INTERRELATIONSHIP OF ADRENAL CORTEX AND THYROID GLAND UNDER NORMAL CONDITIONS AND IN COLD STRESS

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Researches in recent years have demonstrated that thyroid gland activity declines under the influence of various stress factors [2, 8, 13]. However, under the stimulus of cold stress thyroid function increases. This is indicated by the elevated hormone level and also the histological picture of the tissue [6, 9, 12, 14, 15, 16].

The interrelation between thyroid and adrenal cortex attains special significance since in these conditions there is increased activity in both organs. Under conditions of normal temperature thyroid function diminishes under cortisone influence [1, 3, 4, 5, 7, 10].

The theory may be proposed that under cold stress thyroid reactivity to steroids is altered. The problem in the present work is the comparison of cortisone action on the thyroid gland in normal conditions and in cold stress.

EXPERIMENTAL METHOD

The work was performed on 105 male rats weighing 98 to 110 g and 20 male mice weighing 19 to 20 g. In assessing the functional state of the thyroid the height of the follicular epithelium was recorded as well as the diameter of the follicles, character of the colloid, and the general histological appearance. Sections were stained with azocarmine according to Heidenhain. In each preparation the height was estimated for 500 epithelial cells and the diameter of 20 follicles. Attention was paid also to body weight changes in the animals and thyroid gland weight changes calculated per 100 g body weight. Cortisone acetate used in this work was produced by Laboratoires francais de chimiotherapie (Paris). The preparation was injected intraperitoneally. Data was treated statistically.

EXPERIMENTAL RESULTS

The first three experimental series were preliminary, revealing the effect of different cortisone dose levels on the thyroid functional state. With chronic cortisone administration at a dosage of 0.5 mg per rat for 15 days, morphological signs were observed indicating retardation of thyroid activity: the follicle lumina filled with dense colloid, epithelial cell cytoplasm became darker and more homogenous, height of the epithelium decreased from 5.8 $\pm$ 0.2 to 5.1 $\pm$ 0.1 μ. Furthermore, the rate of body weight gain during the period increased (from 12 g in the controls to 26 g in the experimental animals), thyroid weight decreased (from 14 mg in the controls to 13 mg in the injected). The changes in body weight and thyroid weight likewise indicated that thyroid activity and metabolic process intensity declines under cortisone influence.

The greatest interest attaches to results obtained in the fourth experimental series designed to assess the effect of cortisone on thyroid function under cold stress conditions.

The experiments were performed on 5 groups of animals: I and II were control; III, IV, and V were experimental (10 rats in each group). Group I animals remained in the regular animal colony throughout the 20-day period. They were injected daily with Ringer's solution. Groups II, III, IV, and V rats were kept in the animal colony during the first 10 days but for the following 10 days they were placed in a refrigerated room held constantly at 5°. Group II rats were injected only with Ringer's solution. Group III animals received cortisone for the entire experimental period. Group IV animals received cortisone only until they were refrigerated, but thereafter they received Ringer's solution. Group V rats received Ringer's solution until they were refrigerated and thereafter received cortisone. All groups in the series, when given cortisone, received it in 0.5 mg dose (see table).

Organization of Series Four Experiments

Animal group	Ringer's solution until refrigerated	Cortisone until refrigerated	Refrigerated	Ringer's solution during refrigeration	Cortisone during refrigeration
II	+	–	+	+	–
III	–	+	+	–	+
IV	–	+	+	+	–
V	+	–	+	–	+

Study revealed that thyroid glands in group I animals (controls) were of average activity. In thyroids of group II animals (controls) there were distinct morphological changes indicative of heightened thyroid function. Follicular epithelium increased in height from 7.3 ± 0.1 to 8.6 ± 0.2 μ, the cells became narrower with light granular cytoplasm, the colloid was vacuolated in places. Furthermore, the thyroid weight increased (on the 100 g body weight basis) from 22 ± 1.0 to 24 ± 0.3 mg.

In group III animals receiving cortisone for the entire experimental period (10 days before refrigeration and 10 days after refrigeration)signs of thyroid gland stimulation were most sharply evident. Height of the follicular epithelium had increased by 3.4 μ over that in group I animals (from 7.3 ± 0.1 to 10.7 ± 0.4 μ); epithelial cells were greatly swollen, their cytoplasm appeared more light and granular, the nuclei of cells increased in diameter and located in the apical position. Differentiation into central and peripheral zones was impossible inasmuch as the height of follicular epithelium in peripheral follicles was identical with that in the central ones. Connective tissue was present in insignificant amounts. Interfollicular vessels and also the larger arteries and veins were strongly dilated. In places lymphatic capillaries were clearly discernible and filled with a blue dyed homogenous material. The follicles contained comparatively little colloid, in places it was entirely absent, in others there were residues in the form of coarsely looped circles. In those places where colloid was not visible, zones of resorption could be seen. Along with increased height in follicular epithelium there was observed an increased diameter of the follicles in comparison with those in group I animals. This seeming contradiction may be explained in the following way. In each follicle in group I animals the epithelium portion amounts to 14.7μ; the remaining 12μ is occupied by colloid. In group III the portion taken up by epithelium is 21.5μ while that of colloid is 9μ. Consequently animals in group III have a decreased quantity of intrafollicular colloid together with increased height of follicular epithelium.

Beside changes in morphological structure there was observed an increase in thyroid weight by 7 mg (calculated per 100 g body weight).

The given data are indicative that in rate receiving cortisone for 20 days (last 10 days were the refrigeration period) the thyroid gland functional activity increases and in the intensity of metabolic processes it rises.

In animals of group IV thyroid activity also increased. The follicular epithelium grew from 7.3 ± 0.1 to 8.5 ± 0.4μ. Thyroid weight increased also by comparison with that in group I animals.

Finally in group V the histological picture of the thyroid gland was characterized by signs of functional activity. This was evidenced as increased thyroid vascularity and heightening of follicle epithelial cells to 9.5± 0.5 μ.

In the first part of our work it was established that cortisone in a 0.5 mg dose injected daily for 15 days under normal temperature conditions depresses thyroid function. This result agrees well with other experimental findings [1, 3, 4, 11]. In the second part of the work (use of cold as stress factor stimulating thyroid activity [6, 9, 12, 16]) cortisone is observed to have a contrary effect: injecting it at the same dose as before, only superimposed on a background of cold stress, not only fails to depress thyroid function but increases the stimulatory effect of cold.

Thus our data apparently confirm the postulate that under conditions of cooling the organism corticosteroids act on thyroid function differently than under normal conditions.

SUMMARY

As demonstrated, chronic administration of cortisone (0.5 mg daily) in condition of normal temperature reduces the thyroid gland activity.

Cortisone administration in the same dose against the background of cold stress gave a reverse effect: the thyroid gland function not only was depressed, but the stimulating effect of cold, was even more intensified.

The data obtained indicated that the action of corticosteroids on the thyroid gland function in conditions of cold stress differed from that in normal temperature conditions.

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