2019 Annual Conference Abstract Submission

PRESENTATION TITLE:
Effectiveness of Hydrogen Peroxide on the Treatment and Eradication of Cutibacterium (Propionibacterium) Acnes Biofilm

DEGREE:
Doctor of Medicine - Resident

IF NOT ACCEPTED FOR PODIUM PRESENTATION, IS POSTER PRESENTATION ACCEPTABLE?
Yes

LIST ANY DEVICES NOT CURRENTLY APPROVED FOR USE BY THE FDA:

STRUCTURED ABSTRACT (PURPOSE, METHODS, RESULTS, AND CONCLUSIONS) IN LESS THAN 400 WORDS:

PURPOSE: C. acnes infections of shoulder prostheses remains a significant medical problem. Metal-associated biofilm is a major factor in treatment failures. The purpose of this investigation is to determine the efficacy of hydrogen peroxide on the eradication of Cutibacterium acnes (formerly known as Propionibacterium) biofilm on metallic shoulder prosthesis.

METHODS: C. acnes strains were plated onto sheep blood agar plates and incubated at 37°C in an anaerobic chamber with BD GasPaks for 3-4 days. C. acnes ~1E6 CFU ml-1 (colony forming units per milliliter) inoculum (one strain ATCC 6919 and 3 clinical isolates) were grown on sterilized stainless-steel washers for 4-6 days in 3mL TSB (tryptic soy broth) medium anaerobically. This was repeated on all components of reverse total shoulder prosthesis (baseplate, glenosphere, humeral stem, humeral tray, and polyethylene components). Once a biofilm formed, the media in each well was gently removed and 1mL of the indicated peroxide concentrations diluted from a 30% solution in water (0.5%, 1%, 3%, 4%, 5%, 6%, 8%, and 10% concentrations) or from a 3% store-bought prep ("neat") was added for 1, 3, 5, 10, 15, or 30 minutes. The washers were aseptically transferred to a tube containing 4mL DPBS and sonicated for 15 minutes. Dilutions were plated on sheep blood agar plates and grown anaerobically for 4 days before counting. Live/dead staining of the biofilms (Syto9 (green) live, Propidium iodide (PI)(orange) dead) was visualized with a spinning disk confocal microscope at 20X/0.4 NA. After untreated time zero images were acquired, peroxide at a 3% final concentration was added. Images were taken every minute for 10 minutes. Analysis was performed with IMARIS software to determine percentage of live and dead bacteria.

RESULTS: Significant reduction in C. acnes biofilm was demonstrated and was both time and H2O2 concentration dependent. The minimum concentration of 0.5% H2O2 demonstrated statistically significant ($p=0.0004$) log reduction (CFU mL-1) of biofilm (2.94; 95%CI 0.90 to 4.98) after 30 minutes of exposure. 1% H2O2 demonstrated statistically significant ($p<0.0001$) log reduction (CFU mL-1) of biofilm (2.21; 95% CI 0.85 to 3.56) after 1 minute. Limit of detection of biofilm (>99.9% eradication) was reached following 10 minutes of treatment with either 3% dilute or 3% "neat" H2O2 preparations. This was further shortened to 5 minutes using 8% H2O2. Untreated controls showed stable amounts of biofilm at each timepoint tested. Additionally, there was no statistically significant difference comparing 3% "neat" to 3% dilute H2O2 preparations at any time point. A significant reduction in % live bacteria was found following <5 minutes of exposure with 3% H2O2.

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CONCLUSIONS: Both preparations of 3% H2O2 was effective in producing a > 2-log (CFU mL-1) reduction in biofilm by 5 minutes of treatment and reaches limit of detection, >4-log reduction (CFU mL-1), following 10 minutes. Limit of detection for C. acnes biofilm is reached at 5 minutes with use of 8% H2O2. These results provide evidence that H2O2 is effective at eradication of C. acnes biofilm on stainless steel implants and may be a useful tool for the treatment of periprosthetic shoulder infection.