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MPI/MRI/fluorescence multimodal imaging nanoemulsion platform

ID: #237

Topic: Imaging Probes, Chemistry & Reporter Genes > Novel multimodality imaging and reporter probes

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Introduction

Multimodal imaging contrast agents are powerful probes which combine the complementary advantages of different imaging modalities and offer the prospect of improved preclinical applications. For this purpose, we engineered nanoemulsion (NE), submicron size range oily droplets. NE are widely used for human medical applications due to their non-toxic and non-irritant nature and improved physical stability over other nanosystems.

Methods

NE were loaded with superparamagnetic iron oxide nanoparticles (SPION) and optical probes in order to design a multimodal tool for Magnetic Resonance Imaging (MRI), Magnetic Particle Imaging (MPI) and fluorescence imaging. MPI is an emerging preclinical imaging method which allows direct mapping of SPION and seems to exhibit improved performances in comparison to MRI¹. NE were characterized using Dynamic Light Scattering (DLS), Zeta potential and Transmission Electron Microscopy (TEM). NE contrast signal were evaluated for both MRI/MPI technique and fluorescence imaging. Preliminary multimodal MRI/Optical imaging was assessed on macrophages and bio-distribution was performed by Near Infra-Red Fluorescence (NIRF) assessment on mice after tail vein injection

Results

The inclusion of imaging probes did not result in a change of the hydrodynamic diameter, close to 180 nm with a polydispersity index around 0.10. As expected the droplets are negatively charged (zeta potential $\zeta = -30\text{mV}$). TEM showed nanovesicles including iron crystals in the oily phase. Photophysical studies demonstrated that the fluorescent optical probes are located inside the oil phase. The physical properties of the formulation were maintained over 10 months. MRI and MPI signal increase with the size of the SPION loaded in the nanosystem. Tandem MRI/optical imaging was observed on macrophages confirming that complementarities modalities can be loaded inside the same object. *In vivo* injection to mice confirms the ultra-bright NIRF properties of our nano system.

Conclusions

In this study, we demonstrated that a MRI/MPI/fluorescence contrast agent formulated as oil-in-water nanoemulsion loaded with magnetic nanoparticles and optical probes can be developed for future diagnosis applications

1. Pablico-Lansigan MH, Situ SF, Samia AC. Magnetic particle imaging: advancements and perspectives for real-time in vivo monitoring and image-guided therapy. *Nanoscale*. 2013;5(10):4040-55

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