

POST-COVID-19 REHABILITATION – A POLISH PILOT PROGRAM

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ABSTRACT

The current spread of SARS-CoV-2 indicates a long-term fight against the widespread and exponential increase in morbidity and mortality across the globe. A variety of non-pharmacological strategies to mitigate and suppress virus transmission have been investigated and introduced. Currently, emerging studies focus mostly on the management of hospital-treated patients in the acute phase of the disease, including the legitimacy of using physiotherapeutic procedures. However, current literature lacks guidelines for rehabilitation related to maintaining continuity and universality of the therapy after the end of the acute phase of the disease and discharge from hospital. The authors suggest implementing an immediate rehabilitation program in post-infection patients as data from previous epidemics of respiratory-related viral diseases shows that COVID-19 survivors should be expected to have impaired lung ventilation function, and reduced exercise tolerance and muscular weakness, and prolonged return to work and participation. It should be assumed that only the introduction of immediate recommendations for the implementation of rehabilitation procedures based on simple and well-known tests, as well as their obligatory regime, can contribute to the reduction of respiratory disability leading, in a short time, to infections recurrence and, in the long run, to a lower quality of life and socioeconomic burden on the population. This article presents a respiratory rehabilitation program for COVID-19 survivors, recommended by the Polish Society of Physiotherapy. This program was approved by the Polish Minister of Health and implemented as a pilot program at the Hospital of the Ministry of the Interior and Administration in Gluchołazy, Poland. *Med Pr.* 2021;72

Key words: COVID-19 pandemic, physiotherapy, exercise therapy, rehabilitation, physical therapy, standard of care

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INTRODUCTION

Generally, COVID-19 is an infectious disease caused by the recently found virus known as SARS-CoV-2 (or coronavirus). Before the outbreak originated in Wuhan, China, in December 2019, there was no information about this virus, and even less was known about the complications of this disease. The current spread of SARS-CoV-2 indicates a long-term fight against the widespread and exponential increase in morbidity and mortality across the globe. A variety of non-pharmacological strategies to mitigate and suppress virus transmission have been investigated and introduced [1]. Currently, emerging studies focus mostly on the management of hospital-treated patients in the acute phase of the disease, including the legitimacy of using physiotherapeutic procedures [2].

The spectrum of the disease severity ranges from an asymptomatic infection, through a mild upper respiratory tract illness, to severe viral pneumonia with possible respiratory failure and death [3]. Thus, physical therapy management of the patients requires a wider approach and discussion, apart from acute hospital settings with physiotherapy respiratory care (including airway clearance techniques, non-invasive ventilation, inspiratory positive pressure breathing, or techniques to facilitate secretion clearance), mobilization, and exercise prescription [4]. However, current literature lacks guidelines for rehabilitation related to maintaining continuity and universality of the therapy after the end of the acute phase of the disease and discharge from hospital. At the moment, most of the research questions concentrate on the transmission patterns, the surveillance system, protection against the infection, early

Table 1. Qualification criteria for pulmonary rehabilitation

Dyspnoea	Respiratory physiotherapy model*			
	<3 MET <320 m	3–4.9 MET 320–434 m	5–6.9 MET 435–520 m	≥7 MET >520 m
8–7	model D	model D	model C	model B
6–4	model D	model D or C	model C or B	model B or A
3–2	model D	model C	model B	model A
0–1	model D	model C	model B	model A

MET – metabolic equivalent.

Dyspnoea >8 is a contraindication for taking the test. Model E is required.

* Depending on the MET value or the distance achieved.

diagnostic criteria, treatment recommendations, vaccine development, and distribution [5–7].

The priority should be to implement immediate rehabilitation in post-infection patients (post-intensive care syndrome), as data from previous epidemics of respiratory-related viral diseases shows that COVID-19 survivors should be expected to have impaired lung ventilation function and reduced exercise tolerance, muscular weakness and, as a consequence a prolonged return to work after recovery or functional limitations in their work, decreased earning capacity, limited daily activities, a loss of independence, susceptibility to infections, and the presence of other comorbidities [8,9]. It should be assumed that only the introduction of immediate recommendations for the implementation of rehabilitation procedures based on simple and well-known tests, as well as their obligatory regime, can contribute to the reduction of respiratory disability leading, in a short time, to infections recurrence and, in the long run, to a lower quality of life and socioeconomic burden on the population [10]. Another question concerns the management of patients undergoing a mild infection, as at the moment its long-term consequences for the respiratory system are not known.

QUALIFICATION FOR PULMONARY REHABILITATION

The introduction of a holistic respiratory rehabilitation program for SARS-CoV-2 patients with combined treatment focused on the increase in exercise capacity, recovery of pulmonary function, and mental health support, developed by a multidisciplinary team of healthcare professionals, appears vital. The local perspective and availability of different physical therapies should be taken into consideration when developing different models.

Immediately after leaving the hospital or the place of isolation or quarantine, a submaximal exercise tolerance test (with the heart rate limit for patients established at the level of 70–80% of the predicted maximum heart rate), or indirect exercise tolerance assessment should be performed. It is also possible to perform this assessment using a 6-minute walking test [11]. The qualification procedure should also consider the *Modified Borg Dyspnoea Scale* to rate the difficulty of breathing. It starts with 0 where breathing is causing no difficulty at all and progresses through to 10 where breathing difficulty is maximal [12,13].

Based on the results obtained by the patient, qualification of the patient for one of the respiratory physiotherapy models that differ in the intensity of physiotherapy according to patients' needs and abilities should be performed (Table 1).

Patients with contraindications for exercise tests, with dyspnoea >8 on the 10-point *Modified Borg Dyspnoea Scale* and patients with cardiopulmonary insufficiency are qualified for model E.

REHABILITATION PROGRAM

Individual models include physical efficiency training on a cycle ergometer (up to the training heart rate), walking training, breathing exercises, general fitness exercises, resistance training, station training, and relaxation (Table 2).

The involvement of members of the patients' family in supporting and managing requirements of the physical therapy should be considered. The introduction of optional psychological care, as the burden of the disease and its direct and indirect consequences may influence the effect of the rehabilitation process, should be considered as well [14,15].

When complications after COVID-19 affect the musculoskeletal system and/or involve joint/muscles pain,

Table 2. Rehabilitation program

Model	Program	Training intensity
Models A, B, C	individual models include physical efficiency training on a cycle ergometer (up to the training heart rate), walking training, resistance training; breathing exercises (relaxation exercises, extended expiration exercises, diaphragmatic breathing exercises, exercises increasing lower rib cage respiratory movement), general fitness exercises, circuit training, techniques for removing secretions from the bronchial tree (drainage positions, effective cough, active bronchial vibration, chest percussion), inhalations, relaxation	model A – 80% of the submaximal heart rate model B – 70% of the submaximal heart rate model C – 60% of the submaximal heart rate
Models D, E	breathing exercises (relaxation exercises, extended expiration exercises, diaphragmatic breathing exercises, exercises increasing lower rib cage respiratory movement), general fitness exercises, circuit training, techniques for removing secretions from the bronchial tree (drainage positions, effective cough, active bronchial vibration, chest percussion), inhalations, relaxation	model D – heart rate increase during exercises by 20–30% in relation to the heart rate at rest model E – exercises in a sitting position on a chair, heart rate increase during exercises by 20–30% in relation to the heart rate at rest

a possible use of physical modalities may be recommended.

PHYSICAL EFFICIENCY TRAINING

Physical efficiency training on a cycle ergometer

Physical efficiency training, as an integral part of physiotherapy, is currently considered an acknowledged form of treatment for patients with COVID-19. The key aspect of this training is extended time of the dynamic physical effort of adequately determined intensity. This type of training can be implemented in interval or continuous modes.

Interval training on a cycle ergometer

Interval training on a cycle ergometer is characterized by precisely regulated effort and break time. Breaks are calculated so as to apply a new stimulus before the results of the previous stimulus have lapsed.

Continuous cycle ergometer training with increasing load

Continuous training with increasing exercise load involves gradually increasing the load over approximately 30 min until the training heart rate has been reached. The load is increased every 4 min.

Continuous training with 2 levels of intensity

In the continuous training with 2 levels of intensity, patients are asked to perform a 30-minute exercise on a cycle ergometer. The following 2 levels of effort intensity are applied: a 2-minute period of very high intensity exercise at the heart rate close to the training heart rate determined for each patient individually; and a longer, 4-minute period of effort at 50% of the training heart rate.

Continuous training with heart rate stabilization

Continuous training with heart rate stabilization involves exercise in which the exercise load is regulated based on the training heart rate. This training method starts with the load of 30 Watts which is then increased by 10 Watts every minute.

Monitored training system

A system for monitored training includes 4-8 devices (treadmills or cycle ergometers). Training programs allow for training to be controlled by exercise load or heart beat frequency. They ensure a safe and effective implementation of training programs and allow for group rehabilitation with individualized training parameters, with the possibility of individually dosing physical effort.

Treadmill training

Treadmill training with adequate speed and time belongs to the aerobic exercise category. In patients with COVID-19, depending on the rehabilitation model, continuous training modes of varied intensity are used.

Walking training

Fast-paced walk improves exercise tolerance and physical efficiency. The first stage involves increasing the walking time (5-10-15 min), and then increasing the intensity. Finally, the speed can be varied (slow walk, fast walk, short run and slow walk again).

Backwards walking training

Backwards walk, in comparison with forwards walk, involves higher energy expenditure reflected in maximum oxygen absorption. From this perspective, it can be compared with running forward. Therefore, this type of physical activity can be used as a form of physiotherapy at home

BREATHING EXERCISES

Breathing exercises include relaxation, extended expiration, diaphragm breathing, and lower rib cage function increase.

Relaxation exercises

Before this type of exercises, it is important to relax all muscles and decrease chest muscle tension. A reduction of the increased tension of external intercostal muscles can be achieved through holding the chest in the expiration position for a few minutes.

Extended expiration exercises

It is very important to teach the patient to take short breaths with minimum help of inspiration muscles, and to breathe out calmly and slowly through pursed lips with their belly drawn up and avoiding pressure. Expiration exercises can also be done with a non-elastic band covering the lower rib cage.

Diaphragmatic breathing exercises

This type of exercises should be done in the supine position with a pillow supporting the head, the knees bent in the knee and hip joints, and the feet rested on the floor. This position helps to relax muscles which is prerequisite before starting diaphragmatic breathing exercises.

Resistance for diaphragm action during the inspiration stage can be added by placing a sand bag on the patient's upper abdomen.

Exercises increasing lower rib cage respiratory movement

Increase in the lower rib cage respiratory movement and diaphragm function can be achieved by stabilizing the upper limbs and the shoulder girdle. This limits movement of the upper rib cage during inhalation.

GENERAL FITNESS EXERCISES

General fitness exercises include dynamic, strength exercises which have a positive impact on patients' fitness and function. They increase respiratory rhythm and improve lung ventilation function. Exercises are individually selected for each patient to be able to perform them.

Resistance training

Respiratory physiotherapy recommends elements of resistance exercises which help improve muscle strength

which is reduced as ventilation dysfunctions increase or which weakens as a result of sedentary lifestyle.

This type of training is applied to patients from the low risk group, qualified in the physical efficiency test for rehabilitation models A, B or C, and those who show good tolerance for physical efficiency training.

Station training

Station training combines the advantages of strength and resistance training. This method allows for administering exercises which engage main muscle groups in a single training session. Additionally, the modification of exercise load, exercise time and break time gives the opportunity to run the training in the interval mode which improves physical efficiency parameters.

TECHNIQUES FOR REMOVING SECRETIONS FROM THE BRONCHIAL TREE

Drainage positions

Changing positions, maintained for a short time (15–20 s), facilitate expectoration of patients' retained secretions.

Effective cough

In the drainage position, in which the patient expands most easily, Huff coughing is repeated 10 times and the chest is clapped.

Active bronchial vibration

The active vibration of the bronchi causes vibrations of the air column in the respiratory tract, which helps to remove the secretions.

Chest percussion

Chest percussion favors the removal of retained secretions. The number of repetitions and series depends on the patient's condition.

INHALATIONS

Inhalations with a saline solution support the mechanisms of self-cleaning of the respiratory tract and liquefy the residual secretion, favoring its faster removal.

RELAXATION

Focused relaxation is a way to achieve the state of physical and mental relaxation with retained consciousness and focused concentration to influence one's behavior.



Figure 1. Pilot program diagram

The first patient was admitted to a 60-bed hospital ward at the MSWiA Hospital in Głuchołazy, Poland, on September 1, 2020. Initial assessments of the actions taken are very promising. In people who underwent the program (Figure 1), an improvement was observed in all examined aspects: an increase in exercise tolerance, a reduction in musculoskeletal ailments, an improvement in lung ventilation, a reduction in dyspnoea, and an improvement of the mental health which improves the quality of life. Obviously, providing objective conclusions based on scientific evidence requires time and completion of data and analysis. In the next article, the authors are planning to publish the first results of the pilot program.

CONCLUSIONS

It seems that nowadays all attention is focused on extinguishing the world fire which has become a SARS-CoV-2 pandemic. Improving the quality of rehabilitation, with the ongoing fight for life around the world, is of secondary importance. However, only the immediate introduction of obligatory rehabilitation constituting the second stage of COVID-19 treatment can ensure the reduction of social and economic losses. The rehabilitation process does not require discovering new methods and, as the authors believe, is the only remedy for a strong society that can overcome the pandemics.

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