

CATECHOLAMINE CONCENTRATION IN THE  
HYPOTHALAMUS DURING CHANGES IN PITUITARY  
ADRENOCORTICOTROPIC FUNCTION

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The content of noradrenalin, adrenalin, and serotonin in the hypothalamus and mesencephalon of male rats was investigated during exposure to factors stimulating pituitary adrenocortical function. Potentiation of this function was accompanied by some decrease in the noradrenalin level in the hypothalamus and mesencephalon and by the appearance of adrenalin, which is not normally found there. A role of serotonin in the regulation of adrenocorticotrophic function could not be established because its potentiation was observed when the serotonin concentration in the hypothalamus was either raised or lowered.

KEY WORDS: noradrenalin; adrenalin; serotonin; pituitary adrenocorticotrophic function.

Various stressors are known to sharply increase the elimination of catecholamines and serotonin from the body [2-4, 6, 7, 11, 15]. The question of the role of these compounds in the regulation of secretion of hypothalamic corticotropin releasing hormone, however, remains unexplained, although results showing that noradrenalin inhibits it [13, 14] whereas serotonin stimulates it [8] have been published.

In this investigation the concentration of catecholamines and serotonin in the rabbit hypothalamus was determined after increased production of ACTH had been induced by stimulation of the superior cervical sympathetic ganglia [1, 10].

EXPERIMENTAL METHOD

Experiments were carried out on 72 male rabbits weighing 2.0-2.5 kg. To stimulate pituitary adrenocorticotrophic function, for 10 days the superior cervical sympathetic ganglia were chronically stimulated (through coils of thin silver wire placed on them) or stress was induced (by immobilization for 1 h followed by exposure for 30 min on a shaker). In other experiments acute stress was induced in the rabbits after stimulation of their pituitary thyrotrophic function (1 month after thyroidectomy). The experimental animals were quickly decapitated and the concentration of catecholamines [9] determined in their hypothalamus and mesencephalon and the serotonin concentration [5] in the hypothalamus.

EXPERIMENTAL RESULTS AND DISCUSSION

Noradrenalin (Table 1) and serotonin (Table 2) were determined in the hypothalamus of the intact rabbits; no adrenalin was found. The concentration of noradrenalin in the mesencephalon of these animals was rather lower than in the hypothalamus; no adrenalin likewise was found.

Prolonged chronic stimulation of the superior cervical sympathetic ganglia was accompanied by a tendency for the noradrenalin concentration in the hypothalamus to diminish and by a statistically significant fall in the level of this monoamine in the mesencephalon. Adrenalin appeared (in five of the 10 animals) in both the hypothalamus and the mesencephalon under these circumstances. The serotonin concentration in the hypothalamus increased very slightly.

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TABLE 1. Concentration of Catecholamines (in  $\mu\text{g/g}$ ) in Hypothalamus and Mesencephalon of Rabbit ( $M \pm m$ )

Experimental conditions	Number of animals	Hypothalamus		Mesencephalon	
		noradrenalin	adrenalin	noradrenalin	adrenalin
Intact rabbits	7	$0,816 \pm 0,084$	—	$0,524 \pm 0,029$	—
Stimulation of superior cervical sympathetic ganglia	10	$0,730 \pm 0,205$ $P > 0,1$	$0,411 \pm 0,078$	$0,260 \pm 0,400$ $P < 0,01$	$0,193 \pm 0,013$
Stress	7	$0,536 \pm 0,045$ $P < 0,02$	$0,208 \pm 0,626$	—	—
Stimulation of superior cervical sympathetic ganglia + stress	6	$0,748 \pm 0,055$ $P > 0,1$	$0,334 \pm 0,055$	$0,312 \pm 0,031$ $P < 0,001$	$0,241 \pm 0,084$
Thyroidectomy + stress	6	$0,555 \pm 0,063$ $P < 0,05$	$0,374 \pm 0,063$	$0,335 \pm 0,055$ $P > 0,1$	$0,244 \pm 0,031$

TABLE 2. Concentration of Serotonin in Hypothalamus of Rabbit ( $M \pm m$ )

Experimental conditions	Number of animals	Serotonin concentration in hypothalamus (in $\mu\text{g/g}$ )
Intact rabbits	6	$0,744 \pm 0,105$
Stimulation of superior cervical sympathetic ganglia	6	$0,958 \pm 0,131$ $P > 0,1$
Stress	6	$0,279 \pm 0,055$ $P < 0,01$
Stimulation of superior cervical sympathetic ganglia + stress	5	$0,466 \pm 0,031$ $P < 0,01$

Under conditions of stress, which is accompanied by an increase in ACTH secretion by the adenohypophysis, the concentration of noradrenalin and serotonin in the hypothalamus fell, and adrenalin was detected in it in four of the seven rabbits.

Against the background of chronic stimulation of the superior cervical sympathetic ganglia stress also lowered the serotonin level in the hypothalamus and the noradrenalin level in the hypothalamus and mesencephalon. Adrenalin was detected in these structures in four of the six rabbits.

Simultaneous stimulation of the thyrotropic and adrenocorticotrophic functions of the pituitary in rabbits in turn was accompanied by a decrease in the noradrenalin concentration in the hypothalamus and by the appearance of adrenalin in it and in the mesencephalon (in three of the six animals). Acute stress, both by itself and in combination with stimulation of the superior cervical sympathetic ganglia or thyroidectomy, thus led to some decrease in the noradrenalin level in the hypothalamus; in many animals adrenalin appeared under these circumstances. Contrary to the view of Fuxe [12], sympathetic impulses can evidently exert their influence on the adrenergic mechanisms of the hypothalamus, causing a change in the relative concentrations of noradrenalin and adrenalin in it. The results confirm the view that noradrenalin depresses the hypothalamic regulation of pituitary adrenocorticotrophic function [13, 14], for an increase in that function coincided with a decrease in the concentration of this catecholamine in the hypothalamus. Serotonin evidently plays a minor role in the regulation of this function, for an increase in ACTH secretion was recorded during both an increase and a decrease in its concentration in the hypothalamus.

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## SEROTONIN CONCENTRATION IN THE HYPOTHALAMUS DURING CHANGES IN PITUITARY THYROTROPIC FUNCTION

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The serotonin concentration in the hypothalamus was determined in sexually mature male rabbits during changes in pituitary thyrotropic function. No clear parallel was observed between the intensity of the pituitary thyrotropic function and the hypothalamic serotonin concentration. Stimulation of pituitary thyrotropic function by injection of 6-methylthiouracil or by partial thyroidectomy was accompanied by an increase in the serotonin concentration, whereas during aseptic inflammation in the thyroid gland or after a combination of removal of the superior cervical sympathetic ganglia and administration of chlorpromazine, the increase in thyrotropic function occurred without any significant changes in the hypothalamic serotonin concentration.

KEY WORDS: serotonin; hypothalamus; pituitary thyrotropic function.

The hypothalamus differs from other parts of the brain in having a high concentration of serotonin [1-3, 5, 7]. Serotonin is known to participate directly in the hypothalamic regulation of the gonadotropic and adrenocorticotrophic functions of the pituitary. The question of its role in the regulation of pituitary thyrotropic function has not been settled. According to Grimm and Reichlin [8], serotonin has an inhibitory action on pituitary thyrotropic function.

The object of this investigation was to examine the role of serotonin in hypothalamic regulation of pituitary thyrotropic function.

### EXPERIMENTAL METHOD

Sexually mature male rabbits were used. The serotonin level in the hypothalamus [4, 9] was determined during exposure to factors stimulating or inhibiting pituitary thyrotropic function. The concentration of thyrotropic hormone in the pituitary was estimated from the height of the thyroid epithelial cells of guinea pigs into which a suspension of acetone-treated pituitary glands from the experimental rabbits was injected.

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