In Vivo Photoacoustic and Photothermal Nano-Theranostics of Biofilms

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Technology description

Attacking Resistant Bacteria with Gold Nanoparticles
For many years the medical profession has had a good weapon to use to kill bacterial infections – anti-biotics. Yet due to the evolution of bacteria, various strains of bacteria have developed resistance to almost every known anti-biotic. One of the more well-known strains of resistant bacteria is Multi-Resistant Staphlococcus Aureus, or MRSA, which is estimated to be carried by up to 50 million people worldwide. The mortality rate for MRSA infections is about 20%. The number of species of bacteria that are resistant to bacteria is growing, increasing the need for a new way to combat these bacteria in the body.
One new and promising method is to use photo-acoustic nanoparticles, specifically, gold nanoparticles that are functionalized to target bacteria. The gold nanoparticles are coated with material that has an affinity for the target bacteria so that the nanoparticles are attracted to the bacteria and stick to them. After the patient has been injected with the gold nanoparticles, a laser pulse is applied to the site of the infection, which causes the gold nanoparticles to vibrate rapidly, thus heating and destroying the bacteria. Because this method of killing the bacteria is not related to the chemistry of the bacteria, or its metabolism, the method is useful in cases where the bacteria form a film. Antibiotics are not as effective against bacterial in films because of the low metabolism of these bacteria, and thus reduces their effectiveness.
Technology:
Future work would include the evaluation of alternative antibiotics (work done to date has focused on daptomycin), the evaluation of additional S. aureus specific antibodies both alone and in combination with each other (work done to date has been limited to two antibodies), evaluation of therapeutic efficacy in the context of different strains of S. aureus (work done to date has been limited to two strains), and evaluation of therapeutic efficacy in diverse forms of S. aureus infection including bacteremia, osteomyelitis, and implantassociated infection.

Application area

Infectious diseases : To treat infections caused by bacterial pathogens including those resistant to conventional antibiotics and those that cause bio-film associated infections.

Advantages

Antibiotics target bacterial metabolic processes. Acquired antibiotic resistance is a growing problem that is further complicated by the fact that some forms of infection, including those associated with biofilm formation, exhibit intrinsic antibiotic resistance owing to reduced metabolic activity. The novelty and advantage of the proposed technology is that it is capable of the targeted physical destruction of bacterial cells irrespective of their metabolic or antibiotic resistance status while at the same time capable of delivering antibiotics directly to the offending bacterial cells in concentrations high enough to overcome this intrinsic resistance.

Institution

University of Arkansas

Inventors

Daniel Meeker
Jingyi Chen
Associate Professor
Chemistry and BioChemistry
Karen Beenken
Mark Smeltzer
Professor
Microbiology and Immunology

联系我们

叶先生

电 话：021-65679356

手 机：13414935137

邮 箱：yeyingsheng@zf-ym.com