Preparation, Characterizations and Imaging Study of a Nanometric Platform for Magnetic Resonance and fluorescence Imaging

Sarah Garifo (1); Dimitri Stanicki (1); Sébastien Boutry (1,2); Lionel Larbanoix (1,2); Indiana Ternad (1); Robert N. Muller (1,2); Sophie Laurent (1,2)

(1) General, Organic and Biomedical Chemistry Unit, NMR and Molecular Imaging Laboratory, University of Mons (UMONS), 7000 Mons, Belgium
(2) Center for Microscopy and Molecular Imaging (CMMI), 6041 Gosselies, Belgium

Introduction

The association of magnetic resonance imaging (MRI) with optical imaging (OI) presents several advantages in the preclinical imaging field owing to the high spatial resolution of the former and the high sensitivity of the latter. In this context, the objective of this project was to develop an efficient single MRI/OI probe by associating a gadolinium complex with a NIR-emitting compound within a nanoparticular matrix.

Methods

The preparation of the targeted systems required the following steps:

(i) The development of paramagnetic silica nanoparticles (SiO_2-Gd-NPs) by a one-pot reverse micro-emulsion process for the entrapment of a conventional Gd-complex (*i.e*., Gd-HP-DO3A);
(ii) The modification of the particle surface by PEG chains to ensure the colloidal stability;
(iii) The demonstration of the covalent insertion of a carboxylic aryl diazirine photolinker on the outer coating corona;
(iv) The grafting of fluorescent NIR-luminescent probes onto the carboxylated NPs using a classical EDC approach to obtain the desired fluorescent properties.

Results

The confinement of Gd-complexes within SiO_2-NPs resulted in a significant increase in longitudinal relaxivities (>500% at 20 MHz) in comparison with the free chelate, while the PEG-coating procedure has allowed a long-term stability in physiological conditions. In addition, the modification of the PEGylated-particles using a carboxylated diazirine linker by mean of photochemical treatment was considered for the easy post-derivatization with NIR-dye without affecting the colloidal stability. At each step, spectroscopical techniques (UV, NMR,…) were used to validate the efficiency of different surface modifications. Preliminary imaging experiments complete this study.

Conclusions

Stable paramagnetic/fluorescent nanoparticles were successfully prepared and characterized. Preliminary biodistribution and elimination MRI/OI studies have been performed using this system and confirm the potential of the presented system for preclinical imaging experiments. In future development, the as-proposed system will be modified with biological vectors for molecular imaging applications.

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