EFFECTS OF MICROWAVE RADIATION ON ENDOCRINE SYSTEM OF MOUSE

P. Deschaux, R. Santini, R. Fontanges and J.P. Pellissier.

Cellular Physiology Laboratory, Claude Bernard University, 69622 Villeurbanne Cédex, France.

Swiss male mouse, 1 or 2 months old were irradiated in an exposure chamber (32,5x32x54 cm) : microwave frequency 2450 MHz ; time of irradiation : 1, 2, 3 or 4 hours during 5 days. The sacrifice of animals is performed by decapitation immediatly or 24 hours or 5 days after the last irradiation. The density power was calculed from the relationship

$$P = N \times S \times 10^{-2}$$

P : density power (watt)

N : number of animals in the exposure chamber

S : surface of an animal (cm^2)

Ambient temperature was maintened between 23-25°C. In any case a total of irradiated 40 mice and an equal number of non irradiated animals (controls) were studied.

When the mice were decapited immediatly after removal from the exposure cage, colonic temperature was measured within 60 s : we had never observed a variation.

After decapitation trunk blood was collected in iced tubes containing ethylenediamine-tetraacetic acid (EDTA), centrifuged at 2,500 rpm for 10-15 min in a refrigerated centrifuge, and the plasma was frozen at -23°C until it was assayed for hormones.

Testosterone assay. A modification of the radioimmunoassay method of Nieschlag and Loriaux (3) was used for the measurement of testosterone.

The intrassay coefficient of variation was less than 10%, as determined by assaying 10 ml samples of plasma. The base values obtained from water (charcoal treated) were between 0 and 8 pg ; 10 pg was considered significantly different from 0.

Corticosterone assay. The plasma corticosterone level was determined by the competitive binding radioassay of Murphy (2). Rat transcortin was used as the binding protein. Test plasma was extracted with carbon tetrachloride followed by celite chromatography to remove other steroids which might interfere with the assay.

LH assay. Plasma luteinizing hormone assay was performed exactly as described in the radioimmunoassay kit supplied by the Rat Pituitary Distribution Program (NIAMDD). The second antibody used was antirabbit gamma-globulin purchased from Welcome laboratories (England). For the assays to be acceptable, the coefficient of variation for hormone concentration at the 50% level of bound radioactivity intercept was not greated than 6.0% in this LH assay.

ACTH assay. A rabbit antiserum against porcine ACTH (ACTH retard de poc Choay) obtained from Dr Depieds (1) was used. This antibody is produced chiefly against the biological fragment 1-24 ACTH. Buffer used in this procedure consisted of 1.5 ml 20% human albumin, 200 ·µl 1-2 mercaptoethanol, 1.0 ml zymofren at 10 000 U/ml (Specia), 0.02 M veronal (pH 8.6), and water to a final volume of 100 ml. This buffer had no inhibitory effect on the antigen-antibody reaction. The standard curve was done in triplicate using ACTH-free plasma from hypophysectomized animals. Assays of plasma were done in duplicate. After a 48 h incubation at room temperature, free ACTH was adsorbed with 50 mg of talc. The radioactivity was determined in the precipitate after centrifugation.

The statistical significance of differences among data from the different groups of animals was determined using Student's t-test.

The testosterone and LH levels in mice after various microwave exposures are shown in table I,corticosterone and ACTH levels in table II.

The results of the experiments suggest that the mice adrenal axis is transitory stimulated during microwave exposure without regulation by a possible feed-back on ACTH secretion.

This endocrine perturbation seems to be a concomitant to increased testosterone plasma level. We have never observed perturbations concerning spermatogenesis.

REFERENCES

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Table I

Time irradiation (hour/day)	Number of irradiation per day	Time between last irradiation and sacrifice	age of animals (day)	Plasma testosterone level (µg/100 ml)			Plasma LH level (pg/100 ml)		
				control		irradiated	control		irradiated
1	1	0	30	87,2 ± 2,3	↗	106 ± 2,0	94 ± 0,6	↗	108 ± 0,8
			60	313 ± 18,3	↗	341 ± 14,0	82 ± 4,4	↗	112 ± 1,1
		24 h	30	55 ± 2,2	NS	46,7 ± 7,1	92,8 ± 6,1	NS	100 ± 4
			60	297,8 ± 12,2	NS	281 ± 29	83,4 ± 0,8	↗	82 ± 2
		5 D	30	64,2 ± 4,3	NS	65 ± 3,1	101,4 ± 10,2	↗	96,6 ± 7,3
			60	316 ± 18,0	NS	308,8 ± 5,2	79 ± 1	↗	87 ± 22
2	2	0	30	76,4 ± 4,2	↗	106,6 ± 5,6	91,9 ± 1	↗	126 ± 2,2
			60	318,4 ± 8,4	↗	410 ± 20,7	92,4 ± 0,8	↗	101 ± 1
		24 h	30	66,4 ± 3,0	↗	76 ± 2,4	100 ± 9,3	↗	118 ± 2
			60	268,2 ± 11,1	↗	294 ± 6,9	79 ± 4,5	↗	94 ± 0.8
		5 D	30	63,8 ± 5,0	NS	61,6 ± 0,9	88,2 ± 0,9	NS	88 ± 2
			60	243,4 ± 11,0	NS	262 ± 10,7	86 ± 2,4	NS	86 ± 2,4
3	3	0	30	90,8 ± 3,9	↗	105 ± 4,5	96 ± 2,4	↗	124 ± 2,4
			60	314,8 ± 1,3	↗	429 ± 85,0	96 ± 5,3	↗	120 ± 3,1
		24 h	30	88,4 ± 4,1	↗	121,4 ± 4,6	80 ± 2,7	↗	120 ± 1,1
			60	312 ± 22,8	↗	344 ± 5,0	87 ± 4,3	↗	120 ± 4,4
		5 D	30	71,4 ± 3,1	NS	55 ± 5,7	106 ± 5,0	NS	112 ± 4,8
			60	344 ± 8,7	NS	331 ± 11,2	79 ± 3,3	NS	80 ± 2
4	4	0	30	74,2 ± 2,4	↗	152 ± 10,3	91 ± 9	↗	104 ± 2,4
			60	376 ± 2,9	↗	475 ± 30,9	98 ± 8	↗	128 ± 2
		24 h	30	88,8 ± 3,0	↗	162 ± 4,8	105 ± 2,2	↗	122 ± 5,8
			60	392 ± 15,9	↗	423 ± 3,7	99 ± 3,3	↗	120 ± 7,0
		5 D	30	63,4 ± 5,1	NS	107,2 ± 1,7	96 ± 9,79	↗	101 ± 2,69
			60	382 ± 4,6	NS	315,4 ± 9,3	72 ± 2	↗	71 ± 3,3

Table II

Time irradiation	Number of irradiation day	Time between last irradiation and sacrifice	age of animals (day)	Plasma corticosterone level (µg/100 ml).			Plasma ACTH level (pg/ml).		
				control		irradiated	control		irradiated
1	1	0	30	14,8 ± 0,5	↗	18,6 ± 2,1	108 ± 3,7	↗	124 ± 2,4
			60	15,2 ± 0,8	↗	25,4 ± 2,0	76 ± 6	↗	124 ± 4
		24 h	30	14,6 ± 0,8	↗	18,6 ± 0,4	102 ± 2	↗	122 ± 2
			60	12 ± 0,4	↗	14,6 ± 0,9	85 ± 5,3	↗	107 ± 8
		5	30	14,6 ± 1,4	NS	14,4 ± 1,1	118 ± 4,8	NS	119 ± 5,5
			60	14,6 ± 0,7	NS	13,2 ± 0,3	97 ± 2,5	NS	104 ± 6
2	2	0	30	14,2 ± 0,5	↗	18,4 ± 0,4	101 ± 4	↗	117 ± 2
			60	12,2 ± 0,8	↗	16,4 ± 1,3	80 ± 3,5	↗	122 ± 3,3
		24 h	30	14,8 ± 0,3	↗	18 ± 1,6	117 ± 4,8	↗	124 ± 4
			60	15,6 ± 0,8	↗	17,4 ± 1,4	58 ± 1,6	↗	90 ± 3,6
		5 D	30	12 ± 0,3	NS	12,8 ± 1,2	83 ± 7	NS	84 ± 14,6
			60	12,5 ± 0,6	NS	12 ± 0,3	92 ± 8	NS	105 ± 6,3
3	3	0	30	13,2 ± 0,8	↗	16,8 ± 0,7	120 ± 8,9	↗	134 ± 4
			60	14,6 ± 1,0	↗	18,6 ± 0,3	90 ± 4,1	↗	122 ± 2
		24 h	30	13 ± 0,6	↗	18,6 ± 1,6	118 ± 5,8	↗	132 ± 3,7
			60	14 ± 0,7	↗	18 ± 1,5	81 ± 4,8	↗	122 ± 2
		5 D	30	13,2 ± 0,7	NS	12,4 ± 1,3	110 ± 3,4	NS	102 ± 11,1
			60	13 ± 1,6	NS	12 ± 0,5	96 ± 8,1	NS	98 ± 9,6
4	4	0	30	10,8 ± 0,1	↗	20 ± 1	81 ± 3,3	↗	108 ± 7,3
			60	12,4 ± 0,3	↗	19,2 ± 0,5	66 ± 9,1	→	112 ± 9,6
		24 h	30	18,2 ± 0,7	↗	21 ± 0,3	38 ± 5,8	→	56 ± 3,6
			60	17,6 ± 1,4	→	20 ± 2,0	45 ± 6,3	→	73 ± 9,5
		5 D	30	12 ± 0,3	NS	12,2 ± 0,3	76 ± 2,4	NS	78 ± 9,5
			60	17,2 ± 0,2	NS	17,6 ± 1,4	74 ± 7,4	NS	78 ± 5,8