Successful Pulmonary Rehabilitation in COPD During COVID-19 Pandemic Era: A Case Report

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Case Report

Successful Pulmonary Rehabilitation in COPD During COVID-19 Pandemic Era: A Case Report

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Abstract

Background: COPD patients are at high risk for COVID-19 infection and severe pulmonary complications. Exercise-based pulmonary rehabilitation in outpatient settings is essential for COVID-19 survivors with COPD comorbidities, providing the most critical patient benefits, but it's challenging during the pandemic.

Methods: A sixty-four-year-old man with a history of COPD, COVID-19, and Pulmonary Tuberculous came with chief complaints of tiredness, cough and breathlessness after walking for more than 100 meters. We performed PR, including breathing retraining exercise, chest mobility exercise, active cycle breathing technique (ACBT), posture correction, and aerobic exercise with static ergo-cycle for 8 weeks.

Results: Before PR, O_2 saturation was 94-95% room air, single breath counting test (SBCT) 20, weak cough ability (PCF: 100-110-100 L/ m) and low peak flow rate (140-150-145 L/ m). COPD assessment test (CAT) score was 23, and Modified Medical Research Council (mMRC) dyspnea scale was 3. The patient could not perform the sit-to-stand test and a 6-minute walking test. After 8 weeks of PR, there were improvements in the O_2 saturation level (98% room air), SBCT was 38, improved peak cough flow (420-435-425 L/minute) and peak flow meter (380-400-400 L/minute). The sit-to-stand test was 5 times in 30 seconds, and the 6-minute walking test maximum distance was 248 meters. The end CAT score was 9 and mMRC dyspnoea scale was 2.

Conclusion: Eight weeks of pulmonary rehabilitation showed benefits for the patient in reducing dyspnea and improving exercise tolerance and quality of life, especially in hospital-based settings.

Keywords: Pulmonary Rehabilitation, Hospital Based-Rehabilitation, COVID-19, Chronic Obstructive Pulmonary Disease, Exercise Tolerance

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INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a systemic disease that causes progressive obstruction of the respiratory tract, significantly reduces exercise tolerance, and induces mental illness, resulting in disability and decreasing quality of life.[1–3] Based on the National Health Research (RISKESDAS) in 2013, the prevalence of COPD in Indonesia was 3,7%.[4,5] This number is still increasing due to the rising population of active smokers at young and productive ages.[6–8]

According to the Global Initiative for Obstructive Lung Disease (GOLD), patients with a history of COPD are now at an elevated risk for COVID-19 infection and severe pulmonary complications in the survivor. The severity and mortality rate were higher in COPD patients. Therefore, a new therapeutic approach is needed for this population.[7–11]

Pulmonary rehabilitation (PR) and pharmacological treatment for COPD patients may be implemented concomitantly in treating COPD to achieve a successful therapy in improving patient lives.[11–14] Pulmonary rehabilitation has been proven as the most effective non-pharmacological treatment in enhancing a patient's health and has become a standard care in COPD patients.[11,12]

Pulmonary rehabilitation is a multidisciplinary team intervention comprising patient assessment,

exercise training, education, nutritional intervention and psychosocial support.[8,13] Exercise-based PR plays an essential role in the recovery phase of COVID-19 survivors with a history of COPD. The PR aims to restore optimal physical, physiological, and social functions. Fatigue is one of the most common complaints of COVID-19 survivors.[9–11] This complaint also often limits the patient from exercising, therefore educating the patient about energy-conserving techniques to improve compliance in the PR program is important.[13]

Systematic review and meta-analysis have shown the benefits of PR in COPD patients in terms of increasing exercise capacity and quality of life, reducing dyspnoea, and reducing the cost of hospitalization.[8,11,14] Despite the proven benefits, PR has not been widely applicated, especially in developing countries.[15] PR can be performed in inpatient, hospital-based outpatient, community-based outpatient, or home-based settings. Studies have shown that the best PR benefit was achieved in hospital-based outpatient settings. The British Thoracic Society recommends that the PR program be followed up for a minimum of 6 weeks with a frequency of 2 times a week, carried out with supervision. The gold standard of the therapy is the supervised PR, yet this has become a challenge during the COVID-19 pandemic situation.[14–16]

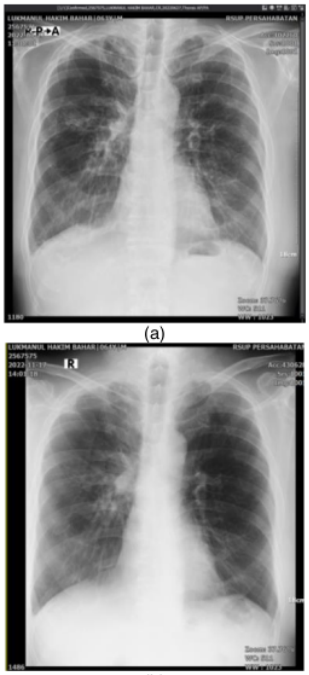
Supervised PR requires supporting facilities and staff in the COVID-19 pandemic era. Prevention of COVID-19 transmission and patient safety has become the top priority. All of the patients are required to wear the appropriate mask.[1,9,15,17] Mask can only be removed during exercise and must be worn during rest. In addition, supporting facilities such as rooms with negative pressure and limiting the number of patients and staff in 1 room should also be provided. Medical staff must use personal protective equipment according to the hospital policy.[14]

CASE

A 64-year-old man, a retired private employee with a sedentary lifestyle, with a history of COPD in the last 2 years, mild COVID-19 in March 2022, history of smoking one pack per day for 30 years before and stopped 2 years ago. He denied any history of diabetes mellitus, cardiovascular, and cerebrovascular disease. He has a history of uncontrolled hypertension, osteoarthritis of both knees KL III-IV, and pulmonary tuberculosis with treatment for 1 year and has been declared cured in September 2022. Since then, the patient has started routinely undergoing a pulmonary rehabilitation program at the hospital 3 times a week. When starting the rehabilitation program, the patient experienced fatigue quickly, with coughs and shortness of breath after walking for more than 100 meters. The patient has to pause every few steps when walking. The patient also reported pain on a pain rating of 5 in both knees, especially while shifting from sitting to standing. Blood pressure was 142/78 mmHg, heart rate was 104 times/minute, respiratory rate was 22 times/minute, and O2 saturation was 94-95% on room air, with a Borg scale of 13-3-1. The COPD Assessment Test (CAT) was 23. The stratification of dyspnoea based on the Modified Medical Research Council (mMRC) Dyspnoea Scale was 3. Chest expansion was decreased (2-4-4 cm) as seen in Figure 1. The single breath counting test (SBCT) was 20. The patient also experienced weak cough ability (PCF: 100-110-100 L/ m) and low peak flow rate (140-150-145 L/ m). The patient could not perform a sit-to-stand or 6-minute walking test.

Figure 1. Chest expansion

The spirometry result in April 2022 showed vital capacity was 2540 ml (81% prediction), forced vital capacity (FVC) was 2460 mL (76% prediction), forced expiratory volume 1 (FEV1%) was 1170 mL (51%), and FEV1%/FVC 48%. Chest x-ray (Figure 2) showed pulmonary fibrosis, and a thorax computed tomography scan found reduced consolidated segment 6 in the right lung without peripheral consolidation of the upper lobe in the left lung. Echocardiography showed good left ventricle function with 68% ejection fraction, diastolic dysfunction grade I, good valve function, and global normokinetic.



(a)

(b)

Figure 2. Chest x-ray. (a) June 27th, 2022, (b) November 17th, 2022

The patient routinely took drugs to control COPD, including a long-acting bronchodilator (Tiotropium bromide) inhaler of 5 mcg once daily, N-Acetyl-cysteine 200 mg three times a day, and short-acting bronchodilator only if shortness of breath occurs. The pulmonary Rehabilitation program included breathing retraining exercises, chest mobility exercises (CM), infrared for chest wall, pursed lip breathing and a diaphragm breathing exercise by a physiotherapist 3 times per week. Active cycle breathing technique (ACBT) was taught to be used when he coughs, and postural correction exercise (PC) by a physiotherapist 3 times a week. The patient received transcutaneous electrical nerve stimulation (TENS) and 6 sessions of high-intensity intraarticular light amplification by stimulated emission of radiation (laser) for knee pain. The patient also received static bicycle aerobic exercise 3 times per week, starting with a 20-watt load for 5 minutes, increasing gradually until 30 minutes.

After 8 weeks of follow-up, the patient rarely experienced cough and shortness of breath during exercise. The patient felt better and could walk for 200 meters with occasional stops. The patient exhibited neither chest pain nor shortness of breath during the exercise and could perform static bicycle aerobic exercise with a 20-watt load for 30 minutes. Blood pressure was 122/78 mmHg, heart rate was 76 times/minute, O2 saturation was 98% on room air, with Borg scale was 9-0-0 during rest.

The CAT score in the follow-up period improved to 9, and the mMRC dyspnea scale improved to 2. Chest expansion was increased to 3-4-4 cm, and SBCT was 38. The peak cough flow was 420-435-425 L/minute, and the peak flow meter was 380-400-400 L/minute. The result of the sit-to-stand test was 5 times in 30 seconds. The 6-minute walking test (6MWT) distance was 248 meters. The spirometry result in October 2022 showed vital capacity was 2790 ml (89% prediction), forced vital capacity (FVC) was 2550 ml (82% prediction), forced expiratory volume 1 (FEV1%) was 1380 ml (60%), FEV1%/FVC 54%, and post-bronchodilator 54%.

DISCUSSION

In our case, the PR performed in 8 weeks reduced shortness of breath symptoms and increased exercise tolerance. A recent meta-analysis found that the longer duration of therapy (at least 6 weeks) and more exercise sessions (more than 28)

showed improvement in the maximum testing distance reached by the 6-minute walking test.[2]

Several challenges may be encountered during hospital-based rehabilitation, particularly in the elderly population, such as COPD exacerbation, transportation problems, and comorbidities that limit patient training compliance.[1–3] Research conducted in Korea has found a high dropout rate during PR research due to knee pain which limits patient activities.[3,4]

Before starting the pulmonary rehabilitation program, patients should perform exercise to measure the training capacity of each patient.[1–3] However, we could either assess the sit-to-stand test or 6MWT due to complaints of shortness of breath and pain in both knees. In addition to the pulmonary rehabilitation program, our patient also received therapy for both knees, a TENS modality lasting 30 minutes on both knees for 6 sessions. Still, there was no improvement in both knees. Then the patient was given intraarticular knee high-intensity laser treatment for 6 sessions and showed improvement so that the patient could perform the 6MWT.

PR as a non-pharmacological intervention provides substantial evidence regarding its effectiveness in enhancing the dyspnoea-related quality of life and exercise capacity.[9,11–13] In our case, dyspnoea symptoms improved after PR from mMRC 3 to 2. This result was in accordance with the study conducted by Kim et al., in which PR was conducted in 8 weeks with 2 sessions of hospital-based exercise, improved exercise capacity and quality of life.[1]

The patient experienced an improvement in dyspnoea symptoms based on the mMRC scale, and its impact on quality of life was measured using the CAT score. A similar result was observed in research conducted by Monica et al where there was a significant association between the degree of shortness of breath in COPD patients with the quality of life (r = -0, 531).[6] The association between the mMRC scale and SGRQ were also found significant in the study of Ekici et al.[16]

We observed a reduction in CAT score by 14 points after pulmonary rehabilitation. Several indicators notably impacted were shortness of breath, cough, and energy. In Houben-Wilke et al study, pulmonary rehabilitation significantly impacts shortness of breath and energy indicators.[5] Energy was the most affected in CAT because PR aims to increase cardiorespiratory fitness by increasing exercise capacity and reducing shortness of breath and fatigue symptoms. Individualized PR program shows an improvement in the daily activities of COPD patients through energy conservation techniques.[9–12] Although all indicators in the CAT score were significantly improved, PR responses vary greatly in each individual, so PR should be tailored for each patient.[12,18,19]

Hansen et al reported that the reduction of CAT score was statistically significant in supervised pulmonary rehabilitation, though it did not exceed the minimal important difference (MID).[16] The MID for the CAT score is a reduction of 2 points.[9,10,12] In our case, a significant improvement was observed due to breathing exercises, including breathing retraining, chest mobility exercise, and supervised provision of infrared modalities for the chest wall so the patient can perform it correctly.

Changes in mechanic pulmonary during exercise are related to the cardiovascular response towards exercise.[6,20–22] During exercise, dynamic hyperinflation increases intrathoracic pressure and decreases cardiac preload by decreasing venous return and left ventricular volume.[2,23] While in COPD patients, there is an improvement in ventilation related to an increase in volume during exercise, which resulted in exercise tolerance improvement in patients undergoing PR, as in our case.

Our patient received static bicycle aerobic exercise, starting with a load of 20-watt with a duration of 5 minutes. In post-COVID-19 patients, exercise should not be started with moderate intensity because of shortness of breath symptoms and restrictive lung disease.[1,2] Before being infected with COVID-19, our patient had COPD and pulmonary TB history. These comorbidities also limit

the patient from performing exercises. Besides, the age factor plays an important role, which in our case is in geriatric age, so the exercise principle is to start low and slow.

In COPD patient, exercise may reduce type IIB muscle fibres and increase type I muscle fibres that require lower oxygen, resulting in more efficient oxygen usage and increased elimination of carbon dioxide after the PR program.[2,21–23] Aerobic exercise results in reduced shortness of breath and increased tolerance during exercise and activity in patients. COPD is a systemic disease with chronic inflammation.[24,25] Exercise has an anti-inflammatory effect and improves the immune system by regulating C-reactive protein (CRP) levels and immunoglobulin function.[2] Aerobic exercise in COPD patients results in improved immunity and respiratory system in a short period.[18,22] According to the PR guidelines, the program is delivered at a frequency of 2 to 5 times per week for 6 to 12 weeks.[3]

CONCLUSION

Eight weeks of pulmonary rehabilitation proved beneficial for the patient in reducing dyspnoea and improving exercise tolerance and quality of life, particularly when performed in hospital-based settings.

Acknowledgments

None

Conflict of Interest

None

Funding

None

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