Original Article

Clinical Significance of Pelvic Peritonization in Laparoscopic Dixon Surgery

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Abstract

Background: Pelvic floor peritoneum reconstruction is a key step in various standard resections for open radical rectal cancer. However, during endoscopic surgery, most surgeons do not close the pelvic floor peritoneum. This study aims to evaluate the efficacy of pelvic peritonization during laparoscopic Dixon surgery using an observational study.

Methods: A total of 189 patients, who underwent laparoscopic Dixon surgery at Tianjin Union Medical Center, China, were analyzed retrospectively. All of the cases were divided into two groups according to the differences of surgical procedure. The 92 patients in Group A (observation group) underwent pelvic peritonization and the 97 patients in Group B (control group) did not undergo this procedure. Postoperative complications were observed in the two groups, compared, and analyzed using the Chi-square or Fisher's exact test.

Results: The incidence of anastomotic leakage was significantly lower in Group A than in Group B ($P = 0.014$). A significant difference was found in the postoperative short-term ($P = 0.029$) and long-term ($P = 0.029$) ileus rates between the two groups, with Group A exhibiting a lower rate than Group B. Patients in Group A had significantly lower rates of postoperative infections than those in Group B ($\chi^2 = 7.606$, $P = 0.006$; $\chi^2 = 4.464$, $P = 0.035$). Patients in Group A had significantly lower rates of deep venous thrombosis than those in Group B ($\chi^2 = 8.531$, $P = 0.003$).

Conclusions: Pelvic peritonization effectively reduces postoperative complications, such as anastomotic leakage, which warrants its increased use in laparoscopic surgery.

Key words: Anastomotic Leakage; Ileus; Laparoscopy; Pelvic Peritonization; Rectal Cancer

Introduction

The mortality rate of patients with colorectal cancer is ranked among the top three malignancies worldwide, and one-third of the tumors originate from the rectum.[1,2] In China, more than 200,000 new cases of rectal cancer are diagnosed every year, of which 40% of patients are Stage III at the time of diagnosis.[1] Surgery is the core method for treating rectal cancer and is universally accepted to control the disease and prolong survival. Currently, endoscopy is widely used in the field of colorectal surgery due to its benefits in reducing bleeding, decreasing the dependence of patients on analgesics, accelerating the recovery of gastrointestinal function, and shortening the length of hospital stay.[3-5] Pelvic floor peritoneum reconstruction is a key step in various standard resections for open radical rectal cancer. However, during endoscopic surgery, most surgeons do not close the pelvic floor peritoneum due to the difficulties inherent in pelvic floor reconstruction and restriction of the learning curve. Several studies examining Miles surgery have confirmed that closing the pelvic floor is vital in laparoscopic surgery.[6-8] However, very few studies have reported the effect of pelvic floor reconstruction during laparoscopic Dixon surgery. Here, we retrospectively reviewed our rectal surgery cases and explored the efficacy of pelvic peritonization during the laparoscopic Dixon procedure.

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Methods

Ethical approval

The study was conducted in accordance with the *Declaration of Helsinki* and was approved by the Tianjin Union Medical Center Institutional Ethical Review Board. Informed written consent was obtained from all patients before their enrollment in this study.

Case collection and patient characteristics

The inclusion criteria were as follows: (1) age between 18 and 80 years; (2) mid-low rectal cancer below the peritoneal reflection; (3) the patient underwent the laparoscopic Dixon procedure; and (4) the operation was not emergency surgery.

The exclusion criteria were as follows: (1) a history of abdominal surgery; (2) a preoperative diagnosis of distant metastasis; (3) the cancer was not a primary tumor; (4) generally severe medical conditions of the patient including severe anemia, hypoproteinemia, or liver and kidney dysfunction; (5) emergency surgery; (6) the patient underwent prophylactic ileostomy; and (7) the patient received neoadjuvant therapy before surgery.

Our study retrospectively reviewed 259 patients who underwent low rectal cancer surgery from September 2014 to February 2017 at Tianjin Union Medical Center, China. A total of 192 cases were selected according to the inclusion and exclusion criteria listed above. The 93 patients in Group A (observation group) underwent pelvic peritoneum reconstruction, whereas the pelvic floor peritoneum was not sutured in the 99 patients in Group B (control group). Three patients converted to a laparotomy during laparoscopic surgery (one person in Group A and two people in Group B). During the 6-month postoperative follow-up, two patients in Group A and eight patients in Group B were lost to follow-up. Thus, 92 patients in Group A and 97 patients in Group B were ultimately included in the analysis. The baseline and clinical characteristics of the patients in each group are shown in Tables 1 and 2.

Surgical procedure

All surgeries were completed by two senior surgeons using a standard laparoscopic procedure after preoperative preparations. For the laparoscopic approach, a five-port technique was employed. Group A: first, the organs in the abdominal cavity were explored, the inferior mesenteric vessels were divided, and the lymph nodes around the vessels were dissected. Then, the rectum was excised above the dentate line after the sigmoid colon and rectum were separated from the surrounding tissues. Next, a 5-cm incision was made in the left lower quadrant for tumor resection, and the intestinal canal was cut 10 cm above the tumor after the colon was pulled out of the incision. End-to-end anastomosis was performed using a stapler, and colonic continuity was reconstructed. For pelvic floor reconstruction [Figure 1], the peritoneum was sutured to the intestinal wall above the anastomosis. Finally, a flushable drainage tube was placed between the colon and sacrum. Group B: all of the procedures were the same as described for Group A except for the pelvic peritonization with direct placement of a drainage tube. All patients required postoperative chemotherapy in our hospital and were followed up at 6 months.

Indicators observed postoperatively

Indicators observed postoperatively were as follows: (1) rate of anastomotic leakage; (2) rate of postoperative short-term (before hospital discharge) ileus; (3) rate of postoperative long-term (6 months after surgery) ileus; (4) rate of respiratory infections; (5) rate of urinary tract infections; and (6) rate of deep venous thrombosis.

Statistical analysis

All data were analyzed using the SPSS version 20.0.0 for Windows (SPSS, Chicago, IL, USA) statistical software. Continuous variables marked as mean ± standard deviation (SD) were analyzed using Student's *t*-test; otherwise, data that were not normally distributed were analyzed using the rank-sum test. The Chi-square or Fisher's exact test was used for categorical variables marked as "rate." $P < 0.05$ was considered statistically significant.

Results

In our study, 189 patients who underwent a laparoscopic Dixon procedure were reviewed. A total of 92 patients were included in Group A, and 97 patients were included in Group B. No significant differences were found in the clinical data between groups including age, gender, body mass index, preoperative absolute white blood cell count,

Table 1: Patient clinical characteristics in the two groups

Clinical characteristics	Group A	Group B	*t* or χ^2	*P*
Gender (male/female)	56/36	60/37	0.019*	0.889
Age (years), mean ± SD	62.23 ± 4.34	62.45 ± 4.89	−0.335	0.738
BMI, mean ± SD	20.53 ± 1.88	20.10 ± 2.07	1.497	0.136
Preoperative absolute WBC count (×10^9/L), mean ± SD	7.16 ± 1.11	7.35 ± 1.13	−1.176	0.241
Preoperative hemoglobin (g/L), mean ± SD	131.86 ± 14.16	133.97 ± 16.61	0.935	0.351
Preoperative albumin (g/L), mean ± SD	37.33 ± 1.95	37.21 ± 1.76	0.425	0.671
Blood loss (ml), mean ± SD	83.39 ± 18.95	86.33 ± 17.62	−1.105	0.271
Operation time (min), mean ± SD	161.84 ± 35.03	166.76 ± 33.93	−0.981	0.328
Anastomotic distance from anal verge (mm), mean ± SD	45.96 ± 12.60	44.30 ± 12.82	0.896	0.371

*χ^2 value. Group A: Observation group; Group B: Control group. SD: Standard deviation; BMI: Body mass index.

preoperative hemoglobin, preoperative albumin, blood loss, operation time, clinicopathological features of the tumor, and the anastomotic location ($P > 0.05$), which indicated that the two groups had consistent baseline characteristics and were comparable.

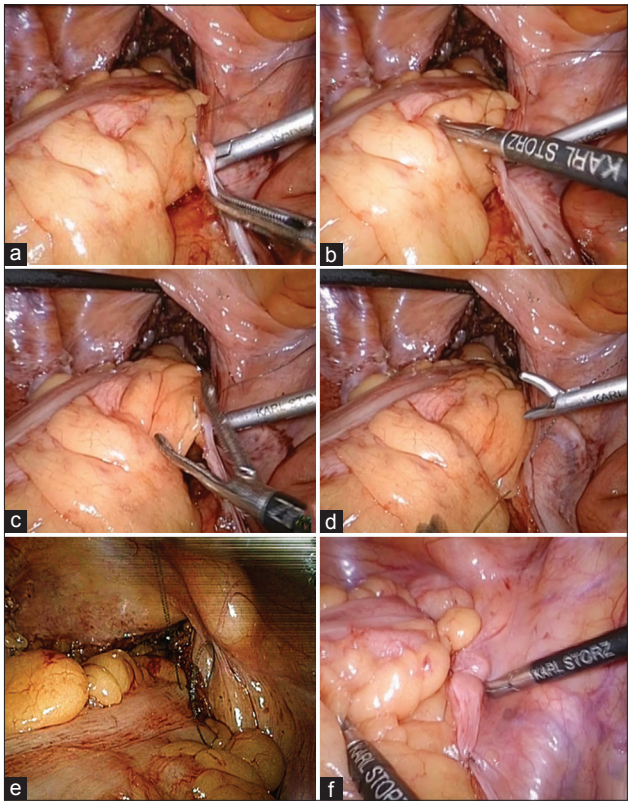

Figure 1: The procedure of the pelvic peritonization. (a) Keep the hand holding the needle still after penetrating the peritoneum; (b) use the other hand to bring up the intestine with the grasping forceps catering to the needle; (c) the hand with the acutenaculum forces the needle through the intestinal wall; (d) strain the suture and finish one stitch; (e) keep on running suture; (f) the pelvic floor has been reconstructed.

Of the indicators observed postoperatively, no patients in Group A suffered from anastomotic leakage, whereas seven cases of anastomotic leakage occurred in Group B, including six patients who were cured after peritoneal lavage and drainage, antibiotic, jejunitis, and parenteral alimentation therapies. One female patient had a pelvic abscess whose prognosis was satisfactory after a posterior vaginal fornix puncture. The anastomotic rate was significantly lower in Group A than in Group B ($P = 0.014$). No case of ileus occurred during the short-term or long-term postoperative period in Group A (two patients were lost to follow-up), but six cases in Group B developed ileus during hospitalization; their symptoms improved after therapy including jejunitis, gastrointestinal decompression, ambulation, and glycerin enema clyster. Six months after the operation, eight patients were lost to follow-up and five patients suffered from intestinal obstruction. Two patients were cured using conservative management, two patients underwent treatment for transnasal intestinal obstruction with catheter implantation, and one patient who had a strangulated peritoneal hiatus hernia recovered well after a celiotomy. During the operation, we observed part of the small intestine herniate into the pelvic cavity and ischemic osteonecrosis; therefore, we excised part of the small bowel. The short- and long-term ileus rates were significantly lower in Group A than in Group B ($P < 0.05$). Moreover, the respiratory and urinary tract infection and deep venous thrombosis rates were also significantly lower in Group A than in Group B ($P < 0.05$) [Table 3].

All patients were required to receive an abdominal computed tomography (CT) scan 6 months after surgery, which were shown in Figures 2 and 3.

Discussion

According to the standard treatment for open surgery for rectal cancer, pelvic floor reconstruction is required in all

Table 2: Characteristics of the tumors in the two groups

Groups	Pathological feature, *n*			TNM staging, *n*		
	Well differentiated	Moderately differentiated	Poorly differentiated	I	II	III
Group A	41	42	9	18	28	46
Group B	44	43	10	20	30	47

The data above were ordinal data, and the rank-sum test was used for the analysis. Pathological feature: $Z = -0.056$; $P = 0.955$. TNM staging: $Z = -0.229$; $P = 0.819$. Group A: Observation group; Group B: Control group. TNM: Tumor, node, and metastasis.

Table 3: Comparison of the postoperative observed indicators

Indicators	Group A ($n = 92$)	Group B ($n = 97$)	χ^2	*P*
Anastomotic leakage, *n* (%)	0	7 (7.2)	–	0.014
Ileus, *n* (%)				
Short-term	0	6 (6.1)	–	0.029
Long-term	0*	5 (5.6)*	–	0.029
Respiratory infections, *n* (%)	5 (5.4)	18 (18.6)	7.606	0.006
Urinary tract infections, *n* (%)	4 (4.3)	14 (14.4)	4.464	0.035
Deep venous thrombosis, *n* (%)	5 (5.4)	19 (19.6)	8.531	0.003

*Group A ($n = 90$) and Group B ($n = 89$) at 6 months after surgery. Group A: Observation group; Group B: Control group.

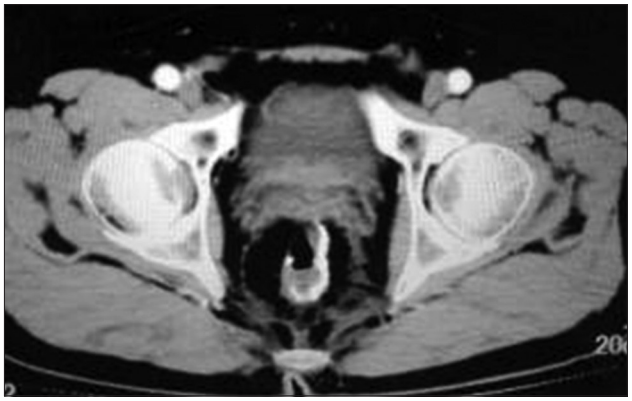

Figure 2: Computed tomography scan of patients in Group A.

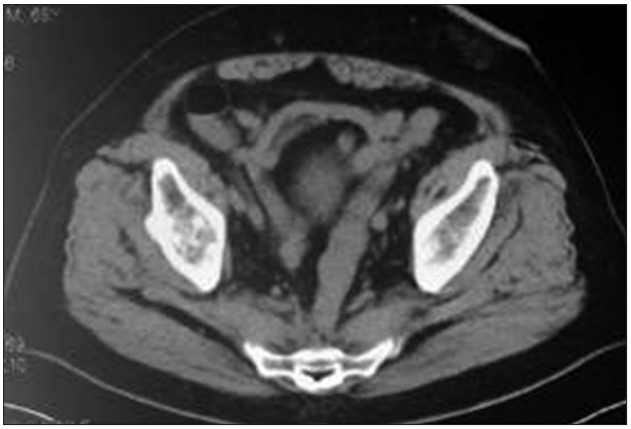

Figure 3: Computed tomography scan of patients in Group B.

types of surgical methods. However, during laparoscopic operations, most surgeons do not suture the pelvic peritoneum due to technical limitations and thus neglect the critical value of pelvic floor reconstruction, especially its role in laparoscopic Dixon surgery.

Our study indicates that pelvic peritoneum reconstruction in Dixon surgery reduces the rate of postoperative anastomotic leakage, which is an issue that greatly concerns all colorectal surgeons. The seven patients in Group B suffered from anastomotic leakage, whereas no patients in Group A suffered from leakage.

Tissue ischemia surrounding the anastomotic portion stemming from various causes is universally accepted to increase the risk of postoperative leakage.[9-14] If pelvic floor reconstruction is not performed during surgery, anastomotic tension will increase when the intestine is stretched with a change of position or intestinal peristalsis after surgery. Subsequently, the microvasculature of the anastomotic tissue will be compressed, resulting in ischemia-hypoxia of the local blood microcirculation. Eventually, the tissue will die and even undergo thanatosis, leading to anastomotic leakage.[15,16] In contrast, the risk of leakage is greatly decreased with a reduction in anastomotic tension due to fixation of the peritoneum to the intestine above the anastomotic portion. The tension will not increase even if the bowel is pulled. Anastomotic tension is presumed to be closely associated with anastomotic leakage. If too much of the intestine is excised and the position of the anastomosis is too low after peritoneal reconstruction, then the left colic flexure should be free to fully reduce the anastomotic tension.[17]

In our study, the patients in Group A ambulated as early as 1 day after the surgery, whereas the patients in Group B required bed rest for 4 days after surgery. The reasons for the delayed ambulation in Group B were as follows: (1) to prevent the anastomotic portion from being compressed by parts of the small bowel falling into the pelvic cavity due to gravity, resulting in intestinal anastomotic ischemia and leakage and (2) to decrease the rate of occurrence of an adhesive ileus. The pelvic inflammatory response is most severe a few days following surgery due to rectal operative trauma. If parts of the small intestine fall into the pelvic cavity at this time, a severe pelvic inflammatory reaction will damage the intestinal serosal mesothelium. Then, the fibrin agglutination cascade will be activated, resulting in the formation of adhesions,[18-22] which will increase the probability of an adhesive ileus. In contrast, when the patients in Group A underwent peritoneal reconstruction, the peritoneum separated the small intestine from the pelvic floor, and the intestine was not able to herniate into the pelvis. Thus, there was no risk of adhesion between the intestine and the pelvic tissue, which reduced the probability of an adhesive ileus after surgery. Given these findings, most of the patients in Group A were allowed to get out of bed on the evening of postoperative day 1 (a few patients who were old and weak ambulated on postoperative day 2). Earlier ambulation can promote recovery from gastrointestinal dysfunction[23,24] and decrease the risk of a paralytic ileus. In the Group B patients, although the wound tissue in the pelvis was partially repaired and the inflammation was not very extensive on the 4th day after surgery, intestinal obstruction occurred during the short- and long-term postoperative periods, even including one case with a pelvic abscess and one case with an internal hernia. All patients were required to receive an abdominal CT scan 6 months after surgery. In almost all Group B patients, parts of the small intestine had fallen into the pelvic cavity. Therefore, we are strongly convinced that it is a high-risk factor for a postoperative adhesive ileus and strangulated internal hernia. Conversely, the CT scans of the patients in Group A showed no presence of small intestine in the pelvic cavity.

Earlier ambulation in the Group A patients not only reduced the rate of intestinal obstruction but also reduced the rates of other complications such as pulmonary atelectasis, pulmonary infection, and deep venous thrombosis.[25] The urethral catheter could also be removed on the 1st day after the operation due to earlier ambulation in these patients. However, the patients in Group B were required to stay in bed for 4 days. To prevent the anastomotic portion from being compressed by distension of the urinary bladder due to urinary retention, the indwelling catheter was removed at a later time (immediately after the patient started ambulating), which could increase the risk of urinary tract infections.[26]

Thus, the rates of postoperative pulmonary infections, urinary tract infections, and deep vein thrombosis were significantly lower in Group A than in Group B ($P < 0.05$). These factors may also contribute to the development of a postoperative ileus.

A large number of studies have indicated that prophylactic ileostomy cannot reduce the incidence of postoperative anastomotic leakage,[13,27,28] but the risk of diffuse peritonitis, sepsis, and other catastrophic events secondary to leakage. Therefore, the majority of surgeons prefer to perform a conventional ostomy. In our hospital, after discussing the options in detail, we fully respect the patients' wishes concerning whether or not they choose to undergo a prophylactic ileostomy after nonpelvic floor reconstruction. In contrast, we did not perform an ileostomy in all cases of pelvic peritonization. In our study, to make the two groups comparable, we only selected cases who did not undergo ileostomy. In our results, anastomotic leakage was not observed in the Group A patients, which indicated that patients with pelvic peritonization could be free of ileostomy. Nonileostomy reduced the rate of complications caused by fistulas,[28] avoided the strike of a secondary procedure with stoma closure on the patents, improved the quality of life after surgery, and decreased the patients' total costs during hospitalization. Furthermore, the patients in Group A were able to avoid prophylactic ileostomy not only due to the extremely low incidence of postoperative leakage but also due to the lack of fatal complications even if anastomotic leakage occurred, which was determined by no risk of diffuse peritonitis due to the location of the anastomotic portion that was under new "peritoneal reflection" and out of the peritoneal cavity after pelvic floor reconstruction. When anastomotic leakage occurs, the leakage can be regarded as a perianal abscess, which can be treated accordingly. In addition, we placed a flushable drainage tube during the operation and only needed to rinse the pelvic cavity repeatedly.

Currently, endoscopic techniques are becoming increasingly popular in abdominal surgery. However, many surgeons believe that suturing and knotting are very difficult under a laparoscope because this procedure requires higher technical requirements. Peritoneal reconstruction is difficult using laparoscopy, which increases the operating time and leads to this significant step being ignored during surgery. However, with the constant emergence of new devices, the gradual maturity of training modes, and more harmonious cooperation among the members of the surgical team, pelvic floor peritoneal reconstruction is no longer a mysterious technique. Our experience is as follows: when we incise the peritoneal reflection, we frequently attempt to stick to the intestinal wall for tissue separation to create more opportunities for the next step of peritoneal reconstruction. When we suture the peritoneum for reconstruction, we hold a grasping forceps and an acutenaculum in each hand and coordinate our two hands mutually. We keep the hand holding the needle still after penetrating the peritoneum and use the other hand to bring up the intestine with the grasping forceps catering to the needle. Finally, the hand with the acutenaculum forces the needle through the intestinal wall, thereby fixing the peritoneum in the intestinal wall. Concerning the selection of an acutenaculum, an automatic resetting needle holder has been recommended by some doctors. However, we realize that adjusting the angle of the needle holder is not as flexible with the laparoscope as during open surgery, and automatic resetting needle holder always keeps a right angle between the needle and the holder. This issue increases the difficulty in obtaining an ideal angle of the needle and leads to an unsatisfactory effect during suturing. Therefore, we recommend using an ordinary holder instead of an automatic resetting needle holder and adjusting the angle of the needle assisted by the grasping forceps in the other hand. When selecting a seamline, we chose the 3-0 barbed suture for continuous suture of the peritoneum. Suturing can prevent the tissue from slipping smoothly without requiring the use of an auxiliary clamp by assistants and thereby reduce the time and decrease the complexity of the suture.

In summary, the advantages of pelvic peritonization are as follows: (1) the peritoneal integrity and continuity are maintained, and the anatomy and physiology of the pelvic floor are recovered to a large extent; (2) the reconstructed peritoneum substitutes for the function of the damaged rectal lateral ligament in surgery, stabilizes the rectum, and reduces the anastomotic tension, resulting in a lower incidence of anastomotic leakage; (3) the extremely short time to ambulation decreases the probability of various infections and deep venous thrombosis after surgery; (4) there is no requirement for prophylactic ileostomy, which reduces the patients' costs due to the secondary stoma closure procedure and leads to a better prognosis; and (5) the occurrence of anastomotic leakage will not lead to fatal complications, and patients require only a simple treatment.

Our research also has some limitations. As an observational study, the study can be influenced by various factors, and thus prospective trials should be performed. Ten patients were lost to follow-up, which could have introduced bias.

In conclusion, pelvic peritoneum reconstruction has significant value during laparoscopic Dixon surgery. Therefore, peritoneum reconstruction should be used during laparoscopic rectal cancer surgery.

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Conflicts of interest

There are no conflicts of interest.

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