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The Synergistic Effect between Electrical and Chemical Factors in Plasma Gene/Molecule-Transfection[1]

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This study has been done to know what kind of factors in plasma and processes on cells promote plasma gene/molecule transfection. We have discovered a new plasma source using a microcapillary electrode which enables high transfection efficiency and high cell survivability simultaneously. However, the mechanism of the transfection by plasma was not clear. To clarify the transfection mechanisms by micro plasma, we focused on the effects of electrical (current, charge, field, etc.) and chemical (radicals, RONS, etc.) factors generated by the micro plasma and evaluated the contribution weight of three groups of the effects and processes, i.e. electrical, chemical and biochemical ones. At first, the necessity of the electrical factors was estimated by the laser produced plasma (LPP). Mouse L-929 fibroblast cell was cultured on a 96-well plate or 12-well micro slide chamber. Plasmids pCX-EGFP in Tris-EDTA buffer was dropped on the cells and they were exposed to the capillary discharge plasma (CDP) or the LPP. In the case of the CDP, the plasma was generated between the tip of the capillary electrode and the cells so that both electrical and chemical factors were supplied to the cells. In this setup, about 20% of average transfection efficiency was obtained. In the case of the LPP, the plasma was generated apart from the cells so that electrical factors were not supplied to the cells. In this setup, no transfection was observed. These results show that the electrical factors are necessary for the plasma gene transfection. Next, the necessity of the chemical factors was estimated the effect of catalase to remove H_2O_2 in CDP. The transfection efficiency decreased to 0.4 by scavenging H_2O_2 with catalase. However, only the solution of H_2O_2 caused no gene transfection in cells. These results shows that H_2O_2 is important species to cause gene/molecule transfection but still needs a synergistic effect with electrical or other chemical factors.

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