EFFECT OF STH ON REPAIR PROCESSES IN THE THYROID GLAND

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The effect of STH on regeneration of the thyroid gland after resection of three-quarters of its parenchyma was studied in 59 rats weighing from 90 to 145 g. STH was found to stimulate proliferation of the epithelial cells in the regenerating gland and growth of thyroid tissue in the region of injury, while the formation of new follicles was somewhat delayed. The function of the residual thyroid parenchyma was stimulated less strongly than in the control.

There is no information in the literature of the effect of STH (purified or mixed with other hormones) on repair processes in the thyroid gland. Only one investigation [3] of the regeneration of the thyroid parenchyma after administration of a preparation containing STH, obtained from the eosinophilic zone of the pituitary, is described. The study of repair processes under the influence of STH is very interesting for this hormone stimulates protein synthesis [1, 6, 8, 9], proliferation of cells [2, 4, 5, 10, 11], and tissue growth [7, 9].

In the investigation described below repair processes in the thyroid gland were studied during administration of somatotropic hormone.

EXPERIMENTAL METHOD

The experiments were carried out on 59 albino rats of both sexes weighing from 90 to 145 g. The animals were divided into three groups: 1) control, 2) receiving bovine STH by daily subcutaneous injection in a dose of 1 or 2 mg, and 3) undergoing a mock operation. Three-quarters of the thyroid (the whole of the left lobe and half of the right) was removed from the rats of the first two groups and the animals were sacrificed 10, 20, 25, and 31 days after the operation. The thyroid glands removed at the operation and at autopsy were weighed on torsion scales and then fixed with Bouin's or Carnoy's fluid and embedded in paraffin wax. Serial sections were stained with hematoxylin-eosin or Heidenhain's azocarmine; polysaccharides were detected by the PAS reaction. The function of the gland was detected autoradiographically, using I^{131}. Mitotic activity was expressed per thousand cells, and in each animal the number of mitoses was counted in 20,000 thyroid cells in two zones of the regenerating residue of the gland: in the uninjured part and in the region of injury. The height of 100 epithelial cells of the follicles was measured in each animal with an ocular micrometer. The number and size of the follicles in the field of vision were determined after their outlines projected on graph paper had been traced. The amount of new thyroid tissue formed in the region of injury was determined by projecting sections through the middle of the regenerating gland on graph paper. The area occupied by the whole section of the gland and of the newly formed thyroid tissue was measured. The ratio between the latter (in percent) and the total area of section of the regenerating residual gland were calculated. All numerical results were subjected to statistical analysis.

EXPERIMENTAL RESULTS

In the control animals 10 days after resection the residual parenchyma of the thyroid showed functional excitation. Medium-sized oval and elongated follicles were predominant in the residual gland and

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TABLE 1. Quantitative Indices of Regeneration in the Thyroid Gland (M ± m)

Quantitative index	Time after operation (in days)	Gland after mock operation	Regenerating gland	
			control	administration of STH
Mitotic activity (%):				
in uninjured part of gland	10	0.10 ± 0.02	0.14 ± 0.02	0.24 ± 0.03 P < 0.05
in region of injury			0.16 ± 0.03	0.31 ± 0.04 P < 0.02
Height of epithelium in uninjured part of gland (μ)	20	5.56 ± 0.09 P < 0.001	7.75 ± 0.10	6.64 ± 0.09 P < 0.001
Percentage of new thyroid tissue formed in region of injury	20	–	6.74 ± 0.23	9.69 ± 0.85 P < 0.02
Weight of regenerating gland (% of weight of gland in animals undergoing mock operation)	20	–	40.7 ± 2.5	42.5 ± 2.2 P > 0.6
Number of follicles in field of vision (in uninjured part of gland)	31	160.7 ± 4.0 P < 0.001	271.7 ± 10.9	280.0 ± 6.8 P > 0.5
Number of microfollicles in percent of total number of follicles in field of vision (in uninjured part of gland)	31	5.3 ± 0.8 P < 0.001	21.3 ± 1.2	21.2 ± 1.2 P > 0.9

Note. P calculated relative to control.

were filled with liquid, vacuolated colloid. The follicle walls were formed by hypertrophied epithelium containing numerous PAS-positive granules. The mitotic activity of the thyroid cells (Table 1) did not differ significantly from the mitotic activity in animals undergoing the mock operation (P > 0.2). In the region of injury and in the adjacent zone of the gland new microfollicles containing liquid colloid, some of them complete, others in the processes of formation, could be seen (Fig. 1).

At the same period after administration of STH the functional excitation of the residual parenchyma of the thyroid after resection was weaker than in the control animals. The resorption of colloid from the central follicles was less marked than in the control and the peripheral vesicles were larger. Hypertrophy of the thyroid epithelium was less than in the control. The mitotic activity of the epithelial cells (Table 1) was significantly higher than in the control animals or after the mock operation, both in the region of injury and in the adjacent zone of the gland (Table 1). Bands and small outgrowths (Fig. 2), consisting of newly formed follicles and thyroid cells, not yet completely differentiated into structural units of the gland, were observed in the zone of resection. Pale cells could be seen in the newly formed follicles.

Marked hypertrophy was seen 20 and 25 days after resection in the residual gland of the control rats. The cavities of the follicles were filled with liquid vacuolated colloid. The thyroid epithelium was hypertrophied and it was significantly higher (Table 1) than in animals undergoing the mock operation. New microfollicles were found among the old vesicles. The residual thyroid parenchyma incorporated I^{131} more actively than the gland after the mock operation and it synthesized protein-bound iodine more intensively. In the region of injury there were small outgrowths of new thyroid tissue consisting of medium-sized and small vesicles together with microfollicles. The new follicles accumulated the isotope and synthesized protein-bound iodine.

The weight of the organ was increased 20 days after resection in the animals receiving STH, in which it was 42.5 ± 2.2% of the weight of the gland in the animals undergoing the mock operation (Table 1); the difference from the control was not statistically significant. The degree of hypertrophy in the residual thyroid parenchyma 20 and 25 days after the operation was less than in the control animals. The epithelial

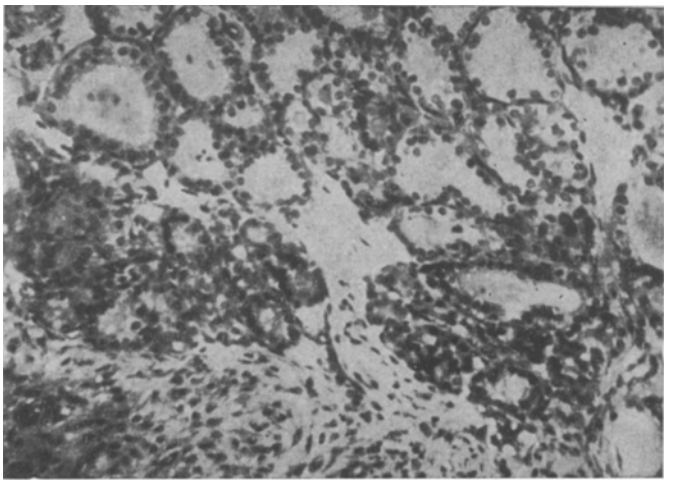

Fig. 1. New and partially formed microfollicles in region of injury of regenerating gland in control rat 10 days after resection. Here and in Fig. 2: hematoxylin-eosin, 100×.

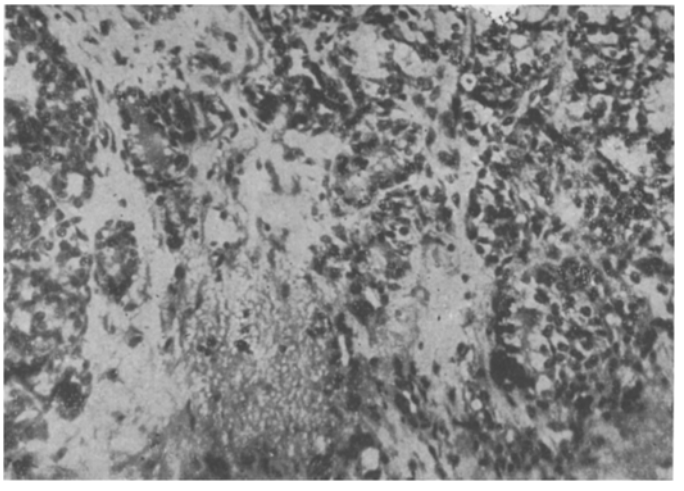

Fig. 2. Outgrowths consisting of thyroid cells and newly formed follicles in region of injury of regenerating gland in rat receiving STH (10 days after resection).

cells of the follicles were significantly lower than in the control (Table 1). The function of the regenerating gland was increased. However, it incorporated rather less of the isotope than in the control and synthesized protein-bound iodine less intensively. In the region of injury the number of small outgrowths of new thyroid tissue, consisting of small vesicles filled with slightly vacuolated colloid, microfollicles containing a homogeneous colloid material, and epithelial cells grouped into follicles, was greater than in the control animals. Significantly more new glandular tissue was formed in the region of injury than in the control (Table 1).

Marked compensatory hypertrophy was observed in the residual gland 31 days after resection in the control animals. The follicle walls were formed by high epithelium,and the colloid was liquid. In the uninjured part of the residue of the organ, just as at the previous periods after the operation, new follicles were formed, as shown by a significant increase in the total number of follicles and microfollicles per field of vision compared with the gland after the mock operation (Table 1). Small outgrowths consisting of new medium-sized and small follicles, filled with liquid colloid, and solitary microfollicles were observed in the region of injury.

In the animals receiving STH moderate compensatory hypertrophy was observed in the residual gland 31 days after resection. Just as in the control the total number of follicles and microfollicles in the thyroid parenchyma was increased (Table 1), evidence of the formation of new structural units in the residual gland. New thyroid tissue occupying part of the former defect was observed in the region of injury. It consisted of new follicles, smaller than in the control and filled with liquid colloid, together with many microfollicles containing homogeneous PAS-positive colloid material.

The results of these experiments showed that after partial thyroidectomy, compensatory hypertrophy develops in the residual parenchyma of the thyroid gland in albino rats and the function of the residual organ is intensified. New follicles are formed in the region of injury and in the uninjured part of the regenerating gland. Under the influence of STH proliferation of the epithelial cells in the regenerating gland and growth of thyroid tissue in the region of injury are stimulated in partially thyroidectomized animals. The compensatory increase in function of the residual thyroid parenchyma after resection is less marked than in the control.

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