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Radioactive arsenic (III) compounds as potential theranostic radiopharmaceuticals

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Arsenic compounds have been known and used in medicine for centuries. Arsenic (III) in the form of simple inorganic compounds easily oxidizes, which makes its administration in the human body difficult. As2O3 is now used in the successful treatment of acute promyelocytic leukemia.
The high affinity of arsenic to sulfur atoms and creating strong bonds with sulfur-containing compounds provides a wide range of applications of arsenic compounds in medicine.
The application of arsenic compounds enables the use of a wide range of radioactive arsenic isotopes in nuclear medicine, both in diagnostics and therapy. Arsenic has four isotopes - β+ emitters (70/71/72/74As) and three β- emitters (74/76/77As), which can be obtained in a reactor or in an accelerator. The half-lives of As radioisotopes are in the range from 53 minutes to 18 days. 72As can be also obtained from the 72Se/72As generator [1,2], which would facilitate the synthesis of radiopharmaceuticals in the hospital. Arsenic is also an interesting candidate for use in the innovative β + γ diagnostic technique, which allows increasing the precision of the examination with the use of a lower dose of the radioisotope for the patient [3].
For the synthesis of arsenic complexes on a weight scale the ligands containing thiol groups were used. The synthesis was carried out in a nitrogen atmosphere under reflux, and chloroform was used as a solvent. The four arsenic (III) compounds with dithiol ligands were obtained. The compounds were examined by X-ray diffraction and their mass was determined by ESI Q-TOF-MS. The results of both studies confirmed the expected structure of the tested compounds, which allowed to determine the retention time of the peaks on HPLC chromatograms. Also, the UV-Vis spectra of the tested complexes were measured. Toxicity studies of arsenic compounds on NB4 acute promyelocytic leukemia cells were performed using the MTS test. All compounds as well as As2O3 induced cytotoxicity in a time and dose-dependent manner.
The established synthesis conditions on a weight scale allowed for the syntheses with the use of the radioactive 76As isotope, which were examined by TLC and HPLC methods. Radioactive complexes were formed with high efficiency within 0.5 h of synthesis and were relatively stable in human serum.

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