HORMONAL INFLUENCES ON COMPENSATORY RENAL HYPERTROPHY

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Among those factors which exert trophic influences on renal tissue the most prominent is that of adenohypophysis. Following hypophysectomy marked reduction in the weight of the kidneys is noted and there is equally marked reduction in all the quantitative indicators of renal function [6, 8]. If a hypophysectomized animal is subjected to unilateral nephrectomy no compensatory hypertrophy of the remaining kidney is observed [8, 3].

Less clear is the importance of other trophic factors. Complete denervation of the kidney in no way affects its ability to undergo compensatory hypertrophy [1, 7]. In castrated animals and those with removed thyroid glands unilateral nephrectomy is followed by hypertrophy of the remaining kidney. However, administration of testosterone and of thyroxine accelerates the development of the hypertrophy [4, 5, 9].

During investigation of the influence of dietary factors on compensatory renal hypertrophy the present author noted greater increase in the weight of the remaining kidney during the winter as compared with hot summer weather. This led to special studies on the relation of compensatory hypertrophy and hormonal influences exerted by the thyroid and the hypophysis, since it is known that the activity of these endocrine glands is enhanced by low temperatures and depressed by high temperatures.

EXPERIMENTAL METHODS

Experiments were carried out on sexually mature white rats (29 animals). Male rats of the same age were taken for each series. Five days prior to the beginning of experiments the rats were put on a standard full diet [2]. 15 days prior to operation the animals were placed under appropriate conditions of temperature and were maintained in them until the end of the experimental period. The environment for "cold" rats varied from 8° to 10°, for "warm" ones from 25° to 30°. The right – control – kidney was removed through a posterior-lateral incision. 20 days later the remaining kidney was removed and compared by weight with the control one. The weight of the kidneys was calculated in absolute units. Renal tissue hypertrophy was expressed in percentage of the increment in the absolute weight of the kidney.

The kidneys and thyroid glands of these rats were subjected to histologic treatment and microscopic examination.

Experimental results are given in Tables 1 and 2.

As can be seen from these tables, renal hypertrophy is more marked in the "cold" rats. It averages 28.7% with limits of fluctuation from 16 to 41.2%, while in the "warm" group the average is 17.4% with limits of fluctuation from 13.1 to 21.7%.

In order to clarify the question concerning the significance of enhanced thyroid activity in this "cold" effect a series of experiments was staged in which thyroxine and methylthiouracil were administered to

TABLE 1

Renal Hypertrophy in Low Temperature Environment

Weight of removed kidney (in mg)	Weight of remaining kidney (in mg)	Wt. increase hypertrophied kidney % of control
1490	2010	34.9
1280	1560	21.9
1000	1290	29.0
1120	1300	16.0
1310	1850	41.2
1065	1430	34.2
970	1200	23.7
Average value of increment		28.7

TABLE 2

Renal Hypertrophy in High Temperature Environment

Weight of removed kidney (in mg)	Weight of remaining kidney (in mg)	Wt. increase hypertrophied kidney % of control
1310	1560	18.2
1250	1430	14.4
900	1080	20.0
920	1120	21.7
990	1185	19.5
985	1130	14.7
910	1030	13.1
1035	1335	17.6
Average value of increment		17.4

nephrectomized rats. Both substances were introduced by tube into the stomach. Methylthiouracil was administered as a 3% aqueous suspension, 30 mg per 100 g weight, thyroxine – 120γ per 100 g weight. Thyroxine was given daily from the day of the operation, whereas administration of methylthiouracil was begun 20 days prior to nephrectomy. The rats were kept at a temperature of 8-12°.

Results of these experiments are summarized in Table 3.

TABLE 3

Increment in Weight of Remaining Kidney in Percentage of Contol

In control group*	Rats given thyroxine	Rats given methylthiouracil
66.6	63.3	111.2
42.8	103.6	132.8
68.4	69.1	104.3
80.9	50.6	110.4
51.2	71 7	—
Average values: 61.9	71 6	114.7

* The greater degree of hypertrophy of the remaining kidney as compared with data in Table 1 is explained by the fact that in the present series the rats were young (average weight 176 g) while in the previous series the rats were old (average weight 260 g).

Table 3 shows that while thyroxine did exert some effect on the development of compensatory renal hypertrophy it was much less clear than the effect of methylthiouracil. It is very probable that the latter could be explained by the well-known enhancement of thyrotropic hormone secretion under conditions when thyroid function is suppressed. The possibility is not excluded, however, that this is accompanied by increased output of other renotrophic factors by the hypophysis.

SUMMARY

In animals kept in the cold, compensatory hypertrophy of the kidneys after unilaterial nephrectomy was considerably greater than in animals kept in warmth. It is quite probable that the effect of cold depends on the intensified secretion of the thyrotropic hormone by the hypophysis, because the introduction of methylthiouracil, which increases the secretion of this hormone, was accompanied by a considerable increase of compensatory renal hypertrophy.

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* In Russian.