

MICROWAVE INTERACTION WITH THE BLOOD BRAIN BARRIER SYSTEM OF LABORATORY RATS. James C. Lin, Department of Bioengineering and Department of Electrical and Computer Engineering, University of Illinois - Chicago, (M/C 154), 851 South Morgan Street, Chicago IL 60607_7053 USA. E-Mail: lin@uic.edu

The blood-brain barrier (BBB) is a cellular layer in the blood vessels of the brain. The blood-brain barrier partitions the circulating blood from the brain tissue proper. It regulates the passage of vital substances and nutrients into brain tissues, and the passage of carbon dioxide and metabolic waste products out of brain tissues. The selective passage prohibits harmful toxins from infiltrating the brain, and also excludes many drugs and therapeutic agents from reaching brain tissues. It is a mixed blessing because drugs that are effective in treating diseases in other parts of the body may not be able to gain entry into the brain to combat infection. On the other hand, unintentional opening of the BBB may subject the central nervous system to assault from extraneous microorganisms. Many investigators have published studies on the effect of microwave radiation on BBB of experimental animals, with varied results. Studies showing -- and not showing -- a microwave-induced increase in rat BBB permeability changes have used both high and low levels of microwave exposure. For a while, the consensus had been that when the applied microwave power is high enough to elevate the temperature of the rat brain to about 42°C, BBB permeability increases for substances normally excluded by the BBB. Moreover, microwave hyperthermia induced BBB disruption had been shown to be reversible. Also, intravenous injection of ethanol prior to microwave irradiation resulted in cooling of the brain, thereby mitigated against an excessive temperature increase and had attenuated the observed changes in BBB permeability. However, within the past 10 years, a series of reports from one laboratory showed consistent disruption of the BBB at various times following low levels of microwave exposure - in the range of cellular mobile telephone radiation - has caught the attention of many in the field. The minute amount of extravasated albumin was visualized by immunohistochemical staining. Immunohistochemical staining was employed in two subsequent attempts to assess microwave-induced BBB permeability changes. In an acute study, groups of individually restrained rats were sham or microwave exposed for four hours at average SAR ranging from 0.3 to 7.5 W/kg, using 900-MHz-GSM fields. The extravasations of serum albumin were assessed either at the end of exposure, or seven days later. A significant increase in albumin extravasations was observed only in the group exposed to the highest SAR, 7.5 W/kg, immediately after microwave exposure. In another study, immunoassaying of albumin was used to investigate the effect of exposure to a 1439 MHz, time-division-multiple-access (TDMA) cell-phone field on the permeability of BBB in rats exposed for two or four weeks. A peak SAR of 2 W/kg was measured in the rat brain, and the average SAR over the whole body was 0.25 W/kg. There were no significant changes in any of the groups of rats investigated. Results from Evans blue-dye injection were also negative.