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Mesenchymal Stem Cells Behaviour in Nano fibrous Environment

Mimicking the complex intricacies of the extracellular matrix (ECM) including three dimensional configurations were traditionally used for producing living tissues from stem cells. Electrospinning is a technique capable of fabricating nanofibers (NFs) with dimensions similar to those of the natural ECM. An advantage of electrospun NFs is that they can be further designed for organization and cell binding properties which turn them within the most promising scaffold for regenerative Nanomedicine. Here we report on the use of a novel hybrid, fibrinogen/polylactic acid (FBG/PLA) nanofibers to control the overall behaviour and differentiation potential of human adipose derived mesenchymal stem cells (ADMSCs). We were particularly interested on the dorsal and ventral cell response to nanofibers organization (random vs. aligned). We found that upon ventral contact with random nanofibers the cells developed a stellate-like morphology with multiple projections where the well-pronounced focal adhesion complexes suggest a successful cellular interaction. Time-lapse analysis however showed significantly lowered cell movements resulting in relatively short distance that they traverse in multiple directions. Conversely, an elongated cell shape with extended actin cytoskeleton and significantly increased cell mobility were typically observed when cells adhering on aligned NFs. To further follow the dorsal cell response (in third dimension) artificial wounds were created on confluent cell layers and covered with either random or aligned NFs. Time-lapse analysis showed significantly faster wound coverage (within 12 h) upon contact of cells with aligned nanofibers vs. almost absent directional migration on random samples. However, quantitative reverse transcription-polymerase chain reaction analysis for Collagen 2, Collagen 10 and SOX9 genes expression showed favourable chondrogenic response of human ADMSCs cultured on random nanofibers (50 days in complete chondrogenic medium) compared to aligned ones indicating that temporary immobilisation of stem cell might promote their differentiation.

Biography

George Altankov is ICREA Research Professor in the Institute for Bioengineering of Catalonia. He got his MD in 1974 in Varna Medical Institute, Bulgaria, where also accomplished his PhD (1984). In 1991-1993 he made his postdoc in Southwestern Medical School at Dallas performing studies on the molecular mechanisms of cell adhesion. During his subsequent work in the Bulgarian Academy of Sciences (1985-2005) he grew up to full professor, head of department and deputy Director of the Institute of Biophysics in Sofia. His studies, performed in close collaboration with GKSS Research Centre (Germany), were among the first highlighting that tissue compatibility of materials is strongly dependent on the ability of cells to reorganize surface associated matrix proteins, such as fibronectin, vitronectin, fibrinogen and collagen. His studies resulting in more than 100 publications in peer reviewed journals and books that are frequently cited.

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