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Human fetal cardiac mesenchymal stromal cells on a novel spider silk 3D scaffold form vessel-like structures and deposit laminins

Authors:
K Ljung1, M Andersson2, L Floderus2, K Nordling2, M Corbascio1, J Johansson3, KH Grinnemo1, C Osterholm1, A Rising3, 1Karolinska Institute, Department of Molecular Medicine and Surgery - Stockholm - Sweden, 2Swedish University of Agricultural Sciences, Department of Anatomy, Physiology and Biochemistry - Uppsala - Sweden, 3Karolinska Institute, Department of Neurobiology, Care Sciences and Society (NVS) - Stockholm - Sweden,

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Background

Mesenchymal stromal cells (MSCs) exhibit a number of properties in addition to the structure-supportive functions in a tissue. These include pro-angiogenic, anti-fibrotic and immune-regulatory properties, all which are of great importance after tissue injury, such as myocardial infarction. Following injection of single-cell suspensions, MSC are at risk for apoptosis due to loss of anchorage. Delivery of cells growing on a scaffold is a strategy for increasing longevity and thereby the therapeutic potential of the cells.

We isolate cardiac mesenchymal stromal cells, hfcMSC, from human fetal hearts. When resuspended in Matrigel these cells are capable of forming vessel-like structures in vitro as well as in vivo. Here we work with a new type of artificial spider silk, NT2repCT, as a 3D scaffold.

Purpose

The purpose of this study was to test NT2repCT as a 3D scaffold for hfcMSC and thereby gain new knowledge about the supportive cells of the human heart as well as about NT2repCT fibers as cell culture scaffolds.

Methods

NT2repCT was produced in E-coli, purified and spun into 10µm fibers that were used to make a 3D structure of densely packed fibers.

HfcMSC were seeded on NT2repCT 3D scaffolds at the bottom of 50 ml test tubes. After 2-8 weeks the scaffolds were frozen and sectioned. Immunohistochemistry was used to assess expression of cell markers and formation of extracellular matrix.

Results

HfcMSC attach to NT2repCT through focal adhesions, form networks, survive and proliferate for at least 8 weeks. The cells grow in vessel-like structures expressing alpha smooth muscle actin, CD31 and Laminin alpha...
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Conclusion
We have shown that hfcMSC can be cultured on artificial spider silk and are capable of producing specific laminins important in healing and angiogenesis.

To enhance cardiac tissue recovery after a myocardial infarction supportive tissue and angiogenesis are very important. The study of supportive cells in a relevant in vitro model can both enhance our basic knowledge and provide better ways for in vitro assessment of drug effects and toxicity.