Cell and molecular bases

Hernández-Bule ML, Trillo, Martínez-García MA, Abilahoud C, Úbeda A. Chondrogenic Differentiation of Adipose-Derived Stem Cells by Radiofrequency Electric Stimulation. Journal of Stem Cell Research & Therapy. 2017;7(12): 10.

Objective: Although capacitive-resistive electric transfer (CRET) therapies, based on transdermal application of electrothermal radiofrequency currents, have shown promising therapeutic effectiveness in regeneration of traumatic or degenerative tissue lesions, their potential effects on tissues like cartilage, having poor regenerative capabilities, have not been studied sufficiently. Here we investigate the effects of the exposure to a 448 kHz current typically used in CRET therapy, on the early chondrogenic differentiation of human, adipose-derived stem cells (ADSC).

Materials and methods: Stem cells obtained from healthy donors were differentiated in chondrogenic medium for 16 days. During the last 2 days of incubation the cultures were intermittently exposed or sham-exposed to a 448-kHz, sine wave current, administered at a 50 μA/mm2 subthermal density. The cellular response was assessed by: XTT proliferation assay, glycosaminoglycans (GAG) and collagen quantification (image analysis, Blyscan assay and immunoblot) and analysis of the expression of chondrogenic factors Sox5 and Sox6, and of the transcription factor ERK1/2 and its active form p-ERK1/2 (immunoflorescence, immunoblot and RT-PCR).

Results: The electric stimulus significantly increased the levels of both, cartilage-specific collagen type II and GAG in the extracellular matrix of the differentiating cultures. Although no changes were observed in the expression of the SOX genes at the end of the 48-hour treatment, the stimulus did induce significant overexpression of transcription factors L-Sox5, Sox6 and p-ERK1/2. Since these proteins are crucial regulators of the synthesis of the extracellular matrix during chondrogenic differentiation, it is likely that their overexpression is involved in the observed increases in the content of extracellular collagen and GAG.

Conclusion: The present data set provides support to the hypothesis that the electric component of the electrothermal treatment applied in CRET therapies could stimulate cartilage repair by promoting chondrogenic differentiation. These data, coupled with previously reported results that in vitro treatment with the same type of subthermal electric signal promotes proliferation of undifferentiated ADSC, identify molecular phenomena underlying the potential repairing and regenerative effects of such radiofrequency currents.