Секция «Биофизика и нанобиотехнологии»

Neurotoxic effects of exposure to gadolinium nanoparticles

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Introduction: The range of applications of magnetic nanoparticles includes targeted drug delivery, magnetic hyperthermia, diagnosis and therapy of oncological diseases, etc. [1, 2]. Particular attention is paid to the use of gadolinium nanoparticles to enhance contrast and increase diagnostic sensitivity during MRI, as well as therapeutic effects on the pathological focus through effective neutron capture. Foreign literature describes cases where, when using gadolinium-containing radiopaque agents in macroform, side effects of the anaphylactoid type were observed, as well as cases of acute renal failure, encephalopathy, and pancreatitis. In this regard, the use of gadolinium in nanoform is promising, making it possible to achieve high contrast images when performing MRI with a significantly smaller amount of injected substance.

Matherials and methods: Experimental studies of the biological effects of the Gd-AG nanocomposite were carried out on 96 outbred white male rats weighing 180–240 g. 3 groups of animals of 32 individuals each were formed. The Gd-AG solution was administered intragastrically for 10 days at a dose of 500 μg/kg (experimental group $GdAG_{500}$) and at a dose of 5000 μg/kg (experimental group $GdAG_{5000}$). One day after the end of the exposure, all animals underwent the "Open Field" test, an electroencephalogram (EEG) was taken, after which some of the animals (16 animals from each group) were left to survive for 6 months and formed the long-term period group. The remaining animals were killed by decapitation under light ether anesthesia; they constituted the early period. Sections of the sensorimotor cortex of animals from both periods of examination were stained using the standard Nissl technique. Also, using the Image Scope M application package, a morphometric study was carried out: the following indicators were calculated programmatically: the total number of neurons per unit area (0.2 mm^2), the number of degenerative neurons and the number of glial cells cells, as well as the number of neuronophagy events.

Results and Discussion: According to the results of the EEG study, the introduction of the nanocomposite did not cause changes in wave activity both in the early and long-term periods of the examination when compared with the control. However, when comparing the experimental groups with each other, depending on the size of the administered dose of gadolinium, changes in the bioelectrical activity of the brain were revealed. The study of motor activity did not reveal stable patterns that were statistically different from the control, while the results of the morphological study showed only an increase in the number of degeneratively changed neurons per unit area in the $GdAG_{500}$ group only in the early period of the examination.

References

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