New stent surface materials: the impact of polymer-dependent interactions of human endothelial cells, smooth muscle cells, and platelets.

Abstract:

Despite the development of new coronary stent technologies, in-stent restenosis and stent thrombosis are still clinically relevant. Interactions of blood and tissue cells with the implanted material may represent an important cause of these side effects. We hypothesize material-dependent interaction of blood and tissue cells. The aim of this study is accordingly to investigate the impact of vascular endothelial cells, smooth muscle cells and platelets with various biodegradable polymers to identify a stent coating or platform material that demonstrates excellent endothelial-cell-supportive and non-thrombogenic properties. Human umbilical venous endothelial cells, human coronary arterial endothelial cells and human coronary arterial smooth muscle cells were cultivated on the surfaces of two established biostable polymers used for drug-eluting stents, namely poly(ethylene-co-vinylacetate) (PEVA) and poly(butyl methacrylate) (PBMA). We compared these polymers to new biodegradable polyesters poly(l-lactide) (PLLA), poly(3-hydroxybutyrate) (P(3HB)), poly(4-hydroxybutyrate) (P(4HB)) and a polymeric blend of PLLA/P(4HB) in a ratio of 78/22% (w/w). Biocompatibility tests were performed under static and dynamic conditions. Measurement of cell proliferation, viability, glycocalix
width, eNOS and PECAM-1 mRNA expression revealed strong material dependency among the six polymer samples investigated. Only the polymeric blend of PLLA/P(4HB) achieved excellent endothelial markers of biocompatibility. Data show that PLLA and P(4HB) tend to a more thrombotic response, whereas the polymer blend is characterized by a lower thrombotic potential. These data demonstrate material-dependent endothelialization, smooth muscle cell growth and thrombogenicity. Although polymers such as PEVA and PBMA are already commonly used for vascular implants, they did not sufficiently meet the criteria for biocompatibility. The investigated biodegradable polymeric blend PLLA/P(4HB) evidently represents a promising material for vascular stents and stent coatings.