



Effects of local exposure to 26.5 GHz-millimeter wave on neuronal cells in rat brain

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The potential of radiofrequency electromagnetic fields from cell phones to cause adverse health effects on the brain has been the subject of numerous studies and publications. In particular, the health effects of millimeter waves (MMW), such as 5th generation wireless systems (5G), are now in focus due to their current expansion. Our previous studies have shown the local SAR threshold for the apparent morphological changes in glial cells in the rat brain after 26.5 GHz MMW exposure under high intensity exposure conditions. However, the effects of this MMW on other cell types, such as neuronal cells, were still unclear. The aim of the present study was to investigate whether the expression of cyclooxygenase type 2 (COX-2), an inflammation-related protein, was modified by local exposure to 5G-MMW in the rat cortex.

To investigate the biological effects of MMW exposure, we designed the systems, consisting of a signal generator, an amplifier, and a patch antenna, to locally expose the rat cortex to a 26.5 GHz wave. The antenna input power was set at 0 to 1 W, corresponding to an incident power density (IPD) of 0 to 1,450 W/m² at the target tissue of the cortex.

Male Sprague-Dawley rats (8-9 weeks old) were used in the experiment. Rats were anesthetized with isoflurane (inhalation). The head of each animal was fixed in the stereotaxic apparatus and locally exposed to 26.5 GHz MMW for 18 min. COX-2 protein expression was quantified in the cortex by Western blotting up to 3 days after exposure. All experimental procedures were conducted in accordance with the ethical guidelines for animal experiments at Kurume University School of Medicine.

The significant expression of COX-2 protein was observed in the cortex exposed at 1,450 W/m² one day after exposure. In contrast, little expression was detected in the cortex exposed at less than 725 W/m². In our previous study, immunoreactivity to anti-COX-2 antibody was observed one day after exposure only in the cortex section at 1,450 W/m², especially in the neuronal cell bodies. Therefore, the present quantitative results also suggest that the threshold of exposure intensity that induces inflammation in the cortex via neuronal cells may be around 1,450 W/m² of IPD.

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