The Exposure to the Non-Thermal Atmospheric Pressure Plasma Can Control the Proliferation of Mammalian Cells

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Recently, atmospheric pressure plasmas (APPs) have been utilized as a novel tool of medical applications such as wound healing and blood coagulation. APP abounds with electrons, various ions, radicals, and neutral atoms which cause specific interactions with cells [1]. However, its application to human cells has been mainly focused on cell death. In this study, a non-thermal APP which was generated by an atmospheric pressure dielectric barrier discharge was applied to three different human cell lines without heat generation. We observed that the exposure of APP to human adipose-derived stem cells (ASC) and the primary lung fibroblast IMR-90 cells induced increased cell proliferation in a specific condition. On the other hand, the same exposure of APP to HeLa cells dramatically decreased their viability. These observations suggest that different types of human cells differentially respond to the exposure of APP. The cleaved forms of caspase-3 and poly ADP-ribose polymerase (PARP) which is the markers for cell apoptosis were detected in APP-exposed HeLa cells, demonstrating that the decreased viability of HeLa cells is due to cell death. In the caspase-dependent apoptotic pathway, PARP can deplete cellular adenosine triphosphate (ATP) which leads to cell death [2]. When APP-exposed HeLa cells were treated with an extracellular ROS scavenger, sodium pyruvate, the viability was recovered in a concentration-dependent manner. These results suggest that APP specifically induces apoptosis in HeLa cells by generating extracellular ROS. Altogether, this study suggests that APP can be a useful method to control the proliferation of different types of human cells.

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References

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