Proceedings of German Society for Stem Cell Research (PGSSCR)

Isolation, characterization and spontaneous differentiation of human umbilical cord-derived mesenchymal stem cells

Fischer J 1,2, Jahnen-Dechent W 2,3, Rosewick S 1,3, Knuchel R 1, Neuss S 1,3

1Institute of Pathology
2Institute for Biomedical Engineering, Biointerface Group
3Interdisciplinary Centre for Clinical Research, IZKF "BIOMAT"
RWTH Aachen University, Aachen, Germany

Published online on 16 May 2007

Introduction:

Bone marrow is the most commonly used source for the isolation of human mesenchymal stem cells (hMSC). Similar cells can also be isolated from various other tissues including adipose tissue, dental pulp and umbilical cord. Umbilical cord-derived stem cells are believed to have a higher proliferation and differentiation capacity due to their primitive developmental stage. We isolated hMSC from bone marrow and the Wharton’s Jelly of umbilical cords and compared the cells regarding their surface epitopes, proliferation and differentiation.

Materials and Methods:

HMSC were isolated from bone marrow according to standard protocols (Pittenger et al., Science, 1999) and from the Wharton’s Jelly of umbilical cords. To this end, 2 cm pieces of umbilical cords were opened lengthwise with a scalpel. The matrix was scraped off and incubated with 2 mg/ml collagenase for 16 h, trypsinized for 30 min, washed and seeded on T75 culture flasks. Proliferation was analyzed using XTT tests. The differentiation into adipocytes, osteoblasts and chondrocytes was performed according to standard protocols (Pittenger et al., 1999). Surface epitopes were analyzed by flow cytometry. Spontaneous 3D aggregation and differentiation within cellular aggregates was investigated by histological staining and immunohistochemistry.

Results:

The flow cytometric analysis of the surface epitopes CD51, CD54, CD73, CD90 and CD105 showed that the isolated cells from bone marrow and umbilical cord displayed an hMSC phenotype. Cells could be readily differentiated into adipocytes, osteoblasts and chondrocytes. Interestingly, the umbilical cord-derived cells spontaneously formed 3D aggregates when cultured under post-confluent conditions. All cells of these aggregates were viable and spontaneously differentiated into several specialized cell types akin to the well-known differentiation of embryoid bodies.

Discussion and Conclusion:

The umbilical cord-derived hMSC resemble bone marrow-derived hMSC and additionally show a spontaneous 3D aggregation and differentiation in vitro. These results indicate that umbilical cord-derived hMSC are a
valuable tool for cell-based therapy, but due to their spontaneous differentiation capacity, teratoma formation might be possible.