

Medical/biological Study (experimental study)

Effects of continuous-wave, pulsed, and sinusoidal-amplitude-modulated microwaves on brain energy metabolism.

By: Sanders AP, Joines WT, Allis JW

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Aim of study (according to author)

To determine whether rat brain metabolism (reflected in brain ATP and creatine phosphate (CP)-concentration) is affected differentially by exposure to continuous wave (CW), pulsed, or sinusoidal amplitude modulated microwaves.

Background/further details:

Brain temperatures of rats were maintained between -0.1 and -0.4°C from the preexposure temperature when subjected to as much as 20 mW/cm² CW, pulsed, or sinusoidal amplitude modulated 591 MHz exposure for 5 min.

Endpoint

- effects on the neurological system: brain metabolism (ATP and creatine phosphate (CP)-concentration)

Exposure

Field characteristics	Parameters
field 1: 591 MHz continuous wave (CW) exposure duration: 5 min	power flux density: 10 mW/cm ² mean value power flux density: 20 mW/cm ² mean value power flux density: 13.8 mW/cm ² mean value (13.25 mW/cm ² , 8 mW/cm ² , 6 mW/cm ² , 4.5 mW/cm ² , 3 mW/cm ² , 1.5 mW/cm ² and 1 mW/cm ²)
field 2: 591 MHz amplitude modulation exposure duration: 5 min	power flux density: 20 mW/cm ² mean value power flux density: 10 mW/cm ² mean value power flux density: 13.8 W/m ² mean value (13.25 mW/cm ² , 8 mW/cm ² , 6 mW/cm ² , 4.5 mW/cm ² , 3 mW/cm ² , 1.5 mW/cm ² and 1 mW/cm ²)
field 3: 591 MHz pulsed (PW) exposure duration: 5 min	power flux density: 13.8 W/m ² mean value (13.25 mW/cm ² , 8 mW/cm ² , 6 mW/cm ² , 4.5 mW/cm ² , 3 mW/cm ² , 1.5 mW/cm ² and 1 mW/cm ²) power flux density: 20 mW/cm ² mean value power flux density: 10 mW/cm ² mean value

Exposed system:

animal (species/strain): rat/Sprague-Dawley

partial body exposure: head

Methods

Endpoint/Measurement parameters/Methodology

- effects on the neurological system: concentration of NADH (*in vivo* determination; fluorescence); concentration of ATP and CP (creatine phosphate) (*in vitro* measurement; biochemical assay); brain temperatures

investigated material: isolated bio./chem. substance (in vitro), isolated organ (in vitro)

investigation on living organism
investigated organ system: brain/CNS

time of investigation: during and after exposure

Main outcome of study (according to author)

The pulse modulated and sinusoidal amplitude modulated (16 Hz) microwaves were not significantly different from CW irradiations in inducing increased NADH fluorescence and decreased ATP and CP concentrations. When the pulse modulation frequency was decreased from 500 to 250 pulses (per second) the average incident power density threshold for inducing an increase in brain NADH increased by a factor of 4, i.e. from about 0.45 to about 1.85 mW/cm². Since brain temperature did not increase, the microwave-induced increase in NADH and decrease in ATP and CP concentrations was not due to hyperthermia. This suggests a direct interaction mechanism. It is consistent with the hypothesis of microwave inhibition of mitochondrial electron transport chain function of ATP production.

(Study character: medical/biological study, experimental study, full/main study)

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- Environmental Protection Agency (EPA), USA
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