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Laparoscopic versus Open Surgery for Colorectal Cancer: Oncologic and Short-term Clinical Outcomes in a Thai Tertiary-care Hospital

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Abstract

Objective: **To compare the short-term operative and oncologic outcomes of laparoscopic surgery with those of open surgery in patients with colorectal cancer in a Thai tertiary-care hospital.**

Methods: **Medical records of 84 patients (36 laparoscopic and 48 open surgery) treated between January 2003 and October 2007 were reviewed. Patients younger than 18 years or harboring major medical co-morbidities were excluded. Baseline clinical characteristics, operative and postoperative events, details of pathological specimens and follow-up information such as cancer recurrence or death were reviewed.**

Results: **All clinical characteristics did not differ significantly between the two groups. Proximal and distal margins of surgical specimens as well as the total number of lymph nodes removed (median number 19 for laparoscopic vs. 17 for open surgery) were also similar. There were no significant differences in postoperative complications, and after a median follow-up time of 7.5 months and 12 months for the laparoscopic and open procedures respectively, no significant differences in the recurrence rates were seen. There were no operative or cancer-related deaths.**

Conclusion: **There was no evidence that operative and early oncologic outcomes differ between laparoscopic and open surgery for colorectal cancer patients in a Thai tertiary-care hospital.**

Key words: Laparoscopy, colorectal cancer, oncology, outcome

Introduction

Laparoscopic surgery for colorectal cancer is a recognized treatment modality. In the decade since its introduction in 1991[1], laparoscopic surgery has been shown to be a viable alternative to open surgery for colorectal cancer. The advantages of the laparoscopic procedure include better visualization of critical structures such as blood vessels, nerves and surrounding organs in the pelvis, less tissue trauma and blood loss, less postoperative pain, earlier operative recovery and shorter hospital stay.[2-6] However, concerns regarding the laparoscopic procedure centered on the adequacy of cancer removal and hence on cancer-related survival or disease-free survival, or "oncologic" outcomes. Short- and medium-term follow up of oncologic outcomes based on several randomized clinical trials have not shown any clear difference between the laparoscopic

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and open procedures.[2-5,7] Long-term outcomes of larger trials are becoming available and, similarly, do not seem to show significant differences.[8,9] The objective of the present study was to review and compare short-term oncologic as well as various peri-operative outcomes between laparoscopic and open surgery for colorectal cancer, as performed by one surgeon at a Thai tertiary-care hospital.

Patients and Methods

Medical records of and pathological findings in patients with colorectal cancer treated by one surgeon (TA) during the period from January 2003 to October 2007 were reviewed. The study was approved by the Hospital's Research Ethics Committee. Patients in the last 2 years usually underwent laparoscopic surgery, while open surgery was mainly done in the earlier period. Baseline data, radiologic results, tumor characteristics, operative findings and follow-up data were abstracted from the records. Colon cancer staging was according to the American Joint Committee on Cancer (AJCC), 6th edition, 2002.[10]

Patients were included in the study if they had colorectal adenocarcinoma, age > 18 years, and had undergone elective surgery. Patients were excluded if they had severe medical co-morbidities. All patients were given preoperative mechanical bowel preparation. Preoperative prophylactic antibiotics were given 30 minutes prior to induction of general anesthesia, and continued until 24 hours after operation.

Both open and laparoscopic operations were performed according to standard procedures. At each tumor location, the attempted extent of resection was the same for both groups. For laparoscopic-assisted surgery, after pneumoperitoneum was achieved the abdominal cavity was explored, the colon or rectum was mobilized (from lateral to medial), and important structures were identified and vascular pedicles were ligated. A small abdominal wall incision was made to allow exteriorization of the colon for resection and anastomosis. For a totally laparoscopic procedure, usually for left-sided colonic and rectal cancer, the abdominal wall incision can be made smaller and the anastomosis done entirely with laparoscopic stapling instruments.

Nasogastric (NG) tubes were retained in all patients postoperatively. The criteria for removing NG tubes were the same for both groups of patients (gastric content less than 100 ml. per day and absence of significant abdominal distension), and oral feeding was resumed after the passing of flatus or defecation.

Continuous variables were summarized as mean (SD) or median (range) as appropriate. Categorical variables were summarized as counts and percentages. Continuous variables were contrasted between treatment groups (type of surgery) using independent samples t-test or Wilcoxon rank-sum test as appropriate, and categorical variables were contrasted using Fisher's exact test or chi-square test as appropriate. All statistical analyses were performed with Stata v. 9 software (Stata Corp, College Station, TX, USA). Significant p-values were defined as values 0.05 or less.

Results

During the period between January 2003 and October 2007, 84 patients fulfilling the inclusion criteria were operated on for colorectal cancer by one surgeon (TA). Of these, 36 (43%) underwent laparoscopic surgery and 48 (57%) underwent open surgery. Baseline clinical and pathologic characteristics of patients in both groups are presented in Table 1. No significant differences could be detected between the two groups in terms of age, gender, height, comorbid diseases, previous surgery, clinical findings, American Society of Anesthesiologists (ASA) class, and radiologic investigation. TNM stage and carcinoembryonic antigen (CEA) levels were also similar between the two groups. There was a significant difference in term of tumor location, however, patients who underwent laparoscopic surgery were more likely to have sigmoid colon and rectal cancer.

Laparoscopic surgery was associated with longer operative time (average: 3 hours and 20 minutes) than open surgery (average: 2 hours and 30 minutes), although there was less blood loss (median blood loss of 100 ml. compared with 200 ml. for open surgery), as may be expected (Table 2). Stapling instruments were more often used for patients in the laparoscopic group, who were also more likely to undergo a Hartmann procedure. Although intraoperative complications occurred in 3 patients in the laparoscopic group (8%) and none in the open group, this difference was not statistically significant. These complications included ileocolic artery injury, too much anastomotic

Table 1 Baseline characteristics of each group

Characteristics	Open surgery[a] (n = 48)	Lap surgery[a] (n = 36)	p-value[b]
Age (years): mean (SD)	60.4 (11.6)	58.4 (14.4)	0.504
Gender (men)	28 (58)	22 (61)	0.797
Height (cm.): mean (SD)	161.8 (8.4)	162.5 (8.1)	0.727
Weight (kg.): mean (SD)	55.7 (9.5)	58.3 (10.4)	0.232
Hypertension (yes)	9 (19)	9 (25)	0.490
DM (yes)	5 (10)	8 (22)	0.139
CAD (yes)	5 (10)	2 (6)	0.693
Previous surgery (yes)	7 (15)	7 (19)	0.554
Alcohol consumption (yes)	10 (21)	8 (22)	0.825
Smoking (yes)	8 (17)	8 (22)	0.521
Symptoms			
Abdominal mass	6 (12)	2 (5)	0.072
Bowel habit change	22 (46)	10 (28)	
Lower GI bleeding	20 (42)	24 (67)	
Physical findings			
Negative	39 (81)	27 (75)	0.136
Abdominal mass	7 (15)	3 (8)	
Rectal mass	2 (4)	6 (17)	
ASA class			
1	34 (71)	28 (78)	0.500
2	13 (27)		
3	1 (2)		
Preoperative CT (yes)	21 (44)	22 (61)	0.115
Preoperative BE (yes)	14 (29)	12 (33)	0.683
Preoperative colonoscopy (yes)	38 (79)	25 (69)	0.309
Tumor location			
Ascending colon	11 (23)	6 (17)	0.026
Transverse colon	3 (6)	0	
Descending colon	7 (15)	0	
Sigmoid colon	19 (40)	19 (53)	
Rectum	8 (17)	11 (31)	
CEA level (ng/ml): median (range)	3.3 (1.15-80.2)	2.47 (0.84-226)	0.238
TNM stage			
I	11 (23)	8 (22)	0.245
II	14 (29)	13 (36)	
III	22 (43)	11 (31)	
IV	1 (2)	4 (11)	

[a]summary statistic is number (%) unless stated otherwise
[b]p-values by chi-square test, Fisher's exact test, t-test and rank test as appropriate
DM: diabetes mellitus; CAD: coronary artery disease; GI: gastrointestinal; CT: computerized tomography; BE: barium enema; CEA (carcinoembryonic antigen); ASA: American Society of Anesthesiologists

tension and anastomotic ischemia, the last requiring the performance of a Hartmann procedure. One patient in the laparoscopic group (3%) was converted to open surgery because of tumor attachment to the duodenum.

Pathological examination of the resected specimens did not reveal any statistically or clinically significant differences between the two groups in terms of proximal tumor-free margins, tumor grade and the number of lymph nodes removed (Table 3). Overall,

laparoscopic procedures removed a median number of 19 lymph nodes (range: 5 to 46) while a median of 17 lymph nodes (range: 5 to 45) were removed via the open procedure. There was a slight tendency for laparoscopic specimens to contain a larger number of lymph nodes for tumors at the ascending and sigmoid colon, compared with open surgery specimens, but fewer at the rectum. Overall, the length of the distal margin was significantly shorter in the laparoscopic group, due to a higher proportion of left-sided lesions in this group. When the distal margins were classified according to tumor location, there were no statistical differences between the two groups (Table 3).

The occurrence of postoperative complications, including infectious complications, was not clearly different between the two groups of patients (Table 4). The amount of postoperative morphine required for pain was significantly less in the laparoscopic group. The delay till bowel movement or oral diet was also significantly less for the laparoscopic group. However,

Table 2 Intraoperative findings

Findings	Open surgery[a] (n = 48)	Lap surgery[a] (n = 36)	p-value[b]
Operative time (min.): mean (SD)	152 (45)	201 (44)	<0.001
Blood loss (ml.): median (range)	200 (50-700)	100 (10-1000)	<0.001
Method of anastomosis			
Hand sewn	26 (54)	8 (22)	<0.001
GIA Staples	22 (46)	24 (67)	
Hartmann operation (pouch & end colostomy)	0	4 (11)	
Intraabdominal adhesions	3 (6)	3 (8)	0.714
Intraoperative complications	0	3 (8)	0.075

[a]summary statistic is number (%) unless stated otherwise
[b]p-value by chi-square test, Fisher's exact test, t-test and rank test as appropriate

Table 3 Pathological findings

Findings	Open surgery[a] (n = 48)	Lap surgery[a] (n = 36)	p-value[b]
Tumor grade			
Well differentiated	27 (56)	18 (50)	0.673
Moderately well differentiated	20 (42)	16 (44)	
Poorly differentiated	1 (2)	2 (6)	
Proximal tumor-free margin (cm.)			
Overall: median (range)	10 (5-37)	11.25 (5-30)	0.165
Tumors at the ascending colon (n = 17)	10 (6-20)	10 (8-24)	0.643
Tumors at the sigmoid colon (n = 38)	10 (6-16)	10 (5-30)	0.703
Tumors at the rectum (n = 19)	10 (8-32)	15 (10-23)	0.045
Distal tumor-free margin (cm.)			
Overall: median (range)	7 (2-19)	5 (2-15)	0.006
Tumors at the ascending colon (n = 17)	9 (6-11)	7.5 (4.5-10)	0.309
Tumors at the sigmoid colon (n = 38)	6 (3-11)	5 (2.5-15)	0.416
Tumors at the rectum (n = 19)	3.5 (2-6)	3 (2-4)	0.347
Number of lymph nodes removed			
Overall: median (range)	17 (5-45)	19 (5-46)	0.277
Tumors at the ascending colon (n = 17)	17 (12-45)	20 (5-32)	0.840
Tumors at the sigmoid colon (n = 38)	17 (5-31)	20 (5-46)	0.024
Tumors at the rectum (n = 19)	18 (8-29)	15 (6-28)	0.147

[a]summary statistic is number (%) unless stated otherwise
[b]p-value by chi-square test, Fisher's exact test, t-test and rank test as appropriate

Table 4 Postoperative and short-term outcomes

Findings	Open surgery[a] (n = 48)	Lap surgery[a] (n = 36)	p-value[b]
Postoperative complications	7 (15)	9 (25)	0.229
Postoperative IV morphine within 24 hrs	35 (73)	16 (44)	0.008
Days on NG tube: median (range)	3 (0-10)	2 (1-4)	0.012
Days on urinary catheter: median (range)	2.5 (0-14)	2 (1-10)	0.510
Days with abdominal drains: median (range)	5 (0-14)	5 (0-21)	0.860
Days till bowel movement: median (range)	4 (1-8)	2 (1-4)	<0.001
Days till oral diet: median (range)	5 (2-10)	3 (2-15)	<0.001
Surgical site infection	1 (2)	0	0.999
Length of hospital stay (days): median (range)	11 (9-26)	10 (7-25)	0.258
Readmission (within 30 days)	1 (2)	0	0.999
Adjuvant therapy (n = 83)			
None	26 (55)	18 (50)	0.889
Chemotherapy	15 (32)	13 (36)	
Radio-chemotherapy	6 (13)	5 (14)	
Death at last follow-up	0	0	-
Recurrence at last follow-up	4 (9)	0	0.131
Follow-up time (months): median (range)	12 (1-48)	7.5 (1-44)	0.002

[a]summary statistic is number (%) unless stated otherwise
[b]p-value by chi-square test, Fisher's exact test, t-test and rank test as appropriate
[c]one patient in the open group was lost to follow-up at one month after surgery

the length of hospital stay was not significantly different between the two groups. There were no operative deaths in either of the two groups. The follow up time was longer for the open surgery group because many patients in this group were operated on at an earlier period. Local recurrence was found in one patient and liver metastasis in three patients in the open surgery group, while no recurrences were noted in the laparoscopic group.

Discussion

The present study confirmed previous studies that the results of laparoscopic surgery for colorectal cancer in terms of extent of resection, lymph node retrieval, and operative complications are comparable to those of the open procedure.[2-8] The advantages including less severe postoperative pain and earlier bowel function recovery, for the laparoscopic procedure, were also observed in the present study as well.

Many randomized controlled trials (RCT)[2-5,7-9], as well as non-randomized observational studies6, have been conducted recently to compare the safety and effectiveness of laparoscopic surgery with those of open surgery for patients with colorectal cancer. All results, whether short-term (less than 5 years) or long-term, have not revealed any significant differences between the two procedures in terms of oncologic outcomes such as the adequacy of tumor resection, lymph node harvest and overall survival or disease-free survival. The benefits of the laparoscopic procedure, including less postoperative pain and earlier functional recovery as demonstrated in the present study, were clearly shown in all studies[2-6]. Port site or incision wound recurrences were rare, or at least equivalent to open surgery.[2,4] Intraoperative blood loss was usually considerably less than in the open approach, and the excellent visualization of and access to the pelvic cavity and organs no doubt contributed to such good outcomes. Although an increase in operative time can be seen in all studies, this increase tends to be much less as the operator becomes more experienced with the procedure. A difference of only 30 minutes was demonstrated in some studies.[7,11] In the present study, after the learning curve period, the operative time was

usually less than one hour longer for the laparoscopic procedure compared with the open procedure.

Hand-assisted laparoscopic surgery for colon cancer has been advocated as an alternative to a purely laparoscopic approach, because the latter has been viewed as being too complicated and time-consuming. Although it is questionable whether a hand-assisted laparoscopic procedure is an easier approach for the surgeon, especially after some years of laparoscopic surgical experience, a recent RCT has also demonstrated that short-term oncologic outcomes of this procedure were similar to those of the open procedure for right-sided colon cancer.[11] Hand-assisted laparoscopic surgery was not used in the present study.

Studies addressing the quality of life after laparoscopic as compared with open surgery did not show any appreciable differences, although there was a tendency for a better quality of life in patients undergoing laparoscopic surgery, especially during the early postoperative period (up to 4 weeks).[8,12] According to some studies, the cost of the laparoscopic procedure compared favorably with the open procedure, because the expense of laparoscopic instruments was partially offset by the savings and economic output associated with shorter hospital stay and earlier return to work, as well as a better quality of life,[13,14] but not all studies agree.[5,15] These economic analyses, done from the viewpoint of developed countries, might not apply to other countries such as Thailand where the cost of laparoscopic surgery overwhelms the costs of open surgery and savings related to shorter hospital stay.

Reasons for the conversion from laparoscopic to open surgery are usually related to locally advanced cancer, inadequate visualization of critical structure and adhesions.[9,16] The conversion rate of 3% in the present study is rather low,[4-6] but this number is unreliable because of the small sample size. Preoperative radiologic evaluation of the primary tumor and evidence of previous, extensive surgery can be used to select appropriate patients for laparoscopic surgery, and in the process reduce the risk of conversion.

Laparoscopic surgery for colorectal cancer is safe and effective in terms of oncologic outcomes even during the learning curve.[9,17] Regarding the same outcome, the current evidence has been consistent in finding no apparent differences between the laparoscopic and open procedures. Most of the evidence has been mainly confined to patients with colon cancer, and more data on the oncologic effectiveness of the laparoscopic procedure for rectal cancer is still needed. Longer follow up studies of larger, well conducted RCTs such as the COST[9] trial, but especially the COLOR[7] and CLASICC[8] trials should help establish laparoscopic surgery as a standard for the surgical treatment of colorectal cancer.

Conclusions

There was no evidence of any significant difference between laparoscopic and open surgery for the patient with colorectal cancer in terms of operative and early oncologic outcomes in the present study. More patients need to be included in a future analysis. Further, long-term follow-up is still warranted to confirm or refute the present findings.

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