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Antimicrobial effect of zinc oxide and silver nitrate nanoparticles against *S. aureus*, *A. baumannii* and *P. aeruginosa*

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Abstract

Background and Objective: Nanoparticles have been introduced as novel antimicrobial agents because of their properties that are different from their bulk properties. Present study was aimed to investigate antimicrobial activity of silver nitrate and zinc oxide nanoparticles against three main bacteria responsible for nosocomial infections, S. aureus, P. aeruginosa and A. baumannii.

Materials and Methods: Solutions of nanoparticles were prepared at various concentrations (31.5-4000 ppm) in a serial method. Disks with various concentrations of nanoparticles were then placed on bacterial cultures for 24 hours and diameter of inhibition was measured after 24 hours of exposure to nanoparticle in incubator. Using a diagram without statistical analysis, diameters of inhibition were compared between various concentrations and kinds of bacteria. Analysis of variance was used to compare the diameter of inhibition between bacteria based on a variety of nanoparticles regarding their concentration.

Results: Nanoparticles of zinc oxide made an inhibitory diameter of 13.6 mm at highest concentration to 7 mm at lowest concentration of nanoparticle for S. aureus. For this bacterium, silver nitrate nanoparticle had a larger inhibitory diameter (16.33 mm to 8.67 mm). Zinc oxide nanoparticle did not have an inhibitory effect on P. aeruginosa and A. baumannii. The maximum inhibitory diameter of silver nitrate nanoparticle on P. aeruginosa and A. baumannii was measured 13.33 mm and 22.67 mm for P. aeruginosa and A. baumannii, respectively. For both bacteria, inhibitory area reached to zero at a concentration of 125 ppm. Inhibitory areas of silver nitrate were significantly greater than those for zinc oxide ($p<0.001$).

Conclusion: In summary, silver nitrate nanoparticles have greater antimicrobial activity. Antimicrobial activity of zinc oxide nanoparticles was restricted to gram-positive bacteria.

Key words: Antimicrobial activity, Nanoparticles, Silver nitrate, Zinc oxide, S. aureus, P. aeruginosa, A. baumannii

1. Introduction

Nosocomial inactions are defined as infections without evidence of incubation at the time of admission to a healthcare setting. It can be said that two main challenges of the infectious disease medicine are facing resistance to antibiotics and nosocomial infections in the current century (1). Widespread usage of antibiotics and high potential to overcome biological targeted agents encourage scientists to develop newer versions of antimicrobial agents such as nanoparticles. Nanoparticles have been introduced as novel antimicrobial agents because of their properties that are different from their bulk properties (2). Antibiotic resistance is a problem of global significance. Moreover, the overuse of antibiotics causes the emergence of bacterial resistance and increases healthcare costs and sepsis-related deaths. Widespread usage of antibiotics and high potential to overcome biological targeted agents encourage scientists to develop newer antimicrobial agents like nanoparticles (2-4). Nanotechnology has been taken global interest in nanoparticles (NP) that are of unique properties as compared to their bulk equivalents. The antimicrobial activity of NP was

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