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Original Article

Anxiety in Patients with Chronic Cor Pulmonale and Its Effect on Exercise Capacity

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Abstract

Background: Chronic cor pulmonale (CCP) is a disease of increasing frequency in Chinese people and profoundly influences their health. CCP is often accompanied by anxiety and other psychological problems, and patients may show signs of motor function decline. However, little attention has been paid to the impact of CCP-related psychological problems on motor function.

Methods: Patients with CCP receiving in- or outpatient treatment in the Respiratory Department of Xiangya Hospital of Central South University and the Second Xiangya Hospital of Central South University in Hunan Province between January and July 2015 were investigated. A total of 167 questionnaires were distributed, with 160 valid questionnaires ultimately collected from 95 male and 65 female participants of mean age (± standard deviation) of 68.2 ± 12.3 yr. Self-Rating Anxiety Scale (SAS) scoring was adopted to evaluate anxiety in the participants, and heart rate, blood pressure, breathing rate, 6-minute walk test and Borg index score were combined to detect the exercise capability of the participants.

Results: Anxiety was present in 48.8% of patients. Heart rate, systolic blood pressure, breathing rate and the Borg score of CCP patients with anxiety were higher than in CCP patients without anxiety ($P < 0.05$), while mean walking distance was shorter ($P < 0.05$).

Conclusion: The rate of anxiety in patients with CCP is relatively high. Anxiety reduces motor function in CCP patients; therefore, in the process of treating patients with CCP, effort should be made to engage simultaneously patients in psychotherapy.

Keywords: CCP, Anxiety, Exercise capacity, Influence

Introduction

Chronic respiratory disease has been identified by WHO as one of the world's four major chronic diseases (1). Chronic cor pulmonale (CCP) is a common chronic respiratory disease, with surveys indicating a detection rate of 12% of the total population in China, and this high rate has an upward trend (2). Cor pulmonale is a type of heart disease predominantly caused by pulmonary hypertension resulting from lesions of bronchial–lung tissues or the pulmonary artery (3). Cor pulmonale may be classified as acute or chronic, according to the urgency and duration of the disease, with the chronic type, CCP, commonly seen in clinical practice. In addition to various symptoms and signs of the original lung and chest disease, the primary feature of CCP is the gradual emergence of lung and heart failure, which may be accompanied by signs of damage in other organs (3, 4).

CCP is often accompanied by dyspnea, a sensation of choking and a number of other subjective experiences. The existence of a direct relationship

between dyspnea and anxiety is reported (5). Da (6) conducted psychological assessments on 30 CCP patients and provided them with psychological care. Some of these patients were suffering from mental disorders, mainly manifesting as anxiety and depression. Psychological care was contributed to the reduction or elimination of depression and anxiety in the patients.

A number of studies on the correlation between CCP and exercise capacity have been carried out. Hassel et al. explored the effect of sports rehabilitation training on CCP and randomized 42 mice in a controlled experiment, finding that high-intensity intermittent exercise training not only strengthened myocardial contractility, but also had important significance for the remodeling of pulmonary vessels (7). Additionally, endurance training has been found to increase the maximal oxygen uptake of experimental mice, and improve systolic function of the left and right ventricles to treat hypoxemia in patients with chronic obstructive pulmonary disease (COPD) (8). Other studies have explored the mechanism of CCP, its complications and their influence on patients' exercise capacity. In a comparative analysis, He compared the cardiopulmonary exercise test results of COPD patients and patients with COPD-induced CCP. The exercise capacity of patients with COPD-induced CCP was significantly lower than those with only COPD, and their exercise capacity was limited simultaneously by their respiratory and cardiovascular function (9). Meena et al. have reported similar results (10).

Exercise rehabilitation has potential as an adjuvant therapy for CCP patients. However, such patients often experience negative emotions, a decline in exercise capacity and decrease in motivation to exercise, suggesting that improvement to patients' initiative to be mobile and promotion of their exercise capacity is required.

In this study, we investigated anxiety in CCP patients and its effect on exercise capacity, to understand better patients' mental state, improve their health status, and provide reliable reference information for the effective management of CCP.

Methods

Participants

A total of 167 CCP patients who received in - and or outpatient treatment at the Respiratory Departments of Xiangya Hospital of Central South University and the Second Xiangya Hospital of Central South University in Hunan Province between January and July 2015 were invited to participate in the study. A total of 160 patients agreed to participate, of whom 95 (59.4%) were male and 65 (40.6%) female. Mean age (± standard deviation [SD]) was 68.2 ± 12.3 yr. Inclusion criteria were: fulfillment of the diagnostic criteria developed at the third Chinese Professional Meeting on CCP in 1980 (11); normal motor function before developing CCP; no obvious defects of liver or spleen; normal blood pressure; and ability to understand the purpose of the study and follow the directions of the medical staff.

Experimental methods

The 6-minute walk test (6MWT) was used to evaluate the exercise capacity of the participants (12). This measure was originally applied to evaluate cardiopulmonary function in patients with heart disease, and used to assess function and histological changes in CCP patients (13). The test procedure is summarized as follows: the participant stands on indoor flat ground ~15 m wide. A marker is placed every 3 m from start to end point and the participant asked to complete round-trip walking. The number of trips completed in 6 minutes is recorded. Participants should not have taken part in high-intensity activities within 2 h of the start of the test and should rest for 10 minutes prior to beginning. For participants unable to continue walking for 6 minutes, the walking distance completed within the time is calculated (12). A total of 42 anxious patients and 42 non-anxious patients were selected to take part in the exercise capacity test.

Detection indicators and standards

1) Self-Rating Anxiety Scale (SAS) (14): SAS is a self-assessment tool for understanding anxiety in counseling settings. According to norms for the Chinese population, the cutoff standard SAS score is 50 points, with 50 – 59 points representing mild

anxiety, 60 – 69 points representing moderate anxiety, and >70 points representing severe anxiety.
2) Detection of exercise capability: Heart rate, blood pressure and number of breaths per minute were recorded in the -fifth minutes of the test and in the second minutes after the test were completed, and 6MWT walking distance was calculated. The Borg index was used to measure dyspnea and degree of fatigue. The Borg index evaluation criteria [16] are 0 – 1 point, slight without dyspnea and fatigue; 2 points, mild; 3 – 4 points, moderate; 5 points, severe; 8 points, very severe; 9 points, extremely severe; 10 points, reaching the limit of severity.

Statistical methods

Data were analyzed using SPSS version 15.0 (Chicago, IL, USA). Theorem data were represented by mean ± SD. Independent sample t-test was used for comparison of the two groups of means, while qualitative data were represented by number of cases and constituent ratio. Group comparison was conducted with $\chi 2$ test. Multivariate logistic regression analysis was applied to study factors related to anxiety detection rate, and $P < 0.05$ was considered statistically significant.

Results

Anxiety scores of the participants

Mean SAS score was 50.1 ± 12.1. A total of 78 participants with SAS scores >50 points were identified as suffering from anxiety, giving a detection rate of 48.8%.

Table 1: Comparison of anxiety detection rate among participants

Variable		Total (n)	Participants with anxiety, *n* (%)	χ^2	*P*
Gender	Male	95	40(42.1)	4.133	0.042
	Female	65	38(58.5)		
Age (yr)	<50	35	16(45.7)	3.612	0.164
	50 – 70	85	47(55.3)		
	>70	40	15(37.5)		
Education level	Junior high school and below	95	58(61.1)	14.822	0.001
	High school or polytechnic school	37	13(35.1)		
	College and above	28	7(25.0)		
Marital status	Married	105	43(41.0)	7.761	0.051
	Unmarried	12	8(66.7)		
	Widowed	33	20(60.6)		
	Other	10	7(70.0)		
Heart failure	No	85	30(35.3)	13.608	0.001
	Right heart failure	46	28(60.9)		
	Left heart failure	29	20(69.0)		
Employment	Employed	45	29(64.4)	6.172	0.013
	Unemployed	115	49(42.6)		
Living alone	Yes	26	18(69.2)	5.212	0.022
	No	134	60(44.8)		
Healthcare funding method	Self-paid	20	13(65.0)	7.358	0.025
	NCMS*	72	40(55.6)		
	State-paid	68	25(36.8)		
Family economic situation	Poor	10	7(70.0)	7.084	0.132
	Relatively poor	25	17(68.8)		
	Average	57	25(43.9)		
	Good	45	19(42.2)		
	Very good	23	10(43.5)		
Total		160	78(48.8)		

* NCMS: New rural cooperative medical system

Comparison of the anxiety detection rate among participants

Table 1 show that the detection rate of anxiety was correlated with gender, educational level, heart failure, employment, living circumstances and healthcare payment method ($P < 0.05$). Age, marital status and family economic situation had no significant correlation ($P > 0.05$).

Factors influencing the detection rate of anxiety

For multivariate logistic regression analysis, anxiety was considered as the dependent variable (1 = yes, 0 = no), and gender (1 = male, 2 = female), education level (1 = junior high school and below, 2 = high school or polytechnic school, 3 = college and above), marital status (1 = married, 2 = other), heart failure (1 = no, 2 = right heart failure, 3 = full heart failure), employment (1 = employed, 2 = unemployed), whether living alone (1 = yes, 2 = no), and medical payment (1 = self-paid, 2 = New rural cooperative medical system (NCMS), 3 = state-paid) as independent variables. The results are shown in Table 2. Female gender, living alone, low education level, right-sided or full heart failure and being unmarried were independent risk factors influencing anxiety detection rate in CCP patients.

Table 2: Factors influencing the anxiety detection rate

Variable	B	SE	χ^2	P	OR	OR 95% CI
Gender (1 = male, 2 = female)	1.353	0.446	9.207	0.002	3.869	1.614 – 9.27
Living alone (1 = yes, 2 = no)	-1.278	0.545	5.506	0.019	0.279	0.096 – 0.81
Employment (1 = employed, 2 = unemployed)	-1.233	0.442	7.78	0.005	0.291	0.123 – 0.693
Education level (1 = junior high school and below, 2 = high school or polytechnic school, 3 = college and above)					1	
	-1.215	0.478	6.473	0.011	0.297	0.116 – 0.756
	-1.594	0.567	7.903	0.005	0.203	0.067 – 0.617
Heart failure (1 = no, 2 = right heart failure, 3 = full heart failure)					1	
	1.406	0.482	8.49	0.004	4.078	1.584 – 10.496
	1.996	0.576	12.01	0.001	7.358	2.38 – 22.747
Marital status (1 = married, 2 = other)	1.079	0.419	6.634	0.01	2.942	1.294~6.689
Constant	0.858	1.531	0.315	0.575	2.360	

Effect of anxiety on exercise capacity

According to the smallest imbalance index method gender, age, education level, marital status, heart failure, employment, and whether living alone, were considered as matching factors. Before the experiment, there were no significant differences in heart rate, systolic blood pressure, breathing rate and Borg index between the control and anxious groups ($P > 0.05$). After the experiment, heart rate, systolic blood pressure, breathing rate and Borg index score of the anxious group were significantly higher than in the control group, while 6MWT distance was significantly shorter ($P < 0.05$).

Table 3: Comparison of physiological indicators and walking distance between the two groups before and after 6MWT ($\bar{\chi}\pm S$)

Variable		Heart rate (beats/min)	Systolic blood pressure (mmHg)	Breathing rate (breaths/min)	Borg index	Walking distance (m)
Before 6MWT	Control group	70.4±6.7	129.5±12.1	16.2±4.3	0.78±0.29	-
	Anxious group	68.1±7.5	130.7±11.7	15.8±3.8	0.82±0.34	-
	t	1.446	-0.451	0.441	-0.566	
	P	0.152	0.653	0.661	0.573	
After 6MWT	Control group	99.2±12.0	139.2±13.2	19.1±5.3	2.71±1.28	322.1±42.3
	Anxious group	108.0±7.4	145.1±12.8	23.4±4.9	3.42±1.24	285.1±37.4
	t	-3.948	-2.029	3.768	-2.520	4.144
	P	0.000	0.046	0.000	0.014	0.000

Discussion

Investigation into anxiety and depression in patients with CCP

CCP is characterized by lengthy duration, slow treatment effects and the continuous emergence of complications, seriously affecting patients' quality of life and satisfaction. A lack of social care and support may place further stress on CCP patients. Subsequently, they tend to suffer from fear, pessimism, anxiety and depression (16). SAS scores for our study participants were significantly higher than average SAS scores under normal conditions, showing an increased detection rate of anxiety compared with the general population. This result is consistent with domestic and foreign research findings. Compared with the general population, patients with acute COPD were more likely to experience anxiety, with a detection rate of 9.3 – 58.0% (17). In the absence of intervention, the anxiety detection rate in CCP patients was 43.3% and 76%, respectively (18, 19).

Although psychological problems such as anxiety and depression are often experienced by CCP patients, these are often overlooked, underdiagnosed or misdiagnosed during medical examination, leading to increasing complexity in patients' symptoms and treatment difficulties. Greater importance should be attached to strengthening the routine assessment of and screening for anxiety and depression in CCP patients. Timely discovery of and attention to psychological complaints is not carried out for most CCP patients due to ignorance, and greater emphasis on treatment for such is required to improve patients' quality of life and prevent premature death (20). It is important for clinicians to recognize the causes of CCP-induced psychological problems, provide health education, offer reasonable explanations and psychological counseling, and select appropriate treatment, which may include drug intervention for severe conditions.

Factors affecting anxiety and depression in CCP patients

Our results suggest that female gender, living alone, low education level, the presence of heart failure, bad marriage and other social factors are independent risk factors influencing anxiety in CCP patients. The development of CCP is irreversible and long-term treatment leads to increased economic burden on the family of CCP patients and enhancement of family compliance. CCP patients may then experience preoccupation, anger and other negative emotions. This

subsequent increase in psychological stress may lead to anxiety symptoms.

The anxiety and depression scores of women with CCP are significantly higher than those of men are (21) and this was reflected in our results. Compared to men, women may lack a sense of security and experience more fear and anxiety in the process of seeking treatment. Both domestic and foreign research has found that women generally are twice as likely to be diagnosed with anxiety as men (22). The reasons for this are varied. First, genetic factors play a significant role and scientists have found a variety of anxiety-related genetic mutations only present in women, including a gene closely associated with female hormone regulation (23). Second, changes in female hormones and mood changes have a direct link to anxiety. Women generally are more likely to fear disease symptoms when ill, fail to recognize the close relationship between mood and disease changes, and constantly develop to anxiety obstacles (24).

Right-sided heart failure was also a factor affecting anxiety in CPP patients, consistent with previous clinical observations and nursing research (25). Zhu observed 120 CCP patients who had accepted comprehensive treatment plus ambroxol, phentolamine treatment, pointing out those patients with CCP often have anxiety, depression and neurological symptoms (25); the cause of which may be related to the occurrence of palpitations, increased heart rate, dyspnea, and shock in serious CCP exacerbations. The long-term physiological symptoms of chest tightness, palpitations and shortness of breath may increase patients' anxiety. Dyspnea is strongly anxiety-stimulating (26). Simultaneous loss of ability to work and even ability to live independently, coupled with family conflicts caused by the long-term disease may enhance the degree of anxiety in CCP patients.

Effect of anxiety on exercise capacity of CCP patients

Our results comparing anxious and non-anxious CCP patients in terms of heart rate, systolic pressure, Borg index and walking distance suggest that anxiety has a significant effect on the exercise capacity of CCP patients. Anxiety and exercise capacity interact with each other and may form a vicious cycle (27), with the reduction of exercise capacity leading to reduced participation in social activities and weakened social support, further increasing patients' sense of insecurity and strengthening their anxiety. Increased anxiety may be accompanied by muscular atrophy, weight loss. These may affect patients' exercise capacity, contributing to the cycle and significantly affecting the lives of CCP patients. Under similar conditions, CCP patients with anxiety have lower life satisfaction than those without anxiety, implying that anxiety has an important relationship with quality of life (28), which is also the same as the result of this research. The social support of CCP patients with anxiety symptoms was significantly lower than those without anxiety symptoms (29, 30). CCP patients with anxiety symptoms may have low subjective self-recognition leading to loss of confidence. Excessive stress and anxiety can cause sympathetic nervous excitement, resulting in higher blood pressure, increased respiratory rate and elevated heart rate, further affecting heart and lung function (31). In addition, cardiopulmonary dysfunction will inevitably cause reduced exercise capacity.

Conclusions

Female CCP patients, as well as patients with lower education levels, symptoms of heart failure, healthcare funding difficulties and those living alone experience more prominent anxiety. These groups of patients require more focus and CCP treatment should include reasonable explanations and psychological support. Anxiety and other negative emotions appear to be associated with reduced motor function in CCP patients, affecting heart rate, systolic blood pressure, breathing rate, Borg index score and other physical indicators, including exercise capacity. Functional exercise of patients with CCP could be combined with psychological counseling, when necessary.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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