

# Tumor pathomorphosis and changes in internal organs of laboratory rats with PC-1 transfected liver cancer at different multiplicity of NaYF<sub>4</sub> +HSA and NaYF<sub>4</sub>+HSA+FA particles administration

Artem M. Mylnikov,<sup>1</sup> Nikita A. Navolokin,<sup>1,2,3</sup> Roman A. Anisimov,<sup>4</sup> Maria V. Lomova,<sup>4</sup> Vyacheslav I. Kochubey,<sup>5,6</sup> Irina Yu. Yanina<sup>5,6</sup>

<sup>1</sup>Department of Pathological Anatomy, Saratov State Medical University, Saratov, Russian Federation

<sup>2</sup> Research-Scientific Institute of Fundamental and Clinic Urology, Saratov State Medical University, Saratov, Russian Federation

<sup>3</sup> Pathological Department, State Healthcare Institution "Saratov City Clinical Hospital No. 1 named after Yu.Ya. Gordeev" st. them. Kholzunova A.I., Saratov, Russian Federation

<sup>4</sup>Education and Research Institution of Nanostructures and Biosystems, Saratov State University (National Research), Russian Federation

<sup>5</sup>Department of Optics and Biophotonics, Saratov State University (National Research), Saratov, Russian Federation

<sup>6</sup>Laboratory of laser molecular imaging and machine learning, Tomsk State University (National Research), Russian Federation

e-mail: [artyom-mylnikov@mail.ru](mailto:artyom-mylnikov@mail.ru)

The aim is to study the efficacy of NaYF<sub>4</sub> +HSA and NaYF<sub>4</sub>+HSA+FA particles on laboratory animals with PC1 liver cancer at different multiples of intravenous administration.

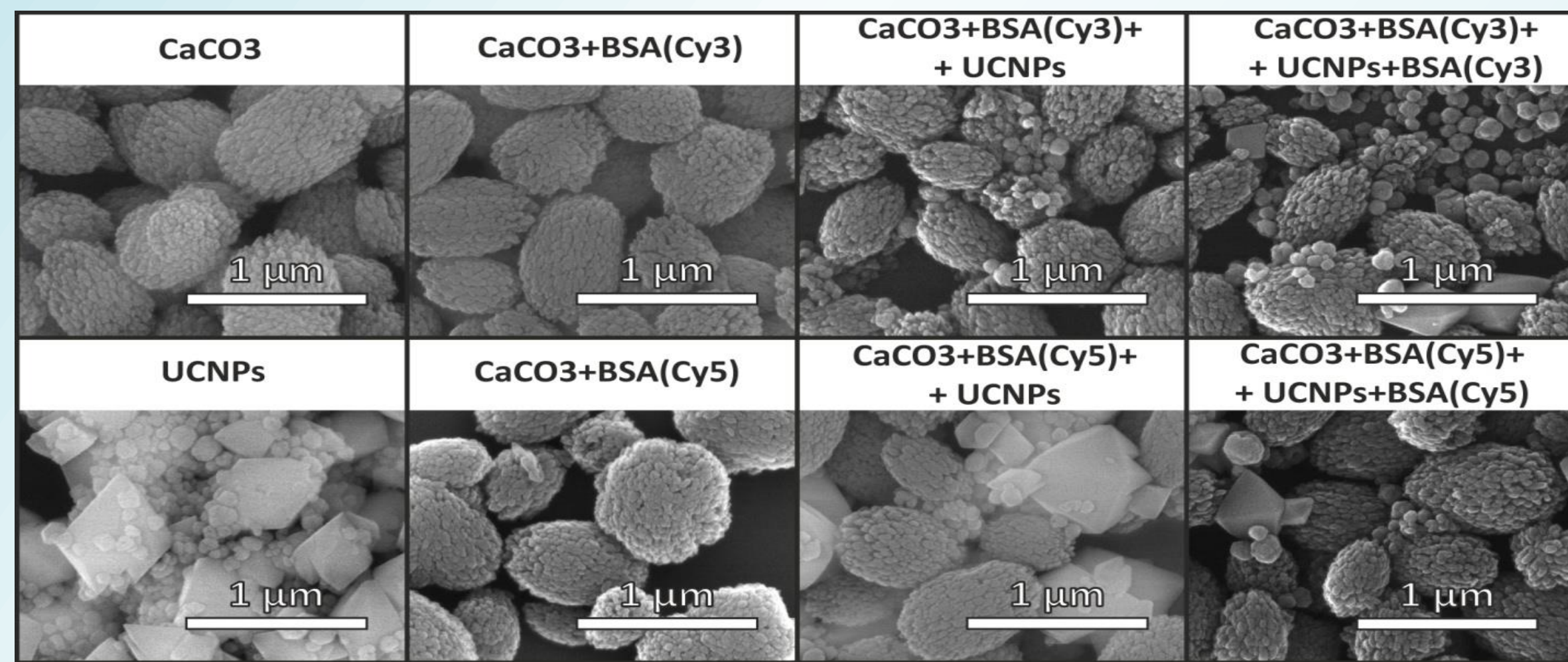
## MATERIALS AND METHODS

### Experimental protocol in vivo

In the experiment, a comparison group without exposure and three groups for each type of NaYF<sub>4</sub>+HSA and NaYF<sub>4</sub>+HSA+FA particles were allocated with single, double and triple intravenous administration of these particles, respectively.



### Types of nanoparticles



### Experimental design

Work with laboratory animals. The study was carried out on 32 white sexually mature male laboratory rats of Wistar breed weighing 150±20 g, 4 in each group. Work with laboratory animals was carried out according to the protocol of research, not contradicting the Geneva Convention of 1985 on "International Principles of Biomedical Research Using Animals", and the Helsinki Declaration of 2000 on the humane treatment of animals, as well as in accordance with the provision of Order No. 755 of the Ministry of Health of the USSR from 12.08.1977. When developing the design of experiments, we used the "Guidelines for experimental (preclinical) studies of new pharmacological substances" (Khabriev R.U., 2005) and "Guidelines for conducting preclinical studies of drugs" (Mironov A.N., 2012). In vivo experiments were performed at the Center for Collective Use "Experimental Oncology" at V.I. Razumovsky Saratov State Medical University of the Russian Federation Ministry of Health. V.I. Razumovsky Saratov State Medical University named after V.I. Razumovsky, Ministry of Health of the Russian Federation (Head of the Center - Dr. B.S. Bucharskaya A.B.).

## RESULTS

Thus, based on the morphological study, it was found that for NaYF<sub>4</sub> +HSA particles the twofold injection was the most effective, causing significant tumor death. For NaYF<sub>4</sub>+HSA+FA particles, a significant effect was achieved with both twofold and threefold administration, as significant tumor death and cyst formation were observed. Also, taking into account the known data on the increase of toxic effect from the multiplicity of administration of any particles, the twofold administration can be considered the most appropriate.

Results of immunohistochemical changes in the tumor of some laboratory rats with transplanted liver cancer PC-1, depending on the type of exposure (typical picture for this type of exposure)

| Group  | ki67 | bax | p53 | CD95 |
|--|------|-----|-----|------|
| Control  |      |     |     |      |
| NaYF <sub>4</sub> unfired + irradiation  |      |     |     |      |
| NaYF <sub>4</sub> + SiO <sub>2</sub> fired                                       |      |     |     |      |
| NaYF <sub>4</sub> + BSA + Cy3 + irradiation 1 hour after particle administration |      |     |     |      |

| Groups  | Immunohistochemical markers % expression |      |      |      |
|---|--|------|------|------|
|   | ki67                                     | Bax  | p53  | CD95 |
| Control                                       | 0±0                                      | 0±0  | 0±0  | 0±0  |
| NaYF <sub>4</sub> annealed with irradiation   | 0±0                                      | 10±1 | 0±0  | 0±0  |
| NaYF <sub>4</sub> unannealed                  | 32±4                                     | 0±0  | 20±1 | 0±0  |
| NaYF <sub>4</sub> unannealed with irradiation | 19±1                                     | 47±3 | 37±9 | 0±0  |