THE DYNAMIC OF THERMAL FIELDS OF THE BRAIN OF RATS IN THE LATE POST-RESUSCITATION PERIOD UNDER STRESS

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The temperature topography of the cerebral cortex of rats following clinical death and resuscitation was investigated with the technique of thermoencephaloscopy. Complete restoration of the neurological status of the animals was achieved over the course of one to two days. Marked disturbances in the background thermal maps and the thermal reactions of the cerebral hemispheres induced by a stressor were identified in the remote post-resuscitation period (up to two months). A pathological mosaicism of the thermal characteristics was detected under the conditions of relative rest, as were disturbances in the dynamics of the temperature reactions of the brain and in the character of the interhemispheric asymmetries under stress. The individual character of the post-resuscitation pathology which is found both in the baseline thermal maps as well as following a functional load is emphasized. The results of the investigation point to the importance of an individual approach in the rehabilitation therapy of the post-resuscitation illness.

The problem of the nature of postischemic encephalopathies remains one of the most pressing concerns in investigations of pathological changes of the brain arising following clinical death and resuscitation. The process of realization of the post-resuscitation pathology of the brain is a prolonged one (weeks and months) [7].

Clinical practice has demonstrated that in patients who have recovered their neurological status completely following clinical death and resuscitation, the appearance of a wide range of psychoneurological disturbances, often associated with a mental or physical load, is possible in the remote post-resuscitation period [1]. It has been established in experiments on rats that even brief ischemia of the brain, accompanied by rapid and complete recovery of neurological status, leads to functional deficiency of the central nervous system; this is revealed in particular during subsequent neuroticizing influences [10]. Such decompensation is probably caused by the presence of residual posthypoxic alterations. The study of the topography of residual disturbances in various brain structures is, in these terms, essential.

It is known that the temperature dynamics is a reflection of the metabolism and microcirculation in various cortical regions [13]. The temperature topography of the cerebral cortex of rats in the late post-resuscitation period, both in rest and under stress, i.e., an additional functional load which may promote the revelation of occult brain pathology, was investigated in the present study using the technique of thermoencephaloscopy.

METHODS

The study was carried out in 15 mongrel white rats, weighing 150–180 g at the beginning of the experiment. Arrest of the blood circulation was carried out for 10 min under ether anesthesia by intrathoracic clamping of the vascular bundle of the heart; reanimation was accomplished by indirect cardiac massage and artificial ventilation of the lungs [3]. The recovery of the neurological status was assessed on the basis of indices of the general state of the animals using a 100-point scale [6]. The control experiments were carried out on 11 intact rats.

The thermoencephaloscopic investigations were carried out using an AGA-780 thermal imager, using the method developed in the Institute of Radio Engineering and Electronics of the Russian Academy of Sciences [2]. The
Fig. 1. Change in the average temperature of the surface of the right (broken) and left (solid line) hemispheres of the brain in an intact rat before (I) and after (II–V) stressor effects (indicated by arrows). Time calibration, 30 sec.

Fig. 2. Change in the average temperature of the surface of the brain of resuscitated rats Nos. 26 and 41. Designations as in Fig. 1.

thermal maps were recorded from the bare bone of the skull (scalping was accomplished one to two months after resuscitation). The baseline topography of the cerebral cortical temperature was investigated first; after that the temperature dynamics, were investigated under a strong functional load, a stressor. For this purpose a "collision" was used: painful electrical stimulation was applied to the animals through the floor of the chamber in which, prior to that, a consolidated conditioned instrumental food-procuring reflex had been developed in them.

The processing of the thermal maps was done on a specialized Pericolor-2001 (France) computer using programs allowing the reduction of noise, the plotting of graphs of temperature change in time in various areas of the cortex and of temperature profiles with respect to various sections of the images, as well as comparison of the average temperature values in the right and left hemisphere.

INVESTIGATION RESULTS

The neurological status of the rats was completely restored over the course of one to two days following resuscitation. However, the temperature maps of the cerebral cortex of the resuscitated rats differed from the temperature maps of the intact animals even in remote periods following resuscitation. The temperature topography of the cerebral cortex in the resuscitated rats was characterized by distinct stable mosaicism of the thermal fields with a difference in the temperature of particular areas of the brain surface that reached tenths of a degree. The stable, dramatically pronounced mosaicism of the thermal pattern in the resuscitated rats differs substantially from the small fluctuations in temperature in various areas of the cortex in the intact animals. The markedness and localization of the zones of elevated and diminished temperature varied in various animals. In the number of cases a clear temperature "reciprocity" was manifested in symmetrical areas of the right and left cerebral cortex: a symmetrical area of decreased temperature corresponded to an area of increased temperature in the same [Trans. note: "the same" is the literal translation, although the author may have intended "the other"] hemisphere.

The comparison of the average temperature of the cortex of the cerebral hemispheres of the resuscitated rats showed that in 7 out of 15 cases the right hemisphere was warmer than the left. In 7 other cases the average temperature of the right and left hemispheres was identical, and only in one rat was a pronounced left-sided asymmetry observed. In the group of intact rats, the average temperature in the baseline recordings, with respect to the hemi-