

Systematic Analysis of Immune Response to Biomaterial Surface Characteristics

Authors : Florian Billing, Soren Segan, Meike Jakobi, Elsa Arefaine, Alik Jerch, Xin Xiong, Matthias Becker, Thomas Joos, Burkhard Schlosshauer, Ulrich Rothbauer, Nicole Schneiderhan-Marra, Hanna Hartmann, Christopher Shipp

Abstract : The immune response plays a major role in implant biocompatibility, but an understanding of how to design biomaterials for specific immune responses is yet to be achieved. We aimed to better understand how changing certain material properties can drive immune responses. To this end, we tested immune response to experimental implant coatings that vary in specific characteristics. A layer-by-layer approach was employed to vary surface charge and wettability. Human-based in vitro models (THP-1 macrophages and primary peripheral blood mononuclear cells (PBMCS)) were used to assess immune responses using multiplex cytokine analysis, flow cytometry (CD molecule expression) and microscopy (cell morphology). We observed dramatic differences in immune response due to specific alterations in coating properties. For example altering the surface charge of coating A from anionic to cationic resulted in the substantial elevation of the pro-inflammatory molecules IL-1beta, IL-6, TNF-alpha and MIP-1beta, while the pro-wound healing factor VEGF was significantly down-regulated. We also observed changes in cell surface marker expression in relation to altered coating properties, such as CD16 on NK Cells and HLA-DR on monocytes. We furthermore observed changes in the morphology of THP-1 macrophages following cultivation on different coatings. A correlation between these morphological changes and the cytokine expression profile is ongoing. Targeted changes in biomaterial properties can produce vast differences in immune response. The properties of the coatings examined here may, therefore, be a method to direct specific biological responses in order to improve implant biocompatibility.

Keywords : biomaterials, coatings, immune system, implants

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