# RESEARCH OF THE BIOLOGICAL ACTIVITY OF GADOLINIUM ORTHOVANADATE NANOPARTICLES

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**Introduction.** Recently, inorganic nanomaterials based on rare-earth metals are of particular scientific interest. Colloidal solutions containing lanthanide ions are most commonly used. They are used in medicine both in the treatment of cancer and as contrast agents in tomography. The use of these solutions allows luminescence analysis of cells due to autoluminescence of biological material. Metals orthovanadates activated by rare earth elements are considered to be particularly effective luminophores.

Nanoparticles have specific physicochemical properties and biological effects on living organisms which make them possible to be potentially used in biological analysis and medicine. Biological properties of lanthanides are mainly due to the presence of *f*-electrons in the electronic shells which create the effect of magnetic microfields.Therefore, the study of the potential risk of effects of nanomaterials on health and environment is very actual. The risk of pathologies caused by nanomaterials is not yet completely clear, therefore, investigation of toxic effects of nanoparticles today is becoming the new direction in experimental medicine.

Nanoparticles entering the body can cause formation of highly reactive intermediates or free radicals participating in many biochemical reactions. These products can catalyze free radical oxidation and can be harmful because they trigger the chain reaction of new free radicals formation. Free radical products can interact with lipid components of membranes leading to the formation of lipid hydroperoxides. As a rule, their excessive accumulation leads to change of membranes structure, alteration of their physicochemical properties, disturbance of ion transport, etc. Metal ions with variable valency are also an equally important factor of the regulation of free radical oxidation in cells and tissues. They are in the composition of the active centers of some enzymes including antioxidant ones. They catalyze many biochemical reactions being in a free state or in the form of complex compounds with proteins and other substances.

Thus, it can be concluded that lipid peroxidation is not only a universal modifier of the properties, structure and function of biological membranes but also an important physiological regulator of normal cell activity and oxidative stress.

Studying the mechanisms of oxidative stress development and preventing its detrimental effects open up new prospects for medical science.

**Purpose.** The aim of this work was to study the effect of $GdVO_4Eu^{3+}$ preparation on a number of biochemical parameters of free radical processes.

**Materials and methods.** The experiments were carried out using 25 sexually mature WAG line female rats. Rats were divided into 2 groups: group 1 included 15 rats that received intramuscular injections of the $GdVO_4Eu^{3+}$ (C = 0.2 g/l) preparation once a day at a dose of 1 mg/kg; group 2 included 10 intact rats. The blood was taken from the caudal vein in test tubes with EDTA solution after the first, third, and fifth

injections. The following lipid peroxidation (LPO) parameters were determined in the blood plasma: the content of diene conjugates (DCs), thiobarbituric acid reactive substances (TBARS). Determination of the DCs level was done in accordance with method is based on lipid peroxidation products determination in the blood using absorption of ultraviolet monochromatic light flux by lipid extract. Determination of the malondialdehyde (MDA) concentration was carried out according to Uchiyma M. & Michara M. using reaction with thiobarbituric acid (TBA).

**Results and discussion.** Intensification of peroxidation processes was observed after the third injection of the studied preparation as evidenced by the increased plasma content of lipids peroxidation products – DCs and TBARS. Peroxidation activity continued to increase after the 5th injection in rats of experimental group. The content of peroxide oxidation products was significantly higher than both intact values and results after the third injection.

Experimental data showed that after the first administration of the studied drugs in the experimental animals, no significant changes in LPO indicators were observed in the blood serum. The level of peroxide products – DCs and TBARS were within the limits of the values characteristic of intact animals.

After the third injection of the drug under study, the rats of this group observed increased peroxidation processes, which was evidenced by the increased content of lipoperoxidation products in the blood plasma – DCs and TBARS. The level of DCs in the rats of the experimental group increased by an average of 23%. The concentration of TBARS increased to an even greater degree: here the increase in the indicator was 33-34%

After the 5th injection, the activity of peroxidation in laboratory rats continued to increase; the content of peroxide products DCs and TBARS was not only significantly higher than intact values, but also increased compared to the previous term.

**Conclusions.** It is still hard to evaluate degree of toxicity of $GdVO_4Eu^{3+}$ due to the short time of experiment. The drug under investigation to some extent affects the processes of free-radical oxidation, in particular, on POL and the state of antioxidant systems, and the reaction of the investigated systems was ambiguous.

During the entire period of the study, administration of the drug did not cause acute intoxication. The rats were mobile, active, there was no decrease in appetite, defecation was normal, the fur was smooth, clean, and the skin was free of lesions.

Most of the biochemical parameters returned to normal values by the end of the study. During the entire period of administration of the drug, an increase in the intensity of LPO was observed, and after the 5th injection, the rats of this group had the highest values of DCs and TBARS (the differences with the intact group were significant). Increased content of DCs and TBARS in the blood plasma of rats is probably due to the presence of V (vanadium) which enhances tissue oxygen uptake and thus can activate LPO. The obtained data indicate that the introduction of the drug $GdVO_4Eu^{3+}$ probably has a destructive effect on cell membranes.

Thus, additional experiments are needed to determine the degree of toxicity of $GdVO_4Eu^{3+}$ and its effect on different types of metabolism.