IMAGING

Chen, F., et al. (2017). "Exosome-like silica nanoparticles: a novel ultrasound contrast agent for stem cell imaging." Nanoscale 9(1): 402-411.

Ultrasound is critical in many areas of medicine including obstetrics, oncology, and cardiology with emerging applications in regenerative medicine. However, one critical limitation of ultrasound is the low contrast of target tissue over background. Here, we describe a novel cup-shaped silica nanoparticle that is reminiscent of exosomes and that has significant ultrasound impedance mismatch for labelling stem cells for regenerative medicine imaging. These exosome-like silica nanoparticles (ELS) were created through emulsion templating and the silica precursors bis(triethoxysilyl)ethane (BTSE) and bis(3-trimethoxysilyl-propyl)amine (TSPA). We found that 40% TSPA resulted in the exosome like-morphology and a positive charge suitable for labelling mesenchymal stem cells. We then compared this novel structure to other silica structures used in ultrasound including Stober silica nanoparticles (SSN), MCM-41 mesoporous silica nanoparticles (MSN), and mesocellular foam silica nanoparticles (MCF) and found that the ELS offered enhanced stem cell signal due to its positive charge to facilitate cell uptake as well as inherently increased echogenicity. The in vivo detection limits were <500 cells with no detectable toxicity at the concentrations used for labelling. This novel structure may eventually find utility in applications beyond imaging requiring an exosome-like shape including drug delivery.

Yang, Q., et al. (2017). "Low-Intensity Ultrasound-Induced Anti-inflammatory Effects Are Mediated by Several New Mechanisms Including Gene Induction, Immunosuppressor Cell Promotion, and Enhancement of Exosome Biogenesis and Docking." Front Physiol 8: 818.

Background: Low-intensity ultrasound (LIUS) was shown to be beneficial in mitigating inflammation and facilitating tissue repair in various pathologies. Determination of the molecular mechanisms underlying the anti-inflammatory effects of LIUS allows to optimize this technique as a therapy for the treatment of malignancies and aseptic inflammatory disorders. Methods: We conducted cutting-edge database mining approaches to determine the anti-inflammatory mechanisms exerted by LIUS. Results: Our data revealed following interesting findings: (1) LIUS anti-inflammatory effects are mediated by upregulating anti-inflammatory gene expression; (2) LIUS induces the upregulation of the markers and master regulators of immunosuppressor cells including MDSCs (myeloid-derived suppressor cells), MSCs (mesenchymal stem cells), B1-B cells and Treg (regulatory T cells); (3) LIUS not only can be used as a therapeutic approach to deliver drugs packed in various structures such as nanobeads, nanospheres, polymer microspheres, and lipidosomes, but also can make use of natural membrane vesicles as small as exosomes derived from immunosuppressor cells as a novel mechanism to fulfill its anti-inflammatory effects; (4) LIUS upregulates the expression of extracellular vesicle/exosome biogenesis mediators and docking

mediators; (5) Exosome-carried anti-inflammatory cytokines and anti-inflammatory microRNAs inhibit inflammation of target cells via multiple shared and specific pathways, suggesting exosome-mediated anti-inflammatory effect of LIUS feasible; and (6) LIUS-mediated physical effects on tissues may activate specific cellular sensors that activate downstream transcription factors and signaling pathways. Conclusions: Our results have provided novel insights into the mechanisms underlying anti-inflammatory effects of LIUS, and have provided guidance for the development of future novel therapeutic LIUS for cancers, inflammatory disorders, tissue regeneration and tissue repair.