Research of the influence of the PHOTONIC device on the parameters of human heart rate variability.

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Abstract

The purpose of the work is to study the effect of PHOTONIC on the adaptive reserves of the body and the possibility of using PHOTONIC to improve the objective well-being of a person.
materials and methods. The studies were carried out on volunteers. The group consisted of 18 people, without any deviations and health disorders. The registration of the pulse wave was carried out and the data of heart rate variability (HRV) were analyzed using the 'Biotest' hardware and software complex. HRV components were compared with and without the PHOTONIC device.
results. It was found that when using the PHOTONIC device, the sympathetic component of the heart rate variability spectrum decreased, while there was a tendency to increase the influence of the autonomic heart rate regulation circuit.
Conclusion. The use of the PHOTONIC device ensures the regulation of the control functions of the heart rate at different levels: autonomous, vegetative, hypothalamic-pituitary, central, and, consequently, increases the adaptive capabilities of the whole organism.
Abbreviations used:
SDNN is the standard deviation of NN intervals. SDANN is the standard deviation of average NN intervals calculated over short periods, typically 5 minutes. The SDNN reflects all the cyclical components responsible for the variability in the period of recording, so it represents the overall variability.
RMSSD is 'mean square value of sequential differences, the square root of the mean of the squared successive differences between neighboring NNs.
NN50 is the number of pairs of consecutive NNs that differ by more than 50 ms.
pNN50 is the proportion of NN50 divided by the total number of NNs.

Introduction. A new promising scientific direction is studying and application of modern environmentally friendly and economical technologies in biology and medicine using electromagnetic fields of non-thermal intensity. Studies of the last decades have shown that the impact of electromagnetic field on biological objects is of scientific and practical interest in the field of weak, low-intensity or information impacts, which are accompanied by pronounced biological responses.

The study of the mechanisms of action of electromagnetic radiation on humans and protection of biological objects from negative impact of man-made electromagnetic (EM) radiation in a wide frequency range is one of the fundamental

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problems of modern science. In recent years, this problem has been discussed by scientists of various specialties. The largest international symposiums and conferences are dedicated to this topic.

Existing methods of protecting BO from technogenic EM radiation are reduced to decrease in the intensity of the EMF, decrease in the exposure time, or increase in the distance from the BO to the radiation source. The **PHOTONIC** device, in contrast to the above mentioned protection methods, has a different principle of operation, namely, it changes the structure of the man-made EM field arising from the radiation source, converts it into a shape that is safe for BO. The spatial structure of the electromagnetic field created by the device is fractal and has chiral properties.

In this study, the HRT analysis method was used to objectively estimate the degree of impact of the PHOTONIC device on the human body.

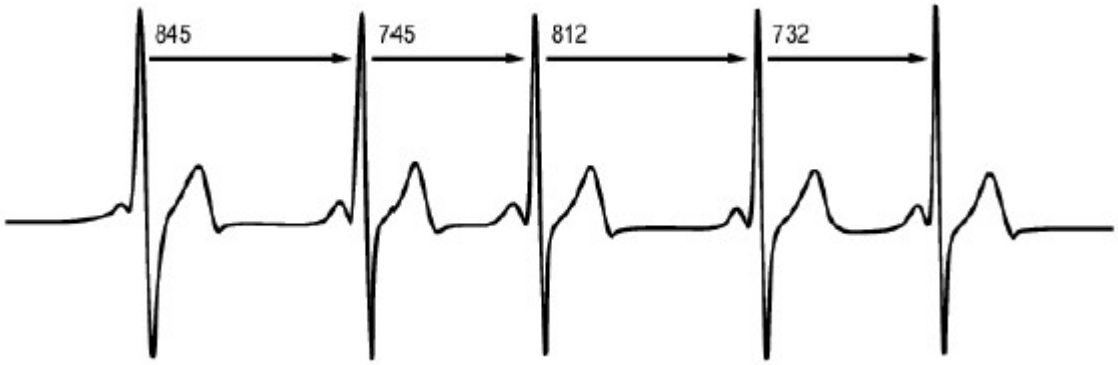

Fig. 1. Heart rate variability - the time difference between two consecutive heartbeats

HRV analysis is a method for estimating the state of the mechanisms of physiological functions regulation in humans and animals, in particular, the overall activity of regulatory mechanisms, neurohumoral regulation of the heart, the relationship between the sympathetic and parasympathetic divisions of the autonomic nervous system. The current activity of the sympathetic and parasympathetic divisions is the result of the reaction of a multi-circuit and multi-level system of blood circulation regulation, which changes its parameters over time to achieve an optimal adaptive response, which reflects the adaptive response of the whole organism. Adaptive reactions are individual and are realized in different bodies with varying degrees of participation of functional systems, which, in turn, have a feedback that changes over time and has a variable functional organization.

Materials and methods. The studies were carried out on volunteers. The group consisted of 18 conditionally healthy people aged 41-65 years. All individuals gave voluntary consent to participate in the study.

After the preliminary selection, the examinees (18 people) were divided into two groups: the control group - 9 people and the experimental group (PHOTONIC application) – 9 people. The subjects of the experimental group used the PHOTONIC

device. The use of the device was reduced to wearing the device on the body, and, if possible, placing the device between the palms or under the feet according to the instructions of usage. The examinees of the control group were subjected to a false effect of this factor (placebo), using a dummy device.

Measurement of HRV parameters was carried out by the Biotest hardware and software complex. In Biotest, there was used a photoplethysmographic method to measure heart rate parameters. Rhythmograms extracted from the photoplethysmogram during the processing are sequences of time intervals between adjacent cardiac excitations. The intersystole interval and heart rate variability components were recorded after applying the **PHOTONIC** device as well as without its application.

The impact was carried out for 10 days, at the same morning hours (from 9.00 to 11.00). The study was started immediately after the exposure at the same time of the day, which made it possible to exclude the influence of daily fluctuations in heart rate variability (HRV) on the study results. Measurement was carried out in a sitting position with quiet breathing for five minutes.

The study of indicators of the functional state of the examinees was carried out daily during 10 days and 7 days after the end of the course of exposure (17th day of the experiment) to register the aftereffect.

Results and discussion. As the results of the study showed, in the control group of examinees, there were no significant changes in the studied parameters in comparison with the initial values during 17 days of observation. At the same time, in the examinees of the experimental group, during a ten day course of application of the PHOTONIC device, statistical methods for analyzing heart rate variability (HRV) revealed a significant ($p<0.05$) increase in RMSSD ($p<0.001$),SDNN($p<0.05$) pNN50 ($p<0.001$), starting from the 4th day of observation (p-value is the level of significance of differences relative to the control group according to Student's t-test).

On the fourth day, in the examinees of the experimental group, the values of the RMSSD and pNN50 indicators increased significantly (by 26% and 172% $p<0.05$, respectively) relative to the values of these indicators in the control group.

From the 4th to the 10th day of exposure RMSSD and SDNN values did not change significantly, that is, they reached a 'plateau'. It is known that SDNN is a total indicator of the variability of the values of RR intervals for the entire period under consideration, characterizing HRV as a whole, and the growth of SDNN indicates increased autonomic regulation.

Increasing indicator of values: SDNN, pNN50, and RMSSD indicate that under the influence of the fractal electromagnetic field created by the PHOTONIC device, the autonomous regulatory circuit was strengthened and the parasympathetic regulation segment was activated, and, consequently, the regulation of physiological functions was optimized (table).

The data obtained are confirmed by the data of the HRV analysis, which indicate that after a fourfold exposure to the fractal electromagnetic field, there was a significant change in the studied parameters.

Fig. 2 shows the ratio of the contribution of high-frequency (HF) and low-frequency (LF) components to the total power of the rhythmograms spectrum. The change in the stress index under the influence of a fractal electromagnetic field in examinees at different times of the experiment is shown in Fig. 3.

Table. Dynamics of RMSSD characteristics of the examinees of the study groups

	Observation time (days)					
	one	3	5	7	ten	17
Control group	55.08±5.45	57.77±4.00	58.53±4.93	60.02±3.41	57.86±3.53	54.6±1.98
Fractal electromagnetic impact of PHOTONIC	55.66±3.09	60.10±2.65	79.68±3.76 p<0.01	79.22±4.34 p<0.02	78.03±3.83 p<0.01	80.56±4.91 p<0.001

It is important to emphasize that the autonomic nervous system performs two main functions in the body: maintaining and preserving homeostasis (maintaining blood pressure, heart rate, body temperature, biochemical parameters, etc. within the physiological norm), and is also responsible for the mobilization of functional systems of the organism to adapt to changes in environmental conditions, i.e. adaptation function.

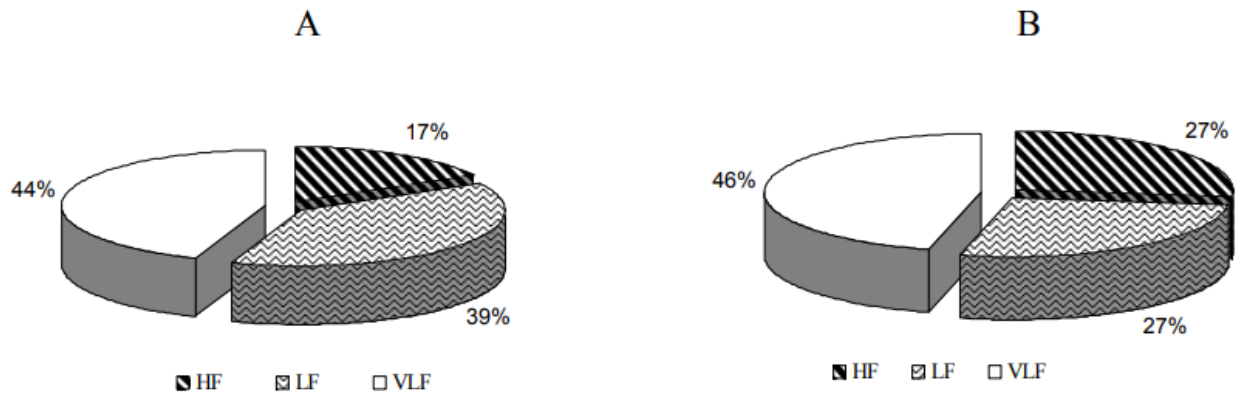

Fig. 2. The ratio of the contribution of high-frequency HF and low-frequency LF components to the total power of the spectrum (in %) on the tenth day of the experiment in the control (A) and experimental (B) groups of examinees

Therefore, given that all processes in the human body are related to the autonomic nervous system, the functions of which are regulated by the hypothalamus (the central integrator of all autonomic processes in the body) it is quite possible that the mechanism of action of the fractal electromagnetic field on the body is based on optimizing the tone of autonomic nervous system.

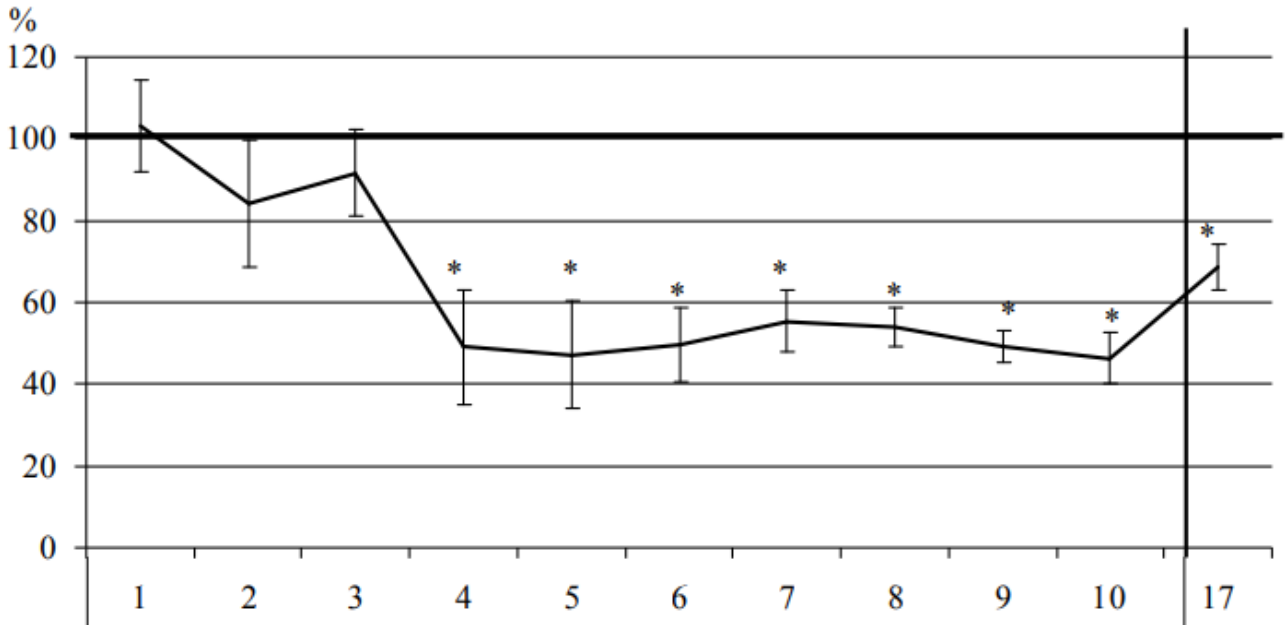

Fig. 3. Change in the stress index under the influence of a fractal electromagnetic field in examinees at different periods of the experiment (in % relative to the values in the control group taken as 100%).

The data obtained are consistent with the data of other authors, indicating the participation of the autonomic nervous system in reactions to the peripheral effect of electromagnetic radiation [4-14].

Thus, it was found that the use of the **PHOTONIC** device ensures the regulation of the control functions of the heart rate at different levels: autonomous, vegetative, hypothalamic-pituitary, central, and, consequently, contributes to an increase in the adaptive capabilities of the whole organism.

Conclusion. There has been implemented a direct method for recording the process of changing the parameters of the human cardiovascular system under the influence of a fractal electromagnetic field created by the **PHOTONIC** device.

The application of the course exposure to a fractal electromagnetic field led to a change in the indicators of heart rate variability in the examinees. There was found correlation in application of **PHOTONIC** devices with the parameters of the cardiovascular system in the examinees.

The received data about the improvements in HRV values in volunteers of the experimental group may be associated not only with an increase in parasympathetic

activity and optimization of baroregulation, but also with the normalization of all autonomic effects on the heart.

It can be concluded that the use of the **PHOTONIC** device leads to a significant increase in the adaptive capacity of the organism of the examinees. The data obtained are consistent with the literature data.

Literature

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