EFFECT OF PARTIAL HEPATECTOMY ON CONTENT OF DNA, RNA, AND PROTEIN IN THE LIVER OF RABBITS WITH THYROTOXICOSIS

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UDC 616.441-008.61-092.9-06:616.36-089.873-07:616.36-008.939.6-074

An excess of thyroid hormones in the body increases the initial concentrations of DNA, RNA, and protein inthe rabbit liver, but reduces the increase in these indices after partial hepatectomy.

Some investigations have shown that thyroid hormones accelerate regeneration in the animal liver [3, 7, 9], while others [4, 6] have shown the opposite effect.

The object of the present investigation was to study the content of protein and nucleic acids in the liver of rabbits receiving various doses of thyroid hormone after partial hepatectomy.

EXPERIMENTAL METHOD

Experiments were carried out on male rabbits weighing 2-3 kg. Thyrotoxicosis was produced by oral administration of thyroid in increasing doses [2]. On the 3rd, 6th, and 13th days of the experiment, under urethane (0.3 g/kg) anesthesia, 2 lobes of the liver (30% of its total weight) were resected. The content of DNA, RNA, and protein in the residual liver tissue was determined 22 h after partial hepatecomy. Nucleic acids and protein were extracted by the method of Schmidt and Thannhauser [10]. The content of DNA and total RNA was determined with a type SF-4 spectrophotometer [1]. The protein content was determined by Lowry's method [8].

EXPERIMENTAL RESULTS AND DISCUSSION

By feeding the rabbits with thyroid in accordance with the above program, thyrotoxicosis of varied degrees of severity was produced. For instance, after 3 days of feeding the animal's weight showed no significant change, but on the 7th and 14th days the weight was reduced on the average by 12 and 19%, respectively. The heart rate on the 4th, 7th, and 14th days was increased by 10, 30, and 48%, respectively. The concentration of protein-bound iodine in the serum rose on the average from 4.4 to 10 μg% or more.

The results given in Table 1 show that the RNA content in the liver of animals receiving thyroid for 3 days was virtually unchanged. By the 7th day this index was significantly increased (by 40%), and by the 14th day the increase was greater still (by 55%). However, the increase in the RNA concentration during the first 7 days of the experiment was considerably greater than its increase in the next 7 days.

In the control animals partial hepatectomy led to an increase in the RNA concentration in the liver. The degree of this increase in the animals receiving thyroid for 3 days was about the same as in the control. By the 7th day of thyrotoxicosis the degree of increase in RNA concentration after partial heptatecomy was about half that in the control animals. The degree of this increase in the animals receiving thyroid for 13 days was smaller still (Table 1).

Laboratory of Pathological Physiology, Institute of Experimental Endocrinology and Hormone Chemistry, Academy of Medical Sciences of the USSR, Moscow. (Presented by Academician of the Academy of Medical Sciences of the USSR N. A. Yudaev.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 72, No. 7, pp. 33-36, July, 1971. Original article submitted December 30, 1970.

TABLE 1. RNA Concentration in the Liver (in mg/100 g fresh weight) in Intact and Partially Hepatectomized Rabbits after Administration of Thyroid for Various Times

Group	Intact animals			Animals after partial hepatectomy	P_3
	$M \pm m$	P_1	P_2		
Control	381,25± 9,54 $n = 4$	—	—	510,86± 12,32 $n = 7$	<0,001
Administration of thyroid for 3 days	402,37± 7,57 $n = 8$	<0,1	—	584,62± 10,23 $n = 8$	<0,001
Ditto for 6 days	534,00± 13,66 $n = 5$	<0,001	<0,001	596,60± 29,60 $n = 5$	<0,1
Ditto for 13 days	592,57± 12,74 $n = 7$	<0,001	<0,01	640,33± 10,41 $n = 9$	<0,02

Note. Here and in Tables 2 and 3, P_1 is the criterion of significance of differences between the control and experimental groups of animals; P_2 the same between the two experimental groups; P_3 the same between groups of intact and partially hepatectomized animals; n is the number of animals.

TABLE 2. DNA Concentration in the Liver (in mg/100 g fresh weight) in Intact and Partially Hepatectomized Rabbits after Administration of Thyroid for Various Times

Group	Intact animals			Animals after partial hepatectomy	
	$M \pm m$	P_1	P_2	$M \pm m$	P_3
Control	119,05± 8,38 $n = 4$	—	—	153,28± 9 16 $n = 7$	<0.05
Administration of thyroid for 3 days	122,25± 2,36 $n = 8$	>0,5	—	157,87± 5,07 $n = 8$	<0,001
Ditto for 6 days	183,20± 3,36 $n = 5$	<0,001	<0,001	152,60± 12,02 $n = 5$	<0,05
Ditto for 13 days	207,71± 7,72 $n = 7$	<0,001	<0,02	189,22± 7,04 $n = 9$	<0,1

TABLE 3. Protein Concentration in the Liver (in g/100 g fresh weight) of Intact and Partially Hepatectomized Rabbits after Administration of Thyroid for Various Times

Group	Intact animals			Animals after partial hepatectomy	P_3
	$M \pm m$	P_1	P_2		
Control	10,63± 0,694 $n = 4$	—	—	12,48± 1,02 $n = 7$	<0,2 >0,1
Administration of thyroid for 3 days	11,48± 0,324 $n = 8$	<0,5	—	12,52± 0,469 $n = 8$	<0,1 >0,05
Ditto for 6 days	13,61± 0,158 $n = 5$	<0,01	<0,001	13,56± 0,18 $n = 5$	>0,5
Ditto for 13 days	14,84± 0,23 $n = 7$	<0,01	<0,01	14,82± 0,428 $n = 9$	>0.5

The changes in the DNA concentration in the liver were similar (Table 2). As the concentration of thyroid hormones in the body increased, the initial DNA concentration at first rose rapidly, but subsequently the rate of increase became slower.

Partial hepatectomy led to an increase in the DNA concentration in the control rabbits and in the rabbits receiving thyroid for 3 days, but in the later stages of thyrotoxicosis it led to a slight decrease in this index.

Protein concentration in the liver also increased with the progressive development of thyrotoxicosis (Table 3). However, whereas in the control animals and the rabbits receiving thyroid for 3 days, this index showed a tendency to increase after partial hepatectomy, in the later stages of thyrotoxicosis this tendency disappeared.

The effect of any factor on metabolic processes is seen to best advantage when the particular metabolic function is under stress. This stress with respect to protein synthesis was represented by regeneration of the liver. The time of investigation after partial hepatectomy chosen in this case (22 h) corresponds to the premitotic period of regeneration, when changes in nucleic acid and protein biosynthesis are clearly evident [5].

The results showed that thyroid hormones in certain concentrations exhibit an anabolic effect, by increasing the initial concentrations of nucleic acids and protein in the rabbit liver. This effect, however, is very relative, for under conditions of stress affecting biosynthetic processes (after partial hepatectomy), an excess of thyroid hormones inhibits these processes. The possibility thus is not ruled out that with a further increase in the concentrations of thyroid hormones in the body the restriction of nucleic acid and protein synthesis may also occur even without partial hepatectomy.

Clearly experiments using labeled precursors of nucleic acids and proteins are necessary for the evaluation of the changes in biosynthetic processes in the animal liver after administration of various doses of thyroid hormones. The results of such investigations will be described in later papers.

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