Clinical Characteristics of Hospitalized Patients with Chronic Obstructive Pulmonary Disease Complicated with Pneumonia and Acute Exacerbation

Lijun Chen[1], Huifang Zhang[1], Wang Xu[1], Xumei Yuan[2], Juanxia Chen[1], Liting Ma[1], Genggeng Yu[1] and Xiaoyong Ma[3]*

[1]Department of Respiratory and Critical Care Medicine, Second Affiliated Hospital of Ningxia Medical University (The First People's Hospital of Yinchuan), Yinchuan, Ningxia, China

[2]The Second Clinical Medical College of Ningxia Medical University, Yinchuan, Ningxia, China

[3]Department of Traditional Chinese Medicine, General Hospital of Ningxia Medical University, Yinchuan, Ningxia, China

***Corresponding Author:** Xiaoyong Ma, Department of Traditional Chinese Medicine, General Hospital of Ningxia Medical University, Yinchuan, Ningxia, China.

Abstract

Purpose: To analyze the clinical data of patients with chronic obstructive pulmonary disease (COPD) admitted due to pneumonia and acute exacerbation, summarize the clinical characteristics of the two groups of patients and provide research data for clinical diagnosis and treatment.

Methods: The clinical data of COPD patients admitted to the Department of Respiratory and Critical Care Medicine of Yinchuan First People's Hospital from July 2020 to July 2021 were retrospectively analyzed. According to whether they were complicated with pneumonia on chest CT at admission, they were divided into COPD complicated with pneumonia group (COPD+CAP group) and COPD acute plus recombination group (AECOPD group).

Results: Age, length of hospital stay, body mass index (bmi), BMI, albumin (ALB), neutrophil count (NEU), C-reactive protein (CRP), eosinophil count (EOS), D-dimer (D-D), fibrinogen (FIB) and the severity of pulmonary hypertension were statistically different ($P < 0.05$); There were no significant differences in gender, smoking history, home oxygen therapy, underlying diseases, Urea (Urea), creatinine (Cr), arterial partial pressure of oxygen (PO_2) and partial pressure of carbon dioxide (PCO_2) between the two groups ($P < 0.05$); The GOLD classification of pulmonary function was mainly II-III and there was no significant difference between the two groups ($P < 0.05$).

Conclusion: Compared with the AECOPD group, the COPD+CAP group had older age, longer hospital stay, worse nutritional status and more severe inflammation, pulmonary hypertension and hypercoagulability.

Keywords: Chronic Obstructive Pulmonary Disease; Merger of Pneumonia; Acute Exacerbation; Clinical Features

Abbreviations

COPD: Chronic Obstructive Pulmonary Disease; GOLD: Global Initiative for Chronic Obstructive Pulmonary Disease; CAP: Community-Acquired Pneumonia; BMI: Body Mass Index; AECOPD: Acute Exacerbation of Chronic Obstructive Pulmonary Disease; WBC: White Blood Cell Count; NEU: Neutrophil Count; CRP: C-Reactive Protein; D-D: D-Dimer; FIB: Fibrinogen; LYM: Lymphocyte Count; EOS: Eosinophil Count; ALB: Albumin; Urea: Urea Nitrogen; Cr: Creatinine; PaO_2: Arterial Partial Pressure of Oxygen; $PaCO_2$: Arterial Partial Pressure of Carbon Dioxide

Clinical Characteristics of Hospitalized Patients with Chronic Obstructive Pulmonary Disease Complicated with Pneumonia and Acute Exacerbation

08

Introduction

Chronic obstructive pulmonary disease (COPD) patients will be hospitalized due to cough, sputum, shortness of breath and other disease changes, although the patient's performance is similar, but in clinical work, it is found that some patients are hospitalized due to acute exacerbation of COPD. Some patients were admitted due to COPD complicated with pneumonia. This paper collected the clinical data of COPD patients hospitalized in the Department of Respiratory and Critical Care Medicine of Yinchuan First People's Hospital from July 2020 to July 2021. They were divided into COPD acute plus combination group and COPD complicated with pneumonia group. To investigate the differences in general data, blood routine, C-reactive protein, serum albumin, renal function, coagulation, blood gas analysis, pulmonary function and the incidence of pneumonia in COPD patients between the two groups, so as to provide a research basis for the standardized management of COPD patients.

Data and Methods

The general information: The clinical data of 277 COPD patients hospitalized in the Department of Respiratory and Critical Care Medicine of Yinchuan First People's Hospital from July 2020 to July 2021 were collected and analyzed retrospectively.

Inclusion and exclusion criteria: All patients with COPD met the diagnostic criteria of the Global Initiative for Chronic Obstructive Pulmonary Disease (GOLD) (2021 edition) [1]. All patients in the pneumonia group met the diagnostic criteria of the Chinese Guidelines for the Diagnosis and Treatment of Adult Community-acquired Pneumonia (2016 edition) [2]. The diagnostic criteria of pulmonary hypertension were based on the clinical diagnosis and classification criteria of pulmonary hypertension jointly formulated by the European Respiratory Society and the Society of Cardiology in 2009 [3]. According to the results of echocardiographic pulmonary hypertension classification, patients were divided into mild (resting pulmonary artery mean systolic blood pressure 30 - 50 mmHg), moderate (resting pulmonary artery mean systolic blood pressure 50 - 70 mmHg) and severe (resting pulmonary artery mean systolic blood pressure > 70 mmHg) pulmonary arterial hypertension. All patients were excluded from active pulmonary tuberculosis, asthma, bronchiectasis, lung cancer, pneumoconiosis and other lung diseases with restrictive inadequate ventilation and malignancy.

The research methods

Grouping: A total of 277 COPD patients were divided into acute COPD plus pneumonia group (AECOPD group, n = 183) and COPD plus pneumonia group (COPD+CAP group, n = 94) according to whether chest CT images were complicated with pneumonia at admission.

The data collection: (1) General information: age, sex, smoking history, body mass index (BMI), length of hospital stay, home oxygen therapy (5 - 10 hours/day), history of underlying diseases; (2) Examination and examination data: complete blood count, C-reactive protein, complete coagulation set, serum albumin, renal function, blood gas analysis, chest CT, pulmonary function and heart color ultrasound, all of which were completed within 0-2 days after admission.

Method of statistics

Statistical software SPSS 23.0 was used for analysis and measurement data were expressed as ±. According to the distribution status, t-test or non-parametric Mann-Whitney U test was used for comparison. 2 test was used to compare the difference between groups and P < 0.05 was considered statistically significant.

Results

Comparison of general information: The age and length of hospital stay in COPD+CAP group were higher than those in AECOPD group and BMI was lower than that in AECOPD group (P < 0.05). There were no significant differences in gender, smoking history, home oxygen

Clinical Characteristics of Hospitalized Patients with Chronic Obstructive Pulmonary Disease Complicated with Pneumonia and Acute Exacerbation

09

therapy status and underlying diseases between the two groups (P > 0.05). The most common three basic diseases in the two groups were hypertension, coronary heart disease and arrhythmia, which were 48.94%, 27.66% and 17.02% in the COPD+CAP group and 44.81%, 27.32% and 14.21% in the AECOPD group, respectively. There was no significant difference between the two groups. See table 1.

The general information	COPD+CAP group (n = 94)	AECOPD group (n = 183)	P values
Age (years, x̄ ± s)	75.27 ± 8.24	72.78 ± 9.51	< 0.05
Gender [n (%)]			
Male	61 (64.89)	124 (67.76)	> 0.05
Female	33 (35.10)	59 (32.24)	
Smoking history [n (%)]	42 (44.68)	81 (44.26)	> 0.05
BMI (Kg/m2, x̄ ± s)	22.68 ± 4.56	23.92 ± 4.56	< 0.05
Hospitalization days (day, x̄ ± s)	15.29 ± 4.71	13.87 ± 3.85	< 0.05
Family oxygen cure [n (%)]	12 (12.77)	26 (14.21)	> 0.05
Basic diseases [n (%)]			
Hypertension	46 (48.94)	82 (44.81)	> 0.05
Coronary heart disease	26 (27.66)	50 (27.32)	> 0.05
Arrhythmology	16 (17.02)	26 (14.21)	> 0.05
Diabetes	13 (13.83)	24 (13.11)	> 0.05
Pleural effusion	14 (14.89)	15 (8.20)	> 0.05
Cerebrovascular disease	7 (7.45)	9 (4.91)	> 0.05
Old pulmonary tuberculosis	2 (2.13)	9 (4.91)	> 0.05
other	15 (15.96)	23 (12.57)	> 0.05

Table 1: *Comparison of general data between the two groups.*

Comparison of GOLD classification of lung function: There was no significant difference in the GOLD classification of pulmonary function between the COPD+CAP group and the AECOPD group (P > 0.05) and GOLD grade II-III was dominant in both groups, with 63.82% in the AECOPD+CAP group and 63.39% in the AECOPD group, see table 2.

GOLD grade [n(%)]	AECOPD+CAP group (n = 94)	AECOPD group (n = 183)	P values
I	11 (11.70)	22 (12.02)	> 0.05
II	29 (30.85)	56 (30.60)	
III	31 (32.97)	60 (32.79)	
IV	23 (24.47)	45 (24.59)	

Table 2: *Comparison of GOLD classification of lung function between two groups.*

Comparison of inspection indexes: The white blood cell count (WBC), neutrophil count (NEU), C-reactive protein (CRP), D-dimer (D-D) and fibrinogen (FIB) in AECOPD+CAP group were higher than those in AECOPD group. The lymphocyte count (LYM), eosinophil count (EOS) and plasma albumin (ALB) of AECOPD+CAP group were lower than those of AECOPD group and the differences were statistically

Clinical Characteristics of Hospitalized Patients with Chronic Obstructive Pulmonary Disease Complicated with Pneumonia and Acute Exacerbation

10

significant (P < 0.05). There was no significant difference in Urea nitrogen (Urea), creatinine (Cr), arterial PH, arterial partial pressure of oxygen (PaO_2) and arterial partial pressure of carbon dioxide ($PaCO_2$) between the two groups (P > 0.05), see table 3.

Test indicators	AECOPD+CAP group (n = 94)	AECOPD group (n = 183)	P values
WBC ($\times 10^9$/L)	7.30 ± 3.26	6.70 ± 2.43	< 0.05
NEU ($\times 10^9$/L)	5.22 ± 3.24	4.45 ± 2.20	< 0.05
LYM ($\times 10^9$/L)	1.35 ± 0.53	1.53 ± 0.77	< 0.05
EOS ($\times 10^9$/L)	0.14 ± 0.13	0.18 ± 0.21	< 0.05
CRP (mg/L)	11.65 (4.15 - 51.99)	3.34 (1.39 - 11.87)	< 0.05
D-D (mg/L)	0.63 (0.37 - 1.09)	0.42 (0.25 - 0.83)	< 0.05
FIB (g/L)	3.48 ± 1.24	2.72 ± 0.93	< 0.05
ALB (g/L)	36.19 ± 4.57	37.44 ± 4.68	< 0.05
Urea (mmol/L)	5.78 ± 2.70	5.54 ± 2.16	> 0.05
Cr (umol/L)	70.26 ± 18.73	71.82 ± 21.33	> 0.05
PH	7.39 ± 0.05	7.38 ± 0.06	> 0.05
PaO_2 (mmHg)	68.04 ± 17.03	68.19 ± 20.10	> 0.05
$PaCO_2$ (mmHg)	43.03 ± 9.57	42.97 ± 11.17	> 0.05

Table 3: Comparison of test indexes between the two groups.

Comparison of the severity of pulmonary hypertension: The severity of pulmonary hypertension in AECOPD+CAP group was higher than that in AECOPD group (P < 0.05), see table 4.

Pulmonary arterial hypertension [n(%)]	AECOPD+CAP group (n = 94)	AECOPD group (n = 183)	P values
Mild	11 (11.7)	20 (10.9)	< 0.05
Moderate	7 (7.4)	12(6.6)	< 0.05
Severe	15 (16.0)	13 (7.1)	< 0.05

Table 4: Comparison of the severity of pulmonary hypertension between two groups.

Discussion

Although the patients in this study had similar clinical symptoms before admission, their actual conditions after admission were different to some extent. Among the 277 patients, 183 were hospitalized for acute exacerbation of COPD (AECOPD group), accounting for 66.06% and 94 were hospitalized for pneumonia (COPD+CAP group), accounting for 33.94%. It is a warning that clinical medical workers should pay attention to the risk factors of acute exacerbation of COPD patients and intervene early to reduce the frequency of acute exacerbation. It has been reported that acute exacerbation is one of the main reasons for hospitalization of COPD patients, which has a significant impact on the mortality of patients [4-6]. Although, acute exacerbation is a common adverse event of COPD, the more serious events of pneumonia in some patients still cannot be ignored. Therefore, the treatment of COPD patients needs to be screened in detail and differentiated individually.

Clinical Characteristics of Hospitalized Patients with Chronic Obstructive Pulmonary Disease Complicated with Pneumonia and Acute Exacerbation

11

The study found that the age and length of hospital stay in the COPD+CAP group were higher than those in the AECOPD group and the BMI, LYM and ALB were lower than those in the AECOPD group, suggesting that the COPD+CAP group had more severe disease, lower nutritional status and immune function. With the increase of age, the body's physiological function and respiratory defense ability gradually decline and it is more likely to be co-infected. Lin SH., *et al*. also showed that low BMI easily increases the probability of lung infection [7,8]. COPD patients are more likely to have low BMI and sarcopenia due to long-term chronic inflammatory stimulation, which increases the risk of respiratory tract infection and causes a vicious circle. Therefore, comprehensive management of diet and nutrition should be taken into account in the treatment of COPD patients. The WBC, NEU and CRP of the AECOPD+CAP group were higher than those of the AECOPD group, suggesting that the inflammation degree of the AECOPD+CAP group was more severe, which was also confirmed in the study of Li Qiang [9]. COPD patients are prone to hypercoagulability or prethrombotic state due to abnormal vascular endothelial function and increased blood viscosity due to chronic inflammation and hypoxia stimulation [10]. Our study found that D-D and FIB in AECOPD+CAP group were greater than those in AECOPD group. This indicates that the amplification of acute inflammation in the AECOPD+CAP group may further increase the risk of blood hypercoagulability. In addition, patients' bed rest increased and activity decreased during admission, which warns that clinical medical workers should pay great attention to the assessment, screening, intervention and prevention of deep vein thrombosis or pulmonary embolism in patients. It has certain clinical significance to shorten the length of hospital stay, improve the quality of life and reduce the mortality.

In this study, there was no statistically significant difference between AECOPD+CAP group and AECOPD combination combined with underlying diseases and GOLD classification of pulmonary function (P > 0.05). Both groups were complicated with hypertension, coronary heart disease, arrhythmia, diabetes and other underlying diseases and the pulmonary function was mainly GOLD grade II-III. The AECOPD+CAP group was 63.82% and the AECOPD group was 63.39%. Existing studies have confirmed that COPD patients are prone to coronary heart disease, diabetes, osteoporosis and other comorbidities due to inflammation, hypoxia and other stimuli [11,12], but comorbidities and GOLD classification of pulmonary function are not differential factors for acute exacerbation or pneumonia adverse events in this study. The severity of pulmonary hypertension in AECOPD+CAP group is higher than that in AECOPD group. Pulmonary hypertension is also a common complication of COPD. COPD patients with pulmonary hypertension will accelerate the progression of cor pulmonale and increase the risk of death, so early diagnosis and effective intervention of pulmonary hypertension are very important to improve the prognosis of COPD patients [13].

In this study, we found that COPD patients hospitalized were mainly acute exacerbations, but about 33.94% of patients were hospitalized with pneumonia. In clinical work, COPD patients admitted with pneumonia should pay more attention to the evaluation and treatment of blood hypercoagulability and pulmonary hypertension, early intervention, improve the clinical cure rate; This study also suggests that the treatment of COPD by clinical medical workers should cover the multi-dimensional comprehensive thinking of anti-inflammatory, nutrition, anticoagulation, correction of hypoxia, standardized management and so on.

Conclusion

Compared with the AECOPD group, the COPD+CAP group had older age, longer hospital stay, worse nutritional status and more severe inflammation, pulmonary hypertension and hypercoagulability.

Conflict of Interest

There is no financial interest or conflict of interest.

Clinical Characteristics of Hospitalized Patients with Chronic Obstructive Pulmonary Disease Complicated with Pneumonia and Acute Exacerbation

12

Bibliography

1. Global Initiative for Chronic Obstructive Lung Disease. Global strategy for diagnosis, management and prevention of Chronic pulmonary obstructive disease (2021).

2. Chinese Society of Respiratory Medicine. "Guidelines for the diagnosis and treatment of community-acquired pneumonia in Chinese adults (the 2016 edition)". *Chinese Journal of Tuberculosis and Respiratory Disease* 39.4 (2016): 253-279.

3. Gali N., *et al*. "Guidelines for the diagnosis and treatment of pulmonary hypertension". *European Respiratory Journal* 34 (2009): 1219-1263.

4. Steriade AT., *et al*. "Predictors of Long-term Mortality after Hospitalization for Severe COPD Exacerbation". *Maedica* 14.2 (2019): 86-92.

5. Steer J., *et al*. "Dyspnoea severity and pneumonia as predictors of in-hospital mortality and early readmission in acute exacerbations of COPD". *Thorax* 67 (2012): 117-121.

6. Andreassen SL., *et al*. "Impact of pneumonia on hospitalizations due to acute exacerbations of COPD". *The Clinical Respiratory Journal* 8 (2014): 93-99.

7. Lin SH., *et al*. "Increased risk of community acquired pneumonia in COPD patients with comorbid cardiovascular disease". *International Journal of Chronic Obstructive Pulmonary Disease* 11 (2016): 3051-3058.

8. Park HJ., *et al*. "The effect of low body mass index on the development of chronic obstructive pulmonary disease and mortality". *Journal of Internal Medicine* 286.5 (2019): 573-582.

9. Qiang Li., *et al*. "Value of PCT,hs-CRP,IL-6 and clinical symptoms in the diagnosis of AECOPD complicated with pneumonia". *World's latest Medical Information Digest* 19.92 (2019): 42-43.

10. Song YJ., *et al*. "Prothrombotic state in senile patients with acute exacerbations of chronic obstructive pulmonary disease combined with respiratory failure". *Experimental and Therapeutic Medicine* 5.4 (2013): 1184-1188.

11. Lin L., *et al*. "Analysis of prevalence and prognosis of type 2 diabetes mellitus in patients with acute exacerbation of COPD". *BMC Pulmonary Medicine* 21.1 (2021): 7.

12. Cui Y., *et al*. "Clinical and economic burden of comorbid coronary artery disease in patients with acute exacerbation of chronic obstructive pulmonary disease: sex differences in a nationwide cohort study". *Respiratory Research* 23.1 (2022): 28.

Clinical Characteristics of Hospitalized Patients with Chronic Obstructive Pulmonary Disease Complicated with Pneumonia and Acute Exacerbation

13

13. Seeger W., *et al.* "Pulmonary hypertension in chronic lung diseases". *Journal of the American College of Cardiology* 62.25 (2013): D109-D116.