J Biotechnol Biomater 2018, Volume 8
DOI: 10.4172/2155-952X-C1-089

Synthetic vectors and mechanical-biological approach to optimize the use of stem cells in neurodegenerative medicine

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PAMs1 are polymeric, biodegradable, biocompatible microcarriers providing a biomimetic 3-dimensional surface to enhance stem cell response for neuroregenerative medicine. MIAMI cells, that can be differentiated towards a neuronal phenotype on a LM surface and secrete many repair factors are candidates of choice for cell therapy studies. Recently, it has been shown that PLGA and PLGA-poloxamer188-PLGA composed particles that are surface functionalized with proteins present in the ECM, can improve stem cell response. MSCs located on the surface of PAMs composed of PLGA-poloxamer188-PLGA with a fibronectin surface survived 7 days longer than on the surface of PLGA. However, it still remains unclear how the chemical and physical microparticle surface properties, as well as protein adsorption influence cellular responses. Our results indicate that the 60 µm PLGA-poloxamer188-PLGA microcarriers have a granular surface and present a rough topography compared to the PLGA microcarriers that have a smooth surface with the presence of holes with variable sizes. The microcarriers exhibit a negative surface charge, and after coating with LM combined with PDL, positive surface charges were acquired for both types of polymer. According to our confocal microscopy results, the coating of the LM is more intense and the distribution tends to be more homogeneous on PLGA PAMs, compared to that seen with the PLGA-poloxamer188-PLGA composed of various spots. LM adsorption is decreased by the presence of the poloxamer188 (hydrophilic polymer), but is enhanced on the PAMs composed of PLGA (hydrophobic polymer) alone, and possibly PDL also influences the adsorption of LM on these surfaces. The MIAMI cells adhered and presented a flattened morphology on the surface of LM PLGA PAMs. In comparison, the MIAMI cells adhered less well and remained round on the surface of LM PLGA-poloxamer188-PLGA PAMs, which maybe is explained by the low adsorption of LM on these surfaces. Survival at 24 hours was lower on PLGA-poloxamer188-PLGA PAMs compared to PLGA PAMs and differentiation analysis is underway. In conclusion, the chemical composition and the wettability of microspheres significantly influence the adsorption of the ECM molecules. Consequently, this factor, in addition to the surface topography has an effect on the adhesion and subsequent behavior of MIAMI cells on their surfaces.

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