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The neurophysiological basis of cerebral effects of low-dose radiation

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Based on the developed protocols, a cross-sectional clinical study with external and internal controls was conducted. The neurophysiological characteristics of individuals exposed to ionizing radiation in adulthood (57 Chornobyl accident clean-up workers (liquidators) with a documented external dose of 0.01-2.90 (0.49 ± 0.67) Sv) are presented. To analyze the impact of ionizing radiation, taking into account the results of our previous studies on the possible threshold of radiation-associated neuropsychiatric effects of 0.30 Sv, Chornobyl clean-up workers were divided into those exposed to doses < 0.30 Sv (n = 34; (0.14 ± 0.09) Sv) and ≥ 0.30 Sv (n = 23; (0.99 ± 0.82) Sv). Chornobyl clean-up workers exposed to doses < 0.30 Sv and < 50 mSv were used as an internal control for adult exposure), as a normative control, prospectively restored examination data for 53 candidates for employment at the Object «Shelter» transformation into environmentally safe system.

The characteristic cerebral electrophysiological changes reflecting the neurophysiological basis of radiation-associated pathology in the long-term period after exposure were determined. In Chornobyl clean-up workers, especially those irradiated at doses ≥ 0.30 Sv, a slowing of cerebral bioelectrical activity is observed mainly in the frontotemporal-parietal areas of the left hemisphere, indicating a synergistic radiation-sensitive cerebral effect with dysfunction (irritation) of the cortico-lymphatic system, especially the hippocampus. Radiation-associated disorders of the central mechanisms of visual afferentation were found.

In Chornobyl clean-up workers irradiated at doses ≥ 0.30 Sv, the subcortical component of the P50 visual evoked potentials to the reversed checkerboard pattern (VEPs) is slowed and the cortical associative component of the P200 VEPs is accelerated. Synergistic radiation-age-related increases in the amplitude of the cortical component of the P100 VEPs in the occipital region and the slowing of the cortical associative component of the P200 VEPs in the parietal region were found. At the same time, the amplitude of the P300 cognitive visual evoked potentials (CVEP) in the occipital region decreases depending on the radiation dose, but increases in proportion to age. This may indicate an atypical aging of the central nervous system after irradiation.

It is possible to use modern diagnostic methods of the VEPs and CVEP to monitor and diagnose visual analyzer lesions in individuals exposed to the ionizing radiation under different exposure scenarios. Exposed persons require medical monitoring throughout their lives.

Authors: KREINIS, Heorhii (NRCRM); PERCHUK, Iryna (NRCRM); ANTYPCHUK, Kateryna (NRCRM); KUTS, Kostiantyn (NRCRM)

Доповідач: PERCHUK, Iryna (NRCRM)

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