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Contribution ID: 4522 Type: Oral Competition (Graduate Student) / Compétition orale (Étudiant(e) du 2e ou 3e cycle)

(G*) Cold atmospheric plasma treatment of chronic wounds—investigation of the effects of reactive oxygen and nitrogen species on fibrosis-related cellular signaling pathways.

Wednesday 29 May 2024 11:30 (15 minutes)

A novel treatment for chronic wounds is cold atmospheric plasma. Non-equilibrium plasmas generate highly reactive species at low temperatures. This allows treatment of human tissue in-vivo and can induce locally confined redox-chemistry in biological organisms. Reactive oxygen and nitrogen species are known to play a vital role in cell signaling and influence a range of mechanisms implicated in all phases of wound healing— inflammation, vascular formation, proliferation, remodeling of scar tissue [1]. Plasma gives us a tool for controlling and modulating dosage of the redox species cocktail deposited on the wound bed—by modifying plasma environment and the mixture in the feed gas [2]. By better understanding the effect of reactive species on cells, we can tailor the plasma reactivity to supply the adapted treatment to the tissue. A special focus is put on fibrosis, a form of disrupted wound healing. Reactive species have dual functions depending on the healing phase, their concentrations, etc. This is why a good characterisation of the plasma composition is essential. Plasma composition was simplified to the hypothesis of 2 regimes which could have dual effects on fibrosis— oxygen regime vs nitrogen regime. Reactive oxygen species are known to be pro-inflammatory by increasing the oxidative stress in the environment of the cells, and reactive nitrogen species have anti-inflammatory behavior [3]. Spectroscopy techniques are used to measure key species density in the plasma, informing us on which regime is at play e.g., UV-absorption spectroscopy at 254nm is used for quantifying ozone. Biological experiments are conducted with each regime, analyzing cell behavior as a response to modulated plasma treatment. Tailoring the plasma reactivity to biological needs, to reach a bio-chemical effect on imbalanced healing environment in tissue models will deepen our comprehension on the physiology of chronic wounds. It will also pave the way to a personalized plasma treatment technology greatly benefiting the health sector.

[1] Dubey, S. K., Parab, S., Alexander, A., Agrawal, M., Achalla, V. P. K., Pal, U. N., Pandey, M. M., & Kesharwani, P. (2022). Cold atmospheric plasma therapy in wound healing. *Process Biochemistry*, 112, 112-123.

[2] Schmidt, B., A., Bansemer, R., Reuter, S., & Weltmann, K.-D. (2016). How to produce an NO_x- instead of O_x-based chemistry with a cold atmospheric plasma jet. *Plasma Processes and Polymers*, 13(11), 1120-1127.

[3] Feibel, D., Golda, J., Held, J., Awakowicz, P., Schulz-von der Gathen, V., Suschek, C. V., Opländer, C., & Jansen, F. (2023). Gas Flow-Dependent Modification of Plasma Chemistry in μ APP Jet-Generated Cold Atmospheric Plasma and Its Impact on Human Skin Fibroblasts. *Biomedicines*, 11(5).

Keyword-1

Plasma Medicine

Keyword-2

Atmospheric Pressure Plasma

Keyword-3

Fibrosis

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