

## Article

# METHODS OF MEDICAL REHABILITATION OF THOSE WHO HAVE SUFFERED COMPLICATIONS OF COVID-19

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**Abstract:** The Covid-19 pandemic could reach several million people worldwide. Presumably, 5-15% of them will need medical rehabilitation after suffering from pneumonia and acute respiratory distress syndrome. The goals of medical rehabilitation at the preclinical stage are to achieve the correction of diseases that contribute to the development of Covid-19 complications (acute respiratory distress syndrome, from 15% to 33 %; acute respiratory failure, 8 %; acute heart failure, from 7% to 20 %; secondary infection, from 6% to 10 %; acute renal failure, from 14% to 53 %; septic shock, from 4% to 8 %; cardiomyopathy, in 33% of critical; disseminated intravascular coagulation, in 71 % of the dead; pregnancy complications are not excluded. Rare complications include mucormycosis and encephalitis. Encephalitis occurs only in about 0.215% of hospitalized patients, but among patients with severe disease, its frequency increases to 6.7%). Non-medicinal technologies have a number of advantages over medicines that have a side effect, and such as glucocorticoids and antibiotics lead to a deterioration in the prognosis of the underlying disease. Medical rehabilitation in the intensive care unit is aimed at reducing the risks of complications and increasing the functional reserves of the body, as well as reducing the area and degree of lung damage, preventing extrapulmonary complications, including secondary infection. The main goal of medical rehabilitation in a hospital setting is to reduce the severity of symptoms, resorption and repair in the lesion of lung tissue, reduce the development of fibrosis, provide bronchial drainage for prevention of secondary infection. In addition, the timely transfer of the patient to a specialized stage of medical rehabilitation makes it possible to increase the functional reserve of the respiratory muscles and exercise tolerance. The second specialized stage of medical rehabilitation can be carried out in the conditions of a sanatorium-resort organization. The goals of this stage are not only to reduce symptoms and increase tolerance to physical activity, but also to improve the quality of life, psychological rehabilitation, and restoration of working capacity.

**Keywords:** medical rehabilitation, spa treatment, prevention of complications, Covid-19, acute respiratory failure, acute heart failure, acute renal failure, septic shock, cardiomyopathy, inhalation therapy, vibrotherapy, climatotherapy.

The COVID-19 pandemic is the current pandemic caused by the spread of the SARS-CoV-2 coronavirus. An outbreak of the virus was first recorded in Wuhan, China, in December 2019. On January 30, 2020, the World Health Organization declared this outbreak a public health emergency of international importance, and on March 11 — a pandemic. As of January 31, 2023, more than 670 million cases of the disease have been registered worldwide; More than 6.8 million deaths have been confirmed, making the COVID-19 pandemic one of the deadliest in history.

The World Health Organization has estimated the total number of deaths directly or indirectly related in 2020 and 2021 to the COVID-19 pandemic (described as «excess mortality») at about 15 million people. This is generally consistent with the results of other studies.

Given the scale of the pandemic, according to the most conservative estimates, there will be several tens of thousands of patients in need of medical rehabilitation in Uzbekistan, which will require significant costs from healthcare, as well as the development of innovative and economically acceptable methods of medical rehabilitation.

It should be emphasized that in a significant proportion of patients who have suffered severe pneumonia, there is a pronounced restriction of physical activity, a decrease in working capacity and quality of life, as a result of which early medical rehabilitation is a socially significant task.

Despite the lack of significant experience in the

medical rehabilitation of patients directly with Covid-19, modern medicine has extensive experience in medical rehabilitation and spa treatment of patients with respiratory diseases and other somatic diseases. In this regard, a large-scale task is to restore health and improve the quality of life of patients who have undergone Covid-19, it can become a driver of the development of the sanatorium treatment industry.

## Materials and methods.

A comprehensive database search was conducted MEDLINE (online system for analyzing and searching medical literature), EMBASE (database Excerpta Medica), Web of Science and MedPilot, CyberLeninka. In addition, the meta-analysis included articles and dissertations that are in libraries only on paper (libraries of scientific institutions). Rehabilitation and Balneology of the Ministry of Health of the Republic of Uzbekistan. In a systematic search, the terms «medical rehabilitation», «medical rehabilitation of respiratory organs» were combined with the terms «COPD», through «and» in all fields. In addition, the terms «balneotherapy», «spa treatment», «respiratory diseases», «SARS pneumonia», «acute respiratory distress syndrome (ARDS)», «medical rehabilitation» were associated through «and» with «COPD». No restrictions were made regarding the language, publication date, duration of the study, or patient demographics. As a result, 48 scientific sources were selected for further analysis and

search for solutions to the problem of restoring the health of patients who have undergone Covid-19.

#### **Research results and their discussion.**

To date, it is known that Covid-19 is caused by the SARS-CoV-2 betacoronavirus, which mainly affects cells of the respiratory and digestive systems. The development of the disease is characterized by a long incubation period, which allows, using, first of all, methods of physical medicine, to minimize the risk of severe complications by correcting early manifestations, existing chronic diseases, as well as sanitizing foci of infection and increasing the resistance of the respiratory tract mucosa.

At the same time, the most frequent is the lesion of the lung tissue, which leads to the development of severe complications, including acute respiratory distress syndrome. Early initiation of rehabilitation measures, directly in the intensive care unit, will significantly reduce the mortality of patients on artificial lung ventilation, as well as reduce the severity of lung tissue damage and the risk of complications from other organs and systems, primarily cardiovascular.

Conducting rehabilitation in a hospital setting, promotes the restoration of lung function and physical activity, reduces the number of complications associated with the development of secondary infection and reduces the severity of fibrosis.

Spa treatment allows you to use a combination of natural and preformed factors, diet therapy, phytotherapy, psychotherapy, manual methods of treatment. At this stage, it is important not only to reduce symptoms, but also to restore tolerance to physical activity, improve the quality of life, and improve the psychoemotional state of the patient.

Complications of Covid-19 are more likely to develop in the elderly and in people with chronic non-communicable diseases. At risk of severe complications are patients with respiratory diseases (COPD, bronchial asthma), diseases of the circulatory system (hypertension, coronary heart disease, etc.), as well as diseases of the endocrine system, eating disorders and metabolic disorders (diabetes mellitus, obesity), in addition, the risk factors include taking antibiotics, cytostatics, glucocorticoids, which requires achieving correction of these diseases without the use of medications that worsen the prognosis of Covid-19. In this regard, this task should be solved based on the methods of medical rehabilitation and sanatorium treatment.

Therefore, an important task in the medium term is to clarify the indications for certain types of medical rehabilitation and sanatorium treatment in patients who have undergone Covid-19, identification of the most effective reduction techniques symptoms, restoration of the quality of life, working capacity, psychological and social adaptation of the patient, using the possibilities of the sanatorium-resort complex of Uzbekistan.

**The main goal of medical rehabilitation in the intensive care unit is to reduce the risks of complications and increase the functional reserves of the body.** It is necessary to strive to reduce the area and degree of lung damage, prevent the development of extrapulmonary complications, secondary infection, fullness of the lungs and weakness of the respiratory muscles.

The objectives of this stage are: reduction of fullness

and swelling of alveolar tissue, destruction of capillaries and alveolar membrane, which is necessary to reduce the lesion zone of lung tissue, provision of bronchial drainage for the prevention of secondary infection, increasing the reserve of respiratory muscles to ensure independent breathing, increasing the efficiency of gas exchange by restoring the regulation of the ventilation-perfusion ratio, improving wall air mixing.

At this stage, the highest efficiency it has been proven in the early (from day 2) use of physical therapy, cyclic mechanotherapy (passive, active-passive and active) and vibratory chest massage. It is possible to use nebulizations of hypertonic sodium chloride solution and silver electrolysis solution, electrostimulation of the diaphragm, electrostimulation of the chest (along the fields with diadynamic currents), as well as lymphatic drainage massage of the extremities.

According to experts, patients with severe viral pneumonia, who are on artificial ventilation in the intensive care unit, it is recommended to carry out the following methods of physical medicine:

On the 2nd day, subject to stabilization of the patient's condition, lymphatic drainage massage of the lower extremities is possible. Vibratory massage of the chest and diaphragm area at this stage leads to an improvement in alveolar gas exchange, drainage of the bronchial tree, activation of lymphatic drainage, as well as an increase in the reserves of respiratory muscles.

Starting from 3 days, postural drainage is performed in the Sims position. Vibration massage of the back and upper extremities.

From 4 days under the supervision of medical staff, conducted exercises involving bending of the arms, legs, twisting movements of the chest and lateroflexion with a small amplitude. Treatment with the position consists in turning the patient from the back to the stomach and back. These exercises are aimed at activating peripheral blood circulation, lymphatic drainage and chest mobilization.

At this stage, the use of cyclic mechanotherapy is effective, in the mode of passive training using bedside simulators for the development of the lower extremities. Dosed physical activity in the passive mode is the most important a factor in the prevention of secondary infection. In general, the use of cyclic mechanotherapy leads to activation of visceral blood and lymph flow, reduction of interstitial edema, bronchial drainage, prevention of thrombotic complications.

In the subsequent period, depending on the severity of the condition and the speed of recovery, it is advisable to conduct more active training on simulators, combining it with passive treatment using drainage positions.

After extubation, dosed physical activity is shown, consisting in taking walks along a specially marked route, conducted under the control of indicators of heart rate, blood pressure, oxygen saturation of arterial blood. At this stage, it is necessary to train respiratory gymnastics (diaphragmatic breathing, breathing with resistance), which should be performed in combination with metered physical activity.

As a result, medical rehabilitation at an early stage in these patients reduces the risk of possible complications,

both the underlying disease and concomitant, including the addition of a secondary nosocomial infection.

Medical rehabilitation in a hospital setting is aimed at reducing the severity of symptoms, resorption and repair in the lesion of lung tissue, reducing the development of fibrosis. In addition, the timely transfer of the patient to a specialized stage of medical rehabilitation makes it possible to increase the functional reserve of the respiratory muscles and exercise tolerance. In addition, the task of this stage is to provide bronchial drainage for the prevention of secondary infection.

The following methods are used as the main methods at this stage: vibration and compression chest massage, vibration training, methods of physical therapy and respiratory gymnastics. Inhalation therapy with various types of solutions is widely used, primarily hypertonic sodium chloride solution, as well as silver electrolysis solution and mineral water. Of the physiotherapeutic techniques, electrostimulation of the diaphragm and chest muscles, electrophoresis, low-intensity

laser therapy, pulse therapy (sinusoidal modulated, diadynamic) with localization on the chest area. Recently, a technique of cyclic chest compression using a pneumatic cuff has been used, the result of which is an increase in the efficiency of the respiratory muscles and activation of bronchodilatory reflexes from the diaphragm and proprioceptors of the chest.

Physical therapy and respiratory gymnastics are aimed at increasing the reserves of the respiratory muscles, drainage of the bronchi, activation of gas exchange in the lungs, reducing the subjective feeling of lack of air.

In patients with complications of Covid-19, after secondary bacterial infection and purulent destruction of lung tissue, bronchiectasis of small bronchi may develop, which leads to the development of «air trap syndrome», which significantly impairs ventilation and drainage of the lungs. In addition, exhalation resistance reduces alveolar and interstitial edema, increases the functional residual capacity of the lungs, promotes the spread of atelectasis.

For drainage of the bronchial tree in the data patients use devices that create positive pressure by the end of exhalation.

The metered resistance to exhalation contributes to the displacement of the point of equal pressure to the area of larger bronchi, which helps to eliminate «air traps». In addition, collateral ventilation is enhanced through the Cohn pores and Lambert channels bypassing obstructive and atelectasis areas of the lungs, which helps to equalize pressure gradients in neighboring lung areas, optimizes alveolar ventilation and helps to eliminate the imbalance between ventilation and perfusion. Due to the increased pressure, previously collapsed alveoli are opened, which leads to an increase in the gas exchange area.

Percussion massage is essentially one of the techniques of low-frequency vibration therapy, which is a rhythmic beating, collected in the form of a «bowl», with palms on the surface of the chest. After a palm strike, secondary, attenuating mechanical vibrations occur, which are in the spectrum of resonant frequencies of the chest tissues. Percussion massage is most often used in drainage positions of the body, which enhances its effectiveness. As

a result of this impact, mobilization improves sputum, there is mixing of the alveolar gas medium and an increase in the diffusion of gases. Due to the improvement of blood circulation and lymphatic drainage, the endurance of the respiratory muscles of the chest increases. Percussion massage is usually well tolerated by patients and has a high subjective assessment.

The effectiveness of chest vibration massage largely depends on the technique of the procedure and the characteristics of vibration. The most pronounced effect of vibration massage is relief of respiratory muscle fatigue syndrome, less pronounced mobilization of sputum and increased its fluidity (due to the destruction of the glycoprotein framework of sputum), optimization of gas exchange as a result of mixing of the alveolar gas medium, bronchodilating effect (due to irritation of certain reflex fields of the skin and areas of deep sensitivity).

To activate mucociliary clearance, achieve an anti-inflammatory effect, normalize hemodynamics in the small circle of blood circulation, the use of halotherapy is effective. An important point at this stage is the psychological correction of the patient's current condition.

Also, the second specialized stage of medical rehabilitation can be carried out in the conditions of a sanatorium-resort organization. In this case, as in sanatorium-resort treatment, methods of climatotherapy, peloid therapy, balneotherapy, as well as inhalation with mineral water are widely used in patients with this pathology. Physical therapy classes are primarily aimed at mobilizing the diaphragm, restoring the kinetics of chest and lung movements. The most commonly used methods are terrenkur, walking in water and aquatrenirovki.

In the case of spa treatment in patients with respiratory diseases, a variety of non-medicinal methods have proven to be highly effective: thalassotherapy, aeroionotherapy, speleotherapy and others.

The climate of the mountains is indicated for the rehabilitation of patients with pulmonary fibrosis after pneumonia, low exercise tolerance, concomitant heart and vascular diseases. The optimal height is from 1000 to 2000 m above sea level. With a small exogenous hypoxia, tissue respiration is activated, there is a release of deposited erythrocytes into the blood, stimulation of erythropoiesis and myelopoiesis.

A mandatory component of the medical rehabilitation of patients who have suffered pneumonia is metered physical activity. Walking helps to strengthen muscles, including respiratory muscles, reduce the subjective component of shortness of breath, activate bronchial drainage, strengthen lymph and blood flow.

Scandinavian walking can be used along the entire length of the terrencourt route or on its individual sections. This type of exercise allows you to include the muscles of the upper extremities, shoulder girdle, neck, which helps to mobilize the structures of the chest, improves the kinetics of the lungs.

In addition, vertical water training is used quite effectively, which can be carried out in natural reservoirs and pools with fresh, sea or mineral water. When using mineral water, the effect of physical activity is potentiated by the general effect on the body of mineral water, which

requires careful dosing of the procedure. For training in the water of patients with respiratory diseases, chlorination of pool water should be avoided.

The therapeutic effect is achieved by partial immersion in water, which leads to easier operation of the diaphragm and activation of blood circulation in this area. It should be noted that the density of water is about 775 times greater than the density of air, which makes it possible to flexibly dose physical activity and load muscles that are little involved when walking in the air.

Inhalations with mineral water are effective in patients with impaired bronchial drainage, decreased gas exchange and decreased exercise tolerance. It should be emphasized that the most pronounced effect is observed when inhaling bromine-containing and siliceous mineral waters. According to the study, inhalation of sodium sulfide waters leads to an increase in the pH of the exhaled air condensate, which indicates a decrease in the activity of inflammation. The study showed that inhalations of chloride-bicarbonate-sodium mineral water contribute to the improvement of respiratory function and quality of life in patients with COPD. The study shows that inhalations of sulfuric thermal sulfide water have mucolytic, antioxidant and anti-elastase activity.

**Medical rehabilitation of patients in outpatient settings is primarily aimed at increasing the level of functional reserves of the patient's body**, as well as improving gas exchange and regulation of perfusion-ventilation ratio, restoring bronchial drainage, improving the psychophysiological status, quality of life, increasing the physical and emotional participation of the patient in daily life. For the most part, at this stage, specially designed integrated methods of physical therapy for patients with respiratory diseases, metered physical activity, in particular, terrenkur and Scandinavian walking.

The effectiveness of balneotherapy, respiratory gymnastics and massage has been proven.

In addition to carrying out medical rehabilitation of patients after an already suffered disease, an important point is to carry out preclinical prevention of the development of possible complications Covid-19 in patients suffering from chronic non-communicable diseases.

In this case, it is especially important to conduct it at patients with a high risk of infection, the incubation period of Covid-19, in patients with chronic infectious diseases of the respiratory system, as well as with disorders of bronchial drainage and bronchial patency.

Among the main tasks of prevention, it is necessary to emphasize the following: rehabilitation of foci of infection, reduction of proinflammatory activity, increased mucociliary clearance and bronchial drainage, and most importantly, achieving disease correction without the use of medications that worsen the prognosis in Covid-19 (antibiotics, glucocorticoids, nonsteroidal anti-inflammatory drugs, ACE inhibitors).

Once again, it should be noted that patients suffering from COPD, chronic diseases of the respiratory system, diseases of the circulatory system, diseases of the endocrine system, eating disorders and metabolic disorders, long-term smokers have a higher risk of complications in Covid-19 not only as a result of primary cell damage by the virus, but also

due to the development of secondary fungal and bacterial infection. The long incubation period of Covid-19 allows you to preventive measures aimed at reducing the risk of complications in patients with chronic non-communicable diseases. In these patients, it is necessary to achieve the maximum possible remission of chronic diseases, sanitize foci of infections in the respiratory tract, and establish sputum drainage. This task is complicated by the fact that the use of antibiotics and inhaled steroids increases the risk of severe complications of coronavirus infection, which it requires the active use of non-drug methods. The task of this stage can be formulated with the paradoxical phrase «preventive rehabilitation».

In the arsenal of physiotherapy, there are several methods of preventing exacerbations of COPD and bronchial asthma, including those induced by respiratory infection. In particular, this inhalation therapy has shown good efficacy of inhalation of alkaline mineral waters, inhalation of sodium chloride aerosols enriched with silver, inhalation of essential oils and extracts of phytoaromatic plants.

**Inhalation of sodium chloride aerosols enriched with silver.** The study showed that in patients with COPD, the use of a dry aerosol of sodium chloride impregnated with silver and nebulizations of an electrolysis solution of silver (at a dose of 2 mg per day for 6 months) allowed statistically significantly reducing the number of exacerbations, hospitalizations and antibiotic prescriptions in patients with COPD during the year without causing side effects. The applied dose is 2 mg / day. (in terms of metallic silver) significantly less doses of silver capable of cause undesirable effects with prolonged use, but sufficient for the prevention of respiratory viral infections.

The use of dry and liquid-droplet sodium chloride aerosols enriched with silver ions makes it possible to sanitize foci of infection by suppressing a wide range of gram-negative and gram-positive microorganisms, including *Pseudomonas aeruginosa*, which plays an important role in the mortality of patients who have had viral pneumonia. Silver ions have high activity against fungal microflora. Resistance to silver pathogenic microflora is produced rather slowly, the suppression of most pathogenic microorganisms can be achieved with non-toxic for human concentrations of silver ions. In addition, the inhalation use of silver can reduce the viscosity of sputum, activate mucociliary clearance and phagocytic activity of macrophages, promote the synthesis of IgA, reduce the production of proinflammatory cytokines in the respiratory tract.

The antiviral activity of silver deserves special attention. Silver ions and nanoparticles showed high antiviral activity in vitro against a wide range of viruses: hepatitis B virus, HIV-1 virus, rhinosyncytial virus, herpes simplex virus type 1. According to the data, it was shown that silver nanoparticles disrupt the penetration of the virus into the cell by denaturing the gp120 receptor located on the cell membrane, prevent infection at the early stage of virus replication and at the stages after penetration into the cell. During the experiments, the development of resistance of viruses to silver was not revealed. Taking into account

Due to the functional proximity of SARSCoV-2 S

glycoprotein and gp120 protein, it can be assumed that silver will actively damage the binding receptor SARS-CoV-2 with a cage. The universality of silver's effect on various virus strains, the use of several replication suppression mechanisms, undetected resistance, makes silver very promising for the prevention of exacerbations of COPD associated with viral infections.

Sodium chloride solution with the addition of silver electrolysis solution can be used for nebulization, indoor spraying with an ultrasonic humidifier, irrigation of the nasal cavity. Sodium chloride particles impregnated with silver can be used in portable halocamers.

**Inhalation of sulphate mineral water.** Oxidative stress plays an important role in the pathogenesis of the destruction of the alveolar membrane and the development of ARDS. The study revealed that the course of sulfate mineral water reduced the prooxidant activity of exhaled air condensate in patients with COPD of moderate to severe degree and improved symptoms. In addition, it has been shown that sulfate waters have a pronounced mucolytic effect, which can be used to prevent secondary infection in patients with Covid-19. The study revealed that the inhalation of bromine-iodine mineral water reduces the attraction of neutrophils in induced sputum, which is important, given the role of neutrophil migration in the destruction of lung tissue.

In patients suffering from bronchial asthma, an important role is played by reducing the activity of allergic inflammation and prevention of bronchospasm without the use of glucocorticoids. For these purposes, it is effective to use halotherapy using a portable halocam. To obtain an aerosol, you can use halite, silvinit, sea salt. Numerous studies have shown anti-inflammatory activity and activation of mucociliary clearance of dry sodium chloride aerosol, which statistically significantly reduced the amount and severity of bronchial asthma in patients with asthma, seizures, decreased the need for bronchodilators. The use of halotherapy made it possible to achieve long-term remission with minimal use of drug therapy.

**Conclusion.** Thus, modern medicine has the necessary experience and arsenal of non-drug methods that can be used in the prevention, medical rehabilitation and sanatorium treatment of people who have suffered complications of COVID-19, which will reduce the development of complications and disability, as well as improve the quality of life of patients.

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