



Revision of gastric bypass: What is on the menu?

Roux-en-Y gastric bypass (RYGB) is one of the most common bariatric surgeries for the management of class II and III obesity. It combines restrictive and malabsorptive physiologies to achieve weight loss. The gastric fundus, body, and antrum, along with the duodenum, are excluded from the alimentary tract after RYGB, with accelerated delivery of nutrients to the jejunum and ileum, leading to favorable hormonal changes such as decreased ghrelin and increased glucagon-like peptide 1 and peptide YY levels to decrease appetite and induce satiety, respectively.¹ However, the restrictive components of the Roux-en-Y procedure, namely, preserving a small gastric pouch and gastrojejunostomy anastomosis (GJA), (preferably <12 mm) are crucial for long-term maintenance of weight loss after surgery.²

In general, patients achieve a maximum percentage of total body weight loss (%TBWL) of 35% to 40% at 1 to 3 years after RYGB, associated with a significant improvement in their metabolic comorbidities, including diabetes and hyperlipidemia.³ However, weight regain after the achievement of weight nadir is very common after RYGB. In a recent analysis of 1406 patients who underwent RYGB and were followed up for >6 years, investigators reported an average weight regain of 27% of the lost weight at 5 years, with 87% of the patients regaining at least 10% of their maximum lost weight.⁴

Postsurgical weight regain is multifactorial, and studies have shown that the extent of weight regain after RYGB is quite variable among patients, with a small percentage of patients maintaining their nadir weight, whereas another subset of patients regain a substantial proportion of their lost weight. Similar to any other bariatric procedure, patients' compliance with postprocedural follow-up and nutritional and behavioral recommendations have proved to be important predictors of weight regain after gastric bypass.^{5,6} Similarly, appropriate management of psychologic comorbidities has been suggested to help prevent weight regain.⁷ As mentioned above, remodeling of the restrictive anatomic changes after gastric bypass are also important predictors of weight regain. Studies have demonstrated that the size of the GJA (ie, stoma) is an independent predictor of weight regain after RYGB.⁸ Similarly, gastric pouch length and volume have been

shown to be associated with maintenance of weight loss after RYGB.⁹ Beyond overeating, the exact physiologic mechanisms by which increases in stoma and pouch size lead to weight regain are not completely understood. It has been suggested that overeating leads to the reversal of the abovementioned favorable postsurgical hormonal changes through increased accommodation of larger food boluses in the gastric pouch and delayed delivery of the nutrients to the distal jejunum and ileum.

Given the clear association between changes in pouch size and especially stoma size and weight regain after RYGB, surgical revision has been studied to induce further weight loss or to stop weight regain. However, open or

It is important to note that the TORe procedure does not preclude the possibility of subsequent surgical revision, as seen in 4 patients in this study who underwent surgery after TORe, highlighting the role of endoscopic approach as a less invasive initial intervention.

laparoscopic surgical revision or redo of the gastroenterostomy anastomosis, along with other techniques such as placing an adjustable gastric band around the pouch, have been shown to be associated with a higher risk of adverse events and morbidity and mortality relative to the initial bariatric procedure, leading to a significant decrease in their use.¹⁰⁻¹² Consequently, endoscopic revision of the GJA, and less commonly the gastric pouch, to treat weight regain have been evaluated and used in clinical practice as a less invasive alternative to treat weight regain after RYGB. Less complicated endoscopic options for stoma revision include sclerotherapy with sodium morrhuate or argon plasma coagulation (APC) mucosal ablation of the stoma to decrease its compliance and size so as to induce weight loss or stop weight regain. These methods are performed by the use of the standard upper endoscopy devices, such a diagnostic gastroscope, and an injection needle or an APC catheter, and by techniques that most endoscopists are familiar with. Both of these techniques have been shown to be safe and effective, but they need repeated treatments to achieve their maximum effect.^{13,14} More advanced endoscopic techniques for GJA and pouch revision involve the use of endoscopic suturing or plication

platforms—also called endoscopic transoral outlet reduction (TORe)—which are generally performed in 1 session, and achieve better results compared with sclerotherapy or APC.¹⁵ The first study on endoscopic suturing for GJA revision was published in 2004 and involved the use of Wilson-Cook ESD platform (Wilson-Cook Medical, Inc, Winston Salem, NC, USA) to place superficial sutures to decrease the GJA size in 4 patients, demonstrating its safety and efficacy.¹⁶ The use of superficial suturing was later studied with a different endoscopic platform (EndoCinch, BARD Endoscopic Technologies, Franklin Lakes, NJ, USA) in 8 patients, confirming its feasibility for treatment of weight regain after RYGB.¹⁷ Since then there has been a significant improvement in endoscopic suturing platforms and techniques, especially with the advent of full-thickness suturing (OverStitch; Apollo Endosurgery, Austin, Tex, USA) and plication (eg, Incisionless Operating Platform; USGI Medical, San Clemente, Calif, USA), which have proved to be superior to superficial suturing for GJA revision.¹⁸ Different approaches with use of the abovementioned techniques, alone or in combination, have been studied over the past decade, and the available evidence shows that a combination of APC mucosal ablation and full-thickness suturing or plication is safe and achieves the best weight loss outcomes after RYGB with a %TBWL of 8% to 10% from 3 to 12 months after the procedure.¹⁹

To date, no studies have reported the long-term outcomes of these techniques. A study published in this journal in 2016 reported midterm efficacy of TORe after RYGB in 150 patients (using a combination of APC ablation and full-thickness suturing for GJA reduction, with additional sutures to decrease the pouch volume if the pouch was judged to be dilated) with a %TBWL of 7% to 7.5% at 3 years.²⁰ Interestingly, the authors did not find a significant difference in weight loss between patients who did or did not receive sutures in the distal pouch to reduce its volume.

In this issue of *Gastrointestinal Endoscopy*, the same group has published their data on long-term follow-up for the same cohort of patients (5-year data on 123 patients), and also short-term and midterm follow-up data on a larger cohort of patients who underwent TORe for weight regain after RYGB with a GJA size of at least 15 mm.²¹ This study shows a similar 6.9 %TBWL at 3 years after TORe. Importantly, the authors report a mean %TBWL of 8.8 at 5 years, preventing weight regain in 77% of patients and achieving a %TBWL of 5% or more in 62% of patients. The safety profile of TORe in this large cohort proved to be quite favorable, with no severe adverse events (based on the lexicon of the American Society for Gastrointestinal Endoscopy) and a 10% risk of mild to moderate adverse events. The majority of adverse events were related to erosion and ulceration at the site of mucosal ablation and suturing, with or

without bleeding, and stenosis of GJA requiring dilation was reported in only 2 patients.

It should be noted that 29% of patients in this study underwent a second endoscopic procedure during the follow-up period, which was associated with significant additional weight loss; however, the vast majority of these procedures (85 patients) were only APC ablations, with repeated suturing or plication performed in only 10 patients.

Finally, the authors report the effect of adjuvant pharmacotherapy in 19% of patients in whom achieving favorable outcomes after TORe were unsuccessful. In both univariable and multivariable analyses, pharmacotherapy was associated with worse weight loss outcomes; however, this was almost certainly not representative of the actual independent effect of adjuvant pharmacotherapy in this population because of the presence of strong selection bias in the study (ie, patients received pharmacotherapy because they were already doing worse than the average). For example, a 2017 multicenter study of patients with inadequate weight loss or weight regain after RYGB and sleeve gastrectomy showed that patients who received pharmacotherapy, particularly topiramate, showed higher additional weight loss than did patients who did not.²²

The results reported by Jirapinyo et al²¹ in this issue of *Gastrointestinal Endoscopy* are quite promising for the endoscopic management of weight regain after RYGB and are an important addition to the literature. The resulting 7% to 8% TBWL seen in this study is consistent with prior studies and is associated with an additional significant improvement in patients' metabolic profiles. Furthermore, these results suggest that weight loss after TORe is durable, at least up to 5 years, in a significant majority of patients. What is more important, however, and should be highlighted, is the fact that at 5 years, TORe was successful at preventing weight gain in 77% of the patient cohort, with the number needed to treat of 1.3.

However, it should be noted that these results may not be generalizable to all clinical settings because endoscopists' expertise and the necessary supportive services such as nutritional, behavioral, and psychiatric care for maintenance of lifestyle changes and management of medical comorbidities in a multidisciplinary weight loss clinic are rarely available in community settings. Additionally, although a follow-up rate of 82% can be considered very reasonable for a retrospective study, it should be noted that it leaves the possibility that the results were significantly affected by differential loss to follow-up (eg, patients who had worse outcomes were also more likely to be lost to follow-up). Finally, it should be noted that the technical aspects of the TORe procedures performed in this cohort have been somewhat variable, reflecting the more general variability of the techniques used by different endoscopists at different centers. An important step forward for the endoscopic management of weight regain after RYGB would be the standardization of the technical aspects of

TORe, including the endoscopic treatment modalities, suture patterns, anatomic goals (eg, goal GJA diameter after TORe), need for suture placement in the pouch, and post-procedural care. For example, as mentioned above, the current evidence suggests that combining APC mucosal ablation with full-thickness suturing is the most effective method to induce weight loss. There is also some evidence to suggest that a purse-string suture pattern might result in better restriction and weight loss compared with interrupted sutures, or that post-TORe GJA size is an important predictor of clinical success (eg, <8–10 mm), and that reinforcement sutures in the distal pouch might be equally important, whereas pouch volume reduction might not be essential for clinical success.^{23,24} A recent study has suggested adding endoscopic submucosal dissection before full-thickness suturing to achieve more durable results and greater reduction in GJA size,²⁵ and the duration of postprocedural liquid diet has been reported with a large amount of variability: from 2 weeks to at least 6 weeks.²⁶

Obesity is considered a chronic disease that needs life-long management, and an important question in the endoscopic management of weight regain after RYGB is the durability of its effect. This study reports important findings on the durability of TORe for the first time while highlighting the fact that preventing additional weight regain may be more important than achieving additional weight loss in this population. An important concept in the management of weight regain after bariatric surgery is the need for early diagnosis and intervention, potentially leading to a greater impact on patients' weight trajectory. As discussed above and highlighted in this study, regardless of the timing and type of intervention used to prevent weight regain, maintenance of the results requires a multidisciplinary approach, with the use of adjunct pharmacotherapy along with repeated endoscopic interventions and subsequent surgical revision in selected patients as components of a multipronged strategy to ensure long-term durability of weight loss. It is important to note that the TORe procedure does not preclude the possibility of subsequent surgical revision, as seen in 4 patients in this study who underwent surgery after TORe, highlighting the role of endoscopic approach as a less invasive initial intervention.

Early intervention and careful patient selection as part of a multidisciplinary approach that includes endoscopic intervention are of paramount importance in the management of weight regain after bariatric surgery. However, variable insurance coverage and lack of uniform standards for endoscopic management can lead to suboptimal outcomes. Therefore, in tandem with a gradual increase in the availability and acceptance of endoscopic management of obesity and weight regain after bariatric surgery, there is a corresponding need for procedure standardization, payer coverage, and ongoing systematic review of the available evidence, such as the study discussed here, possibly by

way of more detailed national and international multisociety guidelines.

DISCLOSURE

Dr Sbaraiha is a consultant for, and the recipient of research support from, Boston Scientific, Olympus, and Lumendi. The other author disclosed no financial relationships.

Kaveh Hajifathalian, MD, MPH

Reem Z. Sharaiha, MD, MS

Division of Gastroenterology and Hepatology

New York-Presbyterian Hospital

Weill Cornell Medicine | Cornell University

New York, New York, USA

Abbreviations: APC, argon plasma coagulation; GJA, gastrojejunostomy anastomosis; RYGB, Roux-en-Y gastric bypass; TBWL, total body weight loss; TORe, endoscopic transoral outlet reduction.

REFERENCES

1. Dimitriadis GK, Randeve MS, Miras AD. Potential hormone mechanisms of bariatric surgery. *Curr Obes Rep* 2017;6:253-65.
2. Wittgrove AC, Clark GW. Laparoscopic gastric bypass, Roux-en-Y- 500 patients: technique and results, with 3-60 month follow-up. *Obes Surg* 2000;10:233-9.
3. Schauer PR, Bhatt DL, Kirwan JP, et al. Bariatric surgery versus intensive medical therapy for diabetes: 3-year outcomes. *N Engl J Med* 2014;370:2002-13.
4. King WC, Hinerman AS, Belle SH, et al. Comparison of the performance of common measures of weight regain after bariatric surgery for association with clinical outcomes. *JAMA* 2018;320:1560-9.
5. Magro DO, Geloneze B, Delfini R, et al. Long-term weight regain after gastric bypass: a 5-year prospective study. *Obes Surg* 2008;18:648-51.
6. Freire RH, Borges MC, Alvarez-Leite JL, et al. Food quality, physical activity, and nutritional follow-up as determinant of weight regain after Roux-en-Y gastric bypass. *Nutrition* 2012;28:53-8.
7. Karmali S, Brar B, Shi X, et al. Weight recidivism post-bariatric surgery: a systematic review. *Obes Surg* 2013;23:1922-33.
8. Abu Dayyeh BK, Lautz DB, Thompson CC. Gastrojejunal stoma diameter predicts weight regain after Roux-en-Y gastric bypass. *Clin Gastroenterol Hepatol* 2011;9:228-33.
9. Heneghan HM, Yimcharoen P, Brethauer SA, et al. Influence of pouch and stoma size on weight loss after gastric bypass. *Surg Obes Relat Dis* 2012;8:408-15.
10. de Csepel J, Nahouraii R, Gagner M. Laparoscopic gastric bypass as a reoperative bariatric surgery for failed open restrictive procedures. *Surg Endosc* 2001;15:393-7.
11. Hedberg J, Gustavsson S, Sundbom M. Long-term follow-up in patients undergoing open gastric bypass as a revisional operation for previous failed restrictive procedures. *Surg Obes Relat Dis* 2012;8:696-701.
12. Schwartz RW, Strodel WE, Simpson WS, et al. Gastric bypass revision: lessons learned from 920 cases. *Surgery* 1988;104:806-12.
13. Abu Dayyeh BK, Jirapinyo P, Weitner Z, et al. Endoscopic sclerotherapy for the treatment of weight regain after Roux-en-Y gastric bypass: outcomes, complications, and predictors of response in 575 procedures. *Gastrointest Endosc* 2012;76:275-82.
14. Baretta GA, Alinho HC, Matias JE, et al. Argon plasma coagulation of gastrojejunal anastomosis for weight regain after gastric bypass. *Obes Surg* 2015;25:72-9.

15. Jirapinyo P, Dayyeh BK, Thompson CC. Gastrojejunal anastomotic reduction for weight regain in Roux-en-Y gastric bypass patients: physiological, behavioral, and anatomical effects of endoscopic suturing and sclerotherapy. *Surg Obes Relat Dis* 2016;12:1810-6.
16. Schweitzer M. Endoscopic intraluminal suture plication of the gastric pouch and stoma in postoperative Roux-en-Y gastric bypass patients. *J Laparoendosc Adv Surg Tech A* 2004;14:223-6.
17. Thompson CC, Slattey J, Bundga ME, et al. Peroral endoscopic reduction of dilated gastrojejunal anastomosis after Roux-en-Y gastric bypass: a possible new option for patients with weight regain. *Surg Endosc* 2006;20:1744-8.
18. Kumar N, Thompson CC. Comparison of a superficial suturing device with a full-thickness suturing device for transoral outlet reduction (with videos). *Gastrointest Endosc* 2014;79:984-9.
19. Brunaldi VO, Jirapinyo P, de Moura DTH, et al. Endoscopic treatment of weight regain following Roux-en-Y gastric bypass: a systematic review and meta-analysis. *Obes Surg* 2018;28:266-76.
20. Kumar N, Thompson CC. Transoral outlet reduction for weight regain after gastric bypass: long-term follow-up. *Gastrointest Endosc* 2016;83:776-9.
21. Jirapinyo P, Kumar N, AlSamman MA, et al. Five-year outcomes of transoral outlet reduction for the treatment of weight regain after Roux-en-Y gastric bypass. *Gastrointest Endosc* 2020;91:1067-73.
22. Stanford FC, Alfaris N, Gomez G, et al. The utility of weight loss medications after bariatric surgery for weight regain or inadequate weight loss: a multi-center study. *Surg Obes Relat Dis* 2017;13:491-500.
23. Patel LY, Lapin B, Brown CS, et al. Outcomes following 50 consecutive endoscopic gastrojejunal revisions for weight gain following Roux-en-Y gastric bypass: a comparison of endoscopic suturing techniques for stoma reduction. *Surg Endosc* 2017;31:2667-77.
24. Schulman AR, Kumar N, Thompson CC. Transoral outlet reduction: a comparison of purse-string with interrupted stitch technique. *Gastrointest Endosc* 2018;87:1222-8.
25. Hollenbach M, Selig L, Lellwitz S, et al. Endoscopic full-thickness transoral outlet reduction with semicircumferential endoscopic submucosal dissection. *Endoscopy* 2019;51:684-8.
26. Tsai C, Steffen R, Kessler U, et al. Endoscopic gastrojejunal revisions following gastric bypass: lessons learned in more than 100 consecutive patients. *J Gastrointest Surg* 2019;23:58-66.

GIE on LinkedIn

Find *GIE* on LinkedIn. Followers will receive news updates and links to author interviews, podcasts, articles, and tables of contents. Use the QR code or search on LinkedIn for “GIE: Gastrointestinal Endoscopy with Editor Michael B. Wallace” and follow us today.

