

NANOCERIA INFUSED CHITOSAN-PVA HYDROGELS TO TREAT BURN WOUNDS

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ABSTRACT

Burn wounds are highly dangerous injuries with significant mortality rates. They are painful and increase the risk of bacterial infection. Burn wounds could also harm adjacent tissues by releasing dangerous compounds. Thus, their treatment should work quickly and effectively. Hydrogels are used as burn wound dressings that provide a suitable environment for regeneration. They closely imitate the structure of the skin's extracellular matrix and have high water uptake properties, providing a moist environment for faster healing. Chitosan-PVA based hydrogels demonstrated antibacterial and healing effects on wounds. Nanoparticles of cerium oxide called nanoceria were shown to reduce local oxidative stress by decomposing reactive oxygen species. The goal of this study is to learn the effects of nanoceria infused chitosan-PVA hydrogels on wound regeneration. We characterized hydrogels with various chitosan-PVA ratios, crosslinked with tetraethyl orthosilicate. These trials improved the procedure for making hydrogels capable of maintaining a moist environment for better wound healing. Further experiments demonstrated the biocompatibility and antibacterial properties of the hydrogels crosslinked with glutaraldehyde, where 3T3 fibroblasts seeded on the hydrogels were shown to be viable and zone of inhibition tests performed with *E. coli* demonstrated the antibacterial capacity of the hydrogels. Future studies will determine the antioxidant capacity and further bioactive properties of the nanoceria infused hydrogel. Once the small-scale procedure is well established the proposed methods could be implemented in clinical applications to aid in burn wound recovery.

Keywords: Wound healing, Hydrogel, Antibacterial hydrogels, Chitosan, PVA, Biocompatibility.

INTRODUCTION

According to the CDC, up to 10,000 people die every year in the United States from burn-related infections due to poorly treated burns [1]. Such devastating infections are a result of burn-induced high surface area wounds [2]. Large amounts of Reactive Oxygen Species (ROS) are released in burn wounds. ROS can cause inflammation, immunosuppression, and organ failure [3]. Current limitations of wound dressings include painful removal of the wound dressing. This can lead to a lack of sterility, poor absorption of wound exudates, and the inability to protect the wound from microbial infection. In the design of a good wound dressing these factors should be considered.

Chitosan (CS) is a useful material in burn wound management. Its properties include high biocompatibility, antibacterial effect, and high modification potential. Its physical and biochemical properties can be used in combination with polyvinyl alcohol (PVA) in wound healing applications. PVA is a synthetic polymer with many applications. However, these polymers alone might not be sufficient for wound healing. The use of glutaraldehyde as a chemical cross-linker for the formation of CS-PVA hydrogels is essential for this application. While toxic at certain concentrations, this crosslinker was specifically chosen for this application due to its ability to crosslink both PVA and chitosan [2]. This combination of chitosan, PVA, and glutaraldehyde can create effective hydrogels for wound management.