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ORIGINAL ARTICLE

Comparison of laparoscopic complete mesocolic excision and traditional radical operation for colon cancer in the treatment of stage III colon cancer

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Summary

Purpose: *To compare the clinical efficacy and safety between laparoscopic complete mesocolic excision (CME) and traditional radical operation for colon cancer in the treatment of stage III colon cancer.*

Methods: *A total of 196 patients with stage III colon cancer treated in out hospital from January 2014 to February 2016 were selected and divided into two groups using a random number table. One group (CME group, n=98) received laparoscopic CME, while another group (Traditional group, n=98) underwent traditional radical operation for colon cancer. The surgery-related indexes and perioperative complications were compared between the two groups, the pathological diagnosis of the patient's surgical specimens was recorded, and the survival of all patients was followed up.*

Results: *The general clinical characteristics of the patients were comparable between the two groups, and no perioperative death occurred. The operation time had no statistically significant difference between the two groups (p=0.190). There was overtly less intraoperative blood loss and shorter postoperative hospital stay in the CME group than those in the Traditional group (129.35±34.54 mL vs. 162.43±38.16 mL, p<0.001, 13.8±3.1 days vs. 15.2±3.4 days, p=0.003). There were no statistically significant differences in the indwelling time of drainage tube after operation, the time of liquid diet after operation and the recovery time of normal diet after operation between the two groups (p>0.05). The time for passage of flatus after operation was significantly shorter in the CME group than that in the Traditional group (p=0.016). The incidence rate of postoperative complications was lower in the CME group (12.2%) than that in the Traditional group (17.3%), but the difference was not statistically significant (p=0.421). The comparisons of surgical specimens revealed that there were no statistically significant differences in tumor size, stage, histopathological classification and differentiation grade between the two groups (p>0.05). The number of lymph nodes dissected and the number of positive lymph nodes detected were clearly greater in the CME group than in the Traditional group (p<0.001). At the end of the follow-up, the overall survival rate and tumor-free survival rate were notably higher in the CME group than in the Traditional group (p=0.046, p=0.038).*

Conclusion: *In comparison with traditional radical operation for colon cancer, laparoscopic CME has higher yield of lymph nodes dissected, smaller intraoperative blood loss, no increase in perioperative complications, and higher overall survival and tumor-free survival of patients, demonstrating it as safe and applicable in the treatment of stage III colon cancer.*

Key words: *laparoscope, complete mesocolic excision, radical operation for colon cancer, colon cancer, efficacy*

Introduction

Colon cancer is a common malignant tumor of the digestive tract, with relatively severe symptoms in stage III, seriously threatening the life and health of patients [1]. Traditional radical operation for colon cancer has such shortcomings as large intraoperative blood loss and slow postoperative recovery, restricting its application in clinical practice [2,3].

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The survival rate of patients with rectal cancer has been significantly improved in the past 3 decades compared with that of patients with colon cancer as the concept of total mesorectal excision (TME) is put forward [4]. The concept of TME proposed by Heald et al in 1982 becomes the globally recognized gold standard for rectal cancer surgery. TME can evidently decrease the local recurrence rate of rectal cancer and notably enhances the 5-year survival rate of patients [5-7]. However, no consensus has been achieved on the surgical methods for colon cancer for decades, leading to uncontrolled quality of surgery. Based on the principles of embryology and anatomy of TME, Hohenberger et al proposed the concept of complete mesocolic excision (CME) in 2009. CME refers to sharp dissociation of the fascial space between the visceral layer and the parietal layer of the colon, maintenance of the integrity of the visceral layer fascia of the colon, and ligation of the corresponding vessels at the root of the mesentery, so as to dissect regional lymph nodes to an extreme and suppress the spread of abdominal tumors, thereby remarkably improving the prognosis of patients with colon cancer [8,9]. As a result, the concept of CME is quickly accepted by the surgical community in China and foreign countries. In this study, surgery-related indexes, perioperative complications and survival of patients followed up were analyzed and compared between laparoscopic CME and traditional radical operation for colon cancer, with the latter as a control, so as to explore the clinical efficacy and safety of CME in the treatment of stage III colon cancer, providing a basis for the selection of surgical methods for patients with stage III colon cancer.

Methods

General data

A total of 196 patients with stage III colon cancer treated at out hospital from January 2014 to February 2016 were selected as subjects and divided into two groups to separately receive laparoscopic CME (CME group, n=98) and traditional radical operation for colon cancer (Traditional group, n=98) using a random number table. All patients were definitely diagnosed with colon cancer by preoperative biopsy. As per the 2002 American Joint Committee on Cancer (AJCC)/UICC staging criteria, they were in stage III. They were aged 18-80 years and satisfied surgical indications.

Exclusion criteria: Patients with distant organ metastasis, history of abdominal surgery or severe immune system or blood system diseases, or complicated by heart or lung dysfunction. This study was approved by the Ethics Committee of Gansu Provincial Hospital. All patients enrolled complied with the Declaration of Helsinki, were informed of this study and signed the informed consent. In the CME group, there were 57 males and 41 females aged 39-74 (mean 59.48±10.13), 45 cases of right colon cancer and 53 cases of left colon cancer, and 88 cases of grade II and 10 cases of grade III preoperative American Society of Anesthesiologists (ASA) score, and the body mass index (BMI) index was 24.2±3.1 kg/m^2. The Traditional group included 63 males and 35 females aged 37-76 years (mean 60.72±9.86), 51 cases of right

Table 1. Baseline demographic and clinical characteristics of the studied patients

Characteristics	*CME group n=98*	*Traditional group n=98*	*p value*
Age, years, mean±SD	59.48±10.13	60.72±9.86	0.386
Gender, n (%)			0.464
Male	57 (58.2)	63 (64.3)	
Female	41 (41.8)	35 (35.7)	
BMI (kg/m^2), mean±SD	24.2±3.1	24.9±3.4	0.134
Tumor location, n (%)			0.475
Left colon	53 (54.1)	47 (48.0)	
Right colon	45 (45.9)	51 (52.0)	
ASA score, n (%)			0.514
I	0 (0)	0 (0)	
II	88 (89.8)	84 (85.7)	
III	10 (10.2)	14 (14.3)	
Histologic type, n (%)			0.538
Adenocarcinoma	66 (67.3)	73 (74.5)	
Mucinous adenocarcinoma	25 (25.5)	20 (20.4)	
Undifferentiated carcinoma	7 (7.2)	5 (5.1)	

CME: Complete mesocolic excision; BMI: body mass index; ASA: American Society of Anesthesiologists

colon cancer and 47 cases of left colon cancer, and 84 cases of grade II and 14 cases of grade III preoperative ASA score, with a mean BMI index of 24.9±3.4 kg/m^2. Patients in the CME group underwent laparoscopic CME, while those in Traditional group were subjected to traditional radical operation for colon cancer. There were no statistically significant differences in the gender, age, BMI, ASA score, histological type and tumor location between the two groups (p>0.05), and these data were clinically comparable (Table 1).

Surgical methods

CME: Patients were subjected to tracheal intubation and general anesthesia and laid in supine position with arms and legs open or in the improved lithotomy position. The middle approach and 4-hole operation method were adopted. For patients in the control group, an abdominal midline incision was made, followed by separation according to the vascular anatomical landmarks and high ligation of the central vessel. Next, the ileocolic blood vessel, the gastrocolic venous trunk and the right branch of the middle colon artery were divided from the root of blood vessels, and mesenteric lymphoid tissues were dissected. Sharp dissociation was performed along the avascular region between the visceral layer and the parietal layer around the mesocolon to completely peel off and remove the visceral layer fascia around the tumor, blood vessels and lymph nodes. For patients with right colon cancer, the Kocher approach was used, with sharp separation of the visceral layer fascia covering the pancreas and mesentery and the parietal layer fascia covering the retroperitoneal tissue to the superior mesenteric vessels, while for those with left colon cancer, the visceral layer fascia covering the descending colon and sigmoid colon and the parietal layer fascia covering the perirenal fat and ureter were sharply separated. The intestinal and mesangial tissues were removed *en bloc*, and the digestive tract was reconstructed using a stapler.

Traditional radical operation for colon cancer: The abdominal cavity was routinely explored (intraoperative colonoscopy was conducted in case of difficulty in locating the tumor) to help the surgeon understand the lesion and initially determine the resection extension of the lesion. The colon was separated along the fascial space to the root of the mesentery, and the lymph nodes around the root of blood vessels were dissected. Extended resection required dissociation along the abdominal aorta and its branches as well as the superior mesenteric vein, which was generally not performed if there were no obviously enlarged lymph nodes in the root of the mesentery. The lymph nodes resected were sorted and counted. The anastomosis was completed routinely.

Observation indexes

Perioperative indicators included operation time, intraoperative blood loss, time for passage of flatus after operation, time of liquid diet after operation, recovery time of normal diet after operation, indwelling time of drainage tube after operation, postoperative hospital stay and perioperative complications. Complications during postoperative hospital stay mainly included respiratory infection, abdominal infection, incision infection, anastomotic leakage, intestinal obstruction and deep vein thrombosis.

Postoperative pathological conditions referred to the size, pathological stage and differentiation grade of tumors, number of lymph nodes resected, number of positive lymph nodes detected, and presence or absence of neurovascular invasion.

Postoperative tumor recurrence rate and survival

After operation, patients were followed up via outpatient visits and telephone contacts at 1, 2, 3, 4, 5, 6, 9 and 12 months after discharge. During the first 2 postoperative years, re-examination was done every 3 months, including signs and symptoms of the abdomen, defecation and urine, blood routine and carcinoembryonic antigen detection, abdominal B-ultrasound or chest and abdomen enhanced CT examination, and electronic colonoscopy was conducted once a year (whole-body PET-CT examination was performed if necessary). From the 3rd to the 5th postoperative year, re-examination was conducted every six months. The follow-up ended in February 2019.

Statistics

SPSS 22.0 (IBM, Armonk, NY, USA) was used for statistical analyses. Measurement data were expressed as mean ± standard deviation (x±s), and t-test was employed for comparison between groups. Enumeration data were expressed as ratio (%), and x^2 test was used for comparison between groups. P<0.05 suggested that the difference was statistically significant. The Kaplan-Meier method was applied to plot survival curves, and log-rank test was utilized to compare the survival rate between the two groups to determine whether there was a statistically significant difference (p<0.05 indicated a statistically significant difference).

Results

Comparisons of surgery-related indicators

The operation time was 163.67±36.43 min and 170.28±33.87 min in the two groups, showing no statistically significant difference (p=0.190). The CME group had overtly lowered intraoperative blood loss and shortened postoperative hospital stay (129.35±34.54 mL and 13.8±3.1 days) in comparison with the Traditional group (162.43±38.16 mL and 15.2±3.4 days, p<0.001, p=0.003). The postoperative catheter drainage time displayed no statistically significant difference between the two groups (8.9±1.8 days vs. 9.3±1.7 days, p=0.111). The time for passage of flatus after operation was significantly shorter in the CME group than that in Traditional group (4.2±1.1 days vs. 4.6±1.2 days, p=0.016). Besides, there were no statistically significant differences in the time of liquid diet after operation and the recovery time of normal diet

after operation between the two groups (5.9±0.5 days vs. 6.1±0.6 days, p=0.112 and 8.0±0.5 days vs. 8.2±0.6 days, p=0.121) (Table 2).

Comparisons of perioperative complications

The incidence rate of postoperative complications was lower in the CME group (12.2%) than that in the Traditional group (17.3%), but the difference was not statistically significant (p=0.421). After operation, there was 1 case (1.0%) and 1 case (1.0%) of incision infection, 3 cases (2.8%) and 4 cases (4.1%) of pulmonary infection, 1 case (1.0%) and 2 cases (2.0%) of abdominal infection, 3 cases (3.1%) and 4 cases (4.1%) of anastomotic leakage, 3 cases (3.1%) and 5 cases (5.1%) of intestinal obstruction and 1 case (1.0%) and 1 case (1.0%) of deep venous thrombosis in the CME group and Traditional group, respectively. The specific perioperative complications are shown in Table 2.

Comparisons of pathological conditions of surgical specimens (Table 3)

The tumor diameter was 5.6±0.4 cm and 5.7±0.4 cm in the two groups, respectively, and the difference was not statistically significant (p=0.082). The number of lymph nodes dissected was 24.9±3.5 in the CME group and 17.3±3.1 in the Traditional group, and the former was clearly greater than the latter (p<0.001). The number of positive lymph nodes was significantly higher in the CME group

Table 2. Comparison of perioperative data and postoperative recovery parameters of the studied patients in two different groups

Characteristics	*CME group n=98*	*Traditional group n=98*	*p value*
Operation time (min), mean±SD	163.67±36.43	170.28±33.87	0.190
Blood loss (mL), mean±SD	129.35±34.54	162.43±38.16	0.001
Hospital stay after surgery (days), mean±SD	13.8±3.1	15.2±3.4	0.003
Postoperative catheter drainage time (days), mean±SD	8.9±1.8	9.3±1.7	0.111
Gas passage after surgery (days), mean±SD	4.2±1.1	4.6±1.2	0.016
Liquid diet after surgery (days), mean±SD	5.9±0.5	6.1±0.6	0.112
Normal diet after surgery (days), mean±SD	8.0±0.5	8.2±0.6	0.121
Complications, n (%)	12 (12.2)	17 (17.3)	0.421
Incision infection	1 (1.0)	1 (1.0)	
Pulmonary infection	3 (3.1)	4 (4.1)	
Intraperitoneal infection	1 (1.0)	2 (2.0)	
Anastomotic leakage	3 (3.1)	4 (4.1)	
Ileus	3 (3.1)	5 (5.1)	
Deep venous thrombosis	1 (1.0)	1 (1.0)	

Table 3. Pathological tumor characteristics of the two groups

Characteristics	*CME group n=98*	*Traditional group n=98*	*p value*
Tumor diameter (cm), mean±SD	5.6±0.4	5.7±0.4	0.082
Lymph node dissection, mean±SD	24.9±3.5	17.3±3.1	0.001
Lymph node positive number, mean±SD	19.6±3.7	15.9±2.8	0.001
Nerve & vessel invasion, n (%)	46 (46.9)	53 (54.1)	0.320
Tumor differentiation, n (%)			0.871
Well	17 (17.3)	19 (19.4)	
Moderate	74 (75.5)	70 (71.4)	
Poorly/ Undifferentiated	8 (7.0)	9 (9.2)	
T stage, n (%)			0.437
T2	10 (10.2)	13 (13.3)	
T3	63 (64.3)	67 (68.4)	
T4	25 (25.5)	18 (18.4)	

CME: complete mesocolic excision

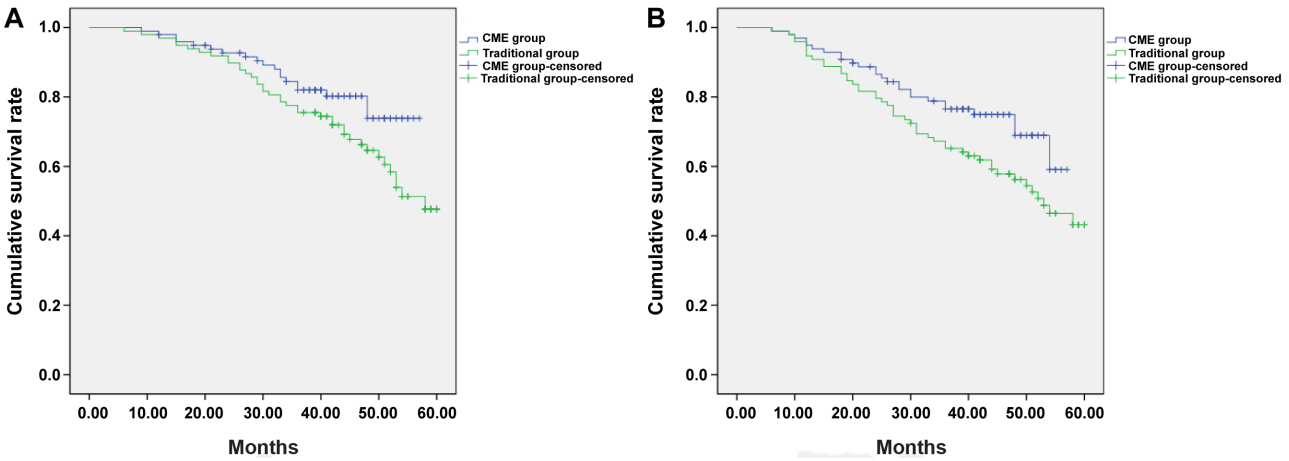

Figure 1. Kaplan-Meier survival curves of patients in the CME group and the Traditional group. **A:** The overall survival rate of patients in the CME group was significantly higher compared with that of the Traditional group (p=0.046). **B:** The tumor-free survival rate of patients in the CME group was significantly higher compared with that of the Traditional group (p=0.038).

than that in the Traditional group (19.6±3.7 vs. 15.9±2.8, p<0.001). There was no statistical difference in neurovascular invasion between the two groups (p=0.320). Biopsies of tumor tissues showed that there were 66 cases (67.3%) and 73 cases (74.5%) of adenocarcinoma, 25 cases (25.5%) and 20 cases (20.4%) of mucinous adenocarcinoma, 7 cases (7.2%) and 5 cases (5.1%) of undifferentiated carcinoma, 17 cases (17.3%) and 19 cases (19.4%) of highly-differentiated carcinoma, 74 cases (75.5%) and 70 cases (71.4%) of moderately-differentiated carcinoma, and 8 cases (7.0%) and 9 cases (9.2%) of poorly-differentiated carcinoma in the two groups, respectively, displaying no statistically significant differences (p=0.871). As to tumor T stage, there were 10 cases (10.2%) and 13 cases (13.3%) of stage II tumor, 63 cases (64.3%) and 67 cases (68.4%) of stage III tumor, and 25 cases (25.5%) and 18 cases (18.4%) of stage IV tumor, without statistically differences (p=0.437) (Table 2).

Survival

The patients were followed up for 6-60 months (40.8±8.8 months and 42.3±9.6 months on average in the CME group and the Traditional group, respectively). In the CME group, 2 patients were lost to follow-up (at 12 and 21 months after operation). In the Traditional group, 4 patients were lost to follow-up (at 37, 39, 41 and 50 months after operation). During follow-up, the 1-year overall survival rate in the two groups was 97.9% (94/96) and 96.8% (91/94), respectively, and the corresponding tumor-free survival rate was 94.8% (91/96) and 91.5% (86/94), respectively (p=0.036). The 2-year overall survival and tumor-free survival rates were 91.7% (88/96) and 86.5% (83/96) in the CME group and 89.4% (84/94) and 78.7% (74/94) in the Traditional group, respectively (p<0.001). The 3-year overall survival and tumor-free survival rates were 81.6% (80/96) and 77.1% (74/96) and 74.5% (70/94) and 63.8% (60/94) in the two groups, respectively (p<0.001). Kaplan-Meier plots, and the log-rank test performed revealed that the CME group had markedly increased overall survival and tumor-free survival rates in comparison with the Traditional group, and the differences were statistically significant (p=0.046, p=0.038) (Figure 1).

Discussion

Since 1991 when the world's first laparoscopic colorectal carcinoma surgery was carried out by Jacobs et al, laparoscope-assisted radical operation for colon cancer has become a common surgical approach in the treatment of this disease [10]. Many studies in China and abroad have proven that laparoscopic radical operation for colon cancer is capable of reaching the criteria for radical resection of tumors in laparotomy [11,12]. CME is a new treatment method with obvious efficacy in the clinic, shortened postoperative recovery time and lowered death rate of patients, providing more options for effective therapies of patients with colon cancer [13,14]. Its core principle is to thoroughly expose the root of blood vessels supplying energy to the colon, followed by high ligation of the root of blood vessels and rational disposal of the corresponding part of the colon based on the metastasis method of lymph nodes and the exact location of tumors [15].

Lymph node metastasis is an independent factor determining the prognosis of locally advanced colon cancer. Increasing the number of lymph

nodes dissected in the operation is essential to ensure the accurate pathological stage [16]. In particular, for patients with stage II and III, the number of lymph nodes dissected is positively correlated with prognosis [17]. One of the essentials of CME is to completely remove the mesocolon within the visceral layer fascia along the lymph node reflux route in the tumor area, so as to obtain the maximum number of lymph nodes dissected. Since lymph nodes spread along the corresponding arteries, high ligation of the central vessel maximizes the number of lymph nodes obtained, except advanced cancer with distant metastasis. West et al [18] compared 49 patients with CME with 40 patients undergoing traditional radical operation for colon cancer and discovered that the number of lymph nodes dissected was raised with the increase in the resection area and integrity of the mesocolon. The same result was found in this study. In patients with stage III colon cancer, the number of both lymph nodes dissected and positive lymph nodes detected was increased in the CME group compared with that in the Traditional group ($p<0.001$), the operation time displayed no statistically significant difference ($p=0.190$), and the intraoperative blood loss was significantly lower in the CME group than in the Traditional group ($p<0.001$), which might be caused by the complex colon vascular anatomy and variation. Based on the principle of separation along anatomical layers of the embryo, CME not only removes the mesentery more completely and dissects more lymph nodes, but also brings less damage to peripheral blood vessels and nerves. However, traditional radical operation cannot completely resect the mesentery due to unclear anatomical layers and has largely increased risk of bleeding because of the complicated vascular structure.

Previous studies and reports have demonstrated that CME has a larger area of resection and an increased number of lymph nodes dissected, without increase in the incidence rate of postoperative complications [19,20]. In this study, it was found that the incidence rate of postoperative complications was lower in the CME group than in the Traditional group (12.2 vs. 17.3%), but the difference was not statistically significant ($p=0.421$). Complications mainly included postoperative infection, anastomotic leakage and intestinal obstruction. No statistically significant differences were detected in the time of liquid diet after operation and the recovery time of normal diet after operation between the two groups ($p>0.05$), but the hospital stay in the CME group was significantly shorter than in the Traditional group ($p=0.003$), probably because CME separates along anatomical layers of the embryo and thus brings no damage to surrounding organs, blood vessels and nerves, thereby improving the safety of the operation and reducing the trauma to the abdominal cavity of patients.

In addition to ensuring the integrity of the mesentery, CME is able to completely remove the mesocolon in a relatively large area and increase the number of lymph nodes dissected. Therefore, it improves the prognosis of patients with colon cancer and reduces the local recurrence rate. West et al studied 399 patients with colon cancer undergoing surgical resection in 1997-2002 and found that the 5-year overall survival rate of patients receiving CME was clearly elevated by 15%, especially of those with stage III colon cancer [21]. This study revealed that the 3-year overall survival and tumor-free survival rates were 81.6% (80/96) and 77.1% (74/96) as well as 74.5% (70/94) and 63.8% (60/94) in the two groups, respectively. The overall survival and tumor-free survival rates were statistically different between the two groups ($p=0.046$, $p=0.038$), and they were notably higher in the CME group than in the Traditional group.

Currently, a previous single-center retrospective study suggested that CME plays a positive role in improving the prognosis of patients with colon cancer [22]. However, whether CME is an independent factor influencing the prognosis of colon cancer is still inconclusive. Whether the exposure of the superior mesenteric artery root through routine method as well as the vena cava and the abdominal aorta via routine Kocher incisions is necessary during CME needs to be confirmed through a multicenter prospective randomized controlled trial with a large sample size.

Conclusions

Laparoscopic CME yields more lymph nodes dissected, smaller intraoperative blood loss, and higher overall survival rate and tumor-free survival rate than traditional radical operation for colon cancer, without increasing the perioperative complications, and is a safer and feasible therapeutic approach for the treatment of stage III colon cancer.

Conflict of interests

The authors declare no conflict of interests.

References

1. Altundag K. Which nut fights stage III colon cancer better? J BUON 2018;23:1204.
2. Zheng Z, Hanna N, Onukwugha E, Bikov KA, Mullins CD. Hospital center effect for laparoscopic colectomy among elderly stage I-III colon cancer patients. Ann Surg 2014;259:924-9.
3. Shoar S, Mahmoodzadeh H, Shoar N, Geilser DP. Single-Incision Laparoscopic Colectomy with Complete Mesocolic Excision Versus Multiport Laparoscopic Colectomy for Colon Cancer. Dis Colon Rectum 2017;60:e631.
4. Bulow S, Harling H, Iversen LH, Ladelund S. Improved survival after rectal cancer in Denmark. Colorectal Dis 2010;12:e37-e42.
5. Heald RJ, Husband EM, Ryall RD. The mesorectum in rectal cancer surgery--the clue to pelvic recurrence? Br J Surg 1982;69:613-6.
6. Enker WE. Total mesorectal excision--the new golden standard of surgery for rectal cancer. Ann Med 1997;29:127-33.
7. Siegel R, Naishadham D, Jemal A. Cancer statistics, 2013. CA Cancer J Clin 2013;63:11-30.
8. Yue M, Wang Y, Kang ZH, Wang X, Weing L. Short- and long-term outcomes of laparoscopic complete mesocolic excision for transverse colon cancer. JBUON 2018;23:950-7.
9. Li J, Yudong L, Chen Y. Short- and long-term outcomes of laparoscopic complete mesocolic excision in elderly patients with right colon cancer. JBUON 2018;23:1625-32.
10. Jacobs M, Verdeja JC, Goldstein HS. Minimally invasive colon resection (laparoscopic colectomy). Surg Laparosc Endosc 1991;1:144-50.
11. Guillou PJ, Quirke P, Thorpe H et al. Short-term endpoints of conventional versus laparoscopic-assisted surgery in patients with colorectal cancer (MRC CLASICC trial): multicentre, randomised controlled trial. Lancet 2005;365:1718-26.
12. Fleshman J, Sargent DJ, Green E et al. Laparoscopic colectomy for cancer is not inferior to open surgery based on 5-year data from the COST Study Group trial. Ann Surg 2007;246:655-62, 662-4.
13. Bertelsen CA, Neuenschwander AU, Jansen JE et al. Disease-free survival after complete mesocolic excision compared with conventional colon cancer surgery: a retrospective, population-based study. Lancet Oncol 2015;16:161-8.
14. Siani LM, Pulica C. Laparoscopic complete mesocolic excision with central vascular ligation in right colon cancer: Long-term oncologic outcome between mesocolic and non-mesocolic planes of surgery. Scand J Surg 2015;104:219-26.
15. Hohenberger W, Weber K, Matzel K, Papadopoulos T, Merkel S. Standardized surgery for colonic cancer: complete mesocolic excision and central ligation--technical notes and outcome. Colorectal Dis 2009;11:354-364, 364-365.
16. Ong ML, Schofield JB. Assessment of lymph node involvement in colorectal cancer. World J Gastrointest Surg 2016;8:179-92.
17. Albandar MH, Cho MS, Bae SU, Kim NK. Surgical management of extra-regional lymph node metastasis in colorectal cancer. Expert Rev Anticancer Ther 2016;16:503-13.
18. West NP, Hohenberger W, Weber K, Perrakis A, Finan PJ, 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;28:272-8.
19. Emmanuel A, Haji A. Complete mesocolic excision and extended (D3) lymphadenectomy for colonic cancer: is it worth that extra effort? A review of the literature. Int J Colorectal Dis 2016;31:797-804.
20. Bertelsen CA, Bols B, Ingeholm P, Jansen JE, Neuenschwander AU, Vilandt J. Can the quality of colonic surgery be improved by standardization of surgical technique with complete mesocolic excision? Colorectal Dis 2011;13:1123-9.
21. West NP, Morris EJ, Rotimi O, Cairns A, Finan PJ, Quirke P. Pathology grading of colon cancer surgical resection and its association with survival: a retrospective observational study. Lancet Oncol 2008;9:857-65.
22. Gouvas N, Pechlivanides G, Kafousi M, Xunos E. Complete mesocolic excision in colon cancer surgery: a comparison between open and laparoscopic approach. Colorectal Dis 2012;14:1537-64.