EXPERIMENTAL AND CLINICAL STUDY OF EHF TREATMENT OF VASCULAR—VESTIBULAR DYSFUNCTION

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The authors present the results of a study of the effectiveness of EHF radiation on the cerebral hemodynamics, bioelectrical activity of the cerebral cortex, and functional state of the vestibular analyzer in chronic studies of cats using a model of vascular—vestibular dysfunction. The clinical part of the work reflects the results of studies of the functional state of cerebral blood circulation and the vestibular analyzer during the EHF treatment of angiovertebrogenic vestibular dysfunction in a background of initial manifestations of cerebral blood supply deficiency (angiodistonic variant).

Disturbance of intracranial hemodynamics is frequency caused by vascular disorders of the vertebrobasilar system with osteochondrosis of the third cervical vertebra. Physical therapy for angiovertebrogenic vestibular dysfunction provides for treatment measures aimed at restoration of the blood supply and functional state of the vestibular analyzer.

The data in the literature indicating the positive effect of EHF therapy in vascular diseases of the brain are scarce [1-3]. At the same time, millimeter-band radiation has not been employed to treat vestibular disorders of vascular origin in a background of cervical osteochondrosis.

Experimental and clinical assessment of the effectiveness of EHF radiation in the treatment of these disorders is of interest in this regard, which determined two interrelated directions of our research, which included the following tasks.

1. Study of the effect of EHF EMR of various frequencies on the blood supply and bioelectrical activity of the brain and the functional state of the vestibular analyzer in animals (cats) under normal conditions and with simulation of vascular—vestibular disorders by occlusion of the vertebral artery.

2. Study of the effectiveness of EHF radiation in the treatment of angiovertebrogenic vascular—vestibular dysfunction in a background of initial manifestations of cerebral blood supply insufficiency (IMCBSI).

The experimental part of the work was performed on 15 adult cats with a weight of 3-4 kg, in which vascular—vestibular dysfunction was simulated. The animals were prepared in two stages. In the first operation (under Nembutal) electrodes were implanted under aseptic conditions to record the bioelectrical activity of the cerebral cortex (electrocor-ticograms (ECoG), rheoencephalograms (REG), and electronystagmograms (ENG)), and a thermal probe was introduced for caloric stimulation of the labyrinthine receptors [4].

After the first operation, a series of experiments was performed on the animals to study their responses to EHF radiation under normal conditions.

After 2-3 weeks, the cats underwent a second operation to simulate vascular—vestibular dysfunction (Fig. 1). We employed a procedure that we developed for ligation of the vertebral artery between the first and second cervical vertebrae and additional (when indicated) unilateral ligation of the carotid artery [4].

Symptoms of disturbance of cerebral hemodynamics and of the functional state of the vestibular analyzer were observed in the postoperative period: reduction of the amplitude of the basilar pulse wave (from REG data), spontaneous nystagmus, and changes in the threshold and amplitude—frequency characteristics of caloric nystagmus (from ENG data) (Fig. 1).
Fig. 1. Effect of ligation of vertebral artery (VA) on cat electrooculogram (EOG), rheoencephalogram (REG), and electrocorticogram (ECoG): a) diagram of operation indicating point of VA occlusion; b) EOG, REG, and ECoG before operation; c) EOG, REG, and ECoG after operation. Calibration: 100 µV, 1 sec.

The studied parameters were recorded on an "Orion" eight-channel electroencephalograph; the REGs were studied with the aid of an RP-1M rheographic attachment. The working current was fed to electrodes implanted in the visual cortex with a spacing of 5 mm.

The EHF radiation was provided by a GCh-141 generator. The millimeter-band EMR was fed to the object through a flexible dielectric waveguide with a radiator tip, which was placed above the reflexogenic zone between the seventh cervical and first thoracic vertebrae. The output power of the radiator was 10 mW/cm², and the duration of irradiation was 30 min.

The effects of the following millimeter-band frequencies were evaluated in the series of chronic experiments: 55.53 GHz, 42.25 GHz, 50.53 GHz, and 40.53 GHz. According to the data from acute experiments that we performed, these frequencies had more-pronounced effects on the induced bioelectrical activity of the cerebral cortex.

In the clinical studies, 65 patients with ages of from 23 to 45 years were under observation. The diagnosis of angiovertebrogenic vestibular dysfunction in a background of IMCBSI (angiodistonic variant) was performed with allowance for the existing classification of vascular diseases of the brain of the Institute of Neurology of the Academy of Medical Sciences, subjective and objective criteria for comprehensive otoneurological examination, and data from REGs, neuroophthalmic studies, and radiography of the skull and cervical and thoracic vertebrae [5].

The reflexogenic zone in the area of the biological active point between the spinous processes of the seventh cervical and first thoracic vertebrae, which is the integrator of the activity of all systems of the channels [6], was used for EHF EMR therapy. This biologically active point is used to treat disorders of cerebral blood circulation, dizziness, and contracture of the cervicooccipital muscles [7]. The EHF therapy was performed by means of Yav'-1-7.1 and BAYuR-01 units. The millimeter-band EMR was delivered to the object by means of a horn antenna at a fixed frequency of 42.25 GHz (in accordance with the experimental data). The exposure time was 30 min. The subjective sensations (dizziness, headaches, vestibular illusions of counter-circulation, etc.) as well as the objective indications of cerebral hemodynamics (from REG data) and the functional state of the vestibular analyzer (from ENG data) were studied before and after treatment (five daily procedures).

The rheoencephalograms were recorded on an RG-4-01 four-channel rheograph and a Medikor (Hungary) eight-channel electroencephalograph. The electrode locations were standard (mastofrontal and mastooccipital). Function tests (nitroglycerin, constriction of the carotid artery, and turning of the head) were used to assess the functional state of the cerebral vessels. The qualitative and quantitative indices of the REGs were evaluated by the generally accepted procedure.