Coatings for Biomedical and Healthcare Applications
Room Royal Palm 1-3 - Session D3

Medical Devices, Biosensors, and Biodegradation

Moderators: Jessica Jennings, University of Memphis, USA, Robin Pourzal, Rush University Medical Center

9:20am **D3-5 Osteochondral Tissue Regeneration into Porous PCL Scaffolds With and Without Chitosan Coatings of 98% or 80% Degree of Deacetylation**, ***Caroline Hoemann***, George Mason University, USA; *J Guzmán-Morales, G Chen, J Rodriguez-Gonzales, E Jalali Dil, B Favis,* Ecole Polytechnique de Montreal, Canada; *J Henderson,* McGill University, Canada **INVITED**

Polycaprolactone (PCL) is a bioplastic currently under development as a bone void filler. According to 3-dimensional *in vitro* osteogenesis assays, porous PCL scaffolds are hydrophobic and non-osteogenic, but the inner pore surfaces can become osteoconductive when coated with chitosan, a linear cationic polysaccharide composed of 98% glucosamine and 2% N-acetyl glucosamine (98% degree of deacetylation, DDA). In this study we tested the hypothesis that osteochondral bone regeneration is accelerated *in vivo* inside porous PCL scaffolds when the surfaces are coated with 80% or 98% DDA chitosan. Experiments were carried out under ARRIVE guidelines and institutional ethics-approved protocols. Sterile cylindrical PCL scaffolds with 155 µm average pore diameter were created, and coated or not with Layer-by-Layer polyelectrolytes followed by a surface coating of 98% DDA chitosan (PCL-98); half of the PCL-98 scaffolds were additionally coated with 80% DDA chitosan (PCL-80). New Zealand White rabbits (N=7) were submitted to small sequential knee arthrotomies to create two 3 mm diameter, 2 mm deep drill holes per trochlea, that were press-fit with PCL, PCL-80 or PCL-98 scaffolds just below the bone surface, or left to bleed as surgical controls. Distal femurs were collected at 1 day (N=1) or 6 weeks (N=6) post-operative and analyzed by micro-computed tomography and by non-decalcified plastic histology for repair tissue characteristics. At day 1, blood clot filled all PCL scaffold pores and drill-only defects. At 6 weeks, micro-CT measures and histological scores showed significant bone repair in drill-only defects compared to initial defects. Both PCL and PCL-98 scaffolds showed a minor and similar degree of bone ingrowth into the pores at the bottom of the scaffold, and PCL-80 scaffolds induced a slight bone resorption at the edges. PCL-98 scaffolds specifically promoted cartilage repair resurfacing, with around 80% repair tissue covering the scaffold surface compared to ≤20% resurfacing of PCL-only and PCL-80. These data revealed that *in vitro* osteogenesis assays do not necessarily predict *in vivo* osteogenesis where complex factors (biofactor deposits, innate immune responses, multiple cell types, angiogenic and mechanical cues) all influence the regenerative response. This study generated new knowledge that PCL-only scaffolds have a similar capacity as PCL-98 scaffolds to allow vascular bone ingrowth in a trabecular bone environment, but have a significantly lower ability to support cartilage resurfacing of the scaffold in the synovial cavity environment. 98% DDA chitosan coatings improved chondroinductive properties of subchondral porous PCL scaffolds.

10:00am **D3-7 Vancomycin-Phosphatidylcholine Spray Coatings for Delivery of Antimicrobials from Implants**, ***Rukhsana Awais***, *B Barr, R Gopalakrishnan, J Jennings,* University of Memphis, USA

Research on point-of-care coatings applied to implant materials has shown that manually applied coatings can be loaded with antibiotics for infection control and control of biofilm formation at the surface of implant. While release of antimicrobials has been shown to be effective at preventing infection in vitro and in vivo, manually-applied coatings are difficult to apply uniformly. In this study spray coatings were deposited on stainless steel coupons at flow rate of 45 and 60 liters per minute with a capillary of inner diameter of 25 micrometers using an aerosol spray device. The objective of the study was to compare the elution rate of the antibiotic deposited as a spray coating with the manually applied coating. Vancomycin mixed with phosphatidylcholine was mixed with deionized water to form a uniform mixture. Coatings loaded with water-insoluble dye Oil-Red O dye was also used to visually inspect the homogeneity of coatings. Control coatings consisted of vancomycin mixed with phosphatidylcholine which were then manually applied to the surface of coupons. An elution study in phosphate buffered saline was conducted for seven days and vancomycin concentrations were determined using HPLC. . Evaluation of the results showed that there was a continuous release of the drug in PBS (phosphate buffered saline) over seven days compared to three day release from manually-applied coatings. A large burst of antibiotic was observed for manually-applied coatings, which was not present in spray-applied coatings. Spray coatings had a uniform distribution over the entire surface of interest, compared to manually applied coatings with varying thickness of deposition observed visually. Coatings remained on the surface for seven days when elution studies were performed with the addition of dye Oil Red O to Phosphatidylcholine in the absence of antibiotic. Our studies suggest that a spray coating method for antibiotic release may be more effective in the application of local antibiotic therapy as prevention for infection in orthopedic surgery. In future studies, methods to increase the amount of coating will be sought, as well as design of a portable hand-held unit.

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