Chara Simitzi et al., J Biotechnol Biomater 2019, Volume 9
DOI: 10.4172/2155-952X-C1-112

Biodegradable microparticles with hierarchical topographical features influence mesenchymal stem cell behaviour

Chara Simitzi and **Richard Day**
UCL, UK

Statement of the Problem: Mesenchymal stem cells (MSCs) are becoming increasingly important due to the broad spectrum of trophic and immunomodulatory factors they secrete. The MSC secretome plays a role in angiogenesis and revascularization, immune modulation and tissue repair; however, there is a lack of methods suitable for controlling this effect. Evidence exists to show cell substrates influence MSC behaviour. Therefore, manipulating the cell substrate could provide improved methods for controlling the secretome for new therapies but there is currently a lack of cell substrates suitable for implantation.

Methodology & Theoretical Orientation: The effect of implantable substrates consisting of biodegradable microparticles with hierarchical topographical features was investigated on MSC behaviour and secretome. Poly(DL-lactide-co-glycolide) microparticles were fabricated via the thermally-induced phase separation technique (TIPS). Three different polymer compositions of lactide/glycolide were studied. Microparticles were characterized in terms of surface topography and porosity. Human adipose-derived MSCs (ADMSCs) were attached to the surface of the microparticles and cultured for 16 days in xeno-free medium. Cell growth on the microparticles was evaluated at different time-points and compared with cells cultured on tissue culture plastic. The angiogenic activity of the ADMSC secretome was evaluated by ELISA and *in vitro* angiogenesis assays.

Findings: Three different types of TIPS microparticles with different morphological and physicochemical characteristics were investigated. ADMSCs adhered and proliferated on all types of the microparticles. Vascular endothelial growth factor (VEGF) secretion was increased from cells cultured on the microparticles compared with cells cultured on tissue culture plastic. MSCs attached to microparticles remained viable after 16 days, were capable of migrating from the microparticles, and retained their lineage plasticity.

Conclusion & Significance: Our results show that attaching MSCs to biodegradable TIPS microparticles can influence their growth and secretion of pro-angiogenic growth factor. This finding may provide a new method for regenerative medicine.

Recent Publications

1. Vizoso F et al. (2017) Mesenchymal stem cell secretome: towards cell-free therapeutic strategies in regenerative medicine. Int. J. Mol. Sci. 18(9):1852.
2. Tran C and Damaser M S (2015) Stem cells as drug delivery methods: application of stem cell secretome for regeneration. Adv. Drug Deliv. Rev. 82-83:1-11.
3. Anderson H J et al. (2016) Mesenchymal stem cell fate: applying biomaterials for control of stem cell behavior. Front. Bioeng. Biotechnol. 4:38.
4. Blaker J, Knowles J and Day R M (2008) Novel fabrication techniques to produce microspheres by thermally induced phase separation for tissue engineering and drug delivery. Acta Biomaterialia 4(2):264-272.
5. Parmar N, Ahmadi R and Day R M (2015) A novel method for differentiation of human mesenchymal stem cells into smooth muscle-like cells on clinically deliverable thermally induced phase separation microspheres. Tissue Eng. Part C Methods 21(4):404-412.

Biography

Chara Simitzi graduated as a Chemical Engineer from the National Technical University of Athens (Greece) and then continued her studies in biomedical and tissue engineering. She pursued her MSc in Biomedical Engineering from RWTH Aachen University (Germany); PhD in Biology from University of Crete (Greece). After her PhD she worked at the Foundation for Research and Technology - Hellas Institute in Crete and the Queen Mary University of London (UK) respectively. She is currently a Postdoctoral Research Associate in the group of Professor Day (Applied Biomedical Engineering group) at the University College London. Her scientific interests focus on the cell-biomaterial interface and more specifically on the development of novel types of scaffolds for tissue engineering applications and cell culture platforms for in vitro studies to address cell biology questions.

c.simitzi@ucl.ac.uk

Notes: