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Biofeedback therapy combined with Baduanjin on quality of life and gastrointestinal hormone level in patients with colorectal cancer

Abstract

BACKGROUND

With the change in people's lifestyles, the incidence of colorectal cancer (CRC) is increasing. It is essential to study the efficacy of various treatment methods for CRC patients to prevent and treat CRC.

AIM

To investigate the efficacy of biofeedback therapy combined with Baduanjin in improving the quality of life and gastrointestinal hormone levels of patients with CRC.

METHODS

A total of 120 patients with CRC who were admitted to our hospital from June 2020 to June 2021 were included in the study. They were randomly divided into four groups (n = 30): the control group (group A), the biofeedback therapy intervention group (group B), the Baduanjin exercise intervention group (group C), and the combination group (group D). Patients in group A adopted the standard nursing mode and necessary health education. Patients in group B were treated with biofeedback therapy based on routine nursing care. Patients in group C were given Baduanjin intervention for 12 wk based on conventional drug treatment and care. Patients in group D were treated with biofeedback therapy and Baduanjin exercise. In this study, patients' quality of life, gastrointestinal hormone levels, and clinical efficacy in the four groups were observed

at baseline and 12 wk after intervention. Meanwhile, the correlation between gastrointestinal hormone levels and various functional areas of quality of life was analyzed. By comparing the observed indicators of patients in the four groups, the efficacy of biofeedback therapy combined with Baduanjin in improving the quality of life and gastrointestinal hormone levels of patients with CRC was explored.

RESULTS

At baseline, there were no significant differences in quality of life, gastrointestinal hormone levels, or clinical efficacy among the four groups ($P > 0.05$). Twelve weeks after the intervention, the combination group's quality of life, gastrointestinal hormone levels, and clinical effectiveness were better than those of the three other groups.

CONCLUSION

On the basis of routine nursing care, patients with CRC combined with biofeedback therapy and Baduanjin exercise can improve the quality of life of patients with CRC and the efficacy of gastrointestinal hormone levels.

INTRODUCTION

Colorectal cancer (CRC), including colon and rectal cancer, is a common type of cancer. Its incidence and mortality are high[1], and it may cause hematochezia, diarrhea, constipation, local abdominal pain, weight loss, and other symptoms[2]. In China, patients with CRC are mostly the elderly, and CRC afflicts more males than females[3]. Although the specific pathogenesis of CRC is unknown, its incidence increases yearly, which may result from a combination of age, environment, dietary habits, heredity, occupation, and other factors[4,5].

At present, the treatment method for CRC is surgical treatment. As the surgical cure rate and five-year survival rate of the disease are about 50% and the local recurrence

rate is high[6], researchers have been recently studying more comprehensive treatment methods[7], such as cognitive behavioral intervention, exercise intervention, and biofeedback therapy in combination, to help delay the illness and improve the quality of life of patients[8]. Exercise can promote intestinal peristalsis, help fecal discharge, and reduce the contact time of intestinal and fecal carcinogens. Fitness Qigong Baduanjin is a medium-intensity aerobic exercise with easy-to-learn and precise movements, and it is widely recognized by people[9]. Biofeedback refers to the use of instruments to process certain biological information in the body related to psychological and physiological processes, such as skin temperature, heart rhythm, and blood pressure, to be displayed in a visual and auditory manner so that people can understand and consciously control their psychological and physiological activities[10].

In this study, patients with CRC were treated with biofeedback therapy combined with Baduanjin exercise for 12 wk to observe the patients' constipation symptoms, quality of life, and changes in gastrointestinal hormone levels and explore the clinical value of biofeedback therapy combined with Baduanjin exercise. This work provides a theoretical reference for future research on the treatment strategies of CRC.

MATERIALS AND METHODS

Patient population

A total of 120 patients with CRC who were admitted to Liaoning Provincial Tumor Hospital from June 2020 to June 2021 were selected as the research subjects, aged 45–64, and numbered according to the order of admission. Patients were divided into four groups by random number table method, including control group (group A), biofeedback treatment intervention group (group B), Baduanjin exercise intervention group (group C) and combined group (group D) with 30 patients in each group.

Inclusion and exclusion criteria

Diagnostic criteria: The diagnostic criteria of CRC were referred from Guidelines for Diagnosis and Comprehensive Treatment of Liver Metastasis from Colorectal Cancer in China[11].

Inclusion criteria: (1) Compliant with the diagnostic criteria of CRC mentioned in the Guidelines for Diagnosis and Comprehensive Treatment of Liver Metastasis from Colorectal Cancer in China; (2) Patients with clear consciousness, normal cognitive function, and being able to actively cooperate with others to complete the experiment; and (3) Surgical treatment of CRC.

Exclusion criteria: (1) Severe diseases such as severe infection and hyperpyrexia; (2) The tumor condition deteriorates rapidly and needs emergency treatment; and (3) Those who are unable to complete specific exercise intensity due to mental or physical disorders.

Off (eliminate) standard: (1) Adverse reactions occurred during the experiment; (2) Active withdrawal due to the inability or unwillingness to cooperate for various physiological or psychological reasons; and (3) Other treatment regimens were adopted during the experiment without permission.

Treatment plan

Control group (group A): We adopt a standard nursing mode and necessary health education for patients. Before the experiment, the nurse asked the patient's medical history, evaluated the patient, and closely monitored the patient's basic vital signs, such as blood pressure, heart rate, and gastrointestinal function recovery. Make patients keep good living habits, proper diet, and adequate sleep, and give patients regular medication.

Biofeedback therapy intervention group (group B): Based on routine nursing, the intervention program of biofeedback therapy was implemented twice a day for 12 wk, each time for 10 minutes. Before implementing this scheme, the therapist explained the experiment's purpose, process, and precautions to the patients and put forward the areas where the patients disagreed with ensuring the patients' active participation.

Biofeedback therapy interventions were as follows: (1) Two weeks before the start of the experiment, the therapist trains the patients to watch the monitor and sphincter contraction and relaxation twice weekly. The investigation officially began when the patients learned to manage the monitor and contract and relax the sphincter; (2) At first, the therapist uses a water-filled pressure probe connected to a colour monitor (Polygraf ID, equipped with Polygram98 instrument, Medtronics, Skovlunde, Denmark) to evaluate the contraction amplitude and duration of the patient's autonomic anal sphincter, and monitors the contraction and electromyographic activity of the patient's sphincter, gluteus muscle and abdominal muscle through the probe; (3) During the experiment, the surrounding environment should be quiet, the light should be soft, and the temperature appropriate. The patient was supine, and therapists helped them untie their belts. Make their lower limbs reach out 60 degrees. During the whole experiment, patients should feel comfortable and relaxed; (4) Biofeedback training uses sensory training and strength training. Sensory training: When the patients receive balloon training, the therapist repeatedly inflates and deflates the balloon in increments of 5 mL air or normal saline for 10s each time, three times in each group, a totally of 10 groups. Therapists help patients determine the volume of bowel movement and the maximum tolerance they can maintain. Strength training: In the absence of an airbag, the patients are required to repeatedly contract the external anal sphincter and guide the patients to breathe naturally without stopping during muscle contraction. The training was repeated for 5s, six times in each group, with ten groups every day. When patients compare their sense of muscle control with the change of muscle control mode displayed on the monitor, the therapist gradually increases the intensity and frequency of their exercise. The therapist should give feedback according to the patient's condition

and constantly encourage the patients in the whole treatment process; and (5) Therapists teach patients the most basic training essentials. After discharge from the hospital, patients still need consolidation training, twice a day for 10 minutes each time, with four weeks as a course of treatment. Therapists evaluated the efficacy of patient training at 3, 6 and 12 wk after intervention.

Baduanjin exercise intervention group (Group C): The therapist gave the patients Baduanjin training based on routine medication and nursing and intervened for 12 wk. A week before the experiment, the professional coaches guided and trained the subjects in movements and postures according to the "Fitness Qigong Baduanjin" (2003) issued by the State Sports General Administration. Doctors have been watching to ensure the safety of patients. Therapists inform the subjects of the purpose, procedures, and training precautions in advance to promote the participants' participation. The training is divided into three class hours, one class hour every two days, and each class hour is one hour. The coach explained and demonstrated eight movements in the first class and a natural breathing method. Patients practice in the second and third classes and coaches, doctors, and therapists observe and correct these movements. After three hours of training, coaches, doctors, and therapists assessed their actions, and those who passed the examination entered the experiment.

When the subjects were in the hospital, they performed the Baduanjin exercise under the guidance and escort of the doctors. After leaving the hospital, they served the Baduanjin exercise under the supervision of their families. During the training, the subjects wore exercise bracelets, which could detect the blood pressure, heart rate, and oxygen consumption of the issues at any time during exercise. They performed the routine four to six times a week, 45 to 60 min each time, and they completed the training every day from 8: 00 to 9: 00 a.m., for a total of 12 wk. The subjects and their families joined the WeChat group. After each exercise, they reported the completion status in the group, uploaded the exercise video, and held a video conference once a

week. All participants and their families exchanged experiences and encouraged each other.

The medical staff followed up by telephone every week to understand the patients' practice and urge the patients to practice. Patients were informed to return to the hospital for reexamination after 12 wk of intervention.

Collaborative group (group D): Combine biofeedback therapy with Baduanjin exercise. The two treatments alternately performed with biofeedback therapy twice a day and eight-part brocade exercise four to six times a week.

Observation indicators

Assessment of symptoms and curative effect of constipation: The therapist used the constipation symptom evaluation table developed by the Colorectal Surgery Group of Surgery Branch of Chinese Medical Association to evaluate the constipation symptoms of patients before and after treatment. They mainly scored the patients' difficulties, excessive excretion, fecal traits, defecation time, falling, endless, distension feeling, defecation frequency, abdominal distension, *etc.* The score of each item is 0-3. The higher the score, the more serious the constipation symptoms are.

Quality of life assessment: Therapists used CRC QLQ-CR38 developed by the European Organization for Research and Treatment of Cancer to assess patients' quality of life before and after treatment. There are 38 entries in QLQ-CR38, including functional areas and symptom areas. The functional areas of the scale include seven aspects: physical function, future expectation, sexual function, sexual satisfaction and others. Symptom areas include eight aspects: urination problems, gastrointestinal symptoms, adverse reactions of chemotherapy, defecation problems, ostomy-related problems, male and female sexual function and weight problems. The scale has a total of 31 items, each with a score of 1-4. When the score of the functional area is higher, the

patient's function is better. The higher the domain score, the more severe the symptoms of patients.

Under the unified guidance of nurses, patients should fill out the QLQ-CR38 form by themselves. The QLQ-CR38 scale was assessed by physicians familiar with the scale at baseline and 12 wk after the intervention.

Assessment of gastrointestinal hormone levels: At baseline and 12 wk after the intervention, 5 mL blood samples were collected from the four groups, centrifuged using a high-speed desktop centrifuge for 5 min (3500 rpm), approximately 2 mL serum was collected, and levels of motilin (MTL) and somatostatin (SS) were measured.

Efficacy evaluation criteria: Record the total therapeutic effects of the four groups at 12 wk after the operation, and the real effective rate = (markedly effective + relieved + effective)/total cases × 100%. Markedly effective: the adverse symptoms and signs of the patient completely disappeared; Remission: mild hiccup, abdominal distension and constipation, and more vital bowel sounds; Effective: noticeable hiccup, abdominal distension and constipation, and weak borborygmus; No effect: Severe hiccup, abdominal distension and constipation, and weak or absent bowel sounds.

Statistical analysis

Data in this study were processed by SPSS25.0 software, and measurement data were expressed as mean ± SD. One-way ANOVA and two-way test analyzed primary data of patients. Quality of life scores, MTL, and SS levels was by the normal distribution, and repeated measures analysis of variance was used. $\alpha = 0.05$ was considered the test level, and $P < 0.05$ indicated a statistically significant difference, and $P < 0.01$ indicated a statistically significant difference.

RESULTS

general information of four groups of patients

In this experiment, one subject in the control group (Group A) dropped out of the study, two subjects in the cognitive behaviour therapy intervention group (Group B), two subjects in the Baduanjin exercise intervention group (Group C) and three subjects in the combined group (Group D). Finally, the therapist included 29 cases in group A, 28 cases in group B, 28 cases in group C and 27 cases in group D. There was no significant difference in age, body mass index and surgical site between the two groups ($P > 0.05$, Table 1).

Clinical efficacy of four groups of patients

Twelve weeks after the intervention, the clinical efficacy of group d was better than that of group A, group B, and group C. The effective rates of a group A, group B, group C, and group D were 59%, 75%, 78.57%, and 92.59%, respectively. The difference was statistically significant ($P < 0.05$, Table 2).

Constipation symptom scores of patients in the four groups before and after treatment

Table 3 shows the constipation symptom scores in the four groups before and after the intervention. There was no significant difference in constipation symptom scores among the four groups at baseline ($P > 0.05$). After 12 wk of intervention, the constipation symptom scores of subjects in Group A were not significantly different from those at baseline ($P > 0.05$), and the constipation symptom scores of subjects in Group B, Group C, and Group D were significantly different ($P < 0.01$). Twelve weeks after the intervention, compared with the issues in group A, constipation symptom scores in groups B, C, and D were significantly different ($P < P\ 0.01$).

QLQ-CR38 scores of four groups before and after treatment

Table 4 shows the change scores of the QLQ-CR38 scale of four groups of subjects before and after the intervention. At baseline, there was no significant difference among groups of QLQ-CR38 scale in four groups ($P > 0.05$). Compared with baseline, after 12 wk of intervention, the scores of body image, future expectation, sexual function, sexual

satisfaction, adverse reactions of chemotherapy, and defecation problems of the subjects in Group A, Group B, Group C, and Group D all increased. Among them, there was no significant difference in the future expectation of the subjects in Group A ($P > 0.05$), but a significant difference in body image and sexual satisfaction ($P < 0.05$), and significant difference in sexual function, adverse reactions of chemotherapy and defecation problems ($P < 0.01$). There were substantial differences in body image, future expectation, sexual function, sexual satisfaction, adverse reactions to chemotherapy, and defecation problems between group B and group C ($P < 0.01$). In group D, there was no significant difference in defecation problems ($P > 0.05$), but a significant difference in adverse reactions of chemotherapy ($P < 0.05$), and a highly significant difference in body image, future expectation, sexual function, and sexual satisfaction ($P < 0.01$). The micturition problems, gastrointestinal symptoms, stoma-related problems, male sexual problems, female sexual problems, and body mass scores in Group A, B, C, and D decreased. Among them, there was no significant difference in micturition and gastrointestinal symptoms ($P > 0.05$), but a substantial difference in stoma-related problems and body mass ($P < 0.05$), and an extremely significant difference in male and female problems ($P < 0.01$). There were substantial differences in urination problems, gastrointestinal symptoms, stoma-related problems, male sexual problems, female sexual problems, and body mass among the subjects in Group B, Group C, and Group D ($P < 0.01$). Twelve weeks after the intervention, compared with the issues in group A, the scores of body image, future expectation, sexual function, and sexual satisfaction in groups B, C, and D all increased. Among them, there was no significant difference in body image and sexual function between group B and group C ($P > 0.05$), but a significant difference in future expectation and sexual satisfaction ($P < 0.01$). There were substantial differences in body image, future expectation, sexual function, and sexual satisfaction among subjects in group D ($P < 0.01$). Adverse reactions to chemotherapy, defecation problems, urination problems, gastrointestinal symptoms, stoma-related problems, male sexual problems, female sexual problems, and body mass scores in Group B, Group C, and Group D decreased. Among them, there were no significant

differences in adverse reactions of chemotherapy, male problems, and female problems in group B ($P > 0.05$), but significant differences in urination problems, gastrointestinal symptoms, and defecation problems ($P < 0.05$), and highly significant differences in stoma-related problems and body mass ($P < 0.01$). In group C, there were no significant differences in female issues and adverse reactions of chemotherapy ($P > 0.05$), but significant differences in urination problems, defecation problems, male problems and body mass ($P < 0.05$), and highly significant differences in gastrointestinal symptoms and stoma-related problems ($P < 0.01$). The adverse reactions of chemotherapy, defecation problems, urination problems, gastrointestinal symptoms, stoma-related problems, male sexual problems, female sexual problems, and body mass of the subjects in group D were all significantly different ($P < 0.01$).

Gastrointestinal hormone levels of four groups before and after treatment

Table 5 shows the changes of gastrointestinal hormone levels in peripheral blood of four groups of subjects before and after the intervention. There was no significant difference in gastrointestinal hormone levels among the four groups ($P > 0.05$). Compared with baseline, after 12 wk of intervention, there was no significant difference in MTL level in group A ($P > 0.05$). Still, there was a substantial difference in MTL level among groups B, C, and D ($P < 0.01$). There is no significant difference in SS level in group A ($P > 0.05$), but there is a substantial difference in SS level among group B, group C, and group D ($P < 0.01$). Twelve weeks after the intervention, compared with group A, the MTL and SS levels in group B, group C, and group D were significantly different ($P < 0.01$).

Correlation analysis of constipation symptom scores and gastrointestinal hormone levels with various functional areas of quality of life in CRC patients

The therapist made a Pearson correlation analysis based on the symptom score of constipation score of CRC patients, scores of gastrointestinal hormone levels and functional areas of quality of life. The results are shown in Table 6. The results showed that the constipation symptom score of CRC patients was negatively correlated with

body image, future expectation, sexual function and sexual satisfaction score, negatively associated with urination problems, gastrointestinal symptoms, adverse reactions of chemotherapy, defecation problems, stoma-related problems, female problems and bodyweight score, but not related to male issues. The MTL level of CRC patients is positively correlated with body image, future expectation, sexual function and sexual satisfaction score, but negatively associated with urination problems, gastrointestinal symptoms, adverse reactions of chemotherapy, stoma-related problems, male problems, female problems and bodyweight score, and has nothing to do with defecation problems. CRC SS level is positively correlated with urination problems, gastrointestinal symptoms, stoma-related problems, adverse reactions of chemotherapy, male problems, female problems, body weight, and negatively associated with body image, future expectation, sexual function and sexual satisfaction scores, but not related to defecation problems.

DISCUSSION

Constipation symptoms, quality of life, and gastrointestinal hormone level disorder in patients with CRC

Patients with CRC may have symptoms such as abdominal pain, diarrhoea, or constipation, which may cause psychological stress and bring many adverse effects on patients' quality of life[10]. Guérin *et al*[11] observed the prevalence of CRC in chronic constipation and non-constipation groups within one year; they found that most CRC in the constipation group was significantly higher than that in the non-constipation group. Moreover, with the increase in the severity of constipation, the incidence of CRC gradually increased. Watanabe *et al*[12] postulated that constipation increases the risk of CRC. They included 251 patients with CRC in a seven-year follow-up of subjects aged 40–64 years, which ultimately determined that constipation increases CRC risk. Akhondi-Meybodi *et al*[13] used the QLQ-C30 questionnaire to evaluate different aspects of the life of 120 patients with CRC. He found no significant relationship between the average quality of life score and gender and tumour stage. However, their physical,

social, clinical, and economic quality of life remain inferior because CRC has serious adverse effects on people's financial situation, social function, pain, and physical function, so the quality of life of patients with CRC is low. Faury *et al*[14] investigated the quality of life and fatigue of patients with CRC. He found that the quality of life and fatigue will be damaged for a long time after the cancer diagnosis and will vary with stoma status. Therefore, we should provide long-term intervention measures to improve CRC survivors' quality of life and fatigue. Silva *et al*[15] reported that colostomy enhances the patients' quality of life for 3–5 mo and improves it 6–8 mo after the operation. By contrast, late-stage radiotherapy and chemotherapy can harm the quality of life. Pate *et al*[16] evaluated the quality of life of 403 patients with CRC and 401 control people in nine different geographical locations. He found no significant difference in fatigue, society, emotion, function, and physical health between patients with CRC and the control group. Nevertheless, the CRC-specific quality of life index was poor. Leermakers *et al*[17] assessed the gastrointestinal function of 289 patients with CRC through the Health-Related Quality of Life (HRQoL) questionnaire before operation and at 3, 6, and 12 mo after the procedure. He found that the gastrointestinal function of patients with CRC improved after the process. However, the risk of postoperative gastrointestinal dysfunction in women and young patients is still high. Similarly, some studies[18] systematically evaluated and conducted a meta-analysis of patients with CRC after treatment and found that fatigue, psychological distress, and gastrointestinal symptoms of CRC survivors are the main problems that plague them and persist after cancer treatment. Therefore, specific intervention measures should be adopted to improve the quality of life and gastrointestinal hormone levels of patients with CRC.

Effect of biofeedback therapy combined with Baduanjin on the quality of life of patients with CRC

Duncan *et al*[19] summarized many studies related to improving the quality of life of patients with cancer. Although many interventions can improve the quality of life of patients with cancer, the efficacy of a single intervention is not very significant because

the patients' physical and psychosocial problems will vary in different periods of cancer course. The effective intervention measures in one stage may not be suitable for the other. By contrast, the combined intervention has a more significant effect on the whole course of patients with cancer than monotherapy. An increasing number of studies showed that exercise intervention could promote patients' mental health with CRC[20]. As an aerobic exercise, Duan Jin exercise combined with biofeedback therapy can alleviate CRC symptoms and improve the quality of life of patients with CRC. Patients' fecal incontinence is significantly related to their quality of life. Liang *et al*[21] evaluated the effect of biofeedback therapy on fecal incontinence in patients with CRC through 61 patients and 48 control groups. Their results showed that patients who received biofeedback therapy for more than 15 wk had significantly improved fecal incontinence. The fecal incontinence scores, defecation frequency, and anorectal manometry were also considerably enhanced. Kuo *et al*[22] treated 32 patients with electrical stimulation and biofeedback. The clinical effect of rehabilitation treatment was evaluated through the functional results, Wexner score, and anorectal manometry. The patients' fecal incontinence and quality of life significantly improved. Similarly, Enck *et al*[23] divided 109 patients with fecal incontinence into two groups. One group received biofeedback training, while the other control group did not; the efficacy of biofeedback training in improving fecal incontinence was evaluated. Biofeedback training was found to be effective in enhancing adult fecal incontinence. Kim *et al*[24] assessed the quality of life, mental health, and physical activity level of 71 patients by performing aerobic exercise at home for 12 wk and finally found that aerobic exercise can improve the quality of life of patients with CRC. Pham *et al*[25] searched some databases, selected various kinds of literature with high impact factors and strong credibility for analysis and evaluation, and finally found that appropriate physical activity in healthy people can prevent the occurrence of rectal cancer. Schmid *et al*[26] studied CRC survivors and compared the highest and lowest levels of physical activity of CRC survivors before diagnosis and found that physical activity reduces the death risk of CRC survivors. Long or excessively strenuous exercise may have adverse physiological effects on

patients. As a moderate-intensity aerobic exercise, Baduanjin significantly improves the quality of life of patients with CRC.

In this study, 38 items of the QLQ-CR38 scale were used to evaluate the efficacy of biofeedback therapy combined with Baduanjin in improving the quality of life of patients with CRC at 12 wk after the intervention. After 12 wk of intervention, male sexual problems, urination problems, gastrointestinal symptoms, stoma-related problems, and body weight of the intervention group were better than those of the control group, which indicated that biofeedback therapy combined with Baduanjin intervention had a good effect on the quality of life of patients with CRC.

Effect of biofeedback therapy combined with Baduanjin on gastrointestinal hormones in patients with CRC

Aerobic exercise can promote the transportation of intestinal gas, improve the clearance rate of intestinal gas, and relieve gastrointestinal symptoms[27]. Song *et al*[28] recently analyzed the influence of diet, lifestyle, exercise, and other interventions on the prognosis of patients with CRC. He found that exercise can improve immune and metabolic homeostasis and enhance gastrointestinal function by changing intestinal microflora. Bilski *et al*[29] provided a comprehensive overview of the beneficial and harmful effects of physical activity on the gastrointestinal tract in recent years. At the same time, they explored the relationship between different forms and intensities of exercise and intestinal physiological function and pathology. Studies have found that regular and moderate exercise has a beneficial effect on some gastrointestinal diseases, improving the gastrointestinal process and alleviating the symptoms. The method, duration and intensity of training can directly affect its curative effect. As a medium-intensity aerobic exercise, Baduanjin can significantly improve gastrointestinal function.

Bartlett *et al*[30] evaluated the intestinal function and quality of life of 19 patients with intestinal dysfunction caused by CRC surgery by biofeedback therapy. They found that the biofeedback scheme can significantly improve the quality of life score and reduce the severity of symptoms, defecation frequency, and incontinence in patients with CRC.

Kim *et al*[31] studied 70 patients with CRC who received biofeedback therapy and reviewed all the data retrospectively. Finally, they found that biofeedback therapy may impact the relief of various gastrointestinal symptoms, especially on fecal incontinence. Kye *et al*[32] conducted a 6-month experiment on 56 patients with rectal excision. Biofeedback therapy did not prevent anorectal dysfunction during temporary stoma intervals after reversing temporary stoma six months after rectal excision. However, biofeedback therapy is helpful to maintain the resting tension of the anal sphincter and has a particular influence on gastrointestinal hormones in patients with CRC.

In this study, MTL and somatostatin SS levels were detected to assess the efficacy of biofeedback therapy combined with Baduanjin in improving gastrointestinal hormone levels of patients with CRC at 12 wk after the intervention. After 12 wk of intervention, the MTL level of each group increased, and the SS level decreased. The curative effect of the combined intervention group was more prominent than that of the control, which indicated that biofeedback therapy combined with Baduanjin intervention played an essential role in gastrointestinal function and gastrointestinal hormone level of patients with CRC.

CONCLUSION

The limitation of this study is that it is a small sample and single-centre study. Based on the results of this study, we believe that biofeedback therapy and Baduanjin training can improve the quality of life and gastrointestinal hormone levels in patients with CRC, and the combined effect is superior to monotherapy. As an economical and effective means of clinical and family intervention, it is worthy of promotion and application in clinical and community-based family rehabilitation.

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Table 1 General data of four groups of patients (n = 112, mean ± SD)

	Group A	Group B	Group C	Group D	Statistic	*P* value
Number of cases (Male/female)	15/14	16/12	15/13	15/12	0.19	0.98
Age (yr)	52.89 ± 6.43	53.93 ± 7.63	52.79 ± 5.85	54.70 ± 6.29	0.53	0.66
BMI	21.17 ± 1.35	21.49 ± 1.02	21.55 ± 1.14	20.95 ± 1.32	1.49	0.22
Operation site/case					0.93	0.99
Left colon	8	8	6	8		
Right colon	6	7	8	6		
Rectum	15	13	14	13		

BMI: Body mass index.

Table 2 Clinical efficacy of four groups

Group	Number of cases	Show effect	Alleviate	Effective	Be invalid	Total effective rate
Group A	29	1	6	8	14	51.72%[b]
Group B	28	3	8	8	9	67.86%[a]
Group C	28	3	11	6	8	71.43%
Group D	27	7	14	4	2	92.59%

[a]$P < 0.05$, between group D, group A, group B and group C 12 wk after intervention.

[b]$P < 0.01$, between group D, group A, group B and group C 12 wk after intervention.

Table 3 Symptom scoring scale of constipation (mean ± SD, score)

Group	Baseline	12 wk
Group A	16.52 ± 0.91	16.14 ± 0.99
Group B	16.36 ± 1.03	12.25 ± 1.93[b,d]
Group C	16.39 ± 0.96	12.11 ± 1.93[b,d]
Group D	16.22 ± 1.12	9.52 ± 1.72[b,d]

[b]$P < 0.01$, the intra-group comparison of each group at different time points.

[d]$P < 0.01$, the comparison of group B, group C and group D with the group A at the same time point.

Table 4 QLQ-CR38 scores of four groups before and after treatment (mean ± SD, min)

Group	Group A		Group B		Group C		Group D	
dimension	Baseline	12 wk	Baseline	12 wk	Baseline	12 wk	Baseline	12 wk
Functional dimension								
Body image	43.17 ± 16.45	49.45 ± 12.25[a]	41.32 ± 16.77	50.46 ± 13.24[b]	43.43 ± 17.16	53.43 ± 15.05[b]	42.48 ± 13.38	79.78 ± 13.75[b,e]
Future expectation	42.48 ± 13.27	47.48 ± 11.83	42.14 ± 14.42	61.93 ± 15.58[b,e]	43.64 ± 16.65	62.75 ± 15.16[b,e]	41.52 ± 15.60	80.48 ± 10.68[b,e]
Sexual function	23.45 ± 9.49	30.45 ± 12.65[b]	24.32 ± 8.35	35.82 ± 12.42[b]	22.64 ± 8.13	36.46 ± 11.55[b]	23.48 ± 9.37	43.33 ± 13.38[b,e]
Sexual satisfaction	38.52 ± 12.42	43.30 ± 13.72[a]	39.07 ± 11.26	52.29 ± 11.92[b,e]	40.07 ± 14.27	53.71 ± 12.60[b,e]	39.33 ± 13.21	65.07 ± 14.07[b,e]
Symptom dimension								
Urination	45.28 ±	42.38	44.86 ±	35.29 ±	46.18 ±	35.29 ±	44.56 ±	23.44 ±

problem	14.14 ± 12.05	13.64	10.73[b,d]	12.16	12.39[b,d]	13.60	7.80[b,e]
Gastrointestinal symptoms	37.34 ± 13.55	35.45 ± 11.06	38.46 ± 16.65	28.50 ± 12.71[b,d]	37.21 ± 15.35	27.54 ± 10.85[b,e]	38.44 ± 14.19	17.63 ± 9.37[b,e]
Adverse reactions of chemotherapy	14.34 ± 4.53	29.28 ± 6.64[b]	15.54 ± 7.09	26.18 ± 7.49[b]	15.46 ± 5.90	25.96 ± 5.98[b]	15.26 ± 5.16	18.41 ± 4.91[a,e]
Defecation problem	23.52 ± 9.70	35.38 ± 8.67[b]	24.18 ± 8.64	30.18 ± 7.83[b,d]	23.43 ± 7.36	29.82 ± 9.29[b,d]	24.56 ± 8.16	26.33 ± 6.52[e]
Issue related to stoma	50.45 ± 11.30	44.52 ± 11.23[a]	50.50 ± 10.90	36.29 ± 9.08[b,e]	49.54 ± 12.23	38.18 ± 6.91[b,e]	49.33 ± 11.68	24.74 ± 6.76[b,e]
Male sexual problems	60.83 ± 14.90	51.07 ± 13.44[b]	62.11 ± 11.25	45.71 ± 12.18[b]	60.93 ± 14.03	43.64 ± 10.73[b,d]	61.56 ± 13.27	42.63 ± 11.08[b,e]
Female sexual problems	26.72 ± 8.69	23.38 ± 5.80[b]	27.43 ± 7.71	21.68 ± 5.83[b]	27.86 ± 6.90	20.36 ± 5.70[b]	27.52 ± 8.10	18.30 ± 5.77[b,e]
Body mass	54.48 ± 14.19	49.41 ± 11.97[a]	55.32 ± 13.65	41.11 ± 9.87[b,e]	55.18 ± 11.44	42.68 ± 11.67[b,d]	55.11 ± 16.54	34.74 ± 9.65[b,e]

[a]$P < 0.05$, the intra-group comparison of each group at different time points.

[b]$P < 0.01$, the intra-group comparison of each group at different time points.

[d]$P < 0.05$, the comparison of group B, group C and group D with the group A at the same time point.

[e]$P < 0.01$, the comparison of group B, group C and group D with the group A at the same time point.

Table 5 Gastrointestinal hormone levels in peripheral blood of four groups (mean ± SD, pg·mL^{-1})

Group	MTL		SS	
	Baseline	**12 wk**	**Baseline**	**12 wk**
Group A	146.07 ± 28.42	159.28 ± 25.69	120.17 ± 21.84	124.52 ± 23.38
Group B	151.75 ± 25.54	192.79 ± 22.75^{b,d}	131.18 ± 22.11	110.36 ± 22.49^{b,d}
Group C	147.57 ± 20.43	189.46 ± 25.06^{b,d}	125.36 ± 19.81	114.14 ± 21.10^{b,d}
Group D	144.52 ± 22.41	269.33 ± 24.74^{b,d}	119.52 ± 21.12	70.26 ± 20.53^{b,d}

$^{b}P < 0.01$, the intra-group comparison of each group at different time points.

$^{d}P < 0.01$, the comparison between group d, group a, group b and group c at the same time point.

MTL: Levels of motilin; SS: Levels of somatostatin.

Table 6 Correlation between gastrointestinal hormone levels and scores of functional areas of quality of life in colorectal cancer patients (R)

Project	Constipation symptom score	MTL	SS
Body image	-0.376[b]	0.617[b]	-0.532[b]
Future expectation	-0.530[b]	0.569[b]	-0.446[b]
sexual function	-0.334[b]	0.290[b]	-0.243[b]
Sexual satisfaction	-0.375[b]	0.369[b]	-0.250[b]
Urination problem	0.393[b]	-0.448[b]	0.334[b]
Gastrointestinal symptoms	0.436[b]	-0.390[b]	0.238[a]
Adverse reactions of chemotherapy	0.329[b]	-0.431[b]	0.305[b]
Defecation problem	0.265[b]	-0.002	0.166
Issue related to stoma	0.507[b]	-0.528[b]	0.410[b]
Male sexual problems	0.151	-0.643[b]	0.803[b]
Female sexual problems	0.305[b]	-0.244[b]	0.190[a]
Body mass	0.314[b]	-0.284[b]	0.195[a]

[a]$P < 0.05$, between gastrointestinal hormone levels and scores of functional areas of quality of life in colorectal cancer patients.

[b]$P < 0.01$, between gastrointestinal hormone levels and scores of functional areas of quality of life in colorectal cancer patients.

MTL: Levels of motilin; SS: Levels of somatostatin.

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