



Original Article

Overview of colorectal resections in a reference center in Curitiba – Brazil: Experience with open and laparoscopic approach



Micheli Fortunato Domingos, Renato Valmassoni Pinho, Júlio Cezar Uili Coelho*,
Guilherme Figueiró Ferronato, Mariane Christina Savio, Caroline Blum,
Andre Gubert Weiss, Yan Sacha Hass Aguilera

Hospital Nossa Senhora das Graças, Departamento de Cirurgia, Curitiba, PR, Brazil

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ABSTRACT

Introduction: Minimally invasive approach has become the preferential option for the treatment of surgical diseases of the Gastrointestinal Tract, due to its numerous advantages. However, in the Colorectal Surgery field, the acceptance of videolaparoscopy was slower. For example, an American study showed that the percentage of laparoscopic cholecystectomy increased from 2.5% in 1988 to 73.7% in 1992, the rate of laparoscopic sigmoidectomy increased from 4.3% in 2000 to only 7.6% in 2004.

Objectives: Our goal was to compare several variables between patients submitted to colorectal resections performed through open surgery or videolaparoscopy.

Methods: This is a retrospective observational study performed in a Teaching Private Hospital of the City of Curitiba, Brazil, with the revision of 395 medical charts of patients subjected to colorectal resections from January 2011 through June 2016.

Results: 349 patients were included in the study. 243 (69.6%) were subjected to laparoscopic colon resection (LCR) and 106 (30.4%) to open colon resection (OCR). Mean age was 62.2 years for patients undergoing LCR and 68.8 year for OCR ($p = 0.0082$). Among emergency procedures, 92.5% consisted of OCR and 7.5% were LCRs. Surgery duration was similar in both types of access (196 min in OCR versus 195 min in LCR; $p = 0.9864$). Diet introduction was earlier in laparoscopic surgery and anastomotic fistula rate was similar in both groups (OCR 7.5% and LCR 6.58%; $p = 0.7438$). Hospital stay was shorter in patients undergoing laparoscopic resections (7.53 ± 7.3 days) than in the ones undergoing open surgery (17.2 ± 19.3) ($p < 0.001$). In the OCR group, 70 patients needed ICU admission (66%), and stayed a mean of 12.3 days under intensive care. In the LCR group, however, only 30 needed ICU (12.3%), and the ones who needed it stayed a mean of 5.6 days ($p < 0.001$).

* Corresponding author.

E-mail: coelhojcu@yahoo.com.br (J.C. Coelho).

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Conclusions: Videolaparoscopic approach is a safe and effective option in the treatment of colorectal diseases. Surgery duration and anastomotic fistula rates are similar to the open resections. Hospital stay and ICU stay durations, however, were shorter in patients submitted to laparoscopic colectomies.

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Aspectos gerais da ressecção colorretal em centro de referência em Curitiba, Brasil: Experiência com abordagens laparoscópica e a céu aberto

R E S U M O

Palavras-chave:

Colectomia
Cirurgia colorretal
Laparoscópico
Cólon

Introdução: Abordagens minimamente invasivas passaram a ser a opção preferencial para tratamento de doenças cirúrgicas do trato gastrointestinal, graças às suas numerosas vantagens. Contudo, no campo da cirurgia colorretal, a aceitação da videolaparoscopia foi mais lenta. Exemplificando, um estudo norte-americano demonstrou que o percentual de colectomias laparoscópicas aumentou de 2,5% em 1988 para 73,7% em 1992, enquanto que o percentual de sigmoidectomias laparoscópicas aumentou de 4,3% em 2000 para somente 7,6% em 2004.

Objetivos: Nosso objetivo foi comparar diversas variáveis entre pacientes submetidos a ressecções colorretais realizadas por cirurgia a céu aberto, ou por videolaparoscopia.

Métodos: Este é um estudo observacional retrospectivo realizado em um Hospital-Escola privado em Curitiba, Brasil, com revisão de 395 prontuários clínicos de pacientes submetidos a ressecções colorretais de janeiro de 2011 até junho de 2016.

Resultados: 349 pacientes foram incluídos no estudo. 243 (69,6%) foram submetidos à ressecção laparoscópica de cólon por laparoscopia (RLC) e 106 (30,4%) foram tratados com ressecção de cólon a céu aberto (RCCA). A média de idade foi de 62,2 anos para os pacientes tratados com RLC e de 68,8 anos para RCCA ($p = 0,0082$). Entre os procedimentos de emergência, 92,5% dos pacientes foram tratados com RCCA e 7,5% com RLC. A duração da cirurgia foi similar para os dois tipos de acesso (196 min para RCCA versus 195 min para RLC; $p = 0,9864$). A introdução da alimentação ocorreu mais cedo nos pacientes tratados com a cirurgia laparoscópica, e o percentual de fístulas anastomóticas foi similar para os dois grupos (RCCA 7,5% e RLC 6,58%; $p = 0,7438$). A permanência no hospital foi mais curta para os pacientes tratados por ressecção laparoscópica ($7,53 \pm 7,3$ dias) versus pacientes tratados com cirurgia a céu aberto ($17,2 \pm 19,3$ dias) ($p < 0,001$). No grupo RCCA, 70 pacientes precisaram ser internados na UTI (66%), com permanência média de 12,3 dias em terapia intensiva. Mas no grupo RLC, apenas 30 pacientes necessitaram de internação na UTI (12,3%), e sua permanência em terapia intensiva foi de, em média, 5,6 dias ($p < 0,001$).

Conclusões: A abordagem videolaparoscópica é opção segura e efetiva no tratamento de doenças colorretais. A duração da cirurgia e os percentuais de confecção de fístula anastomótica são similares ao observado nas ressecções a céu aberto. No entanto, a permanência no hospital e o tempo de permanência na UTI foram mais curtos para os pacientes tratados com colectomia laparoscópica.

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Introduction

The first laparoscopic colectomy was described by Jacobs et al. in 1991¹ and it has been performed in our hospital since 1993. It has become the preferable option for surgical treatment of several colonic disease, such as colorectal cancer and diverticular disease. The increase in the number of laparoscopic colorectal resections is mainly due to the advantages of the minimally invasive surgery, such as safe,² less hospital stay,

less postoperative pain, better acceptance by the patient, and low morbidity and mortality. The risk of fistula is similar to the open access.^{3,4} However, some studies suggested that operative time and cost of laparoscopic colorectal surgery may be higher than the open access.

The acceptance of laparoscopic colorectal resection was slower than other laparoscopic operations. While the percentage of laparoscopic cholecystectomy increased from 2.5% in 1988 to 73.7% in 1992, the rate of laparoscopic sigmoidectomy increased from 4.3% in 2000 to only 7.6% in 2004.⁵ Initially,

laparoscopic colectomy was contraindicated for patients with colorectal cancer due to the possibility of higher recurrence in portal sites and in colonic margins, and removal of a smaller number of lymph nodes.⁶⁻⁸ However, recent reports with a more representative population have demonstrated that the complications of the laparoscopic colectomies are similar to colonic resections performed through the traditional open access. Our objective is to present our experience with colorectal resections performed through open or laparoscopic access.

Methods

This is a retrospective observational study performed in a Teaching Private Hospital of the City of Curitiba, Brazil, with the revision of 395 medical charts of patients subjected to colectomy or rectosigmoidectomy from January 2011 through June 2016. Patients with additional simultaneous operations or colostomy closure were excluded from the study. Postoperative complications were considered until the 30th postoperative day. A total of 349 patients were included in this evaluation. This study was approved by the Ethical Committee of the Hospital.

The following variables were evaluated: age, gender, indications of the surgical procedure, operation duration, hospital stay duration, postoperative diet initiation, surgical complications, preoperative ASA, colon preparation, stoma indication, intensive care unit admission and duration. Statistical analysis was performed with the chi-Square, ANOVA, and Student's t-test, using the software SOFA. It was considered significant the results with $p \leq 0.05$.

Results

Laparoscopic colorectal resection (LCR) was performed in 243 patients (69.6%) and the open resection (OCR) in 106 (30.4%) (Fig. 1). There was a female predominance in both types of resections: 134 in the LCR (55.1%) and 61 in the OCR (57.5%) (Table 1). The mean age was higher in the OCR (66.9 years) than in the LCR (62.3 years) ($p = 0.0082$).

Neoplasia was the main indication of LCR (69.14%), followed by diverticular disease (17.7%), endometriosis (4.12%), fistula (2.88%), perforation (0.42%) and others (5.76%) (Fig. 2). Neoplasia was also the most frequent indication of OCR (45.28%), followed by perforation (24.53%), diverticular disease (9.43%), and fistula (3.77%). Of all elective operations, 84.3%

were performed by videolaparoscopy and 15.6% through the open access. On the contrary, most emergency procedures were performed through the open access (58.5%) ($p < 0.001$). Preoperative colonic preparation was done more frequently in LCR (212 patients; 87.24%) than in OCR (40 patients; 37.73%) ($p < 0.001$).

Operative time was similar in both surgical techniques, 196 min in the OCR and 195 min in the LCR ($p = 0.9864$). Hospital stay length was longer in the OCR (17.2 ± 19.3 days) than in the LCR (7.5 ± 7.3 days) ($p < 0.001$). Intensive care unit stay length was also longer in the OCR (124 ± 15.7 days) than in the LCR (5.7 ± 6.4 days) ($p < 0.001$).

Postoperative diet was introduced earlier in the LCR (1.7 ± 0.95 PO day; CI 95% 1.588–1.828) than in the OCR (3.1 ± 5.2 PO day; CI 95% 2.115–4.092) ($p < 0.001$). In terms of preoperative evaluation, ASA classifications were higher for OCR than for LCR ($p < 0.001$).

Stomas were performed more in OCR group (58 patients; 54.7%) than in LCR (12 patients; 4.9%) ($p < 0.001$). Anastomotic fistulas occurred in a similar rate in both groups (OCR = 7.6%; LCR = 6.6%) ($p = 0.7438$). However, fistula was recognized earlier in LCR (4.5 days) than in the OCR (9.9 days) ($p = 0.02465$). Hospital stay length in patients with anastomotic fistula was higher in the OCR (32.7 ± 16.8 days) than in the LCR (20.8 ± 17.3 days) ($p = 0.1216$) (Table 1). Perioperative mortality rate was higher in the OCR (22.6%) than in the LCR (2.9%) ($p < 0.001$).

Discussion

Few years after the introduction of laparoscopic cholecystectomy, colonic resections through this access began to be performed with success. Colorectal cancer resections were worldwide rapidly accepted. The oncological results were similar to the open resections.^{2,9} The advantages of laparoscopic colorectal resections include less postoperative pain, better esthetic results, less blood loss, and quicker recovery. In our Hospital, videolaparoscopic approach is widely accepted and represent a large percentage of elective colectomies (84.3%), due to its known benefits and also because attending surgeons have experience with this technique.

In our study, the two main indications of colorectal resections were neoplasia and diverticular disease. The patients subjected to OCR were, on average, older than LCR group, possibly because old patients have more comorbidities and complicated colonic diseases that limit the indications of videolaparoscopic procedures. There are some concerns with the hemodynamics and ventilatory state of older patients subjected to videolaparoscopic, procedures due to the pneumoperitoneum and the Trendelenburg position that are required during the operation.¹⁰ However, some studies have demonstrated that videolaparoscopic surgery is safe and has benefits for older patients.

Historically, preoperative colon preparation acceptance has changed during the years in the world literature. Presently, most surgeons use mechanical colon preparations associated with intravenous and/or oral antibiotics.¹¹⁻¹⁴ The objective of colon preparation is to reduce postoperative infection rate and other complications that increase hospital stay length and rate of morbidity and mortality. In our study it was observed that

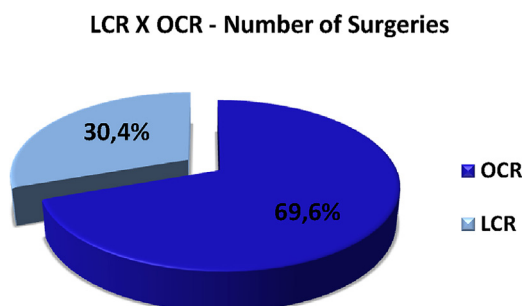


Fig. 1 – Proportion of surgeries – open versus laparoscopic approach.

Table 1 – Variable comparison between open colorectal resection and videolaparoscopic colorectal resection.

Variable	Open resection (n = 106)	Videolaparoscopic resection (n = 243)	p
Age – average	66.877	62.259	0.0082
Gender			0.6776
Female – n° (%)	61 (57.5)	134 (55.1)	
Male – n° (%)	45 (42.5)	109 (44.9)	
Indication – n° (%)			
Neoplasia	48 (45.28)	168 (69.14)	
Diverticular disease	10 (9.43)	43 (17.70)	
Perforation	26 (24.53)	1 (0.42)	
Endometriosis	1 (0.94)	10 (4.12)	
Fistula	4 (3.77)	7 (2.88)	
Others	17 (16.04)	14 (5.76)	
Type of operation – n° (%)			<0.001
Elective	44 (12.6)	238 (68.2)	
Emergency	62 (17.8)	5 (1.4)	
Pre-op preparation – n° (%)	40 (37.73)	212 (87.24)	<0.001
ASA – average	2.39	1.92	<0.001
Surgery duration – average	195.028	195.185	0.9864
Hospital stay – average	17.208	7.531	<0.001
PO diet introduction – average (CI 95%)	3.104 (2.115–4.092)	1.708 (1.588–1.828)	<0.001
Stoma confection – n° (%)	58 (54.71)	12 (4.94)	<0.001
Complication – n° (%)	36 (33.96)	25 (10.29)	<0.001
Intensive care unit admission – n° (%)	70 (66)	30 (12.3)	<0.001
Intensive care unit stay (days) (CI 95%)	12.371 (8.692–16.051)	5.667 (3.372–7.962)	0.0264
Fistula – n° (%)	8 (7.56)	16 (6.58)	0.7438
PO fistula diagnosis – days average	9.875	4.5	<0.001
Antibiotics duration – days average	9.377	1.609	<0.001
Bleeding – %	6.6	3.3	0.1616
Death – n° (%)	24 (22.6)	7 (2.9)	<0.001

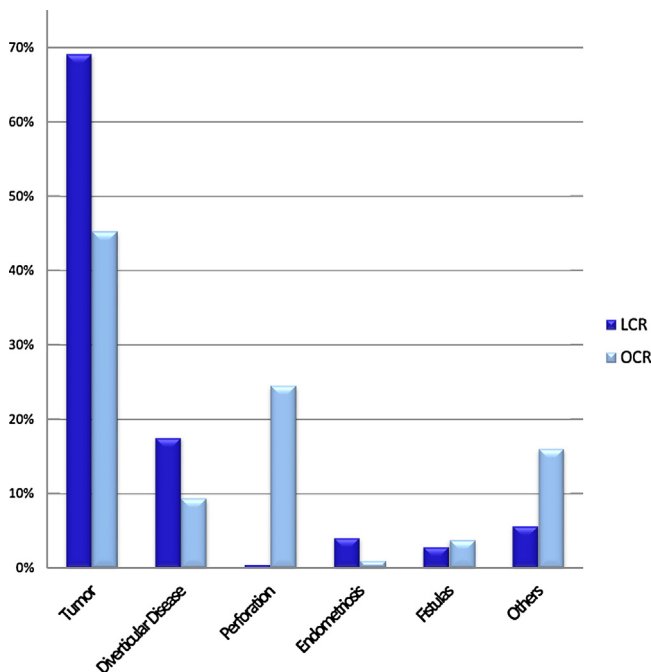


Fig. 2 – Surgery indications – open versus laparoscopic approach.

the rate of colon preparation was higher in LCR than in OCR. This difference is possibly due to fact that most OCRs were emergency operations, with no time or patient condition for colon preparation.

Similar to other studies, our findings showed that hospital stay length is smaller in LCR than in OCR. The necessity of stoma construction, the number of general complications (bleeding, fistula, infection, and death rate) and intensive care unit admission was also smaller in the LCR. Furthermore, post-operative diet was introduced earlier in the LCR than in the OCR. However, it is impossible to conclude from this study alone if these findings are due to laparoscopic technique itself or because majority of cases included in the open group were emergency surgeries.

Regarding surgical time, it did not differ between open and laparoscopic techniques in this study (mean of 195 min in both cases). However, laparoscopic colectomies are known to require longer surgical time, due to its technical difficulty. Our findings may be due to the greater complexity of open cases. Other factor that should be considered is that surgeons in our service have great experience with laparoscopy. We could also infer that, after the learning curve is complete, laparoscopic colectomies can be performed in a shorter time, since the time spent in opening and closing the abdominal wall is shortened.

Although anastomotic fistula rate is variable in the literature, most studies showed similar fistula rate following

colorectal resections performed either by laparoscopic or open access.¹⁵ Occurrence of fistula depends on several factors, including technical aspects, and patients characteristics, such as age above 60 years, smoking, male sex and hypoalbuminemia.¹⁵⁻¹⁸ Some studies have shown that blood supply deficit to the anastomosis is one of the most important causes of fistula.¹⁹ Nutritional deficit such as hypoalbuminemia is considered an independent factor to fistula occurrence.²⁰ The incidence of anastomotic fistula varies from 3% to 23%, depending on the operation type, patient characteristics, tumor location, surgical technique, nutritional condition and presence of comorbidities.^{15,19} There were no difference in the anastomotic fistula rate between LCR and OCR access in our study, thus corroborating that the videolaparoscopic approach can be performed with safety.

A recent large study found smaller fistula rates in laparoscopic colon resections in comparison with the open approach (2.8% in LCR versus 4.5% in OCR; $p < 0.0001$). This data is promising and is probably related to the better dissection provided by videolaparoscopy – such as splenic angle dissection or pelvic dissection in low rectal disease.¹⁵ Although our study found higher rates of anastomotic fistulas than the study cited above, the number described in literature varies among 3% and 23%, placing our 7% at an acceptable rate.^{10,15,21,22} Another important aspect raised in a 2016 study²⁰ is that anastomotic leaks are often underestimated because the diagnosis can be late and often after hospital discharge. In our study, the diagnosis of anastomotic leak was earlier in patients undergoing videolaparoscopic colon resections in comparison with open surgery.

Our study found a higher mortality rate in open surgery compared to laparoscopic. This data is probably related to the fact that open surgery was indicated more often in patients with multiple comorbidities and in emergent situations.

In conclusion, the present study suggests that videolaparoscopic approach is a safe and effective option in the treatment of colorectal diseases. Surgery duration and anastomotic fistula rates are similar to the open resections. Hospital stay and ICU stay durations were shorter in patients submitted to laparoscopic colectomies. However, our analysis compared elective and emergency surgeries, which influenced the results because of the complexity associated with emergency surgeries (evident in the open surgery group).

Conflicts of interest

The authors declare no conflicts of interest.

REFERENCES

- Jacobs M, Verdeja JC, Goldstein HS. Minimally invasive colon resection (laparoscopic colectomy). *Surg Laparosc Endosc.* 1991;1:144-50.
- van der Pas MH, Haglind E, Cuesta MA, Fürst A, Lacy AM, Hop WC, et al. Colorectal cancer Laparoscopic or Open Resection II (COLOR II) Study Group Laparoscopic versus open surgery for rectal cancer (COLOR II): short-term outcomes of a randomised, phase 3 trial. *Lancet Oncol.* 2013;14:210-8.
- Bonjer HJ, Deijen CL, Abis GA, Cuesta MA, van der Pas MHGM, de Lange-de Klerk ESM, et al. A randomized trial of laparoscopic versus open surgery for rectal cancer. *N Engl J Med.* 2015;372:1324-32.
- Veldkamp R, Kuhry E, Hop WC, Jeekel J, Kazemier G, Bonjer HJ, et al., Colon cancer Laparoscopic or Open Resection Study Group (COLOR). Laparoscopic surgery versus open surgery for colon cancer: short-term outcomes of a randomised trial. *Lancet Oncol.* 2005;6:477-84.
- Gervaz P, Inan I, Perneger T, Schiffer E, Morel P. A prospective, randomized single-blind comparison of laparoscopic versus open sigmoid colectomy for diverticulitis. *Ann Surg.* 2010;252:3-8.
- Walsh DC, Wattchow DA, Wilson TG. Subcutaneous metastases after laparoscopic resection of malignancy. *Aust N Z J Surg.* 1993;63:563-5.
- Stocchi L, Nelson H. Laparoscopic colectomy for colon cancer: trial update. *J Surg Oncol.* 1998;68:255-67.
- Stocchi L, Nelson H. Wound recurrences following laparoscopic-assisted colectomy for cancer. *Arch Surg.* 2000;135:948-58.
- Nandakumar G, Fleshman J. Laparoscopy for colon and rectal cancer. *Clin Colon Rectal Surg.* 2010;23:51-8.
- Xie M, Qin H, Luo Q, He X, Lan P, Lian L. Laparoscopic colorectal resection in octogenarian patients. *Medicine (Baltimore).* 2015;94:e1765.
- Murray AC, Kiran RP. Benefit of mechanical bowel preparation prior to elective colorectal surgery: current insights. *Langenbecks Arch Surg.* 2016;401:573-80.
- Althumairi AA, Canner JK, Pawlik TM, Schneider E, Nagarajan N, Safar B, et al. Benefits of bowel preparation beyond surgical site infection. *Ann Surg.* 2016;264:1051-7.
- Kiran RP, Murray AC, Chiuzan C, Estrada D, Forde K. Combined preoperative mechanical bowel preparation with oral antibiotics significantly reduces surgical site infection anastomotic leak, and ileus after colorectal surgery. *Ann Surg.* 2015;262:416-25 [discussion 423-5].
- Kim EK, Sheetz KH, Bonn J, DeRoo S, Lee C, Stein I, et al. A statewide colectomy experience: the role of full bowel preparation in preventing surgical site infection. *Ann Surg.* 2014;259:310-4.
- Murray AC, Chiuzan C, Kiran RP. Risk of anastomotic leak after laparoscopic versus open colectomy. *Surg Endosc.* 2016;30:5275-82.
- Krarp PM, Jorgensen LN, Andreasen AH, Harling H, Danish Colorectal Cancer Group. A nationwide study on anastomotic leakage after colonic cancer surgery. *Colorectal Dis.* 2012;14:e661-7.
- Arezzo A, Passera R, Scozzari G, Verra M, Morino M. Laparoscopy for rectal cancer reduces short-term mortality and morbidity: results of a systematic review and meta-analysis. *Surg Endosc.* 2013;27:1485-502.
- Kang CY, Halabi WJ, Chaudhry OO, Nguyen V, Pigazzi A, Carmichael JC, et al. Risk factors for anastomotic leakage after anterior resection for rectal cancer. *JAMA Surg.* 2013;148:65-71.
- Shekarriz H, Eigenwald J, Shekarriz B, Upadhyay J, Shekarriz J, Zoubie D, et al. Anastomotic leak in colorectal surgery: are 75% preventable? *Int J Colorectal Dis.* 2015;30:1525-31.
- Frasson M, Granero-Castro P, Ramos Rodríguez JL, Flor-Lorente B, Braithwaite M, Martí Martínez E, et al., ANACO Study Group. 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.

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21. Rahbari NN, Weitz J, Hohenberger W, Heald RJ, Moran B, Ulrich A, et al. Definition and grading of anastomotic leakage following anterior resection of the rectum: a proposal by the International Study Group of Rectal Cancer. *Surgery*. 2010;147:339-51.
 22. Trencheva K, Morrissey KP, Wells M, Mancuso CA, Lee SW, Sonoda T, et al. Identifying important predictors for anastomotic leak after colon and rectal resection. *Ann Surg*. 2013;257:108-13.