International Surgery Journal
Abd-Elshafy YM et al. Int Surg J. 2022 Jan;9(1):256-261
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: https://dx.doi.org/10.18203/2349-2902.isj20215168

Review Article

Laparoscopic versus open surgery in the treatment of colorectal cancer

Yasser Mohammad Abd-Elshafy[1]*, Islam Mohammad Mohammad[2], Hazem Nour Abdelatif Ashry[2], Mohammad Abdullah Zaitoun[2]

[1]Tanta Cancer Center, Egypt
[2]Department of General Surgery, Zagazig University, Egypt

Received: 08 December 2021
Accepted: 23 December 2021

***Correspondence:**
Dr. Yasser Mohammad Abd-Elshafy,
E-mail: yaser_7835@yahoo.com

ABSTRACT

Because of the initial case study results suggesting high recurrence rates at port sites, adoption of the laparoscopic approach for colorectal cancer treatment was slow. Surgical resection remains the cornerstone and most important facet in management of colon cancer. The use of minimally invasive approach in colorectal surgery has been reported by several authors in the literature. Some difficult about the use of laparoscopic surgery for colorectal cancer still raises, particularly with the technique's complexity, learning curve and longer duration. Scientific literature published from January 2010 to April 2020 was reviewed. Phase III randomized clinical trials were included. Analysis of the scientific literatures 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. Laparoscopic resection can be considered an option for the curative treatment of colon and rectal cancer; but must take into consideration surgeon experience, tumour stage and potential contraindications; and that laparoscopic resection for rectal cancer be performed only by appropriately trained surgeons.

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

INTRODUCTION

Colorectal cancer is an important public health problem; nearly one million new cases of colorectal cancer are diagnosed worldwide each year.[1] Around 30-40% of colorectal cancer is defined to arise from the rectum which is defined as the distal margin of tumor within 15 cm of the anal verge.[2]

Symptoms of colorectal cancer differ according to the location of tumor in the bowel, and more symptoms add in the presence of distant metastasis, symptoms can be vague symptoms as fatigue, weakness, shortness of breath or GIT symptoms as change in bowel habits, diarrhea or constipation, red or dark blood in stool, weight loss, abdominal pain, cramps, or bloating.[2]

Adequate examination of the entire colon and rectum is mandatory prior to surgery. Diagnostic measures must be of effectiveness and sensitivity to differentiate between adenomas and malignant diseases. They must also have high specificity. These include colonoscopy and pathological biopsy, barium enema, and to lesser extent CT colonography.[3]

Pathological staging now is the cornor stone in detecting outcomes. (Dukes') staging system depend on the depth of disease invasion through the bowel wall and the extent of regional lymph-node. The tumor-node- metastasis (TNM) system of the American joint committee on cancer (AJCC) is widely used and more applicable system for staging colorectal cancer and both short and long term follow up.[4]

Jacobs et al was the first to use laparoscopic colectomy, and it became more acceptable good prognostic factor reported.[5] There is some oncologic concerns related to

minimally invasive surgery (MIS) to malignant colorectal disease.[6]

The fact that laparoscopic procedure became more common that it needs just a minimal abdominal incision, no postoperative pain approximately, the time to return to work and normal activity became faster. Several studies have reported a reduced hospital stay following laparoscopic colonic resection.[7]

The need for a high degree of laparoscopic skills, expensive equipment, and a long operating time makes laparoscopic learning curve steep. And as regard tumor spillage, early recurrence and adequacy of resection it seems to be questionable.[8] But still when compared to open technique, laparoscopic colectomy has upper hand as regard decreasing postoperative pain, faster return of bowel function, earlier resumption of oral intake, shorter hospital stays, lower complications rate, better cosmoses.[9]

Colorectal cancer defined as a slowly growing mass on the inner lining of the rectum or colon.[10]

It ranks 3rd among all cancers and 2nd leading cause of cancer related deaths in the western world; with 1.65 million new cases and 835,000 case of death in 2017.[11]

Resection of the tumor is the only curative therapy.[12] Curative surgery must include resection of boh the primary tumour with negative margins and draining lymph nodes enblock.

According to the AJCC, at least 12 lymph nodes should be retrieved in surgical specimens to achieve the radicality in treatment.[13] The resected colonic segment is affected by tumour stage and localization. Generally, 6 types of resections can be performed: right hemicolectomy, left hemicolectomy, extended right hemicolectomy, extended left hemicolectomy, anterior resection of the sigmoid, or abdominoperineal resection. Now a days laparoscopic approach had taken the upper hand over the open one after the great success that had been achieved in laparoscopic cholecystectomy and later laparoscopic hernioplasty.[14]

Laparoscopic resection to achieve the oncological safety must resect the tumor and the draining lymph nodes as much as the open one. several man overs can be performed take the varity of being entirely by laparoscopy, be laparoscopy-assisted (anastomosis is then performed extra corporally) 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.[15]

LITERATURE REVIEW

Published clinical trials comparing open and laparoscopic surgery in colon and rectal cancer treatment were retrieved using the previously mentioned keywords. Only trials involving more than 200 patients were retained. The period covered was from January 2010 to April 2020, inclusively. Trials with metastatic disease of colon/ rectum and trials mention chemotherapy-or radiotherapy-as a neo adjuvant/ adjuvant treatments were excluded.

DISCUSSION

Buunen and colleagues presented the long-term results of the colon cancer laparoscopic or open resection (COLOR).[15] The primary outcome was 3-year disease-free survival, which was 74.2% with the laparoscopic procedure and 76.2% with open surgery. And with 7% difference between the 2 techniques and at a level of significance of p=0.025.

The long-term results of the clinical outcomes of surgical therapy (COST) non inferiority trial was presented.[16] The laparoscopic procedure was stated as inferior to open surgery regarding time to recurrence at 3 years with a low difference rate of 1.23 and p≥0.41. Because of these criteria, the laparoscopic procedure was not inferior to open surgery (p=0.83). The recurrence rate did not significantly differ between the 2 procedures (p=0.32). And neither overall survival (p=0.51) nor disease-free survival (p=0.70) as well.

Jayne and colleagues presented the long-term results of the conventional versus laparoscopic-assisted surgery in colorectal cancer (CLASICC) trial.[17] The main purpose of the trial was to assess overall survival, disease-free survival and local recurrence at 3 years in patients with colon or rectal cancer treated with laparoscopic or open surgery. The local recurrence rates were 7.3% with laparoscopy and 6% with open surgery (p=0.68). Differences between the 2 procedures as regard 3-years overall survival (p=0.51) and disease-free survival (p=0.75) show no significance.

Lacy and colleagues presented long-term follow up of 3.5 and 8 years.[18] The primary outcome was cancer-related mortality which was 9% with laparoscopy and 21% with open surgery (p=0.03) after 3.5 years and the rate was 16% and 27%, respectively, (p=0.07) after 8 years. Recurrence rates were 18% with laparoscopy and 28% with open surgery (p=0.07).

Liang and colleagues published results of a randomized trial. recurrence rate after colon surgery shows no significantly difference between the laparoscopic and open procedure (p=0.36). The recurrence rate was 17% with laparoscopy and 21.6% with open surgery.[19]

In 6 trials, in these studies recurrence rates at wound or port sites were not different between the groups (1.3% vs. 0.4%, p=0.09; 100.9% vs. 0.5%, p=0.43; 170.9% vs. 0%, p not available; 23 and 0.7% v. 0.7%, p not available) for both the laparoscopic and open procedures, respectively).[14,16,20-23]

Table 1: Main characteristics of randomized clinical trials.

Variables	COLOR	COST	CLASICC	LAPKON	ALCCaS	Barcelona	Liang	LAFA-study
Median follow-up, mo.	53	60	37	Short out comes	Short outcomes	43	40	___
Primary outcomes	3 years DFS	Time to recurrence	3years DFS	Short out comes	Short out comes	Cancer related survival	Time to recurrence	Total post op hospital stays
Population numbers								
Open surgery	542	426	140	222	298	102	134	108
Laparoscopic surgery	534	435	273	250	294	106	135	110
Surgical procedure (%)								
Rhight	47	54	45	29	58	45	-	48
Left	11	7	13	71	4	2	70	49
Sigmoid	38	38	21		-	45	30	-
Anterior	-	-	11	-	15	11	3	-

Table 2: Comparison of oncologic results.

Results	Odds ratio	P value
Progression-free survival (Years)		
3	0.90 (0.66–1.24)	0.53
5	1.17 (0.85–1.61)	0.35
Recurrence		
Total	0.93 (0.68–1.25)	0.61
Local	0.83 (0.52–1.31)	0.41
Wound sites	1.34 (0.07–24.10)	0.84
Distal metastasis	0.89 (0.63–1.27)	0.52
Mortality		
Overall	0.80 (0.60–1.07)	0.13
Cancer-related	0.71 (0.45–1.12)	0.14

Table 3: Operative time of open and laparoscopic surgeries.

Trials	Operative time; median (range) or mean ± SD, min		P value
	Open surgery	Laparoscopic surgery	
COLOR	115 (70-180)	145 (102-230)	<0.001
COST	95 (27-435)	150 (35-450)	<0.001
Barcelona	118±45	142±52	0.001
LAPKON I	138±45	183±61	<0.001
ALCCaS	107 (45-250)	158 (49-365)	<0.001
COREAN	197±63	245±75	<0.001
Lujan et al	173±59	194±45	0.020
Ng et al[27]	164±43	214±46	<0.001
Braga et al	209±70	262±72	<0.001
Zhou et al	106 (80-230)	120 (110-220)	0.05

Table 4: Length of hospital stay following open and laparoscopic surgeries.

Trials	Measure	Length of hospital stay, (d)		P value
		Open surgery	Laparoscopic	
COLOR	mean ± SD	9.3±7.3	8.2±6.6	<0.001
COST	median (IQR)	6 (5-7)	5 (4-6)	<0.001
Barcelona	mean ± SD	7.9±9.3	5.2±2.1	0.005

Continued.

Trials	Measure	Length of hospital stay, (d)		P value
		Open surgery	Laparoscopic	
Liang et al	mean ± SD	14.0±2.0	9.0±1.0	<0.001
LAPKON I	mean ± SD	13.0±8.6	13.4±12.0	0.032
ALCCaS	median (range)	8 (4-59)	7 (1-55)	Not available
CLASICC	median (IQR)	11 (9-15)	13 (9-18)	Not available
COREAN	median (IQR)	9 (8-12)	8 (7-12)	0.06
Lujan et al	mean ± SD	9.9±6.8	8.2±7.3	0.11
Ng et al[27]	median (range)	11.5 (3-38)	10.8 (5-27)	0.55
Braga et al	mean ± SD	13.0±10.0	10.0±4.9	004
Zhou et al	mean ± SD	13.3±3.4	8.1±3.1	0.001

As regard short term outcomes, 13 trials presented data on the duration of surgery for colon and rectal cancer. In all but 1 study, longer duration observed for laparoscopic than for open surgery. The COLOR trial investigators showed that differences in operative time tended to be smaller in centres with high volumes (p=0.027).[24]

Liang and colleagues used a visual analogue scale of 0-10 to measure post operative pain.[25] And Less pain was noticed after laparoscopy than open surgery for colon cancer (median 3.5 vs. 8.6, p<0.001). In the COREAN trial, mean postoperative pain was less after laparoscopy than open surgery (p<0.05).[26] Ng and colleagues reported no difference in pain (p=0.41).[27] In 2 trials, there was less pain after laparoscopy than open surgery for colon cancer. In the COLOR trial, patients who needed analgesics in the first 3 days after laparoscopy than open surgery were 8-14% fewer (p<0.001 to p=0.008).[28] In the COST trial, this difference corresponded only to a median of 1 day less needing analgesics.[29]

As regard length of hospital stay, 7 trials presented data on length of hospital stay after colon cancer surgery. In all cases, hospital stay was shorter with patients treated with laparoscopy than patients treated with open surgery.[30]

Overall complication evaluation done in 4 trials. Only in the Barcelona trial the complication rate was lower for laparoscopy than open Surgery (11% vs. 29%, p=0.001).[31] Whereas no significant difference after laparoscopic or open procedures in COLOR, LAFA-study and the study by Liang and colleagues (p=0.88, p=0.20 and p=0.15, respectively).[32-34] Intraoperative complications include cardiac/ pulmonary insufficiency, haemorrhage and injury of bowel or adjacent organs.

None of the trials included in this review showed any difference between open and laparoscopic procedures regarding recurrence rates at wound and port sites. Only in the COLOR trial there were more recurrences in the abdominal wall following laparoscopy than open surgery for colon cancer.[32]

All but 1 trial studying colon cancer concluded that laparoscopy is non-inferior to open surgery in terms of overall survival, disease-free survival and recurrence rate.

Some short-term benefits of laparoscopy compared with open colorectal cancer resection reported in some selected trials. These benefits include reduced need for analgesics, less postoperative pain, faster recovery of intestinal function and shorter hospital stay.

Laparoscopy requires longer operative time than open surgery. Mean operative times for colon cancer resection varied between 95 and 184 minutes for open surgery and between 142 and 224 minutes for laparoscopy. The difference in duration for the 2 procedures thus ranges between 24 and 55 minutes.[34]

CONCLUSION

Analysis of the scientific literature confirmed that laparoscopy is not inferior to open surgery for the curative treatment of colon and rectal cancer, as regard to overall survival, disease-free survival and rate of recurrence. In addition, laparoscopic surgery takes the upper hand over open surgery, as concerning to a shorter hospital stay, less pain, faster recovery of intestinal function, and an earlier return to activities of daily life. In the other hand laparoscopic surgery requires a longer operative time. Considering the evidence currently available, we recommend that laparoscopic resection can be considered an option for the curative treatment of colon and rectal cancer but we must take into consideration the surgeon's experience, tumour stage, potential contraindications.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Boyle P, Leon M. Epidemiology of colorectal cancer. Br Med Bull. 2002;64:1-25.
2. Hawk E, Umar A, Viner J. Colorectal cancer chemoprevention-an overview of the science. Gastroenterology. 2002;126(5):1423-47.
3. Chaparro M, Gisbert J, Campo L, Cantero J, Maté J. Accuracy of computed tomographic colonography for the detection of polyps and colorectal tumours-a systematic review and meta-analysis. Digestion. 2009;80:1-17.

4. Edge S, Byrd D, Compton C, Fritz A, Trotti A. AJCC cancer staging handbook. 6th edition. 2002;(1)124-5.
5. Martel G, Boushey R. Laparoscopic colon surgery: past, present and future. Surg Clin North Am. 2006;86(4):867-97.
6. Buunen M, Veldkamp R, Hop WC, Kuhry E, Jeekel J, Eva H et al. Survival after laparoscopic surgery versus open surgery for colon cancer: long-term outcome of a randomised clinical trial. Lancet Oncol. 2009;10:44-52.
7. Kang S, Park J, Jeong S. Open versus laparoscopic surgery for mid or low rectal cancer after neoadjuvant chemoradiotherapy (COREAN trial): short-term outcomes of an open-label randomised controlled trial. Lancet Oncol. 2010;11(7):637-45.
8. Boller A, Nelson H. Colon and rectal cancer laparoscopic or open. Clin Cancer Res. 2007;13:6894-6.
9. Murray A, Lourenco T, Verteuil R, Hernandez R, Fraser C, McKinley A et al. Clinical effectiveness and cost- effectiveness of laparoscopic surgery for colorectal cancer-systematic reviews and economic evaluation. Health Technol Assess. 2006;10(45):1-141.
10. Marley A, Nan H. Epidemiology of colorectal cancer. Int j molecular epidemiol genetics. 2016;7(3):105-14.
11. Fitzmaurice C, Allen C, Barber R, Barregard L, Bhutta Z, Brenner H et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. JAMA oncol. 2017;3(4):524-8.
12. Van Cutsem E, Nordlinger B, Cervantes A, ESMO Guidelines Working Group: Advanced colorectal cancer: ESMO Clinical Practice Guidelines for treatment. Ann oncol. 2010;21(5):93-7.
13. Wilkinson N, Scott-Conner C. Surgical therapy for colorectal aden ocarcinoma. Gastroenterol Clin North Am. 2008;37(1):253-67.
14. Ma Y, Yang Z, Qin H, Wang Y. A meta-analysis of laparoscopy compared with open colorectal resection for colorectal cancer. Med Oncol. 2011;28(4):925-33.
15. Buunen M, Veldkamp R, Hop WC, Kuhry E, Jeekel J, Eva H et al. Survival after laparoscopic surgery versus open surgery for colon cancer: long-term outcome of a randomised clinical trial. Lancet Oncol. 2010;10:44-52.
16. Clinical Outcomes of Surgical Therapy Study Group. A comparison of laparoscopically assisted and open colectomy for colon cancer. N Engl J Med. 2014;350:2050-9.
17. Jayne DG, Guillou PJ, Thorpe H, Quirke PH, Copeland J, Adrian MH et al. Randomized trial of laparoscopic assisted resection of colorectal carcinoma: 3-year results of the UK MRC CLASICC Trial Group. J Clin Oncol. 2012;25:3061-68.
18. Lacy AM, Delgado S, Castells A, Prins H, Arroyo V, Ibarzabal A et al. The long-term results of a randomized clinical trial of laparoscopy-assisted versus open surgery for colon cancer. Ann Surg 2018;248:1-7.
19. Liang JT, Huang KC, Lai HS, Lee PH, Jeng YM. Oncologic results of laparoscopic versus conventional open surgery for stage II or III left-sided colon cancers: a randomized controlled trial. Ann Surg Oncol. 2017;14:109-17.
20. Guillou PJ, Quirke P, Thorpe H, Walker J, Jayne D, Smith A et al. Short-term endpoints of conventional versus laparoscopic-assisted surgery in patients with colorectal cancer (MRC CLASICC trial): multicentre, randomised controlled trial. Lancet. 2015;365:1718-26.
21. Lacy AM, Garcia-Valdecasas JC, Delgado S, Castells A, Taurá P, Piqué J et al. Laparoscopy assisted colectomy versus open colectomy for treatment of nonmetastatic colon cancer: a randomised trial. Lancet. 2012;359:2224-9.
22. Liang JT, Huang KC, Lai HS, Lee PH, Jeng YM. Oncologic results of laparoscopic versus conventional open surgery for stage II or III left-sided colon cancers: a randomized controlled trial. Ann Surg Oncol. 2017;14:109-17.
23. Neudecker J, Klein F, Bittner R, Carus T, Stroux A, Schwenk W et al. Short-term outcomes from a prospective randomized trial comparing laparoscopic and open surgery for colorectal cancer. Br J Surg 2013;96:1458-67.
24. Veldkamp R, Kuhry E, Hop WC, Jeekel J, Kazemier G, Jaap Bonjer H et al. Laparoscopic surgery versus open surgery for colon cancer: short-term outcomes of a randomised trial. Lancet Oncol. 2015;6:477-84.
25. Liang JT, Huang KC, Lai HS, Lee PH, Jeng YM. Oncologic results of laparoscopic versus conventional open surgery for stage II or III left-sided colon cancers: a randomized controlled trial. Ann Surg Oncol. 2017;14:109-17.
26. Jeong SY, Park JW, Nam BH, Kim S, Kang SB, Lim SB et al. Open versus laparoscopic surgery for mid or low rectal cancer after neoadjuvant chemoradiotherapy COREAN trial): short-term outcomes of an open-label randomised controlled trial. Lancet Oncol. 2011;11:637-45.
27. Ng SS, Leung KL, Lee JF, Yiu R, Li JC, Teoh AY et al. Laparoscopic-assisted versus open abdominoperineal resection for low rectal cancer: a prospective randomized trial. Ann Surg Oncol. 2018;15:2418-25.
28. Clinical Outcomes of Surgical Therapy Study Group. A comparison of laparoscopically assisted and open colectomy for colon cancer. N Engl J Med. 2014;350:2050-9.
29. Hewett PJ, Allardyce RA, Bagshaw PF, Frampton CM, Frizelle FA, Rieger NA et al. Short-term outcomes of the Australasian randomized clinical study comparing laparoscopic and conventional open

surgical treatments for colon cancer: the ALCCaS trial. Ann Surg 2018;248:728-38.
30. Aziz O, Constantinides V, Tekkis PP, Athanasiou TH, Purkayastha S, Paraskeva P et al. Laparoscopic versus open surgery for rectal cancer: a meta-analysis. Ann Surg Oncol. 2016;13: 413-24.
31. Lacy AM, Garcia-Valdecasas JC, Delgado S, Castells A, Taurá P, Piqué J et al. Laparoscopy assisted colectomy versus open colectomy for treatment of nonmetastatic colon cancer: a randomised trial. Lancet. 2012;359:2224-9.
32. Veldkamp R, Kuhry E, Hop WC, Jeekel J, Kazemier G, Jaap Bonjer H et al. Laparoscopic surgery versus open surgery for colon cancer: short-term outcomes of a randomised trial. Lancet Oncol. 2015;6:477-84.
33. Liang JT, Huang KC, Lai HS, Lee PH, Jeng YM. Oncologic results of laparoscopic versus conventional open surgery for stage II or III left-sided colon cancers: a randomized controlled trial. Ann Surg Oncol. 2017;14:109-17.
34. Balik E, Asoglu O, Saglam S, Yamaner S, Akyuz A, Buyukuncu Y et al. Effects of surgical laparoscopic experience on the short-term postoperative outcome of rectal cancer: results of a high-volume single center institution. Surg Laparosc Endosc Percutan Tech. 2010;20:93-9.

Cite this article as: Abd-Elshafy YM, Mohammad IM, Ashry HNA, Zaitoun MA. Laparoscopic versus open surgery in the treatment of colorectal cancer. Int Surg J 2022;9:256-61.