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Intracorporeal Mechanical Side-to-Side Isoperistaltic Anastomosis in Laparoscopic Right Hemicolectomy: The Best Choice? A Cohort Study

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Abstract

Purpose: Right hemicolectomy is one of the most frequent procedures in colorectal surgery. Despite the introduction of laparoscopy and fast-track programs, rates of postoperative complications are high; among them, Anastomotic Leak (AL) is the most serious. Objective of the study: to assess whether laparoscopic right hemicolectomy, with intracorporeal mechanical side-to-side isoperistaltic anastomosis, obtains better results in terms of postoperative morbidity and mortality than open surgery or extracorporeal laparoscopy.

Methods: Observational cohort study, with prospective data collection and retrospective analysis of three cohorts of 60 consecutive patients undergoing right hemicolectomy and ileocolic anastomosis via open surgery (group 1), laparoscopic surgery with extracorporeal anastomosis (group 2) or laparoscopic surgery with intracorporeal anastomosis (group 3). Overall postoperative morbidity, Comprehensive Complication Index (CCI), AL, reoperation due to AL, Surgical Site Infection (SSI), mortality and hospital stay were analyzed at 30 days.

Results: Group 3 obtained significantly better results than groups 1 and 2 in overall morbidity (3:21.7%, 1:48.3%, 2:35%, p=0.009), CCI (3:4, 2 ± 8.8, 1:20.4 ± 29, 2:9 ± 20, p= <0.001), SSI (3:3.3%, 1:36.7%, 2:16.7%; p= <0.001), hospital stay (3:4.5 ± 2, 1:9 ± 9, 2:6 ± 5, p= <0.001), reoperation due to AL (3:0%, 1:15%, 2:3%, p= <0.002) and mortality (3:0%, 1:5%, 2:0%, p= <0.001).

Conclusion: Laparoscopic right hemicolectomy with intracorporeal anastomosis obtained the best results. These findings should now be confirmed in prospective randomized multicenter studies.

Keywords: Right Hemicolectomy; Intracorporeal Anastomosis; Anastomotic Leak; Mechanical Anastomosis; Laparoscopic Right Hemicolectomy

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Introduction

Colorectal cancer is the second most frequent cancer in the Western world [1]. Roughly a third of colorectal tumors are located in the right colon [2], and right hemicolectomy surgery is the treatment of choice in non-disseminated right colon cancer and other benign pathologies [3]. Despite the introduction of laparoscopy and multimodal fast-track perioperative management programs in recent years, postoperative complication rates remain high [4,5]. The most serious complication is Anastomotic Leak (AL), which is associated with increased mortality, longer hospital stay, and reduced quality of life due to the presence of ostomies [1,6]. For a long time, the importance ofileo-colic AL was underestimated. However, the ANACO study [1], conducted in 52 hospitals in our environment, reported a rate of AL of 8.4% with a range of 0% to 35%. This wide range is due to the differences in the surgical procedures and anastomoses used (the surgical approach may be open or laparoscopic, and the anastomosis may be manual or mechanical, with all its variations).

The results of intracorporeal laparoscopic anastomosis in the literature vary widely, but the latest publications report low rates of morbidity and of surgical space infection (SSI) [5,7]. The aim of the present study is to assess whether laparoscopic right hemicolectomy, with intracorporeal anastomosis, obtains better results than a laparoscopic approach with extracorporeal anastomosis or open surgery, in terms of overall morbidity, SSI, AL, re-interventions and hospital stay.

Table 1: Demographic and preoperative and surgical variables between groups.

Variables	Group 1. Open surgery (n=60)		Group 2. Extracorporeal laparoscopy (n=60)	Group 3. Intracorporeal laparoscopy (n=60)	p
Age (mean ± SD)	70.8 ± 9.4		70.6 ± 12.5	69.2 ± 15.7	0.741*
Sex	Male	37 (61.7%)	40 (66.7%)	31 (54.4%)	0.39^
	Female	23 (38.3%)	20 (33.3%)	26 (45.6%)	
ASA	I	3 (5%)	2 (3.3%)	3 (5%)	0.768^
	II	29 (48.3%)	35 (58.3%)	35 (58.3%)	
	III	28 (46.7%)	23 (38.3%)	22 (36.7%)	
BMI (kg/m^2)	27.3 ± 3.5		28.2 ± 4.1	27.9 ± 3.2	0.796*
POSSUM-Morbidity (Median ± IQR)	43.1 ± 21.2		33.6 ± 36.5	28.4 ± 28.8	0.542**
POSSUM-Mortality (Median ± IQR)	8.6 ± 5		6 ± 8.4	5.1 ± 5.9	0.54**
P- POSSUM (Median ± IQR)	2 ± 1.5		1.8 ± 3.2	1.8 ± 2.2	0.383**
CR- POSSUM (Median ± IQR)	1.9 ± 3.1		2.5 ± 5	1.9 ± 1.6	0.345**
Surgical time (Median ± IQR)	100 ± 30		128 ± 41.5	150 ± 65	<0.001**
Type of hemicolectomy	Standard	52 (86.7%)	53 (88.3%)	51 (85%)	0.86^
	Extended	8 (13.3%)	7 (11.7%)	9 (15%)	
Type of anastomotic continuity	End-to-side. manual	32 (53.3%)	60 (100%)		<0.001^
	End-to-end, mechanical	28 (46.7%)	0		
	Side-to-side mechanical isoperistaltic	0	0	60 (100%)	

SD: Standard Deviation; ASA: American Society of Anesthesiologists; BMI: Body Mass Index; *ANOVA; ^Chi-squared; IQR: Interquartile Range; **Kruskal-Wallis

Method and Patients

Observational cohort study with prospective data collection and retrospective analysis. At our Colorectal Unit, the morbidity data of prospectively admitted patients are recorded systematically [8]. The present study complied with the Declaration of Helsinki and followed the STROBE guidelines for observational studies.

Inclusion criteria

Diagnosis of cancer of the right and transverse colon before the splenic flexure of the colon, not metastatic, undergoing right hemicolectomy or extended hemicolectomy with ileocolic anastomosis. Age over 18. Scheduled surgery performed by the team of surgeons of the Coloproctology Unit, applying the Enhanced Recovery after Surgery (ERAS) multimodal management program.

Exclusion criteria

Colon cancers in other sites. Tumor stage T4 and TNM classification stage IV [9], ASA IV (American Society Anesthesiologists). Non-optimal nutritional status (pre-operative albumin <3.4 g/dl).

All patients underwent the ERAS program. Mechanical colon preparation was performed with oral antibiotics. Adverse effects were followed up until 30 days after surgery.

Three cohorts were created, each comprising 60 consecutively operated patients. In 2010, the multimodal perioperative management program with open surgery was introduced, comprising right or extended hemicolectomy performed by means of a supra-infraumbilical midline laparotomy, and mechanical or manual end-to-side ileocolonic anastomosis, with 3/0 silk loose stitches (section of the transverse colon by Medtronic mechanical suture, DST Series™ TA™ 90 mm Stapler 90-4.8). Patients receiving this surgery constituted our study group 1.

Laparoscopic colon surgery was introduced at our unit in 2013. Our study group 2 (laparoscopic surgery with extracorporeal anastomosis) dates from this period. The surgery comprised ligation of the ileocolic vessels at the root, transverse minilaparotomy in the supraumbilical region (size and location as required), externalization of the specimen, and extracorporeal division of themesoileum and colon with manual end-to-side ileocolic anastomosis, as described in open surgery.

Since January 2017, we have performed laparoscopic right hemicolectomy with intracorporeal mechanical side-to-side isoperistaltic anastomosis (Group 3). In this procedure, intracorporeal division of the mesoileum and transverse colon is performed, as shown in the animation. The ileum and transverse colon are divided with the Endopath® Echelon Flex™ 60 stapler. The specimen is inserted in a plastic bag (Applied-Medical Inzii 12/15 mm Retrieval System), as shown in the animation. Side-to-side isoperistaltic mechanical anastomosis is performed using the same endostapler, as shown in the animation. A running suture is performed of the mechanical suture orifice, with another reinforcing suture with Monocryl™ (poliglecaprone 25) or with STRATAFIX™ Spiral Knotless barbed suture, as shown in the animation. The specimen is extracted through a Pfannestiel minilaparotomy (3.5 cm to 4 cm) on "Alexis® O Wound Protector/Retractor-Applied Medical", as shown in the animation.

Study variables

Epidemiological variables: age, sex. Preoperative variables: ASA (American Society of Anesthesiologists), Body Mass Index (BMI). Surgical variables: type of surgery, surgical time, type of hemicolectomy, type of anastomosis, type of suture, type of anastomotic continuity. Postoperative variables: POSSUM [10], P-POSSUM [11] and CR-POSSUM [12] values, postoperative mortality, overall morbidity, Clavien-Dindo morbidity [13], relevant morbidity (Clavien-Dindo >II [13]), Comprehensive Complication Index (CCI) [14], Surgical Space Infection (SSI), incisional SSI, organ/space SSI, AL, reoperation for AL, and hospital stay.

Table 2: Comparison of postoperative variables between groups.

Variables		Group 3. Intracorporeal laparoscopy (n=60)	Group 1. Open surgery (n=60)	p (Groups 3-1)	Group 2. Extracorporeal laparoscopy (n=60)	p (Groups 3-2)	p (Between groups: 1-2-3)
Overall morbidity		13 (21.7%)	29 (48.3%)	0.002^	21 (35%)	0.78	0.009^
Observed/expected morbidity (POSSUM)		0.76 (21.7/28.4)	1.12 (48.3/43.1)		1.04 (35/33.6)		
Morbidity according to Clavien-Dindo [9]	0	47 (78.3%)	31 (51.7%)	0.003^	39 (65%)	0.016^	0.003^
	I	8 (13.3%)	5 (8.3%)		5 (8.3%)		
	II	2 (3.3%)	8 (13.3%)		11 (18.3%)		
	IIIa	3	2 (3.3%)		0 (0%)		
	IIIb	0	3 (5%)		3 (5%)		
	IVa	0	2 (3.3%)		1 (1.7%)		
	IVb	0	6 (10%)		1(1.7%)		
	V	0	3 (5%)		0(0%)		
Relevant morbidity (Clavien-Dindo >II [9])		3 (5%)	15 (25%)	0.002^	5 (8.3%)	0.359^	0.002^
Comprehensive Complication Index (CCI) (mean ± SD) [10]		4.2 ± 8.8	20.4 ± 29	0.001*	9 ± 20	0.09*	<0.001**
SSI		2 (3.3%)	22 (36.7%)	<0.001^	10 (16.7%)	0.015^	<0.001^
Incisional SSI		0 (0%)	10 (16.7%)	0.001^	3 (5%)	0.122^	0.001^
Organ/space SSI		2 (3.3%)	14 (23.3%)	0.001^	7 (11.7%)	0.081^	0.004^
AL		2 (3.3%)	10 (16.7%)	0.015^	7 (11.7%)	0.081^	0.056^
Reoperation due to AL		0 (0%)	9 (15%)	0.001^	2 (3%)	0.248^	0.002^
Hospital stay		4.5 ± 2	9 ± 9	<0.001^	6 ± 5	0.001*	<0.001**
Postoperative mortality		0	3(5%)	0.12^	0 (0%)	1	0.047^

SSI: Surgical Space Infection; AL: Anastomotic Leak; *Mann-Whitney U test; **Kruskal-Wallis; ^Chi-squared

AL was defined in accordance with Peel et al. [15] and SSI in accordance with the Center for Disease Control (CDC) National Nosocomial Infection Monitoring System [16].

Statistical analysis

The SPSS program version 23 was used. Prospective data collection allowed analysis without missing values. The quantitative and categorical variables are described in the standard way. Univariate analysis of the quantitative variables, with independent groups, was performed by Student's T-test or Analysis of Variance (ANOVA) when their conditions of application were met; otherwise the Mann Whitney U or Kruskal-Wallis Test was used. For categorical variables, Pearson's chi-squared or Fisher's exact statistic was used, depending on the conditions. A p value <0.05 was considered statistically significant, with a confidence interval of 95%.

Results

There were no differences between the groups regarding age, sex, ASA, BMI, POSSUM P-POSSUM, CR-POSSUM risk models or type of hemicolectomy. Surgical time was significantly longer in the intracorporeal anastomosis (Table 1).

Table 2 compares post-operative variables in the groups. Morbidity, both overall and according to the Clavien-Dindo classification [9] was lowest in group 3, the differences being statistically significant (especially with regard to relevant morbidity: Clavien-Dindo [9] > II). These statistically significant differences were maintained when the CCI was calculated [10]. Only group 3 achieved observed-to-expected (O/E) morbidity ratio calculated by POSSUM of below 1. As regards SSI, the same results were found; group 3 presented no incisional SSI and a much lower rate of organ/space SSI. Overall AL was related to organ/space SSI: the rate of 2/60 (3.3%) in group 3 was significantly lower than in group 1 (ten patients, 16.7%) or in group 2 (seven patients, 11.7%). Neither of the AL in group 3 required re-operation or disconnection of the anastomosis. These results correlated significantly with a shorter median hospital stay.

Table 3 displays the results of the different types of anastomosis in the study groups. A lower rate of AL (3.3%), with a trend towards statistical significance, was observed in the intracorporeal side-to-side suture compared with the extracorporeal end-to-side manual laparoscopic (AL rate 11.7%), open manual end-to-side (15.6%) and open mechanical end-to-side (17.9%). The rate of AL requiring surgical intervention was significantly lower with the intracorporeal side-to-side isoperistaltic mechanical anastomosis than with the other types.

Discussion

The overall morbidity in the open surgery group was high. Although it is within the range described in the literature [3], the O/E morbidity rate calculated by POSSUM is above 1. Although there is some debate on the issue, in general laparoscopic surgery achieves better results for overall morbidity than open surgery. In our study, the differences were statistically significant, with overall morbidity rates of 48.3% in group 1, 35% in group 2 and 21.7% in group 3. The differences in the results for relevant morbidity (Clavien-Dindo >II [9]) were even clearer.

The CCI [15] allows comparison of patients with more than one complication, since its algorithm includes all postoperative events and their respective severity. We do not know of any previous reports of morbidity in relation to the CCI in right hemicolectomy. Our CCI results were similar to those for overall and relevant morbidity, with significantly lower values for intracorporeal anastomosis (4.2 ± 8.8) than for extracorporeal and open surgery (9 ± 20 and 20.4 ± 29 respectively).

Table 3: Type of anastomosis and anastomotic leak.

Type of anastomosis	AL Overall	p	AL with re-operation	p
End-to-side mechanical (Open surgery) (n=28)	5 (17.9%)	0.119^	5 (17.9%)	0.003^
End-to-side manual (Open surgery) (n=32)	5 (15.6%)		4 (12.5%)	
End-to-side manual (Extracorporeal laparoscopy) (n=60)	7 (11.7 %)		2 (3.3%)	
Side-to-side mechanical isoperistaltic (Intracorporeal laparoscopy) (n=60)	2 (3.3%)		0 (0%)	
Overall (n= 180)	19 (10.6%)		11 (6.1%)	

AL: Anastomotic Leak; ^Chi-squared

The rate of AL in the open surgery group was high (16.7%), some way above previous reports (8.4%) [2]. By changing from mechanical to manual end-to-side anastomosis, we reduced the rate slightly from 17.9%) to 15.6%, but it remained high; however, the rate of patients requiring surgery improved to 12.5% (Table 3). Laparoscopic surgery with extracorporeal anastomosis improved the results (11.7%) although they were less good than expected; nevertheless, the number of patients requiring surgery fell to 3.3%. The intracorporeal anastomosis obtained the best results for AL (2/60, 3.3%) and neither of these cases required surgery. The results were within the range of previously published series [5,7].

The rate of SSI fell considerably with the introduction of laparoscopy, especially incisional SSI [17]. Since the introduction of intracorporeal anastomosis, organ/space SSI has also fallen, coinciding with the lower number of AL; this is in spite of the fact that there is always a small-scale contamination when performing the intracorporeal anastomosis, and three mechanical sutures are required together with the manual suture of the defect [5,7].

Hospital stay and postoperative mortality were related to complications and AL. However, the differences in hospital stay between the laparoscopic groups observed in this study had not been reported previously [5].

Intracorporeal mechanical ileo-colic anastomosis was first described in the early 1990s [18]. In recent publications it is the technique that obtains the best results, with percentages of AL below 3%. In our study intracorporeal anastomosis obtained the best results, despite its greater complexity and the effect of the learning curve. In our view, there were three factors that improved recovery and favored these good results: the absence of traction of the mesenteries because the specimen is not externalized, the much smaller suprapubic minilaparotomy and, although this point is debated in the literature, the reinforcement on the anastomoses, as a protection mechanism [19].

The limitations of the study are caused by its observational design and the sample size, which does not allow us to present causal conclusions. As strong points, we highlight the objective description of morbidity and mortality based on the Clavien-Dindo classification, the CCI, and incisional and organ/space SSI.

Conclusion

As a final comment, the positive results reported here oblige us to continue studying whether this technique is the best option in right hemicolectomy. There is a need for multicenter, prospective, controlled and randomized studies that strengthen the conclusions and provide external validity.

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References

1. Schild SE, Vokes EE. Pathways to improving combined modality therapy for stage III nonsmall-cell lung cancer. Ann Oncol. 2016;27(4):590-9.
2. Frasson M, Granero-Castro P, Ramos Rodríguez JL, Flor-Lorente B, Braithwaite M, Marti Martinez E, et al. Risk factors for anastomotic leak and postoperative morbidity and mortality after elective right colectomy for cancer: results from a prospective, multicentric study of 1102 patients. Int J Colorectal Dis. 2016;31:105-14.
3. 2015 European Society of Coloproctology collaborating group. The relationship between method of anastomosis and anastomotic failure after right hemicolectomy and ileo-caecal resection: an international snapshot audit. Colorectal Dis. 2017.
4. Vlug MS, Wind J, Hollmann MW, Ubbink DT, Cense HA, Engel AF, et al. Laparoscopy in combination with fast track multimodal management is the best perioperative strategy in patients undergoing colonic surgery: a randomized clinical trial (LAFA-study). Ann Surg. 2011;254(6):868-75.
5. van Oostendorp S, Elfrink A, Borstlap W, Schoonmade L, Sietses C, Meijerink J, et al. Intracorporeal versus extracorporeal anastomosis in right hemicolectomy: a systematic review and meta-analysis. Surg Endosc. 2017;31:64-77.
6. Frasson M, Flor-Lorente B, Rodríguez JL, Granero-Castro P, Hervas D, Alvarez Rico MA, et al. Risk factors for anastomotic leak after colon resection for cancer multivariate analysis and nomogram from a multicentric, prospective, national study with 3193 patients. Ann Surg. 2015;262:321-30.
7. Martinek L, You K, Giuratrabocchetta S, Gachabayov M, Lee K, Bergamaschi R. Does laparoscopic intracorporeal ileocolic anastomosis decreases surgical site infection rate? A propensity score-matched cohort study. Int J Colorectal Dis. 2018;33(3):291-8.
8. Rebasa P, Mora L, Luna A, Montmany S, Vallverdú, H, Navarro S. Continuous monitoring of adverse events: influence on the quality of care and the incidence of errors in general surgery. World J Surg. 2009;33(2):191-8.
9. Benson AB, Venook AP, Al-Hawary MM, Cederquist L, Chen YJ, Ciombor KK, et al. NCCN Guidelines Insights: Colon Cancer, Version 2.2018. J Natl Compr Canc Netw. 2018;16(4):359-369.
10. Copeland GP, Jones D, Walters M. POSSUM: a scoring system for surgical audit. Br J Surg. 1991;78(3):355-60.
11. Whiteley MS, Prytherch DR, Higgins B, Weaver PC, Prout WG. An evaluation of the POSSUM surgical scoring system. Br J Surg. 1996;83(6):812-5.
12. Tekkis PP, Prytherch DR, Kocher HM, Senapati A, Poloniecki JD, Stamatakis JD, et al. Development of a dedicated risk-adjustment scoring system for colorectal surgery (colorectal POSSUM). Br J Surg. 2004;91(9):1174 -82.
13. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients

and results of a survey. Ann Surg. 2004;240(2):205-13.

14. Slankamenac K, Graf R, Barkun J, Puhan MA, Clavien PA. The comprehensive complication index: a novel continuous scale to measure surgical morbidity. Ann Surg. 2013;258:1-7.

15. Peel AL, Taylor EW. Proposed definitions for the audit of postoperative infection: a discussion paper. Surgical Infection Study group. Ann R Coll Surg Engl. 1991;73(6):385-8.

16. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. Infect Control Hosp Epidemiol. 1992;13(10):606-8.

17. Serra-Aracil X, García-Domingo MI, Parés D, Espin-Basany E, Biondo S, Guirao X, et al. Surgical site infection in elective operations for colorectal cancer after the application of preventive measures. Arch Surg. 2011;146(5):606-12.

18. Bergamaschi R, Haughn C, Reed JF, Arnaud JP. Laparoscopic intracorporeal ileocolic resection for Crohn's disease: is it safe? Dis Colon Rectum. 2009;52(4):651-6.

19. Widmar M, Cummings DR, Steinhagen E, Samson A, Barth AR, Greenstein AJ, et al. Oversewing staple lines to prevent anastomotic complications in primary ileocolic resections for Crohn's disease. J Gastrointest Surg. 2015;19(5):911-6.