

Barbed unidirectional V-Loc 180 suture in laparoscopic Roux-en-Y gastric bypass: a study comparing unidirectional barbed monofilament and multifilament absorbable suture

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Abstract

Background This study aimed primarily to evaluate the safety of digestive running suture (in gastrojejunal and antecolic jejunojunal anastomosis closure) using unidirectional absorbable barbed suture (V-Loc 180) in laparoscopic Roux-en-Y gastric bypass (LRYGB) and secondarily to assess the efficacy of V-Loc 180 in reducing operative time.

Methods A prospective cohort study of 315 consecutive patients who underwent LRYGB was performed between October 2009 and October 2012 using an identical procedure technique. For the first 76 patients, a multifilament absorbable suture was used to assess the gastrojejunal anastomosis and the antecolic jejunal suture. For the following 239 patients, a unidirectional barbed monofilament suture was used. Data including operative time, time required for gastric pouch creation, time spent in both anastomoses constructions, conversion rate, and complications were prospectively recorded.

Results The postoperative complications did not differ significantly between the two groups. Early complications were observed for 1 patient (1.3 %) in the multifilament group and for 14 patients (5.8 %) in the barbed procedure group ($p > 0.05$). Late complications were observed for 1 patient (1.3 %) in the multifilament group and for 5 patients (2 %) in the barbed procedure group ($p > 0.05$).

A shortened operative time was achieved in the barbed suture group. The mean operative time was 74.3 ± 15.3 min in the Vicryl group versus 62.7 ± 15.5 min in the V-Loc group ($p < 0.05$). The mean operative time required to fashion the gastrojejunal anastomosis was 21.3 ± 6.3 min in the Vicryl group versus 17.4 ± 5.1 min in the V-Loc group ($p < 0.05$). The mean operative time required to fashion the jejunojunal anastomosis was 21.4 ± 4.9 min in the Vicryl group versus 15.2 ± 5.5 min in the V-Loc group ($p < 0.05$).

Conclusions The authors' experience has demonstrated that the use of interlocked V-Loc suture during LRYGB anastomosis appears to be safe and efficient. The findings show a shortened total operative time in terms of single gastrojejunal or jejunojunal anastomosis time. No statistically significant differences in early or late postoperative complications were observed between the V-Loc and multifilament absorbable suture patients.

Keywords Complications rate · Laparoscopic gastric bypass · Laparoscopic suture · Obesity surgery

Worldwide obesity has more than doubled since 1980. Excess weight and obesity are the fifth leading risk for global death [1]. As findings have demonstrated, conservative treatment of obesity including restrictive calorie intake, physical activity, and medication have failed to achieve significant and long-lasting weight loss [2]. Current evidence has validated surgical therapy as the best hope for the morbidly obese to achieve substantial and sustainable weight loss [3].

The minimally invasive approach (i.e. laparoscopy) has been developed over the last two decades, and laparoscopic surgery currently is considered a “norm” [4]. Indeed,

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laparoscopic Roux-en-Y gastric bypass (LRYGB) is the most regularly performed bariatric surgical procedure in the United States [5, 6].

Nguyen et al. [7] showed that LRYGB is a surgical skills: demanding procedure. Indeed, more than 100 cases are considered necessary to achieve dexterity in performing LRYGB safely, reflecting the technical complexity associated with this procedure [8]. Performing laparoscopic suturing and knotting may become difficult tasks even for well-trained laparoscopic surgeons.

We hypothesize that the use of unidirectional absorbable 3/0 suture (V-Loc 180; Covidien, Mansfield, MA, USA) in LRYGB could provide benefits that would simplify the suture technique by avoiding the knot technique and minimizing external helps during anastomosis construction. The primary aim of this study was to assess the feasibility and safety of the running suture in anastomotic closure by evaluating related postoperative complications. The secondary aim was to evaluate the impact of the procedure on operative time.

Materials and methods

Between October 2009 and October 2012, we performed a prospective cohort study of patients undergoing elective LRYGB with full Department and Institutional Ethical approval. All patients were included in the study who met the National Institute of Health recommendations: age 18–65 years and a body mass index (BMI) $>40 \text{ kg/m}^2$ or $<35 \text{ kg/m}^2$ with comorbidities [9].

Based on the Longitudinal Assessment of Bariatric Surgery (LABS) study, 45 secondary LRYGBs were excluded from the study [10]. Consequently, 315 patients were enrolled to undergo elective primary LRYGB for morbid obesity.

A double-layer running suture was performed to close the gastrojejunal antegastric anastomosis, and a one-layer running suture was used to close the antecolic jejunojunal anastomosis. Multifilament absorbable 3/0 Vicryl (Ethicon, Cincinnati, OH, USA) was used routinely for 76 consecutive patients, and the monofilament barbed absorbable suture V-Loc 180 was used for the following 239 patients. Two experienced bariatric laparoscopic surgeons according to the LRYGB learning curve proposed by Schauer performed the surgical procedures [8].

Surgical technique

Since 2005, we have performed a modified LRYGB Lönroth's technique in our unit, with the surgeon positioned between the patient's legs [11]. A five-port-site technique is systematically performed. Access to the lesser sac is

obtained after fundic mobilization. The lesser omentum is dissected close to the lesser curvature of the stomach, 4 cm away from the cardia.

Division of the stomach is first achieved horizontally using a 45-mm regular linear stapler, blue cartridge (Echelon 45 ENDOPATH Stapler Ethicon; Endo-Surgery, Cincinnati, OH, USA) followed by the use of two 45-mm linear staplers, blue cartridge, in a vertical direction to reach the angle of His in a vertical position.

Division of the greater omentum is not performed routinely. A 60-cm ileal loop is lifted up to the pouch, and a gastrojejunal anastomosis is performed using only 30 mm of a 45-mm regular linear stapler (Echelon 45 ENDOPATH Stapler Ethicon; Endo-Surgery, Cincinnati, OH, USA). A double-layer running suture is made to close the gastrojejunal anastomosis. The Roux limb is measured at 150 cm, and a side-to-side jejunojunal anastomosis is fashioned using a 45-mm regular linear stapler, white cartridge (Echelon 45 ENDOPATH Stapler Ethicon; Endo-Surgery, Cincinnati, OH, USA) and closed by a single-layer running suture.

Bowel division is completed using a 45-mm regular linear stapler, white cartridge (Echelon 45 ENDOPATH Stapler Ethicon; Endo-Surgery, Cincinnati, OH, USA). Closure of the mesentery defect is performed using a multifilament nonabsorbable running suture. Petersen's defect and port sites are not closed.

Postoperative management

A fast-track postoperative program is routinely applied including nonsedative medication, early mobilization, fluid intake 4 h after surgery, and analgesic oral intake starting at 12 h after surgery. Abdominal drain, bladder catheter, or nasogastric tube is not used. Postoperative radiologic control is not included. Patients are normally discharged on postoperative day (POD) 3. Verbal and written instructions specifying warning signs are given to all patients.

Patient follow-up evaluation

For all patients, medical control is previously scheduled to occur 4 weeks after surgery, four times during the first year, and then every year afterward. Micronutrients and regular blood tests are routinely performed. When late complications are suspected, endoscopic or computed tomography (CT) scan investigations are conducted.

Study design

A computerized central database created in the institutional bariatric surgery program included a preoperative workup as well as peri- and postoperative outcomes.

Preoperative workup

The preoperative workup involved upper endoscopy, blood analysis, respiratory investigation, nutritional status appraisal, and psychological and cardiac evaluation. Once the preoperative assessments were performed, the patient data were recorded in the bariatric surgery program database. Patient age, gender, American Society of Anesthesiology (ASA) score, BMI, and comorbidities were assessed.

Perioperative setup

Data including operative time, time required for gastric pouch creation, time spent for both gastrojejunal and jejunojejunal anastomosis constructions, conversion, and complications were recorded prospectively.

Postoperative complication records

The postoperative complication records were analyzed according to the Clavien–Dindo classification [12]. Complications occurring within 30 days after LRYGB were identified as early, whereas complications occurring after 30 days were considered late.

Statistical analysis

The entire statistical analysis was performed using SPSS version 16.0 (SPSS, Chicago, IL, USA) and Microsoft Excel 2007 (Microsoft Excel 2007, Redmond, WA, USA). Continuous variables are expressed as mean \pm standard deviation. Student's *t*-test was used for independent samples comparison, and the chi-square test was used to compare definite variables. A $p < 0.05$ was considered statistically significant.

Results

During the study period, 315 patients consecutively underwent primary LRYGB. The patients had a mean age of 39 years (range, 19–65 years) and a mean BMI of 46 ± 6.8 kg/m². Comorbidities were present in 283 cases (84 %).

Vicryl was used to perform anastomosis construction for 76 patients (24 %), and V-Loc was used for 213 procedures (76 %). No difference in demographics or characteristics was observed between the two groups. Patient demographics and characteristics are displayed in Table 1.

No significant differences were observed in postoperative outcomes (Table 2). Overall, postoperative complications occurred for 21 patients (6.6 %) according to the Dindo–Clavien classification of surgical complications [12], as shown in Table 2.

Table 1 Demographics and characteristics

	Multifilament suture	Barbed suture	<i>p</i> value
Patients (<i>n</i> = 315)	76	239	NS
Sex (F/M)	63/13	213/26	NS
Mean age	40 \pm 10.7	38 \pm 10.8	NS
Mean BMI	44 \pm 6.5	44.9 \pm 6.9	NS
Diabetes: <i>n</i> (%)	12 (16)	34 (14)	NS
Hypertension: <i>n</i> (%)	18 (24)	69 (29)	NS
Arthropathy: <i>n</i> (%)	9 (12)	31 (13)	NS
Dyslipidemia: <i>n</i> (%)	16 (21)	37 (15)	NS
Cardiac failure: <i>n</i> (%)	2 (3)	4 (2)	UT
Respiratory failure: <i>n</i> (%)	10 (13)	24 (10)	NS
Gonarthrose: <i>n</i> (%)	4 (5)	11 (5)	UT

NS nonsignificant, BMI body mass index, UT unrealizable test

The differences between the early complications and the late complications in the two groups were not significant. Overall, early complications were observed in 15 patients: one patient in the multifilament group (1.3 %) and 14 patients in the barbed procedures group (5.8 %) ($p > 0.05$). Late complications were observed in six patients: one patient in the multifilament group (1.3 %) and five patients in the barbed procedures group (2 %) ($p > 0.05$). No conversion to open procedures occurred in either group, and the 30-day mortality rate was zero in both groups.

In one patient, we observed intestinal bleeding at the gastrojejunal anastomosis on POD 9. It was treated by local adrenaline injection and monopolar electrocautery at endoscopy.

Two intestinal injuries, in the small bowel and colon, were clinically evident on PODs 1 and 3, respectively, and both were treated by laparoscopic suturing and drainage. Drainage was not required for the patient with postoperative pneumothorax. In only one of the five patients with unspecific abdominal pain was CT scan and blood tests not normal, as demonstrated by CT scan of necrosis at the greater omentum on POD 7. The nine aforementioned complications occurred in the V-Loc group. They were medically and successfully treated, and recovery was uneventful.

Among the five cases with intestinal occlusion (1 Vicryl vs. 4 V-Loc) diagnosed via abdominal CT scan using oral contrast, one in the barbed suture group was caused by an adhesion 2 months postoperatively and treated successfully by laparoscopic adhesiolysis. The remaining four occlusions confirmed by CT scan presented an abnormal bowel dilation at the jejunojejunal anastomosis and required laparoscopic surgical treatment. The operation consisted of anastomotic lumen enlargement through resection of the hand-sewn suture by means of monopolar scissors followed

Table 2 Clavien–Dindo classification of postoperative complications

Type	Vicryl		V-Loc		<i>p</i> value
	Early	Late	Early	Late	
Number	1	1	14	5	>0.05
Grade (no. of patients)	III _b	III _b	II (7) III _b (7)	II (4) III _b (1)	>0.05
Description (no. of patients)	Intestinal occlusion	Cholecystitis	Intestinal occlusion (3), intestinal injury (2), cholecystitis (3), abdominal pain (4), intestinal bleeding (1), pneumothorax (1)	Cholecystitis (3) Abdominal pain (1) Intestinal occlusion (1)	

Table 3 Operative time (min)

	Vicryl	V-Loc	<i>p</i> value
Mean operative time (min)	74.3 ± 15.3	62.7 ± 15.5	<0.05
Mean gastric pouch construction	16.1 ± 6.2	17.1 ± 7.6	>0.05
Mean gastrojejunal anastomosis	21.3 ± 6.3	17.4 ± 5.1	<0.05
Mean jejunojejunal anastomosis	21.4 ± 4.9	15.2 ± 5.5	<0.05

by its closure performed via a 45-mm regular linear stapler, blue cartridge suture perpendicular to the previous running suture. Laparoscopic cholecystectomy was performed in the seven cases of cholecystitis (1 Vicryl vs. 6V-Loc).

Patients from both suture groups affected by postoperative complications, whether requiring surgical treatment or not, experienced an uneventful recovery.

The median hospital stay was 3.5 ± 1.1 days (3.3 ± 0.6 days in the multifilament absorbable group versus 3.6 ± 1.2 days in the barbed monofilament procedure group) ($p > 0.05$).

The mean operative time was 74.3 ± 15.3 min for the Vicryl procedures versus 62.7 ± 15.5 min for the V-Loc procedures ($p < 0.05$). The mean operative time required to fashion the gastrojejunal anastomosis was 21.3 ± 6.3 min for the Vicryl procedures versus 17.4 ± 5.1 min for the V-Loc procedures ($p < 0.05$). The mean operative time required to fashion the jejunojejunal anastomosis was 21.4 ± 4.9 min for the Vicryl procedures versus 15.2 ± 5.5 min for the V-Loc procedures ($p < 0.05$). The times required to create the gastric pouch did not differ statistically between the multifilament absorbable 3/0 procedure (16 ± 6.2 min) and the monofilament unidirectional barbed absorbable 3/0 suture procedure (17 ± 7.6 min) ($p > 0.05$). The intraoperative data are displayed in Table 3 and Fig. 1.

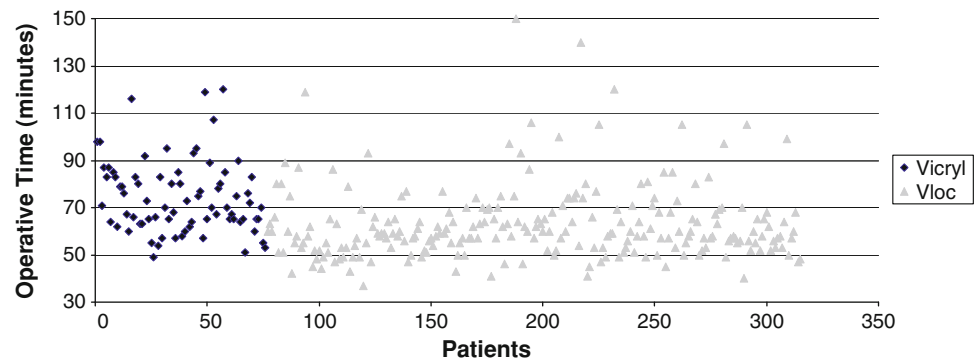
Discussion

Conservative nonsurgical methods have been evaluated, and the long-term results have shown failure in sustainable weight loss and resolution of comorbidities as high as 95 % [13]. Bariatric surgery is the most effective treatment for morbid obesity, producing durable weight loss, improvement in comorbid condition, and longer life [14].

Minimally invasive surgery is a radical and fascinating revolution in bariatric surgery, and the current acquisition of the required skills shows significant change [15]. A few years ago, surgical education was basically provided by conventional teaching methods consisting of theory and practical exercise. Currently, technological developments in minimally invasive surgery have radically changed the tools and strategies for the training of surgeons.

During laparoscopy, all surgical teams assist the procedure, benefiting from the same outstanding image quality. The entire surgical procedure performed by the first operator is clearly shown on screen, which helps trainee surgeons bear every single operative step in mind as they later reproduce those steps as the first operator. Currently, the proven technique of laparoscopic surgical training is a one-to-one (peer-to-peer) on-site mentoring and telementoring, but different tasks, such as knot-tying and hand-made intracorporeal sutures, still require practice and persistence to achieve expertise [16].

Consequently, many surgical procedures estimated to be technically difficult, depending on the number of intracorporeal sutures, have been adapted to reduce them and facilitate the suturing technique (e.g. when barbed unidirectional monofilament is used) [16]. Surgeons have used V-Loc in multiple laparoscopic procedures including urologic [17], gynecologic [18], and orthopedic and plastic [19] surgery, and more recently, in general surgery to close the peritoneum during transabdominal preperitoneal polypropylene (TAPP) procedures [20].

Fig. 1 Operative time

Two recent publications have shown that feasibility is achieved in intestinal sutures for obesity [16, 21]. The intestinal application of barbed suture is not currently approved by French medical bylaws. Currently, our study involving 276 patients represents the largest consecutive series to use unidirectional barbed monofilament suture in LRYGB. Our results support the feasibility and safety of barbed absorbable suture use for anastomosis construction in LRYGB. Indeed, both multi- and monofilament unidirectional barbed suture groups presented a complication rate comparable with published rates [22, 23].

Of the 21 complications in the current study, seven cholecystitis cases were not related to the surgical procedure. In the remaining cases, pneumothorax, intestinal injuries, and intestinal occlusion due to postoperative surgical adhesions were not affected by the suture technique. Five cases of nonspecific abdominal pain, one of which was found to be positive for omental necrosis on abdominal CT scan, were not even favor to suture complications. These cases did not demonstrate any relationship between such complications and the suturing method. Consequently, we could suppose that five complications were suture-related and that only four of them were related to the suture material used. Indeed, postoperative gastrojejunal bleeding is suture dependent and not suture material related as in the case of anastomotic stenosis.

The inflammatory response to a specific suture material is known to play an important role in the resulting scar formation. The surgical technique is an important factor contributing to the formation of anastomotic quality [22]. However, our overall stenosis incidence was nil compared with the rate in some series ranging from 3 to 27 % [10, 23, 24].

The current study shows that even for experienced laparoscopic bariatric surgeons, operative time can be reduced significantly when barbed suture is used. Our results show significant overall time reduction during LRYGB. Indeed, the amount of time used for gastric pouch creation ($p > 0.05$), fashioned with the same technique, did not differ between the two groups. However, both gastrojejunal and jejunojejunal anastomotic constructions were significantly less time consuming.

All the procedures were affected by the use of the barbed suture ($p < 0.05$). There was no difference in the amounts of time dedicated to gastric pouch creation. However, the operative time required to perform both gastrojejunal and jejunojejunal anastomoses was shortened.

The shortened operative time could be explained by the knotless technique and by the fact that no assistance was required to maintain suture tension. Although it really is difficult to evaluate the relationship between external help and barbed suture use, we could hypothesize that a suture performed solely by the operator reduces operative time and has a positive impact on postoperative results.

With regard to V-Loc limitations, a slight technical difficulty was observed during our experience when the unidirectional barbed monofilament was handled, probably due to its stiffness. Additionally, similar to what Tyner et al. [16] described, we noted a technical limitation. When the suture was taken out, it was not perfectly symmetric from a cosmetic viewpoint and as such was estimated to be inadequate. However, according to the direct relationship between reduced mortality and surgeons treating a high number of patients as well as institutions admitting a high volume of incoming patients, our series showed a zero mortality rate and a morbidity rate (6.6 %) for early and late postoperative complications comparable with the lower rates reported in the literature (5–18 %) [10, 23, 24]. Furthermore, the non-adhesion-related occlusion rate was 1.3 % (1/76) for the multifilament suture group and 1.2 % (3/239) for the barbed monofilament suture group [23]. These results supported our research purposes in V-Loc testing through the safety of an experienced bariatric surgery center.

Additionally, in contrast to recent publications, the LRYGBs in our trial were performed by two experienced surgeons, and the standardized surgical technique did not differ for any patient during the study. Indeed, due to the ongoing dexterity improvement in the surgical procedure, the study was performed after the LRYGB learning curve was reached. As a matter of fact, our goal was first not to influence the outcome of the study and second to minimize statistical influences between the two consecutive groups of

patients. Thanks to these study design characteristics, we could sustain our results thanks to the largest consecutive LRYGB series comparing multifilament and unidirectional barbed monofilament suture published to date.

The LRYGB technique is a technically demanding procedure, and construction of gastrojejunostomy and jejunojejunostomy can be achieved in several ways. Both mono- and multifilament sutures can be used safely. Our experience supports the benefit of using the unidirectional barbed monofilament suture in anastomosis construction during LRYGB. Systematic application of the barbed suture reduces operative time thanks to the knotless technique and the absence of an external assistant during the procedure. No significant differences in postoperative complications were observed during the study period between the multifilament and barbed monofilament sutures.

In equipped and experienced institutions, barbed monofilament suture can be used safely in laparoscopic procedures requiring intestinal suture. We support the safety and effectiveness of the barbed monofilament suture technique, but additional studies are needed to evaluate long-term results before to perform a randomized trial.

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