Review Article

Weight regain after gastric bypass: etiology and treatment options

Almantas Maleckas[1,2], Rita Gudaitytė[1], Rūta Petereit[3], Linas Venclauskas[1], Džilda Veličkienė[4]

[1]Department of Surgery, Medical Academy, Lithuanian University of Health Sciences, Kaunas, Lithuania; [2]Department of Gastrosurgical Research and Education, Institute of Clinical Sciences, The Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden; [3]Department of Gastroenterology, Medical Academy, Lithuanian University of Health Sciences, Kaunas, Lithuania; [4]Institute of Endocrinology, Medical Academy, Lithuanian University of Health Sciences, Kaunas, Lithuania

Contributions: (I) Conception and design: All authors; (II) Administrative support: All authors; (III) Provision of study materials or patients: All authors; (IV) Collection and assembly of data: All authors; (V) Data analysis and interpretation: All authors; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Almantas Maleckas. Department of Surgery, Medical Academy, Lithuanian University of Health Sciences, A. Mickevičiaus 9, LT 44307 Kaunas, Lithuania. Email: almantas_maleckas@yahoo.com.

Abstract: Roux-en-Y gastric bypass (RYGB) is one of the most common operations performed for the patients with morbid obesity. Weight regain (WR) is a complication that may decrease efficiency of the surgical treatment and demand further interventions. Different factors including lifestyle, mental health, hormonal/metabolic and surgical plays role in WR after RYGB. Various treatment options have been proposed for WR. Conservative treatment is less effective than surgery. Endoscopic refashioning of gastric pouch/stoma fails to achieve sustainable weight loss. Surgical reduction of pouch has acceptable short-term results, but WR after 3 years is substantial. Banded gastric bypass achieves good short-term results, but long-term follow-up data are needed. Distalization of RYGB has a high risk of protein calorie malnutrition (PCM) and conversion to BP diversion (BPD)/duodenal switch (DS) is a technically demanding procedure. Both procedures achieve sustainable long-term weight loss. More studies are needed to explore long-term results of various surgical interventions for WR after RYGB.

Keywords: Bariatric surgery; gastric bypass; review; weight regain etiology; weight regain treatment

Submitted Oct 16, 2016. Accepted for publication Nov 18, 2016.
doi: 10.21037/gs.2016.12.02
View this article at: http://dx.doi.org/10.21037/gs.2016.12.02

Introduction

The burden of obesity increases in many countries in the world. Obesity is associated with multiple comorbidities (1), decreased health related quality of life (2) and reduced length of life (3). Surgical treatment is more effective than conservative in correcting comorbidities, improving quality of life and reducing mortality associated with obesity (4,5). However, surgical intervention itself may cause long-term complications, which could diminish achieved improvement in health. Weight regain (WR) is an important issue after bariatric surgery and maybe considered as a long-term complication, because it can lead to re-emergence of obesity related comorbidities and impair quality of life (6,7).

Roux-en-Y gastric bypass (RYGB) is one of the most common operations performed for the patients with morbid obesity. It is known as a procedure, which produce good long-term control of weight and co-morbidities with low number of serious complications. O'Brien *et al*. (8) in systematic review have estimated that average % excess weight loss (%EWL) after RYGB during first 2 years was 67. However, some weight increase was observed over time and after 10 years average %EWL was 52 (8). Magro *et al*. (9) found that more than 60% of patients submitted to Fobi-Capella gastric bypass with a non-elastic ring experienced WR with a mean gain of 8.8 kg within 5 years. Recent qualitative study shows that patients accept some WR after RYGB. Nevertheless, the patients with higher WR experience higher emotional impact and describe their situation as intolerable (10). There is no generally accepted

definition for substantial WR and different studies use different descriptions, which are based on kilograms, body mass index (BMI) units or %EWL gained (6). Further, it is important to differentiate WR from insufficient weight loss. The latter is a weight loss <50% of EWL after surgery while the former is increase in weight after initially successful weight loss.

Preoperative information may have an impact on patient's expectations and ability to resist WR. Madan *et al.* (11) have found that only 10% of patients could recall being informed about the possibility of WR after RYGB. The WR after RYGB thus may come as a surprise for the patients and they are reluctant to accept it. Furthermore, they do not know even how they have to deal with it and who can help them. All health care professionals, that are involved in the care of bariatric patient, must be aware of WR after surgery and possess some knowledge about treatment strategies that can be proposed. Different factors such as lifestyle, mental health issues, hormonal/metabolic imbalance and technical issues after surgery may contribute to WR. Thus patients with WR must be investigated and treated in the specialized centers where multidisciplinary teams are available and knowledge about WR is accumulated. Below the main etiological factors responsible for WR and possible treatment options are discussed.

Lifestyle factors and mental health issues

Lack of adherence to postoperative diet may lead to increased intake of calories and subsequently WR (12). Snacks, sweets and fatty foods as well as inappropriate nutritional follow-up significantly increase risk of WR after RYGB (13). The patients need to understand that surgery does not provide a quick fix for their obesity problem and that long-term adherence to the diet recommendations is a key to success. Proper education, diet counseling and long-term follow-up by multidisciplinary team are crucial. Preoperatively patients have to be evaluated for realistic goals, readiness for change and knowledge about nutrition (14). General postoperative nutritional recommendations include higher daily protein intake (1.0–1.5 g/kg of ideal body weight), limitation of sugar (<5 g per serving) and less than 30% of daily calories from fat. Foods with low glycemic index and prolonged absorption such as fruits and vegetables should be preferred and eating regimen should include 4–6 meals per day (14,15).

Physical activity among bariatric patients increases after surgery, however, only 10–24% of patients after RYGB meet minimal physical activity recommendations for general health promotion (16,17). The importance of physical activity for post-operative weight loss was proven by recent meta-analysis (18). ASMBS recommends increase in physical activity after surgery to at least 30 minutes daily (19). However, there is no data on how much physical activity is needed to prevent WR after bariatric surgery. International Association for the Study of Obesity recommends moderate intense activity of 60 to 90 minutes or lesser time of vigorous activity most days of the week in order to prevent WR and get health benefits in conservatively treated patients (20).

Unrecognized and untreated eating and psychiatric disorders may cause WR in some patients after RYGB. Grazing is currently considered to be an eating disorder and is defined as unplanned eating of small amounts of food with loss of control over this eating (21). It was present in about half of the cases with WR after gastric bypass in Kofman *et al.* study (22). Kalarchian *et al.* (23) found that nearly half of the patients after gastric bypass had binge eating and these patients lost less weight and had greater WR. Two or more psychiatric conditions increase risk of inadequate weight loss or WR by six times after RYGB (24). However, patients after surgery have a low psychological follow-up rate (9) and this do not allow timely detection of psychiatric problems and adequate treatment. Cognitive behavioral treatment may be an option in this group of the patients as it was found to be more successful in treating maladaptive eating disorders than programs without psychological part (25).

Meta-analysis of published studies suggest that lifestyle interventions have no or only modest effect on weight loss after bariatric surgery (26,27). Little evidence exists about lifestyle modification in the treatment of WR after bariatric surgery. Recently, a small pilot study has shown that acceptance-based behavioral intervention had a high retention rate and was well rated by the participants (28). Moreover, all participants stopped gaining weight and lost on average 3.6% of their pretreatment weight. It should be mentioned, that the intervention had a moderate positive effect on emotional eating, binge eating and grazing behaviors. However, the authors emphasized the difficulty in recruiting the patients. In this study only 15% of those who expressed initial interest in the treatment were included into the trial (28).

More research is needed in this field in order to understand lifestyle and mental health factors, which drive WR after RYGB. There are few data that adequate preoperative information, nutritional and psychological

evaluation, and follow-up may prevent WR. However, more studies need to explore the way WR maybe prevented, rather than treated as there is even less data on successful lifestyle or behavioral interventions on WR after RYGB.

Hormonal/metabolic imbalance

Patients after RYGB have decreased food cravings due to minimized hunger sensation and early satiety with smaller meals, where alterations in gut hormones seem to play an important role. Because of small pouch and direct connection with small bowel, intestinal epithelium is rapidly exposed to nutrients. This lead to the changes in secretion of glucagon-like peptide 1 (GLP-1), glucose-dependent insulinotropic polypeptide (GIP), ghrelin and others gastrointestinal hormones. Though the results of GIP concentration are contradictory, it is agreed that RYGB is associated with markedly suppressed ghrelin, increased GLP1 levels possibly contributing to the weight-reducing effect of the procedure (29,30). However, it seems that hormonal changes are not the same in all patients with RYGB and it might partially explain WR phenomenon. Recently, Santo and colleagues (31) have found that secretion profile of gastrointestinal hormones differs between patients with satisfactory weight control and those who had WR. There was no difference between the baseline level of GLP1, GIP and ghrelin, but after RYGB early secretion of GIP and GLP-1 after meal stimulation was significant lower in patients with WR as compared to those, who had successful weight loss. No difference was observed between groups in ghrelin concentration after meal stimulation (31). However, patients with higher preoperative ghrelin levels were found to have a higher risk for early WR (32). Return of appetite and increased food intake were observed after inhibition of gut hormones responses by octreotide (33). Thus, hormonal alterations may facilitate portion control and decrease intake of high-caloric food reducing the likelihood of WR (15).

The other reason for WR after RYGB may be a reactive hypoglycaemia. The mechanism for development of late postprandial hypoglycaemia is believed to reflect hypersecretion of GIP and GLP1, which may induce B cell expansion and insulin hypersecretion (34). Roslin *et al.* (35) investigated 11 patients with WR (>10% of total weight loss regained) after RYGB. Abnormal glucose tolerance test was found in 91% of patients and 54% had blood glucose levels consistent with hypoglycaemia. As glucose is a recognized primary appetite mediator, the multiple episodes of low glucose levels due to significant insulin secretion after meals may stimulate appetite and result in snacking or grazing eating behavior, and WR. Patients have to redesign their diets by eating foods with low glycemic index, adding bulk and including gelatinous proteins. The periods between meals should not be too long (35).

The existing data show importance of gut hormones and reactive hypoglycaemia on WR after RYGB. However, future studies need to explore correlation between eating disorders and hormonal/metabolic imbalance. The presence of attenuated postprandial gut hormonal response or reactive hypoglycaemia may severely change hunger and satiety perception, and may explain the fact that lifestyle or cognitive behavioral treatment has little or no effect on WR treatment. This may require new treatment options targeting at gut hormonal imbalance or reactive hypoglycaemia.

Surgical factors

Pouch dilatation, increase in stoma size and gastro-gastric fistula are recognized causes of WR after RYGB. Gastro-gastric fistula is a communication between pouch and remnant stomach, which allow for food to pass through main stomach and duodenum reducing restrictive and malabsorptive effects of RYGB. In long-term deviation of the food transit results in WR (36). The prevalence of gastro-gastric fistula is currently about 1% and has dramatically decreased after the complete transection of staple lines between pouch and excluded stomach were started (37). Gastro-gastric fistula associated with WR is treated by surgical revision.

Pouch dilatation is considered, if pouch is >6 cm long or >5 cm wide (38). However, these measurements are empirical and little scientific evidence exists to support it. Heneghan *et al.* (39) have evaluated a selected cohort of patients who underwent gastroscopy after RYGB for the functional symptoms or weight loss problems. The patients were divided into two groups, those who had an optimal weight loss (n=175) and those who regained weight (n=205). There was no significant difference in average pouch width and average pouch volume between the groups. Only the average length of pouch reached significant difference and was 5.0 and 5.8 cm, respectively (39). Of note, the average pouch in WR group was 26 cm^2 as compared to 21.8 cm^2 in optimal weight loss group. Topart *et al.* (40) have estimated pouch size after barium swallow in 107 patients on average 3 years after operation and found no correlation between

the pouch size and %EWL. Patients who had large pouches (>50 mL) had similar weight loss to those who had normal sized pouches, 68 *vs*. 66 %EWL, respectively. Even in patients with pouches >100 mL in size weight loss was comparable to that with smaller pouches (40).

Wide gastrojejunostomy is considered the one, which exceeds 2 cm (39). Different techniques are used to create gastrojejunostomy in RYGB and results in different stoma size. Hand sewn anastomosis is usually 12–14 mm wide, circular stapled anastomosis maybe 21 or 25 mm in diameter depending on staple size and linear staple anastomosis maybe up to 45 mm. Recent meta-analysis of studies comparing hand sewn anastomosis to stapled anastomosis did not find any difference on weight loss after 12 months (41). However, more long-term follow-up data is needed to estimate the impact of initial stoma size on WR.

The results of these studies do not object the role of large pouch or wide gastrojejunostomy in WR. However, it emphasizes the need for more complex evaluation of the patients with WR as, most probably, surgical factors coexist with psychological and behavioral factors. The importance of surgical factors in WR is further substantiated by the fact that patients who regain weight benefit more from surgical treatment than from lifestyle interventions (42). Several surgical interventions with varying efficiency have been proposed in order to reduce pouch/stoma or to increase restrictive/malabsorptive effect of RYGB in patients with WR.

Reduction of pouch/stoma

Different endoscopic procedures were used for gastroenterostomy reduction including sclerotherapy or transoral outlet reduction (TORe) by placing sutures around dilated stoma. Other techniques, such as Restorative Obesity Surgery Endoscopic (ROSE) and endoscopic gastric plication, aims at creating tissue folds that reduce pouch and stoma size. Endoscopic plication achieves intended pouch and stoma size at 3 months. However, after 12 months it returns to pre-interventional size and patients fail to achieve sustainable weight loss (43).

The other option is laparoscopic refashioning of the gastric pouch. Different techniques were suggested including longitudinal gastric pouch resection on 34 Fr boogie (44), resection of gastric pouch with complementary resection of blind end of the alimentary (AL) limb at gastroenterostomy (45) or proximal jejunum (46), or resection of gastric pouch with a new gastroenteroanastomosis (47). The highest 69 %EWL after a mean follow-up of 20 months was reported in Iannelli *et al*. (44) study. Twenty patients had gastric pouch resection on 34 Fr boogie. Of note is that all patients in this study had dilated stomach, but normal 12–14 mm gastroenterostomies. Furthermore, a 30% complication rate was observed in this study including three patients with intra-abdominal abscesses (44). The other two studies, in which pouch was resected together with a part of the small bowel, found much lower 11.4–29.1 %EWL after a 1 year (45,46). Hamdi *et al*. (47) resected gastric pouch and created a new gastorenterostomy in 25 patients. The % excess body mass index loss (%EBMIL) was 43.3 at 1 year, but decreased to 14 % at 3 years (48). Recently, León *et al*. (49) suggested laparoscopic double-layer gastrojejunal plication for the patients with WR after RYGB. In a series of 4 patients average %EWL after the procedure was 46.2% at 6 months (49). The results of the presented studies suggest that surgical refashioning of gastric pouch may achieve acceptable short-term results. However, more studies with longer follow-up are needed in order to evaluate efficiency of pouch and stoma reduction, as there are data about substantial WR 3 years after these procedures (48).

Banded gastric bypass

Recent systematic literature review (50) investigated salvage banding with adjustable or non-adjustable band as a treatment method for WR after RYGB. Ninety-four patients from seven studies with 12–42 month follow-up were included into the review. Further weight loss after salvage banding varied from 28 to 65 %EBMIL. Long term complications requiring revision were observed in 17% of patients. All studies, except one, included in the review used adjustable gastric band (50). Long-term follow-up studies are needed to find out, if weight loss is sustainable after this procedure and what will be the rate of band removal.

Distalization of RYGB

Systematic review of four randomized studies and several retrospective series have concluded that surgeons should focus on the length of common channel rather than on the length of AL or biliopancreatic (BP) limbs in order to reduce failure rates in RYGB (51). Distal gastric bypass with a common channel of 50 to 150 cm was proposed for the treatment of obesity. However, despite superior

long-term weight loss it causes frequent severe metabolic derangements requiring revisions and should not be used as a primary operation for obesity (52). Distalization of the RYGB was also suggested for the WR. Basically, there are two modifications of distalization of the RYGB. The first modification is when AL limb is divided close to enteroenteroanastomosis and moved distally to create a long BP limb. Different authors suggest different place for AL limb anastomosis. Rawlins *et al.* (53) re-anastomosed AL limb 100 cm and Sugerman *et al.* (54) 150 cm proximal to the ileocaecal valve. Fobi *et al.* (55) selected the place for anastomosis by estimating that the length of AL limb and common channel together would consist 50% of all small bowel length. In the second modification BP limb is divided close to the enteroenteroanastomosis and moved distally and re-anastomosed 75 cm proximal to the ileocaecal valve, creating a very long AL limb (56). The %EBMIL was similar between two modifications after 1 year (43–55% after first modification *vs.* 52% after the second). However, the protein calorie malnutrition (PCM) had a tendency to be lower after the second modification, 7% *vs.* 8–31%. Caruana *et al.* (57) have analyzed weight loss results according to the percentage of intestine bypassed in the first modification. %EWL after 2 years was significantly higher in patients with ≥70% of intestine bypassed, 47% *vs.* 26%, respectively. However, no PCM was observed in the group with <70% of bypassed intestine while PCM reached 44% in the other group (57). More studies are needed to determine an optimal length of different limbs while performing distalization of the RYGB for WR. As PCM is a frequent complication after distalization of the RYGB, the longer common channel might be considered to reduce the risk of PCM.

Laparoscopic conversion to BP diversion/duodenal switch (BPD/DS)

Conversion from RYGB to BPD/DS is a technically challenging procedure, which can be done in one or two steps. The gastro-gastrostomy is done to restore continuity of the stomach and is followed by sleeve gastrectomy. The duodenum is transected 5 cm below pylorus, previous jejunojejunostomy is divided and gastric bypass Roux limb is reconnected to BP limb by side-to-side anastomosis. Then entire length of the bowel is measured. AL and common channel 35–45% and 8–12% of total bowel length, respectively, is created (58). Two studies (58,59) that published results after RYGB conversion to BPD/DS report 62 and 67 %EWL at 1 and 3 years, respectively. However, complexity of the procedure and the risk of malnutrition limit the use of this procedure despite the fact that the rate of perioperative complications was relatively low (in a range from 8% to 12%) in both studies (58,59).

Conclusions

The mechanism that drives WR after RYGB is complex and involves lifestyle, mental health, hormonal/metabolic and surgical factors. Patients with WR should undergo evaluation of multidisciplinary team before surgical treatment is offered. The choice of surgical intervention should be based on the balance between the risks of complications and extent of weight loss. More studies are needed to evaluate long-term results of various surgical strategies for WR after RYGB.

Acknowledgements

None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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Cite this article as: Maleckas A, Gudaitytė R, Petereit R, Venclauskas L, Veličkienė D. Weight regain after gastric bypass: etiology and treatment options. Gland Surg 2016;5(6):617-624. doi: 10.21037/gs.2016.12.02