

4th International Conference on Tissue Science and Regenerative Medicine

July 27-29, 2015 Rome, Italy

Fate decisions of WJ-MSC and HUCB-NSC in 3D microenvironment: Influence of different types of biological scaffolds

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Aim: The aim of the project was to analyse the effect of different scaffolds on the growth, proliferation and differentiation of freshly isolated mesenchymal stem cells from Wharton jelly (WJ-MSC) or neurally-committed progenitor cells derived from umbilical cord blood (HUCB-NSC). Different biological three-dimensional (3D) scaffolds were compared: (1) based on keratin associated proteins, in the shape of small rectangular dots and long hair-like fibers; (2) a new family of scaffold consisting of two components: collagen (Col) and chondroitin sulphate (CS) and (3) electroconductive chitosan scaffold.

Results: The analysis performed with scanning electron microscope revealed that both WJ-MSC and HUCB-NSC did not adhere to small rectangular fibers, but remained seated on the long hair-like fibers. Neural stem cells were following the shape of fibers, while mesenchymal stem cells formed clumps filling the space between fibers. Both cell types predominantly adhered to Col-CS scaffolds. HUCB-NSC growing on the surface of the scaffold had branched phenotype and expressed neuronal markers (β -Tubulin III, MAP2), while the cells that penetrated inside the scaffold remained rounded. Under the same conditions WJ -MSC mostly penetrated inside the scaffold and strongly proliferated (Ki67 positive cells), with no signs of differentiation. Both WJ-MSC and HUCB-NSC seeded on chitosan-based scaffolds remained undifferentiated.

Conclusion: We demonstrated that geometry, structure and composition of the scaffold have an impact on cells adhesion, proliferation and differentiation, but the response to these parameters varies with the cell type and stage of their development. Non-neurally committed progenitors (WJ-MSC) under the shape influence will mainly proliferate, while neural progenitors (HUCB-NSC) in the same conditions will continue to differentiate.

Biography

Martyna Podobinska has completed her MSc from University of Warmia and Mazury in Olsztyn and is currently doing her Doctoral research in Stem Cell Bioengineering Unit, Mossakowski Medical Research Centre Polish Academy of Sciences. The subject of her research is to define biomimetic conditions for self-renewal and differentiation of Human Umbilical Cord Blood derived Neural Stem Cells (HUCB-NSC) *in vitro*, including relationship investigation between spatial arrangement of culture, hypoxia and epigenetic regulation.

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