Antibiotic Elution from a Magnesium Phosphate Resorbable Cement

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Purpose: Successful treatment of bone infection may involve debridement and use of antibiotic-loaded cement. Polymethylmethacrylate (PMMA) has several disadvantages when used for this purpose, including need for second-surgery removal. Calcium sulfate bioresorbable cements are an alternative to PMMA, but resorption is commonly associated with wound drainage. To address these issues, the novel magnesium phosphate resorbable bone void filler cement OsteoCrete has been used increasingly. This study was designed to test the hypothesis that OsteoCrete mixed with an antibiotic would inhibit bacterial growth without decreasing osteoblast viability.

Methods: Antibiotic beads were created by mixing 5 cm3 of OsteoCrete (OC) for 2 minutes, adding 1 g of vancomycin, mixing another 30 seconds, and spreading the putty mixture over a bead mat. Control OC beads did not contain vancomycin (vanc). Beads were incubated for 30 minutes, then removed from the mat. Zone of Inhibition Test: OC-vanc and cntrol beads (n = 6 each) were placed on Staphylococcus aureus and Pseudomonas aeruginosa agar plates. Plates were incubated for 24 hours at 37°C, then zone of inhibition was measured. Osteoblast Cell Culture: Osteoblasts were seeded onto OC-vanc and control beads, cultured with or without 10 mL of Ss aureus or P. aeruginosa, and incubated at 37°C for 9 days. Resazurin Metabolic Assay: After 9 days, the resazurin assay was performed to determine metabolic activity in each well. If beads were cytotoxic, level of fluorescence would be lower than controls. Bacterial growth would increase fluorescence compared to controls. Statistical analyses: Paired t-tests and 1-way analysis of variance with Tukey HSD (honestly significant difference) post hoc test were performed.

Results: Zone of Inhibition: Control beads did not elicit any zones of inhibition for either bacteria. There were significant zones of inhibition for OC-vanc beads (S. aureus 3.51 cm2, P. aeruginosa 0.53 cm2, $P < 0.001$). Resazurin Metabolic Assay: Fluorescent levels were as follows: control = 51,834; OC-vanc = 54,463; OC-vanc + S. aureus = 58,252; Control + S. aureus = 72,937; OC-vanc + P. aeruginosa = 55,544; control + P. aeruginosa = 1,706,360. The significantly ($P < 0.001$) increased level of fluorescence in the control + P.aeruginosa compared to controls was indicative of marked bacterial growth.

Conclusion: The data from this study indicate that OsteoCrete elutes sufficient antibiotic to inhibit bacterial growth while avoiding cytotoxicity to osteoblasts. As such, antibiotic-loaded OsteoCrete can be considered as a viable option for clinical use in bone infections.