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Case report

The Importance of Deconditioned Patient Rehabilitation after Hospital Treatment of COVID-19 Infection: A Case Report

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SUMMARY

Introduction. The COVID-19 pandemic caused by the SARS-CoV-2 virus has led to significant public health problems, severe complications, and functional impairment in persons who have recovered from this disease.

Case report. A 60-years-old male deconditioned patient was transferred from Corona 4 Center to the Center for Physical Medicine and Rehabilitation of the University Clinical Center in Kragujevac for a post-COVID rehabilitation due to pronounced muscle weakness and inability to walk. After functional testing, an individual rehabilitation plan was created and a kinesitherapy program was adjusted daily based on the patient's respiratory status. After the kinesitherapy program, Respivol was used - a volumetric medical device for breathing exercises in patients with respiratory difficulties. At the time of admission, the patient could not move independently, could not move from the lying to the sitting position on his own, and could not maintain balance in the sitting position. Hypotrophy caused by prolonged inactivity of the muscles of the whole body dominated the clinical picture. A six-week rehabilitation treatment performed on the patient showed a significant improvement in functionality (FIM test), muscle strength (manual muscle test), daily life activity (Barthel index), as well as a reduction of anxiety (GAD-7 scale).

Conclusion. The goal of the rehabilitation program is to restore the patient's state of functionality before the initiation of COVID-19 treatment, so that they can perform their regular professional activities and achieve complete independence in performing activities of daily living (ADL).

Keywords: **COVID-19, deconditioning, rehabilitation, kinesitherapy**

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INTRODUCTION

Patients presenting with severe forms of COVID-19 often need respiratory support, from oxygen therapy to prolonged invasive mechanical ventilation. The severe form of COVID-19 causes lung damage and may result in respiratory failure. Prolonged hospitalization of severe patients requiring intensive care may have severe systemic consequences (1). Critically ill patients with respiratory insufficiency are hospitalized in intensive care units for a longer period of time, after which they need a rehabilitation program to combat the consequences of artificial ventilation and prolonged inactivity (2 - 4).

Functional impairment after COVID-19 infection can limit the ability of an individual to perform activities of daily living (ADL), it can reduce functionality, alter professional performance and hinder social interaction. The affected individuals can also become more sedentary which increases the risk of comorbidities. Besides the burden of the disease itself, a prolonged hospitalization can have deleterious effects, such as pulmonary, cardiovascular, muscular, and cognitive changes, as well as anxiety and depression. It is not uncommon for a prolonged ICU stay to lead to the development of ICU-acquired muscle weakness and deconditioning (5, 6).

Due to a multisystem damage caused by COVID-19 infection, a multidisciplinary approach is necessary to treat these patients. Indeed, the implementation of respiratory rehabilitation occupies an important place, both during hospitalization and after the patient's discharge home (7).

CASE REPORT

A 60-years-old male patient stated that before hospital admission he experienced fever of 39.5 °C, dry cough, and fatigue on the 20th of February 2021. On the same day, he was examined by a doctor, and he had a rapid antigen test for SARS-CoV-2, which was positive. On the third day from the appearance of the first symptoms, he began to feel difficulty breathing, shortness of breath, and chest discomfort, accompanied by a loss of smell (anosmia) and taste (ageusia). He also had a few diarrheas on the 24th of February 2021. Then, the patient was referred to the Clinic for Infectious Diseases due to the worsening of his general condition, where he was treated with supplemental oxygen (5 l/min O_2 via nasal cannula). On the 1st of March 2021, respiratory failure occurred (25 l/min O_2 via nasal cannula, gas analysis: pH 7.51; pCO_2 4.4 kPa; pO_2 6.8 kPa; SpO_2 = 89%), due to which the patient was transferred to the Corona 1 intensive care unit (ICU) and transferred to high flow ventilation (HFV FiO_2-fraction of inspired oxygen 100%, on high flow nasal cannula 50 l/min, SpO_2 = 98%). On the 19th of March 2021, after the stabilization of the respiratory status (12 l/min O_2 via nasal cannula, SpO_2 = 98%), the patient was transferred from ICU to the Corona 4 center. Laboratory tests were conducted - biochemistry: complete blood count (CBC), blood clotting test, C-reactive protein (CRP), lipid levels tests. Chest X-rays (CXR) were performed several times (Figure 1). The patient was treated with dual antibiotic therapy, corticosteroids, gastroprotective, low-molecular-weight heparin (LMWH), vitamin therapy, antiviral therapy.

The patient was transferred from Corona 4 Center to the Center for Physical Medicine and Rehabilitation of the University Clinical Center in Kragujevac for post-COVID rehabilitation due to pronounced muscle weakness and inability to walk. A PCR test performed during the admission gave a negative result. The patient was referred by an internist for rehabilitation to achieve functional recovery. On admission, the patient was conscious, oriented, followed the instructions, and was put on an oxygen therapy 3 l/min. He denied allergies to food and drugs. His past medical history included diabetes type 2 (T2D), managed with oral antidiabetic therapy. Functional status of the patient: the patient was not able to move independently, could not move from the lying to the sitting position on his own, and could not maintain balance in the sitting position. Hypotrophy caused by prolonged inactivity of the muscles of the upper and lower extremities dominated in the clinical presentation. He had a urinary catheter placed.

On admission, the patient's respiratory status was assessed by: determining the number of respirations per minute (RR-respiration rate), a modified Borg dyspnea scale (MBS), saturation (SpO_2) and heart rate via a pulse oximeter. After functional testing (Table 1), an individual rehabilitation plan was created, and a daily kinesitherapy program was applied and adapted to the patient's current respiratory status.

The kinesitherapy program included a respiratory rehabilitation program, a program of exer-

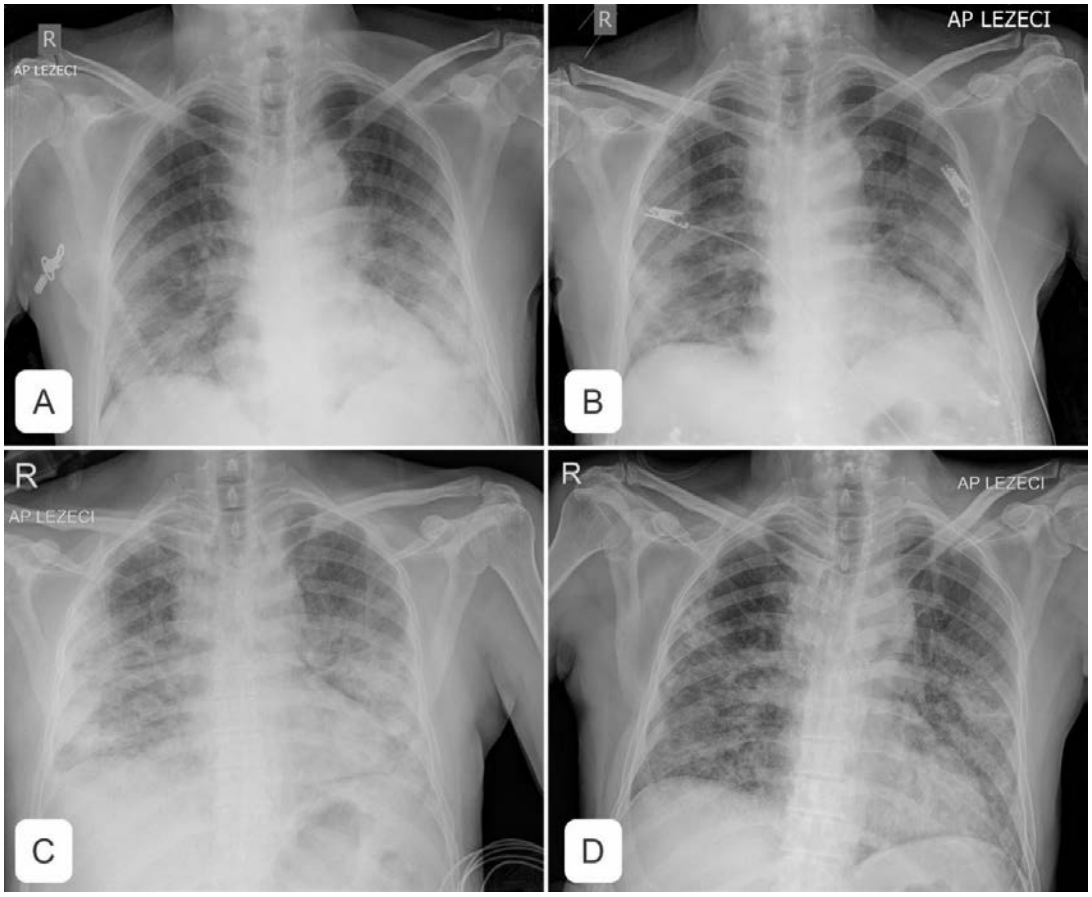

Figure 1. *X-ray finding of the lungs: A) First day; B) Day 7; C) Day 15: D) Day 35*

Table 1. *Functional testing of the patient on admission and on discharge*

Functional testing	On admission	On discharge
Barthel index	5	75
FIM[1] test	49	67
MMT[2] for upper extremities	**Left** upper arm muscles 2 forearm muscles 2 **Right** upper arm muscles 2 forearm muscles 2	**Left** upper arm muscles 4 forearm muscles 4 **Right** upper arm muscles 4 forearm muscles 4
MMT for lower extremities	**Left** thigh muscles 1-2, lower leg muscles 1-2, foot muscles 1 - 2 **Right** thigh muscles 1 - 2, lower leg muscles 1 - 2, foot muscles 1 - 2	**Left** thigh muscles 3, lower leg muscles 3, foot muscles from 3 to 3+ **Right** thigh muscles 3, lower leg muscles 3 foot muscles 3 to 3+
GAD-7[3] scale	12 (moderate anxiety)	4 (minimum anxiety)
RESPIVOL	0 ml	1000 ml

Table legend: 1 Functional Independence Measure, 2 Manual muscle test, 3 Generalized Anxiety Disorder 7-item

cises to strengthen the weakened muscles according to manual muscle test (MMT), balance and transfer exercises, balance exercises, placing the patient in a vertical position, gait exercises, and exercises for gait coordination. In addition to kinesitherapy, electrostimulation (ES) of weakened muscles of the upper and lower extremities was performed, with parameters adjusted according to the manual muscle test (MMT). After positioning, a physical treatment with breathing exercises was applied - training in diaphragmatic breathing to establish breathing control, reducing the consumption of energy needed for breathing, and improving lung ventilation. Postural drainage was then performed with manual chest percussion.

The conducted program of breathing exercises was performed in a semi-sitting position with the head raised. The patient was instructed to inhale the air through the nose and exhale lightly through the mouth in the position of pronouncing the letter "O" so that expiration would be prolonged, two to three times longer than inspiration. This way of breathing leads to control and reduction of dyspnea and reduction of respiratory rate. During the implementation of the exercise program, accessory muscles of the shoulders and neck are relaxed. Attention is paid to the expansion of the lower part of the chest and the mobilization of the upper extremities. These exercises help eliminate secretions from the airways and increase vital capacity.

After the respiratory rehabilitation program, a kinesitherapy program of active and actively-assisted exercises was conducted to strengthen the muscles of the whole body. In addition, transfer exercises from the lying to the sitting position, achieving balance in the sitting position, transfer exercises from the sitting to standing position, placing the patient in the vertical position, balance exercises, and walking with a walker with the help of a therapist were carried out. The kinesitherapy program was corrected after each functional and cardiorespiratory status change and adjusted to the patient's current status. The rehabilitation program lasted between 20 and 45 minutes and was performed once a day. After the kinesitherapy program (Figure 2), the device Respivol (8) was used - a volumetric medical device for breathing exercises in patients with respiratory difficulties (Figure 3). This device stimulates maximum and long-lasting inspiration, expansion of the chest, and increase of the lung capacity. By performing breathing exercises, Respivol helps strengthen the respiratory muscles and thus restores the normal respiratory function. According to the recommendations, Respivol exercise was done two to three times a day for 10 - 15 minutes, according to the patient's current respiratory status.

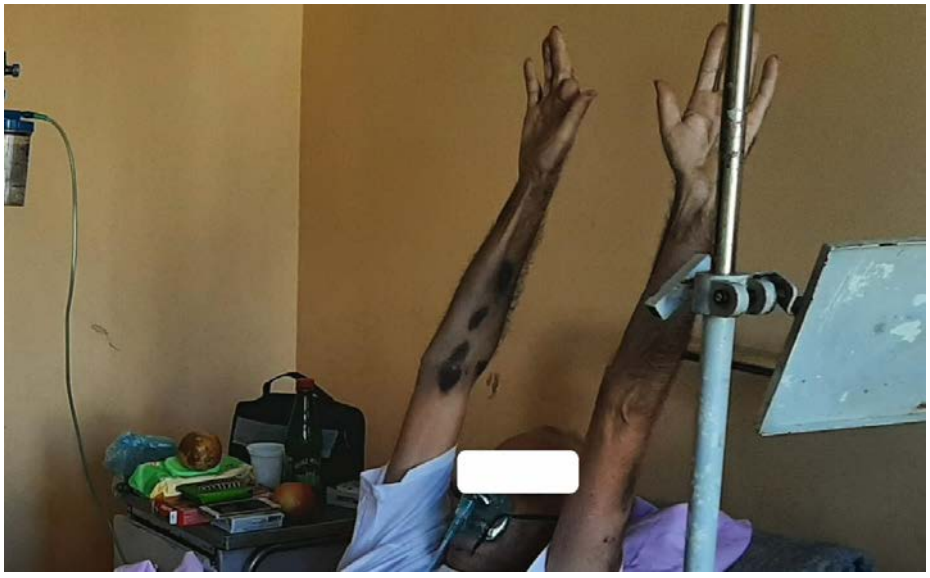

Figure 2. *Kinesitherapy program*

Figure 3. *Respivol for breathing exercises*

On discharge, after six weeks of hospital treatment at the Center for Physical Medicine and Rehabilitation, the patient was placed in the vertical position and was able to walk short distances with the help of a physiotherapist. He achieved transfer from the lying to the sitting position independently and maintained balance in the sitting position for a long time. His entire musculature was strengthened and his mobility improved. The urinary catheter was removed, and urination control was established. The patient was advised to continue using the kinesitherapy program and the respiratory rehabilitation program at home after hospital discharge. Rehabilitation treatment performed on the patient showed a significant improvement in functionality (FIM test) (9), muscle strength (manual muscle test- MMT), daily life activities (Barthel index) (10), as well as anxiety reduction (GAD-7 scale) (11) at the end of the rehabilitation treatment (Table 1).

DISCUSSION

We presented a patient with diabetes mellitus type 2 and COVID-19 infection who was successfully rehabilitated due to post-COVID deconditioning.

Meta-analysis showed that diabetes in patients with COVID-19 is associated with an increase in the severity of COVID-19, as compared to non-diabetics (12), so this is one of the explanations for the severe course of COVID-19 observed in this patient.

The long-term and complex rehabilitation points to the fact that prolonged hospitalizations of patients with moderate and severe COVID-19 are correlated with complex short-term consequences, including severe impairment of muscle function and low quality of life. The imperative of early rehabilitation is the early mobilization of patients with monitoring of the respiratory function parameters (13, 14).

Rehabilitation treatment is individually adapted to each patient after the long-term rest, deconditioning, and respiratory support (respirator, HF ventilation). It is also necessary to keep in mind the patient's comorbidities (various cardiovascular diseases, respiratory disease, T2D, neurological diseases). Also, prolonged hospitalization and the disease itself can lead to detrimental effects on the respiratory, cardiovascular, and musculoskeletal systems (6).

The importance of rehabilitation in a patient after suffering from COVID-19 infection was shown in a study by Udine and associates (15), where the assessment in ADL was performed using the Barthel index, and the patient's functionality was assessed via the FAC test (Functional Ambulation Category). The Daynes et al. (16) study showed a statistically significant improvement in patients treated for COVID-19 infection after a six-week rehabilitation program in terms of exercise capacity, reduction of respiratory symptoms and fatigue, and improve-

ment in mental functioning. Also, we showed that the respiratory exercise program significantly improved anxiety levels in COVID-19 patients (17).

CONCLUSION

The goal of the rehabilitation program is to restore the patient's state of functionality before the initiation of COVID-19 treatment, so that they can perform their regular professional activities and achieve complete independence in performing activities of daily living (ADL). The conducted therapy is of special importance for improving respiratory function, which is significantly impaired in these patients. Consequences that remain after the COVID-19 infection recovery, the most common being the rapid fatigue and shortness of breath, can be significantly reduced by regular physiotherapy and respiratory rehabilitation. In addition, the education of patients after COVID-19 infection in terms of better daily functioning and training in facilitating breathing positions while sitting and standing is essential. Furthermore, it is essential to train these patients in diaphragmatic breathing, which is the most efficient way of breathing that enables economic use of limited and COVID-19 infection-damaged ventilatory capabilities.

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Značaj rehabilitacije kod dekondicioniranog bolesnika nakon hospitalno lečene COVID-19 infekcije: prikaz slučaja

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SAŽETAK

Uvod. Pandemija COVID-19, izazvana virusom SARS-CoV-2, dovela je do ozbiljnih zdravstvenih problema, do teških komplikacija, kao i do oštećenja funkcionalnosti kod osoba koje se oporavljaju od ove bolesti.
Prikaz bolesnika. Dekondicionirani šezdesetogodišnji bolesnik muškog pola je zbog izražene slabosti muskulature i nemogućnosti hodanja, preveden u Službu za fizikalnu medicinu i rehabilitaciju iz Korona 4 centra radi sprovođenja postkovid rehabilitacije. Nakon funkcionalnog testiranja kreiran je individualni plan rehabilitacije i svakodnevno primenjivan kineziterapijski program prilagođen trenutnom respiratornom statusu obolelog. Nakon kineziterapijskog programa primenjen je Respivol – volumetrijsko medicinsko sredstvo za vežbe disanja kod bolesnika sa respiratornim poteškoćama. Bolesnik na prijemu nije bio samostalno aktivno pokretan, nije mogao samostalno da pređe iz ležećeg položaja u sedeći, niti da održi balans u sedećem položaju. Kliničkom slikom dominirala je inaktivitetna hipotrofija muskulature u celini. Na kraju sprovedenog šestonedeljnog rehabilitacionog tretmana uočeno je značajno poboljšanje funkcionalnosti (FIM test), mišićne snage (manuelni mišićni test), aktivnosti dnevnog života (Barthel indeks), kao i smanjenje anksioznosti (GAD-7 skala).
Zaključak. Cilj sprovođenja rehabilitacije bio je da se bolesniku omogući povratak u stanje funkcionalnosti u kojem je bio pre početka lečenja COVID-19 infekcije, povratak redovnim profesionalnim aktivnostima, kao i postizanje potpune samostalnosti u aktivnostima dnevnog života.

Ključne reči: **COVID-19, dekondicioniranost, rehabilitacija, kineziterapija**