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ORIGINAL ARTICLE

Evaluation of the effectiveness of low-frequency magnetotherapy in the rehabilitation of patients with pneumonia caused by the SARS-CoV-2 virus (the causative agent of COVID-19)

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ABSTRACT

The study aimed to evaluate the effectiveness of the low-frequency magnetic therapy with a "running" magnetic field in medical rehabilitation after COVID-19 pneumonia.

Materials and research methods: The study included 42 patients (24 men and 18 women) aged 40 to 65 years, who had pneumonia (J16.8) caused by the new coronavirus SARS-CoV-2. The first group included 22 patients who received standard drug therapy and starting from the 20th day after discharge from the hospital, this group of patients received low-frequency magnetotherapy with a "running" pulsed magnetic field of the ALMAG-02 apparatus. The second group included 20 patients who received the same treatment, except for magnetotherapy.

Results: The course of rehabilitation measures carried out led to an increase in the functional capabilities of the cardio-respiratory system in patients of both groups, an increase in chest excursions, an increase in the vital capacity of the lungs, the normalization of the act of breathing and ventilation of the lungs, and an improvement in the psychosomatic status of patients. In the main group, these changes are more pronounced than in the control group, which is associated with the inclusion in the complex treatment of low-frequency magnetotherapy with a "running" pulsed magnetic field.

Conclusion: The use of low-frequency magnetic therapy with a "running" pulsed magnetic field in the complex of rehabilitation measures for patients who have suffered from COVID-19 pneumonia significantly improves the somatic status of patients, increases exercise tolerance, and optimizes the function of external respiration.

Keywords: magnetotherapy, COVID-19, pneumonia

INTRODUCTION

To date, a new coronavirus infection with the SARS-CoV-2 virus (the causative agent of COVID-19) has acquired the character of a stable epidemic. A severe form of infection (pneumonia) causes diffuse damage to the alveoli with a certain amount of damage, which clinically corresponds to the developing pulmonary edema. The outcome of COVID-19 pneumonia in about 10% of patients occurs in the form of foci of fibrosis in the lung tissue with the possible development of further restrictive respiratory failure [1].

For patients who have undergone coronavirus community-acquired bilateral pneumonia, given the severity of the disease, rehabilitation measures are needed to restore the consequences of the disease, i.e. what is called "pulmonary rehabilitation," respiratory medical rehabilitation ", respiratory therapy" [2,3]. The use of physical factors for these purposes makes it possible to call this component of complex respiratory rehabilitation "respiratory physiotherapy" [4]. In the context of the epidemic of the new SARS-CoV-2 virus (the causative agent of COVID-19), this branch of medicine acquires a new meaning and special significance, as searches for promising physical therapies that have optimized the treatment results for these patients. In this regard, the present study was undertaken.

The aim of the study: to appreciate the effectiveness of the use of low-frequency magnetic therapy with a "running" pulsed magnetic field in the complex of rehabilitation treatment of patients who have undergone pneumonia caused by the new coronavirus SARS-CoV-2 (the causative agent of COVID-19) at the stage of convalescence.

MATERIALS AND METHODS

The research was carried out at Solotcha Sanatorium LLC. Examination and treatment of 42 patients (24 men and 18 women) aged 40 to 65 years, who had community-acquired pneumonia (J16.8) caused by the new coronavirus SARS-CoV-2 (the causative agent of COVID-19), were carried out. All patients had grade 0-I of respiratory failure. In 25 patients (59.5%) during the study at the hospital stage, there was a percentage of ground-glass opacity less than 50% involvement, in 17 (40, 5%) more than 50%. The average score on the rehabilitation routing scale was 3.5±0.5 points. The study did not include patients with a lack of rehabilitation potential or the presence of severe comorbidities.

The first (main) group of patients included 22 people who underwent drug therapy by the Temporary Guidelines for Medical Rehabilitation in New Coronavirus Infection (COVID-19) and physical therapy. Against this background, starting from the 20th day after discharge from the hospital, this group of patients received low-frequency magnetic therapy with a "running" pulsed magnetic field from the ALMAG-02M apparatus (Registration certificate dated November 08, 2016, No. FSR 2009/04790). The impact was carried out on the projection of the lungs from behind with the program № 20: induction: 20 mT; frequency: 100 Hz; exposure time: 20 min. The course includes 15 procedures. The second (control group) included 20

patients who received the same treatment, except for magnetotherapy.

To assess the results of a complex of rehabilitation measures, anamnesis and complaints, a clinical study of patients, a study of the function of external respiration ("SHILLER SPIROVIT SP-1" spirograph), samples of arbitrary breath-holding Genchi and Shtange, the Borg scale for patient assessment of physical activity, a six-minute walk test were used, ECG, measurement of oxygen saturation in the blood (oximeter “NONIN”, model 9500, USA), Hospital scale of anxiety and depression. Studies were carried out before and after the course of treatment. Statistical analysis was carried out using the STATISTICA 12.0 program. To substantiate the correctness of the use of parametric processing methods, with the statistical data used, the normality of the distribution was checked by the Shapiro-Wilk test and the equality of variances by the Leuven test. The method of variation statistics was used to estimate intragroup indicators with the determination of arithmetic means (M) ± standard errors of the mean (m). Intergroup differences, assessed using Student's t-test, were considered statistically significant at $p<0.05$.

The choice of low-frequency magnetotherapy was motivated by the recognized therapeutic effects of the magnetic field: anti-inflammatory, coagulo-correcting, immunomodulatory, vasoactive, drainage-dehydrating, trophic, improving hemodynamics, and microcirculation [5, 6, 7].

RESULTS AND DISCUSSION

Before the start of the study, all patients presented with shortness of breath, cough, and asthenic manifestations: sleep disturbances, headache, and weakness. The average score on the anxiety subscale in patients of the main group was 6.45 points, on the depression scale 5.73 points, and, respectively, 3.80 and 3.40 points in patients of the control group, which indicates the absence of clinically evident affective disorders in patients. After the end of the course of treatment, 79.7% of patients in the main group showed regression of asthenic symptoms, cough, and shortness of breath. In the control group, regression of symptoms occurred in 63%. A qualitative assessment of clinical symptoms in the examined patients: shortness of breath, cough, sleep disorders, weakness, and a headache was carried out on a 10-point analog scale.

As follows from the data presented in Table 1, it is obvious that the positive dynamics of symptoms in patients of the main group are more pronounced than in the control group.

The dynamics of indicators of external respiration function were more demonstrative, the instrumental study of which is an objective means of monitoring the adequacy and effectiveness of treatment and rehabilitation measures [8].

As follows from Table 2, the initial values in both groups occupied the average value or gravitated towards the lower limit of the norm (expiratory power), and the frequency of respiratory movements slightly exceeded the norm, which we explain by compensatory hyperventilation for hypoxia. The vital capacity of the lungs was closer to the lower limit of the norm, which is explained not only by the pathological (restrictive) process in the lungs but also by the low fitness of the patients. The increase in the respiratory minute volume in both groups before the course of treatment can be associated with the mobilization of compensatory mechanisms (hyperventilation against the background of hypoxia). The decrease in the rates of inspiration and expiration is explained by the weakening of the respiratory muscles and/or the influence of restrictive processes in the lung tissue. Certain restrictions on the tolerance of hypoxic tests were observed in patients of both groups (16.69±0.24 sec. For Stange's test in the main group and 16.45±0.31 sec. In the control group, $p>0.05$ and 14.35±0.31 sec. With Genchi's test in the main and 14.41±0.16 sec. In the control, $p>0.05$). After the course of treatment, the indices changed to 50.21±0.51 sec with the Stange test and 30.21±0.6 sec. at the Genchi test in the main group and 40.11±0.41 sec. with the Stange test and 20.15±0.35 sec. ($p<0.05$) with Genchi's test in the control group ($p <0.05$).

Before the course of treatment, the indices of physical activity in the main group were somewhat worse, but after the end of treatment, the indices of both groups leveled off.

Summarizing the data obtained, we can conclude that the course of rehabilitation measures led to an increase in the functional capabilities of the cardio-respiratory system in patients of both groups, an increase in chest excursions: by 51.3% in the main group and 21.3% in the control group, an increase in volume capacity, normalization of the act of breathing and ventilation of the lungs, improvement of the psychosomatic status of patients. Even a short course of treatment led to a decrease in respiratory rate, an increase in volume capacity and forced volume capacity, an increase in minute ventilation of the lungs, and a decrease in the minute volume of respiration, an increase in tidal volume, and the speed of inspiration and expiration. In the main group, these changes are more pronounced than in the control group, which we associate with the inclusion of low-frequency magnetotherapy with a “running” pulsed magnetic field in the complex treatment.

Table 1: Assessment of clinical manifestations in the main and control groups of patients

Symptoms	Main group, n = 22		Control group, n = 20		p
	Before treatment	After treatment	Before treatment	After treatment	
Sleep disturbances	3.8±0.5	-	3.9±0.2	2.2±0.5	<0.001
Headache	4.5±0.2	1.1±0.5	4.5±03	2.5±0.2	<0.05
Weakness	4.4±0.7	0.8±0.2	4.3±0.9	3.2±0.6	<0.001
Dyspnea	3.7±0.5	0.5±0.3	3.7±0.3	1.9±0.2	<0.01
Cough	3.8±0.5	0.5±0.2	3.8±0.3	2.2±0.3	<0.01

p - level of significance of intergroup differences in the main and control groups after treatment.

Table 2: Respiratory function indicators in patients of the main and control groups before and after the course of treatment.

Lung functions indicators	Main group, n = 22		Control group, n = 20		p
	Before treatment	After treatment	Before treatment	After treatment	
Respiratory rate min^{-1}	19.31±0.31	10.31±0.29	18.28±0.32	13.34±0.26	<0.05
Volume capacity, l	2.71±0.1	3.35±0.06	2.61±0.07	3.15±0.08	>0.05
Forced volume capacity, l	2.45±0.06	3.2±0.08	2.46±0.08	2.92±0.07	<0.05
Maximal voluntary ventilation, l/min	61.35±1.32	65.38±0.9	60.45±1.14	62.13±1.12	>0.05
Minute ventilation, l/min	6.24±0.18	4.24±0.15	6.36±0.07	5.18±0.1	<0.05
Tidal volume, ml	356.43±7.01	490.31±12.38	345.7±3.18	441±9.1	>0.05
Speed inspiration, l/sec	3.43±0.08	4.43±0.09	2.84±0.05	3.60±0.06	<0.05
Speed expiration, l/sec	3.4±0.06	4.22±0.06	2.94±0.03	3.51±0.05	<0.05

p - level of significance of intergroup differences in the main and control groups after treatment.

Table 3: Indicators of exercise tolerance in patients of the main and control groups

Test scores	Main group, n = 22		Control group, n = 20		p
	Before treatment	After treatment	Before treatment	After treatment	
6-minute walk test	318,24±2 3 21	440.92±31.07	475.0±34.63	510.3±49.36	>0.05
Borg scale, points	13.45±1.08	9.98±0.59	12.40±1.17	10.75±0.74	>0.05

p - level of significance of intergroup differences in the main and control groups after treatment.

CONCLUSION

The use of low-frequency magnetic therapy with a “running” pulsed magnetic field in the complex of rehabilitation measures for patients who have undergone pneumonia caused by the COVID-19 virus allows optimizing the result of treatment: improving the somatic status of patients, increasing exercise tolerance, and improving respiratory function. These data allow us to recommend the inclusion of the factor in clinical guidelines for the rehabilitation of patients undergoing COVID-19.

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