Antimicrobial activity of bioactive glass S53P4 against representative microorganisms causing osteomyelitis – Real-time assessment by isothermal microcalorimetry

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Bioactive glass (BAG) is a synthetic bone substitute with intrinsic antimicrobial properties, used for bone defect filling. We evaluated the antimicrobial activity of two formulations of BAG S53P4 against representative pathogens of osteomyelitis: Staphylococcus aureus, Staphylococcus epidermidis, Enterococcus faecalis, Escherichia coli and Candida albicans. Antimicrobial activity of BAG S53P4 was assessed by isothermal microcalorimetry, a highly sensitive assay measuring metabolic-related microbial heat production in real-time. Standard CFU counting was performed in parallel. BAG granules (diameter 500−800 μm) and powder (< 45 μm) were evaluated in two concentrations (400 and 800 mg/ml). Isothermal microcalorimetry was performed in glass ampoules containing growth medium, BAG and test microorganism, heat production was measured for 24 h.

BAG S53P4 inhibited heat production of most-tested microorganisms with heat reduction of 60%–98% compared to positive control after 24 h of exposure to the highest-tested concentration (800 mg/ml). BAG S53P4 in powder formulation (< 45 μm) inhibited more microbial growth than in granule formulation (500−800 μm), except for C. albicans for which both formulations presented similar inhibition rates ranging between 87 % and 97 %. The BAG inhibitory ratios estimated from the variation in the growth rate constants of each microorganism compared to the growth control ranged between 2.55 % and 100 %. Comparable results were obtained by CFU counting, with complete reduction in cell viability of most microorganisms after ≤24 h of microbial exposure to BAG S53P4 powder. In summary, BAG S53P4 demonstrated efficient inhibition of microbial growth, especially in powder formulation.

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