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SYSTEMATIC REVIEWS

Peroral endoscopic reduction of dilated gastrojejunal anastomosis after bariatric surgery: Techniques and efficacy

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Abstract

AIM: To investigate the techniques and efficacy of peroral endoscopic reduction of dilated gastrojejunal anastomosis after bariatric surgery.

METHODS: An extensive English language literature search was conducted using PubMed, MEDLINE, Medscape and Google to identify peer-reviewed original and review articles using the keywords "bariatric endoscopic suturing", "overstitch bariatric surgery", "endoscopic anastomotic reduction", "bariatric surgery", "gastric bypass", "obesity", "weight loss". We identified articles describing technical feasibility, safety, efficacy, and adverse outcomes of overstitch endoscopic suturing system for transoral outlet reduction in patients with weight regain following Roux-en-Y gastric bypass (RYGB). All studies that contained material applicable to the topic were considered. Retrieved peer-reviewed original and review articles were reviewed by the authors and the data extracted using a standardized collection tool. Data were analyzed using statistical analysis as percentages of the event.

RESULTS: Four original published articles which met our search criteria were pooled. The total number cases were fifty-nine with a mean age of 46.75 years (34-63 years). Eight of the patients included in those studies were males (13.6%) and fifty-one were females (86.4%). The mean time elapsed since the primary bypass surgery was 5.75 years. The average pre-endoscopic procedure body mass index (BMI) was 38.68 (27.5-48.5). Mean body weight regained post-RYGB surgery was 13.4 kg from their post-RYGB nadir. The average pouch length at the initial upper endoscopy was 5.75 cm (2-14 cm). The pre-intervention anastomotic diameter was averaged at 24.85 mm (8-40 mm). Average procedure time was 74 min (50-164 min). Mean post endoscopic intervention anastomotic diameter was 8 mm (3-15 mm). Weight reduction at 3 to 4 mo post revision noted to be an

average of 10.1 kg. Average overall post revision BMI was recorded at 37.7. The combined technical and clinical success rate was 94.9% (56/59) among studied participants.

CONCLUSION: Endoscopic suturing can be technically feasible, effective and safe for transoral outlet reduction in patients with weight regain following RYGB.

Key words: Endoscopic anastomosis reduction; Bariatric surgery; Endoscopic suturing; EndoCinch; Overstitch bariatric surgery

Core tip: Roux-en-Y gastric bypass is one of the most effective bariatric surgical procedures, but is associated with 5% weight regain during 1 to 3 years post procedure. Such weight regain has been attributed to a dilated gastrojejunal anastomosis (GJA). However given the increased perioperative risk of mortality, surgical revision is not generally considered. Endoscopic suturing system has shown potential in reducing the dilated GJA.

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INTRODUCTION

Obesity is an epidemic and persists as one of the world's leading chronic diseases with increasing prevalence, morbidity and mortality. According to the National Health and Nutrition Examination surveys conducted in 2009-2010, 35.7% of American adults were obese [body mass index (BMI) > 30] with 6.3% considered to have severe obesity (BMI > 40 kg/m^2)[1]. Obesity is associated with increased mortality and risk of developing comorbid conditions such as type 2 diabetes mellitus, hypertension, dyslipidemia, coronary heart disease, obstructive sleep apnea and obesity hypoventilation syndrome[2,3]. Treatment options available for obesity include lifestyle and behavioral modifications, pharmacological, and surgical interventions.

Surgery has proven to be the best option for significant weight reduction with low rates of weight regain[4]. Bariatric procedures work mainly to achieve and maintain weight loss *via* two main modalities; they function to restrict food accommodation in the stomach thereby causing early satiety and reducing caloric intake and or cause intestinal malabsorption[5]. Four main types of bariatric procedures exits, namely laparoscopic adjustable gastric banding, sleeve gastrectomy, biliopancreatic diversion with duodenal switch, and Roux-en-Y gastric bypass (RYGB).

RYGB as a bariatric procedure is considered the best and as a result the most popularly performed in the United States[6]. RYGB is achieved by creating a small gastric pouch which is connected to a Roux limb of the jejunum[7]. Its mechanism of weight loss reduction is mainly three folds: Food intake restriction by the small gastric pouch, dumping syndrome caused by the gastrojejunal anastomosis causing diarrhea and abdominal pain which act as negative reinforcement against high sugar diets, and the selective malabsorption due to the decreased length of Roux limb[8]. Additionally, the reduction of Ghrelin levels due to the bypass of the stomach and duodenum in RYGB is reported to cause decreased stimulation of appetite leading to decreased food intake[9].

Many studies on RYGB have reported weight reduction averages of 65% and more than 85% of patients losing and maintaining 50% of initial excess weight loss. However, studies have noted significant weight regain in patients beyond 18-24 mo after the initial weight loss surgery. Sugerman *et al*[10] reported a 5% weight regain noted in bariatric surgical patients during a follow-up evaluation at 1 to 3 years. Powers *et al*[11] also noted an average of 40 lb excess weight regain in bariatric surgery patients during a 2-year follow-up duration. Many factors have been suggested to contribute to such weight regain in patients who undergo weight loss surgery. Mechanical dehiscence of staple lines has been cited by many studies as a major contributing factor to weight regain[12-14]. Additionally, dilation of the gastrojejunal anastomosis has been suggested as another possible mechanism of weight regain resulting in decreased distension of the gastric pouch and hence a reduction in satiety stimulation.

Fixation of such gastrojejunal dilation is however controversial as it carries significant surgical risks and often times the degree of weight regain does not justify surgical revision. Linner *et al*[15] in their study of revision procedures noted a doubling of perioperative morbidity (15%) and mortality (0.7%) rates when compared to morbidity (8%) and mortality (0.3%) associated with the primary bariatric surgeries. Many different open revision surgeries have been suggested to restrict the dilated gastrojejunal anastomosis; however most of the patients did not achieve significant weight reduction, and suffered major procedural complications[14,16].

Technological advancement in endoscopy has led to a novel approach of endoscopic fixation of gastrojejunal dilation in bariatric patients with weight regain after RYBG. This article discussed the endoscopic devices and their success in transoral gastric pouch outlet reduction to treat weight gain after RYGB.

MATERIALS AND METHODS

An extensive English language literature search was conducted using PubMed, MEDLINE, Medscape and Google to identify peer-reviewed original and review

articles using the keywords "bariatric endoscopic suturing", "overstitch bariatric surgery", "endoscopic anastomotic reduction", "bariatric surgery", "gastric bypass", "obesity", "weight loss". Studies involving human models were selected. The references of pertinent studies were manually searched to identify additional relevant studies. The technical feasibility, safety, efficacy, and adverse outcomes of overstitch endoscopic suturing system for transoral outlet reduction in patients with weight regain following RYGB were considered as inclusion criteria for evaluation. Search results yielded mostly small sample sized studies including case reports and case series.

RESULTS

Four original published articles were considered suitable for inclusion in this review article. All studies were performed in Boston, Massachusetts, United States. All the four articles were case series on human subjects. The total number cases were fifty-nine with a mean age of 46.75 years (range, 34-63 years). Eight of the patients included in those studies were males (13.6%) and fifty-one were females (86.4%). All cases are summarized in Table 1.

Time since primary bypass surgery

The mean time elapsed since the primary bypass surgery in the studied population was 5.75 years with a range from 2 to 10 years[17-19]. Fernández-Esparrach *et al*[20] did not report the number of years after the primary bariatric surgery for their study patients.

Average pre-procedure BMI

The average pre-endoscopic procedure BMI among the study participants was 38.68 with range between 27.5-48.5[17-20].

Average weight regain post RYGB nadir

The mean body weight regained post RYGB surgery was 13.4 kg from their post-RYGB nadir with a range between 0.9-53.6 kg[17-20]. Fernández-Esparrach *et al*[20] did not report the average weight gained post RYGB for their study patients.

Average pre-intervention pouch length and anastomotic diameter

The average pouch length at the initial upper endoscopy was 5.75 cm; ranging between 2-14 cm. The pre-intervention anastomotic diameter was also averaged at 24.85 mm; ranging from 8-40 mm[17-20].

Endoscopic equipment used

Studies have described use of EndoCinch suturing system (CR Bard, Murray Hill, NJ), EndoSurgical Operating System (EOS) (USGI Medical San Clemente, Calif) and Overstitch Endoscopic Suturing System (Apollo Endosurgery) without any differences in outcome.

The Overstitch Endoscopic Suturing System (Apollo Endosurgery) was connected to a two channel endoscope (GIF-2T160; Olympus America, Central Valley, Pennsylvania, United States). With a curved suture arm on one channel, and the anchor exchange on the other channel, stitches were placed through the tissue when the handle was closed. The tissue was released upon opening of the handle and a new stitch placed when the suture arm was returned to the anchor[19]. Mullady *et al*[18] used the EOS (USGI Medical San Clemente, Calif), which has a main component of the TransPort, The TransPort has 4 large channels accepting a 4.9-mm endoscope (GIF-N180; Olympus America, Inc, Center Valley Pa) and flexible equipments. With a 4 way tip, the TransPort uses a shapelock system in suturing, where a tissue approximator (g-Prox; USGI Medical), a tissue grasper and a needle catheter were advanced through the TransPort channels. The tissue grasper grasps the tissue and pulls into the approximator, which then closes onto the tissue. The needle catheter is then passed through the tissue and a self-expanding tissue anchor passed through the catheter is deployed. The approximator is opened and then the tissue anchor released. A stitch connecting the 2 anchors was then tightened, bringing together the 2 anchors[18].

EndoCinch suturing system (CR Bard, Murray Hill, NJ) by Thompson *et al*[17] was passed through the gastrojejunostomy site where tissue at the anastomosis site was pulled into the device and the stitch placed by activation of the handle. The Bard device was then removed and reloaded for a second bite and stitch placement. The process was repeated to attain one to three interrupted sutures around that anastomosis rim. Suture were tightened to plicate the tissue[17,20].

Average number of interrupted stitches applied and procedure time

The average procedure time was charted at 74 min, ranging from 50-164 min[17-20]. The number of interrupted stitches applied at the gastrojejunal anastomosis and the gastric pouch is averaged at 3.8 (range, 0-7)[17-20].

Average post intervention anastomotic diameter

The mean post endoscopic intervention anastomotic diameter was 8 mm with a range between 3-15 mm[17-20]. Overall the average anastomotic diameter reduction was 16.85 mm; a 67.8% reduction.

Average weight loss at 3-4 mo after revision

Weight reduction at 3-4 mo post revision was observed at an average of 10.1 kg (range, 1.4-19.5 kg)[17-20].

Overall post procedure BMI

The average overall post revision BMI was recorded at 37.7[9]. The remaining three articles did not report the post revision BMI[18-20].

Major complications and limitations

The use of EndoCinch as an overstitch endoscopic suturing system for transoral outlet reduction in patients

Table 1 Summary of reports describing use of endoscopic suturing systems for transoral outlet reduction in patients with weight regain following Roux-en-Y gastric bypass

Ref.	Gender	Mean age (yr)	Time since bypass (yr)	Avg. pre-procedure BMI	Avg. weight gain (kg) post RYGB nadir	Avg. preintervention pouch length (cm)	Avg. preintervention anastomotic diameter (mm)	Type of equipment	Avg. number of interrupted stitches	Avg. post intervention anastomotic diameter (mm)	Avg. procedure time (min)	Avg. weight loss (kg) at 3-4 mo post	Overall post procedure BMI	Major complications	Technical success (%)
Thompson *et al*[17] 2006, Boston, United States	F × 8	46 (41-54)	6	40.5	24 (8.6 - 53.6)	5.7 (3-8)	25 (17-25)	EndoCinch suturing system (CR Bard, Murray Hill, NJ)	2 (1-3)	10 (5-15)	98 (50-164)	10 (1.4-19.5)	37.7	None	100 (8/8)
Mullady *et al*[18] 2009, Boston, United States	F × 19 M × 1	48 (36-62)	5.25 (2-9.75)	36.7 (28.4-48.8)	13.3 (0.9-34.6)	7 (4-14)	25 (8-35)	EOS (USGI Medical, San Clemente, Calif)	Pouch: 1.7 (0-6) GJA: 3.4 (0-7)	16 (0-26)	103 (50-154)	8.8	Not reported	None	85 (17/20)
Fernández-Esparrach *et al*[20] 2010, Boston, United States	F × 6	45 (33-63)	Not reported	34.5 (27.5-41.5)	Not reported	5 (4-6)	23 (18.5-27.5)	EndoCinch suturing system (CR Bard, Murray Hill, NJ)	3	8 (7.6-8.4)	Not reported	Not reported	33	None	100 (6/6)
Jirapinyo *et al*[19] 2013, Boston, United States	F × 18 M × 7	48 (34-69)	6 (2-10)	43	24 (1.4-59)	5.3 (2-9)	26.4 (18-40)	Overstitch Endoscopic Suturing System (Apollo Endosurgery)	GJA: 3 (1-7) Pouch: 2 (1-5)	6 (3-10)	Anastomosis: 27 (7-80) Pouch: 15 (4-30)	11.5	Not reported	3/25	100 (25/25)

GJA: Gastrojejunal anastomosis; EOS: EndoSurgical Operating System; F: Female; M: Male; BMI: Body mass index; RYGB: Roux-en-Y gastric bypass.

with weight regain following RYGB has been associated with no reported significant procedure-related complications. Minor complications reported have included postprocedural nausea and vomiting, sore throat, mild transient abdominal pain, diarrhea and constipation[17,20]. Jirapinyo *et al*[19] reported three intra-procedural complications including a small esophageal abrasion which was remedied with fibrin glue and two patients who had arterial bleeding after the stitch placement, resolved with tissue plication.

Technical and clinical success rates

The combined technical and clinical success rate of EndoCinch as an endoscopic suturing system for outlet reduction in post RYGB patients with weight regain was 94.9% (56/59) among studied participants.

DISCUSSION

The reported findings on the use of endoscopic suturing devices are promising and appear to be safe in practice. Outlet reduction appears to be effective in decreasing the gastrojejunal anastomosis diameter and the gastric pouch length, ultimately leading to significant weight reduction and addressing the problem of weight regain in RYGB patients. The cases discussed above have some limitations however. The main limitation is the small number of subjects studied. Also the number of male participants in these studies was disproportionally low (8/59; 13.6%). More studies with larger sample size, are needed to study the long-term efficacy of endoscopic suturing systems in treatment of weight regain in post RYGB.

COMMENTS

Background

Obesity is an epidemic and persists as one of the world's leading chronic diseases. Many treatment options for obesity exist, but surgery has proven to be the best for significant weight reduction with low rates of weight regain. Roux-en-Y gastric bypass (RYGB) is one of the most effective bariatric surgical procedures, but is associated with 5% weight regain during 1 to 3 years post procedure. Such weight regain has been attributed to a dilated gastrojejunal anastomosis (GJA). However given the increased perioperative risk of mortality, surgical revision is not generally considered. Endoscopic suturing system has shown potential in reducing the dilated GJA. The aim of this review is to verify the techniques and efficacy of peroral endoscopic reduction of dilated gastrojejunal anastomosis after RYGB.

Research frontiers

The endoscopic suturing system was first used in 1996, in the treatment of gastroesophageal reflux disease. Sutures were placed at the gastric cardia to plicate and ultimately tighten the gastroesophageal junction. In its application for the treatment of dilated GJA, the endoscopic suturing system is attached to the endoscope *via* channels and advanced to the gastrojejunal anastomosis. By opening and closing of the handle of endoscopic suturing system, endoscopic stitches are applied to plicate the tissues resulting in a tightening of the GJA.

Innovations and breakthroughs

Peroral endoscopic reduction of dilated gastrojejunal anastomosis post RYGB has been successfully performed in various clinical studies. The retrieved manuscripts were reviewed by the authors, and the data were extracted using a standardized collection tool.

Applications

This review suggests that peroral endoscopic reduction *via* the endoscopic suturing system is an efficacious method in reducing dilated gastrojejunal anastomosis, thereby curbing the problem of weight regain post RYGB.

Terminology

The peroral endoscopic reduction technique is a novel modality employed in addressing the problem of dilated gastrojejunal anastomosis in RYGB as the cause of weight regain. The endoscopic suturing system is attached to the endoscope *via* its channels and advanced to the gastrojejunal anastomosis. Stitches are then applied through the tissue with opening and closing of the handle of endoscopic suturing system.

Peer-review

Overall, this is an interesting review of transoral endoscopic fixation of gastrojejunal dilation.

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