

Intracorporeal and Extracorporeal Anastomosis During Right Laparoscopic Colectomy. Comparative Study

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Abstract

Introduction: In recent years, clinical trials shows with good level of evidence the efficiency and the oncologic safety in laparoscopic approach for colon surgery in benign and malignant diseases. Originally, right colectomy was, and it currently is, a laparoscopic-assisted surgery because the anastomosis is still extracorporeal in most cases. Therefore, it will be needed an incision in the abdominal wall due to exteriorize the terminal ileum and the right colon as loop with all its mesentery. Another possibility would be the performance of a completely intracorporeal anastomosis by extracting the specimen through a site in the abdominal wall choose by the surgeon and not where the mobilized colon rich. The potential benefits of this technic is a less morbid abdominal wall extraction site, a better cosmetic, less mobilization length and improve in lymph node count.

Objectives: The aim of this study is to compare the laparoscopic right colectomy with intracorporeal versus extracorporeal anastomosis and to assess their differences in the short and medium term outcomes.

Results: A prospective non-randomized trial has been designed. Fifty-eight laparoscopic right colectomies have been done during 2 and a half years, 30 correspond to IA group (52 %) and 28 to EA group (48%). IA Group reported longer operative times than in the control (162.5 min vs 145.6 min). Two Cases were converted into an open surgery of the series corresponding to EA group (3.4%). All cases of IA have been done side-to-side, mechanical, isoperistaltic fashion. The specimen extraction in IA group was Pfannenstiel incision in 80% of the cases (24), the remaining have been extracted by a midline incision. In EA group, 87% of the extraction sites were midline incision through extension of the umbilical trocar, in remaining 2 Pfannenstiel and 1 transverse incision were used. The average length of incisions for specimen extraction in IA group were 6.8 cm in length while in EA were 11.1 cm, with a p: 0.1.

The length of the specimen were similar in both groups, IA: 21.3 cm (10.5 - 40) and in EA: 20.5 cm (16 - 38). The tumor area in IA group was 12.82 cm² and 13.17 in the control group. The numbers of lymph nodes retrieval in IA group were 14.3 (4-30) and in EA group 12.2 (1-23). The length of hospital stay was 3.91 days for IA group and 5.36 days for EA group, p: 0.1. Fewer overall complications have been observed in IA group (20% versus 63%). Two incisional hernias of the meddle line incisions have been observed in IA group and none in EA group.

Conclusions: Intracorporeal anastomoses were safe and feasible, having fewer overall complications and enhanced recovery than extracorporeal anastomosis. IA allows a better incision for extraction site.

Keywords: *Right Colectomy; Laparoscopic; Intracorporeal Anastomosis*

Introduction

In recent years, well-designed clinical trials show with good level of evidence the efficiency and safety in laparoscopic approach for colorectal surgery in benign and malignant diseases [1-3].

Technical advances and an increased experience of surgical teams brought about a higher development in these types of minimally invasive approaches, making them more attractive to many surgeons who are currently interested in adopting this technique [4].

Originally, right colectomy was and currently is a laparoscopic-assisted surgery due to the need to perform extracorporeal anastomosis in most cases. Therefore, an incision in the abdominal wall is required, which length depends on the size of the loop to be resected. Widening one of the trocars accesses is the most common extraction site use.

This way of assisted-surgery is technically easier to perform. However, different authors reported an increased rate of short-term incisional hernia, a greater number of adhesions and the possibility of an inadvertent rotation or twisted of one of the two ends of the anastomosis with this approach [5-7].

Besides, some authors claim that with this way of specimen exteriorization the lymph node count and the mesocolon integrity might be negatively affected, especially in those patients with a body mass index over 30 [8-9].

A solution to these queries could be a totally intracorporeal anastomosis and the specimen extraction through a different incision site chosen by the surgeon and not one forced by the length of the mobilized loop.

Nowadays, we are going through the second period of the development of laparoscopic surgery. The first one was to achieve its efficiency and safety as mentioned above; this second period consists in pushing and improving the limits of this technique. Some examples are the development of complex procedures such as totally laparoscopic duodenopancreatectomy or gastric bypass, mainly performed by GI surgeons [10-12].

Colorectal surgeons were pioneers in the progress of advanced-laparoscopy, but on the other hand, it has not been the case in the use of intracorporeal anastomosis.

The aim of this study is to assess the feasibility and safety of laparoscopic right colectomy with intracorporeal anastomosis versus the standard extracorporeal, in short and medium-term outcomes.

Methods

Between January 2014 and July 2016 all laparoscopic right colectomies performed at Buenos Aires British Hospital were prospective and non-randomized, recruited in a database.

Laparoscopic right colectomy means the resection between the distal ileum and any sector of the right or transverse colon up to the splenic flexure. Extended right colectomy occurs when the resection includes the ligation of the middle colic artery.

Surgeries were divided into two groups depending on whether the anastomosis was intra or extracorporeal, IA and EA group respectively.

Intracorporeal anastomosis (IA) is defined as the procedure entirely made through laparoscopic approach, and the mini-laparotomy is used just for the specimen extraction. In the extracorporeal group (EA) the mobilization of the colon is done laparoscopically and the section and anastomosis are performed through a mini-laparotomy outside of the abdominal cavity.

The decision of making one approach or the other did not depend on the patients' selection, but on the preference of the acting surgeon. Inflammatory bowel disease and emergency surgeries were not included.

Surgical technique

In all patients, the same antibiotic and antithrombotic prophylaxis was given according to the hospital regulations.

Mechanical bowel preparation was not performed.

Patient position was in the modified Lloyd-Davis with Trendelenburg and left side tilt. Closed technique trans-umbilical pneumoperitoneum was performed.

In extracorporeal anastomosis 3 trocars of 10 mm were used and a fourth accessory trocar was added in intracorporeal anastomosis group. Exploratory laparoscopy was followed by medial approach. The vascular pedicle was either clipped or sealed. Colectomy continued until the sector to be resected was completely mobilized.

IA Group: During the intracorporeal anastomosis, the distal ileum and transverse colon were cut with a lineal mechanical suture 60 mm long. The extracted specimen was temporarily placed over the hepatic dome to proceed with the anastomosis. Both ends to be sutured were aligned side-to-side. Small enterotomy and colotomy were carried out to insert the mechanical suture and perform an isoperistaltic side-to-side anastomosis. Hemostasis of the suture line was checked at this point. The gap was closed with resorbable suture material. The specimen was extracted through a Pfannenstiel incision. Abdominal drainages were not systematically used.

EA Group: the exteriorization of the colon and ileum and the suture were conducted by widening the incision of one of the trocars in the midline or by means of a mini-laparotomy in other sites (suprapubic, etc.) Side-to-side mechanical or end-to-end manual ileocolic anastomoses were performed.

Post-operative measures

Perioperative measures were applied to all patients, in accordance with ERAS dispositions described by our group [13].

The requirements for hospital discharge were general good state, adequate oral intake, bowel movement, lack of fever and good post-operative pain control.

Demographic analysis

Age, sex, BMI (weight/size²), type of surgery, personal clinical history and pathology (benign or malign) were compared.

Operating time, conversion rate, need of endoscopic control and extraction site incision length, as well as incisional hernia rate, were recorded.

Post-operative recovery

Hospital stay for each group, minimum time for oral intake tolerance and bowel movement, defined as the first elimination of flatulence or stool after the surgery, were analyzed.

Pathological features

The length of the specimen defined as the sum of the ileum segment and the ascending and/or transverse colon, the size of the tumor and the number of total lymph nodes were compared.

The tumor size was measured for its area, expressed in cm².

Post-operative complications

Short-time complication

Short-time complications are those that take place within 30 days after surgery.

Surgical ileus was defined as impossibility to start oral intake, the need of a nasogastric tube or clinical signs of abdominal distension, and was confirmed by radiological criteria [15]. Surgical site infections were defined as the appearance of fever and exudate with isolation of pathologic organisms. Anastomotic leak was defined as proposed by the International Study Group of Rectal Cancer [16].

Overall morbidity and mortality rates were assessed [17].

Late complications (until 6 months)

Among late complications were reported cases of incisional hernia diagnosed by clinical examination and CT-scan, and post-operative stenosis, defined as the endoscopic verification of intestinal lumen reduction in the anastomosis site, together with obstruction symptoms.

Statistical analysis

The above-mentioned variations have been compared through the statistical analysis of both cohort studies depending on the type of the anastomosis conducted.

$P < 0.05$ is considered an statistically significant result.

For that purpose, program SPSS 15.0 Inc. Chicago, IL, USA was used.

Results

During the analyzed period, 58 laparoscopic right colectomy were conducted, 30 belong to IA group (52%) and 28 to EA group (48%).

No demographical differences were observed between both groups (Table 1).

More patients in EA group were ASA 3 and had previous surgeries.

The average operative time in minutes was longer in IA group than in the control (162.5 min versus 145.6 min).

Two cases of the series corresponding to EA group (3.4%) were converted into open surgery, one due to peripancreatic bleeding and the other for difficulty in handling a large tumor. Overall, in both groups, 11 extended right colectomies were done. 32% (8) in IA group and 13% (3) in EA group.

Demographic Data	Group IA (%)	Group EA (%)	P
N	30 (52%)	28 (48 %)	
Age (range)	62 (-)	71 (-)	
Masculine	12 (48%)	10 (43,5%)	
Female	13 (52%)	13 (56,5%)	
Average BMI (weight / size ² - media)	28.26	28.54	
ASA III or more	10 (40%)	15 (65%)	
Previous surgeries	7 (28%)	10 (43.5%)	
Malignant pathology	15 (60%)	14 (60%)	
Benign pathology	10 (40%)	9 (40%)	

Table 1

As shown in table 2, all intracorporeal anastomosis were side-to-side mechanical isoperistaltic sutured. In EA group 56% were conducted this way and the remaining were end-to-end hand sewn anastomosis.

Surgery data (n)	Group IA (30)	Group EA (28)	P
Operative time in minutes (range)	162.5 (90-340)	145.6 (60-255)	
Conversion	0	2 (4.3%)	
Standard resection	17	20	
Extended resection	8 (32%)	3 (13%)	
Side-to-side anastomosis	25 (100%)	13 (56.5%)	
End-to-end anastomosis.	0	10 (43.5%)	
Pfannenstiel extraction site	20 (80 %)	2 (8.7%)	
Midline extraction site	5 (20%)	20 (87 %)	
Transverse extraction site	0	1 (4.3%)	
Length of the incision in cm (range)	6.85 (3-12 CM)	11.1 (5-15cm)	0.1
Length of the specimen	21.3 (10.5-40)	20.5 (16-38)	
Lymph nodes harvest	14.3 (4-30)	12.2 (1-23)	0.4
Tumor size (surface - cm ²)	15.8	13.1	
Classified by the TNM staging system T0 - TIS	3	9	
TI - II	13	3	
TIII - IV	9	11	

Table 2

The extraction site of the specimen in IA group was Pfannenstiel incision in 80% of the cases (24), the remaining 6 were extracted by a midline incision. In EA group, in 87% cases the extraction site was a midline incision, in the remaining cases a Pfannenstiel incision and a transverse incision were used.

The average incisions length in IA group was 6.8 cm and in EA group it was 11.1 cm, with p: 0.1.

Pathologic characteristics

The length of the extracted specimen was similar in both groups, IA: 21.3 cm (10.5 – 40), EA: 20.5 cm (16 – 38).

The tumor area in IA group was 15.82 cm² and 13.17 cm² in the control group.

The average number of lymph nodes of the extracted specimens in IA group was 14.3 (4-30) and in EA group it was 12.2 (1-23) (p: 0.4).

In table 2 are displayed the differences in the tumor stage, as classified by the TNM staging system.

Post-operative recovery

The average hospital stay in IA group was 3.91 days and 5.36 days in EA group, p: 0.1.

The oral intake time was shorter in IA group and the bowel movement was similar in both groups (Table 3).

Post-operative recovery and complications (n)	IA (30)	EA (28)	P
Length of stay (range)	3,91 (1-10)	5,36 (2-21)	
Oral intake (hours)	5,86	10,2	
Flatus post op day (hours)	20,3	21	
Catharsis (hours)	38	49	
Overall complications	6 (20%)	14 (50%)	
Anastomotic leak	1	3	
• Reoperation	1	1	
• Conservative treat	0	2	
Ileus	1	2	
SSI (surgical site infection)	2	2	
Urinary retentions	1	0	
Intraoperative lesions	1	1	
Anastomotic loop rotation	0	1	
Anastomotic bleeding	0	3	
Gastrointestinal (GI) bleeding	0	1	
Mortality	0	1 (4,3%)	
Dindo & Clavien			
1-2	5	8	
3	0	4	
4-5	1	2	
Readmission to 30 days	0	3	
Late complications			
Incisional hernia	0	2	

Table 3

Post-operative complications

Fewer overall complications were observed in IA group (20 % versus 63%). In the control group 3 anastomotic leaks were reported. One required surgery and the other two underwent non-surgical treatment. In IA group an anastomotic leak occurred which required reoperation and percutaneous drainage. This patient had lung, heart and vascular diseases prior to initial surgery.

There were three intraoperative events in EA group and one in IA group. In the first group, there was an anastomotic loop rotation, which was confirmed during the same procedure and required a new anastomosis, a lesion of the splenic capsule due to traction of the omentum in the attempt to exteriorize the specimen. This required laparoscopic splenectomy. The third case was a peripancreatic bleeding. A midline laparotomy was necessary for correct hemostasis. The event in IA group was a superficial duodenum injury, which was treated through laparoscopic suture, and the follow up was uneventful. Only the splenectomy extended hospital stay and no further complications were reported.

Three of the patients with extracorporeal anastomosis performed with mechanical suture bled from the stapler line after surgery. Endoscopic clipping solved two and in the other patient no bleeding site was detected at the time of the procedure.

One mortality case was recorded in EA group.

Using the Clavien-Dindo classification system several complications Grade 3 and 4 occurred in EA group and only one in IA group (Table 3).

The readmission rate corresponds to three patients in EA group.

Two incisional hernias were observed in EA group and none in the study group.

Discussion

In our country and all around the world, laparoscopic approach on colorectal pathology is growing slowly due to its complex technical nature, among other factors.

Nowadays, most surgeons perform extracorporeal anastomosis for right colectomies, maybe because the advantages of intracorporeal anastomosis are still unknown by the surgical community and this technique may seem more difficult to perform to colorectal surgeons [18-20].

Although there is a greater percentage of ASA 3 patients and with previous abdominal surgeries within the group of extracorporeal anastomosis, this is not statistically significant and therefore both groups are comparable.

In our series, the operative time to conduct an intracorporeal anastomosis was longer, which matches the data described in published studies, except for Fabozzi's [21].

In a meta-analysis published in 2013 [22] Cirocchi does not analyze differences in operative times in different studies due to the disparity of the measurement criteria used. The author shows two studies with shorter operative time when using intracorporeal anastomosis and other two that have opposite results.

In a recent analysis by Carnuccio, *et al.* [23] the average amount of patients with intracorporeal anastomosis in the different series is 45 (range: 23-82). Therefore, we believe that our numbers shall be considered within a learning curve, as established by other authors [24-28].

In our series, two cases of conversion to open surgery were observed in EA group (3.4%) and none in IA group. Published studies do not show significant differences regarding this issue, as the review performed by Tarta., *et al.* in 11 of 13 studies analyzed the conversion rate in patients with intracorporeal anastomosis was 2.15% (0-10) and in 6 of them the conversion rate in those with extracorporeal anastomosis was 2.58% (0 – 5.2) [20].

Other authors such as Chávez [29] found a higher conversion rate in extracorporeal anastomosis (8% versus 0, p: 0.09). On the other hand, Fabozzi [21] in a comparative study shows 10% of conversion in the intracorporeal group. However, this study does not report the conversion rate in the extracorporeal group. Scatizzi [30] shows that conversion in IA group doubles the ones in EA group (5% versus 2.5%).

Incisional hernia's incidence in colorectal surgery has decreased thanks to laparoscopic approach, but is yet around 11% according to a comparative multicentric series study published in 2015 [31,32].

The specimen extraction sites most frequently used in right laparoscopic colectomy are transverse and midline incisions. Intracorporeal anastomosis allows the surgeon to choose the site for the specimen extraction regardless the length of the intestinal loop.

The overall incisional hernia rate for both groups was 4.2%. But, the only two incisional hernias recorded in this analysis belong to EA group (8.7%), with an average follow up of 26.3 (3 -29) months.

In IA group, Pfannenstiel incision was used in 80% of the cases. In the remaining a midline incision was performed by widening the umbilical trocar. The average incision length was 6.8 cm.

Conversely, in EA group 87% of specimen extraction was performed through midline incisions with an average length of 11 cm. Even though the number of patients in this study is small, this could explain the difference in the incidence of incisional hernia, which is 0 - 2% for suprapubic incisions [33-34].

Another option is the transvaginal extraction of the specimen, which has not been analyzed in this series and the hypothetic advantages are better cosmetics results and recovery after surgery [35].

Despite the difference in the number of lymph nodes resected is not significant, it was higher in the intracorporeal group, which matches the literature.

In our series, as well as in Chávez's, a larger specimen and more lymph nodes were removed in IA group, without a statistically significant result. In IA group the hospital stay was shorter, with a faster recovery time and a lower rate of overall complications (63 versus 20%).

Erguren., *et al.* [36] also found an important difference regarding overall complications when comparing these two techniques (54 versus 7%).

The rate of anastomotic leak in our series was 1 case (3.3%) for IA group and 3 cases (10.7%) for EA group. Since the sample number of our series is small, we cannot reach to any conclusions on this subject. However, other authors also find similar results [36]. In Tarta's [20] review with a greater number of cases, the incidence of leak in IA anastomosis was 1.4% (0 – 8.5) and 2.55% (0 – 6) for extracorporeal respectively. Nevertheless, these results are dissimilar and do not permit to achieve any conclusion.

Other reported complications in extracorporeal anastomosis are the twisting of the anastomotic end [36–37], mesentric or portal venous thrombosis due to the excessive traction the mesentery, and lesion of the omentum or splenic capsule [37].

Anastomosis bleeding rate observed in the multicentric study of Millone, *et al.* in 152 right laparoscopic colectomies was 7% for intracorporeal anastomosis and 5% for extracorporeal. Even though in our series we have not recorded any bleeding in IA group, the three cases in the extracorporeal group were solved by endoscopic approach [34].

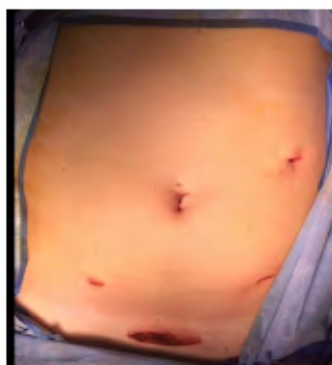


Figure 1: Trocars positions and Pfannenstiel incision site for the specimen extraction in the case of CI group.

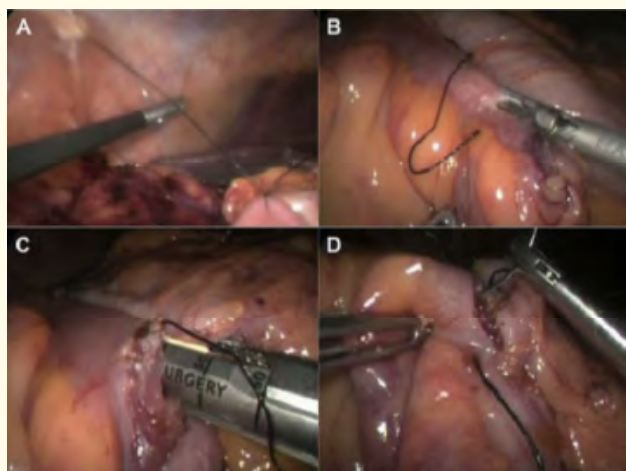


Figure 2: Conduction of isoperistaltic anastomosis.

Conclusions

As strengths for this study, we might conclude that the sample is homogeneous, it is a prospective and comparative study which allowed us to verify the following issues:

1. Intracorporeal anastomosis was found to be safe and feasible.
2. Regarding short-term outcomes, intracorporeal anastomosis had a fewer rate of overall complications and easy recovery than extracorporeal.

3. IA allowed less incisional hernias site for the specimen extraction.

However, this study was not randomized and the sample was small. The performance of prospective randomised studies with more patients will be necessary to support these results.

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