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Cold plasma treatment in wound care: efficacy and risk assessment

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Cold atmospheric plasma is an ideal medium for non-destructive modification of vulnerable surfaces. One of the most promising medical applications of cold plasma treatment is wound healing. Potential advantages in wound healing have been demonstrated in vitro: the plasma does not necrotize the cells and does not affect the extracellular matrix [1], has clear bactericidal or bacteriostatic effects [2], and stimulates fibroblast cells towards faster attachment and proliferation [3]. However, safety issues, such as the potential cytotoxicity of the plasma must be clarified prior to clinical implementation. This work comprises the recent facts on sub-lethal plasma effects on mammalian cells, as well as studies on apoptosis induction and quantitative assessment of DNA damage. Fibroblast, smooth muscle and endothelial cells were treated using the standard cold plasma needle [1,2]; intra- and extracellular oxidant levels as well as the influence of the plasma on intracellular antioxidant balance were monitored using appropriate fluorescent markers [1]. We have studied long-term cellular damage was monitored using flow cytometry to determine the DNA profiles in treated cells. Dose-response curves were obtained: increased proliferation as well as apoptosis were visualized under different treatment conditions. The results from the in vitro studies are satisfying.

[1] I.E. Kieft, "Plasma needle: exploring biomedical applications of non-thermal plasmas", PhD Thesis, Eindhoven University of Technology (2005).

[2] R.E.J. Sladek, "Plasma needle: non-thermal atmospheric plasmas in dentistry" PhD Thesis, Eindhoven University of Technology (2006).

[3] I.E. Kieft, D. Darios, A.J.M. Roks, E. Stoffels, IEEE Trans. Plasma Sci. 34(4), 2006, pp. 1331-1336.