Paper - Basic Science

Paper Session: Infection and
Fracture Healing

Local Antibiotic Delivery Via Calcium Sulfate for Orthopaedic Infections

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Purpose: There has been increasing interest in the use of synthetic absorbable calcium sulfate (CaSO4) material for local antibiotic delivery in orthopaedic infections. Evidence to guide antibiotic selection and dosing within this material is of immediate clinical relevance. The purpose of this study was to quantify and compare the elution characteristics of tobramycin, vancomycin, cefazolin, dalbavancin, minocycline, fosfomycin, amikacin, and meropenem antibiotics from synthetic CaSO4 beads.

Methods: Synthetic 4.8-mm CaSO4 beads were created containing 2.5 to 5% of each antibiotic by weight. Beads were placed individually into Eppendorf tubes containing phosphate-buffered saline. The antibiotic solutions were incubated at 37°C in a shaking incubator to simulate in vivo conditions. The eluent was harvested at 8 time points over 28 days. Antibiotic concentrations at each time point were measured using high performance liquid chromatography and used to calculate hourly elution rates.

Results: CaSO4 beads demonstrated burst release kinetics. Table 1 shows the last timepoint for each antibiotic at which the elution rate was above or equal to the minimum inhibitory concentration (MIC) for 3 bacterial isolates: Staphylococcus aureus, Escherichia coli, and Acinetobacter baumannii. Vancomycin, dalbavancin, minocycline, and cefazolin had elution rates greater than the S. aureus MIC for at least 7 days. Minocycline also demonstrated elution rates greater than the E. coli MIC for 7 days and greater than the A. baumannii MIC for 28 days.

Conclusion: This study evaluated the in vitro elution characteristics of 8 antibiotics from CaSO4 using quantitative methods. Vancomycin, dalbvancin, minocycline, and cefazolin eluent concentrations were sufficient to achieve S. aureus bacterial inhibition for 7 days. Minocycline and meropenem had sustained elution rates above MIC for the tested gram-negative bacteria at 48 hours.

Table 1: Last time point at which antibiotic elution rate (µg/mL/hr) remains above baseline MIC for each antibiotic-isolate combination

	E. Coli	*S. Aureus*	*A. Baumannii*
Tobramycin	24 hours	24 hours	24 hours
Minocycline	7 days	14 days	28 days
Amikacin	24 hours	24 hours	24 hours
Vancomycin	-	7 days	-
Meropenem	48 hours	48 hours	48 hours
Dalbavancin	-	28 days	-
Fosfomycin	-	48 hours	-
Cefazolin	48 hours	7 days	-