ORIGINAL ARTICLE

Outcomes of Laparoscopic vs Open Surgery for Colorectal Cancers

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Abstract

Introduction: Colorectal malignancies are one of the most common cancers diagnosed globally. Minimally invasive surgery has gained importance in treating these cancers. However, there is still skepticism with regard to their oncologic outcomes compared to open surgery. With this study, we aim to compare and evaluate both modalities of therapy.

Materials and methods: We conducted a prospective, observational study at Kasturba Hospital, Manipal, Karnataka, India between 15 September 2019 and 15 September 2021. A total of 79 patients were recruited in the study and considered in the final analysis, out of which 33 underwent surgery by laparoscopic technique) and 46 underwent surgery by open technique. Both groups were weighed against each other in relation to oncologic outcomes, complications of the surgery, duration of stay in the hospital, cost, and other variables.

Results: Both groups were similar with respect to oncologic outcomes, surgical complications, duration of stay in the hospital, and cost.

Conclusion: Laparoscopic surgeries are comparable to open surgeries for colorectal cancers with regard to outcome, complications, and cost and should be considered when planning surgery for such malignancies.

Keywords: Colorectal surgery, Hospital cost, Oncologic outcomes, Open surgery.

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Introduction

In industrialized countries, cancers of the colon and rectum are ranked third in terms of prevalence and are the third most frequent cause of mortality related to cancer in both sexes.[1] When compared to open colorectal surgery, various prospectively randomized studies and meta-analyses of laparoscopic colorectal surgery have found that laparoscopic colorectal surgery had better postoperative outcomes, which included less pain, minimal scar, quick normalization of gastrointestinal functioning, short stay in hospital, with comparable survival in long-term.[2] Due to these benefits, laparoscopic surgery for cancers of colon and rectum has gained widespread acceptance as a viable alternative to traditional open surgery.[3] Despite its potential benefits, laparoscopic aided surgery is not widely practiced for surgical therapy of cancers of the colon and rectum due to concerns about its oncological outcomes. In our study, we set out to assess and compare laparoscopic and open colorectal surgeries, in an attempt to improve our future practice and outcomes.

Aim

To evaluate and compare the outcomes of laparoscopic and open surgeries for cancers of the colon and rectum.

Objectives

- To assess and compare the oncological quality of laparoscopic and open colorectal surgeries for malignancies with respect to circumferential, proximal, and distal margins, and the lymph nodal number retrieved.
- To compare complications between the two groups, which included the incidence of anastomotic leaks, surgical site infections (SSIs) and the need for stoma formation.

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Materials and Methods

Ours is a prospective observational study of individuals, who underwent surgery for colorectal malignancy by laparoscopic or open technique, and who fulfilled the inclusion criteria, in Kasturba Hospital, Manipal, Karnataka, India. The study period was from 15th September 2019 to 15th September 2021. The total number of patients included was 79. All patients were consented to before recruitment. A comparison of circumferential resection margin, proximal margins, distal margins, and the lymph nodal number dissected was made, to establish the oncological quality of the surgery. Perioperative parameters like duration of surgery, loss of blood, and recovery from surgery with respect to initiation of oral feeds and number of days of stay in hospital were studied. Both groups were compared with respect to the rate of complications such as SSIs and anastomotic leaks, and the requirement of a diversion stoma. All individuals aged 18 and above, with a histopathologically confirmed diagnosis of colorectal malignancy undergoing surgery were included in the study. Patients diagnosed

to have colorectal malignancy, not planned for surgery (metastatic carcinoma, patient not fit for procedure), patients who did not consent to be a part of the study, and in individuals where laparoscopy was converted to open technique were excluded. Those undergoing emergency surgery were also not included. Circumferential resection margin, proximal margin, distal margin, and lymph nodal number dissected were the primary outcome variables that were studied.

Statistical Analysis

Analysis was done using the Statistical Package for the Social Sciences (SPSS) application. The mean and standard deviation for continuous variables were presented. Percentages were used for categorical variables. The Chi-square test was used to assess the relation among categorical variables. Mann–Whitney *U* analysis was done to compare the mean and median of the two groups. Wilcoxon signed rank analysis was done to compare the paired sample median. A value of *p* below 0.05 was used to determine significance.

Results

A total of 79 participants were recruited and considered for final analysis, from which 33 underwent surgery by laparoscopic technique and 46 underwent open technique.

The mean age of participants undergoing laparoscopic surgery in our study was 53.1 ± 11.1 years, and that of patients undergoing open surgery was 60.8 ± 12.4 years. There was a male preponderance in the open group (29/46 = 63%), but the numbers were almost equal in the laparoscopic group (17/33 = 51.50% for males and 16/33 = 48.50% for females) (Fig. 1). Pain abdomen was the most common presenting complaint in both groups, followed by bleeding per rectum and diarrhea (Fig. 2).

The participants were further subdivided into six groups on the basis of the surgical procedure for subgroup analysis. As shown in

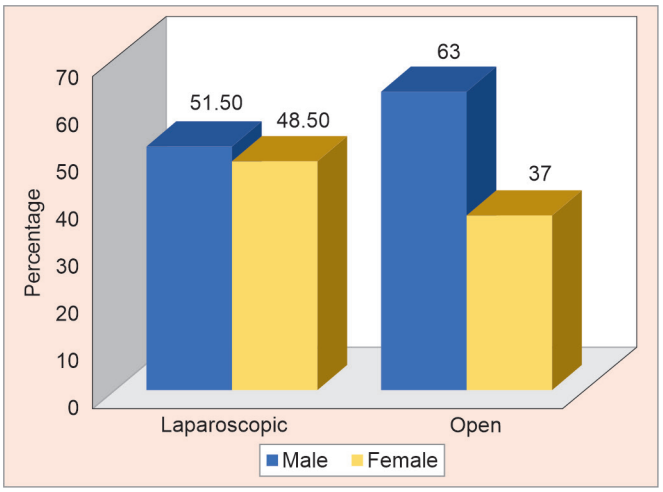

Fig. 1: Sex distribution in the two groups

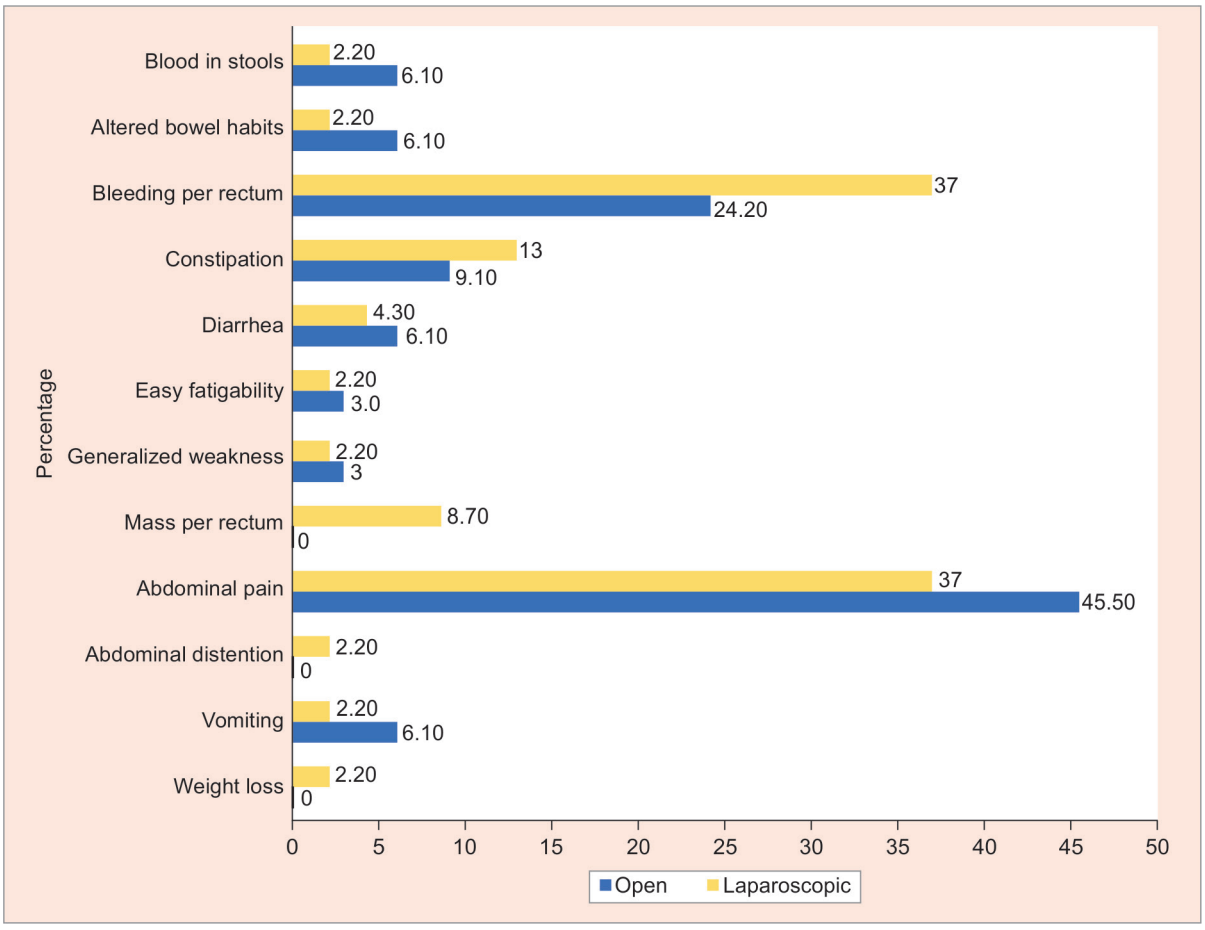

Fig. 2: Presenting complaints and their distribution

Table 1: Types of surgeries performed in each arm

	Laparoscopic	*Open*
Type of surgery	*N*	*N*
Group I – Right-sided surgeries	11	13
Group II – Left-sided surgeries	3	2
Group III – Sigmoid colectomies	1	3
Group IV – Anterior resections	16	17
Group V – Abdominoperineal resections	2	10
Group VI – Total proctocolectomies	0	1
Total	33	46

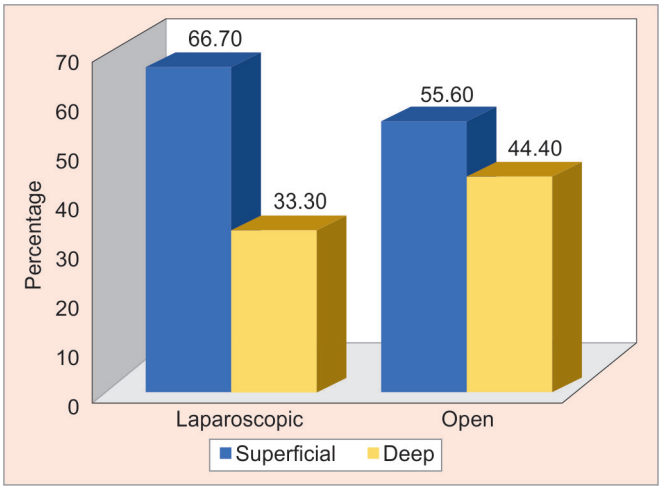

Fig. 3: Type of surgical site infection in each arm

Table 2: Comparison of the various variables between the two arms

Variables	*Laparoscopic (N = 33)*	*Open (N = 46)*	*p-value*
Circumferential margin positivity	1	4	0.308
Mean proximal margin values (cm)	11.8	12.3	0.829
Mean distal margin values (cm)	7.6	7.5	0.933
Mean number of lymph nodes harvested	18.8	20	0.657
Operating time (minutes)	318	264	0.018
Average estimated blood loss (mL)	275.5	416.7	0.095
Mean postoperative day for initiation of oral feeds (days)	2.2	2.9	0.063
Average duration of hospital stays (days)	8.4	9.3	0.229
Average cost of hospitalization (INR)	170,909	166,304	0.769
Incidence of SSI	6	9	0.877
Diversion stoma	2	9	0.087
Number of patients who received NACT/RT	5	15	0.078

INR, Indian rupee; NACT/RT, neoadjuvant chemotherapy/radiotherapy

Table 3: Median pathological stage of the tumor in each arm

	Laparoscopic		*Open*	
Variable	*Colon*	*Rectum*	*Colon*	*Rectum*
NACT/RT received	–	IIA	–	IIA
NACT/RT not received	IIIB	IIB	IIIB	IIIB

NACT/RT, neoadjuvant chemotherapy/radiotherapy

the table (Table 1) above, the clusters were similar with respect to the number of participants. Circumferential positive margin, proximal margin length, distal margin length, and lymph nodes isolated were compared among the groups. All variables were similar with no statistical significance. Average estimated blood loss, mean postoperative day for initiation of oral feeds, average duration of hospital stay, hospital cost, and SSI (Fig. 3) were also compared which were not significantly different among both groups. Duration of surgery was found to be higher in the laparoscopic arm (Table 2). No patients, in either the laparoscopic or the open arm, were diagnosed to have an anastomotic leak, clinically or radiologically. Two patients out of 33 in the laparoscopic arm required the creation of a diversion stoma, compared to nine of the 46 in the group that had open surgery. Additionally, both the patients in the laparoscopic group had a diversion ileostomy, whereas seven in open group had a diversion ileostomy and two had a diversion transverse colostomy.

A total of five patients in the laparoscopic arm received neoadjuvant therapy, in comparison to fifteen patients in the open arm. Among these patients, a total of five patients showed complete response and hence no residual tumor—all in the open arm (Table 3).

Due to a lack of uniform preoperative workup, clinical staging could not be assessed between the groups, and hence pathological staging was examined. The groups were further subdivided to differentiate between colonic and rectal malignancies, due to differences in treatment protocols.

On the final histopathological examination, it was found that the majority of tumors were adenocarcinoma in both arms (97.0% in laparoscopic and 84.8% in open). Five patients had a complete response to neoadjuvant therapy and hence no residual tumor was found. One patient in the open group had a signet ring cell carcinoma, whereas one in the laparoscopic group had a well-differentiated neuroendocrine tumor.

Discussion

The circumferential margin positivity rate in our study was 3.03% for the laparoscopic technique and 8.7% for the open technique, with a *p*-value of 0.308. Thus, both arms showed no significant statistical difference in relation to the margin positivity rate. No circumferential margins were positive in the rectal surgery subgroup of the laparoscopic technique arm, whereas in 2 out of 25 cases, 8% were found to be positive in the open arm. The better percentage in the laparoscopic arm can probably be due to a more complete visualization of the operative field during the surgery, and the lack of tactile guidance, providing the operating surgeon an incentive to take more caution with respect to margin clearance. Circumferential margin is considered positive if the distance from the tumor is below 1 mm, and is an important prognostic marker, as a positive margin increases the chances of recurrence of local disease by 3–4-fold.[4,5] The mean proximal margin distance from the tumor in the laparoscopic arm was 11.8 centimeters, with a deviation of 7.4 cm. The open arm had an average distance of 12.3 cm, with a deviation of 11.2 cm, leading to a *p*-value of 0.829. For rectal surgeries, the mean proximal margin distance was 8.5 cm with a deviation of 4.8 cm for the laparoscopic arm and 10.4 cm with a deviation of 5.5 cm for the open arm. The difference

is thus statistically insignificant, as also seen in studies done by Fujii et al. as well as Chen K et al.[6,7] The Colorectal cancer Laparoscopic or Open Resection II (COLOR II) trial, however, yielded a statistically significant result in this parameter, as well as a considerably longer mean proximal margin distance compared to the rectal surgeries in the current study, though the superiority of the open arm in this situation is not clinically relevant, as a proximal margin of 5 cm is sufficient, which was achieved in both groups.[8,9]

The results for the mean distal margin from the tumor yielded values closer to each other in the two arms. The mean distal margin was 7.6 cm with a deviation of 4.7 cm for the laparoscopic arm and 7.5 cm with a deviation of 7.1 cm for the open arm. The *p*-value was 0.933, proving that there is no significant statistical difference among either of the arms. Fujii et al., Fleshman et al., Chen K et al., and the COLOR II trial have had similar results in regard to this variable.[10] A margin of 2 cm distally is regarded as sufficient in rectal surgeries, with some studies recommending a margin of up to 1 cm in select cases, this result is hence not significant in the long-term outcome, as both the arms led to satisfactory resection.[11]

The average number of lymph nodes isolated was 18.8 among the laparoscopic group with a deviation of 10.2, while the open group yielded 20.0 nodes with a deviation of 13.5. The *p*-value was 0.657. This number was found to be 17.6 with a deviation of 10.2 in the laparoscopic rectal surgeries and 16.5 with a deviation of 11.5 in the open rectal surgeries. The minimum number of lymph nodes that needs to be harvested in resection for colorectal malignancies has been suggested to be 12, with recommendations for harvest of up to 20 nodes for a better long-term outcome. Both arms satisfy the criteria for minimum node harvest and are hence comparable in terms of results.[12]

Laparoscopic surgeries were found to have longer operating times across all types of surgeries. This compares to 264 minutes with a deviation of 84 minutes in the open colorectal surgeries ($p = 0.018$) and 288 minutes with a deviation of 66 minutes in the rectal surgeries ($p = 0.071$), thus being statistically significant. The longer operating times in laparoscopic surgeries were seen in most of the studies with statistically significant results, thus proving that laparoscopic colorectal surgeries are associated with a longer duration of operation. The difference in operating times can probably be explained by the limited access and hence limited degree of freedom in laparoscopic surgery, as well as inexperience and a steeper learning curve leading to more time requirements for each step of the procedure.

The average estimated blood loss in laparoscopic colorectal surgeries was found to be 275.5 mL with a deviation of 152.7 mL, and 416.7 mL with a deviation of 461.2 mL in the open group, leading to a *p*-value of 0.095, which is statistically insignificant. Similarly, the values for rectal surgeries were 276.1 mL with a deviation of 149.8 mL in the laparoscopic group and 393.3 mL with a deviation of 208.3 mL in the open group. This result was significant as the value of *p* is 0.046. This trend was similarly observed in studies by Fujii et al., Chen K et al., Chiu Chong-Chi et al., Bedirli Abdulkadir et al., Fleshman et al., Kang et al. and the COLOR II trial, proving that laparoscopic surgeries are superior in terms of lesser blood loss.[13–16]

The mean postoperative day for initiation of oral feeds (liquids) was found to be 2.2 with a deviation of 1.2 days in the laparoscopic arm, and 2.9 with a deviation of 1.7 days in the open arm, yielding a *p*-value of 0.063. While the result is not statistically significant, it is relevant in comparison to studies like Chen K et al. and Bedirli Abdulkadir et al., demonstrating that laparoscopic surgeries have a better outcome in terms of early initiation of feeds, with both studies yielding statistically significant results. However, in the rectal surgeries, the average was 1.9 days with a deviation of one day in the laparoscopic arm and 3.1 days with a deviation of 1.9 days among open arm, yielding the value of *p* as 0.019, thus being significant statistically, and comparable to the COLOR II trial.

The average duration of stay at the hospital among the laparoscopic surgery group was 8.4 days and had a deviation of 3.0 days. It was 9.3 days with a deviation of 3.5 days for those who underwent open colorectal surgeries. The results did not have statistical significance. The duration of stay at the hospital was 9.2 days with a deviation of 3.5 days for laparoscopic rectal surgeries and 9.7 days with a deviation of 3.4 days for open rectal surgeries, which too was statistically insignificant. Though the results were in accordance with those observed in studies conducted by Fujii et al. and Fleshman et al., other studies by Chen K et al., Chiu Chong-Chi et al., Bedirli Abdulkadir et al., Kang et al., and the COLOR II trial, all yielded statistically significant results with laparoscopic surgeries having a shorter stay in hospital. The difference in results could probably be explained by the need for prolonged stay due to insurance issues, the occurrence of complications such as SSI or pneumonia, and lack of a standard protocol across various units in the hospital. Even then, the numbers were found to be comparable.

A total of 6 patients among the 33 who underwent laparoscopic colorectal surgeries developed SSI, compared to 9 among the 46 in the open group. In rectal surgeries, 3 patients out of 18 who underwent laparoscopic resection developed the complication, compared to 7 out of the 27 in the open group. Both of these results were found to be statistically insignificant. Additionally, 4 patients (66.67%) out of the 6 who developed SSI in the laparoscopic arm had a deep SSI, requiring intravenous antibiotics, compared to 5 out of 9 (55.60%) in the open arm. The rest of the patients had a superficial SSI, which was managed with oral antibiotics. Studies by Chiu Chong-Chi et al. and Bedirli Abdulkadir et al. yielded results that showed significance in this regard, with laparoscopic surgeries proving to be superior, but other studies by Fujii et al., Chen K et al., Kang et al., and the COLOR II trial failed to show such significant results.

No patients, in either the laparoscopic or the open arm, were diagnosed to have an anastomotic leak. These values were found to be an exception, as other studies did show the occurrence of anastomotic leak in both arms, though the numbers were low and variable, except for the COLOR II trial but comparable to the study done by Braga et al.[17]

Two patients out of 33 in the laparoscopic arm required the creation of a diversion stoma, compared to nine of the 46 in the open group, yielding a *p*-value of 0.087, which is statistically insignificant. Both the cases of diversion stoma in the laparoscopic technique group were for rectal malignancy, and six of the nine in the open group fell into the same category. Additionally, both the patients in the laparoscopic group had a diversion ileostomy, whereas seven in the open group had a diversion ileostomy and two had a diversion transverse colostomy. The discretion of creating a stoma, as well as the type of stoma was left to the operating surgeon, who took a call intraoperatively, as judged based on findings. The results were comparable to the study by Kang et al., which also yielded statistically insignificant results.

The average cost of hospital stay was found to be as mentioned in Table 2, with a *p*-value of 0.769 for colorectal surgeries and 0.300

for rectal surgeries, both statistically insignificant. Compared to the study by Chen K et al., where the results were significant, in favor of open surgeries, the difference in the current study could be due to a wide number of insurance schemes available at the center, leading to similar expenditures and hence insignificant results.

Conclusion

- As per the results of our study, we would like to conclude that laparoscopic colorectal surgeries are non-inferior to their open counterparts, in terms of oncological quality, perioperative parameters, and complications and considerations.
- Laparoscopic surgeries provide comparable results with respect to margins and lymph nodes harvested and have a lesser loss of blood and shorter stay in hospital. On the other hand, laparoscopic surgeries take significantly longer operating time.
- Thus, laparoscopic surgeries should be considered as an equivalent modality when planning for a curative resection for colorectal malignancies.

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