

Development of a Novel Nanobiosystem for the Selective Nanophotothermolysis of Meticilin Resistant Staphylococcus Aureus Using Anti-MRSA Antibody Functionalized Gold Nanoparticles

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Abstract : Introduction: Due to antibiotic resistance, systemic infections caused by Meticilin resistant Staphylococcus Aureus (MRSA) are the main cause of millions of deaths each year. Development of new active biomolecules that are highly effective and refractory to antibiotic resistance may open new avenues in the field of antimicrobial therapy. In this research, we have focused on the development of a novel nanobiosystem with high affinity for MRSA microorganism to mediate its selective laser thermal ablation. Materials and Methods: Gold nanoparticles (15nm in diameter) linked to a specific antibody against MRSA surface were selectively delivered (at various concentrations and incubation times) and internalized into MRSA microorganism following the treatment these multidrug-resistant bacteria were irradiated using a 2w, 808 nm LASER. Results and Discussions: The post-irradiation necrotic rate ranged from 51.2% (for 1 mg/L) to 87.3% (for 50 mg/L) at 60 seconds ($p < 0.001$), while at 30 minute the necrotic rate increased from 64.3% (1 mg/L) to 92.1% (50 mg/L), p value < 0.001 . Significantly lower apoptotic rates were obtained in irradiated MRSA treated with GNPs only (control) treated for 60 seconds and 30 minutes at concentrations ranging from 1 mg/L to 50 mg/L. We show here that the optimal LASER mediated the necrotic effect of MRSA after incubation with anti-MRSA-Ab was obtained at a concentration of 50 mg/L. Conclusion: In the presented research, we obtained a very efficacious pulse laser mode treatment of individual MRSA agents with minimal effects on the surrounding medium, providing highly localized destruction only for MRSA microorganism.

Keywords : MRSA, photothermolysis, antibiotic resistance, gold nanoparticles

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