Antimicrobial Activity of Silver Nanoparticles Incorporated in a Cryogel Matrix

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INTRODUCTION

Hospital acquired infections are a major financial and societal burden with high mortality, morbidity and cost. Such infections are caused by a number of pathogenic and opportunistic bacteria, many of which are resistant to front line antibiotics. To combat their emergence and spread, new approaches have been developed such as adding biocides to wound dressings and surgical implants, but have met with limited success. We proposed an innovative technology capable of improving the clinical outcomes associated with bacterial infection of skin, deep wounds and surgical implants. This approach will exploit the ability of silver nanoparticles (NPs)[1] to produce antibacterial radicals and reactive compounds. To begin with, antimicrobial activity of NPs and cytotoxicity of materials were tested.

EXPERIMENTAL METHODS

Silver nanoparticles have been synthesized using sodium borohydride reduction of silver nitrate. For the synthesis of the scaffold, silver nanoparticles were added to acrylamide and N,N'-Methylenebisacrylamide solution. The mixture was placed into a cryobath at -20°C. After 5 hours it was moved to freezer at -20°C for 12 hours.

To test antimicrobial effect, method of agar well diffusion was used. Briefly, small wells were cut in the agar medium, which was previously cultured with *Staphylococcus aureus.* Cryogel alone and cryogel with NPs were cut and placed in the wells. After incubation at 37°C for 24 hours, zone of inhibition was measured.

Morphological studies were carried out using SEM.

For cytotoxicity studies MTT assay was used. Cytotoxicity of cryogels, NPs, and cryogels with nanoparticles wore tested. All experiments were carried in triplicates.

RESULTS AND DISCUSSION

Polymerization of acrylamide and N,N'-methylenebisacrylamide eliminates toxicity of cryogels. Cryogels are sponge-like materials with medium to large pore sizes. The prepared cryogels were elastic, wet, and the colour was white. Upon drying, cryogel solidified and lost its properties. However, due to its property of shape memory, addition of water brought back the initial shape and characteristics. Nanoparticles were successfully incorporated into the pore walls of the cryogels according to SEM images.

Agar well diffusion method is based on the diffusion of NPs through the semi-solid agar growth medium to inhibit the growth of potentially sensitive microorganisms. The assessment of antibacterial activity of NPs within the cryogel demonstrated good inhibition zone of *S.aureus* by silver NPs within the cryogel matrix. Thus, silver NPs were not blocked by the cryogel and are available for interaction with the surrounding environment. Cytotoxicity experiments demonstrated no toxicity either by cryogels or NPs or both.

CONCLUSION

Acrylamide cryogel and nanoparticles were successfully fabricated and fused together. The prepared novel combination demonstrated good properties for use in wound healing: good adsorption, moist environment, no toxicity, and good antimicrobial effect. Our future work will be focused on application of microwaves to NPs in a controlled regime and pulsed motion, studying effect of microwaves on antimicrobial activity of NPs and formation of free radicals.

REFERENCES

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