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REHABILITATION WITH THE APPLICATION OF THERAPEUTIC PHYSICAL CULTURE FOR PATIENTS AFTER CORONAVIRUS INFECTION AT THE OUTPATIENT STAGE

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Annotation : The article presents a review of scientific literature, clinical observations, containing data on the features of neurological manifestations and mental disorders, complications from the nervous system in a new coronavirus infection, illustrated with clinical examples. Neurological manifestations are not leading in the clinic for diseases caused by coronaviruses. However, the development of the nervous system is also possible with respiratory, sensory, motor, autonomic and other disorders of the central and peripheral nervous system. In addition, COVID-19 can worsen the course of already existing neurological diseases, therefore, this article provides basic recommendations for the management of certain groups of patients with nervous diseases. Given the earlier epidemics of other coronavirus infections, neurologists most often face cognitive and psycho-emotional disorders and other pathologies in the subsequent period. Therefore, it is important to choose the appropriate treatment and monitor the development of early and long-term consequences of neurological manifestations and complications of COVID-19 and then evaluate the effectiveness of effective individual rehabilitation programs for patients.

Key words: Covid 19, nervous system, neurological symptoms, disease, coronavirus, rehabilitation, complicated by neuropsychiatric disorders, program, traditional oriental (Korean) medicine.

АННОТАЦИЯ

В статье представлен обзор научной литературы, клинических наблюдений, содержащий данные о особенностях неврологических проявлений и психических расстройств, осложнениях со стороны нервной системы при новой коронавирусной инфекции, иллюстрированный клиническими примерами. Неврологические проявления не лидируют в клинике заболеваний, вызванных коронавирусами. Однако развитие нервной системы возможно и при респираторных, сенсорных, двигательных, вегетативных и других нарушениях центральной и периферической нервной системы. Также COVID-19 может ухудшить течение уже существующих неврологических заболеваний, поэтому в

данной статье представлены основные рекомендации по ведению определенных групп пациентов с нервными заболеваниями. Учитывая более ранние эпидемии других коронавирусных инфекций, неврологи чаще всего сталкиваются с когнитивными и психоэмоциональными расстройствами и другими патологиями в последующий период. Поэтому важно выбрать соответствующее лечение и следить за развитием ранних и отдаленных последствий неврологических проявлений и осложнений COVID-19 и последующей оценки эффективности действенных индивидуальных программ реабилитации пациентов.

Ключевые слова: Covid 19, нервная система, неврологические симптомы, болезнь, коронавирус, реабилитация, осложненной психоневрологическими расстройствами, программа, традиционной восточной (корейской) медицины.

The purpose of the study: to develop an individual comprehensive program for the rehabilitation of patients who have had a coronavirus infection complicated by neuropsychiatric disorders, using therapeutic physical culture.

Introduction. The realities of the recent months of the coronavirus pandemic have forced us to re-evaluate the features of neurological pathology, the degree of detection of new and decompensation of existing diseases, when this comorbidity becomes sharply threatening to health, including leading to tragic outcomes.

COVID-19 (CoronaVirus Disease 2019) is a new viral infection that has a number of features, such as rapid spread, high mortality, significant social and economic consequences that destroy the usual way of life [1, 2]. The virus is able to mutate, and all of its forms can be potentially dangerous to humans. The natural reservoir of SARS-CoV is bats, the intermediate hosts are camels and Himalayan civets.

Confirmation of COVID-19 infection is a positive laboratory test for the presence of SARS-CoV-2 RNA by polymerase chain reaction (PCR), regardless of clinical manifestations. In 97.5% of people, the incubation period is 11.5 days, ranging from 2 to 14 days, with an average of 5–7 days. COVID-19 is characterized by the presence of clinical symptoms of an acute respiratory viral infection: fever (> 90%); cough (dry or with a small amount of sputum) in 80% of cases; shortness of breath (55%); fatigue (44%); feeling of congestion in the chest (> 20%), sore throat, rhinitis. There may also be a decrease in smell and taste, signs of conjunctivitis [3]. Basically, the clinical picture is characterized by a triad of symptoms: fever, cough, shortness of breath. In addition to systemic and respiratory symptoms, the virus causes neurological disorders, as it has neurotropic properties. Neurological disorders occur in approximately 36.4% of patients with COVID-19 [4]. Recently, severe viral hemorrhagic encephalitis, toxic encephalopathy, acute demyelinating lesions, acute cerebrovascular accident (ACC) and other complications have been described. The direct effect of coronavirus on the nervous system, the likelihood of its penetration through the olfactory and trigeminal nerves and through the hematogenous route through the endothelial cells of the blood-brain barrier (BBB) are discussed [5].The SARS-CoV-2 virus, like SARS-CoV-1, enters human cells through the receptor for angiotensin converting enzyme 2 (ACE2) [6]. The outbreak of coronavirus infection around the world will remind itself of various kinds of consequences for a long time to come. And mainly complications in patients who have undergone COVID-19, up to neurological and psychiatric. This phenomenon was called a "pandemic" (from the Greek πανδημία - "the whole people") - an unusually strong epidemic that has spread to the territories of countries and continents. Most people who have been personally affected by the coronavirus will experience acute stress

disorder, many will experience post-traumatic stress disorder (PTSD), but a number of people will have a deeper trace of the experience in the form of prolonged anxiety disorders, depressive episodes, neurotic disorders and personality deformations. Thus, touching on the topic of mental disorders provoked by the COVID-19 pandemic, we can talk about the "coronavirus syndrome". [eight]. In humans, ACE2 is expressed by most organs and tissues, and, according to X. Zou et al. (2020), the most vulnerable to the SARS-CoV-2 virus are the lungs and lower respiratory tract, heart, kidneys, intestines, as well as smooth muscle cells of the vascular wall (mainly the microvasculature). It is necessary to assess the damaging effect of the virus on the brain and other parts of the central and peripheral nervous system, taking into account the fact that ACE2 is expressed by neurons, glial cells, and endotheliocytes [9].

Taking into account previous publications on neurological disorders in SARS-CoV-1 and MERS-CoV infections, neurological disorders caused by SARS-CoV-2 virus can be divided into two groups. The first group of disorders is direct damage to the central and peripheral nervous system by the SARS-CoV-2 virus. The second is a change in the course of neurological diseases against the background of an infection caused by the SARS-CoV-2 virus, especially with the development of pneumonia and SARS.

Neurological disorders caused by human coronaviruses, including SARS-CoV-2, are attracting the attention of researchers [10].

Experimental models have shown that SARS-CoV-1, related to the SARS-CoV-2 virus, can enter the brain and cause serious neurological disorders [11].

The pathophysiology of neurological disorders in SARS-CoV-2 infection is likely similar to that of SARS-CoV-1, and entry into the brain may occur via the hematogenous and/or perineural route.

To date, works have been published that consider the damage to the nervous system by the SARS-CoV-2 virus. The first review of neurological manifestations was carried out by L. Mao et al. (2020) in patients with a confirmed diagnosis of COVID-19 who were in a hospital in Wuhan.

According to the materials presented by L. Mao et al. (2020), out of 214 patients, 88 (41.1%) patients had a severe course of the disease, 126 (58.9%) had a mild or moderate course. The group with a severe course was characterized by older age (58.7±15.0 and 48.9±14.7 years) and more frequent comorbidity (47.7 and 32.5%).

Neurological symptoms were detected in 78 (36.4%) of 214 patients and were more often observed in severe cases (45.5 and 30.2%). In the same group, cerebral strokes (5.7 and 0.8%), impaired consciousness (14.8 and 2.4%) and muscle damage (19.3 and 4.8%) more often developed.

In general, if we summarize the currently available publications, we can distinguish three options for damage to the nervous system in COVID-19: damage to the central nervous system; damage to the peripheral nervous system and damage to the muscular system.

One of the variants of damage to the peripheral nervous system with subsequent possible penetration of infection into the brain is the defeat of the olfactory nerves. Previously, it was experimentally established that the SARS-CoV-1 virus related to the SARS-CoV-2 virus from the nasal cavity through the olfactory nerves penetrated into the cranial cavity and further into the brain, causing its severe damage [12].

L. Mao et al. (2020) diagnosed olfactory disorders in patients with COVID-19 in 5.1% of cases, while slightly more often in patients with a mild form of the disease. The latter may be due to difficulties in identifying olfactory disorders in patients with a severe form.

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According to the British Otorhinolaryngology Association [ENT UK], in the current situation, an acute decrease / loss of smell should be considered as a marker of COVID-19. It is important to note that olfactory disturbances in COVID-19 differ to some extent from olfactory changes in other viral diseases in which nasal congestion is present. In cases of hypo/anosmia with COVID-19, the question of the possibility of further penetration of the virus through the olfactory pathways into the brain remains an open and important question.

The data on changes in taste are also interesting. L. Mao et al. (2020) found changes in taste in 5.6% of cases, with slightly more frequent occurrence in mild than severe disease (7.1 and 3.4%). Differences in frequency, as well as changes in the sense of smell, probably need to be interpreted in light of the difficulty of detecting them in patients with a severe form. In 1.5% of cases, changes in taste preceded infectious symptoms, their frequency did not differ between patients with mild and severe forms of the disease. The question of the localization of the process and pathogenetic mechanisms of taste disturbance in COVID-19 remains open.

Given that ACE2 receptors are abundant on the gustatory surface of the tongue, a direct effect of the virus on taste receptors and/or nerve fibers cannot be ruled out.

Results and Discussion. When patients were evaluated at the time of referral to an outpatient health centre, 31% (51 patients) had 1-2 symptoms, and 59% (115 patients) had three or more symptoms. Quality of life deterioration was observed in 45.7% (76 people) of patients. The most frequent symptoms seen one month after COVID-19 infection included: fatigue (65%), insomnia (24%), anxiety and depression (26%), hair loss (23%), anosmia (9%), joint pain (12%), palpitations (11%), decreased appetite (9%), taste disorder (8%), dizziness (5%), diarrhoea and vomiting (3%), chest pain or tightness (7%), sore throat (3%), skin rash (2%), headache (4%), myalgia (4%). The clinical and functional characteristics of patients on admission for MR are shown in Table 1.

Table 1.

Clinical and functional characteristics of patients in all observation groups at the beginning of rehabilitation measures

Parameters	I group (n=38)	II group (n=40)	III group (n=42)	IV group (n=46)
Age	56,6± 11,9	45,9± 11,8	49,71±1 1,10	53,86± 9,52
BMI, kg/м^2	26,6± 7,9	30,5± 5,5	35,5±2, 8	36,6±2 ,9
M/F	13 -F 25-M	20 -F 20-M	22 -F 20-M	27 -F 19-M
Total score on a HADS scale	32,2± 2,74	33,2± 2,21	31,2±2, 98	32,8±2 ,63
Anxiety	9,82± 1,72	6,46± 2,37	8,80±1, 70	8,82±2 ,72
Depressio n	6,46± 2,37	9,80± 1,70	7,42±1, 38	6,24±2 ,85
Subscale «Insomnia »	2,78± 0,52	2,88± 0,35	2,65±0, 48	2,82±0 ,62
Subscale «Vegetati	2,59± 0,32	2,54± 0,39	2,49±0, 79	2,62±0 ,28

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ve disorders»				
Subscale «Cardiovascular disorders»	2,37±0,87	2,39±0,45	2,41±0,67	2,43±0,39
SpO2 at rest	95±2,5	96±2,5	95±2,5	94±2,5
Quality of life according to the EQ-5 questionnaire, points	14,2±2,8	16,4±1,4	13,9±2,5	15,3±3,5
Pain syndrome according to VAS, points	6,46±2,37	7,80±1,70	5,82±1,38	6,24±2,85
Physical activity tolerance according to the Borg Scale	7,0±1,72	8,1±2,37	8,80±1,70	7,82±2,72
Dyspnea on the MRC scale	1,37±0,87	2,39±0,45	2,41±0,67	1,43±0,39
Muscle strength on the MRC scale	4,0±1,5	5±0,5	4,1±1,1	4,7±0,3

In the course of rehabilitation measures, the patients' condition improved in all groups, but to varying degrees.

The total score on the HADS scale decreased in Group I by 26%, in Group II by 39%, in Group III by 37%, and in Group IV by 86%. The severity of anxiety and depression decreased most in the group where patients performed exercises with Qigong, yoga and meditation ($p<0,05$) against the background of reflexotherapy.

The pain syndrome decreased in the groups using physical factors and reflexotherapy to an equal degree, to the maximum in the group combining reflexotherapy with the developed therapeutic exercises.

The tolerance of physical activity according to the Borg Scale improved in Groups II and III (by 27 % and 24 % respectively), more expressed ($p<0,05$) in the groups using regular physical activity (by 39 % in Group I and by 51 % in Group IV). By the end of 1 month from the beginning of MR, dyspnea had decreased by 34% in group I and muscle strength on the MRC scale had increased by 33%, 12% and 23% in group II, 19% and 22% in group III, respectively, and most dramatically by 45% and 46% in group IV.

Reduced severity of pain syndrome, dyspnea, anxiety and depression, improved quality of sleep, increased physical performance and muscle strength combined to improve quality of life indicators. Total quality of life on the EQ-5 questionnaire increased by 40% in group I, by 37% in group II, by 39% in group III, and by 67% in group IV.

The dynamics of the clinical and functional indicators of the patients as a result of different rehabilitation treatment programs are shown in Table 2.

Table 2.

Dynamics of clinical and functional indicators of patients of all observation groups during rehabilitation measures

Parameters	I group (n=38)	II group (n=40)	III group (n=42)	IV group (n=46)
Total score on a HADS	32,2±2,74 23,83±1,97*	33,2±2,21 20,25±2,09*	31,2±2,98 19,65±1,91*	32,8±2,63 4,59±2,13**

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scale				
Anxiety	9,82±1,67 7,42±1,06*	7,46±1,37 4,87±1,03*	8,78±1,94 4,18±0,92*	8,82±1,72 3,13±0,65**
Depression	6,46±1,37 4,32±0,69	8,80±1,70 4,18±0,65*	7,42±1,38 3,19±0,53*	6,24±1,85 2,38±0,69**
SpO2 at rest	95,26±2,52 97,87±2,84	96,12±2,85 98,39±1,13	95,79±2,28 98,19±2,89	94,87±2,79 98,86±1,64*
Quality of life according to the EQ-5 questionnaire, points	14,2±2,8 19,9±1,9*	16,4±1,4 22,6±0,9*	14,9±2,5 20,8±1,8*	15,3±3,5 25,7±1,2**
Pain syndrome according to VAS, points	6,46±2,37 4,24±1,03*	7,30±1,70 3,85±1,12*	6,82±1,38 3,56±0,98*	6,24±2,85 2,74±0,82**
Physical activity tolerance according to the Borg Scale	7,06±1,72 9,85±1,17*	8,14±2,37 10,37±1,93	8,80±1,70 10,92±1,13	7,82±2,72 11,86±1,58**
Dyspnea on the MRC scale	1,97±0,87 1,29±0,38*	2,19±0,45 1,92±0,63	2,31±0,67 1,87±0,59	2,63±0,39 1,44±0,39*
Muscle strength on the MRC scale	4,6±1,5 6,2±1,	5,2±0,5 6,4±0,	4,8±1,1 5,9±1,	4,7±0,3 6,9±0,7*

Note: in the numerator - before the beginning of rehabilitation measures, in the denominator - by the end of 1 month from the beginning of rehabilitation.

* - reliability of differences between the indicators before and after 1 month from the beginning of rehabilitation measures, $p<0.05$.

** - reliability of the differences between the observation groups, $p<0.05$.

The data we obtained are confirmed by the results of Chinese colleagues. The article "Cognition and Thinking about New Coronavirus Pneumonia in Traditional Chinese Medicine" by Chinese scientists notes the important role of Chinese medicine in treating new coronavirus pneumonia (Miao Qing, Cong Xiaodong, Wang Bing, 2020).

PRC regional programs work mainly in three areas, carrying out activities aimed at prevention, treatment and rehabilitation. In the prevention stage, they recommend the use of Yu Ping Feng San (5PM), a powder containing the roots of medicinal plants. At the stage of rehabilitation, using methods of traditional Chinese medicine, such as Zen-Ju therapy (Zheng Wenke, Zhang Junhua, Yang Fengwen, 2020).

According to the studies of a number of authors, there is a positive effect of the combination of acupuncture and moxibustion. The choice of acupuncture points for the new coronavirus infection COVID-19 is considered based on the principle of "point selection by symptoms". In a study (Cui Hanjin, Wang Wenzhu, Wang Yu, 2020), physicians from the Chinese Acupuncture and Cauterization Association analyzed the symptoms associated with the diagnosis and clinic of COVID-19, developed and proposed certain point combinations. The authors in the article give the following symptomatic point combinations: 14 XIII Dazhui (DU14) and 11 II Quchi (LI11) for

fever; 14 XIII Dazhui (DU14), 13 VII Feishu (BL13) and H45 Dingchuan (asthma point) for cough; for asthenia - 36 III Zusanli (ST36), 4 XIV Guanyuan (CV4) and 6 XIV Qihai (CV6); for digestive system disorders - 12 XIV Zhongwan (CV12), 36 III Zusanli (ST36) and 25 III Tianshu (ST25) [43].

Zhang Jiale, Yang Li, Xian Tiancai, Du Jia (2020) the collective of authors, headed by Miao Qing, also offers principles of treatment of patients using methods of traditional Chinese medicine.

Other authors (Seselkina T.N., Zhernov V.A. (2020) present the data on the effect of different methods of reflexotherapy on the parameters of blood flow in the cerebral vessels, the state of the blood coagulation system was studied (decrease of platelet aggregation and blood viscosity was revealed). The positive effects of reflexotherapy in the treatment of arterial hypertension were revealed; a scientific substantiation of the hirudo-reflexotherapy method was given. At the third stage of medical rehabilitation, to prevent thrombosis, in the absence of contraindications, it is possible to supplement the rehabilitation of patients who had a new coronavirus infection COVID-19 with hirudo-reflexotherapy. This method has prospects for use in the follow-up of patients with acute and chronic lung diseases.

According to some studies (Bian Yaqian; Ma Jing; Ren Yue;2020), reflexotherapy can be used in respiratory rehabilitation during the first two months after the acute period of coronavirus infection - during the therapeutic window. It is reasonable to use acupuncture in combination with tszu (heating), point massage and manual therapy methods.

Conclusion.

Neurotropism of SARS-CoV-2 coronavirus leads to neurological disorders of varying severity, which can persist for a long time in the post-COVID-19 period.

High attendance for anxiety disorders, sleep disorders, pain syndrome, persisting dyspnea and asthenia, their significant severity long after the end of the acute period of the disease, and reduced ability to work require special rehabilitation measures.

The application of physical factors and modified complexes of physical exercises contributes to the alignment of excitation and inhibition processes in the CNS, as well as the development of psychotonic, analgesic and trophostimulating effects.

The program that included the use of reflexotherapy and a complex of physical exercises with elements of traditional oriental gymnastics (qigong, yoga with meditation) proved to be the most effective. This is evident from a greater increase in PC (physical capability) indices, better dynamics of pain reduction, dyspnea, increase in muscle strength indicators, quality of life and psycho-emotional status. Patients without additional training and ART showed the smallest increase in the indicated indices.

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