

## Original Article

# Effects of low negative pressure suction rectal drainage on postoperative intestinal function recovery and postoperative complications of rectal cancer

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**Abstract:** Objective: The goal of this study was to investigate the effects of low negative pressure suction rectal drainage on intestinal function recovery after rectal cancer surgery. Methods: A total of 150 patients that underwent rectal cancer surgery were enrolled. Patients were randomly divided into experimental group and control group with 75 patients in each group. The experimental group was given low negative pressure suction rectal drainage and the control group was given regular negative pressure suction rectal drainage. The time of bowel sounds recovery and the time of gastric tube removal were compared between the two groups. The volume of abdominal drainage on the 1st, 3rd, and 7th postoperative day were also compared between the groups. The incidence of rectal drainage tube blockage and postoperative complications (incision infection, pneumonia, gastric retention, anastomotic leakage, intestinal obstruction) was also evaluated. Results: There was no significant difference in the general condition between the two groups ( $P > 0.05$ ). The time of bowel sounds recovery and the time of the gastric tube removal were significantly shorter in the experimental group than the control group (both  $P < 0.05$ ). There was no difference between the two groups regarding the volume of abdominal drainage on the 1st, 3rd, and 7th postoperative day ( $P > 0.05$ ). The incidence of rectal drainage tube blockage in the experimental group was significantly lower than the control ( $P < 0.05$ ). The incidence of anastomotic leakage was lower in the experimental group ( $P < 0.05$ ), while the other complications were not significantly different between the two groups ( $P > 0.05$ ). Conclusion: The use of low negative pressure suction rectal drainage after rectal cancer surgery can shorten the time of bowel sounds recovery, and reduce the incidence of drainage tube blockage and the occurrence of anastomotic leakage, which is highly recommended in clinical practice.

**Keywords:** Low negative pressure suction, rectal drainage, rectal cancer surgery, intestinal function

## Introduction

In the past 10 years, the incidence and mortality of rectal cancer in China have increased dramatically. Studies have reported that the mortality rate of rectal cancer in China was as high as 46.6% in 2015 [1, 2]. Among them, patients over 45 years old accounted for 93.28% [3, 4]. More often than not, rectal cancer patients have no specific symptoms in the early stage. However, distant metastases often occur in the middle and late stages; as a result, the cure rate is significantly decreased. Therefore, early diagnosis and early treatment is crucial [5]. Currently, the mainstream treatment of rectal cancer is surgical resection. When the tumor has not invaded the anus, the surgery will spare

the anus to improve the patient's quality of life. If the tumor has invaded the anus, the anus should be removed with the tumor [6, 7]. It is also important to ensure recovery of intestinal function after surgery. Usually, a negative pressure suction device is used to drain the liquid from the rectum after surgery, which is not only beneficial to early recovery, but also beneficial to long-term prognosis.

At present, the commonly used method for gastrointestinal decompression is a disposable negative pressure suction, which can aspirate gastrointestinal contents, blood remains, and inflammatory exudate after surgery [8, 9]. Inappropriate suction pressure is not only detrimental to the aspiration of the residue, but also

## Low negative pressure suction drainage promotes recovery

**Table 1.** Comparison of general conditions

Group	Experimental group (n = 75)	Control group (n = 75)	t/ $\chi^2$	P
Gender	39/36	40/35	0.027	0.870
Age (year)	46.7 ± 4.6	47.2 ± 5.4	0.610	0.542
BMI (kg/m <sup>2</sup> )	24.52 ± 3.54	24.82 ± 3.24	0.541	0.589
Comorbidities				
Hypertension	15	12	0.407	0.524
Diabetes	6	7	0.084	0.772
Clinical staging			0.123	0.726
Stage I	52	50		
Stage II	23	25		

damages the gastrointestinal mucosa [10]. Low-pressure suction uses a suction pressure that is lower than the disposable suction canister, so that the residue is maximally drained out without damaging the intestinal mucosa, thus facilitating early intestinal recovery [11]. Studies have shown that low-pressure suction drainage can be used in postoperative patients with breast cancer, which enhances drainage of the wound [12]. However, the effects of low-pressure suction rectal drainage on the recovery of intestinal function and postoperative complications after rectal cancer surgery is by far poorly studied.

### Materials and methods

#### Patients

A total of 150 rectal cancer patients, including 79 males and 71 females, admitted in the Department of General Surgery of the First Affiliated Hospital of Gannan Medical University from January 2015 to December 2018 were enrolled in the study. All patients underwent anus-sparing rectal cancer surgery. The study was approved by the Ethics Committee of the First Affiliated Hospital of Gannan Medical University and all patients signed informed consent. Based on the negative pressure suction pressure of the rectal drainage, patients were randomly divided into two groups after surgery, with 75 patients in each group. The experimental group was given low-pressure suction rectal drainage (-7~-5 kPa) and the control group was given regular pressure suction rectal drainage (-14~-8 kPa). The size and location of the abdominal cavity drainage were the same in both groups.

Inclusion criteria: Patient has confirmed diagnosis of rectal cancer through endoscopy and biopsy; Patient underwent transabdominal resection of rectal cancer (Dixon procedure) [13].

Exclusion criteria: Patient has severe malnutrition or mental disorders. Patient cannot tolerate surgery. Patient cannot cooperate during hospitalization.

#### Methods

Rectal drainage tube placement: Appropriate silicone drainage tube was selected based on the patient's stature and surgery site. The diameter of the silicone tube is 1.0-2.0 cm. At the side of the tube, 3-5 holes were cut for better draining effect. Then the drainage tube was placed 3-5 cm proximal to the anastomosis, and the tube was pulled out from the anus and connected with a disposable suction canister to drain the stool and residue in the rectum. The suction canister was placed 10 cm below the patient's bed. The suction drainage tube was removed at 7th day after surgery.

Suction pressure setting procedures: The pressure of the disposable suction canister was adjusted to -8 kPa. Then the draining tube of the suction canister was placed in the water; fully open the regulating valve before adjusting the valve. The pressure of the control group was adjusted to -14~-8 kPa; the pressure of experimental group was adjusted to -7~-5 kPa. After the patient was awoken from anesthesia, the patient was transferred to the ward, and the suction canister was placed 10 cm below the bed.

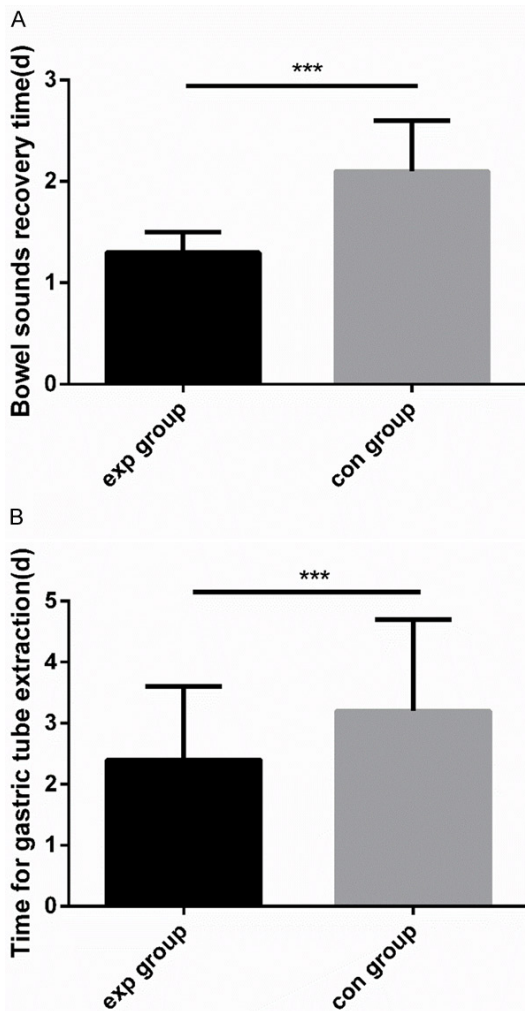
#### Observational indicators

The time of bowel sounds recovery and the time of gastric tube removal were compared between the two groups. The volume of abdominal drainage on the 1st, 3rd, and 7th postoperative day were also compared between the groups. The incidence of rectal drainage tube blockage and postoperative complications (incision infection, pneumonia, gastric retention, anastomotic leakage, intestinal obstruction) were also evaluated.

## Low negative pressure suction drainage promotes recovery

**Table 2.** Comparison of the time of bowel sounds recovery and the time of gastric tube removal (mean  $\pm$  sd)

Group	Experimental group (n = 75)	Control group (n = 75)	t/ $\chi^2$	P
Time of bowel sounds recovery (d)	1.35 $\pm$ 0.27	2.14 $\pm$ 0.57	10.850	< 0.001
Time of gastric tube removal (d)	2.44 $\pm$ 1.22	3.25 $\pm$ 1.57	3.528	< 0.001



**Figure 1.** Comparison of the time of bowel sounds recovery and the time of gastric tube removal. Exp group: experimental group; con group: control group. \*\*\*P < 0.001.

### Statistical analysis

All data were analyzed with SPSS 22.0 statistical package. Quantitative values are expressed as mean  $\pm$  sd and differences between groups were evaluated using independent t-test. Enumeration data are expressed as number/percentage (n/%) and differences between groups were compared by  $\chi^2$  test. Statistical figures were generated using Graphpad Prism

7. A P value less than 0.05 is considered significant.

### Results

#### Comparison of general information

There was no significant difference in gender, age, BMI, and underlying diseases between the two groups (all P > 0.05) as shown in **Table 1**.

#### Comparison of the time of bowel sounds recovery and the time of gastric tube removal

The time of bowel sounds recovery and the time of gastric tube removal in the experimental group were significantly shorter than those in the control group (all P > 0.05) as shown in **Table 2** and **Figure 1**.

#### Comparison of the volume of abdominal cavity drainage

There was no significant difference in the volume of abdominal drainage between the experimental group and the control group on the 1st, 3rd, and 7th day after surgery (all P > 0.05) as shown in **Table 3** and **Figure 2**.

#### Comparison of the incidence of rectal drainage tube blockage

The incidence of rectal drainage tube blockage after surgery in the experimental group (4.00%) was significantly lower than that in the control group (18.67%) (P < 0.01) as shown in **Table 4**.

#### Comparison of postoperative complications

The incidence of anastomotic leakage in the experimental group (5.33%) was significantly lower than that in the control group (16.00%) (P < 0.05), while the other complications were not significantly different between the two groups (all P > 0.05) as shown in **Table 5**.

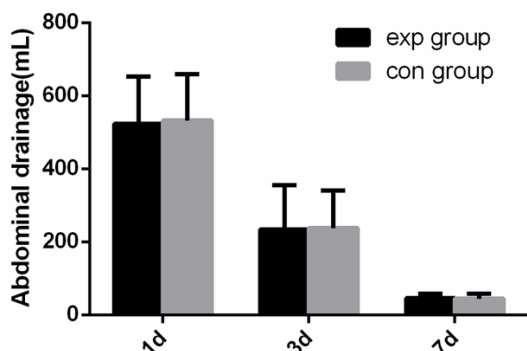
### Discussion

The disposable negative pressure suction canister is widely used in clinical surgical depart-

**Table 3.** Comparison of the volume of abdominal cavity drainage (mean ± sd)

Group	Experimental group (n = 75)	Control group (n = 75)	t/χ <sup>2</sup>	P
POD 1 (mL)	523.45 ± 129.32	532.25 ± 127.22	0.420	0.675
POD 3 (mL)	234.51 ± 121.32	237.82 ± 103.34	0.180	0.857
POD 7 (mL)	45.63 ± 12.36	44.41 ± 13.28	0.583	0.561

POD: Postoperative day.



**Figure 2.** Comparison of the volume of abdominal drainage. 1d: postoperative day 1; 3d: postoperative day 3; 7d: postoperative day 7; exp group: experimental group; con group: control group. \*\*\*\*P < 0.001.

ments, such as breast surgery department, thyroid surgery department, etc. The negative pressure suction canister can drain the gas and fluid residue from the wound cavity through negative pressure and siphon principle [14, 15]. According to the magnitude of the negative pressure, the suction devices can be categorized as regular pressure or low pressure suction devices, both of which can be used for drainage based on the type and site of the surgery. Abele et al. found that using negative pressure suction devices can effectively drain the residual fluid from the surgery site and promote healing of the wound after thyroidectomy [16]. In terms of gastrointestinal surgery, due to the inhibition of neuromuscular function, the non-dynamic intestinal paralysis and decreased absorption function caused by sympathetic excitation following surgery, the intestinal peristalsis, secretion and absorption function of the patient decreased significantly, which was manifested as a series of complications such as prolonged gastric emptying, delayed exhaust time and difficulty in defecation [17, 18]. Severe complications can affect the patient's nutritional status and prognosis. Through negative pressure suction, gastrointestinal con-

tent can be drained out thoroughly, which enhances intestinal peristalsis. As a result, even in the fasting condition, the peristaltic rhythm appears regular; if enteral nutrition is given, the patient can expect faster intestinal function recovery and early passage of gas and bowel movements [19]. However, if the suction pressure is too high, the mucosa could be damaged,

which is detrimental to the gastrointestinal peristalsis and function recovery [20]. Our study also demonstrated that after low negative pressure suction, the time of bowel sounds recovery was significantly shorter, which can be explained by the fact that low-pressure suction effectively gets rid of the luminal contents without damaging the gut mucosa.

Negative pressure suction uses a certain negative pressure to aspirate the luminal contents including blood and inflammatory exudate, which reduces the pressure in the gastrointestinal lumen and further improves the local and overall conditions. On the other hand, the reduction of intra-abdominal pressure is conducive to the alleviation of respiratory and circulatory disorders [21]. Our results are consistent with the study conducted by Sharma et al. who found that there was no difference in the volume of abdominal drainage after pyloric obstruction surgery between low negative pressure suction and regular pressure suction [22]. Similarly, our study showed no significant difference in the volume of abdominal drainage on the 1st, 3rd, and 7th postoperative day between low-pressure suction group and regular pressure suction group. It has been fully demonstrated that low negative pressure suction rectal drainage after rectal cancer surgery will not affect absorption and drainage of exudate in the abdominal cavity. In addition, it has no apparent adverse effect on abdominal pressure, and will not delay the healing of wounds.

Anastomotic leakage is a common complication after gastrointestinal surgery. As the gastrointestinal content leak through the anastomosis, if not fully drained out, the content will continue to leak into the abdominal cavity to cause severe infection [23]. Negative pressure suction effectively drains residue out from the gastrointestinal tract, which makes the incidence of anastomotic leakage significantly reduced.

## Low negative pressure suction drainage promotes recovery

**Table 4.** Comparison of the incidence of rectal drainage tube blockage [n (%)]

Group	Experimental group (n = 75)	Control group (n = 75)	t/ $\chi^2$	P
Cases of tube blockage	3 (4.00%)	14 (18.67%)	8.027	0.005

**Table 5.** Comparison of postoperative complications [n (%)]

Group	Experimental group (n = 75)	Control group (n = 75)	t/ $\chi^2$	P
Incision infection	4 (5.33)	5 (6.67)	0.118	0.731
Pneumonia	3 (4.00)	2 (2.67)	0.207	0.649
Gastric retention	2 (2.67)	4 (5.33)	0.694	0.405
Anastomotic leakage	4 (5.33)	12 (16.00)	4.478	0.038
Intestinal obstruction	4 (5.33)	3 (4.00)	0.150	0.699

Other postoperative complications such as incision infection, pneumonia, gastric retention, intestinal obstruction, etc. are not affected by intra-abdominal pressure. The major influencing factor of incision infection is pathogen. Because the silicone drainage tube is sterile, we didn't see any difference in infectious complications between the two groups. Gastric retention and intestinal obstruction are usually the results of intestinal motility disorders. Different negative pressures have no direct effect on intestinal motility and secretion, so there was no difference in the incidence of those complications between the two groups.

This study analyzed the clinical efficacy of low-pressure suction drainage on the recovery of intestinal function after rectal cancer surgery, which is rarely studied so far. However, the relatively small sample size in this study limited the further analysis of the results. Future studies will delve into how low-pressure suction drainage improves patient's prognosis by protecting intestinal mucosa and function.

In conclusion, the use of low-pressure suction drainage after rectal cancer surgery can shorten the time of bowel sounds recovery, reduce the incidence of tube blockage, and effect anastomotic leakage without affecting the drainage of abdominal cavity, which is highly recommended in clinical practice.

### Disclosure of conflict of interest

None.

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## Low negative pressure suction drainage promotes recovery

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