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Laparoscopic sleeve gastrectomy: its place in bariatric surgery for the severely obese patient

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Abstract

Aim Laparoscopic sleeve gastrectomy (LSG) was initially used as a staging procedure for high-risk patients undergoing bariatric surgery. However, it is now being increasingly favoured as a single-stage procedure. This article discusses the use of LSG as a single-stage procedure for the treatment of obesity and related comorbidities.

Methods A literature review was conducted using specific search terms in multiple medical databases.

Results Early and mid-term weight loss results show that LSG is comparable to more established bariatric procedures. It also produces satisfactory resolution of obesity related comorbidities such as type two diabetes mellitus (T2DM). There are minimal published outcome data to assess its long-term effectiveness and safety. This is particularly true in super-obese patients with current data suggesting less satisfactory acheivement of a normal BMI in this group of patients.

Conclusion LSG is safe and produces satisfactory weight loss and comorbidity resolution in the early and mid-term period. However, further data are required to assess its long-term effectiveness as well as its effectiveness in super-obese patients.

Laparoscopic sleeve gastrectomy (LSG) is one of many bariatric procedures used for weight loss and the resolution of obesity-related comorbidities in severly obese individuals. It has evolved from a series of other operations and has become increasingly popular as stand-alone bariatric procedure.[1,2]

LSG was initially used as a staging procedure for high-risk patients undergoing bariatric surgery prior to biliopancreatic diversion with duodenal switch (BPD-DS) or Roux-en-Y gastric bypass (RYGB). It has now being increasingly favoured as a single-stage procedure with the major advantage over other bariatric procedures being that it is less invasive whilst still achieving comparable weight loss.

At Counties Manukau District Health Board, South Auckland, over 500 LSG procedures were performed between 2006 and 2011. This article discusses the use of LSG as a single-stage procedure for the treatment of obesity and related comorbidities.

Methods

A literature review was conducted independently by two authors (DPL, PPS). Several medical databases were utilised including MEDLINE, Scopus, Pubmed and EMBASE from inception to August 2011. The search terms used were ‘sleeve gastrectomy’, ‘laparoscopic sleeve gastrectomy’, ‘LSG’, ‘bariatric surgery’, ‘weight loss surgery’, ‘obesity surgery’, ‘obesity’, ‘complications’, ‘outcomes’,

'weight loss', 'comorbidity' and 'comorbidity resolution'. Additional articles were recovered by scrutinising reference lists in recovered articles by two authors (DPL, SS). There were no specific exclusion criteria.

The history of the sleeve

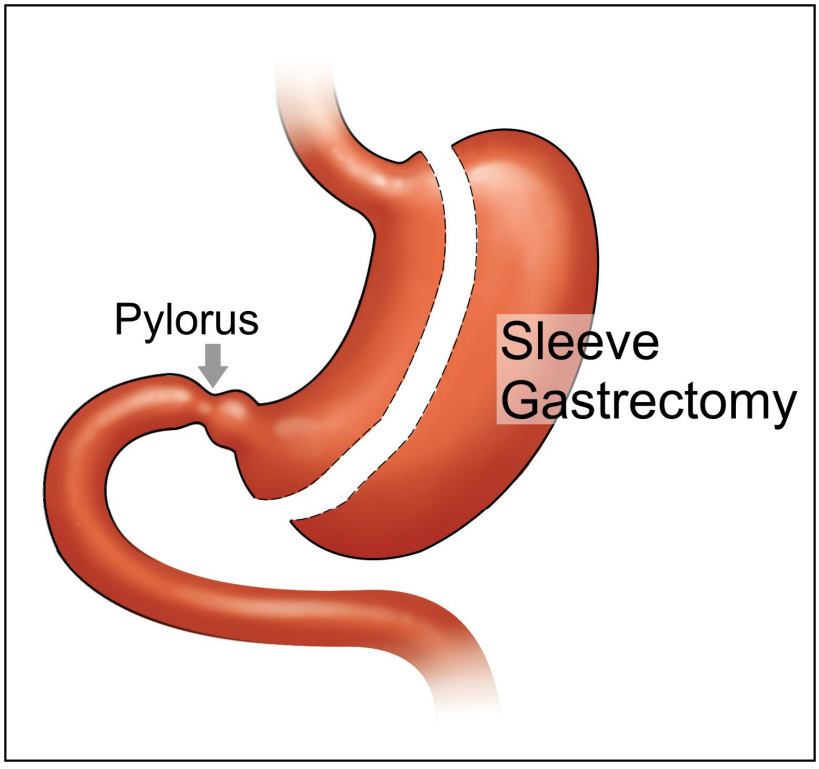
LSG is vertical gastrectomy to create a tubular stomach approximately 100–150 ml in volume[3] (Figure 1). This concept was initally developed in the setting of anti-reflux surgery by Lawrence Tretbar who was able to demonstrate weight loss following fundoplication.[4]

In 1988, Doug Hess modified this concept by substituting plication with a vertical gastrectomy to develop a sleeve. This become part of the BPD-DS,[2–5] and had the advantages of leaving an intact pylorus, which prevented dumping syndrome, and utilising a dudodenal-enteric anastomosis which helped prevent marginal ulcers.[5]

BPD-DS was first attempted laparoscopically in 1999 on pigs.[6] With this proving to be feasible, it was attempted in humans. However, it was noticed that for patients with higher BMI, there was an increased incidence of postoperative morbidity.[3] In order to solve this, it was decided to split the restrictive and malabsorptive components of the procedure by performing LSG as the first stage followed by the laparoscopic enteric anastomosis as the second stage.[3]

Eighteen cases were performed between September 2000 and September 2001 and there was noted to be a drastic reduction in the incidence of major morbidity.[3].

Figure 1. Diagram of laparoscopic sleeve gastrectomy



LSG as a primary procedure was first reported in the literature in 2003[7,8] with the report showing excellent weight loss results. These results have been compared to other more established bariatric procedures and have been shown to be comparable to laparoscopic Roux-en-Y gastric bypass (LRYGB) and BPD-DS with less morbidity and superior weight loss results compared to laparoscopic adjustable gastric banding (LAGB) [1, 9-12]. This weight loss has been attributed not only to anatomical restriction but also to significant hormonal suppression inducing early satiety which is not demonstrated after LAGB and more so than that seen in LRYGB.[1,13]

Mechanism of weight loss

LSG is classified as a restrictive procedure, affecting weight loss through anatomical restriction.[14] As understanding of the factors which regulate appetite increase, it is now also believed that LSG also affects weight loss through the modulation of gut hormones.[1,9,13]

Several studies have demonstrated that circulating levels of ghrelin, a hormone thought to increase appetite, are significantly decreased early after LSG leading to earlier satiety.[1,13] This is thought to occur as a result of removing the fundus which is where ghrelin producing cells are located.[15]

Studies have also been conducted comparing the effects of LSG versus other bariatric procedures on gut hormones. One study demonstrated that while ghrelin levels are significantly lower following LSG, LAGB has little to no effect on circulating levels of ghrelin.[11] It has also been shown that LSG is superior to LRYGB in its effects on gut hormones, which not only regulate appetite but also those that regulate glucose homeostasis.[15,16]

Selection criteria

Established patient selection guidelines exist within the current literature including the American National Institutes of Health (NIH) Consensus Statement on Gastrointestinal Surgery for Severe Obesity and the Interdisciplinary European Guidelines for Surgery for (Morbid) Obesity.[17,18].

Criteria for referral include patients with a body mass index (BMI) greater than or equal to 40 kg/m^2 alone or BMI greater than or equal to 35 kg/m^2 with at least one comorbidity which is improved by surgically induced weight loss, and have tried and failed to lose weight or maintain weight loss despite appropriate non-surgical care. Individual bariatric centres will also have local guidelines which may have additional considerations specific to their practice or institution.

Contraindications to surgery are detailed in these same guidelines. As detailed in the European guidelines, these include absence of periods of identifiable medical management, inability to participate in prolonged follow-up, presence of non-stabilised psychiatric disorders, alcohol abuse and/or drug dependencies, diseases which are life threatening in the short term and inability to care for oneself or absence of social support.[18] These conditions are standard for all bariatric procedures. Currently, there are no specific indications which would select patients for a specific bariatric procedure.

Efficacy

Weight loss—There is an increasing amount of literature to support the use of LSG as a single stage procedure. Studies have demonstrated that LSG produces weight loss results in the short term which are comparable to, and in some cases superior to, other more established bariatric procedures.[15,19–22]

A recent systematic review of LSG found that the mean percentage excess weight loss (%EWL) at 1 year was 59.8% (range of 46% to 83.3%).[23] For follow-up at 2 and 3 years, the mean %EWL was 64.7% and 66% respectively.[23] This compares favourably to weight loss results reported for LRYGB which at 1, 2 and 3-year follow-up achieved a mean %EWL of 62.8%, 54.4% and 66% respectively.[23] However, when compared to %EWL for LAGB of 37.8%, 45% and 55% at 1, 2 and 3 years respectively, LSG appears to achieve superior weight loss.[23]

A randomised controlled trial conducted by Kehagias and colleagues found LSG and LRYGB to equally safe and effective procedures.[24]

Though there is robust evidence demonstrating excellent short to mid-term weight loss results after LSG, there is a lack of long-term data to show the durability of these results. Himpens and colleagues reported follow-up data for 41 out 53 patients who underwent LSG out to 6 years and showed a mean %EWL of 57.3%, though this had decreased from 72.8% at 3 years.[25]

Similarly, in a series of 26 patients who underwent LSG, Bohidjalian and colleagues found a reduction in %EWL from a peak of 60.3% at 2-year follow-up to 55% at 5-year follow-up [26]. The longest follow-up data available from Sarela and colleagues reports %EWL in 19 patients assessed at up to 9 years postoperatively of which 11 had sustained %EWL greater than 50%.[27]

It is thought that though LSG affects short-term weight loss, there is a tendency towards weight regain which has been demonstrated in series that report follow-up greater than 5 years.[28] With this in mind, it is unclear whether a second stage procedure is required for patients who undergo LSG and longer follow-up data are required to clarify this.

Comorbidity resolution—The current literature suggests that LSG is effective at resolving obesity related comorbidity. Shi and colleagues reported in their systematic review comorbidity resolution rates of between 45% to 95.3% in patients with type 2 diabetes mellitus (T2DM) hypertension, obstructive sleep apnoea (OSA), hyperlipidaemia, osteoarthritis, gastroesophogeal reflux, depression and peripheral oedema at 12 to 24 months follow-up [23]. Resolution of urinary incontinence in women after LSG has also been reported by Srinivasa and colleagues who found a resolution rate of 90% at 12 months.[13]

The majority of the literature describes the efficiacy of LSG at resolving T2DM. Reported resolution rates for T2DM are in the range of 63%-100%.[29–31] LSG has been shown to be not only comparable, but often superior, to other laparoscopic bariatric procedures with regards to T2DM resolution.

Abbatini and colleagues reported that diabetes resolution after LSG was 80.9% at three months.[30] This result was comparable to LRYGB at 81.2% and superior to LAGB at 60.8%.[30] Omana and colleagues demonstrated significant resolution of

diabetes after LSG with a result of 100%. This was again vastly superior to LAGB (46%).[31]

Though the current evidence is consistent that LSG is superior to LAGB with regards to T2DM resolution, there is still some conjecture when compared to gastric bypass with a recent randomised controlled trial by Lee and colleagues showing T2DM resolution to be significantly higher in laparoscopic mini gastric bypass at 12 months follow-up.[32] How this resolution occurs in LSG is not well understood. Initially, resolution was attributed to weight loss. However, biochemical improvement has been shown to occur well before weight loss,[30] and may be related to neuro-hormonal mechanisms.

There is also substantial evidence describing the efficacy of LSG with regards to resolution of hypertension and obstructive sleep apnoea. Complete resolution of hypertension ranges from 55% through to 93% at 6 to 18-month follow-up with a mean resolution rate of 71.7% out to 24 months.[23] Similarly, resolution rates of OSA have shown to be acceptable with rates ranging between 52.6% to 100% with a mean rate of 83.6% at 24 months follow-up [23].

Other benefits of LSG—Though weight loss and comorbidity resolution are the most recognised outcomes of this procedure, LSG also offers other postoperative benefits. These benefits are described in Box 1.

Box 1. Additional benefits of LSG

- Little food intolerance
- Low incidence of late (more than 30 days postoperatively) complications
- Less micronutrient deficiencies compared to gastric bypass
- Minimal dumping

Complications

The postoperative complication rate reported in the literature varies from 1 to 29% after LSG.[33] This may depend on surgical technique (bougie size, amount of antrum excised, staple-line re-inforcement etc), patient factors, complication definitions and the follow-up period. This complication rate is comparable to other more established bariatric procedures.

The major complications associated with single stage LSG are listed in Box 2. This is not an exhaustive list and the incidence of each of these complications is low. The Michigan Bariatric Surgery Collaborative reported on the largest LSG series. This included 854 patients who underwent LSG between 2006 and 2009 across 25 hospitals and 62 surgeons and they reported a major complication rate of 2.2%.[34]

In a retrospective comparative analysis, Lakdawala and colleagues showed no difference in complication rates between LRYGB and LSG.[21] There have also been shown to be no significant difference in complication rates when compared to LAGB.[35]

Staple line leak—The risk of staple line leak is the greatest concern for bariatric surgeons and patients. Leak rates range between 0–7% with a mean occurrence of 2.4%.[36] Staple line leak is associated with significant morbidity, prolonged convalescence and increased risk of mortality. It is difficult to manage with little consensus in the current literature regarding an optimal treatment approach.

Most leaks occur relatively early after surgery which often makes surgical management difficult due to poor tissue quality and inflammation.[37] The placement of endoscopic stents and percutaneous drains in conjunction with gut rest and parenteral nutrition is generally the preferred management option though resolution often takes an extended period of time.[36]

Box 2. Major postoperative complications associated with LSG

- Staple line leak
- Intra-abdominal haemorrhage
- Intra-abdominal abscess
- Stricture
- Wound infection
- Splenic injury
- Pulmonary embolism
- Trocar site hernia
- Late cholelithiasis
- Bowel obstruction
- Respiratory failure
- Renal failure
- Death

Effectiveness in the super-obese

Surgical risk is thought to increase significantly with BMI greater than 50 kg/m^2. It is recognised as an independent predictor of postoperative morbidity and mortality, and this has been attributed to a greater burden of obesity-related comorbidity.[38–40]

Previous studies have investigated postoperative morbidity in super-obese patients after laparoscopic bariatric surgery and found increased rates of postoperative complications.[41,42] As mentioned previously, LSG was initially used as the first stage of BPD-DS in high-risk patients and this stepwise approach was demonstrated to decrease postoperative mortality.

Though it is thought that LSG is safe in the super-obese population, it is unclear whether it is effective in producing satisfactory weight loss in these patients. Several studies have demonstrated that although LSG affects excellent absolute weight loss in this group of patients, a large proportion remain with a BMI of more than 40 kg/m^2 at follow-up of 12–18 months.[9]

According to European guidelines, these patients would still qualify for further bariatric surgery which may suggest that LSG might be more effective as a staging procedure in this select group of patients.[18] This is supported by a recent systematic review which found that studies identifying patients as super-obese or high-risk were

likely to have a second stage procedure approximately 2 years after the initial LSG. More long-term follow-up data are required to clarify this.[20]

Conclusion

LSG is an increasingly popular stand alone bariatric procedure. It produces significant and sustainable weight loss in severely obese patients and effectively cures obesity related comorbidity. It is safe with a major complication rate which is comparable to other common bariatric procedures. With the majority of the literature reporting short to mid-term weight loss results, further research is required to investigate long term weight loss outcomes. Further research is also required to investigate the efficacy of LSG in super-obese patients.

Competing interests: None known.

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