

Effect of Plasma Radiation on Keratinocyte Cells Involved in the Wound Healing Process

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Abstract : Plasma medicine, which involves the use of gas discharge plasmas for medical applications is a rapidly growing research field. The use of non-thermal atmospheric pressure plasmas in dermatology to assist tissue regeneration by improving the healing of infected and/or chronic wounds is a promising application. It is believed that plasma can activate cells, which are involved in the wound closure. Non-thermal atmospheric plasmas are rich in chemically active species (such as O and N-atoms, O₂(a) molecules) and radiative species such as the NO, N₂⁺ and N₂ excited molecules, which dominantly radiate in the 200-500 nm spectral range. In order to understand the effect of plasma species, both of chemically active and radiative species on wound healing process, the interaction of physical plasma with the human skin cells is necessary. In order to clarify the effect of plasma radiation on the wound healing process we treated keratinocyte cells - that are one of the main cell types in human skin epidermis - covered with a layer of phosphate-buffered saline (PBS) with a low power atmospheric pressure plasma. For the generation of such plasma we have applied a plasma needle. Here, the plasma is ignited at the tip of the needle in flowing helium gas in contact with the ambient air. To study the effect of plasma radiation we used a plasma needle configuration, where the plasma species - chemically active radicals and charged species - could not reach the treated cells, but only the radiation. For the comparison purposes, we also irradiated the cells using a UV-B light source (FS20 lamp) with a 20 and 40 mJ cm⁻² dose of 312 nm. After treatment the viability and the proliferation of the cells have been examined. The proliferation of cells has been studied with a real time monitoring system called Xcelligence. The results have indicated, that the 20 mJ cm⁻² dose did not affect cell viability, whereas the 40 mJ cm⁻² dose resulted a decrease in cell viability. The results have shown that the plasma radiation have no quantifiable effect on the cell proliferation as compared to the non-treated cells.

Keywords : UV radiation, non-equilibrium gas discharges (non-thermal plasmas), plasma emission, keratinocyte cells

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