

Original Article

The effect of multi-supportive nursing on the postoperative rehabilitation of breast cancer patients

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Received January 30, 2021; Accepted February 21, 2021; Epub June 15, 2021; Published June 30, 2021

Abstract: Objective: To explore the effect of multi-supportive nursing on the postoperative rehabilitation of breast cancer (BC) patients. Methods: A total of 96 BC patients who underwent radical mastectomies in our hospital from January 2014 to January 2017 were recruited as the study cohort. The patients were equally divided into a regular group and a research group, with 48 cases in each group. The regular group underwent conventional postoperative nursing, and the research group underwent multi-supportive nursing. We compared the changes in the two groups of patients' quality of life, their psychological states, and their upper limb function before and after the nursing. The nursing satisfaction and the two groups' survival times were also analyzed after the 3-year follow-up. Results: The Functional Assessment of Cancer Therapy-Breast (FACT-B) and the Connor- Davidson Resilience Scale (CD-RISC) subitem scores and the activity angles of the involved shoulder joints in the two groups were increased after the nursing and were better in the research group (all $P < 0.05$). The involved upper limb lymphedema scores in the two groups were reduced after the nursing and the research group showed a lower level than the regular group (all $P < 0.05$). The nursing satisfaction was higher in the research group compared with the regular group (97.92% vs. 85.42%, $P < 0.05$). During the 3-year follow-up, the Progression Free Survival (PFS) in the research group was longer than it was in the regular group ($P < 0.05$). Conclusion: Multi-supportive nursing plays a positive role in promoting patients' postoperative rehabilitation.

Keywords: Breast cancer, postoperative rehabilitation, centrosome-related kinase 2, extracellular regulatory protein kinase 2, galectin-3, nursing

Introduction

Breast cancer (BC), a frequently reported malignancy in the female population with a high incidence worldwide, ranks first in morbidity among female malignancies [1-3]. Radical mastectomy, which is fundamental to the treatment of this disease, can reduce patients' clinical mortality and prolong their survival times [4-6]. Evidence suggests that, although radical mastectomy can remove malignant tumor tissue completely, it produces a series of adverse effects on the patient's physiology and psychology. Therefore, breast cancer patients' postoperative rehabilitation and prognoses have become an indispensable part of radical mastectomy that cannot be ignored. Recent studies have indicated that there is an unambiguous relationship among centrosome-related kinase 2 (NEK2), extracellular regulated protein kinase 2 (ERK2), galectin-3, and the formation and progression of BC. There is increasing concern

that there is an increased risk of metastasis and recurrence in BC patients who are positive for NEK2, ERK2, and galectin-3 [7, 8]. To upgrade BC patients' postoperative rehabilitation and quality of life, our hospital summarized previous nursing experience and developed a multi-supportive nursing model. During the multi-supportive nursing, intensive care was administered to patients who were positive for NEK2, ERK2, and Galectin-3. The specific objective of this study was to evaluate the new nursing model objectively. Our hospital specially conducted this study, and the study information is summarized as follows.

Materials and methods

General data

A total of 96 BC patients who underwent radical mastectomies in our hospital from January 2014 to January 2017 were recruited as the

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study cohort. Diagnostic criteria: breast cancer-related criteria in obstetrics and gynecology [9]. Inclusion criteria: ① Patients who met the above diagnostic criteria and who were confirmed to have breast cancer using medical imaging, pathological tests, and surgical pathology in our hospital. ② Patients who met the requirements for radical mastectomy as assessed by the physician in our hospital. ③ Patients who gave their informed consent and signed the relevant documents. ④ Patients with complete and relevant examination data. Exclusion criteria: ① Patients who underwent non-surgical BC treatment. ② Patients with incomplete relevant data in our hospital. ③ Patients with an estimated survival time of < 1 year. ④ Patients also suffering from other malignant tumors. ⑤ With Patients suffering from pre-existing psychiatric diseases, psychic disorders, or with a family history of psychiatric diseases. ⑥ With Patients with communication disorders. ⑦ Patients who failed to cooperate with the 3-year follow-up. ⑧ Patients with a prior history of affected upper limb dysfunction. This study was approved by the Ethics Committee of our hospital. The enrolled patients were randomly divided into the regular group and the research group, and 48 patients were included in each group. The patients in the regular group were female and ranged in age from 27 to 69 years old, with an average of 52.87 ± 8.96 years. There were 24 patients with invasive ductal carcinoma, 14 with invasive lobular carcinoma, 4 with medullary carcinoma, 1 with mucinous carcinoma, and 5 with breast carcinoma in situ. There were 16 patients with positive postoperative lymph node metastasis. Their surgical tumor diameters ranged from 1.6 to 5.4 cm (3.16 ± 0.98 cm on average). There were 17 patients who had reached menopause. Regarding the AJCC stages, there were 8 patients in stage I, 22 in stage II, and 18 in stage III. There were 31 NEK2 positive patients, 28 ERK2 positive patients, and 33 galectin-3 positive patients and 26 patients who were positive for all three. The patients in the research group were female, ranged in age from 27 to 71 years old, and had an average age of 53.12 ± 9.07 years. There were 26 patients with invasive ductal carcinoma, 12 with invasive lobular carcinoma, 2 with medullary carcinoma, 3 with mucinous carcinoma, 5 with breast carcinoma in situ. There were 19 patients with positive postoperative lymph node metastasis. Their surgical tumor diam-

eters ranged from 1.3 to 5.6 cm (3.18 ± 0.99 cm on average). There were 19 patients who had reached menopause. Regarding their AJCC stages, there were 7 patients in stage I, 21 in stage II, and 20 in stage III. There were 33 who were NEK2 positive, 29 who were ERK2 positive, and 34 who were galectin-3 positive, and there were 29 patients who were positive for all three. There were no significant differences between the two groups' general data ($P > 0.05$).

Methods

Regular group: The regular group underwent conventional postoperative nursing, including postoperative conventional anti-infection therapy, routine rehabilitation training, compliance with medical adjuvant therapy, and regular discharge education, out-of-hospital guidance, etc.

Multi-supportive nursing: The multi-supportive nursing was performed in addition to the conventional nursing. The specific measures included the following: ① We established a multi-supportive team with the head nurse serving as the leader. The team included a hospital commissioner, all the nursing staff, the physician in charge, a psychiatrist, a psychological counselor, a hospital legal consultant, a laboratory physician, and a medical imaging physician. A patient group was established by the head nurse using a WeChat platform, and all the members were included in the patient group. Lectures on disease knowledge, pathogenesis-related pictures, and texts and video information were regularly shared. ② Health education. The education content was conducted by the nursing staff according to the patients' specific circumstances and revised by the physician in charge. The team provided information about the disease, the postoperative self-care methods, the self-management methods, the postoperative complication judgment criteria, the importance of scheduling follow up visits, the importance and significance of documenting the patients' medical treatment in detail, especially for the clinical significance and postoperative precautions of the patients who tested positive for NEK2, ERK2 and galectin-3 as well as the significance and importance of the postoperative adjuvant chemoradiotherapy, and they introduced the preparation methods and the detailed adjuvant therapy rules. ③

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Support from family members. The team carried out special classes for the family members to explain the importance of the family members and their support for the patients, and the specific contents and methods of patient care and psychological support were explained. ④ Individual support. It was necessary for the physician in charge to offer corresponding interventions or informational support for the patients' individual situations. ⑤ Out-of-hospital support. It was necessary to establish case files for the patients, regularly follow up with the patients through a WeChat platform, telephone, or other means to understand the patients' rehabilitation, to give corresponding guidance accordingly, and to invite the physician in charge to contribute if necessary. It was essential to perform the key follow-ups with the positive NEK2, ERK2, and galectin-3 patients, to increase the frequency of the follow up visits, and to increase the postoperative adjuvant chemotherapy cycle according to the doctor's advice to reduce the risk of postoperative metastasis and recurrence. ⑥ Dietary support. It was necessary to interact with the patients, so a postoperative rehabilitation dietary plan was formulated with the patients and their families according to the patients' specific circumstances to improve the dietary plans' feasibility. ⑦ Rehabilitation training support. According to the scope of the operation, the basic health conditions, and the patients' lab results, the physician in charge and the rehabilitation specialist were organized to jointly develop the rehabilitation training program in consideration of each patient's hobbies. The rehabilitation training followed a segmented and gradual process so the patient could tolerate it and adhere to it for a long time. ⑧ Psychological support. The team listened to each patient's complaints and organized their family members to participate also. Thus, to assess their psychological states, they provided professional intervention accordingly, and they provided acceptable and feasible solutions according to their specific circumstances, including prognostic appearance improvement measures.

Observation indicators

The changes in Functional Assessment of Cancer Therapy-Breast (FACT-B) scores, the Connor-Davidson Resilience Scale (CD-RICS) scores, and the involved upper limb function

results (lymphedema, shoulder flexion, extension, adduction, and abduction angle) before the nursing and at three months after the nursing were compared between the two groups to investigate their satisfaction with the nursing implementation. The progression-free survival (PFS) and overall survival (OS) were statistically analyzed after three years of follow-up.

The postoperative quality of life was assessed using the Functional Assessment of Cancer Therapy-Breast (FACT-B) scores and the postoperative psychological status was assessed using the Connor-Davidson Resilience Scale (CD-RICS) [10]. A higher score indicated a better quality of life or a better psychological state in the two scales.

For involved upper limb lymphedema, the circumference of the arm of the healthy and affected upper limb was measured with a flexible ruler at 10 cm above and below the transverse striation from the wrist to the elbow to compare the differences in the circumferences of the healthy arm and the affected arm, and which was assigned 0 points for < 0.5 cm, 1 point for 0.5~3 cm, 2 points for 3~5 cm, and 3 points for > 5 cm. A protractor was used to measure the range of motion of each patient's shoulder joint. Forward flexion: 0°-180°, extension: 0°~60°, adduction: 0°~5°, abduction: 0°~180°.

The detection of NEK2, ERK2, and galectin-3, and the determination of the results were carried out according to the standards established in the medical literature [11, 12]. Cancer tissues were taken during the surgery and routinely prepared for diagnosis using immunohistochemical Elivision TM plus the two-step method. And five fields were randomly observed in each section under a lighted microscope, with 100 cells counted in each field, and the staining intensity criteria were as follows: colorlessness was deemed as 0 points, light yellow as 1 point, and yellow and brownish-yellow as 2 points. The criteria for the numbers of positive cells were as follows: < 10% was regarded as 0 points, 10%~50% as 1 point, and > 50% as 2 points, and a score ≥ 2 after multiplying the two indicated the positive criteria.

The satisfaction of the patients and their families with the nursing implementation was investigated using our hospital's scale, which was

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Table 1. Comparison of the FACT-B scores before and after the nursing in the two groups ($\bar{x} \pm s$, points)

Group	Time	Physiological state	Social status	Functional status	Emotional state	Additional attention
Regular group n=48	Before nursing	10.29 ± 2.21	10.01 ± 1.12	5.17 ± 1.15	6.77 ± 1.31	10.2 ± 1.09
	After nursing	15.24 ± 3.74*	14.01 ± 2.22*	9.67 ± 2.00*	10.77 ± 1.47*	16.67 ± 2.18*
Research group n=48	Before nursing	10.13 ± 2.47	9.88 ± 1.29	5.14 ± 1.15	6.75 ± 1.23	10.11 ± 1.02
	After nursing	19.31 ± 4.12*	19.34 ± 1.82*	13.31 ± 2.08*	14.84 ± 2.01*	24.19 ± 2.83*
Before nursing	<i>t</i>	0.330	0.534	0.132	0.078	0.408
	<i>p</i>	0.742	0.595	0.895	0.938	0.684
After nursing	<i>t</i>	5.069	12.890	8.741	11.343	14.579
	<i>p</i>	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Note: *indicates a comparison within a group ($P < 0.05$).

Table 2. Comparison of the CD-RICS scores before and after the nursing in the two groups ($\bar{x} \pm s$, points)

Group	Time	Tough	Striving to improve	Optimistic
Regular group n=48	Before nursing	12.21 ± 0.99	11.07 ± 2.34	2.26 ± 1.02
	After nursing	22.10 ± 1.13*	15.37 ± 2.96*	5.67 ± 1.32*
Research group n=48	Before nursing	12.20 ± 0.94	10.92 ± 2.19	2.29 ± 1.16
	After nursing	30.37 ± 2.12*	21.12 ± 3.16*	10.19 ± 1.37*
Before nursing	<i>t</i>	0.017	0.330	0.107
	<i>p</i>	0.987	0.742	0.915
After nursing	<i>t</i>	23.832	9.210	16.456
	<i>p</i>	< 0.001	< 0.001	< 0.001

Note: *indicates a comparison within a group ($P < 0.05$).

divided into very satisfied, satisfaction, basic satisfaction, and unsatisfied, except that the number of unsatisfied cases was the total number of satisfied cases.

Statistical analysis

SPSS 23.0 software was used for statistical analysis, in which rank-sum tests were used for the grade data, and chi-square tests were used for the enumeration data, all were expressed as n (%). The measurement data were analyzed using t tests and represented as ($\bar{x} \pm s$). A survival function was used for the survival times: Kaplan-Meier, LogRank analysis. $P < 0.05$ indicated statistical significance.

Results

Comparison of the quality of life before and after the nursing

There was no significant difference in the FACT-B subitem scores between the two groups

before the nursing ($P > 0.05$). The FACT-B subitem scores in the two groups were increased after the nursing compared with before the nursing, and the research group showed a higher level than the regular group ($P < 0.05$). This is shown in **Table 1**.

Comparison of the psychological states before and after the nursing

There was no significant difference in the CD-RICS subitem scores between the two groups before the nursing ($P > 0.05$). The CD-RICS subitem scores in the two groups were increased after the nursing compared with before the nursing, and the research group showed a higher level than the regular group ($P < 0.05$). This is shown in **Table 2**.

Comparison of the involved upper limb function before and after the nursing

No statistical differences in the involved upper limb function indicators were observed be-

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Table 3. Comparison of the involved upper limb function before and after the nursing in the two groups ($\bar{x} \pm s$)

Group	Time	Lymphedema (points)	Forward flexion (°)	Extension (°)	Adduction (°)	Abduction (°)
Regular group n=48	Before nursing	1.21 ± 0.28	87.03 ± 7.64	19.37 ± 2.30	36.15 ± 2.87	77.65 ± 7.67
	After nursing	0.65 ± 0.16*	127.21 ± 13.96*	33.43 ± 5.45*	54.48 ± 3.81*	134.61 ± 8.27*
Research group n=48	Before nursing	1.25 ± 0.26	86.36 ± 8.69	18.87 ± 2.08	35.82 ± 2.34	77.50 ± 6.43
	After nursing	0.44 ± 0.10*	149.16 ± 14.83*	43.96 ± 5.89*	66.83 ± 4.65*	154.72 ± 10.86*
Before nursing	t	0.740	0.400	1.124	0.626	0.107
	p	0.461	0.690	0.264	0.533	0.915
After nursing	t	7.938	7.468	9.090	14.243	10.203
	p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Note: *indicates a comparison within a group (P < 0.05).

Table 4. Comparison of the nursing satisfaction in the two groups [n (%)]

Group	n	Very satisfied with	Satisfaction	Basic satisfaction	Unsatisfied	Total satisfaction
Regular group	48	12 (25.00)	14 (29.17)	15 (31.25)	7 (14.58)	41 (85.42)
Research group	48	23 (47.92)	17 (35.42)	7 (14.58)	1 (2.08)	47 (97.92)
Z/ χ^2			-2.204			4.909
P			0.028			0.027

Table 5. Detailed statistical values for the survival function (months)

Group	n	Mean	Standard deviation	95% confidence interval		Mean	Standard deviation	95% confidence interval	
				Lower limit	Upper limit			Lower limit	Upper limit
Regular group	48	34.425	5.476	34.227	38.002	36.760	4.657	36.710	39.790
Research group	48	38.126	3.131	38.878	41.241	38.376	2.785	39.963	42.010
Chi-square				6.579				3.570	
P				0.010				0.059	

tween the two groups before the nursing (P > 0.05). The involved upper limb lymphedema scores in the two groups were reduced after the nursing compared with before the nursing (P < 0.05), and the forwarding flexions, extension, adduction, and abduction angle scores of the affected shoulder joints were higher after the nursing than they were before the nursing. The research group showed lower lymphedema scores than the regular group (P < 0.05) but it showed a higher activity angle in the involved shoulder joint than the regular group (P < 0.05). This is shown in **Table 3**.

Satisfaction with the nursing

The nursing satisfaction was higher in the research group compared with the regular group (97.92% vs. 85.42%, P < 0.05). This is shown in **Table 4**.

Comparison of the survival times

After the three-year follow ups, the PFS and OS were (38.13 ± 3.13) months and (38.38 ± 2.79) months in the research group, respectively. The PFS and OS were (34.43 ± 5.48) months and (36.76 ± 4.66) months in the regular group, respectively. The PFS in the research group was longer than it was in the regular group (P < 0.05), and there was no significant difference in the OS between the two groups (P > 0.05). This is shown in **Table 5**.

Discussion

Breast cancer is one of the most common malignant tumors with a high incidence worldwide. BC accounts for about 25% of all female malignant tumors, with about 520,000 deaths due to breast cancer every year, making breast

cancer the leading cause of death among females with malignant tumors [13, 14]. Therefore, the prevention and treatment of BC is at the heart of women's health issues of concern to society as a whole. NEK2, ERK2, and galectin-3 are increasingly important BC research areas. Evidence indicates that the expression levels of NEK2, ERK2, and galectin-3 have an important correlation with the occurrence and progression of BC. Galectin-3 is a galectin with a conserved amino acid sequence, which is expressed in many cells of the human body. Researchers have proved that galectin-3 can heterosexually bind β -galactoside and play an important role in various physiological and pathological processes such as cell migration, growth, apoptosis, and tumor invasion and metastasis. NEK2 can indirectly regulate centrosomes through the centrosome separation mechanism, maintain microtubule stability, participate in the process of chromatin condensation and separation, and interfere with genome stability by acting on chromosomes. NEK2 is associated with promoting the malignant transformation of cells and accelerating the formation, invasion and development of malignant tumors. ERK2 is a major factor in regulating the cell cycle. When expressed at elevated levels, ERK2 can stimulate the regulation of the cell cycle, thereby controlling the expression, differentiation, proliferation, and apoptosis of the related genes.

Radical mastectomy is currently the most common approach for removing malignant tumors and prolonging patients' survival times. However, radical mastectomy has its shortcomings. The surgical procedure requires surgeons to excise a patient's breast, and the scope of the surgical resection is large, so it results in physical defects in the prognosis, and it adversely affects their appearance and physiological function to varying degrees. Patients may suffer more psychological problems, which in turn leads to a decrease in their prognoses and quality of life [15, 16]. Because of the extent of surgical resection, patients are prone to lateral functional limitations after surgery and can also develop lateral upper extremity lymphedema. Lymphedema is mainly caused by lymphatic circulation disorder. It might cause lymphatic fluid retention in the tissue spaces, inducing limited shoulder joint movement, arm swelling, limb numbness and weakness, and abnormal sensations, further causing the

patient psychological stress [17, 18]. Therefore, the postoperative rehabilitation of BC patients has become an important part of the surgical treatment. Patients who are positive for NEK2, ERK2, and galectin-3, especially those who are positive for all three at the same time, have a high risk of metastasis and recurrence after radical surgery and should be given special attention in postoperative rehabilitation.

Previous conventional postoperative care has not dealt with the postoperative rehabilitation needs of patients [19, 20]. So, we developed the multi-supportive nursing plan based on past clinical experience. Multi-supportive nursing programs break the routine of traditional medical, nursing, and family disconnections. It organizes the physician in charge, the nursing staff, and the family members together and combines professionals from various specialties such as psychological counselors, psychiatrists, and hospital commissioners to improve the overall professional level. In particular, the detection and reexamination of NEK2, ERK2, and galectin-3 are enhanced. And the relevant knowledge and necessity of treatment are explained to the patients and their families in detail to improve compliance and cooperation and to better reduce the risk of postoperative recurrence and metastasis. Using information and education and the establishment of the WeChat group, the out-of-hospital support and nursing levels are improved. In the process of enhancing the self-care and management levels of the patients and their families, the enthusiasm and subjective initiatives of the patients are fully mobilized. It improves the patients' prognoses from a physical point of view and it enhances their psychological flexibility and forms a bidirectional benign complementary framework of physiology and psychology. The rehabilitation training program and the diet plan are developed with the support of multiple parties and the patients' themselves. It can improve their compliance, make them willing to implement the program, adhere to it for a long time, and lay a good foundation for enhancing their prognoses during their rehabilitation.

The results of this study showed that the patients' psychological states in the research group were better than they were in the regular group, suggesting that multi-supportive nursing can effectively enhance the postoperative psychological flexibility of patients and improve

their psychological states. The involved limb function in the research group was better than it was in the regular group, suggesting that multi-supportive nursing is an effective way to improve the prognoses of patients with physiological rehabilitation levels. The quality of life of the patients in the research group was higher than it was in the regular group, suggesting that multi-supportive nursing can comprehensively improve the prognoses and quality of life of patients by upgrading the rehabilitation levels, the physiological functions, and the psychological flexibility, along with other comprehensive mechanisms. According to the 3-year follow-up, the PFS in the research group was longer than it was in the regular group but with no significant difference in terms of OS. This suggests that multi-supportive nursing can effectively prolong the postoperative PFS of BC patients. Although no prolongation of OS was observed, the prolongation of PFS had a positive effect on prolonging OS [21]. It had a clear and positive impact on upgrading the patients' prognoses and quality of life. Given the small number of cases enrolled in this study, the results need to be validated by increasing the size of the study cohort.

In summary, multi-supportive nursing can enhance the psychological flexibility of BC patients, including patients positive for NEK2, ERK2, or galectin-3, and patients positive for all three, upgrade their rehabilitation levels, and prolong their PFS, so it improves their postoperative rehabilitation.

Acknowledgements

This study was supported by Xingtai City Science and Technology Plan Project (Grant no. 2018CZ147).

Disclosure of conflict of interest

None.

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