Journal of Coloproctology

www.jcol.org.br

Original article

Laparoscopic training in colorectal surgery: can we do it safely?

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ARTICLE INFO

Article history:
Received 1 July 2012
Accepted 1 September 2012

Keywords:
Videolaparoscopy
Colectomy

ABSTRACT

Objective: Laparoscopic approach should be offered for most patients requiring colectomy, as it is a safe procedure, associated with shorter hospitalization, better cosmetic results, and does not affect negatively the oncological outcomes of patients with colon cancer. However, there is no consistent data on the safety of laparoscopic surgery training during residency. Therefore, the aim of this study was to assess whether or not the resident participation in laparoscopic colectomy affected the postoperative outcomes.

Methods: The database of the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) was searched for patients undergoing laparoscopic colectomies between 2005 and 2007. We excluded patients with no data regarding whether or not there was a resident participation in the operation. The study population was divided into 2 groups (resident and nonresident), according to residents participation in the surgical procedure. Perioperative variables and postoperative complications were compared between groups. A multivariate analysis was performed to evaluate the association between postoperative complications and resident participation in the operation.

Results: The search yielded 5,912 patients with a median age of 63 years. Of these, 3,112 (53%) were female and 3.887 (66%) had a resident involved in their operation. The resident group had a significantly longer mean operative time (163 ± 64 min vs 138 ± 58 min, $p < 0.0001$). Other variables did not differ significantly between groups. Moreover, multivariate analysis showed no association between resident participation and the occurrence of postoperative complications.

Conclusion: Laparoscopic training during residency may be safely performed without threatening the patient's integrity.

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Colectomia videolaparoscópica: é seguro treinar o residente?

Palavras-chave:
Videolaparoscopia
Colectomia

RESUMO

Objetivo: Cirurgia videolaparoscópica é a via preferencial para colectomias eletivas por ser um procedimento seguro, associado à menor tempo de internação, melhores resultados estéticos e por não influenciar negativamente os resultados oncológicos dos pacientes com câncer de cólon. Entretanto, ainda não existem dados consistentes sobre a segurança do treinamento em cirurgia laparoscópica durante a residência. Sendo assim, o objetivo deste estudo foi avaliar se a participação do residente em colectomias laparoscópicas afetou os resultados pós-operatórios.

Métodos: A base de dados do American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) foi pesquisada para colectomias laparoscópicas entre os anos de 2005 e 2007. A população do estudo foi dividida em dois grupos de acordo com a participação ou não do residente na cirurgia: residente vs. não residente. Os grupos foram comparados em relação às variáveis perioperatórias e complicações pós-operatórias. Uma análise multivariada foi realizada para investigar possível associação entre complicações pós-operatórias e o envolvimento de residentes na operação.

Resultados: A pesquisa retornou 5.912 pacientes, com mediana de idade de 63 anos. Em 3.887 casos (66%) o residente estava envolvido na operação. O grupo Residente apresentou tempo operatório mediano significantemente maior que o grupo Não Residente (163 ± 64 min vs. 138 ± 58 min, $p < 0.0001$). Todas as outras variáveis estudadas não diferiram significativamente entre os grupos. Além disso, a análise multivariada não demonstrou nenhuma associação entre o envolvimento do residente na operação e a ocorrência de complicações pós-operatórias.

Conclusão: O treinamento laparoscópico durante a residência pode ser realizado com segurança sem colocar em risco a integridade do paciente operado.

Introduction

Videolaparoscopy is one of the latest advancements in coloproctology. This approach results in improved respiratory performance, pain control, shorter hospital stay, and better cosmetic results.[1,2] Additionally, studies show that videolaparoscopy applies not only to the treatment of benign diseases, but also to colon cancer.[3,4]

Despite all the advantages of laparoscopy, it is estimated that this approach was used only in half of the oncologic colectomy performed in the United States (U.S.) between 2008-2009.[5] Brazilian data are scarce, but it is unlikely that our reality is better than that of the U.S.[6]

In order to improve this situation, laparoscopic training during residency in coloproctology becomes critical. However, there are insufficient data on the effects of resident participation in laparoscopic colectomy regarding postoperative complications.

Thus, the aim of this study was to determine whether resident participation in videolaparoscopic colectomy is associated with higher rates of postoperative complications.

Methods

To meet the objective of this study, we used the database of the American College of Surgeons – National Surgical Quality Improvement Program (ACS-NSQIP).

This database was originally created in the 1980s as a response of the U.S. Congress to the frequent complaints of surgical care poor quality in the Department of Veterans Affairs (VA). Therefore, the Congress established that a mechanism for measuring the quality of surgical treatment in the VA Hospitals should be created, so that the treatment provided at these centers could be compared to the private sector. Due to the success of the program in the VA centers, it was later adopted by the American College of Surgeons and the private sector. Currently, more than 40 U.S. hospitals contribute to this database through a systematic and standardized collection of preoperative, intraoperative, and postoperative complication variables (within 30 days).[7-13]

The search for laparoscopic colectomy in the ACS-NSQIP database was conducted between the years 2005 and 2007. Surgeries were identified by procedure codes (Current Procedural Terminology) numbers 2204 and 2205, as shown in Table 1.

Table 1 – CPT Code vs meaning.

CPT code	Meaning
44204	Laparoscopic partial colectomy with anastomosis
44205	Laparoscopic partial colectomy with terminal ileum removal and anastomosis

CPT, current procedure terminology.

The initial population was divided into two groups (resident and nonresident), according to resident participation or not in laparoscopic colectomy. Patients without information regarding resident participation were excluded from this study.

Preoperative, perioperative, and postoperative variables were compared between groups. Potential associations between resident participation in the procedure and postoperative complications were also evaluated.

To assess whether the resident's training time influenced the surgical time, length of stay, and postoperative complication rates, the resident group was subdivided into three subgroups according to the years of training: R1-2 (up to 2 years of training) R3-4 (three to four years), > R4 (over four years). Perioperative variables and postoperative complications were compared between subgroups of residents.

Statistical analysis

Parametric continuous variables were summarized as mean and standard deviation and compared using Student's t test. Non-parametric continuous variables were summarized as median and interquartile range (IQR) and compared with the Wilcoxon Rank Sum test. Nominal variables were represented as absolute numbers and percentages and compared with chi-square and Fisher's exact tests.

Associations between the resident presence during surgery and intraoperative and postoperative variables were evaluated by multivariate analysis.

All statistical tests were two-tailed and $\alpha = 0.05$ was used. A p value < 0.05 was considered statistically significant.

Results

The database search initially yielded 6,040 patients. Information regarding the presence or absence of residents during surgery was not available for 128 patients (2%). Thus, 5,912 patients constituted the study population, with 1,810 undergoing right colectomy (31%) and 4.102 undergoing left colectomy (69%). Residents participated in 3,887 operations (66%).

Demographics

Table 2 shows the demographic data. There were 2,800 men (47%) and 3,112 women (53%). Median age and body mass index (BMI) were 63 years (IQR 53-74) and 27 kg/m^2 (IQR 24-31), respectively. Furthermore, the proportion of obese (BMI ≥ 30 kg/m^2) was significantly higher in the nonresident group (699 patients [35%]) than in the resident group (1,220 patients [32%]), p = 0.04.

Preoperative characteristics

Preoperative characteristics are shown in Table 3. Both groups did not differ on most characteristics; however, the resident group had a higher proportion of patients who used corticosteroids for more than 30 days and lower preoperative serum albumin, both statistically significant. Despite this statistical significance, a more detailed analysis of the absolute numbers reveals that this certainly does not translate into clinical significance.

Table 2 – Resident vs nonresident: demographics.

Variable[a]	Resident	Nonresident	p value
	n = 3887 (66%)	n = 2025 (34%)	
Sex			0.19
Female	2070 (53%)	1042 (51%)	
Male	1817 (47%)	983 (49%)	
Age (years)[a]	62 ± 0.2	63 ± 0.3	0.37
BMI (kg/m^2)[a]	27,7 ± 6.1	28,1 ± 6.0	0.01

BMI, body mass index.
[a]Continuous variables expressed as means and standard deviation.

Table 3 – Resident vs nonresident: preoperative characteristics.

Variable	Resident	Nonresident	p value
	n = 3887 (66%)	n = 2025 (34%)	
Diabetes	473 (12%)	249 (12%)	0.90
Smoking	581 (15%)	309 (15%)	0.75
Alcoholism	144 (3.7%)	82 (4.1%)	0.52
COPD	142 (3.6%)	87 (4.3%)	0.23
ICC	20 (0.5%)	17 (0.8%)	0.16
Angina	22 (0.6%)	10 (0.5%)	0.82
Hypertension	1873 (48%)	1013 (50%)	0.19
Corticosteroid use[a]	211 (5.4%)	56 (2.8%)	< 0.001
Creatinine[b]	0.99 ± 0.58	0.97 ± 0.48	0.77
Albumin[b]	3.9 ± 0.57	3.8 ± 0.59	< 0.001
Hematocrit[b]	39 ± 5.4	39.2 ± 5.4	0.14
Prob. morb[c]	13% (11% – 18%)	13% (11% – 19%)	0.87
Prob. mort[c]	0.4% (0.2% – 1%)	0.4% (0.2% – 1%)	0.95

COPD, chronic obstructive pulmonary disease; CHF, congestive heart failure; Prob. morb, probability of morbidity; Porb. mort, probability of mortality.
[a]Corticosteroid use for more than 30 days.
[b]Values expressed as mean and standard deviation.
[c]Values expressed as median and interquartile range.

One of the great innovations of the ACS-NSQIP is the probability of morbidity and mortality calculation. This calculation takes into account several aspects, such as extent of surgery and preoperative comorbidities. In this study, the probability of morbidity and mortality was similar between both groups (resident and nonresident).

Diagnosis

Regarding diagnosis, the distribution was significantly different between the two groups. Colectomy for treatment of cancer and inflammatory bowel disease were significantly more common in the resident group, while the nonresident group had significantly more patients undergoing surgery for diverticular disease (Table 4).

Intraoperative characteristics

Table 5 shows the intraoperative variables. There was no difference regarding the American Society of Anesthesiology classification. However, the proportion of patients with in-

Table 4 – Resident vs nonresident: diagnosis.

Variable	Resident n = 3887 (66%)	Nonresident n = 2025 (34%)	p value
Cancer	2620 (67%)	1258 (62%)	< 0.001
IBD	243 (6%)	56 (3%)	
DD	720 (19%)	599 (28%)	
Other	304 (8%)	154 (8%)	

IBD, inflammatory bowel disease; DD, diverticular disease.

Table 5 – Resident vs nonresident: demographics.

Variable	Resident n = 3887 (66%)	Nonresident n = 2025 (34%)	p value
Wound classification			0.02
Clear/Contaminated	3781 (97,3%)	1991 (98,3%)	
Infected	106 (2,7%)	34 (1,7%)	
ASA			0.44
1/2	2410 (62%)	1282 (63%)	
3/4	1477 (38%)	742 (37%)	
Operative time (min)[a]	163 ± 64	138 ± 58	< 0.001

ASA, American Society of Anesthesiology; min, minutes.
[a]Values expressed as mean and standard deviation.

fected wounds and the median operative time were higher in the resident group.

Length of hospital stay and postoperative complications

Patients in resident group had a significantly longer hospital stay (5 days IGR 3-7) than patients in nonresident group (4 days 3-6), p = 0.006. Moreover, the occurrence of wound infection was significantly higher in the resident group (275 patients [7%]) than in nonresident group (107 patients [5%]), p = 0.008. Other postoperative complications did not differ significantly between groups (Table 6).

Years of training vs complications

There was no difference between operation and hospitalization times, as well as with most of the postoperative complications between the R1-2, R3-4, and > R4 sub-groups (Table 7). However, the difference between abdominal abscess rates in

Table 6 – Resident vs nonresident: postoperative complications.

Variable	Resident n = 3887 (66%)	Nonresident n = 2025 (34%)	p value
UTI	99 (2.6%)	40 (1.9)	0.17
DVT	28 (0.7%)	17 (0.8%)	0.64
PTE	16 (0.41%)	11 (0.45%)	0.54
Wound infection	275 (7.1%)	107 (5.3%)	0.008
Abdominal abscess	97 (2.5%)	39 (1.9%)	0.17
Reoperation	173 (4.5)	83 (4.1)	0.54

UTI, urinary tract infection; DVT, deep vein thrombosis; PTE, pulmonary thromboembolism.

Table 7 – R1-2 vs R3-4 vs > R4: hospitalization, operative time, and postoperative complications.

Variable	R1-2	R3-4	> R4	p value
Operative time (min)[a]	153 (121-201)	150 (116-195)	152 (117-200)	0.42
Hospitalization (days)[a]	4 (4-7)	5 (3-7)	4 (3-7)	0.73
Wound infection	24 (8.3%)	94 (6.9%)	157 (7%)	0.71
Reoperation	9 (3.1%)	55 (4.1%)	109 (4.9%)	0.27

[a]Values expressed as median and interquartile range.

group R3-4 was statistically higher, although the absolute differences are of doubtful clinical significance (1.2% for R3-4 vs > R4 and 2.2% for R3-4 vs R1-2), (Fig. 1).

Multivariate analysis

To better evaluate the possible association between resident participation and higher rates of wound infection, longer operative time, and hospitalization, three multivariate analyzes were performed using each of these factors as dependent variables. The probabilities of morbidity and mortality were used as independent variables, in addition to perioperative variables that were significantly different between the resident and nonresident groups (percentage of obesity, steroid use, serum albumin, and diagnosis).

To design the statistical model, continuous variables were dichotomized. The variable albumin was dichotomized into < 4 mg/dL vs ≥ 4 mg/dL, as 4 mg/dL is the reference value for normal serum albumin. The median value of the probability of morbidity and mortality was used (13.3% and 0.4%, respectively).

Resident participation during surgery was significantly associated with longer operative time. However, no association between the resident group and higher rates of wound infection and prolonged hospitalization could be established (Table 8).

Discussion

Our study showed that resident participation in video laparoscopic colectomy is not associated with increased rates of

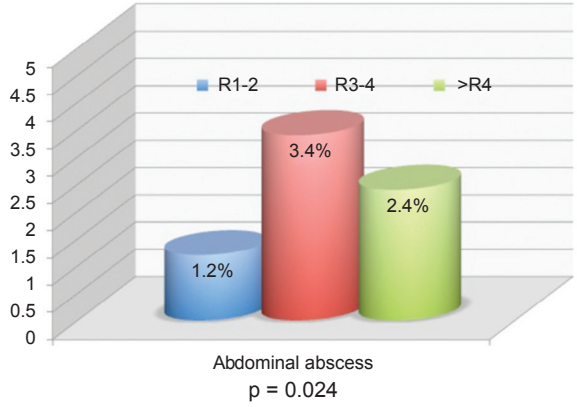

Fig. 1 – R1-2 vs R3-4 vs > R4 – abdominal abscess.

Table 8 – Multivariate analysis: factors associated with wound infection, operative time, and hospital stay.

Variable[a]	Operative time			Hospital stay			Wound infection		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Prob. morb > 13.3%	0.7	0.6-0.8	< 0.0001	0.6	0.5-0.7	< 0.0001	1.2	0.4-3.3	0.78
Prob. mort > 0.4%	0.8	0.7-0.99	0.04	1.5	1.3-1.9	< 0.0001	0.6	0.2-1.5	0.27
Cancer	1.0	0.8-1.4	0.82	1.5	1.1 -1.9	0.01	0.2	0.1-0.6	< 0.0001
DD	0.4	0.3-0.6	< 0.0001	1.7	1.3-2.4	0.00	0.3	0.1-0.9	0.03
IBD	0.9	0.6-1.3	0.52	0.8	0.5-1.3	0.34	0.8	0.2-2.7	0.72
Resident	2.2	1.9-2.6	< 0.0001	0.9	0.8-1.1	0.22	0.6	0.3-1.2	0.13
Obesity	1.4	1.1-1.7	< 0.0001	1.1	0.9-1.3	0.23	1.5	0.7-2.9	0.27
Corticosteroid use	1.4	1.01-2.1	0.04	1.4	0.9-2	0.10	2.2	0.8-5.8	0.14
Albumin	1.2	0.9-1.5	0.09	0.4	0.3-0.5	< 0.0001	1.9	0.9-4.0	0.09
Wound infection	1.0	0.7-1.6	0.92	0.9	0.6-1.4	0.61	2.3	0.6-6.5	0.20

Prob. morb, probability of morbidity; Porb. mort, probability of mortality; IBD, inflammatory bowel disease; DD, diverticular disease.

postoperative complications, although operative time was longer with resident participation.

Additionally, we have demonstrated that the postoperative complication rates did not vary greatly according to the resident involved training time. This is probably due to the staff surgeon who limits the participation of each resident according to the skills previously acquired.

The use of laparoscopy in coloproctology has been consistently established as the ideal surgical approach for a variety of diseases.[3,14-18] However, most colectomy is still performed by open surgery.[5,19] To revert this scenario, training in laparoscopy during colorectal residency is critical. The American Society of Colon and Rectal Surgeons (ASCRS) requirement for residency programs in coloproctology is that a resident should be involved in at least 50 colorectal resections during his training. Moreover, the ASCRS has consistently encouraged the dissemination and training in videolaparoscopy. Such actions have proven effective, as the use of laparoscopy for oncological colectomy in the U.S. has increased in recent years from 10%-15%[19] to 50%.[5]

To encourage training in laparoscopic colorectal surgery in our country, the Braziliam Society of Coloproctology began requiring in 2012 the participation in at least 15 videolaparoscopic colectomis and a theoretical-practical course with a minimum of 15 hours of duration as a prerequisite for the specialist title examination. Such actions are a breakthrough in the development of the colorectal laparoscopic surgery in Brazil, and it is likely that in a few years, similar to what happened in the U.S., the percentage of laparoscopic colectomy performed in our country also increases.

Given the current efforts to expand the use of colorectal laparoscopy, proper training becomes crucial. However, although there are several studies with data on laparoscopic colectomy learning curves,[20-26] literature reporting the effects of laparoscopic training on postoperative complication rates is still scarce. More specifically, according to our literature review, this is the first study to demonstrate consistently that laparoscopic training is safe.

Our study has the typical limitations of a retrospective study. In our study, we chose to use the ACS-NSQIP database. Thus, one could argue that the availability of laparoscopic instruments more appropriate in some U.S. hospitals compared to Brazilian hospitals would limit the applicability of our results to the reality of our country. However, we believe that these potential differences in the material used would not be sufficiently important to influence the operative results, a fact corroborated by the existing similarity between the postoperative results of the Brazilian and American studies.[1,2,6,27-29]

Moreover, using the ACS-NSQIP database, we had a large sample of patients from various U.S. services, many of them similar to the Brazilian reality, which gives our study the ability to identify or exclude possible, discrete but important, associations between resident participation in laparoscopic colectomy and postoperative morbidity, which would not be evident in smaller samples.

However, the same large sample of patients helping to detect more subtle associations may also be responsible for generating statistically significant but not necessarily clinically significant differences, such as abdominal abscess rates among the R1-2, R3-4, and > R4 groups.

Unfortunately, it was not possible to analyze data on conversion rates to open colectomy, ureteral injury, enterotomies, and anastomotic fistula, as this information is not collected in the ACS-NSQIP database.[7] However, we tried to overcome these limitations by analyzing the rates of abdominal abscess and reoperation, as anastomotic fistulas with more prevalent symptoms and visceral lesions of greater morbidity generally evolve with abdominal abscesses or require early reoperations.[30]

Conclusion

Despite the aforementioned limitations, we conclude that laparoscopic training during residency may be performed safely without endangering the operated patient's integrity.

Conflict of interest

The authors declare no conflict of interest.

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