Original Article

The application of personalized rehabilitation exercises in the postoperative rehabilitation of breast cancer patients

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Background: This study sought to explore the effects of personalized rehabilitation exercises in the postoperative rehabilitation of breast cancer patients.

Methods: A total of 93 breast cancer patients admitted to our hospital from January 2018 to December 2019 were taken as research subjects for this study. Based on order of admission, patients were assigned to a control group (46 cases) or an observation group (47 cases). All patients underwent a modified radical mastectomy for breast cancer. Patients in the control group received routine nursing and rehabilitation training after their operations, while those in the observation group received personalized rehabilitation exercises (for a period of 6 months) in addition to the rehabilitation training received by the control group. The immune function indicators, the incidence of upper limb-related complications, the movement of the shoulder joint, upper limb function, ability of daily living (ADL), and quality of life (QoL) was then compared between the two groups before and after the intervention.

Results: Patients in the observation group had lower incidences of upper limb edema and subcutaneous fluid than those in the control group ($P<0.05$). Further, following the intervention, compared to patients in the control group, patients in the observation group had higher CD4+, CD4+/CD8+ levels, lower CD8+ levels, a greater range of motion in their shoulder joints ($P<0.05$), lower upper limb function impairment scores [based on the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire] ($P<0.05$), higher ADL scores ($P<0.05$), and higher QoL scores ($P<0.05$).

Conclusions: Personalized rehabilitation exercises reduced the postoperative upper limb complications experienced by breast cancer patients, improved their immune function, shoulder joint mobility and upper limb function, and improved their ADL and QoL.

Keywords: Breast cancer; personalized rehabilitation exercises; shoulder joint activities; upper limb function; quality of life (QoL)

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Introduction

Breast cancer is a common malignant tumor in women. Recent research has shown that the morbidity and mortality rates of breast cancer are increasing, while the age of onset is decreasing (1,2). Thus, it represents a great threat to women's health. At present, the main clinical treatment of breast cancer is surgical resection, and the most common surgical option is a modified radical mastectomy. However, after surgery, each patient's axillary lymphatic reflux and blood supply are affected differently, and upper

limb function can also be impaired (3). Improving the postoperative upper limb function and the quality of life (QoL) of patients are important areas for clinical medical workers to explore. Rehabilitation training has a positive effect on the recovery of upper limb function in breast cancer patients. Thus, a scientific and reasonable exercise program needs to be developed to improve the recovery of upper limb function (4). Although there have been studies and analyses on the application of rehabilitation training in the recovery of breast cancer patients after surgery, the observation content is mostly limited to the patient's limb function activity, and no analysis of its serological indicators has been performed. Personalized rehabilitation exercises refer to a group of rehabilitation exercises for breast cancer patients after surgery. Such exercises were designed to assist patients to recover postoperative upper limb function and improve their QoL. This study explored the effects of personalized rehabilitation exercises among breast cancer patients after surgery, and observed its impact on the patient's immune function, upper limb activity and prognosis. The results provide a reference for the postoperative recovery of breast cancer patients. We present the following article in accordance with the TREND reporting checklist (available at http://dx.doi.org/10.21037/apm-21-497).

Methods

Research subjects

Breast cancer patients who received a modified radical mastectomy for breast cancer at our hospital from January 2018 to December 2019 were the participants of this study. A total of 93 patients were enrolled in the study. To be eligible to participate in this study, patients had to meet the following inclusion criteria: (I) meet the diagnostic criteria of breast cancer (5) and have been diagnosed by imaging and pathological examination; (II) be aged from 18 to 70; (III) have a normal communication ability; (IV) meet the criteria for a modified radical mastectomy and have undergone this operation; and (V) provide their informed consent to participate in this study. Conversely, patients were excluded from this study if they met the following exclusion criteria: (I) have advanced breast cancer with distant metastasis or organ failure; (II) have severe solid organ disease; (III) have blood coagulation dysfunction; (IV) have non-primary breast cancer; and/or (V) have other tumors.

Based on order of admission, 93 patients were allocated to an observation group (47 patients) or a control group (46 patients). Patients in the observation group were aged from 33 to 69, and had an average age of 48.52±7.01. In relation to breast cancer, 7 patients had Stage I breast cancer, 22 had Stage II, and 18 had Stage III. In relation to education level, 18 patients held a middle-school degree or below, 6 held a specialist degree, and 23 held an undergraduate degree or above. Patients in the control group were aged from 32 to 68, and had an average age of 47.8±6.44. In relation to breast cancer, 5 patients had Stage I breast cancer, 27 had Stage II, and 14 had Stage III. In relation to education level, 15 patients held a middle-school degree or below, 10 held a specialist degree, and 21 held an undergraduate degree or above. There was no significant difference in the general information between the two groups ($P>0.05$); thus, the two groups were comparable. All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by institutional ethics board of Harbin Medical University Cancer Hospital and informed consent was taken from all the patients.

Study methods

Patients in the control group received a routine nursing intervention, including condition observation, ward environment maintenance, medication, and diet guidance. They were also provided with health education brochures to read, and underwent routine rehabilitation training, including fisting (hold the ball for 5 seconds and then release it for 5 seconds, hold the ball again, repeat 20 times), wrist (flexion and extension), and lifting exercises (upper limbs). In addition to the routine nursing, patients in the observation group received personalized rehabilitation exercise intervention, which was divided into 3 stages: (I) early rehabilitation exercises; (II) mid-term rehabilitation exercises, and (III) late rehabilitation exercises. The early rehabilitation exercises were suitable for patients at 24 h to 1 month after surgery, and comprised 10 sections, including fist, wrist, forearm, elbow, elbow holding, upper arm, neck, body extension, and shoulder lifts, which patients were directed to start at 24 h, 48 h, 3 d, 5 d, 7 d, 9 d, 10 d, 11 d, 12 d, 14 d after surgery, respectively. The mid-term rehabilitation exercises were suitable for patients at 1 to 3 months after surgery, and comprised 10 sessions, which included stretching, pushing, and pulling, shaking hands, chest expansions, side lifting, lifting, encircling, abdominal and back, body rotation, and finishing exercises. Finally, the late rehabilitation exercises were suitable for patients

at 3 months after the operation, and comprised 8 sections, including warm-up, head shaking, head-up, arm extension, waist, waist turning, circle, and finishing exercises. Patients were directed to undertake the exercises 3 times a day for a period of 10–15 min each.

The following should be noted: (I) the rehabilitation exercises were chosen based on the time that had elapsed since the breast cancer surgery. (II) If a patient had an axillary drainage tube after the operation, it was necessary to ensure that the drainage tube was well fixed, and the movement range was sufficiently small to prevent the drainage tube from coming out. (III) Patients with a central venous catheter inserted through a peripheral vein (PICC) or an arm-mounted port of infusion (PORT) were prohibited from doing forearm exercises and elbow exercises at 24 h to 1 month after their operations, and the upper arm and body extension exercises were also kept in a small range. Further, the amplitudes of shoulder lifting and neck movement were carefully monitored among patients with trans clavicular or inferior vein catheterization (CVC) or a PORT. (IV) Patients' wound healing was fully evaluated at 1 to 3 months after surgery. Patients with a PICC and arm PORT were not allowed to complete the chest expansion exercises and attention was paid to the range of side Vera and abdominal and back exercises. (V) At 3 months post-surgery, if patients had a recurrence or it would be easy to rupture a lesion, exercise was prohibited immediately to prevent any such rupture of the lesion. For patients with a neck PORT, attention was paid to the amplitude when they engaged in the head shaking exercise. Similarly, for patients with an arm PORT or PICC, attention was paid to the amplitude of the arm extension. (VI) Excessive exercise and physical exertion were avoided by patients on the day(s) of their chemotherapy treatments. Following chemotherapy, appropriate exercise actions were selected according to the side effects of the drug. Patients in both groups participated in the interventions for 6 months.

Both groups intervened for 6 months. The intervention site for inpatients was in the rehabilitation center room of the hospital. After being discharged from the hospital, patients can come to the hospital rehabilitation center room to perform rehabilitation exercises at home or on their own, and arranged the daily exercise time according to the patient's personal time.

Observation indicators

The observation indicators were as follows:

(I) Immune function indicators were tested before and after the intervention of the two groups. 3 mL of peripheral venous blood was drawn from the patient, centrifuged at 2,500 r/min, and the supernatant was collected for CD4+, CD8+ level detection.

(II) The occurrence of upper limb-related complications after the interventions, including the presence of an upper limb edema and/or subcutaneous fluids, were recorded for the two groups. The upper limb edema was evaluated by measuring the circumference of the biceps brachii muscle abdominal or the most prominent part of the upper arm and the affected side. The circumference of the affected limb (i.e., the circumference of the healthy upper limb ≥3 cm) was judged as the edema (6). The presence of subcutaneous fluid was determined in accordance with Teiler's approach (7). Specifically, there was subcutaneous fluid if there was a sense of fluctuation after the subcutaneous touch in the operation area on the 2nd day after the drainage tube was removed, or if the drainage volume was more than 30 mL on the 5th day after the operation, or if the amount of fluid extracted by the puncture was more than 5 mL.

(III) Before and after the intervention, a special goniometer was used to measure the range of motion of the shoulder joints. The measurement included extension, flexion, adduction, and abduction. The measurement was considered appropriate as long as the patients had no discomfort.

(IV) The upper limb function impairment score [based on the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire] (8) and the ability-of-daily-living (ADL) score (9) were used to assess each patient's upper limb function and activities of ADL before and after the intervention. The DASH questionnaire comprises 3 parts. This study used 2 parts to understand the patient's upper limb functional activity (via 23 items), and upper limb discomfort symptoms (via 7 items). All items were evaluated using a 5-level scoring method. A patient's final DASH score ranges from 0 to 100 points, corresponding to a completely normal upper limb function and an extremely limited upper limb function. The higher the score, the more severe the limitation of the upper limb function. The ADL test comprises 10 items. A patient's final ADL score

Table 1 Comparison of immune function indicators between the two groups before and after the intervention ($\bar{x} \pm s$)

Groups	Time	CD4+ (%)	CD8+ (%)	CD4+/CD8+
Observation group (n=47)	Before intervention	41.72±4.36	32.39±3.58	1.29±0.11
	After intervention	46.88±4.05*#	28.53±3.11*#	1.64±0.15*#
Control group (n=46)	Before intervention	42.35±4.18	32.12±3.46	1.32±0.12
	After intervention	44.59±4.27*	30.07±3.25*	1.47±0.13*

Compared to before the intervention, *P<0.05; compared to the control group, #P<0.05.

Table 2 Comparison of the incidence of upper limb-related complications between the two groups

Groups	Cases	Upper limb edema, n (%)	Subcutaneous fluid, n (%)
Observation group	47	1 (2.13)	1 (2.13)
Control group	46	9 (19.57)	8 (17.39)
χ^2		5.661	4.573
P		0.017	0.032

ranges from 0–100 points. The higher the score, the better a patient's ADL.

(V) The QoL measurement scale Functional Assessment of Cancer Therapy—Breast (FACT-B) questionnaire (10) was used to evaluate the QoL of patients in the two groups before and after the intervention. The scale included questions related to their physiological status, social/family status, emotional status, functional status, and an additional 5 dimensions. The higher the score, the better a patient's QoL.

Statistical analysis

SPSS19.0 software was used to analyze the data. The count data were expressed as a rate (%), and the χ^2 test was used for the statistical analysis. The scores were expressed as $\bar{x} \pm s$, and the paired t-test was used to determine the difference before and after the intervention. An independent-sample t-test was used to compare the groups. A P<0.05 was considered statistically significant.

Results

Comparison of immune function indicators before and after intervention between the two groups

Before the intervention, there was no significant difference in the immune function indicators between the two groups (P>0.05). After the intervention, the CD4+, CD4+/CD8+ levels of the observation group were higher than those of the control group (P<0.05), and the CD8+ levels were lower than the control group (P<0.05; see *Table 1*).

Comparison of the occurrence of upper limb-related complications between the two groups

As *Table 2* shows, the incidences of upper limb edema and subcutaneous fluid were lower in the observation group than the control group (P<0.05).

Comparison of shoulder mobility before and after intervention between the two groups

Before the intervention, there was no significant difference in the range of motion of patients' shoulder joints between the two groups (P>0.05); however, after the intervention, the range of motion of the shoulder joints of patients in the observation group was greater than that in the control group (P<0.05; see *Table 3*).

Comparison of upper limb function and activities of daily living between the two groups before and after the intervention

Before the intervention, there was no significant difference in the DASH and ADL scores between the two groups

Table 3 Comparison of the range of motion of patients' shoulder joints before and after the intervention between the two groups ($\bar{x} \pm s$)

Groups	Time	Extension	Flexion	Abduction	Adduction
Observation group (n=47)	Before intervention	25.85±3.36	84.69±5.08	73.64±4.57	19.27±2.31
	After intervention	38.16±4.12*#	114.54±6.63*#	93.88±5.49*#	35.96±3.35*#
Control group (n=46)	Before intervention	24.37±3.10	83.32±5.47	72.53±4.23	18.61±2.19
	After intervention	33.62±3.95*	102.11±5.90*	84.71±4.68*	27.13±2.26*

Compared to before the intervention, *P<0.05; compared to the control group, #P<0.05.

Table 4 Comparison of upper limb function and activities of daily living between the two groups before and after the intervention ($\bar{x} \pm s$, points)

Groups	Time	DASH	ADL
Observation group (n=189)	Before intervention	57.18±5.55	10.53±3.17
	After intervention	24.79±3.04*#	15.38±4.18*#
Control group (n=189)	Before intervention	58.42±5.27	10.62±3.05
	After intervention	37.56±4.18*	13.91±3.92*

Compared to before the intervention, *P<0.05; compared to the control group, #P<0.05. DASH, Disabilities of the Arm, Shoulder and Hand; ADL, ability-of-daily-living.

Table 5 Comparison of quality of life between the two groups before and after the intervention ($\bar{x} \pm s$, points)

Groups	Time	Physiological status	Social/family status	Emotional status	Functional status	Additional attention
Observation group (n=47)	Before intervention	20.75±2.29	20.53±3.17	19.62±2.61	19.14±2.30	19.80±2.24
	After intervention	25.43±3.17*#	26.12±3.20*#	24.55±2.88*#	25.06±2.69*#	24.37±2.33*#
Control group (n=46)	Before intervention	20.03±2.65	19.92±2.71	18.95±2.37	18.64±2.16*	19.45±2.12
	After intervention	22.98±2.83*	24.91±3.04*	22.34±2.59*	22.42±2.30*	22.01±2.25*

Compared to before the intervention, *P<0.05; compared to the control group, #P<0.05.

(P>0.05); however, after the intervention, the DASH scores of the patients in the observation group were lower than those of patients in the control group (P<0.05), and the ADL scores of patients in the observation group were higher than those of patients in the control group (P<0.05; see *Table 4*).

Comparison of quality of life between the two groups before and after the intervention

Before the intervention, there was no significant difference in the QoL scores between the two groups (P>0.05); however, after the intervention, the QoL scores of patients in the observation group were higher than those of patients in the control group (P<0.05; see *Table 5*).

Discussion

At present, the clinical treatment of breast cancer generally involves a modified radical mastectomy, supplemented by radiotherapy and chemotherapy or targeted therapy. Such clinical treatment can control a patient's disease progression and prolong their survival. If a modified radical mastectomy is performed to treat breast cancer, the surgical wound is typically large, and if the axillary lymph nodes and surrounding fatty tissue are dissected, the skin flap is often directly overlaid on the body surface for suture. As the flaps adhere to the chest wall and axillary, patients are prone to upper limb edema and pain after surgery, which affects their upper limb activities. Consequently, they need to engage in upper limb functional exercises (11,12). Studies have

shown that reasonable functional exercises for breast cancer patients after surgery can improve the muscles of the upper limbs and promote local blood circulation, both of which are important to the recovery of the upper limbs in the affected area (13,14).

Routine postoperative functional exercises are generally carried out by the patients themselves. There is no uniform standard for exercise methods, and thus the effect obtained is also different, which is not optimal. Rehabilitation exercises, also called postoperative functional exercises, refer to specific exercise methods to improve blood circulation, regulate limb function, and thus promote early recovery post-surgery. Segerer *et al.* (15) showed that after lateral neck lymph node dissection in patients with thyroid cancer, rehabilitation exercises can enhance their muscle strength and promote the recovery of neck and shoulder functions. The personalized rehabilitation exercises adopted in this study were divided into the following three stages: (I) the early stage; (II) the mid-term stage; and (III) the late stage. The main purposes of training at the different stages differed.

The early stage rehabilitation exercises use arm exercises and muscle contractions to improve blood and lymph circulation, inhibit local exudation, and promote wound healing. Early exercises can increase a patient's postoperative upper limb pain; however, in terms of long-term effects, after a certain period of regular exercise of the upper limb, such exercises can relieve a patient's long-term pain and reduce edema. The results of this study showed that the incidences of upper limb edema and subcutaneous fluid in the observation group were lower than those in the control group. Thus, the personalized rehabilitation exercises reduced the incidences of postoperative upper limb edema and subcutaneous fluid.

The mid-term rehabilitation exercise fully exercises the patient's shoulder joint muscles to gradually replace the role of the armpit tissue. Additionally, the repeated traction of the tissue around the wound helps to prevent scar adhesion and adjusts the movement of the shoulder joint. The results showed that the range of motion of patients' shoulder joints in the observation group was greater than that in the control group. Thus, the personalized mid-term rehabilitation exercises improved the range of motion of patients' shoulder joints.

The range of late rehabilitation exercises was relatively large to consolidate the exercise effect and improve each patient's upper limb function. Following this intervention, the DASH scores of patients in the observation group were lower than those of patients in the control group. Thus, once again, the personalized late rehabilitation exercises were found to have a positive effect in promoting the recovery of patients' upper limb function.

The entire personalized rehabilitation exercises adopted the principles of gradual progress and adjustment of intensity (from simple to difficult) while also paying attention to the symmetry of the movements. Notably, the rehabilitation training did not require a venue or any equipment. Thus, the patients were able to train during their hospitalization and after they had been discharged from hospital to meet their postoperative rehabilitation requirements. In addition, the immune function indicators of the two groups of patients were tested and analyzed. The results showed that the improvement of the immune function indicators of the observation group after intervention was better than that of the control group, indicating that personalized rehabilitation exercises can better improve the immune function of patients. Analyzing the reasons, personalized rehabilitation exercises can promote the blood circulation of patients, improve the absorption and intake of nutrients by the tissues, and enhance the body's immunity. After the intervention, the ADL and QoL scores of patients in the observation group were higher than those of patients the control group. Thus, the personalized rehabilitation exercises also improved patients' ADL and QoL scores. As patients typically undergo chemotherapy after surgery, most patients have channels (e.g., a CVC, a PICC, or a PORT). Consequently, attention must also be paid to avoid damage to the such channels as patients engage in personalized rehabilitation exercises.

In summary, individualized rehabilitation exercises for breast cancer patients were found to reduce postoperative upper limb complications, improve shoulder joint mobility, promote the recovery of upper limb function, and improve patients' ADL and QoL.

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Footnote

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References

1. Fahad Ullah M. Breast Cancer: Current Perspectives on the Disease Status. Adv Exp Med Biol 2019;1152:51-64.
2. de la Mare JA, Contu L, Hunter MC, et al. Breast cancer: current developments in molecular approaches to diagnosis and treatment. Recent Pat Anticancer Drug Discov 2014;9:153-75.
3. Adrada BE, Candelaria R, Rauch GM. MRI for the Staging and Evaluation of Response to Therapy in Breast Cancer. Top Magn Reson Imaging 2017;26:211-8.
4. Stubblefield MD. The Underutilization of Rehabilitation to Treat Physical Impairments in Breast Cancer Survivors. PM R 2017;9:S317-23.
5. Cardoso F, Kyriakides S, Ohno S, et al. Early breast cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up†. Ann Oncol 2019;30:1194-220. Erratum in: Ann Oncol 2019;30:1674.
6. Bojinović-Rodić D, Popović-Petrović S, Tomić S, et al. Upper extremity function and quality of life in patients with breast cancer related lymphedema. Vojnosanit Pregl 2016;73:825-30.
7. Tejler G, Aspegren K. Complications and hospital stay after surgery for breast cancer: a prospective study of 385 patients. Br J Surg 1985;72:542-4.
8. King EA, Siljander BR, Ozer K. Clinical Outcomes of Explosion Injuries to the Hand. Ann Plast Surg 2018;81:50-4.
9. Brekke MF, la Cour K, Brandt Å, Peoples H, Wæhrens EE. The Association between ADL Ability and Quality of Life among People with Advanced Cancer. Occup Ther Int 2019;2019:2629673.
10. Nguyen J, Popovic M, Chow E, et al. EORTC QLQ-BR23 and FACT-B for the assessment of quality of life in patients with breast cancer: a literature review. J Comp Eff Res 2015;4:157-66.
11. McNeely ML, Campbell K, Ospina M, et al. Exercise interventions for upper-limb dysfunction due to breast cancer treatment. Cochrane Database Syst Rev 2010;(6):CD005211.
12. Soriano-Maldonado A, Carrera-Ruiz Á, Díez-Fernández DM, et al. Effects of a 12-week resistance and aerobic exercise program on muscular strength and quality of life in breast cancer survivors: Study protocol for the EFICAN randomized controlled trial. Medicine (Baltimore) 2019;98:e17625.
13. De Groef A, Van Kampen M, Dieltjens E, et al. Effectiveness of postoperative physical therapy for upper-limb impairments after breast cancer treatment: a systematic review. Arch Phys Med Rehabil 2015;96:1140-53.
14. Zhou K, Wang W, An J, et al. Effects of Progressive Upper Limb Exercises and Muscle Relaxation Training on Upper Limb Function and Health-Related Quality of Life Following Surgery in Women with Breast Cancer: A Clinical Randomized Controlled Trial. Ann Surg Oncol 2019;26:2156-65.
15. Segerer FJ, Biko J, Reiners C, et al. Exercise-Induced Hypoxemia in Juvenile Thyroid Carcinoma With Lung Metastases. Pediatr Exerc Sci 2017;29:361-70.

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