Int J Clin Exp Med 2020;13(10):8095-8101
www.ijcem.com /ISSN:1940-5901/IJCEM0116330

Original Article

Effects of rehabilitation training on cardiopulmonary function, life quality and inflammatory factors in serum of elderly patients with COPD

Jing Wang[1], Yongai Zhang[1], Xiaoli Zhou[1], Guangxiu Zhao[2], Yingying Liu[3], Mei Song[1]

[1]*School of Nursing, Xi'an Medical University, Xi'an 710021, Shaanxi, China;* [2]*Department of Nursing, Shaanxi Province People's Hospital, Xi'an 710068, Shaanxi, China;* [3]*Department of Cardiology, The First Affiliated Hospital of Xi'an Jiaotong University, Xi'an 710061, Shaanxi, China*

Received June 15, 2020; Accepted July 15, 2020; Epub October 15, 2020; Published October 30, 2020

Abstract: Objective: This paper discussed the impacts of rehabilitative training on cardiopulmonary function, life quality and serum inflammatory factors in elderly patients suffering with chronic obstructive pulmonary disease (COPD). Methods: A total of 155 elderly patients with COPD in our hospital were selected and divided into the control group and the observation group. The control group was given by conventional treatment, while the observation group was treated with cardiopulmonary rehabilitation therapy in addition to the treatment in the control group. The cardiopulmonary function, life quality and serum inflammatory factors after treatment were compared between the patients in the two groups. Results: After treatment, the measures of cardiopulmonary indicators [forced expiratory volume in one second (FEV1)%, FEV1 and the ratio of FEV1 to forced vital capacity (FVC) (FEV1/FVC)] in patients of the observation group were obviously higher than which in the control group (P<0.05). Compared with the patients in control group, the patients in the observation group had evidently decreased COPD assessment test (CAT) scores, and notably increased scores of the 36-item Health Survey Scale (SF-36), as well as St. George's Respiratory Questionnaire (SGRQ). Moreover, there was a statistically evident difference in the 6-min walk distance (6MWD) between the two groups (P<0.05). For the observation group, the levels of anti-inflammatory factors [interleukin-10 (IL-10) and transforming growth factor-beta (TGF-β)] were markedly elevated, while that of inflammatory factors [C-reactive protein (CRP) and tumor necrosis factor-alpha (TNF-α)] were declined, compared to thoes in the control group (P<0.05). Conclusion: Cardiopulmonary rehabilitation training can significantly improve the cardiopulmonary function and life quality in elderly patients suffering with COPD, and as such it possess a high clinical treatment value.

Keywords: Cardiopulmonary rehabilitation, senile COPD, cardiopulmonary function, life quality

Introduction

Chronic obstructive pulmonary disease (COPD), a kind of chronic bronchitis [1], and it is mainly manifested as impaired lung function, muscle atrophy and moodiness of patients [2]. Patients with COPD often have alternating stable phases and acute phases, which leads to a more difficult treatment. Once COPD occurs, the patients generally have a course of disease ranging from several years to a decade, and the long-term illness will have a great impact on the patients' life and work [3, 4]. Currently, the treatment methods are mainly therapies with drugs [5, 6], such as salbutamol and tiotropium bromide, which have excellent efficacy in relieving cough and reducing sputum. However, according to clinical research the clinical effects of such drugs are not effective clinically, and long-term administration will cause many side effects. As medical breakthroughs have constantly been made in clinical treatment techniques, cardiopulmonary rehabilitation therapy has been applied to respiratory rehabilitation [7]. Current studies have shown that cardiopulmonary rehabilitation training can effectively improve the exercise endurance of patients with COPD in the stable period and relieve the symptoms of respiratory difficulties, thus contributing to the improvement of patients' quality of life [8]. Nevertheless, such therapy is rarely used for elderly patients with COPD. This research aims to provide better understanding for clinical treatment by investigating the clinical utility of cardiopulmonary rehabilitative therapy in elderly patients suffering with by COPD.

Data and methods

General data

There were 155 elderly patients with COPD hospitalized between January 2016 and February 2018 who were selected and organized into the control group (n=75) and the observation group (n=80) by a random number table. There was no difference in the general clinical data for the two groups. This study was approved by the hospital ethics committee.

Inclusion criteria: 1) Patients met all related diagnostic criteria for COPD [9], 2) Patients who were able to cooperate with the health-care workers, 3) Patients who were not complicated with other cardiovascular diseases, 4) Patients with good mental status. 5) Patients voluntarily signed informed consent.

Exclusion criteria: 1) Patients who were allergic to drugs utilized in this research; 2) Those with severely damaged vital organs; or 3) Patients who have other received relevant treatments recently.

Methods

The conventional treatment for the control group was the administration of tiotropium bromide (specification: 18 μg/pill) once every day (1 pill/time). Applied health education and information about the precautions during the treatment was given to the patients besides the drug therapy.

For the observation group, cardiopulmonary rehabilitation therapy was applied in addition to the conventional treatment. Detailed individualized cardiopulmonary rehabilitation training therapy was formulated based on the cardiopulmonary function, 6-min walk distance (6MWD) score, etc. of every patient. The patients performed the exercise twice every day (1 h per time). The purpose, effects and specific methods of cardiopulmonary rehabilitation training were given to the patients. The training methods were guided by specialized rehabilitation physicians, and abdominal breathing training was performed in addition to the pursed-lips breathing training. As for the pursed-lips breathing, the air was inhaled through the nose and exhaled through the pursed lips in a whistling manner. In terms of abdominal breathing, the patients sat upright or stood vertically, with the left hand on the upper chest and the right hand on the abdomen. During inhalation, the right hand was elevated as the abdomen expanded. During exhalation, the right hand was slightly pressed toward the back and chest to assist the exercise of the diaphragm. This breathing training was conducted three times a week (15 min per time). To relieve the anxiety and improve the life quality of the patients, it was necessary to carry out in real time psychological counseling and explain in detail the incidence characteristics and therapeutic approaches of COPD as well as the great significance of cardiopulmonary rehabilitation therapy. The course of treatment was 1 month for both groups.

Observation indexes

6MWD: The patients were instructed to walk quickly without supplementary oxygen along a 50-m-long ring road marked with scales for 6 min, and the walk distance of the patients was recorded [9].

Indicators for cardiopulmonary function: A pulmonary function detector was utilized to measure the forced expiratory volume in one second (FEV1), forced vital capacity (FVC) and the ratio of FEV1 to FVC (FEV1/FVC) of the patients before and after treatment.

36-item Health Survey Scale (SF-36): 8 items were rated, including physiological functioning, social functioning, comprehensive health status, role-physical, bodily pain, vitality, mental health and emotional role [10].

The SGRQ (St. George's Respiratory Questionnaire) score: was evaluated from three aspects of respiratory state, disease and limitation of mobility, with a total score of 100 points for each aspect. A higher score indicated a more sever disease condition and a lower quality of life [11].

COPD assessment test (CAT): The patients' clinical manifestations were scored by eight aspects, with a total score of 40 points. The higher score indicated more sever disease conditions [12].

Measurement of serum inflammatory factors: The venous blood of the patients was drawn and centrifuged to collect the serum. Enzyme-linked immunoassay was performed to determine the degree of serum interleukin-10 (IL-10), transforming growth factor-beta (TGF-β), C-reactive protein (CRP) and tumor necrosis factor-alpha (TNF-α) in strict accordance with the steps in the kit instructions.

Table 1. Comparison of general clinical data between the two groups of patients ($\bar{x}\pm s$)

Group	N	Average age (years old)	Gender (male/female)	BMI (kg/m^2)	Course of disease (year)
The observation group	80	65.93±7.87	42/38	25.76±3.09	3.45±0.54
The control group	75	66.65±6.99	40/35	24.98±2.99	3.61±0.49
t	-	0.601	0.011	1.595	1.928
P	-	0.549	0.917	0.113	0.056

Table 2. Comparison of cardiopulmonary function pre-and post-treatment between patients in two groups ($\bar{x}\pm s$)

Index	Time	The observation group	The control group
FEV1%	Before treatment	42.98±5.09	43.09±4.89
	After treatment	49.87±5.32	45.09±4.98*
	T	8.370	2.482
	P	0.000	0.014
FEV1 (L)	Before treatment	1.11±0.11	1.09±0.11
	After treatment	1.69±0.21	1.23±0.12*
	T	21.883	7.448
	P	0.000	0.000
FEV1/FVC (%)	Before treatment	37.99±4.09	38.09±4.54
	After treatment	44.56±4.77	40.03±4.98*
	T	9.352	2.493
	P	0.000	0.014

Note: *P<0.05 vs. the observation group.

Statistical methods

The SPSS 20.0 software was adopted for statistical analysis. The measurement data were denoted by mean ± standard deviation ($\bar{x}\pm s$), and *t*-test was adopted for comparison between the groups. The count data shown by n. P<0.05 indicated that the difference was statistically significant.

Results

Comparison of general clinical data

The general clinical data of both groups of patients, such as average age, gender, body mass index (BMI) and course of disease, were not statistically different (**Table 1**).

Comparison of cardiopulmonary function pre-and post-treatment between patients in two groups

No differences existed in the FEV1%, FEV1 and FEV1/FVC in either group of patients before treatment. While after treatment, those indicators were increased obviously in patients of the observation group compared to those in the control group (P< 0.05) (**Table 2**).

Comparison of CAT score between patients in two groups

There was significant difference in the CAT score between the two groups before treatment; the observation group had a notably lower CAT score than the control group after treatment (P<0.05) (**Figure 1**).

Comparison of SF-36 score between patients in two groups

Before treatment, there were no differences of SF-36 score between the two groups; while after treatment, the score remarkably lifted of the patients in the observation group compared to that in control group (P<0.05) (**Figure 2**).

Comparison of 6MWD between patients in both groups

Before treatment, the difference in the 6MWD between the patients in each group was not significant, while it was statistically significant after treatment (P<0.05) (**Figure 3**).

Comparison of SGRQ score between patients in both groups

Before treatment, the SGRQ score had some differences between the patients in the two groups. For post-treatment, the score had a statistically significant difference between patients in both groups (P<0.05) (**Figure 4**).

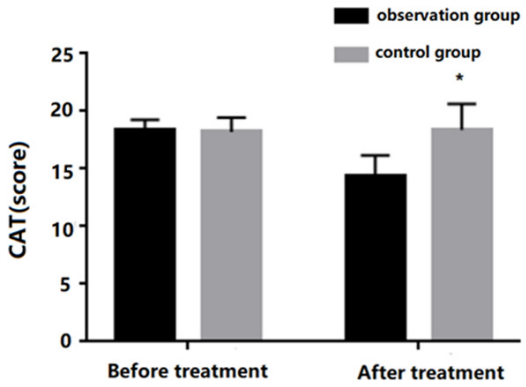

Figure 1. Comparison of CAT score before and after treatment between patients in the two groups. Note: Comparison with the observation group, **P<0.05.*

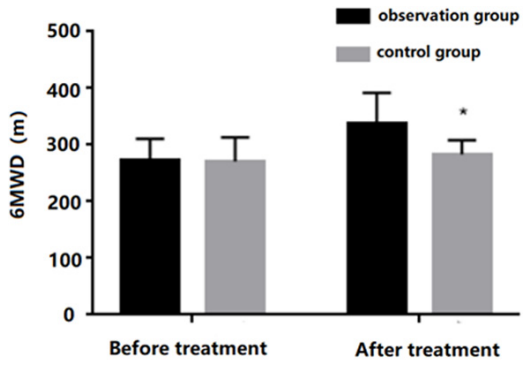

Figure 3. Comparison of 6MWD between patients in both groups. Note: Comparison with the observation group, **P<0.05.*

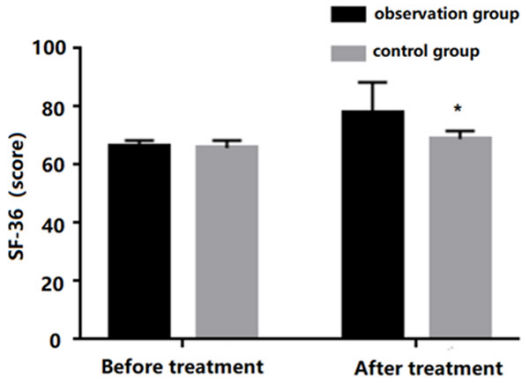

Figure 2. Comparison of SF-36 score of patients in both groups. Note: Comparison with the observation group, **P<0.05.*

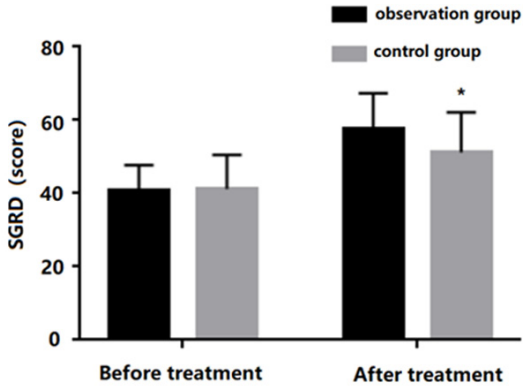

Figure 4. Comparison of SGRQ score between patients in both groups. Note: Comparison with the observation group, **P<0.05.*

Comparisons of inflammatory factors pre-and post-treatment between patients in two groups

The differences in the inflammatory factors were not significant between patients in either group during the pre-treatment period. While post-treatment, the observation group had evidently higher IL-10 and TGF-β levels ($P<0.05$), as well as notably lower CRP and TNF-α levels than the control group (**Table 3**).

Discussion

In this research, the levels of cardiopulmonary indicators FEV1%, FEV1 and FEV1/FVC of patients in the observation group after treatment were obviously higher than those in control group. The data suggested that the dyspnea symptoms, ventilatory capacity of the bronchus and cardiopulmonary function of the patients can be improved remarkably through the cardiopulmonary rehabilitation therapy. Compared with patients in the control group, patients in the observation group had an evidently decreased CAT score and notably increased scores of SF-36, 6MWD and SGRQ after treatment, suggesting that cardiopulmonary rehabilitation therapy is capable of increasing patients' quality of life, strengthening the cardiopulmonary endurance and reducing the occurrence of adverse reactions. After treatment, the levels of inflammatory factors CRP and TNF-α in the observation group decreased from the control group, indicating that cardiopulmonary rehabilitation therapy can reduce the secretion and release of inflammatory factors and decrease the occurrence of inflammation so as to improve the body immunity. Clinical studies have revealed that cardiopulmonary rehabilitation therapy can ameliorate

Table 3. Comparisons of inflammatory factors pre-and post-treatment between patients in two groups ($\bar{x}\pm s$)

Index	Time	The observation group	The control group
IL-10 (pg/mL)	Before treatment	3.76±0.72	4.09±0.64
	After treatment	15.87±3.15	9.87±1.79*
	t	33.521	26.332
	P	0.00	0.000
TGF-β (pg/mL)	Before treatment	10.98±1.79	9.98±1.65
	After treatment	27.54±5.16	19.87±4.97*
	t	27.120	16.892
	P	0.000	0.000
CRP (ng/L)	Before treatment	6.45±1.35	6.98±1.21
	After treatment	4.09±0.97	5.65±1.03*
	t	12.698	7.486
	P	0.000	0.000
TNF-α (pg/mL)	Before treatment	18.98±3.17	19.04±2.79
	After treatment	11.03±2.11	16.09±2.07*
	t	18.673	7.354
	P	0.000	0.000

Note: *P<0.05 vs. the observation group.

the cardiopulmonary function of the patients, and such intervention methods have been extensively used for senile heart and lung diseases and have improved the quality of life and mental status of patients. Patients were instructed to receive varied cardiopulmonary rehabilitation training, such as pursed-lip breathing, abdominal breathing, chest stretching and activities of all four limbs; which can increase the activity amount of the patients' heart and lung tissues [10-12]. Cardiopulmonary rehabilitation training can evidently improve the contraction and diastole function of patients suffering with COPD, the endurance of wellness increases, and reduces well fatigue and paralysis. It helps patients to increase alveolar strength and the effective exchange of gas, thereby promoting the discharge of residual capacity and improving hypoxemia to reduce the inflammatory response of the body and improve patients pulmonary function. Therefore, improving the patient's quality of life and increasing the immune function can be achieved through these mechanisms [13-16]. During the treatment, it is necessary to conduct psychological counseling and active have communication with the patients to reduce their fear and anxiety and boost their self-confidence in the treatment. FEV1/FVC, FEV1 and FVC have been clinically defined as the gold standards for judging the conditions of COPD [17]. The inflammatory factors are activated in the COPD patients, and the content of inflammatory mediators is elevated in the body, thereby increasing the possibility of inflammation and decreasing the immunity in the patients. It has been discovered in clinics that the levels of serum CRP and TNF-α, which are also early inflammatory markers, are elevated markedly in the patients. However, the increased content of IL-10 and TGF-β, as anti-inflammatory factors, indicates a declined inflammation degree. Therefore, the purpose of clinical treatment should be to reduce the content of inflammatory cytokines and elevate the degree of anti-inflammatory cytokines [18]. The results of this research are consistent with the findings of Zhang T [19], which, by applying conventional treatment and cardiopulmonary rehabilitation therapy to 100 elderly patients with COPD, revealed that the cardiopulmonary rehabilitation group had an evidently higher quality-of-life index and longer 6MWD than the control group, thus determining that cardiopulmonary rehabilitation training is conducive to improving the life quality of the elderly patients suffering with COPD in the stable phase and increasing the treatment effects. Chun-Lan H E [20] applied cardiopulmonary rehabilitation therapy to patients with coronary heart disease and found that the peak oxygen pulse and uptake and SF-36 score in the cardiopulmonary rehabilitation group remarkably increased compared to those in the control group. These results indicate that cardiopulmonary rehabilitation can effectively ameliorate the cardiopulmonary function of the patients with coronary heart disease and improve their health status.

However, as the sample population enrolled is elderly patients, we cannot completely exclude that some of the patients did not have hidden cardiovascular disease; and the small sample size of this study may interfere with the experimental results. It is suggested that further research needs to minimize the interference

factors and further expand the sample size to obtain more reliable clinical research data under the requirements of diagnostic criteria.

In conclusion, the adoption of cardiopulmonary rehabilitation therapy can significantly improve the cardiopulmonary function and life quality of the elderly patients suffering from COPD, and can greatly reduce the inflammatory factors, which has a fairly high clinical value in treating diseases.

Acknowledgements

Research of the service path and strategy of medical and nursing combination for community elders based on health needs (Project No. 2018KRM170).

Disclosure of conflict of interest

None.

Address correspondence to: Mei Song, School of Nursing, Xi'an Medical University, No. 1 Xinwang Road, Weiyang District, Xi'an 710021, Shaanxi, China. Tel: +86-029-86177525; E-mail: songmei2015@yeah.net

References

[1] Vujic T, Nagorni O, Maric G, Popovic L and Jankovic J. Metabolic syndrome in patients with chronic obstructive pulmonary disease: frequency and relationship with systemic inflammation. Hippokratia 2016; 20: 110-114.

[2] Leung JM, Tiew PY, Mac Aogáin M, Budden KF, Yong VF, Thomas SS, Pethe K, Hansbro PM and Chotirmall SH. The role of acute and chronic respiratory colonization and infections in the pathogenesis of COPD. Respirology 2017; 22: 634-650.

[3] Bhatt SP, Kim YI, Harrington KF, Hokanson JE, Lutz SM, Cho MH, DeMeo DL, Wells JM, Make BJ, Rennard SI, Washko GR, Foreman MG, Tashkin DP, Wise RA, Dransfield MT and Bailey WC; COPDGene Investigators. Smoking duration alone provides stronger risk estimates of chronic obstructive pulmonary disease than pack-years. Thorax 2018; 73: 414-421.

[4] Taylan M, Demir M, Kaya H, Selimoglu Sen H, Abakay O, Carkanat Aİ, Abakay A, Tanrikulu AC and Sezgi C. Alterations of the neutrophil–lymphocyte ratio during the period of stable and acute exacerbation of chronic obstructive pulmonary disease patients. Clin Respir J 2017; 11: 311-317.

[5] Pang Q and Lin C. Meta-analysis and systematic review of procalcitonin-guided treatment in acute exacerbation of chronic obstructive pulmonary disease. Clin Respir J 2018; 12: 10-15.

[6] Kern DM, Davis J, Williams SA, Tunceli O, Wu B, Hollis S, Strange C and Trudo F. Comparative effectiveness of budesonide/formoterol combination and fluticasone/salmeterol combination among chronic obstructive pulmonary disease patients new to controller treatment: a US administrative claims database study. Respir Res 2015; 16: 52-55.

[7] Liu CY, Parikh M, Bluemke DA, Balte P, Carr J, Dashnaw S, Poor HD, Gomes AS, Hoffman EA, Kawut SM, Lima JAC, McAllister DA, Prince MA, Vogel-Claussen J and Barr RG. Pulmonary artery stiffness in chronic obstructive pulmonary disease (COPD) and emphysema: the multi-ethnic study of atherosclerosis (MESA) COPD study. J Magn Reson Imaging 2018; 47: 262-271.

[8] Mediano MF, Mendes Fde S, Pinto VL, Silva GM, Silva PS, Carneiro FM, Sangenis LH, Saraiva RM, Xavier SS, Brasil PE, Hasslocher-Moreno AM and Sousa AS. Cardiac rehabilitation program in patients with Chagas heart failure: a single-arm pilot study. Rev Soc Bras Med Trop 2016; 49: 319-28.

[9] Ouellette DR and Lavoie KL. Recognition, diagnosis, and treatment of cognitive and psychiatric disorders in patients with COPD. Int J Chron Obstruct Pulmon Dis 2017; 12: 639-650.

[10] Papi A, Vestbo J, Fabbri L, Corradi M, Prunier H, Cohuet G, Guasconi A, Montagna I, Vezzoli S, Petruzzelli S, Scuri M, Roche N and Singh D. Extrafine inhaled triple therapy versus dual bronchodilator therapy in chronic obstructive pulmonary disease (TRIBUTE): a double-blind, parallel group, randomised controlled trial. Lancet 2018; 391: 1076-1084.

[11] Barnes PJ. Targeting cytokines to treat asthma and chronic obstructive pulmonary disease. Nat Rev Immunol 2018; 18: 454-466.

[12] Onishi K. Total management of chronic obstructive pulmonary disease (COPD) as an independent risk factor for cardiovascular disease. J Cardiol 2017; 70: 128-134.

[13] Paliogiannis P, Fois AG, Sotgia S, Mangoni AA, Zinellu E, Pirina P, Negri S, Carru C and Zinellu A. Neutrophil to lymphocyte ratio and clinical outcomes in COPD: recent evidence and future perspectives. Eur Respir Rev 2018; 27: 170-113.

[14] Pollmann AGE, Frederiksen M and Prescott E. Cardiac rehabilitation after heart valve surgery: improvement in exercise capacity and morbidity. J Cardiopulm Rehabil Prev 2017; 37: 191-198.

[15] Wang Y, Liu J, Zhou JS, Huang HQ, Li ZY, Xu XC, Lai TW, Hu Y, Zhou HB, Chen HP, Ying SM, Li W, Shen HH and Chen ZH. MTOR suppresses cigarette smoke-induced epithelial cell death and airway inflammation in chronic obstructive pulmonary disease. J Immunol 2018; 200: 2571-2580.

[16] Åhrman E, Hallgren O, Malmström L, Hedström U, Malmström A, Bjermer L, Zhou XH, Westergren-Thorsson G and Malmström J. Quantitative proteomic characterization of the lung extracellular matrix in chronic obstructive pulmonary disease and idiopathic pulmonary fibrosis. J Proteomics 2018; 189: 23-33.

[17] Singh S, Verma SK, Kumar S, Ahmad MK, Nischal A, Singh SK and Dixit RK. Correlation of severity of chronic obstructive pulmonary disease with potential biomarkers. Immunol Lett 2018; 196: 1-10.

[18] Dey T, Dutta P, Manna P, Kalita J, Boruah HPD, Buragohain AK, Unni B, Ozah D, Kumar Goswami M and Kotokey RK. Cigarette smoke compounds induce cellular redox imbalance, activate NF-κB, and increase TNF-α/CRP secretion: a possible pathway in the pathogenesis of COPD. Toxicol Res (Camb) 2016; 5: 895-904.

[19] Ali MS, Talwar D and Jain SK. The effect of a short-term pulmonary rehabilitation on exercise capacity and quality of life in patients hospitalised with acute exacerbation of chronic obstructive pulmonary disease. Indian J Chest Dis Allied Sci 2014; 56: 13-19.

[20] Pinto R, Angarten V, Santos V, Melo X and Santa-Clara H. The effect of an expanded long-term periodization exercise training on physical fitness in patients with coronary artery disease: study protocol for a randomized controlled trial. Trials 2019; 20: 208.