Multifunctional Delivery Degradable Cationic Polymer Based on Disulfide Exchange Polymerization for Infected Skin Defect Therapy

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Bacterial infections are one of the world's major public health challenges. The most widely used methods to treat bacterial infection are antibiotic therapies. However, traditional antibiotics are becoming less efficient because of the development of drug-resistant bacterial strains. It is of great urgency to develop new and potent antibacterial materials.

With the development of antimicrobial agents, cationic compounds such as quaternary ammonium (QA), imidazolium, pyridinium, and phosphonium salts are extensively used for thebiocidal properties against a broad spectrum of bacteria. However, the main chain of the cationic compounds are usually composed of C-C bonds, which is difficult to be effectively degraded and excreted in the body, leading to potential biological cytotoxicity. Thus, degradable cationic compounds are of great important in vivo antibacterial.

The epidermal growth factor (EGF) could stimulate the proliferation and migration of keratinocyte, endothelial cells, and fibroblast and facilitate skin regeneration. However, the EGF level has been proved to decrease in wounds. Although the application of exogenous EGF can accelerate wound healing, it is difficult to maintain bioactivities due to proteolytic degradation. Thus, functional nucleic acid (NA)-based therapy has been proposed for skin defect therapy.

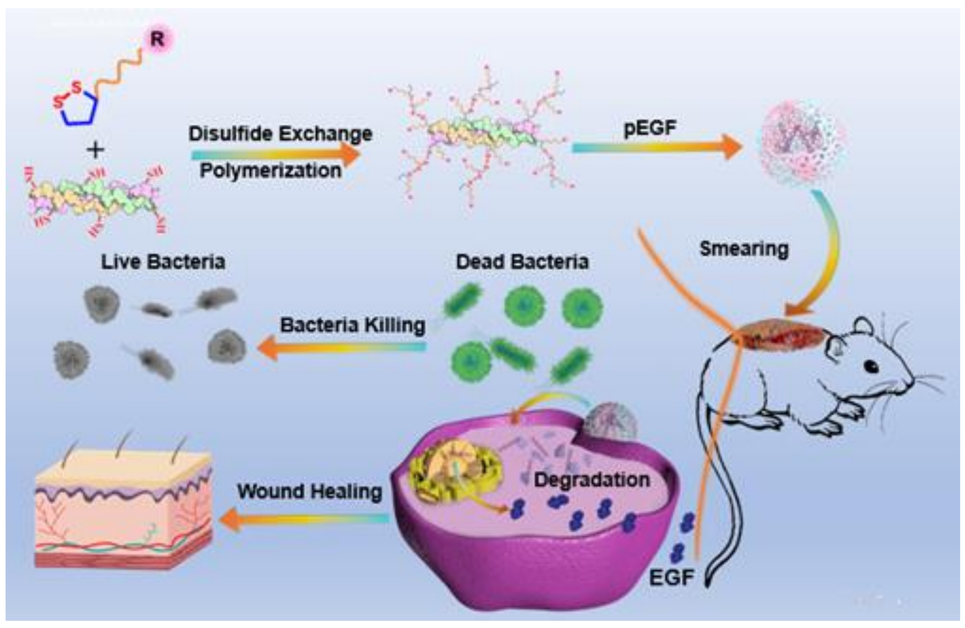

Figure 1. Schematic illustration of the degradable cationic polymer for infected skin defect therapy

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Herein, we successfully prepared the degradable cationic polymer via the disulfide exchange polymerization. The successfully obtained degradable cationic polymer was used as gene vectors to transport the epidermal growth factor (EGF) which was easily accepted by cell membranes (Fig. 1). The delivery of pEGF mediated by degradable cationic polymer was followed by the therapy of infected skin. The antibacterial ability, cytotoxicity, cellular uptake and transfection capability of degradable cationic polymer were assessed in detail. In addition, the in vivo therapy of infected skin was also evaluated.

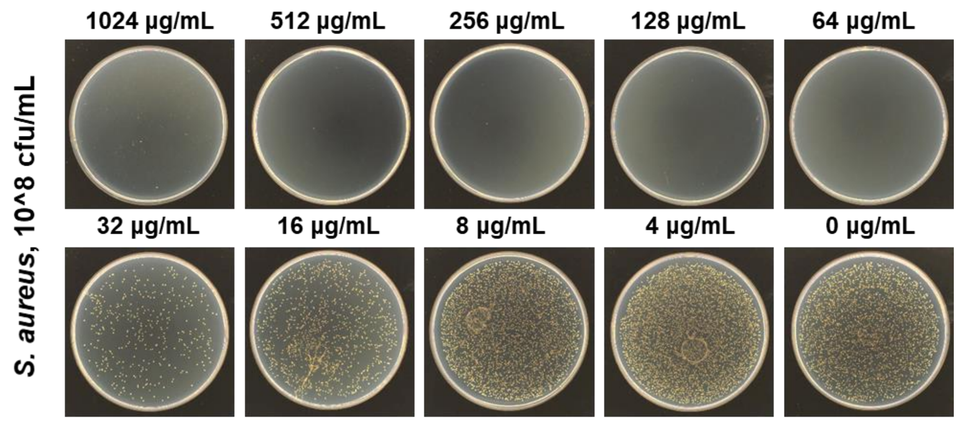

Figure 2. The pivotal data of degradable cationic polymer in vitro and in vivo

In summary, the degradable cationic polymer were successfully prepared via the disulfide exchange polymerization. The degradable cationic polymer exhibited excellent antibacterial activities against both *E.coli and S. aureus*. Notably, the degradable cationic polymer could simultaneously realize the antibacterial therapy and tissue healing of infected skin defect in vivo benefiting from the delivery of pEGF by the degradable cationic polymer .

References

[1] H-Q. Song, M-Y. Shao, Y Li, X-J. Ding,* F-J. Xu*, Multifunctional Delivery Nanosystems Formed by Degradable Antibacterial Poly(Aspartic Acid) Derivatives for Infected Skin Defect Therapy. *Adv. Healthcare Mater*. **2018**, 1800889.