INFECTION TREATMENT WITH A UHMWPE/GS SPACER

1. O. Muratoglu, D. Gil, R. Connolly, K. Wannomae, E. Oral

Harris Orthopaedic Laboratory, Massachusetts General Hospital, Boston, MA, USA

Infection remains as one of the major challenges of total joint surgery. One-stage irrigation, debridement and reimplantation, or two-stage revision surgery with a temporary implantation of antibiotic eluting bone cement spacer followed by reimplantation are two methods often used to treat infected patients with mixed outcomes. Like bone cement, ultra-high molecular weight polyethylene (UHMWPE) can also be used as a carrier for antibiotics. We carried out a survey among the USA Knee Society membership about their preference for spacer use in two-stage revision surgery. We modified our implant design based on the majority’s preference for a total knee system, rather than bone cement spacers, in the temporary two-stage approach. In this study, we explored the material properties of gentamicin sulfate (GS) in UHMWPE (UHMWPE/GS) and the effect of UHMWPE/GS tibial inserts on bacterial colonization on CoCr surfaces.

We molded UHMWPE/GS powder blends and characterized the morphology using SEM and Energy Dispersive X-Ray Spectroscopy (EDS). We characterized wear and mechanical properties of the material with a knee simulator test and a tensile test. We submerged samples of molded UHMWPE/GS in buffered phosphate solution (PBS) at 37°C and quantified the extent of GS elution into PBS with a method described by Gubernator et al. using o-phthalaldehyde (OPA). We evaluated the eluted GS with Nuclear Magnetic Resonance and minimum inhibitory concentration tests. We used agar diffusion tests and the “daughter cells” method developed by Bechert et al. to assess anticolonizing properties of UHMWPE/GS. Additionally, we developed two new techniques to assess the colonization of bacteria on CoCr surfaces in the presence of GS eluting from UHMWPE/GS test samples.

SEM showed small groups of agglomerated domains at the virgin resin boundaries of UHMWPE after molding. Sulfur signature from the EDS analysis identified the agglomerated domains as GS particles. NMR and MIC confirmed that the chemical structure of GS and its potency remain the same after molding.

Elution of GS started with an initial burst and was followed by steady elution up to 12 weeks. The agar diffusion test showed similar inhibition zones for the eluates collected from UHMWPE/GS and BC/GS, suggesting that these samples yield similar antibacterial activity against S. aureus. UHMWPE/GS demonstrated pronounced anticolonizing properties, effectively mitigating the proliferation of S. aureus “daughter” cells. Anticolonizing activity of Palacos R+G was not significantly different when compared with UHMWPE/GS. CoCr surfaces showed little-to-no colonization in the presence of UHMWPE/GS, indicative of excellent antibacterial properties of UHMWPE/GS against S. aureus.

UHMWPE/GS continues to be a promising material for treating PJI.