Nanomedicine within Biomaterials for Healthcare Applications

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Abstract

This talk will focus on the application of a non-viral peptide to deliver nucleic acid therapies from two different biomaterials for vaccine and wound healing applications. Nucleic acid vaccination holds appeal for those patients with a particular disease, particularly as both a prophylactic and therapeutic effect can occur. However, the bottle-neck in nucleic acid vaccination lies in an effective delivery technology. Our '*solution*' to this problem is a two-pronged approach of; i) a peptide delivery system, termed RALA, that is able to wrap the nucleic acids into nanoparticles, protect the nucleic acid from degradation, enter cells, disrupt endosomes and deliver the cargo to the cytoplasm (mRNA) or nucleus (DNA) ii) a microneedle patch (MN) that will house the nanoparticles within the polymer matrix, painlessly breach the skin's stratum corneum barrier and dissolve upon contact with skin interstitial fluid thus releasing the nanoparticles into the skin to the antigen presenting cells. Using our novel technology platform we have created both DNA and RNA vaccine for cervical cancer in a dissolvable microneedle patch and demonstrated both prophylactic and therapeutic responses in vivo. We have also developed an electrospun nanofibrous wound healing patch loaded with RALA nanoparticles with siRNA designed give temporal downregulation of the FK506-binding protein-like (FKBPL) gene in order to promote angiogenesis. The nanofibrous patch was designed to accommodate the nanomedicine specifically for wound healing and in vivo studies demonstrated a functional prototype.

Biography

Professor McCarthy's research team focuses on the development of non-viral delivery systems for nanomedicine applications. These biomimetic systems are designed to overcome the extra and intracellular barriers, so that the macromolecular payload can be delivered at the destination site in order to exert the optimal therapeutic effect. We have designed and patented a peptide delivery system, termed RALA that is able condense large and small anionic entities into nanoparticles, protect the cargo from degradation, cross cell membranes, escape endosomes and deliver the cargo to the cytoplasm and nucleus. Current research projects involve gene therapy for metastatic deposits; miRNA therapeutics for oncology and wound healing applications; mRNA and DNA vaccination strategies; repurposing of bisphosphonates and regeneration of bone by increasing the bioavailability of ceramics. The wide-spread utility of RALA delivery system has led to a spin-out company pHion Therapeutics www.phiontx.co.uk. Phion have commenced two lead therapeutic pre-clinical development programs supported by Innovate UK funding (i) a RALA/mRNA therapeutic vaccine for HPV; and (ii) a tumour targeted chemotherapeutic for pancreatic cancer. https://scholar.google.co.uk/citations?user=-4C6BasAAAAJ&hl=en