Original Article
H2H rehabilitation care promotes high quality recovery of patients with lung cancer comorbid with chronic obstructive pulmonary disease

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Abstract: H2H is a patient and family-centered approach that integrates hospital and home care, emphasizing continuity, individualized rehabilitation training, and the active participation of patients and their families. However, it is still unclear whether H2H improves the efficacy for patients with COPD and lung cancer. This study investigated the efficacy of Hospital-to-Home (H2H) rehabilitation nursing for lung cancer patients with Chronic Obstructive Pulmonary Disease (COPD). We conducted a retrospective analysis to the clinical data of 95 patients treated in the Pingdingshan University Medical College from January 2018 to January 2020. We compared the effects of conventional nursing (control group, n=45) and H2H nursing (observation group, n=50) on the clinical efficacy for the patients. In this study, after nursing intervention, the quality of life and adverse emotions in the observation group were significantly improved compared to the control group (P<0.0001). Moreover, the lung function and blood oxygen saturation of patients in the H2H nursing model improved after the intervention (P<0.0001). In addition, there was no difference in the 3-year survival rate between the control group and the observation group (P=0.260). Multivariate COX regression analysis showed that the nursing scheme had no effect on the patients' 3-year survival, but the SAS score, SDS score, and CEA were independent prognostic factors affecting the 3-year survival rate (P<0.05). These results demonstrate that H2H rehabilitation care significantly improves the quality of life, emotional health, and lung function of patients with COPD and lung cancer, but does not affect the patients' 3-year survival rate.

Keywords: H2H rehabilitation care, lung cancer, chronic obstructive pulmonary disease, quality of life, emotion, lung function, 3-year survival

Introduction

Chronic obstructive pulmonary disease (COPD) is a disease that triggers persistent respiratory symptoms and airflow restriction, with a high morbidity and high mortality worldwide [1]. Reportedly, despite the differences in COPD prevalence worldwide, the prevalence of COPD in all places is high and shows a rapid growth [2, 3]. In 2017, COPD became one of the most common global chronic respiratory diseases, with a global prevalence rate of 3.92%. The risk factors of COPD include heredity, tobacco, occupational dust and smoke, indoor air pollutants, outdoor air pollutants, age, gender, asthma, inflammation, social economy and related factors [4]. Lung cancer is a common disease

and one of the main causes of death [5]. There are millions of new cases of lung cancer and deaths from it worldwide each year. The incidence and population distribution of cancer vary greatly between different countries and regions, and smoking and economic development probably impact the incidence [6]. The most common risk factors of lung cancer include smoking, biofuels, occupational exposure, environmental air pollution and other environmental contacts. Smoking is one of the primary causes of morbidity and mortality of most cancers [7, 8].

A growing number of studies have reported that COPD is bound up with the increased risk of lung cancer, and COPD can be deemed as an

independent risk factor for lung cancer [9]. Reportedly, the risk of lung cancer in COPD patients is 2-6 times higher than that in smokers without airflow obstruction [10]. According to prior research [11], approximately 23% of patients with lung cancer suffer from COPD meantime. There may be a shared mechanism between COPD and lung cancer, which probably involves epithelial mesenchymal transition, chronic lung inflammation, oxidative stress, abnormal DNA damage and repair, and immune system damage [12]. Comorbid COPD and lung cancer affect the formulation of treatment plan against lung cancer, so more attention should be attached to the early detection and timely diagnosis of the comorbidity.

The long course of lung cancer comorbid with COPD often puts patients under great pressure physically and mentally. In addition, patients may suffer negative emotions such as depression and anxiety, which seriously compromises their quality of life and life safety [13]. With the increase of patients' demand, the conventional nursing mode has been unable to meet their demand. Therefore, it is of great importance to take effective nursing measures to reduce the psychological burden of patients and alleviate their clinical symptoms to improve comfort. Hospital-to-Home (H2H) rehabilitation care refers to the patient-centered and family-based rehabilitation nursing mode [14]. It emphasizes the participation and support of family and community. Through good communication and cooperation among patients, families and medical teams, rehabilitation nursing programs can be worked out together to restore patients' functions and improve their quality of life [15]. Yang et al. [16] have revealed that H2H rehabilitation care mode can effectively improve the mental state, quality of life, sleep quality and coping adaptability of schizophrenic patients with type 2 diabetes, and lower their blood glucose level.

In the literature, although the benefits of H2H rehabilitation care in addressing various diseases have been discussed many times, its specific impact in the combined management of lung cancer and COPD is unclear. No studies have reported whether H2H rehabilitation care can improve the quality of life, mood and lung function in patients with both lung cancer and COPD. Thus, our study fills this gap in the literature and provides new perspectives on the potential of H2H rehabilitation care in the management of these complex patients.

Methods

Case selection

The data of 189 patients with both COPD and lung cancer treated in School of Medicine of Pingdingshan University from January 2018 to January 2020 were analyzed retrospectively. This study was approved by the Medical Ethics Committee of School of Medicine of Pingdingshan University. Ethical lot number: LL2020 (A) 42.

Inclusion and exclusion criteria

Inclusion criteria: patients meeting the diagnostic criteria of COPD in 2017 Global Strategy for the Diagnosis, Management and Prevention of COPD [17]; patients pathologically confirmed with lung cancer, patients whose lung cancer belongs to non-small cell lung cancer; patients with detailed clinical data; patients with estimated survival time >3 months.

Exclusion criteria: patients with lung diseases other than COPD and lung cancer, such as bronchial asthma, interstitial lung disease, tuberculosis, etc., patients with primary tumors in other parts; patients with serious heart, liver, kidney or brain diseases, rheumatic immune diseases or mental diseases, patients suffering from serious systemic infections; patients received other care programs.

According to the inclusion and exclusion criteria, 95 eligible cases were screened out. Patients admitted from January 2018 to January 2019 received the conventional nursing care were set as the control group (n=45), and patients admitted from February 2019 to January 2020 received H2H rehabilitation care were set as the observation group (n=50).

Nursing scheme

Patients in the control group were given conventional care, including home oxygen therapy, drug usage and dosage guidance, inhalation device use, respiratory function exercise, discharge guidance, routine vital signs monitoring, diet management and routine admission publicity and education, and were given a knowledge manual of health education about COPD.

Patients in the observation group were given H2H rehabilitation care.

(1) Hospital: A "H2H" nutrition management team was set up, with the head nurse as the leader, including 1 specialist in charge, 3 nurses, 1 nutritionist and 1 rehabilitation doctor. Within 24 hours after admission to the hospital, nurses and nutritionist were arranged to conduct nutritional risk screening to the patient. If the Nutritional Risk Screening (NRS)-2002 score was ≥3, the team members would discuss the case according to the patient's specific situation and make a personalized nutrition treatment plan. The group was responsible for guiding patient's diet and encouraging the patient to eat more foods with high protein, high fat and low carbohydrate. Additionally, nurses and nutritionist were arranged to implement nutrition management and report any abnormality to the competent doctor in time. During the hospitalization, the team was required to strengthen the bedside teaching of patients through various forms including language persuasion and physical comfort to help the patients to relieve negative psychological emotions, and was also required to patiently answer patients with psychological doubts, guide them to take deep breaths to effectively vent their negative emotions, and promote them to maintain a good mental state. The team was arranged to give patients oxygen inhalation to keep the oxygen inhalation catheter unobstructed, and adjust the oxygen flow according to the condition. The team was also arranged to instruct patients to expectorate effectively, cough consciously after taking a deep breath, or assist in expectoration by changing body position and patting the back, and give hot compress to patients with pain. Additionally, the team was required to introduce lip-contraction breathing training and abdominal breathing training to patients, and guide patients to actively participate in outdoor activities, such as Tai Chi, walking and other aerobic exercises, to improve the body's immunity and cardio-pulmonary function.

(2) Family: A family "H2H" nutrition support group was established for each patient after the patient was discharged from the hospital, which included additionally a patient's family member based on the department's "H2H" nutrition management team. The group was responsible for nutritional guidance and support to patients and their families, and regular weekly follow-up in nursing clinics. The medical staff were arranged to keep regular contact with patients and teach patients to record their diet and keep a diet diary. The staff used official WeChat account to publish knowledge about diet of COPD patients every week and daily diet recipes every day. Patients can also leave a message through official WeChat account, and the team would reply and answer in time.

Data collection

The clinical data and detection indexes of patients were collected from the electronic medical record system of School of Medicine of Pingdingshan University. The clinical data included age, gender, body mass index (BMI), smoking history, alcoholism history, past medical history and TNM staging. The self-rating anxiety scale (SAS) and self-rating depression scale (SDS) were adopted for anxiety and depression evaluation, and the EORTC Quality of Life Questionnaire (QLQ-C30) was adopted for quality of life evaluation. Detection indexes included lung function-associated indexes (forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1)/FVC and maximal voluntary ventilation (MMV)), blood gas analysis indexes (arterial partial pressure of oxygen (PaO_2) and arterial carbon dioxide partial pressure ($PaCO_2$)), acute infection-associated indexes (interleukin-6 (IL-6) and C-reactive protein (CRP)), tumor markers (carcino-embryonic antigen (CEA), carbohydrate antigen 125 (CA125) and CA199) and pathological types of lung cancer.

Primary outcome measures: The changes of quality of life score, anxiety score and depression score in the two groups were compared before and after nursing (6 months after nursing care). The changes of lung function were compared before and after nursing.

Secondary outcome measures: The clinical data of the two groups were compared. Cox regression was conducted for analysis of factors affecting the patients' prognosis.

Follow-up data

Based on electronic medical records and outpatient re-examination records, all patients were followed up to death or for 3 years.

Table 1. Comparison of baseline data

Factors	Control group (n=45)	Observation group (n=50)	P value
Gender			0.661
Male	25	30	
Female	20	20	
Age			0.269
≥60 years old	21	29	
<60 years old	24	21	
BMI			0.635
≥25 kg/m^2	15	19	
<25 kg/m^2	30	31	
Smoking history			0.661
Yes	25	30	
No	20	20	
Alcoholism history			0.559
Yes	3	5	
No	42	45	
Hypertension			0.719
Yes	12	15	
No	33	35	
Diabetes mellitus			0.334
Yes	8	13	
No	37	37	
Pathological type			0.155
Adenocarcinoma	29	25	
Squamous carcinoma	16	25	
TNM staging			0.905
Phase I	13	15	
Phase II	32	35	

Note: BMI: body mass index.

Statistical analyses

This study adopted SPSS26.0 software for statistical analysis. Inter-group comparison of measurement data was conducted using the t test or corrected t-test after mean square error test, and presented by the mean ± standard deviation (SD). Counting data were described by percentage (composition ratio), and analyzed using the X^2. The risk factors of COPD comorbid with lung cancer were analyzed through binary Logistic regression. The Kaplan Meier method was used for survival analysis, and corresponding survival curve was drawn. Univariate COX regression analysis was carried out to screen the indicators with possible influences on the prognosis of COPD comorbid with lung cancer, and the statistically significant indicators in univariate analysis were subjected to the multivariate COX regression model to analyze the independent risk factors that impact the prognosis of comorbid COPD and lung cancer. P<0.05 suggests a notable difference.

Results

Comparison of clinical data

Firstly, the clinical data of the two groups were compared. According to the results, the two groups were similar in age, gender, BMI, smoking history, alcoholism history, past medical history, pathological type and TNM stage (P>0.05, **Table 1**).

Influence of H2H rehabilitation care on quality of life

According to comparison of the two groups in the changes of quality of life before and after nursing, before nursing, the two groups were similar in the quality of life scores (P>0.05, **Figure 1**), while after nursing, the quality of life scores of both groups increased notably (P<0.0001, **Figure 1**), and the observation group got notably higher quality of life scores than the control group (P<0.0001, **Figure 1**).

Influences of H2H rehabilitation care on alleviation of negative emotions

According to comparison of the changes in SAS score and SDS score between the two groups before and after nursing, before nursing, the two groups were similar in ASA and SDS scores (P>0.05, **Figure 2**), while after nursing, the SAS and SDS scores of both groups decreased notably (P<0.0001, **Figure 2**), and the observation group got notably lower SAS and SDS scores than the control group (P<0.0001, **Figure 2**).

Influences of H2H rehabilitation care on improvement of patients' lung function

According to comparison of FVC, FEV1/FVC and MMV levels between the two groups before and after nursing, before nursing, the two groups were similar in the levels of FVC, FEV1/FVC and MMV (P>0.05, **Figure 3**), while after
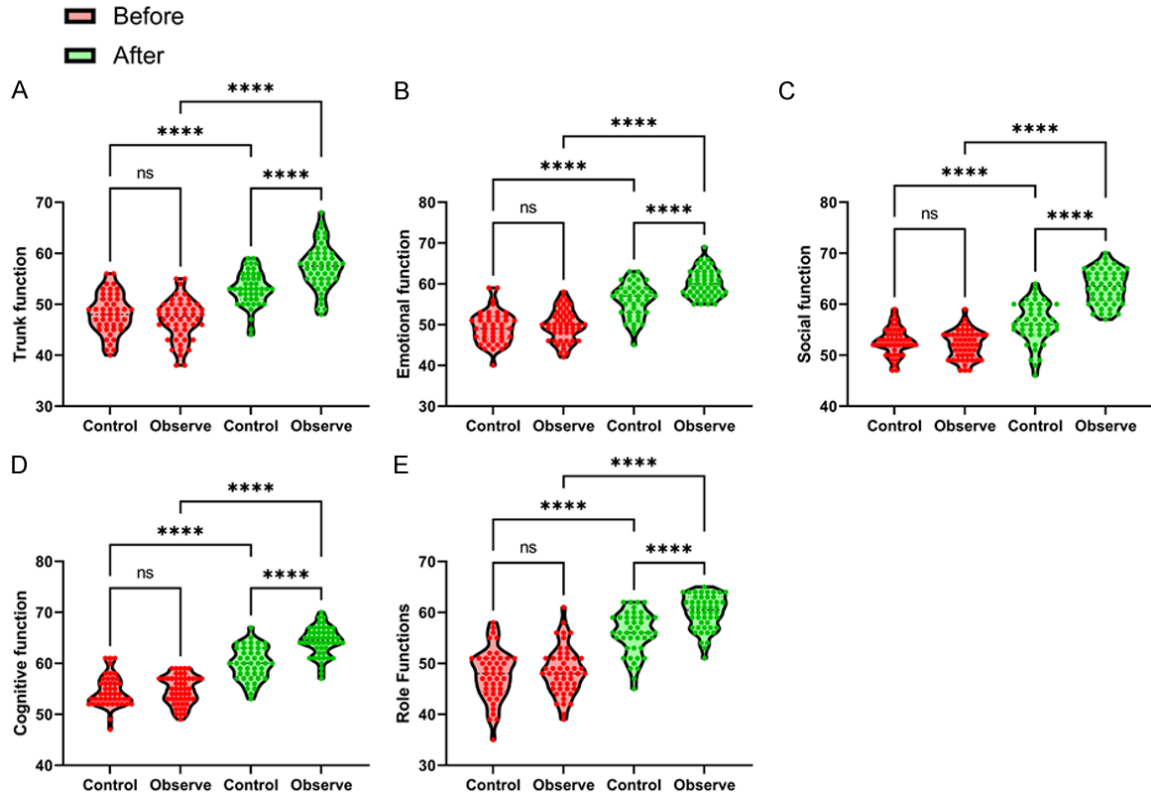
Figure 1. Changes in various quality of life scores of patients before and after nursing. A: Comparison of the changes in trunk function scores of the two groups before and after nursing; B: Comparison of the changes in emotional function scores of the two groups before and after nursing; C: Comparison of the changes in social function scores of the two groups before and after nursing; D: Comparison of the changes in cognitive function scores of the two groups before and after nursing; E: Comparison of the changes in role function scores of the two groups before and after nursing. Notes: nsP>0.05, ****P<0.0001.
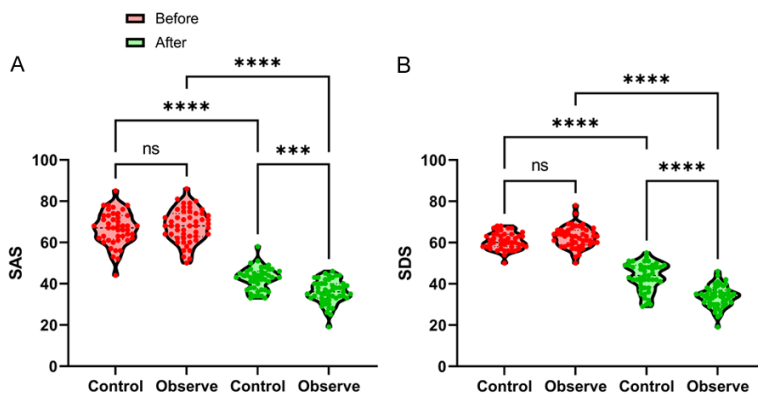

Figure 2. Changes of SAS and SDS scores in patients before and after nursing. A: Comparison of SAS scores in patients before and after nursing. B: Comparison of SDS scores in patients before and after nursing. Notes: nsP>0.05, ****P<0.0001. SAS: Self-rating anxiety scale; SDS: Self-rating depression scale.

nursing, the levels of FVC, FEV1/FVC and MMV in both groups increased notably (P<0.0001,

Figure 3), and the observation group showed notably higher levels of them than the control group (P<0.0001, **Figure 3**).

Influence of H2H rehabilitation care on improvement of patients' blood gas indexes

The changes of blood gas indexes were compared between the two groups before and after nursing. According to the results, before nursing, the PaO_2 and $PaCO_2$ of the two groups were not greatly different (P>0.05, **Figure 4**), while after nursing, both groups showed notably increased PaO_2 and notably decreased $PaCO_2$ (P<0.0001, **Figure 4**).
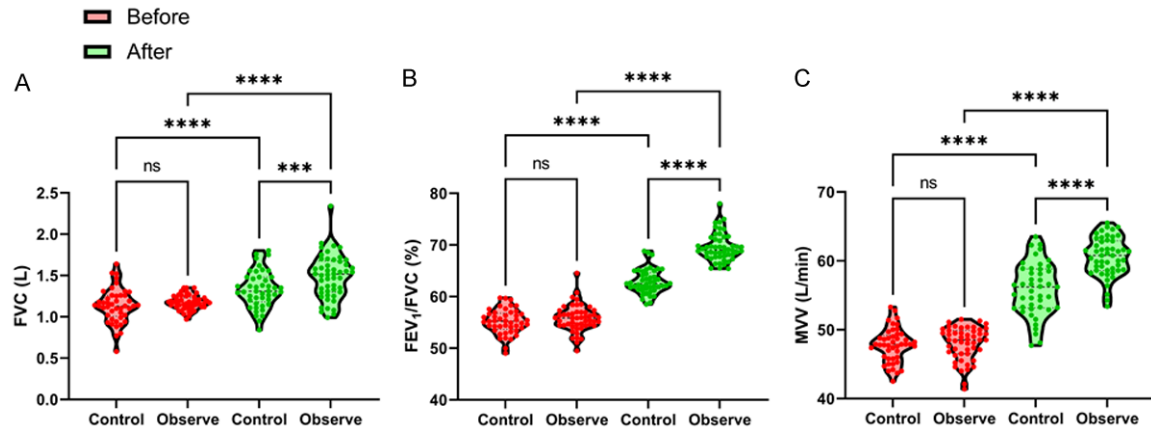
Figure 3. Changes in lung function of the patients before and after nursing. A: Comparison of the changes in FVC between the two groups before and after nursing; B: Comparison of the changes in FEV1/FVC between the two groups before and after nursing; C: Comparison of the changes in MVV between the two groups before and after nursing; Note: nsP>0.05, ***P<0.001, ****P<0.0001. FVC: Forced vital capacity; MVV: maximal voluntary ventilation; FEV1/FVC%: forced expiratory volume in 1 second/FVC.
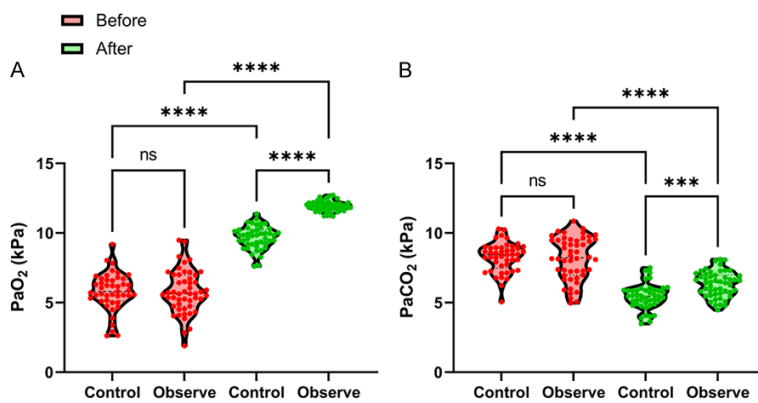

Figure 4. Changes of blood gas indexes in patients before and after nursing. A: Comparison of the changes in PaO_2 between the two groups before and after nursing; B: Comparison of the changes in $PaCO_2$ between the two groups before and after nursing; Note: nsP>0.05, ****P<0.0001. PaO_2: Arterial partial pressure of oxygen; $PaCO_2$: Arterial carbon dioxide partial pressure.

servation group and control group (P>0.05, **Figure 5**).

Influences of H2H rehabilitation care on improvement of patients' tumor markers

The changes of CEA, CA125 and CA199 were compared between the two groups before and after nursing. According to the results, before nursing, the two groups were similar in the levels of CEA, CA125 and CA199 (P>0.05, **Figure 6**), while after nursing, CEA, CA125 and CA199 in the two groups decreased significantly (P<0.0001, **Figure 6**), but the levels of them were not significantly different between the two groups (P>0.05, **Figure 6**).

The observation group showed a notably higher PaO_2 level and a notably lower $PaCO_2$ level than the control group (P<0.0001, **Figure 4**).

Influences of H2H rehabilitation care on improvement of patients' inflammatory factors

The changes in IL-6 and CRP were compared between the two groups before and after nursing. According to the results, before nursing, the two groups were not greatly different in IL-6 and CRP (P>0.05, **Figure 5**), while after nursing, IL-6 and CRP in the two groups decreased (P<0.0001, **Figure 5**), but the IL-6 and CRP levels were not greatly different between the ob-

Effects of H2H rehabilitation care on patients' survival

Statistics were made on the 3-year survival of the two groups. According to the results, 22 of the 95 patients survived in 3 years, showing a survival rate of 23.15% (**Figure 7**). Further comparison revealed no statistical difference between the two nursing schemes on patients' 3-year survival (P=0.260, **Figure 7**).
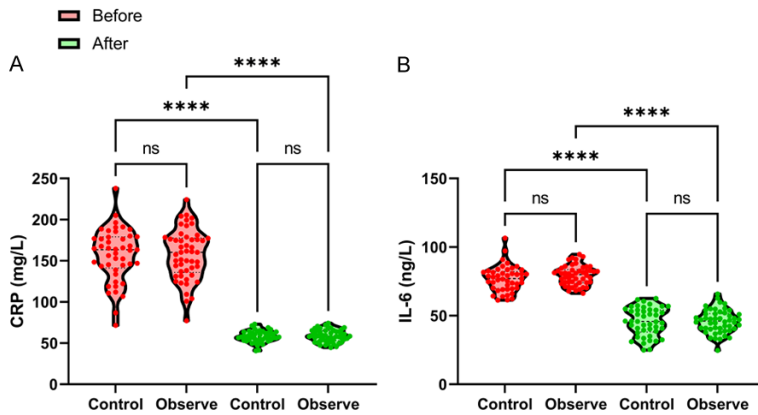
Figure 5. Changes of inflammatory factors in patients before and after nursing. A: Comparison of the changes in CRP between the two groups before and after nursing; B: Comparison of the changes in IL-6 between the two groups before and after nursing; Notes: nsP>0.05, ****P<0.0001; CRP: C-reactive protein; IL-6: interleukin-6.

Analysis of prognostic factors impacting patients' survival

The collected data were subjected to univariate Cox analysis. As a result, SAS score, SDS score and CEA were found to be prognostic factors affecting patients' 3-year survival (P<0.05, **Table 2**). Furthermore, nursing plan had no effect on the 3-year survival time of the patients, but SAS score, SDS score and CEA were found to be independent prognostic factors affecting the patients' 3-year survival (P<0.05, **Table 2**).

Discussion

In this study, the quality of life, negative emotions and lung function of the control group were significantly improved after nursing. According to further comparison, the observation group experienced better quality of life than the control group, with less negative emotions and better improved lung function. Yang et al. [16] have revealed that H2H management mode can effectively improve the mental state, quality of life, sleep quality and coping ability of schizophrenic patients with type 2 diabetes mellitus, and lower their blood glucose. In addition, Song et al. [18] have reported that H2H nutritional management mode can effectively improve the postoperative nutrition of patients with laryngeal cancer, lower the incidence of complications, readmission rate and mortality rate, and improve their quality of life. Their research conclusions all indicate that H2H

management mode can improve patients' quality of life and psychological state. We believe the main reasons are as follows: First, through language persuasion, improving physical comfort and other forms, H2H rehabilitation care mode can effectively eliminate the negative emotions of patients, improve their cooperation in treatment and nursing, and keep them positive and optimistic in the face of treatment. Secondly, in terms of the respiratory tract, additional respiratory training can prevent patients from cough with fatigue and increased respiratory secretions, and keep the respiratory tract unobstructed by correctly guiding patients to cough and expectoration; Then, the guidance of functional rehabilitation training can help improve the body's immunity and cardiopulmonary function, promote the rapid recovery of disease, and help enhance patients' confidence in healing. It can improve the quality of life and lung function of patients with lung cancer comorbid with COPD and relieve their anxiety and depression. This study compared the inflammatory factors and tumor markers of the two groups before and after nursing. According to the results, no significant difference was found in the changes of inflammatory factors and tumor markers between the two groups before and after treatment. This may be because the therapeutic regimens of the two groups are almost the same, which suggests that although the nursing scheme has a positive impact on the quality of life and emotional health of patients, it will not affect the changes of inflammatory factors and tumor markers. This discovery further emphasizes that in the joint management of lung cancer comorbid with COPD, therapeutic regimen plays a leading role in controlling inflammation and tumor progression.

COPD and lung cancer are both diseases with high mortality and serious economic burden worldwide, among which COPD is a risk factor for lung cancer [19, 20]. It is of great significance to identify high-risk patients and carry out early screening and treatment. Finally, the
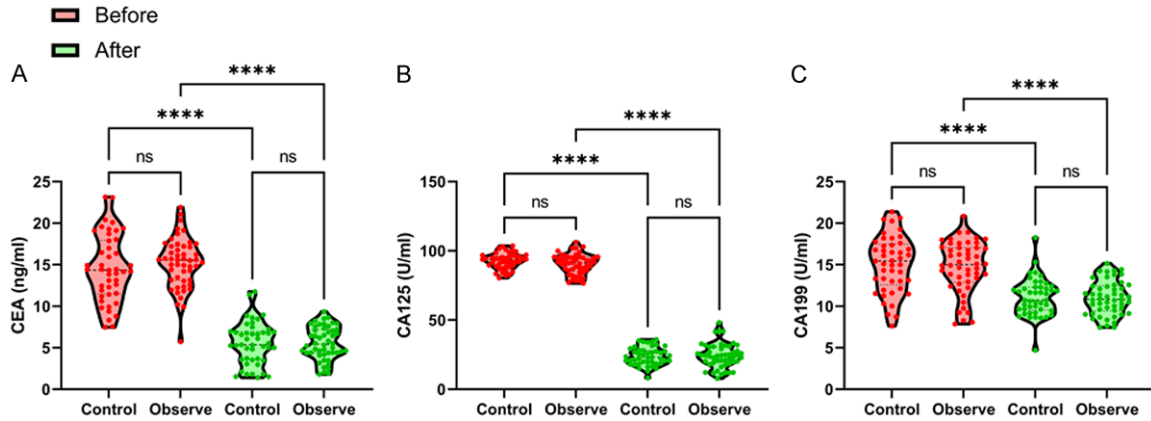
Figure 6. Changes of tumor markers in patients before and after nursing. A: Comparison of the changes in CEA between the two groups before and after nursing; B: Comparison of the changes in CA125 between the two groups before and after nursing; C: Comparison of the changes in CA199 between the two groups before and after nursing; Notes: nsP>0.05, ****P<0.0001; CEA: carcinoembryonic antigen; CA125: Carbohydrate antigen 125; CA199: Carbohydrate antigen 199.
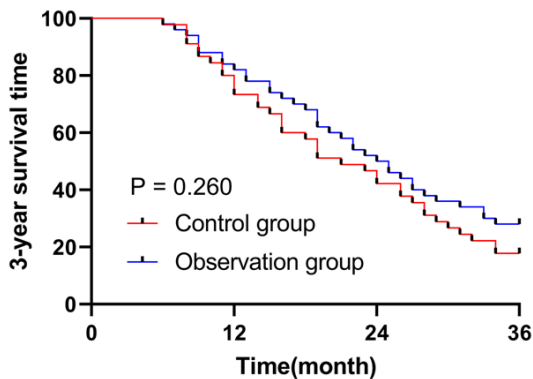

Figure 7. Comparison of the 3-year survival time between patients in the observation and control groups.

factors affecting the 3-year survival rate of patients were analyzed. According to the results, SAS, SDS and CA199 were strongly bound up with the 3-year survival rate of patients, but nursing scheme caused no obvious effect on the 3-year survival rate. According to previous research [21], anxiety may compromise the survival rate of lung cancer patients, because it may result in decreased immune function, hormonal imbalance and excessive psychological stress, which probably accelerates the development of lung cancer. In addition, lung cancer patients are generally depressed, which will compromise their quality of life, treatment and survival. Reportedly, lung cancer patients with high depression scores have obviously shorter survival time and face a higher risk of death [22]. CEA is a tumor marker

extensively adopted in lung cancer screening and efficacy monitoring [23]. According to prior research [24], CEA, as an index of prognosis evaluation of lung cancer, is helpful to evaluate the survival time of patients and predict the risk of tumor recurrence. In the treatment of lung cancer, the change of CEA can also be used to monitor the efficacy and guide the adjustment of subsequent therapeutic regimen.

However, in this study, H2H rehabilitation care failed to prolong the 3-year survival time of patients. The possible reasons are as follows: First of all, H2H rehabilitation care is more inclined to improve patients' mental state and quality of life, and does not directly affect the survival time. Secondly, the survival rate is affected by various factors including the severity of the disease, the overall health status, the effectiveness of therapeutic regimen and complications. The existence of these factors determines that H2H nursing method has no obvious influence on the survival rate statistically. Although H2H rehabilitation care is not a direct factor affecting the survival rate of patients, it does not mean that H2H rehabilitation care is of no value to the overall curative effect on patients. On the contrary, our research results emphasized the important role of H2H rehabilitation care in improving patients' quality of life, psychological state and lung function. It is of far-reaching significance to detect and treat the depression and anxiety symptoms of lung can-

Table 2. Cox regression analysis

Factors	Univariate Cox			Multivariate Cox		
	P value	OR value	95% CI	P value	OR value	95% CI
Nursing plan	0.271	1.294	0.818-2.049			
Age	0.543	0.867	0.546-1.375			
Gender	0.941	0.983	0.620-1.558			
BMI	0.667	1.111	0.688-1.796			
Smoking history	0.544	1.153	0.728-1.827			
Alcoholism history	0.614	1.223	0.560-2.667			
Hypertension	0.982	1.006	0.609-1.661			
Diabetes mellitus	0.535	0.839	0.481-1.462			
Pathological type	0.910	1.027	0.645-1.635			
TNM staging	0.625	0.881	0.531-1.463			
SAS score	<0.001	1.058	1.028-1.088	0.001	1.053	1.022-1.085
SDS score	0.007	1.083	1.022-1.148	0.038	1.063	1.003-1.127
FVC	0.825	1.202	0.237-6.102			
FEV1/FVC	0.087	0.912	0.821-1.014			
MMV	0.346	1.049	0.950-1.159			
PaO$_2$	0.704	1.033	0.873-1.222			
PaCO$_2$	0.708	0.969	0.821-1.143			
IL-6	0.778	0.999	0.991-1.007			
CRP	0.105	1.025	0.995-1.055			
CEA	0.008	1.105	1.026-1.189	0.011	1.109	1.024-1.201
CA125	0.726	0.994	0.959-1.029			
CA199	0.994	1.000	0.930-1.076			

Note: BMI: body mass index; SAS: Self-rating anxiety scale; SDS: self-rating depression scale; FVC: Forced vital capacity; MVV: Maximal voluntary ventilation; FEV1/FVC%: Forced expiratory volume in 1 second/FVC%; PaO$_2$: Arterial oxygen partial pressure; PaCO$_2$: Arterial partial pressure of oxygen; CRP: C-reactive protein; IL-6: Interleukin-6; CEA: Carcinoembryonic antigen; CA125: Carcinoembryonic antigen 125; CA199: Carcinoembryonic antigen 199.

cer patients with COPD in the early stage, because various psychological intervention measures can be taken to alleviate the symptoms of depression and anxiety and improve the quality of life to exert a possible positive impact on the treatment and survival of patients.

This study has confirmed that H2H rehabilitation care mode can improve the quality of life, emotion and lung function of patients with lung cancer comorbid with COPD, but it still has some limitations. First of all, we have not carried out prospective research, and the results obtained through retrospective research need more data for verification. Secondly, the follow-up time of this study is short, so whether the nursing scheme impacts the long-term survival of patients needs further investigation. Therefore, we hope to carry out prospective research in the future to supplement the research results.

To sum up, H2H rehabilitation care mode can improve the quality of life, emotion and lung function of patients with lung cancer comorbid with COPD, but it does not improve the survival of patients.

Disclosure of conflict of interest

None.

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