Curr Obes Rep (2012) 1:87–90
DOI 10.1007/s13679-012-0014-y

OBESITY TREATMENT (AM SHARMA, SECTION EDITOR)

The Effectiveness of Roux-En-Y Gastric Bypass Versus Laparoscopic Sleeve Gastrectomy and Laparoscopic Adjustable Gastric Banding in Morbidly Obese Individuals

Richdeep S. Gill · Joseph R. LaBossiere · Daniel W. Birch · Arya M. Sharma · Shahzeer Karmali

Published online: 8 March 2012

Abstract An estimated 1.5 billion individuals are overweight worldwide, with the prevalence of morbidly obese individuals increasing rapidly. Despite modest weight loss secondary to lifestyle modification, bariatric surgery remains the only evidence-based approach to producing marked weight loss in morbidly obese individuals. Currently, bariatric surgical procedures are classified as primarily restrictive or malabsorptive. Laparoscopic adjustable gastric banding (LAGB) and laparoscopic sleeve gastrectomy (LSG) are the most common restrictive procedure performed. Of the primarily malabsorptive surgical procedures, Roux-en-Y gastric bypass (RYGB) is the most common. Both LAGB and LSG have been shown to lead to adequate weight loss with minimal morbidity. RYGB remains the most effective treatment for morbid obesity; however, it is also the most technically demanding and complex of these procedures. Determining the optimal bariatric surgical procedure for a particular morbidly obese patient remains a complex decision based on evolving evidence.

Richdeep S. Gill and Joseph R. LaBossiere that have contributed equally

R. S. Gill · J. R. LaBossiere
Department of Surgery, University of Alberta,
Edmonton, AB, Canada

D. W. Birch · S. Karmali (✉)
Center for the Advancement of Minimally Invasive Surgery (CAMIS), Royal Alexandria Hospital,
Room 405, Community Services Center, 10240 Kingsway,
Edmonton, AB T5H 3V9, Canada
e-mail: shahzeer@ualberta.ca

A. M. Sharma
Department of Medicine, University of Alberta,
Edmonton, AB, Canada

Keywords Morbid obesity · Bariatric surgery · Gastric bypass · Sleeve gastrectomy · Roux-en-Y gastric bypass · Laparoscopic sleeve gastrectomy · Laparoscopic adjustable gastric banding

Introduction

The prevalence of obesity continues to grow at an escalating rate and although definitions vary, obesity is generally defined as a body mass index (BMI) greater than 30 kg/m^2. The World Health Organization estimates that 1.5 billion adults are overweight and that 500 million are defined as clinically obese [1]. These estimates are expected to continue to increase during the upcoming decades [2•]. In Canada, approximately 60% of the population is overweight with 24% defined as clinically obese [3]. Morbidly obese individuals (BMI>40 kg/m^2) are at an increased risk of developing obesity-related comorbidities such as type 2 diabetes mellitus and hypertension leading to cardiovascular events. Despite ongoing lifestyle modifications, bariatric surgery remains the only strategy to produce marked sustainable weight loss. Determining the appropriate bariatric surgical procedure for a select patient involves thorough consultation and strategy planning with a multidisciplinary team. In this review, we explore the effectiveness of primarily malabsorptive and restrictive bariatric surgical procedures in morbidly obese individuals.

Bariatric Surgery

Bariatric surgical procedures can be classified as primarily malabsorptive or primarily restrictive. The latter are defined based on mechanical restriction or limitation of the size of the stomach, and include surgical procedures such as laparoscopic adjustable gastric banding (LAGB) and laparoscopic sleeve

gastrectomy (LSG). LAGB involves placement of an adjustable band across the fundus of the stomach, leading to reversible restriction of the functional stomach. Similarly, LSG involves formation of a gastric "tube" to restrict the size of stomach; however, this procedure is irreversible. In contrast, primarily malabsorptive bariatric surgical procedures such as Roux-en-Y gastric bypass (RYGB) involve resection of the stomach to form a small gastric pouch along with rearrangement of the small bowel to bypass the duodenum and deliver gastrointestinal contents directly to the distal jejunum. The bypass is achieved by attaching a Roux limb to the gastric pouch.

Bariatric surgery is typically considered when medical and behavioral strategies fail. Despite a limited number of studies directly comparing weight loss following bariatric surgery to nonoperative management, marked weight loss has been observed following bariatric surgery. In a recent systematic review, Picot et al. [4] concluded that bariatric surgery is a clinically effective and cost-effective intervention in moderate to severe obese people compared to conventional nonsurgical interventions.

Laparoscopic Adjustable Gastric Banding

Comparatively, LAGB is the least complex bariatric surgical procedure currently available, with a low overall morbidity rate [5]. In addition, the relatively short duration of surgery and hospital stay has made LAGB one of the most commonly performed bariatric surgical procedures in Europe [6]. The band can be fitted on the stomach to achieve the desired effect. A systematic review done by Chapman et al. [5] comparing LAGB to RYGB in the treatment of obese individuals reported that LAGB has a lower mortality rate and morbidity rate (0.05% and 11.3% vs 0.50% and 23.6%, respectively), with a mean follow-up of 4 years (Table 1). Furthermore, these authors suggested that LAGB was as effective as RYGB in producing weight loss in the short term. These findings are supported by a more recent systematic review done by O'Brien et al. [7]. The authors reported that, although RYGB had a higher mean percent excess weight loss (EWL) compared to LAGB in the first (67% vs 42%) and second (67% vs 53%) years post procedure, there was not a significant difference at 7 years (55% vs 51%, respectively). Based on 7-year follow-up results, these authors concluded that LAGB was as effective as RYGB in the medium term. In contrast, a systematic review by Buchwald et al. [8] reported increased weight loss following RYGB compared to LAGB (mean percent EWL 62% vs 48%, respectively).

Dixon et al. [9] randomized 60 obese patients with type 2 diabetes mellitus to receive conventional therapy (lifestyle modifications) or LAGB. They reported a significantly greater mean weight loss of 21% in the LAGB-treated group compared to 1.7% in the conventional therapy group. Supportively, Ray and Ray [10] reported 60% EWL at 5 years in 31 patients following LAGB. Interestingly, Van Nieuwenhove et al. [11] observed 50% EWL in 44% of 656 morbidly obese patients following LAGB with a mean follow-up of 95 months. However, these authors suggest LAGB may not be an ideal first option to treat morbid obesity, with a failure rate near 25% in morbidly obese patients. Despite controversy regarding the efficacy of LAGB and its long-term success it remains an appropriate, evidence-based surgical treatment option for obesity. With low morbidity rates, and immediate reversibility, it is a reasonable option in select patients.

Laparoscopic Sleeve Gastrectomy

LSG was initially the first step to a two-staged approach for high-risk obese patients. However, current evidence supports

Table 1 Comparison of RYGB versus LAGB and LSG

Study	RYGB			LABG			LSG		
	Change in BMI	Mortality rate, %	Morbidity rate, %	Change in BMI	Mortality rate, %	Morbidity rate, %	Change in BMI	Mortality rate, %	Morbidity rate, %
Chapman et al. [5]	−16.8	0.98	27.4	−10.9	0.22	10.7			
O'Brien et al. [7][a]	EWL 68.5%			EWL 52.9%					
Buchwald et al. [8][a]	−16.7	0.5		−10.43	0.1				
Dixon et al. [9]				−7.4	0	0.13			
Kehagias et al. [12••]	−13.6	0	10				−16.2	0	10
Karamanakos et al. [14]	−15.1	0	0				−16.2	0	0
Himpens et al. [15]				−18	0	0.18	−27.5	0	0.05
Angrisani et al. [17]	−14		12.5	−8.5	0	7.7			
Tice et al. [18][a]	EWL 62.75%	0.017		EWL 37.75%	0.32	0.1			

[a] Systematic reviews

BMI body mass index; *EWL* excess weight loss; *LAGB* laparoscopic adjustable gastric banding; *LSG* laparoscopic sleeve gastrectomy; *RYGB* Roux-en-Y gastric bypass

its application as a stand-alone bariatric surgical procedure. Kehagias et al. [12••] randomized 60 morbidly obese patients (BMI<50 kg/m^2) to undergo LSG or RYGB and observed similar EWL between both groups (68% vs 62%, respectively) at 3 years follow-up. In addition, both groups had comparable early morbidity (13% for LSG vs 10% for RYBG) and late morbidity (10% for both groups). Supportively, a recent systematic review including 673 morbidly obese patients (mean BMI 47.4 kg/m^2) undergoing LSG reported a mean EWL of 47.3% at 13.1-month follow-up [13].

Marked weight loss following LSG was initially attributed to the restriction of caloric intake; however, new theories have been suggested. It has been proposed that resection of ghrelin-secreting cells with the gastric fundus leads to suppression of the patient's appetite. Karamanakos et al. [14] randomized 32 obese patients to LSG or RYGB and observed an EWL of 69.7% and 60.5%, respectively, at 1 year. In addition, ghrelin levels decreased further (as measured 2 h post meal) in the LSG-treated group (21.5% decrease) than in the RYGB-treated group (14%), which was associated with greater appetite suppression in the LSG group.

Early data suggest that LSG may be more effective at producing weight loss than LAGB. Himpens et al. [15] randomized 80 patients to undergo LSG or LAGB and reported a median EWL of 57.5% for LSG at 1 year compared to 41.4%. At 3-year follow-up, median EWL was 66% for LSG versus 48% for LGB. Minor and major (defined as the need to reoperate) complications were higher in the LGB group; however, the authors suggested that the major complications seen in the LSG group were of greater severity.

Roux-En-Y Gastric Bypass

Currently, RYGB is the most commonly performed bariatric procedure in North America. It functions as both a restrictive and malabsorptive bariatric surgical procedure that produces clinically significant weight loss. Suter et al. [16] followed 922 morbidly obese patients who underwent RYGB surgery between 1999 and 2008, with 379 of these patients having follow-up of 5 years or greater. These authors reported greater than 50% EWL in 74.9% of there patients, along with 76.8% of these patients reducing their BMI to less than 35 kg/m^2 at 5-year follow-up. Angrisani et al. [17] randomized 51 morbidly obese patients (> 35 kg/m^2 to <50 kg/m^2 BMI) to LAGB or RYGB surgery and observed a significantly greater weight loss in the RYGB group (mean EWL 66.6%) versus the LAGB group (mean EWL 47.5%) at 5-year follow-up.

The most important early complication associated with RYGB is anastomotic leak. Despite being a life-threatening complication, early diagnosis and management leads to good clinical outcomes. With RYGB being a more technically demanding procedure than primarily restrictive bariatric procedures, complications are more likely to occur. However, studies have demonstrated that, overall, rate of complication tends to be comparable or even lower in RYGB than other less effective surgical interventions. In a recent systematic review, Tice et al. [18] suggested that despite RYGB having greater short-term complications, RYGB had fewer complications and reoperation rates in the long-term compared to LAGB.

Conclusions

The prevalence of obesity has reached epidemic proportions worldwide. Morbidly obese individuals are at increased risk of cardiovascular events and associated morbidity. Despite modest gains through lifestyle modification and pharmacologic intervention, bariatric surgery remains the only evidence-based strategy to produce marked weight loss. Determining the appropriate bariatric surgical option for a particular patient remains a complex decision requiring a multidisciplinary approach. Currently LAGB, LSG, and RYGB all are reasonable surgical options with acceptable morbidity in morbidly obese patients. Nevertheless, bariatric surgical strategies will continue to evolve as further evidence is accumulated.

Disclosure Conflicts of interest: R.S. Gill: none; J.R. LaBossiere: none; X. Shi: ; D.W. Birch: none; A.M. Sharma: has been a consultant for Abbott, Merck, Arena, Vivus, Novo-Nordisk, Sanofi-Aventis, Glaxo-Smith-Kline, Boehringer-Ingelheim, NeuroSearch, Allergan; has given expert commentary for Glaxo-Smith-Kline; has received grant support from Abbott; has received payment for development of educational presentations including service on speakers' bureaus from Boehringer-Ingelheim, Abbott, Novo Nordisk, Allergan, Johnson & Johnson, Sanofi-Aventis; and has received travel/accommodations expenses covered or reimbursed from various organizations in conjunction with consulting and speaker bureau activities as outlined here; S. Karmali: none.

References

Papers of particular interest, published recently, have been highlighted as:
- • Of importance
- •• Of major importance

1. Ahima RS. Digging deeper into obesity. The Journal of Clinical Investigation. 2011;121:2076–9.
2. • Finucane MM, Stevens GA, Cowan MJ, Danaei G, Lin JK, Paciorek CJ, et al. National, regional, and global trends in body-mass index since 1980: Systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9.1 million participants. Lancet. 2011;377:557–67. *This paper describes the increasing global trend in BMI, and projects increasing rates of obesity in the future.*

3. Statistics Canada. Canadian health measures survey: adult obesity prevalence in Canada and the United States. 2011; Available at: http://www.statcan.gc.ca/daily-quotidien/110302/dq110302c-eng.htm. Accessed August 31, 2011.
4. Picot J, Jones J, Colquitt JL, Gospodarevskaya E, Loveman E, Baxter L, et al. The clinical effectiveness and cost-effectiveness of bariatric (weight loss) surgery for obesity: A systematic review and economic evaluation. Health Technology Assessment (Winchester, England). 2011;13:1–190, 215–357, iii-iv.
5. Chapman AE, Kiroff G, Game P, Foster B, O'Brien P, Ham J, et al. Laparoscopic adjustable gastric banding in the treatment of obesity: A systematic literature review. Surgery. 2004;135:326–51.
6. Franco JV, Ruiz PA, Palermo M, Gagner M. A review of studies comparing three laparoscopic procedures in bariatric surgery: Sleeve gastrectomy, roux-en-Y gastric bypass and adjustable gastric banding. Obesity Surgery. 2011;21:1458–68.
7. O'Brien PE, McPhail T, Chaston TB, Dixon JB. Systematic review of medium-term weight loss after bariatric operations. Obesity Surgery. 2006;16:1032–40.
8. Buchwald H, Avidor Y, Braunwald E, Jensen MD, Pories W, Fahrbach K, et al. Bariatric surgery: A systematic review and meta-analysis. JAMA : The Journal of the American Medical Association. 2004;292:1724–37.
9. Dixon JB, O'Brien PE, Playfair J, Chapman L, Schachter LM, Skinner S, Proietto J, Bailey M, Anderson M. Adjustable gastric banding and conventional therapy for type 2 diabetes: a randomized controlled trial. JAMA. 2008;299:316–23.
10. Ray JB, Ray S. Safety, efficacy, and durability of laparoscopic adjustable gastric banding in a single surgeon U.S. community practice. Surg Obes Relat Dis. 2011;7:140–4.
11. Van Nieuwenhove Y, Ceelen W, Stockman A, Vanommeslaeghe H, Snoeck E, Van Renterghem K, et al. Long-term results of a prospective study on laparoscopic adjustable gastric banding for morbid obesity. Obesity Surgery. 2011;21:582–7.
12. •• Kehagias I, Karamanakos SN, Argentou M, Kalfarentzos F. Randomized clinical trial of laparoscopic roux-en-Y gastric bypass versus laparoscopic sleeve gastrectomy for the management of patients with BMI<50 kg/m2. Obesity Surgery. 2011. *This paper demonstrates similar and marked weight loss in obese patients following RYGB and sleeve gastrectomy, with 3-year follow-up.*
13. Gill RS, Birch DW, Shi X, Sharma AM, Karmali S. Sleeve gastrectomy and type 2 diabetes mellitus: A systematic review. Surgery for Obesity and Related Diseases. 2010;6:707–13.
14. Karamanakos SN, Vagenas K, Kalfarentzos F, Alexandrides TK. 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. Annals of Surgery. 2008;247:401–7.
15. Himpens J, Dapri G, Cadiere GB. A prospective randomized study between laparoscopic gastric banding and laparoscopic isolated sleeve gastrectomy: Results after 1 and 3 years. Obesity Surgery. 2006;16:1450–6.
16. Suter M, Donadini A, Romy S, Demartines N, Giusti V. Laparoscopic roux-en-Y gastric bypass: Significant long-term weight loss, improvement of obesity-related comorbidities and quality of life. Annals of Surgery. 2011;254:267–73.
17. Angrisani L, Lorenzo M, Borrelli V. Laparoscopic adjustable gastric banding versus roux-en-Y gastric bypass: 5-year results of a prospective randomized trial. Surgery for Obesity and Related Diseases. 2007;3:127–32.
18. Tice JA, Karliner L, Walsh J, Petersen AJ, Feldman MD. Gastric banding or bypass? A systematic review comparing the two most popular bariatric procedures. The American Journal of Medicine. 2008;121:885–93.