Scripta Scientifica Medica, 2023;55(suppl. 1):21-27
DOI: 10.14748/ssm.v55i0.9249

ISSN 0582-3250 (Print)
ISSN 1314-6408 (Online)

PROCEEDINGS

ROBOTIC RIGHT AND LEFT COLECTOMIES: EXTRA- OR INTRACORPOREAL ANASTOMOSIS

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ABSTRACT

INTRODUCTION: Robotic right and left hemicolectomies for colon cancer are among the most common surgical procedures. In the past decades they began to be performed laparoscopically and in recent years—by robotic surgical systems. Despite the enhanced recovery protocols and minimal invasiveness of the procedure, there are still complications. Robotic right and left hemicolectomies with an intracorporeal anastomosis (ICA) are less invasive than the same robotic-assisted procedures, and could lead to fast recovery and shortening of the postoperative period.

AIM: The aim of the study is to evaluate the feasibility and safety of the intracorporeal anastomosis after robotic left and right colectomies.

RESULTS AND DISCUSSION: Surgical time was found to be insignificantly shorter in the intracorporeal anastomosis group: 125.1±37.1 vs. 128.2±21.1 for right colectomy and 147.3±39.1 vs. 153.8±58.1 for left colectomy.

Many studies show similar results, but the advantages of intracorporeal anastomosis evaluated by visual analog scale (VAS) are even more significant. Our results did not indicate significant difference in number of harvested lymph nodes: 24.9±11.3 vs. 25.1.9±10.1 and 26.8±9.3 vs. 25.9±11. Anastomotic leakage in extracorporeal anastomosis (ECA) after left colectomy was significantly higher: 2 (11.7%), <0.001. Wound infections in our patients again were insignificantly higher in ECA 0.0 vs. 1 (4.2%) in right and 1 (6.2%) vs. 1 (5.9%) in left colon. Overall hospital stay was also significantly shorter in ICA left colectomies and insignificantly in right ones: 7.0±4.9 vs. 7.8±4.1, P=0.217, and 6.1±2.5 vs. 8.0±4.9, P<0.001.

CONCLUSION: The results of our study confirmed the literature data that ICA after colon resection is a safe and feasible procedure, accepted by many colorectal surgeons

Keywords: *robotic colorectal surgery, intracorporeal anastomosis*

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Received: June 29, 2023
Accepted: September 7, 2023

INTRODUCTION

Robotic right and left hemicolectomies for colon cancer are among the most common surgical procedures. In the past decades they began to be performed laparoscopically and in recent years—by robotic surgical systems. Despite the enhanced recovery protocols and minimal invasiveness of the procedure, there are still complications. Robotic right and left hemicolectomies with an intracorporeal anasto-

mosis (ICA) are less invasive than the same robotic-assisted procedures and could lead to fast recovery and shortening of the postoperative period. The current standard technique includes an extracorporeal anastomosis (ECA) with mobilization of the colon, mesenteric traction, and extraction wound located in the mid/upper abdomen with relatively higher postoperative morbidity compared to extraction incisions located in the lower abdomen (1,2).

How to restore the intestinal tract after colonic resection and create safer anastomosis is still a problem, which is under debate. Lowering the complications rate of anastomotic leakage, intraabdominal abscesses, and surgical site infection is mandatory, because it will lead to faster recovery, early hospital discharge, and return to daily activities (3).

Surgical Technique of Extracorporeal Right Anastomosis

After full mobilization of the specimen and the terminal ileum, cecum, ascending and right side of transverse colon, and undocking of the DaVinci surgical system, supraumbilical midline incision is made and wound protector is placed. The specimen is then exteriorized. The ileum and transverse mesentery could be transected intracorporeally or after the specimen extraction using bipolar sealing devices. The terminal ileum and transverse colon are divided by linear stapler or suture ligation with invagination of the ends of the bowels by purse string. Ileotransverse anastomosis is constructed using endo GIA or hand sewn anastomosis. After the completion of the anastomosis, the bowel is returned in the abdominal cavity, the drain is placed, and closure of abdominal wall is performed.

Surgical Technique of Extracorporeal Left Anastomosis

For left colectomies, after adequate mobilization of the left flexure, transverse, descending colon, and the proximal part of the sigmoid, after high or low ligation of the inferior mesenteric vein (IMA), a left pararectal mini laparotomy is done and, after a wound protector is placed, the specimen is extracted. Again the mesocolon could be resected intra- or extracorporeally in the borders of the resection, using bipolar sealing devices. Further, after manual, purse string, or linear stapler transection of the specimen the anastomosis could be created manually or using endo GIA.

Surgical Technique of Intracorporeal Right Anastomosis

After complete mobilization of the specimen, using medial-to-lateral (or CME) or lateral-to-medial mobilization of the right half of the colon and the terminal ileum with transection of the mesocolon and ileum mesentery using a vessel sealer, the terminal ileum and transverse colon are transected using a laparoscopic or robotic endo GIA. The ileum and transverse colon are aligned and a few traction sutures are placed. After that colotomy and enterotomy are made and endo-GIA jaws are placed and fired. The created anastomosis is checked for bleeding and, if there is no hemorrhage, the enterotomies are closed, using one- or two-layer suturing. The specimen is then removed trough a small infra-umbilical or Pfannenstiel incision. If it is possible, the perfusion of the future anastomosis is evaluated, using indocyanine green (ICG).

Surgical Technique of Intracorporeal Left Anastomosis

For left colectomy, after adequate mobilization of the left flexure, transverse, descending colon, and the proximal part of sigmoid, high or low IMA ligation, the mesocolon is resected intra corporally in the borders of the resection using bipolar sealing device—a vessel sealer. After that, the proximal and distal resected boundaries are transected using laparoscopic or robotic endo GIA. If it is possible, the perfusion of the remnant colon could be evaluated using ICG. The proximal and distal part of the colon are subsequently aligned and a few traction suture are placed. After that, colotomies are performed using monopolar energy and endo-GIA jaws are placed and fired. A check for bleeding is recommended, then the colotomies are closed by one- or two-layer sutures.

Extracorporeal Anastomosis Advantages and Disadvantages

Extracorporeal anastomosis allows visual inspection and evaluation of the borders of resection and macroscopic perfusion of the bowels. It decreases the risk of intra-abdominal spillage of intestinal content during the creation of anastomosis (3).

Because of the need of exteriorization of the specimen, the bowel and mesentery must be widely mobilized to obtain extraction and anastomosis, especially in obese patients with thick abdominal wall and short mesentery. In these obese cases, the exteriorization of the specimen is challenging, with high risk of tearing of the bowel mesentery with further devascularization. In some cases, the specimen cannot reach the extraction site easily due to tumor size, mesenteric fat, or short mesentery and the abdominal opening needs to be enlarged. Midline laparotomies are also associated with an increased risk of incisional hernias (3,4).

In the intracorporeal anastomosis the colon and/or ileum are not going to be exteriorized and the mobilization of the specimen does not have to be extensive. This decreases the risk of mesenteric tearing, bleeding, and intestinal wall injuries. This may result in less adhesions and postoperative ileus. The extraction laparotomy is short because the specimen is already divided, and it is usually placed bellow the umbilicus, not in the most proper place, where the colon or ileum will reach the abdominal surface. In obese patients the creation of intracorporeal anastomosis is facilitated, and it is important to note that, in some obese patients, extracorporeal minimally invasive anastomosis is impossible. The postoperative pain and risk for incisional hernia are minimized, because the specimen extraction could be made in the most atraumatic part of abdominal wall. The use of ICG for evaluation of the intestinal perfusion prior to anastomosis could decrease the risk for anastomotic leakage with resection of the ischemic part of the bowels if it is necessary. Some surgeons consider that the enterotomies for the creation of the anastomosis increase the risk of spillage of intestinal content intra-abdominally, but others are of the opposite opinion and believe that, if the patients do not have intestinal obstruction and if the surgical technique is precise, this risk could be minimized (5,6,7).

MATERIALS AND METHODS

A retrospective analysis of the data from the robotic surgery registry of Kaspela University Hospital was conducted. This study was approved by the Institutional Review Board of the Hospital (approval No. 11/02.04.2023) and performed in accordance with the Declaration of Helsinki. All data were recorded in the hospital database and used for research purposes.

We chose the last 24 patients with robotic right colectomy and extracorporeal anastomosis and 16 patients with intracorporeal. In regard to left-sided hemicolectomies, 17 patients with extracorporeal and 16 patients with intracorporeal anastomosis were included.

Pre-operative variables: age, sex, BMI, comorbidity, history of previous abdominal surgery, ASA score, protein and albumin level, were analyzed. The blood sample was obtained one or two days prior to surgery. The operative method, duration of surgery, concomitant surgery, need of conversion, blood loss, type of anastomosis created, and type of mini laparotomy for specimen extraction and/or anastomosis were assessed. The pathological information about tumor location and size, number of harvested lymph nodes were also analyzed. The comparison of intra- and extracorporeal anastomosis included complications, morbidity and mortality rate, VAS score, time to first flatus, time to stool passage, surgical site infection, length of hospital stay, and readmission within 30 days.

Statistical Analysis

All parameters were analyzed using the Statistical Package for Social Sciences (SPSS) version 22 (IBM Corp., Armonk, New York, USA). Propensity score matching (PSM) was performed using a logistic regression model. The variables were compared using chi-squared test. $P < 0.05$ was considered statistically significant.

RESULTS

The results that we received can be seen in Table 1.

DISCUSSION

In the past decade, due to the improvement of surgical instrumentation and consumables, like laparoscopic linear staples and barbed suture, the safe creation of intracorporeal anastomosis during colonic resections became possible. In 2008, Bergamaschi et al. first described the technique of intracorporeal anastomosis after a right colectomy. Despite the good results, many surgeons still do not use intracorporeal anastomosis after right and left colectomies due to lack of proper instruments, technical difficulties,

Table 1. Results.

	Right Colon Intracorporeal anastomosis n = 16	Right Colon Extracorporeal anastomosis n = 24	P Value	Left Colon Intracorporeal anastomosis n = 16	Left Colon Extracorporeal anastomosis n = 17	P Value
Age (years)	63.24 ± 12.86	64.33 ± 11.65	0.125	61.03 ± 10.78	62.43 ± 11.96	0.134
Male	9 (56.25%)	14 (58.33%)	0.082	8 (50%)	10 (58.82%)	0.152
Female	7 (43.75%)	10 (41.66%)		8 (50%)	7 (41.17%)	
BMI (kg/m^2)	25.21 ± 2.55	24.31 ± 4.16	0.752	24.01 ± 2.43	24.89 ± 3.08	0.715
Comorbidity						
Hypertension	4 (25%)	6 (25%)	1.000	4 (25%)	4 (23.5%)	0.973
Diabetes	2 (12.5%)	2 (8.3%)	0.987	2 (12.5%)	1 (5.88%)	0.867
Cirrhosis	1 (6.25%)	1 (4.2)	0.870	0	1 (5.88%)	0.781
ASA						
I	6 (37.5%)	8 (33.3%)	0.539	2 (12.5%)	3 (17.64%)	0.231
II	8 (50.0%)	13 (54.2%)	0.436	10 (62.5%)	9 (52.94%)	0.102
III	2 (12.5%)	3 (12.5%)	1.000	4 (25.0%)	5 (29.41%)	0.131
Albumin						
< 35 g/L	2 (12.5%)	2 (8.33%)	0.987	3 (18.75%)	4 (23.5%)	0.142
≥ 35 g/L	14 (87.5)	22 (91.66%)	0.092	13 (81.25%)	13 (76.5%)	0.128
Operative time	125.1 ± 37.1	128.2 ± 21.1	0.874	147.3 ± 39.1	153.8 ± 58.1	0.673
Anastomosis						
Hand sawn	1 (6.25%)	22 (91.66%)	< 0.001	-	9 (52.95%)	< 0.001
Stapled	15 (93.75%)	2 (8.33%)	< 0.001	16 (100%)	8 (47.05%)	< 0.001
Extraction incision						
Supraumbilical		24 (100%)	< 0.001			
Infraumbilical	16 (100%)			16 (100%)		<0.001
Pararectal					17 (100%)	
Lymph nodes	24.9 ± 11.3	25.1.9 ± 10.1	0.458	26.8 ± 9.3	25.9 ± 11.0	0.782
Tumor size (cm)	5.5 ± 4.7	4.8 ± 3.9	0.578	6.1 ± 3.6	6.3 ± 4.2	0.351
Complications						
	1 (6.2%)	2 (8.33%)	0.241	1 (6.25%)	4 (16.7%)	< 0.001
Type of complications						
Anastomotic leakage	----------	----------		----------	2 (11.7%)	< 0.001
Wound infection	----------	1 (4.2%)		1 (6.2%)	1 (5.9%)	
Postoperative ileus	----------	----------		----------	1 (5.9%)	
Intraabdominal abscess	1 (6.2%)	1 (4.2%)				
Hospital stay	7.0 ± 4.9	7.8 ± 4.1	0.217	6.1 ± 2.5	8.0 ± 4.9	< 0.001
Hospital readmission < 30 days	--------	1 (4.2%)		1 (6.2%)	2 (11.7%)	

Visual analog scale						
1st POD	4.1 ± 1.8	4.8 ± 2.0	0.356	4.9 ± 2.7	5.2 ± 1.9	0.217
2nd POD	3.2 ± 1.3	3.4 ± 1.8	0.151	4.1 ± 1.7	4.4 ± 1.9	0.483
3rd POD	2.3 ± 0.7	2.9 ± 0.9	<0.001	3.2 ± 1.3	3.4 ± 1.1	0.134
First flatus	2.1 ± 1.2	2.5 ± 1.2	0.031	2.7 ± 1.1	2.9 ± 1.3	0.121
First bowel movement	3.1 ± 1.5	4.2 ± 1.6	< 0.001	3.8 ± 1.2	4.4 ± 1.3	< 0.001

or concerns about intestinal content and tumor cell spillage during the creation of anastomosis (8,9).

Surgical time in our patients was found to be insignificantly shorter in the intracorporeal anastomosis group. This is mainly attributed to our gained experience in laparoscopic hand sewing and knotting, which is facilitated when using robotic system. Studies usually show longer surgical time when performing intracorporeal anastomosis (10,11,12).

Extracorporeal anastomosis requires proper positioning of the laparotomy for extraction of the specimen and mobilized left or right colon. Often due to the BMI of the patients, short mesocolon, or the size of the tumor, the mini laparotomy has to be enlarged. Many surgeons believe that patients with an infra-umbilical laparotomy have less postoperative pain, early bowel function recovery, less complications, especially wound infection (13,14). We preferred infra-umbilical incision (or Pfannenstiel) for specimen extraction.

Postoperative pain evaluated by the visual analog scale (VAS) showed significantly less pain on the third postoperative day only in the intra corporal right colon anastomosis. Many studies show similar results, but the advantages of intracorporeal anastomosis evaluated by VAS were even more significant. In the long term many surgeons reported a low rate of incisional hernias in cases with ECA. Unfortunately, we do not have a sufficient time interval to have obtained a significant data collection for this criteria (15,16,17).

Some of the advantages of ICA are the better visualization and alignment of the anastomotic bowels. In ECA the bowels need to be pulled out by a small opening, and sometimes excessive traction is used, which may cause lacerations of the mesentery or bowel (13).

Our results did not indicate a significant difference in the number of harvested lymph nodes between extra- and intracorporeal left and right colectomies like many others authors. But there are also researchers' published results with a higher number of harvested lymph nodes in intracorporeal anastomosis (18,19).

When we focus on the postoperative complications, it is obvious that anastomotic leakage in ECA after left colectomy is significantly higher. Our series shows that ICA is a safe and feasible technique, which does not increase the risk of adverse outcomes in right and left colectomies (21,22). Wound infections in our patients are insignificantly higher in ECA. These results are in accordance with the results of many researchers in the past decade (23,24,25). The 30-day readmission again shows a similar result. This result is generally linked to wound complications, which occur after hospital discharge.

The overall hospital stay is significantly shorter in ICA left colectomies and insignificantly shorter in right ones. This is explained with a lower percentage of postoperative complications in these groups, less pain, early bowel movement and verticalization of the patients. The same results are confirmed by other researchers (14,23).

The strength of this study is that we try to evaluate the advantages and disadvantages of intra- and extracorporeal anastomosis in left and right colon cancer. This study is limited by its retrospective nature and small number of patients. Long-term results by larger prospective trials are necessary to confirm these findings.

CONCLUSION

The results of our study confirmed the literature data that intracorporeal anastomosis after colon resection is a safe and feasible procedure, accepted by

many colorectal surgeons, associated with low complications rate.

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