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# FUNCTIONAL DISORDERS OF THE NERVOUS SYSTEM IN PATIENTS WITH COVID-19.

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**Abstract** We studied the functions of the suprasegmental division of the vegetative nervous system in patients with PS. Vegetative tone (VT), vegetative reaction (VR) and vegetative support of activity (VSA) were investigated. A comparative analysis of the above indicators was carried out in 46 male and 32 female patients with the control group. Vegetative functions were investigated for 4 to 12 weeks. The study of vegetative functions in patients with PS showed the presence of both local and generalized, and permanent, paroxysmal vegetative disorders in each of them.

**Keywords:** post-COVID syndrome, coronavirus, vegetative disorders.

**Introduction**. In December 2019, an epidemic outbreak of viral pneumonia associated with the new coronavirus began in Wuhan city, China; it was initially called the Wuhan virus or the new coronavirus 2019.

Which was originally a localized epidemic outbreak has turned into a global pandemic of unstable and tragic consequences. In February 2020, the official taxonomic name of the new virus was established - coronavirus (CoV) of the second type, associated with severe acute respiratory syndrome (SARS) (SARSCoV-2), and the disease caused by it COVID-19 (coronavirus disease 2019) [11, 12,14,14]. On January 30, 2020, the World Health Organization declared this epidemic emergency in public health of international importance and then a global pandemic, too.

The neurotropene virus, that is, entering the nervous system through the olfactory receptors in the upper nasal cavity, can directly damage brain structures, such as the limbic system, hypothalamus [5], cerebellum, respiratory center, and others. Damage to large nerves such as the vagus causes a wide variety of symptoms and also determines their wavy nature. This disorder is associated with an imbalance of the two systems, parasympathetic and sympathetic [4], which causes heart rate problems, orthostatic tachycardia, sleeping problems, a kind of panic attacks and anxiety disorders [5,10].

In most patients with post-COVID syndrome (PS), vegetative disorders (VD) are sometimes one of the main complaints requiring special attention and correction [1,3]. But in practice, VD is often not given enough attention, and they are considered as a concomitant symptom. As evidenced by clinical experience, the manifestation

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and dynamics of local VD in PS have a certain prognostic value [1,3,7,8,9,10]. In this connection, a detailed study of VD in PS, monitoring their dynamics and the development of correction methods are of great practical importance [2,4].

Permanent or paroxysmal manifestations of dysfunction of the suprasegmental part of the VDS, primarily due to psychoemotional disorders of patients who are characterized by the presence of trouble, and in the case of a protracted course - depression [5,6,11,13].

**The aim of the study** is to study vegetative disorders in post-COVID syndrome depending on the course of periodand sexual dimorphism.

**Materials and research methods**.

To identify vegetative dysfunction in PS, we studied the following functions of the suprasegmental division of the vegetative nervous system using the following methods:

1. Vegetative tone (VT), investigated according to the Giyom- Wayne scale.
2. The vegetative reaction (VR) , investigated using the Danin-Ashner test.
3. Vegetative support of activity (VSA), investigated by carrying out orthostatic tests.

The study included 78 patients with post-COVID syndrome (PS) aged 18 to 56 years, of whom there were 18 young people (up to 45), 60 middle aged (45-56). From the anamnesis of all patients , they were 4 to 12 weeks after being infected with a coronavirus infection. The diagnosis of PS was established on the basis of the results of a complex clinical and neurological examination . All the examined patients underwent an in-depth general clinical and neurological examination. The condition of the vegetative nervous system was studied in accordance with the methodological recommendations of vegetative pathology [4].

**Results of the research.**

In the study of the vegetative tone in patients with PS, sympathetic tone prevails in comparison with the control group ($p<0.01$-$0.001$).

A detailed analysis of each clinical case indicates that the more severe the manifestation of PS and the older the patient's age, the higher the sympathetic tone. This was especially true of male cases, when in 13.3% of men and 10% of women, we observed sympathoadrenal reactions within 8 weeks of the disease. Thus, the longer the duration of the disease, the stronger the prevalence of sympathetic tone, both among female and male.

Table № 1

Features of vegetative tone in PS of male and female patients

| Parameters of VT | PS with a periodof 4 weeks (group I) | | PS with a periodof 8 weeks (group II) | | PS with a periodof 4 weeks (group III) | | Control group n = 10 |
|---|---|---|---|---|---|---|---|
| | м (n=15) | ж (n=10) | м (n=15) | ж (n=9) | м (n=16) | ж (n=12) | |

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|---|---|---|---|---|---|---|---|
| Sympathetic | 57,6±1,2 | 56,1±0,6 | 60,6±0,9 | 59,1±0,9 | 65,6±0,8*б | 60,4±0,72*a | 55,1±0,75 |
| P<, to control | | | 0,01 | 0,01 | 0,001 | 0,01 | |
| Parasympathetic | 42,4±0,8 | 43,9±0,6 | 49,5±0,58* | 40,9±0,6*a | 34,4±0,4**бб | 30,6±0,52**ба | 44,9±0,5 |
| P<, to control | | | 0,01 | 0,05 | 0,01 | 0,01 | |

* - credibility to light level indicators (* - P <0.05-0.01); ^ - credibility to light level indicators (* - P <0.05-0.01); b - the credibility of the data to average level indicators (b - P <0.05-0.01); a - credibility of data between indicators by gender (a - P <0.05)

The study of VSA revealed significant differences in the indicators of pulse and blood pressure, both in a quiet state and during the orthostatic test, between the compared groups and the control group. The obtained results showed the presence of significant differences between the group of patients with a period of 12 weeks, compared with the control group and with a group of patients with a period of 4 weeks. ($p<0.01$). This difference was more pronounced in males: gender differences were more manifested when comparing the heart rate in patients with a period of 12 weeks (i.e., between men and women of group III). (Tab. № 2)

At the same time, according to the indicators of the pulse parameter of the VSA, between the group I of males and females and the control group, the difference had no significance.

When studying the average systolic BP, both in a quiet state and during the orthostatic test, the following results were obtained: so, in patients of group I, male and female, no significant differences were found between them and with the control group.

Significant differences were found when comparing SBP in a quiet state, between groups I and III, both male and female, which indicates the sympathetic orientation of VSA. When carrying out an orthostatic test, both in patients of groups I and III of males, and in groups I and III of females, there was a significant difference ($p<0.01$). Thus, the differences revealed when comparing the indicators of pulse and blood pressure between groups I and III (both in a quiet state and during the orthostatic test), indicate the sympathetic orientation of the VSA.

Table № 2

**Features of vegetative support of activity in PS in male and female patients**

| Parameters VSA | | PS with a periodof 4 weeks (group I) | | PS with a periodof 8 weeks (group II) | | PS with a periodof 4 weeks (group III) | | Control group n = 10 |
|---|---|---|---|---|---|---|---|---|
| | | м (n=15) | ж (n=10) | м (n=15) | ж (n=9) | м (n=16) | ж (n=12) | |
| HR | Quiet state | 77,4±0,5 | 73,2±0,8a | 80,1±0,67* | 74,4±0,6a | 86,2±0,6**б | 79,0±1,0*ба | 75,0±0,7 |
| | P<, to control | 0,01 | | 0,001 | | 0,001 | 0,01 | |
| | Orthostat | 88,0±1,1 | 85,0±1,1a | 95,0±0,9* | 94,0±0,9* | 112,0±2,1**бб | 109,0±1,3**ба | 87,0±0,7 |
| | P<, to control | | | 0,01 | 0,01 | 0,001 | 0,01 | |

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|---|---|---|---|---|---|---|---|---|
| SBP | Quiet state | 90,0±1,6 | 87,0±1,4a | 93,0±1,8 | 95,0±1,4** | 95,0±1,8* | 92,0±0,86*ба | 91,0±1,5 |
| | P<, to control | | | | | | | |
| | Orthostat | 102,0±2,3 | 99,0±1,7a | 105,0±2,2 | 102,0±1,8* a | 108,0±2,3* | 109,0±1,9*б | 106,0±1,5 |
| | P<, to control | | 0,05 | | | | | |

* - credibility to light level indicators (* - P <0.05-0.01); ^ - credibility to light level indicators (* - P <0.05-0.01); b - the credibility of the data to average level indicators (b - P <0.05-0.01); a - credibility of data between indicators by gender (a - P <0.05)

The results of a comparative analysis of VR in patients with PS (table № 3) also confirms the predominance of sympathetic activity in response to external influences, which is more pronounced in patients of group III, both male and female, and in patients of group II, compared with the group control. At the same time, the initial sympathetic activity is traced, the most pronounced in the group of patients of group III, especially among men. In the same patients, the number of heart contractions during the Danin-Ashner test did not practically change from the initial value, and on average was -2.0 ± 0.27 in men, and -3.0 ± 0.3 in women. Whereas in group I of male and female patients, the values did not significantly differ from the control group.

Table № 3

**Features of the vegetativeresponse in PS in male and female patients**

| Parameters VR | PS with a periodof 4 weeks (group I) | | PS with a periodof 8 weeks (group II) | | PS with a periodof 4 weeks (group III) | | Control group n = 10 |
|---|---|---|---|---|---|---|---|
| | м (n=15) | ж (n=10) | м (n=15) | ж (n=9) | м (n=16) | ж (n=12) | |
| HR in a quiet state | 78,4±0,7 | 72,2±0,5a | 80,1±0,8* | 74,4±0,7a | 86,2±0,61**б | 80,0±0,5*a | 75,1±0,7 |
| P<, to control | 0,01 | 0,05 | 0,01 | | 0,001 | 0,01 | |
| Test with reactivity | -6,5±0,28 | -5,4±0,3a | -4,0±0,35** | -4,0±0,4* | -2,0±0,27***бб | -3,0±0,3**ба | -6,0±0,2 |
| P<, to control | | 0,05 | 0,01 | 0,01 | 0,001 | 0,001 | |

* - credibility to light level indicators (* - P <0.05-0.01); ^ - credibility to light level indicators (* - P <0.05-0.01); b - the credibility of the data to average level indicators (b - P <0.05-0.01); a - credibility of data between indicators by gender (a - P <0.05)

## Conclusion:

Thus, the study of vegetative functions in the group of patients with PS showed the prevalence of sympathetic activity of both in patients VT, in VSA, and the focus of VR, especially among males, with a period of 12 weeks. There is a connection between the severity of vegetative disorders and the duration of the disease: the longer the duration of PS is, the more the shifts in the sympathetic direction of vegetative functions. The presence of clear tendencies towards certain generalized vegetative shifts in patients with PS indicates the need for correction of vegetative disorders.

Vegetative disorders, limiting the adaptive capabilities of the body, can have a significant impact on the prognosis of the disease as a whole. Despite the continued

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growth in the number of publications on this topic, to this day, information on the neurological aspects of COVID-19 is incomplete and requires further research in this direction.

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