

Ex vivo scavenging of pro-inflammatory nucleic acids by electrospun cationic nanofibers

Value proposition

Chronic wounds are a challenge to treat and consume a great deal of healthcare resources around the globe. In the setting of chronic wounds, dead and dying cells are continuously releasing nucleic acids that trigger inflammatory pathways and prevent wound healing. Furthermore, microorganisms can colonize chronic wounds and form biofilms, which further contributes to the ongoing cycle of inflammation that sabotages effective wound healing. A means of inhibiting inflammatory molecules and the ability of microorganisms to form biofilms may assist in the healing of chronic wounds.

Technology

Polycationic nanofibers are made by electrospinning a neutral polymer to produce nanofibers $<2\mu\text{m}$ in diameter and grafting a cationic polymer onto the neutral polymer nanofiber. Polycationic nanofibers can then absorb anionic substances in a solution such as pro-inflammatory cytokines, anti-coagulant proteins, or microorganisms capable of forming biofilms. Polycationic nanofibers can be incorporated into a medical device, bandage, or dressing, or may be used in a solution or administered directly to the patient. Thus, this has the potential to greatly reduce the incidence of inflammation and microbe infiltration at the wound site and improve wound healing.

Other applications

The use of polycationic nanofibers to scavenge pro-inflammatory nucleic acids, other anionic compounds such as anticoagulant proteins, and to inhibit the growth of microbes and biofilms can also be applied to other situations, including, but not limited to, the following:

- Use of polycationic nanofibers at site of chemotherapeutic treatment or other treatment likely to induce cell death or inflammation
- Ex vivo extracorporeal circuit for hemofiltration to deplete anionic compounds from the bloodstream
- Medical devices coated with polycationic nanofibers
- Administration to a patient to reverse the effects of an anionic anti-coagulant such as heparin

Advantages

- Experimental evidence from the inventors demonstrates that polycationic nanofibers:

 **Duke File (IDF) #**

T-004350

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- Block activation of pro-inflammatory NF-kB cells by selectively inhibiting nucleic acid based agonists
- Reduce chemotherapeutic cytotoxicity by scavenging extracellular nucleic acids released from doxycycline-killed cells
- Significantly reduce total biofilm mass on adjacent surgaces and do not promote biofilm growth of two species of *Staphylococcus aureus*.

These properties of polycationic fibers may improve current chronic wound management strategies by decreasing inflammatory compounds and preventing infections.

Patents

Patent Number: 10,066,323

Title: ELECTROSPUN CATIONIC NANOFIBERS AND METHODS OF MAKING AND USING THE SAME

Country: United States of America

Patent Number: 10,808,335

Title: ELECTROSPUN CATIONIC NANOFIBERS AND METHODS OF MAKING AND USING THE SAME

Country: United States of America