

## ORIGINAL RESEARCH

# Effect of Using the Active Cycle of Breathing Technique Combined with Watson's Theory of Human Caring in Rapid Patient Rehabilitation Following Lung Cancer Surgery

Xiaona Ji, BS; Yangde Yan, BS

### ABSTRACT

**Background and Objective** • We explored the effect of the Active Cycle of Breathing Technique (ACBT) on rapid patient rehabilitation following lung cancer (LC) surgery and the advantages of Watson's Theory of Human Caring.

**Method** • A total of 64 patients with LC were chosen and randomly divided into 2 groups: the ACBT group and the routine care group. The ACBT group received Watson's Theory of Human Caring, and ACBT was adapted for respiratory training to promote airway secretions, excretions and pulmonary function (PF) recovery. After the intervention, PE, 6-Minute Walk Test (6MWT) distance, heart rate (HR), clinical treatment, quality of life (QoL), nursing satisfaction, negative emotions and postoperative complications were compared in the 2 groups.

**Results** • The results showed that PF levels (peak expiratory flow [PEF], forced expiratory volume in 1 second/forced vital capacity ratio [FEV1/FVC], vital capacity [VC], partial pressure of oxygen dissolved in blood [PaO<sub>2</sub>], oxygenation index [OI] and oxygen saturation as measured by blood analysis [SaO<sub>2</sub>]) in the ACBT group were significantly higher than in the routine care group, while

partial pressure of carbon monoxide (PaCO<sub>2</sub>) was significantly lower. In addition, after ACBT training, patient 6MWT distance increased, and the maximum HR, Borg fatigue score and Borg dyspnea score in the training group were lower than in the routine care group. In terms of clinical treatment, duration of drainage tube retention, total oxygen therapy, out of bed time, hospital stay and visual analog score (VAS) score in the ACBT group were all lower. At the same time, QoL and nursing satisfaction in patients in the ACBT group were higher, and anxiety and depression were significantly lower. Moreover, the incidence of postoperative complications was 6.25% in the ACBT group and 28.13% in the routine care group.

**Conclusion** • ACBT combined with the Watson Theory of Human Caring can better restore LF in patients with LC following surgery, so as to promote rapid recovery and reduce postoperative complications. In addition, Watson's Theory of Human Caring is of great significance for improving the nurse-patient relationship and building a harmonious hospital. (*Altern Ther Health Med*. 2023;29(2):14-20)

**Xiaona Ji, BS**, Nurse, Department of Thoracic Surgery; **Yangde Yan, BS**, Nurse, Department of Interventional Surgery; Cancer Hospital Affiliated with Shandong First Medical University, Jinan, Shandong, China.

Corresponding author: Xiaona Ji, BS  
E-mail: [jixiaona8080@163.com](mailto:jixiaona8080@163.com)

### INTRODUCTION

Lung cancer (LC), with a 15% 5-year survival rate, can be thought of as a common respiratory tumor with a bad prognosis.<sup>1</sup> Currently, surgical resection of the tumor(s) is considered the first choice for LC treatment and has achieved certain therapeutic results. However, due to the significant surgical trauma involved, the resection of lung tissue

significantly reduces the alveolar capillary bed and affects the self-clearing of secretions in the respiratory tract, which adversely affects lung ventilation and ventilation function.<sup>2</sup> In addition, the placement of a postoperative drainage tube or use of a chest band will also have an adverse impact on a patient's thoracic movement. These adverse factors can lead to complications such as atelectasis and pulmonary infection, which affects patients' postoperative treatment and prognosis. Therefore, in the postoperative rehabilitation of patients with LC, it is imperative to take high-quality nursing measures and optimize postoperative rehabilitation methods in order to reduce postoperative stress and complications, thus shortening the length of patient hospital stay and improving their prognosis.

In the rapid postoperative rehabilitation of patients with LC, promoting the elimination of airway secretions and

improving their respiratory function are important goals.<sup>3</sup> The Active Cycle of Breathing Technique (ACBT) is a common respiratory function exercise method used in clinical therapy that has a good effect on purifying the respiratory tract and improving respiratory function.<sup>4</sup> ACBT mainly consists of 3 parts: breath control (BC), thoracic expansion exercise (TEE), and forced expiratory technique (FET).<sup>5</sup> During the training process, each respiratory muscle is fully mobilized to participate in the contraction exercise, so as to increase muscle strength and endurance. BC exercises can help patients recover respiratory control after surgery, effectively preventing hypoxemia and tracheal spasm.<sup>6</sup> TEE exercises can increase lung ventilation, effectively driving the distal bronchial secretions through the high air flow, and have a good vibration effect on airway secretions, which is significant for their effective discharge.<sup>6</sup> In addition, FET changes the pressure in the chest and helps discharge airway secretions. It can also make the isobaric point in the airways move dynamically, which is helpful for moving secretions in the proximal distal airway. Therefore, effective ACBT training can improve lung ventilation and promote discharge of airway secretions, which is of great significance for preventing postoperative complications such as atelectasis and pulmonary infection.<sup>7</sup>

The efficacy of ACBT is closely related to the guidance of the medical staff and patients' self-management. Due to the widespread fear of cancer and the low 5-year survival rate, the negative emotions in patients with LC can be increased, which will become an obstacle to patient compliance in postoperative rehabilitation therapy. Therefore, improving the quality of postoperative nursing is an important link in patients' rapid rehabilitation.

With the progress and development of nursing disciplines, the importance of humanistic care is being recognized by more and more nursing staff. Formulating a patient-centered nursing plan can better provide patients with high-quality nursing, and help nurses fully understand and be able to guide changes in patients' motivation, so as to further strengthen their confidence in rehabilitation and promote a positive attitude.<sup>8,9</sup> Watson's Theory of Human Caring is a new medical nursing model that emphasizes human care. Its clinical use can effectively improve the overall nursing effect, change nurses' ideas and strengthen the service consciousness and humanistic care in the nursing process,<sup>10,11</sup> which is important for improving patient compliance with postoperative ACBT training and rebuilding life confidence. Therefore, this study discusses the impact of using ACBT combined with Watson's Theory of Human Caring on rapid rehabilitation in postoperative patients with LC, so as to better guide nursing.

## MATERIALS AND METHODS

### Selection of Study Participants

A total of 98 patients undergoing radical resection for LC admitted to the Cancer Hospital Affiliated with Shandong First Medical University in China from January 2019 to

January 2021 were chosen for the study. All patients who participated in the study voluntarily signed an informed consent form.

**Inclusion criteria.** Patients: (1) in whom LC was diagnosed according to the criteria of the UK National Institute for Health Care Excellence (NICE) Guideline (NG122): Lung cancer: diagnosis and management<sup>12</sup>; (2) in age range: 18 to 60 years; (3) in whom thoracoscopic or thoracotomy lobectomy was performed; (4) had a life expectancy of >6 months; (5) had a forced expiratory volume in 1 second (FEV1) >0.8.

**Exclusion criteria.** Patients: (1) in whom the tumor had distant metastases; (2) had a previous history of thoracic surgery; (3) had LC combined with malignant tumors in other parts of the body; (4) had LC combined with chronic obstructive pulmonary disease (COPD), asthma or other respiratory diseases; (5) had LC combined with severe cardiovascular or cerebrovascular diseases.

Patients were randomly assigned to either the routine care group (32 patients), who received routine nursing care, or the ACBT group (32 patients), who received ACBT combined with Watson's Theory of Human Caring. The general data of the 2 groups are shown in Table 1.

**Table 1.** General Patient Data

Factor	Routine Care Group (n = 32)	ACBT Group (n = 32)	t/ $\chi^2$	P value
Age (years)	45.31 $\pm$ 7.61	42.92 $\pm$ 7.52	1.264	.211
Gender n (%)				
Male	18 (56.25)	20 (62.50)	.259	.611
Female	14 (43.75)	12 (37.50)		
BMI (kg/m <sup>2</sup> )	25.31 $\pm$ 2.61	25.02 $\pm$ 2.16	0.484	.630
ASA grade n (%)				
I	23 (71.88)	20 (62.50)	-0.851	.395
II	6 (18.75)	7 (21.88)		
III	3 (9.37)	5 (15.62)		
TNM grade n (%)				
I	20 (62.50)	18 (56.25)	-0.629	.530
II	9 (28.13)	9 (28.13)		
III	3 (9.37)	5 (15.62)		
Lesion site n (%)				
Left lung	13 (40.63)	16 (50.00)	0.567	.451
Right lung	19 (59.37)	16 (50.00)		
Surgery type				
Wedge resection	5 (15.62)	8 (25.00)	1.190	.551
Segmental resection	21 (65.63)	17 (53.13)		
Lobectomy	6 (18.5)	7 (21.87)		

**Abbreviations:** ACBT, Active Cycle of Breathing Technology; ASA, American Society of Anesthesiology; BMI, body mass index; TNM, Tumor size and spread to tissue, Spread of cancer to nearly lymph Nodes, (M) Metastases.

## Basic Treatment Following Surgery

Patients received ECG and pulse monitoring and continuous low flow oxygen inhalation. The acid-base balance of water and electrolytes was also monitored and corrected accordingly. Two cycles of etoposide + cisplatin or paclitaxel + cisplatin were given to patients following surgery.

## Routine Nursing Program

Oral education was given to the patients following surgery, and they were instructed to pay attention to their nutritional intake. Otherwise, patients were instructed to practice lip contraction and abdominal breathing for rehabilitations exercise, 10 minutes per session, 4 times a day. The patient's family members were also asked to pat the patient's back for a total of 10 minutes, 2 times a day. In addition, nurses carried out health education, guided family members on how to help patients move their limbs, and kept the ward clean, so as to provide patients with a comfortable medical environment.

## Active Cycle of Breathing Technique (ACBT) Training

ACBT is mainly composed of respiratory control, thoracic expansion and forced expiratory exercises. Specific rehabilitation therapists and nurses were assigned to help patients carry out ACBT rehabilitation training twice a day, for 6 to 8 cycles each session. The training period lasted for 3 months following surgery.

For the entire training process, patients found a comfortable position and actively cooperated with the breathing exercises. An ACBT cycle consisted of 4 breath control (BC) exercises, 2 thoracic expansion (TEE) exercises and 2 forced expiratory technique (FET) exercises (see Figure 1).

**BC:** Patients inhaled deeply through the nasal cavity, subject to the bulge of the lower abdomen, and then opened their mouths and exhaled slowly. The ratio of inhalation to exhalation was 1:2-3. During the exercise, the contraction and relaxation of the lower chest was used as much as possible to complete the respiratory activity.

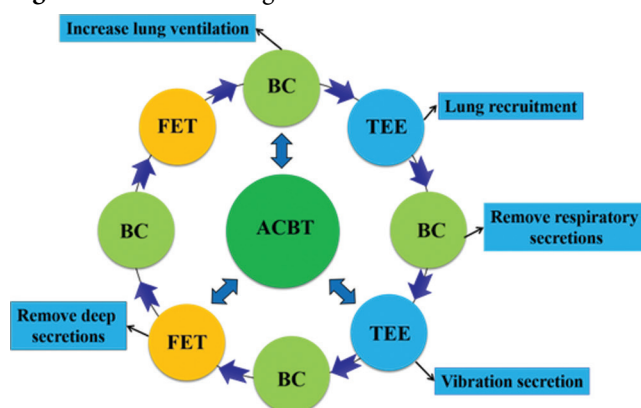
**TEE:** Patients actively inhaled deeply through the nasal cavity to expand the chest, placing their hands on the chest wall to help better feel the chest expansion movement. Then, patients held their breath for 2-3 seconds at the end of inhalation, and exhaled passively.

**FET:** After normal deep inhalation, patients held their breath for 1-3 seconds, and then contracted their chest and abdominal muscles at the same time to exhale the air from their lungs quickly, which helps to discharge airway secretions.

## Watson Care Implementation Plan

**Establishment of Watson Theory of Human Caring Nursing Team.** The team included 1 head nurse, 3 charge nurses and 5 nurses. The team leader should train the team members, so as to change the nurses' nursing concepts. They

**Figure 1.** ACBT training flow chart.



functional exercise machines. Indoor exercise can be organized once every 2m weeks, and former patients with cancer can be invited to provide peer education during the session, in order to better help patients build confidence.

**Network platform for continuous nursing.** In order to do a good job of extended continuous nursing for outpatients and better guide and supervise patients for continuing ACBT training, rehabilitation training using a WeChat group can be created to provide continuous guidance for patients discharged during the same time period, which can also facilitate patient exchange of rehabilitation experiences. Nurses conduct intensive interventions once a week via telephone or WeChat for the 3 months following surgery.

### Improvement in Lung Function

Before and 1 month after the intervention, patients' PEF, FEV1/FVC and VC were measured with a PF instrument (AS-407, Shanghai Siou Medical Devices Co., Ltd., China). In addition, blood gas results can better reflect blood oxygen and acid-base balance *in vivo*, as well as better determine patients' respiratory function. Arterial blood samples were taken before and 1 month after the intervention, and then PaO<sub>2</sub>, PaCO<sub>2</sub>, OI and SaO<sub>2</sub> were measured via blood gas analyzer (ABl90, Redumite Medical equipment (Shanghai) Co., Ltd., China).

### Exercise Improvement

Exercise can effectively reflect the recovery of postoperative cardiopulmonary function. Before surgery, the fourth day after surgery, and the first month after the intervention, patients are instructed to perform the 6MWT: they walk continuously at their fastest speed for 6 minutes between 2 points that are 30 meters apart. Cutoff time is 6 minutes or when unbearable symptoms (such as chest pain or dyspnea) occur. Walking distance is calculated and noted; a walking distance <150 m represents severe, 150-450 m moderate and >450 m represents mild PF.<sup>13</sup> During the 6MWT 1 month after the intervention, the maximum patient heart rate (HR) is monitored by Smart bracelet, and the Borg scale is used to evaluate fatigue and dyspnea after exercise.<sup>14</sup>

### Evaluation of Clinical Treatment

In order to assess patients' postoperative rehabilitation status, we evaluated their rehabilitation effect from the retention time of the thoracic closed drainage tube, total oxygen therapy, time out of bed, length of hospital stay and pain level. Pain level was determined with the Visual Analogue Scale (VAS),<sup>15</sup> with a total possible score of 10. The higher the score, the stronger the pain.

### Postoperative Complications

Possible post-operative complications include atelectasis, pulmonary infection, hypoxemia, respiratory failure, and pneumothorax.

### Nursing Satisfaction and Evaluation of Negative Emotions

A self-designed scale was used to evaluate 5 aspects of nursing satisfaction: service attitude, health education, psychological intervention, medical environment and professional ability. Each index was evaluated with a 4-level scoring method. The higher the score, the more satisfied the patients were. In addition, the Self-Rating Anxiety Scale (SAS) and Self-rating Depression Scale (SDS) were used to evaluate patients' anxiety and depression.<sup>16,17</sup> Each comprised 20 questions, and a 4-level scoring method was used. If the score was >50 points, a tendency toward anxiety and depression was considered.

### Quality of Life

The Quality of Life – Cancer 30 (QLQ-C30) scale was used to evaluate patients' QoL in terms of physical function, role function, emotional function, cognitive function and social function.<sup>18</sup> Each dimension was evaluated by a percentage system, and the higher the score, the better the QoL.

### Statistical Analysis

IBM<sup>®</sup> SPSS version 22.0 and MedCalc<sup>®</sup> software were adopted for statistical analysis. The data were described by n (%) and  $\chi^2$  test was used for intergroup comparison; the measurement data was described by  $\bar{x} \pm s$ , and *t* test was employed for inter-group comparison. *P* < .05 was a significant difference.

## RESULTS

### ACBT Combined with Watson Care Theory Nursing Can Significantly Improve Patients' Lung Function

PF determination can effectively reflect patients' pulmonary ventilation function, so as to effectively evaluate pulmonary rehabilitation after surgery. It was found that PEF rose markedly in both groups after the intervention, especially in the ACBT group (*P* < .05; see Figure 2A). As to FEV1/FVC, the same changes were observed, namely, post-intervention FEV1/FVC rose in both groups and was higher in the ACBT than the routine care group (*P* < .05; see Figure 2B). Finally, VC was found to be increased in both groups, but especially in the ACBT group (*P* < .05; see Figure 2C).

### ACBT Combined with Watson's Theory of Human Caring Can Significantly Improve Blood Oxygen Content

Blood gas analysis can quantify the oxygen and carbon dioxide content of the blood, so as to reflect patients' lung ventilation function. Our study found that after the intervention, PaO<sub>2</sub> was found to be increased in both groups, especially in the ACBT group (*P* < .05; see Figure 3A). In terms of OI, similar changes were observed; the level increased in both groups and was higher in the ACBT group than in the routine care group (*P* < .05; see Figure 3B). In addition, SaO<sub>2</sub> levels rose in both groups after the intervention, with a more marked increase in the ACBT than the routine care group (*P* < .05; see Figure 3C). Finally, the PaCO<sub>2</sub> level was reduced after



the intervention, but was lower in the ACBT than the routine care group ( $P < .05$ , Figure 3D). Hence, patients' ventilation function in the ACBT group was more improved.

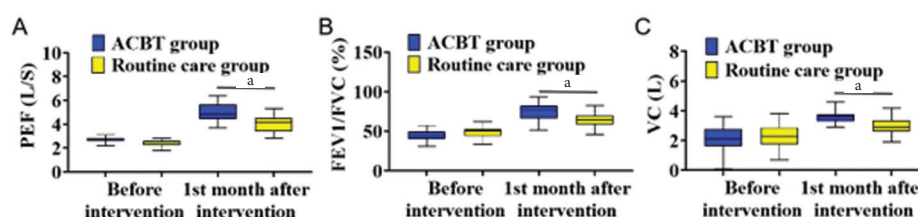
### ACBT Combined with Watson's Theory of Human Caring Can Effectively Restore Patients' Postoperative Motor Ability

The recovery of postoperative exercise levels can reflect PF. On the fourth day after surgery and 1 month after the intervention, the 6MWT distance in both groups was shorter than before surgery, but was longer in the ACBT group ( $P < .05$ ; Figure 4A). In addition, maximum HR, Borg fatigue score and Borg dyspnea score in the ACBT group were lower than in the routine care group ( $P < .05$ ; Figure 4B through 4D), suggesting that patients in the ACBT group had better PF recovery and could better adapt to postoperative rehabilitation exercise.

### ACBT Combined with Watson's Theory of Human Caring Can Improve Clinical Efficacy

Our results showed that the indwelling time of the drainage tube in the ACBT group was shorter than in the routine care group. In a similar fashion, shorter total oxygen therapy time, time in bed, and length of hospital stay were observed in the ACBT group vs the routine care group ( $P < .05$ ; see Figure 5A). Finally, pain relief was more significant in the ACBT group, with lower VAS scores than in the routine nursing group ( $P < .05$ ; Figure 5B). Therefore, clinical efficacy was more improved in the ACBT group vs the routine nursing group.

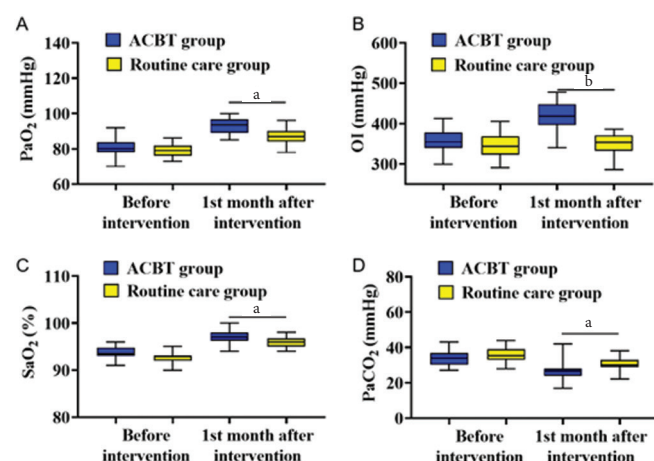
**Figure 2.** Detection of lung ventilation function. (2A) Changes in PEF. (2B) Changes in FEV1/FVC. (2C) Changes in VC.



<sup>a</sup> $P < .05$ .

**Abbreviations:** FEV1/FVC, ratio forced expiratory volume in 1 second/forced vital capacity ratio; PEF, peak expiratory volume; VC, vital capacity.

**Figure 3.** Arterial blood gas analysis. (3A) Changes in  $\text{PaO}_2$ . (3B) Changes in OI. (3C) Changes in  $\text{SaO}_2$ . (3D) Changes in  $\text{PaCO}_2$ .

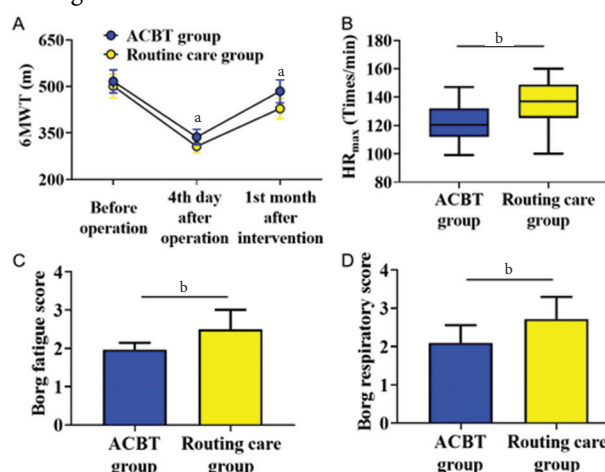


<sup>a</sup> $P < .05$

<sup>b</sup> $P < .01$

**Abbreviations:** OI, oxygen index;  $\text{PaCO}_2$ , partial pressure of oxygen dissolved in blood;  $\text{SaO}_2$ , oxygen saturation as measured by blood analysis.

**Figure 4.** Comparison of exercise ability. (4A) 6MWT before and after surgery. (4B)  $\text{HR}_{\text{max}}$  during 6MWT. (4C) Borg fatigue score during 6MWT. (4D) Borg respiratory score during 6MWT.

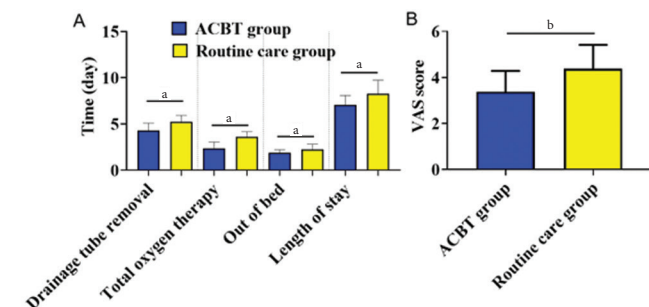


<sup>a</sup> $P < .05$

<sup>b</sup> $P < .01$

**Abbreviations:** 6MWT, 6-minute walk test;  $\text{HR}_{\text{max}}$ , maximum heart rate

**Figure 5.** Comparison of clinical efficacy. (5A) Comparison of clinical treatment in terms of drainage tube indwelling time, total oxygen therapy time, time out of bed and length of hospital stay. (5B) VAS score.

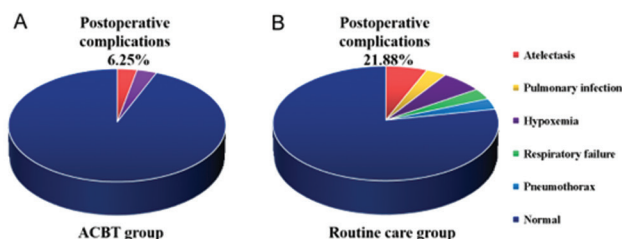


<sup>a</sup> $P < .05$

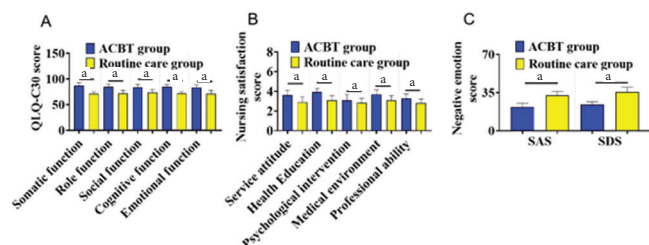
<sup>b</sup> $P < .01$

**Abbreviations:** Visual Analog Scale

**Figure 6.** Comparison of post-operative complications in terms of atelectasis, pulmonary infection, hypoxemia, respiratory failure, and pneumothorax.



**Figure 7.** Comparison of QoL, satisfaction and negative emotion. (7A) QLQ-C30 score. (7B) Satisfaction in terms of service attitude, health education, psychological intervention, medical environment and professional ability. (7C) SAS and SDS score.



<sup>a</sup> $P < .05$

**Abbreviations:** QLQ-C30, Quality of Life-Cancer 30; SAS, Self-rated Anxiety Score; SDS, Self-rated Depression Score.

## ACBT Combined with Watson's Theory of Human Care Can Effectively Inhibit the Occurrence of Postoperative Complications

Our study evaluated the occurrence of postoperative complications such as atelectasis, pulmonary infection, hypoxemia, respiratory failure and pneumothorax, and the total incidence of these complications in the ACBT group was significantly lower ( $P < .05$ ; Figure 6), suggesting that ACBT can better restore patients' LF and promote their rapid recovery.

## ACBT Combined with Watson's Theory of Human Caring Can Improve Patients' QoL and Emotional State

After treatment, patients' QoL in the ACBT group was significantly better than in the routine care group in terms of physical, cognitive, emotional, role and social function ( $P < .05$ ; see Figure 7A). In addition, their nursing satisfaction in terms of service attitude, health education, psychological intervention, medical environment and professional ability were also higher ( $P < .05$ ; see Figure 7B). Otherwise, patients' anxiety and depression were significantly relieved in the ACBT group ( $P < .05$ ; see Figure 7C).

## DISCUSSION

In recent years, the concept of rapid rehabilitation has played an increasingly important role in postoperative therapy. It can reduce the surgical stress response and postoperative complications by optimizing relevant treatment measures and nursing schemes in the perioperative period, which is important in shortening hospital stays and reducing medical expenses.<sup>19</sup> As an important part of rapid surgery rehabilitation, nurses need to adopt advanced nursing concepts and high-quality nursing schemes in postoperative rehabilitation management so as to give patients a good nursing experience and provide a curative effect.<sup>20,21</sup> In the postoperative rehabilitation management of patients with LC, due to the partial resection of lung tissues, the capillary bed is reduced, which has an adverse impact on pulmonary ventilation, thus reducing patients' blood oxygen supply.<sup>22</sup> In addition, the changes in lung morphology and physiological structure caused by lobectomy leads to a decline in the airway secretion clearance function.<sup>23</sup> As an important factor affecting postoperative rehabilitation, the retention of sputum in the airway will cause atelectasis and infection, which will significantly affect rapid postoperative rehabilitation.<sup>24</sup>

Therefore, how to effectively restore patients with LC's respiratory and secretion clearance functions in postoperative rehabilitation has attracted more and more attention in clinical therapy. Compared with traditional breathing training methods, ACBT training can better exercise patients' respiratory muscles, so as to effectively restore their ventilation function.<sup>25</sup> In addition, it can also shake up airway secretions and quickly discharge them through forced exhalation, in order to effectively improve PF recovery.<sup>26</sup> However, the effect of ACBT training is closely related to patients' mastery of training and treatment compliance.

Therefore, patients should be at the center of the postoperative nursing process, and given all-round support in terms of rehabilitation training, psychological intervention, nutritional support and continuous outpatient management so as to fully reflect humanistic care, which is of great significance in improving therapy compliance and enhancing patients' confidence in facing the disease.<sup>27</sup> Watson's Theory of Human Caring is a humanized nursing model that is "people-oriented" and can effectively strengthen the service consciousness of nurses and improve the overall nursing effect.<sup>28,29</sup> Therefore, ACBT training combined with Watson's Theory of Human Caring provides an important guarantee of rapid patient rehabilitation in patients following LC surgery.

PF and blood gas results are important indices for evaluating the postoperative rehabilitation effect in patients after LC surgery. Our study found that the improvement in pulmonary ventilation function and blood gas in the ACBT group was significantly better, suggesting that the effect of postoperative lung exercise is better, as it better facilitates the expulsion of secretions and improves the blood oxygen supply. Moreover, a good blood oxygen supply can effectively improve patients' cardiopulmonary function, in order to help them exercise sooner and improve their exercise ability. Our study found that although postoperative 6MWT results in LC patients were lower than before surgery, the distance was recovered better in the ACBT group. Otherwise, patients' maximum HR, fatigue score and respiratory score were lower than in the routine care group during 6MWT. Therefore, ACBT training combined with Watson's Theory of Human Caring can better restore patients' PF and promote recovery of their exercise ability, so as to shorten hospitalization stays and oxygen therapy and improve their clinical treatment level.

Patients' cancer phobia will have a negative impact on their treatment compliance and emotion. Therefore, effective psychological counseling is of great importance in the postoperative rehabilitation of patients with LC. Thanks to the more detailed health education of nursing staff in Watson's Theory of Human Caring, the treatment and process is clear to patients. In addition, the establishment of an activity room will not only enrich patients' daily life, but also increase opportunities for mutual communication, so that patients can encourage each other and jointly build the confidence to overcome the disease. Therefore, the degree of anxiety and depression in patients in the ACBT group was significantly lower than in the routine care group, and nursing satisfaction was significantly improved, which had a positive impact on building harmonious nurse-patient relationships. The increased recovery of PF in the ACBT group can effectively reduce the incidence of postoperative complications and improve patient QoL.

## Study Limitations

This study did have some limitations. First, we did not set up a control group that received simple ACBT training. Second, the study sample was small, which may have offset the results. Therefore, these aspects need to be improved in future studies.

## CONCLUSION

ACBT combined with Watson's Theory of Human Caring can better restore PF and ventilation function in patients following LC surgery and reduce the occurrence of postoperative complications. Moreover, it can promote patient rehabilitation exercise, which will shorten postoperative hospital stays and improve their QoL. In addition, Watson care theory nursing can improve patient satisfaction and reduce their anxiety and depression, which is of great significance for building a harmonious nurse-patient relationship.

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