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Research Article

The Use of Transcranial Magnetotherapy for the Correction of the Psycho-Emotional State of Patients with Post-Covid Syndrome

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Abstract

The article is devoted to a comprehensive prospective clinical study of effectiveness of use transcranial magnetotherapy for the correction of the psycho-emotional state of patients with post-covid syndrome.by comparing it with a group of patients not receiving magnetic therapy in the rehabilitation program. The aim of this work is to study the effect of transcranial magnetotherapy on the effectiveness of the use of low-frequency magnetic therapy in the complex medical rehabilitation of patients with pneumonia caused by COVID-19 in the convalescence phase.

For an objective assessment of the dynamics of the state of all patients at the stage of registration of the subject of the study and the collection of primary information and after the completion of courses of treatment in patients of the main and control groups, a control assessment of the quality of life of patients was carried out according to the EQ-5D scale, the Spielberger-Khanin personal anxiety scale (State-Trate Anxiety Inventory , STAI), the Beck depression scale, the WAM questionnaire (well-being, activity, mood).

Results and Discussion: assessing of the quality of life according to the EQ-5D questionnaire, positive dynamics was noted in the main group - an improvement in the quality of life by 30%, a decrease in anxiety by 28% and depression by 35%.

Assessment of the quality of life according to the EQ-5D questionnaire, anxiety and depression in the control group showed a less pronounced positive dynamics of indicators.

Conclusion: application of low-frequency magnetic therapy in the complex rehabilitation of patients, who have had pneumonia caused by the new coronavirus infection, improves the function of external respiration of the patients, which is confirmed by a decrease in the severity of anxiety on the Spielberger-Khanin scale, decrease of depression on the Beck scale reducing asthenoneurotic syndrome, improving the general well-being of patients, increasing tolerance to physical activity, normalizing the psycho-emotional status and, as a result, restoring activity in everyday life and improving the quality of life of patients.

Keywords: Transcranial Magnetotherapy; Medical Rehabilitation; Pneumonia; New Coronavirus Infection; COVID-19

Introduction

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by SARS-CoV-2 that primarily affects the respiratory system, such as interstitial pneumonia and acute respiratory distress syndrome (ARDS) [5].

SARS-CoV-2 has been shown to disrupt normal immune responses leading to immune system disruption and uncontrolled inflammatory responses in patients with severe COVID-19. These patients present with lymphopenia, lymphocytic activation and dysfunction, granulocyte and monocyte abnormalities, high levels of cytokines and increased levels of immunoglobulin G (IgG) and total antibodies [8].

A study of 85 deaths in patients with COVID-19 with an average age of 65 years in Wuhan found that the majority of patients died from multiple organ failure. Respiratory failure, shock and ARDS were observed in 94%, 81% and 74% of cases, respectively [9]. Along with the high prevalence of multiple organ failure, high levels of d-dimer, fibrinogen, and prolonged thrombin were detected in severe disease [10].

Severe forms of COVID-19 are characterized by a massive anti-inflammatory response or cytokine storm that leads to ARDS and multiple organ dysfunction. It is also assumed that inflammatory responses in adults and children are very different [2]. Aging is associated with an increase in anti-inflammatory cytokines that regulate neutrophil function and correlate with severity ARDS [4].

Although the lungs are definitely the first target organ of SARS-CoV-2 infection, evidence is accumulating indicating that the virus can spread to various organs, including the heart, blood vessels, kidneys, intestines, and brain [6]. For this reason, a multidisciplinary approach is critical for the evaluation and follow-up of patients with COVID-19.

Patients who have recovered from COVID-19 have gone through a dramatic experience not only because of the severity of the illness, but also because of the special conditions of their hospitalization. Prolonged fever, pain, shortness of breath, and exhaustion leave most patients feeling desperate, hopeless, and depressed. In patients admitted to the intensive care unit, the fear of death reaches a peak with a desperate manifestation. In any case, during hospitalization, patients were forced to live in isolation due to the presence of biological risk. The isolation was usually long and intense. Patients spent hours and days alone, meeting with several nurses or doctors for short periods of time, which increased their suffering and feelings of loneliness [1]. Some patients felt like plague and were afraid of being contagious even after being discharged from the hospital. The risk of death, social isolation, disease severity, and sleep problems increase the risk of psychiatric disorders such as anxiety, as well as acute and post-traumatic stress disorder. In addition, objective social isolation and subjective feelings of loneliness are associated with a higher risk of mortality due to suicide in particular. In light of the above, mental health support is provided in post-COVID-19 rehabilitation to prevent the possible development of severe mental disorders in the future [7].

Purpose of the study

To evaluate the effectiveness of low-frequency magnetic therapy in the complex medical rehabilitation of patients who have undergone pneumonia caused by COVID-19 in the convalescence phase.

Material and Methods

The present study included 60 patients with a diagnosis of community-acquired pneumonia caused by a new viral infection COVID-19, DN 0-1, (J 16.8). Asthenic condition after a new viral infection COVID-19 (G 93.3) in the convalescence phase at the rehabilitation stage.

Subjects were included in the study sequentially, at the stage of medical rehabilitation after viral pneumonia, after examination and examination of medical records for the absence of exclusion criteria from participation in the study, and after obtaining voluntary informed consent to participate in the study.

The criteria for inclusion of subjects in the study are defined as:

- Female and male patients;
- Age from 18-85 years old inclusive;
- Patients at the stage of rehabilitation for asthenic condition after suffering community-acquired pneumonia caused by a new viral infection COVID-19 in the presence of a negative PCR test for coronavirus COVID-19.

The criteria for exclusion of subjects from the study were defined as:

- Lack of rehabilitation potential.
- DRS (the disability rating scale) 4 and 5 points (TSM = 150-300 m, tests with physical activity (veloergometry/ spiroergometry) = 25-50 W/2-3.9 IU.
- The presence of angina pectoris that occurs when walking from 100 to 500 m on level ground, when climbing one flight of stairs, at an average pace of walking and under normal conditions.
- The need for outside help in performing daily tasks (dressing, undressing, going to the toilet, eating, etc.).
- Instability of somatic and neurological status.
- Severe intoxication, hyperthermic syndrome (body temperature above 37.0°C).
- pO2 <95%.
- II-III stages of cardiopulmonary insufficiency.
- Chronic kidney disease and liver failure above II stage;
- Pronounced violations of the heart rhythm and conduction (multiple group and polytopic ventricular extrasystoles, complete AV blockade, tachysystolic form of atrial fibrillation).
- Blood diseases, hemorrhagic syndrome, pulmonary bleeding and the presence of blood in the sputum.
- Pneumothorax.
- Suspicion of the presence or presence of a neoplasm in the affected area.
- The presence of a pacemaker and foreign metal bodies.
- Psychoorganic syndrome.
- Convulsive syndrome.
- Secondary forms of arterial hypertension.
- The presence of other contraindications to the use of devices ALMAG-03 (Diamag) (hereinafter referred to as "Diamag").

Methodology for carrying out procedures with the apparatus "DIAMAG".

All subjects of the present study were randomized into 2 groups with an equal number of participants:

- **Main group:** A group of patients receiving transcranial magnetotherapy from the DIAMAG device in the complex rehabilitation program - 30 people;
- **Control group:** A group of patients receiving exposure to a placebo device that is outwardly identical to the device "DIAMAG", but does not generate a magnetic field when switched on - 30 people.

In the course of this study, the patients included in the main group, starting from the day following the day of completion of the initial examination, received magnetotherapy using the DIAMAG device with the following magnetic field parameters:

- The first 7 days Program No. 1: type of magnetic field - running, excitation frequency. bursts of pulses (imp./s.) from 1 to 5 Hz, the frequency of pulses inside the burst is 7 Hz, magnetic induction is 10 mT, the duration of exposure is 20 minutes.
- The next 7 days Program No. 2: type of magnetic field - traveling, pulse frequency 7 Hz, magnetic induction - 10 mT, duration of exposure 20 minutes.

During the exposure procedure, the emitters were placed with the "N" (north) side to the head in such a way that inductors No. 1 of each radiating line were located on the occipital region, and inductors No. 6 were located on the frontal part of the head. Before placing the emitter, a disposable medical cap of the "clip-beret" type was put on the subject's head, which was disposed of after the procedure was completed.

14-day course of treatment according to the scheme presented in table 1.

Day of treatment	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Program number	1	1	1	1	1	1	1
Exposure time, min	20	20	20	20	20	20	20
Day of treatment	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Program number	2	2	2	2	2	2	2
Exposure time, min	20	20	20	20	20	20	20

Table 1

The patients included in the first control group underwent simulation of magnetotherapy procedures with the main emitter of a placebo device, outwardly identical to the DIAMAG device, but not generating a magnetic field in the on state, starting from the day following the day the primary examination was completed. At the same time, the placebo emitter was placed in similar projections and placebo procedures were performed once a day, lasting 20 minutes, with a course of 14 procedures.

In addition to magnetotherapy or placebo exposure, patients of the main and control groups received standard therapy: a set of breathing exercises, chest massage, aerosol therapy or ozone therapy, and psychoemotional correction.

For an objective assessment of the dynamics of the state of all patients at the stage of registration of the subject of the study and the collection of primary information and after the completion of courses of treatment in patients of the main and control groups, a control assessment of the quality of life of patients was carried out according to the EQ-5D scale, the Spielberger-Khanin personal anxiety scale (State-Trate Anxiety Inventory , STAI), the Beck Depression Scale, the WAM questionnaire (well-being, activity, mood).

After 4 weeks from the end of the course of procedures, all patients were invited by the investigators for a follow-up visit in order to assess the dynamics of clinical data based on the results of delayed follow-up after the course of treatment.

For an objective assessment of the dynamics of respiratory function and the severity of respiratory failure, all patients after the completion of the course of treatment underwent control spirometry and pulse oximetry, assessment of dyspnea according to the mMRC scale and the Borg scale.

Using the EQ-5D questionnaire, we assessed the dynamics of the quality of life of patients, assessed personal anxiety on the Spielberger-Khanin scale (State-Trate Anxiety Inventory, STAI), and determined the presence of depression on the Beck Depression Scale. Assessment of the general emotional and physical state was carried out using the WAM questionnaire (well-being, activity, mood).

After 6 weeks from the end of the second course of procedures, patients were again invited for a follow-up examination in order to assess the long-term clinical results of treatment based on the results of a prospective follow-up.

At this stage, the researchers again conducted the same survey of patients in order to assess the dynamics of complaints and a physical examination in order to assess the dynamics of the somatic status.

For the purpose of an objective assessment of the effectiveness of treatment, according to the interim clinical recommendations of the Ministry of Health of the Russian Federation “Prevention, diagnosis and treatment of a new coronavirus infection (COVID-19)” (version 15 dated February 22, 22) [12], the interim clinical recommendations of the Ministry of Health of the Russian Federation “Medical rehabilitation in case of new coronavirus infection (COVID-19)” (version 2.0 dated July 31, 2020) [11], the following clinical and instrumental methods and scales: spirometry using the MIR spirograph (Italy), chest excursion, DRS, quality of life questionnaire (EQ- 5D), the Borg scale to assess the patient’s exercise tolerance, ECG, measurement of oxygen saturation in the blood.

After completion of the examination of all patients included in the study, a statistical analysis of clinical data obtained during the study was carried out. Comparative analysis was carried out on a personal computer running the MSWindows 10 (Microsoft) operating system by the method of primary mathematical and statistical analysis of the obtained data using the GraphPadPrism7 program. To assess the statistical significance of differences between the main and control groups before and after treatment, the nonparametric Wilcoxon W test for dependent variables was used.

Results

According to the results of the analysis of primary data, at the time of completion of treatment in the inpatient department of a hospital specialized in the treatment of COVID-19-associated pneumonia, and the inclusion of patients in the study, the use of the Beck scale revealed signs of depression in all groups of patients ($p < 0.01$). An increase in anxiety on the Spielberger-Khanin scale was also found in 24 (80%) patients of the main group, in 22 (73.3%) patients of the control group.

The statistical analysis of clinical data obtained from the results of the initial examination of patients and examination during control visits (immediately after the end of the rehabilitation course, 3 weeks after the end of the rehabilitation course, 6 weeks after the end of the second course of rehabilitation) confirmed the positive clinical dynamics, significantly more pronounced in patients of the main group who received magnetotherapy from the device "DIAMAG".

Results of the first stage

In the main group of patients with viral pneumonia in the convalescence phase, there were significant improvements in general mobility, household activity, reduction of pain/discomfort, in particular, an increase in the quality of life according to the EQ-5D questionnaire by 25.7% (before treatment - 12.1 ± 0.2 points, after treatment - 9.0 ± 0.1 points p = 0.0019), in the control group by 11.5% (before treatment - 12.2 ± 0.2 points; after treatment - 10.8 ± 0.1 points p > 0.05). Figure 1.

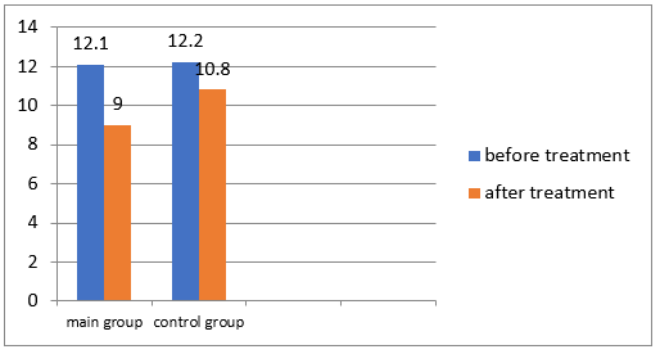

Figure 1: Assessment of the quality of life according to the EQ-5D questionnaire (scores) before and after treatment in the first part of the study.

There was also a decrease in the level of anxiety according to the Spielberger questionnaire in the main group by 20% (before treatment - 33.4 ± 0.5 points; after treatment - 27 ± 0.2 points p = 0.0019), in the control group there was an increase anxiety by 7% (before treatment - 31.4 ± 0.2 points; after treatment - 33.6 ± 6.7 points, p > 0.05). Figure 2.

After the course of medical rehabilitation in the main group, a decrease in the level of depression by 30% was noted (before

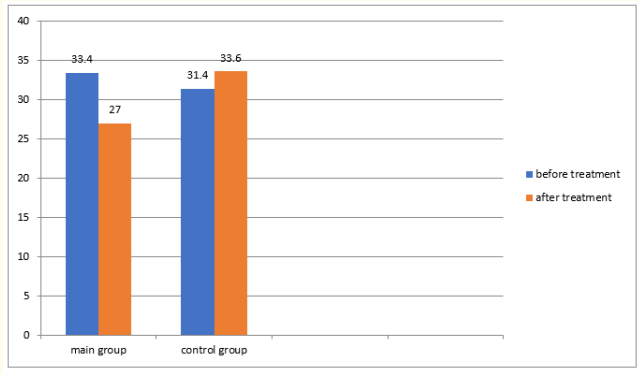

Figure 2: Dynamics of the level of anxiety according to the Spielberger questionnaire before and after treatment at the first stage of the study

treatment, 10.3 ± 0.1 points; after treatment, 7.2 ± 0.2 points; p < 0.001), in the control group by 19% (before treatment 10.7 ± 0.1 points, after - 8.7 ± 0.1) (p > 0.05). Figure 3.

Results of the second stage

3 weeks after the complex medical rehabilitation in patients:

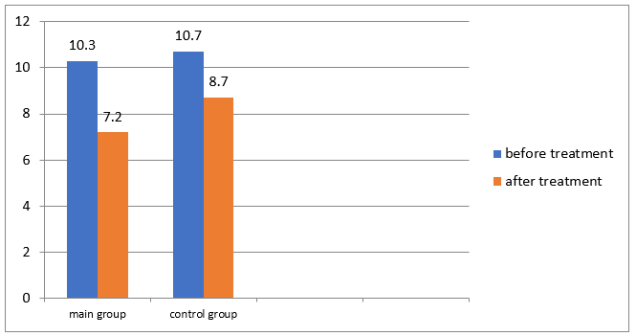

Figure 3: Dynamics of the level of depression before and after treatment at the first stage of the study.

In the main group of patients, an improvement in the quality of life according to the EQ-5D questionnaire by 25.7% was noted (before treatment - 12.1 ± 0.2 points; after treatment - 8.8 ± 0.1 points. p = 0.0019) , a significant decrease in the level of anxiety by 26.7% (before treatment - 33.4 ± 0.5 points; after treatment - 24.5 ± 0.2 points. p = 0.0019) and depression by 32.0% (before treatment 10.3 ± 0.1 points, after treatment - 7.0 ± 0.2 points, p < 0.001). Figure 4.

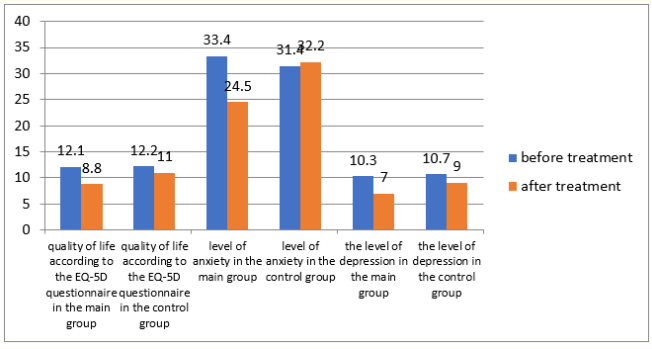

Figure 4: Dynamics of quality of life, levels of anxiety and depression before and after treatment at the second stage of the study.

Prospective results

The follow-up examination of patients, conducted after the end of the prospective observation, 6 weeks after the completion of complex medical rehabilitation, demonstrated further positive dynamics of clinical data, more pronounced in the main group, in which the complex of rehabilitation measures included low-frequency magnetotherapy from the "DIAMAG" apparatus.

When assessing the quality of life according to the EQ-5D questionnaire, further positive dynamics was noted in the main group - an improvement in the quality of life by 30% (before treatment - 12.1 ± 0.2 points; after treatment - 8.5 ± 0.1 points; p = 0.01).

In the main group, a further decrease in the level of anxiety by 28% (before treatment - 33.4 ± 0.5 points; after treatment - 24.3 ± 0.2 points, p = 0.0019) and depression by 35% (before treatment) was noted. treatment 10.3 ± 0.1 points, after treatment - 6.7 ± 0.2 points; p < 0.001). Figure 5.

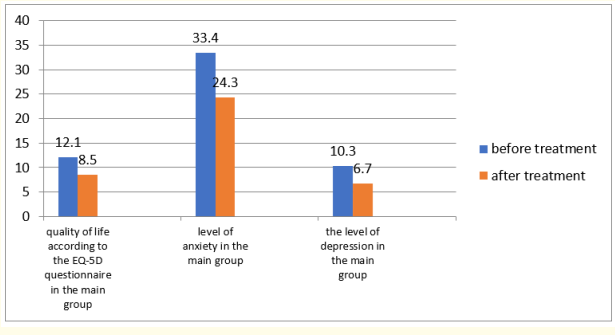

Figure 5: Dynamics of the quality of life according to the EQ-5D questionnaire, the level of anxiety and depression before and after treatment as a result of prospective observation.

Assessment of the quality of life according to the EQ-5D questionnaire, anxiety and depression in the control group showed a less pronounced positive dynamics of indicators.

Conclusion

The results of our prospective, randomized, blind, placebo-controlled clinical trial allow us to conclude that the inclusion of low-frequency magnetic therapy in the comprehensive medical rehabilitation of patients who have undergone pneumonia caused by a new coronavirus infection COVID-19 significantly contributes to:

- Reduction of asthenoneurotic syndrome with transcranial technique, which is confirmed by a decrease in the severity of anxiety on the Spielberger-Khanin scale, depression on the Beck scale;
- Improving the general well-being of patients, increasing tolerance to physical activity, normalizing the psycho-emotional status and, as a result, restoring activity in everyday life and improving the quality of life of patients.

The results of the study confirm the feasibility of using low-frequency magnetic therapy in the complex of medical rehabilitation of patients who have undergone COVID-19-associated pneumonia.

Participation of authors: concept and design — R.A. Bodrova; collection and processing of material - R.A. Bodrova, A.M. Delyan; analysis of the obtained data - R.A. Bodrova, R.O. Chaikovsky; review of publications on the topic of the article - E.R. Yunusova; writing the text of the article - R.A. Bodrova, E.R. Yunusova.

The authors declare no conflict of interest.

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