ABSORPTION OF RADIOACTIVE IODINE (I^{131}) BY THE ISOLATED THYROID GLAND IN VITRO UNDER CONDITIONS OF THE ACTION OF NEUROPITUITARY HORMONES

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The regulating influence of the central nervous system on the endocrine functions of the organism, including the functional activity of the thyroid gland, has been established by numerous investigations. However, "the question is not whether the thyroid gland depends on the higher divisions of the central nervous system, but how and by what means this dependence is realized" [1].

A special role in the regulation of the endocrine functions of the organism is played by the hypothalamic region, which is the center of the vegetative functions of the organism and brings about this regulation by neural and humoral means. Actually, local damage to the region of the anterior hypothalamus removed the goitrogenous reaction of the thyroid gland to the administration of propylthiouracil, at the same time without changing the increased accumulation of radioactive iodine by the thyroid gland, which occurs under these conditions [11,15,16]. When the stem of the pituitary is damaged, a decrease in the height of the cells of the thyroid epithelium is noted [12].

With the discovery of the phenomena of neurosecretion [10,17], the opinion was confirmed that "the brain is the site of generation of hormones which chemically influence the endocrine glands and enter into the general system of correlative interrelationships" [5]. In view of this, the attention of researchers has been attracted to the clarification of the role of the neuropituitary hypothalamic peptides (vasopressin, oxytocin) in the regulation of the functions of the endocrine glands, including the thyroid gland. However, the data obtained are extremely contradictory; some authors have noted stimulation of the thyroid function by neuropituitary hormones [13,14], others have noted its inhibition [7-9, 20,21], while still others generally have found no changes in the thyroid activity [22]. Moreover, most researchers believe that the neuropituitary hormones influence the thyroid gland through the thyrotropic hormone of the pituitary [4,19,23]. The possibility of their direct action on the thyroid parenchyma by "paraadenopituitary" means [6], has not always been considered.

In our previous investigations, we demonstrated that the neuropituitary hormones can act directly upon the thyroid cells, changing their respiration; moreover, the effect depends to a considerable degree on the dose of the hormone [3]. In a comparison of our data with the results of other investigations [18], it was proposed that the hormones of the posterior lobe of the pituitary may differently modify different indices of the thyroid function.

In this work, we studied the influence of the neuropituitary hormones on the absorption of I^{131} by isolated thyroid parenchyma.

EXPERIMENTAL PROCEDURE

Slices of thyroid glands (50 mg) of white rats were incubated at 38° for 90 min. The incubation medium was blood serum of the same animals, to which 0.5 microcurie of I^{131} without a carrier and 0.2 unit of synthetic oxytocin, 0.5 unit of pituitrin M, and 1 unit of pituitrin P were added. At the end of the incubation, the slices were removed, washed with physiological saline, and their radioactivity determined with the aid of a PS-5M ("Volna") scintillation counter for γ radiation. The absorption of I^{131} by intact thyroid glands, as well as by such thyroid glands with the addition of 0.04, 0.1, and 0.2 ml of a 0.25% solution of phenol (which is contained in the pituitrin preparations as a

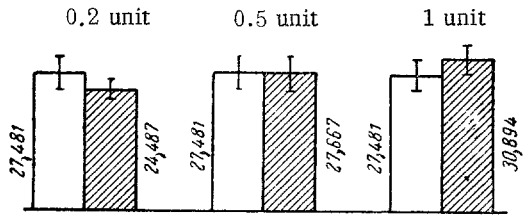

Fig. 1. Influence of oxytocin on absorption by isolated thyroid parenchyma (in counts/100 sec/50 mg of tissue). Light columns, absorption of the isotope by the control (intact) thyroid glands; shaded columns, absorption of the isotope by thyroid glands with the addition of oxytocin to the incubation medium.

preservative [2]) to the incubation medium, served as a control. The data obtained were treated statistically by the method of dispersion analysis.

EXPERIMENTAL RESULTS

The data cited in Fig. 1 show that synthetic oxytocin, in a dose of 0.2 unit, inhibits the absorption of I^{131} by the thyroid parenchyma ($P = 0.05$); in a dose of 0.5 unit, it proves ineffective ($P > 0.1$), while, when one unit of oxytocin is added to the incubation medium, there is a tendency of an increased accumulation of I^{131} by the cells of the isolated intact thyroid gland ($0.05 < P < 0.1$). Pituitrin M and pituitrin P in doses of 0.2 and one unit (Fig. 2a and b) inhibit the absorption of I^{131} by the isolated thyroid parenchyma, both in comparison with the intact thyroid gland (control) and in comparison with that in the addition of a 0.25% solution of phenol ($P < 0.001$). In a dose of one unit, their effect is identical ($P < 0.1$), while in a dose of 0.2 unit, the action of pituitrin P is more pronounced ($P = 0.05$). Pituitrin M, in a dose of 0.5 unit, inhibits the absorption of I^{131} by thyroid cells in comparison with the intact gland ($P < 0.001$); however, in the case of action on the latter (0.1 ml of a 0.25% phenol solution), its effect proves stimulating ($0.01 < P < 0.02$). The same phenomenon also exists when 0.5 unit of pituitrin P is added to the incubation medium. In comparison with the intact thyroid gland, this dose of the preparation is inhibiting ($P < 0.001$), while, in comparison with the influence of 0.1 ml of a 0.25% phenol solution, which in this dose itself inhibits the absorption of I^{131} by the thyroid parenchyma ($P < 0.001$), it is stimulating ($0.02 < P < 0.05$).

Thus, the effect of vasopressin and oxytocin on the absorption of I^{131} by the isolated thyroid gland is almost equivalent; in this case, no opposite direction of their action is observed, as was noted in the case of a change in the respiration of the thyroid parenchyma [3].

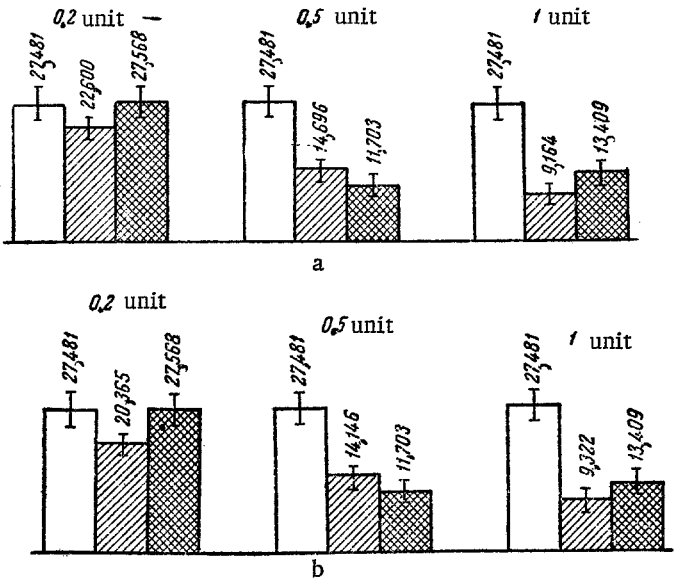

Fig. 2. Influence of pituitrin M (a) and pituitrin P (b) on the absorption of I^{131} by isolated thyroid parenchyma (in counts/100 sec/50 mg of tissue). Light columns, absorption of the isotope by control (intact) thyroid glands; shaded, absorption of the isotope by thyroid glands after the addition of pituitrin M to the incubation medium; columns with cross-hatching, absorption of the isotope by thyroid glands after the addition of 0.25% phenol solution to the incubation medium.

In a comparison of the effect of the neuropituitary hormones on the processes of absorption of I^{131} with their influence on the respiration of the thyroid cells, the absence of parallelism between the influence of hormones on these two processes is noteworthy. Thus, although 0.2 unit of synthetic oxytocin, 0.2 and one unit of pituitrin M stimulate respiration, on the contrary, they inhibit the absorption of I^{131}. Pituitrin M and P in a dose of 0.5 unit does not influence the respiration of thyroid cells, while these preparations stimulate the absorption of I^{131} by the thyroid parenchyma. The parallelism in the influence on respiration and absorption of I^{131} is maintained only for 0.2 and one unit of pituitrin P (vasopressin).

The results of the investigations agree with the data of [18] on the stimulating influence of 0.5 unit of pituitrin (in the experiments of the authors of the indicated source, one unit of pitressin per 100 mg of thyroid tissue) on the absorption of I^{131} by the thyroid parenchyma also confirm the hypothesis advanced earlier on the nonequivalence of the effect of neuropituitary hormones on different indices of the thyroid function.

Thus, the data cited indicate that the neuropituitary hormones may act directly upon the thyroid parenchyma; moreover, their effect (chiefly the effect of oxytocin) on various indices of the thyroid function is nonequivalent and depends to a considerable degree on the dose of the hormone introduced. In view of this, the intimate mechanism of the action of oxytocin appears to differ from that of vasopressin.

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