DC, Douketis JD, Morrison KM, et al. 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children. *CMAJ* 2007;176:S1-13.
- Birmingham CL, Muller JL, Palepu A, et al. The cost of obesity in Canada. *CMAJ* 1999;160:483-8.
- Padwal RS. Characteristics of patients undergoing bariatric surgery in Canada. *Obes Res* 2005;13:2052-4.
- Steinbrook R. Surgery for severe obesity. *N Engl J Med* 2004;350:1075-9.
- Padwal RS, Lewanczuk RZ. Trends in bariatric surgery in Canada, 1993-2003. *CMAJ* 2005;172:735.
- Ontario launches diabetes strategy. \$741 million plan will make patients partners in care [news release]. Ontario Ministry of Health and Long-Term Care; 2008 July 22. Available: www.health.gov.on.ca/english/media/news_releases/archives/nr_08/jul/nr_20080722.html (accessed 2010 Feb. 1).
- Almogly G, Crookes PF, Anthone GJ. Longitudinal gastrectomy as a treatment for the high-risk super-obese patient. *Obes Surg* 2004;14:492-7.
- Parikh M, Gagner M, Heacock L, et al. Laparoscopic sleeve gastrectomy: Does bougie size affect mean %EWL? Short-term outcomes. *Surg Obes Relat Dis* 2008;4:528-33.
- Sherman V, Brethauer SA, Chand B, et al. 19.2. Laparoscopic sleeve gastrectomy. In: Schauer PR, Schirmer BD, Brethauer SA, editors. *Minimally invasive bariatric surgery*. New York (NY): Springer Inc; 2007. p. 173-9.
- Consten EC, Gagner M, Pomp A, et al. Decreased bleeding after laparoscopic sleeve gastrectomy with or without duodenal switch for morbid obesity using a stapled buttressed absorbable polymer membrane. *Obes Surg* 2004;14:1360-6.
- Karamanakos SN, Vagenas K, Kalfarentzos F, et al. Weight loss, appetite suppression, and changes in fasting and postprandial ghrelin and peptide-YY levels after Roux-en-Y gastric bypass and sleeve gastrectomy: a prospective, double blind study. *Ann Surg* 2008;247:401-7.
- Langer FB, Reza Hoda MA, Bohdjalian A, et al. Sleeve gastrectomy and gastric banding: effects on plasma ghrelin levels. *Obes Surg* 2005;15:1024-9.
- Mognol P, Chosidow D, Marmuse JP. Laparoscopic sleeve gastrectomy as an initial bariatric operation for high-risk patients: initial results in 10 patients. *Obes Surg* 2005;15:1030-3.
- Baltasar A, Serra C, Perez N, et al. Laparoscopic sleeve gastrectomy: a multi-purpose bariatric operation. *Obes Surg* 2005;15:1124-8.
- Himpens J, Dapri G, Cadière GB. A prospective randomized study between laparoscopic gastric banding and laparoscopic isolated sleeve gastrectomy: results after 1 and 3 years. *Obes Surg* 2006;16:1450-6.
- Milone L, Strong V, Gagner M. Laparoscopic sleeve gastrectomy is superior to endoscopic intragastric balloon as a first stage procedure for super-obese patients (BMI > or =50). *Obes Surg* 2005;15:612-7.
- Doldi SB, Micheletto G, Di Prisco F, et al. Intragastric balloon in obese patients. *Obes Surg* 2000;10:578-81.
- Regan JP, Inabnet WB, Gagner M, et al. Early experience with two-stage laparoscopic Roux-en-Y gastric bypass as an alternative in the super-super obese patient. *Obes Surg* 2003;13:861-4.
- Cottam D, Qureshi F, Mattar S, et al. Laparoscopic sleeve gastrectomy as an initial weight-loss procedure for high-risk patients with morbid obesity. *Surg Endosc* 2006;20:859-63.
- Lalor PF, Tucker ON, Szomstein S, et al. Complications after laparoscopic sleeve gastrectomy J. *Surg Obes Relat Dis* 2008;4:33-8.
- Moon Han S, Kim WW, Oh JH. Results of laparoscopic sleeve gastrectomy (LSG) at 1 year in morbidly obese Korean patients. *Obes Surg* 2005;15:1469-75.
- Langer FB, Bohdjalian A, Felberbauer FX, et al. Does gastric dilatation limit the success of sleeve gastrectomy as a sole operation for morbid obesity? *Obes Surg* 2006;16:166-71.
- Vidal J, Ibarzabal A, Nicolau J. Short-term effects of sleeve gastrectomy on type 2 diabetes mellitus in severely obese subjects. *Obes Surg* 2007;17:1069-74.
- Deitel M, Crosby R.D., Gagner M. The First International Consensus Summit for Sleeve Gastrectomy (SG), New York City, October 25-27, 2007. *Obes Surg* 2008;18:487-96.
- American Society for Metabolic and Bariatric Surgery. Position statement on sleeve gastrectomy as a bariatric procedure. Available: www.asbs.org/Newsite07/resources/sleeve_statement.pdf (accessed 2010 Feb. 1).
- Katzmarzyk PT, Mason C. Prevalence of class I, II and III obesity in Canada. *CMAJ* 2006;174:156-7.