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ORIGINAL ARTICLE

Comparative study of Overlap anastomosis and traditional anastomosis in total laparoscopic radical resection of left colon cancer

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Summary

Purpose: *To investigate the safety and feasibility of using linear stapler to complete the side-to-side anastomosis (Overlap method) of distal and proximal colon on taenia coli along the long axis of the intestine in laparoscopic radical resection of left colon cancer.*

Methods: *From January 2017 to December 2019, the clinical data of 24 patients with total laparoscopic radical resection of left colon cancer and Overlap anastomosis in the general surgery department of Wuhu First People's Hospital were retrospectively analyzed (research group, RG). In addition, 36 patients who underwent laparoscopic-assisted radical resection of left colon cancer during the same period and whose intestinal tubes were removed from the abdominal wall to complete specimen resection and intestinal anastomosis through auxiliary incision were used as controls (control group, CG). The advantages and disadvantages of the two surgical methods were compared through the research indexes during and after the operation.*

Results: *Compared with CG, the total operation time of the patients in RG was shortened ($p<0.001$), the intraoperative blood loss was less ($p<0.001$), the abdominal wall incision length was shorter ($p<0.001$) and the postoperative hospital stay was shorter ($p=0.014$). There was no significant difference between RG and CG in the number of lymph node dissection, the time of first postoperative anal exhaust and the incidence of postoperative complications (all $p>0.05$).*

Conclusion: *The Overlap anastomosis technique of total laparoscopic radical resection of left colon cancer is feasible and easy to perform. It has the advantages of low incidence of complications, better cosmetic effect and short hospital stay. Although further prospective randomized studies are needed to determine its effects and limitations, it is still recommended that this operation can be popularized in clinical practice.*

Key words: *laparoscopy, overlap anastomosis, colonic neoplasm, radical operation*

Introduction

With the improvement of living standards and the prolongation of mean lifespan, the incidence rate of colon cancer is getting higher and higher, among which the incidence rate of male is higher than that of female, which seriously threatens the life and health of Chinese people (here are two references about colon cancer in Chinese population) [1,2]. Surgery is the main treatment for colon cancer. In the past 30 years, minimally invasive surgery for colon cancer has received much attention [3]. In 1991, Jacobs et al [4] have reported the first laparoscopic assisted colectomy. Compared with open surgery, it has obvious advantages, such as fewer complications at the surgical site, less postoperative pain and faster recovery [5]. In addition, randomized trials have shown that the short-term and oncological outcomes of laparoscopic colon cancer surgery are similar to those of open surgery

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[6,7]. Nowadays, laparoscopic-assisted colectomy has been widely used in colon cancer patients, and the advantages of this method have been widely verified [8-10]. With the improvement of surgical equipment and performance, experienced surgeons have gradually adopted total laparoscopic colectomy [11,12]. Theoretically, total laparoscopic colectomy (TLC) is more in line with the concept of minimally invasive surgery and the principle of tumor-free technology, and *in vivo* anastomosis was used for intestinal anastomosis. The common method of *in vivo* anastomosis is to use the linear stapler to complete the side-to-side anastomosis (Overlap method) of distal and proximal colon on the taenia coli along the long axis of the intestine. Although *in vivo* anastomosis has been proved to be safe and effective in right hemicolectomy [13], the efficacy of *in vivo* anastomosis in left hemicolectomy is still controversial due to limited data. This study aimed to report the results of comparative analysis of the Overlap and the auxiliary incision anastomosis in total laparoscopic left colectomy, so as to provide the diagnosis and treatment suggestions for clinical workers

Methods

Clinical data

From January 2017 to December 2019, 60 patients who underwent endoscopic radical surgery for left colon cancer in Wuhu First People's General Surgery Department were selected, including 24 colon cancer patients with Overlap anastomosis and 36 colon cancer patients with traditional anastomosis. According to the latest edition of Union Internationale Contre le Cancer (UICC) and TNM staging standards, the included patients were reasonably staged.

Inclusion criteria for this study: (1) The patient underwent left colon cancer surgery for the first time; (2) The patient was diagnosed as left colon cancer by preoperative biopsy and imaging examination, and confirmed as left colon cancer by postoperative pathology; (3) The patient underwent total laparoscopic Overlap anastomosis or laparoscopic assisted intestinal anastomosis; (4) The patient had no distant visceral metastases before surgery; (5) The clinical case data and follow-up data of the patients were complete.

Exclusion criteria for this study: (1) The patient was diagnosed with benign colon disease before surgery; (2) The patient had a previous history of colorectal cancer surgery or other abdominal operations; (3) The patient had a large mass, obstruction, dilatation and edema of the proximal colon; (4) The patient's clinical data were incomplete.

Surgical methods

General anesthesia was performed by endotracheal intubation, and the patient was placed in supine straddle position. The operator stood on the right side of the patient, the assistant was on the left side of the patient, and the laparoscopic assistant could stand on the left side or between the legs of the patient according to different operating positions. 12mmTrocar was placed under the umbilicus as the observation hole, and 12mmTrocar was inserted at the level of the anterior superior iliac spine in the midline of the right clavicle, and 5mmTrocar was placed in the corresponding part of the opposite side and the outer edge of the rectus abdominis 3 cm below the bilateral costal margin. The operation strictly followed the principles of D3 lymph node dissection, Complete mesorectal excision (CME) and radical tumor resection. The middle approach from bottom to top and from inside to outside was adopted to separate the left mesocolon upward along the aorta and dissect the root of the inferior mesenteric artery. Lymph node No.253 was cleared to avoid damaging the superior and inferior abdominal nerves. The left colon artery and sigmoid colon artery were ligated and severed at the root according to the tumor location from the naked inferior mesenteric artery to the vascular bifurcation. The left Toldt gap was extended to protect the lower ureter and reproductive vessels. The inferior mesenteric vein was ligated and

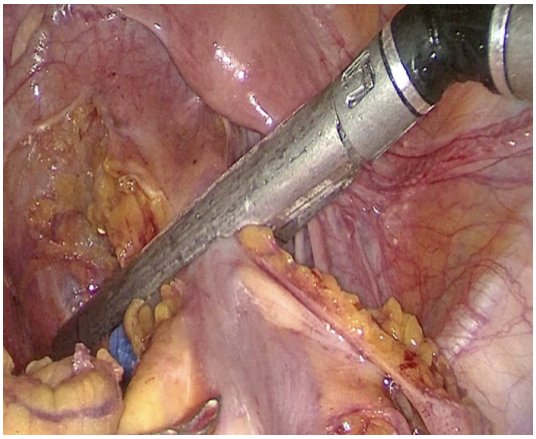

Figure 1. ENDO-GIA disconnects the intestine from the distal end of the tumor.

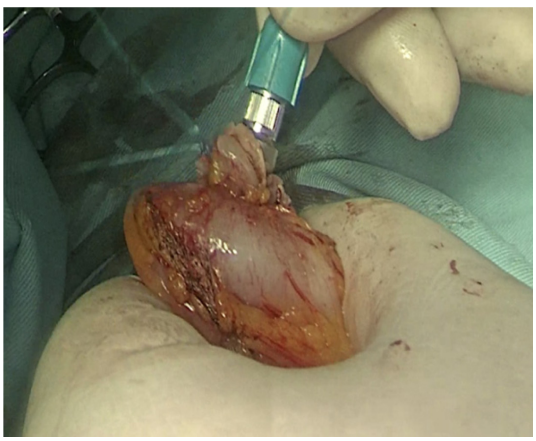

Figure 2. Stapler inserted *in vitro*.

severed up to the lower margin of the pancreas and laterally to the left paracolic sulcus. The attachment of the abdominal wall was cut along the lateral side of the colon and met with the medial free plane to fully dissociate the sigmoid colon and the descending colon. The splenic colon ligament and the gastric colon ligament were severed along the lower edge of the left gastroepiploic artery, and the left branch of the middle colon artery was naked and the corresponding lymph nodes were cleaned, thus completing the full dissociation of the left colon. Digestive tract reconstruction method in the traditional anastomosis group: Left rectus abdominis incision was performed, and the length was appropriate to be able to smoothly take out the tumor and have enough space to complete anastomosis, and the incision protective sleeve was placed. The left colon was pulled out, and the determination of cutting edge of the intestine, mesangial clipping and specimen separation were completed under direct vision *in vitro* to ensure that the cutting edge was ≥ 10cm from the edge of the lesion. The functional end-to-end anastomosis of the distal and proximal intestine was performed with a linear stapler. Digestive tract reconstruction method in Overlap anastomosis group: The upper and lower incised edges of the intestine were determined by 10cm segment under laparoscopy, and mesocolon was cut out. The linear stapler direction was adjusted to separate the intestine from the antimesenteric border to the mesangial margin, and the specimen was placed into the specimen bag. Overlap anastomosis: (1) Transverse colon distal end, splenic flexure and descending colon tumor: the intestinal cavity was opened at the broken end of the proximal intestine taenia coli and the taenia coli 6cm from the broken end of the distal colon respectively. The distal colon was lifted up, and both arms of the linear stapler (60mm) were placed into the distal and proximal colon lumen from the caudal part respectively to pull the mesocolon at the distal and proximal ends, so that the distal and proximal colon residual ends overlapped and the colon-to-colon bands were matched. After the linear stapler blow, the Overlap side-to-side anastomosis was completed. V-lock line was manually anastomosed to close the common opening. (2) Upper sigmoid colon cancer: The distal cutting edge of the colon was located at a low position, which was usually located at the level of the sacropromontory, and it was difficult to complete Overlap anastomosis through the main operation hole. At this time, the operator's left-hand operation hole could be replaced with 12mm

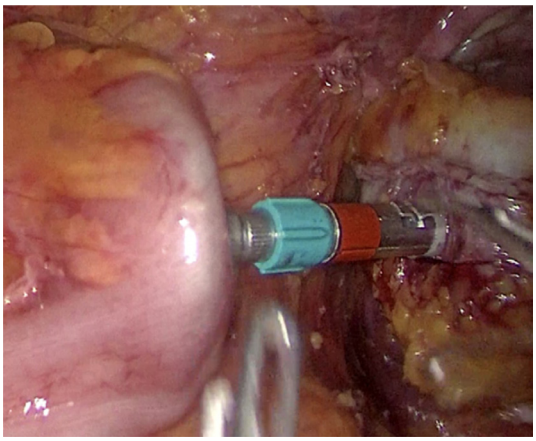

Figure 3. Re-establishment of posterior pneumoperitoneum-type stapler.

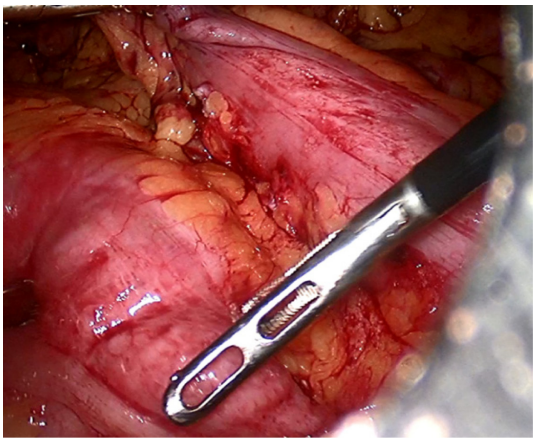

Figure 5. The proximal and distal intestinal canal are close to each other.

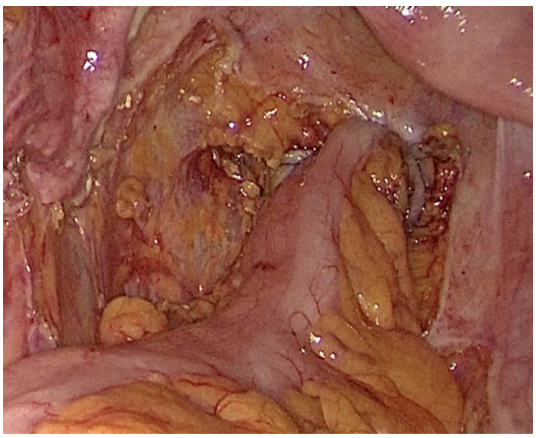

Figure 4. Fire the stapler to complete the anastomosis.

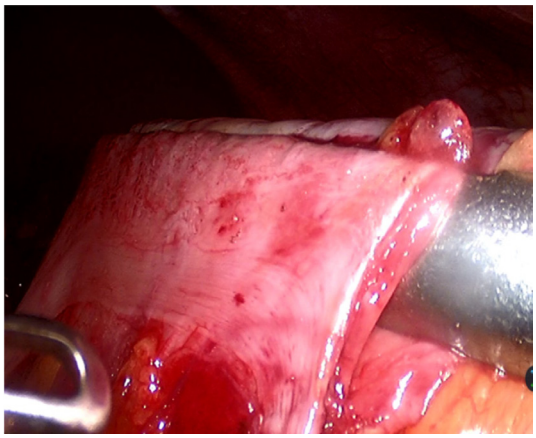

Figure 6. Fire ENDO-GIA to complete side-to-side anastomosis.

Trocar, and the common opening position was placed at the 6cm position from the proximal colon to the cutting edge, and a linear stapler (60 mm) was inserted through the left-hand Trocar to extend from the head side into the proximal and distal intestinal lumens to complete anastomosis. The specimen was taken by expanding the umbilical sighthole or taking a transverse incision (3 cm) above the pubic tubercle (Figures 1-8).

Statistics

In this study, SPSS 21.0 was used to analyze the obtained data. The measurement data were expressed as mean number ± standard deviation and tested by t-test. The counting data was expressed as rates and tested by x^2 test. The difference was statistically significant with $p<0.05$.

Results

Comparison of general baseline data

There were 14 males and 10 females in RG, with an age of 63.38±4.02 years and a body mass index (BMI) of 22.52±1.49 kg/m^2. The tumors were located in distal transverse colon in 2 cases, in 6 cases in splenic flexure of colon, in 8 cases in descending colon and in 8 cases in the upper sigmoid colon. There were 16 cases of stage II and 8 cases of stage III colon cancer. All of them were anastomosed by Overlap under total laparoscopy without conversion to laparotomy. In CG, there were 20 males and 16 females, with mean age of 62.25±4.80 years and a BMI of 22.58±1.49 kg/m^2. The tumors were located in distal transverse colon in 3 cases, in 9 cases in splenic flexure of colon, in 11 cases in descending colon and in 13 cases in upper sigmoid colon. There were 23 cases of stage II and 13 cases of stage III colon cancer. There was no significant difference in baseline data between the two groups (all $p > 0.05$; Table 1).

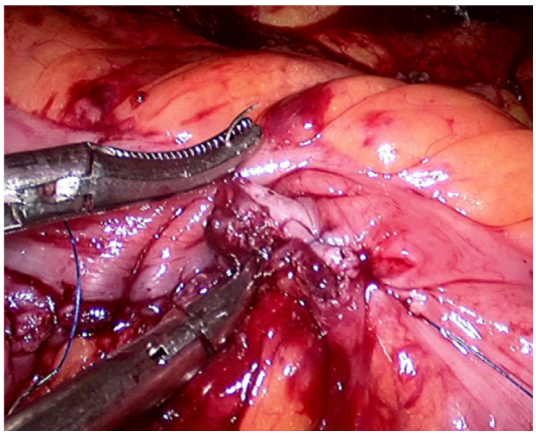

Figure 7. Manual stitching to close the common opening.

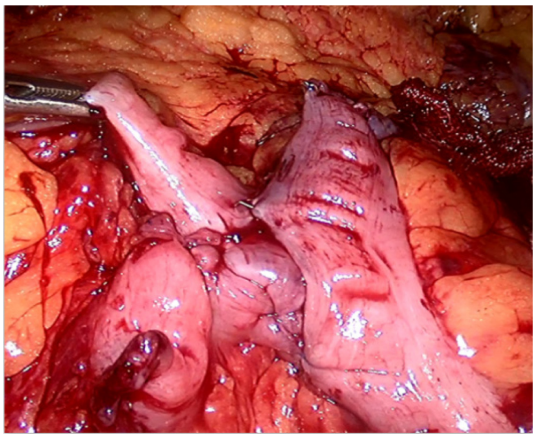

Figure 8. The common opening is sutured.

Comparison of intraoperative and postoperative indicators

Compared with CG, the total operation time of the patients in RG was shortened (145.21±8.71 min vs 171.94±16.28 min, t=-8.243, p=0.000), the intraoperative blood loss was less (47.21±7.99 ml vs 70.5±20.0 ml, t=-9.587, p=0.000), the incision length of abdominal wall was shorter (3.9±0.9 cm vs 6.7±1.3 cm, t=7.056, p=0.000), and the postoperative hospitalization time was shorter (7.25±0.53 d vs 7.72±0.91 d, t=-2.525, p=0.014). The differences were statistically significant. There were no significant differences in the number of lymph node dissection (17.58±1.53 pieces vs 17.08±1.65 pieces), the time of first postoperative anal exhaust (2.92±0.72 d vs 2.89±0.71 d) and the incidence of postoperative complications between RG and CG (all p>0.05; Table 2).

Discussion

With the popularization of screening such as colonoscopy, colon cancer can be detected early and treated surgically, with a 5-year survival rate of 70-90% [14]. In the past several decades, this technique has been rapidly implemented in many surgical fields since laparoscopic cholecystectomy was applied. The laparoscopic revolution is an example of surgical innovation, and the technology is rapidly spreading through academic networks [15]. Since then, a large number of comparative studies and meta-analyses have shown that laparoscopic colorectal cancer surgery can reduce pain, reduce intestinal adhesion, restore intestinal peristalsis earlier and shorten hospital stay compared with open surgery [16-20]. It has been suggested that the short-term advantage of laparoscopic surgery is related to the reduction of inflammatory response [21,22]. Researches [23] have confirmed that the

Table 1. Comparison of basic data of patients with left colon cancer between RG and CG

Factors	*RG*	*CG*	t/x^2	*p*
Gender (cases)				
Male	14	20	0.045	0.832
Female	10	16		
Age (years old)	63.38±4.02	62.25±4.80	0.948	0.347
Body mass index (kg/m^2)	22.52±1.49	22.58±1.49	-0.148	0.883
Location of primary tumor (cases)				
Distal transverse colon	2	3	0.067	0.995
Splenic flexure of colon	6	9		
Descending colon	8	11		
Upper sigmoid colon	8	13		
Tumor staging (cases)				
Stage II	16	23	0.049	0.825
Stage III	8	13		

Table 2. Comparison of intraoperative and postoperative recovery between RG and CG

Factors	*RG*	*CG*	t/x^2	*p*
Operation time (min)	145.21±8.71	171.94±16.28	-8.243	0.000
Intraoperative blood loss (ml)	47.21±7.99	73.92±13.55	-9.587	0.000
Number of lymph node dissection (pieces)	17.58±1.53	17.08±1.65	1.185	0.241
Length of incision (cm)	4.50±0.59	7.08±0.60	-16.390	0.000
Anus exhaust time (d)	2.92±0.72	2.89±0.71	0.148	0.883
Postoperative complications (cases)	0	3	0.716	0.397
Postoperative hospital stay (d)	7.25±0.53	7.72±0.91	-2.525	0.014

levels of serum interleukin-6 and other pro-inflammatory cytokines after laparoscopic colectomy are lower than those of open colectomy, and these indicators are sensitive markers of tissue damage. At this stage, the main principle of surgical operation is to minimize physical trauma without impairing the long-term prognosis of patients, so as to improve the survival and quality of life of patients and achieve better prognosis [24]. There is no doubt that total endoscopic colon cancer surgery is better than any traditional surgery in minimally invasive and cosmetic aspects. It is reasonable to believe that if total endoscopy is as safe as traditional surgery in colon cancer surgery, it can be used as a preferred method for eligible patients. However, laparoscopic surgery is limited in operating space and requires higher technology, so it needs to be performed by experienced surgeons.

The results of this study showed that in the absence of significant differences in baseline data between the two groups, the mean operative time of patients in RG was not prolonged by the completion of intestinal anastomosis *in vivo* compared with CG. On the contrary, the data from our study proved that the time of total endoscopic surgery was shorter, mainly because the free splenic flexure could be minimized without changing the body position and opening and closing the abdomen, and the perineum group was not required to assist in the surgery, thus saving time. In the Overlap anastomosis group, the intraoperative blood loss was less and the safety was higher. The surgical incision was smaller, the postoperative pain of patients was less, the postoperative hospitalization time was shorter and patients could recover early. It greatly improved the postoperative efficacy of patients and further explained the advantages of Overlap anastomosis surgery. In addition, our results showed that there was no significant difference in the number of lymph node dissection between RG and CG, which also indicated that the Overlap anastomosis operation could achieve the same tumor resection effect as laparoscopic-assisted small-incision reconstruction operation. Although there was no statistically significant difference in the incidence of postoperative complications between the two groups, we found that 3 cases of postoperative complications developed in CG, including 1 case of incision infection, 1 case of anastomotic stenosis and 1 case of anastomot-

ic leakage. Although these complications can be cured by conservative treatment such as dressing change and drainage tube placement, they increase the pain of these patients.

To sum up, it is safe and feasible to perform total laparoscopic redical resection of colon cancer. Overlap anastomosis by experienced surgeons. The extraction of specimens through a small suprapubic incision can not only reduce the development of incisional hernia, but also has high anastomosis strength and low incidence of fistula and hemorrhage. At the same time, it can cater to colon cancer patients who need medical cosmetology. Thus, TLC's Overlap anastomosis will become the gold standard for colon cancer surgery. Of course, our study was retrospective, involving only 60 patients, so the results might be affected by the sample size. Therefore, a large number of sample prospective randomized controlled trials are still needed to further verify the limitations of TLC overlap anastomosis.

Conflict of interests

The authors declare no conflict of interests.

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