Susceptibility of gram-negative rods to metallic nanoparticles

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Background. Nowadays nosocomial infections caused by multi-drug-resistant microorganisms have become the most urgent problem of public health. Gram-negative rods such as E. coli, K. pneumoniae, P. vulgaris, P. aeruginosa are major causes of hospital-acquired infections. Due to dramatic increase of antibiotic resistance among these pathogens the innovative approaches in the development of antimicrobial agents play crucial role in solving this problem.

Aim. In order to search new effective substance with antibacterial activity we have analyzed susceptibility of gram negative bacilli isolated from patients to silver and cooper nanoparticles alone as well as in their combination.

Methods. Cu and Ag nanoparticles were synthesized with use PVP. X-ray diffraction, transmission electron microscopy, UV-VIS spectroscopy and inductive-coupled plasma atomic spectrometry used for nanoparticle characterization. Clinical strains of E. coli, K. pneumoniae, P. vulgaris, P. aeruginosa were isolated from patient. In-vitro investigation of the antimicrobial agent's activity was performed by tube serial dilution method to determine the minimal inhibitory concentration.

Results. All species except E. coli that was less sensitive were inhibited with Ag NPs at concentration 25 μg/ml. Antibacterial activity of Cu NPs varied from 125 μg/ml against E.coli to 1000 μg/ml against K. pneumonia, P. aeruginosa and P. vulgaris. In order to evaluate impact of ultrasound on the Ag NPs and Cu NPs antimicrobial efficiency we sonicated them before their use. It was found ultrasound treatment improves silver and copper nanoparticles antibacterial activity at least two times in all cases. Mixture of the Ag and Cu NPs led to sharp increasing of their antibacterial activity. Minimal inhibitory concentration of both components dropped more than 100 times for all types of microorganisms.

Conclusions. Silver and cooper nanoparticles possess antimicrobial activity against E. coli, K. pneumoniae, P. vulgaris, P. aeruginosa. Sonication and combination of nanoparticles improve their antimicrobial effectiveness.

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