REGENERATION OF THE THYROID GLAND IN DOGS AFTER RESECTION

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UDC 616.441-089.87-092.9-07:616.441-003.93-07

In experiments on 44 dogs after removal of one lobe of the thyroid gland or one complete lobe and two-thirds of the other, no increase in weight of the residual part of the gland was observed. Restoration of thyroid function took place through hypertrophy of the thyroid epithelium in the residual gland, brought about by hyperplasia of the intracellular structures.

KEY WORDS: resection of the thyroid gland; hypertrophy of thyrocytes.

Many experiments have demonstrated the ability of the thyroid gland to regenerate. In Voitkevich's opinion [1], after resection of the greater part of the thyroid gland in rats its weight is almost completely restored on account of tissue growth from the wound surface and in the remnant of the gland. Meanwhile, Gibadulin [3] and Savva [4] state that regeneration hypertrophy takes place only in the residual part of the gland after its resection and that compensatory hypertrophy follows removal of one lobe of the paired organ. Both these workers studied changes in weight of the residual part of the thyroid gland and morphological changes in the parenchyma and stroma.

Although regeneration of the thyroid gland in dogs was studied by workers in the West mainly at the end of last and the beginning of the present century, no accounts of investigations of this problem could be found in the Soviet literature.

Although most workers agree on the question of regeneration of the thyroid gland in rats, guinea pigs, and rabbits that the weight of the residual part of the gland increases after resection, this is not true of regeneration of the thyroid in dogs. Some workers [10] have observed a marked increase in weight of the residual part after resection of the thyroid gland in these animals, others [9] did not observe any increase, and a third group [8] states that the manifestations of thyroid regeneration in dogs are very slight in degree.

Accordingly a morphological and histochemical investigation was made of the thyroid gland in dogs after removal of one lobe with the other lobe intact and after removal of the whole of one lobe and part of the other.

EXPERIMENTAL METHOD

Operations with ether anesthesia and with aseptic precautions were performed on 44 sexually mature mongrel dogs of both sexes. Parts of the thyroid gland removed at operation were used as the control. The animals were killed at the following times after the operation: 5, 30, and 60 days after removal of one lobe and 5, 30, and 60 days after removal of two-thirds of the residual gland.

Material taken at operation and subsequent sacrifice of the animals was weighed and fixed in neutral formalin and Carnoy's gluid, after which it was embedded in celloidin and paraffin wax. Sections were stained with hematoxylin–eosin and gallocyanin. Acid and alkaline phosphatase activity was demonstrated by Gomori's method, adenosinetriphosphatase activity by the method of Pedykula and Herman, and esterase

Department of Pathological Anatomy, Blagoveshchensk Medical Institute. (Presented by Academician of the Academy of Medical Sciences of the USSR A. P. Avtsyn.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 81, No. 1, pp. 64-65, January, 1976. Original article submitted December 31, 1974.

TABLE 1. Mean Weight of Thyroid Gland [in g] and Area of Cell Nuclei of Follicular Epithelium [in μ^2] (M ± m)

Time after operation (in days)	Mean weight of lobes of gland		Area of thyrocyte nuclei	
	left lobe (control)	right lobe (experiment)	left lobe (control)	right lobe (experiment)
5	0,83±0,11	0,85±0,12	12,3±1,24	13,8±1,31
15	0,62±0,24	0,66±0,25	12,9±1,35	13,5±1,38
60	0,6±0,25	0,6±0,25	14,0±1,24	14,5±1,26

TABLE 2. Mean Weight of Left Lobe, of Resected Lower Parts, and of Residual Upper Parts of Right Lobe of the Thyroid Gland [in g] and Area of Cell Nuclei of Follicular Epithelium [in μ^2]

Time after operation (in days)	Left lobe (control)	Right lobe			Area of thyrocyte nuclei	
		lower part	residue (experiment)	total weight	left lobe (control)	residual part of right lobe (experiment)
5	0,61±0,24	0,29	0,32	0,61±0,24	14,8±1,10	17,3±1;2
30	0,5±0,10	0,16	0,33	0,49±0,10	15,2±1'94	16,7±2,0
60	0,3±0,10	0,11	0,26	0,37±0,10	13,9±1,30	16,4±1,4

activity by the azo-coupling method. Acid phosphatase activity was determined at pH values of the incubation medium of 4.7, 5.2, 5.7, 6.2, and 6.7. The height of the follicular epithelium was measured with an ocular micrometer and the area of the nuclei of the thymocytes was determined with the aid of the FMN-3 photomicrographic attachment.

EXPERIMENTAL RESULTS

In the experiments of series I the weight of the residual lobe at the various times (5, 15, and 60 days) after removal of one lobe of the thyroid gland was unchanged with the control (Table 1). Histological investigation of the residual lobe showed increased function of the follicular epithelium, as reflected in increased height of the thyrocytes (4-8 μ compared with 2-4 μ in the control), an increased area of the nuclei of these cells (Table 1), liquefaction of colloid, and the appearance of more numerous resorption vacuoles in it than in the control.

Acid phosphatase activity was increased in the nuclei in medium at pH 4.5 and 5.2, and in the cytoplasm of the follicular cells in medium at pH 5.7 and 6.7; activity in the nuclei at these last pH values was reduced.

In the reaction for adenosinetriphosphatase, alkaline phosphatase, and esterase an increase in their activity was found in the basement membranes of the follicles and, in particular, in the blood vessels walls, in harmony with the supposed role of these enzymes in the transport of metabolites through the cell membranes and their participation in the exchange of materials with the surrounding medium. Increased activity of phosphatases in the membranes and walls of the blood vessels is evidence of their increased permeability, thereby promoting the transport of energy-producing and structural materials and stimulating the formation of internal secretions and, in particular, of thyroid hormones.

In the experiments of series II, after removal of the whole of one lobe and part of the other no appreciable increase in weight of the residual gland could be found 5, 30, or 60 days after the operation (Table 2). A histological and histochemical study of the remnant of the gland showed the same increase in functional activity of the thyroid parenchyma as in the experiments of series I. Analysis of the results of these experiments shows that no increase in weight or any marked signs of proliferation of the parenchyma in the residual part of the thyroid gland took place after hemilobectomy or subtotal resection in dogs. The results thus differ from those of other workers [2, 3, 7, 10] who carried out similar experiments on other animals and who describe an invariable increase in weight of the residual part of the thyroid after resection.

An increase in the height of the cells and in the area of the nuclei of the follicular epithelium as well as increased activity of hydrolytic enzymes were found in the residual lobe of the thyroid gland or in the residual part of that lobe after resection. These observations point to hypertrophy of the cells of the thyroid epithelium and to an increase in its function, evidently through the increased thyrotropic effects of the pituitary after resection of the thyroid gland, possibly on account of appropriate hyperplasia of the cellular ultrastructures [5, 6].

Consequently, the restoration of thyroid function after loss of thyroid parenchyma in dogs occurred not through cellular proliferation but through cellular hypertrophy, i.e., through hyperplasia of intracellular structures, the material basis for increased function of parenchymatous cells.

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