Effect of Cold Plasma on Wound Healing: In vitro Study

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OPEN ACCESS

Citation:
Naderi MS, Tabaie SM. Effect of Cold Plasma on Wound Healing: In vitro Study. *Iran Biomed J.* Supplementary (2-2026): 74.

ABSTRACT

Introduction: Cold plasma is a partially ionized gas in which the application of an electric field generates a mixture of ions, electrons, and reactive chemical species, while the overall temperature remains near ambient levels. This distinctive characteristic allows cold plasma to interact effectively with living tissues without inducing thermal damage. The generation of reactive oxygen and nitrogen species, weak ultraviolet photons, and electric fields constitutes the primary biological mechanisms underlying its function. In recent years, cold plasma has attracted considerable attention in regenerative medicine and wound healing due to its antimicrobial, anti-inflammatory, and cell-stimulatory properties. It has been shown to enhance wound healing by promoting skin cell proliferation, increasing collagen synthesis, and accelerating angiogenesis. Fibroblasts, as the principal cells responsible for connective tissue regeneration, play a central role in wound repair. They migrate to the wound site, undergo active proliferation, synthesize collagen and other extracellular matrix components, and secrete growth factors, thereby facilitating angiogenesis and wound contraction.

Materials and Methods: In this study, the effects of cold plasma on a human fibroblast cell line were investigated. Fibroblast cells were initially cultured in DMEM + 10% FBS, followed by exposure to cold plasma at different power levels and time durations. Cell proliferation, viability, and relevant cellular factors were subsequently assessed.

Results and Discussion: The results demonstrated that plasma treatment at power levels of 5 and 7 for 100–200 seconds significantly enhanced fibroblast proliferation and improved cellular factors, indicating a positive impact on wound healing.

Conclusion: These findings suggest that optimization of plasma treatment can effectively stimulate fibroblast activity. Given the critical role of fibroblasts in wound repair, refining cold plasma application protocols may contribute to the development of novel therapeutic strategies and represent a promising approach for improving outcomes in patients with chronic wounds.

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Keywords: Cold plasma, Fibroblast cell line, Wound healing

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