Applications of electrospinning/electrospraying in drug delivery

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Summary
During recent years, nanoscaled materials have gained much attention because of their applications in the field of pharmaceutical and biomedical sciences. Electrospinning/electrospraying, as simple, effective and single-step methods, are used in the preparation of nanostructured materials (nanofibers and nanobeads). They offer an opportunity for direct encapsulation of the different types of drug molecules. The generated nanomaterials possess high surface area with porous characteristics, and the liberation of the loaded drugs follows a controlled-release pattern. Because of their wide applications in medical/pharmaceutical researches, the aim of this editorial is to highlight the importance of electrospinning/electrospraying technologies in drug delivery.

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During recent decades, nanoscaled drug delivery systems (DDSs) have gained much attention in the area of pharmaceutical and biomedical applications.1 Nanosized delivery systems are able to improve the physicochemical as well as the pharmacokinetic properties of either water-soluble or -insoluble drugs in the case of both local and systemic drug deliveries. Nanostructured materials are very beneficial for drug delivery purposes because of their several outstanding attributes such as (a) reduced particle size; (b) efficient drug transport; (c) the ability to target cells, extracellular origins, or special organs in the body; and (d) avoidance of unwanted mucociliary clearance and epithelial phagocytosis as well as reduction of undesirable reticuloendothelial uptake. Hence, delivery of drugs using nanosized DDSs, with novel and desired properties, has great potentials for a wide range of medical and pharmaceutical applications.2-4 Among different nanoparticle preparation techniques, electrospinning is known as one of the effective methods for the preparation of nanostructured materials.5 Electrospinning technique has been introduced as a method that employs the electrostatic force as a driving force for the fabrication of fibers in different shapes and sizes. In this method, a desired polymeric solution is subjected to a high electrostatic force, which results in the formation of fibers or particles. This procedure is usually called electrospraying when it leads to formation of nanoparticles (nanobeads) instead of nanofibers. The morphology and properties of the obtained nanoparticles or nanofibers are affected by several factors including process parameters (e.g., applied voltage, flow rate, distance between nozzle and collector, and size of the nozzle orifice), solution parameters (e.g., concentration, viscosity, conductivity) and ambient parameters (e.g., ambient temperature and humidity).6 Normally, an increase in the electrospraying solution concentration leads to higher viscoelastic forces, which could dominate the surface tension and initiate the fiber formation. The higher loading efficiency, the narrower particle-size distribution. The simplicity of preparation (due to single-step nature of the process) are the main prominent indicators of the electrospinning/electrospraying methods.7 Furthermore, these techniques offer great opportunity for the direct encapsulation of various types of drug molecules (hydrophobe, hydrophilie, and biomacromolecules) into the electrosprund structures. Thus, electrospinning and electrospraying methods seem to be promising pro-

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