Indian Institute of Science
Centre for BioSystems Science and Engineering

BSSE Annual Work Presentation

11th February 2019, 4:00 PM, MRDG Seminar Hall, 1st floor, Biological Sciences Building

Surface modification of particulates: Understanding its impact on biological interactions

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ABSTRACT

Particulate systems, both at nano and micro scale, are being developed for a wide range of applications including delivery of therapeutic agents, as vaccines, diagnostics and for imaging. For successful translation of particulate technology, a better understanding of their interaction with immune cells, protein adsorption on particle surface, and mode of endocytosis in case of intracellular delivery is required. Many times, to achieve desired functionality, modulation of the interaction of particulates with proteins and immune cells is required. A variety of strategies have been adopted to achieve modulation, of which one is surface modification of particles. Surface characteristics are a major determinant of the behavior of particles in the biological milieu. For example, studies on nano-particles have shown that surface functionalization with polyethylene glycol (PEG) or proteins such as albumin increases circulation times by reducing their phagocytic uptake. However, studies on surface functionalized micro-particles have reported contradictory results. We have investigated the effects of surface functionalization using polystyrene particles with diameters ranging from 30 nm-2.6 µm and coating them either with albumin or PEG. Our results show that with increasing particle size, surface functionalization has less to no effect on altering phagocytic uptake. Further, these differences are observed even with a dense arrangement (required to escape phagocytosis) of molecules on the surface, appear to be independent of the serum proteins adsorbing on particles surfaces and is independent of the endocytic uptake pathway. These results provide insight into the differences in the ability of surface modified nano- and micro-particles to avoid phagocytic uptake. Next, we hypothesize that surface modification of particulates might induce changes in expression of genes in phagocytic cells because cells may recognize these particles as different from the ones which are non-modified. Thus, we are interested in exploring whether surface-modification leads to altered expression of genes essential to phagocytosis of different particle types. Additionally, we also aim to work towards stabilizing various proteins such as antibodies on particle surfaces so that they could be used for development of therapeutics. This is because most often in the process of formulation of a particle associated therapeutic system, its biological activity gets affected. Therefore, there is a further need to assess the stabilization and activity of the particle associated therapeutic agent under various physiological conditions.