Genetics and Epigenetics of Cold Atmospheric Plasma Acting on Breast Cancer Cells

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Cold atmospheric plasma (CAP) has received attention from basic biological science, as well as medical fields, by virtue of its efficacy of preferentially inducing death of cancer cells over normal cells. When the DNA of cells is targeted by CAP, directly or indirectly, the anti-proliferation effect can be achieved by genetic or epigenetic change. Genetic events include DNA breakage and possibly nucleotide mutation. Epigenetic regulation implies control of gene expression without accompanying genetic alteration, which can be inherited to daughter cells. Apparently, there are three epigenetic events: methylation at the cytosine residue of DNA, recognition of and binding to the 3′-untranslated region of mRNA by microRNA, and structural modification of histones. Our experimental results of epigenetic changes by CAP in breast cancer cells, which were achieved over the past a few years will be overviewed at the meeting.

As another theme of the presentation, the potential applications of CAP to overcome the cancer cells' drug resistance will be debated. We developed a tamoxifen–resistant MCF-7 (MCF-7/TamR) and a taxol–resistant MCF-7 (MCF-7/TaxR) breast cancer cell model and examined the effect of CAP on the recovery of drug sensitivity at cellular as well as molecular level. CAP was proven to restore sensitivity by up to 70% against the drugs after CAP treatment. The comparison of genome-wide expression in cells between the acquisition of drug resistance and CAP treatment identified 20 and 48 genes for MCF-7/TamR and MCF-7/TaxR, respectively, which showed significant expression changes and furthermore showed opposite expression change during the course of drug resistance and CAP treatment. Notably, the dysregulation of selected genes in the drug-resistant cells alleviated the drug sensitivity recovery effect of CAP.

The potential of CAP whether it can prevent the acquisition of drug resistance was also challenged by establishing the CAP treatment condition in combination with therapeutic chemicals. Pre-treatment of CAP to cancer cells before applying therapeutic chemicals suppressed the appearance of drug-resistant cells. These findings may lend credence to CAP as an alternative or complementary tool in the treatment or prevention of chemo–resistant cancer.

This research was supported by the Leading Foreign Research Institute Recruitment Program (NRF-2016K1A4A3914113) through the National Research Foundation of Korea (NRF) funded by the Korea government (MSIT).

References

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