Laparoscopy for Colon Cancer

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Abstract

The use of laparoscopy has become widespread across many surgical specialties. Its utility as treatment for colon cancer was initially met with hesitancy due to concern for port site and wound recurrences; however, this was later disproven by large retrospective series. Subsequently, there have been multiple, large, prospective, randomized studies evaluating laparoscopic versus open colectomy for colon cancer. All studies yielded similar results and showed no statistical difference in overall survival, disease-free survival, and recurrence. Additionally, these studies revealed similar operative outcomes with respect to complication rates, perioperative mortality, and conversion to open colectomy, as well as equivalent oncologic resections. Overall in the laparoscopic colectomy groups, hospital stays were shorter, and often times patients required less narcotics postoperatively, but laparoscopic operative times were longer. With adequate training, the use of laparoscopy can be safely employed for patients with colon cancer.

Keywords

- laparoscopy
- colon cancer
- colon surgery

Laparoscopy was first introduced in the 1980s, and during this time, technical skill in general surgery was acquired through biliary and appendiceal surgeries. The following years saw a surge in minimally invasive surgery with laparoscopy now being the gold standard for several general surgery procedures. The depth and breadth of laparoscopy continues to grow across different specialties, and notably in colon and rectal surgery. The first account of a minimally invasive colon resection was a case report in August 1991, describing a villous lesion removed via right hemicolectomy.¹ This was quickly followed by Jacobs et al, who described their experience with 20 laparoscopic-assisted colectomies (LAC) for both benign (10) and malignant (10) diseases.² Neither of the studies reported a need for conversion to an open colectomy (OC), and Jacobs' complication rate of 15% fell into an acceptable range for colorectal procedures.

Over the subsequent years, multiple new studies evaluated the feasibility and utility of minimally invasive colon surgery with promising results. Early studies investigated LAC technique and outcomes for both benign and malignant diseases. Their results demonstrated low complication rates, acceptable conversion to open rates, and shorter hospital lengths of stay.^{3,4} In 1994, Hoffman et al prospectively compared 80 patients undergoing LAC and 53 patients undergoing OC, with

half of patients in each group having cancer.⁵ The study showed a conversion to open rate of 22.5% with similar complication rates. Most importantly, they demonstrated adequate specimen margins and lymph node dissections for malignant cases. The largest of early studies on laparoscopic colectomy evaluated the morbidity and mortality of 240 patients undergoing LAC with and without proctectomy (103 of 240 for malignancy).⁶ When compared with OC controls, LAC patients had an 8% conversion rate, similar complication rates, and a decrease in overall wound infection rate when compared with historical data. Despite the numerous studies showing promising results for LAC, surgeons were hesitant due to operative concerns of inadequate resection margins, lymph node dissection, and, most notably, local wound and port site recurrences (PSR).

Port Site Recurrences

Multiple incisions, insufflation, and specimen extraction raised concern for PSR when using laparoscopy for colon cancer. The idea of a local wound recurrence in colorectal surgery is not new, and was first introduced by Sistrunk in 1928. Although his work references open surgery, he introduces the concern that "Carcinoma cells are also likely to

become implanted in the raw surfaces of the wound ... and later produce recurrence."⁷ While incision length is smaller, the theoretical risk of aerosolizing cancer cells and removing a cancer specimen through a small incision prevented many surgeons from employing LAC in their practice. Soon after the first LAC, case reports began to appear describing PSR after surgery for colon cancer.^{8,9} Furthering concerns, the largest report during this time described a 21% abdominal wall recurrence rate in 14 LAC patients over a 3-year follow-up.¹⁰

The growing concern of PSR within the surgical community prevented many institutions from using laparoscopy for colon cancer. An extensive review by Johnstone et al reported on the incidence of PSR from 1993 to 1995 and found only 35 reported cases in colon cancer.¹¹ Furthermore, the risk of PSR

was low across other minimally invasive surgical procedures for cancer, including ovarian, lung, and other gastrointestinal malignancies. The review did reveal that a majority of PSRs occurred in patients with a higher stage cancer. This evidence was supported by a prospective registry of the American Society of Colon and Rectal Surgeons, American College of Surgeons, and Society of American Gastrointestinal and Endoscopic Surgeons who followed up 480 patients after laparoscopic colectomy showing a 1% PSR rate.¹² All patients with a PSR had TNM Stage III disease. This rate is similar to the previously published wound recurrence rate of 0.6% in patients who underwent OC for malignancy, again with a higher incidence among those patients with advanced disease.¹³ The fear of PSR was overestimated and unfounded which allowed

Table 1 Patient, operative, and postoperative data of randomized studies

Variables	OC	LAC	p
Barcelona			
Patients	108	111	–
Operative time (min)	118	142	0.001
Lymph nodes	10.7	11.1	0.70
Hospital length of stay (d, mean)	7.9	5.2	0.005
Complications (%)	10.8	28.7	0.001
COST			
Patients	428	435	–
Operative time (min)	95	150	<0.001
Lymph nodes	12	12	NC
Hospital length of stay (d, median)	6	5	<0.001
Complications	20%	21%	0.64
CLASICC			
Patients	268	526	–
Operative time (min)	135	180	NC
Lymph nodes	13.5	12	NC
Hospital length of stay (d, median)	9	9	NC
Complications	27%	26%	NC
COLOR			
Patients	621	627	–
Operative time (min)	115	145	<0.0001
Lymph nodes	10	10	0.35
Hospital length of stay (d, mean)	9.3	8.2	<0.0001
Complications	20%	21%	0.88
ALCCaS			
Patients	298	294	–
Operative time (min)	107	158	<0.001
Lymph nodes	13	13	0.16
Hospital length of stay (d, mean/median)	10.6/8	9.5/7	0.068/ < 0.0001
Complications	45.3% ^a	37.8% ^a	0.06

Abbreviations: LAC, laparoscopic-assisted colectomy; NC, not calculated; OC, open colectomy.

^aIncludes fever and ileus.

prospective trials to move forward and compare operative and survival metrics between LAC and OC.

Laparoscopic versus Open Colectomy

It remained unclear whether LAC was surgically adequate to remove the colon and regional lymph nodes en bloc. The next two decades spurred multiple trials to evaluate this and other laparoscopic controversies including oncologic outcome and, ultimately, survival. In the United States, the Clinical Outcomes of Surgical Therapy (COST) study group was formed. Prior to a prospective analysis, the group performed a feasibility study and retrospectively evaluated 372 patients with colon cancer treated with LAC.¹⁴ Similar to case series around this time, conversion to open, local recurrence rates, operative mortality, and short-term survival were all comparable to previous OC data. The first randomized trial comparing LAC and OC was in a single-center study in Barcelona by Lacy et al.¹⁵ Their group evaluated 219 patients from 1993 to 1998 and assessed cancer-related survival as their primary outcome. Both short- and long-term data showed a decrease in

morbidity in the LAC group as well as improved cancer-related and overall survival that approached statistical significance.^{16,17}

Multiple countries followed the Barcelona study and performed similar prospective, randomized trials comparing OC and LAC. Operative and survival data for all trials are found in ►Tables 1 and 2, respectively. The COST group studied 872 patients to test for noninferiority of LAC compared with OC. Results mirrored their previous study and showed equivalent complication rates, recurrence, and survival. Interestingly, patients undergoing LAC had a shorter hospital length of stay and decreased narcotic requirement.^{18,19} Each study that followed showed similar results. In the United Kingdom, the Conventional versus Laparoscopic-Assisted Surgery in Patients with Colorectal Cancer (CLASICC) trial compared OC with laparoscopic-assisted rectal and colon resections. Similar short- and long-term outcomes were seen when cases were controlled for colon surgery, specifically with respect to complication rates, disease-free survival, and overall survival.^{20,21} These efforts were followed by the European Colon cancer Laparoscopic or Open Resection (COLOR) trial, which evaluated LAC as a curative treatment. The

Table 2 Recurrence and survival data of randomized studies

Variables	OC	LAC	p
Barcelona			
30-d mortality	2.7%	0.9%	NC
Recurrence	28%	18%	0.07
Cancer-related mortality	27%	16%	0.07
Overall survival	51%	64%	0.06
COST			
30-d mortality	1%	<1%	0.40
Recurrence (5 y)	21.8%	19.4%	0.25
Disease-free survival (5 y)	68.4%	69.2%	0.94
Overall survival (5 y)	74.6	76.4%	0.93
CLASICC			
In-hospital mortality	5%	4%	0.57
Recurrence	–	–	–
Disease-free survival (mo)	106.6	86.6	0.44
Overall survival (mo)	105.7	81.9	0.35
COLOR			
28-d mortality	2%	1%	0.47
Recurrence	14.8%	16.7%	0.24
Disease-free survival (5 y)	67.9%	66.5%	NS
Overall survival (5 y)	74.2%	73.8%	NS
ALCCaS			
30-d mortality (in-hospital)	0.7%	1.4%	0.45
Recurrence	14.8%	13.8%	0.73
Disease-free survival (5 y)	71.7%	72.3%	0.82
Overall survival (5 y)	76.0%	77.7%	0.94

Abbreviations: LAC, laparoscopic-assisted colectomy; NC, not calculated; NS, not significant; OC, open colectomy.

study design was similar to the COST trial, evaluating only colon cancer, and represents the largest randomized trial studying 1,248 patients. Disease-free survival in each group was comparable, and the group interpreted LAC as noninferior. Although LAC cases were longer in duration, blood loss was significantly less, patients required less narcotics postoperatively, and hospital length of stay was shorter.^{22,23} In the last large randomized trial, the Australian Laparoscopic Colon Cancer Surgery (ALCCaS) group aimed to evaluate equivalence in disease-free survival. Results from this trial again showed no difference in short-term outcomes and demonstrated an equivalent disease-free survival between groups.^{24,25}

Each randomized study failed to show statistical differences in survival outcomes between LAC and OC. However, in a prospective, nonrandomized study from Hong Kong, Law et al showed improved operative mortality and better survival for LAC patients.²⁶ In this study, operative approach was not randomized, and the choice for laparoscopy depended on multiple variables, including patient preference and surgeon availability. Their divergent survival data could be explained by nonrandomization which is often fraught with confounders and selection bias.

All of the randomized trials consistently showed the safety and efficacy of LAC. The studies demonstrated adequate oncologic resection evidenced by equivalent lymphadenectomy and rate of positive margins on final specimen pathology. Furthermore, the incidence of PSR was reported in four trials and ranged from 0.9 to 1.9%, reconfirming what was reported in previous retrospective analyses. The conversion to OC rate across all trials was 11 to 25% with tumor fixation, and advanced disease being the most common reason for conversion. Interestingly, patients who required conversion often had a higher complication rate and longer length of hospital stay; however, intention to treat analysis showed that LAC had an overall shorter hospital stay. It should be noted that these trials occurred prior to the fast track recovery programs for colorectal surgery, and total hospital length of stay does not reflect current hospital standards. Despite all studies demonstrating longer operative times for LAC, the COLOR trial showed a statistically significant decrease in duration of LAC surgery times with increasing number of patients.²² This could suggest that LAC operative times will approach those of OC with increasing surgeon experience. This was evidenced in a recent retrospective study published in 2015 which showed similar operative times (194 ± 57 vs. 177 ± 51 minutes, $p = 0.118$) in LAC and OC, respectively, for colon cancer.²⁷ This trend is likely to continue with the current push for minimally invasive surgery and subsequent laparoscopic training across all residency and fellowship training programs. The findings in these studies have resulted in the American Society of Colon and Rectal Surgeons to give laparoscopy a Grade 1A recommendation for the surgical treatment of colon cancer when performed by an experienced and credentialed surgeon.²⁸

Conclusion

Since the introduction of LAC for colon cancer, multiple trials have demonstrated its safety and efficacy when compared

with OC. Short-term outcomes balance longer operative times with quicker recovery, decreased narcotic requirement, and shortened hospital stay. Analysis of pathology specimens is oncologically equivalent and long-term results show similar recurrence rates as well as similar rates of disease-free survival and overall survival. Appropriately trained surgeons should consider laparoscopic colectomy for all patients undergoing surgery for colon cancer.

References

- Cooperman AM, Katz V, Zimmon D, Botero G. Laparoscopic colon resection: a case report. *J Laparoendosc Surg* 1991;1(4):221–224
- Jacobs M, Verdeja JC, Goldstein HS. Minimally invasive colon resection (laparoscopic colectomy). *Surg Laparosc Endosc* 1991;1(3):144–150
- Monson JR, Darzi A, Carey PD, Guillou PJ. Prospective evaluation of laparoscopic-assisted colectomy in an unselected group of patients. *Lancet* 1992;340(8823):831–833
- Phillips EH, Franklin M, Carroll BJ, Fallas MJ, Ramos R, Rosenthal D. Laparoscopic colectomy. *Ann Surg* 1992;216(6):703–707
- Hoffman GC, Baker JW, Fitchett CW, Vansant JH. Laparoscopic-assisted colectomy. Initial experience. *Ann Surg* 1994;219(6):732–740, discussion 740–743
- Lumley JW, Fielding GA, Rhodes M, Nathanson LK, Siu S, Stitz RW. Laparoscopic-assisted colorectal surgery. Lessons learned from 240 consecutive patients. *Dis Colon Rectum* 1996;39(2):155–159
- Sistrunk WE. The Mikulicz operation for resection of the colon: its advantages and dangers. *Ann Surg* 1928;88(3):597–606
- Alexander RJ, Jaques BC, Mitchell KG. Laparoscopically assisted colectomy and wound recurrence. *Lancet* 1993;341(8839):249–250
- Fusco MA, Paluzzi MW. Abdominal wall recurrence after laparoscopic-assisted colectomy for adenocarcinoma of the colon. Report of a case. *Dis Colon Rectum* 1993;36(9):858–861
- Berends FJ, Kazemier G, Bonjer HJ, Lange JF. Subcutaneous metastases after laparoscopic colectomy. *Lancet* 1994;344(8914):58
- Johnstone PA, Rohde DC, Swartz SE, Fetter JE, Wexner SD. Port site recurrences after laparoscopic and thoracoscopic procedures in malignancy. *J Clin Oncol* 1996;14(6):1950–1956
- Vukasin P, Ortega AE, Greene FL, et al. Wound recurrence following laparoscopic colon cancer resection. Results of the American Society of Colon and Rectal Surgeons Laparoscopic Registry. *Dis Colon Rectum* 1996;39, (10 Suppl):S20–S23
- Reilly WT, Nelson H, Schroeder G, Wieand HS, Bolton J, O'Connell MJ. Wound recurrence following conventional treatment of colorectal cancer. A rare but perhaps underestimated problem. *Dis Colon Rectum* 1996;39(2):200–207
- Fleshman JW, Nelson H, Peters WR, et al. Early results of laparoscopic surgery for colorectal cancer. retrospective analysis of 372 patients treated by Clinical Outcomes of Surgical Therapy (COST) Study Group. *Dis Colon Rectum* 1996;39(10, Suppl):S53–S58
- Lacy AM, García-Valdecasas JC, Piqué JM, et al. Short-term outcome analysis of a randomized study comparing laparoscopic vs open colectomy for colon cancer. *Surg Endosc* 1995;9(10):1101–1105
- Lacy AM, García-Valdecasas JC, Delgado S, et al. Laparoscopy-assisted colectomy versus open colectomy for treatment of non-metastatic colon cancer: a randomised trial. *Lancet* 2002;359(9325):2224–2229
- Lacy AM, Delgado S, Castells A, et al. The long-term results of a randomized clinical trial of laparoscopy-assisted versus open surgery for colon cancer. *Ann Surg* 2008;248(1):1–7
- Nelson H, Sargent DJ, Wieand HS, et al; Clinical Outcomes of Surgical Therapy Study Group. A comparison of laparoscopically assisted and open colectomy for colon cancer. *N Engl J Med* 2004;350(20):2050–2059

- 19 Fleshman J, Sargent DJ, Green E, et al; Clinical Outcomes of Surgical Therapy Study Group. Laparoscopic colectomy for cancer is not inferior to open surgery based on 5-year data from the COST Study Group trial. *Ann Surg* 2007;246(4):655–662, discussion 662–664
- 20 Guillaou PJ, Quirke P, Thorpe H, et al; MRC CLASICC trial group. Short-term endpoints of conventional versus laparoscopic-assisted surgery in patients with colorectal cancer (MRC CLASICC trial): multicentre, randomised controlled trial. *Lancet* 2005;365(9472):1718–1726
- 21 Green BL, Marshall HC, Collinson F, et al; MRC CLASSIC Trial Group. Long-term follow-up of the Medical Research Council CLASICC trial of conventional versus laparoscopically assisted resection in colorectal cancer. *Br J Surg* 2013;100(1):75–82
- 22 Veldkamp R, Kuhry E, Hop WC, et al; Colon cancer Laparoscopic or Open Resection Study Group (COLOR). Laparoscopic surgery versus open surgery for colon cancer: short-term outcomes of a randomised trial. *Lancet Oncol* 2005;6(7):477–484
- 23 Buunen M, Veldkamp R, Hop WC, et al; Colon Cancer Laparoscopic or Open Resection Study Group. Survival after laparoscopic surgery versus open surgery for colon cancer: long-term outcome of a randomised clinical trial. *Lancet Oncol* 2009;10(1):44–52
- 24 Hewett PJ, Allardyce RA, Bagshaw PF, 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* 2008;248(5):728–738
- 25 Bagshaw PF, Allardyce RA, Frampton CM, et al; Australasian Laparoscopic Colon Cancer Study Group. Long-term outcomes of the Australasian randomized clinical trial comparing laparoscopic and conventional open surgical treatments for colon cancer: the Australasian Laparoscopic Colon Cancer Study trial. *Ann Surg* 2012;256(6):915–919
- 26 Law WL, Lee YM, Choi HK, Seto CL, Ho JWC. Impact of laparoscopic resection for colorectal cancer on operative outcomes and survival. *Ann Surg* 2007;245(1):1–7
- 27 Huang JL, Wei HB, Fang JF, et al. Comparison of laparoscopic versus open complete mesocolic excision for right colon cancer. *Int J Surg* 2015;23(Pt A):12–17
- 28 Chang GJ, Kaiser AM, Mills S, Rafferty JF, Buie WD; Standards Practice Task Force of the American Society of Colon and Rectal Surgeons. Practice parameters for the management of colon cancer. *Dis Colon Rectum* 2012;55(8):831–843