BILE-SECRETING FUNCTION OF THE LIVER IN ALBINO RATS WITH EXPERIMENTAL HYPER- AND HYPOTHYROIDISM

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Administration of thyroid to rats stimulates bile secretion and the excretion of bilirubin with the bile. Thyroidectomy is followed by the opposite changes. The intensity of these changes correlates with the degree of the change in oxygen absorption by the animals.

The thyroid gland plays an important role in the regulation of function of the digestive organs, including the external secretion of the liver [1-3, 5, 8-12].

In this investigation, bile secretion was studied in albino rats with experimental hyper- and hypothyroidism, and the results were compared with the severity of the changes in basal metabolism.

EXPERIMENTAL METHOD

Experiments were carried out on 108 female albino rats weighing 140-180 g. All the animals were divided into three groups: group 1 (10) euthyroid (control), group 2 (50) hyperthyroid, and group 3 (48) hypothyroid. Hyperthyroidism was produced by administration of thyroid in a dose of 100 mg/100 g body weight daily for 5 and 10 days. Hypothyroidism was produced by thyroidectomy [6]. The animals were tested on the 15th, 30th, and 45th days after operation. In addition, thyroidectomized rats receiving replacement therapy with dry thyroid were studied. The degree of thyroid function was studied by determination of the oxygen absorption of the animals in Veselkin's apparatus [4]. Under sodium amytal anesthesia laparotomy was performed on the rats and a glass cannula inserted into the common bile duct. Bile was collected in hourly portions for 10 h. The rate of bile secretion was expressed in mg/min/100 g body weight. In addition, the content of water, solids, bilirubin, and bile acids was determined in bile taken every hour of the experiment from 10 rats simultaneously [7].

EXPERIMENTAL RESULTS

The rate of bile secretion during the 10-h experiment in the control rats fell from 4.6 ± 0.3 to 3.4 ± 0.2 mg/min/100 g (Table 1). The liver of these animals every hour excreted from 276 ± 18 to 204 ± 12 mg bile/100 g body weight, with a mean total for the 10 h period of 2400 mg/100 g body weight. During the experiment the water content in the bile increased from 966.7 to 983.1 mg/g, while the content of solids, on the other hand, fell from 33.3 to 16.9 mg/g. The decrease in content of organic substances was largely at the expense of salts of bile acids. The concentration of cholates fell during the first 5 h from 1233 to 475 mg%, and toward the end of the 10th hour to 325 mg%. The total content of cholates excreted during the 10 h did not exceed an average of 14.463 mg/100 g body weight. The bilirubin concentration rose from 8.6 to 14.5 mg%, and the total quantity excreted during the 10 h of the experiment was 0.272 mg/100 g body weight.

In rats which received thyroid for 5 days, the oxygen absorption rose by 71.6%, while in those receiving thyroid for 10 days it rose by 76.6%.

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TABLE 1. Rate of Secretion of Bile in Albino Rats with Experimental Hyper- and Hypothyroidism (M + m)

Experimental conditions	No. of experiments		Rate of secretion (mg/min/100 g body weight) hours of experiment									
			1	2	3	4	5	6	7	8	9	10
Control	10		4,6±0,3	4,3±0,3	4,4±0,3	4,4±0,3	4,3±0,3	3,9±0,3	3,6±0,3	3,6±0,2	3,5±0,2	3,4±0,2
Given thyroid for 5 days	20		7,3±0,5	6,3±0,6	6,9±0,7	6,3±0,5	6,0±0,4	6,0±0,4	5,6±0,4	5,4±0,4	5,3±0,4	5,3±0,4
		P	<0,001	0,006	0,003	0,001	0,002	0,001	<0,001	<0,001	<0,001	<0,001
Given thyroid for 10 days	20		7,9±0,5	7,9±0,5	7,4±0,5	7,1±0,4	7,1±0,4	7,1±0,4	6,9±0,4	6,9±0,3	6,8±0,3	6,8±0,3
		P	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001
Normalization of basal metabolism after thyroidization	10		4,2±0,2	4,1±0,2	4,1±0,3	3,9±0,3	3,8±0,3	3,8±0,2	3,6±0,2	3,5±0,2	3,4±0,2	3,4±0,2
		P	0,24	0,56	0,43	0,21	0,21	0,77	1,0	6,69	0,69	1,0
15 days after thyroidectomy	10		2,4±0,1	2,3±0,1	2,2±0,1	2,0±0,1	2,0±0,1	1,8±0,1	1,8±0,1	1,7±0,1	1,6±0,1	1,5±0,1
		P	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001
30 days after thyroidectomy	19		2,9±0,1	3,0±0,1	2,9±0,1	2,8±0,1	2,7±0,1	2,6±0,1	2,6±0,1	2,5±0,1	2,4±0,1	2,4±0,1
		P	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,004	<0,001	<0,001	<0,001
45 days after thyroidectomy	10		3,0±0,1	3,1±0,2	2,8±0,2	2,7±0,2	2,8±0,2	2,7±0,2	2,8±0,2	2,6±0,1	2,5±0,1	2,6±0,1
		P	<0,001	0,004	<0,001	<0,001	<0,001	<0,004	<0,040	<0,001	<0,001	<0,001
Treatment of thyroidectomized rats with thyroid until normalization of basal metabolism	9		4,3±0,3	4,2±0,3	4,0±0,3	4,0±0,3	3,8±0,3	3,6±0,2	3,4±0,2	3,3±0,2	3,3±0,2	2,6±0,1
		P	>0,5	>0,5	>0,5	>0,5	>0,5	>0,5	>0,5	>0,5	>0,5	>0,5

The excretion of bile during the first hour of the experiment in rats receiving thyroid for 5 days was 438 ± 30 mg, and during the 10th hour 318 ± 24 mg/100 g body weight. The total quantity of bile excreted during the 10 h did not exceed 3642 mg/100 g body weight. The concentration of bile acids fell from 942 to 220 mg%, but the total quantity of cholates obtained during the experiment showed no significant change. Excretion of bilirubin with the bile was increased. The total quantity of pigment during the 10 h of the experiment was 0.342 mg/100 g compared with 0.272 mg/100 g body weight in the control.

In rats receiving thyroid for 10 days, the total bile excreted during the experiment rose by 80% compared with the control and by 28% compared with animals receiving thyroid for less than the course of experiment. The water content in the bile of these rats was slightly increased, and the content of solids was reduced. The concentration of bile acids was lowered from 833 to 228 mg%. The excretion of bilirubin during the 10-h period rose to 0.423 mg/100 g body weight.

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Normalization of oxygen absorption when thyroid administration was stopped occurred after 19-20 days. By this time, the intensity of bile secretion was fully restored and most indices of the chemical composition of the bile were normal. The concentration of cholates in the bile was approximately 30% higher than initially.

In hypothyroidism rats oxygen absorption was reduced. It reached a minimum (on the average 27% below the control) on the 15th day after thyroidectomy. On the 30th day it was a little higher, and on the 45th day it was only 14% below the control. Meanwhile a decrease in the intensity of bile secretion was observed. The water content in the bile was reduced. The concentration of bile acids and bilirubin was increased. Nevertheless, the total content of cholates was reduced on the average by 27%, and of pigment by 32%. With normalization of the basal metabolism as the period after thyroidectomy increased, these changes became less marked.

Treatment of the thyroidectomized animals with thyroid led to restoration of the normal basal metabolism and bile secretion. However, the intensity of bile secretion and the composition of the bile were restored to normal rather more slowly: on the second-third day after the beginning of treatment.

During hyperthyroidism, therefore, the bile-secreting function of the liver is increased, while during hypothyroidism it is depressed.

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