Contribution ID: **254** Type: **Oral report**

Post-Effects of Radioactive Decay in DOTA Chelator and Magnetite Nanoparticles Labelled with Auger- and Internal Conversion Electron-Emitters, Alpha- and Beta Decay Radionuclides

Tuesday, 13 October 2020 16:35 (25 minutes)

As it has been demonstrated by the conducted experiments, the production of targeted radioactive pharmaceutical preparations (RPHs) that are based on alpha-emitters using the traditional approach (biologically active molecular constructs with a chelate, DOTA, that carries a radioactive tracer) is just a sort of scientific mystification: the recoil nuclei formed after such decay will destroy the carrier molecules thus completely excluding a targeted transport of the preparation.
A success in the production of such pharmaceutical formulations that are based on the use of alpha-emitters is possible only in the case when there is some way of "levelling"the harmful effect of recoiling nuclei, for example, by means of using inorganic compounds ("nano-containers") of a high radiation resistance.
As such a model matrix material, magnetite, Fe3O4, has been used whose main transport characteristic that accounts for the transportation accuracy of magnetite-based RPHs is the value of the internal magnetic field on the iron nuclei. The magnetite nano-crystallites have been prepared labelled with Auger- and internal conversion electrons, beta- and alpha-emitters (57Co, 60Co and 241Am radionuclides).
A comparative analysis has been conducted of radiation-induced damage patterns in nano-crystallites in the dependence of nuclear- and physical characteristics of the radioactive tracer and total fluence. It has been established that under irradiation there is a comminution of crystallites taking place, the effective magnetic fields on the iron atoms in the labelled nano-crystallites remaining unchanged irrespective of the "dose load".
Taking into consideration the typical recoil energies (90 keV to 150 keV) of the daughter atoms that are produced as a result of alpha-decay, the chemical composition and density of possible "carriers"needed for an efficient "conservation"of traditional therapeutic radionuclides (in particular, 211At, 212Bi, 213Bi, and 223Ra), "nano-containers"should be used with the particle size of not less than 80 nm.
The work was supported by a grant from the Russian Foundation for Basic Research (18-03-00832).

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Session Classification: Section 8. Nuclear medicine

Track Classification: Section 8. Nuclear medicine.