

Scientific Paper:

Cell Communication and Signaling 8:18, 2010

Effects of hypoxic culture conditions on umbilical cord-derived human mesenchymal stem cells

Antonina Lavrentieva¹, Ingrida Majore¹, Cornelia Kasper^{1*}, Ralf Hass²

¹Institut für Technische Chemie, Leibniz Universität Hannover, Callinstraße 5, 30167 Hannover, Germany

Abstract:

Following cultivation of distinct mesenchymal stem cell (MSC) populations derived from human umbilical cord under hypoxic conditions (between 1.5% to 5% oxygen (O_2)) revealed a 2- to 3-fold reduced oxygen consumption rate as compared to the same cultures at normoxic oxygen levels (21% O_2). A simultaneous measurement of dissolved oxygen within the culture media from 4 different MSC donors ranged from 15 $\mu\text{mol/L}$ at 1.5% O_2 to 196 $\mu\text{mol/L}$ at normoxic 21% O_2 . The proliferative capacity of the different hypoxic MSC populations was elevated as compared to the normoxic culture. This effect was paralleled by a significantly reduced cell damage or cell death under hypoxic conditions as evaluated by the cellular release of LDH whereby the measurement of caspase 3/7 activity revealed little if any differences in apoptotic cell death between the various cultures. The MSC culture under hypoxic conditions was associated with the induction of hypoxia-inducing factor-alpha (HIF-1 α) and an elevated expression of energy metabolism-associated genes including GLUT-1, LDH and PDK1. Concomitantly, a significantly enhanced glucose consumption and a corresponding lactate production could be observed in the hypoxic MSC cultures suggesting an altered metabolism of these human stem cells within the hypoxic environment.