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# Effects of high intensity local exposure to 26.5 GHz-millimeter-waves on glial cells in rat brain

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The potential of radio frequency 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) and WiGig (IEEE 802.11ad) are now being focused on because of their current expansion. Our previous studies have shown the threshold of local SAR for the obvious morphological changes in glial cells in the rat brain after 10 GHz EMF exposure under high intensity exposure conditions. However, the threshold of these effects for MMWs using the 5G systems was still unclear. The aim of the present study was to investigate the threshold of local exposure intensity of the 5G-MMW for glial cell activation.

Male Sprague-Dawley rats (8-9 weeks old) were used in this 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 using an antenna. The field strength was adjusted to give 0, 118, 261, 1,219, 2,546 W/kg averaged SAR in the target tissue area. The two types of glial cells, microglia and astrocyte, were observed by immunohistochemistry 3 days after exposure. All experimental procedures were performed in accordance with the ethical guidelines for animal experimentation at Kurume University School of Medicine.

Expression of Iba1, an actin cross-linking protein in macrophages/microglia, was increased around the target area in the right cortex exposed only to 2,546 W/kg. In addition, the shape of Iba1-positive cells in this area changed to an amoeboid type. The expression level of GFAP, an indicator of astrocyte activation, also increased on day 3 under the highest intensity conditions, especially around the target area. In the area adjacent to the target, hypertrophic changes were observed in several GFAP-positive cells. In contrast, no differences in protein expression or morphological changes were found among the other exposure intensities. These results suggest that the threshold of local SAR that could induce inflammatory activation of microglia and astrocyte cells in rat cortical tissue was around 2,546 W/kg under the present experimental conditions.

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