



L. A. Rybina **, *A.O. Ivanov, *M.V. Alexandrov*****

** I.P. Pavlov Institute of Physiology at the Russian Academy of Science*

*** S.M. Kirov Army Medical Academy*

Changes in parameters of spontaneous bioelectrical activity of the brain observed in the course of BIP-therapy in patients with neurotic disorders

To determine neurophysiological correlatives of the changes in psychoemotional status of the patients with neurotic disorders in the course of resonance therapy, spontaneous bioelectrical activity was registered. We took readings before the course of the treatment, immediately after it, and three weeks after the course of BIP-therapy.

Research technique

Characteristics of the testees. Persons who took part in the test had in the past no craniocerebral traumas, acute toxic or infectious diseases of the brain, and took no stimulants. All the patients were true right-handers; hemisphere dominance was revealed through a standard questionnaire. The age of the patients ranged from 22 to 41 years.

EEG was recorded under standard conditions: the patients were awake, comfortably at rest mentally and physically in a light- and soundproof chamber. Electroencephalograms were registered in 16 unipolar leads from the electrodes attached according to the international pattern "10/20", with a unified ear electrode as a reference electrode.

There was registered spontaneous EEG as well as functional changes in the brain waves stimulated by sensory input. To define the rate the adjustment reaction tends to decrease (to block α -rhythm or dominating activity) the patients were exposed to randomized flashes of light. Rhythmical white-light stimulation was carried out to estimate the parameters of reaction of involvement (assimilation). Discrete rhythmic photostimulation was within the range of 4 Hz to 27 Hz with the interval of 1 Hz. On each of the frequencies stimulation remained till the effect of assimilation occurred, but not less than for 30 seconds. The interval between the exposures was 30 seconds.

Amplitude and time parameters of bioelectrical activity was registered and analyzed with the help of the EEG unit (EEG-100C) of a polygraph "MP-150 Acknowledge System" by "BIOPAC Systems, Inc." (USA, 2000), Reference Manual Version 3.7.0 for Windows '98. The upper passband — 100 Hz, time constant — 0.01 seconds.

Analysis of the amplitude-time parameters of spontaneous activity was carried out according to the standard procedure of fast Fourier transformation (FFT) in real-time, every 5 seconds. The frequencies

analyzed were in the following ranges: Δ -rhythm — 0 - 4 Hz, τ -rhythm — 4 - 8 Hz, α -rhythm — 8 - 12 Hz, β_1 -rhythm — 12 - 16 Hz, β_2 -rhythm — 16 - 25 Hz.

Electrical activity of the brain was recorded before the course of BIP-therapy, immediately after the course of BIP-therapy and 3 weeks after the course. In all cases EEG was registered before the noon. Eight-hour night's sleep before the investigation was a must for the testees. EEG of the initial state was recorded twice; analyzed were the average parameters.

Statistics were processed with the help of IFR BMDP ver 5.0. After variability of the distribution had been checked, reliability of the deviations was estimated according to the Wilcoxon-Mann-Witney criterion and Student t-criterion for related pairs of samples.

Research results

High polymorphism of the EEG patterns was characteristic of the *initial state* of spontaneous activity, which partly reflected cerebral disturbances lying at the basis of the neurotic disorders observed. Nevertheless, if we take dominating α -rhythm for a systematizing factor, the patients, depending on the EEG types before the course of therapy, can be divided into two groups (Table 1).

Table 1

Distribution of the patients over the groups according to the changes in EEG patterns

№	Types of the groups	Average age, years	Number of the patients observed in the initial state	Type of EEG approaching the "ideal" norm	
				at the end of the course of therapy	after a certain period of time
1	EEG type without a dominating rhythm («dysrhythmic» type)	32.4 ± 4.5	9	7	6
2	EEG type with a dominating α -rhythm and irregular zonal distribution	23.5 ± 1.5	3	2	2

Patients whose background EEG did not reveal any predominant rhythm formed the first group (9 people). The EEG pattern from these patients showed alpha-activity and slow waves represented mostly by the waves of theta-range interleaved with a large portion of fast waves (Table 2). Slow-wave tracings did not exceed 40 % and their amplitude was lower than that of the dominating alpha activity. The EEG pattern described is characterized as a "dysrhythmic" condition.

Three of the patients had dominating α -rhythm, but its distribution from the occipital to the frontal regions did not follow the regular pattern: it did not decrease (see Table 3). Owing to the fact that while α -rhythm had a relatively high index, it did not form "spindles", activity, judging by the shape of the waves,

was closer to the so-called "machine-like" rhythm. Patients with the activity pattern described were combined into the second group.

According to the results shown in the Table 1, "dysrhythmic" type of EEG was registered in the patients of older age group (in this group, patients at the age of 28 to 37 are considered as middle-aged people). Second Patients in the group belonged mainly to the younger age category: they were under 25.

Table 2

**Changes in the parameters of spontaneous bioelectrical activity of the brain (left occipital electrode)
during the course of BIP-therapy in patients with dysrhythmic type of EEG
($\bar{X} \pm m$, n=9)**

EEG parameters		Initial state	At the end of the course of therapy	After a certain period of time
Index of α -rhythm in percent		41.1 $\pm$ 4.9	51.7 $\pm$ 7.2*	46.1 $\pm$ 6.0
Frequency of α -rhythm in Hz		10.2 $\pm$ 1.1	10.1 $\pm$ 1.4	10.3 $\pm$ 1.4
Number of modulations of α -rhythm observed		0+1	6.7 $\pm$ 0.5*	5.5 $\pm$ 0.5*
Proportion of the rhythm as expressed in percent	α -rhythm (%)	49.0 $\pm$ 6.5	59.2 $\pm$ 7.2*	49.6 $\pm$ 7.4
	τ -rhythm (%)	17.4 $\pm$ 2.8	11.4 $\pm$ 3.6*	15.2 $\pm$ 4.6
	Δ -rhythm (%)	20.0 $\pm$ 6.8	12.5 $\pm$ 5.2*	19.5 $\pm$ 3.4
	β 1-rythm (%)	6.6 $\pm$ 1.8	8.4 $\pm$ 2.3	7.6 $\pm$ 1.5
	β 2-rythm (%)	7.0 $\pm$ 3.1	8.3 $\pm$ 2.4	8.1 $\pm$ 2.1
Excitation-inhibition ratio (in arbitrary units)		-23.8 $\pm$ 9.5	-7.2 $\pm$ 8.8*	-19.1 $\pm$ 7.6
Extinction of the adjustment reaction, number of exposures		10.5 $\pm$ 2.4	5.8 $\pm$ 1.8*	5.9 $\pm$ 1.9*
Adjustment to rhythmic photostimulation	number of the cases observed	4	8*	5
	lower bound, Hz	9.0 $\pm$ 0.8	9.0 $\pm$ 0.8*	9.0 $\pm$ 0.7
	upper bound, Hz	11.5 $\pm$ 0.5	19.8 $\pm$ 4.1*	16.0 $\pm$ 3.7*
	latent period, seconds	20 $\pm$ 4	12 $\pm$ 5*	15 $\pm$ 3*

* reliable deviations ($p < 0.05$) from the initial values

It is evident from the results of the functional tests performed that before the course of therapy EEG patterns from the patients of the first or "dysrhythmic" group revealed slight disturbances of reactivity.

They had a tendency to change the pattern of reaction to external stimuli (extinction of the adjustment reaction) only after 10-th or 12-th exposure. In case of rhythmic photostimulation it is only in four

patient of nine that the assimilation reaction (involvement) was observed and it was formed only within the frequency range close to their own α -rhythm. Latent period of the reaction formation was not less than 15 seconds.

Table 3

Changes in the parameters of spontaneous bioelectrical activity of the brain during the course of BIP-therapy in patients with irregular zonal distribution of α -rhythm in EEG patterns

($\bar{X} \pm m$, n=9)

EEG parameters		Initial state	At the end of the course of therapy	After a certain period of time
Index of α -rhythm traced from the occipital electrode (%)		68.3 $\pm$ 2.9	70.0 $\pm$ 5.0	63.3 $\pm$ 7.6
Index of α -rhythm traced from the frontal electrode (%)		41.6 $\pm$ 2.9	21.7 $\pm$ 2.9*	21.7 $\pm$ 2.9*
Frequency of α -rhythm, Hz		11.2 $\pm$ 0.5	11.5 $\pm$ 0.4	11.8 $\pm$ 0.4
Number of modulations of α -rhythm observed		0+1	0.7 $\pm$ 0.5*	0.3 $\pm$ 0.3
Proportion of the rhythm as expressed in percent	α -rhythm (%)	69.3 $\pm$ 2.1	72.0 $\pm$ 7.5	66.6 $\pm$ 3.6
	τ -rhythm (%)	9.3 $\pm$ 2.1	7.0 $\pm$ 1.7	7.7 $\pm$ 0.6
	Δ -rhythm (%)	15.0 $\pm$ 5.0	11.3 $\pm$ 3.2	13.5 $\pm$ 1.7
	β 1-rhythm (%)	3.0 $\pm$ 1.0	4.7 $\pm$ 1.5	5.6 $\pm$ 0.6*
	β 2-rhythm (%)	3.3 $\pm$ 0.5	5.0 $\pm$ 1.7	8.1 $\pm$ 2.1*
Excitation-inhibition ratio (in arbitrary units)			-8.6 $\pm$ 3.5*	-8.0 $\pm$ 2.6*
Extinction of the adjustment reaction, number of exposures			5.0 $\pm$ 1.0	6.7 $\pm$ 0.6*
Adjustment to rhythmic photostimulation	number of the cases observed	3	3	3
	lower bound, Hz	10.0 $\pm$ 0.5	9.0 $\pm$ 1.0*	9.0 $\pm$ 1.0*
	upper bound, Hz	11.7 $\pm$ 0.6	17.3 $\pm$ 6.1*	14.0 $\pm$ 2.0*
	latent period, seconds	23.3 $\pm$ 2.9	6.7 $\pm$ 2.9*	10.6 $\pm$ 1.5*

* reliable deviations ($p < 0.05$) from the initial values

Patients with dominating α -activity also had in initial state insufficient level of liability of the CNS: assimilation reaction was formed only within a narrow α -range after a long latent period.

Changes which took place in the pattern of the background EEG after the course of BIP-therapy in both groups had analogous character and demonstrated normalization of the pattern of electrical activity (Table 1). Nine patients (7 from the first group and 2 from the second) had EEG patterns approaching the state known as "ideal norm": leads from occipital electrodes traced 55-75% of the time α -rhythm of middle amplitude well-shaped into "spindles". There were observed distinct zones of distribution of α -rhythm - maximum of activity in the occipital regions decreasing towards the frontal departments. Frequency of α -rhythm in all encephalograms did not change more than 1 Hz as compared with the initial state. Three of the patients maintained the initial type of EEG.

Changes in the EEG spectrum allowed us to make judgements about the changes in the basic processes of the nervous system: excitation and inhibition. When monopolar leads are used, power of any of the rhythms of EEG is in direct proportion to the number of neurons located in the zone under the electrode and generating this rhythm - the more there are such neurons with synchronous bioelectrical activity, the higher is the intensity of the rhythm. Consequently, sum of the fast rhythms (beta 1 and beta2) and sum of the slow rhythms represented in the spectrum of EEG can provide quantitative characteristics of the processes taking place in the brain (excitation and inhibition respectively). In its turn, difference between the sums of fast and slow rhythms quantitatively characterize predominance either of the process of excitation or inhibition. This value is defined as an index of prevalence of the basic cortical processes where positive value implies the predominance of the processes of excitation and negative value - of inhibition. Hypothetically, basic processes (excitation and inhibition) being thoroughly balanced, value of the index of prevalence will equal zero. In other words, the farther from zero the value of this index is, the less balanced the "basic" processes of the nervous system are.

In context of the positions touched upon, a course of BIP-therapy caused normalization in the ratio of the processes of excitation to the processes of inhibition in the patients of both groups: the coefficient of predominance has lowered 2.5-3 times when compared with the initial state.

Reactivity of the CNS at the end of the course of therapy has increased significantly. At the exposure to discrete flashes of light, extinction of the adjustment reaction took place after 4-7 flashes. There were observed significant changes during the rhythmic photostimulation: in initial state, assimilation reaction was formed only in four of the patients with "dysrhythmic" type of EEG (Table 2); at the end of the therapy - in eight patients. The range of the frequencies assimilated during the photostimulation has widened from 9 to 24 Hz (in initial state it was 9-12 Hz). Latent period of the formation of the reaction has shortened almost two times.

Patients in the other group (see Table 3) have noticeably widened the range of assimilation of rhythmic photostimulation, too; latent period of the formation of reaction shortened.

Hemispheric asymmetry in occipital departments, estimated according to the index of alfa-rhythm, has not changed its sign in any of the cases. Nevertheless, at the end of the whole cycle of resonance therapy, mean value of the asymmetry coefficient had an actual tendency to decrease in this group (Table 4).

Analysis of asymmetry in the amplitudes over the frontal poles permits estimation of the emotional status of the patients. Neurophysiologically, investigations of the emotional status with the help of EEG are based on investigations of reciprocal relationships between the frontal cortex regions of both right and left hemispheres. By the concept describing the sign of emotion according to the relations between the hemispheres, left and right frontal cortices represent anatomical substrate to manifest the tendencies of approach and withdrawal respectively. These two tendencies being opposed to each other, we can determine the sign of emotion. Dominance of the "approach" tendency is connected with the activation of the left frontal cortex and the appearance of positive emotions. Sign of emotion depends on the ration in which activity of the left frontal cortex (LFC) and right frontal cortex (RFC) are.

Table 4

**Changes in parameters of hemispherical asymmetry of bioelectrical activity during the BIP-therapy
($\bar{X} \pm m$, n=12)**

EEG parameters	Initial state	At the end of the course of therapy	After a certain period of time
RFC/ LFC asymmetry	1.28±0.22	0.93±0.04*	0.97±0.15*
Hemispherical asymmetry over the occipital leads (%)	34±6	29±5*	30±5

* reliable deviations ($p < 0.05$) from the initial values

Predominance of the frontal departments was estimated by the mean amplitude of the EEF under the frontal electrodes both on the right and on the left. There was calculated a ratio between the amplitudes over the right and left frontal poles. The difference between the values being more than one, the sign of emotion was taken to be "negative"; less that one - "positive". As indicated in Table 4, activity of the left frontal cortex was significantly lower in the initial state, which corresponded to the negative emotional background of the patients. By the end of the course of therapy, practically all of the patients had activity of the right frontal departments dominating over the left ones, which was reflected by a small value of dispersion of the amplitudes ratio.

On the whole, ratio between the amplitudes of the right and left frontal cortices has significantly fallen down over the groups: from 1.28±0.22 to 0.93±0.04.

Three weeks after the course of BIP-therapy changes found in the EEG patterns of the patients with dominating α -rhythm (Tables 1 and 3) turned out to be more stable as compared with those of the patients with "dysrhythmic" type of EEG (see Tables 1 and 2). The latter revealed an obvious tendency to restore the parameters of bioelectrical activity to the initial abnormal pattern. As a result, many of the parameters registered during this period have lost their validity as compared with the initial status. However, deviations

from the values obtained immediately after the course of resonance therapy did not reach the level of reliability.

Conclusions

1. Resonance therapy results in certain changes either in spontaneous or provoked electrical activity of the brain in patients with psychiatric problems like neurotic disorders.
2. In asthenoneurotic cases, application of BIP-therapy leads to "normalization" of the EEG pattern and increase in CNS reactivity.

Neurotic patients who are above 30 years of age and have "dysrhythmic" type of EEG will most likely require another course of resonance therapy three-four weeks later.

Resonance BIP-therapy in the treatment of the patients with stress-related asthenoneurotic disorders and symptoms of chronic tiredness

Introduction

Excessive physical, intellectual and psychoemotional strains are the main pathogenic factors in the development of *psychogenic disorders*. This fundamental tenet lies at the basis of the contemporary military psychiatry. Nowadays, a characteristic of psychogenic disorders which comprises psychological, neurotic (borderline cases) and psychotic levels (A. V. Rustanovitch, V.K. Shamrey, 1995) is considered to be most optimal.

Psychologically-based forms of reactivity lie in the zone between the mental norm and mental disorders. Capacity for professional work is, in these cases, a guide to decide whether the patient has a mental disorder or not. Indicative of such states are various asthenoneurotic and psychosomatic manifestations (patients get quickly mentally or physically exhausted, have various sleep and somatovegetative disorders, lowered mood, anxiety, general hyperesthesia and so forth). Nevertheless, such a patient is usually aware of his responses to various situations, remains an ability to communicate with others and make relatively adequate judgements about his behavior; remains selectivity of such analysis, he is open to external influences, and can find ways out of difficult situations.

According to many authors (Y.A. Alexandrovsky, 1979; B.D. Karvasarsky, 1987 and others) such states, when patients do not receive sufficient psychotherapy, may have a tendency to worsen and turn into either chronic forms (post-traumatic stress disorders) or nosologically more severe states like psychopathological psychogenic disorders.

Unlike psychological disorders, *psychopathological psychogenic* ones are morbid conditions that put a person out of action, deprive him of successful communication with other people or prevent him from

purposeful activity. In some cases, there may be observed disturbances in thought as well as pathological manifestations accompanied by a wide range of psychotic disorders.

Consequently, one of the main concerns of the medicine of today, and military medicine in particular, is search for new medical and psychological means and techniques that people who developed asthenoneurotic disorders after experiencing traumatic events, or as a result of chronic tiredness or overfatigue can benefit from.

With this purpose in mind, we found it expedient to carry out this investigation in order to put to trial "Aires" applicators as a means of BIP-therapy in treating functional states of the patients with the signs of psychogenic disorders like acute asthenoneurotic reactions.

Procedure

We have tested 12 servicemen, both male and female, (8 men and 4 women) at the age of 22 to 41 (the average age of the group is 30 years) who had shown symptoms of acute asthenoneurotic reactions during the medical examination.

To correct these disorders we applied a set of graphite matrices "Aires" according to the standard A with the exposition time 10-14 hours a day; the period of treatment included three six days' cycles with a one-day interval between the cycles. Over the whole period of the treatment, the patients received no medicines and a minimum of psychological counseling (in the form of rational psychotherapy).

The following groups of techniques had been involved:

1. Patients' accounts of their states: questionnaires regarding their complaints, standardized interview schedule GAM (general state, activity, mood).
2. Assessment of psychoemotional status and personality traits:
 - Spilberg-Hanin technique;
 - Standardized Method of Personality Assessment (SMPA);
 - Lusher test.
3. Registration of spontaneous and provoked bioelectrical activity of the brain.
4. Blood tests for its biochemical composition.
5. Tests for blood viscosity.
6. Immune status assessment.
7. Examination of the state of humoral regulation.

The techniques of all the groups have been employed for three times each: in the initial state, at the end of the third six-day cycle of application, three weeks after the course had been finished.

In developing the "questionnaire on complaints", we paid special attention to the complaints of "asthenovegetative" and "neurotic" character. The questionnaires were filled out from the patients' reports by a doctor, which provided for more detailed analysis of the complaints while talking with the patients. For the assessment there was used a five-point scale where 0 means a norm, 1 point - unstable and highly

insignificant changes, 2 stands for constantly observed slight changes, 3 points for rather steadily manifested changes, and 4 points for strongly manifested changes. Along with the assessment in points we calculated in percentage terms and ranged the people according to the types of complaints they made.

General state, activity and mood of the patients were assessed with the help of the GAM technique (N.A. Doskin, 1973). The interview schedule comprises 30 pairs of antonyms with each of the categories mentioned (general state, activity, mood) characterized by 10 pairs of words. The assessment technique implies that the patient should correlate his state with the characteristics listed. The degree of manifestation of each of the symptoms was estimated according to the seven-point scale and thus the results were ranged. Interpreting the filled-in cards, we decoded the symptoms marked into a numerical series from one to seven.

Level of reactivity and personal anxiety was estimated according to the Spilberger-Hanin technique (Manual on military labor physiology, 1991).

Standardized method of personality assessment is an adapted variant of the Minnesota Multiple Personality Inquiry (MMPI). We used in this research the variant offered by L. N. Sobchik (1990). Complete inquiry consists of 566 questions-statements, concerning the general state of the patient, his attitude towards himself and other people, fields of his interests, certain characteristic features of his behavior, etc. Answers to the statements listed in the inquiry are prioritized according to 3 reference and 10 basic scales. We included into the present research only those of them which showed the presence of asthenoneurotic reactions (the so-called scales of neurotic triad), namely: 1 (Hs) — hypochondria, 2 (D) — depression, 3 (Hy) — hysteria. Other than these, we assessed also the seventh scale (Pt) — psychoasthenia, because most of the patients revealed elevated profile on this scale, which often accompanies neurotic states. Results of the research were presented in T-points. Conventional norm of the personality profile SMPA lies within the range from 30 to 70 T-points. Nevertheless, some of the authors (G.K. Ushakov, 1987, L.N. Sobchik, 1990 and others) consider the scores between 60-70 T-points as signs of accentuated personality. This opinion was also taken into account in the present work.

M. Lusher color test. This technique was devised abroad and scores of material have been accumulated on its basis (H. Clar, 1961; 1968). This easy-to-use investigation technique with a convenient way of results processing as well as reliable scientific background behind it received further support in our country (Y. I. Filimonenko and others, 1982 and their later works). Projective Lusher test is based on the scientific evidence that there is a correlation between the psychological state of a person and the shades of color he/she gives preference to. To meet the objectives of the present work we have chosen an eight-color variant of the test adapted by the home researchers (Y. I. Filimonenko et al., 1982) who developed qualitative assessment indices which were not present in the original technique: vegetative coefficient, deviations from the autogenic norm, capacity for work. In calculating and analyzing these indices we were guided by the formulae and norms suggested by the authors mentioned above.

For monitoring the dynamics of physico-chemical, biochemical and immune indices, and also of the hormone level in the bloodstream we took blood for tests from the ulnar vein three times over the course of therapy (simultaneously with the other tests).

There was estimated the number of erythrocytes and leukocytes, hemoglobin level, leukocytic formula with the relative number of segmented and rod-nuclear neutrophils calculated, eosinophiles, basophiles, lymphocytes and monocytes.

Radioimmunoassay with the agents produced at the Institute of Bioorganic Chemistry at the Academy of Science of Belorussia was employed to determine the amount of cortisol and insulin in the blood serum: to determine cortisol there were used cortisol marked with iodine-125 and precipitating reagent «STERON-K-125I-M»; to determine insulin - insulin marked with iodine-125 and the reagent «rio-INS-PG125I». The results of the radioactivity tests were processed with the help of «Tracor Analytic 1285» (USA-Holland). Fractions of the serum proteins were checked by agarose electrophoresis technique with the help of densitometer, model «CDS-200» by «Beckman» (USA). Concentration of the globulins (α_1 -antitrypsin, α_2 -macroglobulin, transferrin, hepatocuprein, serum immunoglobulins) were determined via the radial immunodiffusion (G. Mancini et al., 1965).

Such parameters as glucose, cholesterol, total bilirubin, total protein, creatinine, albumines, globulins, and alkaline phosphatase were estimated with the help of analyzer «Spectrum» by «Abbott» (USA).

The state of *humoral immunity* was estimated from the concentration in the blood serum of immunoglobulins A, M and G, and circulating immune complexes (U. A. Grinevitch, A.N. Alferov, 1981) determined through radial immunodiffusion (G. Mancini et al., 1965).

To determine *whole blood and plasma viscosity* we employed a special measuring technique suggested by A. N. Tulupov in 1991. This method consists in determining dynamic viscosity of the whole blood and plasma passing through the capillaries of a viscosimeter "VK-4" fixed at different angles to the horizon. Patients' whole blood viscosity was calculated with the shift rate (h) being 1c^{-1} , 9c^{-1} , 25c^{-1} , 100c^{-1} . Plasma viscosity was determined at the shift rate of 9c^{-1} .

Besides that there was estimated erythrocytes deformability according to the filtration method suggested by Z. D. Feodorova and co-authors (1989).

Technique investigating spontaneous and provoked bioelectrical activity of the brain will be presented in a special paragraph devoted to the results of the research.

Research results

Devising the "complaints questionnaires" we put special emphasis on asthenovegetative symptoms, paying attention to subjectively assessed level of tiredness and capacity for professional work. As we have mentioned above, to assess the degree of manifestation of the symptoms we used a five-point scale (from 0

to 4). Changes in the degree of manifestation of the subjective symptoms and frequency of the complaints made in the course of BIP-therapy are presented in the Table 1.

Table 1

Dynamics in manifestation (presented in points) and the number of complaints made by the patients examined in the course of resonance correction (n=12, $\bar{X} \pm m$)

Complaint	Period of observation		
	Before the treatment	By the end of the treatment	3 weeks after the treatment
Sleep disturbances	1.00±0.30(58.2)	0.75±0.21(58.2)	0.58±0.15*(58.2)
Headache	1.08±0.31(58.2)	1.08±0.26(75)	0.83±0.28(58.2)
Irritability	0.66±0.23(50)	0.41±0.15(41.6)	0.25±0.13+(25)
Cardiac pain	0.41±0.20(33)	0.41±0.15(33)	0.41±0.15(33)
General weakness	1.42±0.26(83.3)	0.92±0.23+(66.7)	0.67±0.19*(41.6)
Fatigability	1.25±0.31(75)	0.92±0.20(83.3)	0.67±0.14+(66.7)
Lowered capacity for work	1.75±0.22(100)	1.00±0.25*(66.7)	0.83±0.24**(66.7)
Tinnitus	0.42±0.26(25)	0.5±0.29(25)	0.33±0.19(25)
Sensation of heat	0.25±0.18(16.7)	0.17±0.11(16.7)	0.17±0.11(16.7)
Sweating	0.25±0.13(25)	0.25±0.13(25)	0.25±0.13(25)
Dry mouth	0.5±0.23(33)	0.17±0.11+(16.7)	0.17±0.11+(16.7)
Hypersalivation	0.42±0.20(33)	0.33±0.14(33)	0.25±0.13(25)
Nausea	0.25±0.13(25)	0.17±0.11(16.7)	0.08±0.08(8.3)
Average number of the complaints	6.75±0.27	6.00±0.32+	5.25±0.35**

Figures in brackets show a relative number of the patients (in %) who made this particular complaint. Reliability of the deviations from the initial states: + — $p < 0.1$; * — $p < 0.05$; ** — $p < 0.01$; *** — $p < 0.001$.

According to the data obtained, at the initial state lowered capacity for work was characteristic of all of the patients, three fourths of the patients had complaints of high fatigability, ten patients of twelve complained of general weakness; other complaints of asthenoneurotic and vegetative character were not infrequent at all, which allowed us on the basis of obligatory medical comments made by a psychiatrist and a physician and studies of the patients' histories to formulate diagnosis as "asthenoneurotic state". Some of the patients (about 50%) mentioned experiencing psychic traumas in the recent past; in others the disorder has developed due to excessive intellectual, physical and psychoemotional strains.

At the very beginning of resonance correction there were not observed any evident changes in the structure and character of the patients' complaints. First signs of improvement in the subjective state were noticed only towards the end of the course of correction (by the end of the third week). It consisted in a reliable decrease in the number of the patients who made complaints about their working capacity and also in weaker average manifestation of this symptom over the group. Besides, it was registered that average manifestation of the complaints of general weakness as well as of some vegetative dysfunctions dropped down. It should be mentioned, however, that no significant positive shifts in the subjective status were noticed during this period of observation, though all the general state scores had a tendency to decrease. This tendency was reflected in a near-to-reliable decrease (by 11-12%) in the average number of all the complaints presented.

Data obtained three weeks after the treatment had been finished (that is 1.5 months after its beginning) turned out to be much more optimistic. For example, the number of the patients who reported lowered capacity for work reduced by one third, and at the same time the degree of manifestation of this symptom was lower (on average, about two times lower as compared with the initial state). To our opinion, significant reduction in manifestation of the sleep disorders is a very important improvement, because it is difficulty sleeping that is thought to be the trigger for the development of chronic tiredness in most of the patients who took part in this research. Positive changes in subjective status such as lower fatigability and irritability, fewer manifestations of general weakness and vegetative disorders may be the result of a better-quality night rest. During this period of observation there was observed the lowest value of the average number of complaints (on the average, 22% lower as compared with the background results).

Healing effect of the correction performed was supported by the results of the analysis of the GAM questionnaires filled in by the patients at the same stages of observation. (see Table 2).

Table 2

Results of the GAM test (expressed in percentage terms) obtained over the course of examination by the patients observed ($X \pm m$)

Parameter	Period of observation		
	Before the treatment	By the end of the treatment	Three weeks after the treatment
Activity	3.33±0.18	3.66±0.14	4.08±0.15**
Interest	4.08±0.34	4.66±0.18+	4.75±0.18+
Attention	4.00±0.21	4.41±0.22	4.5±0.28
Mood	4.58±0.14	5.00±0.21+	4.91±0.022

State of the Health	4.67±0.14	5.08±0.22+	5.08±0.22+
Peace if mind	4.50±0.19	4.91±0.19+	5.08±0.19*
Confidence	4.33±0.14	4.33±0.22	4.58±0.29
Self-assessed General State	4.21±0.13	4.58±0.14*	4.71±0.10**

The results were assessed according to a seven-point scale (from 1 to 7). Significance of the deviations from the initial states: + — $p < 0.1$; * — $p < 0.05$; ** — $p < 0.01$.

Interesting that with the average number of the points scored for interest, mood, health and peace of mind having a tendency to grow, self-assessment of the general state had already risen (by 9% on the average) by the end of the course of treatment. At the end of the whole period of observation changes in the parameters under investigation were still more significant. Patient's activity rose and anxiety lowered reliably as compared with their initial states, which was reflected in a highly realistic growth of the average self-assessed general state (on the average, 12% from the initial state).

Analysis of the Spilberger-Hanin questionnaires had proved the findings presented above. As it was expected, most of the patients in the initial state scored high for the level of situational anxiety - up to 59 points in some cases (the average is 51.5 ± 0.11 points). However, the level of personal anxiety of most of the patients turned out to be within the average normal range (46.9 ± 0.11 points on the average). These results provided another proof that the patients had situationally determined psychophysiological disorders and therefore did not require any help from professional psychiatrists.

Dynamics of the parameters under research also exhibited some regular trends. For instance, the level of situational anxiety had a tendency to lower by the end of the BIP-correction course down to 48.8 ± 0.91 points on average ($p < 0.05$), with the indices of personal anxiety remaining unchanged.

In this way, analyzing the scores reflecting subjective states of the observed patients with asthenoneurotic disorders, we can draw several conclusions. Firstly, initial state of the patients was characterized by expressed asthenoneurotic symptoms and vegetative dysfunctions resulting, according to the patients' histories, from psychotraumatizing events, previous emotional stresses, overwork, and lack of sufficient rest.

Secondly, resonance correction in such patients by means of "Aires" matrix applicators led to accumulation of positive changes in their general state like diminution in the anxious tendencies, elevated mood, better sleep, which, on the whole, resulted in optimization of subjectively-assessed capacity for professional work and in the absence of the symptoms of tiredness.

Thirdly, positive tendencies in the dynamics of subjective state of such patients reach their maximum several weeks after the course of BIP-correction.

Unfortunately, time limits of the present work did not allow us to trace the results of the treatment in perspective; however, judging by the directivity of the positive changes, it is possible to make, by and large,

a favorable prognosis regarding stability of the positive effects of the BIP-correction on general subjective state of the patients.

To obtain more specific and supporting evidence we found it expedient to place our patients under more detailed psychophysiological observation that included, on the one hand, one of the most valid psychometrical techniques - GMPA, and on the other hand, projective technique - Lusher test, which made possible objective analysis of the dynamics of the patients' psychological state over the period of observation.

Initial results of the Lusher test showed significant deviations of the most of the patients' parameters observed from the average norm, which manifested itself in the low level of working capability (on the average, $4,11 \pm 0,19$ in arbitrary units), largely in sympathicotonic type of regulation of the vegetative functions (mean value of vegetative regulation was $0,075 \pm 0,65$).

These peculiarities determined the significant deviations from the autogenic norm (up to 60-62%) - integral index of the color test (Figure 1). As a result of the treatment, index of working capability in the patients of both groups had significantly grown, the degree of sympathicotonia had lowered, which was manifested in fewer deviation of the state from the autogenic norm.

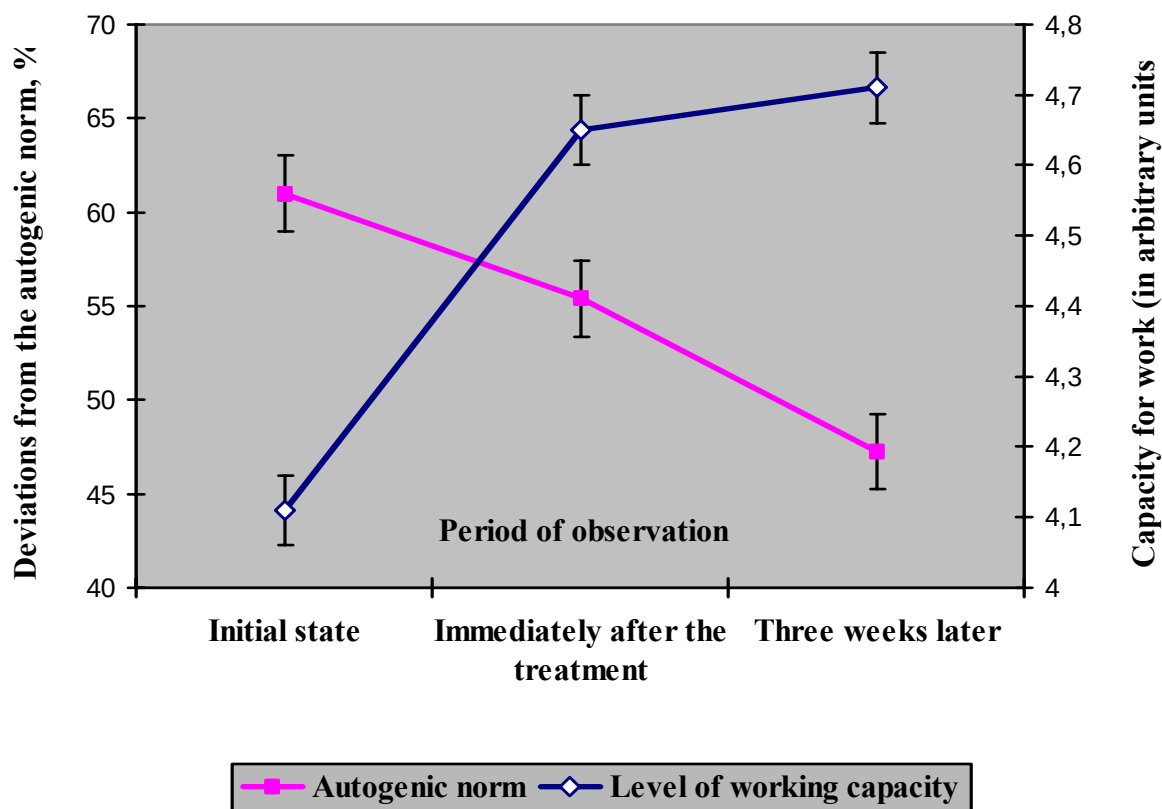


Diagram 1. Dynamics in the figures the patients scored over the period of observation when performing the Lusher test

Further observation showed that these tendencies also remained three weeks after the course of the treatment, which accounted for the significant deviations of the parameters observed from the background data.

According to the results of the standardized method of personality assessment (Figure 2), averaged psychological SMPA profile of the patients under examination demonstrated that it were mainly neurotic disorders that deviated from the norm: moderate rise of the scales of "neurotic" triad (between 60-70 T-points) accompanied by the rise of the 7-th scale - psychoasthenia. It is characteristic that there were not observed deviations of other averaged SMPA scales from the norm, which is typical of accentuated persons with neurotic disorders.

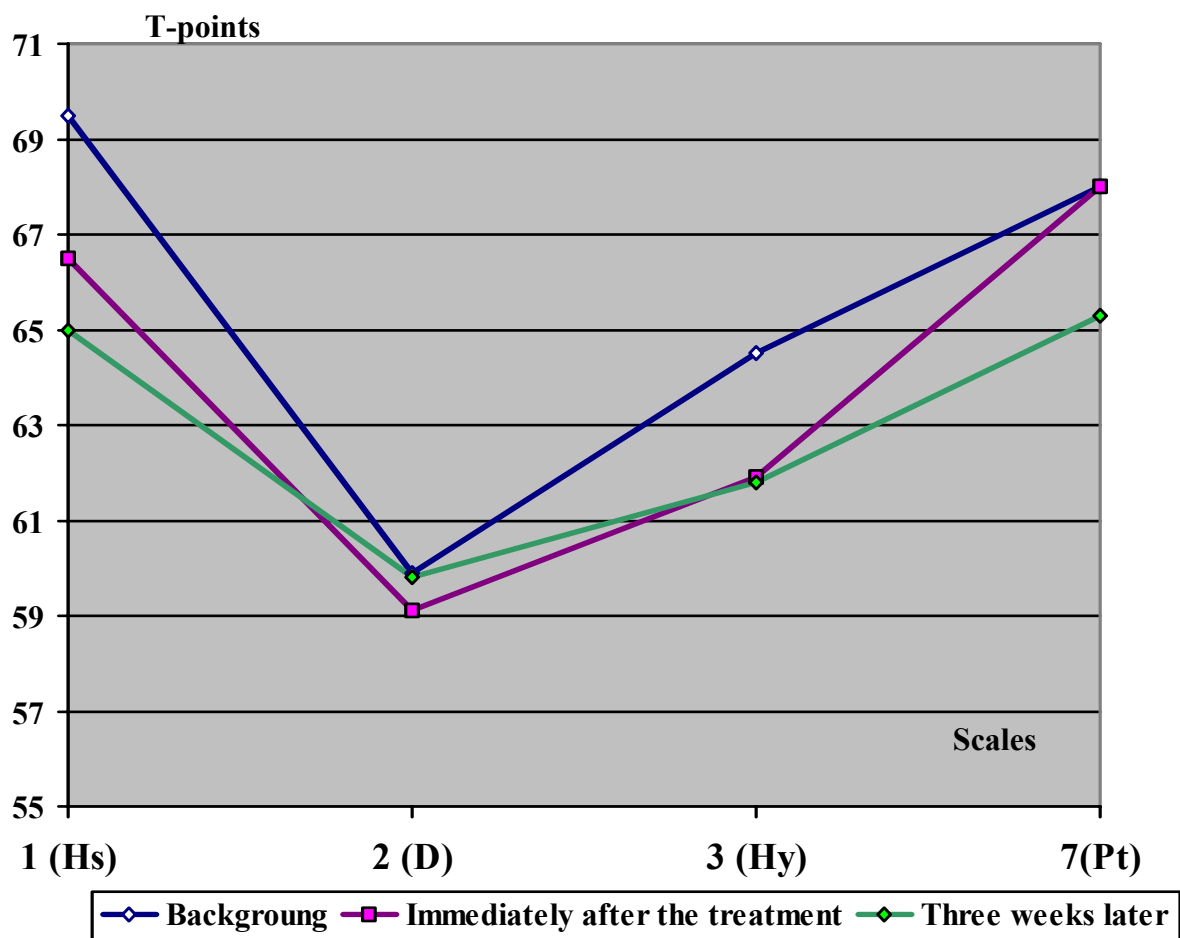


Diagram 2. An averaged SMPA profile the patients showed during the period of observation

As a result of the treatment conducted there were observed significant changes in SMPA scales in most of the cases, which was reflected in the dynamics of the averaged profile. For example, at the end of the course of treatment there was noticed a tendency of the whole of the profile to decrease at the cost of the 1-st (hypochondria), 3-rd (hysteria) and the 7-th (psychoasthenia) scales, which implies certain reduction of neurotic symptoms even in the absence of reliable deviations from the initial state. The last observation showed that this tendency remained true for the 1-st and the 7-th scales deviations of which from the initial states proved to be significant and close to reliable. Profile of the third scale did not change when compared with that of the previous investigation, remaining within the values corresponding to norm (61-63 T-points). Over the whole period of investigation there were not observed any significant shifts of the second scale which characterizes depressively accentuated personality; however, neither were observed any rises of the averaged second scale both in the initial state and in the course of the treatment, which testified that the patients observed had no expressed psychological disorders of depressive character. In this way, the results obtained show that resonance bio-correction with "Aires" applicators of the persons with asthenoneurotic conditions results not only in reduction of undesirable subjective symptoms, but also is accompanied by deeper changes - changes at the level of dynamic personal characteristics and vegetative regulation. It is worth mentioning that this drugless therapy caused in neither of the cases undesirable side effects; on the contrary, most of the patients wished to prolong the course of biocorrection or have another course.

Next objective of the present work was investigation of physiological mechanisms that had caused the changes observed. With this purpose in mind we resorted to a number of the techniques which, judging by our preliminary investigations, could help us certain about physiological, electrophysiological, and metabolic changes accompanying the course of resonance correction of the functional state of the persons with the mild forms of asthenoneurotic and vegetative disorders.

Dynamics of the parameters characterizing physical characteristics of the blood is shown in Table 3. According to the analysis of the parameters of the initial state, most of the patients, especially people with the signs of chronic tiredness and vegetative disorders, had unfavorable changes which consisted in impairment of rheologic properties of the blood.

Table 3

**Changes in physical properties of the blood revealed in the patients over the course of observation
($\bar{X} \pm m$; N=12)**

Parameter, units		Period of observation		
		Initial state	After the course of treatment	Three weeks later
Whole	shift V 1 c ⁻¹	56.6±1.0	54.6±1.0	53,0±0,9*

blood viscosity, MPa*c	shift V 9 c ⁻¹	15.7±0.8	14.8±0.8	13,4±0,5*
	shift V 25 c ⁻¹	12.1±0.6	11.3±0.5	10,6±0,5+
	shift V 100 c ⁻¹	9.3±0.5	8.5±0.4	8,2±0,3*
	shift V 256 c ⁻¹	7.0±0.1	6.1±0.4	5,7±0,3*
Erythrocytes deformability index, in arbitrary units		1,22±0,04	1.23±0.03	1.23±0.02
Plasma viscosity, MPa*c		13,2±0,4	13.0±0.4	12.6±0.3+

Note. Significance of the deviations from the initial states: — p<0.1; * — p<0.05; ** — p<0.01.

As it has been proved by a number of researches such as A.V. Muraviov et al. (1985, 1990), V.S. Novikov et al. (1998 and others), including the authors of the present work (A.O. Ivanov et al., 1996), states of chronic tiredness and adaptational disorders in most cases are accompanied by disturbances in rheologic characteristics of blood owing to failure of the mechanisms maintaining homeostasis, and accumulation in the organism of harmful substances. These reasons are most likely to account for high values of the parameters of whole blood and plasma viscosity, failures of erythrocytes deformability in the patients with such functional states.

Nevertheless, it was exactly in these patients that significant changes in rheologic characteristics were observed during the period of resonance correction which testified to the improvement in blood flowability. Changes in the average indices of blood and plasma viscosity were observed already by the end of the course of bioresonance correction. These positive changes kept progressing after the course of BIP-therapy had been finished, so that during the last observation there was registered a reliable fall in the whole blood viscosity at all the shift velocities and a close to statistically significant drop of the index of plasma viscosity in the average over the group of the patients observed.

Along with the changes in rheologic indices there were noticed a regularity which, to our opinion is worth attention: changes in the blood composition and in the indices of antigen-structural homeostasis that followed the treatment (see Table 4).

Table 4

Indices of blood composition and antigen-structural homeostasis of the patients observed during the course of resonance correction ($\bar{X} \pm m$, N=12)

Parameter, units	Period of observation		
	Initial state	At the end of the treatment	Three weeks after the course of treatment
Erythrocytes, 10 ¹² /l	4.90±0.14	4.76±0.13	4.57±0.11+
Hemoglobin, g/l	153.8±2.8	150.9±2.7	148.8±2.4+

Leukocytes, $10^9/l$	9.8 ± 0.6	9.00 ± 0.040	$8.3 \pm 0.3^*$
Granulocytes s/n, %	60.2 ± 0.9	59.0 ± 1.4	$56.4 \pm 1.0^*$
Granulocytes r/n, %	4.41 ± 0.3	2.8 ± 0.4	$2.1 \pm 0.2^{**}$
Lymphocytes, %	25.8 ± 1.3	30.1 ± 1.5	$34.0 \pm 1.2^{***}$
Monocytes, %	5.8 ± 0.4	5.0 ± 0.3	$5.1 \pm 0.3^+$
Eosinophiles, %	3.08 ± 0.3	2.5 ± 0.2	$2.3 \pm 0.2^*$
Basophiles, %	0.75 ± 0.27	0.5 ± 0.2	$0.08 \pm 0.08^*$
IgA, g/l	1.64 ± 0.04	1.58 ± 0.04	$1.53 \pm 0.04^+$
IgG, g/l	11.38 ± 0.33	10.87 ± 0.29	$10.49 \pm 0.29^*$
IgM, g/l	1.42 ± 0.03	1.38 ± 0.02	$1.35 \pm 0.03^+$
CIC, %	74.74 ± 3.17	$73.2 \pm 3.06^*$	71.4 ± 3.21

Note. Significance of the deviations from the initial state: + - $p < 0.1$; * - $p < 0.05$; ** - $p < 0.01$; *** - $p < 0.001$.

There was observed a steady tendency of the number of erythrocytes, leukocytes and hemoglobin of the peripheral blood to decrease, so that by the last stage of observation values of these indices were reliably lower than the initial ones. It is most likely that physiologically these changes are a result of the general adaptational tendency of the organism to "economize its functioning", or, in other words, is a sign of the organism going to a qualitatively new level of homeostasis. Researchers came across such phenomena studying the processes of human adaptation to physical work, to high and low temperatures (V.V. Goranchuk, 1996; V.S. Novikov, 1998 and others). Interdependence between the level of the organism's adaptation to the factor of external environment and blood composition was the cumulative effect of these investigations. For instance, highly qualified sportsmen have the number of erythrocytes 10-15% lower than people who do not do any sports at all (A.N. Vinogradov, 1986). It is possible that one of the main reasons for this directivity of hematological shifts in adaptational process is the organism's "desire" to unload the transportation mechanisms improving rheology of the blood which directly depends on the cellular composition of blood.

Also there were observed shifts in the leukocytic formula and parameters of the both cell-mediated and humoral immunity, which is an evidence of the influence of bioresonance therapy on the state of protective functions of the organism. General tendency registered in the present work appeared to be redistribution of the fractions of the circulating erythrocytes towards agranulocytosis at the cost of lowered relative and absolute amounts of neutrophils. At the same time, growth in the number of lymphocytes by the end of the period of observation was highly reliable (36% from the initial state). Among other things there was registered drop in the concentration of the circulating immunoglobulins. We consider such shifts as well as other researches (P.D. Gorizontov et al., 1983) to be the result of the lowered general hyperimmune

background (which was observed in some of the patients as manifestation of a stress-reaction), lowered tension of the cellular and humoral immunity, rise in its "reliability".

To our opinion, these registered for the first time multifaceted significant changes in the antigen-structural homeostasis are one of the most important effects of bioresonance correction on the organism and require additional investigation and analysis.

For more detailed analysis of the state of humoral regulation and exchange processes of the organism in the patients who had a course of BIP-therapy we had conducted blood tests for biochemical composition of the blood (Table 5).

Table 5

**Changes in biochemical parameters of the blood revealed in the patients over the period of observation
($\bar{X} \pm m$)**

Parameters, units	Period of observation		
	Initial state	After the course of treatment	Three weeks after the course of treatment
Cortisol, nmoles/l	449 $\pm$ 17	441 $\pm$ 16	429 $\pm$ 16+
Insulin, nmoles/l	12.4 $\pm$ 0.7	13.0 $\pm$ 0.66	13.3 $\pm$ 0.6+
Cortisol / Insulin	37.0 $\pm$ 1.9	34.7 $\pm$ 2.0	32.7 $\pm$ 1.55*
Creatinine, μ moles/l	121.9 $\pm$ 6.2	119.7 $\pm$ 5.2	124.0 $\pm$ 4.8
Bilirubin, μ moles/l	22.2 $\pm$ 1.9	20.7 $\pm$ 1.6	22.3 $\pm$ 1.6
Alkaline Phosphatase, nmoles/l	157 $\pm$ 7	151 $\pm$ 5	155 $\pm$ 5
ALT, ME	40.3 $\pm$ 2.5	38.4 $\pm$ 2.6	36.5 $\pm$ 2.4+
AST, ME	30.1 $\pm$ 2.1	28.7 $\pm$ 2.0	27.3 $\pm$ 1.9
Glucose, μ moles/l	4.27 $\pm$ 0.1	4.20 $\pm$ 0.05	4.12 $\pm$ 0.03+
Total protein, g/l	70.3 $\pm$ 2.1	67.8 $\pm$ 1.9	65.3 $\pm$ 1.4+
Albumines, %	53.1 $\pm$ 0.4	53.7 $\pm$ 0.4	54.5 $\pm$ 0.2+
Globulins, %	46.9 $\pm$ 0.4	46.3 $\pm$ 0.4	45.5 $\pm$ 0.23*
α 1- globulins	3.49 $\pm$ 0.24	3.23 $\pm$ 0.22	3.21 $\pm$ 0.21+
α 2 – globulin's	12.0 $\pm$ 0.5	11.7 $\pm$ 0.4	11.4 $\pm$ 0.4
β – globulin's	13.7 $\pm$ 0.7	13.9 $\pm$ 0.7	13.0 $\pm$ 0.5*
γ – globulin's	15.5 $\pm$ 1.1	13.6 $\pm$ 0.8	12.1 $\pm$ 1.0+
Cholesterol, μ moles/l	6.32 $\pm$ 0.37	6.11 $\pm$ 0.39	5.85 $\pm$ 0.33+

triglycerides, $\mu\text{moles/l}$	2.23 ± 0.12	2.13 ± 0.09	1.99 ± 0.09
------------------------------------	-----------------	-----------------	-----------------

Note. Significance of the deviations from the initial state: + — $p < 0.1$; * — $p < 0.05$.

Amount of cortisol measured for our research, which actually reflects the process of re-organization of humoral regulation of the functions in the organism, can to our mind serve as a tenseness marker for the compensatory regulatory mechanisms. Control of the dynamics of the insulin level in blood can be used as a model in investigating transport of the hormones-effectors in the context of the therapy performed.

According to our observations, one of the typical characteristics of the change in biochemical blood composition of the patients observed that appeared as a result of the treatment was a tendency of the level of cortisol to decrease. Parallel with this there was noticed an increase in the insulin content. Opposite dynamics in the content of these hormones had led to the reliable drop in their ratio by the end of the period of observation.

We think that decreased cortisolemia level as a consequence of the correction performed reflects a tendency towards normalization of the mechanisms of humoral immunity through lowering of the functional activity of hypothalamus-hypophysis-adrenal glands system. It is common knowledge that this system is "responsible" for nonspecific humoral stress-reaction of the organism. Consequently, high initial indices for the level of cortisol observed in many our patients can be one of manifestations of the stress-reaction. In this connection, it is possible, to our mind, to consider the decrease in cortisolemia as a reflection of the reduction in these parameters caused by the therapy performed. Indirect evidence of this is lowered ratio between the levels of cortisol and insulin, high values of which are characteristic of the stress-reaction of the organism (V.S. Novikov et al., 1998).

A tendency towards reduction in the concentration of glucose in blood was a characteristic feature indicative of the changes in metabolism taking place in the organism during the course of BIP-therapy, which, to our opinion, together with a reliable decrease in the insulin level attest an increased role of aerobic carbohydrate metabolism in supplying energy to the organs and tissues; this can be a reflection of higher plasticity of the mechanisms supporting the adequate level of metabolism.

A tendency towards the reduction in the content of total protein in circulating blood (mainly at the cost of α_1 - and β -globulins) is a sign of compensatory changes in protein metabolism. Moreover, the more effective the treatment was in some of the patients, the more significant this decrease proved to be, which in the mean came to $7.5 \pm 0.7\%$ from the initial. Consequently, a tendency towards reduction in the content of the total protein in blood and concentration of its globulin fractions can be considered as one of the criteria of the effectiveness of the treatment performed.

As for the indices of fat metabolism, significant changes were registered in the level of cholesterol which had a steady tendency to decrease.

Summing up the findings presented in this part of the research, we would like to point it out that according to our investigations resonance biocorrection is indicated in the treatment of the patients with

manifestations of stress-reaction which often accompanies such conditions as chronic tiredness, asthenoneurotic and asthenovegetative states.

Main results of the treatment of these patients were reduction in manifestations of the stress-syndrome and consisted in re-organization of the regulatory, plasticity, and protective mechanisms which consisted in a tendency to "economize" functioning of the organism and optimize transporting mechanisms.

In this way, the research conducted showed that bioresonance correction with the use of the "Aires" applicators proved to be effective in treating the patients with asthenoneurotic syndrome, symptoms of chronic tiredness and overfatigue. The most effective results of the treatment are observed three weeks after the treatment and consisted in better subjective state, optimization of psychophysiological functions, improvement in the mechanisms of regulation of the physiological functions.