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Aptamer-based radiopharmaceutical for PET/CT detection of lung cancer

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Abstract. The paper describes a new radiopharmaceutical for diagnosis of lung cancer obtained on the basis of a radiolabeled ^{11}C oligonucleotide and the study of its effectiveness in-vivo. As a result of the synthesis, an aptamer to lung cancer containing ^{11}C in the 3'-position was obtained and remained stable for 60 minutes. Prior to xenotransplantation of human lung cancer cells, the mice were immunosuppressed. Tumour volumes and locations were monitored using PET/CT. The study of accumulation of the radiopharmaceutical in the organs of mice *in vivo* has shown that the ^{11}C-labeled lung cancer aptamer specifically binds to lung cancer cells. A radiopharmaceutical based on ^{11}C-labeled LC aptamer against lung cancer is a promising drug for lung cancer diagnosing.

Key words: radionuclide, lung cancer, aptamer, PET/CT.

Conflict of interest. The authors declare the absence of obvious and potential conflicts of interest associated with the publication of this article.

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Introduction

One of the most sensitive diagnostic methods is positron emission tomography with computed tomography (PET-CT) using radionuclides [1]. ^{18}F-fluorodeoxyglucose, ^{11}C-methionine, ^{11}C-choline and other radionuclides are used to detect malignant neoplasms, determine the stage and extent of the tumour process [2]. However, despite the high sensitivity of the method, the radiopharmaceuticals themselves do not show high specificity since they can accumulate not only in the malignant tumours, but also in all organs and tissues with high metabolic activity [1]. An alternative to this radiopharmaceutical is a drug based on the ^{11}C aptamer [3]. The paper describes a new radiopharmaceutical for the diagnosis of lung cancer, obtained on the basis of a radiolabeled ^{11}C oligonucleotide and the study of its effectiveness *in vivo*.

Material and methods

The introduction of ^{11}C into the lung cancer aptamer was carried out in a dipolar aprotic solvent, which well supports DMSO 2nd order nucleophilic reactions. Synthesis of the product is carried out in the "Synthra MeI-Plus" module (Synthra, Germany), which makes it possible to obtain ^{11}C-CH3I methyl iodide from carbon dioxide ^{11}C-CO_2 produced in a cyclotron and delivered to the synthesis module in the target gas stream. The synthesis includes the step of labelling with ^{11}C the targeting molecule - the thiolated DNA-aptamer.

The mice were immunosuppressed prior to xenotransplantation of human lung cancer cells. The tumour in the lungs of the mice developed within 2 weeks.

Results and discussion

As a result of the synthesis, an aptamer to lung cancer containing ^{11}C in the 3'-position was obtained that remained stable for 60 minutes. The efficiency of the binding of the 3'-^{11}C-LC aptamer complex to cancer cells *in vivo* was assessed in ICR mice with a transplanted human lung tumour using PET/CT. The ability of the ^{11}C radionuclide (LC 3'-^{11}C aptamer) to find and identify tumour foci and metastases in the body was assessed using immunosuppressed ICR mice transplanted with a primary culture of lung cancer into the right lung. The study of the accumulation of the radiopharmaceutical in the organs of mice *in vivo* showed that the ^{11}C-labeled lung cancer aptamer specifically binds to lung cancer cells (see the Figure).

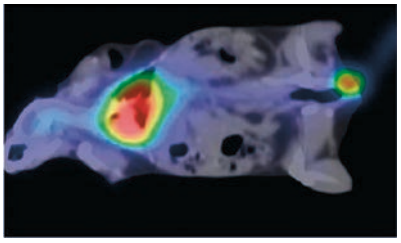

Figure. Lung tumour lesion detected by PET/CT using ^{11}C-labeled lung cancer aptamer.

Conclusion

A radiopharmaceutical based on ^{11}C-labeled LC aptamer against lung cancer is a promising drug for lung cancer diagnostics.

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