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Pulsed-Electromagnetic Fields Protect DPSC From Oxidative Damage and Trigger Differentiation

V. Rosa[1], D. F. Mardhian[2], L. M. Ji An[1], A. Franco-Obregon[1]
[1]National University of Singapore, Singapore, Singapore, [2]Padjadjaran University, Badung, Indonesia

Objectives To investigate the dual potential of pulsed electromagnetic fields (PEMF) in protecting dental pulp stem cells (DPSC) from oxidative stress-induced damage and triggering differentiation mechanisms.
Methods DPSC were treated with tert-butyl hydroperoxide (tBHP; 100, 150, or 200 mMol, 6 or 24 h duration) before or during the exposure to PEMF (2 mT, 10 min). In addition, conditioned media (CM) was obtained from naïve DPSC exposed to PEMF after 24 h from exposure. DPSC were treated with wither CM mixed with tBHP or by tBHP alone followed by exposure to PEMF. Cell viability (MTS assay) and morphology (confocal microscopy) were evaluated after 6 and 24 h after the treatments (n=3). Single-cell RNA sequencing (scRNA-seq) was carried out 24 h after exposure to PEMF to identify genes triggered by the exposure. Statistical analyses were performed with one-way ANOVA and Tukey, and global significance was preset at 5%.
Results tBHP decreased cell viability and induced significant changes in cell morphology regardless of the concentration and treatment duration tested. However, exposure to PEMF during and after the treatment with tBHP maintained both cell viability (> 90%) and morphology regardless of the concentration and duration of tBHP treatment tested. The scRNA-seq identified 411 genes significantly upregulated in DPSC exposed to PEMF.
Conclusions PEMF has the potential to protect and reverse oxidative stress-induced damage caused by tBHP and upregulate over 400 genes. The results indicate that PEMF might serve as a non-invasive method to protect pulp cells from oxidative damage and trigger differentiation for pulp regeneration.