ORIGINAL RESEARCH

The Therapeutic Effect of Laparoscopic Combined with Plasma Electric Cutting Knife on Patients with Rectal Cancer and its Impact on Serum Inflammatory Factors: A Retrospective Study

Wei Yan, BD; Juanjuan Zhao, MD; Jun Tang, BD; Hui Yu, BD; Zhihong Li, BD

ABSTRACT

Objective • This study investigated the therapeutic effect of laparoscopic surgery combined with the plasma electric cutting knife on patients diagnosed with rectal cancer and its impact on serum inflammatory factors in the bloodstream.

Methods • The researchers examined the clinical data of 85 patients who underwent laparoscopic low anterior resection for rectal cancer in our hospital from April 2020 to December 2021. The patients comprised two groups: an observation group of 40 cases and a control group of 45 cases. The CD3+, CD4+, CD8+, and CD4+/CD8+ levels in both groups were detected using flow cytometry. The levels of relevant inflammatory factors in serum were measured using an automatic biochemical analyzer. The researchers then compared the perioperative outcomes between the two groups.

Results • The observation group demonstrated significantly shorter duration for the first time passing gas after surgery (P = .029) and hospital stays (P = .002) than the control group. Both groups experienced decreased levels of CD8+ cells following treatment, with the observation group exhibiting lower levels than the control group (P < .05). After three months of treatment, both groups showed reduced levels of relevant serum inflammatory factors, TNF-α, IL-1, IL-6, and IL-8; however, the observation group was significantly lower than the control group with statistical significance (P < .05). Similarly, after three months of treatment, both groups exhibited lower levels of relevant serum electrolytes K+, Na+, and Cl-, with the observation group having lower levels than the control group (P < .05). Throughout the 12-month follow-up period, the two groups had no significant differences (P > .05) in complications such as urinary tract infection, anastomotic leakage, or anastomotic bleeding.

Conclusion • Using a combination of laparoscopic techniques and a plasma electric cutting knife proved a highly effective surgical approach in treating rectal cancer. The method has numerous advantages, such as enhanced safety and few complications. When considering perioperative complications, it was evident that laparoscopic combined with the plasma electric cutting knife surpassed other surgical methods in treating rectal cancer. (*Altern Ther Health Med.* [E-pub ahead of print.])

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INTRODUCTION

Colorectal cancer is a malignant tumor closely associated with patients' lifestyle, diet, and emotional well-being. Its incidence rate continues to rise yearly. Colorectal cancer currently ranks third among malignant tumors[1,2] and has the second-highest death rate related to malignant tumors in the digestive system.[3] Surgery is the standard treatment option for colorectal cancer. However, traditional open radical surgery for the condition is highly traumatic, with high levels of postoperative pain. It also has noticeable effects on the abdominal and pelvic organs, leading to intestinal adhesions that significantly affect patients' quality of life.[4,5] Fortunately, advancements in minimally invasive techniques have led to the implementation of laparoscopic surgery as an alternative treatment option for colorectal cancer patients. Compared to traditional open surgery, laparoscopic surgery is less traumatic, involving smaller incisions and shorter recovery times.

Currently, the primary use of plasma electrosurgery is for treating prostate and bladder cancer.[6,7] Compared to traditional electrosurgery, this method offers enhanced safety and efficacy. Plasma electrosurgery exhibits lower thermal damage and less thermal penetrating energy when compared to conventional radical surgery. Additionally, it facilitates

rapid blood coagulation while preventing hyponatremia through saline rinsing, thereby providing a safer and more effective alternative to conventional electrosurgery.[8] This study investigated the impact of combining laparoscopy with plasma electroscope on serum inflammatory factors in patients with rectal cancer.

MATERIALS AND METHODS

General Information

The researchers analyzed the clinical information of 85 patients who underwent laparoscopic low anterior resection for rectal cancer at our hospital between April 2020 and December 2021. The researchers divided these patients into two groups based on the treatment methods: an observation group of 40 patients and a control group of 45 patients.

The observation group received laparoscopy combined with plasma electroscope treatment, while the control group only received laparoscopy treatment. The inclusion criteria for this study were as follows: (1) patients who met the diagnosis and treatment criteria for rectal cancer outlined in the "China Guidelines for Diagnosis and Treatment of Colorectal Cancer (2023 Edition)"[9], which includes symptoms such as changes in bowel habits and stool shape, abdominal pain, presence of an abdominal mass or symptoms related to intestinal obstruction, colonoscopy and magnetic resonance imaging that revealed rectal tumors histopathologically diagnosed as cancerous; (2) all patients between the ages of 29 and 76 years successfully underwent the operation without requiring a change to open surgery; (3) the lower margin of the tumor was 4~8 cm from the anal margin; (4) preoperative examinations showed no signs of distant metastasis or extensive implementation metastasis in the abdomen; and (5) no neoadjuvant therapy had been performed before surgery. The exclusion criteria consisted of (1) patients with a history of rectal cancer recurrence or those who had other concurrent malignant tumors; (2) patients with positive findings at either proximal, distal, or periannular edges; (3) patients with severe dysfunction affecting their heart, liver, or kidneys; (4) patients diagnosed with hematological diseases, chromosomal abnormalities, or systemic disorders; (5) or incomplete clinical data. This study followed and complied with the guidelines of the Helsinki Declaration. All patients were informed of the study content and signed consent forms approved by the hospital's ethics committee.

Surgical Methods

The same group of physicians operated on all patients in the study. The observation group was treated with a laparoscope combined with the use of a plasma electroscope, while the control group was treated only with a laparoscope. The medical procedure involved the insertion of a tube into the patient's windpipe, followed by administering anesthesia through an IV. The patient was positioned in lithotomy with the head lowered and feet raised, using a conventional method that involved five punctures. After creating an artificial pneumoperitoneum, incisions were made at various locations, including the umbilical area (10 mm), around the right and left abdominis near the navel (5 mm), right lower abdomen (12 mm), and left lower abdomen (5 mm). The surgical approach was through a weakened section of the rectum located 3 cm~5 cm below the sacral promontory. In both groups, surgeons performed the low anterior rectum resection following total mesorectal excision (TME) principles for treating rectal cancer.

Surgeons used laparoscopy to explore the inferior mesenteric artery (IMA) anatomy and vein. The sigmoid colon, located in the Toldt space, was separated from its attachment to the root of the IMA, followed by the dissection of the bone surrounding the area. After the dissection of IMA, an incision was made at its root to expose both the sigmoid artery and superior rectal artery along their respective mesenteric borders. Protecting the inferior abdominal nerve was a high priority throughout this process. The removal of perivascular fat and lymph nodes followed. The inferior mesenteric vein, situated 1 cm outside of its origin at the IMA root, underwent dissection and subsequent ligation at this level.

Group 253 underwent perivascular fat and lymph node dissection. During lymph node dissection within close proximity to the mesenteric root area, surgeons must master a technique that involves resecting them as a whole unit while gradually moving from near tissue to further away. Afterward, attention turns towards removing any tumor present before proceeding with intestinal reconstruction according to principles laid down by TME.

Index Detection Method

Patients in the observation and control groups provided fasting blood samples before treatment and three months after treatment. After centrifugation, the samples were placed in the refrigerator at -80°C for examination. Flow cytometry determined the levels of T lymphocyte subsets (CD3+, CD4+, CD8+, CD4+/CD8+) of the two groups. The researchers used an advanced biochemical instrument[i] to assess the levels of key inflammatory factors, namely TNF-α (tumor necrosis factor-α), IL-1 (interleukin-1), IL-6 (interleukin-6), and IL-8 (interleukin-8)] of the two groups.

Observation Indicators

The operation time, the number of lymph node dissections in group 253 lymph nodes, the total number of lymph node dissections, intraoperative blood loss, intraoperative stump ischemic changes, and prophylactic ostomy were compared between the observation and control groups. The method used to determine the amount of blood lost during surgery was by weighing the gauze. The formula for calculating intraoperative blood loss involves subtracting the weight of dry gauze from the weight after wiping all blood loss, with 1 gram of gauze equaling 1 milliliter of blood.

i. The Shenzhen Kubel Biotechnology Co., LTD (National drug approval code: J20150032) produced the device.

The researchers compared several other factors between the two groups, including the time before the first exhaust, fluid intake, and hospital stay duration. Additionally, they compared the anal function and gastrointestinal motility using the Wexner constipation score in both groups before and after surgery. The researchers collected blood samples from both groups following one day of fasting before surgery and three days after surgery to measure levels of motilin (MTL) and gastrin (GAS) using an automated biochemical analyzer with the radioimmunoassay technique. The Shanghai Coaibo Biotechnology Co. provided the relevant testing kit.

The Wexner constipation score evaluated the frequency and integrity of defecation, time spent in the toilet, etc., with a total score ranging from 0 to 30; the higher the score, the worse the anal function. The study compared the clinical effectiveness of the two groups and observed the changes in T lymphocytes (CD3+, CD4+, CD8+, CD4+/CD8+) as well inflammatory cytokines (TNF-α, IL-1, IL-6, IL-8) before treatment and three months after treatment. Additionally, the study compared the recurrence and spread of the two sets after a 12-month follow-up period. Both groups experienced complications such as urinary retention, incision infection, and anastomotic leakage during this time.

Statistical Analysis

The data were analyzed and processed by SPSS 22.0 software. The measurement data was expressed by mean ± standard deviation and compared using a *t* test. The counting data was expressed by n (%) and compared using the Chi-square test, which indicated a statistically significant difference ($P < .05$).

RESULTS

There were 25 males and 15 females in the observation group; the mean age was 47.12±15.33 years. Thirty-five patients were adenocarcinoma, and 5 patients were adenosquamous carcinoma. In the control group, there were 29 males and 16 females; the mean age was 47.09±16.20 years. Forty-two patients were adenocarcinoma, and 3 patients were adenosquamous carcinoma. There were no significant differences in age, gender, TNM stage, tumor distance from the anal margin, and other general data between the observation and control groups ($P > .05$), as shown in Table 1.

Comparison of Operation-Related Indexes Between the Two Groups

An analysis showed that the operation time for the observation group was significantly longer than that in the control group, and the difference was statistically significant ($P < .05$). The number of lymph node dissections in group 253, the total number of lymph node dissections, intraoperative blood loss, intraoperative stump ischemic changes, and preventive ostomy were compared between the two groups. As noted in Table 2, there was no significant difference ($P > .05$).

Table 1. Comparison of general data between the two groups

Group	n	Gender		Age (years)	Distance from anal verge	TNM			Histologic classification	
		Male	Female			I	II	III	Adenocarcinoma	Adenosquamous carcinoma
Observation group	40	25	15	47.12±15.33	6.01±1.04	8	21	11	35	5
Control group	45	29	16	47.09±16.20	6.23±1.12	11	26	8	42	3
χ^2/t		0.035		0.009	0.935	1.189			0.845	
P value		.853		.993	.353	.552			.358	

Table 2. Comparison of surgery-related indexes between the two groups

Group	n	Operation time (min)	Intraoperative blood loss (mL)	Total number of lymph nodes dissected	Group 253 Number of Lymph nodes dissected	Intraoperative stump ischemic changes	Preventive stoma
Observation group	40	161.31±20.05	80.24±9.21	13.02±2.09	4.02±0.81	0 (0.00)	0 (0.00)
Control group	45	152.24±19.08	78.32±8.30	13.62±2.10	4.10±0.93	4 (8.89)	3 (6.67)
χ^2/t		2.136	1.011	1.318	0.42	2.012	1.153
P value		.036	.315	.191	.675	.156	.283

Table 3. Comparison of postoperative recovery between the two groups

Group	n	First postoperative exhaust time (d)	Feeding time of fluids (d)	Postoperative hospital stay (d)
Observation group	40	2.64±0.45	5.02±1.18	7.73±1.15
Control group	45	2.87±0.50	5.45±1.24	8.58±1.26
t		2.218	1.632	3.234
P value		.029	.106	.002

Table 4. Comparison of gastrointestinal motility and anal function between the two groups

Group	n	MTL (ng/L)		GAS (ng/L)		Wexner Constipation score (points)	
		Preoperative	Postoperative	Preoperative	Postoperative	Preoperative	Postoperative
Observation group	40	140.02±10.58	130.14±12.75[a]	113.75±9.26	86.33±9.02[a]	4.03±0.87	14.63±2.01[a]
Control group	45	141.10±11.37	126.48±10.31[a]	110.33±11.07	84.63±10.10[a]	3.96±0.92	15.24±2.15[a]
t		0.452	1.462	1.534	0.814	0.359	1.346
P value		.653	.148	.129	.418	.72	0.182

[a]$P < .05$, compared with the same group before surgery

Comparison of Postoperative Recovery Between the Two Groups

The length of hospital stay and the first postoperative exhaust time of patients in the observation group were significantly shorter than those in the control group ($P < .05$), and there was no significant difference in the time of fluid intake between the two groups ($P > .05$), as shown in Table 3.

Comparison of Gastrointestinal Motility and Anal Function Before and After Operation Between the Two Groups

There was no significant difference in serum MTL and GAS levels and the Wexner constipation score between the two groups before surgery ($P > .05$). Serum MTL and GAS levels between the two groups after surgery were significantly lower than before surgery ($P < .05$), while the Wexner constipation score was significantly higher than before surgery ($P < .05$). However, there was no statistically significant difference between the two groups ($P > .05$), as shown in Table 4.

Table 5. Comparison of T lymphocyte subsets between the two groups

Group	n	Time	CD3+ (%)	CD4+ (%)	CD8+ (%)	CD_4^+/CD_8^+
Observation group	40	pre-treatment	28.31±3.69	11.65±2.53	13.09±2.51	0.86±0.13
		After 3 months of treatment	36.65±3.52[a,b]	16.41±2.56[a,b]	11.03±1.15[a,b]	1.38±0.20[a,b]
Control group	45	pre-treatment	28.62±3.48	11.49±2.61	13.11±2.52	0.87±0.12
		After 3 months of treatment	32.65±3.48[a]	13.23±2.44[a]	12.58±1.12[a]	1.12±0.11[a]

[a]Compared with before treatment, $P < .05$
[b]Compared with the control group, $P < .05$

Table 6. Comparison of serum inflammatory factors between the two groups

Group	n	Time	IL-1	IL-6	IL-8	TNF-α
Observation group	40	pre-treatment	5.71±1.12	26.59±4.33	13.59±2.21	61.93±8.07
		After 3 months of treatment	3.45±0.76[a,b]	17.67±2.34[a,b]	6.23±1.12	35.41±5.98[a,b]
Control group	45	pre-treatment	5.69±1.13	27.12±4.25	13.62±2.23	61.89±8.10
		After 3 months of treatment	4.53±0.74[a]	21.42±2.63[a]	9.52±1.24	41.46±5.95[a]

[a]Compared with before treatment, $P < .05$
[b]Compared with the control group, $P < .05$

Table 7. Comparison of serum electrolyte levels between the two groups

Group	n	time	K^+	Na^+	Cl^-
Observation group	40	pre-treatment	4.86±0.75	146.55±11.23	92.13±9.88
		After 3 months of treatment	4.20±0.54[a,b]	120.34±10.12[a,b]	73.04±8.52[a,b]
Control group	45	pre-treatment	4.89±0.74	145.53±12.01	92.59±9.72
		After 3 months of treatment	4.63±0.52[a]	133.46±10.59[a]	86.65±9.12[a]

[a]Compared with before treatment, $P < .05$
[b]Compared with the control group, $P < .05$

Table 8. Comparison of complications between the two groups at 12 months of follow-up

Group	n	Anastomotic leakage	Incision infection	Urinary retention	Anastomotic hemorrhage	Urinary tract infection
Observation group	40	1 (2.50)	0 (0.00)	3 (7.50)	2 (5.00)	1 (2.50)
Control group	45	5 (11.11)	1 (2.22)	4 (8.89)	3 (6.67)	2 (4.44)
χ^2		1.261	-	0.027	0.018	0.011
P value		.261[a]	1.000[b]	0.871[a]	0.892[a]	0.917[a]

[a]Continuity correction χ^2 test was used
[b]Fisher exact probability method is adopted

Comparison of T Lymphocyte Changes Between the Two Groups

After three months of treatment, T lymphocyte levels (CD3+, CD4+, CD4+/CD8+) in the observation and control groups were higher than before treatment, and the observation group's level was significantly higher than that of the control group. The difference was statistically significant ($P < .05$). CD8+ levels in both groups were lower than before treatment. Indeed, the observation group's level was significantly lower than the control group, with statistical significance ($P < .05$), as shown in Table 5.

Comparison of Serum Inflammatory Factors Between the Two Groups

After three months of treatment, the levels of serum inflammatory factors (TNF-α, IL-1, IL-6, IL-8) in the observation and control groups were significantly lower than before treatment. The observation group's levels were significantly lower than the control group's, with statistical significance ($P < .05$), as shown in Table 6.

Comparison of Serum Electrolyte Levels Between the Two Groups

After three months of treatment, serum electrolyte levels (K+, Na +, Cl-) of patients in the observation and control groups were lower than before treatment, and the observation group was significantly lower than the control group. The difference was statistically significant ($P < .05$), as shown in Table 7.

Comparison of Recurrence and Metastasis Between the Two Groups at 12 Months of Follow-Up

After 12 months, there was 1 case of local recurrence in the observation group (2.50%) and 3 cases of local recurrence in the control group (6.67%). The groups had no significant difference ($\chi^2 = 0.154$, $P > .05$). There were 2 cases of liver metastasis in the observation group (5.00%) and 3 cases of liver metastasis in the control group (6.67%), with no significant difference between groups ($\chi^2 = 0.018$, $P > .05$).

Comparison of Complications Between the Two Groups at 12 Months of Follow-Up

During the 12-month follow-up period, there was no significant difference in the incidence of complications such as anastomotic leakage, anastomotic bleeding, or urinary system infection between the two groups ($P > .05$), as shown in Table 8.

DISCUSSION

The treatment approach known as TME involves completely removing tumors, following the principle of radical resection. In addition to ensuring the integrity of the mesorectal membrane, thorough dissection of the IMA root lymph nodes is also an essential factor in evaluating the curative effect of surgery for patients with middle and low rectal cancer. IMA root lymph nodes are central lymph nodes, named group 253 lymph nodes according to Japan's pathological protocol of colorectal cancer. Located between the initiation of IMA and the left colic artery (LCA), this tissue is the last barrier for rectal cancer cells to metastasize to distant places.

In previous treatments, most experts believed ligation of the IMA root could remove group 253 lymph nodes in one piece, which was beneficial to postoperative survival. However, clinical studies continue to find no significant correlation between different IMA treatment methods and the number of lymph nodes dissected, and most domestic experts prefer laparoscopic combined plasma electric endoscopic low ligation treatment to ensure a better blood supply of the anastomosis.

In this study, 85 patients with rectal cancer respectively received laparoscopic low anterior resection with or without laparoscopy combined with plasma electroscope. The results showed no significant difference in the total number of lymph nodes dissected between the two groups and the number of lymph nodes dissected in group 253. This result indicates that laparoscopy combined with plasma electric laparoscope can perform better dissection of central lymph nodes, with good feasibility.[10-12]

The comparison of surgery-related indicators between the two groups showed that the operation time of the control group was significantly shorter than that of the observation group. In comparison, the difference in intraoperative blood loss between the two groups was not significant and did not have statistical significance. This result is because, during the operation, the IMA root lymph node dissection was performed simultaneously with laparoscopy combined with plasma electroscopy, resulting in a slight extension of the operation time.

In this study, the two groups of patients were all operated by experienced physicians in the same group, so the amount of intraoperative blood loss was effectively measured. Studies have shown that skilled laparoscopic surgeons do not increase intraoperative blood loss during laparoscopic procedures combined with plasma electroscopy for rectal cancer, which is consistent with the conclusions of this study.

Insufficient anastomotic blood supply can lead to intraoperative stump ischemic changes. After traditional IMA high-level ligation, the anastomotic blood supply mainly comes from the middle colon artery's marginal branch. Laparoscopy combined with plasma electrotomy and its ascending branch can increase the proximal stump blood supply and reduce the intraoperative stump ischemic changes. The laser Doppler blood flow instrumentation confirmed that the blood supply of the intestinal stump by laparoscopy combined with plasma electroscope is significantly better than that of the non-reserved group. In this study, although the number of intraoperative stump ischemic changes and preventive ostomy in the observation group was less than that in the control group, there was no statistically significant difference between the two groups. This result may be related to the study's small sample size, which needs to be further verified.

After anterior resection of rectal cancer, some patients will be weakened due to intestinal peristalsis, resulting in defecation difficulties, including diarrhea, liesia, and other symptoms. In this study, serum MTL, GAS levels, and the Wexner constipation score served as a means to evaluate the gastrointestinal momosity and anal function of the two groups of patients before and after treatment, indicating that the serum MTL and GAS levels of the two groups after surgery were significantly lower than before surgery. The Wexner constipation score was significantly higher than before surgery, but there was no statistical significance between the groups. This study suggests no difference in the effects of laparoscopy combined with plasma electroscope on gastrointestinal and anal functions of patients undergoing laparoscopic preresection for rectal cancer. In addition, the results of this study also showed that the first postoperative exhaust time and the length of hospital stay of patients in the observation group were significantly shorter than those in the control group. This result may be related to preserving colonic blood vessels in reducing gastrointestinal injury and protecting the IMA root nerve plexus.

Due to the extended section near the origin and elevated blood pressure, there is a lack of assurance that the anastomosis will receive enough blood supply from the vascular arch located at the border of the middle colon artery. This insufficient blood supply can lead to complications after surgery, such as leakage at the anastomotic site and infection in the incision. These risks are of more significant concern for elderly patients with weakened immune systems, resulting in a higher rate of postoperative complications.

Previous studies have shown that laparoscopy combined with plasma electric laparoscope can share the blood pressure of the anastomosis, promote the recovery of intestinal function, and thus reduce the probability of anastomotic leakage. However, there was no statistically significant difference in the incidence of postoperative complications in this study between the observation and control groups, which may result from factors such as sample size and severity of patients' conditions. In terms of postoperative tumor recurrence and metastasis of the two groups, at the 12-month follow-up, there was 1 case of local recurrence and 2 cases of metastasis in the observation group, and 3 cases of local recurrence and 3 cases of metastasis in the control group, all of which were liver metastases. There was no significant difference in the incidence of recurrence and metastasis between the two groups. This result indicates that laparoscopy combined with plasma electroscopy does not increase the risk of postoperative recurrence and metastasis of rectal cancer. However, long-term accurate follow-up is still required to improve the reliability of these conclusions.[13,14]

Laparoscopy combined with plasma electroscope can exchange and remove metabolites in the body of patients through diffusion, convection, and other ways and can continuously replace the damaged kidney function of patients. The results of this study showed that the total clinical effective rate of patients in the observation group was significantly higher than that in the control group. The analysis suggests that laparoscopy combined with plasma electroscopy does not affect electrolyte levels and hemodynamics and could metabolize related toxins in the body stably and continuously. Studies have shown that laparoscopy combined with plasma electroscopy can help patients maintain hemodynamic and osmotic pressure stability, thus effectively reducing the occurrence of cardiovascular adverse events. Infection is a significant risk factor for rectal cancer, which can severely impact patients' immunity. Some scholars have pointed out that foreign antigens can reduce the secretion of T lymphocytes and other related factors, resulting in immune regulation disorders. This study showed that after three months of treatment, the level of T lymphocytes (CD3+, CD4+, CD4+/CD8+) in the observation group was significantly higher than in the control group. However, CD8+ levels in the observation group were lower than in the control group. This indicates that laparoscopy combined with plasma electroscope can improve the immune function of patients. The reasons may be related to the slow and continuous metabolism of toxins in patients by laparoscopy combined with plasma electroscopy, reducing the inflammatory response, improving immune function, and rebuilding the immune balance of patients.

The release of inflammatory factors is likely to cause an inflammatory cascade of reactions in the body, which can aggravate kidney injury. Such an occurrence is a factor that can lead to a poor prognosis for patients. Studies have reported that laparoscopy combined with plasma electroscopy combined with continuous perfusion can effectively improve the levels of serum inflammatory factors [tumor necrosis factor-α (TNF-α), interleukin-1 (IL-1), interleukin-6 (IL-6) and interleukin-8 (IL-8)] in patients with rectal cancer, and reduce the inflammatory response of patients. In addition, some scholars have pointed out that laparoscopy combined with plasma electroscopy is not a selective partial clearance of inflammatory media. The results of this study showed that after three months of treatment, the levels of serum inflammatory factors TNF-α, IL-1, IL-6, and IL-8 in the observation group and the control group were lower than those in the control group, which further confirmed the anti-inflammatory effect of laparoscopy combined with plasma electroscopy in rectal cancer. The reason may be that laparoscopy combined with plasma electroscopy can remove tumor necrosis factor-α in patients through convection, increase the ultrafiltration rate, and effectively increase the therapeutic effect of removing serum inflammatory factors.[15-17]

In summary, laparoscopy, combined with plasma electroscopy, is a surgical method with accurate efficacy, high safety, and few complications for patients with rectal cancer. Regarding the probability of intraoperative and postoperative complications, laparoscopy combined with plasma electroscopy is a more advantageous treatment for rectal cancer patients.

AUTHOR CONTRIBUTIONS

Wei Yan and Juanjuan Zhao contributed equally to this work.

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