Curative effect of low load aerobic exercise in combination with inhalation of air negative oxygen ion on occupational patient with cotton pneumoconiosis

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Abstract: Objective: This study aimed to observe curative effect of low load aerobic Yoga-based exercise in co-therapy with inhalation of air negative oxygen ions on occupational patient with cotton pneumoconiosis. Methods: Select 60 female patients with occupational cotton pneumoconiosis aged between 30 and 50 and randomly divide them into an observation group and a control group with each group consisting of 30 patients. The patients in the control group do low load aerobic Yoga-based exercise for the purpose of improving their physical and respiratory functions, while the patients in the observation group accept co-therapy that combines inhalation of air negative oxygen ions with Yoga exercise. Respectively test and compare the clinical signs and pulmonary function indicators of the two groups of patients at the time of their selection and after 3 months’ treatment. Results: after 3 months’ treatment, the pulmonary function indicators of the two groups of patients are significantly improved in comparison with their counterparts before the treatment (P<0.05), while the improvement of the pulmonary function and the clinical curative effect of the observation group are more obvious when compared with their counterparts before the treatment or those of the control group, P<0.05. The difference between the improvements shows statistical significance. Conclusion: low load aerobic exercise in the normal air environment can improve lung function of the patient indeed, however, the curative effect is more significant if the exercise is done in the environment with higher air negative oxygen ion content.

Keywords: Aerobic exercise, negative oxygen ion, cotton pneumoconiosis, pulmonary function, combination, curative effect

Introduction

Cotton pneumoconiosis, also known as “Monday fever”, cotton dust disease or abdominal pigmentation, is one of the pneumoconiosises and an obstructive respiratory tract disease induced by bronchoconstriction and pulmonary function damage as a result of inhalation of the patients of cotton dust, flax dust and cork dust. It is a occupational disease [1, 2] as it is related to a cotton dust environment in which the patients work for a long time. The early clinical manifestation is chest tightness in the work environment, accompanied by breath shortness symptom. However, once the person leaves the work environment, the symptom disappears quickly. As the disease aggravates, the symptom can be worsened and accompanied by the aggravated cough, asthma and sputum. Moreover, the symptom may last permanently. From time to time, it is difficult for the patients to breathe, and it even induces emphysema and pulmonary heart disease. At this stage, it may bring a great burden to patients' physical and mental health [3, 4]. As far as the disease is concerned, there is no special therapy. As a popular treatment, the patients with obvious symptoms are treated by bronchodilators and antihistamines so as to relieve the symptoms and they are moved away from the cotton dust working environment and paying attention to reasonable nutrition, rest, fitness exercise and other means of physiotherapy [5, 6]. In this study, based on such pathological phenomena of the patients with cotton pneumoconiosis as respiratory tract obstruction, low pulmonary ventilation capacity and poor exercise load withstand capability, the patients use low load aerobic Yoga-based exercise as their functional rehabilitation exercise. In order to incre-
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Table 1. Comparison of the basic data of the two groups of patients before the treatment (x̄±s, female, n=30)

<table>
<thead>
<tr>
<th>Group</th>
<th>Age (Years old)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>Working period (Years)</th>
<th>Disease course (Month)</th>
<th>Disease classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>44.31±5.24</td>
<td>160.20±4.63</td>
<td>51.83±5.37</td>
<td>13.71±3.25</td>
<td>13.80±5.29</td>
<td>10</td>
</tr>
<tr>
<td>Observation group</td>
<td>43.85±5.37</td>
<td>160.32±4.60</td>
<td>50.45±4.92</td>
<td>14.20±3.46</td>
<td>13.36±5.73</td>
<td>9</td>
</tr>
</tbody>
</table>

Note: P>0.05.

Table 2. Comparison of FVC and FEV₁ testing of the two groups of the selected patients both before and after the treatment (x̄±s, female, n=30)

<table>
<thead>
<tr>
<th>Group</th>
<th>FVC (ml) Before treatment</th>
<th>FVC (ml) After treatment</th>
<th>FEV₁ (ml) Before treatment</th>
<th>FEV₁ (ml) After treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>1850.21±209.37</td>
<td>1941.33±211.59</td>
<td>1405.51±160.29</td>
<td>1557.13±164.74</td>
</tr>
<tr>
<td>Observation group</td>
<td>1834.72±214.86</td>
<td>1992.70±225.60</td>
<td>1412.30±167.54</td>
<td>1640.78±172.39</td>
</tr>
</tbody>
</table>

Note: Comparison before treatment, a P<0.05; comparison with the control group at same time points after the treatment, b P<0.05.

ase the oxygen supply in the exercise environment, the intervention measure of air negative oxygen ions is used as an adjuvant therapy. After the 3 months’ co-therapy, it is found that the curative effect is significant in the observation group. It is hereby reported as follows.

Data and method

Study subject

The patients have engaged in cotton work for more than 10 years and the duration of their disease duration is from 6 months to 2 years. According to the clinical symptoms, diagnosis and classification standards of cotton pneumoconiosis, 19 patients are in the preliminary stage of the disease, that is, they usually feel chest tightness or suppression, cough and show other respiratory symptoms at the first working day after holiday or for several days in a week. After working, FEV₁ decreases by more than 10% in comparison with that before working. 41 patients enter the second stage of the disease, that is, their respiratory symptoms aggravate from time to time, accompanied by chronic pulmonary function impairment in addition to recurrent attacking of byssinosis, and their FVC or FEV₁ is less than 80% of the expected value. Meanwhile, this study excludes the patients diagnosed with other types of respiratory diseases, mental illness, serious cardiovascular and cerebrovascular diseases and limb dysfunction, which make them unfit for participating in this study. All selected patients give their informed consent and volunteer to join this study. The random number table method is adopted to divide the selected patients into an observation group and a control group, with each group consisting of 30 patients. By statistical analysis of the basic data of the two groups of patients, P>0.05, which means that there is no statistical significance of the intergroup difference, and it is comparable. See Table 1.

Study method

The two groups of patients are trained for 1 to 2 weeks, after which, the patients can basically master the postures and key points of yoga breathing exercise and they can do self-exercise under the guidance of relevant videos and musics.

The patients in the control group are treated with Yoga breathing exercise. The exercise is designed to be a low load aerobic Yoga-based exercise in which it focuses on strengthening deep breathing exercise in the process of the limb function exercise. The full set of postures lasts for 16 minutes. For the specific exercise and training content and methods, see the literature [7]. Training is carried out in a normal indoor ventilation environment (about 25°C room temperature). They do Yoga exercise once each afternoon which is repeated for one time and lasts for 35 minutes. Such exercise lasts for 3 months in total.

Co-therapy, combining the above said Yoga breathing exercise with air negative oxygen ion therapy, is provided to the patients in the obser-
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Table 3. Comparison of the clinical effect of the two groups of patients after the treatment (female, n=30)

<table>
<thead>
<tr>
<th>Group</th>
<th>Improvement (patients, %)</th>
<th>Unchanged (patients, %)</th>
<th>Aggravation (patients, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>21, 70.00</td>
<td>7, 23.33</td>
<td>2, 6.67</td>
</tr>
<tr>
<td>Observation group</td>
<td>26, 86.67</td>
<td>4, 13.33</td>
<td>0, 0.00</td>
</tr>
</tbody>
</table>

Note: comparison with the control group, improvement rate, \( P<0.05 \).

Before the treatment and after 3 months’ treatment, an intelligent spirometer is used to respectively test and compare such indicators as the Forcibly Vital Capacity (FVC) and the forced expiratory volume in first second (FEV\(_1\)) of the two groups of patients; After the treatment, evaluate the clinical efficacy based on the clinical diagnostic criteria: curative effect is classified into three categories: improved, unchanged and aggravated. Among these, if the patients’ symptoms, such as cough, chest pain, breath shortness, sputum and other symptoms, are obviously improved in comparison with those before the treatment, they can be evaluated as improved; if the above symptoms are not changed in comparison with those before treatment, they can be evaluated as unchanged; if the above symptoms are aggravated in comparison with those before treatment, they can be evaluated as being aggravated.

Statistical analysis

SPSS19.0 statistical software is used for data processing. The data obtained in this study is expressed by (\( \bar{x} \pm s \)). Meanwhile, respectively adopt \( t \) and \( x^2 \) to test the measurement data and the count data. In case of \( P<0.05 \), the difference has statistical significance.

Results

It is shown from Tables 1 and 2 that basic data, FVC and FEV\(_1\) testing value present no significant difference between the two groups of selected patients before treatment, \( P>0.05 \). After 3 months’ treatment, it is shown from Table 2 that FVC and FEV\(_1\) values of the two groups of patients are significantly improved in comparison with those before treatment, \( P<0.05 \), respectively, FEV\(_1\) value of the observation group is improved and its improvement effect is more obvious than that of the control group \( (P<0.05) \), but the inter-group FEV\(_1\) improvement effect difference is obvious. Additionally, it is known from comparing and evaluating clinical effect in Table 3 that the improvement rates of the observation group and the control group are 86.67% and 70.00% respectively. The improvement rate of the observation group is significantly higher than that of the control group, \( P<0.05 \). The inter-group difference shows statistical significance.

Discussion

Pneumoconiosis is a severe lung disease induced by the patient’s long-term inhalation of production dust in their occupation activities. The disease not only seriously reduces the workers’ working and production capacity, but tends to cause disability and other diseases that may affect the patient’s life. It is on the top of all occupational diseases in China [8]. According to the types of the inhaled dust, pneumoconiosis can be divided into two categories: inorganic and organic. For example, pneumoconiosis induced by the patient’s long-term inhalation of organic dust (such as cotton pneumoconiosis and farmer pneumoconiosis), is called organic pneumoconiosis. Cotton pneumoconiosis, as its name implies, is an obstructive respiratory tract disease induced by bronchoconstriction and pulmonary function damage as a result of the patients’ inhalation of cotton dust, flax dust and hemp dust. “Monday symptom” is its unique feature [9, 10]. Patients with cotton pneumoconiosis feel breath shortness and fatigue after coughing and their often lose their appetite for food. The pulmonary
function of the patients in the second stage of the disease declines significantly, especially their FVC and FEV\textsubscript{1}. Thus, as far as the clinical diagnosis is concerned, the seriousness of the disease is judged in reliance on the proportion of FVC or FEV\textsubscript{1} to their expected value. In this study, FVC and FEV\textsubscript{1} are also used as the important observation indexes.

It is believed in the exercise rehabilitation theory and the related practice reports that, the moderate patients should adopt exercise therapy in which functional rehabilitation training is necessary, such as Taichi, Qigong and breathing function exercise. Such exercises not only improves the body immunity, but increases the lung capacity and the strength of the respiratory muscle, thereby improving the patients' respiratory function [11, 12]. Kabitz [13] respectively treats them with respiratory training and exercise training and achieved a satisfactory result; Cruz [14] adopts feedback-type lung function exercise device to provide inspiratory training to patients. After 1 month’s training, it is found that their vital capacity, breath shortness and dyspnea symptoms are obviously improved. In this study, the control group is provided with yoga breathing exercise. After 3 months’ exercise, it is found that the patients' FVC and FEV\textsubscript{1} testing values are significantly improved in comparison with their counterparts before the treatment. The evaluation of the clinical effect shows that the disease of 70% of the patients has been improved. The results indicate that the patient’s conditions indeed are improved if Yoga breathing exercise is used as the functional rehabilitation, which is consistent with the related study report mentioned above.

As it is known to all that, pneumoconiosis is an obstructive respiratory tract disease. Since the patient’s pulmonary ventilation function declines obviously, his/her normal air exchange is thereby affected. In the process of fitness exercise or function rehabilitation exercise, the body is prone to be oxygen-lacking. Therefore, the relevant reports remind patients of their exercise load in the function rehabilitation exercise process, in particular, the patients with poor physical fitness should take appropriate rest during the exercise to avoid any reverse result [15]; meanwhile, the patients should receive oxygen therapy intervention in the training process. In this way, it can improve the exercise tolerance of the body and enhance the overall training effect [16] based on the above description, the low load aerobic Yoga-based exercise is used as the function rehabilitation exercise in this study and is intended to gradually improve the patient body’s suitable capability and physical fitness in a form of low intensity and aerobic exercise-yoga. In addition, Yoga is an aerobic exercise, focusing on breathing. Thus, in the study, Yoga is combined with deep breathing exercise to improve the respiratory function of the patients. This is an important factor for the control group to achieve obvious effect.

During the process of practical training, as the blood oxygen content of the patients with cotton pneumoconiosis is lower than the normal value, they may feel physical discomfort or dizzy in the training process due to lack of oxygen supply. In order to improve the oxygen supply in the training environment, air negative oxygen ion intervention measures for the observation group are taken as an adjuvant therapy. In the medical field, the negative oxygen ion in the air is called “air vitamin” and it is believed that, the content of negative oxygen ions in the air not only affects people’s physical and mental health, but restricts the fitness effect of the people [17]. It is believed in related reports that [18, 19] sufficient negative oxygen ions in exercise environment can provide sufficient oxygen supply to the people and are helpful for oxygen delivery, absorption and utilization; furthermore, it can promote human metabolism, regulate human body function balance and refresh the body, hence, it is conducive to eliminate the body fatigue, improve the training quality and promote the oxygen consumption and energy metabolism. It is seen from comparison of the curative effect of the two group patients that, the effect evaluation of the clinical signs and FEV\textsubscript{1} value in the observation group are significantly better than those in the control group. This is attributable to the adjuvant curative effect produced by the intervention measure of air negative oxygen ions in the observation group. Inter-group FVC value is not improved obviously in the study, which may be because of the relatively short intervention period (3 months) and calls for further observation.

In summary, the results of this study suggest that, the moderate patient with cotton pneumoconiosis can indeed alleviate their disease if they do Yoga breathing exercise and that the intervention measure of negative oxygen ions can significantly improve the effect of a single exercise. It is recommended that patients
should do exercise in an outdoor environment with a possibly high negative oxygen ion content during the rehabilitation process, or that the indoor environment should be equipped with a negative oxygen ion instrument to guarantee the sufficient oxygen supply in the exercise so as to improve the training effect.

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Disclosure of conflict of interest

None.

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References


