


**Review****The Role of Cardiopulmonary Rehabilitation in Patients with Infected COVID-19**Zuhal Kunduracılar<sup>1</sup> 

<sup>1</sup>Department of Physical Therapy and Rehabilitation, Faculty of Health Sciences, University of Health Sciences, Hamidiye, Istanbul, Turkey

**Abstract:** The 2019 new type of coronavirus, or 2019-nCoV (with new name is SARS-CoV-2), is closely related to the coronavirus (batSL-CoVZC45 and bat-SL-CoVZXC21), which have similar characteristics like as severe acute respiratory syndromes. Spread of the virus happens from person to person with droplets or direct contact. The average incubation period of the infection is 5-6 days (2-14 days). In patients recovered from Covid-19 pneumonia and acute respiratuar distress sendrome (ARDS). However, post-acute physiotherapy and rehabilitation needs for the patients are not completely known. According to the informations from other viral infections such as H1N1 and SARS, respiratory and physical function losses (muscle mass and muscle function loss, myopathy, contractures, neuropathy and/or weakness acquired in intensive care) are observed after acute illness, ARDS and intensive care processes. Furthermore cognitive and emotional dysfunctions (anxiety, depression, post traumatic stress syndrome) may affect participation and quality of life. Rehabilitation interventions should be started as early as possible in mild and moderate cases. The short-term goal of cardiopulmonary rehabilitation is to alleviate dyspnea, anxiety and depression, the long-term goal is to maximize the funcnctionality of the patient, improve the quality of life and facilitate her return to society. Cardiopulmonary rehabilitation programme should be done mainly via videos, brochures, remote consultations or online to prevent cross infection for the patients with Covid-19. Guidelines for Covid-19 show that physiotherapy and rehabilitation practices should practised an individual basis, based on the results of multidisciplinary evaluation, when clinically necessary. Current guidelines and protocols state that applications using airway cleaning techniques, breathing exercises and assistive devices, exercise training and respiratory muscle training should not be applied in the acute period.

**Keywords:** *Coronavirus; Covid-19; cardiac rehabilitation; pulmonary rehabilitation*

**Address of Correspondence:** Zuhal Kunduracılar- zuhal.kunduracilar@sbu.edu.tr  0000-0002-2983-2287, Department of Physical Therapy and Rehabilitation, Faculty of Health Sciences, University of Health Sciences, Hamidiye, Mekteb-i Tibbiye-i Şahane (Haydarpaşa) Külliyesi Selimiye Mah. Tibbiye Cad. No:38, 34668, Üsküdar, Istanbul, Turkey

## 1. Introduction

### 1.1. Cardiac Rehabilitation

It includes a multidisciplinary approach carried out under the coordination of many disciplines such as physicians, physiotherapists, nurses, dieticians, psychologists, social workers to improve the physical, psychological and social functions of patients with cardiac disease to stabilize the progression of the disease and reduce mortality, allowing a more active life (Kim et al., 2019).

Cardiac rehabilitation is strongly recommended by the American Cardiology Association (ACC) and the American Heart Association (AHA) for the treatment of patients with coronary artery disease and chronic heart failure, as it has strong evidence levels (Scherrerberg, 2020). Core components of cardiac rehabilitation: healthy behaviour changes and education, lifestyle risk factor management, physical activity and exercise, diet, smoking cessation, psychosocial health, medical risk factor management, cardioprotective therapies, long-term management, audit and evaluation (Kim et al., 2019).

### 1.2. Pulmonary Rehabilitation

In the declaration published by the American Thoracic Society and the European Respiratory Society in 2006, pulmonary rehabilitation is recommended to all chronic respiratory patients with symptomatic, have limited activities and/or whose disease cannot be controlled despite optimal medical treatment. Pulmonary rehabilitation is an interdisciplinary approach. It consists of a pulmonologist, a physiotherapist, a nurse, a dietician, a psychologist, a social worker, and a healthcare professional suited to the patient's needs (Nici et al., 2006). Core components of pulmonary rehabilitation: exercise training, supplemental oxygen during exercise, breathing low density gas mixtures, mechanically assisted ventilation, nutritional supplementation and advice, anabolic steroids, education, breathing retraining techniques, respiratory muscle training, neuromuscular electrical stimulation (Nici et al., 2006).

## 2. Covid-19 Infection Originated New Type Coronavirus (SARS-CoV-2)

The 2019 new type of coronavirus, or 2019-nCoV (with new name is SARS-CoV-2), is closely related to the coronavirus (batSL-CoVZC45 and bat-SL-CoVZXC21), which has similar characteristics of severe acute respiratory syndromes. The virus spreads from person to person through droplets or direct contact. The average incubation period of the infection is 5-6 days (2-14 days) (Vanessa, 2020). Based on the increasing evidence of increasing infection incidence we can say that due to the possibility of transmission by asymptomatic carriers, the SARS-CoV-2 shows a high pandemic. The most common symptoms of Covid-19 infection are dyspnea, tachypnea, oxygenation disorder  $SpO_2 < 93\%$ ,  $PaO_2/FiO_2$  ratio  $< 300$  infiltration of the lung area in 24-48 hours (Vanessa, 2020).

Patients with moderate or severe Covid-19 cannot separated from medical managements. Decubitus, peripheral muscle weakness, muscular retractions, articular limitations, balance/postural disorders, and physical deconditioning are caused by prolonged bed rest. This complications could dramatically reduce

the chances of returning to pre-infection functional status (Brugliera, 2020). According to the severity of the disease, patients with uncomplicated (mild) Covid-19 infection, patients with moderate Covid-19 infection (viral pneumonia), patients who developed ARDS due to severe Covid-19 infection (Brugliera, 2020).

## **2.1 Cardiopulmonary Rehabilitation in Patients with Infected Covid-19**

Physiotherapists are likely to have a role in the management of patients admitted to hospital with confirmed Covid-19. Globally, physiotherapists often work in acute hospital wards and intensive care units (ICU). In particular, cardiorespiratory physiotherapy focuses on the management of acute and chronic respiratory conditions and aims to improve physical recovery following an acute illness (Thomas, 2020).

### ***Patients with uncomplicated (mild) Covid-19 infection***

Almost all of these cases are recovering. It does not contain viral pneumonia. In an average of 80% of cases, there are symptoms fever, muscle/joint pain, cough, sore throat and nasal congestion. Airway secretion burden is extremely low. Respiratory physiotherapy and rehabilitation practices are not effective on the course of the disease. In cases with mild Covid-19 infection, it is recommended to be physically active at home, although it is stated that there is no indication for respiratory physiotherapy. In addition, the patients who are in quarantine at home can reduce their anxiety with relaxation exercises, pursed lip breathing, thoracic expansion exercises, respiratory control in prone lying down (Ince et al., 2020).

### ***Patients with moderate Covid-19 infection (viral pneumonia)***

In patients are observed ARDS in 67% acute kidney damage in 29%, acute cardiac damage in 23%, liver dysfunction in 29%, multiple organ failure after intensive care. It was reported that ARDS and/or multiple organ failure developed in 6% of the cases requiring intensive care hospitalization. Affected systems in the acute period are respiratory system, the cardiovascular system, the circulatory system, blood parameters, muscular system, neurological system (Vanessa, 2020).

### ***Physiotherapy and rehabilitation in the acute period of Covid-19 infection***

Guidelines for Covid-19 show that physiotherapy and rehabilitation practices should practised an individual basis, based on the results of multidisciplinary evaluation, when clinically necessary (Ince et al., 2020; Thomas, 2020). Current guidelines and protocols state that applications using airway cleaning techniques, breathing exercises and assistive devices, exercise training and respiratory muscle training should not be applied in the acute period. In the acute period of patients infected with Covid-19, airway secretion burden is extremely low. Therefore, Covid-19 infection does not require the use of airway cleaning techniques (Lazzaeri, 2020).

There is no indication for use of respiratory physiotherapy methods for the patients with moderate Covid-19 infection (viral pneumonia). Oxygen therapy may be required in half of the hospitalized patients due to Covid-19 pneumonia (Ince, 2020; Polastri, 2020). However, patients with moderate severity of Covid-19

infection (viral pneumonia) exercises in the bed, getting out of bed, sitting balance, standing, walking and upper/lower extremity exercises can be applied. Mobilization and exercises can be done with brochures and tele-rehabilitation applications (training videos, video calls, phone calls) for the effective and safe operation of physiotherapists (Ince et al., 2020; Vanessa, 2020).

### ***Patients who developed ARDS due to severe Covid-19 infection (severe viral pneumonia)***

It is especially severe in the patients with advanced cardiovascular and metabolic comorbidities. Negative hematological changes are seen more often in patients with severe disease: lymphocytopenia in 83.2%, thrombocytopenia in 36.2%, leukopenia in 33.7%. the high level of C-reactive protein reduce frequently, but alanine aminotransferase, aspartate aminotransferase, creatine kinase and D –dimer levels increase (Litao, 2020). Some of these cases show ARDS, sepsis, septic shock, and multiple organ failure, which are characterized by acute hypoxemic respiratory failure. Intubation and invasive mechanical ventilation are required in these patients who are followed up in the ICU. There is no indication for respiratory physiotherapy including airway cleaning techniques in viral pneumonia and ARDS (Ince et al., 2020). Physiotherapists who practise in the ICU can assist in positioning patients with severe respiratory failure associated with Covid-19, including the use of prone position to optimise oxygenation (Avard et.al., 2020).

Applications are beneficial such as 30-45 degree high lying. Passive/active joint opening exercises and mobilization can be done. Passive and active mobilization techniques should not be applied or cut off in the below cases; high fever, worsened dyspnea, breathing frequency >30 breaths/min, SpO<sub>2</sub> <93% during the oxygen therapy FIO<sub>2</sub> > 50% during NIMV implementation, PEEP or CPAP >10cmH<sub>2</sub>O, presence of respiratory distress, the presence of arterial hypertension, bradycardia or tachycardia, arrhythmias, shock, deep sedation (Ince et al., 2020).

### ***Physiotherapy and rehabilitation after Covid-19 acute period (post-acute)***

In patients recovered from Covid-19 pneumonia and ARDS, the post-acute physiotherapy and rehabilitation needs are not completely known. Physiotherapy may play a vital role in the respiratory management and rehabilitation of patients with SARS-CoV-2/Covid-19. A cardiorespiratory therapist contributes a significant role in the management of patients with confirmed/suspected SARS-CoV-2/Covid-19 (Avard et al., 2020).

Information obtained from viral infections such as H1N1 and SARS, after acute illness, ARDS and intensive care processes; respiratory and physical function losses (muscle mass and muscle function loss, myopathy, contractures, neuropathy and/or weakness acquired in intensive care) indicate that cognitive and emotional dysfunctions (anxiety, depression, post-traumatic stress syndrome) may affect participation and quality of life (Beeching, 2020).

Patients who have successfully recovered from the acute Covid-19 infection will require health support to define and quantify the consequences of the disease. Indeed, it is not clear if Covid-19 will leave permanent lung and/or physical damage. Alterations of lung tissue such as ground-glass opacities, consolidation,

vascular thickening, bronchiectasis, pleural effusion, crazy paving pattern and irregular solid nodules, may progress in over 80% of patients (Polastri et al., 2020).

In cases recovering from Covid-19 infection, physiotherapy and rehabilitation applications may be needed due to respiratory and physical function losses, cognitive disorders and emotional problems during the rehabilitation phase (Beeching, 2020). Prone positioning in intensive care can cause pressure sores, brachial plexus injury and plantar flexion contractures (Ince et al., 2020). Continued infection risk period (first 6-8 weeks); physiotherapy and rehabilitation can also contribute to reduce anxiety and depression in patients who experience delirium, anger, fear, dysthymia, insomnia, panic attacks or isolation due to isolation and intensive care during treatment or who show risk of non-compliance (Ince et al., 2020). In hospitalized patients with Covid-19; kidney dysfunction, hypertension, diabetes mellitus, comorbidities such as chronic heart disease and obesity cancer are observed (Scherrenberg et al., 2020). It is important for possible complications to be followed by telerehabilitation after discharge. Planning of blood pressure pulse and oxygen saturation controlled physical activities in kidney patients infected with Covid-19 (Scherrenberg et al., 2020).

Avoiding exercise and activities related to upper extremities that increase peripheral resistance. Exercise and activity should cut off if the pulse increases more than 20 beats and the blood pressure increases above 20 mmHg after the activity and post-exercise compared to rest. Planning of exercise and physical activity by individual follow-up. It should be kept in mind when when exercise describe. Because, Covid-19 can cause arrhythmia and/or myocarditis with cardiac involvement. Furthermore the drugs used in the treatment of Covid-19 can cause arrhythmia. Physiotherapists contribute to the functional levels of patients after discharge. While being included in the treatment program in this patient group, they should be monitored strictly and their clinical status should be monitored. Possible cardiac problems (e.g. arrhythmia, myocarditis) that may occur in the hospital period before starting rehabilitation should be controlled and stabilized (Sheehy, 2020). During the discharge from the hospital, it should be recorded the patient's emergency needs in terms of rehabilitation (e.g. safe mobility, symptom control (dyspnea, fatigue, pain), supplemental oxygen demand, adequate nutrition, adequate psychological/social support) and an individual assessment, including short/medium term needs (Gómez, 2020).

During the first 6-8 weeks of the patient's homelife, if no exercise capacity assessment has been made, infected patients are recommended to perform low-intensity physical activity/exercises on probability (including functional strengthening; the value of dyspnea and/or fatigue in the modified Borg Scale (0-10) points). Safe and effective communication solutions should be considered between patient and physiotherapist using video calling, digital resources (Sheehy, 2020). Do not use non-invasive ventilator support during exercise training in Covid-19 patients in infectious period, or use with patient-specific equipment supply (Gómez, 2020).

### ***Covid-19: Time to reach the center stage of alternative models in cardiac rehabilitation***

In the current pandemic, all options are to continue the delivery of cardiac rehabilitation. Using technology-based cardiac rehabilitation (TDCR) can increase accessibility to CR in areas where healthcare is difficult to

deliver. The short-term goal of pulmonary rehabilitation is to alleviate dyspnea and anxiety and depression, while the long-term goal is to maximize the patient's functionality, improve the quality of life and facilitate return to society (Sheehy, 2020).

Rehabilitation interventions should be started as early as possible in mild and moderate cases. Operations that can increase the risk of infection should be minimized. To avoid from the infection, a closed plastic bag should be used to close the mouth during expectoration. In addition, pulmonary rehabilitation of patients with Covid-19 should be done mainly through training videos, brochures, remote consultations or online instruction to prevent cross-infection. In acute care it may be necessary to take patients earlier than usual (Ince et al., 2020).

Patients should stay in their rooms. Group therapy and therapy should be prohibited in rehabilitation gyms; therapy should be provided in the patient rooms. Shared equipment should be decontaminated among patients; where possible, use disposable equipment (e.g. TheraBands instead of hand weights). Electrode sponges, hydrocollator heat packs, gels, topical lotions, dexterity training items, etc. special attention should be paid. When possible, plan therapeutic activities to minimize the number of staff involved. The number of staff should be reduced minimize when entering a patient's room (Gómez, 2020).

International Physical Activity Survey, Physical Activity Scale for the Elderly and The Barthel Index can be used to measure activities of daily living (ADL). Physiotherapy should begin at the inpatient treatment center and continue after inpatient rehabilitation. Early mobilization should include frequent changes of position, in-bed mobility, sitting position, simple bed exercises, and ADLs. Active limb exercises should be accompanied by progressive muscle strengthening (recommended program: 8-12 reps, 1 to 3 sets with 2 minutes of rest between sets, 3 sessions per week for 6 weeks).Neuromuscular electrical stimulation can be used to help strengthen. Walking, cycling or arm ergometry can apply (Ince et al., 2020).

Initially, aerobic activity should be kept below 3 MET. Then, progressive aerobic exercise should be increased to 20-30 minutes 3-5 times a week. Balance work should be included. Occupational therapy should focus on targeted interventions to facilitate functional independence and prepare patients for discharge as well as ADL guidance. Speech-language pathologists should evaluate and treat dysphagia and voice disorders caused by prolonged intubation (Sheehy, 2020).

Increasing aerobic capacity can provide short-term safe improvements in the function of the immune and respiratory systems in coronavirus patients. This can be produced mainly by three mechanisms: first, it can improve immunity by increasing the level and function of immune cells and immunoglobulins, regulating CRP levels, and reducing anxiety and depression. Second, it can improve respiratory system functions by acting as antibiotics, antioxidants and antimycotic by restoring normal lung tissue elasticity and strength. Finally, Covid-19 can act as a protective barrier to reduce risk factors, helping to reduce the incidence and progression of Covid-19 (Gómez, 2020).

### **Conflict of Interest**

We declare that we have no conflict of interest.

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