Micro and Macro-vascular Endothelial Cells Behave Differently on Polycaprolactone Membranes with Smooth and Rough Surface Topography

Wojciech Szymczyk,1 Sven Halstenberg,2 Ronald E. Unger,2 Alexandra P. Marques,1 Rui L. Reis,1 C. James Kirkpatrick,2

Corresponding Author: kirkpatrick@pathologie.klinik.uni-mainz.de

13B’s Research Group, University of Minho, Caldas das Taipas, Guimarães, Portugal and 2Institute of Pathology, Johannes Gutenberg University, Mainz, Rhineland-Palatinate, Germany

Introduction: Surface topography of the cell surrounding environment is one of the key factors that determine cell behaviour and its function. The aim this study was to evaluate the effect of surface topography over macro (HUVECs) and microvascular (HPMEC-ST1.6R) endothelial cells (ECs) adhesion, proliferation and gene expression profile.

Materials and Methods: Bi-layer scaffolds were fabricated by heat merging polycaprolactone (PCL) (Sigma, Steinheim, Germany) smooth surface solvent cast membranes (SC) and rough PCL electrospun nanofibre meshes (NF). Human umbilical cord vein ECs (HUVECs) and microvascular HPMEC-ST1.6R ECs were seeded on both sides (SC and NF surfaces) and cultured for 1, 3 and 7 days. The DNA of the samples was collected at all time points in order to infer about cell proliferation. The level of expression of EC markers (vWF, PDGF-B, PECAM-1, VE-Cadherin) related to several physiological processes was determined by real time RT-PCR. The expression of those markers at the protein level was confirmed by immunocytochemistry and visualized in a Confocal Microscope.

Results: The DNA quantification results showed that HUVECs did not proliferate on the NF contrarily to HPMEC-ST1.6R. In addition both cell types proliferated at normal rates on the smooth SC membranes. The level of expression of vWF (fig. 1), like for the other markers, was more affected on the HUVECs than on the HPMEC-ST1.6R cultures, which depicted a significantly lower expression than HUVECs. While the expression of vWF was not affected during culture, HUVECs vWF expression on SC decreased from day 1 to day 3 and stabilised until day 7. Contrarily, on the NF the HUVECs vWF expression seemed to be constant until day 3 then increasing until day 7. The gene expression results were confirmed at the protein level (Fig 2).

Conclusions: In conclusion, HUVECs preferred smooth (SC) over rough (NF) surfaces and were shown to be more responsive to surface topography than HPMEC-ST1.

Acknowledgments: Authors acknowledge the European Union’s NoE EXPERTISSUES (500283-2), Marie Curie Actions (MEST-CT-2004-008104), the German Federal Ministry of Education and Research (0313405C), and Portuguese Foundation for Science and Technology (SFRH/BD/45238/2008) for the financial support. We would further like to thank Anne Sartoris for her expertise and technical assistance.