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Biomimetic microenvironment for neural stem cell reprogramming and differentiation

Advancements in biotechnology provides tools to build up in vitro "biomimetic" microenvironments resembling a natural stem cell niche, where the cell is provided with diverse extracellular signals exerted by soluble and structural cues, mimicking those found *in vivo*. On the other hand, recent progress in stem cell technology enables tools for obtaining stem cells for personalized medicine either by direct isolation of somatic tissue specific stem cells or by generation of induced Pluripotent Stem (iPS) cells from any tissue of the body. We intent to bridge biomedical research and material science by building up biomimetic 2D and 3D cell growth functional domains to control *in vitro* reprogramming, proliferation capacity and neuronal differentiation of stem cells derived from human cord blood (non-transformed HUCB-NSC cell line derived in our laboratory). In this report bioactive surface domains and epigenetic cues were applied to investigate cellular developmental processes of HUCB-NSC and to direct their fate toward desired neural lineages. Emerging technologies used to create miniaturized cell growth platforms with defined arrays of cell attractive biomaterials included a nano/micro-fabrication techniques: microcontact printing and piezoelectric microspotting of biomolecules on plasma deposited cell repellent surface. Epigenetic cues influencing neural stem cell fate during reprogramming and differentiation included modulation of chromatin methylation and acetylation status, oxygen tension conditions and small signaling molecules. We have shown that HUCB-NSC fate decisions are dependent on the type of biomaterial defining cell/surface interface interaction and the geometry of the bioactive domains. Stimulation of selected intracellular pathways by signaling molecules immobilized to the surface with ECM proteins resulted in differentiation of HUCB-NSC to either neuronal or astroglial lineage. The influence of epigenetic control over reprogramming of HUCB-NSC to pluripotency and their further differentiation into neuronal cells will be also discussed. Sponsored by grant from Polish Ministry of Scientific Research and Higher Education No 5978/B/PO1/2010/38 and 0141/B/P01/2008/35.

Biography

Professor Buzanska completed her PhD in 1990 from Warsaw University, Department of Biology and habilitation qualification (DSc) in 2007 in medical sciences from Mossakowski Medical Research Centre, Polish Academy of Sciences. For 15 years she was working in Department of Biology, Warsaw University, from 1996 in NeuroRepair Department, MMRC PAS. Presently she holds a professor position in MMRC PAS and is the Head of Stem Cell Bioengineering Laboratory. Her sabbaticals included University of Aberdeen, State University of NY (SUNNY) and European Commission, Joint Research Centre. In the latter she was a visiting senior scientists for 4 years (between 2005 and 2009). Present scientific interests include mainly somatic stem cell bioengineering and neural tissue engineering. She has published more than 60 original peer review articles in reputed journals and a few book chapters. She is an internationally recognized reviewer and the member of Scientific and Executive Boards for International Societies and Journals.