

## Original Article

# Comparative analysis of modified Bacon operation and double stapler operation in the treatment of rectal cancer

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**Abstract:** Objective: To investigate the efficacy of modified Bacon operation and double stapler operation in treating lower rectal cancer. Methods: A total of 73 patients with lower rectal cancer admitted to the general surgery department of our hospital from March 2016 to March 2017 were selected for the study. According to different operation methods, the patients were divided into an observation group and a control group. Modified Bacon operation was used in the observation group (39 cases), while double stapler operation was adopted for the control group (34 cases). The intraoperative and postoperative conditions and 3-year survival rates were observed. Results: The bleeding volume and anal exhaust time in the observation group were better than those in the control group, the difference being statistically significant ( $P < 0.05$ ). No significant difference was found between the two groups in terms of the operation time, abdominal drainage volume, anal extubation time, or the number of lymph node dissection ( $P > 0.05$ ). The anal function of the two groups was evaluated one month and six months after operation respectively, and no significant difference was found between the function of the two groups ( $P > 0.05$ ). There was no significant difference in postoperative complications, local recurrence, and distant metastasis between the two groups ( $P > 0.05$ ). The 3-year survival rate was 89.74% in the observation group and 91.18% in the control group. Our analysis found no significant difference in the cumulative survival rates between the two groups ( $P > 0.05$ ). Conclusion: Modified Bacon operation and double stapler operation are effective treatment for lower rectal cancer, and the survival benefit of patients is obvious. The methods are worthy of clinical promotion.

**Keywords:** Lower rectal cancer, modified Bacon operation, double stapler operation, laparoscopy

## Introduction

Rectal cancer is a common malignant tumor of the digestive tract with many pathogenic factors, which may be related to heredity, dietary habits and social environment [1]. Symptoms of early rectal cancer are not obvious. With the progression of the disease, patients may present with clinical symptoms such as diarrhea, constipation, urinary tract stimulation and blood in the stool, which seriously threaten the patients' health and quality of life [2]. Surgery is a preferred treatment for rectal cancer. With clinical improvement, further understanding of the lymph node metastasis and biological characteristics of rectal cancer has been achieved. There have been higher requirements for the operation, that is, the function of anal defecation should be retained as much as possible in

the case of thorough removal of the cancer [3]. About 40% of rectal cancer is lower rectal cancer, which is generated in the peritoneum at a distance of 3-7 cm from the anal margin. Several studies have confirmed that an operation to preserve the anus of lower rectal cancer patients is feasible [4-6]. The double stapling technique is frequently used in clinical anus-preserving surgery, but the difficulty of the anastomotic technique and the lack of anastomosis can lead to complications of an anastomotic fistula [7]. In recent years, modified Bacon surgery technique has ensured no anastomosis in the abdominal cavity of anus-preserving surgery, but disputes still exist over the best choice of operation methods for patients with lower rectal cancer [8, 9]. The study investigated patients with lower rectal cancer treated by these two methods in our hospital to pro-

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**Table 1.** Baseline information of the two groups

Information	Observation group (n = 39)	Control group (n = 34)	t/ $\chi^2$ /Z	P value
Gender			0.020	0.877
Male	20	18		
Female	19	16		
Age (years old)	56.72±3.21	55.39±3.87	1.605	0.113
Diameter of tumor (cm)	4.17±1.58	4.49±1.22	0.958	0.342
Distance between the tumor and the anus margin (cm)	5.44±0.72	5.65±0.57	1.367	0.176
TNM phases			0.236	0.814
I	15	14		
II	13	11		
III	11	9		
Pathological type			0.151	0.880
Polypoid adenocarcinoma	27	24		
Canalicular adenoma	8	7		
Mucinous adenocarcinoma	4	3		
Signet-ring cell carcinoma	0	0		

vide references for the clinical treatment of rectal cancer. The report is as follows.

### Material and methods

#### General information

A total of 73 patients with lower rectal cancer admitted to the general surgery department of our hospital from March 2016 to March 2017 were selected for the study. All the patients were diagnosed with lower rectal cancer by digital rectal examination, barium enema, colonoscopy and other comprehensive examinations before surgery, and met the surgical indications. There were no complications of other major organ diseases and no history of pelvic surgery. Patients treated with modified Bacon's radical resection of rectal cancer were categorized into the observation group, and patients treated with the double stapling technique were in the control group. All patients signed informed consent. The study was approved by the Ethics Committee of First hospital of Shanxi Medical University (Approval No. K089-201912). No significant difference was found in baseline data between the two groups ( $P>0.05$ ). The data were comparable as shown in **Table 1**.

#### Surgery methods

The observation group received the improved Bacon technique: The pneumoperitoneum (14 mmHg) was performed with the five-hole meth-

od. The Trocar at 10 mm of the upper umbilical edge was taken as the observation hole and the Trocar at 12 mm of the right hypogastric McBurney's point was the operation hole. An incision was made in the peritoneum in front of the sacral promontory and the root of the inferior mesenteric artery was dissected and clipped 1.0 cm from the root. The same operation was conducted on the inferior mesenteric vein. The mesocolon was dissociated in the space between the parietal pelvic fascia and the intrinsic fascia of the rectum by ultrasonic scalpel in an inward-outward manner. The lower part of the rectum was dissociated to the plane of coccyx tip, and then its two sides were dissociated. Attention that the pelvic nerve needs protection here. The peritoneum was incised in front of the rectum, and the rectum antetheca was dissociated in the space of the Denonvillier fascia. The resection line of the proximal colon was at 10-15 cm from the upper margin of the tumor. Then, the sigmoid colon was cut and closed by JNJ's EndoGIA60, and the anus was dilatated to 3-4 fingers in the perineum. Oval forceps were used to clamp the distal end of the colonic segment through the intestinal cavity. The rectum, the tumor and the distal sigmoid colon were then everted and pulled out of the anus. The rectum was severed at 2 cm from the lower edge of the tumor under direct vision while the specimens were removed. The proximal broken end of the colon was pulled about 3-5 cm outside the anus, and the rectal muc-

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sa and the colonic serous membrane were fixed with 6-8 stitches of interrupted suture at the anus. An anal canal was placed in the external colon, and a drainage tube was placed in the pelvic floor and extracted from the right lower abdomen Trocar. The external colon was cut off at 1 cm below the dentate line by an ultrasound scalpel 2 weeks after surgery.

The control group was treated with double operation: The rectum and colon were dissociated in the same way as above. Afterward, the rectum was dissected at 2 cm outside the lower margin of the tumor by JNJ's EndoGIA60, and an auxiliary incision of 4-5 cm was made in the left lower abdomen protected by the incision sleeve. Dissection of the colon was performed at 10 to 15 cm above the tumor and the end was closed with a purse-string suture. The stapler holder No. 29/32 was placed and the purse-string suture line was ligated to reconstruct the pneumoperitoneum. Rectum anastomosis was performed laparoscopically after anal dilation and stapler placement. One anal canal was placed above the anastomotic site from the anal canal, and one drainage tube was placed on the pelvic floor and extracted from the right lower abdominal Trocar.

### *Observation index*

The intraoperative and postoperative conditions of the two groups were observed, including the amount of surgical blood loss, operation time, abdominal drainage volume, anal canal extraction time, number of lymph nodes dissected, anal exhaust time, anal function evaluation, complication rate, local recurrence, distal metastasis, 3-year survival rate, etc.

The anal function of all patients was evaluated at 1 month and 6 months after the operation. Excellent: the patients had awareness before defecation, and the control time was  $\geq 2$  minutes. Defecation was performed 1 to 4 times within 1-3 days. Good: the excretion of dry feces can be controlled by themselves; occasional dry feces flowing out with the air exhausted; occasional incontinence at night; able to distinguish excretion and exhaust; weak defecation awareness with only 1-2 minutes control; 1 to 10 times of defecation in 1-3 days. Poor: patients were not aware of defecation; both dry and thin feces are incontinent, the defecation being irregular and continuous.

### *Follow-up visit*

The patients were followed up by outpatient service, telephone and Internet communication at 1 month and 6 months after surgery and once every 6 months after that. The anal function, complications and survival period of the patients were recorded. Follow-up was terminated when the patients were lost to study or died, and the 3-year cumulative survival rate of the two groups was calculated.

### *Statistical analysis*

The statistical analysis was conducted with software SPSS 22.0 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.) and figures were drawn by GraphPad Prism (GraphPad Software, La Jolla, CA). The measurement data were expressed as mean  $\pm$  standard deviation under t test. The binary classification data were expressed as rate under  $\chi^2$  test, and the rank-sum test was used for the multi-classification data; Kaplan-Meier was used for survival analysis.  $P < 0.05$  was considered statistically significant.

## Results

### *Surgical condition*

The observation group was superior compared to the control group in terms of the amount of surgical blood loss and the time of anal exhaust, the differences being statistically significant ( $P < 0.05$ ). No significant difference was found between the two groups in terms of the operation time, abdominal drainage volume, anal canal extraction time, and the number of lymph nodes dissected ( $P > 0.05$ ). See **Table 2** for details.

### *Anal function evaluation*

The anal function of the two groups was evaluated at 1 month and 6 months after surgery, respectively. The difference was not statistically significant ( $P > 0.05$ ). See **Table 3** for details.

### *Complications*

There were 4 postoperative complications in the observation group, including 1 case of infection of incisional wound, 2 cases of anal pain, and 1 case of external colorectal retrac-

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**Table 2.** Surgical condition

Observation index	Observation group (n = 39)	Control group (n = 34)	t value	P value
Surgical blood loss (ml)	103.23±11.25	108.25±9.87	2.013	0.048
Operation time (h)	1.89±0.42	2.02±0.37	1.394	0.168
Intraperitoneal drainage volume (ml)	128.34±33.17	141.25±32.88	1.666	0.100
Anal canal extraction time (d)	5.89±0.47	6.13±0.59	1.933	0.057
Number of lymph nodes dissected (n)	17.24±3.26	16.75±3.44	0.624	0.534
Anal canal exhaust time (d)	3.17±0.86	3.64±0.92	2.255	0.027

**Table 3.** Anal function evaluation

Group	1 month after surgery			6 months after surgery		
	Excellent	Good	Poor	Excellent	Good	Poor
Observation group (n = 39)	16	14	9	19	17	3
Control group (n = 34)	11	12	11	16	13	5
Z value	0.947		0.415			
P value	0.344		0.678			

**Table 4.** Complications

Group	Stomal leak	Stomal hemorrhage	Infection of incisional wound	Anal pain	External colorectal retraction	Total Complications
Observation group (n = 39)	0	0	1	2	1	4
Control group (n = 34)	1	1	2	3	0	7
χ <sup>2</sup> value						0.815
P value						0.367

**Table 5.** Survival status

Group	Local recurrence	Distant METASTASIS	3-year survival rate
Observation group (n = 39)	4	4	35
Control group (n = 34)	3	2	31
χ <sup>2</sup> value	0.043	0.461	0.043
P value	0.826	0.497	0.836

tion. There were 7 in the control group, including 1 case of stomal leak, 1 case of stomal hemorrhage, 2 cases of infection of incisional wound, and 3 cases of anal pain. No statistically significant difference was observed ( $P > 0.05$ ). See **Table 4** for details.

### Survival status

There were 4 cases of local recurrence in the observation group and 3 cases in the control group with no statistically significant difference ( $P > 0.05$ ). There were 4 cases of distant metastasis in the observation group and 2 cases in the control group with no statistically significant difference ( $P > 0.05$ ). The 3-year survival

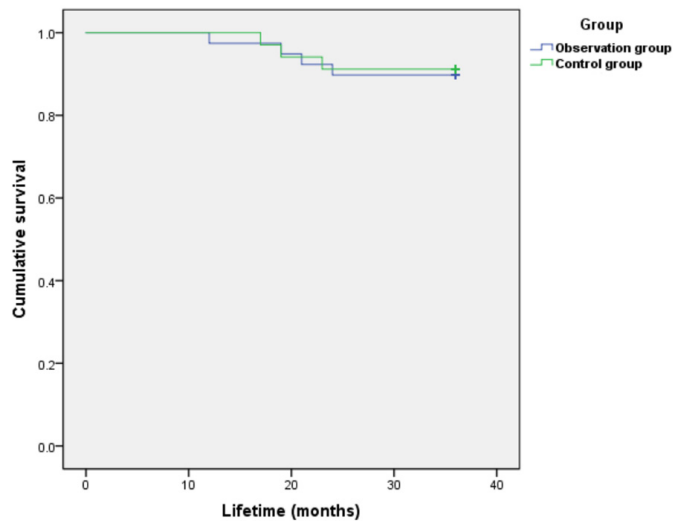
rate of the observation group was 89.74% (35/39), and that of the control group was 91.18% (31/34) (See **Table 5** and **Figure 1**).

### Discussion

In the surgery of rectal cancer patients, radical resection of the tumor lesion should be guaranteed

first, and then the anal function should be retained or not depending on the situation [10]. Therefore, patients should be systematically examined before surgery; only after the tumor can be completely removed, should the anus-preserving operation be performed [11]. However, the premise of anal-preserving surgery is that the distance between the distal end of the nest lesion and the normal intestine is more than 2 cm. All patients in this study met this requirement. For lower rectal cancer, anus-preservation by laparoscopy is one frequently used surgical method at present. Compared with laparotomy, it has ascendancy of small wounds, light pain and short postoperative recovery time with the same effect on tumor

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**Figure 1.** The 3-year survival analysis.

resection [12, 13]. In recent years, improved Bacon operation and double stapler operation have emerged as major treatments for anus preservation under laparoscopy. However, controversy still exists over the effect of these two methods and the occurrence of complications [14].

This study found that the observation group was superior in terms of surgical blood loss and anal exhaust time, the differences being statistically significant. No significant differences were found in the operation time, abdominal drainage volume, anal canal extraction time, number of lymph nodes dissected, or the evaluation of anal function at 1 month and 6 months after surgery. There was no significant difference between the two groups in terms of postoperative complications, while the types of complications were different. Complications of improved Bacon surgery included incision infection, anal pain, external colorectal retraction; complications of double stapling technique were mainly anastomotic leakage, anastomotic bleeding, infection of incision, anal pain. Therefore, in the intraoperative and postoperative periods, attention needs to be paid to complications caused by different operative methods; early detection and timely intervention can prevent surgical outcomes. The rates of local recurrence and distal metastasis were relatively low in the two groups, and the 3-year survival rates were 89.74% and 91.18%, respectively, indicating that both of the two operations can benefit the survival of patients. We

hypothesize that the possible mechanism lies in the following points. Firstly, as previous studies have established [15, 16], the use of a stapler for anal preservation in patients with lower rectal cancer can replace manual sutures with a faster suture of better quality and few adverse reactions. Previously, staplers were used to resect tumors that are difficult to operate. Secondly, the modified Bacon operation is a type of natural orifice specimen extraction surgery. Its operation with laparoscopy not only leaves small wounds but also no anastomotic in the abdominal cavity. So, there is no risk of anastomotic fistula in the modified Bacon operation. Thirdly, the lesion can be removed more thoroughly by pulling it out of the anus and performing under direct vision. Meanwhile, on the premise of ensuring the safety of the lower incision margin, the rectum and complete sphincter complex on the dentate line can be retained as much as possible to improve the anal defecation control function after surgery [17, 18]. This is also why in recent years the natural orifice specimen extraction surgery has attracted much attention [19, 20]. However, when the tumor is large, pulling it out through the anus may squeeze it, thus increasing the risk of the proliferation of cancer tissues and cells. Therefore, when the tumor is relatively large, it is necessary to evaluate whether the patient is suitable for modified Bacon operation and strictly follow the indications for each operation [21]. Fourthly, a complete preservation of anal structure can improve postoperative anal defecation control. There are few operations related to tumors and bacteria in the abdominal cavity, which are more in line with the principle of asepsis and tumor free [22]. Limitations of this study are that the follow-up period is only 3 years and that the long-term survival rate was not followed up. The long-term efficacy of the two surgical methods needs to be further explored and verified.

In summary, modified Bacon operation and double stapling operation are effective for patients with lower rectal cancer and contribute to a markable survival benefit. Therefore, the two methods are worthy of clinical promotion.

### Disclosure of conflict of interest

None.

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