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Research Article

Correlation Between Serum 25-(OH) D Level and Quality of Life in Patients with COPD

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Abstract

Objectives: To determine the difference of serum 25-(OH) D level between COPD patients and healthy people, and analyze the correlation between serum 25-(OH) D level and CAT score of COPD patients.

Methods: 1. Select 122 patients with COPD who visited our hospital from December 2021 to December 2022, including 62 patients in the AECOPD group, 60 patients in the stable COPD group, and 60 healthy people in our hospital during the same period as the control group, analyze the difference of 25-(OH) D among the above three groups of subjects, and analyze the correlation between 25-(OH) D level and CAT score of COPD patients by linear correlation method.

Results: 1. The level of 25-(OH) D in AECOPD group and stable COPD group was significantly lower than that in control group (P; The vitamin D deficiency rate in AECOPD group and stable COPD group was significantly higher than that in control group (P; 2. According to the correlation analysis, the level of 25-(OH) D in AECOPD group and stable COPD group was negatively correlated with CAT score ($P < 0.05$).

Conclusion: 1. The level of serum 25-(OH) D in patients with COPD was significantly reduced, and AECOPD patients had a high vitamin D deficiency rate; 2. Vitamin D deficiency has a negative impact on the quality of life of COPD patients.

Keywords: *COPD; 25-(OH)D; Vitamin D Deficiency; CAT Score; Quality of Life*

Chronic obstructive pulmonary disease (COPD) is a common disease that can be prevented and treated. Currently, about 300 million people worldwide suffer from COPD, and the annual death toll caused by COPD is as high as 419/100000 (5.7% of the total global deaths) [1,2]. Vitamin D (VitD) deficiency is also very common in COPD, and studies have shown that 58% of COPD patients experience VitD deficiency [3]. Therefore, it is speculated that there is a certain connection between VitD and the onset of COPD.

The lack of VitD may affect the quality of life of COPD patients, and the higher the severity of COPD, the greater the likelihood of VitD deficiency [4,5].

Aim of the Study

This study aims to observe the differences in serum 25-(OH)D levels between COPD patients and healthy individuals, analyze the correlation between serum 25-(OH)D levels and CAT scores, and explore the potential role and clinical significance of 25-(OH)D in the prevention and treatment of COPD, providing experimental basis for the prevention and treatment of VitD deficiency in COPD patients.

Materials and Methods

Research subjects

From October 2021 to October 2022, 62 patients with acute exacerbation of COPD (AECOPD), 60 patients with stable COPD, and 60 healthy people in the same period were selected from the First People's Hospital of Yinchuan (the Second Affiliated Hospital of Ningxia Medical University), and were divided into AECOPD group, COPD group, and health control group. All patients signed informed consent.

Discharge standards

The diagnostic criteria comply with the 2020 Global Initiative for Chronic Obstructive Pulmonary Disease (GOLD) standards. Patients with Bronchiectasis, bronchial asthma, malignant tumors, severe heart, liver and kidney dysfunction, and those who had used VitD preparations in the past 6 months were excluded.

Observation indicators and detection methods

CAT score

The symptoms of COPD are evaluated using the COPD assessment test (CAT). The CAT score is a more comprehensive and comprehensive scale that can provide a reliable assessment of the health status of COPD patients from multiple dimensions, comprehensively reflecting the severity of clinical symptoms, with a score range of 0 - 40 points. According to the rating, it is divided into the following four levels: 0 - 10 points for mild, 11 - 20 points for moderate, 21 - 30 points for severe, and 31 - 40 points for extremely severe.

Observation indicators

1. Observe the differences in VitD levels among the AECOPD group, stable COPD group, and healthy control group;
2. Observe the VitD deficiency rate among the AECOPD group, stable COPD group, and healthy control group;
3. Observe the correlation between VitD and CAT scores between the AECOPD group and the stable COPD group.

Statistical methods

SPSS 24.0 statistical software was used for data processing, with measurement data expressed in $x \pm s$, multiple group comparisons using one-way ANOVA, and pairwise comparisons between groups using LSD-t-test; The counting data were compared by Chi-squared test; Pearson correlation analysis was used for correlation analysis. The difference was statistically significant with $P < 0.05$.

Results

General information comparison

A total of 182 subjects were included in this study, including 62 in the AECOPD group, including 44 males and 18 females, with an average age of 67.95 ± 6.04 years old; There are 60 stable COPD patients, including 40 males and 20 females, with an average age of 66.17 ± 6.84 years old; There are 60 healthy control groups, including 43 males and 17 females, with an average age of 65.28 ± 6.47 years. There was no statistically significant difference in age and gender composition among the three groups of study subjects ($P > 0.05$). See table 1.

Variable	AECOPD group (n = 62)	COPD stable phase group (n = 60)	Healthy control group (n = 60)	P value
Age (years)	67.95 ± 6.04	66.17 ± 6.84	65.28 ± 6.47	0.069
Gender n, (%)				0.811
Male	44 (71.0)	40 (66.7)	43 (71.7)	
Female	18 (29.0)	20 (33.3)	17 (28.3)	

Table 1: *Comparison of general data among three groups.*

Comparison of 25-(OH) D levels and deficiencies

The levels of 25-(OH) D in the AECOPD group and stable COPD group were significantly lower than those in the control group ($P < 0.05$), and the decrease in 25-(OH) D levels in the AECOPD group was statistically significant compared to the stable COPD group ($P < 0.05$); In terms of VitD deficiency, there were 62 cases in the AECOPD group, of which 38 cases (61.3%) were VitD deficient. There were 60 cases in the COPD group, of which 26 cases (43.3%) were VitD deficient. There were 60 cases in the healthy control group, of which 12 cases (20.0%) were VitD deficient. The VitD deficiency rate in the AECOPD group and stable COPD group was significantly higher than that in the control group, and the difference was statistically significant ($P < 0.05$). See table 2.

Variable	AECOPD group (n = 62)	COPD stable phase group (n = 60)	Healthy control group (n = 60)	P value
25-(OH)D (ng/ml)	19.93 ± 6.37[ab]	24.20 ± 8.23[a]	30.26 ± 10.60	0.000
Lack (n, %)	38 (61.3)[a]	26 (43.3)[a]	12 (20.0)	0.000
Unlack (n, %)	24 (38.7)[a]	34 (56.7)[a]	48 (80.0)	

Table 2: *Comparison of 25- (OH) D levels and deficiencies among three groups.*

Note: a: Compared with the control group, P < 0.05; b: Compared with the COPD group, P < 0.05.

Correlation analysis between 25-(OH)D levels and CAT scores in COPD patients

The 25-(OH)D levels in AECOPD and stable COPD patients were negatively correlated with CAT scores ($P < 0.05$). See table 3.

Variable	AECOPD level	25-(OH)D group	25-(OH)D levels in the stable	COPD group
	r	P	r	P
CAT score	-0.680	0.000	-0.673	0.000

Table 3: *Correlation analysis between 25-(OH)D levels and CAT scores in COPD patients.*

Discussion

COPD is a heterogeneous lung disease that can be prevented, controlled, and treated [6,7]. Therefore, exploring effective prevention and treatment methods for COPD is currently a research hotspot. The acute deterioration of COPD symptoms, known as AECOPD, is the

main cause of patient death. COPD patients are prone to a lack of VitD, and low VitD levels can worsen the patient's condition, forming a vicious cycle. Therefore, it is urgent to explore the changes in VitD levels in COPD patients and their relationship with relevant indicators of COPD pathogenesis.

COPD patients are prone to vitamin D deficiency

Vitamin D deficiency has become a global public health problem, and the currently recognized standard for VitD deficiency is 25-(OH) D below 20 ng/ml. Globally, over 1 billion children and adults have been affected by this health problem [8,9]. A cross-sectional study reported that 24.18% of adults in a certain area of Beijing suffer from VitD deficiency, and 61.50% suffer from VitD deficiency [10-12]. VitD deficiency is more common in the elderly, and although COPD patients are currently becoming younger, the elderly population is still the main group of COPD patients.

Among all COPD patients (including AECOPD and stable COPD patients) in this study, there were 64 cases of VitD deficiency, with a VitD deficiency rate of 52.46%. A study [13] shows that the proportion of VitD deficiency in late stage COPD patients ranges from 33% to 77%. In a study that included 152 hospitalized COPD patients, 42.8% of patients had VitD deficiency and 40.8% had VitD deficiency [14]. Both studies were consistent with the results of this study. The reason why COPD patients are more prone to vitamin D deficiency than the healthy control group is related to the degenerative changes in physiological functions of the elderly population, as well as the impact of COPD disease itself and its extrapulmonary complications. COPD patients have significantly reduced outdoor sunshine time and decreased liver and kidney function (which together leads to a decrease in synthesized VitD), as well as a decrease in intake and absorption of VitD caused by weakened gastrointestinal function.

Vitamin D deficiency and acute exacerbation in COPD patients

In COPD, VitD deficiency can lead to events such as acute exacerbation. The acute exacerbation is mainly caused by microbial infection, leading to the expansion of inflammation. Vitamin D plays an anti-inflammatory role by activating monocyte and macrophages, inducing cathelicidin, and enhancing the chemotaxis and phagocytosis of inflammatory cells. Low levels of vitamin D cannot up regulate the innate immune defense system and reduce the load and colonization of pathogens, resulting in frequent exacerbation of diseases, deterioration of airflow restriction, and even dyspnea [15].

In this study, the VitD level in the AECOPD group was the lowest at (19.93 ± 6.37) ng/ml, while the levels in the COPD and control groups were (24.20 ± 8.23) ng/ml and (30.26 ± 10.60) ng/ml, respectively, which were significantly higher than those in the AECOPD group, and the difference was statistically significant ($P < 0.05$).

The lower levels of VitD in AECOPD patients may be due to the fact that patients in the acute exacerbation stage often do not engage in outdoor activities, further weakening their gastrointestinal and liver and kidney functions, and generally requiring hormone treatment, which in turn increases the catabolism of VitD and further reduces its reserve. On the other hand, low levels of VitD cannot effectively regulate Cathelicidin, increase the risk of frequent respiratory infections, poor immune response to various pathogens and increase the proliferation of airway smooth muscle, leading to the aggravation of the disease. Therefore, a vicious circle has formed between acute exacerbation of COPD and low levels of VitD, but the causal relationship between the two is still unclear. Lehouck., *et al*. [16] included 182 moderate to severe COPD patients with a recent history of acute exacerbation who received VitD supplementation. The results showed that high-dose supplementation with VitD formulations did not reduce the incidence of acute exacerbation. However, in subjects with severe VitD deficiency at baseline, supplementation with VitD reduced disease progression, indicating that supplementing VitD is beneficial for COPD patients with VitD deficiency. The study by Martineau., *et al*. [17] suggests that VitD supplements can prevent moderate or severe acute exacerbation in COPD patients with VitD deficiency. However, in a meta-analysis conducted by Zhu., *et al*. three studies

were included on the association between VitD deficiency and exacerbation of COPD, and no significant correlation was detected between VitD deficiency and acute exacerbation of COPD. However, this can only reflect that the level of VitD in AECOPD patients is significantly reduced, and it does not mean whether the lack of VitD exacerbates the acute exacerbation of patients. The current research conclusions on whether the acute exacerbation of COPD patients with VitD deficiency will occur are inconsistent, so more Prospective cohort study is needed to explain.

The impact of vitamin D levels on the quality of life in COPD patients

In recent years, improving the quality of life of COPD patients has received increasing attention, including alleviating their physical discomfort and mental health. Therefore, it is crucial to be able to assess the quality of life of COPD patients in a simple and comprehensive manner. In this study, the evaluation standard recommended by the GOLD guidelines is the COPD Assessment Test (CAT). The CAT score covers a wider range of 8 indicators, including important clinical symptoms of COPD, such as cough, phlegm, asthma, chest tightness, and sleep quality. These can objectively evaluate the impact of COPD on patients' daily life and health damage status from multiple dimensions, and are applicable globally. It can also reflect changes in the disease and treatment and rehabilitation status. The higher the score, the more severe the impact on COPD patients, When the score is ≥ 10 points, it indicates a high degree of severity and requires gradually increasing intervention in COPD [18,19]. The GOLD guidelines recommend using a CAT score of 10 or an mMRC score of 2 as the symptom threshold.

Conclusion

In this study, there was a negative correlation between VitD levels and CAT scores in AECOPD and COPD patients (AECOPD group $r = -0.680$, $p = 0.000$, COPD group $r = -0.673$, $p = 0.000$), indicating a correlation between VitD levels and quality of life in COPD patients. The lower the VitD level, the worse their quality of life, suggesting that supplementing with VitD preparations may improve their quality of life. Studies have confirmed that there is a negative correlation between the VitD level and CAT score in COPD patients [20,21]. This study also reached the same conclusion, indicating that the lower the VitD level in COPD patients, the poorer their quality of life. Some clinical studies have also confirmed the above conjecture, indicating that VitD plays a central role in the prevention and treatment of COPD, improving lung function indicators, reducing acute attack frequency, enhancing the St. George's Respiratory Questionnaire (SGRQ) score, and increasing 6-minute walking distance, thereby improving the quality of life of COPD patients [21].

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