VIRTUAL SEMINAR
Friday, 9.4.2021 at 13:00

MPŠ Seminar 1

Stealth biomimetic nanocarriers for diagnostic and gene therapy

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The advent of nanotechnology marked a turning point in chemistry, and, therefore, in pharmacology. Nanostructures are currently used as drug delivery system (DDS) or as drug themselves. While showing a remarkable and interesting evolution, last generation drug delivery system has now taken advantage of biomimetic, "stealth", properties, of multiple artificial carriers. The advancements in nanotechnology also lead to the birth of the concept of "theranostic" (a portmanteau for therapeutic + diagnostic), i.e. a single agent loaded with a therapeutic drug and a diagnostic agent (or more than one) for in-vivo imaging or straightforward assessment of the progression of the illness. Recently, after the discovery of phenomena like RNA interference, gene therapy has become the leading candidate in drug development in anti-cancer therapy and for the cure of genetic illnesses. Therefore, a next-generation Drug Delivery System, must also be able to: 1) protect the drug and the diagnostic agents from body clearance; 2) extend the formulation half-life and so therapeutic effect; 3) reduce their eventual toxicity, immune system recognition and avoid their bioaccumulation; 4) show smart drug delivery and eventually release upon a stimulus (light, heat, target recognition, ultrasounds) the cargo. Lastly, it should not destructively interact with its payload.

Currently, the most widespread approach to achieve the afore-mentioned aims is PEGylation. It has been recently shown the statistically significant arise of anti-PEG IgM and IgG in population, and the clear relation with phenomena like Accelerated Blood Clearance and Complement activation-related pseudoallergy, that hamper therapeutic effect of the drug. Thus, there's an urgency of developing new strategies for stealth and multifunctional DDS, like cell membrane-based ones. Among other cell lines, erythrocyte membrane would be the most suitable to be used as Drug Delivery System for theranostic agents since red blood cells are abundant, easy to collect and well-known in terms of biochemical and viscoelastic properties. Patient's own red blood cells can be used as carrier for theranostic agents, avoiding allergic reactions and immune-cell recognition. They can be surface-decorated, internal loaded with agents of interest and used as biomimetic coating for artificial nanoparticles. A few successful attempts to use them as loading agents concretized in FDA/EMA approved encapsulated drug, and in the arise of company like Erydel. Erythrocytes show peculiar properties in terms of rheology; their membrane can be further improved via shear stress processing, i.e. sonication and extrusion, originating thus nanoerythrosomes, which can be characterized as colloidal matter. Erythrocytes have been successfully loaded with enzymes, xenobiotic drugs, IR-imaging contrast agents and MRI contrast agents. Due to their ductile properties, they could represent an elegant platform to develop a theranostic agents for in-vivo imaging and gene therapy.

Kindly invited.