Int J Colorectal Dis (2017) 32:517–520
DOI 10.1007/s00384-016-2702-7

ORIGINAL ARTICLE

Laparoscopic surgery should be considered in T4 colon cancer

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Accepted: 7 November 2016 / Published online: 12 November 2016

Abstract
Introduction Laparoscopy in T4 colon cancers is not widely advocated due to concerns regarding safety and oncologic efficacy. We conducted this study to compare the short- and long-term oncological outcomes between laparoscopic and open approaches in T4 colon cancers.
Methods A retrospective analysis of all patients who underwent surgery for T4 colon cancer from 2008 to 2014 was performed. Margin positive rate, lymph node yield, local or distant recurrence and overall survival were analysed.
Results A total of 59 patients received open surgery, whilst 93 underwent laparoscopic surgery, with a conversion rate of 8.6%.

There was no difference in the various measured outcomes between the laparoscopic and open groups. The relative risks of positive margins and inadequate lymph node yield for staging were 0.95 (0.74–1.23, p = 0.692) and 1.01 (0.97–1.05, p = 0.710), respectively, for the laparoscopic group when compared to the open approach.

Regarding long-term outcomes, the relative risk of local recurrence in the laparoscopic group was 0.99 (0.96–1.02, p = 0.477), whilst there were also no increased risks of developing distal recurrences at the liver (RR 1.19, 0.51–2.82, p = 0.684), lungs (RR 1.20, 0.50–2.87, p = 0.678) and peritoneum (RR 1.22, 0.51–2.95, p = 0.653) in the laparoscopic group.

There was also no difference in the overall survival (RR 0.70, 0.42–1.16, p = 0.168). Patients were followed up for a median of 73.3 months (range 34.8–144.7).
Conclusion Laparoscopic surgery does not compromise oncological outcomes in T4 colon cancers compared to the open approach. Because of its proven associated benefits, laparoscopy should be considered in selected T4 colon cancers.

Keywords Colon cancer · Laparoscopic surgery · Outcomes · Locally advanced

Introduction

The advantages of laparoscopic colectomy in colon cancer are well proven. These include improved postoperative pain, shortened length of hospital stay, earlier return of bowel function as well as improved cosmesis, without compromise of oncological principles [1–4]. However, in T4 colon cancers, the American Joint Committee on Cancers as well as the European Association of Endoscopic Surgery have cautioned against the use of laparoscopic surgery due to increased technical difficulty as well as prolonged operative times [5]. In addition, the increased manipulation of the often bulky T4 tumour led some surgeons to feel that it may enhance its risks of peritoneal contamination during the surgery. As a result, T4 tumours have often been deemed to be a relative contraindication for laparoscopic surgery [6, 7].

However, with the increasing availability of laparoscopic expertise across the globe and lack of extensive literature documenting the adverse oncological outcomes of the laparoscopic approach in T4 colon cancers, we conducted this study to determine if there was a true purported difference in short- and long-term oncological outcomes among patients with T4 colon cancers that underwent laparoscopic and open surgery.

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Methods

A retrospective review of our prospective collected colorectal cancer database was performed. This database collected information of all patients diagnosed with colorectal cancer. Patients with T4 colon cancers who underwent surgery from January 2008 to December 2014 were reviewed. Institutional Review Board (IRB) approval was obtained for this study.

All patients were staged according to the sixth or seventh editions of the AJCC manual for colon and rectal cancer, depending on the most recent edition at the time of diagnosis. All patients with tumours distal to the ileocaecal valve until the rectosigmoid junction were included in our study. The T4 staging was based on the final histological analysis of the resection specimen. All emergency cases were excluded from the analysis. Cancers with direct invasion to adjacent organs or were already metastatic at presentation were also excluded.

The decision to perform either laparoscopic or open surgery was at the discretion of the consultant colorectal surgery specialist. Laparoscopic surgery performed in this study included the standard multi-port laparoscopic approach as well as robotic- and hand-assisted approaches. Follow-up for patients was in accordance with the American Gastroenterology Association guidelines of regular history and physical examination, laboratory, endoscopic as well as radiologic investigations [8].

Preoperative and demographic data analysed included the patient's gender, age, American Society of Anaesthesia (ASA) grade and site of metastases. Preoperative carcinoembryonic antigen (CEA) levels as well as the procedure performed by the surgeon were also recorded. Patients who underwent conversion from a laparoscopic to open procedure were analysed in an intention to treat manner and were categorised as having undergone laparoscopic surgery. Univariable comparisons of categorical data between open and laparoscopic intervention groups were performed by Fisher's exact test, whilst continuous data were analysed by Student's *t* test.

Outcomes analysed in the study included margin positivity as well as adequate lymph node yield more than 12 to meet staging criteria determined on histology, presence or absence of recurrence at the local operative site, the liver, lungs, peritoneum and overall survival (OS). Univariate Poisson regression with these outcome variables was performed. A p value <0.05 was considered to be statistically significant.

Results

A total of 59 patients received open surgery, whilst 93 underwent laparoscopic surgery. The conversion rate from laparoscopic to open surgery was 8.6%. There was no significant difference in the distribution of gender, age, ASA status and procedure performed between both groups. Median CEA levels were not found to be significantly different between both groups (6.65 (units) vs. 5.9, $p = 0.476$). At the time of diagnosis, there was no difference in the presence of metastases at the liver, lung, small bowel, bladder and gynaecological organs. We, however, noted that two (3.4%) patients in the open group had peritoneal disease compared to none in the laparoscopic group ($p = 0.039$).

Following surgery, only one (0.7%) patient in our entire cohort had a positive margin, whilst 9 (6.0%) patients had a lymph node yield of <12 lymph nodes. After comparing the two groups, the laparoscopic group did not have a higher proportion of patients with positive margins (relative risk (RR) 0.95, 95% confidence interval (CI), 0.74–1.23, $p = 0.692$), and it also did not demonstrate a difference in lymph node yield (RR 1.01, 95 % CI, 0.97–1.05, $p = 0.710$).

In terms of long-term recurrence rates with laparoscopic surgery, there was no increase in local recurrence (RR 0.99, 95 % CI, 0.96–1.02, $p = 0.477$) or at distant sites such as the liver (RR 1.19, 95 % CI, 0.51–2.82, $p = 0.684$), the lungs (RR 1.20, 95 % CI, 0.50–2.87, $p = 0.678$) and the peritoneum (RR 1.22, 95 % CI, 0.51–2.95, $p = 0.653$).

At the end of our follow-up, there was no survival disadvantage with the laparoscopic approach (RR 0.70, 0.42–1.16, $p = 0.168$). Patients were followed up for a median of 78.0 months (33.3–159.1) in the open group and 71.9 months (37.0–143.4) in the laparoscopic group. There was also no difference in the overall survival as seen on the Kaplan Meier plot ($p = 0.271$) (Fig. 1).

Discussion

Although laparoscopic colectomy has been shown to confer significant benefits to patients with colon cancer, the use of laparoscopy in T4 colorectal cancer has not been established

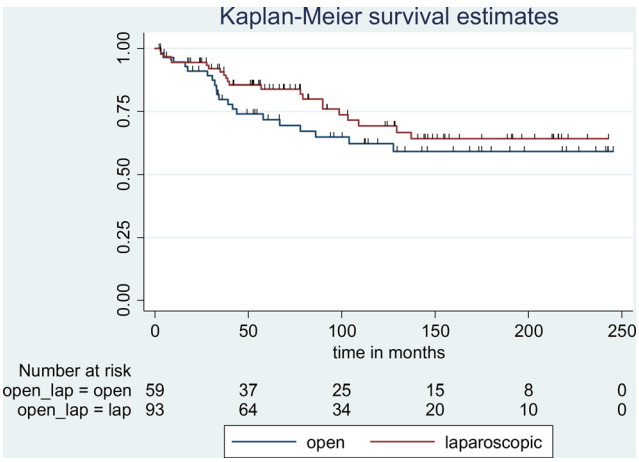

Fig. 1 Kaplan Meier curve showing survival between patients who underwent open versus laparoscopic surgery ($p = 0.271$)

due to concerns about the technical difficulty of tumour fixity to surrounding structures as well as potential complications which may arise from prolonged operative time. In fact, the Conventional versus Laparoscopic-Assisted Surgery in Colorectal Cancer (CLASICC), Colon Cancer Open or Laparoscopic (COLOR) and Barcelona trial [4] excluded T4 tumours from their analysis. As a result, safety and oncologic efficacy in T4 colorectal cancers remains to be validated in large-scale randomised controlled trials.

However, in selected T4 colon cancers, our results show that there were no differences in the short- and long-term oncologic outcomes treated with laparoscopic surgery. There was only one case with a positive resection margin following surgery in our entire cohort. Our overall conversion rate was 8.6%. This is concordant with the published rates of 5.4–18% by various authors [9, 10]. The results from our study build on Elnahas et al. by showing that the laparoscopic approach did not lead to a higher incidence of positive resection margins and also did not result in a difference in local recurrence rates at the resection site. An analysis of lymph node yield also showed that there was no difference in the odds of achieving sufficient lymph node clearance for accurate staging purposes.

Over a median follow-up period of 73.3 months (range 34.8 to 144.7), there were no significant differences in the recurrence rate either locally at the resection margins or distally at the lungs, liver and especially the peritoneum between the two groups. There was also no increased risk for overall mortality between the two approaches. These results are consistent to results published by other study groups [6, 11]. Patients with T4 colon cancers who underwent the laparoscopic approach were therefore able to benefit from the advantages accorded by laparoscopic surgery whilst at the same time achieving equivalent oncologic outcomes.

We recognise the potential for heterogeneity in the laparoscopic and open groups which reflects the limitations of the retrospective study design. As there were no fixed criteria to determine the suitability for laparoscopic resection, the decision to perform either an open or a laparoscopic resection was left to the discretion and judgement of the consultant colorectal surgeon. It was therefore surprising that there was no significant difference in the proportion of patients with poor ASA status between the two groups. Patients with a poor ASA status reflecting the presence of severe life-limiting comorbidities (ASA >3) would have been expected to be associated with open surgery in view of potentially shorter anaesthetic and surgical time. However, this was not the case and would probably suggest that the most important factor is the confidence of the surgeon in either surgical approach. In institutions with experienced laparoscopic colorectal surgeons, achieving low conversion rates is important so as to avoid unnecessary complications of extended incision, longer operative time, longer hospital stay as well as increased surgical morbidity [12].

That said, the authors do not propose laparoscopic approach in all patients with T4 colon cancers. In those with extensive local invasion into the surrounding organs, an open approach may be more prudent especially, since the eventual length of incision would be sizeable. However, even in such instances, a diagnostic laparoscopy to rule out peritoneal metastasis could be performed to minimise the implications of a huge midline laparotomy incision. Moreover, the ability to mobilise the proximal or distal colon laparoscopically would also help to minimise the extent of the incision and thereby facilitating post-operative recovery.

Thus, our findings further lend weight to the proposition that patients with T4 colon cancer should not be deemed as non-candidates for elective laparoscopic surgery. The comparable short- and long-term oncologic outcomes between the two groups coupled with the low conversion rates in the laparoscopic group have changed our institution's approach towards adopting a diagnostic laparoscopic approach first in all suitable colon cancer patients before determining safety and feasibility of performing an oncological resection laparoscopically.

Conclusions

Laparoscopic surgery in patients with T4 colon cancer is safe and feasible. The comparable short- and long-term oncological outcomes strongly favour a laparoscopic approach in suitable patients.

Compliance with ethical standards Institutional Review Board (IRB) approval was obtained for this study.

Conflict of interest The authors declare that they have no conflict of interest.

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