Liposomal co-encapsulation of iron oxide nanoflowers and Atorvastatin for theranostic applications in atherosclerosis

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Atherosclerosis, is a chronic inflammatory disease caused by accumulation of fat-laden deposits in the vascular endothelium and is currently affecting approximately 1 billion people worldwide [1]. The necessity of early-stage diagnosis and effective treatment can be addressed by nanomedical approaches. Herein we investigate the stability and hemocompatibility of a multifunctional theranostic system of liposomes containing iron oxide nanoflowers (IONfs) and a hypolipidemic statin drug, Atorvastatin (ATV). Liposomes are lipid containing nanovesicles that improve the pharmacokinetic properties of hydrophobic drugs like ATV and prolong the circulation of metallic nanoparticles [2]. IONfs are superparamagnetic nanoparticles with excellent colloidal stability and biocompatibility rendering them suitable MRI contrast agents [3].

In this project we synthesized liposomes consisting of the lipids 1,2-dipalmitoyl-sn-glycero-3-phosphocholine (DPPC) and N-(Carbonyl-methoxyPEG 2000)-1,2-distearoyl-sn-glycero-3-phosphoethanolamine (DSPE-mPEG$_{2000}$) (95:5) according to the lipid thin film hydration method and extrusion through 100nm membrane filters. Atorvastatin was mixed with the lipids prior to hydration while IONfs were encapsulated during the hydration step in order to stabilize ATV in the hydrophobic bilayer and IONfs in the hydrophilic lumen of the liposome. 15 nm IONfs were produced by the polyol method, further oxidized to achieve maghemite crystal structure and then modified with citrate. All formulations were structurally characterized *via* different spectroscopic techniques (FT-IR, UV-Vis, DLS, NMR) and morphologically via electron microscopy techniques (TEM, SEM). Hemocompatibility studies, executed as a critical factor of systemic in vitro toxicity, showed negligible hemolysis rate (<10%) while observing limited morphological alterations on erythrocytes by optical microscopy. The outcome of this work is the development of a biocompatible theranostic nanostructure with potential application in atherosclerosis.

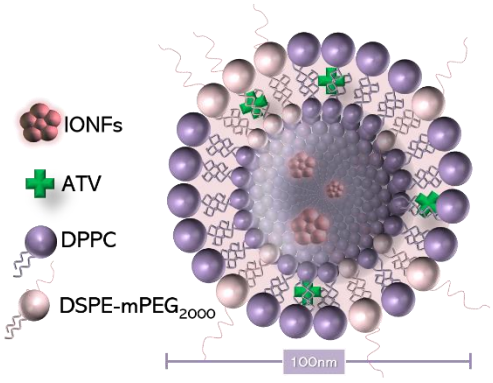

Figure 1: Representation of ATV loaded liposomes containing IONfs

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