Laparoscopic versus Open Surgery for Treatment of Colorectal Cancer

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ABSTRACT

Background: Colorectal cancer (CRC) is the fourth most frequently diagnosed cancer in United States and has the second highest cancer related mortality rate after lung cancer. Cancer of the colon is equally frequent in men and women while cancer of the rectum occur 20-50% more frequently in men. This study aimed to compare the outcome of laparoscopic and open approach in surgical management of colorectal carcinoma and to better selection of the best procedure for treatment of colorectal cancer.

Patients and Method: This prospective randomized study included 18 cases who underwent colorectal surgeries during the period October, 2019 till October, 2020 in the Surgery Unit at Zagazig Faculty of Medicine. These patients were subdivided into equal two groups: 9 cases underwent the open approach while the remaining 9 cases underwent the laparoscopic approach, with a period of one year follow up postoperative. **Results**: Intraoperatively, the laparoscopic group showed some cons like total operative time ($p = 0.001$) and time needed for dissection ($p < 0.001$), which were significantly higher when compared to the open group. In the postoperative period, close monitoring of all clinical and laboratory parameters was performed with bedside imaging by ultrasound in indicated cases. The laparoscopic group took the upper hand over open group regarding day of first motion, when to start oral intake and hospital stay ($p = <0.001, <0.001$ and 0.002 respectively).

Conclusion: Analysis of the scientific literature confirmed that for the curative treatment of colon and rectal cancer, laparoscopy is not inferior to open surgery with respect to overall survival, disease-free survival and rate of recurrence.

Keywords: Colorectal cancer, Laparoscopic surgery, Oncologic outcomes, Traditional surgery.

INTRODUCTION

Colorectal cancer is the slowly developing cancer that begins as a tumor or tissue growth on the inner lining of the rectum or colon[(1)]**.** It is the third most common form of cancer and the second leading cause of cancer related deaths in the western world; with 1.65 million new cases and 835,000 case of death in 2017[(2)]**.**

Surgery is the only curative therapy for colorectal cancer[(3)]**.**

Curative surgery requires resection of the primary tumour with negative margins and a complete oncologic lymphadenectomy**.** The resected colic segment depends on vascularization and lymphatic drainage at the tumour site and, according to the American Joint Committee on Cancer, a minimum of 12 lymph nodes should be retrieved in surgical specimens[(4)].

The surgical approach for colorectal cancer is affected by tumour stage and localization. Generally, 6 types of resection can be performed: right hemicolectomy, left hemicolectomy, extended right hemicolectomy, extended left hemicolectomy, anterior resection of the sigmoid, or abdominoperineal resection. Traditionally, colorectal cancer resection has been performed exclusively through open surgery. However, following successful laparoscopic procedures, such as cholecystectomy, appendectomy and treatment of incisional hernias, this surgical approach has gradually been introduced first in the treatment of colon cancer and then in the treatment of rectal cancer[(5)].

Laparoscopic resection should result in the removal of the colon or rectal segment containing the tumour and associated lymphatic drainage to the same extent as open surgery. Surgery can be performed entirely by laparoscopy, be laparoscopy-assisted (anastomosis is then performed extracorporeally) or be hand-assisted (in which case a sufficiently long incision is made to allow the surgeon's hand to enter the abdominal cavity). For all 3 strategies, the abdominal wall incision should be protected to prevent tumour dissemination[(6)].

The aim of this study was to compare the outcome of laparoscopic and open approach in surgical management of colorectal carcinoma and to better selection of the best procedure for treatment of colorectal cancer.

PATIENTS AND METHODS

This current observational retrospective study was conducted in Surgery Unit at Zagazig Faculty of Medicine among 18 patients who underwent laparoscopic or open surgery for colorectal cancers in the time period from October 2019 to October with a period of one year follow up postoperatively.

These patients were subdivided into equal two groups: 9 cases underwent the open approach while the remaining 9 cases underwent the laparoscopic approach.

Inclusion criteria: Age from 18 to 80 years old, all sexes, and operable patients.

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Exclusion Criteria: Inoperable patients, refusal of surgery, contraindication of laparoscopic surgery, multicentric tumor, and presence of distant metastasis.

Preoperative:

All included patients were subjected to history taking, digital rectal examination (DRE). Clinical examination and laboratory investigations were done for all patients including complete blood picture, liver and kidney functions and metastatic workup; pelvi-abdominal ultrasound, chest X-ray and bone survey. Radiological investigations (mandatory CT or MRI); the tumor should be radiologically proven to be localized.

Pathological diagnosis; malignant tumor should be pathologically proven by colonoscopy and biopsied.

Postoperative Evaluations:

Early postoperative complications during the hospital stay (maximum of 14 days), patients was assessed for the onset of: Wound infection. Dehiscence. Bowel function. The hospital stay. Anastomotic leaking, and respiratory complications.

Delayed postoperative complications:

In the outpatient visits minimal required follow-up included annual clinical examinations for 2 years after surgery.

CT or MRI of the pelvis combined with imaging of the liver and the chest were performed. Recurrent disease was defined as the presence of locoregional recurrence, the presence of distant metastases, or death from rectal cancer.

Ethical consent:

An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of the operation and participation in this study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures were coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. According to the type of data, qualitative were represented as number and percentage, quantitative continues group were represented by mean ± SD, median, and range. The following tests were used to test differences for significance; difference and association of qualitative variable by Chi square test (X^2) and differences between quantitative independent groups by t test. P value < 0.05 was considered significant.

RESULTS

There was no significant difference between groups as regard age and sex (Table 1).

Table (1): Comparison of age and sex between the studied groups

			Laparoscopic N=9	Open N=9	t/ X^2	P
Age			**63.11±13.54**	**53.22±14.77**	**1.480**	**0.158**
Sex	**Female**	**N**	**6**	**3**		
		%	**66.7%**	**33.3%**		
	Male	**N**	**3**	**6**	**2.0**	**0.157**
		%	**33.3%**	**66.7%**		
Total		**N**	**9**	**9**		
		%	**100.0%**	**100.0%**		

Operation time was significantly longer in laparoscopic group while hospital stay was longer in open group (Table 2).

Table (2): Comparison of operation time and hospital stay between studied groups

	Laparoscopic N=9	Open N=9	t	P
Operation Time	**343.33±62.64**	**124.44±41.19**	**-8.565**	**0.00****
Hospital stay	**5.33±1.58**	**8.88±2.42**	**0.576**	**0.172**

Table 3 shows that no significant difference was found between groups as regard lymph nodes.

Table (3): Comparison of number of lymph nodes between groups

	Group		Mann-Whitney	P
	Laparoscopic N=9	Open N=9		
Median (Range)	**11.0±3.26**	**10.52±3.01 14**	**0.423**	**0.69**

There were only 2 cases with positive margin in laparoscopic group with no significant difference (Table 4).

Table (4): Surgical margin distribution between groups

			Group		X^2	P
			Laparoscopic	Open		
Surgical margin	Free	N	7	9		
		%	77.8%	100.0%		
	+ve	N	2	0	0.13	0.56
		%	22.2%	0.0%		
Total		N	9	9		
		%	100.0%	100.0%		

Table 5 shows that there was no significant difference between groups as regard postoperative treatment.

Table (5): Treatment after operation distribution between groups

			Group		X^2	P
			Laparoscopic	Open		
Treatment after operation	No	N	6	2		
		%	66.7%	22.2%		
	Neo adjuvant concomitant chemoradiotherapy	N	2	3		
		%	22.2%	33.3%	4.0	0.135
	Postoperative chemotherapy	N	1	4		
		%	11.1%	44.4%		
Total		N	9	9		
		%	100.0%	100.0%		

Table 6 shows that there was no significant difference or association between groups as regard life style during the follow up period.

Table (6): Comparison of life style and follow up between groups

			Group		X^2	P
			Laparoscopic	Open		
Sleep	Bad	N	0	1		
		%	0.0%	11.1%		
	Good	N	7	4	3.01	0.389
		%	77.8%	44.4%		
	Very good	N	2	3		
		%	22.2%	33.3%		
	Excellent	N	0	1		
		%	0.0%	11.1%		
Physical condition	Bad	N	0	1		
		%	0.0%	11.1%		
	Good	N	9	7	2.25	0.325
		%	100.0%	77.8%		
	Very good	N	0	1		
		%	0.0%	11.1%		
Fatigue	No	N	0	1		
		%	0.0%	11.1%		
	Mild	N	6	5		
		%	66.7%	55.6%	2.29	0.514
	Moderate	N	3	2		
		%	33.3%	22.2%		
	Severe	N	0	1		
		%	0.0%	11.1%		
Total		N	9	9		
		%	100.0%	100.0%		

Table 7 shows that as regard complications, there was no significant difference or association between groups.

Table (7): Complication distribution between groups

			Group		X^2	P
			Laparoscopic	Open		
Wound infection	**No**	**N**	**9**	**7**		
		%	**100.0%**	**77.8%**		
	Yes	**N**	**0**	**2**	**2.25**	**0.134**
		%	**0.0%**	**22.2%**		
Anastomotic leakage	**No**	**N**	**7**	**7**		
		%	**77.8%**	**77.8%**		
	Yes	**N**	**2**	**2**	**0.00**	**1.0**
		%	**22.2%**	**22.2%**		
Respiratory complications	**No**	**N**	**7**	**7**		
		%	**77.8%**	**77.8%**		
	Yes	**N**	**2**	**2**	**0.00**	**1.0**
		%	**22.2%**	**22.2%**		
Total		**N**	**9**	**9**		
		%	**100.0%**	**100.0%**		

Table 8 shows that there was no significant difference or association between groups as regard recurrence and metastasis.

Table (8): Recurrence and distant metastasis distribution between groups

			Group		Total	X^2	P
			Laparoscopic	Open			
Locoregional recurrence	**No**	**N**	**7**	**8**	**15**		
		%	**77.8%**	**88.7%**	**77.9%**		
	Yes	**N**	**2**	**1**	**3**	**2.25**	**0.13**
		%	**22.2%**	**11.3%**	**22.1%**		
Distant metastasis	**No**	**N**	**8**	**8**	**16**		
		%	**88.9%**	**88.9%**	**94.4%**		
	Yes	**N**	**1**	**1**	**2**	**1.05**	**0.303**
		%	**11.1%**	**11.1%**	**5.6%**		
Total		**N**	**9**	**9**	**18**		
		%	**100.0%**	**100.0%**	**100.0%**		

DISCUSSION

Age of participants in the current study ranged from 18 to 80 years, with a mean ±SD of 63.11±13.54 and 53.22±14.77 years respectively for laparoscopic and open groups. The highest age-group in this study was 52–74 years in laparoscopic group and 39–67 years age-group in open group. These results were consistent with literature in which colorectal cancer incidence rates rose with increasing age[(7)] **.** CRC is uncommon among people aged 40 or younger; the incidence begins to raise significantly between the ages of 40 and 50 and age specific incidence rates further increase in each succeeding decade thereafter[(8)]. However, some data from cancer registries reported a rising incidence of large bowel cancer particularly rectal cancer among young adults even under 40 years of age[(9)].

In our study we found that the duration of operation was much longer in laparoscopic surgery as compared to open surgery, mean operative time for open colon surgery varied between 80 and 164 minutes and between 280 and 400 minutes for laparoscopic colon surgery, thus the difference in duration for the two procedures ranged between 200 and 240 minutes. These results are in line with the **Buunen and colleagues** trials that resulted in that operative time was longer for laparoscopic than for open surgery but that differences in operative time between the 2 procedures for colon cancer tended to be smaller in centers with high volumes[(10)] .

Presented data according to hospital stay postoperatively after colon surgery showed that patient underwent open surgery had a longer hospital stay time than patients underwent laparoscopic surgery, in laparoscopic group hospital stay postoperatively ranged from 4 days to 6 days and this for open surgery ranged from 7 to 10 days. Several trials emphasizes this, however, the **ALCCAS** trial showed that among laparoscopy patients whom their operation converted to open surgery had longer hospital stay time than open patients[(11)] **.**

As regard postoperative pain, was measured by a visual analogue scale of 0-10, less pain was recorded after laparoscopic surgery than open surgery and necessarily less analgesic use, in the **COREAN** trial, mean postoperative pain was less after laparoscopic

surgery compared to open surgery up to 3 days after operation[12].

One of the short term benefits of laparoscopic surgery as compared to open surgery is the faster recovery of intestinal function, postoperative ileus lasts for a mean of 48 hours after laparoscopic surgery and 96 hours after open one. In the **Barcelona** trial peristalsis began at a mean of 36 hours after laparoscopic surgery and 55 hours after open surgery[13].

As regard evaluation of the quality of life, social function, physical condition and fatigue at 2 weeks and 12 weeks there was no difference between the two groups who underwent either laparoscopic or open surgery. In the CLASICC trial evaluation of social function at 2, 4 and 12 weeks, there was no difference in any of the scales evaluated between laparoscopic and open surgery at any time point and as regard sleep, fatigue and physical condition they were better, 3 months after laparoscopy, than open[14].

A greater frequency of sexual problems after surgery than before the intervention was observed with worse global sexual and erectile function, with no difference between groups. In the CLASICC trial, it was shown that men who underwent laparoscopic surgery tend to have worse global sexual and erectile function however, this difference was not significant. Conversion and total mesorectal excision were identified as prognostic factors negatively affecting sexual function. Urinary function was similar following laparoscopic and open surgery[14].

Overall intraoperative complications rates as regard haemorrhage, cardiac or pulmonary insufficiency, injury of bowel or adjacent organs, there was no difference between laparoscopic and open surgery. **Liang and colleagues** reported no significant difference after open or laparoscopic surgery as regard intraoperative complications[15].

No difference in postoperative complication rates was found in our trial between laparoscopic and open surgery. Wound infection was found in 2 patients in the group of open surgery and one of them developed burst abdomen latter. Urinary tract infection was reported in 5 patients of each group and this is attributed to long time of urinary catheter stay postoperatively not the procedure itself. Anastomotic leakage was reported in 2 patients of the laparoscopic group and also 2 patients of the open group, pulmonary complications as regard chest infection was reported in one patient of each group so there was no difference between open and laparoscopic surgery as regard postoperative complications. Several trails observed similar complication rated for the 2 procedures, however, complication rates remained at an acceptable level following both procedures and were generally low grade in laparoscopic surgery, it ranged from 14 to 24% and from 6 to 52% in open surgery, it also presumed that these complications rate would be affected by the surgeon`s experience, the complexity of the performed surgery[11].

As regard short term outcomes and follow up of the patients, we found that 2 patients who underwent laparoscopic surgery developed locoregional recurrence at port sites and 2 patients in the group of open surgery developed locoregional recurrence at the wound site. So there was no difference between open and laparoscopic procedures regarding recurrence rates. And when we compare postoperative distant metastasis we found that one patient of each group of the open and laparoscopic surgery developed distant metastasis at the interval of follow up and that emphasis that there is no difference between the two procedures regarding the development of distant metastasis.

What emphasis our trail at this point, the large randomized trials that showed no difference between open and laparoscopic procedures. In the **COLOR** trial there were more recurrences in the abdominal wall observed following laparoscopy than open surgery for colon cancer (at port site and at the tumor extraction site), but the difference was not significant[16].

CONCLUSION

Analysis of the scientific literature confirmed that for the curative treatment of colon and rectal cancer, laparoscopy is not inferior to open surgery with respect to overall survival, disease-free survival and rate of recurrence. In addition, laparoscopic surgery provides short-term advantages over open surgery, particularly a shorter hospital stay, reduced need for analgesics, faster recovery of intestinal function, and an earlier return to activities of daily life. In contrast, laparoscopic surgery requires a longer operative time.

Considering the evidence currently available, we recommend that laparoscopic resection should be considered an option for the curative treatment of colon and rectal cancer. The decisions regarding surgical approach (laparoscopic or open surgery) for the curative treatment of colon cancer should take into consideration the surgeon's experience, tumour stage, potential contraindications and patient expectations; and that laparoscopic resection for rectal cancer be performed only by appropriately trained surgeons who perform a sufficient volume annually to maintain competence.

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