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Lipidomics study of mesenchymal stromal cells derived from human placenta

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The interest for lipid metabolism in the stem cell field has increased in the last few years (1,2,3). Membrane lipidomics embraces many aspects of cell metabolism and the role of lipids is now considered more than merely inert and structural in delimitating the extra- and intra-cellular compartments (4,5). Nevertheless, we are still far from understanding the impact of membrane lipidomics in stemness maintenance and differentiation patterns.

The aim of our work was to study membrane lipidomics of mesenchymal stromal cells derived from human placenta and correlate it to specific biological properties, by using chemically-defined tailored lipid supplements (Refeed®). In the experimental study, the cell membranes of freshly isolated mesenchymal stromal cells obtained from human fetal membranes (FM-MSCs) were characterized for fatty acid composition. Then, we investigated cell morphology, viability, proliferation, differentiation and immunomodulation after in-vitro exposure to Refeed® supplements. Control MSCs were cultured without lipid supplementation.

Our results showed a significant reduction of membrane fluidity for in-vitro primary cells, with cell membrane fatty acid composition greatly differing from the in-vivo one. By tailoring lipid supplementation, the fatty acid composition and biophysical properties of in-vitro cell membranes resulted more similar to the in-vivo counterparts, with higher omega-6 fatty acid content and increased membrane fluidity. These modifications of membrane composition and properties had no effect on cell morphology and viability, whereas ameliorated cell proliferation rate, diffentiation ability and immunomodulatory properties. In particular, supplemented FM-MSCs showed an increased expression of cell membrane molecules like Vascular Endothelial Growth Factor Receptors 1 (VEGFR-1 or Flt-1) and 2 (VEGFR-2 or KDR), that correlated with a more efficient response to angiogenic commitment. Moreover, regarding immunomodulation, supplemented FM-MSCs displayed an increased expression of the tolerogenic cell surface protein HLA-G, that positively influenced the in-vitro cell immunomodulatory ability.

Finally, these data suggest that specific lipid supplementation have functional consequences on in-vitro MSC behavior and may influence cell-based therapeutic approaches.

References

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Keywords

Mesenchymal stromal cells; cell membranes; lipid metabolism; fatty acids.