Example of the Effects on Humans (mm Waves)

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Reactions of the Central Nervous System to Peripheral Effects of Low-Intensity EHF Emission

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(Translation from Russian)

Abstract

The study of reactions of the human central nervous system (CNS) to peripheral effects of EHF emission, created by therapeutic apparatus Yav-I (7.1 mm wavelength) revealed restructuring of the space-time organization of biopotentials of the brain cortex of a healthy individual which indicate development of a non-specific activation reaction in the cortex. The study of sensory indication of EHF field with these parameters showed that it is can be reliably detected at the sensory level by 80% of the subjects.

Introduction

In the process of study of reactions of living systems with a different level of organization to millimeter waves, non-thermal (informational) effects were discovered.[1-3] The distance from the place affected by the emission to the location of appearance of the biological reaction may be hundreds and thousands times larger than the distance at which the emission decreases one order of magnitude. This fact demonstrates participation of the nervous system in perception of millimeter-range emission by living organisms.

There is a wide-spread opinion that biological effects of EMF are realized in humans at a subsensory level. However, in the recent years there is interest to their sensory detection in the form of radiosound, magnetophosphenes, or skin sensations.[4-9]

Changes in EEG to EMF effects were most often observed in the form of an increase in the slow waves and spindle-shape oscillations in reptiles, pigeons, rats, rabbits, monkeys, and humans.[10-12]

We have not found studies devoted specifically to the effects of millimeter waves on the central nervous system in the available literature; thus, the current study has been undertaken. This study employed electrophysiological and psychophysiological methods for the evaluation of the state of the central nervous system while affected by EMF.

Methodology

Twenty healthy subjects aged 17 to 40 years participated in the experiments. Apparatus Yav-I with the wave length of 7.1 mm was used as the EMF source. A flexible waveguide with the power of 5 mW/cm^2 at its end was directed at He-Gu [4 Gi] acupuncture point in the right or left hand of the subject.

Two experimental series have been conducted. In the first one (10 subjects, 10 tests with each subject, 20 instances of field action in each test), sensory detection of the field was studied. The length of the EMF signal or control trial without the signal was 1 minute. To evaluate the subject's EMF sensitivity, the indicator of response strength (RS) was used, i.e., the ratio between the number of correctly identified

trials and the total number of EMF signals. Another indicator used was the level of false alarms (FA), i.e., the ratio between the number of false positives to the total number of control trials. The significance of the difference between RS and FA was evaluated by using the Mann-Whitney test. The analysis of latent time T_{lat} included total histograms of true responses and false alarms.

In the second series (10 subjects, 11 tests with each, including placebo tests) the exposure to the field was 60 minutes.

EEG recording was conducted before and after the EMF influence by using EEG-16S (Hungary), with 4 paired leads, located according to 10-20% system (in the frontal F-F, central C-C, parietal P-P and occipital O-O areas). As the reference electrode, a joint ear electrode was used.

Together with EEG recording on paper, the data were fed for on−line processing into an IBM-PC Amstrad computer using spectrum coherent analysis by means of rapid Fourier transformations with plotting power spectra and computing mean coherence levels. Selected for the study were frequencies from 2 to 30 Hz in major physiological ranges of the EEG spectrum.

Results and Discussion

In the first experimental series, the subjects showed a division into two unequal subgroups according to their RS and FA indicators. The first subgroup (8 individuals) could detect at a statistically significant level: the differences between RS and FA were significant according to Mann-Whitney test, the means for RS and FA being 64.3±10.5% and 20.6±11.2%, respectively. The second subgroup (2 individuals) could not reliably distinguish between EMF effects and control trials, the means for RS and FA being 59.0±14.25% and 43.53±16.5%, respectively.

From the eight individuals who could detect the EMF well, two could reliably distinguish it from control trials with both hands, one could do this only with the left hand and the others only with the right hand. An analysis of distribution of Tlat of true responses and false alarms showed single mode distribution in both instances. The mean of latent time for eight subjects was 46.1±5.8 sec.

The prevalent sensations were pressure (46.7%), tingling (36.3%), itching (8.9%), warmth-coolness (5.3%), and other sensations (2.8%). All the sensations were experienced either in the palm of the hand or in the fingers, each subject having his own set of sensations.

An analysis of the data obtained experimentally justifies the assumption that humans are capable to perceive sensorially the EMF in the millimeter range, similarly to their capacity of perceiving the ELF fields,[4-6] which is in accordance with the results obtained elsewhere.[9]

Interaction of any physical factor with biological systems of complex organization begins on their surface, and the skin is the first receptor. Unlike other analyzers, the skin does not have absolutely specific receptors. This was confirmed in experiments conducted by A. N. Leontiev and his associates,[13] who conducted similar studies with non-thermal emission in the visible range of spectrum and found that their subjects were capable of reliably distinguishing the emission effects from control trials. The modes of perception were similar to those observed in our tests. Thus, our results as well as data of other authors indicate the importance of the skin analyzer in EMF perception.

Study of the modes of perception which occur in the process of EHF field reception makes it possible to assume that EMF stimuli are perceived either by mechanical receptors (sensations of touch or pres-

sure), or by pain receptors, i.e., nociceptors (tingling and burning sensations). From mechanical receptors, only Ruffini's and Merkel's endings and tactile disks may be involved in the process, according to the depth of their location in the epidermis, their adaptation speed and their capacity to spontaneous activity. The assumption that nociceptors may be responsible for the reception of EMF signal is based on the following: their polyspecificity in relation to stimuli; the kind of sensations (e.g., tingling and burning), which are considered precursors of pain; experiments which showed complete disappearance of EMF sensitivity in individuals whose skin at the place of influence was treated by ethyl chloride that turns off pain receptors; facts from medical practice that the EHF influence on the respective dermatome causes sensory response in the afflicted organ of the body which may be the result of convergence of nociceptive afferents from the dermatomes and the internal organs on the same neurons of pain pathways. With this, skin hypersensitivity occurs because visceral impulses increase the excitability of inter-stitual neurons and facilitation takes place.

The latent time of EMF responses (to both ELF range and millimeter range EMF) is unusually large. While the reaction time of visual and auditory sensory systems is from dozens to hundreds of milliseconds, the perception of EMF takes dozens of seconds. This is in a good agreement with theoretical calculations by I. V. Rodshtat[14] who made an assumption that a single time cycle of microwave sensory reception, including detection of sensory sensation, is within 40 to 60 seconds. This is explained by a complex structure of the reflex arc which includes both nervous and humoral links.[14]

An analysis of inter-central EEG ratios is one of the approaches to the study of regulation mechanisms of functional states of the human brain.

As known from the literature,[15] the indicator of coherence level (COHm) is the most significant of EEG correlates which characterizes the peculiarities of the human brain functioning.

Major changes of the cortical EEG with regard to both inter-central and intra-hemispheric connections in placebo tests can be characterized either by a decrease in COHm, especially in the range of delta and theta, or by maintaining the background level. A power spectrum analysis shows a decrease in the brain waves magnitude, especially in the alpha range (Fig. 1).

Thus, as a result of placebo (control) tests, a kind of "expectancy reaction" with specific space-time organization of the cortex biopotentials takes place.

A different EEG pattern is observed after the individual is exposed to EMF. There is a significant power increase in the alpha range, especially in occipital and parietal areas in both hemispheres; in other parts of the spectrum the power remains close to the background level (arrows 2 and 3 in Fig. 1). Unlike in placebo tests, an increase in the mean of the coherence level COHm takes place practically in all the subjects resulting from exposure to EHF. It mainly occurs in the frontal and central areas of the cortex and is mostly expressed in slow wave spectrum range (delta and theta). A similar pattern of brain waves is characteristic of the state of an increased brain tone (i.e., it occurs in non-specific activation reaction).[16] This kind of response is characteristic because it is known that frontal areas of the cortex are sensitive to various external factors. These zones have broad bilateral connections with other cortical and subcortical structures which determine the involvement of frontal areas in many functional response systems.

Conclusions

(1) Peripheral effects of EHF (7.1 mm wave length, 5 mW/cm^2) with a 60 minute exposure causes restructuring of the cortical brain waves in a healthy individual; this points to the developments of a non-specific activation reaction (i.e., to an increase in the tone of the cortex).

(2) The study of sensory detection of EMF in EHF range showed that the field with the above parameters is detected at a statistically significant level by 80% of the subjects.

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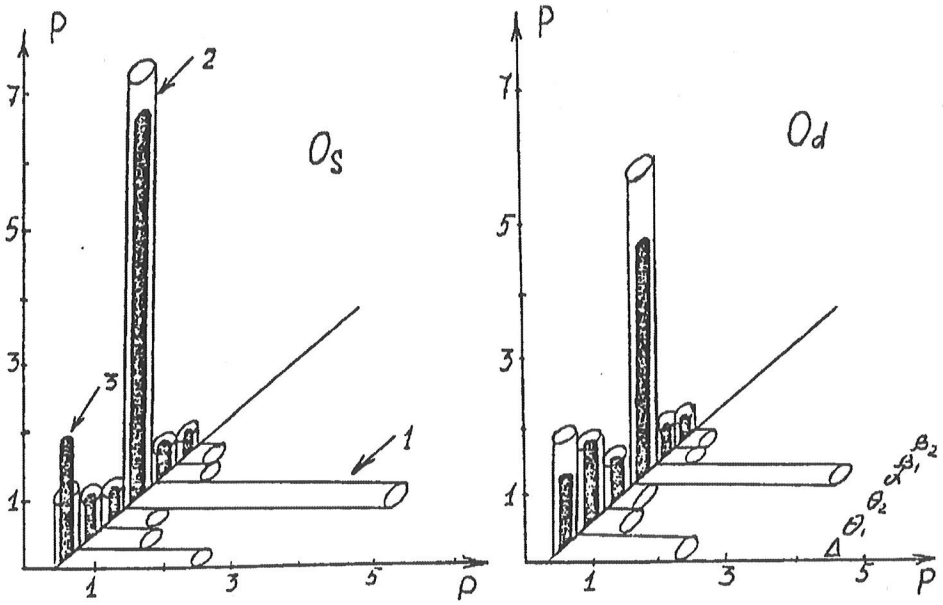

Fig. 1.