Nanostructure Enhanced Targeting (NSET) of Inflammatory Cells

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Technology description

Nanoparticles that selectively enter dendritic cells without the need for a targeting ligand. #biomedical #therapeutic #diagnostictool #theranostics #imaging #nanotechnology #nanoparticles #reagent #anti-inflammatory #atherosclerosis #MRI

Atherosclerosis, a leading cause of heart disease, results from chronic vascular inflammation that is driven by diverse immune cell populations. Nanomaterials may function as powerful platforms for diagnostic imaging and controlled delivery of therapeutics to inflammatory cells in atherosclerosis. However, their efficacy is limited by nonspecific uptake by cells of the mononuclear phagocytes system (MPS). Further, MPS cells located in the liver, spleen, blood, lymph nodes, and kidney rapidly remove the vast majority of intravenously administered nanomaterials from circulation regardless of surface functionalization or conjugation of targeting ligands. In addition, the therapeutic potential of nanoparticles has been hindered by the fact that they can be costly to manufacture if a targeting ligand is required. Northwestern scientists have demonstrated that they can tailor the morphology of nanostructures to enhance targeting specificity and have a technology that can address the current issues related to therapeutic nanomaterials.

Northwestern researchers have developed a nanoparticle that overcomes several aforementioned shortcomings of nanomaterials that have previously been proposed for therapeutic use. This nanoparticle exhibits specificity of entering dendritic cells (DCs), a subset of immune cells which mediate a variety of human diseases such as atherosclerosis. Atherosclerosis is a chronic inflammatory disease characterized by the deposition of cholesterol and fat within the walls of blood vessels and can lead to stroke or heart attack. Unstable plaques, which are more likely to rupture, are marked by an increased abundance of DCs. The nanoparticles developed at Northwestern, which specifically enter DCs, can be loaded with an imaging agent (i.e. MRI contrast agent) as a diagnostic tool to identify unstable plaques. The nanoparticles can also be used as a therapeutic if the particles are loaded with a drug or genetic material, providing a way to specifically deliver drugs to DCs. These nanoparticles have great potential to be used as a diagnostic and therapeutic, and may lead to new treatments for atherosclerosis and other diseases mediated by DCs.

Application area

Diagnostics
Identification of unstable atherosclerotic plaques for early detection of heart disease
Delivery of apoptotic inducing agents or anti-retrovirals to HIV-infected DCs
Delivery of radio-contrast agents
Therapeutics
Delivery of anti-inflammatory agents, chemotherapeutics, statins, siRNA/microRNA/plasmids
Delivery of vaccine formulations (to prevent atherosclerosis or to prevent infection of DCs by HIV)

Advantages

Increased targeting specificity and efficacy, resulting in decreased side effects and toxicity
Low production costs because high throughput methods are available for rapid assembly
New drug delivery method for cardiovascular- and inflammation-driven diseases
Dual function as a diagnostic and therapeutic

Institution

Northwestern University

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