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EFFECTS OF BFB-THERAPY ON RESPIRATORY DYSFUNCTION AND ASTHENIA IN PATIENTS WITH PARKINSON'S DISEASE

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КОРРЕКЦИЯ ДЫХАТЕЛЬНЫХ И АСТЕНИЧЕСКИХ ПРОЯВЛЕНИЙ МЕТОДОМ БОС-ТЕРАПИИ У ПАЦИЕНТОВ С БОЛЕЗНЬЮ ПАРКИНСОНА

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The pilot study was conducted to assess the effectiveness of the sensorimotor respiration control (SRC) method based on the biological feedback principle, in the complex correction of respiratory dysfunction and asthenia in 48 patients with Parkinson's disease. Initially, in all patients, there was identified a significant correlation between subjective respiratory disorders, biomechanical changes in the respiratory pattern and the respiratory cycle ($r=0.81$), and varying degrees of asthenia. The severity of respiratory dysfunction ($r=0.76$), motor deficit ($r=0.71$), asthenia ($r=0.81$) and anxiety-depressive manifestations ($r=0.63$) have a significant impact on the decline of the quality of patient's life. During course of treatment, there was a significant improvement in the parameters of the respiratory cycle, asthenia, quality of life and the psycho-emotional state of the patients ($r<0.05$), the normopnoic version of the respiratory pattern was reached in 62.5 % of patients ($p<0.05$), and the physiological type of the respiratory pattern was achieved in 41.7 % of patients.

Keywords: Parkinson's disease, respiratory dysfunction, asthenia, non-motor symptoms, BFB-therapy, quality of life

Пилотное исследование по оценке эффективности метода сенсомоторного управления дыханием (СУД) было основано на принципе биологической обратной связи в комплексной коррекции дыхательных и астенических нарушений у 48 пациентов с болезнью Паркинсона. Исходно у всех больных выявлена значимая корреляция между субъективными дыхательными нарушениями, биомеханическими изменениями дыхательного паттерна и дыхательного цикла ($r=0,81$) и различной степенью выраженности астенического синдрома. Существенное влияние на снижение качества жизни оказывают выраженность дыхательных нарушений ($r=0,76$), моторный дефицит ($r=0,71$), астения ($r=0,81$) и тревожно-депрессивные проявления ($r=0,63$). В процессе лечения наблюдалось достоверное улучшение показателей дыхательного цикла, проявлений астении, качества жизни и психоэмоционального состояния пациентов ($r<0,05$). У 62,5 % больных удалось достигнуть нормопноического варианта дыхательного паттерна ($p<0,05$), у 41,7 % пациентов – физиологического типа дыхательного паттерна.

Ключевые слова: болезнь Паркинсона, дыхательные нарушения, астения, немоторные симптомы, БОС-терапия, качество жизни

BFB – biological feedback
MoCA – Montreal Cognitive Assessment

PD – Parkinson's disease
SRC – sensomotor respiration control

Nowadays, Parkinson's disease (PD) is considered as a complex combination of motor and non-motor symptoms with an individual natural course of development, including a long prodromal stage in the non-motor symptoms form [1]. It's promising to study the premotor stage in terms of searching for specific markers of non-motor symptoms for early making a diagnosis andof this disease and the timely treatment appointment. On the other hand, it's known thatthe majority of non-motor manifestations have non-dopaminergic nature, and thereforetheyare not corrected by drugs of levodopa, which, inturn, requires the search for other mainly non-drug methods of treatment [2].

Among non-motor disorders, respiratory dysfunction and asthenia are of particular interest [3, 4, 5]. The prevalence of respiratory diseases in PD is 16–18 % [6, 7]. Impaired respiratory function leads to a high risk of pulmonary complications: on average, 44.1 % of patients with PD die from bronchopneumonia in the late stages of the disease [6]. The prevalence of asthenia in PD varies from 40 to 50 %, in the early stages of the disease – in 30 % of cases, significantly reducing the quality of life [5, 7, 8]. There is a specific relationship between respiratory pattern disorders and asthenia in patients with PD, mainly in the early stages [9, 10]. Because of the functional (reversible) nature of respiratory diseases due to motor deficiency, respiratory muscle rigidity, it is promising to use methods of treatment the respiratory pattern based on biological feedback (BFB) [11, 12, 13]. BFB technology, in combination with traditional methods of complex exposure, implies the active patient's participation in the treatment, characterized by non-invasive, safety, which allows achieving more sustainable results of therapy under the control of physiological parameters [14, 15, 16].

The purpose of the study was to identify the effectiveness of the sensorimotor respiration control (SRC) method using the software-hardware complex «DiaTrek-P», based on the biological feedback principle, in the complex correction of respiratory dysfunction and asthenia in Parkinson's disease.

Material and Methods. There was a pilot study conducted. The study included 48 patients with PD (25 males and 23 females) with classic movement disorders, respiratory disorders, and asthenic syndrome. The average age of participants was 59.6±7.4 years; Hoehn – Yahr scale I–II – in 64.6 %, III – in 35.4 % of patients, the average PD duration was 4.75±3.2 years. The diagnosis of idiopathic PD was established according to the UK Brain Bank criteria [10]. Besides traditional therapy in PD, all patients received ten sessions of respiratory pattern correction using the SRC-method. The assessment of the participant's state was carried out before and after ten sessions of therapy. The respiratory system state was assessed subjectively (according to the questionnaire for identification of respiratory dysfunction in PD, which had been developed at the Department of Neurology of Volg GMU) and objectively (according to various indicators of external respiration and the respiratory cycle recorded in a specially designed map of respiratory disorders). PD motor status was assessed using the Unified Parkinson's Disease Rating Scale (UPDRS), asthenia severity – according to the Malkova scale, emotional state – on the Beck Depression Scale and Spielberger Khanin Anxiety Scale, autonomic disorders – on the Questionnairefor signs of autonomic changes O. M. Wayne, quality of life – according to the PDQ-39 questionnaire (Peto V. et al., 1997), the cognitive status of patients – according to the Montreal Cognitive Assessment (MoCA). Exclusion criteria: chronic respiratory diseases, surgeries, and injuries to the chest organs.

To assess the respiratory cycle, the software and hardware complex «DiaTrek-P» (rats. proposal of VolGMU № 34 – 2002 dated 10.25.2002) was used, which has diagnostic and therapeutic regimes. In the diagnostic administration, various respiratory pattern parameters were recorded (duration of the respiratory cycle, inhalation phase, exhalation phase and respiratory pause, breathing rate, inspiratory and expiratory respiratory coefficients). Evaluation of these indicators before and after the treatment allowed controlling the effectiveness of therapeutic measures. The course of the respiratory pattern correction, based on biofeedback method, included ten daily procedures. Each procedure consisted of two sessions of 15 minutes with a 10-minute rest in between.

The Mann – Whitney test and the Wilcoxon rank were used to assess the significance of quantitative differences. Confidence was considered the probability of events of more than 95 %, which corresponds to the error $p < 0.05$. The relationship between the indicators was determined using the Pearson correlation coefficient (r). Statistical analysis was carried out with Statistica 10.0 (StatSoft, USA).

Results and Discussion. During analyzing the initial indicators in the PD group, the following data were obtained. According to the original questionnaire for respiratory dysfunction identification in PD, all patients had respiratory dysfunction of varying degrees (the average score of diagnostic questions was 18.07±6.9, the differential questions – 6±2.7 points). In all patients, subjective respiratory discomfort was accompanied by various objective biomechanical parameters changes of respiration. The average restriction of chest excursion was 2.42±0.69 cm. The auxiliary inspiratory and expiratory muscles involved in breathing, asymmetric the respiratory wave spread were observed in all subjects. These changes were combined with the localization of active trigger points in these muscles (r=0.83) and were accompanied by the mobility restriction and the functional PDS blocking in the cervical and thoracic regions of the vertebra column (r=0.72). The breathing rate at rest was above the norm (on average, 20.9±3.3 per min). According to the ratio of the respiratory cycle indicators (duration of inhalation phase, exhalation phase, respiratory pause, respiratory coefficients), structural changes of the cycle were found in all patients, which correspond to the tachypnoea and restrictive types of respiratory patterns. The breathing rate increase was associated with a chest excursion decrease both in the upper and lower parts and auxiliary muscles involved in breathing. These changes are necessary to compensate for the increased oxygen demand caused by constant static exertion due to motor deficit. There was found a high correlation between the changes in the respiratory pattern, the disease duration (r=0.8), and the severity of motor deficit (r=0.73). Most patients had mild and moderate asthenia (77.1 %), 22.9 % had pronounced manifestations of asthenia, caused by both motor deficit (r=0.79) and respiratory dysfunction (r=0.73) Moderate and mild depression were diagnosed in 56.2 % of cases, severe depression – in 43.8 %. Patients with Hoehn – Yahr scale I–II had more personal anxiety, but with Hoehn – Yahr scale III – reactive anxiety caused by worsening

of symptoms (r=0.63). 91.7 % patients had signs of autonomic dysfunction. The cognitive status of all patients corresponded to mild and moderate cognitive impairment (average MoCA test was 23.3±3.5). In general, besides motor impairment, respiratory dysfunction and asthenia reduce the quality of patient's life in PD significantly. In most patients correlation analysis revealed a relationship between the quality of life decline due to the indicators of «mobility», «daily activity», «general discomfort», and the severity of respiratory dysfunction (r=0.76), motor deficit (r=0.71), asthenia (r=0.81) and anxiety and depressive manifestations (r=0.63).

The inclusion of SRC sessions in the treatment of patients with PD showed a positive effect on respiratory performance and some non-motor symptoms. The original questionnaire for respiratory dysfunction identification in PD revealed a decrease of respiratory dysfunction severity due to conducted therapy (a reduction of the total score on diagnostic questions by 5.1±1.3). According to the obtained data using the complex «DiaTrek-P», the average breathing rate at rest increased from 12.8±2.5 to 16.2±2.1, reaching the normal variant respiratory pattern in 62.5 % of patients (p<0.05). The duration of the phases of the respiratory cycle also had significant differences, such as reduction of the exhalation phase duration and prolongation the inhalation phase duration (p<0.05). The total respiratory cycle duration has remained unchanged. The respiratory coefficients analysis revealed that 41.7 % of patients achieved the physiological respiratory pattern. The chest excursion increased and averaged 4.31±1.05 cm.

Improved respiratory parameters contributed to a significant decrease in asthenia in 56.3 % of patients (according to Malkova scale, by an average of 9.2±2.6 points). A positive effect of SRC sessions was also observed with vegetative parameters (p<0.05). The emotional state assessment identified some decrease the reactive anxiety level (according to the Spielberger Khanin Anxiety Scale for 7.6±3.7 points) and depression in general by 35.7 %, mainly by transferring the moderate dysfunction to mild in 16.7 % of patients. Some improvement was also observed in cognitive function of patients that indicated the neurodynamic nature of these disorders. The quality of life assessment according to the PDQ-39 questionnaire showed a positive clinical effect with such parameters as daily activity, general discomfort (r<0.05). Despite the absence of a significant effect on motor impairment, the majority of patients rated quality of life improvement after an SRC course than before therapy (r<0.05).

Conclusions. The obtained results allow us to consider the SRC method using the software and hardware complex «DiaTrek-P» as a perspective method in the complex therapy of respiratory dysfunction and asthenia in PD and, as a result, in some psycho-vegetative manifestations. Improving the respiratory parameters will reduce the risk of bronchopulmonary complications in the advanced and late stages of the disease, which will help to minimize asthenia and the energy consumption level, improve the quality of life and prolong the patient's life. This method is simple to use and can be used by doctors in everyday practice.

Disclosures:
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