

## VILOSENUM INFLUENCE ON THE PERFORMANCE OF THE AND SYSTEM IMMUNE SYSTEM NEURODYNAMIC FUNCTIONS FOR THE PEOPLE WITH THE MYOPIA

**Sheiko V.I., Marunenko I.M.**  
Borys Grinchenko Kyiv University

The aim of our research was to study the neurodynamic functions and the state of the immune system on the background of the medium myopia and also to study the immunostimulation influence on the neurodynamic functions and the state of the immune system on the background of the myopia. In the modern society a man is exposed to the stress influences among which the most widespread one is the informative (emotional information stress). We exposed that the medium myopia is accompanied by the functional tension of the immune system, namely by the cellular link secondary immunodeficiency, the improvement of the neurodynamic functions indexes (functional mobility of the nervous processes) is observed. The vilosenum appliance was accompanied by the latent periods increase of the simple sensor-motor reactions and by the indexes increase of the FMNP. The positive correlative relationship was exposed between the functional mobility of the nervous processes and the monocytes amount in the peripheral blood ( $r=0,7$ ). The same relationship was exposed between the functional mobility of the nervous processes and the T-suppressors amount in the peripheral blood ( $r=0,6$ ).

**Keywords:** immune system, immunostimulation, functional mobility of the nervous processes, sensor-motor reactions.

**Introduction.** The supersaturating of the modern man's life by the various irritants after the modality, different after the force and the stress influences duration allows to assert that the adaptive changes progress is determined by the stand-by capacity of the adaptation mechanisms. The functional rearrangement in the organism takes place by the mobilization of the neurogenic, hormonal and humoral links of the regulation. The activity of the central nervous system (CNS) changes in response to the stimulus, the activation of the hypothalamo-pituitary-adrenocortical system takes place simultaneously which are directed towards the homeostasis renewal and support [16, 17]. The immune system plays an important role in the homeostasis support under the different influences on the organism [15, 18]. There are changes of the products, differentiation, migration and functional state of the immunocompetent cells in the process of the adaptation syndrome forming, and at the same time the amount of the biologically active substances changes which have an immunopath activity [11, 21, 22]. On the basis to the above, the study of the organism reaction features on the action of the different irritants by the force and modality gives an opportunity to understand how far the power and plastic reserves are attracted for the adaptive rearrangement realization of the organism systems. It is known that information from the external environment and internals comes into the central nervous system from the specialized receptors or special organs of reception, the structure of which is related to the perception specificity and processing of this information. The feelings organs activity is represented objectively in the origin of the excitation in their receptor formations, and subjectively it shows up in the feelings. Among the feelings organs the leading role in the information perception from the external environment belongs to the visual analyzer by which a man perceives approximately 80% information [4]. The morpho-functional changes in the sensory visual system, which were formed in the short period of evolution under the influence of the powerful informatively-emotional tension, can be examined as an adaptive reaction, due to which they influence on the brain functioning. As an eye is not simply a feeling organ, but it is a part of the brain, which is taken away on the «leading edge» of perception [4], it is proved that the functional state of the visual analyzer at the informatively-emotional tension, on the one hand, can be accompanied by

the functional rearrangement of the nervous system, and on the other hand, it can be accompanied by the organism immune system disfunction [4, 5, 12]. At the same time the mechanisms of the adaptive rearrangement are investigated not enough. No less actual and little examined is a problem of the functional linkage between the neurodynamic properties and functional state of the immune system, as the same ligands work in the nervous and in the immune systems, to which there are similar receptor formations in the observable systems [7]. The different functional properties of the visual analyzer which are accompanied by the nervous and immune systems tension, probably, predetermine the peculiarities of the neurodynamic functions.

The **aim** of our research was to study the properties of the higher nervous activity (HNA), and also to study the changes of the neurodynamics and immune system indexes in the conditions of the vilosenum appliance for the people with the medium myopia.

**Object and research methods.** The researches of the HNA individual properties and the functional state of the immune system were carried out on the basis of the chair of human anatomy and physiology of the Borys Grinchenko Kyiv University and on the basis of the biochemical laboratory Kiev children's clinical hospital; the researches were carried out in two groups of the volunteers with the total amount of 160 persons: the first group (80 persons) are practically healthy people, the second group (80 persons) are people which suffer from the medium myopia (an acquired form). Vilosenum-immunostimulant as the nasal drops was proposed for the second group of the volunteers during a fortnight according to the instruction [9]. Vilosenum isn't a protein drug which is made of the cattle hemolysate thymus. During the fortnight physiological solution as the nasal drops was proposed for the volunteers of the first group instead of the vilosenum.

All the experimental participants were observed by the general practitioners of the Kiev children's clinical hospital.

M. Makarenko's method was used for the research of the neurodynamic properties [14]. According to this method the researches were begun with the determination of the sensor-motor reactions which had a different complication degree. The latent period of the simple visual-motor reaction (SVMR) was determined on the neurodynamic testing device NDTD-1. On the assumption of any irritant appearance on

the screen (geometrical figures – «circle», «triangle», «square») the examined person had to press the right button on the desk quickly. 30 irritants in all were produced. Time of the latent period of the visual-motor choosing reaction one of three irritants (LPCR<sub>1-3</sub>) was farther investigated. Such signals in the same amount as in the process of SVMR determination were produced to the examined person, but it was suggested to press the right button only in the appearance of every irritant «square»; he didn't have to react in the appearance of the others. During the research of the latent period of the visual-motor choosing reaction two of three irritants (LPCR<sub>2-3</sub>), the examined person had to press the right button with his right hand quickly on the assumption of the figure «square» appearance on the screen, and he had to press the left button with his left hand on the assumption of the irritant «circle» appearance. The button didn't have to be pressed on the assumption of the irritant «triangle» appearance, which was considered to be inhibitory.

The functional mobility of the nervous processes (FMNP) was determined by the greatest rate of the positive and inhibitory irritants differentiation in their producing minimum exposition in the «feedback» mode. That is the period which is needed for the test realization.

The functional state of the immune system was studied by such indexes as: determination of the leucocytes general amount in the peripheral blood, relative and absolute lymphocytes, neutrophils and monocytes amount, the T-lymphocytes amount of all the subpopulations (T-helpers, T-suppressors, T-killers) and B-lymphocytes, concentration of the serumal immunoglobulins IgA, IgM, IgG [12, 17]. The absolute amount of the leucocytes was counted by the generally accepted method with the help of the Gorjaev chamber [13].

The leukogram was determined in the blood films painted by the Pappenheim-Kryukov method [20].

The determination of the serumal immunoglobulins concentration was conducted by Mancini method in the radial immunodiffusion in the agar gel. This method is based on the precipitation area determination of the experimental serums in the agar gel. The experimental serums were brought in the small lunulas with 2,5 mm diameter in the 15 mm distance one from another and they were incubated 24 hours for IgG, IgA and 48 hours for IgM in the moist chamber. Then the precipitin rings diameter was measured. It is shown that this area square is proportional to the immunoglobulins amount in the experimental serum [6, 23].

The T-lymphocytes amount of all the subpopulations (T-helpers, T-suppressors, T-killers) and B-lymphocytes amount were determined by the method of the lymphocytes phenotype in the tests of rosetting with the particles covered by the monoclonal antibodies: T-lymphocytes a monoclonal antibody (mAB) to the receptor Cd3, T-helpers mAB to CD4, T-suppressors mAB to CD8, T-killers mAB to CD16, B-lymphocytes mAB to CD19. For a test a The light microscope (eyepiece magnification is 15, lens is 10) and the lymphocytes native films with the monoclonal antibodies particles were used for the test [6, 8].

The statistical treatment of the results was conducted with the help of the computing software Microsoft Excel – 97 [1].

**Results and their discussions.** According to the assigned aim the indexes changes were studied among the volunteers with the acquired medium myopia which characterize the functional state of the central nervous and immune systems. The dynamics of the neurodynamic indexes changes is resulted in table 1. It is determined that the average quantity of the simple sensor-motor reaction and the quantity of the choosing reaction latent period two of three signals (CR<sub>2-3</sub>) didn't differ in the first and in the second groups. At the same time, time diminishing of the

Table 1

**Indexes of the neurodynamic functions (M ± m)**

Indexes	Control group		Experimental group	
	Outgoing data	After the saline	Outgoing data	After the vilosenum
SVMR, ms	264±4,6	258±5,5	265,9±5,9	290,6 ± 3,6**
LPCR <sub>1-3</sub> ms	341,5±4,4	354,2±4,8	314,9±6,6*	339,4±2,74**
LPCR <sub>2-3</sub> ms	389,9±3,5	393,4±4,0	396,0±7,1	375,0±6,2**
FMNP s	72,0±1,1	71,2±2,2	65,5±1,2*	59,6±1,5**

\* – authenticity of the indexes change between the groups (P < 0,05)

\*\* – authenticity of the indexes changes within the group (P < 0,05)

Table 2

**Immunological indexes in the volunteers' peripheral blood (M±m)**

Indexes	Control group		Experimental group	
	Outgoing data	After the saline	Outgoing data	After the vilosenum
Leucocytes, x10 <sup>9</sup> / l	6,8±0,12	6,8±0,2	6,45±0,08	6,7±0,08
Lymphocytes, x10 <sup>9</sup> / l	2,2±0,01	1,9±0,08	2,0±0,04	2,2±0,02
Monocytes, x10 <sup>9</sup> / l	0,36±0,05	0,34±0,06	0,29±0,01*	0,34±0,03**
Neutrophils, x10 <sup>9</sup> / l	4,1±0,03	4,2±0,03	3,78±0,04*	3,85±0,08
T-lymphocytes, x10 <sup>9</sup> / l	1,5±0,06	1,4±0,08	0,86±0,03*	1,14±0,02**
T-helpers, x10 <sup>9</sup> / l	0,57±0,06	0,58±0,04	0,55±0,04	0,57±0,05
T-suppressors, x10 <sup>9</sup> / l	0,32±0,02	0,32±0,03	0,23±0,03*	0,31±0,03**
B-lymphocytes, x10 <sup>9</sup> / l	0,36±0,02	0,37±0,05	0,43±0,05	0,44±0,06
IgM, g/l	1,24±0,04	1,26±0,04	0,84±0,19*	0,89±0,2
IgA, g/l	1,86±0,08	1,95±0,1	1,55±0,3	1,65±0,2
IgG, g/l	15,3±0,2	15,0±0,3	7,5±0,2*	7,7±0,3

\* – authenticity of the indexes change between the groups (P < 0,05)

\*\* – authenticity of the indexes changes within the group (P < 0,05)

sensor-motor choosing reaction one of three (CR<sub>1-3</sub>) and increase of the functional mobility of the nervous processes (FMNP) were observed in the second group of the volunteers with the distinct myopia in comparison with the control group.

The findings testify that the human acquired myopia is accompanied by the functional rearrangement of the CNS. Some authors consider that in such conditions the adaptive syndrome origin of the ocular cells of the neuroglia (stationary macrophages) synthesize neuropeptides more actively which are able to increase the functional activity of the neurons [4, 7, 12]. Except this fact, there is an assertion that the increase of the neurons bioelectric activity can be accompanied by the immunological reactions and vice versa [7, 10].

During the research of the organism immunoreactivity we determined that the general amount of leucocytes in the human peripheral blood with the medium myopia did not differ from the practically healthy people's leucocytes amount (table 2). At the same time the comparison of the neutrophilic leucocytes and monocytes quantitative characteristics, which form the nonspecific link of the immune system, showed that the people with the medium myopia have their less quantity in comparison with the control group, and the young forms of the neutrophils prevail (table 2).

We determined in our researches that the absolute number of the lymphocytes in the peripheral blood so the myopes, as the absolute number of the practically healthy people does not differ, but in the conditions of the myopia the T-lymphopenia is found out, and it is predefined by the content descent of the T-helpers, T-suppressors and T-killers (table 2). So, the received results testify that the disfunction of the organism immune system cellular link is formed on the myopia background.

The humoral link of the immunity is formed by the B-lymphocytes and by the antibodies of the classes IgA, IgM, IgG. The general amount of the B-lymphocytes, and also the concentration of the IgA immunoglobulin in the blood serum did not undergo any changes on the myopia background in comparison with the practically healthy people's indexes. At the same time the medium myopia was accompanied by the concentration diminishing of the IgM and IgG antibodies in comparison with the control (table 2). Obviously, the disparity between the B-lymphocytes amount and between the IgM and IgG immunoglobulins concentration is predefined by the B-lymphocytes, as antibody synthesizing cells, reduce the activity in the appearance of the adaptive syndrome when the medium myopia takes place. Our conclusion is conformed with the organs and organism systems immunoregulation theory [5].

The use of the saline in the control group did not cause any changes in the indexes of the neurodynamic functions and immune system (tables 1, 2).

In the second group in the process of the vilosenum appliance, the reliable increase of the monocytes and T-lymphocytes content was set due to the T-suppressors subpopulation in the peripheral blood in comparison with the outgoing data, and it testifies the functional activation of the immunity cellular link. The indexes of the immune system humoral link did not undergo any changes when the vilosenum was used (table 2).

Due to the results of V. Shirinskiy, Ye. Zhuk, N. Lunina researches, it was found out that under the influence of the vilosenum introduction, the increase of the monocytes and lymphocytes absolute amount

at the expense of the T-suppressors subpopulation in the peripheral blood is observed [19, 20].

Analysing the indexes of the neurodynamic functions in the experimental group after the immunopotentialization, the tendency to the time increase of the SVMR and LPCR<sub>1-3</sub> latent periods was searched out, and the LPCR<sub>2-3</sub> index had a tendency to diminishing. The functional mobility of the nervous processes after the vilosenum appliance increased for certain in comparison with the outgoing data (table 1).

It is discovered by the results of our researches that the myopia is accompanied by diminishing of the neutrophilic leucocytes amount. Obviously, taking into account the long period of the myopia origin and of the stress state forming, the diminishing of the immunity heterospecific link functional activity takes place during the adaptive syndrome. Thus, according to the stress state origin theory, the adaptive syndrome has three stages, and the myopia arises in the end of the second stage which is answered by diminishing of the neutrophilic leucocytes absolute amount in the peripheral blood, predefined by the granulocytopenia oppression [5, 24].

Relying on the stress-adaptive syndrome theory, it should be noted that adaptation is accompanied by the corticosteroids concentration change [6], which have a depressant influence on the T-helpers. Taking into account that the T-helpers and the monocytes are the key cells of the immune system, which influence on all the subpopulations of the lymphatic row [2, 3], we assert that the fact explains the origin of the second immunodeficiency.

Some authors assert that the secondary immunodeficiency caused by the adaptive syndrome to the emotionally informative tension is accompanied by the activation of the immunity local link and by the active synthesis of the S-100 neuropeptide (by the ocular cells of neuroglia) [5, 7, 17], that may possibly influence on the state of the neurodynamic functions.

On the assumption of the vilosenum usage for the myopes, as a corrector of the immune system state, the sizes increase of the sensor-motor reactions SVMR, LPCR<sub>1-3</sub> latent periods was observed. Probably such changes in the noted latent periods are conditioned by the inhibitory influence of immunohormones on the nervous impulse transmission in the nervous muscular synapses [10]. Concerning to the size change of the LPCR<sub>2-3</sub> downward bias, it may be related with the bioelectric activity increase of the neurons cerebrum during the CNS functional rearrangement on the background of the immunological rearrangements caused by the immunopotentialization [10]. Taking into account that the vilosenum caused the increase of the monocytes and T-suppressors amount in the peripheral blood, the cytokines synthesis might be risen in these conditions, the source of which the noted cells of the immune system had been. It is known that some cytokines have a stimulant influence on the nervous system [7, 10]. It is necessary to notice that the immune systems cells, and, first of all, the monocytes are able to synthesize the S-100 neuropeptide [7], which causes the increase of the cerebrum neurons functional activity. Maybe in our case, the increase of the nervous processes functional activity after the immunostimulant usage was caused by the increased content of the cytokines and S-100 neuropeptides.

The functional mobility main indices increase of the people's nervous processes who suffer from the myopia have likely a different genesis in the conditions of the secondary immunodeficiency and after the immunostimulation. In the conditions of the

immunodeficiency (the myopia), the FMNP increase may be caused by the local immunity link activation. After the immunostimulation the FMNP increase may be caused by the dual activation, i.e. due to the local immunity activation and due to the increase of the monocytes and T-suppressors amount in the peripheral blood, which reached the indices of the control group.

On the basis of our correlation analysis, the direct positive correlation is revealed between the functional mobility of the basic neural processes and the monocytes amount ( $r=0,7$ ), and also between the T-lymphocytes amount, namely between the T-suppressors ( $r=0,6$ ).

Thus, the findings indicate the functional link existence between the immune system state and the indices of the organism neurodynamic functions, it is known that any immunological rearrangements influence on the bioelectric activity of the neurons and cause the functional changes in the central nervous system [10], and perhaps this is what causes changes in the parameters of the neurodynamic functions.

**Conclusions.** 1. In people with moderate myopia The latent period reduction of the complex sensor-motor choosing reaction one of three is observed at the people with the medium myopia, and the FMNP increase is also observed.

2. The medium myopia is accompanied by the reduction of the neutrophil leukocytes, monocytes, T-lym-

phocytes of all the subpopulations absolute number in the peripheral blood and by the M and G immunoglobulins decreased concentrations in the blood serum, i.e. the secondary immunodeficiency appears.

3. The vilosenum usage on the background of the acquired myopia caused the increase of the monocytes, T-lymphocytes absolute number at the expense of the T-suppressors subpopulation in the peripheral blood, the immunity humoral link indices didn't undergo any changes.

4. After the immunostimulation the latent periods increase of the simple sensor-motor reaction and the LPCR<sub>1-3</sub> is observed at the myopes, the LPCR<sub>2-3</sub> reducing and the FMNP increase were also observed.

5. The positive correlative link between the level of the FMNP with the monocytes number and T-lymphocytes number, namely T-suppressors number.

**Prospects for the further research.** Based on the fact that the modern society is characterized by the high information flow (the information cybernetic society is being formed), accompanied by the emotional information stress and the immune and nervous systems activity disorder, the necessity to investigate the state of the neurodynamic functions and immune system was appeared. The researches in this direction will enable the painless overcoming of the emotional information stresses in the information cybernetic society, and will also add the facts about the nervous and immune systems functional relationship.

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**Шейко В.І., Маруненко І.М.**

Київського університету імені Бориса Грінченка

## **ВПЛИВ ВИЛОЗЕНУ НА СИСТЕМНИЙ ІМУНІТЕТ ТА НЕЙРОДИНАМІЧНІ ФУНКЦІЇ ЛЮДЕЙ З МІОПІЄЮ**

### **Анотація**

Метою нашого дослідження було вивчення нейродинамічних функцій та стан імунної системи на тлі середньої міопії, а також вивчення впливу імуностимуляції на нейродинамічні функції і стан імунної системи на тлі міопії. У сучасному суспільстві людина піддається впливу стресових впливів, серед яких найбільш поширеним з них є інформативним (емоційна інформація стресу). Ми встановили, що середній короткозорість супроводжується функціональним напруження імунної системи, а саме вторинного імунодефіциту клітинної ланки, зміни показників нейродинамічних функцій (функціональна рухливість нервових процесів) не спостерігається. Використання вилозену супроводжувалося збільшенням латентних періодів простих сенсомоторних реакцій і покращення показників ФРНП. Позитивне кореляційна залежність спостерігалась між функціональної рухливості нервових процесів і кількості моноцитів в периферичній крові ( $r = 0,7$ ). Така ж закономірність спостерігалась між функціональної рухливості нервових процесів і кількістю Т-супресорів в периферичній крові ( $r = 0,6$ ).

**Ключові слова:** імунна система, імуностимуляція, функціональної рухливості нервових процесів, сенсомоторні реакції.

**Шейко В.И., Маруненко И.М.**

Киевский университет имени Бориса Гринченко

## **ВЛИЯНИЕ ВИЛОЗЕНА НА ПОКАЗАТЕЛИ СИСТЕМНОГО ИММУНИТЕТА И НЕЙРОДИНАМИЧЕСКИХ ФУНКЦИЙ У ЛЮДЕЙ С МИОПИЕЙ**

### **Аннотация**

Целью нашего исследования было изучение нейродинамики функции и состояние иммунной системы на фоне средней миопии, а также изучение влияние иммуностимуляция на нейродинамических функций и состояние иммунной системы на фоне миопии. В современном обществе человек подвергается воздействию стрессовых влияний, среди которых наиболее распространенным из них является информативным (эмоциональная информация стресса). Мы установили, что средняя близорукость сопровождается функциональным напряжением иммунной системы, а именно клеточного вторичного иммунодефицита, улучшение нейродинамических функций (функциональная подвижность нервных процессов) не наблюдается. Применение вилозена сопровождалось увеличением латентных периодов простых реакций сенсомоторных и увеличением показателем ФПНП. Положительное корреляционная зависимость наблюдалась между функциональной подвижности нервных процессов и количества моноцитов в периферической крови ( $r = 0,7$ ). Такая же закономерность наблюдалась между функциональной подвижности нервных процессов и количеством Т-супрессоров в периферической крови ( $r = 0,6$ ).

**Ключевые слова:** иммунная система, иммуностимуляция, функциональной подвижности нервных процессов, сенсомоторные реакции.