OMICS Group Conferences
Accelerating Scientific Discovery
3rd World Congress on
Cell Science & Stem Cell Research
November 20- 22, 2013 DoubleTree by Hilton Baltimore-BWI Airport, USA

Differentiation of stem cells derived from human infrapatellar fat pad for cartilage engineering: Characterization of cells undergoing chondrogenesis

Raed Felimban
University of Melbourne, Australia

Abstract

Background: Hyaline cartilage repair is a significant challenge in orthopedics. Current repair techniques result in suboptimal long-term outcomes due to inability of cartilage to regenerate. Human infrapatellar fat pad (hIPFP) derived mesenchymal stem cells (MSC) are capable of differentiation into multiple connective tissue lineages, including cartilage and bone. Cartilage tissue development is essential for normal skeletal development, but the molecular mechanisms regulating in situ chondrogenesis are yet to be completely defined. The aims of this study are: (1) to investigate chondrogenesis using MSC derived from hIPFP tissue; and, (2) to characterize the temporal changes in gene expression and gene profiles using micromass culture.

Methods: Human IPFP-derived MSC were maintained in chondrogenic medium supplemented with TGFβ3 and BMP6 for 7, 14 and 28 days. Endpoints included histology, immunohistochemistry (IHC), gene expression profiles using a microarray technique and changes in expression of specific genes using quantitative real-time PCR (qPCR).

Results: Over 28 days, clusters of encapsulated chondrocytes formed that were predominantly surrounded by collagen and aggrecan in the extracellular matrix (ECM). Production of collagen type II and aggrecan was confirmed using IHC. Between days 14 and 28, collagen type 2A1 (COL2A1) and aggrecan gene expression increased substantially. SRY-related transcription factor (SOX9) gene expression was also increased. Normalized microarray data highlighted 608 differentially expressed genes during the time course. Ten chondrogenic genes were up-regulated (2- to 87-fold) through to days 14 and 28; this included COL2A1, COL10A1, COL9A1, COL11A1, COL9A2, COL11A2, COL1A1, COMP, SOX9 and COL3A1. We found that the up-regulated genes (2-fold or more) represent significant level of expression (Enrichment score) for the ECM structural constituent of the molecular functional at days 7, 14 and 28 during chondrogenesis.

Conclusion: Therefore, we have successfully demonstrated in vitro production of hyaline-like cartilage from IPFP-derived MSC in micromass culture. Microarray has provided novel information concerning genes involved in the chondrogenesis of hIPFP-derived MSC. Our approach offers a potentially useful strategy for generating clinically relevant cartilage for therapeutic use.

Keywords: Hyaline cartilage; mesenchymal stem cells (MSC); human infrapatellar fat pad (hIPFP) tissue; chondrogenesis; micromass culture; microarray, extracellular matrix (ECM).

Biography

Raed Felimban is a PhD candidate in the department of orthopaedics at St Vincent's Hospital, University of Melbourne in Australia. He received Master Degree in Laboratory Medicine in 2010 from the Royal Melbourne Institute of Technology (RMIT) University, Melbourne, Australia. From 2003 to 2008, he was with King Abdul-Aziz Medical City Hospital (JCI, CAP, and AABB accredited) Jeddah, Saudi Arabia, as a medical Technologist (Hematology-Flowcytometry). Since 2009, he has been Teacher Assistant at King Abdul-Aziz University. He is a student member of The Australasian Society for Stem Cell Research (ASSCR). His major current research interest is in adult mesenchymal stem cells (MSCs) tissue engineering.