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ADRENOCORTICAL RESPONSE IN RATS EXPOSED TO 1.29 GHz MICROWAVES

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ABSTRACT

Male, Long-Evans rats (350-450 gm) were exposed to 15 mW/cm^2, 1.29 GHz pulsed microwave radiation for 90 minutes. The exposures were carried out in an anechoic chamber in the far-field zone of a horn antenna. Ambient temperature was 25 ± 1°C. Blood samples were drawn before and during exposure via chronically indwelling venous catheters, and were assayed for plasma corticosterone levels. After 30 min of exposure, plasma corticosterone levels began to rise in exposed rats as compared to sham-exposed rats and increased to a level 6-8 times that of sham-exposed rats after 75 min of exposure. These results indicate that rat adrenocortical function is stimulated at a lower power density at 1.29 GHz than has previously been observed for exposures at 2.45 GHz.

SUMMARY

Previous experiments have demonstrated adrenocortical responses in rats exposed to 2.45 GHz microwave exposure for 60 to 120 min. These changes, as indicated by increased plasma corticosterone levels, had a threshold intensity of effect at 20-50 mW/cm^2, with the lower intensity causing a response at the longer exposure duration. In addition, behavioral changes in rats exposed to 2.45 GHz microwaves have been reported by de Lorge of this laboratory at approximately the same field intensities that caused adrenocortical stimulation. Following the observance by de Lorge of behavioral changes at lower power densities for 1.29 GHz than occurred for 2.45 GHz, these experiments were done in an effort to determine if adrenocortical changes also occur in rats at lower field intensities of 1.29 GHz radiation than of 2.45 GHz radiation.

Male, Long-Evans rats (350-450 gm) were used in these experiments. One week prior to an experiment, a polyethylene catheter was surgically implanted in the jugular vein of the rat under Nembutal anesthesia. The rats were "gentled" over a two week period prior to use in an experiment, and were given three periods (4 hours each) of adaptation to the exposure cages prior to an experiment.

The rats were exposed in an anechoic chamber in the far zone of a horn antenna. During exposure they were not restrained, but were housed in a cage (20 x 20 x 30 cm) made of Styrofoam and polystyrene. Microwave power was provided by a military radar type AN/TPS-1G, operating at 1.29 GHz with a 2 μsec pulse width and a 0.001 duty cycle. Power density measurements were made in the absence of the rats and cages with a Narda Model 8306B broadband probe. Two rats were exposed simultaneously in each experiment. Their individual cages were placed so that the rats were separated by 38 cm at all times. The average whole body SAR, as determined with a saline phantom and normalized per unit of incident power density, was 0.20 (W/kg).

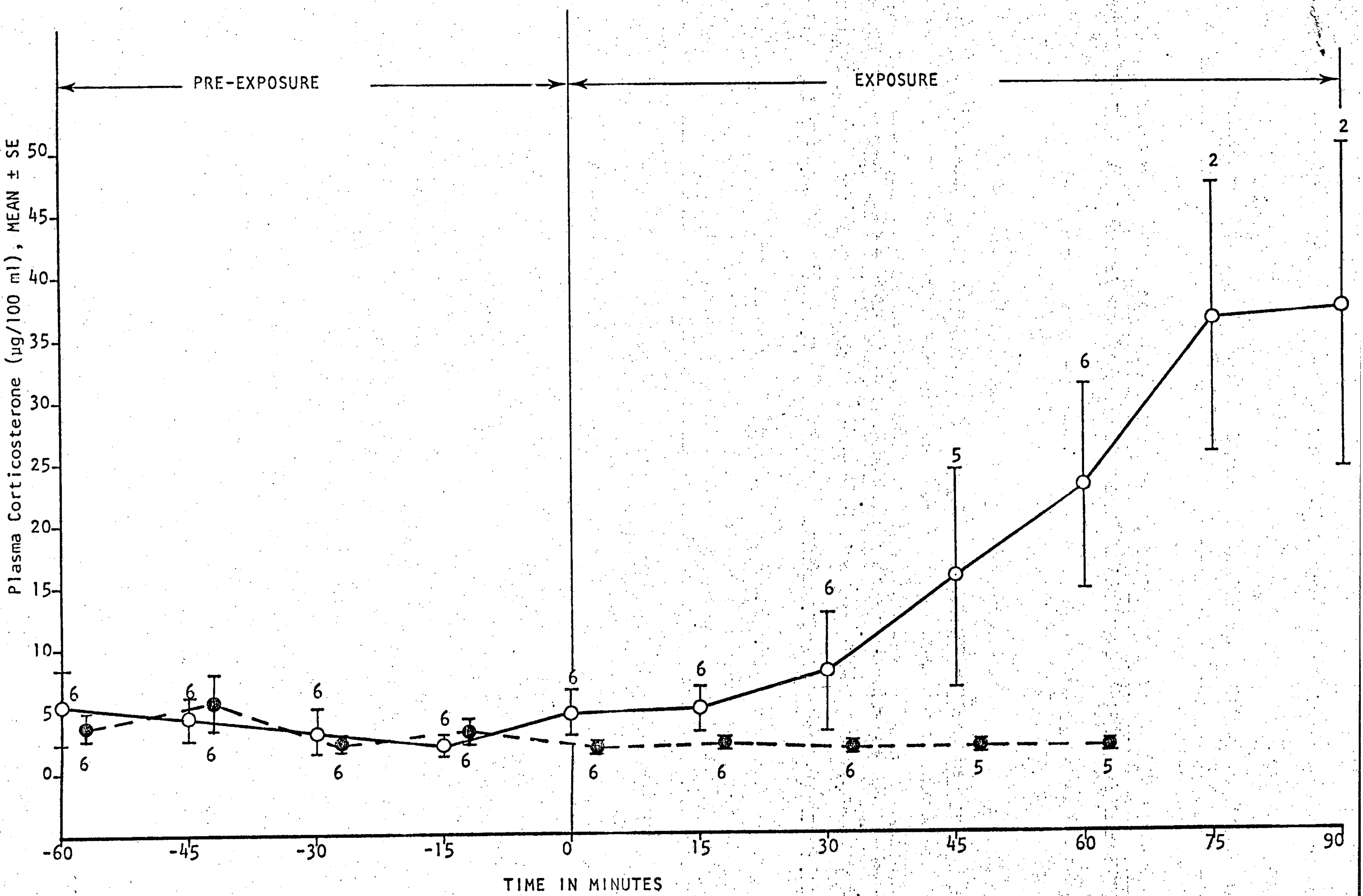
Following transfer of the rats to the exposure cages, the rats were given a two-hour equilibration period before sampling was started to allow the corticosterone levels to return to baseline following the stimulation caused by the transfer. Blood samples were drawn via an extension of the indwelling catheter at times 60, 45, 30, 15, and 0 min before the onset of the exposure and at 15, 30, 45, 60, 75, and 90 min of exposure. Sham-exposure sampling sessions were also conducted. All samples were drawn between 1000 and 1300 hours. Blood samples were promptly centrifuged and the

plasma was separated and frozen. Plasma samples were assayed for corticosterone by a competitive protein binding technique.

Figure 1 illustrates the results of exposures of six rats to 15 mW/cm^2 for 60 to 90 min following a period of 60 min pre-exposure sampling. The number next to each point indicates the number of samples in that group. An increase in plasma corticosterone appears to begin in the exposed rats at 30-45 min of exposure and continues up to 75 min of exposure, at which time the corticosterone level is 6-8 times the sham-exposed or pre-exposed level.

The clear stimulation of rat adrenocortical function in these experiments at an average whole body SAR of about 3.0 W/kg occurs at a lower SAR than that previously shown to be necessary to elicit an adrenocortical response in the rat exposed to 2.45 GHz for the same duration. This may be due to the different distribution of absorbed energy in the rat that would exist at these two frequencies. This comparison of the effects of two frequencies of radiation upon rat adrenocortical function illustrates the need to carefully consider frequency and internal energy distribution in evaluating microwave bioeffects.

Figure 1


15 mW/cm2; 1.29 GHz
PRE-EXPOSURE
EXPOSURE
Plasma Corticosterone (µg/100 ml), MEAN ± SE
50
45
40
35
30
25
20
15
10
5
0
-60
-45
-30
-15
0
15
30
45
60
75
90
TIME IN MINUTES