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ORIGINAL ARTICLE

Laparoscopic and conventional left hemicolectomy in colon cancer

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Summary

Purpose: *This study aimed to compare the efficacy of laparoscopic and conventional left hemicolectomy for treating colon cancer and their effects on stress response and quality of life of patients.*

Methods: *92 patients with colon cancer were selected. Forty three patients in the study group were treated with laparoscopic left hemicolectomy, and 49 patients in the control group were treated with conventional left hemicolectomy. The surgery, postoperative recovery, intraoperative and postoperative complications were compared between the two groups. The enzyme-linked immunosorbent assay (ELISA) was used to detect the levels of IL1β and IL-6. The quality of life of patients after surgery was analyzed by the Functional Assessment of Cancer Therapy-Lung (FACT-L).*

Results: *The operation time and intraoperative blood loss of the study group were statistically lower than those of the control group (p<0.05). The postoperative exhaust time and hospitalization time of the study group were statistically shorter than those of the control group (p<0.05). Serum IL-1β and IL-6 levels in the study group were significantly lower than those in the control group (p<0.05). In the two groups, the overall scores of quality of life after surgery were significantly lower than those before surgery (p<0.05). After surgery, the overall score of quality of life in the study group was significantly higher than that in the control group (p<0.05).*

Key words: *colon cancer, efficacy, laparoscopy, left hemicolectomy, quality of life, stress response*

Introduction

Colon cancer is one of the most common human malignant tumors and the second leading cause of cancer-related death [1]. In 2012, the morbidity of colon cancer accounted for about 10% of all cancers and it is mainly induced by environmental factors, instead of genetic dysfunctions [2]. With heterogeneity results and a variety of potential pathological and molecular characteristics [3], colon cancer can also be influenced by gene mutations, diet, inflammation and intestinal microbiota [4]. It may also be caused by a low-fiber diet, alcohol abuse and heavy smoking [5]. Currently, colectomy is the standard surgical option for treating colon cancer [6].

Conventional open surgery for colon cancer resection can effectively remove cancer tissue. However, compared with laparoscopic surgery, its large wound area causes trauma to the organs in the abdominal cavity and the abdominal wall and brings more complications and longer recovery time. In recent years, laparoscopic surgery has been successfully applied in acute appendicitis and gallbladder diseases, and clinical researchers

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are making progress in applying this technology to other pathological diseases of the gastrointestinal tract [7]. Compared with conventional surgery, laparoscopic surgery ensures faster recovery rate of lung and gastrointestinal function for patients with cancer or polyps who are subjected to colorectal resection [8]. Laparoscope-assisted colon cancer resection is superior to traditional colon cancer resection, since it is safe and reliable and causes less pain and smaller amount of blood loss and patients recover fast after surgery. Therefore laparoscope-assisted colon cancer resection has been widely used in clinical practice [9,10].

Studies on the clinical efficacy of laparoscopic surgery and traditional open surgery are numerous, but studies on the postoperative stress response and the impact on postoperative quality of life (physical status, physical function, emotional status, social status, etc.) are few. This study compared the efficacy, postoperative stress response and quality of life between the two groups of colon cancer patients receiving laparoscopic surgery and conventional open surgery.

Methods

General information

A total of 92 patients with colon cancer admitted to Huashan Hospital, Fudan University, from January 2014 to March 2015 were collected. Among them, 43 patients were enrolled in the study group and treated with laparoscopic left hemicolectomy, and 49 patients were enrolled in the control group and treated with conventional left hemicolectomy. The study group consisted of 21 males and 22 females, aging from 45 to 80 years, with a mean age of 62.51±6.11 years. In the study group, 27 cases were at stage I and II and 16 at stage III; 31 cases were with high and moderate differentiation and 12 with poor differentiation. The control group consisted of 25 males and 24 females, aging from 50 to 75 years, with a mean age of 63.13±6.05 years. In the control group, 31 cases were at stage I and II and 18 were at stage III; 28 cases were with high and moderate differentiation and 21 with poor differentiation. This study was approved by the ethics committee of Huashan Hospital, Fudan University. The patients and their guardians were informed, and informed consent was signed by all of them.

Inclusion and exclusion criteria

Inclusion criteria: Patients in line with the National Comprehensive Cancer Network (NCCN) Clinical Practice Guidelines in Oncology [11]; patients at TNM stage I to III without distant metastases according to CT, color Doppler ultrasound, MRI, and other imaging examinations; patients with no history of chemotherapy or radiation therapy, diagnosed for the first time; patients aged from 45 to 80 years with no major organ dysfunction; patients with detailed clinical and pathological data.

Exclusion criteria: Patients with other malignant tumors, hematological disease, severe complications, immune system diseases, severe mental illness and poor treatment compliance, as well as patients unwilling to participate in the study.

Surgical methods

The study group: patients received intravenous and general anesthesia through tracheal intubation. The position of the patient was determined by the surgical methods and tumor positions. Generally, the modified lithotomy position or supine position was selected, and then an adjustment was required according to the surgical needs. The pneumoperitoneum pressure was set at about 12-15 mmHg (1 mmHg = 0.133 KPa). The 30-degree high-definition laparoscope entered the body through a 10 mm-sized observing hole 0.5 cm away from the umbilicus. The position of the main operation hole and the auxiliary operation hole were selected according to the lesion site. The 5-hole method was used for patients receiving laparoscopic surgery. The position of the surgeon was determined by the lesion sites, generally on the opposite side of the lesion, and could be changed during the operation if needed. The primary surgical assistance stood on the opposite side of the surgeon, and the camera holder stood on the same side of the surgeon; the nurse stood at the end of the operation bed, and the position of laparoscopic imaging system was adjusted according to the lesion sites. The 30-degree high-definition laparoscope was inserted into the abdominal cavity through the umbilicus to check whether the organs in the abdominal cavity had lesions, invasions, ascites, severe abdominal adhesion or tumor metastasis. The non-invasive intestinal clamp was used to determine the tumor site, then an examination was performed to check the lesion size, tumor adhesion to surrounding tissues, the severity of tumor adhesion, invasion of the serosa, metastasis to the mesenteric lymph node and distant metastasis.

The control group: for conventional laparotomy, general anesthesia and conventional tracheal intubation were performed before surgery. An incision was cut at the left or middle transabdominal rectus after routine disinfection. If severe intestinal obstruction was found, the small intestine should be decompressed first and the surgery should be in line with the principle of radical tumor resection. Then, the left colon was freely removed, followed by the single-barrel transversostomy. After 2 to 5 months, stoma reversion of colon was performed.

Outcome measures

1. The indicators of the perioperative period including the length of intraoperative incision, intraoperative blood loss and operation time of the two groups, as well as the postoperative exhaust time, postoperative pain time, hospitalization time, number of lymph node dissection, and postoperative complications were recorded.
2. The quality of life of patients before surgery and 6 months after the surgery was assessed using the FACT-L [12]. FACT-L contains 27 items, including physical

status, physical function, emotional status, social status and 5 grades were set for each item (the score ranges from 0 to 4 points, 0=no, 4=very much).

Determination of serum IL-1β and IL-6 levels

5 ml of fasting venous blood was taken from all patients before the operation, 1 day, 3 days, and 7 days after the surgery. The serum was separated by centrifugation at 5000 rpm for 15 min. ELISA was used to determine the level of IL-1β (Shanghai Yiji Industrial Co., Ltd., item number: FR4442) and IL-6 (Xiamen Yanke Biotechnology Co., Ltd., item number: EYK-DBHZ-19196). The serum was stored in a -80°C refrigerator and the determination was carried out in strict accordance with the ELISA kit instructions. The kits and samples were taken out from the refrigerator 30 min before the determination to make them return to the room temperature. The blank well, standard well, and sample well were set. Standard 0 (S0) (concentration=0) was added to blank well, and 50 µl of the standard of different concentrations was separately added to each standard well; 10 µl of the sample was added to the sample well. 40 µl of the sample dilution was added to the standard well and the sample well, and 100 µl of horseradish peroxidase (HRP)-labeled detection antibody was added to the standard well and the sample well. All wells were covered with a membrane and incubated at 37°C for 1 h. Then, the supernatant in each well was discarded to dry the wells, and this procedure was repeated 5 times. After that, 50 µl of substrate A working solution and 50 µl of substrate B working solution were added to each well and got mixed, and then the incubation was conducted at 37°C for 10-15 min in the dark. Finally, 50 µl of stop solution was added to each well, and a fully automated chemiluminescence enzyme-free analyzer (Beijing Qinye Yongwei Technology Co., Ltd. Item number: Diamond) was used to measure the optical density (OD) value of each well at a wavelength of 450 nm within 15 min. The IL-1β and IL-6 levels were calculated.

Statistics

Statistical analyses were performed using SPSS 19.0 (IBM Corp, Armonk, NY, USA). The count data were expressed with the case number/percentage [n (%)] and compared between two groups by the x^2 test. The measurement data were expressed with mean ± standard deviation and compared between two groups by the t-test. The comparison between data before and after the treatment within the group was performed by the paired t-test. The comparison between multiple time points within the group was performed by the Repeated Measures ANOVA. The pairwise comparison between any two-time points within the group was performed by the Bonferroni method. Statistical difference was set at $p<0.05$.

Results

General information

No statistical difference was observed between the study group and the control group in relation to gender, age, body mass index, smoking, drinking, exercise, TNM stage, cell differentiation and obstruction time ($p>0.05$) (Table 1).

Table 1. Comparison of general baseline data between the study group and the control group

Baseline data	*Study group (n=43) n (%)*	*Control group (n=49) n (%)*	*t/x^2*	*p*
Gender, n (%)			0.436	0.835
Male	21 (48.84)	25 (51.02)		
Female	22 (51.16)	24 (48.98)		
Age (years), mean±SD	62.51±6.11	63.13±6.05	0.488	0.627
Body mass index (kg/m^2), mean±SD	22.84±2.15	22.42±1.71	1.043	0.299
Smoking			0.722	0.396
Yes	19 (44.19)	26 (53.06)		
No	24 (55.81)	23 (46.94)		
Drinking			0.302	0.583
Yes	23 (53.49)	29 (59.18)		
No	20 (46.51)	20 (40.82)		
Exercise			0.051	0.821
Yes	15 (34.88)	16 (32.65)		
No	28 (65.12)	33 (67.35)		
TNM stage			0.002	0.963
Stage I and II	27 (62.79)	31 (63.27)		
Stage III	16 (37.21)	18 (36.73)		
Cell differentiation			2.225	0.136
High and moderate	31 (72.09)	28 (57.14)		
Poor	12 (27.91)	21 (42.86)		

Comparison of intraoperative conditions between the two groups

The incision length and intraoperative blood loss of the study group were significantly smaller than those of the control group (p<0.05). The operation time of the study group was significantly longer than that of the control group (p<0.05) (Table 2).

Comparison of postoperative recovery between the two groups

The postoperative exhaust time, postoperative pain time, and hospitalization time of the study group were statistically shorter than those of the control group (p<0.05). No significant difference was observed in the number of lymph node dissection between the two groups (p>0.05) (Table 3).

Comparison of postoperative complications between the two groups

The study group had 5 cases of incision infection (11.63%), 3 cases of urinary tract infection (6.98%), 3 cases of pulmonary infection (6.98%), 1 case of urinary retention (2.33%), but no anastomotic leakage. The control group had 8 cases of incision infection (16.33%), 7 cases of urinary tract

Table 2. Comparison of intraoperative conditions between the two groups (mean±SD)

Intraoperative conditions	*Study group (n=43)*	*Control group (n=49)*	*t*	*p*
Length of incision (cm)	6.5±1.6	17.8±2.9	22.690	<0.001
Intraoperative blood loss (ml)	120.7±11.4	138.3±15.7	6.077	<0.001
Operation time (min)	135.5±20.7	125.7±20.1	2.301	0.024

Table 3. Comparison of postoperative recovery between the two groups (mean±SD)

Factor	*Study group (n=43)*	*Control group n=(49)*	*t*	*p*
Postoperative exhaust time (day)	3.1±0.7	3.7±1.2	2.876	0.005
Postoperative pain time (day)	3.4±0.9	4.5±1.4	4.412	< 0.001
Hospitalization time (day)	6.7±1.5	8.2±2.1	3.892	0.002
Number of lymph node dissection (single lymph node)	23.2±3.4	21.9±4.3	1.593	0.115

Table 4. Comparison of postoperative complications between the two groups

Factor	*Study group (n=43) n (%)*	*Control group (n=49) n (%)*	x^2	*p*
Incision infection	5 (11.63)	8 (16.33)	0.417	0.519
Urinary tract infection	3 (6.98)	7 (14.29)	1.263	0.261
Pulmonary infection	3 (6.98)	5 (10.20)	0.301	0.584
Urinary retention	1 (2.33)	3 (6.12)	0.794	0.373
Anastomotic leakage	0 (0.00)	2 (4.08)	1.794	0.180

Table 5. Comparison of serum IL-1β level between the two groups before the operation, 1 day, 3 days, and 7 days after the operation (mean±SD, pg/ml)

Time	*Study group (n=43)*	*Control group (n=49)*	*t*	*p*
Before the operation	0.84±0.18	0.77±0.19	1.807	0.074
T_1	$1.85±0.55^{ab}$	$2.54±0.54^{a}$	6.062	$< 0.001^{cdc}$
T_3	$1.42±0.21^{ab}$	$1.56±0.39^{ab}$	2.101	0.038^{cdc}
T_7	$0.45±0.15^{ab}$	$0.66±0.21^{ab}$	5.449	$< 0.001^{cdc}$
F	164.000	282.900	-	-
P	< 0.001	< 0.001	-	-

^{a}p<0.05 when compared with data before the operation; ^{b}p<0.05 when compared with data at T1; ^{c}p<0.05 when compared with data at T3; ^{d}p<0.05 when compared with data of the control group infection (14.29%), 5 cases of pulmonary infection (10.20%), 3 cases of urinary retention (6.12%), and 2 cases of anastomotic leakage (4.08%). The study group was not significantly different from the control group in the incidence of complications (p>0.05) (Table 4).

Comparison of serum IL-1β and IL-6 levels between the two groups before the operation, 1 day, 3 days, and 7 days after the operation

Before surgery, no significant difference was seen between the study and the control group in serum IL-1β and IL-6 levels (p>0.05). One day, 3 days, and 7 days after surgery, serum IL-1β and IL-6 levels in the study group were significantly lower than those in the control group (p<0.05). The expression levels of IL-1β and IL6 in the two groups gradually decreased with time (p>0.05). (Tables 5 and 6, Figures 1 and 2).

Comparison of preoperative and postoperative quality of life between the two groups

In both groups, no significant difference was observed between preoperative condition and post-operative condition in the scores of physical status, physical function, emotional status, social status,

Table 6. Comparison of serum IL-6 level between the two groups before the operation, 1 day, 3 days, and 7 days after the operation (mean±SD, pg/ml)

Time	*Study group (n=43)*	*Control group (n=49)*	*t*	*p*
Before the operation	0.82±0.21	0.78±0.15	1.061	0.292
T_1	1.92±0.53[abcd]	3.64±0.61[abc]	14.340	<0.001
T_3	1.65±0.36[abcd]	2.07±0.19[abc]	7.118	<0.001
T_7	0.55±0.22[abcd]	0.96±0.21[abc]	9.138	<0.001
F	146.200	714.000	-	-
P	<0.001	<0.001	-	-

[a]p<0.05 when compared with data before the operation; [b]p<0.05 when compared with data at T1; [c]p<0.05 when compared with data at T3; [d]p<0.05 when compared with data of the control group

Table 7. Comparison of preoperative and postoperative quality of life between the two groups (mean±SD)

	Study group (n=43)				*Control group (n=49)*			
Physical status	18.39±2.79	19.13±1.99	1.416	0.161	18.37±2.58	18.07±2.03	0.639	0.524
Physical function	20.77±2.35	20.01±2.09	1.585	0.117	20.04±2.15	19.83±2.37	0.459	0.647
Emotional status	19.98±2.47	19.21±1.87	1.630	0.107	19.23±2.01	18.71±1.85	1.332	0.186
Social status	18.55±4.31	17.21±3.11	1.653	0.102	18.25±4.11	17.10±2.83	1.613	0.110
Additional status	25.05±5.32	23.17±4.05	1.844	0.069	23.98±4.23	22.87±3.21	1.463	0. 147
Overall status	102.74±7.24	98.73±5.11*	2.967	0.003	99.87±7.24	96.51±4.89	2.692	0. 008

*p<0.05 when compared with the control group after the operation

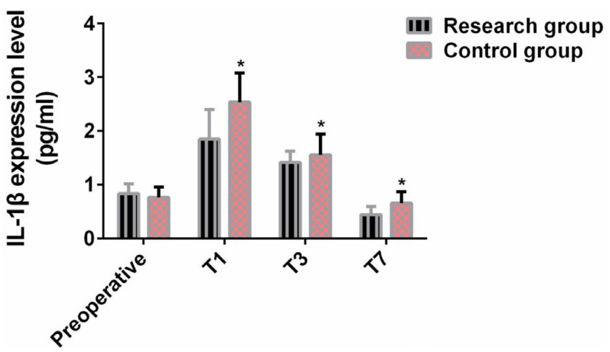

Figure 1. Comparison of serum IL-1β level between the two groups before the operation, 1 day, 3 days, and 7 days after the operation. According to the ELISA results, 1 day, 3 days, and 7 days after the surgery, serum IL1β level in the study group was significantly lower than that in the control group (*p<0.05).

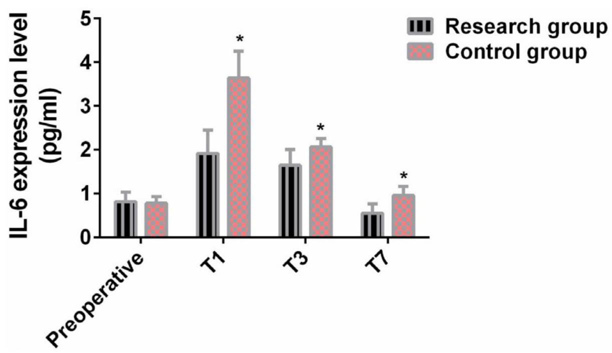

Figure 2. Comparison of serum IL-6 level between the two groups before the operation, 1 day, 3 days, and 7 days after the operation. One day, 3 days, and 7 days after the surgery, serum IL-6 level in the study group were significantly lower than that in the control group (*p<0.05).

and additional status ($p>0.05$). In both the study and the control group, the overall scores of quality of life after surgery were significantly lower than those before surgery ($p<0.05$). After surgery, the overall score of quality of life in the study group was significantly higher than that in the control group ($p<0.05$) (Table 7).

Discussion

Colon cancer, the third most common cancer worldwide [13], is a heterogeneous disease [14]. Each year about 1.2 million cases of colon cancer are reported and more than 600,000 patients die of it [12]. The morbidity of colon cancer ranks third in gastrointestinal tumors. People with chronic inflammation of the colon and bad eating and drinking habits are more likely to get colon cancer than the general population. Surgery is the main clinical treatment for colon cancer, such as conventional open surgery and laparoscopic surgery [15,16].

Both conventional open surgery and laparoscopic surgery can treat colon cancer. The prognosis of colon cancer is associated with postoperative recurrence and metastasis which are closely related to complete surgical resection [17]. Laparoscopic surgery for colon cancer, with lower recurrence rate and mortality than open surgery [18,19], is clinically safe and oncologically acceptable [20]. In the study by Bonjer et al [21], patients treated with laparoscopic surgery for colon cancer had a lower incidence of peripheral resection and a lower rate of local recurrence than patients undergoing open surgery. Laparoscopy has a better field of view than open surgery in a narrow space such as the pelvis, and a clear surgical view is crucial for performing the resection of cancer with sufficient margins. In the study by Chen et al [22], patients treated with laparoscopic surgery had less pain, shorter incision, less blood loss, shorter flatulence time, and shorter postoperative hospitalization time than patients treated with open surgery. In this study, the intraoperative blood loss and the length of the incision in the study group treated with laparoscopic surgery were significantly lower than those in the control group treated with traditional open surgery. The postoperative exhaust time and postoperative pain time in the study group were also significantly shorter than those in the control group, however, the operation time in the study group was longer than that of the control group because laparoscopic surgery involves more complex technical expertise. The clear sight of structures of vessels and nerves amplified by the laparoscope is conducive to the cleaning of lymph nodes and causes small damage to the blood vessels, while achieving the same treatment effect as the open surgery. These results fully reveal the advantages of laparoscopic surgery, similar to the results in the studies of Bonjer [21] and Chen [22]. No significant difference was observed between the two groups in the postoperative complications.

IL-1β and IL-6 are acute mediators involved in B cell stimulation. IL-6 level typically reaches its peak 2 h after the operation and thereafter rapidly declines in patients without postoperative complications [23]. Therefore, IL-1β and IL-6 can be used as objective biochemical markers reflecting the trauma severity of surgical tissues. In this study, no significant difference was observed in serum IL-1β and IL-6 levels between the two groups before surgery. Serum IL-1β and IL-6 levels were significantly increased in the two groups after surgery, and the postoperative IL-1β and IL-6 levels in the study group were significantly lower than those in the control group. IL-1β and IL-6 levels reached a peak on the first day after surgery and gradually returned to normal levels from the seventh day after surgery. The levels of these two indicators clearly suggest that laparoscopic surgery brings less interference to the immune function than the open surgery, which can be proved by the shorter postoperative hospitalization time of patients subjected to laparoscopic surgery.

Quality of life is an important reflection of the influencing factors of cancer, including the psychological status, physical status and social status. Doctors are attaching increasing importance to improving the quality of life of cancer patients, which has become an important criterion for tumor efficacy evaluation [24]. In the study by McCombie et al [25], patients with laparoscopic surgery for colon cancer had a better quality of life than those with open surgery, as well as better appetite, relieved insomnia, less pain, and better daily life. According to the half-year follow-up, in both groups, no significant difference was observed between preoperative and postoperative condition in the scores of physical status, physical function, emotional status, social status, and additional status. In both the study and the control group, the overall scores of quality of life after the surgery were significantly lower than those before surgery. After surgery, the overall score of quality of life in the study group was significantly higher than that in the control group. It is suggested that open surgery may impact the quality of life of colon cancer patients. Laparoscopic surgery has less influence on colon cancer patients than open surgery because it causes smaller trauma to patients.

The selection of subjects in this study was in strict accordance with the inclusion and exclusion criteria. This study is rigorous and reliable because the study group was not significantly different from the control group in gender, age, and other clinical baseline data. This study confirmed that laparoscopic surgery has better perioperative efficacy than open surgery for colon cancer. However, this study has limitations, for example, the follow-up time was not long enough to explore the influencing factors of the quality of life of patients. Future studies will be performed to support the results of this present study.

In summary, laparoscopic surgery achieves the same therapeutic effect as conventional open surgery in reducing the intraoperative blood loss, postoperative pain, and the damage to the body. It is safe and reliable, and is beneficial to the recovery of quality of life.

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Conflict of interests

The authors declare no conflict of interests.

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