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Editorial Open Access

Electrospun-nanofibers for Controlled, More Effective Chemotherapy

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Editorial

Electrospinning is the technique in which a high voltage applied across polymer solution enables the production of fibers of thickness in nanofibers, from a few nm to 100s of nm. The polymer solution could be therapeutic for cancer drug delivery, etc. Electro spinning enables to directly engineer Nano fibers that have many advantages as local drug delivery vehicles for therapeutic molecules [1,2], such as high loading capacity, extremely large surface area, porosity, high encapsulation efficiency, ease of modification, combination of two or more drugs, low cost and excellent outcome [3]. They are becoming potential important and versatile class of one dimensional material that has many promising clinical applications including controlled drug delivery for chemotherapy purposes [4]. With suitable components of the solution materials, such as long lasting or slow degrading composites it is possible to have slow release of growth factors and other chemotherapeutic molecules for a sustained release of encapsulated drug molecule for chemotherapy.

Both materials variables and the process variables influence the outcome- the structure, properties including porosity, weight, size and length of the Nano fiber [1]. The materials variables include chemical composition, polymer molecular weight, polymer molecular weight distribution, solution viscosity, surface tension, solvent nature, solution concentration, charge density and solution conductivity. The various processing variables are applied voltage (and hence the electric field strength-electrode-ground distance), electrode materials, electrode type-shape and size, solution evaporation rate and solution flow rate. The attractive attribute of electro spinning s that it is done at room temperature and at atmospheric pressure, which makes it very useful for many applications. By varying one or more of these variables, it is possible to enhance the porosity and hence adapt them for delivering various chemo drugs.

Use of electrospun nanofibers co-loaded with cisplation and curcumin were used to study the efficacy of this treatment to prevent local recurrence of cervical cancer after surgery [5]. Using He-La cells, the *in vitro* study results indicated growth inhibition and apoptosis induction. The *in vivo* study, using local implantation of nanofibers showed high accumulation of both the drugs at the surgical site. Considering that curcumin has low bioavailability and solubility, this is great news to know that in both *in vitro* and in vivo studies it is possible to use combination nanofibers to achieve better outcome for cervical cancer, which has locoregional recurrence following surgical resection. Similar good results were also obtained by other researchers.

Another method involves implantable drug delivery of electrospun nanofibers for cancer therapy. These electrospun nanofibers with high surface to volume ratio would accelerate the solubility of the drug in aqueous solution and enhance their efficacy of the drug. In addition, the drug release profile can be modulated by polymer degradation and the complicated diffusion pathway along special channels within nanofibers after being implanted at the target tumors [3]. Electrospun Polyvinyl Alcohol/Chitosan (PVA/CS) core-shell nanofibers were used to load and control the release of Doxorubicin (DOX) for inhibiting human ovary cancer cells, SKOV3 [6]. The drug was mostly distributed in the nucleus and less in the cytoplasm, improving the anti-tumor activity of DOX. Similarly the efficacy of Doxorubicin-Loaded Polylactide (DOX-PLA) electrospun nanofibers was studied by Liu et al., for Secondary Hepatic Carcinoma (SHCC). In this case, the growth of the SHCC nodules were significantly inhibited and the median survival time was increased more than 250%.

Electrospun nanofibers were also studied using DU145 prostate cancer cells [7]. In this case, highly porous chistosan nanofibers were used, which were produced by electrospinning of chitosan/ Polyethylene Oxide (PEO) blend solutions and then removing PEO with water. Chitosan is a natural, cationic amino polysaccharide copolymer of glucosamine and N-acetylglucosamine, commercially extracted from crab, shrimp, etc. It is the most common natural polysaccharide after cellulose and has several advantageous biological properties that are useful for cancer drug delivery, such as biodegradability, lack of toxicity, antifungal effects, wound healing acceleration, biocompatibility and immune system stimulation. Use of Paclitaxel nanoparticles, encapsulated in the pores of the nanofibers enables less or no side effects with no adverse reactions.

The properties of electrospun nanofibers results from the strong shear forces to which they are subjected during the rapid electrospinning process and from the small diameters [1]. Using multijet electrospinning it is possible to have a combination of materials/molecules/drug components to obtain a nanofiber of desired characteristics to treat for chemotherapy. Production of drug-loaded nanofibers is cost-saving. These nanofiber layers could be processed into the forms of pills, globules, insert, etc. for oral, rectal and other administrations [3elmarco]. It enables dramatic increase in poorly soluble drugs. It also enables controlled release and more than one drug molecules could be combined to enhance the drug efficacy, and has the potential to be the next generation of chemotherapy method.

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