Silver-Curcumin Nanoparticle Eradicate Enterococcus faecalis in Human ex vivo Dentine Model

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Abstract: Background and Significance: Among the dental infections, inflammation and infection of the root canal are common among all age groups. Currently, the management of root canal infections involves cleaning the canal with powerful irrigants followed by intracanal medicament application. Though these treatments have been in vogue for a long time, root canal failures do occur. Treatment for root canal infections is limited due to the anatomical complexity in terms of small micrometer volumes and poor penetration of drugs. Thus, infections of the root canal seem to be a challenge that demands development of new agents that can eradicate E. faecalis. Methodology: In the present study, we synthesized and screened silver-curcumin nanoparticle against E. faecalis. Morphological cell damage and antibiofilm activity of silver-curcumin nanoparticle on E. faecalis was studied using scanning electron microscopy (SEM). Biochemical evidence for membrane damage was studied using flow cytometry. Further, the antifungal activity of silver-curcumin nanoparticle was evaluated in an ex vivo dentinal tubule infection model. Results: Screening data showed that silver-curcumin nanoparticle was active against E. faecalis. silver-curcumin nanoparticle exerted time kill effect. Further, SEM images of E. faecalis showed that silver-curcumin nanoparticle caused membrane damage and inhibited biofilm formation. Biochemical evidence for membrane damage was confirmed by increased propidium iodide (PI) uptake in flow cytometry. Further, the antifungal activity of silver-curcumin nanoparticle was evaluated in an ex vivo dentinal tubule infection model, which mimics human tooth root canal infection. Confocal laser scanning microscopy studies showed eradication of E. faecalis and reduction in colony forming unit (CFU) after 24 h treatment in the infected tooth samples in this model. Further, silver-curcumin nanoparticle was found to be hemocompatible, not cytotoxic to normal mammalian NIH 3T3 cells and non-mutagenic. Conclusion: The results of this study can pave the way for developing new antibacterial agents with well deciphered mechanisms of action and can be a promising antibacterial agent or medicament against root canal infection.

Keywords: ex vivo dentine model, inhibition of biofilm formation, root canal infection, silver-curcumin nanoparticle

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