

Original Article

The effect of loaded deep inhale training on mild and moderate COPD smokers

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Abstract: Objective: To research the therapeutic effect of loaded deep inhale training on mild and moderate COPD smokers. Design: 30 mild and moderate COPD smokers were divided into the observation group and the control group at random. The observation group underwent loaded deep inhale training in the morning and in the evening twice for 30 minutes each time for 3 months. The control group did regular aerobics like jogging twice a day for 30 minutes as well for 3 months. The power of respiratory muscles and pulmonary function parameters of each group were measured and compared before and three months after the training. Results: After 3 months of hard training, pulmonary function parameters of the observation group was impressively improved compared with the control group and before training. Conclusions: Loaded deep inhale exercise has a remarkable effect on improving pulmonary function of mild and moderate COPD.

Keywords: Loaded, inhale training, smokers, COPD, therapeutic effect

Introduction

Smoking inevitably damages all human organs. Tobacco has become No. 2 killer globally, only second to hypertension. According to WHO statistics, there are 1.3 billion smokers. Every year 5 million people died of smoking related diseases, among which, victims of pulmonary function decline brought about by smoking feature prominently and chronic obstructive pulmonary diseases (COPD) victims take up a large percentage. Simple medication does not work for them. In recent years, rehabilitation like exercises has been accepted both by doctors and patients [1-3]. But studies home and abroad on treating COPD by loading smokers are lacking. Loaded deep inhale designed in this particular research is an exercise-rehabilitating method to improve pulmonary functions of the patient. It builds up thoracic and abdominal pressure and air resistance while breathing so as to challenge the strength of respiratory muscles when they contract, and meantime to deepen exchange amount of alveolar air. In this way, the demand of the power of respiratory

muscles is increased and pulmonary function improved. The major indexes of the two groups, namely, MIP, MEP, SVC, FVC, FEV₁ and MVV before and after the training were measured and contrasted in order to verify the effect of weighted deep inhale training on improving pulmonary function of senior COPD smokers, as is the focal problem of this study. The study is reported in the following.

Subjects and methods

Subjects

Basic information of patients was obtained from the hospital affiliated to Henan Polytechnic University and Henan No. 2 Charity Hospital. 30 male smokers aged from 50 to 65 years old were selected. The symptoms, physical examination, thoracic X-ray, pulmonary function test and blood gas analyses in all patients were collected and the diagnosis of COPD was based on *Guidelines for the diagnosis and treatment of chronic obstructive pulmonary disease* published in 2002 by Respiratory branch of Chinese

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Table 1. Characteristics of the enrolled patients ($\bar{x} \pm s$)

Group	Case	Height (cm)	Weight (kg)	Age (years)	Time of smoking years				Stages of COPD	
					5-10;	11-15;	15-20;	20+	mild	moderate
Observation group	15	169.70±2.62	66.34±3.80	55.53±4.58	2	2	7	4	9	6
Control group	15	171.31±2.73	67.37±3.51	57.20±5.22	1	4	6	4	8	7

Note: General information of the patients of the two groups, $P > 0.05$.

Table 2. Lung function Index comparison of observation and control group before and after training ($\bar{x} \pm s$)

Before training	case	MIP (pa)	MEP (pa)	SVC (L)	FVC (L)	FEV ₁ (L)	MVV (L)
Control group	15	6.47±1.36	8.38±1.48	3.08±0.80	2.74±0.62	1.71±0.42	108.87±7.21
Observation group	15	6.32±1.24	8.41±1.41	3.10±0.72	2.70±0.61	1.73±0.47	110.14±6.43

Note: Comparison of the subjects of the two groups before and after training, $P > 0.05$.

Medical Association. All patients enrolled were mild or moderate COPD and were randomly divided into the observation group and the control group. The characteristics of the patients in two groups are summarized in **Tables 1** and **2**. Statistical treatment does not imply statistical significance between groups ($P > 0.05$), and therefore, they are comparable.

Methods

Equipments: The US made SENSOR MEDICS-2200 spirometer, China made RMS-II respiratory muscles microcomputer determiner, scales, altimeter, self-made 3 kilogram sandbag (to increase abdominal pressure and the strength of respiratory muscles), self-made air resistance mouthpiece (which was adapted from a spirometer mouthpiece, and reduced to 4-5 mm² in leakage hole in order to add to air resistance and increase thoracic load pressure while breathing deep).

Method employed by the observation group: The group took up weighted deep inhale training twice for 30 minutes in the morning and in the evening respectively for 3 months. The training procedure is as follows. (1) Weighted deep inhale training: The subject lies on his back, relaxed, with the body straight. Put the 3 kg sandbag on his upper abdominal part and breathe steadily and slowly. When inhaling, lift the sandbag on the body consciously; when exhaling, lower the sandbag consciously. The inhale and exhale constitute a pair of exercise which lasts 2 to 3 minutes. Take a two-minute break after each pair. (2) Natural inhale training: Stand and relax. Breathe normally for 30

seconds to adjust. (3) The training of deep inhale with resistance: Stand upright and relax the muscles. Breathe out as hard as possible, press the spirometer mouthpiece onto the mouth closely, inhale at the highest speed to the utmost capacity of the lung, and then breathe out naturally. 10 to 20 times form a set. And it is the most favorable that one does not feel dizzy when doing this. (4) Natural inhale training: Stand and relax. Breathe normally for 30 seconds to adjust. (5) The training of deep exhale with resistance: Stand upright and relax the muscles. Breathe in as hard as possible, press the spirometer mouthpiece onto the mouth closely, exhale at the highest speed, and then breathe in naturally. 10 to 20 times form a set. And it is the most favorable that one does not feel dizzy when doing this. (6) Natural inhale training: Stand and relax. Breathe normally for 30 seconds to adjust. (7) The training of turning around and patting the chest: Stand and drop the arms naturally. Relax muscles and breathe normally. The two hands pat the front and back chest for 2 to 5 minutes as the body turns. Follow the procedure in order as described from (1) to (6). The training lasts 30 minutes every time. What is listed in (7) helps relax and recover of the concluding part of the training.

The training of the control group: The control group conducted aerobics twice a day in the morning and in the evening, each lasting for 30 minutes for 3 months in succession. Training content: the regular aerobics like jogging.

Index measurements: Use China made RMS-II respiratory muscles microcomputer determiner and the US made SENSOR MEDICS-2200 spi-

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Table 3. Comparison of pulmonary function parameters between observation and control group ($\bar{x}\pm s$)

After training	case	MIP (pa)	MEP (pa)	SVC (L)	FVC (L)	FEV ₁ (L)	MVV (L)
Control group	15	6.59±1.30	8.49±1.63	3.16±0.68	2.79±0.93	1.70±0.43	110.37±6.59
Observation group	15	7.98±1.62	9.98±1.62	3.95±0.71	3.81±0.86	2.36±0.52	119.68±6.77

Note: The observation group compared before and after training, $P<0.05$; comparison between the observation and control group, $P<0.05$.

rometer to check the pulmonary function parameters of the patients in the two groups. The medical check mainly includes: maximum inspiratory pressure (MIF), maximum expiratory pressure (MEP), slow vital capacity (SVC), forcibly vital capacity (FVC), forced expiratory volume in one second (FEV₁), and maximal voluntary ventilation (MVV).

Statistical treatment: Apply SPSS 13.0 software to statistical treatment. The measurement data was expressed in ($\bar{x}\pm s$); the comparison among groups with t test; and $P<0.05$ indicates that the discrepancy has statistical significance.

Results

When the two groups of patients were first chosen, their personal information and the various pulmonary function parameters demonstrate no statistical significance ($P>0.05$). After three months of training, the control group did not improve much compared with before training ($P>0.05$); the discrepancy did not imply statistical significance, whereas the observation group improved remarkably in terms of pulmonary function parameters ($P<0.05$). Moreover, the observation group achieved a much better improvement compared with the control group. Minute details can be seen in **Table 3**.

Discussion

When cigarettes burn, they send out many toxic chemicals, among which are tar, carbon monoxide, nicotine, dioxin, and irritant gas. Tar in tobacco smoke accumulates on pulmonary villi and damages their function, which consequently increases phlegm and induces chronic bronchial diseases. Studies have confirmed that prevalence of smokers is over ten times larger than nonsmokers and a quarter of heavy smokers eventually develop into COPD [4-6]. COPD patients' pipe is blocked, the compliance of the lung and thorax declines, and the lung inflates

exceedingly. All that squeezes diaphragm and its mobility and contractibility weakens. And eventually diaphragm wastes away, the pipe falls and it is obstructed when breathing. In this way, alveolar gas cannot be expelled effectively and normal air exchange is obstructed [7, 8]. Relevant studies also show that no single medicine can completely cure COPD and an unavoidable part of COPD treatment involves non-medical treatment, that is, rehabilitation therapy. It advocates moderate exercise on the part of patients, balloon blowing and whistling for example, to strengthen pulmonary function [9-11]. Because pulmonary circulation has enormous potential to compensate, it might generate sufficient compensation through guided training, although respiratory diseases have damaged part of pulmonary function and even caused symptoms. That is the theoretical basis of respiratory training.

Loaded deep inhale increases the load pressure of thoracic cavity and empowers respiratory muscles when they contract by building up thoracic and abdominal pressure and air resistance while breathing. The increasingly powerful abdominal muscles can build up the mobile extent and intensity of diaphragm and, in the meantime, enlarge the exchange amount of alveolar air, uplift FVC and MVV, reduce residual volume, improve the state of lack of oxygen, improve oxygen supply of respiratory muscles, and increase contractibility of respiratory muscles [12-14]. Larson and etc found in their experiment that respiratory training of loading the stomach could significantly enhance the strength of respiratory muscles and then boost pulmonary function of the body [15]. Turner and etc pointed out in their study that, under 30% of peak airway pressure as load pressure to forge respiratory muscles, their strength, stamina and the walking distance covered in 12 minutes all improved greatly, whereas the other group under 15% of peak airway pressure showed no changes [16, 17]. Fregonezi found

that the group of heavy load beat the one of light load considerably in peak airway pressure, maximum continuous ventilation, maximum continuous oral inspiratory pressure, peak inspiratory flow and maximum sustained power [18]. Therefore, it is generally acknowledged that the load on respiratory muscles is in immediate proportion to the effect of exercise. Low FVC mainly results from less developed respiratory muscles which cannot endure [19-21]. So a specially designed respiratory exercise impacts respiratory muscles, and their strength and endurance are greatly enhanced. That contributes to the positive results of deep loaded respiratory exercise.

The experimental statistics of MIP, MEP, SVC, FVC, FEV₁ and MVV before and after exercise in **Tables 2** and **3** suggest that all pulmonary function parameters of the observation group were significantly improved, much better than before training and the control group. The study indicates that mild and moderate COPD patients did not improve if they did regular aerobics for less than 3 months ($P>0.05$). In contrast, specially designed loaded deep inhale training brought about positive results over 3 months ($P<0.05$). The conclusion is that loaded deep inhale training triumphs over regular aerobics impressively, and, moreover, the therapy is easy to follow and free of side effect. It is worth clinical application and popularization.

Disclosure of conflict of interest

None.

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