Effect of Glucagon-like Peptide-1 on the Differentiation of Adipose-derived Stem Cells into Osteoblasts and Adipocytes

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Objectives: Glucagon-like peptide-1 (GLP-1) is an intestinally secreted hormone and it plays an important role in the regulation of glucose homeostasis. However, the possible role of GLP-1 in the differentiation of adipose-derived stem cells (ADSCs) remains unknown. Therefore this study investigated the effect of GLP-1 on the differentiation of ADSCs into osteoblasts and adipocytes.

Methods: ADSCs were isolated from human adipose tissues of the abdomens, cultured and characterized by flow cytometry and multi-lineage potential assay. ADSCs were induced in osteogenic and adipogenic media treated with two different doses (10 and 100 nM) of GLP-1, and then the effect of GLP-1 on differentiation of ADSCs into osteoblast and adipocyte was examined. The signaling pathway involved in these processes was also examined.

Results: Isolated human ADSCs expressed mesenchymal stem cell (MSC) specific markers as well as GLP-1 receptor (GLP-1R) proteins. They also showed multiple-lineage potential of MSC. GLP-1 was upregulated the activity and mRNA expression of osteoblast-specific marker, alkaline phosphatase and the mineralization of calcium. In contrast, GLP-1 significantly suppressed the expression of adipocyte-specific markers, peroxisome proliferator-activated receptor gamma (PPAR-γ), lipoprotein lipase (LPL) and adipocyte protein 2 (AP2). This decreased expression of adipocyte specific markers caused by GLP-1 was significantly reversed by the treatment of extracellular signal-regulated kinase (ERK) inhibitor, PD98059 (P < 0.05).

Conclusion: This result demonstrates that GLP-1 stimulates osteoblast differentiation in ADSCs, whereas it inhibits adipocyte differentiation. The ERK signaling pathway seems to be involved in these differentiation processes mediated by GLP-1.

Key Words: Adipocytes, Adipogenesis, Adipose tissue, Cell differentiation, Glucagon-like peptide 1, Osteogenesis