Long after the lockdowns: Effect of Inpatient Rehabilitation Protocol in a middle-aged male diagnosed with COVID-19 Pneumonia

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Abstract*—Coronavirus disease 2019 (COVID-19) severely challenged healthcare systems worldwide, with later waves associated with greater respiratory compromise, higher intensive care utilisation, and prolonged recovery. Survivors of severe infection frequently develop persistent symptoms and reduced functional capacity, underscoring the need for structured rehabilitation. This case report presents the clinical course and physiotherapy rehabilitation of a 52-year-old male with severe COVID-19 pneumonia complicated by acute respiratory distress syndrome and extended invasive mechanical ventilation. A personalised, staged physiotherapy program was initiated early during the intensive care unit stay and advanced systematically over three weeks. The intervention included diaphragmatic and thoracic expansion exercises, Buteyko-based breathing retraining, airway clearance techniques, passive and active-assisted limb mobilisation, progressive strengthening, balance training, gait re-education, and aerobic conditioning. Rehabilitation goals focused on improving ventilation, preventing immobilisation-related complications, restoring muscle strength, and achieving functional independence. Outcomes were measured using validated scales, including the ICU Mobility Scale, Hospital Anxiety and Depression Scale, Post-COVID Functional Status Scale, and Borg Rating of Perceived Exertion. Marked improvements were observed across mobility, functional status, exertion tolerance, and psychological well-being at program completion. This case highlights the clinical value of early, structured, and individualised physiotherapy in critical respiratory illness recovery and supports its role in improving overall function, independence, and quality of life after severe COVID-19.

***Index Terms*—COVID-19, Severe pneumonia, Pulmonary rehabilitation, Physiotherapy, SARS-CoV-2, Long COVID, Return of COVID**

I. INTRODUCTION

Coronavirus disease 2019(COVID-19) developed in late 2019 in Wuhan, China, and rapidly became a global pandemic. This epidemic disorganised healthcare systems and changed clinical practices all over the world (1). SARS-CoV-2 was an extremely infectious, enveloped, positive-sense RNA virus that mostly attacks the respiratory system. Early clinical descriptions from Wuhan cohorts documented characteristic pneumonia patterns and high hospitalisation burden (8,9). India met its first wave of COVID-19 from March to September 2020. This wave promoted a gradual rise in cases and manageable healthcare claims. However, the second wave, which struck between March and May 2021, was very bad and extra harmful (2). Cases increased at twice the rate of the initial wave, which put pressure on the healthcare system. Hospitals faced severe shortages of beds, medical oxygen, ventilators, and essential medications. During the second wave, the patient had greater oxygen needs. There was also more use of invasive mechanical ventilation, an increase in ICU

admissions, more organ dysfunction, and higher mortality rates compared to the first wave. This increased wave was mainly driven by highly contagious variants of SARS-CoV-2, which showed major virulence and the ability to evade immunity. Rapid disease progression and severe clinical presentations are led by this (3,11). Numerous survivors faced ongoing symptoms and functional issues after healing from acute COVID-19. This condition was known as long COVID or post-acute sequelae of SARS-CoV-2 infection (PASC). Long COVID contains several prolonged symptoms such as fatigue, shortness of breath, cognitive problems, muscle weakness, and decreased exercise capacity. These often last for weeks or months after the acute phase.

The rise of long COVID emphasised the need for rehabilitation to address not just immediate respiratory and physical issues from severe illness, but also long-term function and mental health recovery (4,15). In addition to conventional pulmonary rehab, specific breathing retraining techniques such as the Buteyko Breathing Method have been studied for respiratory conditions and post-COVID recovery, showing improvements in dyspnea, exercise capacity and quality of life in adults recovering from SARS-CoV-2 infection with structured programs of breathing control and breath pattern modification after three weeks of intervention in post-COVID patients (7). In these post-COVID-19 times, health systems all over the world remained highly alert due to lessons learnt. Recently, with the outbreak of the Nipah Virus in late In December 2025, in West Bengal, India, there has been a rapid tracing of cases across the country. Nipah infection is said to be rare and caused by animal reservoirs. It has been stated that there is no specific therapy or vaccination available for the management of this infection.

Both diseases share homogenous characteristics, human-to-human transmission, respiratory symptoms, and systemic inflammatory response.
Targeted and tailored physiotherapy rehabilitation programs have worked efficiently in conditions with respiratory compromise and systemic involvement. Results have shown regained physical capacity and overall functional tolerance. This report figures out the clinical pathway and rehabilitation of an old man with severe COVID-19 pneumonia. He was admitted during the second wave and developed ARDS and required prolonged mechanical ventilation (12). The peculiarity of this case lies in its full documentation of a gradually personalised physiotherapy protocol that was initiated early in the ICU, and it was performed systematically to attain complete functional independence. The present case highlights the essential role of early and focused rehabilitation in upgrading healing outcomes and acts as a practical guide for clinicians managing patients in the situation of growing infections of zoonotic origin.

II. CASE PRESENTATION

The patient was a 52-year-old male with a personal history of non-smoking and who occasionally consumed alcohol. He worked as a software engineer, which involved mostly sedentary work with minimal physical exertion. The patient presented with complaints of high-grade fever, persistent dry cough, and progressively worsening shortness of breath over a span of 7 days. The patient initially experienced low-grade fever and malaise, which had progressed over three days to high-grade fever with temperature peaks reaching 38.5°C, with a dry cough. Three days before his hospital admission, he developed significant dyspnea at rest, which rapidly deteriorated further to the point that it significantly impeded his ability to perform his activities of daily living. There was no chest pain, haemoptysis, or weight loss. The patient had no known history of chronic illnesses such as hypertension, diabetes mellitus, cardiovascular diseases, or respiratory disorders. He had not had any surgeries or previous hospitalisations. Immunisations were updated, including influenza and pneumococcal vaccines. There was no known drug allergy. The patient reported no significant environmental exposures. He stayed in a well-ventilated apartment and has been working from home since the COVID-19 pandemic started. He denied any recent travel history or known contact with active or suspected COVID-19 individuals at the onset of symptoms. No history of toxic substance exposure or particulate matter was noted. The patient was referred to physiotherapy due to severe respiratory compromise and prolonged immobilisation after invasive mechanical ventilation for critical COVID-19 pneumonia. Physiotherapy aimed at preventing

complications such as joint stiffness and muscle atrophy, improving pulmonary ventilation and airway clearance, strengthening of respiratory muscles, and progressive restoration of mobility and endurance to allow a safe return to independence and improve the overall quality of life. Written informed consent was obtained from the patient before inclusion in this case study. The patient consented to the use of clinical information, rehabilitation data, and relevant images for academic and publication purposes. Confidentiality of the patient's identity was strictly maintained throughout the study.

Diagnostic Assessment

Laboratory tests performed included RT-PCR from a nasopharyngeal swab, which tested positive. Haematological investigations revealed marked lymphopenia, with a lymphocyte count of 900 cells/µL, along with significantly elevated inflammatory markers, including C-reactive protein measuring 75 mg/L and a D-dimer level of 1200 mg/ML. Imaging studies supported these findings; the chest X-ray demonstrated bilateral patchy infiltrates with ground-glass opacities predominantly in the lower lobes, consistent with viral pneumonia. Standard Hospital Management strategies, including corticosteroid therapy and thromboprophylaxis, have been supported by major clinical guidance and trials (13,14). High-resolution computed tomography (HRCT) further confirmed extensive bilateral lung involvement, showing diffuse ground-glass opacities and consolidations characteristic of COVID-19 pneumonia, as shown in Figure 1.

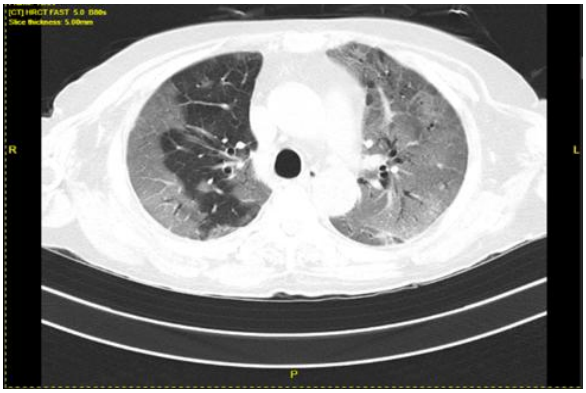

Figure 1 shows the presence of ground glass opacities suggestive of COVID-19 Pneumonia

III. CLINICAL FINDINGS

On examination, the patient appeared tired and exhibited laboured breathing with the use of accessory respiratory muscles during both quiet and deep respiration. The respiratory rate was elevated to 28 breaths per minute, accompanied by nasal flaring and mild diaphoresis, although no cyanosis was observed. Palpation revealed asymmetric chest expansion with reduced movement of the lower posterior lobes bilaterally, and tactile vocal fremitus was increased over the affected lung segments, indicating consolidation. Percussion findings showed bilateral dullness over the lower lung fields, suggestive of alveolar consolidation, with no hyper-resonance or tympany. Auscultation revealed coarse symmetrical crackles predominantly over the posterior lower lobes, with occasional expiratory wheeze and diminished breath sounds in the affected areas, without any pleural rubs. Cardiovascular examination was normal, with a regular heart rate and rhythm and palpable, symmetrical peripheral pulses. Other systemic examinations were within normal limits.

Timeline

Date	Event
27/06/2025	Date of Admission
01/07/2025	RT-PCR result positive for COVID-19
03/07/2025	Physiotherapy rehabilitation started in the ICU
23/07/2025	Hospital discharge after functional independence is achieved
07/08/2025	Follow-up

Therapeutic Intervention

The goal of this therapy was to stabilise respiratory function, prevent complications that can occur in the ICU, and gradually help the patient regain their functional independence through a planned physiotherapy program, as shown in Table

Week	Day	Intervention	Frequency	Duration	Sets/Reps	Outcome
Week 1	Day 1-7	Passive and active-assisted range of motion exercises on the shoulder, elbow, wrist, hip, knee, and ankle joints	2x daily	15 min	2x10	Prevent joint stiffness, maintain mobility
		Diaphragmatic breathing and thoracic expansion exercises	2x daily	10 min	2x10	Improve lung ventilation
		Incentive spirometry	2x daily	15 min	3x10	Promote alveolar expansion, prevent atelectasis
		Buteyko Breathing Technique	Once daily	15 min	3x5	Enhances oxygen concentration at the tissue level, reduces sympathetic overactivity, and improves diaphragmatic efficiency
	Day 4-7	Airway clearance techniques	2x daily	20 min	N/A	Aid secretion removal
		Edge-of-bed sitting and sitting balance exercises	1-2x daily	15 min	N/A	Improve posture and endurance
Week 2	Day 8-10	Assisted standing (sit-to-stand, bed-to-chair transfers, supported squats), gait training with a walker	2x daily	30 mins	3 sets x 12	Focus on regaining postural control, improving transfers
		Lower limb strengthening: static quadriceps sets, gluteal sets, heel raises, straight leg raises	2x daily	20 mins	3 sets x 10	Target muscle reconditioning, prevent lower limb weakness
		Respiratory muscle training: inspiratory muscle trainer (IMT), incentive spirometry	2x daily	10 mins	3 sets x 10	Improve respiratory endurance
		Marching in place, active knee lifts	1x daily	10 mins	2 sets x 15	Early gait and aerobic conditioning

	Day 11-14	Gait progression: walking with a walker, step-ups on the bottom stair, heel-to-toe walking	2x daily	20–30 mins	3 sets x 15	Combined endurance and balance, progress distance as tolerated
		Functional upper limb activities: biceps curls with light weights, wall push-ups	1x daily	10 mins	2 sets x 12	Improve arm strength for daily living
Week 3	Day 15-18	Independent walking (room, corridor), stair climbing, outdoor walking as tolerated	2x daily	30 mins	3 sets x 15	Focus on functional independence, progress terrain
		Endurance training: continuous walking, step-ups, cycling (if feasible)	2x daily	30–40 mins	3 sets x 20	Aim for sustained aerobic activity, and increase intensity slowly
		Upper limb strengthening: shoulder presses, wall push-offs, sit-to-stand with arm swings	1x daily	15 mins	2 sets x 12	Increase upper body support and activity level
		Flexibility & balance: trunk rotations, side bends, standing marches, single leg stance	1x daily	10 mins	2 sets x 10	Enhance flexibility, proprioception, and balance
	Day 19-21	Pulmonary rehabilitation: combined aerobic (walking, cycling), strengthening, and deep breathing exercises	2x daily	30–40 mins	3 sets x 20	Comprehensive recovery, target return to pre-illness fitness

Table 1: The plan of physiotherapy intervention over a period of 2 weeks

Outcome Measures

The effectiveness of the physiotherapy treatment was measured using a comparison of the patient's condition on several outcome measures (Table 2).

Parameter	Pre-Rehabilitation (Day-1)	Post-Rehabilitation (Day-21)
ICU Mobility Scale (18)	2	9
Hospital Anxiety and Depression Scale (19)	A-12, D-10	A-5, D-4
Post-COVID-19 Functional Status Scale (20)	3	1
Borg Scale (RPE) (21)	6 (severe exertion)	2 (light exertion)

Table 2: The effectiveness of rehabilitation of the patient over a span of 2 weeks

Figure 1: (A)Patient performing incentive spirometry in a hospital bed under the supervision of a physiotherapist, aimed at improving lung expansion and airway clearance, (B) Patient engaging in bedside balance and mobility exercise with physiotherapist support, demonstrating active lower limb strengthening and early rehabilitation after critical illness, (C) Patient ambulating in the hospital corridor with minimal therapist assistance, illustrating progression to independent walking as part of the stepwise physiotherapy protocol.

IV. DISCUSSION

This case report demonstrated that staged physiotherapy rehabilitation significantly improved lung function, exercise capacity, muscle strength, and overall quality of life in a patient with severe post-COVID-19 pneumonia. The treatment included breathing exercises, limb movement, gradual postural and aerobic training, and allowed for a safe return to independence while reducing post-COVID symptoms like shortness of breath, fatigue, and decreased activity tolerance, as supported by an article by Ponce-Campos et al. (2022) (5). They introduced a new 12-session, 4-week physiotherapy program for post-COVID-19 patients. Their results showed about a 50% reduction in post-COVID symptoms, an improvement in emotional well-being, a 7–8% increase in FEV1 and FVC, a 13% improvement in the 6-minute walk test distance, and increased grip strength, closely reflecting the outcomes of this case. Their study highlighted how personalised respiratory and aerobic retraining, combined with strength exercises, could speed up symptom relief and functional recovery for COVID-19 survivors.

Likewise, Chen et al. (2022), in systematic and meta-analytic reviews, supported early team-based pulmonary rehabilitation to improve shortness of breath, exercise capacity, and mental health in post-acute COVID-19 cases. This author emphasised the need for therapist-led programs focusing on breathing techniques, aerobic fitness, and emotional recovery as essential for regaining independence (10). Barker-Davies et al. (2020) reported significant and rapid improvements in FVC and FEV1, as well as overall quality of life in both post-hospital and outpatient COVID-19 patients through structured pulmonary rehabilitation (16,17).

However, the broader literature also points out some variability and uncertainty in physiotherapy results. The Cochrane Rehabilitation REH-COVER

systematic review by Arienti et al. (2024) analysed 53 randomised controlled trials and found that in non-severe COVID-19 or post-acute conditions, breathing and strengthening exercises had uncertain effects on lung function compared to no treatment (6). While tele-rehabilitation and muscle-strengthening may slightly boost exercise capacity and reduce shortness of breath, there was only low-to-very-low confidence in the evidence for improvements in FEV1/FVC ratios and inspiratory muscle strength. This indicates ongoing questions about the effectiveness and consistency of certain therapies for milder cases or home-based interventions. Therefore, this case, along with several high-quality studies, reinforces the need for personalised physiotherapy in early team-based management for post-COVID-19 rehabilitation. Although recent studies confirm meaningful improvements in function and symptom relief with well-structured rehabilitation, systematic reviews stress the necessity for more rigorously designed studies with standardised protocols to determine the best approaches for less severe cases or long-COVID presentations.

V. CONCLUSION

Early and thorough physiotherapy rehabilitation significantly reduces issues after COVID-19, which might mimic the symptoms of Long COVID syndrome. Early rehabilitation has shown its effectiveness in improving the overall quality of life of patients.

Patient Perspective:

I was exhausted from even the smallest movements after my ICU stay, and I felt very weak and out of breath. With physiotherapy, I gradually gained confidence and strength. The supervised exercises helped me move more freely and with less fear. I am pleased with my recuperation and believe that physical therapy was very important.

Declarations

Ethics approval and consent to participate- Ethics approval is not required for the case report. Consent to participate is taken from the patient.

Consent for publication- Written consent was obtained from the patient for publication of this case report and any accompanying images. A copy of written consent is available for review by the editor-in-chief of this journal.

Availability of data and materials- None

Competing interests- The authors declare that they have no competing interests.

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Authors' contributions- MD and PC analysed and interpreted the patient data regarding the condition and rehabilitation of the patient. PC and PB were major contributors to writing the manuscript. PB and TP reviewed the final draft and did major revisions. All authors read and approved the final manuscript.

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