BioSystems Science and Engineering

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Development of a Nanoparticulate Drug Delivery System for the Treatment of Diabetic Retinopathy

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Current protocols for the treatment of retinal diseases such as diabetic retinopathy (DR) typically involve administration of drugs using invasive techniques such as intravitreal injections. Repeated use of such injections can cause damage to the retina and in some cases even lead to blindness. Therefore, developing non-invasive routes for administration of drugs to retina would be desirable. However, administration of drugs via the topical route in therapeutic concentration and for adequate durations is challenging because of barrier properties of different layers of the eye. The differential permeability towards hydrophilic or hydrophobic molecules and tear fluid combined with mucus at the surface of the eye further complicates the matter. To address this problem we developed a noninvasive (topical administration) core-shell nanoparticle-based drug delivery system for targeting retina. In this study, we developed three different core-shell nanoparticle-based drug delivery systems consisting of a hydrophobic polycaprolactone core and a hydrophilic chitosan, gelatin or pluronic F68 shell. Biodistribution of these three nanoparticulate systems was studied in C57BL/6J mice after loading with a fluorescent dye, coumarin-6. Polycaprolactone particles coated with pluronic F68 (PCL-PF68) showed highest fluorescent intensity in the retina after topical route of administration. Further, PCL-PF68 nanoparticles were loaded with triamcinolone acetonide (TCA) and its clinical efficacy was evaluated in a diabetic rat model for the treatment of DR. Fundoscopic examination of the retina and retinal flat mount staining with isolectin-B4 indicated that topical administration of TCA loaded PCL-PF68 nanoparticle suspension decreased retinal neovascularization as compared to free drug suspension. Immunohistochemistry of glial fibrillar acidic protein (GFAP) and vascular endothelial growth factor (VEGF) indicated decreased expression of GFAP and VEGF in nanoparticles administered animals compared to animals administered with free drug. Taken together these results indicated that PCL-PF68 core-shell nanoparticle-based drug delivery system shows promise for the treatment of DR.

About the Speaker

Prof. Dhirendra Katti (BSc from Fergusson College, Poona University, PhD in Chemistry from Bombay Univesity) is currently Professor and Head of the Department of Biological Science and Bioengineering at IIT-Kanpur. He had also worked at IICT-Hyderabad, Drexel University-Philadelphia, and University of Virginia-Charlottesville. His research interests are in drug-delivery systems, tissue engineering, nano-biotechnology, and biomaterials. He serves on the editorial boards of Biomedical Nanotechnoogy, Trends in Biomaterials and Artificial Organs (India), and International Journal of Nanomedicine.