EFFECT OF PHYSICAL REHABILITATION ON THE FUNCTIONAL STATE OF POST COVID-19 PATIENTS

INTRODUCTION

The spread of coronavirus infection has become a challenge for the entire world community, including the community of medical workers and rehabilitation therapists. The selective focus of coronavirus infection on various age categories of citizens makes rehabilitation physicians of all countries optimize the search for the most effective existing methods to improve the rehabilitation potential, to restore physical capabilities, to prevent disability and reduce mortality. The use of physical methods of rehabilitation is attractive because it uses non-medicinal and non-specific methods of rendering assistance to post-covid-19 rehabilitants. Thus, the number of patients who can receive professional help is significantly increasing. According to Grabowski et al. (2020), up to 20% of those who have had a severe form of COVID-19 will need medical assistance at home.

The issues of treatment of post-covid complications and rehabilitation are not given full attention. Thus, AA Zuikova et al. (2020) believe that the recovery process largely depends on the timeliness of the start of rehabilitation measures after the relief of respiratory failure and the threat of death. However, when starting a complex of rehabilitation measures, it must be remembered that functional disorders of vital organs and body systems have the ability to remain for a long time in the post-covid period. Thus, the priority of all rehabilitation for those who have been ill should be aimed at restoring the function of external respiration (BUBNOV, 2020), tissue oxygen availability, improving muscle strength and physical activity, as well as improving the quality of life and psychological status YT Xiang et al. (2020).

It is extremely important to maintain the three-stage rehabilitation of patients with COVID-19. It is necessary to carry out stage 1 in the early stages, starting with the intensive care unit and continuing in the conditions of the infectious diseases department of the hospital. Prolongation of the 2-nd stage of rehabilitation in inpatient conditions, probably, can guarantee minimal complications of this disease and contribute to the psychophysical recovery of patients. The third stage of rehabilitation, which is carried out in outpatient-polyclinic and sanatorium conditions, involves the use of a wide variety of rehabilitation measures, both in individual and group forms (KOKHAN et al., 2019; Temporary guidelines. Version 10, 02.08.2021).

The damage of the lung tissue by the SARS-CoV-2 virus leads to a weakening of the immune system, which becomes a serious problem on the way to the recovery of a patient with COVID-19. The presence of concomitant diseases only worsen the course of this disease and contribute to an increase in deaths. The study carried out by Q. Ruan (2020) and WJ. Guan (2020) showed that 50% of patients with mild to moderate severity of COVID-19 disease had...
more than one comorbidity. Up to 72% of patients had two or more concomitant diseases in a severe form of the disease. Comorbidity worsened the prognosis 1.9 times more often among patients who died from coronavirus infection. The existence of several comorbidities increased the likelihood of death 9.5 times more often compared with the presence of one COVID-19 disease. To optimize rehabilitation measures for those who have recovered from COVID-19 who have postcoid pulmonary complications that lead to disability, it is necessary to rationally use scientifically based physical rehabilitation methods (CARDA et al., 2020). A comprehensive rehabilitation approach allows you to achieve significant results with the timely relief of respiratory failure, a reduction in the recovery time of physical activity, temporary disability and a decrease in the number of cases of primary disability (RAZUMOV et al., 2020).

Stanford Hall’s statement of consensus on rehabilitation after COVID-19 is that a return to exercise and physical activity should only occur after an asymptomatic period of at least seven days (BARKER-DAVIES et al., 2020). As noted by A.J. Rodriguez-Morales et al. (2020), 80% of COVID-19 coronavirus cases were diagnosed with mild or moderate severity with a predominance of characteristic signs: shortness of breath, cough, high temperature and fever. In the remaining 20% of people, the disease is severe, with a high risk in people over the age of 65 years, with burdensome courses, chronic diseases (VERTITY et al., 2020; YANG et al., 2020). In critical condition, 6.2% of patients with respiratory failure, septic shock or multiple organ failure are registered.

During the height of the disease, manifested by severe symptoms and the need for hospitalization in a medical institution, patients often lose physical activity, thereby contributing to the development of new or worsening existing disorders in the body (RAWAL et al., 2017). According to Herridge et al. (2016), the decrease in physical functioning is facilitated by prolonged immobility of the patient who is motionless due to the severity of the disease. The result is a decrease in physical endurance, muscle weakness of all muscle groups, aerobic activity. Long-term impairment of the functional state and physical fitness of a COVID-19 patient is also caused by his/her hospitalization in the Intensive Care Unit (ICU) (STEVENS et al., 2007). The purpose of the study. The purpose of the study is to assess the physical condition of the patients by severity and the effectiveness of the use of therapeutic physical culture as part of a comprehensive post-covid rehabilitation.

MATERIALS AND METHODS

The study involved 74 patients aged 32 to 80 years, of them men – 43% (n = 32), women – 68% (n = 42). The average age was 53±12.6. All have been diagnosed with coronavirus infection caused by the COVID-19 virus, moderate to severe pneumonia. The damage of the lung tissue was CT-3 - 51-75%, CT-4 76-85%. 12 patients (16%) were on artificial lung ventilation (ALV) during treatment, 57 persons (77%) used mask oxygen. All completed inpatient treatment in an infectious disease’s hospital or in a repurposed mono inpatient hospital. Treatment of patients was carried out from February to June 2021. According to hospital discharge lists of epicrisis, all were discharged with an improvement in health and with recommendations to continue comprehensive rehabilitation measures. Physical therapy and breathing exercises were held daily on an outpatient basis for 14 days for 30-60 minutes from February to June 2021 in the district polyclinic of the city Chita.

Classes included exercises focused on deep/slow breathing, with a focus on the respiratory rate of 12-15 times / min. Breathing through slightly compressed lips. Exercises to change the structure of the respiratory act (Temporary guidelines. Version 10, 08.02.2021). The use of elements of A.N. Strelnikova’s respiratory gymnastics (IVANOVA et al., 2020). Therapeutic gymnastics included a set of low-medium intensity exercises for the prevention of ICU-AW syndrome (DEMCHENKO et al., 2020). To determine the functional capabilities of the body, the following indicators were recorded: respiratory rate (RR), heart rate (HR), systolic and diastolic blood pressure (BP), vital capacity (VC), blood oxygen saturation level, Kerdo vegetative index (KVI). Functional tests: Stange and Gench’s test, walking test (6 MWT), quality of life (EQ-5D questionnaire).

Measurements of the obtained indicators were carried out at the beginning and at the end of the cycle of physical exercises. Classes were organized in an individual format, in connection with the different physical capabilities of post-covid patients. The study was carried out in
accordance with the principles of the Declaration of Helsinki and existing national norms on the observance of the rights, safety and well-being of the study participants. To process the data statistically, we used Microsoft Excel and the statistical software Statistica (version 6.0) for Windows. Differences were considered statistically significant at p<0.05.

RESULTS
Practically, all seriously ill COVID-19 and patients with moderate severity with chronic diseases and complications presented the above complaints: fatigue and weakness - 51 persons (68.9%), shortness of breath during exercise 42 persons - 56.7%, cough - 44 persons (59.5%), chest pain - 33 persons (44.6%), decreased chest rise - 46 persons (62.2%), crepitus and dry rales - 37 persons (50%). Cognitive disorders - sleep disturbance 16 persons (21.6%), memory impairment - 38 persons (51.3%), internal discomfort - 21 persons (28.3%). The carrying out a 14-day course of complex rehabilitation on an outpatient basis, which included physical education, made it possible to significantly reduce the indicators of subjective symptoms in patients. So, fatigue decreased by 2.3 times, there was a tendency to a decrease in shortness of breath. Respiratory complaints after the end of classes significantly decreased: cough by 2 times, chest pain by 1.7 times, decreased lung excursion by 2.7 times. Crepitus in the lungs did not have significant reduction figures - only 10.8%, in our opinion, due to the presence of bronchopulmonary complications and chronic diseases. Changes in cognitive sleep and memory disorders improved insignificantly - by 1.5 and 1.3 times, internal discomfort was felt by 17.5%, and it decreased by 1.6 times.

**Fig. 1** Data on indicators of subjective symptoms in postcovid patients

Source: Search data.

The study of the functional state indicators of those who had recovered (Table 1) clearly showed a tendency for an improvement in the frequency of respiratory movements at rest after a course of physical rehabilitation classes. The heart rate has significantly decreased. Systolic and diastolic blood pressure data remained unchanged. Kerdo vegetative index actually decreased by 2.3 times. Saturation of blood with oxygen and vital capacity of the lungs after dosed physical exertion had dynamics to improvement.

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Table 1. Indicators of the functional state of post Covid-19 patients

| Investigated indicators                  | Before a course of physical rehabilitation | After a course of physical rehabilitation |
|------------------------------------------|---------------------------------------------|-------------------------------------------|
| Respiratory rate at rest, beats / min    | 22.6±2.3                                   | 17.4±1.7                                  |
| Heart rate, beats / min                  | 90.5±3.9                                   | 73.8±5.1*                                 |
| Systolic BP, mm Hg                       | 137±1.8                                    | 126±4.3                                   |
| Diastolic BP, mm Hg                      | 74.6±3.3                                   | 69.7±2.8                                  |
| Kerdo vegetative index, cu               | 21.3±4.7                                   | 9.1±3.1*                                  |
| Blood oxygen saturation, %               | 93.1±0.9                                   | 97.2±2.2*                                 |
| Vital capacity, ml                       | 3310±240.5                                  | 3885±300.1                                |
| Expiratory breath hold test (Gench), sec.| 19.1±4.2                                   | 33±5.3*                                   |
| Inspiratory breath hold test (Shtange), sec.| 32.3±2.7                                   | 49.8±6.1*                                 |
| 6-minute walk test (6 MWT)               | 426.1±78.9                                  | 513.5±71.9*                               |
| Quality of life (EQ 5D questionnaire)    | 9.9±2.9                                    | 7.2±1.3*                                  |

* Differences are significant compared to the result before the course of physical rehabilitation, p < 0.05

Source: Search data.

When carrying out functional tests (Gench and Shtange’s tests), a significant improvement in the dynamics of indicators was registered in most of the subjects (Table 1). The 6-minute walk test (6 MWT) was used to assess exercise tolerance and objectivity to the functional status of post-covid patients. This test is an important informative method to assess patient's physical condition (CHIKINA, 2015). After the course of the measures taken, there was an improvement in indicators in the studied patients with moderate and severe severity.

According to the assessment of the quality of life (EQ 5D questionnaire), the data clearly demonstrate a significant improvement in the results obtained after physical rehabilitation. The average indicator after the end of the class was 7.4.

DISCUSSIONS

A professional approach to the proposed physical rehabilitation services for those who have been down with Covid-19 is of great importance for maintaining health, reducing disability and mortality among this category of citizens. Taking into account the presence and exacerbation of chronic diseases of organs and systems, aggravated by the severity of the course, age category, physical condition, it is extremely important to selectively approach the planned recovery activities. Currently, while there is no sufficient evidence base on the actual return of post-covid patients with lung damage of more than 50% to physical activity and taking into account all the existing limitations and complications, it is impossible to suggest the immediate recovery. The rational approach lies in the reality of a gradual approach, individual, based on motivation and tolerance in relation to physical activity during the period of complex rehabilitation. The use of physical rehabilitation methods aimed at improving blood circulation, increasing ventilation and gas exchange, restoring the work of skeletal muscles, quality of life, is extremely important for those who have recovered from SARS-CoV-2 pneumonia. The timeliness of the start of a complex of rehabilitation measures also affects the reduction of negative consequences for post-covid patients (DE BIASE et al., 2020; BETTGER et al., 2020).

The researchers note that the state of health of a person who has recovered from Covid-19 infection remains uncertain and post-infection syndrome can persist for a long time and become chronic. Although Mongolia has experience in the rehabilitation therapy of non-communicable diseases, the problem of post-covid rehabilitation of people was a new, as for other countries too. Therefore, the Ministry of Health of Mongolia, paying attention to this issue, recommended that post-covid rehabilitation be carried out in accordance with the WHO recommendation and in order to increase the immunity of people who have been ill, combine to intake the decoctions of herbs “Norov-7” and “Mana-4” of traditional medicine with traditional Mongolian probiotics such as mare’s and camel milks.

The inclusion of various complexes of pulmonary and physical rehabilitation significantly improves the ventilation-perfusion capacity of the lungs, thereby contributing to a decrease in subjective symptoms. At the same time, taking into account the severity of the disease, the existing complications and the age category of patients, it is necessary to observe and continue the restorative rehabilitation processes during the next year (CARDA et al., 2020).
CONCLUSION
This material presents the existing sets of exercises that form the basis of medical rehabilitation programs for patients who have undergone pneumonia associated with the new coronavirus infection COVID-19 in moderate and severe severity. The use of these techniques is an additional component to drug therapy and is necessary at the 3rd stage of rehabilitation in outpatient or sanatorium conditions. The dynamics of the indicators of the function of external respiration after the course of physical rehabilitation has a positive trend. As a result of individual dosed physical activity in post-covid patients, blood oxygen saturation SpO2 was significantly improved SpO2 > 97.2%. The data on heart rate and Kerdo vegetative index significantly improved. VC has improved on average by 475 ml. Functional tests of Gench and Shtangeafter a training cycle recorded a positive improvement in the indicators of these tests. The initial data on the 6MWT test recorded a steady dynamic of improvement in indicators, as in the middle group.

As a result of our research, it was found that the applied complexes of statistical, dynamic, breathing and restorative exercises made it possible to improve the mobility of the chest and form the correct stereotype of respiratory movements. Also, developmental exercises to strengthen the respiratory and abdominal muscles, balance and coordination training contributed to a decrease in respiratory symptoms and the absence of progression of respiratory failure. Funding Sources – The research was carried out at the own funds of the group of authors.

CONFLICT OF INTERESTS
The authors declare no conflict of interest.

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Effect of physical rehabilitation on the functional state of post covid-19 patients

Efeito da reabilitação física no estado funcional dos pacientes pós-covid-19

Efecto de la rehabilitación física sobre el estado funcional de los pacientes post covid-19

Resumo
O artigo apresenta os resultados da reabilitação física de pacientes pós-COVID-19 com gravidade moderada e grave. Todas as sessões com pacientes foram realizadas ambulatoriais em formato individual durante 14 dias. Levando-se em conta a natureza multisistema do COVID-19, a presença de doenças crônicas e complicações, o período de recuperação para aqueles que estão doentes geralmente depende do início de medidas complexas de reabilitação. Nosso estudo mostrou de forma confiável que, no contexto das prescrições médicas, fisioterapia, indicadores psicológicos e sociais, um complexo de sessões de treinamento para reabilitação pulmonar e física, técnicas de ensino para melhorar a estrutura do ciclo respiratório em quem esteve doente proporciona uma melhoria na tolerância ao exercício e estado psicoemocional e qualidade de vida. No contexto da reabilitação física, os pacientes apresentaram melhora tanto nos parâmetros clínicos quanto no estado funcional.

Palavras-chave: Pós COVID-19 pacientes. Infeção por coronavírus. Reabilitação física. Exercícios respiratórios.

Abstract
The article presents the results of physical rehabilitation of post COVID-19 patients with moderate and severe severity. All sessions with patients were carried out on an outpatient basis in an individual format for 14 days. Taking into account the multisystem nature of COVID-19, the presence of chronic diseases and complications, the recovery period for those who have been ill generally depends on the start of complex rehabilitation measures. Our study has reliably shown that against the background of medical prescriptions, physiotherapy, psychological and social indicators, a complex of training sessions for pulmonary and physical rehabilitation, teaching techniques for improving the structure of the respiratory cycle in those who have been ill provides an improvement in exercise tolerance and psycho-emotional state and quality of life. Against the background of physical rehabilitation, the patients showed an improvement in both clinical parameters and functional state.

Keywords: Post COVID-19 patients. Coronavirus infection. Physical rehabilitation. Breathing exercises.

Resumen
El artículo presenta los resultados de la rehabilitación física de pacientes post COVID-19 con gravedad moderada y severa. Todas las sesiones con pacientes se realizaron de forma ambulatoria en formato individual durante 14 días. Teniendo en cuenta la naturaleza multisistémica de COVID-19, la presencia de enfermedades crónicas y complicaciones, el período de recuperación para aquellos que han estado enfermos generalmente depende del inicio de medidas de rehabilitación complejas. Nuestro estudio ha demostrado de forma fiable que en el contexto de las prescripciones médicas, la fisioterapia, los indicadores psicológicos y sociales, un complejo de sesiones de entrenamiento para la rehabilitación pulmonar y física, la enseñanza de técnicas para mejorar la estructura del ciclo respiratorio en aquellos que han estado enfermos proporciona una mejora en la tolerancia al ejercicio y el estado psicoemocional y la calidad de vida. En el contexto de la rehabilitación física, los pacientes mostraron una mejoría tanto en los parámetros clínicos como en el estado funcional.

Palabras-clave: Pacientes post COVID-19. Infección por coronavirus. Rehabilitación física. Ejercicios de respiración.