Effect of Individualized Exercise Therapy on Cancer-related Fatigue and Negative Emotion in Patients with Gastrointestinal Tumor during Perioperative Period

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Abstract [**Objectives**] To investigate the effect of exercise therapy in gastric cancer patients during perioperative period. [**Methods**] 100 patients with gastric cancer who underwent elective operation in the Department of Gastrointestinal Surgery of Taihe Hospital Affiliated to Hubei University of Medicine were divided into observation group and control group by convenience sampling. The control group received routine nursing measures, and the experimental group received exercise therapy intervention measures on the basis of the control group. The patients were evaluated by the General Information Questionnaire, Self-Rating Anxiety Scale, Self-Rating Depression Scale and Cancer-related Fatigue Scale at the time of admission, the second week and the sixth week after operation. [**Results**] The time effect, intervention effect and interaction effect of anxiety score, depression score and cancer-related fatigue score were significant (all $P<0.05$) and the index of enhanced recovery after surgery was significant ($P<0.05$) in the two groups at the second and sixth week after operation. [**Conclusions**] Exercise therapy is beneficial to promoting the enhanced recovery after surgery in advance, reduce cancer-related fatigue, negative emotion and accelerate rehabilitation in patients with gastrointestinal tumors.

Key words Gastrointestinal tumor, Exercise therapy, Anxiety, Depression, Index of enhanced recovery after surgery, Cancer-related fatigue

1 Introduction

In recent years, the clinical incidence of cancer symptoms such as cancer pain, cancer-related fatigue, anxiety and depression in patients with gastric cancer during perioperative period has increased significantly[1]. American College of Sports Medicine (ACSM) released the *Nutrition and Exercise Guidelines for Cancer Survivors*, which states that specific aerobic exercise, resistance training, or a combination of the two can improve common cancer accompanying symptoms[2]. *The "Healthy China* 2030" *Planning Outline* regards exercise as an effective intervention method to promote physical health, disease prevention, rehabilitation and adjuvant treatment[3]. At the same time, the concept of enhanced recovery after surgery also puts forward the point of view of early postoperative out-of-bed activity. But there is no detailed activity plan for when and how to exercise. Therefore, exercise therapy is used in patients with gastrointestinal tumors before, during and after surgery, and good results have been achieved.

2 Information and method

2.1 General information Using convenience sampling method, 100 patients with gastric cancer were selected from Taihe Hospital affiliated to Hubei University of Medicine, and divided into groups according to the order of admission, 50 patients in each group. Patients admitted from October 2022 to December 2022 formed the study group, and patients admitted from February 2023 to April 2023 formed the control group.

Inclusion criteria: (i) age≥18 years old; (ii) diagnosed as a patient with gastrointestinal tumors after pathological diagnosis; (iii) patients undergoing elective general anesthesia.

Exclusion criteria: (i) mental illness, disturbance of consciousness and communication disorders; (ii) organ failure, severe cardiopulmonary insufficiency; (iii) distant metastasis of tumor; (iv) pregnant women; (v) severe osteoarthrosis, edema, severely affecting exercise; (vi) symptoms of deep vein thrombosis, limb swelling, pressing pain, and fever.

2.2 Intervention method The control group received routine nursing measures, including preoperative and postoperative care. The experimental group was given exercise therapy on the basis of the control group.

2.2.1 Establishing an implementation team. The exercise therapy group consisted of 8 members. The head nurse is the team leader, responsible for the implementation and quality control of the whole stage of exercise treatment; 1 deputy chief doctor of gastrointestinal surgery, responsible for medical safety control during exercise; 2 rehabilitation therapists, responsible for implementing perioperative exercise therapy prescriptions; 4 responsible nurses, responsible for cooperating with rehabilitation therapists to implement exercise therapy at various stages.

2.2.2 Constructing exercise prescriptions. The exercise therapy prescription was finally formed after the whole group reviewed the literature, screened prescription and evaluated the quality, and 5 experts in the field of gastrointestinal tumors and rehabilitation therapy were invited to revise and comment. Before the exercise therapy prescription was implemented, the team leader conducted theoretical training for the whole group members, and the whole staff can only carry out clinical practice after the assessment and mastery. Each responsible nurse told the selected patients and

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their families about the benefits of exercise therapy for gastrointestinal tumor patients and the implementation methods, unified guidance caliber, made a good demonstration, and asked patients to practice until the patients fully mastered it. At the same time, exercise therapy education manuals were distributed to facilitate patients' understanding. Exercise prescription was combined with the characteristics of the ward environment, exercise therapy methods, and daily exercise habits of patients.

2.2.3 Precisely controlling the exercise process. Physical fitness assessment before exercise: After the patient is admitted to the hospital, the rehabilitation therapist conducts muscle strength, hand grip strength test, arm flexion and extension test, sitting and standing test, and conducts a six-minute walk test to evaluate the patient's physical fitness and measure exercise endurance.

(i) Hand grip strength test: Use electronic grip strength meter to test the grip strength of left and right hands respectively, and calculate the average value of the grip strength of both hands. (ii) 30 sec arm flexion and extension test: Grasp the 2.25 kg dumbbell with the dominant hand, and calculate the number of forearm flexions within 30 sec. (iii) 30 sec sitting and standing test: Sit on a chair of standard height, cross hands in front of chest and perform repeated movements of standing up and sitting down, and calculate the number of times within 30 sec. (v) 6 min walking test: The patient walks back and forth in the corridor marked in the ward according to his own walking speed, the rehabilitator reports the time every minute, and the nurse detects the dynamic changes of the patient's blood oxygen saturation, heart rate, and electrocardiogram.

Evaluation of diseases and signs before exercise: For patients with cardiovascular disease, diabetes, kidney disease and physical discomfort, dyspnea, dizziness, syncope, ankle edema, palpitations, intermittent claudication, fatigue and other symptoms, the exercise intensity is low to moderate, and it can be advanced to higher intensity according to the Guidelines for Exercise Testing and Prescription[5] issued by ACSM. For patients with exercise habits of 3 d/week, 30 min/d and lasting more than 3 months, the exercise intensity can be advanced to the larger amount of activity.

Determination of the intensity of exercise goals: Set by the talk trial according to the *ACSM Standards and Guidelines for Health/Fitness Facilities*[6]:

(i) Intensity: Low, subjective measurement: able to speak and sing. (ii) Intensity: Medium, subjective measurement: able to speak but not sing. (iii) Intensity: Large/larger, subjective measurement: unable to speak a complete sentence.

Low intensity is gradually increased to medium-high intensity, reaching between slightly tired feeling and tired feeling.

2.3 Evaluation method Patients were evaluated by responsible nurses through WeChat, outpatient clinics, and home visits after discharge.

(i) General data scale: It was self-designed, including gender, age, education level, TIM stage, postoperative time of getting out of bed, postoperative gas passage time, hospitalization time, postoperative pulmonary infection, lower extremity venous thrombosis, anastomotic leakage, *etc.* to investigate the general situation of the two groups of patients, whether there are complications after surgery, and the implementation of enhanced recovery after surgery.

(ii) Self-rating anxiety scale (SAS)[7]: There are 20 items in this scale, including mental anxiety and somatic anxiety. The 4-grade scoring method was used, the higher the score, the higher the anxiety level of the patient. Anxiety severity evaluation: <50 points normal, 50 – 59 points mild anxiety, 60 – 69 points moderate anxiety, $\geqslant 70$ points severe anxiety. The anxiety scores of the patients at the time of admission, the second week after discharge, and the sixth week after discharge were investigated respectively.

(iii) Self-rating depression scale (SDS)[8]: There are 20 items in this scale, including four dimensions: mental-emotional symptoms, somatic disorders, psychomotor disorders, and depressive psychological disorders. The higher the score, the more severe the depression of the patient. Depression severity evaluation: <53 points normal, 53 – 62 points mild depression, 63 – 72 points moderate depression, $\geqslant 73$ points severe depression. The depression scores were investigated at admission, 2 weeks after discharge and 6 weeks after discharge.

(iv) Cancer-related fatigue scale[9]: there are 15 items, 3 dimensions (physical fatigue, emotional fatigue, cognitive fatigue), and each item was graded on a scale of 1 – 5 points. The score range of physical fatigue dimension is 0 – 28 points, the score of affective dimension and cognitive dimension is 0 – 16 points, and the score of total scale is 0 – 60 points. The higher the score, the more serious the fatigue. The scores of cancer-related fatigue at admission, 2 weeks after discharge and 6 weeks after discharge were investigated.

2.4 Statistical methods SPSS 25.0 software was used for t-test, χ^2 test and analysis of variance of repeated measurements, and the test level $\alpha = 0.05$.

3 Results and analysis

3.1 Implementation of index of enhanced recovery after surgery The postoperative hospitalization date, the date of getting out of bed, the time of gas passage, the incidence of pulmonary infection, venous thrombosis of lower extremity and anastomotic leakage were compared between the two groups. As can be seen from Table 1, the hospitalization time, postoperative out-of-bed time and gas passage time of the patients in the experimental group were significantly shorter than those in the control group ($P < 0.05$). The incidence of postoperative pulmonary infection, lower extremity venous thrombosis and anastomotic leakage in the experimental group was significantly lower than that in the control group. No postoperative complications occurred, and the differ-

ence was statistically significant ($P<0.05$). This showed that the implementation of individualized exercise therapy can significantly promote the implementation of patients' postoperative enhanced recovery after surgery.

Table 1 Implementation of index of enhanced recovery after surgery in the two groups ($n=50$)

Group	Out-of-bed time (d, $\bar{x}\pm s$)	Gas passage time (d, $\bar{x}\pm s$)	Hospitalization time (d, $\bar{x}\pm s$)	Postoperative complication rate//%		
				Pulmonary infection	Lower extremity venous thrombosis	Anastomotic leakage
Experimental group	1.03±0.32	3.15±0.52	15.24±2.74	0	0	2
Control group	2.75±1.26	4.11±0.23	13.78±2.56	2	2	4
Statistic	$t=-4.72$	$t=-9.07$	$t=-2.64$	$x^2=2.04$	$x^2=2.04$	$x^2=0.70$
P value	<0.05	<0.05	<0.05	>0.10	>0.10	>0.10

3.2 Comparison of anxiety, depression and cancer-related fatigue between two groups at different time Self-rating anxiety scale, self-rating depression scale and cancer-induced fatigue scale for the observation group and the control group were collected at admission, the second week after discharge, and the sixth week after discharge. The results showed that the scores of anxiety, depression and cancer-related fatigue in the two groups were in accordance with the normal test by normal analysis and variance homogeneity test. ANOVA for repeated measurement was used for statistical analysis, and the Mauchly spherical test showed that $P=0.058$, $P>0.05$, it conformed to the spherical test hypothesis. The results showed that the mean scores of cancer-related fatigue scale, self-rating depression scale, and self-rating anxiety scale in the experimental group were significantly lower than those in the control group at the second and sixth week after discharge. The difference was statistically significant in F_{time}, $F_{intervention}$, and $F_{interaction}$ between the two groups ($P<0.05$, $P<0.01$). The results are shown in Table 2.

Table 2 Comparison of anxiety, depression and cancer-related fatigue between two groups at different time ($n=50$, points, $\bar{x}\pm s$)

Item	Group	At admission	The second week after discharge	The sixth week after discharge	F_{time}	$F_{intervention}$	$F_{interaction}$
Anxiety score	Experimental	45.82±6.22	39.92±3.56	38.26±4.01	26.625**	8.813*	5.568**
	Control	45.78±6.26	44.18±5.84	42.72±6.77			
Depression score	Experimental	48.94±8.12	40.90±5.18	40.78±4.94	18.010**	26.602*	5.595*
	Control	49.18±8.08	47.22±6.85	46.70±6.61			
Cancer-related fatigue score	Experimental	47.56±5.12	36.50±2.98	34.26±4.12	10.168**	0.119*	5.263*
	Control	47.12±6.24	44.60±4.53	43.60±5.08			

NOTE * $P<0.05$, ** $P<0.01$.

4 Discussion

The concept of enhanced recovery after surgery aims to provide perioperative intervention measures, reduce complications and promote patient rehabilitation. Experts in enhanced recovery after surgery reached a consensus that postoperative patients should get out of bed as soon as possible. The difference in the index of enhanced recovery after surgery between the two groups was significant ($P<0.05$). In the experimental group, the time of getting out of bed and the time of gas passage were shortened, no case of pulmonary infection and deep vein thrombosis occurred, and the incidence of anastomotic leakage was significantly reduced. It showed that individualized exercise therapy was conducive to the implementation of index of enhanced recovery after surgery for gastrointestinal patients. Beginning exercise as early as possible before surgery is helpful in promoting gastrointestinal peristalsis and shortening the gas passage time of patients. At the same time, it can increase the level of hemoglobin in the body, cardiac output, increase blood oxygen content, and stimulate the secretion of β-endorphin by the pituitary gland[10]. β-endorphin is a physiological sedative, which can relieve muscle tension and mental stress, enhance the body's cardiac reserve, promote tissue metabolism, improve the patient's muscle strength, body endurance and various organ functions, reduce the incidence of postoperative complications, and shorten the number of hospitalization days[11].

To sum up, as a new nursing method, exercise therapy conforms to the concept of enhanced recovery after surgery in the new era, can significantly reduce cancer-related fatigue in patients with gastrointestinal tumors, and relieve patients' anxiety, depression and other negative emotions to a certain extent. In the future, relevant departments should improve relevant policies and medical and health systems to promote the wide application of individualized exercise therapy in tumor treatment. However, the sample size of this study was small, and the intervention effect was only observed until the sixth week after the intervention. In the next step, the study needs to expand the sample size, extend the observation period, and deepen the study of the response of different individuals to individualized exercise therapy, to explore the long-term effect and durability.

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(To page 91)

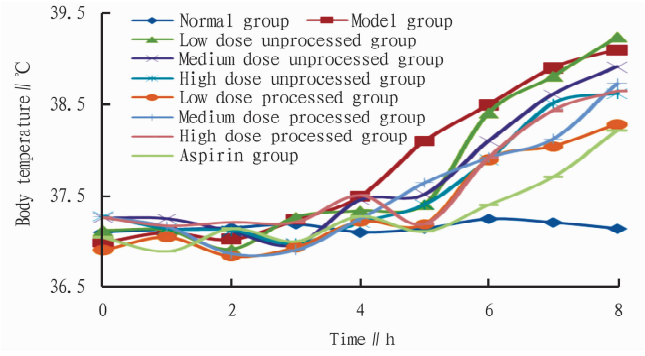
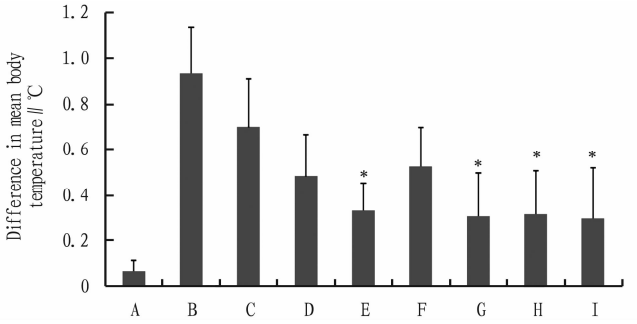


Fig. 3 Temperature change curve of rats at each time point



NOTE A. normal group; B. model group; C. low dose unprocessed group; D. medium dose unprocessed group; E. high dose unprocessed group; F. low dose processed group; G. medium dose processed group; H. high dose processed group; I. aspirin group. Compared with the model group, $P<0.05$.

Fig. 4 Change in difference of mean body temperature in each medication group

4 Discussion and conclusions

4.1 Discussion Because the temperature of different positions of the rat's intestine is different, it is necessary to insert the animal thermometer into the rat's anus at a fixed depth each time to reduce the error caused by the operation. The dry yeast fever model was slow, and the lipopolysaccharide fever model was tried, but failed, so only one rat fever model was investigated. The reason for the increase in body temperature after 6 h in the aspirin group may be that the potency of the drug decreases after 6 h, and the half-life of aspirin is 5.6 – 7.2 h[6]. If aspirin is supplemented in time, better results may be obtained.

The resources of Arnebiae Radix in China are increasingly exhausted, and Inner Mongolian *Lithospermum erythrorhizon* has become rare. The milk processed Arnebiae Radix of that low dose group and the unprocessed Arnebiae Radix of the medium dose group has the similar effect of lowering the body temperature. It can be seen that the efficacy of Arnebiae Radix is enhanced after processing, and the dosage of Arnebiae Radix can be reduced, which has certain significance in protecting the resources of Arnebiae Radix.

4.2 Conclusions In conclusion, the efficacy of Arnebiae Radix is enhanced after milk processing, and the fever of rats in each group is inhibited to different degrees, and the milk processed Arnebiae Radix has a "synergistic" effect. Specifically, the milk processed Arnebiae Radix of the high dose group and the medium dose group can well inhibit the rising of the body temperature of the rats, and the milk processed Arnebiae Radix of the low-dose group also can delay the rising time of the body temperature of the rats. Compared with the unprocessed group, the processed group with the same administration dose shows better experimental results, indicating that the efficacy of the processed Arnebiae Radix is enhanced, and the dosage of the Arnebiae Radix can be reduced under the condition that the milk processed Arnebiae Radix is used to achieve the same efficacy.

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(From page 85)

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