



# **A Pioneering Physiotherapeutic Approach to the Treatment of a COVID Affected Patient – A Case Report**

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## **Authors' contributions**

*This work was carried out in collaboration between both authors. Author VS evaluated the case, author VS and OCW contributed equally in documenting and planning the management. All authors read and approved the final manuscript.*

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**Case Study**

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## **ABSTRACT**

The Coronavirus (SARS-CoV-19) originated from Wuhan, China and has affected globe since 2019. The virus spread to India in January, 2020. It is highly contagious. In its severe form, the victims of the virus suffered from symptoms such as breathing difficulties, fever, weakness, loss of taste and smell, amongst others. Patients were put on mechanical ventilators and as a result, the requirement of the role of cardio-respiratory physiotherapists became more and more essential. Even after weaning off from the ventilators and being detected Coronavirus negative, the role of the physiotherapists still remained indispensable in order to bring about improvement in the muscle strength of the affected weakened muscles, especially for patients whose movements were limited for extended periods of times due to being dependent on the ventilators; physiotherapists were also

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required to bring about improvement in the lung capacities and function, to teach gait training for those who find it difficult to walk, to improve in-coordination and overall allow the patients to come back to normal and carry out all the ADL independently and well. He had a severe difficulty in breathing and coughing, along with a generalized weakness all over his body, specifically both his lower limbs. He was admitted in the ICU immediately and was on mechanical ventilator. After all the physiotherapy sessions, the patient was able to carry out his activities of daily living independently; he regained his muscle strength and improved his coordination and ability to walk with a proper gait. He was also able to breathe independently with adequate respiratory muscle strength; and did not feel fatigued as quickly as he used to when he was detected positive for Coronavirus.

**Keywords:** COVID-19, Respiratory rehabilitation; ADL; gait training; coordination exercises; muscle strengthening; Post-COVID.

## ABBREVIATIONS

QOL	:	Quality of Life
ICU	:	Intensive Care Unit
ADL	:	Activities of Daily Living
AVBRH	:	Acharya Vinoba Bhave Rural Hospital
MMT	:	Manual Muscle Testing
GADL	:	General Activities of Daily Living (scale)
AROM	:	Active Range of Motion
FAS	:	Fatigue Assessment Scale
ETT	:	Endotracheal Tube

## 1. INTRODUCTION

The novel Coronavirus labelled a pandemic by the director-general of WHO (World Health Organization) in March 2020 [1]. The symptoms of this Coronavirus commonly include coughing, the feeling of fatigue, the production of expectoration and fever. In fact, in 20% of the cases, respiratory failure occurs which even includes the occurrence of Acute Respiratory Distress Syndrome (ARDS) [2]. Victims of the pandemic can either experience symptoms which are mild to moderate, while some (20%) experience symptoms that are more severe. These more severe symptoms usually include the necessity of a mechanical ventilator to aid the breathing, hospital stay for long periods of time, and acute care from the initial stages [3]. In the rehabilitation sessions run by the physiotherapists, exercise prescription and mobilization techniques in the early stages are given to limit the ICU-acquired weakness and eventually result in a fruitful discharge from the hospital with the ability of the patient to carry out movements and activities functionally well [4].

As far as physiotherapy is concerned, from day one of care for patients in the ICU, intensive rehabilitation and adequate care for the

respiratory system of the patient should be the first main concern. In addition to this, importance should also be given to the appropriate positioning of the patient to avoid the complications related to prolonged bed rest [5]. For patients who are hospitalized, exercises should be especially prescribed and performed to prevent the loss of the mass and strength of muscle fibers [6]. Physiotherapists working on the pulmonary rehabilitation perform the removal of secretions of the affected patients, improves the breathing cycle and the lung ventilation, ultimately aiming at improving the QOL [7].

## 2. CASE REPRESENTATION

### 2.1 Patient Information

A 16-yr old male from Wardha, Maharashtra was detected positive for Coronavirus on the 15<sup>th</sup> of June 2020. He was brought to the emergency department of the AVBR Hospital in Sawangi, and his condition was examined. Patient was febrile and avoiding strenuous activity, he complained of generalized body weakness, especially in the lower limbs; and difficulty in coughing. He had no history of smoking or alcoholism. An X-ray of his chest was taken and his chest was auscultated for breath and heart sounds. After being in the ICU for one and a half months and getting detected negative for Coronavirus, he was moved to the general ward where he then complained of issues related to the complications of prolonged immobilization. These included his consistent feeling of tiredness, overall feeling of weakness, and the inability to independently carry out his activities of daily living (that included going to the washroom).

### 2.2 Clinical Findings

Patient was thoroughly examined. Upon the examination, he was found to had tachypnea (26

bpm), and tachycardia (119 bpm). His chest expansion at the nipple level was notably decreased (expanded only 1.5 cm). Heart sounds (S1 and S2) were heard and normal. At the time, persistent fever was present along with grade 3 dyspnea according to NYHA since the last seven days. His chest X-ray showed bilateral interstitial thickening and consolidation of the lung parenchyma. His lower limbs had the MMT grade 3 'Fair' in which they could do the activities against gravity. His upper limbs had the MMT grade 4 'Moderate' in which they could do activities against gravity with moderate resistance. During the course of his stay in the ICU short after, his muscle strength from both his upper and lower limbs worsened because of the prolonged period of reduced mobilization. It was then MMT grade 2 'Poor' for

the lower limbs where ranges of motions could only be completed in the gravity omitted planes. The upper limbs had a MMT grade 3.

### 3. TREATMENT PROTOCOL

The physiotherapy sessions commenced on the first day itself of hospital stay. In the first one and a half months, the isolated ICU room could only be accessed while wearing the appropriate personal protective equipment. During these sessions, postural drainage, suctioning, huffing techniques and breathing exercises, were focused on, as well as frequently changing the position of the body. Brief counseling sessions were also conducted to boost the morale of the patient.



Fig. 1. Treatment of patient



Fig. 2. Patient morphology

**Table 1. MMT (Manual Muscle Testing) – lower limbs**

AROM	Time of admission into the hospital		Time of being shifted from the ICU to the general ward		Time of discharge	
	Left	Right	Left	Right	Left	Right
Hip flexion	3/5	3/5	2/5	2/5	4/5	4/5
Hip extension	3/5	3/5	2/5	2/5	4/5	4/5
Knee flexion	3/5	3/5	2/5	2/5	4/5	4/5
Knee extension	3/5	3/5	2/5	2/5	4/5	4/5
Ankle flexion	3/5	3/5	2/5	2/5	5/5	4/5
Ankle extension	3/5	3/5	2/5	2/5	4/5	5/5

**Table 2. MMT (Manual Muscle Testing) – upper limbs**

AROM	Time of admission into the hospital		Time of being shifted from the ICU to the general ward		Time of discharge	
	Left	Right	Left	Right	Left	Right
Shoulder flexion	4/5	4/5	3/5	3/5	5/5	5/5
Shoulder extension	4/5	4/5	3/5	3/5	4/5	4/5
Elbow flexion	4/5	4/5	3/5	3/5	4/5	5/5
Elbow extension	4/5	4/5	3/5	3/5	4/5	4/5
Wrist flexion	4/5	4/5	3/5	3/5	5/5	5/5
Wrist extension	4/5	4/5	3/5	3/5	5/5	5/5

**Table 3. FAS (Fatigue Assessment Scale) scores**

FAS Score at the time of admitting into the hospital (15 <sup>th</sup> June 2020)	34/50
FAS Score at the time when patient was shifted from the ICU to the general ward (2 <sup>nd</sup> August 2020)	46/50
FAS Score at the time of discharge from the hospital (1 <sup>st</sup> September 2020)	20/50

**Table 4. GADL (Generalized Activities of Daily Living) scores**

GADL Score at the time of admitting into the hospital (15 <sup>th</sup> June 2020)	12/26
GADL Score at the time when patient was shifted from the ICU to the general ward (2 <sup>nd</sup> August 2020)	4/26
GADL Score at the time of discharge from the hospital (1 <sup>st</sup> September 2020)	21/26

**Table 5. Timeline of events**

Events	Dates of events
Detected positive for Coronavirus	15 June 2020
Admitted into AVBRH and placed in the ICU	15 June 2020
Initiation of physiotherapy sessions in the ICU	16 June 2020
Detected negative for Coronavirus	27 July 2020
Patient shift to general ward	2 August 2020
Initiation of physiotherapy sessions in the general ward	3 August 2020
Discharge from the hospital	1 September 2020

**Week 1-6(ICU period):** Postural Drainage was done bilaterally on the lungs, especially focused on the lower lobes, to enable the removal of the accumulated mucus in the system. This was preceded with humidification to ease the dislodgment of the mucus in the lungs.

Suctioning was carried out after the percussions and vibrations were given, as part of the routine procedure of Postural Drainage. This is important for the maintenance of the tracheobronchial areas. Besides this, suctioning was also conducted routinely every 3-4 hours or when there was audible evidence of the build-up of mucus.

Breathing exercises (Pursed-lip and Segmental breathing) were taught to the patient. This increased the lung expansion capacity and improved the air inflow into the lungs and hence positively affected the whole body.

Frequent changes in the position of the body was done by the nurses every 2 hours. This was to prevent the complications associated with long term immobilization which included the formation of decubitus ulcers.

After the sixth week, the patient was detected negative for Coronavirus, and showed an improvement in his ability to breathe independently and had successfully weaned off from the mechanical ventilator. He was moved to the general ward by the 7<sup>th</sup> week where the physiotherapy sessions were continued. This included strengthening and endurance exercises for the whole body, conducting coordination exercises, teaching coughing techniques, gait training, and using an incentive spirometer.

**Week 7-10:** Strengthening exercise sessions were begun and gradually progressed. In the 7<sup>th</sup> week, the patient could carry out free exercises in the gravity eliminated plane only, for 5-7 repetitions before he got fatigued. His lower limbs were more affected than his upper limbs. He gradually progressed by the 8<sup>th</sup> week, when

the patient was able to carry out 2-3RM load for 4-5 repetitions, 2 sets each time with a 5 minute interval of rest between the sets. This took place twice a week. By the end of the 10<sup>th</sup> week, it had progressed to 8-12RM load for 8-12 repetitions, 2-3 sets with 2 minutes of rest between the sets. This took place thrice a week. Endurance training was done by decreasing the loads and increasing the repetitions. Both strengthening and endurance exercises were conducted in sitting position and supine position.

Coordination exercises for the upper and lower limbs were carried out twice a day, daily. This was done to improve the coordination. Finger-to-nose, Finger-to-finger, Heel-to-shin, foot placements on the Frenkel's mat and reach out exercises were done.

Ask the patient to focus on putting equal pressure on both feet and then perform side to side movements by shifting your weight from one leg to the other. Shift your weight to the right leg and hold for 5 seconds. Then shift your weight to your left leg and hold for 5 seconds. Move back to your neutral position.

Coughing techniques were taught in order to expectorate the mucus, so as to avoid its accumulation of the in the airways. This was aided by the ability to huff, (that was initially taught in weeks 1-7 of the physiotherapy sessions).

Gait training was also begun. Because the patient had been bedridden in the ICU for one and a half months, the requirement for gait training was very essential. The patient walked with the absence of heel strike in both of the limbs and so with the help of a walker, he was taught to regain his normal gait by week 8.

Incentive spirometry was introduced in the 7<sup>th</sup> week. The improvement of the lung volume was clearly noticed in the following weeks, progressing from 500ml to an impressive 1200ml by the 10<sup>th</sup> week of the physiotherapy sessions.

After this, by the 11<sup>th</sup> week, the patient was discharged from the hospital and was allowed to go home. A home exercise program was prescribed to promote the well-being of the patient. Taking a 20 minute jog in the mornings followed by continuing his strengthening and endurance protocol, gradually progressing as he got better. Exercises like cycling and swimming were also advised twice a week as well as the suggestion to see a psychologist in case he felt the need to see one. Physiotherapy follow up checks were conducted once a week for 4 weeks after the patient was discharged from the hospital to monitor the progression of his condition.

## **4. DISCUSSION**

### **4.1 Postural Drainage**

Postural drainage provides relief for the patient by clearing mucus from the airways. Gravity assists the movement of the mucus to move towards the central direction from the targeted lung unit of the affected patient [8]. With the reduction of the build-up of mucus, the patient will be able to breathe better. Techniques including applying vibrations and percussions aid in the process.

### **4.2 Suctioning**

After postural drainage, there may be a requirement for suctioning in patients, especially those fixed with an ETT. With the help of suctioning, airway secretions are removed, hence improving the lung ventilation and oxygenation, and the patient's overall ability to breathe [9].

### **4.3 Breathing Exercises: Purse Lip Breathing**

Purse lip breathing is an expiratory breathing exercise that increases the use of the diaphragm while breathing and reduces the use of accessory muscles. It can be used for people with irregularities in breathing patterns, specifically the occurrence of dyspnea episodes. Purse lip breathing is believed to work by keeping the airways open as the back-pressure in the airways is generated, hence increasing the tidal volume in the lungs [10]. This is how it helps people who have breathing irregularities and breathing difficulties.

### **4.4 Strengthening**

The strength of a muscle is the contractile tissue's ability to produce tension and hence a

resultant force. These are completely dependent on the demand placed on the muscle [11]. In order to bring about actual strengthening, the overload principle is the key principle to be focused on. It states that in order to improve a muscle's performance, the metabolic capacity of the muscle must be challenged with a greater load than what it is accustomed to [12].

### **4.5 Coordination Exercises**

Coordination tests generally can be divided into two main categories: gross motor movements and fine motor movements. Gross motor tests include body posture, balance, and extremity movements involving large muscle groups. Examples of gross motor activities include crawling, kneeling, standing, walking, and running. Fine motor tests address movements concerned with utilization of small muscle groups that involve skillful, controlled manipulation of objects. Examples of fine motor activities include finger dexterity tasks such as buttoning a shirt, typing, or handwriting [13]. It also includes reach out activities such as Finger-to-nose, Finger-to-finger, Heel-to-shin, foot placements on the Frenkel's mat. After suffering from Coronavirus and having been immobilized for an extended period of time, the coordination was noticed to be diminished and hence the need of coordination exercises was required.

### **4.6 Coughing Techniques**

A successful cough is when a large inspiratory efforts is followed by forceful expiration. This is necessarily taught to the post Coronavirus patient because of their prolonged immobilization due to begin independent on mechanical ventilation. Assisted cough is used to increase the inspiratory volume of the Coronavirus patient. compressive forces, directed by the therapist hand placed over the abdomen, and produces inward and outward which facilitates the muscles: diaphragm and intercostal muscles [14].

### **4.7 Gait Training**

Gait training aids in maintaining the support of the upper part of the body and prevents the lower limbs from collapsing; it maintains the balance and upright position of the patient's body which is necessary in patients who have experienced a long period of immobilization; it aids in the control of foot trajectory and also maintains the velocity of the body's movement. These are essential in post-Coronavirus patients who have not had

adequate body movements for long periods of time due to being hooked on to mechanical ventilators [15].

#### 4.7.1 Incentive spirometry biomechanics of normal and pathological gait

In order to encourage the affected patients to take deeper breaths, incentive spirometry is introduced into the rehabilitation program. The atelectatic areas of the lungs are hence opened when a sustained maximal inspiration is done by the patient [16]. Whenever there is deterioration in the working of the pulmonary system, the performance using the incentive spirometer is also reduced. Incentive spirometry is hence can be used as an indicative method of determining the progress of the pulmonary rehabilitation [17]. The advantages of using incentive spirometry is that it needs relatively minimal supervision, it is non-invasive and cheap [18].

#### 4.8 Breathe Stacking

Breathe stacking aid in maximizing the lung volumes which also ultimately results in the removal of secretions. It is not expensive and the involvement of a one way valve ensures multiple breaths are taken in before the initiation of exhalation can take place. This is necessary for post-COVID patients because of their difficulty in breathing and inefficiency in lung function [14].

### 5. CONCLUSION

The case has demonstrated the importance of physiotherapy from the first day of being detected positive for Coronavirus all the way up to the stage where the patient is fully functionally independent and can affectively carry out their activities of daily living. He was also able to breathe independently with adequate respiratory muscle strength; and did not feel fatigued as quickly as he used to when he was detected positive for Coronavirus.

#### CONSENT AND ETHICAL APPROVAL

As per international standard or university standard guideline patients consent and ethical approval has been collected and preserved by the authors.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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