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## Original article

# Implementation of a colorectal laparoscopic surgical program - short-term outcomes and conversion rates

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## ABSTRACT

**Purpose:** although laparoscopic surgery for the treatment of colorectal diseases represents a major advance, it is currently performed in less than a third of patients undergoing colectomies. The aim of this study is to analyze the initial results of laparoscopic-assisted colorectal surgeries (LACS) performed in a department of Coloproctology in a tertiary hospital, as well as to study the impact of age, gender and body mass index (BMI) and use of ultrasonic scissors or vessel sealing devices in relation to conversion rate.

**Methods:** this is a prospective observational study with 215 patients who underwent LACS between January 2006 and June 2010 in the Department of Coloproctology at Felício Rocho Hospital, Belo Horizonte. The data obtained from a specific electronic database included demographics, diagnosis, use of ultrasonic scissors or vessel sealing devices, reason for conversion, duration of hospitalization, lymph node harvest in cancer specimens, complications, and deaths.

**Results:** the laparoscopic-assisted approach corresponded to 36.4% of all colorectal surgeries performed during the study period. Most patients were female (74%), with a mean age of 53.2 years. Ultrasonic scissors or vessel sealing devices were used in 32% of LACS. Specimen extraction and anastomosis were performed through an auxiliary incision in most cases. The overall conversion rate was 12%, with a decrease of 47% after the first year. We did not observe any association between conversion rate and age, gender, BMI, and the use of ultrasonic scissors and vessel sealing devices. The average hospital stay was of 7.7 days and the overall rate of complications was 20%, including 10 anastomotic leaks (4.65%). The rate of postoperative mortality was 1.86%.

**Conclusions:** despite the difficulties related to the learning curve and unavailability of ultrasonic scissors or vessel sealing devices in most cases, the implementation of LACS in our department can be considered successful in relation to short-term results and conversion rates.

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## Implementação de programa de cirurgia colorretal laparoscópica - resultados de curto prazo e taxas de conversão

### R E S U M O

#### Palavras-chave:

Laparoscopia  
Cirurgia colorretal  
Morbidade  
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Conversão

**Objetivo:** embora o uso da cirurgia laparoscópica no tratamento de doenças colorretais represente um avanço significativo, é realizada atualmente em menos de um terço dos pacientes submetidos à colectomias. O objetivo desse estudo é analisar os resultados iniciais de cirurgias colorretais laparoscópicas vídeo-assistidas (LACS) realizadas no departamento de Coloproctologia de hospital terciário, bem como estudar o impacto da idade, sexo e índice de massa corporal (IMC) e a utilização de tesoura ultrassônica ou dispositivos para selamento hemostático dos vasos em relação à taxa de conversão.

**Métodos:** esse é um estudo observacional prospectivo com 215 pacientes submetidos à LACS entre janeiro de 2006 e junho de 2010 no Departamento de Coloproctologia do Hospital Felício Rocho, em Belo Horizonte. Os dados obtidos a partir de uma base de dados eletrônica específica incluíram dados demográficos, diagnóstico, uso de tesouras ultrassônicas ou dispositivos para selamento hemostático dos vasos, taxa de conversão, tempo de hospitalização, linfonodo dissecados na peça cirúrgica, complicações e mortes.

**Resultados:** a abordagem laparoscópica correspondeu a 36,4% de todas as cirurgias colorretais realizadas durante o período de estudo. A maioria dos pacientes era do sexo feminino (74%), com idade média de 53,2 anos. A tesoura ultrassônica ou dispositivos para selamento hemostático dos vasos foram utilizados em 32% das LACS. A extração de amostras e a anastomose foram realizadas através de uma incisão auxiliar na maioria dos casos. A taxa de conversão global foi de 12%, com uma diminuição de 47% após o primeiro ano. Não observamos associação entre a taxa de conversão e idade, sexo, IMC, bem como a utilização de tesouras ultrassônicas e dispositivos para selamento hemostático dos vasos. O tempo médio de internação foi de 7,7 dias, a taxa global de complicações foi de 20%, incluindo 10 fístulas anastomóticas (4,65%). A taxa de mortalidade pós-operatória foi de 1,86%.

**Conclusões:** apesar das dificuldades relacionadas com a curva de aprendizado e indisponibilidade da tesoura ultrassônica ou dispositivos para selamento hemostático dos vasos na maioria dos casos, a implementação de LACS em nosso departamento pode ser considerada bem sucedida em relação aos resultados de curto prazo e taxas de conversão.

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## Introduction

Although laparoscopic surgery for treatment of colorectal diseases, described in 1990,<sup>1</sup> represents a major advance in the field of colorectal surgery, it is currently used in less than a third of the patients undergoing colectomy worldwide.

At first there was great enthusiasm for the method, however its use for treatment of colorectal neoplasms was frustrating because of a supposed high incidence of recurrence in the portals, reported in early publications. Later studies showed that such findings were anecdotal and did not represent reality; subsequently, a series of publications reported the oncologic safety of this new technique.<sup>2</sup> Careful analysis of this data led to great enthusiasm for the method, with a geometric increase in the number of patients operated with the laparoscopic approach.

The establishment of a center for laparoscopic surgery is an important event, since it allows for dissemination of knowledge and increases access to the new technology. Difficulties associated with the implementation of a new laparoscopic surgery center include a long learning curve and professional and institutional costs related to the introduction of new and expensive technology. In addition, a high

conversion rate to open surgery, especially at the beginning of the learning curve, is another source of discouragement for the consolidation of the technique. Several factors, such as obesity, gender and the unavailability of special cutting and dissecting instruments, like ultrasonic scissors and vessel sealing devices, are some of most important variables involved in the conversion rates.

This study aims to analyze the initial results of the implementation of the practice of laparoscopic-assisted colorectal surgeries (LACS) in a specialized Department of Colorectal Surgery in a tertiary hospital and the possible factors involved in conversion to the open technique.

## Materials and methods

This is a prospective observational study designed to observe the results of all patients submitted to LACS performed between January 2006 and May 2010 in the Department of Coloproctology at Felício Rocho Hospital, a tertiary health center located in Belo Horizonte. In the last two years of evaluation, we carried out analysis of factors possibly associated with conversion rate to open surgery in 112 consecutive patients.

Data obtained from a specific electronic database included demographics, diagnosis, use of ultrasonic scissors or vessel

sealing devices, reason for conversion, duration of hospital stay, lymph node harvest in cancer specimens, complications, and deaths. Surgical mortality was defined as deaths occurring within 30 days of surgery.

Sodium phosphate mechanic bowel preparation and antibiotic prophylaxis with intravenous metronidazole and ceftriaxone were used in all cases. Patients were safely positioned and submitted to general anesthesia, with special care to avoid prolonged ventilation before intubation and overhydrating, to minimize intestinal distention. We used five trocars, located in the periumbilical region, at the right and left iliac fossa, and at the right and left hypochondrium. The main vessels were dissected at their origin, then clipped and sectioned. The colon and rectum were dissected, in most cases, with scissors and monopolar electrocoagulation. When available, ultrasonic scissors or vessel sealing devices were used.

Anastomoses were performed with linear cutting in cases of right and transverse colectomies, and curve linear-cutting and circular endoanal staplers were used in cases of left colectomies or anterior resection. Small transumbilical or supra-pubic auxiliary incisions were performed for stapling and specimen removal, since laparoscopic staplers were unavailable in most cases.

Conversion cases were considered to have occurred when the laparoscopic procedure was initiated but could not be completed laparoscopically, requiring vertical or auxiliary incisions larger than 8 cm. Age, gender, body mass index (BMI) and use of ultrasonic scissors or vessel sealing devices were evaluated as possible factors related to conversion.

Statistical analysis was performed using Epi-Info 7 software (public domain, [www.cdc.gov/epiinfo](http://www.cdc.gov/epiinfo)). Categorical variables are summarized as frequencies and percentages. Quantitative variables are summarized as mean  $\pm$  standard deviation. Tests for association between the conversion and non-conversion groups and categorical variables were performed using the Fisher Test. A *p* value of 0.05 was accepted as statistically significant.

This study was submitted and approved by Ethics Committee on research of Felicio Rocho Hospital.

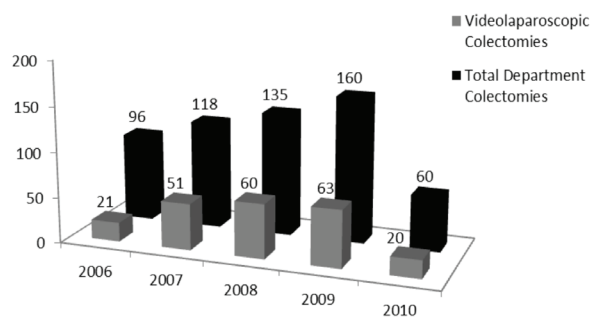
## Results

Between January 2006 and June 2010, 215 laparoscopic colorectal surgeries were performed. The mean age of patients was 53.2 years and 74% were female. The percentage of LACS in relation to the total caseload of colorectal surgeries was 36.4% during the study period, with a progressive increase since its implementation (Fig. 1).

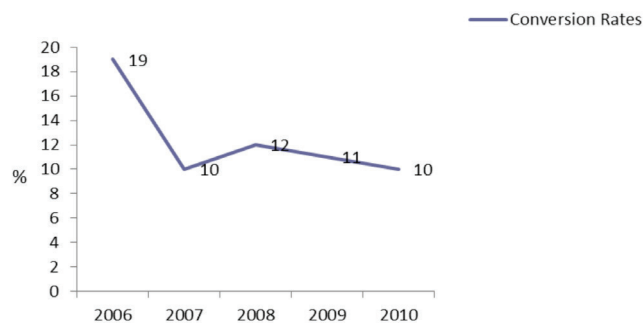
The overall conversion rate was 12%, with a significant drop after the first year (Fig. 2). The main causes for conversion were advanced lesions (27%), adhesions (20%) and technical difficulties (20%).

The mean hospital stay was 7.7 days. The overall complication rate was 20%, and the death rate, 1.86%. There were 10 cases of anastomotic leakages (4.65%).

There were four deaths all directly related to procedures: one due to inadvertent gastric injury, one due to an ischemia of the colon, one due to an anastomotic fistula, and one due to postoperative gastric dilatation followed by rupture. The surgical laparoscopic specimen had an average of 13.3 lymph nodes dissected, compared with an average of 14 lymph



**Fig. 1 - Colectomies performed by videolaparoscopy related to total department colectomies per year.**

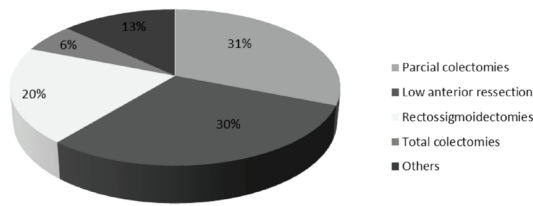


**Fig. 2 - Evaluation of conversion rates.**

nodes harvested in the open surgery group from 2009 (unpublished data).

Partial colectomy (right, left and transverse) accounted for 31% of cases, low anterior resection for 30%, rectosigmoidectomy for 20%, total colectomy for 6%, and other procedures, including abdominoperineal excisions, for 13% (Fig. 3). About 84% of surgeries were indicated for cancer, 8% for diverticular disease and 8% for other causes, such as endometriosis. Ultrasonic scissors or vessel sealing devices were used in 69 cases, representing 32.1% of surgeries.

In the last two years of evaluation, we analyzed factors possibly associated with conversion rate to open surgery in 112 consecutive patients. In this group the conversion rate was 14.3%. There was no significant correlation between conversion rates and age, sex, BMI or use of ultrasonic scissors or vessel sealing devices (Table 1).



**Fig. 3 - Types of laparoscopic colorectal surgeries performed (n = 215).**

**Table 1 - Correlation between BMI, gender, age and ultrasonic or vessel sealing dissection, and conversion to open surgery.**

	Converted (n)	Not converted (n)	p
BMI > 30	5	16	0.1141
BMI < 30	8	68	
BMI > 25	10	47	
BMI < 25	3	37	
Ultrasonic dissection	3	25	0.1290
Not ultrasonic or vessel sealing dissection	13	71	0.3918
Age > 70	6	23	0.1984
Age < 70	10	73	
Male	8	43	0.4516
Female	8	53	

**Discussion**

The safety of laparoscopic colorectal surgery has been proven in several clinical studies<sup>2,3,4</sup> and this kind of surgery has become the preferred approach in large centers. Particularly for oncologic safety, the initial doubts have been clarified with studies that showed a similar number of lymph nodes in specimens using either the laparoscopic or open technique.<sup>3,4</sup> This study also confirms the similarity between the two approaches, even during the learning curve.

Laparoscopic colorectal surgery decreased the duration of hospital stays by two to three days in most published series.<sup>5</sup> However, fast-track proponents argue that this difference can be attributed largely to postoperative rehabilitation programs –not necessarily due to the laparoscopic approach.<sup>5</sup> These authors claim that the wide variation in numerous studies<sup>6</sup> of hospital stay duration (5.7 to 18.7 days) is a direct consequence of the different practices in the postoperative period, with fast-track postoperative programs presenting the shortest lengths. Schlachta et al.<sup>7</sup> suggest that the learning curve in laparoscopic surgery also influences the duration of hospital stay and reports that there was a reduction in length after

the first 30 cases of laparoscopic colorectal surgeries. In our department, mean hospital stay for LACS was 7.7 days, with no standard protocol for the postoperative period. At the discretion of the attending physician and dependent on the clinical outcome, increments in diet are progressively adopted.

Large prospective and randomized studies, such as the COLOR trial, have shown a 1% mortality rate for laparoscopic colorectal surgeries, with a rate of anastomotic leakages of 3%, these rates are slightly lower than those observed in the present study (1,86% and 4,65%, respectively).

The conversion rates reported in comparative studies ranged from 4% to 28%.<sup>6</sup> The most common causes were the invasion of adjacent structures, adhesions, technical difficulties, and bleeding. The overall rate of conversion in the present study was 12% and the main causes were similar to those reported in the literature.

The conversion rate is heavily influenced by the learning curve, with a reduction after 30 laparoscopic colectomies.<sup>7</sup> In a study of 461 patients operated by three surgeons, Schlachta et al.<sup>7</sup> showed a drop in the rate of conversion, from 13.5% to 9.7%, after the first 30 cases. In this study, we observed an initial decline in the conversion rates from 2006 to 2007, probably due to the improvement of the team’s learning curve, which leveled off at about 10%.

Despite the great expansion of the technique, the use of laparoscopy in colorectal surgery is still generally uncommon.<sup>8</sup> In the United States,<sup>9</sup> 3.3% of colectomies are performed with this approach, while in Italy<sup>10</sup> this proportion reaches 19.5% and varies between 5% and 10% in Taiwan.<sup>11</sup> Furthermore, laparoscopic colorectal surgery is concentrated in some reference centers, making it an innovation unavailable for most patients with colorectal diseases around the world.

We observed an increase in the percentage of LACS, in relation to the total number of colectomies performed, since its implementation in our department, stabilizing at around 40% within two years. This percentage demonstrates not only technical improvement, but also the team’s motivation, regardless of technical limitations.

The availability of ultrasonic scissors or vessel sealing devices has been restricted by cost containment imposed by health plans and, above all, the public health system. In this way, most of our LACS were performed using only conventional laparoscopic scissors with monopolar electrocoagulation. Despite this technical drawback, the percentage of LACS remains high, with no associated increase in complications or conversion rates.

Gervaz et al.<sup>12</sup> and Agha et al.<sup>13</sup> have demonstrated that the conversion of laparoscopic to open surgery results in prolonged hospitalization and increased complications in the early postoperative period. With this background, some criteria for patient selection have been proposed. Obesity is a factor often involved in higher technical difficulty in laparoscopic surgery.<sup>14</sup> Pikarsky et al.<sup>14</sup> published a study comparing 31 obese and 131 non-obese patients undergoing similar elective laparoscopic colorectal procedures, and observed higher conversion rates in the obese patients group (39% versus 13.5%, p = 0.01).

In a comparative study with patients submitted to laparoscopic colectomy for sigmoid diverticulitis, Tuech et al.<sup>15</sup> noted



the evolution of 29 patients with normal weight (BMI between 18 and 25), 27 overweight patients (BMI between 25 and 30), and 21 obese patients (BMI between 30 and 39). There was no difference in conversion rates (17.2%, 14.8% and 19%, respectively) and morbidity (17.2%, 14.8% and 19%) among the three groups. Campos,<sup>16</sup> studying the risks of old age and obesity in patients submitted to LACS, observed an increase in technical difficulties, but did not consider these individual features as important limitations for the procedure, when performed by surgical teams with appropriate training.

In our series, neither excess weight (BMI greater than 25), nor obesity (BMI greater than 30) was statistically associated with the conversion factors. Likewise, analyzing patients over 70 years of age, we observed no significant conversion rate increase ( $p = 0.1984$ ).

Law et al.<sup>17</sup> compared the outcomes of patients over 70 years of age submitted to open colectomy ( $n = 89$ ) or LACS ( $n = 65$ ). The group that underwent laparoscopic resection had earlier return of bowel functions, shorter hospital stays and less cardiopulmonary morbidity. They concluded that surgical teams with proper postoperative training to handle elderly patients could perform LACS with very good outcomes.

In prospective studies of colorectal laparoscopic surgery, Schwandner et al. and Thorpe et al. identified the male gender as a significant conversion factor, using univariate and multivariate analysis, respectively.<sup>18,19</sup> In a study of 300 patients Agha et al. also identified the males with a high BMI as predisposing factors for conversion.<sup>13</sup> In our assessment whether a patient was male was not significantly associated with the high conversion rate ( $p = 0.4516$ ).

Electronic devices using high frequency ultrasonic energy or bipolar electrocoagulation vessel sealing were introduced in laparoscopic surgery with the promise of making dissection and coagulation safer and more efficient. Morino et al.<sup>20</sup> performed a study with 146 patients undergoing laparoscopic colectomy, divided into two groups: one using ultrasonic dissection (UD), and another with standard electrical dissection (SED). The overall rate of conversion to open surgery was 11.6%, with no statistical difference between the two groups. There was no significant difference between the surgical time (UD 93 minutes vs. SED 102.6 minutes,  $p = 0.46$ ). However, 20% of cases that started with SED were converted into ultrasonic dissection due to technical difficulties. There were significant differences in perioperative blood loss between groups (UD = 140.8 mL versus SED = 182.6 mL,  $p = 0.032$ ), which did not result in increased complications or morbidity. The study concludes that the use of ultrasonic dissection facilitates the handling of difficult cases and minimizes blood loss. However, the vast majority of cases can be handled with standard electrical dissection. The authors believe that, due to the costs of the ultrasonic device, its use should be limited to the most difficult cases.

In our study, there was no difference in conversion rate in cases performed with or without ultrasonic or sealing dissection ( $p = 0.3918$ ). The costs of these devices are a very important issue in developing countries; therefore, we also recommend the use of ultrasonic dissection in patients for whom a procedure is expected to be more difficult, such as those who are obese or who had had previous surgery or diverticulitis, cases that present a higher inci-

dence of adhesions. More complex surgeries, such as total colectomy or proctocolectomy should also be performed with these devices.

## Conclusions

The implementation of the laparoscopic surgical practice in a Department of Coloproctology can be achieved with good short-term results in terms of oncologic safety, morbidity, mortality and conversion rates, which were not related to age, gender, BMI and the use of ultrasonic scissors or vessel sealing device. Our favorable results may be useful as a stimulus to others to initiate this kind of minimally invasive surgery, mainly in specialized and high-volume departments with well-trained teams.

## Conflicts of interest

The authors declare no conflicts of interest.

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