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Original Article

Comparison of laparoscopic versus open complete mesocolic excision in elderly patients with right hemicolon cancer: retrospective analysis of one single cancer

Zhiliang Chen[1], Qinsong Sheng[1], Xiaojiang Ying[2], Wenbin Chen[1]

[1]*Department of Colorectal and Anal Surgery, The First Affiliated Hospital of College of Medicine, Zhejiang University, Zhejiang, China;* [2]*Department of Colorectal and Anal Surgery, Shaoxing People's Hospital, Zhejiang, China*

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Abstract: Objective: To investigate the clinical safety, performance, perioperative and oncologic outcome of laparoscopic complete mesocolic excision (CME) for elderly patients with right hemicolon cancer. Methods: A total of 82 patients with right hemicolon cancer who underwent CME between January 2011 and December 2012 were included in this study and divided into laparoscopic colectomy (LC, n=27) group and open colectomy (OC, n=55) group according to surgical procedure. Demographic variables, perioperative and oncologic outcomes of these two groups were compared. Results: There were no significant differences of demographic and tumor characteristics between two groups. During the surgical procedures, the patients in LC group had shorter incision length (P<0.05), longer operation time (P<0.05) and similar blood loss (P>0.05) compared to those in OC group. After the operation, compared to OC group, LC group had lower pain scores (P<0.05), proceeded an earlier first passage of flatus (P<0.05), and restored the ability to consume solid food sooner (P<0.05). Moreover, when LC group was compared to OC group, hospitalization (P<0.05) was recorded shorter, total costs (P<0.05) were increased, similar numbers of lymph nodes were obtained (P>0.05), and comparable levels of postoperative complications occurred (P>0.05). With a 39-month follow-up, significant differences of postoperative adjuvant chemotherapy, local recurrence, distant metastasis, 3-year overall survival and disease-free survival were not observed. Conclusions: Laparoscopic CME has short-term advantages and comparable long term outcomes compared to open CME. It is safer, more feasible and more effective minimally invasive surgery procedure for elderly patients with right hemicolon cancer.

Keywords: Laparoscopy, right hemicolon cancer, complete mesocolic excision (CME), colectomy, elderly patient

Introduction

Total mesorectal excision (TME) is a golden standard for surgical treatment of rectal cancer. This procedure, which involves holo-resection of the mesorectum, is now accepted worldwide as a surgical treatment choice for this disease [1-3]. In 2009, Hohenberger et al [4] extrapolated the TME principle to the treatment of colon cancer and thus proposed the concept of complete mesocolic excision (CME). It appears that in comparison to the previous radical approach, the CME technique can reduce the incidence rate of local recurrence and improve the prognosis of colon cancer. Pramateftakis et al [5] confirmed that CME, combined with high ligation, was associated with reduced rate of local recurrence and increased survival.

Since laparoscopic colorectal cancer operation was introduced by Jacobs in 1991 [6], laparoscopic radical resection of colon cancer has become the mainstay for the treatment of colon cancer [7]. In some prospectively randomized trials and meta-analyses, colectomy showed short-term advantages such as lower wound infection, less blood loss, postoperative pain and similar oncologic outcomes when compared with conventional open surgery [8-11]. Although it is difficult to apply laparoscopy to CME for colon cancer due to its complex and variable vascular anatomy and splenic flexure mobilization [12], growing numbers of studies

have compared the laparoscopic CME with the open approach for colon cancer treatment with regards to the feasibility, safety, outcome and the results were inconsistent. Some studies suggested that laparoscopic CME was associated with better short-term surgery safety and oncologic benefits [13-15], while others did not report any difference in survival aspect between the two groups [16, 17]. Especially, there are still many concerns about performing laparoscopic CME in elderly patients due to the increasing risk of postoperative morbidities and mortalities [18].

The considerations mentioned above prompted us to explore the feasibility, clinical safety and oncologic outcome of laparoscopic CME for elderly patients with right hemicolon cancer and to compare the result to that which has been achieved with the open procedure.

Materials and methods

Materials

All patients (n=82) admitted to our Hospital from January 2011 to December 2012 who fulfilled the study criteria were included in this study. The inclusion criteria consisted of: (1) age of at least 70 years at the date of hospital admission; (2) pathologically-confirmed ileocecal, hepatic flexure, or ascending colon cancer; (3) no distant metastases at preoperative stage; (4) physical status classified as American Society of Anesthesiologists (ASA) class I-III; (5) underwent CME. The exclusion criteria included: malignant lymphoma or other non-cancer pathology or underwent emergency operation. All enrolled patients were divided into either the laparoscopic colectomy (LC) group (n=27) or the open colectomy (OC) group (n=55) according to the type of surgery they had received. All patients and their families provided written informed consent for their decision to the surgical procedure (open or laparoscopic), however, their informed consent was waived for the retrospective design of this study. This study was approved by the Institutional Review Board of our hospital.

Methods

LC group: Patients in the LC group were placed in a modified low lithotomic position during surgery. After establishing pneumoperitoneum, a 10-mm trocar with a 30° telescope was created in the lower edge of the umbilicus. Visually guided by the telescope, three standard trocars were placed in the anti-McBurney point of the left lower quadrant (12 mm), the McBurney point of the right lower quadrant (10 mm), and 3-4 cm below the right costal margin on the midclavicular line.

The dissection started at the ileocolic vessel and proceeded along the superior mesenteric vein [19], exposing Toldt's and the prerenal fascia. Subsequently, uncover the head of the pancreas, mobilize the duodenum, thus exposed the large intestine from the origin of transverse colon mesentery to the peritoneal reflection. Then, dissect the entire mesocolon and ligate the origins of the central vessels. This operation was followed by dissecting the lymph nodes and lymphatic tissues. For tumors located at the caecum and the ascending colon, this was performed on the basis of the corresponding vessels, while dissection of the subpyloric lymph nodes (when the tumor was located at the hepatic flexure) was performed after ligation at the origin of right-omentum veins, being followed by dissection of the greater omentum within 15 cm of the tumor. To achieve radical lymph node resection at the root of central supply vessels, the mobilization of the duodenum and exposition of the head of the pancreas and the origin of the mesocolon were required. Dissection ended at the right part of the gastrocolic ligament, the peritoneum of the right paracolic gutter and the peritoneal reflection of the terminal ileum. Then the specimen was exteriorized through a 5 cm vertical incision, which was located at the trocar of the right upper quadrant. Subsequently, the specimen was resected and a side-to-side stapled ileotransverse colon anastomosis was performed. Finally, a suction drainage tube was inserted into the right paracolic gutter, and the abdominal walls were closed layer-by-layer (**Figure 1**).

OC group: Place patients in OC group in a supine position during surgery. Make a midline incision of about 15-20 cm and subsequently dissect a medial to lateral to the anterior surface of the superior mesenteric vessels below the third portion of the duodenum. If the carcinoma was located at the caecum or proximal ascending colon, the right branches of the middle colic vessels would be dissected, whereas if

Figure 1. The surgery in the LC group. A: Trocar position of L-CME. B: The right hemicolon specimen. C, D: Selection of lymph nodes.

the carcinoma was located at the hepatic flexure, then the middle colic vessels would be dissected. When the right colon was completely mobilized and mesenteric division was executed, ileocolic side-to-side anastomosis was performed by a linear cutter stapler. Then insert a suction drainage tube into right paracolic gutter and close the abdominal walls layer-by-layer.

Measurement of patient outcomes

Demographic and perioperative data were obtained from medical records. Demographic data including age, sex distribution, body mass index (BMI), previous abdominal surgery, prior comorbidities and ASA class. Tumor characteristics were also collected, such as tumor location, pathological type and TNM stage. Perioperative and other clinical parameters also were assessed, including incision length, operation time, blood loss, postoperative pain score, postoperative first passage of flatus, postoperative time to first meal, time of hospitalization, total cost, number of lymph nodes retrieved following dissection, and postoperative complications. All the patients had been followed up by the surgical polyclinic or by a telephone interview from the time of colectomy to July, 2015, or the time of death for any cause. And oncologic data including uses of chemotherapy, local recurrence rate, distant metastasis rate, 3-year overall survival and disease-free survival were collected.

Statistical analysis

Continuous variables were expressed as mean ± standard deviations ($\bar{x}$±S), and compared by the independent student's t-test since all of them were in normal distribution. Categorical variables were expressed as numbers and percentages, and compared by Chi-square test or Fisher exact probability test. Differences in overall survival and disease-free survival between two groups were compared by using Kaplan-Meier curves and tested by log rank test. All statistical tests were two-sided, and $P<0.05$ were considered to indicate statistical significance.

Results

Eighty-two patients with cancer of the right hemicolon (LC=27, OC=55) who fulfilled the inclusion criteria were included in this analysis. All the operations in these two groups were performed successfully by a single surgical team. There was no conversion to OC for patients who underwent the laparoscopic procedure in this study.

The demographic characteristics of the two groups were listed in **Table 1**. The distributions of age, sex, previous abdominal surgery, ASA class, tumor distribution, and comorbidity were

Table 1. Demographic variables of the patients in the laparoscopic CME group and the open CME group

Demographic variables	LC (*n*=27)	OC (*n*=55)	*P*
Age (years)	73.5±5.6	75.1±6.4	0.140
Gender			
Male	18 (66.7)	34 (61.8)	0.668
Female	9 (33.3)	21 (31.2)	
BMI (kg/m^2, mean ± SD)	23.7±3.2	25.1±3.6	0.090
Previous abdominal surgery, *n* (%)			
No	23 (85.2)	45 (81.8)	0.703
Yes	4 (14.8)	10 (18.2)	
ASA classification, *n* (%)			
I	4 (14.8)	8 (14.6)	0.515
II	10 (37.0)	19 (34.6)	
III	13 (48.2)	28 (50.2)	
Previous comorbidities, *n* (%)			
Hypertension	19 (70.4)	36 (65.5)	0.656
Coronary disease	8 (29.6)	14 (25.5)	0.688
Diabetes	6 (22.2)	15 (27.3)	0.622
Pulmonary insufficiency	2 (7.4)	5 (9.1)	0.798
Cerebrovascular disease	2 (7.4)	5 (9.1)	0.798

Table 2. Tumor characteristics of the patients in the laparoscopic CME group and the open CME group

Tumor characteristics	LC (*n*=27)	OC (*n*=55)	*P* value
Tumor distribution			
Hepatic flexure	9	20	0.787
Ascending colon	18	35	
Pathological type			
Well-differentiated	4 (14.8)	9 (16.4)	0.645
Moderately-differentiated	20 (74.1)	35 (63.6)	
Poorly-differentiated	3 (11.1)	11 (20.0)	
TNM stage			
I	3 (11.1)	7 (12.7)	0.746
II	11 (40.7)	23 (41.8)	
III	13 (48.1)	25 (45.5)	

similar between two groups (all P>0.05). BMI in LC group was lower than that in OC group, but it did not reach the statistical significance (P>0.05). Similarly, there were no significant differences in tumor characteristics in regarding tumor location, pathological type and TNM stage (all P>0.05, **Table 2**).

The perioperative parameters of these two groups were presented in **Table 3**. During surgery, compared to those in OC group, the patients in LC group had shorter incision length (5.5±0.6 cm *vs.* 15.1±3.8 cm, P< 0.001), longer operation time (185± 46 min *vs.* 123±42 min, P<0.001), and similar blood loss (110±45 ml *vs.* 128±87 ml, *P*>0.05). After the operation, the patients in LC group had lower pain scores (3.5±0.8 *vs.* 4.9± 0.9, P<0.001), earlier first passage of flatus (52.8±12.3 h *vs.* 86.4±17.1 h, P<0.001), shorter time to the consumption of solid food (84.1±18.9 h *vs.* 138±32.4 h, P<0.001), shorter hospitalization time (9.2±5.4 d *vs.* 15.2±7.3 d, P<0.001), higher total costs (32,528±3,219 RMB *vs.* 28,924±3,326 RMB, P<0.05), similar numbers of retrieved lymph nodes (24.8±9.9 *vs.* 22.4±7.4, P>0.05), similar TNM classification (P>0.05), and comparable incidence rate of postoperative complications (P>0.05) compared to the patients in OC group (**Table 3**).

All patients were followed up for a median of 39 months, and the oncologic outcomes in two groups were presented in **Table 4**. During follow-up, some patients accepted postoperative adjuvant chemotherapy (Xelox or mFolfox6), which was administered according to the TNM classification and their own wishes. The incidence rate of chemotherapy, local recurrence, distant metastasis were similar between these two groups (all P>0.05). In addition, there were no significant differences in 3-year overall survival and disease-free survival between two groups, which were 88.1% and 84.4% in LC group, 82.9% and 81.3% in OC group respectively (all P>0.05, **Figure 2**).

Discussion

Prevailing anatomical theory considers that both visceral and parietal planes which cover the mesocolon like an envelope, similar to the mesorectum, but exploitation of these anatomical characteristics for colon cancer surgery remained elusive until Hohenberger proposed the concept of CME as a radical technique for

Table 3. Operative parameters of the patients in the laparoscopic CME group and the open CME group

Operative parameter	LC (*n*=27)	OC (*n*=55)	*P*
Length of incision (cm)	5.5±0.6	15.1±3.8	<0.001
Operative time (min)	185±46	123±42	<0.001
Intraoperative blood loss (ml)	110±45	128±87	0.082
Postoperative pain score	3.5±0.8	4.9±0.9	<0.001
First passage of flatus (h)	52.8±12.3	86.4±17.1	<0.001
Time to diet (h)	84.1±18.9	138±32.4	<0.001
Postoperative hospitalization time (d)	9.2±5.4	15.2±7.3	<0.001
Overall medical cost (RMB)	32528±3219	28924±3326	0.018
Number of lymph node dissection	24.8±9.9	22.4±7.4	0.710
Postoperative complications, *n* (%)			
Ileus	1 (3.7)	1 (1.8)	0.603
Anastomotic bleeding	0	1 (1.8)	0.481
Wound infection	1 (3.7)	2 (3.6)	0.988
Pulmonary infection	0	1 (1.8)	0.481
Chylous leakage	0	1 (1.8)	0.481
Gastroplegia	0	1 (1.8)	0.481
Heart failure	1 (3.7)	2 (3.6)	0.988

Table 4. Follow-up data of patients in the LC group and OC group

Oncologic outcome	LC (*n*=27)	OC (*n*=55)	*P*
Chemotherapy, *n* (%)			
Xelox	8 (29.6)	16 (29.1)	0.960
mFolfox6	7 (25.9)	16 (29.1)	0.764
No chemotherapy	12 (44.4)	23 (41.8)	0.821
Local recurrence, *n* (%)	4 (14.8)	9 (16.4)	1.000
Distant metastasis, *n* (%)	0	1 (1.8)	1.000
3-year overall survival (%)	88.1	82.9	0.518
3-year disease-free suivival (%)	84.4	81.3	0.713

the surgical treatment of this disease [4]. Compared to traditional right colon cancer radical surgery, CME has several characteristics as followings: (1) dissection of tumor-draining lymph nodes along the major vessels (superior mesenteric vessels); (2) excision of a complete and smooth visceral fascia; (3) more extensive resection along the colonic blood vessels. The authors analyzed the data of 1329 patients undergoing R0 resection for colon cancer. And they found that by consequent application of the procedure of CME, the local 5-year recurrence rate in colon cancer decreased from 6.5% in 1978-1984 to 3.6% in 1995-2002, while the cancer related 5-year survival rates increased from 82.1% to 89.1% in the same period [4]. Since then, many other studies also showed CME surgery yielded better survival and more acceptable to treat complication rates [20-22]. However, as a more extensive procedure, it might still cause some unusual complications, such as chyle leakage, duodenal injury and major vascular injury [23].

Several studies and meta-analysis reported that laparoscopic colectomy showed clear short-term advantages, including less postoperative pain, lower wound infection and earlier recovery when compared to conventional open laparoscopy [24-28]. Accordingly, laparoscopic techniques have been extensively used for the surgical management of colorectal cancer during the last two decades in China [7]. However, there is still controversy about that whether the favorable outcomes of open CME can be reproduced with laparoscopic CME since the technical difficulty existed for the combination of laparoscopy and CME for colon cancer [29].

Many studies have investigated of feasibility and safety of laparoscopic CME, most of which suggested short-term advantages [15, 30]. In our study, patients in LC group had shorter length of incision, experienced less postoperative pain, shorter time to first postoperative defecation, enhanced postoperative solid food consumption, shorter hospitalization time and low rate of postoperative complications, which suggest that laparoscopic CME can be safely performed compared to open colectomy. Besides, similar to other studies [15], our study showed that long-term oncologic outcomes regarding 3-year overall survival and disease-free survival were better in LC group than those in OC group, though the difference did not reach significance due to relatively short follow-up and small sample size. However, in some other studies, survival benefits were

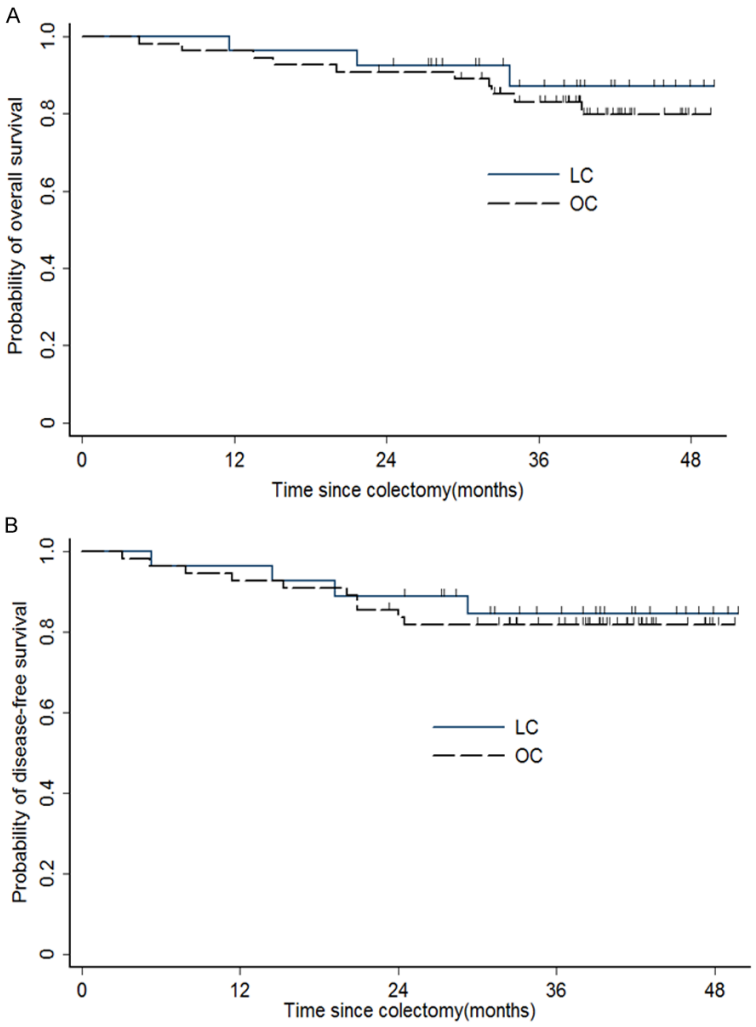

Figure 2. Comparison of the 3-year overall survival (A) and disease-free survival (B) between the laparoscopic and open colectomy groups, LC = laparoscopic colectomy, OC = open colectomy.

not observed [17, 31]. It was reported that immune system might be impaired by surgical stress, especially in open surgery than that in laparoscopic surgery. A randomized, prospective study suggested that acute phase systemic response was attenuated in patients who underwent laparoscopic-assisted colectomy, which might accelerate the recovery of these patients [32]. In addition, Immunity played a critical role in tumour progression and metastatic spread, this might partly explained that the association existed between lower recurrence and longer survival and laparoscopic colectomy [27]. However, the potential favorable impacts of laparoscopic CME on prognosis need to be further investigated since the controversial results.

There were few data available in the literature for laparoscopic CME in elderly patients with right colon cancer. Some studies reported that postoperative morbidities and mortalities increased with age in older patients [18, 33]. Laparoscopic CME for elderly patients with colon cancer might affect hemodynamic and ventilatory functions due to the longer operation time and pneumoperitoneum. However, many studies suggested that laparoscopic colorectal resection improved short-term postoperative more in elderly patients than that in younger patients, while the survival rates were similar between the elderly patients who had laparoscopic resections and those who had open surgery [34, 35]. Our study provided further evidences for the advantages of Laparoscopic CME for elderly patients.

The duration of surgery remained one of the largest obstacles for laparoscopic CME [29]. In our study, the operation time in laparoscopic colectomy group was significantly longer than that of open surgery group. Laparoscopic CME is a technically demanding procedure and requires a steep learning curve due to technical difficulty. However, learning curve issues may be diminished by the collaboration of interested colleagues to establish safe and reproducible operations.

There were several limitations in this study including its retrospective nature, which might lead to selection bias. Though the baseline and tumor characteristics were similar in two groups, the confounding effect of some potential unmeasured factors could not be eliminated. In addition, the decision to undergo laparoscopic or open procedure was not based on randomization but depended on patients' choices. Besides, the relatively small sample

size and relatively short follow-up might underestimate the advantages of laparoscopic CME procedure. Despite these limitations, our study provided further evidence for the short-term benefit and comparable results regarding oncologic outcomes.

Conclusion

This study showed that laparoscopic CME in elderly patients with right hemicolon carcinoma offered advantages of being minimally invasive and associated with better peri- and postoperative outcomes and similarly long-term recurrence and survival. Despite the longer operation time and the higher cost in comparison to open surgery, it seems that laparoscopic CME is safer, more useful and more feasible for elderly patients with right hemicolon cancer. Further long-term follow-up study is still needed to address the long-term curative potential of these tow CME modalities.

Disclosure of conflict of interest

None.

Authors' contribution

Zhiliang Chen, Qinsong Sheng, Xiaojiang Ying, and Wenbin Chen performed the operations (LC and OC); Qinsong Sheng and Wenbin Chen assisted with study design, data analysis and literature research; Zhiliang Chen wrote the paper.

Address correspondence to: Wenbin Chen, Department of Colorectal and Anal Surgery, The First Affiliated Hospital of College of Medicine, Zhejiang University, No. 79 Qingchun Road, Hangzhou 310003, Zhejiang, China. Tel: +86-571-87236131; Fax: +86-13396553806; E-mail: chenwenbinsurgery3@163.com

References

[1] Martling A, Holm T, Rutqvist LE, Johansson H, Moran BJ, Heald RJ and Cedermark B. Impact of a surgical training programme on rectal cancer outcomes in Stockholm. Br J Surg 2005; 92: 225-229.

[2] Zheng MH, Feng B, Hu CY, Lu AG, Wang ML, Li JW, Hu WG, Zang L, Mao ZH, Dong TT, Dong F, Cai W, Ma JJ, Zong YP and Li MK. Long-term outcome of laparoscopic total mesorectal excision for middle and low rectal cancer. Minim Invasive Ther Allied Technol 2010; 19: 329-339.

[3] Wibe A, Moller B, Norstein J, Carlsen E, Wiig JN, Heald RJ, Langmark F, Myrvold HE and Soreide O. A national strategic change in treatment policy for rectal cancer-implementation of total mesorectal excision as routine treatment in Norway. A national audit. Dis Colon Rectum 2002; 45: 857-866.

[4] Hohenberger W, Weber K, Matzel K, Papadopoulos T and Merkel S. Standardized surgery for colonic cancer: complete mesocolic excision and central ligation-technical notes and outcome. Colorectal Dis 2009; 11: 354-364; discussion 364-355.

[5] Pramateftakis MG. Optimizing colonic cancer surgery: high ligation and complete mesocolic excision during right hemicolectomy. Tech Coloproctol 2010; 14 Suppl 1: S49-51.

[6] Jacobs M, Verdeja JC and Goldstein HS. Minimally invasive colon resection (laparoscopic colectomy). Surg Laparosc Endosc 1991; 1: 144-150.

[7] Jin K, Wang J, Lan H and Zhang R. Laparoscopic surgery for colorectal cancer in China: an overview. Int J Clin Exp Med 2014; 7: 4635-4645.

[8] Biondi A, Grosso G, Mistretta A, Marventano S, Toscano C, Gruttadauria S and Basile F. Laparoscopic-assisted versus open surgery for colorectal cancer: short- and long-term outcomes comparison. J Laparoendosc Adv Surg Tech A 2013; 23: 1-7.

[9] Levy BF, Tilney HS, Dowson HM and Rockall TA. A systematic review of postoperative analgesia following laparoscopic colorectal surgery. Colorectal Dis 2010; 12: 5-15.

[10] Buunen M, Veldkamp R, Hop WC, Kuhry E, Jeekel J, Haglind E, Pahlman L, Cuesta MA, Msika S, Morino M, Lacy A and Bonjer HJ. Survival after laparoscopic surgery versus open surgery for colon cancer: long-term outcome of a randomised clinical trial. Lancet Oncol 2009; 10: 44-52.

[11] Braga M, Frasson M, Zuliani W, Vignali A, Pecorelli N and Di Carlo V. Randomized clinical trial of laparoscopic versus open left colonic resection. Br J Surg 2010; 97: 1180-1186.

[12] Jamali FR, Soweid AM, Dimassi H, Bailey C, Leroy J and Marescaux J. Evaluating the degree of difficulty of laparoscopic colorectal surgery. Arch Surg 2008; 143: 762-767; discussion 768.

[13] Huang JL, Wei HB, Fang JF, Zheng ZH, Chen TF, Wei B, Huang Y and Liu JP. Comparison of laparoscopic versus open complete mesocolic excision for right colon cancer. Int J Surg 2015; 23: 12-17.

[14] Kim IY, Kim BR, Choi EH and Kim YW. Short-term and oncologic outcomes of laparoscopic and open complete mesocolic excision and central ligation. Int J Surg 2016; 27: 151-157.
[15] Bae SU, Saklani AP, Lim DR, Kim DW, Hur H, Min BS, Baik SH, Lee KY and Kim NK. Laparoscopic-assisted versus open complete mesocolic excision and central vascular ligation for right-sided colon cancer. Ann Surg Oncol 2014; 21: 2288-2294.
[16] Fleshman J, Sargent DJ, Green E, Anvari M, Stryker SJ, Beart RW Jr, Hellinger M, Flanagan R Jr, Peters W and Nelson H. Laparoscopic colectomy for cancer is not inferior to open surgery based on 5-year data from the COST Study Group trial. Ann Surg 2007; 246: 655-662; discussion 662-654.
[17] Jayne DG, Guillou PJ, Thorpe H, Quirke P, Copeland J, Smith AM, Heath RM and Brown JM; UK MRC CLASICC Trial Group. Randomized trial of laparoscopic-assisted resection of colorectal carcinoma: 3-year results of the UK MRC CLASICC Trial Group. J Clin Oncol 2007; 25: 3061-3068.
[18] Al-Refaie WB, Parsons HM, Habermann EB, Kwaan M, Spencer MP, Henderson WG and Rothenberger DA. Operative outcomes beyond 30-day mortality: colorectal cancer surgery in oldest old. Ann Surg 2011; 253: 947-952.
[19] Gouvas N, Pechlivanides G, Zervakis N, Kafousi M and Xynos E. Complete mesocolic excision in colon cancer surgery: a comparison between open and laparoscopic approach. Colorectal Dis 2012; 14: 1357-1364.
[20] Bertelsen CA, Neuenschwander AU, Jansen JE, Wilhelmsen M, Kirkegaard-Klitbo A, Tenma JR, Bols B, Ingeholm P, Rasmussen LA, Jepsen LV, Iversen ER, Kristensen B and Gogenur I. Disease-free survival after complete mesocolic excision compared with conventional colon cancer surgery: a retrospective, population-based study. Lancet Oncol 2015; 16: 161-168.
[21] Bertelsen CA, Bols B, Ingeholm P, Jansen JE, Neuenschwander AU and Vilandt J. Can the quality of colonic surgery be improved by standardization of surgical technique with complete mesocolic excision? Colorectal Dis 2011; 13: 1123-1129.
[22] West NP, Hohenberger W, Weber K, Perrakis A, Finan PJ and Quirke P. Complete mesocolic excision with central vascular ligation produces an oncologically superior specimen compared with standard surgery for carcinoma of the colon. J Clin Oncol 2010; 28: 272-278.
[23] Feng B, Sun J, Ling TL, Lu AG, Wang ML, Chen XY, Ma JJ, Li JW, Zang L, Han DP and Zheng MH. Laparoscopic complete mesocolic excision (CME) with medial access for right-hemi colon cancer: feasibility and technical strategies. Surg Endosc 2012; 26: 3669-3675.
[24] Abraham NS, Young JM and Solomon MJ. Meta-analysis of short-term outcomes after laparoscopic resection for colorectal cancer. Br J Surg 2004; 91: 1111-1124.
[25] Deijen CL, Vasmel JE, de Lange-de Klerk ES, Cuesta MA, Coene PL, Lange JF, Meijerink WJ, Jakimowicz JJ, Jeekel J, Kazemier G, Janssen IM, Pahlman L, Haglind E, Bonjer HJ; COLOR (COlon Cancer Laparoscopic or Open Resection) Study Group. Ten-year outcomes of a randomised trial of laparoscopic versus open surgery for colon cancer. Surg Endosc 2016; [Epub ahead of print].
[26] Schwenk W, Haase O, Neudecker J and Muller JM. Short term benefits for laparoscopic colorectal resection. Cochrane Database Syst Rev 2005; CD003145.
[27] Lacy AM, Garcia-Valdecasas JC, Delgado S, Castells A, Taura P, Pique JM and Visa J. Laparoscopy-assisted colectomy versus open colectomy for treatment of non-metastatic colon cancer: a randomised trial. Lancet 2002; 359: 2224-2229.
[28] Liao CH, Tan EC, Chen CC and Yang MC. Real-world cost-effectiveness of laparoscopy versus open colectomy for colon cancer: a nationwide population-based study. Surg Endosc 2016; [Epub ahead of print].
[29] Melich G, Jeong DH, Hur H, Baik SH, Faria J, Kim NK and Min BS. Laparoscopic right hemicolectomy with complete mesocolic excision provides acceptable perioperative outcomes but is lengthy-analysis of learning curves for a novice minimally invasive surgeon. Can J Surg 2014; 57: 331-336.
[30] Adamina M, Manwaring ML, Park KJ and Delaney CP. Laparoscopic complete mesocolic excision for right colon cancer. Surg Endosc 2012; 26: 2976-2980.
[31] Li JC, Leung KL, Ng SS, Liu SY, Lee JF and Hon SS. Laparoscopic-assisted versus open resection of right-sided colonic cancer-a prospective randomized controlled trial. Int J Colorectal Dis 2012; 27: 95-102.
[32] Delgado S, Lacy AM, Filella X, Castells A, Garcia-Valdecasas JC, Pique JM, Momblan D and Visa J. Acute phase response in laparoscopic and open colectomy in colon cancer: randomized study. Dis Colon Rectum 2001; 44: 638-646.
[33] Panis Y, Maggiori L, Caranhac G, Bretagnol F and Vicaut E. Mortality after colorectal cancer surgery: a French survey of more than 84,000 patients. Ann Surg 2011; 254: 738-743; discussion 743-4.

[34] She WH, Poon JT, Fan JK, Lo OS and Law WL. Outcome of laparoscopic colectomy for cancer in elderly patients. Surg Endosc 2013; 27: 308-312.
[35] Hinoi T, Kawaguchi Y, Hattori M, Okajima M, Ohdan H, Yamamoto S, Hasegawa H, Horie H, Murata K, Yamaguchi S, Sugihara K and Watanabe M. Laparoscopic versus open surgery for colorectal cancer in elderly patients: a multicenter matched case-control study. Ann Surg Oncol 2015; 22: 2040-2050.