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Original Article

Effects of respiratory rehabilitation nursing on improving postoperative respiratory function and quality of life of patients with lung cancer surgery

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Abstract: Objective: This study aimed to explore effects of respiratory rehabilitation nursing on postoperative respiratory function and quality of life of patients with lung cancer (LC) surgery. Methods: A total of 106 LC patients were selected as research objects and randomized into a research group (RG) and a control group (CG), with 53 patients in each group. Patients in the RG received respiratory rehabilitation training nursing mode after surgery, while those in the CG received routine nursing mode. The respiratory function, blood gas index, postoperative sputum excretion and hospital stays of those in the two groups 2 weeks after nursing were recorded and compared. Then the complications, self-care ability, quality of life and nursing satisfaction of those in both groups within one month after surgery were recorded and compared. Results: After nursing, the VCmax, FEV1, FVE1/FVC, PaO_2 and SpO_2 in the RG were dramatically higher than those in the CG, while $PaCO_2$ was obviously lower than that in the CG ($P < 0.05$). The hospital stays and incidence of complications in the RG were dramatically lower than those in the CG, and the daily sputum excretion was obviously higher than that in the CG ($P < 0.05$). The self-care ability score, quality of life and nursing satisfaction of patients in the RG were dramatically higher than those in the CG ($P < 0.05$). Conclusion: The application of respiratory rehabilitation training and nursing after LC surgery can effectively improve the respiratory function of patients, reduce the incidence of postoperative complications, and also improve their self-care ability and quality of life, which is worthy of clinical promotion.

Keywords: Respiratory rehabilitation nursing, lung cancer surgery, respiratory function, quality of life

Introduction

Lung cancer (LC), as a common clinical respiratory malignant tumor, not only has a high morbidity, but also has the highest mortality among malignant tumors, which poses a serious threat to human life [1]. At present, the main treatment method for LC patients is surgical treatment. Although surgical treatment has good effects on those patients, due to different degrees of thoracic muscle damage to their lungs during surgery, and the residual anesthetic drugs during surgery can inhibit their central nervous system, their lung function and respiratory function will be reduced to a certain extent [2, 3]. However, when patients' respiratory function drops, it will further affect their postoperative rehabilitation and quality of life, which is not conducive to their prognosis [4]. Therefore, how to improve the postoperative respiratory function and quality of life of LC patients by the application of postoperative rehabilitation mode is also an urgent clinical problem to be solved.

LC, as a malignant tumor with high morbidity and mortality, is still treated by surgery [5]. However, due to lung lesions and surgical trauma and other problems, their respiratory secretions of LC patients after surgery are easy to increase to more than the normal load of mucociliary system, which brings about respiratory dysfunction [6, 7]. In addition, factors such as surgical trauma and postoperative pain will also lead to postoperative immunity decline of patients, which will further lead to increased

risk of complications and delay postoperative recovery [8]. Nursing, as a very important component in the postoperative recovery of LC patients, is of great clinical significance to them if a reasonable nursing mode is effectively applied to improve their postoperative respiratory function [9].

In the past, post-operative care for LC was mostly limited to basic post-operative care and related health education and dietary guidance for patients, and there was no professional training for postoperative respiratory function exercise for them [10]. Respiratory rehabilitation nursing is a kind of nursing method for improving patients' pulmonary ventilation function through exercise therapy and physical factor therapy [11]. In the past, it had been widely used in respiratory diseases. For example, research [12] showed that respiratory rehabilitation nursing could effectively improve patients' respiratory function in chronic obstructive pulmonary diseases. Previous studies [13, 14] have found that breathing exercise for patients can effectively relieve symptoms such as dyspnea after LC surgery. However, previous breathing exercise methods are complicated, and some even rely on professional breathing exercise tools, which is not conducive to patients' independent breathing exercise.

Although respiratory rehabilitation training and nursing have many applications in respiratory diseases, there are relatively few researches on its application in LC, and postoperative LC patients are groups that have urgent needs for respiratory function training. Therefore, we have explored the application effect of respiratory rehabilitation training and nursing in patients with LC surgery, with a hope to provide more suitable programs for their nursing.

Materials and methods

General materials

A total of 106 LC patients who underwent radical LC surgery in our hospital from June 2016 to November 2018 were selected as research objects, including 64 male patients and 42 female patients, with an average age of 65.47±4.76 years. The patients were randomized into a research group (RG) and a control group (CG), with 53 patients in each group. Patients in the RG received respiratory rehabilitation training nursing mode after surgery, while those in the CG received conventional nursing mode. Inclusion criteria: Patients diagnosed with LC by pathological diagnosis and those between 55 and 75 years old, according to the principles of lung cancer staging established by the United Cancer Joint Commission to separate patients. Exclusion criteria: Patients with contraindications to surgery; patients with severe liver and kidney dysfunction; patients with coagulation disorders; patients with other malignant tumors; patients with severe immune system diseases; patients with cognitive impairment and communication impairment; patients who did not cooperate with the experiment. All patients and their families agreed to participate in the study and signed an informed consent form, and this study has been approved by the Ethics Committee of the First Hospital of Jilin University.

Nursing methods

Patients in the CG received conventional nursing mode after surgery. Postoperative monitoring of their vital signs, postoperative routine health education, postoperative respiratory tract management, postoperative analgesia, and diet and medication guidance were included. Patients in the RG received respiratory rehabilitation training on the basis of the CG after surgery, specifically as follows: (1) Abdominal respiration: Patients were in the decubitus position, and the sitting position was used when they could sit up, so that they put one hand on the abdomen and the other hand on the chest, inhaled through the nose, protected the mouth from closing tightly while inhaling, and forcibly drummed up the abdomen, while exhaling, tucked in the abdomen and squeezed with hands like the abdomen, with 15-20 breaths per training, 7-8 breaths per minute, and practiced 3-4 times a day. (2) Cough training: Patients were allowed to inhale deeply, then the diaphragm was raised and the glottis was opened to cough. With the help of explosive force generated by contraction of thoracic abdominal muscles and diaphragm, sputum and gas were flushed out. Each training lasted for 8 min. (3) Lip-retraction breathing training: Patients were in the supine position or sitting position, made the nose inhale with maximum force while closing the mouth, held the breath for 3 seconds after inhaling, then slowly exhaled the gas by shrinking the mouth like a fishmouth, exhaled slowly as far as possible. Each exercise

lasted for 8 min, and practiced 3-4 times a day. (4) Resistance breathing training: Patients took a deep breath first, then held his breath and blew the gas into a balloon with a capacity of about 800 ml with maximum strength, exercised for 3 minutes each time and 3 times a day.

Outcome measures

(1) The respiratory function of patients in the two groups before and 2 weeks after nursing was detected by VMAXB220 lung function meter of US-Canada Company: The maximum vital capacity (VCmax), forced expiratory volume in one second (FEV1), and FVE1/FVC (forced expiratory volume in the first second/forced vital capacity) were included. (2) Blood gas analysis indexes of patients in both groups before and 2 weeks after nursing were measured: arterial partial pressure of carbon dioxide ($PaCO_2$), arterial partial pressure of oxygen (PaO_2), arterial oxygen saturation (SpO_2). (3) The sputum excretion and hospital stays of patients in both groups were recorded and compared. (4) The complications of patients in both groups within one month after surgery were recorded and compared, including pulmonary infection, dyspnea, atelectasis, etc. (5) The self-care ability scale (ESCA) [15] was employed to evaluate the self-care ability of patients in both groups after nursing for one month, including self-responsibility, self-care ability, disease knowledge understanding and self-concept. (6) QLQ-C30 scale [16] was employed to evaluate and compare the quality of life of patients in both groups one month after nursing. (7) The self-made nursing satisfaction questionnaire was employed to record and compare the nursing satisfaction of patients in both groups one month after nursing.

Statistical methods

The experimental data were statistically analyzed by SPSS18.0 (Boyi Zhixun (Beijing) Information Technology Co., Ltd.). The counting data were under Chi-square test, and the measurement data were expressed by mean ± standard deviation. The independent samples t-test or ANOVA was performed to analyze the significance of different groups, and comparison before and after nursing in the group was under paired t test. $P < 0.05$ indicates statistically significant differences.

Results

Comparison of general materials

There was no remarkable difference in gender, age, BMI, and pathological types of patients in both groups ($P > 0.05$), which was comparable (**Table 1**).

Comparison of respiratory function, VO2 peak, and blood gas index of patients in the two groups before and after nursing

The VCmax, FEV1, FVE1/FVC, PaO_2, $PaCO_2$, and SpO_2 of patients in both groups before nursing had no remarkable difference ($P > 0.05$). Two weeks after nursing, the VCmax, FEV1, FVE1/FVC, PaO_2, and SpO_2 of patients in both groups were dramatically higher than those before nursing, and $PaCO_2$ was dramatically lower than that before treatment, with significant differences ($P < 0.05$). After nursing, the VCmax, FEV1, FVE1/FVC, PaO_2, and SpO_2 of patients in the RG were obviously higher than those in the CG, while $PaCO_2$ was obviously lower than that in the CG, with significant differences ($P < 0.05$) (**Figure 1**).

Postoperative sputum excretion and hospital stays of patients in the two groups

The postoperative sputum excretion of patients in the RG was 20.95±5.65 ml/time, and the hospital stays was 15.95±0.72 d. The postoperative sputum excretion of patients in the CG was 15.71±3.87 ml/time, and the hospital stays was 21.33±1.18 d. The postoperative sputum excretion of patients in the RG was dramatically higher than that in the CG, and the hospital stays was obviously lower than that in the CG. Differences were statistically significant ($P < 0.05$) (**Table 2**).

Prevalence of complications of patients in the two groups

The incidence of pulmonary infection, dyspnea and atelectasis in the RG was 1, 3 and 2 respectively within 1 month after surgery, with an incidence of complications of 11.32%. The incidence of pulmonary infection, dyspnea and atelectasis in the CG was 3, 5 and 5 respectively within 1 month after surgery, with an incidence of complications of 24.52%. The incidence of complications in the RG was dramati-

Table 1. General materials table

Factor	Research group n=53	Control group n=53	X^2/t	P
Gender			0.158	0.691
Male	33 (62.26)	31 (58.49)		
Female	20 (37.74)	22 (41.51)		
Age (years)			0.041	0.839
≥ 65	28 (52.83)	27 (50.94)		
< 65	25 (47.17)	26 (49.06)		
BMI			0.038	0.845
≥ 23	23 (43.40)	24 (45.28)		
< 23	30 (56.60)	29 (54.72)		
Pathological typing			0.158	0.924
Squamous carcinoma	18 (33.96)	17 (32.08)		
Adenocarcinoma	20 (37.74)	22 (41.51)		
Small cell carcinoma	15 (28.30)	14 (26.42)		
Coagulation function				
APTT s	28.12±2.15	28.06±2.14	0.144	0.886
PT s	11.58±1.09	11.62±1.07	0.191	0.849
FIB g/l	3.09±0.16	3.11±0.15	0.664	0.508
Smoking history			0.039	0.843
Yes	31 (58.49)	32 (60.38)		
No	22 (41.51)	21 (39.63)		
Glutamic-pyruvic transaminase (IU/L)	26.96±1.34	26.81±1.41	0.561	0.576
Glutamic oxaloacetic transaminase (IU/L)	21.31±1.14	21.29±1.15	0.090	0.929
Creatinine (umol/L)	67.02±4.51	65.97±4.49	0.120	0.232
Nutriture			0.163	0.922
Good	19 (35.85)	21 (39.62)		
General	20 (37.74)	19 (35.85)		
Poor	14 (26.42)	13 (24.53)		

cally lower than that in the CG, with significant difference (P < 0.05) (**Table 3**).

Comparison of ESCA scores between patients in the two groups one month after nursing

After one month of nursing, the self-responsibility, self-care ability, disease knowledge and self-concept scores of patients in the RG were dramatically higher than those in the CG, with statistically significant differences (P < 0.05) (**Table 4**).

Comparison of quality of life of patients in the two groups one month after surgery

The role function, physical function, emotional function, cognitive function and social function scores of patients in the RG were dramatically higher than those in the CG one month after surgery, and differences were statistically significant (P < 0.05) (**Table 5**).

Comparison of nursing satisfaction of patients in the two groups

After patients in both groups implemented nursing intervention respectively, the number of those in the RG who were very satisfied, satisfied and dissatisfied with nursing service was 36, 15 and 2 respectively, with a nursing satisfaction rate of 96.23%. The number of those in the CG who were very satisfied, satisfied and dissatisfied with nursing service was 24, 16 and 13 respectively, with a nursing satisfaction rate of 75.47%. The nursing satisfaction rate of patients in the RG was obviously higher than that in the CG, with statistically significant difference (P < 0.05), as shown in **Table 6**.

Discussion

Respiratory rehabilitation respiratory training nursing is a nursing mode that effectively combines respiratory training and nursing. It mainly

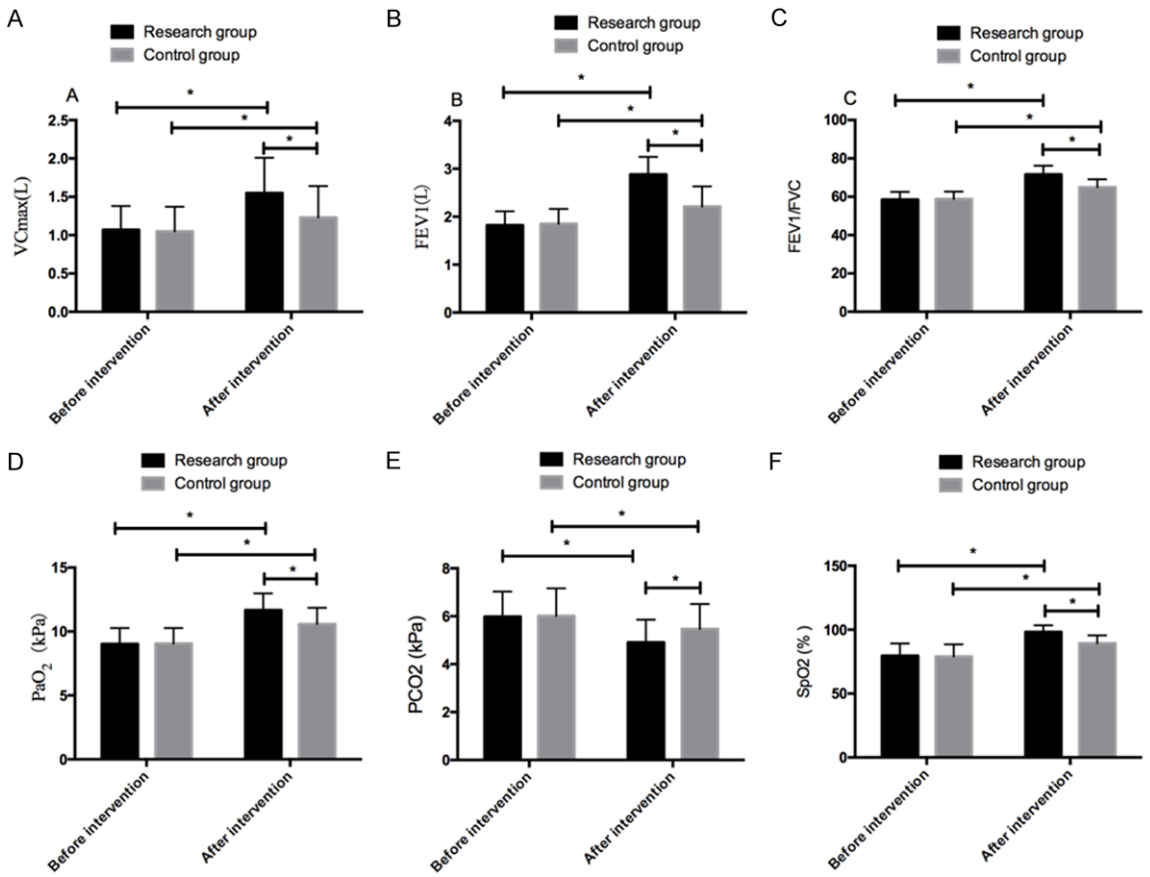

Figure 1. Comparison of respiratory function, VO2 peak, and blood gas index of patients in the two groups before and after nursing. A. Two weeks after nursing, the VCmax of patients in both groups was dramatically higher than that before nursing, and the VCmax of patients in the RG was obviously higher than that in the CG after nursing. B. Two weeks after nursing, the FEV1 of patients in both groups was dramatically higher than that before nursing, and the FEV1 of patients in the RG was obviously higher than that in the CG after nursing. C. The FVE1/FVC of patients in both groups 2 weeks after nursing was dramatically higher than that before nursing, and the FVE1/FVC of patients in the RG was obviously higher than that in the CG after nursing. D. The PaO_2 of patients in both groups 2 weeks after nursing was dramatically higher than that before nursing, and the PaO_2 of patients in the RG was obviously higher than that in the CG after nursing. E. Two weeks after nursing, the $PaCO_2$ of patients in both groups was dramatically lower than that before nursing, and the $PaCO_2$ of patients in the RG was obviously lower than that in the CG after nursing. F. Two weeks after nursing, the SpO_2 of patients in both groups was dramatically higher than that before nursing, and the SpO_2 of patients in the RG was obviously higher than that in the CG after nursing.

Table 2. Postoperative sputum excretion and hospital stays of patients in the two groups

Factor	Research group n=53	Control group n=53	t	P
Postoperative sputum excretion (ml/time)	20.95±5.65	15.71±3.87	5.570	< 0.001
Hospital stays (d)	15.95±0.72	21.33±1.18	28.33	< 0.001

guides patients to carry out a series of respiratory training according to their specific conditions, thus achieving the purpose of improving their respiratory function [17]. After LC patients in the two groups underwent conventional nursing and respiratory rehabilitation training nursing, we found that their lung function index and blood gas index in the RG were dramatically better than those in the CG after a period of nursing. It suggested that the application of respiratory rehabilitation training nursing after LC surgery can effectively improve their respiratory function. And then we also compared the daily sputum excretion, hospital stays and complications of patients in both groups. The results showed that the daily sputum excretion of patients in the RG was obviously higher than that in the CG, but the hospital stay was obvi-

Table 3. Prevalence of complications of patients in the two groups within one month after surgery

Project	Research group n=53	Control group n=53	X^2	P
Pulmonary infection	1 (1.89)	3 (5.66)	1.039	0.308
Dyspnea	3 (5.66)	5 (9.43)	0.541	0.462
Atelectasis	2 (3.77)	5 (9.43)	1.377	0.241
Total incidence rate	6 (11.32)	13 (24.52)	1.377	0.241

Table 4. Comparison of ESCA scores of patients in the two groups

Factor	Research group n=53	Control group n=53	t	P
Self-responsibility	45.96±4.02	37.62±3.69	11.13	< 0.001
Self-care ability	36.26±4.74	22.81±3.42	16075	< 0.001
Disease knowledge	34.66±2.30	24.47±3.41	18.04	< 0.001
Self-concept scores	37.09±3.76	26.84±3.11	15.29	< 0.001

Table 5. Comparison of quality of life scores of patients in the two groups one month after surgery

Project	Research group n=53	Control group n=53	t	P
Role function	68.65±3.05	52.33±2.49	30.18	< 0.001
Physical function	65.34±3.01	52.85±2.34	23.85	< 0.001
Emotional function	67.54±3.22	53.03±2.63	25.41	< 0.001
Cognitive function	67.96±3.11	52.35±2.67	27.73	< 0.001
Social function	62.33±2.81	51.81±2.70	19.65	< 0.001

Table 6. Comparison of nursing satisfaction of patients in the two groups

Project	Research group n=53	Control group n=53	X^2	P
Very satisfied	36 (67.92)	24 (45.28)	5.530	0.019
Satisfied	15 (28.30)	16 (30.19)	0.046	0.831
Dissatisfied	2 (3.77)	13 (24.53)	9.396	0.002
Nursing satisfaction	51 (96.23)	40 (75.47)	9.396	0.002

ously shorter than that in the CG, and the incidence of complications was also dramatically lower than that in the CG. Previous studies have reported that functional training of respiratory muscles in LC patients can effectively improve their lung function [18]. The abdominal breathing and lip contraction breathing used in our study can fully mobilize the respiratory muscle, thus improving the endurance and strength of the respiratory muscle, delaying exhalation and increasing the frequency of respiration, and finally achieving the purpose of improving lung function [19, 20]. Cough training can effectively expand alveoli and increase the exchange of gas. It can also promote the expectoration of patients and enhance their cleaning ability to respiratory secretions, thus reducing the risk of complications [21]. In addition, the resistance breathing training we have conducted can also effectively reduce the invalid cavity volume of patients, promote the elimination of residual gas in their thoracic cavity so as to increase the effective ventilation volume, and also improve their respiratory function to some extent [22]. All these studies can explain our conclusion.

Then, in order to further study effects of respiratory rehabilitation training on patients besides respiratory function improvement, we also compared the ESCA scores and quality of life of those in both groups. The results signified that one month after nursing, the ESCA scores and quality of life scores of patients in the RG were dramatically higher than those in the CG, which suggested that the respiratory rehabilitation training and nursing for those after LC surgery could enhance their respiratory function and help improve their self-care ability and quality of life. The ESCA and QLQ-C30 scales we used in the study both objectively evaluate patients' self-care ability and quality of life from multiple dimensions. As scales used in various diseases clinically, they have high evaluation value [23, 24]. Through the analysis of our experimental process and results, we believe that the improvement of respiratory function is beneficial to the improvement of patients' quality of life. In the end, we found that patients in the RG had obviously higher nursing satisfaction than those in the CG after carrying out nursing satisfaction survey. We believe that the improvement of patients' self-care ability, quality of life and nursing satisfaction further promotes them to actively carry out respiratory rehabilitation training, thus forming a virtuous circle.

To sum up, the application of respiratory rehabilitation training and nursing in LC patients after surgery can effectively improve their respiratory function, reduce the incidence of postoperative complications, and also improve their self-care ability and quality of life, which is worthy of clinical promotion. However, this study also has certain deficiencies. For instance, first of all, we have not explored further whether there are more feasible training methods in respiratory rehabilitation training. Moreover, we need to explore further in future studies whether there are better nursing modes to improve the respiratory function of patients. Last but not least, due to the shortage of sample size and the lack of previous studies of this kind, our conclusions have yet to be further confirmed. In future experiments, we will further expand the sample and compare various nursing modes to further demonstrate their effects.

Disclosure of conflict of interest

None.

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