ININVESTIGATION OF THE EFFECT OF VARIATIONS IN THE AMOUNT OF ACTIVE SPECIES DUE TO CHANGES IN THE CONDITIONS OF THE VOLTAGE GENERATED BY ATMOSPHERIC PRESSURE LOW-TEMPERATURE PLASMA ON WOUND HEALING

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ABSTRACT

Wound is physical injuries caused by internal and external factors, and current treatment methods mainly include dressings and antiseptics. However, current treatment methods carry the risk of wound infection, which may lead to bacteremia or sepsis. Therefore, as a new minimally invasive treatment method, I focused on reactive species generated by Atmospheric Low Temperature Plasma (ALTP) irradiation, which has been reported to promote cell proliferation and angiogenesis. In this study, I investigated the relationship between reactive species and therapeutic effects by comparing the healing process of wound produced on the back of rats in the ALTP-irradiated and non-irradiated groups. The amount of reactive species generated from ALTP was expected to increase with changes in the ALTP generation voltage conditions, based on the principle of ALTP generation. Therefore, we investigated the effect of changes in the amount of reactive species generated from ALTP with changes in the ALTP-generating voltage conditions on the healing of a rat model of wound.

First, differences in the therapeutic effect for different voltage conditions (wave height values) were assessed by comparing the rate of change in area and measuring biophotons. The results of the evaluation suggested that the cellular stimulation of reactive species generated by ALTP irradiation increased endogenous mitochondria-derived reactive oxygen species, which tended to promote wound closure by tilting the control toward cell survival/proliferation.

Next, the differences in therapeutic efficacy between the current treatment, disinfectant, and the novel treatment, ALTP, were assessed by comparison of area change rates and gene expression analysis. The target genes for gene expression analysis were selected as *VEGF-a*, a growth factor whose expression is induced by vascular endothelial cell proliferation and lumen formation, and *HIF-1α*, a transcription factor located upstream of *VEGF*. The evaluation results suggest that stimulation of cells with active species generated by ALTP irradiation induces activation of *HIF-1α* and expression of *VEGF-a*, thereby promoting angiogenesis.

Finally, the differences in therapeutic effects with changes in output voltage due to changes in waveform and voltage conditions (duty ratio) were evaluated by comparing area change rate, biophoton measurement, and gene expression analysis. The results suggest that higher output voltages tend to enhance the promotion of cell proliferation and angiogenesis, leading to a shorter wound healing period. From the above, it was concluded that ALTP11 [kV0-p] (duty ratio 0.9) was the most effective voltage condition for wounds.