Title:Eradication of Biofilm Related Infection Using AC Generated Electromagnetic Force at Very Low-Low Frequency and MIC Doses of Antibiotics in a CBE Flow Reactor

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INTRODUCTION:

Introduction: Approximately 1-3% of patients with total joint replacements develop bacterial or fungal infections which respond poorly to antibiotic treatment. These infections are often serious enough to warrant removal, debridement, and replacement of the implant. There is a need to provide a non-invasive solution for treating infections occurring on medical implants. Attention has been directed at DAIR procedures to do this. New technologies may allow for interruption of Quorum Sensing of biofilms the and render the bacteria to more bactericidal to antibiotics at MIC levels.

METHODS:

Methods: Coupons (19 mm x 25.4 mm x 2 mm) composed of 430 stainless steel, were inoculated with MRSA M2 Methicillin and incubated for one week at 37 C in Tryptic Soy Broth (TSB) to culture biofilms. M2 MRSA was minimally susceptible to 1 µg/ml of vancomycin. After biofilm growth, the coupons were washed to remove non-adherent bacteria and transferred to 50 mL tubes containing 40 mL TSB with and without vancomycin. Bacteria were exposed to an AC-EMF at 10.7 mTelsa at low radio frequency of 30-100kHz frequency for varying times to heat the coupons to 45, 55, 60, and 65 degrees C. After exposure to EMF and overnight incubation, the coupons were washed four times with PBS. Biofilm bacteria were removed from the coupons using a plastic scraper. Bacteria in the culture supernatant and in the biofilm were enumerated by plating on agar plates and colony-forming units (CFU) were determined.

RESULTS:

Results: The increased temperatures had little effect on the CFU/mL when cultured without the addition of vancomycin. However, in the presence of 1 µg/ml of vancomycin, temperatures increase of 45C and 55C resulted in significant reductions of CFU. The CFU had a log 3 reduction at 45C and went below the limit of detection at 55C. Increases in temperatures from 37 C to 55C and to 65C results in reductions of CFU's dropped to below the limit of detection in the supernatant at 65C.

DISCUSSION AND CONCLUSION:

Discussion: EMF at very low to low frequency and mTesla can eradicate biofilm when externally applied through AC wires with MIC amounts of antibiotics. This may result in in the non-invasive treatment of biofilm related infection on implants or give higher rates of success with procedures like DAIR.

Conclusion: EMF at very low-low frequency and high Tesla heating up to 65 degrees celsius destroyed biofilm with use of antibiotics at MIC on prosthetic devices in a CBE (Center for Biofilm Engineering) fluid flow reactor for biofilm.