Temporal Quantification of Infection in a Preclinical Prosthetic Joint Infection Model

Erik P. Rader[1], Elizabeth Stewart[1], Nour Bouji[1], Matthew J. Dietz[1]
West Virginia University School of Medicine, Morgantown, WV
erik.rader@hsc.wvu.edu

Disclosures: Erik P. Rader (N), Elizabeth Stewart (N), Nour Bouji (Heraceus Medical), Matthew J. Dietz (Heraeus Medical, Peptilogics)

INTRODUCTION: Prosthetic joint infection (PJI) is a leading cause of orthopaedic morbidity coincides with a 5-year mortality rate of 20%. While the systemic response to PJI is well documented, research regarding the local response over time is limited. Therefore, the objective of this study was to perform the initial step of quantifying infection in the days following a localized infection in a preclinical PJI model.

METHODS: This study was approved by the Institutional Animal Care and Use Committee. Kirschner wire (K-wire) implants were inserted into the femoral canals of the right femurs of male and female adult Sprague-Dawley rats and were inoculated with 10^5 colony-forming units (CFUs) of methicillin sensitive Staphylococcus aureus (*S. aureus*) directly into the joint space before closing the incision. The K-wire implants and bone tissue samples were collected at 1, 7, 10, and 21 days (sample sizes per group are listed in figures). Two methods were used to assess infection - (1) *S. aureus* on K-wires were labeled by immunofluorescence and the optical density (mean grey value multiplied by % area) of 2D images were evaluated by ImageJ and (2) tissue samples were cultured and CFU per gram were measured (data from this method were reported in a previous conference abstract and is included here for comparison purposes with the data regarding the immunofluorescent method). ANOVA with Tukey's correction was performed (Prism 9, GraphPad, San Diego, CA).

RESULTS: The temporal profile for *S. aureus* optical density exhibited a pattern of higher values at the middle timepoints of 7 and 10 days (Figure 1). However, values were highly variable and no significance was observed ($p = 0.65$). Tissue culture data were less variable and increases at 7 and 10 days reached significance ($p < 0.05$) (Figure 2).

DISCUSSION: The findings demonstrate temporal changes in bacterial tissue burden in a local simulation of PJI. Detection of these changes were apparent in tissue culture quantification. Further work will explore whether 3D analysis will improve quantification by immunofluorescence labeling of *S. aureus*.

SIGNIFICANCE/CLINICAL RELEVANCE: This research highlights the temporal response of local infection and methods of infection quantification – important topics for clinical research design regarding PJI. Understanding these features will aid in selecting timepoints for research regarding PJI treatment.

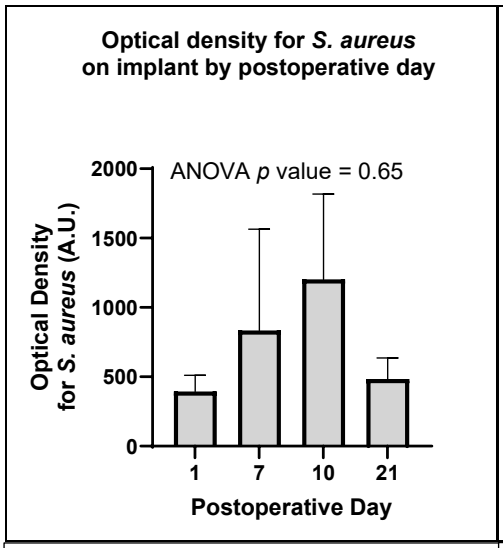

Figure 1. Optical density for immunofluorescent-labeled *S. aureus* on K-wire implants following inoculation of *S. aureus*. Sample sizes were 4 per group with exception of 10 day data, *n*=3. Values are mean ± SEM.

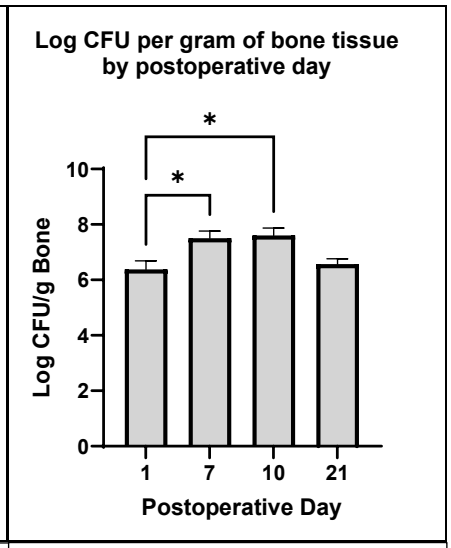

Figure 2. Log CFU/g of bone tissue following inoculation of *S. aureus*. Sample sizes were 4 per group. Values are mean ± SEM. (*) Different from 1 day value, $p < 0.05$. No other differences were observed.