Application of cold atmospheric plasma to overcome drug-resistance in cancer cells

SUN JUNG KIM [1], Sungbin Park [1], Hyeon Woo Kim [1], Dawoon Jeong [1], Juyeon Ham [1], and Eun Ha Choi [2]

[1]*DONGGUK UNIVERSITY, Korea, Republic of*

[2]*KWANGWOON UNIVERSITY, Korea, Republic of*

Cancer recurrence during or afterchemotherapy remains a great challenge in cancer treatment. This study wascarried out to examine the potential applications of the reactive oxygen andnitrogen species-producing cold atmospheric plasma (CAP) to overcome the cancercells' drug resistance, which has been emerged as an alternative therapeutictool for cancer. To do this, we developed a tamoxifen–resistant MCF-7 (MCF-7/TamR)and a taxol–resistant MCF-7 (MCF-7/TaxR) breast cancer cell models, andexamined the effect of CAP on the recovery of drug sensitivity at the cellularand molecular level. The ROS level was increased up to 20-fold in CAP-treated drug-resistantcells compared to the non-treated cell. CAP was proven to restore sensitivity byup to 70% for the resistant cells against the drugs after CAPtreatment. The comparison of genome-wide expression between the acquisition of drugresistance and CAP treatment identified 20 and 48 genes for MCF-7/TamR and MCF-7/TaxR,respectively, which showed significant expression changes and furthermoreshowed opposite expression change during the course of drug resistance and CAPtreatment. The RNA and protein expression of selected genes was recovered closeto the level of their parental cells by CAP. Furthermore, the dysregulation of selectedgenes in the drug-resistant cells alleviated the drug sensitivity recoveryeffect of CAP. Taken together, CAP inhibited the growth of Tam– and Tax–resistantMCF-7 cancer cells and reset it to the drug-sensitive status by restoring theexpression of drug resistance–related genes. These findings may lend credenceto CAP as an alternative or complementary tool in the treatment or preventionof chemo–resistant cancer.

This research was supported by theLeading Foreign Research Institute Recruitment Program (NRF-2016K1A4A3914113) and by the BasicScience Research Program (2016R1D1A1B01009235) through the National Research Foundation of Korea(NRF) funded by the Korea government (MSIT)