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Plasma Medicine and its Mechanism for Cancer Therapy

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Nonthermal biocompatible plasma sources and their characteristics operating at atmospheric pressure have been introduced and overviewed for plasma bioscience and medicines for biological cell interactions, especially used in Plasma Bioscience Research Center (PBRC). The electron temperatures and plasma densities are measured to be 0.8 ~ 2.8 eV and 3×10^{12} ~ 3×10^{15} cm^{-3}, respectively, for the nonthermal biocompatible plasma jet and micro-DBD plasma sources [1-2] in PBRC. We have observed that plasma-initiated ultraviolet (PUV) photolysis is responsible for the generation mechanism of reactive oxygen and nitrogen species (RONS) in the solution or tissues [3]. Based on this PUV photolysis, the nonthermal biocompitable plasma and their activated medium/water (PAM/PAW) can be considered as a potential cancer treatment for clinical applications. We have investigated enhanced anticancer effect of monocytes and macrophages activated by nonthermal plasma which act as immune-modulator on these immune cells [4]. Recently, we also apply micro-DBD plasma and PEG-coated gold nano-particles in-vivo on the solid cancer cells to enhance apoptosis of lung cancer efficiently [5]. We previously developed a microwave-torch plasma system, by which nitric oxide plasma activated water (NO-PAW) could be processed. In this study, we explored the effects of NO-PAW on a cervical cancer cell line, in comparison with micro-DBD plasma [6]. We also have carried out to examine the potential applications of the reactive oxygen species (ROS) -producing micro-DBD plasma to overcome the cancer cells' drug resistance, which has been emerging as an alternative therapeutic tool for cancer. For this, we developed a tamoxifen (Tam)-resistant MCF-7 (MCF -7/TamR) breast cancer cell model and examined the effect of miro-DBD plasma on the recovery of Tam sensitivity at the cellular and molecular level [7]. We have also observed OD induced apoptosis on melanocytes G361 cancer cells through DNA damage signaling cascade [8]. Furthermore, we provide the possibility that nonthermal plasma jet could be developed as a potential anti-diabetic therapy via ROS and NO dependent signaling pathway for glucose uptake and insulin secretion[9] based on the RONS generation mechanism of PUV photolysis inside the cell or tissues.

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