ENGINEERING NANOPARTICLES FOR DRUG AND GENE DELIVERY

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ABSTRACT

Engineered nanoparticles show great promise for the treatment of a broad range of diseases, from inflammation, to tissue damage, to cancer. However, the success of the therapy depends on the design of nanoparticles that effectively interact with target cells, and efficiently overcome the intracellular barriers, thus resulting in low drug doses and reduced toxicity to non-target cells.

This seminar consists of three parts that address the overall engineering principles for nanoparticle-mediated therapy. The first part highlights our recent discovery of nanoparticle design criteria for specific binding and uptake by target cells. Emphasis will be given on the effect of nanoparticle geometry, particularly shape on the cell membrane binding, uptake and intracellular localization of macromolecular drugs. Our study showed that non-spherical nanoparticles exhibited higher cell-membrane adhesion, uptake and localization than those using spherical nanoparticles. Mechanisms of shape-induced enhancement will be discussed.

In the second part, I will present the design and synthesis of cationic polymer nanoparticles for gene delivery. I will discuss our understanding of the pathways through which the polymer-DNA complexes are transported inside cells. This fundamental understanding of gene delivery mechanisms is important for developing effective gene therapies.

In the third part, I will discuss my future research interests that include drug delivery, bioimaging, and tissue regenerative medicine using biodegradable particles for the prevention and detection of disease as well as for regenerative medicine therapy to repair damaged tissues.