



The Use of Barbed Suture for Intracorporeal Mechanical Anastomosis During a Totally Laparoscopic Right Colectomy: Is It Safe? A Retrospective Nonrandomized Comparative Multicenter Study

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Surgical Innovation

1–7

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DOI: 10.1177/1553350618765871

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Abstract

Background. A totally laparoscopic right colectomy could be perceived as a more challenging procedure over a laparoscopic-assisted right colectomy owing to the difficulty of intracorporeal anastomosis and the closure of the enterotomy. The aim of this study is to evaluate the safety and efficacy of the barbed auto-locking absorbable suture for the closure of an anastomotic stapler-access enterotomy during a totally laparoscopic right colectomy. **Methods.** From January 2010 to April 2016, data from patients who had undergone a laparoscopic right colectomy in 2 different departments of 2 institutions (the Department of General and Minimally Invasive Surgery, San Camillo Hospital in Trento and the Department of Surgical Specialties and Nephrology, University Federico II in Naples) were retrospectively analyzed. We compared the data of patients in whom the stapler-access enterotomy was closed through a conventional absorbable suture (Group A), with the data of patients in whom a stapler-access enterotomy was closed through a V-Loc 180 suture (Group B). Biometric features and intraoperative and postoperative data were collected and analyzed. **Results.** The 2 groups (Group A: 40 patients; Group B: 40 patients) were comparable for biometric features and postoperative outcomes. The anastomosing time was lower in Group B. A statistically significant difference was noted in the mean operative time between Groups A and B (Group A = 134.92 ± 34.17 ; Group B = 120.92 ± 23.27 , $P = .035$). Only one anastomotic leakage per group was recorded, each treated with an anastomosis redo. During the reoperations, we find in both groups an intact stapler-access enterotomy. **Conclusion.** On retrospective analysis, barbed suture appears to be safe and efficient for closure of the stapler-access enterotomy during totally laparoscopic right colectomy.

Keywords

laparoscopy, right colectomy, cancer, barbed suture, V-Loc

Introduction

The laparoscopic approach is currently the gold standard in colorectal surgery.¹ When not contraindicated (bowel occlusion or related patient comorbidities), it not only ensures comparable oncological results as with open surgery but also allows for better recovery and resumption of daily activities, less postoperative pain, and a better aesthetic outcome.^{2–5} For right colon cancer, a totally laparoscopic right colectomy (TLRC) with intracorporeal anastomosis (IA) could be considered the technique of

choice by surgeons due to the fact that it ensures faster time to flatus, earlier postoperative mobilization, and less

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likelihood of wound infection when compared with a laparoscopic-assisted right colectomy (LARC) with extracorporeal anastomosis (EA).^{6,7} However, TLRC can be perceived as a more challenging procedure than LARC, owing to the difficulty of IA and the closure of the enterotomy.^{6,7} In order to reduce the difficulty of enterotomy closure, barbed sutures (BS) have been introduced in daily clinical practice. However, published reports of its use in colorectal laparoscopic surgery are lacking.

The V-Loc 180 suture (Covidien, New Haven, CT) consists of a barbed, knotless, absorbable suture. The loop at the end of the suture can be used for knotless suturing with the first 2 cm of the suture-lacking barbs in order to allow the throws to be readjusted before the barbs are engaged.⁸ The clinical efficacy and suitability of BS in dermal closure and orthopedic surgery have been reported in the literature, as has its intracorporeal application in urology and gynecology.⁹⁻¹²

Other studies have reported on the efficacy of BS during a hand-sewn gastrojejunal anastomosis for laparoscopic gastric bypass.^{13,14}

In this multicenter retrospective study on TLRC, we compare the results of a double-layer BS versus a conventional double-layer suture for a stapler-access enterotomy closure during an IA.

Materials and Methods

Data from patients from 2 surgical departments at 2 institutions (Department of General and Minimally Invasive Surgery, San Camillo Hospital, Trento, Italy; Department of Surgical Specialties and Nephrology, University Federico II, Naples, Italy) who had undergone TLRC from January 2010 to April 2016, with a stapler-access enterotomy closure using the V-Loc 180 suture were collected and retrospectively compared with a group of patients from the same departments who had undergone a TLRC with a stapler-access enterotomy closure using a conventional suture.

An IA had been performed in all the patients. The first group of patients (Group A) received a conventional double-layer suture for the closure of the stapler-access enterotomy, and the second group of patients (Group B) were treated with a double-layer BS with V-Loc 180 suture.

Laparoscopic surgeons from both institutions operated on patients in each group including the enterotomy closure step with a comparable percentage of operations performed per group. Operative time (OT), anastomosing time (AT), blood loss, conversion rate, and short-term outcomes (lymph nodes harvested, length of specimen, postoperative surgical complications according to Clavien-Dindo classification,¹⁵ 30-day mortality, time to first flatus, length of hospital stay, and 30-day readmission rate) were collected from a database and

retrospectively reviewed. Anastomotic leakage was considered as all conditions with clinical or radiologic features of anastomotic dehiscence in accordance with the UK Surgical Infection Study Group.^{6,16,17} All adverse events that occurred after the 30th day following surgery were considered late complications. Following our internal protocol, patient data were measured at 7, 30, 180 days, and 1 year after surgery by clinical examination.

Statistical Analysis

The statistical analysis was carried out using IBM SPSS Statistics 23. Continuous data were expressed as mean \pm standard deviation (SD). To compare continuous variables, an independent sample *t* test was performed. Regarding nonparametric variables (such as time to flatus and length of stay), we used a Mann-Whitney *U* test. The χ^2 test was employed to analyze categorical data. All the results are presented in this article as 2-tailed values with statistical significance if $P < .05$.

Perioperative Management

All patients underwent a preoperative colonoscopy and total body computed tomography scan and followed the enhanced recovery protocol.¹⁸ No bowel preparation was administered, and no diet restriction was imposed on the patient. A nasogastric tube and urinary catheter were routinely inserted intraoperatively. The nasogastric tube was removed after surgery and the urinary catheter was removed on the first postoperative day. Routine antibiotic prophylaxis was administered. Free fluid intake was adopted as tolerated from day 0, and a normal diet was resumed from day 1 onward. Patients were mobilized in the first postoperative day, and a low-molecular-weight heparin was used for deep venous thrombosis prophylaxis. Pain management was achieved by a peridural catheter and nonsteroidal anti-inflammatory drugs were administered if the postoperative Visual Analogue Scale was more than 5. Discharge criteria included tolerance of routine meals without nausea or vomiting, absence of abdominal distension, and the passing of flatus.¹⁹

Surgical Technique

The patient was placed in a supine position in the Trendelenburg position (30°) and right flank rotation. Pneumoperitoneum was established with the Veress technique.²⁰ Three trocars were placed in the left flank. Following abdominal exploration, the ileocolic vessels, right colic vessels, and right branches of the middle colic vessels were ligated and sectioned at their origin. The dissection was conducted between Toldt's and Gerota's fascia. The procedure continued with the opening of the



Figure 1. Ileocolic anastomosis.

gastrocolic ligament and the division of the parietal attachments of the Monk's line. The complete section of the ileal mesentery allowed for full mobilization of the right colon. The transverse colon and terminal ileum were transected by laparoscopic 45-mm ENDOPATH ETS Articulating Linear Cutters (Ethicon Endo-Surgery, Cincinnati, OH) with blue and white load, respectively. The enterotomy and colotomy on the antimesenteric side were both subsequently performed. A side-to-side ileocolic anastomosis was made by laparoscopic 45-mm ENDOPATH ETS Articulating Linear Cutters with a blue load (Figure 1), and the stapler-access enterotomy was closed by a double layer running absorbable suture (in Group A, a 3/0 caliber absorbable conventional; and in Group B, a V-Loc 3/0; Figure 2). The mesentery was closed by absorbable stitch (Vicryl 3/0, Ethicon) or fibrin glue (Tisseel, Baxter Healthcare Corp, Deerfield, IL). The specimen was retrieved by Pfannenstiel incision.²¹

Results

Patient demographics and the American Society of Anesthesiologists (ASA) score were similar in both groups (Table 1). The study included a total of 80 patients, 40 for each group, including 51 males and 29 females with a mean age of 72.88 years (SD = 10.13; range = 42-87 years). Mean body mass index was 30.32 kg/m² (SD = 7.7; range = 20-42 kg/m²). Patient demographics, the ASA score, and indications for a right colectomy with pathology staging according to Wittekind and Oberschmid²² are all reported in Table 1. Exclusion criteria was the need for an emergency colectomy, clinical T4 tumors, and an ASA score of >3.

Overall indications for surgery were adenocarcinoma in 70 cases and dysplastic polyps in the remaining cases.

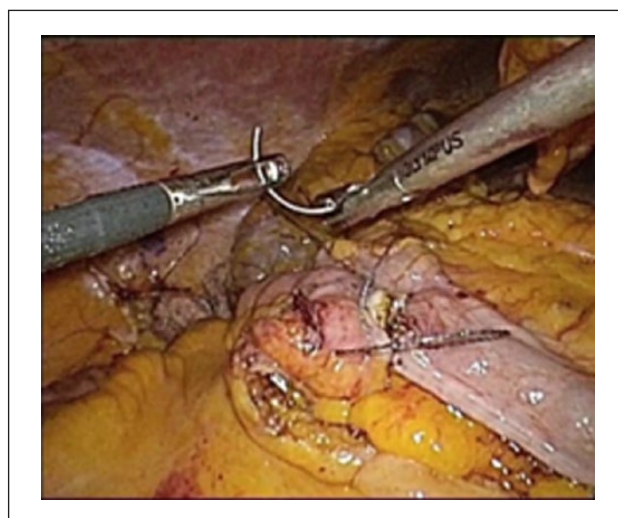


Figure 2. Enterotomy closure with V-loc.

Intraoperative data are reported in Table 2. The conversion rate was 0% in both groups. No intraoperative complications had taken place in either group. The AT was lower in Group B (Group A = 17.55 ± 2.25 minutes; Group B = 12.15 ± 2.34 minutes; $P < .05$). A statistically significant difference was noted in the mean OT between Group A and Group B (Group A = 134.92 ± 34.17; Group B = 120.92 ± 23.27; $P = .035$). In Group B, no conversion from V-Loc to conventional suture to close the enterotomy had taken place.

Bowel recovery time (Group A = 2.05 ± 1.17 days; Group B = 2.27 ± 1.55 days; $P = .89$) and length of hospital stay (Group A = 5.12 ± 2.65 days; Group B = 4.92 ± 2.17 days; $P = .47$) were similar in both groups.

The complication rate according to the Clavien-Dindo classification¹⁵ is recorded in Table 3. Four patients required blood transfusions for related surgery postoperative anemia: 2 in Group A and 2 in Group B. Only one anastomotic leakage per group was recorded, each treated with an anastomosis redo. During reoperations, dehiscence was detected in both groups, which was localized on the mechanical colic stump suture, with an intact enterotomy suture. One anastomotic bleeding was recorded in Group B and treated endoscopically. One death occurred in Group A due to massive myocardial infarction. No readmissions were necessary. At 1 year, none of the patients had reported complications.

Discussion

Since 1991, when Jacobs and colleagues described the first laparoscopic colectomy,²³ many studies with high levels of evidence, such as COST,²⁴ CLASICC,²⁵ Barcelona,²⁶ and the COLOR²⁷ studies, have demonstrated that laparoscopic colon resection when compared with open resection could

Table 1. Biometric Features.

	All Patients (N = 80)	Group A (n = 40)	Group B (n = 40)	P
Age (mean \pm SD)	72.8 \pm 10.1	74.1 \pm 9.9	72.5 \pm 11.2	.50
Sex, male/female, n (%)	51/29 (64%/36%)	23/17 (64%/36%)	28/12 (70%/30%)	.24
BMI (mean \pm SD)	30.3 \pm 7.7	30.6 \pm 7.5	30 \pm 7.9	.75
ASA, n (%)				
I	11 (13.75%)	6 (15%)	5 (12.5%)	
II	49 (61.25%)	24 (60%)	25 (62.5%)	
III	20 (25%)	10 (25%)	10 (25%)	
Comorbidities, n (%)				
Smoke	20 (25%)	12 (30%)	8 (20%)	.30
Diabetes	22 (27.5%)	12 (30%)	10 (25%)	.61
Hypertension	18 (22.5%)	8 (20%)	10 (25%)	.59
COPD	3 (3.75%)	1 (2.5%)	2 (5%)	.55
Steroid therapy	2 (2.5%)	1 (2.5%)	1 (2.5%)	1
Staging (according to Wittekind and Oberschmid ²²), n (%)				
Dysplastic polyps	10 (12.5%)	4 (10%)	6 (15%)	
I	22 (27.5%)	11 (27.5%)	11 (27.5%)	
II	27 (33.75%)	14 (35%)	13 (32.5%)	
III	21 (26.25%)	11 (27.5%)	10 (25%)	

Abbreviations: BMI, body mass index; ASA, American Society of Anesthesiologists; COPD, chronic obstructive pulmonary disease.

Table 2. Intraoperative and Postoperative Outcomes.

	All Patients (N = 80)	Group A (n = 40)	Group B (n = 40)	P
Anastomotic time, minutes (mean \pm SD)	22.0 \pm 14.8	17.5 \pm 2.2	12.1 \pm 2.3	<.05
Operative time, minutes (mean \pm SD)	127.9 \pm 28.8	134.9 \pm 34.1	120.9 \pm 23.2	.03
Blood loss, mL (mean \pm SD)	60.3 \pm 20.3	58.8 \pm 20.8	61.8 \pm 20.0	.51
Harvested nodes (mean \pm SD)	23.4 \pm 2.4	23.5 \pm 2.5	23.4 \pm 2.3	.89
Length of specimen, cm (mean \pm SD)	38.5 \pm 3.6	38.2 \pm 3.2	38.8 \pm 4	.46
Conversion	0	0	0	1
Drain, n (%)	11 (13.75%)	7 (17.5%)	4 (10%)	.33
Anastomotic leakage, n (%)	2 (2.5%)	1 (2.5%)	1 (2.5%)	1
Time to flatus, days (median)	2.1 \pm 1.3	2 \pm 1.1 (2)	2.2 \pm 1.5 (2)	.89
Length of stay, days (median)	5 \pm 2.4	5.1 \pm 2.6 (4)	4.9 \pm 2.1 (4)	.47

Table 3. Complication According to Clavien-Dindo Classification^a.

Grade	Complication	All Patients (N = 80)	Group A (n = 40)	Group B (n = 40)
I		7 (8.75%)	4 (10%)	3 (7.5%)
	Pain	3 (3.75%)	2 (5%)	1 (2.5%)
	Nausea and vomit	4 (5%)	2 (5%)	2 (5%)
II		8 (10%)	4 (10%)	4 (10%)
	Bleeding	4 (5%)	2 (5%)	2 (5%)
	Ileus	4 (5%)	2 (5%)	2 (5%)
III		3 (3.75%)	1 (2.5%)	2 (5%)
	Anastomotic leakage	2 (2.5%)	1 (2.5%)	1 (2.5%)
	Bleeding	1 (1.25%)	0	1 (2.5%)
V	Death	1 (1.25%)	1 (2.5%)	0

^aData are presented as n (%).

improve short-term surgical outcomes with the same safe and oncologic results.

Technically, the reconstructive step of a laparoscopic right colectomy can be performed by EA during LARC or by IA during TLRC.

Several advantages of the IA have been reported in the literature. First, mobilization of the transverse colon can be avoided as there is no need to reach the abdominal wall to allow for anastomosing.²⁸ Second, a Pfannenstiel incision can be used for the specimen extraction as it reduces the higher incisional hernia rates reported for midline incisions.²⁹ In contrast, EA could increase the risk of unrecognized twisting of the mesentery of the terminal ileum due to lack of direct vision.³⁰

As reported by Feroci et al³¹ in their meta-analysis comparing IA with EA in performing a laparoscopic right colectomy, the 2 techniques did not result in any differences in terms of mortality and complications. Other studies reported^{6,32} a number of advantages of TLRC over LARC: earlier first flatus and food intake, reduced analgesic consumption, shorter hospital stay, and less surgical scar infection. Other studies^{21,33,34} reported that LARC was associated with shorter OT than a TLRC, because an IA is more difficult than an EA to perform.

The IA can be done in either isoperistaltic or antiperistaltic orientation. In the first case, the anastomosis is performed as described in this article, requiring the closure of a stapler-access enterotomy with stitches. With an antiperistaltic orientation, the anastomosis can be performed with a totally stapled anastomosis as described by Bergamaschi et al.³⁵ A recent review of the laparoscopic ileocolic anastomosis³⁶ reported that a potential disadvantage of a totally stapled IA is a resulting everted staple line closing the enterotomy, which cannot be inspected for intraluminal bleeding. The review reports a 0.8% rate of bleeding originating in everted staple lines, which in all cases was managed with blood transfusions. Additional drawbacks of totally stapled anastomoses could include a reduced size of the anastomosis, a possible requirement of an additional port, risk of inadvertently stapling the mesenteric side of the bowel wall,³⁶ and higher ensuing costs.²⁸

Conversely, an intracorporeal suture for the closure of a stapler-access enterotomy could be technically demanding, and therefore, BS could be useful in overcoming this difficulty. BS has recently been used intracorporeally in other procedures such as gastrojejunal anastomosis and/or closure of the peritoneum during laparoscopic hernia repair.^{9-14,37} Only one article in the literature describes the use of an auto-locking suture for the closure of a stapler-access enterotomy during TLRC, which was applied to the first of the 2 layers.³⁸

Based on reported experience, it can be hypothesized that the advantages of a double-layer V-Loc suture for the closure of a stapler-access enterotomy during TLRC

could be a faster and easier laparoscopic suture resulting in reduced OT.

Regarding the AT, our studies revealed a statistically significant difference between Group A and Group B, which may be due to the auto-locking technology of BS that has proven to save time during suture. In comparing our AT series with the results of Reggio et al,³⁸ we found that using BS alone allowed for time savings during the procedure (our Group B: 12.15 ± 2.34 minutes; Reggio Double Layer Group: 20 minutes, range = 14-33 minutes). Moreover, a statistically significant difference was found in the OT, which was most likely due to the reduction in anastomotic time.

The reported time-saving effect in the BS group could be not only due to the absence of 4 knots during the double layer suture but also because of the progressive sealing effect of the immediately auto-locking suture.

With regard to other measurable surgical outcomes, no statistically significant differences were noted between the 2 groups; therefore, it was not possible to find a correlation between the use of BS and anastomotic leakage.

To the best of our knowledge, the use of BS during TLRC for stapler-access enterotomy closure has never been reported, but evaluations of its use during a hand-sewn gastrojejunal anastomosis or for a stapler-access enterotomy closure during gastric bypass^{8,39,40} have been published.

In contrast, other authors describe complications of intracorporeal use of V-Loc such as mechanical bowel obstruction⁴¹⁻⁴⁵ or intestinal injury due to barbs, as reported by Burchett and colleagues.⁴⁶ In our series, no complications of this nature were found.

Our study is somewhat limited due to its retrospective design, the size of our analyzed sample, and possible selection bias. The results are encouraging, but confirmation of the efficacy of the BS requires further evaluation in a prospective, randomized setting.

In conclusion, to the best of our knowledge, this is the first retrospective comparative multicenter study on the use of BS for enterotomy closure during TLRC. Based on the data as presented from our study, the use of a BS for enterotomy closure can be considered safe and effective for completion of the stapled anastomosis in performing a TLRC.

Author (s) note

Jacopo Andreuccetti and Giusto Pignata are now affiliated to San Camillo Hospital, Trento, Italy.

Acknowledgments

We thank Juliet Ippolito, BA, Vassar College, MPhil, University of Dundee, for English language editing. We thank Dario Bruzzese and Raimondo Costabile, SD, University of Federico II of Naples, for statistical data revision.

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Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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