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RESEARCH-CLINICAL

Risk of Gastrojejunal Anastomotic Stricture with Multifilament and Monofilament Sutures after Hand-Sewn Laparoscopic Gastric Bypass: A Prospective Cohort Study

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Abstract
Background Gastrojejunal (GJ) stricture is one of the most common late complications after laparoscopic Roux-en-Y gastric bypass (LRYGBP) with a hand-sewn anastomosis. The object of this study was to assess the risk of stricture for two types of resorbable suture (multifilament and monofilament) in a series of LRYGBPs performed by the same surgeon.
Methods Design: Prospective cohort study. The study population consisted of a series of consecutive morbidly obese patients who underwent primary hand-sewn LRYGBP between March 2004 and May 2008 at the University Hospital in Getafe, Madrid, Spain. The study comprised 242 LRYGBPs with a four-layer continuous hand-sewn anastomosis using absorbable 3/0 gauge suture. The suture material was Ethicon Vicryl® multifilament in the first 105 cases and Ethicon Monocryl® monofilament in the following 137 cases. All patients were followed up monthly for the first 6 months and then every 6 months after that.
Results The mean BMI was 46±4 for the multifilament cohort and 48±6 for the monofilament cohort with no significant difference between the two (p=0.567). There were no anastomotic leaks, and no cases of marginal ulcer, abscess, abdominal sepsis, deep vein thrombosis, or pulmonary embolism were recorded. No cases required conversion to open surgery, and perioperative mortality was zero. In all, 11 cases of stricture (4.4%) were recorded, 10 in the multifilament suture cohort (9.5%), and only one in the monofilament suture cohort (0.7%; p= 0.001). The odds ratio was 14.3 (95% CI=1.8–113.4). The mean outpatient follow-up period was 30 months (range= 6–42).
Conclusions Anastomotic GJ stricture is a common and well-known complication of laparoscopic gastric bypass for morbid obesity. Hand sewing with monofilament suture significantly lowered the frequency of this complication, and hence, monofilament should be the suture material of choice for this suturing technique.

Keywords Bariatric surgery · Laparoscopic Roux-en-Y gastric bypass · Hand-sewn anastomosis · Gastrojejunostomy strictures · Monofilament suture

Abbreviations

LRYGBP	Laparoscopic Roux-en-Y gastric bypass
GJ	Gastrojejunostomy

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Introduction

Gastrojejunostomy (GJ) stricture is one of the most frequent late complications after laparoscopic Roux-en-Y gastric bypass (LRYGBP) and is reported to occur in 1.6% to 31% of patients [1]. Many patients who have recurring episodes of dysphagia, vomiting, or abdominal pain require multiple invasive therapeutic procedures with the resulting risk of perforation and/or hemorrhage [2–4].

The postulated mechanisms underlying stricture formation are local tissue ischemia, tension on the anastomosis, subclinical leak, submucosal hematoma, acid or peptic ulceration, early experience with LRYGBP, and method of gastrojejunostomy construction [5]. Hand-sewn anastomoses have low complication rates in the immediate postoperative period [6], though GJ stricture is the most common late complication (4.9%) in large series like that reported by Higa et al. [7].

To date, there has been no study evaluating the behavior of the suture material employed by the surgeon as a factor influencing the incidence of GJ stenosis. The object of this prospective study was to compare two types of resorbable sutures (multifilament and monofilament) and determine the risk of stricture formation for each in a large cohort of hand-sewn RYGBPs constructed by an experienced bariatric surgeon.

Materials and Methods

Design: prospective cohort study The study population consisted of a series of consecutive morbidly obese patients who underwent primary hand-sewn LRYGBP between March 2004 and May 2008. All cases were performed by the same surgeon (J.C.R.A.) with the Getafe University Hospital (HUG) Bariatric Surgery Program who had previously undergone training and completed the learning curve by performing 100 hand-sewn laparoscopic gastrojejunal anastomoses. Pre-, peri-, and postoperative data were prospectively collected by a research assistant (J.L.H.) and entered in the HUG Bariatric Program Database.

All patients were referred after a comprehensive endocrine workup and fulfilled the surgical indication criteria of the National Institutes of Health Consensus Development Conference. All were fully briefed on the methods, results, and most common complications and signed a written acceptance of the risks associated with the procedure.

Surgical procedure The LRYGBP procedure, described elsewhere [8], was performed using a loop proximal to the ligament of Treitz to form a Roux-en-Y limb that was variable in length (100 to 150 cm). Routinely, the alimentary loop was brought upwards retrocolically, and the anastomosis was formed according to the method of Higa et al. [7], with a continuous four-layer hand-sewn anastomosis sized at 34F (two layers for each side). Absorbable multifilament suture material (Ethicon Vicryl®) was used in the first 105 cases (multifilament cohort), and absorbable monofilament suture material (Ethicon Monocryl®) was used in the following 137 patients (monofilament cohort), in both cases 3/0 gauge. The number of intracorporeal knots was four for the multifilament suture material and seven for the monofilament suture material. All patients were discharged on proton pomp inhibitor for 4 weeks. Follow-up was monthly for the first 6 months after surgery and then every 6 months for all patients.

The BMI, presence of gastroesophageal reflux, surgical procedure time, anastomosis construction time, and the number of strictures were analyzed. GJ stricture was suspected in patients with dysphagia, postprandial vomiting, or epigastric abdominal pain. The diagnosis was confirmed by an esophagogram or endoscopic inspection. Once a stricture was confirmed, sequential balloon dilatation was performed up to a maximum of 20 mm. Anastomotic stricture was defined as a combination of the following findings: relevant clinical findings, radiologically or endoscopically demonstrated narrowing, failure of conservative treatment, and the need for balloon dilatation. The frequency of GJ stricture was compared using the logistic regression test and Fisher's exact test.

Results

A total of 242 patients were included in the series: 105 in the multifilament cohort and 137 in the monofilament cohort. Table 1 shows clinical characteristics and surgical results of all patients. The mean BMI was 46±4 for the multifilament cohort and 48±6 for the monofilament cohort, with no significant difference (p=0.567). Similarly, there were no significant differences in patient age (40 vs. 48 years, p=0.478) or in the presence of symptoms of gastroesophageal reflux (37% vs. 34%, p=0.423).

All the procedures were carried out using laparoscopy by the same surgeon (J.C.R.A). No cases of anastomotic leak, marginal ulcer, abscess, abdominal sepsis, deep vein thrombosis, or pulmonary embolism were recorded. No cases had to be converted to open surgery, and perioperative mortality was zero. Procedure duration was 149±27 min for the multifilament cohort and 142±20 min for the monofilament cohort. Mean anastomosis time was 38±12 min for the former cohort and 35±15 min for the latter cohort, and the difference was not significant (p=0.392). All cases were seen monthly at the clinic for at least 6 months after surgery. The mean outpatient follow-up period was 30 months (range 6–42).

Table 1 Demographics and results of both groups

	Multifilament $n=105$	Monofilament $n=137$	P value
BMI mean±SD	46±4	48±6	0.567
Gastroesophageal reflux symptoms	37%	34%	0.423
Leak or marginal ulcer	0%	0%	–
Anastomosis time in minutes (mean±SD)	38±12	35±15	0.312
Anastomotic stricture	9.5%	0.7%	0.001

In all, 11 (4.4%) cases of GJ stricture were recorded in the series as a whole, in chronological order in cases nos. 15, 17, 18, 44, 49, 55, 63, 75, 80, and 95 (all sewn with Vicryl®) and, lastly, 139 (sewn with Monocryl®). None of the patients reported taking non-steroidal anti-inflammatory drugs. In other words, there were 10 cases of GJ stricture in the first 105 patients using multifilament suture and only a single instance of stricture in the following 137 patients using monofilament suture (9.5% vs. 0.7%, $p=0.001$). The odds ratio was 14.3 (95% CI=1.8–113.4). Onset was in all cases in the first 3 months following surgery, with a mean time to onset of 55 days (range=31–74). The stricture was resolved by a single dilatation, either radiologically guided [9] or endoscopic [1] in 10 patients, while one case required two dilatations, yielding a mean of 1.1 sessions/patient. There were no complications associated with the procedure.

Discussion

The success of RYGBP in treating morbid obesity relies partially on a narrow and restrictive GJ [9]. Nevertheless, GJ stricture is the most common late complication [1] and is associated with substantial morbidity [2–5].

Surgical technique is an important factor contributing to the formation of anastomotic strictures. Apposition of the mucosal edges, tension, ischemia caused by tissue approximation, fibrosis resulting from foreign body reaction, and the like all play a role. Several studies have analyzed the incidence of these strictures associated with hand-sewn and circular and linear stapling methods of creating the gastrojejunal anastomosis and have reported the highest incidence in the case of the circular stapling technique [1]. Recently, Takata et al. [5] studied the rate of GJ stricture following circular and linear stapler anastomosis and found use of a 21-mm circular stapler to be the only independent predictor for this complication.

Higa is the surgeon with the most extensive experience using continuous hand-sewn suturing for RYGBP [7]. After numerous procedures using multifilament suture, he reported a stricture rate of 4.9%. We reproduced his technique, but our incidence of stricture was twice as high during our first 100 cases learning curve. For that reason, we began to reapply the same technique used previously, but this time, sewing the anastomosis with monofilament suture material because it is more inert and results in more constant and uniform tension at the anastomotic margins. The resulting stricture rate in this large monofilament suture cohort is the lowest rate published in the literature to date (0.7%).

The inflammatory response to a specific suture material is known to play an important role in the resulting scar formation. Vicryl® is a braided synthetic suture material composed of a lactate/glycolate copolymer, while Monocryl® is a monofilament suture material composed of glycolate and epsilon-caprolactone. Both absorbable sutures are manufactured by the same company and are broken down completely by hydrolysis in the body's tissues, with loss of all the effects resulting from the material's physical properties. Thus, the tensile strength of Vicryl® falls to zero in 35 days and that of Monocryl® in 28 days. According to the absorption profile, Vicryl® is completely absorbed after 56–70 days and Monocryl® is completely absorbed after 90–120 days [10, 11]. Even though hydrolysis is faster for the multifilament suture, causing the material to degrade sooner, associated scarring results in a high rate of symptomatic strictures compared to the monofilament material. In this cohort study, continuous suturing with the absorbable monofilament material lowered the risk of stricture 14 times, on average, compared to the absorbable multifilament material. We associate this finding with a lower foreign body reaction and more constant tension produced by the monofilament material throughout the healing process of the gastrojejunal anastomosis.

The surgeon's technique is a possible confounding factor for postoperative gastrojejunostomy strictures. The same technique for constructing the hand-sewn GJ anastomosis sized 34F and the same retrocolic route were used in all the patients in this study. All anastomoses were performed by the same experienced surgeon who had completed the learning curve of 100 hand-sewn laparoscopic gastrojejunal anastomoses before undertaking the series. Takata et al. [5] reported that the stricture rate of 6% in their first 50 patients subsequently decreased to 2.6%.

The nonrandomized design of this study means that the surgeon had more experience for the monofilament cohort comprising the last 137 cases. However, the stricture frequency rate was similar throughout the entire multifilament series, indicating that there was no causative

relationship between the learning curve and stricture formation. On switching to the monofilament suture, new cases of stricture fell off abruptly, and indeed only a single case was recorded over the course of the entire lengthy series considered. The authors attribute this sharp drop-off in the stricture rate solely to the physical properties of the suture material used and consider the contribution of the experience gained by the surgeon after some additional procedures to be very low. No other risk factors for stricture, such as age or the presence of gastroesophageal reflux disease described by Blackstone [12], were observed.

Endoscopic or radiologically guided balloon dilatation is reliable, safe, and the therapy of choice for treating GJ stricture [13]. In our study, a single dilatation completely resolved symptoms in all patients but one, in which two dilatations were necessary. These results were better than those described for dilatation of mechanical anastomoses [13]. Goitein et al. [2] reported that 78% of their patients needed two or more dilatations, and according to Takata et al. [5], a single dilatation resolved only 60% of strictures. These findings suggest that mechanical anastomoses are stiffer than hand-sewn anastomoses and, therefore, require several dilatations and more balloon inflation pressure, with the resulting risk of complications (perforation, hemorrhage, tear) and/or reoperation [2–4].

Anastomotic stricture of the gastrojejunostomy is a common and well-known complication of laparoscopic gastric bypass for morbid obesity. We conclude that hand-sewn formation of the anastomosis using monofilament suture significantly lowered the GJ stricture rate compared with multifilament suture, and consequently, monofilament suture should be the suture material of choice for surgeons performing this type of anastomosis. Additional experimental studies to examine the inflammatory response, undertake histological evaluation, and assess the degree of scar formation using this type of suture are needed.

References

1. Carrodeguas L, Szomstein S, Zundel N, et al. Gastrojejunal anastomotic strictures following laparoscopic Roux-en-Y gastric bypass surgery: analysis of 1 291 patients. Surg Obes Relat Dis. 2006;2:92–7.
2. Goitein D, Papasavas PK, Gagne D, et al. Gastrojejunal strictures following laparoscopic Roux-en-Y gastric bypass for morbid obesity. Surg Endosc. 2005;19:628–32.
3. Papasavas PK, Caushaj PF, McCormick JT, et al. Laparoscopic management of complications following laparoscopic Roux-en-Y gastric bypass for morbid obesity. Surg Endosc. 2003;17:610–4.
4. Nguyen NT, Stevens CM. Incidence and outcome of anastomotic stricture after gastric bypass. J Gastrointest Surg. 2003;7:997–1003.
5. Takata MC, Ciovica R, Cello JP, et al. Predictors, treatment and outcomes of gastrojejunostomy stricture after gastric bypass for morbid obesity. Obes Surg. 2007;17:878–84.
6. Baltasar A. Hand-sewn laparoscopic duodenal switch. Surg Obes Rel Dis. 2007;3:94–6.
7. Higa KD, Ho T, Boone KB. Laparoscopic Roux-en-Y gastric bypass: technique and 3-year follow-up. J Laparoendosc Adv Surg Tech A. 2001;11(6):377–382.
8. Ruiz de Adana JC, López-Herrero J, Hernández-Matías A, et al. Laparoscopic hand-sewn gastrojejunal anastomoses. Obes Surg. 2008;18:1074–1076.
9. Rossi TR, Dynda DI, Estes NC, et al. Stricture dilation after laparoscopic Roux-en-Y gastric bypass. Am J Surg. 2005;189:357–60.
10. VanHeerden J. Comparison of inflammatory response to polyglytone 6211 and polyglecaprone 25 in a rat model. S Afr Med J. 2005;95:972–4.
11. Molea G. Comparative study on biocompatibility and absorption times of three absorbable monofilament suture materials: polydioxanone, polyglecaprone 25, glycomer 631. Br J Plastic Surg. 2000;53:137–41.
12. Blackstone RP, Rivera LA. Predicting stricture in morbidly obese patients undergoing laparoscopic Roux-en-Y gastric bypass: a logistic regression analysis. J Gastrointest Surg. 2007;11:403–9.
13. Csendes A, Burgos AM, Burdiles P. Incidence of anastomotic strictures after gastric bypass: a prospective consecutive routine endoscopic study 1 month and 17 months after surgery in 441 patients with morbid obesity. Obes Surg. 2009;19:269–73.