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**Laparoscopic colorectal surgery in a private center in Bahía Blanca**

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ABSTRACT

**Introduction:** Laparoscopic surgery is a fundamental approach for the treatment of colorectal diseases. Whether lower-volume centers with trained surgeons can replicate the outcomes obtained by high-volume centers remains to be determined.

**Objective:** To analyze the short-term outcomes of the laparoscopic approach to colorectal pathology and the predictive factors for conversion to open surgery and reoperation.

**Design:** Retrospective cohort study.

**Material and Methods:** Patients with colorectal pathology treated by laparoscopy between October 2014 and August 2020, in a private hospital of the city of Bahía Blanca, were included. Emergency surgeries, anal tumors and combined pathology were excluded. Conversion, readmission, and morbidity were analyzed based on demographic variables, surgical technique, and learning curve. Multivariate analysis was performed for conversion and reoperation.

**Results:** One hundred and sixty-seven patients underwent surgery (51.5% men, mean age 66.1 years, mean BMI 26.5 km/m2). Operative time: 231.3 minutes, significantly longer for rectal tumors (p<0.001).Conversion rate was 5.4%. Male patients and ultralow anterior resection (ULAR) had a higher conversion rate. The hospital stay was 4 days, 9.6% of patients underwent reoperation and 16.8% was readmitted. Twenty-six percent of the patients presented minor postoperative complications (Clavien I-II) and 16% major (Clavien III-IV-V), the most frequent being surgical site infection (21%), ileus (13.8%) and anastomotic fistula (7.8%). Mortality was 3.6%. Patients with ASA≥3 (p=0.015) and males (p=0.01) had a higher rate of complications. Anastomotic fistula was a positive predictive factor for reintervention (p<0.01).

**Conclusions:** Laparoscopic surgery for colorectal diseases in our setting proved to be an effective and safe procedure that meets the short-term outcomes standards established by the scientific community. Male patients and ULAR have a higher chance of conversion. Anastomotic fistula is a positive predictive factor for reoperation.

**Keywords:** Laparoscopic Colorectal Surgery; Minimally Invasive Colorectal Surgery; Conversion; Reoperation

INTRODUCTION

The laparoscopic approach occupies a prominent place in colorectal surgery as a diagnostic and therapeutic method. Multiple publications have confirmed the benefit of its implementation, allowing the definition of quality and safety standards for surgical practices.1-4 At the beginning of the experience, its applicability was not as fast as in other areas of surgery due to the complexity of the procedures, the longer learning curve and the need to demonstrate its non-inferiority compared to open techniques.3

The surgeon plays a major role in defining the course of the pathology, interfering with perioperative and intraoperative variables.5 At the national level, reference centers share their experiences and accept new challenges to improve the safety and quality of procedures.6-9 In smaller hospitals and with surgeons trained in laparoscopy, we need to assess whether these outcomes can be reproduced, audit them frequently, and share them with the scientific community.

Systematizing this process makes it possible to compare the quality of care, with the aim of implementing improvements in treatment.

Laparoscopic colorectal surgery is safe, its short-term outcome report less bleeding and shorter hospital stay, with longer operative time compared to open surgery,2,10 and its long-term outcome is satisfactory.3 This, together with accelerated recovery programs, allows significant improvements in the quality of care.11 The literature reports conversion rates of around 16%.2,12 This event, which is not considered a complication in itself, is related to higher morbidity and mortality and lower overall and disease-free survival than those presented by patients resected exclusively by laparoscopy.12,13

Predictive factors are variables that influence the development of an event and make up a model that indicates the risk that a patient has of suffering from it. Conversion to open surgery can be previously suspected based on a set of variables related to the patient, the disease, the type of surgery, and the experience of the surgical team. Knowing them allows strategies to be put into practice to reduce their incidence.12,14,15 The evaluation of risk factors for reoperation allows predicting this event and developing strategies for diagnosis and early treatment of its causes, including the valuable contribution of laparoscopic surgery.16,17

The objective of this study is to assess the short-term outcomes of colorectal laparoscopic surgery, identify the variables that can modify them and propose a model to predict conversion and reoperation.

**MATERIAL AND METHODS**

Patients operated on for colorectal pathology using a laparoscopic approach between October 2014 and August 2020, were included. Those who underwent emergency procedures and those with anal tumors and combined pathologies were excluded. The procedures were performed and/or supervised by a specialist in coloproctology.

A retrospective cohort was analyzed, for which a database was generated in SPSS, IBM®, assessing a 60-day postoperative period. Demographic variables, indication for surgery, type of procedure, intraoperative variables (complications and conversion), and postoperative variables (morbidity and mortality, frequent complications, hospital stay, readmission and reoperation) were recorded. Data were collected retrospectively from a prospective database and recorded in an spreadsheet (Excel®, Office 2000 Microsoft Corp., WA, USA).

Operative risk assessment was performed using the American Association of Anesthesiology (ASA) score. For perioperative management, the recommendations of the Enhanced Recovery After Surgery (ERAS) protocol were partially applied,11 including antimicrobial prophylaxis, mechanical bowel preparation in surgery of the left colon and rectum, perioperative thromboprophylaxis, transurethral bladder catheter removed in less than 24 hours, ingestion of fluids in the first postoperative hours and early mobilization in the first 24 hours.

Conversion was defined as the situation in which, in order to perform intra-abdominal maneuvers, an incision larger than that required to extract the surgical specimen had to be implemented.

Postoperative complications were recorded based on the Clavien-Dindo classification, with major complications being Clavien-Dindo III, IV, and V.

Surgical site infection (SSI), ileus, and anastomotic fistula (AF) were analyzed separately. SSI was defined according to the criteria of the Centers for Disease Control and Prevention (CDC), dependent on the US federal government.18 Postoperative ileus was defined as the absence of bowel function for more than 72 hours.19 We adopted the term AF for the communication between the intra and extraluminal compartments due to a defect in the integrity of the bowel wall at the level of the anastomosis,20 which can be evidenced by the exit of intestinal fluid through the drain.

The study was verified and approved by the Teaching and Research Committee of the Hospital Italiano Regional del Sur de Bahía Blanca. The data was stored and protected to prevent its dissemination and protect confidentiality, adhering to the Helsinki principles. All patients signed the informed consent in accordance with current hospital regulations.

***Statistic analysis***

Statistical analysis was performed by members of the Center for Total Quality Studies, Mathematics Faculty, Universidad Nacional del Sur, using SPSS, IBM® software. Numerical variables were presented as medians and interquartile ranges, or means and standard deviations according to distribution, and categorical variables were presented as percentages. Comparison of numerical variables was made with the Student T test and the Wilcoxon test for normal and non-normal distribution, respectively. Categorical variables were analyzed with the Chi-square test or the Fisher's test, as appropriate. For the multivariate model, binary logistic regression analysis was performed for the conversion and reoperation variables. To study the learning curve, the comparison of variances test and the Kruskall-Wallis comparison of means test were used. A p<0.05 was considered statistically significant and a confidence interval (CI) of 95%.

RESULTS

We included 167 patients (51.5% men) with a mean age of 66.1±10.8 (range 31-91) years and a body mass index (BMI) of 26.5±5.2 (range 17 .1-49.9) kg/m2. They were classified as ASA 1: 3.6%, ASA 2: 60.5%, ASA 3: 35.3%, and ASA 4: 0.6%; 37.7% had a history of previous laparotomies. Surgical procedures were performed due to malignant pathology in 82.6% (138) of the patients, including 49.1% (82) colon and 33.5% (56) rectal tumors, 94.2% treated with curative intention. The rest of the patients underwent surgery for benign disease: resection of colorectal polyps in 3.6% (6), diverticular disease in 10.8% (18) and intestinal transit reconstruction in 3% (5). The most frequent surgical procedures were left colectomy and anterior resection. Transanal total mesorectal excision (TATME) was performed in 6 ultra-low anterior resections (ULAR) (Table 1).

**Table 1.** Surgical procedures.

|  |  |
| --- | --- |
| **Procedures** | n (%) |
| Right colectomy  Transverse colectomy  Left colectomy  Sigmoidectomy  Anterior rectal resection  High  Low  ULAR  Total colectomy  Total proctocolectomy  Abdominoperineal resection  Segmental resection Colostomy  Transit reconstruction Hartmann | 30 (18)  6 (3.5)  31 (18.5)  21 (12.5)  53 (31.7)  12  7  34  6 (3.5)  1 (0.5)  4 (2.3)  5 (3)  5 (3)  5(3)  1 (0.5) |

ULAR: Ultralow anterior resection.

The conversion rate was 5.4%, 9 (95% CI 1.8-9.6) cases, all associated with malignant pathology (5 rectal and 4 colon tumors) (Table 2). Conversion was due to oncological causes in 78% of cases and to anatomical causes in the remaining 22%; there were no conversions associated with diverticular disease.

The mean operative time was 231.3±91.7 (95% CI 217-245) minutes. It was significantly higher (p <0.001) in rectal tumors: 274.9 (95% CI 252.2-297.7) minutes, followed by diverticular disease: 225.5 (95% CI 185.4-265, 7) minutes and colon tumors: 11.15 (95% CI 192.3-229) minutes (Table 2).

The rate of intraoperative complications was 5.4%, 9 cases (Table 2). There was difficulty introducing the stapling device in 4 cases, anastomotic leak with a positive pneumatic test in 1 (suture was performed); small bowel injury in 1 (suture repair), rectal injury in 1 (suture repair), and mesentery bleeding in 2 (controlled with electrocoagulation). Without being considered a complication, one of the cases of stapling failure was converted to conventional surgery for oncological safety reasons.

**Table 2.** Intraoperative variables.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | Overall | CC | RC | CRP | DD | RBC | p |
| Conversion (%) | 5.4 | 4.9 | 8.9 | 0 | 0 | 0 | 0.54 |
| Operative time (min) | 231.3 | 211.1 | 275 | 152.8 | 225.5 | 195 | <0.001 |
| IOC (%) | 5.4 | 4.9 | 5.4 | 0 | 11.1 | 0 | 0.76 |

IOC: Intraoperative complication; CC: Colon cancer; RC: Rectal cancer; CRP: Colorectal poyp; DD: Diverticular disease; RBC: Restoration of bowel continuity.

Anastomosis was performed in 153 (91.6%) patients. The median hospital stay was 4 days, mean 5.78 (95% CI 5-6.5) days.

The overall rate of postoperative complications at 60 days was 42.5% (71 cases), 62% of patients had minor complications (Clavien I-II) and 38% major complications, the latter corresponding to 16% of the series (Fig. 1). The most frequent complication was SSI (21.6%), followed by ileus (13.8%) and AF (7.8%). Male gender (p=0.01), ASA ≥ 3 (p=0.02) and BMI >30 (p=0.001) were more associated with infection.

Mortality was 3.6% (6 patients); 2 patients died due to pulmonary thromboembolism on the 5th and 7th day, 1 due to massive hemorrhage in the immediate postoperative period, and 3 due to multiple organ failure secondary to abdominal sepsis (2 AFs and 1 necrosis of the descending colon). All cases of mortality were associated to malignant pathology.

**Figure 1.** Postoperative complications according to the Clavien-Dindo classification.

Sixteen (9.6%) patients underwent reoperation and 28 (16.8%) were readmitted to hospital. Considering the most prevalent pathology in the series, the 82 patients with colon tumors had a complication rate of 37.8%, with 13.4% readmissions and 12.2% reinterventions. The 56 patients with rectal tumors suffered some complication in 48.2% of the cases, 63% were minor, with a readmission rate of 25% and a reoperation rate of 7.1%. Analyzing conversion, morbidity and readmission discriminated by surgical technique, we found that ULAR presented the highest readmission rate (p=0.009), with no statistically significant differences regarding conversion and morbidity. According to demographic characteristics, patients with ASA ≥ 3 (p=0.015) and males (p=0.04) presented significantly more complications. There was a trend for morbidity in patients older than 60 years (Table 3). Table 4 shows that the most frequent complications were SSI (21.6%), ileus (13.8%) and AF (7.8%) and how morbidity affected hospital stay, mortality, reintervention and readmission. All cases of peritonitis were secondary to anastomotic leak. AF was more frequent in male patients (p<0.01). Furthermore, it was observed that patients with AF underwent more reinterventions (p<0.01). Multivariate analysis confirmed that AF is a predictive factor for reoperation (OR 63) and that men are more likely to undergo reoperation than women.

**Table 3.** Conversion, morbidity and readmission analyzed based on demographic characteristics.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variable | Conversion | | Morbidity | | Readmission | |
|  | % | p | % | p | % | p |
| Age (yrs)  < 60  > 60 | 5  5.5 | 0.9 | 30  46.5 | 0.07 | 10  18.9 | 0.23 |
| Sex  Male  Female | 7  3.7 | 0.49 | 50  34.6 | 0.04 | 19.8  13.6 | 0.28 |
| BMI  < 25  25- 30  > 30 | 2.5  10.7  3.3 | 0.11 | 39.5  41.1  53.3 | 0.41 | 14.8  23.2  10 | 0.24 |
| ASA  I-II  III- IV | 5.6  5 | 0.66 | 35.5  55 | 0.01 | 14.4  19.7 | 0.37 |

**Table 4.** Hospital stay, mortality, reoperation and readmission analyzed based on the most frequent complications.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable | AF (%) | Ileus (%) | SSI (%) | Probability |
| Hospital stay (days) | 15,5 (IC 95% 9,8–21,1) | 11 (IC 95% 6,7–15,3) | 8,6 (IC 95% 5,2–12) | 0,19 |
| Mortality | 15,4 | 4,3 | 5,6 | 0,41 |
| Reoperation | 76,9 | 13 | 19,4 | <0,01 |
| Readmission | 30,8 | 43,5 | 30,6 | 0,56 |

AF: Anastomotic fistula. SSI: Surgical site infection.

Conversion, morbidity, and readmission rates were evaluated based on the experience of the operative team. For this, the series was divided according to chronological order into 4 periods of 18 months each, finding significant differences in morbidity and readmission, but a marked decrease in conversion in the last period (Table 5). There were no significant differences in the average operative time in the four periods (p>0.54). Variation in total operative time was observed in the 4 groups, but without a clear trend (p<0.05). There were no significant differences in the mean hospital stay (p>0.35).

**Table 5.** Conversion, morbidity and readmission analyzed based on the surgical experience of the operative team.\*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variable | Conversion | | Morbidity | | Readmission | |
|  | % | p | % | p | % | p |
| Cases |  | 0.07 |  | 0.71 |  | 0.28 |
| 0-42 | 2.4 |  | 38 |  | 7.3 |  |
| 43-84 | 11.9 |  | 38 |  | 19.5 |  |
| 86-126 | 7.1 |  | 47.6 |  | 21.9 |  |
| 127-167 | 0 |  | 45.2 |  | 19.5 |  |

**\* Four**  periods of 18 months each.

DISCUSSION

In different series, including the national ones, the conversion rate varies between 9 and 16%2.12,14,15Malignant disease has a higher conversion rate than other indications, with rectal cancer being the most frequent.12 Our population presents a conversion rate of 5.4%, in all cases associated with malignant pathology. Some authors suggest that a low conversion threshold is recommended to avoid intraoperative complications, arguing that the increased postoperative morbidity in converted patients is related to the intraoperative complication leading to reactive conversion. In this series, the conversions were to avoid dangerous dissections and ensure oncologic safety. No conversion had to be done urgently. The multivariate analysis shows a tendency to conversion in men and in ULAR, compared to other techniques. These findings are related to those published by national groups.

The rate of intraoperative complications was 5.4% (9 cases), all resolved laparoscopically, although we believe that this goes hand in hand with the experience of the operative team and the severity of the complication.

The overall rate of postoperative morbidity in colorectal surgery is high, with reported values ​​above 40%.2,21 The indication for surgery, the inclusion criteria and the definition of each complication explain its variability. In this series, morbidity is 42.5% and is stratified by levels of complexity. The importance lies in the fact that most of the patients who presented some complication responded to medical treatment.

When we analyze the complications according to Clavien-Dindo, 38% were major and 62% minor. Of the patients who presented major complications (16%), 59.2% required reintervention and 40.8% received medical treatment as the only measure.

We believe that laparoscopic surgery benefits patients with postoperative complications, especially those who must face a reoperation.16,17 In the present series, 9.6% of patients underwent reoperation, more frequently in those with AF. According to our predictive model, we can affirm that AF and male sex increase the risk of reoperation. We believe this is because AF is significantly more common in men.

For reoperation, the laparoscopic approach (relaparoscopy) was used as first intention with a conversion rate of 6.2% (1 case), demonstrating that it is a satisfactory method for diagnosis and resolution of the complication.

Overall mortality was 3.6% (5 patients), an expected percentage for a series with a low number of patients.22,23 We believe that these results are directly affected by the malignant disease, a long-lived population and a small sample.

In our series, men and patients with ASA ≥ 3 had more complications. Among the complications with the greatest impact in laparoscopic colorectal surgery, the variables analyzed were SSI, ileus, and AF.

SSI has an incidence of up to 26%,24 related to risk factors such as obesity, diabetes, transfusion, paralytic ileus or intra-abdominal abscess. In the present series, SSI was 21.6%, more frequent in patients with ASA ≥ 3, BMI ≥ 30 and males.

Considering postoperative ileus, the current debate lies in identifying the time interval to consider this manifestation as an expected event or a complication. Despite attempts to stratify the entity, the lack of consensus is important to understand the variability of its incidence. Some authors consider that the placement of a nasogastric tube is a more reproducible parameter to recognize this event as a complication.19 The overall incidence of postoperative ileus is 15%, even in accelerated recovery programs, with a very variable range, between 13 and 25%.25 In this series, using a cut-off point of 72 hours without bowel function to define ileus, we recorded an incidence of 13.8%. In addition to the classic causes, we believe that ileus may be associated with a clinically undetectable event, such as incipient contamination of the peritoneal space. Its outcome will be determined by this event and by the patient's immunocompetence. Astute diagnosis allows these underlying causes to be sought out and treated early.

AF reaches up to 20%.2,26 Its early detection and treatment determine the development of associated morbidity and mortality.27 In this series, the AF rate was 7.8% and 76.9% of these patients had to undergo reoperation. AF had a statistically significant association whith the need for reoperation, compared to other frequent complications such as wound infection and ileus.

When analyzing the results of the approach to colorectal pathology globally, there are many factors and variables that can affect each of the subpopulations under study. This series, with a long-lived population was more prone to postoperative complications. Although elderly patients constitute a population at risk for adverse postoperative events, laparoscopic surgery benefits this age group to a greater extent, reducing morbidity and hospital stay compared to open surgery.28

Finally, analyzing the currently available evidence and our experience, we believe that laparoscopic surgery is a safe, effective, reproducible and oncologically satisfactory method for the treatment of colorectal pathology, offering all the advantages of the minimally invasive approach, such as less tissue trauma, better immune response, adequate radicalization in case of malignant pathology and shorter hospital stay. However, before facing this practice, it must be taken into account that the indications must be precise and the selection of patients must be correct by a multidisciplinary team. In addition, it is necessary to have adequate technology and to go through a severe learning curve to develop the specific technical skills in advanced laparoscopy that these procedures require.

Likewise, we believe that it is very important to publicize the results obtained, so that they can be collated by the scientific community.

CONCLUSION

The laparoscopic approach to colorectal pathology in our environment is an effective and safe procedure, meeting the standards of short-term results established by current evidence. Male patients and ultralow rectal resections have a higher chance of conversion. Anastomotic fistula is a predictive factor for reoperation.

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