

**SUPERIOR LYMPH NODE RESECTION
IS ACHIEVABLE WITH LAPAROSCOPIC COLECTOMY**
Even in initial 30 cases

Authors:

Robert C Wright, M.D., F.A.C.S.
C. Anthony Kim, M.D., F.A.C.S.
Ian Horner, B.S.
Richard Wright

Robert C Wright, M.D., F.A.C.S.
1703 South Meridian #304
Puyallup, WA 98371

Telephone: (253) 840-1999
Fax: (253) 445-4125
drbwright@msn.com

ABSTRACT:

Background: Recent studies demonstrated the validity of laparoscopic technique in colon cancer resections, and thousands of surgeons are learning the technique. Recent node resection data in open colectomies shows inadequate nodal removal is common. In this study, two experienced laparoscopic surgeons in the community setting evaluated their initial outcomes with laparoscopic colectomy, including resections for malignancies.

Methods: A retrospective review of clinic and hospital records involving 69 consecutive patients who underwent laparoscopic colectomies from July 2000 thru December 2005. Patients were assessed for a number of variables. These outcomes were compared with 1,000 patients from Senagore and Delaney. Adequacy of oncologic resection was assessed by review of pathology report, tabulation of TNM stage and nodal count, and compared with the NCI published database.

Results: Sixty-nine resections were undertaken, 43 were hand-assist laparoscopic colectomies (HALS) and 26 were conventional laparoscopic assisted colectomy (LAC). 27 were right and 42 were left colectomies. 32 resections were for colon cancer. Overall complication and conversion rates were comparable to Senagore and Delaney with the exception of days of hospitalization at 6.0 compared with 3.7 ($p < 0.01$), and readmission at 4.2% compared with 9.1% ($p < 0.01$). Adequate node resection occurred in 26 of 32 patients (81%) compared with 37% of open colectomies in NCI nationwide database ($p < 0.05$). The overall median number of nodes resected was 18; the median with HALS was 17.5, and LAC the median was 18. However, LAC on the left side had a median of 8.

Conclusions: For veteran laparoscopic surgeons in a community hospital, the initial experience with LAC can provide excellent results; meeting standards set in large published series. In addition, the resection of nodes in colon cancer can be significantly better when performed laparoscopically. The authors have chosen HALS as the dominant oncologic surgery for left colectomies.

Key words: Laparoscopy – Colectomy – Colon Cancer – Lymph Node – Hand-Assisted – Learning Curve

Introduction

The adequacy of laparoscopic-assisted colectomy (LAC) for colon cancer has been heavily scrutinized, and most surgeons have awaited survival data before undertaking laparoscopic resection for malignancy. Encouraging results were published by Lacy, *et al*, in 2002 [8] in which experienced laparoscopic surgeons undertook a randomized trial comparing LAC against open colectomy (OC) for colon cancer resection. Their results showed the predicted short-term benefits of lower morbidity, shorter hospital stays, and lower surgical stress while revealing long-term benefits of increased survival rates and low tumor recurrence.

In May of 2004, a multi-institutional group led by the Clinical Outcomes of Surgical Therapy (COST) Study Group published a similar study, and demonstrated LAC slightly increased short-term benefits and held comparable long-term results with OC, and suggested the laparoscopic approach is an acceptable alternative to open surgery for colon cancer [13]. The Clasicc Trial confirmed similar results in 2005. The Clasicc Trial also showed intermediate follow-up was effective and concluded that a laparoscopic assisted colectomy was likely to produce similar long-term outcomes as open colectomy [5].

Still, open resection for colon cancer has been the standard for many decades. Only recently has adequacy of resection for colon cancer been questioned. Beginning in 1990, the standard number of lymph nodes set for resection was twelve, established by the Institute for Gastroenterology [4]. A twelve-node resection was reaffirmed in 2000 by the Institute of Pathologists [6], and the National Cancer Institute (NCI) set a standard of a minimum of twelve nodes for resection in 2001 [12].

Adequacy of lymph node resection has been under more scrutiny since the 2001 recommendations. Recent laparoscopic series by Jacob and Salkey were criticized for having an average number of resection nodes at ten with LAC [7, 14]. This was nearly simultaneous with publication by The American College of Surgeons in *Surgery News* that suggested a resection of fifteen lymph nodes improves cancer survival in colon cancer [1]. In another study involving survival rates, Le Voyer, *et al* found that absolute nodal count correlated with improved survival in patients whose stage of colon cancer required adjuvant therapy [10]. The number of nodes resected correlated positively with overall survival, cause specific survival, and disease free survival ($P = 0.0001$ for all three end points). The NCI databank was published in 2005 evaluating 111,000 nationwide open colectomy patients, and showed only 37% of all resections met the standard of a twelve node resection [3]. Therefore, the number of nodes has attracted a lot of attention, yet there is very little published data regarding adequacy of node resection with LAC. Table 1 provides a comparison of the mean or median number of lymph nodes resected by the above-mentioned studies.

Currently in America, thousands of surgeons are attempting to learn laparoscopic colectomy and many are using hand assist techniques. These techniques decrease the transitional barrier for the surgeons who have spent their career doing open surgery to adopt laparoscopic techniques. There have been recommendations by the America Society of Colon and Rectal Surgeons (ASCRS) and the Society of American Gastrointestinal Endoscopic Surgeons (SAGES) for 20 benign laparoscopic colectomy resections being done before a surgeon should undertake resection of malignancy [9]. Hand assisted laparoscopic colectomy (HALS) has been utilized to some degree by

surgeons, first being published in the late 1990's [2]. The technique has been utilized with total abdominal colectomy as well as resection of colon cancers and benign disease. The overall results are comparable when compared with open colectomy in a small series; however, laparoscopic colectomy and hand-assisted colectomy have not been compared in a published series.

In this retrospective analysis, two experienced laparoscopic surgeons have undertaken analysis of their initial results with laparoscopic colectomy. One surgeon has performed over a thousand laparoscopic hiatal hernia repairs (Wright). The other surgeon (Kim) has completed a laparoscopic fellowship, and performs many other advanced laparoscopic procedures.

In July of 2000, these two surgeons in a community hospital began routinely doing elective laparoscopic colectomy for benign disease, and by 2003 had undertaken laparoscopic colectomy for malignancies with encouragement by the results from the Lacy study [8]. The series includes the initial 30 laparoscopic resections for both surgeons. The pathologists who evaluated these specimens were community pathologists who were unaware of the retrospective analysis being done on their work. The goal was to evaluate the clinical outcomes in the short term with a large published database of two dedicated colorectal surgeons in their recent published series of a thousand cases, and to compare adequacy of lymph node resection for colon malignancies against the NCI database.

Methods

This study assesses the clinical outcomes of the learning phase of elective laparoscopic colectomies performed by two experienced laparoscopic surgeons in a community hospital setting, comparing against two large published databases. The choice of whether to perform hand assisted laparoscopic colectomy versus laparoscopic colectomy was at the discretion of the surgeon.

Between July 2000 and December 2005 over 100 patients underwent colon surgery. Patients were excluded on these pretexts: Unprepared emergency cases, transverse colon resections, rectal cases, cardiovascular issues contraindicating laparoscopy, and synchronous contra lateral cancer resections. Our eventual goal was to compare the quality of the laparoscopic procedures and the adequacy of lymph nodes resection in laparoscopic colectomies for cancer. Ultimately, 69 consecutive patients who underwent laparoscopic colectomies for benign and malignant were evaluated via retrospective review of clinic, hospital, and pathology records. The pathologists were also community hospital based pathologists and unaware of the impending scrutiny on the nodal count.

Data was tabulated for patient age, mass, ASA classification, operative indications, type of resection, complications, concomitant procedures, length of hospital stay, and readmission. These outcomes were compared statistically with a two surgeon series recently published by Senagore and Delaney [15]. In addition, TNM stage and overall nodal count were also tabulated for colon cancer patients. This data, indicating adequacy of oncologic resection, was statistically compared with the published database of the National Cancer Institute (NCI) [12].

Senagore and Delaney have recently published a series of one thousand patients undergoing a laparoscopic colectomy in a referral center [15]. The data of these

colorectal surgeons was compared with our data using the binomial test, performed by an unaffiliated biostatistician. In addition, the adequacy of lymph node resection was compared with the NCI database previously mentioned, again using the binomial test for comparison purposes.

Patient care protocol was not utilized in the management of laparoscopic patients, and they were managed similarly to the management of our open colectomy patients during their hospital stay.

Results

Sixty-nine consecutive, elective laparoscopic colectomy patients were evaluated from July 2000 and December 2005. Table 2 demonstrates the raw data regarding age, mass, ASA classification, operative indications, type of resections, complications, and length of stay. Outcomes of Senagore and Delaney are also tabulated, and results were comparable to those of Senagore and Delaney; however, conversion rate was lower ($p < 0.01$). The length of stay was higher with our series, and our readmission was lower (both $p < 0.01$). A summary of this data is in Table 3. No trocar site metastases were found in the cancer patients with a minimum follow up of one year.

Thirty-two of our patients had colon malignancy resection and 26 met the standard of 12 or greater nodes (81%, $p < 0.05$). Adequacy of lymph node resection met the standard of 12 nodes in only 37% of patients nationwide according to the NCI database of 111,730 colon cancer resections. See Table 4 for comparison. Subset analysis showed that 17 colon resections were hand-assisted colectomy and 16 of those met the standard of 12 nodes (94%, $p < 0.01$). Conventional laparoscopy, with opening only for retrieval of the specimen, showed adequacy of lymph node resection in ten of fifteen patients (67%, $p = 0.065$). The overall median number of lymph nodes removed was 18, with a median of 23.5 on the right side and 11.5 on the left side. LAC and HALS proved to be near equal for resections on the right side, with medians of 19 and 25 respectively. LAC on the left side showed the lowest results with a median of 8, while HALS left colectomy had a median node resection of 17.5. Table 5 shows our data for resected nodes in colon cancer patients.

Discussion

This small series of laparoscopic colectomy cases, done as an initial series by two experienced laparoscopic surgeons in the community setting, has demonstrated that clinical outcomes of patients can be similar to those of a large published series by surgeons dedicated to performing colorectal surgery. In addition, we have demonstrated that laparoscopic resection for malignancy can result in superior resection of nodes than historically has been reported for open colectomy resections. The number of nodes resected positively correlates with survival according to Le Voyer ($p < 0.01$) [10], and it is our hope that our patients will indeed experience a superior long-term survival based on the nodal projection states for stage.

Our data shows that experienced laparoscopic surgeons, in their initial undertaking of laparoscopic colectomy for malignancies, can provide similar results in a community setting to surgeons committed to laparoscopic colorectal surgery like those of Senagore and Delaney. Complication rates were similar in both studies while there was marked improvement on readmission rates ($p < 0.01$) and conversion to open resection ($p <$

0.01). While we had a greater length of hospital stay ($p < 0.01$), we did not hold to a strict postoperative care plan, which has been shown to reduce hospital stay [16]. Quality of resection was compared with the NCI database for open colon resections. The number of nodes resected was used as the standard because of aforementioned positive correlation with survival rates [10]. When compared with the open colectomies (OC) in the NCI database, the median number of lymph nodes resected for our study was superior for cases on the right and left sides. The lowest median was shown on the left side and is discussed below. The superior lymph node resections in our study encourages the idea that experienced laparoscopic surgeons in a community setting can provide an adequate colon resection via laparoscopy during their initial experiences involving malignancies.

Laparoscopic colectomy has been demonstrated to be both safe and effective for management of colon cancer patients. The Cost Trial and the Clasicc Trial have both demonstrated an adequate lymph node resection (twelve each) and have shown survival curves to be similar. Certainly, ten-year survival data is pending, and some surgeons may choose to await that long-term follow-up before making conclusions. Adequacy of lymph node resection certainly can be looked at as a surrogate for survival, as demonstrated in two published series [1, 10]. It should be the team goal of the surgeon and the pathologist at each institution to maximize the number of nodes both resected and evaluated.

Novice surgeons have been encouraged to perform 20 resections for benign disease before undertaking laparoscopic colectomy for malignancy. Other studies have suggested learning curves with ranges between 30 and 70 cases [18]. A comparison of four accomplished laparoscopic surgeons learning curve for LAC was done in 1995. Two surgeons took twice the number of surgeries to learn the procedure as the other surgeons, but the consensus was 11 to 15 surgeries was necessary to learn LAC and have a mean operative time of 130 minutes [17]. Our data suggests experienced laparoscopic surgeons may do well with laparoscopic colectomies if an endeavor to keep the same oncologic principles used for open surgery is kept in mind while performing laparoscopic colectomy.

Hand assisted laparoscopic colectomy has fewer data, and this particular technique was not utilized in the Cost Trial or the Clasicc Trial. Our data shows a superior number of lymph nodes resected in the left colon with the hand assisted laparoscopic technique, and may reflect a better control of the lymph node basin with some tactile feedback to the surgeon during the process of performing the resection. It should be noted however, that 100% of our right colectomy patients met the twelve-node standard and the median number of nodes on the right was 23.5. The median number of nodes on the left was 11.5, but all six patients with an inadequate nodal resected (<12) showed to be cases concerning the left colon. This data comes even though 27 of the 32 resections in the left colon included the take down of the splenic flexure. Other studies have shown similar difficulties on the left side, resulting in higher conversion rates to open [18].

Our data suggests that either HALS or LAC provide similar resections concerning the number of nodes resected on the right side. It can be concluded that both methods of colon resection are viable options for colon resection on the right side. But for left colectomies, both surgeons involved with this study have decided that HALS would be the procedure of choice, partly based on speed of operation and partly based on the node resection data demonstrated here. The validity of HALS for increased tactile

sensation, decreased conversion rates, and aid in learning for advancing laparoscopic techniques have been previously reported, and our newer data continues to support these findings [2, 11].

Scrutiny must always be undertaken when there is an inadequacy of nodal resection. Table 6 shows the data for the six patients with a resected lymph node count of less than twelve. In only one of these patients was the node count under staged enough to effect possible therapy, and this was a minimally invasive cancer in a small polyp. Another resection was palliative care with known metastases to the liver. In the remaining four patients with a node count below twelve, the patients were shown to have node positive disease and the pathologist had staged the patient adequately for adjuvant treatment to begin. Of these four patients, two could not have been upstaged from N_1 to N_2 even if the minimum of twelve nodes were evaluated.

Given our data, it seems possible that our patients with lower node counts hold skewed prognoses based on the total number of lymph nodes evaluated. Once a prognosis is defined for a patient, the pressure on the pathologist to evaluate more nodes decreases. This is especially true for patients with higher stages of cancer. When the pathologist demonstrates node positivity and the need for adjuvant therapy, the need to look for more nodes decreases. Continuing to search for nodes would bias the node count towards a worse prognosis and is somewhat unnecessary once an appropriate prognosis is reached.

Our pathologists were evaluating these patients outside of a specified protocol, and their work has been scrutinized in a retrospective fashion. They provided accurate staging, for treatment purposes, in 96.9% of the patients. In only one case was the node count substandard, calling into some question the adequacy of the pathologic evaluation on that case. Table 7 shows data concerning lymph nodes resected and cancer staging. Since recent studies have been published, our pathologists have adopted new fat stripping techniques that will certainly boost their node evaluation beyond that which we have published here.

Due to this study's small series, a larger series should be undertaken to evaluate adequacy of nodal resection when performed in the setting of both hand assisted laparoscopic colectomy and conventional laparoscopic colectomy. This should be incorporated when a comparison study is undertaken in the future. The small numbers in our series reflect the reporting of our initial experience with laparoscopic colectomy, and by definition the numbers therefore must be small.

This study shows that experienced laparoscopic surgeons in a community setting can achieve excellent patient outcomes when compared with larger series of dedicated colorectal surgeons. In addition, when the experienced laparoscopic surgeon takes careful attention to detail, adequacy of node resection for LAC can be superior to large published series of OC. Much larger series need be undertaken to further assess adequacy of node resection with laparoscopic colectomy being performed for malignancy.

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Tables

Table 1
Mean (Median) number of resected nodes in colon cancer cases

Study	Total Number in the Study	Laparoscopic Number of patients	Open Number of Patients	Open Mean Number of Nodes Resected	Laparoscopic Mean Number of Nodes Resected
NCI	116,995	--	111,730	9 (Median)	--
Lacy	219	118	111	11.1	11.1
COST	863	435	428	12 (Median)	12 (Median)
Clasicc Trial	794	526	268	13.5	12
Jacob and Salkey	81	81	--	--	10.1

Table 2
Laparoscopic Colon Resections for Wright and Kim

Type of Resection	Total	Age (years)	Mass (pounds)	ASA Classification	Operative Indications	Length of Stay (days)	Complications	Conversions
Laparoscopic	Right = 12	62.4 ± 15.2	186.0 ± 36.3	Type 1 n = 7	Colon Cancer n = 15		n = 1	
	Left = 14			Type 2 n = 14	Diverticulitis n = 6	6.0 ± 4.3		n = 0
	n = 26 (37.7%)	Range (32, 84)	Range (116, 248)	Type 3 n = 5	Other n = 5			
Hand Assist	Right = 15	56.9 ± 15.6	196.4 ± 57.4	Type 1 n = 3	Colon Cancer n = 17		n = 6	
	Left = 28			Type 2 n = 27	Diverticulitis n = 20	6.3 ± 2.7		n = 2
	n = 43 (62.3%)	Range (25, 85)	Range (116, 316)	Type 3 n = 13	Other n = 6			
Total	Right = 27	59.0 ± 15.7	192.5 ± 47.8	Type 1 n = 10 (14.5%)	Colon Cancer n = 32		n = 7 10.1%	
	Left = 42			Type 2 n = 41 (59.4%)	Diverticulitis n = 26	6.2 ± 3.4		n = 2 (2.9%)
	n = 69 (100%)	Range (25, 85)	Range (116, 316)	Type 3 n = 18 (26.1%)	Other n = 11			

Table 3
Comparison with Senigore and Delaney

	Senigore and Delaney	Wright and Kim	
Number of Surgeons	2	2	
Location	Case Western University Cleveland, Ohio	Good Samaritan Hospital Puyallup, Washington	
Study Type	Prospective	Retrospective	
Number of Cases	1000	69	
Right Colon	314	42	
Left Colon	435	27	
Total Colon	61	0	
Procto-colectomy	14	0	
Other	176	0	
Diverticular Disease	285	28	
Colorectal Neoplasia	285	32	
Inflammatory Bowel Disease	172	1	
Rectal Prolapse	81	0	
Other	177	0	
Complication Rate	9.9%	10.1%	NS
Ileus	2.8%	2.9%	NS

Pulmonary	1.6%	0%	NS
Cardiac	1.4%	2.9%	NS
Wound Infection	2.6%	1.4%	NS
Other	--	2.9%	NS
Conversion Rate	11.4%	2.9% (n = 2)	p < 0.01
Mortality	not reported	2.9% (n = 2)	
Length of Hospital Stay (days)	3.7±3.8	6.2±3.4	p < 0.01
30-day Readmission	9.1%	4.3%	p < 0.05

Table 4
Comparison with NCI Database

		NCI	Wright and Kim		
		Open Surgery	Hand-Assisted	Conventional Laparoscopy	Overall
Patients Evaluated		n = 111,730	n = 17	n = 15	n = 32
Adequate lymph node removal (>12 nodes)		n = 41,340	n = 16	n = 10	n = 26
Percentage		37%	94%	66%	81%
p-value			p < 0.01	p = 0.065	p < 0.05
Median Nodes Removed	Right Colon	11	19	25	23.5
	Left Colon	7	17.5	8	11.5
	Rectum	8	--	--	--
	Total	9	16	19	18

Table 5
Nodal Count for Various Types of Resections

Total Number of Cancer Cases n = 32	
Mean Nodes removed = 19.3	
Median Nodes removed = 18	
Mode Nodes remove = 16	
Right All Cases n = 20	Left All Cases n = 12
Range 12-40	Range 2-26
Mean = 23.3	Mean = 12.75
Median = 23.5	Median = 11.5
Right HALS n = 10	Left HALS n = 6
Range 12-40	Range 2-26
Mean = 23.1	Mean = 16.3
Median = 19	Median = 17.5
Right LAC n = 10	Left LAC n = 6
Range 12-35	Range 5-17
Mean = 23.5	Mean = 9.2
Median = 25	Median = 8

Table 6
Analysis of cases with <12 nodes resected

TNM	Dukes	Stage	Number of Nodes Examined	Number of Positive Nodes	Possible Upstaging with 12 Nodes Considered	Notes
T ₁ N ₀ M ₀	A	I	6	0	N ₀ to either N ₁ or N ₂	Very early cancer case found in small polyp, possibly under staged by fewer nodes being examined
T ₃ N ₀ M ₁ (liver)	D	IV	6	0	N ₀ to either N ₁ or N ₂	Node status is irrelevant in staging as this patient had known liver metastases
T ₂ N ₁ M ₀	C ₁	IIIA	10	1	Unchanged	The next level of staging (N ₂) could not be reached if 12 nodes were examined
T ₃ N ₁ M ₀	C ₂	IIIB	11	1	Unchanged	
T ₂ N ₁ M ₀	C ₂	IIIA	2	2	N ₁ to N ₂	These patients may have been under staged (possibly N ₂) but therapy would not change
T ₄ N ₁ M ₀	C ₂	IIIB	5	3	N ₁ to N ₂	

Table 7
Staging Correlation With Nodal Count

Staging	Number of patients (N = 32)	Median Number of Nodes Resected	Median Number of Positive Nodes
IV	N = 2	9	0
III	N = 11	16	3
II	N = 9	23	0
I	N = 10	18	0

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