PST/PBM-01-3-I-M

Plasma-activated medium as a novel cancer therapeutic approach

Hiromasa TANAKA[1]*, Masaaki MIZUNO[2], Fumitaka KIKKAWA[3] and Masaru HORI[1]

[1] *Institute of Innovation for Future Society, Nagoya University, Japan*
[2] *Center for Advanced Medicine and Clinical Research, Nagoya University Hospital, Japan*
[3] *Department of Obstetrics and Gynecology, Nagoya University, Japan*

htanaka@plasma.engg.nagoya-u.ac.jp

Non-thermal atmospheric pressure plasma provides an innovative approach for sterilization, wound healing, and blood coagulation. We have developed non-thermal atmospheric pressure plasma for medical applications, and treated several cancer cells with plasma. We created plasma-activated medium (PAM) to treat cancer cells, and PAM has broadened the ways by which plasma can be applied [1-3]. It is expected that PAM is especially effective for disseminated cancers such as peritoneal disseminated ovarian cancers and gastric cancers.

Numerous studies revealed that PAM induced reactive oxygen species (ROS) and apoptosis on cancer cells, and ROS is responsible for anti-tumor effects. These results suggest that PAM provides a novel therapeutic approach to control redox balances. Cancer bears various mutations to promote cell cycles and inhibit apoptosis. Mutations of genes in the survival and proliferation signaling network constitutively activate the signaling pathways such as RAS-MAPK signaling pathway and PI3K-AKT signaling pathway, which leads to promote cell cycles and inhibit apoptosis. It was found that PAM down-regulates such survival and proliferation signaling network. Based on these results, we constructed the model of intracellular molecular mechanisms for PAM to induce apoptosis on cancer cells.

We investigated differences of sensitivity to PAM in each cell line. We found that fast-dividing cells are more sensitive to PAM, packed cells are less sensitive to PAM, and genetic background of cell lines affect sensitivity to PAM. These results provide important insights into cancer treatment option using PAM.

This work was partly supported by a Grant-in-Aid for Scientific Research on Innovative Areas “Plasma Medical Innovation” Grant No. 24108002 and 24108008, and a Grant-in-Aid for Young Scientists (A) Grant No. 15H05430, and a Grant-in-Aid for Challenging Exploratory Research Grant No. 15K13390 from the Ministry of Education, Culture, Sports, Science and Technology of Japan.

References

[1] H. Tanaka et al., IEEE T Plasma Sci, 42 (2014) 3760-3764.
[2] H. Tanaka et al., Phys Plasmas, 22 (2015) 122003.
[3] H. Tanaka et al., Clinical Plasma Medicine, (2015) 72-76.