INTRAVITAL-MICROSCOPIC EVALUATION OF EXPOSURE EFFECTS TO RADIO-FREQUENCY ELECTROMAGNETIC FIELDS ON THE CEREBRAL CIRCULATION IN RATS, SPECIAL REGARD TO BLLOD-BRAIN BARRIER FUNCTION.

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Introduction

Biological effects of radio-frequency electromagnetic fields(EMF) on human are one of the most health concern in the world. Its effects on the blood-brain barrier (BBB) function has been extensively studied in experimental animal models. These studies, however, have been only histologically or morphologically performed due to postmortem examination. Besides these, little information are available about the exposure effects of EMF on cerebral microcirculation. We have developed a cranial window method for evaluating the exposure effects of EMF on the BBB function, hemodynamics of pial microcirculation and behavior of intramicrovascular leukocytes by using an intravital microscopy in the rat as shown in Figure 1.

Materials and methods

Thirty-six male Sprague-Dawley rats each (B.W. 512±9 g for an acute exposure experiment and 516±10 g for an chronic exposure experiemnt) were used in the present study. Under anesthesia with a cocktail (100mg/kg i.m.) of Ketamine hydrochloride and Xylazine hydrochloride (10:1, w/w), they were subjected to the cranial window implantation and intravital-microscopic observation. EMF exposure system consisted of a small anechoic chamber and a monople antenna. The head of each rat was positioned toward the central antenna and was locally exposed to 1,439MHz electromagnetic near-field TDMA (time division multiple access) signal for PDC (Personal Digital Cellular, Japanese cellular telephone standard) system. At acute exposure experiment, the degree of intensity of EMF exposure was controlled by mean specific absorption rate (SAR) of the brain at 1, 4 and 8W/kg and at chronic exposure experiment mean SAR was controlled at 4W/kg, respectively. The EMF exposure duration was 10 minutes for the acute exposure experiment and was 60 minutes everyday for the chronic exposure experiment which was intermittently performed 5 days a week for 4 weeks.

After the exposure to EMF, the animal's head was immediately positioned in a stereotactic frame for microscopic observations. The pial microcirculation within the cranial window was investigated by a fluorescence microscope equipped with an SIT camera. In order to measure vascular diameters, plasma velocities, leukocyte behavior and BBB-function, several-types of fluorescent dyes and fluorescent microparticles were administered via the tail vein.

Results

Acute Exposure Experiment: The values in the diameters and maxmal plasma velocity of the pial venule of pre- and post-exposures did not significantly differ from each other for any SARs tested. Corresponding to the increase in SAR, the number of rolling leukocytes on the venular endothelia tended to decrease, however, no significant differences were recognized between the values for pre- and post-exposures. No extravasation of two kinds of fluorescence dyes, FITC-Dx (MW: 250,000) and sodium-fluorescein (MW: 376), from the pial venule was noticed due to any SARs.

Chronic Exposure Experiment: The values in the diameters and maxmal plasma velocity of the pial venule of pre- and post-exposures did not significantly change. No significant differences were recognized between the values for pre- and post-exposures in vascular diameters, plasma velocities and adherent leukocyte counts. No extravasation of two kinds of fluorescence dyes, FITC-Dx (MW: 250,000) and sodium-fluorescein (MW: 376), from the pial venule was noticed.

Conclusion

These results from acute and chronic exposure experiment of EMF suggested that no noticeable changes in the cerebral microcirculation including BBB function occurred under the present EMF exposure conditions by using our *in vivo* model. Further investigation are required under different exposure conditions.

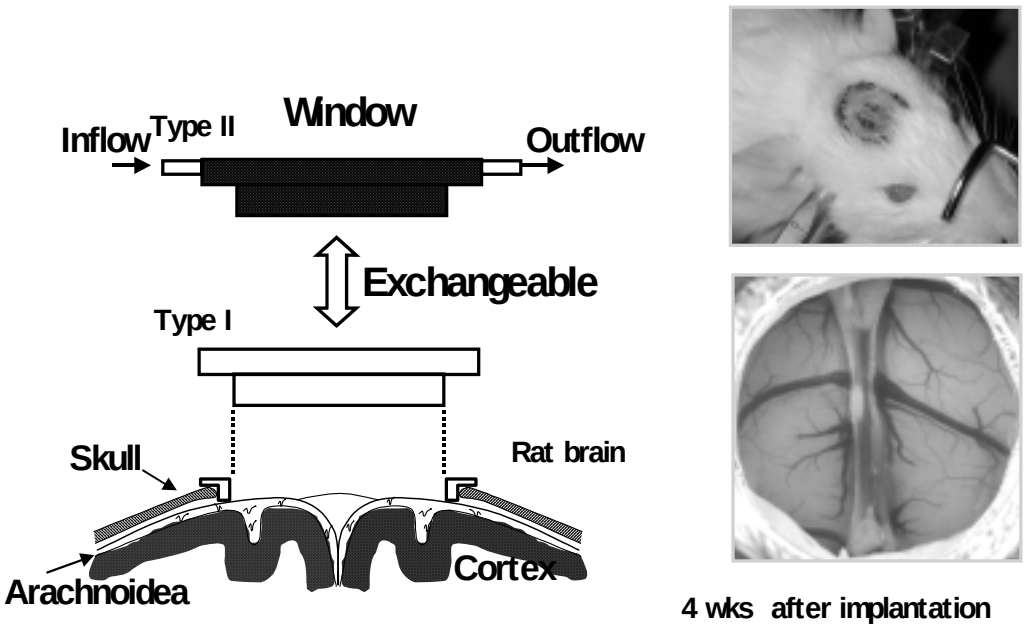

Figure 1. Cranial window for chronic implantation

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