Plasma-based surface modification and *active biomolecules* grafting for regenerative medicine

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Over the last 50 years, biomaterials, prostheses and implants saved and prolonged the life of millions of humans around the globe. Today, nano-biotechnology, nanomaterials and surface modifications provides a new insight to the current problem of biomaterial complications, and even allows us to envisage strategies for the organ shortage. In this talk, creative strategies for designing advanced coatings for health will be discussed. Based on plasma surface modification a platform was developed for grafting biologically active molecules for interfacing biomaterials and medical devices with the living environment mainly composed by cells and tissue. This presentation will focuses on the study of the biological performance commercially available medical devices (bare metal stents) after their modification with this multi-step plasma-based strategy. A combination of in vitro tests on flat samples were proposed in order to predict the in vivo performance of the cardiovascular devices. In vitro tests involved the incubation of human coronary artery endothelial cells (HCAEC) onto flat surfaces to assess their adhesion, distribution and their phenotype by quantifying the soluble factors release in the supernatant. For that purpose, three specific molecules were selected: a) Vascular cell adhesion molecule-1 (VCAM-1), a protein that mediates the adhesion and interaction of leukocytes onto the endothelium; b) interleukin-6 (IL-6) an inflammatory cytokine released during the first steps of endothelial inflammation [7], and c) tissue factor pathway inhibitor (TFPI), a primary inhibitor of the blood coagulation cascade, produced by a healthy endothelium. Regarding in vivo studies, the implantation of bare metals stents, drug eluting stents and the functionalized stent with the bioactive peptide (PEG-Pept) were implanted in porcine coronary arteries, due to their similarities to human arteries. Short-term studies, 7 days, were performed to evaluate the re-endothelialization. Furthermore, in-stent restenosis was assessed after 28 days of implantation. Thus, by combining both in vitro and in vivo assays an insight about how these devices, functionalized by this original multi-step plasma-based approach, can perform in a human trial. Finally, results of in vitro tests with human cells and blood will be discusses, and new strategies for innovative human-based advanced *in vitro* models from 3D regenerative medicine will be overviewed.