Analysis of Oxidative Stress on Cancer Cell using Atomic Force Microscopy

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Photodynamic therapy is a useful medical treatment that induces a necrosis of cancer cells by activating oxidative stress through irradiation of light. However, the details of the mechanism how the oxidative stress in cancer cells induces the necrosis have not been sufficiently understood. Reactive oxygen species (ROS) produced by the applied oxidative stress are known to break intracellular materials, such as DNA, cell membrane, and cytoplasm. On the other hand, however, ROS are signal-transduction materials which increase a production of cytoskeleton in a cell [1]. Namely, influence of ROS on a cancer cell can be determined by the conditions of cellular membrane and cytoskeleton. Therefore, influence of ROS and the necrosis mechanism for the cancer cells are expected to be analyzed by observing the elastic module of cells. In this study, we studied the influence of ROS on cancer cells by observing the shape and elastic modulus of rat cancer cells with atomic force microscopy (AFM).

Figure 1 shows a phase-contrast image of cancer-like mutated rat gastric mucosal cell (RGK1) and its elastic-module maps. The elastic modules of RGK1 were increased by light irradiation. Figure 2 shows the average values of elastic modules around cell nuclei. The average values of the elastic modules after irradiation of 5 and 10 minutes were estimated to be 2.9 kPa and 3.4 kPa, respectively. The results indicate that Rho family protein which regulates cytoskeletons was activated by ROS, increasing a production of some stress fibers in a cell, and the elastic modules were temporarily increased. Details will be discussed at the colloquium.

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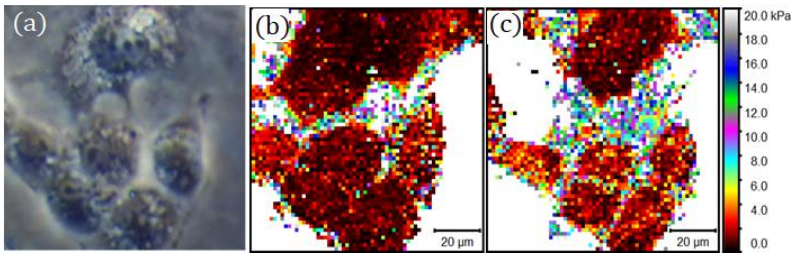

Figure 1 (a) Phase-contrast image of RGK1. Elastic module maps measured (b) before and (c) after light irradiation.

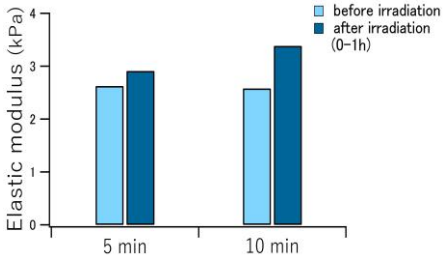

Figure 2 Average of elastic modules around the cell nuclei

Reference

[1] C. E. MacKay et al., *Free Radical Biology and Medicine* **110**, 316-331 (2017).