A Novel Technique for Low Rectal Cancer: Pushing the Anus in Laparoscopic Radical Resection

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Research Article

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Abstract

Background: In sphincter-preserving surgery for low rectal cancer, it is significant to reduce the number of stapler cartridges and the incidence of anastomotic leakage. On this basis, we have developed a safer and more economical technique— pushing the anus in laparoscopic radical resection of low rectal cancer.

Method: From January 2015 to July 2020, 213 consecutive patients with rectal cancer received laparoscopic radical surgery. For 151 of these patients, the surgeon used the stapler cartridges (Ethicon Intraluminal Linear Staplers EC60A, Ethicon, USA) to transect the edge of tumor of the rectum (Conventional Surgery Group). And for another 62 patients, besides applying the stapler cartridges, the surgeon had the assistants push the anus forward from the perineum during the process of transecting the rectum (Pushing the Anus Group). The postoperative outcomes and complications were compared between the two groups.

Results: In terms of the number of the stapler cartridges, the Pushing the Anus Group was less than the Conventional Surgery Group ($P < 0.001$). Moreover, the incidence of anastomotic leakage in the Pushing the Anus Group is lower than that in the Conventional Surgery Group ($P = 0.043$).

Conclusions: With pushing the anus forward during the process of transecting the rectum, the sphincter-preserving surgery can be performed more safely and economically.

Introduction

Colorectal cancer (CRC) is a common malignant tumor in the gastrointestinal tract. Around the world, CRC ranks 2nd among cancer deaths, with its incidence rate ranks third.¹ And the rectal cancer accounts for approximately 40% of CRC and constitutes a serious global public health burden. And surgery remains the cornerstone of curative intent treatment for rectal cancer.² There are a lot of consensuses on rectal cancer surgery: such as total rectal mesenteric excision (TME), root lymph node dissection of the inferior mesenteric artery (IMA), pelvic autonomic nerve preservation, etc.³

However, as for low rectal cancer, how to perform anal preservation surgery and reduce anastomotic leakage has still been a hot topic of research. Despite significant advances in laparoscopic instrumentation and anastomoses, anal preservation of low rectal cancer is still very difficult for those with narrow pelvis and obese patients,⁴ especially when transecting the rectum at the lower edge of the tumor. In the conventional procedure, the surgeon often needs to use additional stapler cartridges. Besides, increased tension caused by excessive straining of the rectum has a negative influence on the nail formation and may lead to tearing of the seromuscular layer, as well as affect the blood supply of the broken end of the rectum. All of these would result in increased incidence of anastomotic leakage when we create an anastomosis later. For this reason, during the rectal transection, the surgeon pushed the anus forward from the perineum in order to bring the operating plane closer to the pelvic inlet to obtain a wider operating space.

The study describes a novel technique to reduce the incidence of anastomotic leakage in the sphincter-preserving surgery with fewer stapler cartridges. The details and evaluation of this technique are described below.

Patients And Methods

Patients

We retrospectively collected the clinical data of 237 consecutive patients who underwent laparoscopic radical surgery for rectal cancer with the lower margin of the tumor at a distance of 2.8-5cm from the anal verge between January 2015 and July 2020. All patients are operated on independently by the same surgical team. In 18 of these patients, a protective ileostomy was performed because of minor colonic edema. And in 6 patients, the splenic flexure was released to allow sufficient intestine for anastomosis because the marginal vessels were found to be incompetent intraoperatively. These 24 patients were excluded in order to avoid bias on surgical outcomes, and 213 patients were eventually included in the study. All patients were actively prepared for surgery, including controlling blood glucose, correcting hypoproteinemia and routine smoking cessation, etc. In addition, all patients underwent adequate bowel preparation and no patients required surgery due to obstruction. Patient's clinicopathological features are summarized in Table 1. In 62 of these patients, the anus was pushed by an assistant from the perineum toward the pelvic inlet plane during transecting of the rectum with the cartridges (Pushing the Anus Group). The remaining 151 patients were artificially assigned to the Conventional Surgery Group. We observed the operative outcomes, postoperative recovery and postoperative complications of both groups.

Table 1
Clinicopathological features

	Conventional Surgery Group(n=151)	Pushing the Anus Group(n=62)	P-value
Age, mean±SD (years)	62.0±9.7	63.6±10.1	0.283
Sex			0.267
Male	109	40	
Female	42	22	
BMI, mean±SD (kg/m ²)	19.1±2.9	18.8±3.0	0.504
ASA classification			0.560
I	78	29	
II	61	28	
III/IV	12	5	
PT stage			0.206
T1	12	8	
T2	21	7	
T3	19	13	
T4	97	34	
PN stage			0.927
N0	26	11	
N+	125	51	
Tumor size (cm)	3.6(2.8,4.5)	3.5(2.5,4.5)	0.655
Neoadjuvant therapy	13	3	0.508
Distance from the lower edge of the tumor to the anal verge	4.09±0.61	4.03±0.68	0.533
<i>SD</i> standard deviation, <i>BMI</i> body mass index, <i>ASA</i> American Society of Anesthesiology			

Each patient signed an informed consent before surgery. Patients were managed based on the critical protocols of our institution. The Institutional Review Board of Southwest Medical University approved this retrospective study. In addition, all methods were performed in accordance with the relevant guidelines and regulations.

Surgical Techniques

Under the condition of general anesthesia, the patient was placed in the Lloyd-Davies position. The surgeon stood on the right side of the patient, while the first assistant stood on the left side of the patient and the laparoscope operator stood on the patient's head side. After pneumoperitoneum was established, a 10mm camera trocar was introduced below the umbilicus. Four additional trocars were created in the lower abdomen. (Fig. 1)

Under the Trendelenburg position, the small intestine was displaced from the pelvis through tilting the body to the right. The sigmoid colon was detached from the abdominal wall. And then the foot of the sigmoid mesocolon is dissociated from the medial to the lateral. Lymph nodes in the root of the inferior mesenteric artery were cleared and the left colonic artery was preserved. Then, the inferior mesenteric artery and the inferior mesenteric vein were ligated and transected. The lateral colonic attachments were then loosened along the White line of Toldt to completely mobilize the lower descending sigmoid colon. And take care to protect the ureter, the inferior ventral nerve and the pelvic parasympathetic plexus. Similar to a beaded plastic Foley catheter bag hanger, we used gauze to pull the rectum to maintain its tension and make it easier to operate. ⁵ (Fig. 2)

Following the principles of total rectal mesenteric excision (TME) as described by Heald et al, the rectum was freed to the lower edge of the tumor. ⁶ And performing partial or full intersphincteric resection (ISR) depending on the intraoperative situation. ⁷ (Fig. 3)

Unlike traditional surgery, during the transverse rectotomy, an assistant applied an external force to the folded gauze with his fist to push the anus forward from the perineum so that we could bring the surgical plane closer to the pelvic inlet to obtain a wider surgical space (Fig. 4). Then a surgical incision of about 5-8 cm was made in the left lower abdomen. And for patients whose resection margins of the distal end of the tumor were less than 2 cm, the cut-off end of specimens should be sent for intraoperative frozen biopsies. And the tumor was completely removed and the anastomotic anvil was successfully placed. Reconstruct the pneumoperitoneum, then place circular stapler (Ethicon Intraluminal Circular Staplers CDH29A, Ethicon, USA) through the anus, and complete the anastomosis successfully. Plasma drainage tube was placed through the perineum and right lower abdomen, while the anal canal was placed in the bowel lumen through anus. (Fig. 5)

Statistical analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS®) version 23.0. Quantitative data were described by mean $\pm$ standard deviation if they obeyed normal distribution, otherwise they were described by median and upper and lower quartiles; qualitative data were described by number of cases and percentage. The comparison of quantitative data between two groups was based on whether the data obeyed normal distribution using student's t test or Mann-Whitney U test, respectively. The comparison of qualitative data was based on whether the data were ordered

using Mann-Whitney U test or Pearson chi-square test, and when the theoretical frequency was too small the Fisher's exact probability method (Fisher's exact test) instead of the chi-square test. $P < 0.05$ was considered statistically significant.

Results

Clinicopathological features

Table 1 shows the summary of patients' clinicopathological features. The Conventional Surgery Group and the Pushing the Anus Group consisted of 151 and 62 patients, with the average age of 62.0 ± 9.7 years and 63.6 ± 10.1 years, respectively ($P=0.283$). In the Conventional Surgery Group, 109 (72.2%) patients were male compared to 40 (64.5%) in the Pushing the Anus Group ($P=0.267$). The mean BMI in the Conventional Surgery Group was $19.1 \pm 2.9 \text{ kg/m}^2$ compared to $18.8 \pm 3.0 \text{ kg/m}^2$ in the Pushing the Anus Group ($P=0.504$). And there was no significant difference in terms of the ASA classification ($P=0.560$), the proportion of pathologic depth of invasion ($P=0.206$), the lymph node metastasis ($P=0.927$), the tumor size ($P=0.655$), Neoadjuvant therapy ($p=0.508$) and the distance from the lower edge of the tumor to the anal verge ($P=0.533$).

Operative Outcomes And Postoperative Recovery

The summaries of operative outcomes and postoperative recovery are shown in Table 2. During pushing the anus forward from the perineum, we used an epidural anesthesia catheter (One scale represents one centimeter) to measure the distance the distal rectum advanced to the pelvic inlet plane (Fig. 6a-c). In the Pushing the Anus Group, the distal rectum was moved forward an average of 2.51 cm towards the pelvic inlet plane. Among them, male patients' distal rectums were moved forward an average of 2.31 cm, while those of female patients were moved forward an average of 2.89 cm. This may be due to the wider pelvis in female patients. There was no significant difference in the aspect of the proportion of intraoperative bleeding ($P=0.701$), the time of first postoperative meal ($P=0.218$), the time of first anal exhaust ($P=0.139$), the postoperative length of hospital stay ($P=0.340$), the operative time ($P=0.884$). However, compared with the Conventional Surgery Group, the number of stapler cartridges was less in the Pushing the Anus Group ($P<0.001$).

Table 2

Operative outcomes and postoperative recovery compared between Conventional Surgery Group and Pushing the Anus Group

	Conventional Surgery Group (n=151)	Pushing the Anus Group(n=62)	P-value
Intraoperative bleeding (ml)	50.0(30.0,50.0)	50.0(30.0,50.0)	0.701
First postoperative meal (day)	5.0(4.0,5.0)	5.0(4.0,5.0)	0.218
First anal exhaust (day)	3.0(3.0,4.0)	3.0(3.0,4.0)	0.139
Postoperative hospital stay (day)	9.0(9.0,10.0)	10.0(9.0,12.0)	0.340
Operative time(min)	249.3±45.6	250.2±39.7	0.884
Number of stapler cartridges	2.0(2.0,3.0)	1.0(1.0,2.0)	<0.001*
The average distance of anus moved forward(cm)			
All people		2.51	
Women		2.89	
Men		2.31	
* $P < 0.05$			

Postoperative Complications

The statistical analysis of postoperative complications is summarized in Table 3. The anastomosis leakage is diagnosed and graded according to the proposal by the ISREC.⁸ The statistic data show that there was no significant difference in the anastomotic bleeding ($P=1.000$), the anastomotic stenosis ($P=0.582$), the pulmonary complication ($P=1.000$), the postoperative obstruction ($P=1.000$), the urinary retention ($P=1.000$), the Chylous ascites ($P=0.582$) and the abdominal infection ($P=0.418$). However, the incidence of anastomotic leakage in the Pushing the Anus Group is much lower than that in the Conventional Surgery Group ($P=0.043$).

Table 3

Postoperative complication compared between Conventional Surgery Group and Pushing the Anus Group

	Conventional Surgery Group(n=151)	Pushing the Anus Group(n=62)	P- value
	(n=151)	(n=62)	
Anastomotic leakage	17	1	0.043*
Anastomotic bleeding	8	3	1.000
Anastomotic stenosis	2	2	0.582
Pulmonary complication	11	4	1.000
Postoperative obstruction	5	2	1.000
Urinary retention	6	2	1.000
Chylous ascites	2	2	0.582
Abdominal infection	4	3	0.418
* $P < 0.05$			

Discussion

In this study, the anus was pushed forward from the perineum to make the surgical plane closer to the pelvic entrance and obtain wider surgical space. This technique reduced the use of stapler cartridges, saved economic costs, and reduced the incidence of anastomotic leakage. Due to the soft tissue structure of the pelvic floor and the course of the rectum itself, the distal rectum can move forward by pushing the anus of the patient who is in the Lloyd-Davies position. Although the distal rectum is moved forward only 2.51cm on average with this method, the increased operating space for funnel-shaped pelvis and laparoscopic surgery with refinement and magnification is huge.

Anal preservation of low rectal cancer is still very difficult for men with narrow pelvis and obese patients. With the development of laparoscopy and anastomosis technology, as well as the mature of ISR technology in recent years,⁹ it has become a reality to preserve the anus of rectal cancer patients whose tumor distance from the anal margin is less than 5cm. In addition to the traditional laparotomy, the surgical methods mainly involve the robotic-assisted laparoscopic surgery (R-TME),¹⁰ the laparoscopic total mesorectal excision,¹¹ and the transanal total mesorectal excision (taTME).¹² It is not yet possible to prove which approach is more advantageous.¹³ Some studies recommend taTME for obese male patients and low rectal cancer,^{14,15} however, in some countries such as Norway, this procedure was discontinued due to a higher incidence of postoperative anastomotic leakage than nationwide, unfavorable local recurrence rates and growth patterns.¹⁶ Besides, inclusion criteria regarding the

distance of the tumor from the anal verge have not been standardized and taTME may cause unnecessary organ loss with very low potential morbidity and functional defects of the anastomosis.¹⁷ And the robotic surgery is not widely used due to the high cost and the complexity of the operation, so the laparoscopic mesorectal resection is still the main surgical method.¹³

In terms of the surgical therapy of low rectal cancer, how to reduce its anastomotic leakage has always been a huge problem. Studies have reported that the incidence of anastomotic leakage after rectal cancer surgery is 3–26%.^{18–20} The distance between the tumor and the anal margin is an independent risk factor for anastomotic leakage after laparoscopic sphincter-preserving surgery for rectal cancer.^{21,22} Currently, the stapler cartridges of the linear staplers still cannot be rotated 90° laparoscopically because of its structure. In addition, due to the narrow space in the lower part of the funnel-shaped pelvis, the surgical dissection and the creation of an anastomosis is technically challenging and often require additional stapler cartridges to complete the surgical procedure. Some studies have shown that anastomotic leakage is related to the number of stapler cartridges used. Three or more cartridges of the linear stapler are a risk factor for anastomotic leakage.^{23–25} In addition, recent systematic evaluation has shown that using two cartridges also have a higher incidence of anastomotic leakage than using one during laparoscopic rectal cancer resection.²⁶ In all of our patients with anastomotic leaks, the number of stapler cartridges used was more than two, which may have contributed to a higher incidence of anastomotic leaks in the conventional surgery group. It is reported that the limited vascular supply is an important risk factor of anastomotic leakage.²⁷ The more stapler cartridges used during the operation, the more the Junction and length of the cutting edge, and the worse blood supply of the anastomosis, can lead to the greater risk of postoperative anastomotic leakage.²⁸

In this regard, during the rectal transection, we create an innovative method that pushing the anus forward from the perineum to bring the operating plane closer to the pelvic inlet. And a wider operating space can be obtained, so that the resection margin can be nearly perpendicular to the long axis of the rectum with the use of the linear staplers, which helps to reduce the number of stapler cartridges used in transverse rectal transection. In addition, the pushing technique can also reduce the tension during nailing to a certain extent, improve the nailing effect accordingly, and protect the integrity of the seromuscular layer and the blood supply of the broken end of the rectum better. All of these are helpful to reduce the occurrence of anastomotic leakage.

Furthermore, it saves economic costs due to the reduction in the number of stapler cartridges. Therefore, this useful technique has the advantage to popularize easily. However, the weaknesses of the study lie in retrospective nature and small number of the patients. Further studies will involve more patients and studies of short-term and long-term surgical outcome.

Conclusion

In sphincter-preserving surgery for low rectal cancer, pushing the anus forward from the perineum reduces the incidence of anastomotic leakage. This technique can be developed as a safe and cost-effective

method for low rectal cancer patients.

Declarations

Ethics approval and consent to participate

We comply with all ethical requirements. Each patient signed an informed consent before surgery. Patients were managed based on the critical protocols of our institution. The Institutional Review Board of Southwest Medical University approved this retrospective study.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analysed during this study are included in this published article.

Competing interests

No competing interests exist.

Funding

No funds were received in support of this work.

Author Contribution statement

Rui Yang and Yuyi Yang are members of our team who have made a direct and substantial contribution to the study by conceiving and designing the study—collecting and analyzing the data and writing this paper.

Qingqiang Yang is leader of our team who has been involved in the design and revision of this study.

Jianxin Li is a member of our team who has been involved in the related operations and collection of data.

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Figures

Figure 1

Placement of trocar. **a** 10-mm metal trocar for the scope, **b** 10-mm trocar, **c** 10-mm trocar, **d** 10-mm trocar, **e** 12-mm trocar

Figure 2

Pulling the rectum with gauze

Figure 3

Pelvic floor condition after dissociation. **a** posterior rectum, **b** Anterior rectum

Figure 4

Transecting the rectum while pushing the anus. **a** Pushing the anus by assistant (position of pushing the anus: in male patients, it is between the upper edge of the anus and the lower edge of the scrotum; in female patients, it is between the upper edge of the anus and the lower edge of the labia majora), **b** Transection of the rectum below the tumor

Figure 5

The completion of anastomosis. **a** Digestive tract reconstruction, **b** Placement of plasma drainage tube

Figure 6

The distance of the distal rectum advance towards the pelvic inlet plane by pushing technique. **a** placing the gauze strip in the pelvic inlet plane, **b** the distance from the distal rectum to the gauze strip before pushing the anus, **c** the distance from the distal rectum to the gauze strip after pushing the anus