

# Effectiveness of Supervised Pulmonary Rehabilitation in a Patient with Post-COVID Syndrome: A Case Report

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## ABSTRACT

Coronavirus-2019 has turned out to be a global pandemic impacting millions of people. Following recovering from Covid-19, patients suffer from post-COVID Syndrome which has an impact on lung function resulting in exertional dyspnea, cough, hypoxia or pulmonary fibrosis thereby reducing exercise as well as functional capacity. Along with medical intervention, pulmonary rehabilitation program is essential to reduce the symptoms in post-COVID-19 survivors and thereby improve the quality of life. This case study describes a 38 year diagnosed with viral pneumonitis with acute respiratory distress syndrome (ARDS) who was given a structured supervised home based Pulmonary Rehabilitation (PR) program for 6 days a week, for 8 weeks post discharge from hospital. Results showed improvement in oxygen saturation at rest on room air, 6 minute walking distance (6MWD), Post Covid-19 Functional Status (PCFS) Scale, Functional Independent Measure (FIM) scale, World Health Organization Quality of Life Instruments (WHOQOL-BREF) and Depression, Anxiety and Stress Scale-21 (DASS-21). This case report proposes PR as an important intervention to improve exercise as well as functional capacity thereby reducing the significant negative impact on post COVID survivors.

**Keywords:** COVID-19, Pulmonary Rehabilitation, Post-COVID, Exercise

## INTRODUCTION

A novel coronavirus 2019 (COVID-19) was identified in Wuhan, China, in late December of 2019. It rapidly spread to more than 200 countries around the globe and was officially declared as a pandemic in mid march 2020.<sup>[1]</sup> More than a year has passed, the second wave of the virus spread like a wildfire in India. According to WHO, India reported an average of 3.9 lakhs of new cases during the first week of May 2021, which equals 47% of new cases reported globally putting India with the second highest COVID-19 cases across the world.<sup>[2]</sup> However, from the recent data (as on 2nd July, 2021), the recovery rate was documented to be 97.1% and mortality rate

to be 1.31%.<sup>[3]</sup> With increase in the numbers of COVID cases and post COVID survivors, integration of Pulmonary Rehabilitation (PR) is recommended in the treatment protocol.<sup>[4]</sup> Post-COVID pulmonary manifestations include dyspnea, cough, chest pain, fatigue and palpitation owing to the degree of pulmonary fibrosis or requirement of oxygen support.<sup>[5]</sup> The purpose of PR in these patients is to improve symptoms of dyspnea, relieve anxiety, reduce complications, minimize disability, preserve function and improve quality of life.<sup>[4,6]</sup> Thus in this case report we aim is to highlight the role of supervised home-based PR in a patient with Post-

COVID Syndrome and its significant positive outcomes.

## CASE REPORT

This case report describes a 38 year old male, with no pre-existing comorbidities; diagnosed as viral pneumonitis with acute respiratory distress syndrome (ARDS) was hospitalized 6 days post his reverse transcription-polymerase chain reaction (RT-PCR) came positive. His room air oxygen saturation (SPO<sub>2</sub>) was 85%. His investigations revealed C reactive protein of 88.06 mg/L, serum lactate dehydrogenase of 490.2 U/L and serum Ferritin of 986.0 ng/mL. His high resolution computed tomography (HRCT) showed patchy ground-glass and reticular opacities as well as consolidations in both upper lobes, right middle lobe and both lower lobes and his computed tomography (CT) scan and CT severity index was 20/25 suggestive of severe COVID-19 pneumonia. He was managed with non-invasive ventilation, injectable steroids and remdesivir, anticoagulants, baricitinib along with other supportive medications. He was discharged from hospital after 30 days with repeat RT-PCR negative and was maintaining SPO<sub>2</sub> of 92% on room air and was advised SOS supplemental oxygen through nasal cannula (NC) in case of SPO<sub>2</sub> drop below 90%. Patient was referred to physiotherapy for improving his pulmonary and functional capacity. PR sessions were carried out at the patient's home. After performing baseline assessment, PR program was designed and incorporated for the patient.

## INTERVENTION

PR program was started immediately post discharge which consisted of one session, 6 days a week, which was carried out for 8 weeks. Following goals were formulated: (1) to reduce dyspnea and breathing retraining, (2) to enhance lung expansion, (3) to improve exercise tolerance and functional capacity, (4) to improve the strength and endurance of respiratory

muscles. The main focus was, before discharging the patient from PR, he should be able to manage all accustomed activities in accordance with his lifestyle in ease. The protocol was designed as per the standard PR guidelines.<sup>[7]</sup> PR sessions incorporated educational support, lung expansion therapies, volumetric spirometer, breathing control techniques and energy conservation techniques. Session consisted of warm-up; functional and strength training followed by cool down. For the initial 2 weeks, functional training included only symptom-limited walking based on 6-20 Borg's scale, which was later progressed walking at 60% of maximal heart rate. Strength training was performed for major muscle groups using weight cuffs by 10 RM protocol (2 sets of 10 repetitions). Inspiratory muscle training (IMT) was also incorporated later in the PR program using the Threshold Inspiratory Muscle Trainer. Each IMT session consisted of 3 sets of 10 repetitions performed thrice a day. Session ended with cool down exercises and Jacobson's relaxation therapy. Detailed treatment protocol is mentioned in table 1.

## Outcome Assessment:

Following outcome measures were assessed in the patient:

1. Oxygen Saturation at rest on room air
2. 6 minute walking distance (6MWD)
3. Post Covid-19 Functional Status (PCFS) Scale
4. Functional Independent Measure (FIM) scale
5. World Health Organization Quality of Life Instruments (WHOQOL-BREF)
6. Depression, Anxiety and Stress Scale-21 (DASS-21)

PCFS scale assesses functional status in COVID 19 patients. It is assessed at the time of discharge, after 6-8 weeks and 6 months post COVID 19 recovery to assess the degree of persistent disability. It is graded from 0 to 4 where grade 0 reflects absence of any functional limitations and grade 4 reflects severe functional limitations requiring assistance in activities of daily

livings (ADLs).<sup>[8]</sup> FIM scale is an 18 item questionnaire used to assess scale to assess independence in ADLs with a score ranging from 18- 126. Higher the score denotes complete independence.<sup>[9]</sup> WHOQOL-BREF is a self-reported 26-item questionnaire, which address QOL using 4 domains. The WHOQOL-BREF score ranges from 0 to 100. Higher score corresponds to better QOL.<sup>[10]</sup> DASS-21 is a quantitative measure, which assesses 3 axes of depression, anxiety and stress. DASS scores ranges from 0 to 18-24 for each axes.<sup>[11]</sup> On completion of PR, following improvements were seen in the outcome variables. (Table 2) 6 MWD improved from 179 meters to 420 meters.

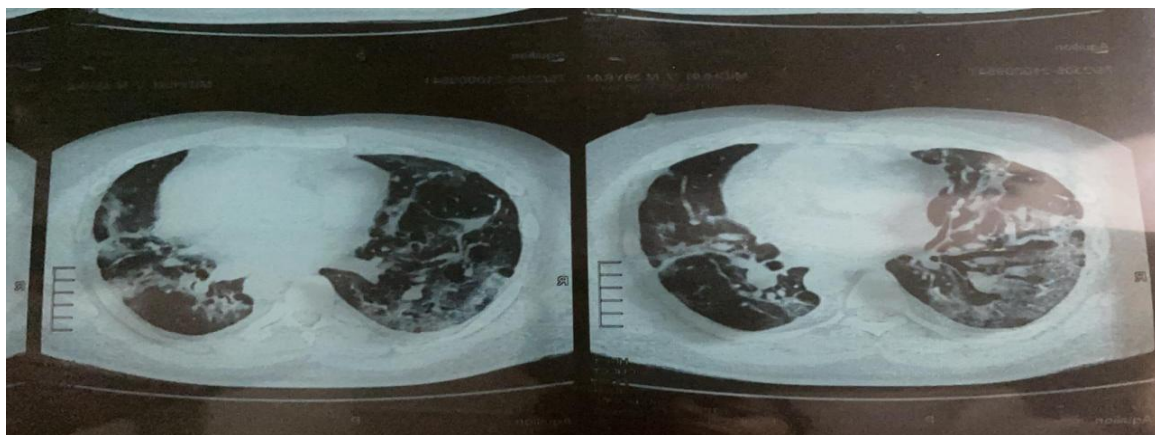
Oxygen saturation on room air improved from 92% to 99%. PCFS reduced from grade 4 to grade 0 reflecting absence in functional limitations. WHOQOL-BREF questionnaire score showed an improvement from 45 to 88. DASS-21 depression subscale score reduced from 11 denoting severe depression level to 5 denoting mild level and anxiety subscale score reduced from 8 denoting severe anxiety level to 3 that is normal level and stress subscale score reduced from 16 denoting severe stress level to 6 denoting normal level. After undergoing PR for 8 weeks, the subject was able to manage all accustomed activities in accordance with his lifestyle in ease.

**Table 1: PR protocol:**

Individualized Pulmonary Rehabilitation Program				
	1-2weeks	2-4weeks	4-6weeks	6-8weeks
Endurance training	Symptom Limited walking on 6-20 Borgs scale	Walking at 40% of maximal heart rate	Walking at 50% of maximal heart rate	Walking at 60% of maximal heart rate
Strength Training for major muscle groups of upper and lower limb using weight cuffs by 10 RM protocol	-	2 sets of 10 repetitions	2 sets of 12 repetitions	2 sets of 15 repetitions
Flexibility Training: for all the major muscle groups for upper and lower limb (1 set of 3 repetitions)				
Breathing Exercises: lung expansion therapies, volumetric spirometer				
Inspiratory muscle training (IMT)	-	3 sets of 10 repetitions x 2/day	3 sets of 10 repetitions x 3/day	3 sets of 10 repetitions x 4/day

**Table 2: Outcome variables studied prior to and post rehabilitation intervention;**

Outcome variable	Pre- Rehabilitation	Post- Rehabilitation
6MWD	179 meters	420 meters
Oxygen Saturation at rest on room air	92%	99%
PCFS	Grade 4	Grade 0
FIM	93/126	126/126
WHOQOL-BREF	45	88
DASS-21		
i. Depression	11	5
ii. Anxiety	8	3
iii. Stress	16	6



**Figure 1: CT chest shows diffuse patchy ground glass and reticular opacities as well as consolidations extensively involving the lung bilaterally especially in the peripheral and peribronchovascular location.**

## DISCUSSION

Severe COVID-19 survivors are at risk of developing long-term functional impairment<sup>[5]</sup>. Pulmonary rehabilitation is a recognized multidisciplinary approach incorporated by the global initiative for chronic respiratory conditions as a standard of care in management<sup>[7]</sup>. Covid-19 being a novel virus, paucity of literature is seen with limited guidelines available regarding conducting PR in post-COVID cases. Due to severe fatigue, dyspnea, continuous monitoring of oxygen saturation and SOS requirement of oxygen supplement unit; if need arrives especially during his commute to OPD setup, home-based PR program was considered best for the patient. Supervised home-based PR was incorporated for our subject based on possible pathophysiological changes and decision-making depending on existing guidelines on PR in chronic respiratory conditions for early recovery.<sup>[7]</sup> To the best of our knowledge, this is the first case study investigating the effects of supervised home-based PR in a patient with post COVID-19 syndrome.

In this case report, individualized supervised home-based PR enhanced functional capacity in the patient with post COVID syndrome. Hanada M et al (2020) in their systematic review showed a significant improvement in 6MWD and dyspnea with PR in patients with pulmonary fibrosis.<sup>[12]</sup> We observed similar results; there was improvement in the 6MWD and resting room air oxygen saturation values in our patient following PR. Many studies have shown that incorporating PR helps in alleviating symptoms of the disease condition, thereby improving QOL, functional capacity and decreasing psychological distress in patients with chronic respiratory diseases conditions.<sup>[13-15]</sup> Similar results were seen in our study, there was improvement in QOL and reducing in anxiety, depression and stress levels following 8 weeks of PR.

PR interventions can lead to improved exercise capacity as it challenges

the entire pathway of oxygen transport; it improves the gas exchange by boosting oxygen transport; enhancing oxygen extraction, cellular uptake, utilization and consumption by skeletal muscles.<sup>[7]</sup> Patients diagnosed with COVID-19 not only demonstrate anxiety, depression, insomnia and stress due to fear of the disease<sup>[16]</sup> but due to various clinical manifestations of the disease condition like dyspnea, fatigue, decreased functional capacity, patient become heavily dependent on others for basic ADLs consequently demonstrating more psychological distress. Supervised home-based PR helps in optimizing exercise capacity, enhances QOL and also helps in reducing anxiety, depressive and stress symptoms as seen this case report. This exercise intervention was safe and effective for our patient.

## CONCLUSION

Supervised home-based PR had positive effects by improving exercise capacity, functional reserve and QOL in patient with post COVID syndrome. Thus, it can be considered as an important adjunct in these patients, we need to identify the individuals who need pulmonary rehabilitation and to give early referrals.

## Declaration of Patient Consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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**Conflict of Interest:** None

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