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Effect of Physical Therapy Rehabilitation on Chronic Obstructive Pulmonary Disease Patients - A mini review

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ABSTRACT

Background: The third leading cause of death globally is chronic obstructive pulmonary disease (COPD), which has attracted considerable attention from researchers and professionals in this field. One of the most important aspects of treating individuals with COPD is physical therapy. This study sought to explore the combined effect of inspiratory muscle training (IMT) and aerobic exercise on pulmonary in COPD patients. In addition, it aims to summarize the available literature related to the topic.

Methods: We reviewed the literature and conducted a randomized interventional trial, which included 60 COPD patients. Their age ranged from 50 to 60 years. Patients were randomly allocated into two equal groups: Group A (N = 30), received IMT plus aerobic activity, while group B (N = 30) received aerobic exercise. The intervention lasted for 4 weeks, with sessions conducted 3 times per week. Pre and post assessments included parameters of pulmonary function [forced expiratory volume in the first second (FEV1), forced vital capacity of the lungs (FVC), FEV1/FVC ratio, peak expiratory flow (PEF)] as well as functional capacity.

Results: Analysis of the study's findings revealed that after 4 weeks of intervention, all measurements demonstrated a substantial rise ($P<0.05$), including pulmonary function parameters (FEV1, FVC, FEV1/FVC and PEF), and functional capacity, when comparing the experimental group to the control group.

Conclusion: Chronic Obstructive Pulmonary Disease Patients may benefit from a combination of IMT and aerobic training to improve their ventilatory and overall functional capacity.

Keywords: Chronic Obstructive Pulmonary Disease; Rehabilitation; Forced Expiratory Volume; Exercise.

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INTRODUCTION

The underlying cause of chronic obstructive pulmonary disease (COPD) is chronic blockage of lung airflow, which has a significant impact on heart health and gas exchange, ultimately leading to systemic repercussions [(1)].

This varied lung illness is characterized by persistent ventilatory symptoms and airflow restriction brought on by anomalies in the alveoli or airways [(2)]. Typical symptoms include dyspnea (shortening of breathing), coughing, increased sputum output, and a decreased threshold for effort [(3)].

COPD has been shown to be an independent contributor to systemic inflammation. Both variables can contribute to the development of atherosclerosis via a shared oxidative stress mechanism. Thus, the risk of cardiovascular complications and mortality is independently increased by COPD [(4)].

The decline in the strength of breathing muscles in individuals with COPD holds significant clinical relevance and importance. In COPD, the main breathing muscle, the diaphragm, experiences wasting and shrinking due to atrophy [(5)].

Complications are present in most COPD patients. The five complications that are most common are atherosclerosis, dyslipidemia, osteoporosis, hypertension, and hyperglycemia. Anxiety and depression are examples of psychiatric complications that may negatively affect the frequency of exacerbations [(6)].

Weakness in breathing muscles is the main cause for the failure of these muscles to satisfy the heightened breathing requirements during exercise, leading to significant additional issues. These issues involve shortness of breath, difficulty tolerating physical exertion, problems sleeping, issues with speech and swallowing, and issues with posture and balance due to the diminished support provided by the breathing muscle groups [(7)].

One popular physical therapy method that is extensively utilized in pulmonary rehabilitation programs is inspiratory muscle training (IMT). It has been demonstrated to be useful in treating a variety of illnesses by enhancing respiratory function, muscle strength of respiration, and capacity for physical activity [(8)]. Therefore, interventions can improve pulmonary functions and functional capacity in this population is highly recommended in their rehabilitation

IMT has already been used extensively in the treatment of COPD patients, offering benefits such as improved exercise tolerance, decreased dyspnea, and increased inspiratory muscle strength and endurance [(9)]. IMT has been employed for an extended period. Its advantages have been shown in improving quality of life, decreasing shortness of breath, and enhancing physical ability to exercise [(10)].

The purpose of this prospective study was to assess the clinical efficacy of aerobic exercise training and IMT in enhancing respiratory and functional capacity. IMT in addition to aerobic exercise training was believed to improve COPD patients' respiratory and functional capacities.

METHODS

Study design:

The current study is a randomized controlled trial that was done on 30 COPD patients; they had been recruited from Sadr Damanhour hospital, Damanhour, Egypt. Patients were selected to be participants in the current study according to the following inclusion criteria: Sixty male patients with diagnosed with grade I and grade II COPD, the patients' ages ranged from 50 to 60 years, all patients were clinically and medically stable when attending the study.

Exclusion criteria:

Cardiovascular disorders that affect patients' performance, such as heart failure, recent myocardial infarction, arrhythmia. Patients with musculoskeletal disorders that prevent them from exercising, such as fractures, or those with cognitive impairment that prevents them from participating in exercises.

Allocation:

Following blind selection from sealed envelopes containing numbers generated by a random number generator, an independent individual assigned the participants at random into two groups: the experimental group (n = 30) and the control group (n = 30). To guarantee that the experimental and control groups received equal randomizations, the randomization was limited to permuted blocks. Each participant's assigned sequence was placed in an envelope with the group allocation.

Assessments:

A. A detailed history taking including [Age (year), mass (kg), height (m), body mass index (BMI) kilogram per square meter (kg/m^2)] and gathering information on the patient's current medications, physical activity, blood pressure, and overall health.

B. Spirometry test: (spirolab ver 4.8 by MIR made in china): to measure ventilatory function. Spirometry is a medical examination that evaluates the capacity to take in and release air over a period. It is a diagnostic tool for various prevalent lung conditions, including COPD [(11)].

C. Functional capacity by 5 repetitions sit to stand test (5R-STS): To start the test, the participants sat in the middle of the chair with their wrists on their chests and their arms crossed. Five fast transitions from a completely seated to a fully standing posture and back to the fully sitting position were required of participants on a chair without hand

support. The timer started when the participant's back left the backrest and continued until it made five contacts with the backrest [12].

Training procedure:

Aerobic exercise:

Both the experimental and control groups exercised three times each week for four weeks on a treadmill (Model 601, Life Sport 150 kg, motor: AC 2.5 HP (4.5 HP Peak) USA-made motor). Each participant exercised for 40 minutes every session while being observed by research physiotherapists and a physician, who assessed their heart rate, blood pressure, and tiredness levels. Treadmill walking began with a 5-minute warm-up at 1.5 km/h and 0% gradient. During the 30-minute training phase, the pace was gradually raised until there was moderate claudication pain (4 out of 5). The walk was then followed by a 5-minute cool down period [13].

IMT (The Breather device):

Patients in the experimental group used the BREATHER device (PN Medical, BD12438, USA) to do inspiratory muscle training. Each participant's session lasted 15 to 20 minutes. Participants in experimental training received respiratory muscle training with the Breather device. Participants used a breather device to strengthen their respiratory muscles. They started with the easiest setting, moving the inhale and exhale dials at a constant resistance level. Participants were asked to inhale deeply and strongly for 2-3 seconds, stop briefly, and then exhale for 2-3 seconds for 10 repetitions in two sets [14].

Research Objective:

The objective of this mini review is to synthesize the existing data comparing aerobic exercise alone and combination of aerobic exercise training and IMT on ventilator function and functional capacity in COPD patients.

Search Strategy:

Along with the study's clinical component, a scoping review was carried out to investigate new uses of aerobic exercise training and IMT for improving pulmonary function {FEV1/FVC ratio, forced vital capacity of the lungs (FVC), forced expiratory volume in the first second (FEV1), peak expiratory flow (PEF)}, and functional capacity. The research was mainly conducted using the databases ScienceDirect and PubMed

RESULTS

The 60 male COPD patients in this study ranged in age from 50 to 60 years old, with a mean age of 56.70±5.30 years. The subjects were split into two groups: 30 patients in the experimental group, which got IMT and aerobic exercise, and another 30 patients in the control group. At baseline, the experimental group and the control group did not differ significantly in terms of age, weight, height, FEV1/FVC, FVC, FEV1, PEF, or the 5-repetition sit-to-stand test.

There were statistically significant increases in all measurements including (FEV1/FVC, FVC, FEV1, and PEF) from pre- to post-4 weeks of intervention in the experimental group as well as the control group. The experimental group showed a statistically significantly greater improvement, with increases of 37.25% in FEV1/FVC, 28.12% in FVC, and 77.15% in FEV1, compared to the control group (2.43%, 0.62%, and 2.45%, respectively).

Concerning the 5 repetitions sit to stand test, both groups experienced a statistically significant decline from before to after the intervention, with the experimental groups experiencing a particularly large decline in the 5 repetitions sit to stand test by 6.92s (30.24%) compared to the control group (MD= 0.54s and 2.55%).

DISCUSSION

In summary, the current study's findings demonstrated that, across all evaluated areas, pairing of aerobic exercise training with IMT produced greater benefits than aerobic exercise training alone. We will next go into further detail to provide a summary of the literature that is currently accessible. COPD was defined as a chronic obstruction airway, which has a significant impact on heart health and gas exchange, ultimately leading to systemic repercussions which can contribute to the development of atherosclerosis [14-16].

Exercise training programs have been shown to enhance symptoms, exercise capacity, and physical well-being in people with COPD [17].

IMT has already been used extensively in the treatment of COPD patients [18].

Supervised aerobic exercise is the best kind of exercise for COPD patients to enhance health-related quality of life [19].

Consistent with study of **Liu *et al.*** [20] on patients with lung cancer saw substantial increases in respiratory muscle strength and aerobic fitness after six weeks of IMT and aerobic exercise following video-assisted thoracoscopic surgery.

As well as **Yekta *et al.*** [21] after eight weeks, IMT and aerobic exercises saw a considerable increase in their standard of living ($P<0.05$), and group 3 showed the greatest improvement. The Lifestyle quality of COPD patients was improved more by aerobic exercise and IMT than by standard treatment plans.

According to **Hanada *et al.*** [22] in the systematic review with meta-analyses demonstrated that in addition to increasing exercise capacity, aerobic training and breathing techniques like IMT appeared to work in concert to reduce dyspnea. These results contribute to the increasing amount of evidence showing that IMT and aerobic exercises can assist individuals with COPD who have intermittent claudication.

IMT is characterized as a special type of exercise that strengthens the respiratory muscles by putting a lot of effort into the inspiratory muscles. Pulmonary function can be enhanced by gradually increasing the strength of the breathing muscles. With enough skeletal muscle loading and training, the size of the respiratory muscles increases [(23)].

Enright *et al.* [(24)] demonstrated Asthma and COPD patients are frequently treated with IMT, which can lower heart rate, blood lactate concentration, breathing sensation, and limb effort

Breathing energy is reduced when the inspiratory muscles do not fatigue, enabling deeper, slower, and more effective breathing. These findings emphasize the relevance of IMT.

The study of **Bostanci *et al.*** [(23)] IMT dramatically increases strength of respiratory muscles. Stronger respiratory muscles prevent or eliminate inspiratory muscle exhaustion, making it easier to perform essential respiratory functions.

According to **Azambuja *et al.*** [(25)] forced pulmonary parameters are dependent on respiratory muscle function. Enhancing the strength of the diaphragm, the most vital respiratory muscle, increases the capacity and forceful volume of expiration. Additionally, higher contractile activity, increased metabolic enzyme activity in respiratory muscles, decreased muscular stiffness, increased nerve conduction velocity, and improved lung and chest wall flexibility are all linked to extended pulmonary system adaptation to exercise. These perspectives can aid in comprehending the process underlying our other findings, which is that pulmonary functions and respiratory muscle strength considerably improve after the 4-week IMT training.

Cutrim *et al.* [(26)] explained that IMT could improve vascular function and muscle metabolism by having an additional impact on cardiovascular autonomic control. Reduced sympathetic activity and increased vagal activity are the hallmarks of this.

Also, **Craighead *et al.*** [(27)] observed that in midlife/older persons with above-normal blood pressure, six weeks of high-resistance inspiratory muscular strength increases endothelial function, nitric oxide bioavailability, and oxidative stress while lowering blood pressure.

According to earlier research, IMT increases nitric oxide bioavailability and decreases peripheral vascular resistance to enhance vascular function. Therefore, it is anticipated that during physical activity, there would be a greater increase in blood flow to the muscles. This will enable the muscles to get oxygen in response to metabolic needs, thereby improving physical performance [(26)].

According to **Hackett** [(28)] research, Aerobic training increases the respiratory muscles' strength and endurance, which enhances respiratory adaptability. Following modified aerobic training brought on by endurance training, respiratory patterns may enhance expiratory flow and decrease smooth muscle tone in the airways.

Marangoz *et al.* [(29)] observed that aerobic training decreases airway resistance by extending the lungs on a regular basis. Air resistance can be reduced by smooth muscle contraction and decreased tone. Lung volume, airway resistance, and smooth muscle tone all decrease; these processes are expected to improve airflow. **Yu *et al.*** [(30)] explained that aerobic exercise has been shown to improve lung function by enhancing cardiovascular fitness and increasing the efficiency of oxygen utilization.

Exercise encourages antiatherogenic changes in the artery wall, including impacts on endothelial and smooth muscle cell activity as well as structural changes to the arteries. Exercise-induced angiogenic increases in capillaries and micro arterioles may be a part of this remodeling, but it is more likely to be the result of outward circumferential remodeling of bigger arterioles and feed arteries, which are primarily important for regulating vascular resistance [(31)].

Limitations:

We are aware of our study's shortcomings. The intervention lasted four weeks, limiting insights into long-term effects.

Conclusion:

Based on the study's outcomes and the literature review, patients' ventilatory function and total functional ability were greatly improved when combining aerobic exercise with inspiratory muscle training. Additionally, it was found to reduce sensations of dyspnea. These results could be beneficial for COPD patients.

Disclosure:

Neither financial disclosure nor a conflict of interest existed.

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