TROPHIC FUNCTION OF THE AUTONOMIC NERVES OF THE THYROID GLAND

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Experimental results obtained in the last 10 years have shown that the nerves of the thyroid gland do not fulfill a specific secretory function [14-16, 18, 19].

The authors' previous investigations have shown that the trigger effects of the central nervous system reach the thyroid through humoral mechanisms. The denervated gland is still capable of reacting to the trigger influences of the central nervous system but has lost its power of adaptive regulation. Secretion of the denervated gland is excessive both in volume and in duration [1, 3, 4]. The suggestion was made that the nerves of the thyroid gland regulate trophic processes therein, ensuring an adequate reaction to external environmental conditions.

To discover the nature of this phenomenon it was necessary to investigate the course of the more important biochemical processes, especially protein metabolism, developing in the thyroid tissue after denervation of the gland. One of the authors [5] investigated protein synthesis in the denervated thyroid by studying incorporation of S^{35}-labeled methionine.

In the present investigation autolysis, the activity of certain transaminases, and the content of SH-groups in the thyroid was determined.

EXPERIMENTAL METHOD

Experiments were carried out on intact dogs (young males weighing 20-30 kg). The thyroid gland of the experimental animals was denervated unilaterally, and the intact gland on the opposite side acted as control.

The thyroids were denervated by excising all visible nerve fibers. The blood vessels of the gland were treated with 5% phenol solution until they turned white. The animals were used in the experiment 7-13 days after the operation, at the time of maximal degeneration of the nerve fibers [2]. In some dogs the gland was denervated on the left side, in others on the right. Autolysis was determined by Folin's method. The content of SH-groups was determined in the gland tissue and in the blood flowing from it by the method of amperometric titration with silver nitrate. The transaminase activity was studied colorimetrically in the blood flowing from the thyroid gland.

EXPERIMENTAL RESULTS

The mean level of autolysis of the intact thyroid tissue was 56.6 μg tyrosine/100 mg fresh tissue. After denervation intensification of catalytic processes by 29.8% ($P < 0.02$) was observed, and the mean content of tyrosine reached 73.5 μg/100 mg fresh tissue. The intensity of autolysis was unchanged after the operation in some animals, possibly because of incomplete denervation of the thyroid.

Transamination was estimated from the activity of glutamate-oxaloacetate (GOT) and glutamate-pyruvate (GPT) transaminases in the blood flowing from the thyroid gland. The mean GOT activity in the serum of blood flowing from the intact gland was 16.8 units; after denervation of the gland the mean GOT level rose very slightly to 18.8 units, an increase of 11.9% ($P < 0.01$). As a rule the changes were very slight, and only in 3 of the 11 experiments was the activity of this enzyme relatively high. In all the experiments the changes were, however, in the same direction and statistically significant.

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The mean GPT content in the venous blood serum from the intact thyroid was 3.3 units, rising to 5.1 units after denervation, an increase in activity of 54.5% ($P < 0.01$). In 11 of the 16 investigations the enzyme activity was clearly increased.

The content of SH-groups in the serum of blood flowing from the intact gland was 50.2 μmole/100 ml serum. After denervation their content fell by 9% ($P < 0.01$) and the mean level of this index was 45.7 μmole/100 ml serum.

The mean content of SH-groups in the tissue of the intact thyroid was 0.74 μmole/100 mg tissue, falling after denervation to 0.62 μmole, i.e., by 16.1% ($P < 0.05$). Although these changes are very small they are statistically significant and exceed the limits of experimental error.

The decrease in content of SH-groups both in the blood flowing from the denervated gland and in its tissue, accompanied by an increase in the intensity of autolysis and an increase in transaminase activity, at first sight appears paradoxical. From data in the literature it is generally considered that the content of SH-groups changes in accordance with the intensity of oxidative processes [6, 12, 20]. However, the present results indicate changes in the protein composition of the thyroid tissue as a result of denervation. Moreover, according to Kh. S. Koshtoyants, acetylcholine promotes the active liberation of SH-groups. It may be assumed that the decrease in the content of these groups in the denervated thyroid is associated with this phenomenon.

The increase in intensity of autolysis in the denervated gland tissue discovered in these experiments is in agreement with data reported in the literature showing intensification of proteolytic activity in muscles, liver, and spleen after denervation [8-11, 17, 22].

Elimination of the regulatory influence of the central nervous system thus leads to marked disturbances of protein metabolism in the thyroid gland. Autolysis is intensified, activity of the enzymes of amino acid metabolism is increased, and the rate of incorporation of S^{35}-labeled methionine into proteins is increased in the denervated thyroid gland [5]. This suggests that as a result of denervation not only is the breakdown of the thyroid tissue proteins intensified, but the rate of their synthesis is also increased.

Differences in the degree of changes in GPT and GOT activity suggest that some selectivity exists in the nervous regulation of the enzymic processes.

A clear relationship is thus found between the intensity of protein metabolism and activity of the autonomic centers. The changes observed suggest that metabolic processes taking place in the thyroid gland are maintained at a certain level because of the regulatory role of the nervous system, ensuring that the activity of the gland is commensurate with the external environmental conditions.

The results described may shed light on the basis of the trophic influence of the autonomic nerves on the thyroid gland.

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