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Sustained Release Nanoparticulate Silver

Implantable, absorbable AgNP carriers provide tunable sustained local antimicrobial release for hard-to-treat and MDR infections.

Silver nanoparticles (AgNPs) have emerged as a potent antimicrobial agent to combat a broad range of microbial infections. The unique characteristics of AgNPs, such as their extensive surface area and silver's capacity to disrupt essential biological activities in microbes, contribute to their high effectiveness. Currently, there are silver coated implants and silver impregnated wound dressings that are utilized due to silver's antimicrobial properties. However, there are no treatment options using implantable sustained release nanoparticulate silver for deep seated, organ, and body cavity infections.

Researchers at Purdue University have developed three distinct implantable and absorbable sustained-release silver nanoparticle (AgNP) compositions for treating microbial infections in animals and humans. These compositions consist of an antimicrobial calcium sulfate hemihydrate (CSH) bead (AgNP–CSH bead), a poloxamer 407 gel (AgNP–gel), and a compressed absorbable gelatin sponge (AgNP–sponge). Each of these formulations encapsulates AgNPs and facilitates their prolonged dispersion. These compositions enable the delivery of high concentrations of antimicrobials at the site of infection, thereby inhibiting localized bacterial growth.

The researchers first demonstrated AgNP release from all three carrier media. Each carrier exhibited an initial burst of AgNP release, which was then sustained for at least 72 hours. The choice of carrier media offers flexibility in the release timing of AgNPs, thereby providing options for an immediate, high-concentration release or alternatively a steady, long-term release. Silver nanoparticles contained within gel and sponge exhibited antibacterial properties in vitro, with AgNP-gel having a bactericidal effect at the concentrations tested for a G- (E coli) and multidrug resistant G+ microbe (Staphylococcus pseudintermedius).

The innovation described here allows for immediate and localized treatment of wounds and surgical site infections. It also provides another treatment

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option for multidrug-resistant infections. Further, through choice of delivery mode and its corresponding rate of AgNP release, this innovation creates new avenues for personalizing antimicrobial treatment strategies based on specific patient needs and infection types.

Technology Validation:

- Release rate of the AgNPs were studied with the AgNP–gel constructs releasing 98.84% of the total initial AgNPs, AgNP–sponge constructs releasing 17.69%, and AgNP–CSH bead constructs releasing 1.03%

- Both AgNP carried by sponge and beads were effective against 102 CFU/ml E. coli while AgNP carried by gel was against 102-104 CFU/ml E. coli (MSRP results)

Advantages:

- Sustained released of AgNPs compared to traditional methods

- Depending on the distinct carrier construct, a range of release profiles is possible from the AgNP–gel's rapid burst release to the AgNP–sponge's steady, longer-term release

- Enhanced efficacy due to the AgNP–gel's high initial release of AgNPs

Applications:

- Localized treatment of wound infections by directly injecting the AgNP composite into tissue at wound sites.

- Wound healing and prevention of infections

- Treatment of multi-drug resistant (MDR) infections in veterinary and human medicine

- Drug delivery

Webpage for Additional Information:

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