Multimodal detection of atherosclerosis using Solid Lipid Nanoparticles

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Atherosclerosis and its clinical complications are major constraints to living long and healthy lives. Therefore, tools capable of measuring disease activity are necessary. During this work, Solid Lipid Nanoparticles (SLNPs), a type of NP that is formed by a solid lipid core matrix and that is stabilized using surfactants, were synthesized as potential contrast agents for atherosclerosis. For that purpose, the enzyme driven accumulation of Sphingomyelin (SPH) in the atherosclerotic plaque was exploited.

SLNPs have been produced using Sphingomyelin (SPH) as the main lipid and cholesterol as the stabilizer. They were synthesized using the Solvent Injection Method. In this method, surfactants and lipids are solubilized in a semi-polar water miscible solvent. Afterwards, this organic phase is rapidly injected, under constant stirring, into an aqueous phase. As a result, organic solvent distributes rapidly into the aqueous phase and SLNPs are formed. After thorough sample characterization, the accumulation of the SPH-SLNPs in atherosclerotic plaques was evaluated with ex vivo fluorescence imaging.

Hydrodynamic size distributions measured by dynamic light scattering (DLS) showed a narrow size distribution for all samples. In addition, TEM imaging also showed a narrow distribution of NPs. SPH-SLNPs showed aggregation when incubated with their specific enzyme Sphingomyelinase. Furthermore, ex vivo fluoresce imaging showed accumulation of the SPH-SLNPs in the aorta of LDLR-/- mice. These characteristics make SPH-SLNPs a suitable potential probe for pathophysiology and activity characterization.