

Clinical outcome of laparoscopic and open colectomy for right colonic carcinoma

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ABSTRACT

INTRODUCTION Laparoscopic colorectal surgery has gained widespread acceptance. While many studies have compared laparoscopic and open left-sided resections, there is limited literature on right colonic resections. We aimed to analyse the short-term outcome of laparoscopic (LRH) and open right hemicolectomy (ORH) in our unit.

METHODS Consecutive patients undergoing elective right hemicolectomies over a period of 28 months were included in the study. No selection criteria were used to allocate the surgical approach. Study parameters included surgical technique, demographic details, ASA grade, body mass index (BMI), length of hospital stay (LOS), post-operative mortality and morbidity, readmission rate and histopathological data.

RESULTS A total of 164 patients underwent right hemicolectomies during the study period (LRH: 89, ORH: 75). Both groups were comparable in age, sex, BMI, ASA grade, tumour stage and lymph node harvest. Four patients (4.5%) in the laparoscopic group required conversion to open surgery. In resections with curative intent, microscopic margins were positive in two patients (3%) in the ORH group compared to one (1%) in the LRH group. Seven ORH patients had an adverse post-operative outcome (three anastomotic leaks, four deaths); there were no deaths/immediate complications in the LRH group ($p < 0.05$). The median LOS for LRH patients (4 days, range: 2–21 days) was significantly shorter than for ORH patients (8 days, range: 3–38 days) ($p < 0.0001$, Mann–Whitney U test). By day 5, 77% of LRH patients were discharged compared to only 21% of patients in the ORH group. There were two readmissions (2.7%) in the ORH group and nine (10.1%) in the LRH group.

CONCLUSIONS Our findings demonstrate advantages in favour of LRH in terms of a shorter hospital stay and reduced post-operative major complications. LRH is safe and should therefore be available to all patients requiring colonic resection.

KEYWORDS

Laparoscopy – Right hemicolectomy – Colon cancer

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The advantages of laparoscopic surgery in terms of smaller scar, reduced analgesic requirements, lower risk of wound complications, earlier return of bowel function and routine activities, and shorter hospital stay have been well documented.^{1,2} The advent of laparoscopic cholecystectomy transformed the management of gallstone disease. However, the uptake of laparoscopy in colorectal surgery was rather slow and it was not until 1991 that the first laparoscopic colectomy was reported.³ The risk of port site metastasis, concerns of oncological clearance, longer operating times, challenging techniques and expensive equipment were among the factors that deterred surgeons from embracing this technique.^{4–6}

Trials have shown that laparoscopic anterior resection and sigmoid colectomy have superior short-term outcomes compared to open surgery.^{7–10} Nevertheless, some reports comparing laparoscopic to open right colonic resections for cancer have provided conflicting results.^{11,12} The main reason for this could be the diversity of procedures including

right hemi- and extended right hemicolectomy, transverse colectomy, and variable and complex regional anatomy on the right side.

In this study we aimed to compare the clinical and oncological outcomes for a cohort of patients having a laparoscopic right hemicolectomy (LRH) with those who had an open right hemicolectomy (ORH) during the same time period.

Methods

Patients with a diagnosis of right or transverse colon adenocarcinoma undergoing LRH or ORH between October 2006 and February 2009 were included in this study. Patients having emergency surgery or those who did not have a colonic resection were excluded. Data were entered into a prospective database and patients were followed up routinely. Recorded data included patients’ age, sex, American Society of Anaesthesiologists (ASA) grade, body mass index (BMI),

Table 1 Patient demographics

	ORH (n=75)	LRH (n=89)	p-value
Median age (range)	74 (46–89)	76 (53–92)	NS
Male	41 (55%)	37 (42%)	NS
Female	34 (45%)	52 (58%)	NS
Median BMI (range)	26kg/m ² (18–35kg/m ²)	26kg/m ² (17–47kg/m ²)	NS
ASA grade*			
ASA grade 1	7	7	NS
ASA grade 2	43	50	
ASA grade 3	18	28	

ORH = open right hemicolectomy; LRH = laparoscopic right hemicolectomy; NS = not significant; BMI = body mass index

* There were 11 cases without a record of ASA data.

site of tumour and type of surgery. Operative data included operating time, type of operation, conversion to open procedure, extraction site and size of extraction wound.

Following staging and multidisciplinary team discussion, patients were seen in clinic by either a consultant surgeon or a colorectal specialist nurse. The oncologic aspects of a radical right hemicolectomy were explained and the patients were advised that this could be achieved by either a conventional or a laparoscopic approach. Patients were informed that the unit was aiming to perform increasing amounts of this surgery laparoscopically but that this would not be possible for all patients. The chances of having an open or laparoscopic operation were dependent on list availability and cancer target breach dates. There was no case selection at this stage. A few patients requested laparoscopic operations but most were happy to go along with the policy as described.

All open operations were performed by five colorectal consultant surgeons or by senior trainees under direct supervision of a consultant surgeon. LRH was performed by two of the five consultant surgeons as well as a third new consultant in the latter part of the series. A consultant was present in all open and laparoscopic cases (scrubbed in 87% [65/75] of the ORH cases and in 99% [88/89] of the LRH cases). No selection criteria were employed to allocate patients to a laparoscopic or open resection. The surgeon and the patient decided on the choice of approach after discussing the risks and benefits of the procedure in detail.

Open surgery was performed with either a midline or transverse incision. The procedure for LRH included the standard Lloyd-Davies position for the patient, open insertion for establishing pneumoperitoneum and a four-port technique routinely. No bowel preparation was administered. The oncological principles of *en bloc* resection, clear resection margins and ligation of vascular pedicles with lymphadenectomy were adhered to in both open and laparoscopic groups. At laparoscopy, dissection was carried out using the monopolar diathermy or ultrasonic dissector. The ileocolic or middle colic vascular pedicle was isolated and divided using either absorbable clips or an endovascu-

lar stapler. The right branch of the middle colic was ligated routinely during laparoscopic procedures. A combination of medial-to-lateral and subileal dissection was carried out to mobilise the right colon and terminal ileum. The specimen was delivered through a small transverse or paraumbilical extraction wound (median length: 5cm) after placing a wound protector.

After resection of the specimen, an ileocolic anastomosis was performed by either a hand sewn or stapling technique according to the surgeon's preference. Patients in both groups were managed in an enhanced recovery programme, modelled on the practice of Kehlet and Kennedy,^{13,14} apart from selective rather than routine use of epidural anaesthesia and omission of pre-operative carbohydrate loading. Patients were discharged after meeting the criteria set in the enhanced recovery programme. The follow-up included a six-week clinic visit followed by six-monthly cancer follow-up as part of local protocol.

Statistical comparisons of clinical outcomes were made between the laparoscopic and open groups. Variables analysed included patient demographics, type of surgery, lymph node yield, readmission rates, length of post-operative hospital stay (LOS), morbidity and 30-day mortality. Continuous data were expressed as a median (range). To compare treatment groups, the Mann-Whitney U test was applied to continuous data and the chi-square test to categorical data. A *p*-value of <0.05 was considered statistically significant. All analyses were performed using the GraphPad Prism[®] 5 (GraphPad Software Inc, La Jolla, CA, US).

Results

Between October 2006 and February 2009, 164 patients (78 male) underwent an elective right-sided colonic resection. Eighty-nine patients (54%) were in the LRH and seventy-five in the ORH group. Patients in both groups were well matched for age, sex, BMI and ASA grade (Table 1).

Operative details, site of tumour, major complications, 30-day reoperation rate and mortality are shown in Table 2. There were no anastomotic leaks or deaths in the LRH

	ORH (n=75)	LRH (n=89)	p-value
Tumour site			NS
Caecum	33 (44%)	39 (44%)	
Ascending colon	15 (20%)	30 (34%)	
Hepatic flexure	7 (9%)	11 (12%)	
Transverse colon	16 (21%)	7 (8%)	
Splenic flexure	3 (4%)	2 (2%)	
Appendix	1 (1%)	0 (0%)	
Type of incision			
Midline	27 (36%)		
Transverse	42 (56%)		
Conversion		4 (4%)	
Dukes' staging			NS
A	6 (8%)	20 (22%)	
B	39 (52%)	44 (49%)	
C1	23 (31%)	21 (24%)	
C2	7 (9%)	4 (5%)	
Tumour staging			NS
pT1	3 (4%)	1 (1%)	
pT2	4 (5%)	20 (22%)	
pT3	50 (67%)	54 (61%)	
pT4	18 (24%)	13 (15%)	
Lymph node yield	13 (range: 1–37)	15 (range: 3–34)	NS
Median hospital stay (days)			
Primary	8 (range: 3–38)	4 (range: 2–21)	<0.0001
Total (includes readmission)	8 (range: 3–38)	4 (range: 2–48)	<0.0001
Mortality	4 (5%)	0 (0%)	0.0418
Major morbidity	4 (5%)	0 (0%)	0.0418
30-day reoperation	3 (4%)	1 (1%)	NS
Readmission within 30 days	2 (3%)	9 (10%)	NS

ORH = open right hemicolectomy; LRH = laparoscopic right hemicolectomy; NS = not significant

group. However, one patient developed a port site hernia and required an operation to repair this. Three patients in the ORH group had an anastomotic leak and required reoperation. Two of the three had standard resections for caecal and hepatic flexure tumours and the third had an extended resection for a proximal transverse colon tumour. All three were T3 tumours. There were four deaths in the ORH group: three patients died of cardiopulmonary causes and one patient of septicaemia following an anastomotic leak. None

of these patients had extended resections and all were T2/T3 cancers. In addition, three of the four patients were ASA grade 2 while the fourth patient was grade 3 with cardiac co-morbidity.

In the laparoscopic group, 58 patients (45%) had previous abdominal surgery. Four patients were converted to an open procedure. Adhesions resulting in difficult dissection were responsible for two of these conversions. A difficult dissection and oncological uncertainty were responsible

for the other two. The decision to convert was made early during the LRH. The converted patients were included in the LRH group on an intention-to-treat basis. The median LOS in the converted group was 7 days (range: 3–16 days). No major morbidity was recorded in any of these converted patients.

The median lymph node yield was 13 in the ORH and 15 in the LRH group. This difference was not statistically significant. The R0 resection margins were achieved in 97% of ORH and 99% of LRH patients. The majority of patients were staged as Dukes' B in both groups (52% in ORH, 49% in LRH). In the ORH group, 91% of patients were staged as pT3/4. For LRH patients the figure was 76%. A detailed distribution of Dukes' and pathology tumour staging is shown in Table 2. For T3 and T4 cancers there was no difference in distribution between the ORH and LRH groups.

The median LOS was 4 days (range: 2–21 days) in the LRH group and 8 days (range: 3–38 days) for ORH cases ($p < 0.0001$). In terms of type of incision for ORH patients, the median LOS was 8 days for both midline ($n=27$, 36%) and transverse ($n=42$, 56%) (6 unrecorded). Altogether 77% of LRH patients were discharged by day 5 compared to only 21% patients in the ORH group. Eleven patients were readmitted within 30 days of surgery (2 ORH, 9 LRH), the median total length of post-operative stay (including readmission) remained at 4 days in the LRH and 8 days in the ORH group. Of these 11 readmissions, 4 were admitted due to infective wound complications, 2 for pain management and 3 with nausea, vomiting and diarrhoea. Two patients had subphrenic abscesses requiring radiological drainage.

The median operating time for LRH was 120 minutes (range: 70–250 minutes) and the median length of incision for LRH was 5cm (range: 4–8cm).

Discussion

The last decade has seen a rapid development in laparoscopic colorectal surgery. A laparoscopic approach to the management of colorectal cancer is attractive due to the associated benefits to the patient and the healthcare system. The evidence from early randomised studies suggests that the short-term outcomes for laparoscopic colorectal surgery are better than for open surgery without compromising oncological clearance.^{7,15} There has been no difference in most studies between open and laparoscopic surgery in long-term survival, disease free survival or local recurrence.¹⁶ However, the Barcelona series showed a significantly better cancer related survival in the laparoscopic group.¹⁷

The uptake for laparoscopic/extended right hemicolectomies has been slow compared to left-sided resections. More variable and complex anatomy on the right side, the need for extracorporeal anastomosis and the steep learning curve may have been responsible for this hesitation among surgeons.^{18,19}

Most of the trials comparing open and laparoscopic colorectal surgery include a heterogeneous group of patients undergoing a variety of procedures including right, extended right, transverse and left hemicolectomies and sigmoid resections. A few studies have compared the open

and laparoscopic approach for right-sided colon cancers.^{20–25} One could argue that, in selected patients, ORH can be performed through a small (8–10cm) transverse incision. With better post-operative analgesia (patient controlled anaesthesia, wound catheters, transversus abdominis plane blocks) and an enhanced recovery programme, outcomes equivalent to those for LRH can be achieved.^{24,25} This approach, however, may not be suitable for patients with a higher BMI or distal transverse colon tumours and it may not be acceptable to some for cosmetic reasons. Furthermore, the clear views at laparoscopy ensure safety of surgery and good oncological clearance.

In this study we have shown that major morbidity, mortality and length of hospital stay were significantly less in the LRH than in the ORH group (Table 2). We have reported major morbidity and reoperation rates for laparoscopic and open surgery. There were four major complications in the open group (three leaks and one bleed) with no major complications in the laparoscopic group ($p < 0.04$). Although the method of anastomosis was extracorporeal for both groups, it may be that the lower immune and stress response instigated with a laparoscopic technique could have contributed to reduced leak rates and fewer major complications. This has been hypothesised previously in a randomised controlled trial.⁷

The median hospital stay for a right hemicolectomy in the COST (Clinical Outcomes of Surgical Therapy) trial was six days.²⁶ We have shown that it can be reduced further to four days. Even in the group of patients who were converted in the LRH group, the median hospital stay was less than for the ORH group (7 vs 8 days).

The oncological safety of laparoscopic colorectal cancer surgery has been well established and the results of our study are in agreement with this. We did not find any difference between ORH and LRH in terms of lymph node yield or R0 resection. The conversion rate for LRH in this study was 4%, which compares favourably with the published literature.²¹ The reasons for conversion were locally advanced disease and adhesions due to previous surgery. The outcomes for converted patients were good. The median length of stay in this group was seven days.

This study is not without limitations. The patients were not randomised and this may have caused a degree of selection bias. Nevertheless, the two groups are well matched in terms of patient demographics, tumour site, ASA grade and BMI. There was no mortality in the LRH group although there were four deaths (5%) in the open group. The cause of death was cardiopulmonary ($n=3$) and multiple organ failure following an anastomotic leak ($n=1$). None of these patients had either locally advanced disease or an extended resection. The lymph node yield and circumferential margins were also comparable.

The comparison of open and laparoscopic colorectal surgery has been reported in various case controlled and randomised controlled studies. However, one could argue that ORH with a transverse incision offers similar short-term clinical outcomes compared to the laparoscopic approach. Although there are a few case controlled series^{20,22} that have compared the clinical and oncological outcomes

between LRH and ORH, there is no level one evidence in the literature. We have in particular focused on the issue of LRH versus ORH, demonstrating that the laparoscopic approach still offers better short-term outcomes compared to ORH, regardless of whether transverse or midline incisions were used.

Conclusions

Only a prospective randomised controlled trial can settle the debate of superiority between ORH and LRH. However, in the present era with increasing evidence of safety and good outcomes for LRH, some will argue that it is not ethical to design such a trial. It is envisaged that over 90% of right-sided tumours may be suitable for laparoscopic intervention although open surgery would remain an option for bulky tumours or multivisceral *en bloc* resections necessitating a larger extraction site.

This study shows that LRH is surgically safe and has similar oncological outcomes to ORH. There is also significant benefit to patients in terms of lower morbidity and mortality rates and a shorter hospital stay.

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