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Neural Progenitor Cell Attachment on IKVAV Functionalized Supported Phospholipid Bilayers

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INTRODUCTION: The ability to control cell behavior on different surfaces is desirable in many biotechnical applications like medical implants and tissue engineering. This control requires knowledge of the cells and how the cells interact with different surfaces. Cell-surface interactions are dependent on cell recognition of ligands, often proteins, peptides or sugars, on a surface, why an appropriate ligand presentation is necessary. One way to present ligands is to immobilize them to a supported lipid bilayer. Bilayers are formed from phospholipid vesicles rupturing on a variety of surfaces, one of which is SiO_2. Bilayers provide a surface inert to cell and protein adhesion, but can be functionalized to expose cell signaling molecules. These molecules can direct different cell functions, for example cell attachment, differentiation or proliferation.

METHODS: All surface modifications were quantified by quarts crystal microbalance with dissipation (QCM-D) and cell attachment were evaluated using immunocytochemistry and fluorescence microscope.

RESULTS: In the present study, maleimido-terminated lipids incorporated in the bilayer, were functionalized with a peptide sequence containing the laminin-derived pentamer IKVAV (CSRARKQAAS**IVKAV**SADR) or a scrambled sequence (CSRARKQAASVKAIVSADR). The IKVAV sequence was found to be specifically recognized by the adult-derived hippocampal progenitor cells (AHP) as proved in comparative studies where cell attachment showed an 11-fold increase to IKVAV functionalized bilayers compared to bilayers functionalized with the scrambled peptide sequence.

Further investigated was cell response to different amounts of IKVAV on the surface, where it was shown that a critical peptide density is required for cell attachment. Surfaces modified subsequently with polyornithine and laminin are standard substrates for AHP cell culture and were used as a reference.

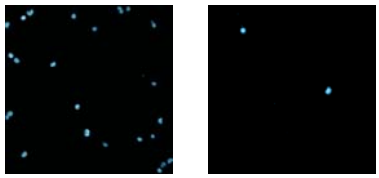

Fig. 1. Cell attachment to a maleimido-bilayer functionalized with IKVAV (left) and VKAIV (right).

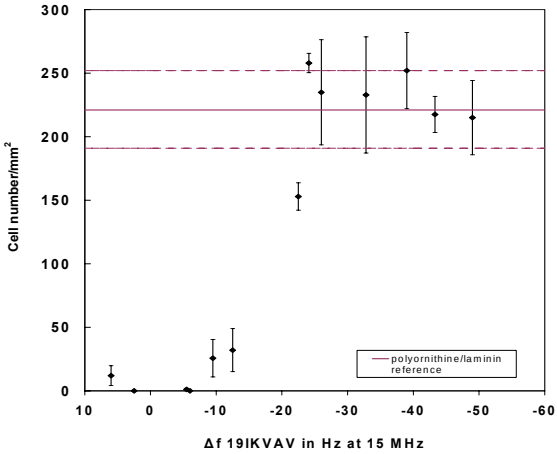

Fig 2. Cell attachment varied with the degree of IKVAV-functionalization and a critical density had to be reached before any cells attach.

DISCUSSION & CONCLUSIONS: Assuming each maleimido-group couples one peptide, the critical IKVAV density for cell attachment is correlated to a maleimido concentration of about 2 mol%. It was also proved that already at a maleimido concentration of 3 mol% cell attachment to IKVAV functionalized maleimido-bilayers was comparable to the control surfaces. The maleimido doped bilayers not presenting any IKVAV showed very low cell attachment, leading us to believe that IKVAV functionalized bilayers are attractive surfaces for stem cell cultivation.

REFERENCES: [1]A-S Andersson et al (2003), J Biomed Mater Res **64A**:622-629, [2]Svedhem at al (2003),Langmuir **19**:6730-6736, [3]Keller & Kasemo (1998), Physical J: **75**:1397-1402