Abstract

Cardiovascular stents have been developed and have evolved over the last few decades to clinically address the burgeoning problem of heart disease due to atherosclerosis around the world. In the latest iteration, fully resorbable scaffolds have been envisioned and deployed with the hypothesis that they will support the coronary arteries till local healing is complete. Within this domain, the present work aims to address a particular issue of the reformation of the endothelial layer over the stent and artery that occurs within days of implantation. Based on the literature surveyed and the clinical needs identified for rapid and efficient stent endothelizaliztion post implantation, modification of a polylactic acid (PLA) based scaffold with Magnesium and polycaprolactone (PCL) up to 5% by weight was attempted and tubes from the resultant materials were fabricated by a biaxial extrusion method for enhanced radial strength, previously patented in-house. *In vitro* and *in vivo* studies with L929 mouse fibroblasts and rat subcutanea respectively were conducted to check capsular formation around implant materials as a proxy for endothelialization. Higher cell proliferation was seen on PCL-modified samples *in vitro* at all time points, however, visually, limited cytoplasmic extensions and only bidirectional processes were seen. Mg- containing samples showed promise due to the defined spindle-like morphologies and cytoplasmic extensions, up to ~60μm, by 168 hours. Angiogenesis at the 7 day time point was not found significant to report *in vivo*, suggesting late initiation of this process in the peri-implant capsule. Both PLA/PCL5% and PLA-Mg4%, however, in the same *in vivo* study had significantly higher chronic inflammatory cells (macrophages) as well as the inflammatory markers (TNF- α & IL-1 β) compared to PLA by 8 weeks. While IL-6 is purely inflammatory, TNF-α and IL-1β have been linked to fibroblasts. Even so, no significant effect of the heightened cytokine levels was seen on calculated capsule thicknesses of the modified materials calculated from both the Hematoxylin & Eosin and Masson's Trichome stained sections. Both modifying materials may be considered for future PLA based bioresorbable scaffolds, but synthesis or copolymerization of tailor-made materials rather than processing may be preferred for reduced inflammatory response *in vivo*. Material development for cardiovascular stents may be furthered by continued exploration of bioresorbable polymer & metal composites and use of low cost biopolymers to increase accessibility & affordability of this life saving device. The material systems presented in this thesis can be tested in the atherosclerotic swine model, after cutting of tubes to the final stent design, and the effectiveness for use in humans can then be extrapolated.