

Laparoscopic versus Open Surgery in Colorectal Cancer: Is Laparoscopy Safe Enough?

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ABSTRACT

Objective: To compare the early and long-term outcomes of laparoscopic and open surgery in colorectal cancer stages 1-3.

Study Design: Comparative study.

Place and Duration of Study: Department of Gastroenterological Surgery, Health Sciences University, Gulhane Training and Research Hospital, Ankara, Turkey, from January 1, 2017 to January 1, 2021.

Methodology: A total of 142 patients, who underwent surgery for colorectal cancer with a follow-up period of at least 3 years, were included in the study. The groups of the patients; (Group A) treated with laparoscopic surgery, and (Group B) treated with open surgery, were compared in respect of general characteristics, short and long-term morbidity, mortality, and oncological outcomes.

Results: Body Mass Index (BMI) values were higher, and the duration of surgery was shorter in Group A patients compared to Group B ($p < 0.05$). The re-operation rate (12.2%) was observed to be statistically and significantly high in Group B ($p = 0.040$). In comparison of the oncological outcomes, a significantly greater number of metastatic lymph nodes were removed in Group B ($p = 0.004$). Stage 2A (31.1%) was observed at a higher frequency in Group A, and Stage 3C was significantly higher in Group B (25.7%) ($p = 0.037$). There was no statistically significant difference between the groups in terms of the number of lymph nodes removed, insufficient lymph nodes dissection (< 12), surgical margin negativity, local recurrence, and distant metastasis.

Conclusion: For the selected patient group with early-stage colorectal tumours, laparoscopic surgery has short-term oncological outcomes similar to those of open surgery and relatively lower morbidity and mortality rates.

Key Words: Laparoscopic surgery, Colorectal cancer, Open surgery, oncological Outcomes.

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INTRODUCTION

According to the Globacan 2018 data, the incidence of new cases of colorectal cancer (CRC) was 1.8 million which increased to 1.93 million in 2020. It is estimated that this figure will be as high as 3.2 million by 2040.^{1,2} As laparoscopic surgery is a minimally invasive intervention, it has been widely used in the colorectal cancer treatment.³ In the past 20 years, laparoscopic surgery has been shown to be as safe and effective as conventional surgery in respect of success in obtaining negative surgical margins, local recurrence, wound site infection, overall survival, and intraoperative blood loss.⁴

The learning curve of laparoscopic surgery is relatively long. Laparoscopic surgery is more preferred in tumours that do not reach the serosa and do not involve lymph nodes (stage 1-2A). This study was performed in a single centre by the surgeons. Therefore, all the patients were randomised to surgery, except for stage 4 patients with distant metastases. The aim of this study was to compare the early and long-term results of the laparoscopic and open surgery in the treatment of stage 1-3 colorectal cancer.

METHODOLOGY

This comparative study included 142 patients, who underwent surgery for colorectal cancer (adenocarcinoma) at the University of Health Sciences, Gulhane Training and Research Hospital, Ankara, Turkey, between January 2017 and January 2021. The operations were performed by the surgeons in a single centre. The type of operation (laparoscopic or open) was selected according to the patient's primary surgery. Therefore, the distribution of the patients into the groups was completely random.

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Table I: Comparisons of the general characteristics of the groups.

	Group A mean ±SD/M (IQR)	Group B mean ±SD/M (IQR)	Total mean ±SD/M (IQR)	P
Age (years)	60.87±11.82	64.88±14.42	62.96±13.35	0.074*
BMI	26 (3.2)	25 (3.1)	25.75 (3.1)	0.015#
Operation time (mins)	220 (82.5)	187.5 (50)	200 (60)	<0.001#
Length of stay in hospital (days)	10 (5)	11.5 (7)	11 (7)	<0.010#
Gender n(%)				
Female	20 (29.4)	28 (37.8)	48 (33.8)	<0.2891
Male	48 (70.6)	46 (62.2)	94 (66.2)	
Tumour localisation n(%)				
Sigmoid	12(17.6)	23 (31.1)	35 (24.6)	0.0302
Hepatic flexura	2(2.9)	1 (1.4)	3(2.1)	
Cecum	5(7.4)	11 (14.9)	16(11.3)	
Rectum	32(47.1)	15 (20.3)	47(33.1)	
Transverse	0(0)	4 (5.4)	4(2.8)	
Appendix	1(1.5)	1 (1.4)	2(1.4)	
Rectosigmoid	7(10.3)	7 (9.5)	14(9.9)	
Left colon	3(4.4)	3 (4.1)	6(4.2)	
Splenic flexura	1(1.5)	2 (2.7)	3(2.1)	
Synchronous	2(2.9)	1 (1.4)	3(2.1)	
Right colon	3(4.4)	6 (8.1)	9(6.3)	

p*: Student's t-test; p#: Mann-Whitney U test; p1: Pearson's chi-square test; p2: Fisher's exact test; SD: Standard deviation; and M: Median.

Table II: Comparison of complications between the groups.

	Group (A) n (%)	Group (B) n (%)	Total	p
30-day mortality	1 (1.5)	3 (4.2)	4 (2.9)	0.620
Ileus	1 (1.5)	3 (4.1)	4 (2.9)	0.622
Wound site infection	5 (7.4)	12 (16.2)	17 (12)	0.125
Anastomosis leakage	0 (0)	3 (4.3)	3 (2.2)	0.245
Intra-abdominal sepsis	6 (8.8)	9 (12.2)	15 (10.6)	0.518
Stoma leakage	2 (2.9)	1 (1.4)	3 (2.1)	0.526
Re-operation	2 (2.9)	9 (12.2)	11 (7.7)	0.040
Pulmonary d	6 (8.8)	6 (8.1)	12 (8.5)	0.878
Renal d	8 (11.8)	15 (20.3)	23 (16.2)	0.181

n(%) p-value was obtained from the Pearson's chi-square test.

Table III: Oncological outcomes of the groups.

	Group A M(IQR)	Group B M(IQR)	Total M(IQR)	p
Lymph nodes removed	17.5 (17)	18.5 (16)	18 (16)	0.786*
Metastatic lymph nodes	0 (1)	0.5 (3)	0 (1)	0.004*
TNM				
1	19 (27.9)	13 (17.6)	32 (22.5)	
2	0 (0)	1 (1.4)	1 (0.7)	
2A	28 (41.2)	18 (24.3)	46 (32.4)	
2B	1 (1.5)	3 (4.1)	4 (2.8)	
2C	0 (0)	1 (1.4)	1 (0.7)	
3A	2 (2.9)	3 (4.1)	5 (3.5)	
3B	12 (17.6)	16 (21.6)	28 (19.7)	
3C	6 (8.8)	19 (25.7)	25 (17.6)	
Local recurrence n(%)	2 (3)	7 (9.5)	9 (6.4)	0.170 ¹
Distant metastasis				
Liver	4 (5.9)	5 (6.8)	9 (6.3)	
Lungs	2 (2.9)	2 (2.7)	4 (2.8)	0.975 ¹
Surgical margin	0 (0)	0 (0)	0 (0)	
Insufficient lymph nodes	19 (27.9)	16 (21.6)	35 (24.6)	0.438*

p¹: Pearson's chi-square test; p[#]: Mann-Whitney U test; p*: Student's t-test; p²: Fisher's Exact test; SD: Standard deviation; and M: Median.

Two groups of the patients were compared; one treated with the laparoscopic surgery (Group A, n=68,47.89%) and the other with open surgery (Group B, n=74, 52.11%).

The study inclusion criteria were: age in the range of 18-99 years, diagnosis of colorectal cancer, stage 1-3 colorectal cancer, and elective surgery conditions.

Exclusion criteria were: Stage 4 cancer, recurrent colorectal cancer, if laparoscopy was converted to open surgery, or if surgery was applied under emergency conditions. A record of age, gender, type of operation, total number of the lymph nodes and pathological lymph nodes, and TNM stage (American Joint Committee on Cancer: 7th edition), was made for each operated patient. The data were recorded for analysis in the SPSS program.

Cases with distant metastasis were evaluated by the oncology council. Operability was reviewed, and patients were referred to the medical oncology. The tumour localisation and characteristics were evaluated by the different surgeons in a single centre, and according to the results of this evaluation, either laparoscopic or open surgery was selected for the patient. Loop ileostomy was performed for tumours when the safety of the anastomosis was doubtful. With the postoperative evaluation of the patients by oncology and radiation oncology specialists, the necessary adjuvant treatments were administered. Follow-up with colonoscopy was made at the end of one year, and subsequent follow-ups were applied 3 times a year for the first two years, then once every 6 months for the following 3 years. Complete blood count, biochemical tests, and tumour markers (CEA, Ca 19-9) were examined at each follow-up visit in addition to the history and physical examination. If necessary, abdominal ultrasound and tomography were also taken. The study was approved by the Health Sciences University Gülhane Scientific Research Ethics Committee (decision No. 2020-456).

The Data were analysed statistically using SPSS for Windows vn. 24.0 software. Conformity of the data to normal distribution was assessed with the Shapiro-Wilk test. In comparisons of the variables between the groups, the Student's t-test was used for normal parametric assumptions and the Mann-Whitney U test for non-normal distribution. The analysis of relationship between the categorical variables was done using the Pearson's chi-square test and Fisher's exact test. Descriptive statistics were shown as mean \pm standard deviation (SD) or median values for numerical variables and number (n) and percentage (%) for the categorical variables. A $p < 0.05$ was considered statistically significant.

RESULTS

Both groups of the patients were of nearly similar age. The BMI values were higher and the mean operation time was longer in Group A than in Group B ($p < 0.05$). The length of stay in hospital was statistically and significantly longer in Group B than in Group A ($p < 0.001$). Sigmoid tumours were seen at a significantly higher rate ($n=23$, 31.1%) in Group B, and rectum tumours were observed at a significantly higher rate in Group A ($n=32$, 47.1%, $p=0.030$, Table I).

Complications such as mortality in the first 30 days, ileus, wound site infection, anastomosis leakage, intra-abdominal sepsis, postoperative development of renal failure, and lung pathologies were seen more in Group B, but not at a statistically significant level. The re-operation rate ($n=9$, 12.2%) in Group B was determined to be statistically and significantly high ($p=0.040$, Table II).

In comparison of the oncological outcomes, a significantly higher number of metastatic lymph nodes were removed in Group B ($p=0.004$). The frequency of Stage 2A ($n=28$, 41.17%) was observed to be higher in Group A, and Stage 3C

was significantly higher in Group B ($n=19$, 25.7%, $p=0.037$). There was no statistically significant difference between the groups in terms of the number of lymph nodes removed, insufficient lymph nodes dissection (<12), surgical margin negativity, local recurrence, and distant metastasis (Table III).

In six (4.16%) patients, laparoscopic surgery was started and had converted to open surgery because of technical difficulties.

DISCUSSION

Laparoscopic surgery is a minimally invasive intervention. A limited abdominal incision prevents unnecessary blood loss and too much traction of the abdominal organs. Thus, immune activity and catabolism associated with surgical trauma are reduced.⁵ In colorectal cancers, laparoscopic surgery has advantages compared to the open surgery. There is less postoperative pain, length of stay in hospital is shorter and return to work is earlier.⁶ In the current study, the length of stay in hospital was statistically and significantly shorter in the laparoscopic group ($p < 0.001$). In the ALCCaS study, postoperative quality of life was seen to be increased with the laparoscopic surgery.⁷

After the case series of laparoscopic colorectal surgery published by Jakops *et al.* in 1991, there started to be a rapid increase in its use worldwide.⁸ As surgeons have gained experience in this period of approximately 30 years, the trend for laparoscopy has increased. According to the Korean National Database Data in 2018, laparoscopic colorectal surgery has been performed at the rate of 78.5%.⁹ However, as industry has also been involved in this process, oncological results, mortality, and morbidity have been constantly discussed. The cost of the laparoscopic colorectal surgery has been investigated in several studies, but no consensus has been reached. While some studies have shown laparoscopic surgery to be more expensive, others have shown higher costs of open surgery, and some have shown no difference.⁶

The scope of laparoscopic colorectal surgery has broadened over time. It has been reported that it can be safely used in the elderly patients, in patients with obstruction following colonic stenting, and in patients with synchronous liver metastasis.^{3,10,11}

In the prospective multi-centre COLOR study (Colon cancer Laparoscopic or Open Resection), comparisons were made between the early results of laparoscopic and open colorectal surgery. In the group treated with laparoscopic surgery, advantages were seen such as less blood loss, shorter operating time, shorter length of stay in hospital, early return to work, and an earlier start of the intestinal functions. No difference was determined between the groups in terms of the number of lymph nodes removed and the bowel length.⁵

The long-term results of the COLOR study showed that the 3-year disease-free survival durations were similar in both groups.¹²

Biondi *et al.* compared laparoscopic and open surgery in patients with stage 1-3 colorectal cancer. The early results of laparoscopic surgery were better, and the long-term results were seen to be similar to those of the open surgery.¹³ In the literature, opinions on the laparoscopic colorectal surgery of the colon section are similar. In several countries, it is accepted as standard surgery, but there are different opinions regarding the rectum. In a meta-analysis by Nienhuser *et al.* laparoscopic rectum surgery was reported to be more advantageous in respect of the total mesorectal excision (TME) and the number of lymph nodes removed, and the long-term oncological results were found to be similar to those of the open surgery.¹⁴

The phase 3 COLOR study examined 1044 selected cases of rectum cancer operated on by the experienced surgeons. The oncological and pathological results of the patients operated with laparoscopic surgery were similar to those of patients who underwent open surgery, but the postoperative recovery of the laparoscopic group was found to be better. Both groups were followed up for 3 years, and were found to be similar in terms of pelvic or perineal local recurrence, disease-free survival, and overall survival.^{15,16}

Moreover, in two randomised, controlled studies (ACOSOG Z6051 and the AlaCaRT), which compared laparoscopic surgery and open surgery, laparoscopic surgery was revealed not to be inferior to the open surgery in any aspect.¹⁷⁻¹⁹

In the current study, pathology samples of the patients, operated on with the laparoscopic (Group A) or open surgery technique (Group B) because of colorectal cancer, were examined. There was no statistically significant difference between the groups in terms of the number of lymph nodes removed, insufficient lymph node dissection (<12), surgical margin negativity, local recurrence, and distant metastasis. The number of metastatic lymph nodes removed was seen to be statistically and significantly higher in Group B (p=0.004). During the 18-month follow-up period, the rates of local recurrence and distant metastasis were similar in the two groups.

Complications such as mortality in the first 30 days, ileus, wound site infection, anastomosis leakage, intra-abdominal sepsis, postoperative development of renal failure, and lung pathologies were seen more in Group B, but not at a statistically significant level. The re-operation rate (12.2%) in Group B was determined to be statistically and significantly high (p=0.040, Table II). The patients treated with laparoscopic surgery were selected as those more often with rectum localisation and stage 2A tumours.

The rate of conversion from laparoscopic to the open surgery varies according to the experience of the surgeon and the status of the patient. This rate has been reported as 1.2%-34% in the literature.¹⁵ In the current study, the surgery was started laparoscopically and had converted to the open surgery because of technical difficulties in 6 (4.16%) patients. This study was retrospective and conducted in a single centre, and the patient selection was subjective as operations were recorded from the several surgeons in the same centre.

CONCLUSION

In a selected patient group with early-stage colorectal tumours, laparoscopic surgery has early oncological outcomes similar to those of open surgery, and relatively lower morbidity and mortality rates.

ETHICAL APPROVAL:

The study was approved by the Health Sciences University Gülhane Scientific Research Ethics Committee (decision No. 2020-456).

PATIENT'S CONSENT:

Informed consents were taken.

COMPETING INTEREST:

The authors declared no competing interest.

AUTHORS' CONTRIBUTION:

MAU: Conceptualisation, design, literature review, methodology, project administration, data curation, visualisation, and writing the original draft.

AD: Data curation, statistical analysis, supervision, writing the original draft, and methodology.

MAU, AS: Data curation, literature review, writing the original draft, and methodology.

All the authors have approved the final version of the manuscript to be published.

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