

EFFECT OF ENCEPHALECTOMY ON CORTICOSTERONE CONTENT IN THE FETAL RAT ADRENALS

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The functional state of the pituitary-adrenal system was studied after removal of the hypothalamus from rat fetuses (encephalectomy in utero). Hormonal activity of the adrenal glands was estimated by fluorometric determination of their corticosterone content. Removal of the hypothalamus in fetuses aged 18.5-19.5 days lowered the adrenal corticosterone level. Injection of a homogenate of the hypothalamus into the fetuses immediately after encephalectomy prevented this decrease. The results confirm the presence of a functional link between the hypothalamus and the pituitary-adrenal system in rat fetuses.

KEY WORDS: rat fetuses; hypothalamus; adrenals; corticosterone.

Removal of the hypothalamus from rat fetuses leads to changes in the weight of the adrenals [3], in the karyometric indices of adrenocortical cells and their ascorbic acid content [2], and in glycogen accumulation in the liver [5] and adrenals [4]. However, to assess the role of the hypothalamus more precisely, it is necessary to determine how the corticosterone level varies under these conditions. It was shown previously [1] that the corticosterone content in rat fetal adrenals reaches a maximum between the 18th and 20th days of pregnancy; the greatest percentage decrease in the corticosterone level in the gland after decapitation of fetuses is observed at this same age.

In this investigation, changes in the corticosterone level in the rat fetal adrenals were studied after removal of the hypothalamus at the age of 18.5-20.5 days of intrauterine development.

EXPERIMENTAL METHOD

Fetuses of 22 noninbred albino rats were studied. The age of the fetuses was determined from the time of discovery of spermatozoa in the smear [7]. Encephalectomy was performed on the fetuses by the method developed in the writer's laboratory [3]; fetuses of the same litter, undergoing a mock operation involving a deep puncture wound of the cranial cavity, were used as the control. An additional series of experiments was carried out on fetuses undergoing encephalectomy together with an injection of homogenate of fresh tissue of the median eminence from four to five adult male rats (in 0.5 ml physiological saline). Control fetuses of the same litter received an injection of brain homogenate. Fixation was carried out after 1-2 days. The heads of the encephalectomized fetuses were examined histologically to verify the success of the operation. Corticosterone was determined in the pair of adrenals from each fetus fluorometrically [9] by means of the Hitachi MP72A fluorescence spectrophotometer at wavelengths of excitation of 470 nm and fluorescence of 525 nm; crystalline corticosterone (Organon) was used as the standard.

EXPERIMENTAL RESULTS AND DISCUSSION

As Table 1 shows, removal of the hypothalamus from 18.5-day fetuses led to a substantial decrease in the relative weight of the adrenals. This was seen particularly clearly in fetuses killed 2 days after encephalectomy. The results agreed fully with those of analogous investigations [3, 5, 6, 8].

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TABLE 1. Changes in Adrenal Corticosterone Level and Relative Weight of Adrenal Glands in Rat Fetuses after Encephalectomy

Series of expts.	Treatment of fetuses	Age of fetuses (in days)		Relative wt. of adrenals (mg/g body weight)	P	Corticosterone in adrenals		
		at operation	at autopsy			ng/organ	P	ng/mg tissue
I	Mock operation			$0,73 \pm 0,03$ (12)		$75 \pm 10,4$ (9)		$51,8 \pm 9,68$ (7)
	Encephalectomy (number of litters 4)	18,5	19,5	$0,61 \pm 0,02$ (17)	$<0,01$	$48 \pm 9,2$ (13)	$>0,05 < 0,1$	$44,8 \pm 11,23$ (8)
II	Mock operation			$0,64 \pm 0,02$ (15)		$59 \pm 12,3$ (7)		$26,8 \pm 5,69$ (7)
	Encephalectomy (number of litters 3)	18,5	20,5	$0,42 \pm 0,02$ (17)	$<0,001$	$22 \pm 4,2$ (10)	$<0,05$	$16,4 \pm 3,18$ (10)
III	Mock operation			—		$75 \pm 7,1$ (16)		—
	Encephalectomy (number of litters 7)	19,5	20,5	—	—	$46 \pm 4,3$ (29)	$<0,01$	—
IV	Encephalectomy + injection of brain homogenate	18,5	19,5	—	—	$27 \pm 2,5$ (18)	$\leq 0,05$	$17,3 \pm 5,25$ (18)
	Encephalectomy + injection of homogenate of hypothalamus (number of litters 8)			—		$35 \pm 2,5$ (24)		$21,5 \pm 2,79$ (24)

Legend. Number of fetuses given in parentheses.

The corticosterone content in the adrenals of the encephalectomized fetuses was lower than in fetuses undergoing the mock operation; this effect also was most marked in the fetuses undergoing encephalectomy at the age of 18.5 days and autopsied at the age of 20.5 days. Irrespective of the time of autopsy of the fetuses after encephalectomy, the degree of decrease in the adrenal corticosterone content (36 and 63%) was greater than the degree of decrease in the relative weight of the glands (17 and 35%).

The results of the experiments of series IV support the view that the depression of adrenal function in the fetuses after encephalectomy is in fact connected with removal of the hypothalamus. The corticosterone content in the adrenals 24 h after injection of homogenate of median eminence intracranially into 18.5-day fetuses (immediately after removal of their own hypothalamus) was 30% higher than in fetuses from the same litters subjected to encephalectomy and then injected with brain homogenate. The differences in the corticosterone levels in the fetuses of the different series of experiments could be due to the fact that the experiments were carried out at different times of year.

The content of hormone discovered in the adrenals of the control fetuses agreed on the whole with the results obtained by other workers for intact rat fetuses of the same age [10]. Although the differences in corticosterone concentration in the adrenals of the control and experimental fetuses did not reach statistical significance (because of the great scatter of the individual values), the tendency of the change in this index coincided with the direction of the change in the total hormone content in the gland.

The results as a whole afford clear evidence of the presence of hypothalamic control over pituitary-adrenocortical function in the last days of prenatal development of rats.

LITERATURE CITED

1. M. S. Mitskevich, E. V. Proshlyakova, and N. A. Sergeeva, *Ontogenez*, No. 6, 612 (1973).
2. M. S. Mitskevich and O. N. Rumyantseva, *Ontogenez*, No. 4, 376 (1972).
3. M. S. Mitskevich, O. N. Rumyantseva, E. V. Proshlyakova, et al., *Ontogenez*, No. 6, 631 (1970).
4. O. N. Rumyantseva and M. S. Mitskevich, *Ontogenez*, No. 4, 372 (1974).
5. J. P. Dupouy and A. Jost, *C. R. Soc. Biol.*, **164**, 2442 (1970).
6. Y. Eguchi, O. Hirai, Y. Morikawa, et al., *Endocrinology*, **93**, 1 (1973).
7. Y. M. Everett, in: *Sex and Internal Secretions*, Vol. 1, London (1961), pp. 497-555.
8. T. Fujita, Y. Eguchi, Y. Morikawa, et al., *Anat. Rec.*, **166**, 659 (1970).
9. D. Glick, D. von Rendlich, and S. Levine, *Endocrinology*, **74**, 653 (1964).
10. A. Kamoun, C. Mialhe-Voloss, and F. Stutinsky, *C. R. Soc. Biol.*, **158**, 828 (1964).