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Promotion of refractory wound healing treated by a cold atmospheric plasma jet

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Refractory wounds constitute a serious health problem, which seriously reduces the life quality of patients. In this study, the animal models are established with the wound of genetic diabetic mice and the New Zealand rabbit wound infected by the methicillin-resistant staphylococcus aureus (MRSA). The experimental studies on the healing processes and the possible mechanisms of the preceding refractory wounds are conducted after treated by an helium cold atmospheric plasma (CAP) jet.

The experimental results show that there exist abundant chemically reactive species, e.g., excited helium atoms, NO, OH, O, and N, in the CAP jet region produced by a prototype of the helium CAP generator developed in our group. The helium CAP jet is employed to treat the diabetic wounds and the wounds infected by MRSA. The histology and cytokine analyses during the wound healing process are conducted to evaluate the plasma treatment efficacy and the possible acting mechanisms. Analysis of the histological results shows that the plasma treatment can effectively inactivate MRSA and control the lesion infection in the early stage, and thus, promote the wound healing. The cytokine analysis shows that CAP jet can induce organisms to release a variety of growth factors, such as fibroblast growth factors (FGFs) and the secretion of transforming growth factor-β (TGF-β) to regulate angiogenesis, re-epithelialization, fibroblast repopulation, and ECM remodeling. At the same time, the secretion of TGF-β and FGFs can be regulate and limit the inflammatory response and excessive cell proliferation to avoid scar tissue formation. And finally promote the wound healing process and inactivation of bacteria [1,2]. Therefore, it can be concluded that the chemically reactive species in the CAP jet are responsible for the chronic wound healing process resulting not only from the killing effects of the pathogenic microorganisms but also from the regulation function of the immune cells.

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References

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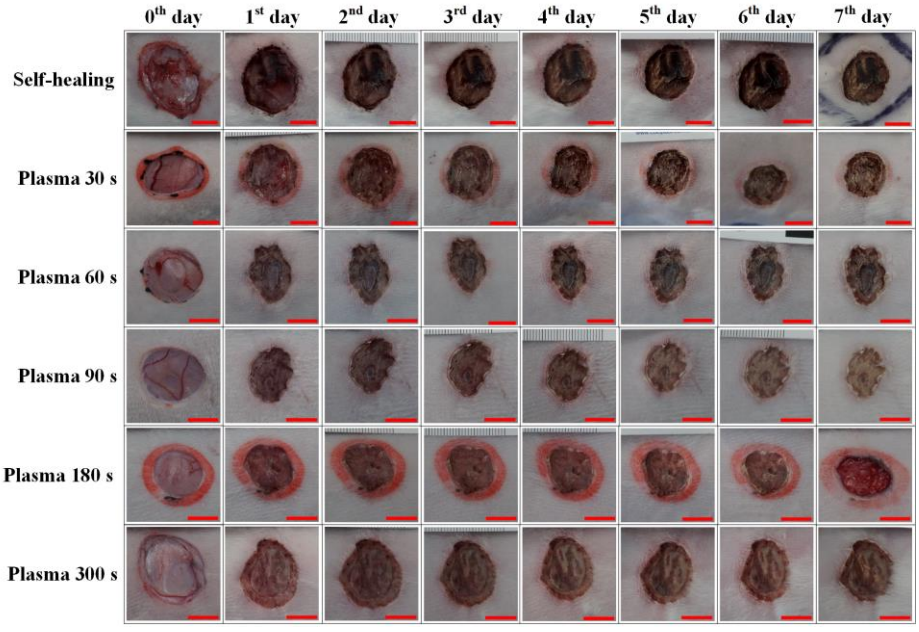

Figure 1. Photographs of the wound areas on the skin of the New Zealand rabbit during the healing processes with or without the plasma treatments. (The rabbit heads point toward the top with the rabbit tails pointing toward the bottom; scale bar: 1 cm).