

## Research Article

# The Shift to Laparoscopic Colon Resection: A Single Center Experience

**Abdul-Mujib Cadili, Sunita Ghosh and Ali Cadili\***  
Department of Surgery, University of Saskatchewan,  
Canada

**\*Corresponding author:** Ali Cadili, Department  
of Surgery, Saskatoon, Saskatchewan, University of  
Saskatchewan, Canada, Email: alicadili1@gmail.com

**Received:** February 09, 2015; **Accepted:** August 05,  
2015; **Published:** August 14, 2015

## Abstract

**Introduction:** Laparoscopic colon resection has been shown to not compromise oncological outcomes. It also provides superior results with regards to postoperative recovery. Laparoscopic resection, therefore, has become accepted as the standard technique for surgical treatment of colon cancer. We sought to document our experience with transitioning from open to laparoscopic colon resection in a high volume community center.

**Methods:** A retrospective review of all colon resections at the Sturgeon Community Hospital in St Albert, Alberta over a six year period was carried out. Collected data included patient demographics (age, gender, and medical comorbidities), surgical intervention characteristics (extent of colonic resection, open versus minimally invasive technique) and patient outcomes (mortality, intraoperative and perioperative complications).

**Results:** 175 colon resections for neoplasia were performed during the study period. 45 Cases were performed laparoscopically, 43 total laparoscopic cases (2 hand assisted). 130 cases were open with midline laparotomy incisions.

**Conclusion:** Laparoscopic resection resulted in less blood loss, mortality risk, as well as length of hospital stay compared to open surgery. There were no negative outcomes with the adoption of minimally invasive techniques compared to the traditional open approach. This study does support the premise that the shift from laparoscopic surgery for colon neoplasia can be done in a safe and effective manner without compromising outcomes.

**Keywords:** Laparoscopic resection; ASA class; Minimally invasive technique

## Introduction

At its outset, the minimally invasive method of colon resection was met with significant skepticism. Besides the technical complexity anticipated with this procedure, several concerns regarding oncological safety were also voiced. Such concerns included adequate margin and lymph node status, port site metastasis, and CO<sub>2</sub> pneumoperitoneum effect on tumor biology [1]. Landmark trials, however, have shown that laparoscopic colon resection does not compromise oncological outcomes and provides superior results with regards to postoperative recovery compared to traditional open surgery [2-4]. In addition, laparoscopic colon surgery has been shown to result in decreased length of hospital stay, use of postoperative analgesics, and wound infections compared to traditional open surgery [5]. Today, laparoscopic colon resection has become accepted as a standard technique for surgical treatment of colon cancer. Studies have shown the safety and efficacy of this technique compared to open surgery. The widespread adoption and uniformity of implementation of this modality, however, remains hindered for a variety of reasons [6,7]. Formal studies have actually documented the variability with which laparoscopic surgery has been adopted in the treatment of colonic disease [8]. A myriad of factors, most important of which are surgeon training, have been identified as being responsible for this hampered implementation. With the ever increasing exposure to laparoscopy

in residency training, combined with the popularity of laparoscopic fellowship training programs, the use of laparoscopic surgery as the standard of care is only expected to be further entrenched [9]. For community surgeons not formally trained in laparoscopic surgery through either residency or fellowship training.

The purpose of this study was to document our experience with transitioning from open to laparoscopic colon resection in a high volume community center. Comparison of outcome between the two surgical modalities with regards to efficacy of the surgery, morbidity (both short and long term), and mortality was sought to be determined.

## Methods

A retrospective review of all surgeries performed for colon neoplasia (encompassing the spectrum from benign to cancerous) at the Sturgeon Community Hospital in St Albert, Alberta over a six year period (from November 2006 until December 2012) was carried out. Collected data included patient demographics (age, gender, medical comorbidities), surgical intervention characteristics (extent of colonic resection, open versus minimally invasive technique), and patient outcomes (mortality, intraoperative and perioperative complications, tumor characteristics (malignant versus benign on final histology, histologic type, grade, number of lymph nodes

**Table 1:** Baseline patient and tumor characteristics.

Variable	N	Open	Minimally Invasive	P Value
<b>Patient Factors</b>				
Gender				0.730
Male	103	77	26	
Female	72	52	20	
Age		68.4	66.2	0.599
ASA Class				0.063
I	33	20	13	
II	88	65	23	
III	40	35	5	
IV	1	1	0	
Comorbidities	125	94 (77.7%)	31 (77.5%)	0.056
<b>Tumor Factors</b>				
Size (largest dimension cm)		5.1	4.3	0.07
Site				0.0019
Right Colon	87	55	32	0.002
Left Colon	74	60	14	0.05
Transverse Colon	13	13	0	0.02
Histology				0.005
Benign	40	20	20	
Malignant	133	107	26	
Grade				0.383
Low Grade		84	24	
High Grade		18	10	
Stage				0.096
I	20	14	6	
II	47	33	14	
III	33	30	3	
IV	31	26	5	
Distant Metastasis	36	30 (23.8%)	6 (13.1%)	0.143

harvested and involved in cancer, margin status). Colon resections performed for emergency cases (such as perforated diverticulitis or fulminant colitis) were excluded from this study.

**Statistical analysis**

Descriptive statistics were reported for the study variables. Mean and standard deviation was used for continuous variables and frequency and percentages were reported for categorical variable. Logistic regression analysis was used to compare the outcome midline vs. minimally invasive group. The following variables average operation time, deceased status (deceased vs. alive), circumferential margin (Involved vs. Uninvolved), reoperation (yes vs. no), surgical complication (yes vs. no), length of hospital stay, number of lymph nodes and blood loss measured in cc were introduced in the univariate model. The variables significant at p<0.10 level in the univariate model were chosen for the multivariate model. The final model was chosen with the significant predictors of midline vs. minimally invasive group. SAS software (SAS Institute Inc. Cary, NC) version

9.3 was used for analysis purpose and a p-value<0.05 was used for statistical significance.

**Results**

A total of 175 colon resections for neoplasia were performed during the specified study period. 45 cases were done using minimally invasive techniques; 2 hand-assisted cases and 43 total laparoscopic cases. 130 cases were performed using traditional open technique utilizing midline incisions. Table 1 summarizes the baseline patient and tumor characteristics across the two study groups. The two groups were not significantly different in baseline patient characteristics except for histology; more malignant cases tended to be performed by the open rather than minimally invasive method (P value 0.005). No statistically significant difference emerged, however, with regards to age, gender, ASA class, the presence of major medical comorbidities, tumor size, or stage. The site of colon resection, Table 2 lists the differences between the two study groups with regards to the analyzed outcomes. Compared to minimally invasive surgery, open colonic resection exhibited a trend towards greater operative time however this was not statistically significant. Open colon resection cases did, however, result in significantly higher operative blood loss (P value 0.0001) higher 30 day mortality (P value 0.001), and greater length of postoperative hospital stay (P value 0.001). The two study groups also differed according to site of colon resection: right colon, versus left colon, versus transverse colon. There was no significant difference between the two groups, however, with regards to rate or reoperation, rate of postoperative complication development, surgical margin status, and number of lymph nodes resected. Interestingly, a trend towards open surgery in right sided lesions was noted; being contrary to expectations, this trend likely resulted from variability and inexperience early on in selecting patients for the laparoscopic approach.

**Discussion**

Minimally invasive approaches to colon resection for neoplasia have been steadily taking hold in community and academic training centers. This has produced a generation of surgeons that is increasingly comfortable with this technique for managing neoplastic diseases of the colon. For the experienced surgeons who trained and practiced exclusively in the era of traditional open colonic resection, however, the transition to minimally invasive colon resection has faced many barriers. Such barriers initially included concerns regarding procedure safety and oncologic outcomes. In the current time, however, these barriers mainly center around garnering the technical

**Table 2:** Outcomes according to open vs. minimally invasive surgery.

Variable	Open	Minimally Invasive	P Value
Circumferential Margin Positivity	5 (3.9%)	(4.3%)	0.307
Number of Harvested Lymph Nodes	18	16	0.246
Reoperation	10 (7.9%)	3 (6.5%)	0.766
Mortality	38 (29.5%)	3 (6.5%)	0.001
Operative Blood Loss (ml)	169	131	0.0001
Operative Complications	24 (18.6%)	9 (19.6%)	0.866
Length of Hospital Stay (days)	13.4	8.9	0.001
Operative Time (min)	88.1	98.9	0.697

expertise necessary to affect outcomes that are at least as satisfactory as the open technique. In our study, we documented the transition from open to laparoscopic colon resection for neoplasia in a single high volume Canadian center. Patient outcomes, including quality indicators of adequate oncologic surgery such as margin status and lymph node clearance, were not significantly different between open and minimally invasive surgery. This indeed confirms the premise, proven by multiple other studies, that laparoscopic surgery does not compromise surgical outcomes, both oncological and otherwise. Laparoscopic cases did, however, involve a trend towards greater length of operative time although this was not statistically significant; this is not an unexpected finding considering that the study period encompassed the learning curve for performing laparoscopic colonic resections. Conversely, cases done by the open technique were associated with greater operative blood loss and increased mortality. This certainly could have resulted, at least partially, from the selection process whereby those cases anticipated to be most technically and physiologically challenging were booked as open rather than laparoscopic procedures. It is interesting to note, however, that the baseline characteristics of disease type, age, ASA class, and major medical comorbidities were not significantly different between the two groups of patients. It is difficult to conclude from this study that laparoscopic surgery results in superior outcomes to open surgery with regards to blood loss and mortality. This is, again, because of the potential for selection bias in our series. Laparoscopic surgery did, however, result in a significantly decreased length of postoperative stay in our series ( $P$  value= 0.001). This finding is in line with previous studies that have established decreased length of postoperative stay as a firm advantage of laparoscopic over open colon surgery [10].

The main limitation of this paper was the fact that it was retrospective in nature thus introducing the possibility of selection bias on the study outcomes. No significant differences in age, gender, ASA class, or major medical comorbidities between the two study groups were found in our analysis, however. In addition, the minimally invasive category encompassed both hand-assisted as well as total laparoscopic techniques. These techniques could be considered as separate modalities requiring a distinct set of skills and philosophy. The hand-assisted method is often used by “open” surgeons in practice wanting to transition to minimally invasive surgery; the main reasoning is that they may feel uncomfortable initially with immediately adopting the total laparoscopic method [11]. We included hand-assisted and total laparoscopic cases in the same category in our analysis as we felt that this more realistically reflect the journey towards transitioning from an open to a minimally invasive approach for colon resections (which is the main purpose of this study). At any rate, there were only two hand-assisted

laparoscopic colon resection cases out of the 175 cases included in our study for analysis. Also, the postoperative survival analysis in this study was limited to 30 day mortality. Long-term survival was not assessed in this study given the recent nature of the most recently collected data (ex in 2012). This review was meant to review the safety and practicality of transitioning to minimally invasive approach rather than long-term oncologic and survival outcomes.

## Conclusion

In conclusion, we did not observe any negative outcomes with the adoption of minimally invasive techniques compared to the traditional open approach. This study does indeed support the premise that the shift from open to laparoscopic surgery for colon neoplasia can be done in a safe and effective manner without compromising outcomes.

## References

1. Wexner SD, Cohen SM. Port site metastases after laparoscopic colorectal surgery for cure of malignancy. *Br J Surg.* 1995; 82: 295-298.
2. Lorenzon L, La Torre M, Ziparo V, Montebelli F, Mercantini P, Balducci G, et al. Evidence based medicine and surgical approaches for colon cancer: evidences, benefits and limitations of the laparoscopic vs open resection. *World J Gastroenterol.* 2014; 20: 3680-3692.
3. Hasegawa H, Okabayashi K, Watanabe M, Ashrafian H, Harling L, Ishii Y, et al. What is the Effect of Laparoscopic Colectomy on Pattern of Colon Cancer Recurrence? A Propensity Score and Competing Risk Analysis Compared with Open Colectomy. *Ann Surg Oncol.* 2014.
4. Biondi A, Grosso G, Mistretta A, Marventano S, Toscano C, Drago F, et al. Laparoscopic vs. open approach for colorectal cancer: evolution over time of minimal invasive surgery. *BMC Surg.* 2013; 13: S12.
5. Abraham NS, Young JM, Solomon MJ. Meta-analysis of short-term outcomes after laparoscopic resection for colorectal cancer. *Br J Surg.* 2004; 91: 1111-1124.
6. Hahnloser D, Nelson H. Laparoscopic colectomy for colon cancer. *Minerva Chir.* 2003; 58: 431-438.
7. Martel G, Boushey RP. Laparoscopic colon surgery: past, present and future. *Surg Clin North Am.* 2006; 86: 867-897.
8. Robinson CN, Chen GJ, Balentine CJ, Sangsiry S, Marshall CL, Anaya DA, et al. Minimally invasive surgery is underutilized for colon cancer. *Ann Surg Oncol.* 2011; 18: 1412-1418.
9. Mackenzie H, Miskovic D, Ni M, Parvaiz A, Acheson AG, Jenkins JT, et al. Clinical and educational proficiency gain of supervised laparoscopic colorectal surgical trainees. *Surg Endosc.* 2013; 27: 2704-2711.
10. Hemandas AK, Abdelrahman T, Flashman KG, Skull AJ, Senapati A, O'Leary DP, et al. Laparoscopic colorectal surgery produces better outcomes for high risk cancer patients compared to open surgery. *Ann Surg.* 2010; 252: 84-89.
11. Romanelli JR, Kelly JJ, Litwin DE. Hand-assisted laparoscopic surgery in the United States: an overview. *Semin Laparosc Surg.* 2001; 8: 96-103.