

418 cases of laparoscopic colorectal resections: a single-institution experience and literature review

Wong M T C, Ng K H, Lim J F, Ooi B S, Tang C L, Eu K W

ABSTRACT

Introduction: Evidence from randomised controlled trials has shown that laparoscopic colon and rectal cancer resection not only confers short-term benefits but also does not differ considerably in terms of its long-term oncological outcomes, as compared with open surgery.

Methods: All laparoscopic colon and rectal resections performed between January 2005 and December 2007 were included. Patient records were reviewed from a prospective database and the relevant clinical data was obtained, with a subgroup analysis of cancer procedures performed.

Results: 418 patients (247 male), median age 63 years (range 24 to 88), underwent laparoscopic resection of the colon and rectum. The median Body Mass Index (BMI) was 22.5 (range 13.5 to 39.3). The majority of the procedures were performed for malignant disease (81.3 percent) and the most common procedure was anterior resection (79.4 percent). The median duration of surgery was 135 minutes (range 65 to 330), with conversions to open surgery in 44 patients (10.5 percent). Complications occurred in 78 patients (18.7 percent), including anastomotic leaks in five (1.20 percent). The median length of hospital stay was five days (range 3 to 90) and the median follow-up was 19 months (range 1 to 46). In the 340 patients with malignant disease, the median number of lymph nodes harvested was 13 (range 5 to 48), and at the latest review, 230 patients (67.6 percent) were disease-free, with locoregional recurrence in 2.9 percent and systemic recurrence in 10 percent.

Conclusion: To date, this is the largest series of laparoscopic colorectal resections reported locally, and our results show that it is safe, feasible and produces favourable results.

Keywords: benign, colon, laparoscopic, malignant, minimally invasive, rectum

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INTRODUCTION

Colorectal cancer is one of the most prevalent cancers in the industrialised world. It now ranks as the most common cancer in Singapore, accounting for 17.8% of all cancers in males, and is only second to breast cancer in females, at 14.5%.⁽¹⁾ Evidence from numerous randomised controlled trials has shown the short-term benefits of laparoscopic colon cancer resection over open surgery, and its long-term oncological outcome also does not differ considerably from that of open surgery.⁽²⁻⁶⁾ Recent published data suggests similar benefits for laparoscopic rectal cancer resection.⁽⁷⁾ We reviewed our experience by assessing the results of laparoscopic colorectal resections performed in our centre over a three-year period.

METHODS

All laparoscopic colon and rectal resections performed between January 2005 and December 2007 were included in this study. The clinical and operative records of these patients were retrospectively reviewed from a prospectively collected laparoscopic database. The relevant clinical data, intraoperative parameters and postoperative outcomes were obtained. Subgroup analysis of the laparoscopic procedures performed for colorectal cancer was conducted.

All procedures were performed by consultant colorectal surgeons in the department, all of whom had been trained in laparoscopic colorectal surgery in overseas centres of excellence. Patients were selected based on individual surgeon preference and included those with both benign and malignant conditions. All procedures were performed in an elective setting, with patients admitted one day prior to surgery. Bowel preparation was performed with two litres of polyethylene glycol solution on the evening prior to surgery; thromboembolic prophylaxis with subcutaneous low molecular weight heparin was administered on the evening prior to surgery

Department of
Colorectal Surgery,
Singapore General
Hospital,
Outram Road,
Singapore 169608

Wong MTC, MBBS,
FRCS, FAMS
Associate Consultant

Ng KH, MBBS, FRCS,
FAMS
Consultant

Lim JF, MBBS, FRCS,
FAMS
Consultant

Ooi BS, MBBS, FRCS,
FAMS
Associate Professor

Tang CL, MBBS,
FRCS, FAMS
Associate Professor

Eu KW, MBBS, FRCS,
FAMS
Professor and Head

Correspondence to:
Prof Eu Kong Weng
Tel: (65) 6321 4677
Fax: (65) 6226 2009
Email: eu.kong.weng@
sgh.com.sg

Table I. Patient demographics and indications for surgery.

Patient demographic (n = 418)	No. of patients
Gender*	
Male	247 (59)
Female	171 (41)
Median age; range (yrs)	63; 24–88
Median BMI; range (kg/m ²)	22.5; 13.5–39.3
Ethnic group*	
Chinese	391 (93.5)
Malay	20 (4.8)
Indian	4 (1.0)
Others	3 (0.7)
Indications for surgery	
Malignant disease (n = 340)	
Adenocarcinomas	336
Squamous cell carcinoma	1
Melanoma	1
Carcinoid	1
Gastrointestinal stromal tumour	1
Benign disease (n = 78)	
Polyp	51
Diverticular disease	18
Megacolon/chronic constipation	3
Endometriosis	2
Benign ulceration	2
Ischaemic colitis	1
Familial adenomatous polyposis	1

*Numbers in parenthesis are in percentages.

BMI: body mass index

and daily from the first postoperative day until the patient was ambulant. All procedures were performed under general anaesthesia and in the Lloyd Davies position. The patients were firmly secured to the operating table to allow for placement in the Trendelenburg position as required. The open technique of insertion of the initial 10 mm umbilical trocar was adopted for all cases. Carbon dioxide insufflation was used to create pneumoperitoneum, maintaining a 12–15 mmHg intra-abdominal pressure. Subsequent placements of 5 mm, 10 mm or 12 mm trocars were all performed under direct laparoscopic vision. A combination of straight-viewing zero-degree or 30-degree laparoscopes were used, according to the individual surgeon's preference. Dissection was facilitated by the use of harmonic shears (Harmonic-Scalpel, Ethicon Endo-Surgery Inc, Cincinnati, OH, USA), the Ligasure (Valleylab, Tyco Healthcare, Boulder, CO, USA) or laparoscopic scissors. The incision made for delivery of the resected specimen was decided by the individual surgeons, based on the site of the lesion and the procedure performed. Surgical drains were not routinely used.

Postoperatively, all patients were initially monitored in the high dependency ward, and analgesics were administered using either patient-controlled analgesia (PCA) pumps or a low-dose continuous morphine infusion. Medications were converted to oral analgesics

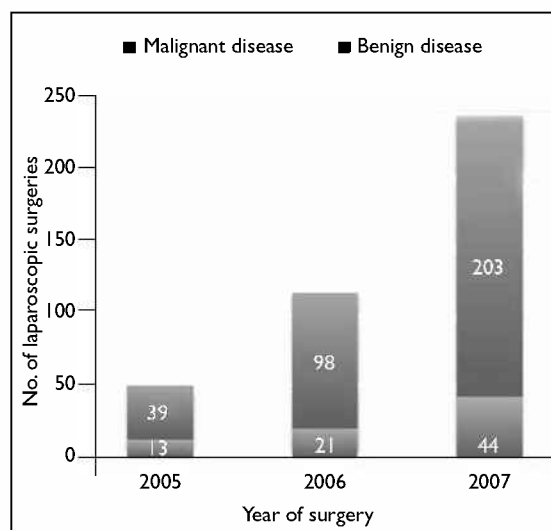


Fig. 1 Number of laparoscopic surgeries performed from January 2005 to December 2007.

once the patients could tolerate oral feeding. All patients were managed using a standard laparoscopic colorectal care path.

RESULTS

Over a three-year period from January 2005 to December 2007, 418 patients underwent laparoscopic resection of the colon and rectum. The majority of the procedures were performed for malignant disease. The patient demographics and indications for surgery are shown in Table I. The number of laparoscopic surgeries performed increased over the three-year study period. Fig. 1 illustrates the rising trend of surgeries performed, as well as the rising proportion of cancers removed laparoscopically. The most common laparoscopic procedure performed was anterior resection (79.4%); 243 (58.1%) were high anterior resections, 47 (11.2%) were low anterior resections and 40 (9.6%) were ultra-low anterior resections. High anterior resections were defined as those in which the colorectal anastomoses were established above the peritoneal reflection; low anterior resections referred to anastomoses that were established below the peritoneal reflection; ultra-low anterior resections were those in which a colo-anal anastomosis was performed. Table II shows the distribution of procedures performed.

The median duration of surgery was 135 (range 65–330) minutes. The median length of the incision (for extraction of a specimen or following conversion to open procedure) was 5 (range 3–15) cm and the median number of lymph nodes harvested was 13 (range 5–48). Conversion to open surgery was necessary in 44 (10.5%) patients, most commonly for excessive adhesions.

Table II. Distribution of surgical procedures performed.

Type of procedure	No. of cases
Anterior resection	332
Right hemicolectomy	41
Left hemicolectomy	17
Abdominoperineal resection	16
Total colectomy	11
Panproctocolectomy	2

Table III shows the reasons for conversion to open surgery. Complications occurred in 78 (18.7%) patients, including anastomotic leaks in five (1.2%) patients. 30-day operative mortality occurred in two patients, yielding an operative mortality rate of 0.5%. The incidence of surgery-related complications is shown in Table IV. Early postoperative complications were defined as complications occurring within 30 days after surgery; late complications were defined as those occurring 30 days after surgery. The median duration of hospital stay was five (range 3–90) days. Patients were followed up for a median duration of 19 (range 1–47) months, with 15 patients lost to follow-up.

A subgroup analysis was performed for the 340 (81.3%) patients who had laparoscopic surgery for malignant disease. Table V illustrates the tumour characteristics. 33 (9.7%) patients required conversions to open procedure, with one-third due to excessive tumour fixity. The median number of lymph nodes harvested was 13 and the median specimen length was 15 cm. The five cases of anastomotic leaks mentioned previously were from this subgroup of patients. 24 (7.1%) patients required 30-day readmission, most commonly for superficial wound infections. More than half of these wound infections (15 patients) occurred in cases that either had to be converted to an open procedure or were laparoscopically-assisted, i.e. where a significant portion of the surgery was completed open following laparoscopic ligation of the vascular supply. The subsequent larger wound sizes and possible increased manipulation could have accounted for these infections. At the time of the latest review, 230 of these patients (67.6%) were disease free. There were three cases of port-site recurrence, all associated with *Carcinomatosis peritonei*. Locoregional recurrence occurred in ten (2.9%) patients and systemic recurrence occurred in 34 (10.0%) patients.

DISCUSSION

Laparoscopic colorectal resection has come a long way since the first reported case in 1991.⁽⁸⁾ It has

Table III. Reasons for conversion to open procedure.

Reason	No. of cases
Excessive adhesions	14
Tumour fixity	11
Anatomic uncertainty	5
Inaccessible tumour site	3
Vessel injury	3
Ureteric injury	2
Tumour rupture	2
Equipment failure	1
Obesity	3

now evolved to become an integral component in the colorectal surgeon's armamentarium. However, the widespread application of this technique had initially been hampered by the steep learning curve as well as concerns regarding oncological safety, with early reports of port-site recurrences.^(9,10) In recent years, results from several well-conducted randomised controlled trials have confirmed the oncological safety of laparoscopic colectomy for cancer and have further shown that long-term outcomes are equivalent to open surgery.⁽²⁻⁶⁾ In keeping with the worldwide increase in laparoscopic colorectal surgeries performed, there has been a similar resurgence in laparoscopic cases performed in our unit in recent years.

In this prospective series conducted over a three-year period from 2005 to 2007, we have shown that laparoscopic colorectal resections, when performed in a specialised colorectal unit, can yield favourable short-term results. In this series, we included all cases of elective colorectal resections performed without restriction to the disease type. Our low anastomotic leak rate of 1.2% and low operative mortality of 0.4% show that it is a safe and feasible procedure. Our results are comparable to those demonstrated in a systematic review of the short-term outcomes of laparoscopic surgery for colon and rectosigmoid cancers, in which Tjandra and Chan demonstrated that the incidence of overall operative mortality was in fact lower in the laparoscopic group compared to the open group (0.6% vs. 2.01%, odds ratio [OR] 0.33, $p = 0.005$), suggesting that laparoscopic surgery is likely the optimal treatment in appropriately selected patients.⁽¹¹⁾

Operative morbidity is also an important consideration in any surgical procedure, and the Cochrane Review of the short-term benefits of laparoscopic colorectal surgery showed a lower postoperative complication rate in the laparoscopic group compared to the conventional group (18.2% vs. 23.0%, relative risk [RR]=0.72, $p=0.02$).⁽¹²⁾ The overall complication

Table IV. Surgery-related complications.

Type of complication	No. of patients
Intraoperative	
Bowel injury	2
Bladder injury	1
Ureteric injury	2
Early postoperative (\leq 30 days)	
Anastomotic leak	5
Acute myocardial infarction	8
Cardiac arrhythmias	4
Cerebral vascular accidents	3
Intra-abdominal abscess	4
Burst abdomen	1
Wound infection	22
Pneumonia	5
Ileus	9
Bleeding	8
Late postoperative (\geq 30 days)	
Intestinal obstruction	5

rate of 18.3% in our study compared favourably with the above study. In particular, the laparoscopic group in the Cochrane Review had lower rates of wound infections (4.6% vs. 8.7%, RR = 0.56, $p = 0.002$) and intra-abdominal abscesses (0.9% vs. 1.3%, RR = 0.71, $p = 0.47$),⁽¹²⁾ and our study achieved similar results, with a low rate of wound infection (5.0%) and intra-abdominal abscesses (0.9%).

It has been suggested that a low conversion rate contributes to reduced operative morbidity, with some fearing that the benefit of laparoscopic surgery is not only lost in patients with conversion, but that outcomes may even be compromised compared to open procedures. In the Clinical Outcome of Surgical Therapy Study Group (COST), Colon cancer Laparoscopic or Open Resection (COLOR) and CLASICC trials,^(2,4,13) with conversion rates ranging from 17% to 29%, similar operative morbidities were demonstrated between the laparoscopic and open groups. However, in both the Barcelona trial conducted by Lacy et al and the randomised trial conducted by Braga et al, with lower conversion rates of 11% and 5% respectively,^(5,13) a significant reduction in overall morbidity was reported in the laparoscopic groups. In the current series, our conversion rate was 10.5%. Although this was lower than those in the COST, COLOR and CLASICC trials, our results were from a non-randomised series of prospective patients, in which patient selection based on the preferences of individual consultants could have accounted for the lower conversion rates.

Oncological outcome is an important measure of success in the management of any malignancy, and colorectal cancer is no exception. The early phase of the learning curve met with initial discouragement from port-site recurrences, likely due to suboptimal

Table V. Tumour characteristics.

Tumour characteristic	No. (%)
Histology	
Adenocarcinoma	335 (98.5)
Squamous cell carcinoma	1 (0.5)
Others	4 (2.0)
Differentiation	
Well differentiated	34 (10.1)
Moderately differentiated	286 (85.1)
Poorly differentiated	16 (4.8)
Duke Staging	
A	56 (16.7)
B	95 (28.3)
C1	138 (41.1)
C2	47 (13.9)
D	0 (0.0)

surgical techniques.^(15,16) However, subsequent randomised controlled trials have consistently shown a very low incidence of port-site recurrence in the laparoscopic group, effectively dispelling this initial fear.^(2,4,6) The current evidence has also demonstrated that there is no significant difference between the number of lymph nodes examined and the margins of resection between laparoscopic and conventional methods of open surgery.^(2,4,13) The majority of cases in our series (81.3%) were operated on for malignant disease, and to date we have no cases of port-site recurrence on follow-up. We also managed to achieve an overall median yield of 13 lymph nodes, suggesting that it is feasible to perform laparoscopy for oncological surgery, consistent with the recommended minimum of 12 lymph nodes for accurate staging.⁽¹⁷⁾ The oncological equivalence or superiority of laparoscopic resection is most reliably measured from long-term survival data emerging from randomised controlled trials. It is thus encouraging that Lacy et al in 2002,⁽⁵⁾ reporting on the results of a randomised trial of 219 patients with a median follow-up of 43 months, showed no difference in the overall survival and tumour recurrence rates between the two groups, and even showed a significantly better cancer-related survival rate in the laparoscopic group. The COST trial, with a median follow-up of seven years, confirmed that the overall survival, disease-free survival, overall recurrence rates and the patterns of recurrences were similar in the two groups.⁽²⁾ Recently published three-year results from the CLASICC trial showed no difference in the overall three-year survival rates between the two groups (laparoscopic surgery group: 68.4%; open surgery group: 66.7%, $p = 0.55$), as well as disease-free survival, local recurrence and distant metastasis; this applied to both colon and rectal cancer.⁽¹⁸⁾ Bonjer et al, from the Transatlantic Laparoscopic Assisted vs. Open Colectomy Trials

Study Group, performed a meta-analysis of the database from the Barcelona, COST, CLASICC and COLOR studies, and found no significant difference between laparoscopic and open resections, in terms of the three-year disease-free survival (75.8% vs. 75.3%) and overall survival (82.2% vs. 83.5%).⁽¹⁹⁾ The median follow-up duration in our study was 19 months, and we eagerly await maturation of our data to report on the long-term results.

Surgery for rectal cancer is a complex procedure, and the type of surgery is dependent on the location of the tumour. Laparoscopic surgery for rectosigmoid and upper rectal tumours is technically easier to perform, with circumferential resection margins being less of an issue. Conversely, laparoscopic surgery for mid to low rectal tumours can be a challenge even in the most experienced hands, particularly when sphincter preservation is required. Total mesorectal excision with precise sharp dissection, as advocated by Heald et al,^(20,21) is paramount in order to minimise local recurrence, and this remains a challenge in laparoscopic pelvic surgery. The CLASICC trial provides the most robust data on laparoscopic rectal cancer surgery, with recently published three-year outcome data showing no difference in overall survival, disease-free survival or local recurrence in patients with anterior resection or abdominoperineal resection.⁽¹⁸⁾ Although a higher incidence of a positive circumferential margin was reported in laparoscopic compared to open anterior resections, this did not translate to higher local recurrence rates (7.8% vs. 7.0%, $p = 0.70$). In a recent Cochrane Systematic Review of the long-term results of laparoscopic colorectal cancer resection, Kuhry et al concluded that the current evidence reaffirms that laparoscopic surgery for colon cancer is associated with a long-term outcome no different from that of open colectomy, while suggesting that more randomised trials need to be conducted to assess the long-term outcomes of laparoscopic rectal cancer resection.⁽²²⁾

As a specialised centre for minimally invasive surgery, our unit continuously strives to push the envelope of advanced surgical technologies, so as to achieve better patient outcomes. To date, this is the largest series of laparoscopic colorectal resections reported locally, and our results show that it is a safe and feasible option that produces favourable results.

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