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Michael R Whittaker, J Pharm Drug Deliv Res 2017, 6:4 (Suppl)
DOI: 10.4172/2325-9604-C1-020

International Conference and Exhibition on

Nanomedicine and Drug Delivery

May 29-31, 2017 Osaka, Japan

Smart soft matter enabled nanomedicines

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Synthetic functional materials designed specifically to respond to biological cues are the subject of intense research interest due to their possible application in nanomedicine drug delivery. These "smart" materials offer not only new avenues for overcoming some of the current limitations in drug delivery via nanomedicines but also open pathways to new treatment strategies. In this Keynote I will highlight our current research in the following areas: A) Improved Subcellular Targeting: Novel polymers which respond to biochemical differences between the extra-and intracellular environments are useful for preparing particles which can chaperone a therapeutic agent in the systemic extracellular environment, and release said agent only when the particle is internalized by a target cell and in a specific sub cellular location. For example, the specific subcellular targeting of the NK1 internalized receptor signaling complex in spinal neurons shows promise as a new treatment for chronic pain and itch; B) Exploiting Cell Communication Pathways: Developing new materials which can specifically interact with or recruit cell communication pathways, for example those involving gasotransmitters (nitric oxide, hydrogen sulfide etc.), offer unique opportunities for improving therapeutic outcomes in cancer treatment. We are particularly interested in improving the chemotherapy treatment of chemoresistant cancers by developing materials which switch off cellular efflux pumps. C) Designed Biomimetic Polymers: Translating the functional motifs of antibacterial lipopeptides to synthetic polymers opens new approaches for addressing increasing global concerns of drug resistant bacteria. We have developed new synthetic antibacterial peptide analogues that exhibit broad spectrum antibacterial activity using the latest polymer synthesis techniques.

Biography

Michael R Whittaker is a Senior Researcher at the Monash Institute of Pharmaceutical Sciences (MIPS) and Project Leader within the ARC Centre of Excellence in Convergent Bio-Nano Science & Technology (CBNS). Previously, he worked as Senior Researcher within the Centre for Advanced Macromolecular Design (CAMD) and Australian Centre of Nanomedicine (ACN). His current work examines the translation of biological-control of macromolecular synthesis to wholly synthetic polymer systems and the use of stimuli-responsive "smart" soft matter for nanomedicine. Applications include novel antibacterial materials, soft matter nanoparticles that communicate with cells to give improved therapeutic outcomes, nanomaterials for improved theranostics and "smart" nanomaterials for sub-cellular targeting.

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