ISSN 2706-6819 Vol.6, Issue 9: 67-73, DOI: 10.25236/IJFM.2024.060910

Influencing factors of prognosis in elderly patients with COPD complicated with respiratory failure and the intervention effect of specialized nursing and respiratory training mode

Yu Feifei

Leshan Vocational and Technical College, Leshan, Sichuan, China

Abstract: *To study the influencing factors of prognosis in elderly patients with chronic obstructive pulmonary disease (COPD) complicated with respiratory failure and the intervention effect of specialized nursing and respiratory training mode. A total of 168 COPD patients with respiratory failure admitted to our hospital from May 2021 to April 2023 were enrolled. According to their prognosis in the hospital, they were divided into good prognosis (121 cases) and poor prognosis (47 cases). logistic regression was used to analyze the independent risk factors of poor prognosis in elderly COPD patients with respiratory failure, and Pearson correlation coefficient was used to analyze the correlation.The results of multivariate analysis showed that arterial partial pressure of carbon dioxide (PaCO2), hypoxia-inducible factor-1α (HIF-1α), and High-sensitivity C-reactive protein (hs-CRP) to albumin (Alb) ratio (HCAR), Neutrophil count (Neut) to lymphocyte count (LYMPH) ratio (NLR) and Platelet count (PLT) to LYMPH ratio (PLR) were independent risk factors for poor prognosis in elderly COPD patients with respiratory failure (P < 0.05).Pearson correlation analysis showed that HIF-1α, HCAR and PLR were positively correlated with arterial blood gas index PaCO2 (P < 0.05), and NLR was not correlated with arterial blood gas index PaCO2 (P > 0.05).It can be seen that PaCO2, HIF-1α, HCAR, NLR and PLR are independent risk factors for poor prognosis in elderly COPD patients with respiratory failure, and special nursing and respiratory training mode intervention can be used to improve the prognosis of patients.*

Keywords: *Senile chronic obstructive pulmonary disease; Respiratory failure; Prognosis; The influencing factors; Specialized nursing; Respiratory training mode*

1. Introduction

Chronic obstructive pulmonary disease (COPD) is a chronic disease characterized by airflow limitation, which is more common in elderly people and is not completely reversible. Acute exacerbations of chronic obstructive pulmonary disease (AECOPD) is the main reason for patients to be admitted to the hospital, and eventually leads to systemic complications, most commonly respiratory failure [1], which leads to invasive mechanical ventilation and increased risk of transferring to ICU, with a mortality rate of about 15%[2].At present, non-invasive positive pressure ventilation is commonly used in clinical treatment of COPD complicated with respiratory failure, but it is easy to induce physical and psychological discomfort, leading to patients' intolerance to treatment. The implementation of specialized nursing and respiratory training mode intervention has a positive effect on the recovery of exercise ability and lung function of patients and the acquisition of high-quality prognosis [3]. Therefore, this study aims to analyze the independent risk factors affecting the prognosis of elderly COPD patients with respiratory failure and the intervention effect of specialized nursing and respiratory training mode, in order to provide a reference for clinical intervention, which is reported as follows.

2. Objects and Methods

2.1 Object of study

A total of 168 COPD patients with respiratory failure admitted to our hospital from May 2021 to April 2023 were enrolled. Inclusion criteria: (1) All patients were diagnosed with COPD by lung CT

ISSN 2706-6819 Vol.6, Issue 9: 67-73, DOI: 10.25236/IJFM.2024.060910

examination and were in the acute exacerbation stage [4]; (2) Admission due to AECOPD with respiratory failure; (3) age 65-79 years old; (4) Partial Pressure of Oxygen (PaO2) < 60 mmHg and Arterial Carbon Dioxide Pressure (PaCO2) > 50mmHg at rest without oxygen inhalation.Exclusion criteria: (1) complicated with pulmonary bulla (2) Patients with Complicated malignant tumors (3) Patients with complicated systemic infectious diseases (4) Patients with complicated coagulation disorders (5) Patients with organ dysfunction caused by other causes (6) The deceased had a myocardial infarction or cerebral infarction 2 weeks before admission (7) Patients who underwent other surgical procedures 2 weeks prior to admission. This study was approved by the ethics committee of the hospital, and informed consent was signed by the patients and their families.

2.2 Methods

The clinical data of the two groups were collected, including: basic data of patients [gender, age, Body Mass Index (BMI), course of COPD, antibiotic use time, number of acute attacks within 1 year, length of hospital stay, smoking history, drinking history, whether complicated with hypertension, diabetes, cerebrovascular disease, chronic kidney disease, laboratory indicators, etc.].

The levels of Arterial oxygen saturation (SaO2), PaO2 and PaCO2 were detected by blood gas analyzer (Wuhan Mingde Biotechnology Co., LTD., Hubei Mechanical injection Standard 20192222694) on the day of admission.Using Lung function detector (sichuan cisco technology co., LTD., sichuan machinery medical device registration certificate 20212070081) assessment of Forced expiratory volume in onesecond (FEV1) and Forced vital capacity (FVC), FEV1/FVC was calculated.Fasting venous blood (5.0mL) was collected on the day of admission or the next day, and the supernatant was collected by centrifugation for later use. The level of HIF-1α was detected by enzyme linked immunosorbent assay (ELISA), and the levels of hs-CRP and Alb were detected by immune nephelometry. The White Blood Cell Count (WBC), Neut, PLT and LYMPH were recorded.

2.3 Statistical Analysis

SPSS 26.0 was used to analyze the clinical data of the patients. The measurement data were expressed as ($\bar{x}$±s), and the t test was used between groups. Count data were expressed as n and %, and $\chi 2$ test was used between groups.Logistic regression analysis was performed on the factors with statistical significance for poor prognosis in elderly COPD patients with respiratory failure. Pearson correlation analysis was used to analyze the correlation. $P < 0.05$ was statistically significant.

3. Results

3.1 Univariate analysis of poor prognosis in elderly patients with COPD complicated with respiratory failure

Among 168 elderly patients with COPD complicated with respiratory failure, 47 patients had poor prognosis, with dyspnea, aggravated blood gas indexes and changed to mechanical ventilation by tracheal intubation. There were 29 cases of myocardial infarction, 4 cases of heart failure, 3 cases of renal failure, 3 cases of pulmonary infection, 2 cases of multiple organ dysfunction, and 6 cases died after ineffective rescue.The prognosis of 121 patients was good, the clinical symptoms and signs were improved, dyspnea was relieved, lung function was recovered, and blood gas indexes were improved.The results showed that there were significant differences in smoking history, cerebrovascular disease, PaCO2, HIF-1α, PLT, HCAR, NLR and PLR between the poor prognosis group and the good prognosis group ($P < 0.05$). See Table 1.

Table 1 Univariate analysis of poor prognosis in elderly patients with COPD and respiratory failure[n(%),(±s)]

Factors	Poor prognosis group(n=47)	Good prognosis group(n=121)	$\chi 2$/t	P
Gender(Male/Female)	30/17	74/47	0.103	0.749
Age (years)	73.47±4.56	72.98±4.72	0.610	0.543
BMI(kg/m2)	23.21±2.25	23.47±2.57	0.609	0.544
COPD Course of disease	5.13±0.98	4.96±1.03	0.973	0.332
Duration of Antibiotic use(d)	12.29±3.45	11.19±3.26	1.931	0.055
The number of acute attacks in 1	0.82±0.23	0.75±0.21	1.888	0.061

ISSN 2706-6819 Vol.6, Issue 9: 67-73, DOI: 10.25236/IJFM.2024.060910

year				
Length of stay(d)	11.23±2.56	10.54±2.24	1.721	0.087
Smoking history(Yes)	22(46.81)	37(30.58)	3.913	0.048
drinking history (Yes)	24(51.06)	58(47.93)	0.133	0.716
Complication				
Hypertension(Yes)	23(48.94)	54(44.63)	0.253	0.615
Diabetes(Yes)	11(23.40)	25(20.66)	0.151	0.697
Cerebrovascular disease(Yes)	9(19.15)	10(8.26)	3.998	0.046
Chronic kidney Disease(Yes)	25(53.19)	58(47.93)	0.374	0.541
SaO2(%)	73.13±5.35	74.84±5.49	1.825	0.070
PaO2(mmHg)	54.09±4.38	55.64±4.92	1.888	0.061
PaCO2(mmHg)	84.12±7.81	71.83±7.71	9.241	0.000
FEV1(L)	1.03±0.35	1.12±0.41	1.328	0.186
FVC(L)	1.85±0.41	1.97±0.43	1.645	0.102
FEV1/FVC(%)	55.24±4.73	56.82±4.69	1.955	0.052
HIF-1α(ng/L)	87.68±8.96	81.81±9.95	3.526	0.001
hs-CRP(mg/L)	32.11±9.02	29.34±7.87	1.964	0.051
ALB(g/L)	31.54±5.34	33.35±5.65	1.892	0.060
WBC(×109/L)	8.21±2.13	7.90±1.94	0.904	0.367
Neut(×109/L)	5.64±1.23	5.41±1.16	1.134	0.258
PLT(×109/L)	208.28±23.12	197.90±22.76	2.642	0.009
LYMPH(×109/L)	0.95±0.27	1.05±0.31	1.943	0.054
HCAR	1.01±0.28	0.86±0.19	3.991	0.000
NLR	6.08±1.22	5.41±0.92	3.852	0.000
PLR	216.04±29.59	193.77±24.56	4.974	0.000

Notes: HCAR=hs-CRP/Alb, NLR=Neut/LYMPH, PLR=PLT/LYMPH

3.2 Multivariate analysis of poor prognosis in elderly patients with COPD complicated with respiratory failure

The dependent variable was whether the elderly COPD patients with respiratory failure had poor prognosis (poor prognosis =1, good prognosis =0). Variables with $P < 0.05$ in univariate analysis (Smoking history, Cerebrovascular disease, PaCO2, HIF-1α, PLT, HCAR, NLR, PLR) were included in Logistic regression analysis, and the specific assigned values are shown in Table 2.Multivariate analysis showed that PaCO2, HIF-1α, HCAR, NLR and PLR were independent risk factors for poor prognosis in elderly COPD patients with respiratory failure ($P < 0.05$). See Table 3.

Table 2 Variable assignment methods

variate	Method of assignment
Smoking history,	Yes=1, No=0
Cerebrovascular disease	Yes=1, No=0
PaCO2	Continuous variables
HIF-1α	Continuous variables
PLT	Continuous variables
HCAR	Continuous variables
NLR	Continuous variables
PLR	Continuous variables

Table 3 Multivariate analysis of poor prognosis in elderly patients with COPD and respiratory failure

variate	B	SE	Wald	P	OR	95%CI
Smoking history,	-0.991	0.642	2.385	0.122	0.371	0.106~1.305
Cerebrovascular disease	-1.047	0.960	1.190	0.275	0.351	0.053~2.303
PaCO2	0.365	0.083	19.233	0.000	1.440	1.224~1.695
HIF-1α	0.146	0.042	12.223	0.000	1.157	1.066~1.256
PLT	0.009	0.014	0.350	0.554	1.009	0.980~1.038
HCAR	5.895	1.756	11.273	0.001	363.094	11.630~11335.521
NLR	1.574	0.408	14.894	0.000	4.826	2.170~10.735
PLR	0.036	0.015	6.180	0.013	1.037	1.008~1.067

ISSN 2706-6819 Vol.6, Issue 9: 67-73, DOI: 10.25236/IJFM.2024.060910

3.3 The correlation between HIF-1α, HCAR, NLR, PLR and arterial blood gas index PaCO2 in patients was analyzed

Pearson correlation analysis showed that: HIF-1α, HCAR, PLR were positively correlated with PaCO2 of patients (r=0.186, 0.173, 0.279, P < 0.05), NLR was not correlated with PaCO2 of patients (r=0.121, P > 0.05), as shown in Figure 1.

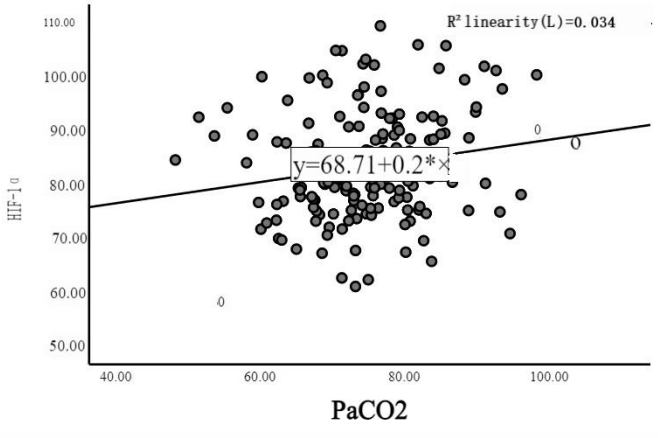

Figure 1a HIF-1α and $PaCO_2$

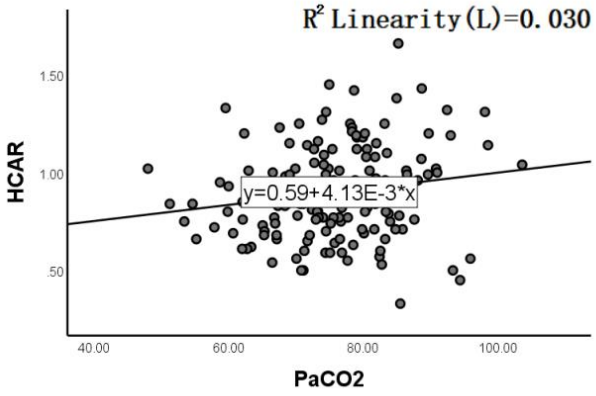

Figure 1b HCAR and $PaCO_2$

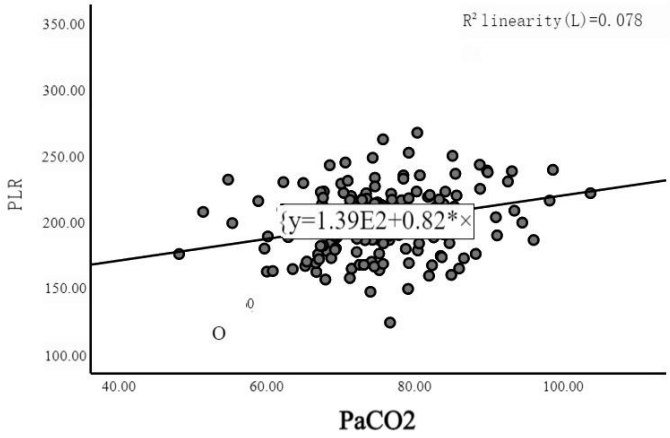

Figure 1c PLR and $PaCO_2$

Figure 1 Correlation analysis diagram

4. Discussion

Patients with COPD complicated with respiratory failure usually have poor pulmonary function, long course of disease and serious condition. Once acute attack, it is easy to induce serious

ISSN 2706-6819 Vol.6, Issue 9: 67-73, DOI: 10.25236/IJFM.2024.060910

complications and even death. At present, with the continuous progress of medical technology, the diagnosis and treatment of acute exacerbation of COPD combined with respiratory failure have achieved certain curative effect. According to relevant studies, about 30.51% of patients have poor short-term prognosis after admission [5].The incidence of poor prognosis in this study was 27.98% (47/168), which was slightly lower than the results reported above, indicating that although specialist nursing and respiratory training mode intervention can improve the prognosis of elderly COPD patients with respiratory failure to a certain extent, objective biomarkers for the prognosis of these patients still need to be explored. In order to early diagnose and deal with the acute attack of the disease in the elderly, and reduce the mortality and disability rate.

4.1 Risk factors for poor prognosis in elderly patients with COPD complicated with respiratory failure

In this study, multivariate results showed that: PaCO2, HIF-1α, HCAR, NLR and PLR were independent risk factors for poor prognosis in elderly COPD patients with respiratory failure, and Pearson correlation analysis showed that HIF-1α, HCAR and PLR were positively correlated with arterial blood gas index PaCO2, and the reasons may be as follows:PaCO2 is a commonly used blood gas index in clinical practice, which can reflect pulmonary ventilation function. When CO2 retention is caused by irreversible airflow limitation in COPD patients, the level of PaCO2 in their body increases. It has been reported that the short-term mortality risk of AECOPD patients with respiratory failure increases with the increase of PaCO2 [6].In addition, airflow limitation can also cause hypoxemia. HIF-1α is an important transcription factor mediating cellular response to hypoxia. When its secretion level is increased, it can promote the phosphorylation of serine-threonine kinase (AKT) and inhibit the release of phosphatidylinositol 3-kinase (PI3K) and Neut elastase, thereby aggravating the damage of airway epithelial cells.Wang Na et al. [7] reported that HIF-1α level was significantly increased in COPD patients when their condition was aggravated again. HCAR is affected by acute-phase proteins hs-CRP and ALB. hs-CRP is more sensitive than CRP and is highly expressed immediately after tissue injury or inflammation.However, when the ALB level is decreased, the nutritional status of patients is poor. Negative nitrogen metabolism occurs in the body and energy is obtained through muscle decomposition, which leads to respiratory muscle atrophy, further damage to airway function, and aggravation of respiratory failure.Therefore, HCAR can better reflect the systemic inflammatory and nutritional status of elderly COPD patients with respiratory failure through the mechanism of hs-CRP and ALB.Wang Hongjun et al. [8] reported that PLR and NLR are independent risk factors for predicting the prognosis of COPD patients with respiratory failure, and play an important role in the inflammatory response of patients. Among them, PLR is the ratio of PLT to LYMPH. The increase of PaCO2 leads to acid-base imbalance, the decrease of pH and further promote the activation of PLT, while the decrease of LYMPH level indicates the impairment of immune function, and the level of PLR increases. NLR reflects the levels of Neut and LYMPH in the body, but the results of Pearson correlation analysis in this study showed that NLR was not correlated with the arterial blood gas index PaCO2 in patients, which may be because Neut and LYMPH could not accurately reflect the degree of inflammation and prognosis due to bone marrow suppression in patients with severe infection. At this time, other indicators should be combined to analyze the condition .

4.2 Analysis of the intervention effect of specialized nursing and breathing training mode

Specialized nursing and respiratory training mode intervention mainly focused on the results of vital signs of patients such as lung function. In addition to comprehensive and professional specialized nursing such as airway clearance, anti-infection, acid-base balance correction, bronchodilator and glucocorticoids medication, and non-invasive positive pressure ventilation, respiratory training such as lip contraction exercise and abdominal muscle breathing was added. To help hospitalized elderly patients with COPD complicated with respiratory failure to establish a positive face treatment, gradually improve the patient's lung function, alleviate the development of the disease.

Specialized nursing and respiratory training model interventions include:(1) Health education: the pathogenesis and outcome of AECOPD with respiratory failure, drug usage, dosage and precautions, and the use of ventilator were explained to improve the treatment compliance of patients.(2) Psychological nursing: provide a quiet and comfortable treatment environment, ensure the sleep quality of patients, communicate with patients every day with a smile to close the relationship between nurses and patients, evaluate the psychological state of patients in time, mediate the negative emotions such as anxiety and depression of patients, and enhance their confidence in rehabilitation;(3) Condition

ISSN 2706-6819 Vol.6, Issue 9: 67-73, DOI: 10.25236/IJFM.2024.060910

monitoring: patients with AECOPD combined with type I respiratory failure were given intermittent high-concentration oxygen inhalation with oxygen flow of 4 to 6L/min, and patients with AECOPD combined with type II respiratory failure were given continuous low-concentration oxygen inhalation with oxygen flow of 1 to 2L/min. Vital signs of patients were closely monitored to evaluate the condition, and timely symptomatic treatment was given when potential risk factors appeared.(4) Life care: maintaining the ventilator mask every day, changing the ventilator tube every week, cleaning the patient's nose and mouth in the morning and evening, guiding the patient to pay attention to daily oral cleaning to prevent aspiration pneumonia, and guiding the diet to ensure adequate nutrition and heat supply; (5) Respiratory training :① The patient was instructed to perform lip contraction breathing training. The candle was placed at a horizontal distance of about 15 cm from the lip. The patient was instructed to use the nasal cavity to inhale to the maximum amount of breath holding for 2 s, and the abdomen was slightly tilted forward. According to the principle of not blowing out the candle, the lips were whistled to exhale the gas, and the breathing time ratio was gradually controlled from 2 : 1 to 5 : 1.②The patients were guided to carry out abdominal breathing training. The patients took a standing or sitting position and relaxed the abdominal muscles. The hands were placed on the abdomen, and the nasal cavity was used to breathe slowly and feel the respiratory activity to the maximum extent. When inhaling, the abdominal hands had a sense of lifting, and the respiratory rhythm was maintained 5 ~ 7 times a day, 5 ~ 15 minutes each time ;

③body is upright and his feet are naturally separated, cooperate with breathing to stretch his arms, and breathe up and down. When inhaling, both arms open to both sides and lift up to the top of the head. The palm is lifted up on both hands, and the palm root is lifted up hard. When exhaling, both arms are restored downwards, and the rhythm of breathing and arm extension is maintained 5 ~ 7 times a day, 5 ~ 15 minutes each time. The closed hands are closed and placed on the chest to adjust breathing. ④Guide patients to carry out moderate intensity aerobic exercise, such as short-distance walking, climbing stairs, pedaling, chest expansion gymnastics, etc., fully warm up before exercise and gradually carry out, once a day, 15 to 30 minutes each time, and adjust the exercise mode and amount according to the patient 's own tolerance [9-10].

Specialized nursing and respiratory training mode intervention can comprehensively and timely grasp the vital signs and psychological state of elderly COPD patients with respiratory failure, provide targeted clinical symptomatic treatment, psychological nursing and dietary support, so as to effectively alleviate the patient's condition. At the same time, it can improve the respiratory muscle function of patients through scientific respiratory function exercise guidance and rehabilitation training. Through continuous lip contraction exercise and abdominal muscle breathing, the residual volume of the lungs is promoted, so as to achieve the purpose of restoring lung function, which creates a good foundation for the prognosis and recovery of patients [11].

5. Conclusion

In conclusion, PaCO2, HIF-1α, HCAR, NLR and PLR are independent risk factors for poor prognosis in elderly COPD patients with respiratory failure. Special nursing and respiratory training mode intervention can be used to provide patients with professional and systematic nursing mode to promote the recovery of patients. However, due to the small sample size included in this study, and the lack of standardized quality control standards in the specific implementation process of specialized nursing and respiratory training mode, this study has certain limitations. In the future, sample size should be increased and further improvement should be performed to improve the comprehensiveness of the study.

References

[1] Shen H Y. Must-read manual for home management of chronic obstructive pulmonary disease published: exploring the role of comprehensive nursing intervention in the nursing of patients with acute exacerbation of chronic obstructive pulmonary disease complicated with respiratory failure [J]. J Interventional Radiology,2021,30(04):433.

[2] Barker AL,Eddy RL,MacNeil JL,et al. CT Pulmonary Vessels and MRI Ventilation in Chronic Obstructive Pulmonary Disease: Relationship with worsening FEV1 in the TINCan cohort study[J]. Acad Radiol.2021; 28 (4) : 495-506.

[3] Shen Yani, Wei Lili, Jing Zhixin, et al. Effectiveness of respiratory training in patients with chronic obstructive pulmonary disease complicated with respiratory failure: a systematic review [J]. Chin J

ISSN 2706-6819 Vol.6, Issue 9: 67-73, DOI: 10.25236/IJFM.2024.060910

Rehabilitation Med,2021,36(02):186-192.
[4] CAI Baiqiang, Chen Rongchang. Chinese expert consensus on diagnosis and treatment of acute exacerbation of chronic obstructive pulmonary disease (AECOPD) (2017 update)[J]. International J Respiratory,2017,37(14):1041-1057.
[5] Fu Z B, LI Z Z, QIANG Z C, et al. The role of HCAR and clinical indicators in predicting the prognosis of patients with COPD complicated with respiratory failure [J]. International J Respiratory, 2021,42(12):922-927.
[6] LIU Sijie, SUN Wei, Wang Jing, et al. Risk factors for short-term prognosis in patients with acute exacerbation of chronic obstructive pulmonary disease complicated with respiratory failure [J]. International J Respiratory, 2012,42(24):1902-1908.
[7] Wang Na, Zhu Heng, Chen Hao. Clinical significance of serum PGRN, HIF-1α and HCAR in re-acute exacerbation of chronic obstructive pulmonary disease [J]. Journal of Xuzhou Medical University,2023,43(07):485-491.
[8] Wang H J, Chu Q X, Ma D W, et al. Predictive value of inflammatory markers, NLR, PLR and red blood cell distribution width levels in the prognosis of patients with acute exacerbation of chronic obstructive pulmonary disease complicated with type II respiratory failure [J]. China Medicine Review, 2012,19(17):155-158.
[9] Min Xinzhen, Huang Hanpeng, Dai Chunhui. Effect of comprehensive nursing intervention on prognosis and nursing quality of patients with chronic obstructive pulmonary disease complicated with respiratory failure [J]. Journal of Qilu Nursing,2019,25(11):30-33.
[10] Wang Shihao, Wang Zhiwan. Research progress of rehabilitation exercise on respiratory muscle fatigue of chronic obstructive pulmonary disease [J]. Nursing Research,2021,35(20):3641-3646.
[11] Liu Wei, Wang Wuwei, Bian Hujing. Effect of respiratory function exercise combined with diet nursing intervention on lung function and hospitalization time of COPD patients with respiratory failure [J]. Guizhou Medicine,2024,48(09):1492-1493.