Nano-innovation and Drug-delivery: technological and biological issues

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The main goal of the pharmaceutical research is to design systems able to deliver the drug to the sites of interest, in the right dose, with a controlled rate and without any degradation. The conventional formulations have many limitations, such as poor bioavailability and fluctuations in plasma drug level, which compromise their therapeutic effect. Nanostructured materials have emerged as a valid alternative, being able to control drug release and targeting. In this way, they improve therapeutical performance of drugs, offering significant advantages in terms of enhanced therapeutic efficacy, reduced toxicity and improved patient compliance. In this context, polymeric or lipid nanoparticles have many advantages to achieve a desired therapeutic response. Due to their nature, they can enhance the permeation through biological membranes of encapsulated drug, improving its bioavailability. Furthermore, their high biocompatibility, low sizes and possibility of surface functionalization can permit the selective release of drugs to the suffering organ with high clinical efficacy and safety. Cyclodextrins are cyclic oligosaccharides, presenting a hydrophobic cavity and a hydrophilic external surface. They are able to include inside their cavity apolar drugs, forming "host-guest" inclusion complexes. In this way, physical-chemical properties of the included molecules are changed. For example, chemical stability, water solubility and dissolution rate are generally improved, with a consequent increase of bioavailability. Different products are today marketed for oral, parenteral and ophthalmic administration. The realization of an effective drug delivery system requires preformulation studies, comprising deeper physical-chemical and technological characterization of the formulated systems. Furthermore, in vitro/ex vivo and in vivo studies are needed to evaluate the safety and therapeutical activity of the new formulation.