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Multifunctional Gold Nanoparticles for Cancer Theranostics

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Radionuclide therapy is an anticancer therapeutic modality based on the use of radiopharmaceuticals, which are drugs containing radionuclides emitting ionizing radiation (β- and α particles or Auger-electrons). Many of these radionuclides are also gamma- or positron-emitters and then are suitable for imaging applications using single-photon emission computerized tomography (SPECT) or positron emission tomography (PET) imaging, respectively. This possibility renders some radiopharmaceuticals intrinsically suited to provide therapeutic effects and, simultaneously, to monitor non-invasively therapeutic outcome in real-time. Therefore, radionuclide therapy has unique advantages within a theranostic approach for cancer when compared with other therapies, showing a great promise towards the application of precision and personalized medicine. To fully profit from these advantages, it is essential to design "smart"radioconjugates (molecular or nanosized) that specifically recognize the target tumoral cells to enhance the therapeutic effect and spare the surrounding normal cells from radiation damage.
In this communication, we will present relevant contributions of the C2TN team in this field, focusing on gold nanoparticles (AuNPs) (Fig. 1) [1] targeted at the gastrin releasing peptide receptor (GRPr) overexpressed in several tumors, like prostate cancer and glioblastoma multiforme. The strategies used to design these molecular or nanosized GRPr-targeted conjugates will be summarized, as well as the different biological studies employed in their preclinical evaluation. It will be highlighted how a combination of expertise is required to elucidate the theranostic potential of these target-specific radioconjugates, spanning from radiopharmaceutical sciences (e.g., ligand design, labelling chemistry, metabolism and biodistribution studies) to radiobiology (e.g. assessment of DNA damage and cellular viability) and physics (e.g., micro-and nanodosimetric calculations at the cellular and the DNA level).

[1] F. Silva, A. Zambre, M. P. C. Campello, L. Gano, I. Santos, A. M. Ferraria, M. J. Ferreira, A. Singh, A. Upendran, A. Paulo and R. Kannan, Bioconjugate Chemistry, 2016, 27, 1153-1164.

Scientific Area

Primary author: SILVA, Francisco (C2TN)

Co-authors: Ms MENDES, Carolina; Ms MARQUES, Ana; Dr BELCHIOR, Ana; Dr MARQUES, Fernanda; Dr PAULA C. CAMPELLO, Maria; Dr GANO, Lurdes; Dr PAULO, António

Presenter: SILVA, Francisco (C2TN)

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