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Impact of platelet activation electric stimulation protocols on hematopoietic and mesenchymal stem cells

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Electric pulse (EP) treatment of biological cells commonly use conductive coupling, where the electrodes make direct contact with the biological sample. Alternatively, one may use capacitive coupling, where air or a dielectric separates the electrodes from the sample, to mitigate the disadvantages of conductive coupling, such as contamination from the electrodes. One critical difference is that the samples are exposed to high electric fields with conductive coupling and lower intensity, bipolar electric fields with capacitive coupling. Several studies show that electric stimulation of platelet rich plasma (PRP) with nanosecond and microsecond duration EPs can activate platelets with conductive coupling [1] while more recent experiments demonstrated similar platelet activation efficiency with capacitive coupling. This raises the general question about the impact of electric stimulation on biological matrices containing complex cell populations, particularly non-platelet cell types in PRP. We investigated this issue by studying the growth of hematopoietic (HSC) and mesenchymal stem cells (MSC) after electrically stimulating cells contained in buffy coat separated from human bone marrow aspirate.

While conductive and capacitive coupling induced relatively similar growth factor release levels from platelets in PRP, conductive coupling adversely impacted stem cell differentiation and proliferation while capacitive coupling did not. Despite similar cell viability immediately following treatment, the coupling techniques induced dramatically different growth over two weeks. Maintaining long-term HSC and MSC viability and morphology is critical for wound treatment because their ultimate cellular function plays a critical role in healing and tissue regeneration [2].

[1] V. B. Neculaes et al., "Ex vivo platelet activation with extended duration pulse electric fields for autologous platelet gel applications," *EWMA J.*, vol. 15, no. 1, pp. 15-19, 2015.

[2] A. M. DiMarino, A. I. Caplan, and T. L. Bonfield, "Mesenchymal stem cells in tissue repair," *Front. Immun.*, vol. 4, no. 201, 2013.

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