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ORIGINAL ARTICLE

Short- and long-term outcomes of laparoscopic complete mesocolic excision for colon cancer in the elderly: A retrospective cohort study

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Summary

Purpose: *Laparoscopic complete mesorectal excision (CME) can be used for the treatment of colon cancer. This study was designed to assess short-term and long-term outcomes of laparoscopic CME in elderly colon cancer patients.*

Methods: *We retrospectively reviewed colon cancer patients who underwent laparoscopic CME at a single medical center between January 2014 and January 2019. Short-term surgical outcomes and long-term survival outcomes were analyzed, including overall survival (OS) and disease-free survival (DFS).*

Results: *A total of 152 patients were included in the study, of which 54 were classified as elderly group (≥70 years) and 98 were classified as younger group (<70 years). The elderly group had more Charlson comorbidity index (CCI) scores >3. The short-term results of the two groups were similar. The overall complication and major complication rates were comparable between the two groups. The 5-year OS rates of the elderly and younger groups were 67% and 71%, respectively (p=0.846). The 5-year DFS rates in the elderly and younger groups were 59% and 62%, respectively (p=0.995).*

Conclusion: *Compared with younger patients, laparoscopic CME in elderly colon cancer patients can achieve similar short-term and long-term outcomes. For elderly colon cancer patients, age is not a contraindication to laparoscopic CME.*

Key words: *laparoscopy, elderly, colon cancer, prognosis, complete mesocolic excision*

Introduction

Colorectal cancer is the most common malignancy in the digestive system and is the second leading cause of cancer-related death worldwide [1,2]. Although colon cancer and rectal cancer are often collectively referred to as colorectal cancer, however, due to the difference in surgical resection, surgical difficulty, and neoadjuvant therapy for colon cancer and rectal cancer, the two are often studied separately in surgical oncology [3]. Age is widely considered to be a risk factor for colon cancer, and it has been reported that the incidence of cancer increases in patients over the age of 70 [4,5]. Due to the existence of medical diseases, effective treatments are only suitable for young people [4,5]. There is still a lack of evidence to prove whether these useful treatments are also beneficial for elderly patients. Therefore, managing a drastically increased elderly colon cancer patient has become a clinically common problem.

Complete mesocolic excision (CME) is considered to be the main treatment option for colon cancer [6-9]. However, aging can cause many struc-

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tural and functional changes that may reduce the tolerance of CME. Some surgeons are concerned that elderly colon cancer patients are tolerant to CME. Laparoscopic CME has been shown to be effective and safe as a minimally invasive treatment with less blood loss, shorter hospital stay, fewer postoperative complications, and a comparable survival rate [9-17]. However, most studies have not included elderly colon cancer patients. Whether the benefit of laparoscopic CME for elderly patients is similar to that of younger patients remains unclear. To address this clinical problem, we designed a retrospective study to evaluate the safety and efficacy of laparoscopic CME in elderly patients by studying the short- and long-term outcomes of laparoscopic CME in elderly colon cancer patients.

Methods

This study complied with the Declaration of Helsinki. This retrospective research was approved by the ethics review board of our institution. The need for informed consent from all patients was waived because of retrospective study, not prospective trial.

We retrospectively reviewed the data of consecutive patients who underwent laparoscopic CME for colon adenocarcinoma in our institution from January 2014 to January 2019. Patients who were younger than 18 years old, other than colon adenocarcinoma, synchronous or metachronous multiple primary colon cancer, rectosigmoid colon cancer, ASA score> IV, absence of clinical data or lost to follow-up were excluded. The indication of performing laparoscopic CME for colon cancer included clinical T1-3N0-2M0 disease, ASA score no worse than IV, as well as absence of other malignant diseases. All laparoscopic CMEs were performed by the same team of experienced gastrointestinal surgeons. Laparoscopic CME was the initial therapy for all patients in this study. The diagnosis of colon adenocarcinoma was confirmed by histologic examination after radical resection.

Laparoscopic left hemicolectomy

The surgical procedure for laparoscopic left hemicolectomy included the following: First, the inferior mesenteric blood vessels were exposed and identified and Toldt's fascia was accessed after an incision was placed on the peritoneum at the angle between a point 1 cm below the inferior mesenteric blood vessel projection and the abdominal aorta. Toldt's fascia was sharply dissected, and the downward position was determined according to the tumor site. The anterior renal fat, left ureter, and blood vessels of the reproductive system were gradually and completely separated toward the medial side up to the left abdominal aorta and upwards and outwards up to the side of the left colon and lower margin of the pancreas. The inferior mesenteric blood vessels were exposed, the roots of those blood vessels or the left colic blood vessel bifurcation were ligated according to the tumor site, and the corresponding blood supply was cut off. The left colic mesentery was excised upwards along the left side of the abdominal aorta up to the mesentery of the transverse colon at a point 1 cm from the left side of the middle colic artery, followed by ligation. The left branch of the middle colic artery was also cut off. The retroperitoneum at the left paracolic sulcus was cut open from the bottom to the top up to the splenic flexure. The left greater omentum was sharply dissected and the left half of the mesentery of the transverse colon was cut off at the lower margin of the pancreas leftwards up to the splenic flexure. An auxiliary incision was placed over the left abdomen and the intestine was removed. The intestine and mesentery at 10 cm from the distal and proximal ends of the tumor were completely resected, and an anastomosis was created [18-25].

Laparoscopic right hemicolectomy

The surgical procedure for laparoscopic right hemicolectomy included the following: An incision was performed at the ascending colon mesentery at the junction between the ileocolic blood vessels and inferior mesenteric blood vessels, and Toldt's fascia was exposed. The peritoneum on the surface of the superior mesenteric veins was opened from the bottom to the top, and the blood vessels were exposed. Adipose tissues on the surface lymph nodes were removed and the root of the blood vessel was ligated. The ileocolic blood vessels, right colic blood vessels, and right branch of the middle colic blood vessels were separated and the adipose tissues over the perivascular lymph nodes were removed. The colic visceral fascia and parietal fascia were sharply separated on the right side and at the head of Toldt's space for complete exposure of the head of the pancreas, duodenum, right ureter, and blood vessels of the reproductive system. Suitable protection measures were implemented. The greater omentum was excised from the medial side to the lateral side along the vascular arch of the gastric omentum, and the transverse colon mesentery and right half of the hepatic flexure were cut off. The ascending colon was separated along the tail end and around the ileocecal part. A path to access the posterior space of the medial ileum and free 10–20 cm of the ileum was created. An ancillary incision was placed over the right abdomen and the intestine was removed. The colon and mesenteric samples were resected and an ileotransverse anastomosis was created [18-25].

Complications

Clavien-Dindo classification was used to classify postoperative 30-day complications [26]. Follow-up status was evaluated using physical examinations, laboratory tests, colonoscopy, abdominal CT scans according to the surveillance protocols. The final follow-up was conducted in September 2019.

Statistics

Data were calculated as means and standard deviations for variables following normal distribution and were analyzed using *t*-tests. For data not normally distributed, the results were expressed as medians and ranges and compared by using nonparametric tests.

Differences in semiquantitative results were analyzed using the Mann–Whitney *U*-test. Differences in qualitative results were analyzed using the chi-square test or Fisher's exact test, as appropriate. Univariate analyses were performed to identify prognostic variables related to overall survival (OS) and disease-free survival (DFS). Univariate variables with probability values <0.10 were selected for inclusion in the multivariate Cox proportional hazard regression model. Adjusted hazard ratios (HR) along with the corresponding 95% confidence interval (CI) were calculated. P<0.05 was considered to indicate statistical significance. The SPSS 13.0 statistical package (SPSS Inc., Chicago, IL, USA) was applied.

Results

Baseline characteristics

A total of 152 patients were enrolled in the study, 54 aged ≥70 years, and 98 aged <70 years. Table 1 summarizes the demographic and baseline characteristics of elderly and young patients. The proportion of Charlson comorbidity index (CCI) score >3 in the elderly group was higher than that in the younger group. Other variables, including gender, body mass index, and scores of the American Society of Anesthesiologists (ASA), showed no significant differences in tumor location and clinical tumor stage.

Short-term outcomes

Table 2 shows the surgical and postoperative results for both groups. There was no difference in median blood loss and blood transfusion requirements between the two groups. There was no difference in the median length of hospital stay in the elderly group compared with the younger group. In the elderly group, 2 patients were converted to open surgery, and 2 patients in the young group were converted to open surgery. The overall postoperative 30-day complication rate in the elderly group was similar to that in the younger group. There were 13 patients with complications in the elderly group, including 5 cases of anastomotic leakage, 4 cases of pulmonary infection, 3 cases of intestinal obstruction, and 1 case of respiratory failure. Complications occurred in 15 patients in the young group, including 6 cases of anastomotic leakage, 3 cases of pulmonary infection, 2 cases of intestinal obstruction, 2 cases of heart failure, and 2 cases of urinary retention. The rate of major complications in the two groups was comparable. Pathological data in the elderly group included TNM staging, and cancer differentiation and surgical margins were similar to those in the younger group (Table 3).

Table 1. Baseline characteristics of the two groups

Characteristics	*Elderly (n=54)*	*Younger (n=98)*	*P value*
Age (years)	73 (70-77)	61 (49-69)	0.000
Gender			0.752
Male	35	66	
Female	19	32	
BMI (kg/m^2)	21 (18-26)	22 (17-25)	0.358
ASA score			0.918
I	31	54	
II	14	30	
III	9	14	
Clinical stage (cTNM)			0.302
I	25	54	
II	20	31	
III	9	13	
Charlson comorbidity index (CCI)			0.026
CCI ≤ 3	42	89	
CCI > 3	12	9	
Tumour site			0.909
Left	32	59	
Right	22	39	

BMI: body mass index, ASA: American Society of Anesthesiologists, CCI: Charlson comorbidity index

Long-term outcomes

The median follow-up time for the elderly and younger groups was 32 months and 34 months, respectively. At the last follow-up, 9 patients had died in the elderly group and 17 patients in the young group. There was no significant difference in mortality between the two groups (Table 4). Eleven patients in the elderly group developed metastasis, and 21 patients in the young group developed metastasis. There was no significant difference between the two groups. No case in each group suffered port-site metastasis. There was no difference in recurrence patterns between the two groups.

The 5-year OS were 67% and 71% in the elderly and younger group respectively. There was no significant difference of OS between the two groups (p=0.846) (Figure 1). Multivariate analysis identified pathological T_3/T_4 and pathological N_2 as independent prognostic factors for OS (Table 5). The 5-year DFS was 59% in the elderly group,

Table 2. Perioperative and postoperative outcomes of the two groups

Outcomes	*Elderly (n=54)*	*Younger (n=98)*	*P value*
Operative time (min)	220 (160-280)	200 (150-260)	0.324
Blood loss (ml)	170 (140-440)	150 (110-380)	0.097
Conversion to open surgery	2	2	1.000
Bleeding	1	2	
Adhesion	1	0	
Blood transfusion	2	3	1.000
Postoperative hospital stay (d)	10 (6-19)	9 (5-21)	0.327
Post-operative complications	13	15	0.182
Major complications	1	2	1.000
Minor complications	12	13	
Postoperative 30-day death	0	0	-

Table 3. Pathological data of the two groups

Pathological data	*Elderly (n=54)*	*Younger (n=98)*	*P value*
Pathological stage (pTNM)			0.537
I	19	39	
II	18	32	
III	17	27	
Lymph nodes resected	19 (14-28)	21 (15-31)	0.128
Histologic differentiation			0.980
Well	22	39	
Moderate	14	27	
Poor	18	32	
Residual tumor (R0/R1/R2)	54/0/0	98/0/0	1.000

Table 4. Long-term outcomes of the two groups

Outcomes	*Elderly (n=54)*	*Younger (n=98)*	*P value*
Tumor recurrence	11	21	0.878
Locoregional	4	6	
Systemic	6	13	
Mixed	1	2	
Time to first recurrence (months)	24 (20-40)	27 (10-42)	0.417
Mortality	9	17	0.807
Died of cancer	8	16	
Died of non-cancer-related diseases	1	1	

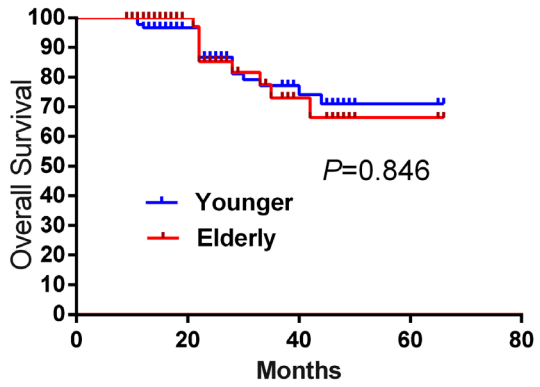

Figure 1. Comparison of overall survival rate between elderly and younger group. There was no significant difference between the two groups (p=0.846).

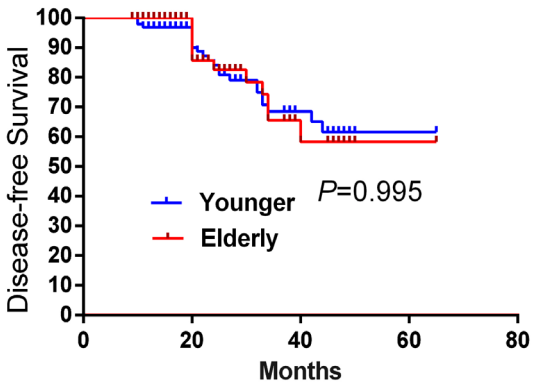

Figure 2. Comparison of disease-free survival rate between the elderly and younger group. There was no significant difference between the two groups (p=0.995).

Table 5. Multivariate analysis of overall survival

Regression variables	*Adjusted hazard ratio*	*95% CI*	*P value*
Pathological T stage			
T_1-T_2	1.00		
T_3-T_4	3.41	1.54–7.55	0.015
Pathological N stage			
N_0-N_1	1.00		
N_2	1.94	1.24–3.04	0.034

Table 6. Multivariate analysis of disease-free survival

Regression variables	*Adjusted hazard ratio*	*95% CI*	*P value*
Pathological N stage			
N_0-N_1	1.00		
N_2	2.54	1.43–4.44	0.025
Differentiation grade			
Well–Moderate	1.00		
Poor	2.08	1.59–2.72	0.038

compared to 62% in the younger group (p=0.995) (Figure 2). Multivariate analysis identified pathological T_3/T_4 and poor cancer differentiation grade as independent prognostic factors for DFS (Table 6).

Discussion

To the best of our knowledge, there are relatively few studies on the safety and efficiency of laparoscopic CME in the treatment of colon cancer in the elderly. To date, this study is the first study to evaluate the short- and long-term outcomes of laparoscopic CME in the treatment of colon cancer in English literature. This study shows that laparoscopic CME treatment of colon cancer can achieve the same surgical and survival benefits compared with younger patients. For elderly colon cancer patients, age is not a contraindication to laparoscopic CME.

In our study, we found that there are some differences in demographic and baseline characteristics between elderly patients and young patients. First, the median age of the elderly group was 12 years older than the younger group. Second, the two groups differed in their distribution in medical diseases. As shown in Table 1, the CCI score >3 was higher for the elderly.

In this study, we found no statistically significant differences in the overall postoperative complications and major complications between the elderly and younger groups [27,28]. In this study, the trend of non-surgical complications in the elderly group was higher, which might be due to

the significant difference in expected CCI scores in elderly patients with decreased body function and physical activity. Therefore, when performing laparoscopic CME in the elderly, more attentions should be paid to physical conditions, comorbidities and organ function, rather than age.

Previous studies have reported that perioperative mortality from open colon colectomy in elderly colon cancer patients ranged from 1.0% to 5.6% [29,30]. However, our results show that the perioperative mortality of laparoscopic CME in the elderly is zero, which may be related to the reduction of blood loss and the minimally invasive features of laparoscopic surgery [31-34].

Whether laparoscopic CME treatment of colon cancer long-term outcome is affected by age is a key issue to be addressed in this study, so this study analyzed DFS and OS. We found similar survival outcomes in elderly and young patients. Although the elderly group had a higher CCI score and was 10 years older, the long-term outcome of older patients was not affected.

Epidemiological data shows that the proportion of cases involving colon cancer associated with colorectal cancer is gradually increasing every year, with surgical specifications and quality control problems attracting increased attention from Chinese and overseas experts [6]. Study data dating back 30 years show that the prognosis of colon cancer is significantly better than that of rectal cancer because the colon is anatomically simple and surgical manipulations are easy [6-9]. However, recent studies showed that the 5-year survival rate for rectal cancer has approached that for colon cancer [6-9]. One of the reasons for this is the effects of neoadjuvant chemoradiotherapy in patients with rectal cancer. Another reason is the widespread implementation of total mesorectal excision for rectal cancer, which lowers the recurrence rate and increases survival. Hohenberger et al also proposed the concept of CME as a standardized surgical operation for colon cancer on the basis of the embryonic anatomy [35]. The surgery includes the following key points: (1) sharp dissection of the visceral and parietal fascia and complete resection of the mesentery along the anatomic plane of embryonic development; (2) determination of the intestinal area to be excised from the number of main colic arteries; and (3) complete exposure of the primary central vessels above the root with ligation at a superior position [35,36]. In CME, surgical resection is performed along the anatomic plane of embryonic development, which is scientific and conforms to clinical development directions. This has provided a foundation for the establishment of a quality control system for standardized colon cancer surgery [35]. Because the resection range in CME is larger than that in conventional surgery, some researchers questioned whether CME will increase the incidence of surgical complications and the associated mortality. A retrospective study in 2017 showed that the incidence of surgical complications and the mortality rate after CME were similar to those after non-CME surgery [37]. Another study conducted in 2018 [8], which was a prospective, nonrandomized, double-blind, controlled clinical study, enrolled 220 and 110 patients who underwent CME and non-CME, respectively. The results showed that CME can increase the survival rate for colon cancer without increasing the surgical complications. In the present study, the incidence of postoperative complications and the associated mortality rate are similar between the elderly and younger groups. In addition, the long-term follow-up results are similar between the two groups [8]. This fully demonstrates the safety and efficacy of laparoscopic CME for elderly patients with colon cancer.

Several limitations of this study must be considered, such as the retrospective analysis and limited size. The elderly operated group might suffer from selection bias for non-operated of minimal invasively treatment population was missing. Furthermore, the results of this study only came from a single specialized center, so the results may not be generalized to the whole population.

Conclusion

This study showed that laparoscopic CME treatment of old colon cancer patients can achieve the same surgical and survival benefits compared with younger patients. For elderly colon cancer patients, age is not a contraindication to laparoscopic CME.

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Conflict of interests

The authors declare no conflict of interests.

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