CONTENTS OF HIGH-ENERGY PHOSPHORUS COMPOUND IN TISSUES OF ALBINO RATS WITH THYROTOXICOSIS

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The content of adenosine phosphates, creatine phosphate, and inorganic phosphate in the liver, brain, and skeletal muscles was studied in experiments on rats with thyrotoxicosis. Thyrotoxicosis was induced by feeding the animals with thyroid extract for two weeks. A fall in the ATP content in the liver was found to be accompanied by an increase in the AMP and inorganic phosphate concentration. The content of phosphorus compounds in the brain and skeletal muscles was unchanged.

Investigations have shown that metabolism of high-energy phosphorus compounds is disturbed in thyrotoxicosis. It is not clear, however, how their concentrations in different tissues vary in this condition. Some investigators have found a decrease in the level of high-energy compounds [4], while others found no change [5] or even an increase in their tissue concentrations [3].

The object of this investigation was to study the content of high-energy phosphorus compounds in the liver, brain, and skeletal muscles of rats following administration of large doses of thyroid hormones.

EXPERIMENTAL METHOD

Experiments were carried out on sexually mature albino rats weighing 120-200 g. Thyrotoxicosis was induced by feeding the rats with thyroid extract in a dose of 0.2-0.3 g/100 g body weight for two weeks. The degree of thyrotoxicosis was monitored by observing changes in the animals' body weight. The mean loss of weight was 17-19%. Before investigation the rats received an intraperitoneal injection of 1.5 ml 10% urethane solution. To determine high-energy compounds in the brain and liver tissue, the rat was frozen whole in liquid nitrogen. Muscle tissue was taken after preliminary decapitation and ground in a mortar with liquid nitrogen to a fine powder. Three weighed samples of powder were used for the estimation of adenine nucleotides [2], creatine phosphate (CP) [1], and inorganic phosphate (IP) [6].

EXPERIMENTAL RESULTS

The concentrations of adenosine phosphates, CP, and IP in the liver, skeletal muscles, and brain of the rats are given in Table 1.

It is clear from Table 1 that the concentration of ATP fell during the development of thyrotoxicosis by 0.74 μmole/g ($P < 0.01$). The ADP concentration showed no significant change. The AMP concentration rose by 0.2 μmole/g ($P < 0.05$), and the inorganic phosphate concentration also rose, by 2.8 μmoles/g ($P < 0.01$). A decrease in the reserves of high-energy phosphorus compounds in the liver was thus observed on account of a marked decrease in the ATP level. Dephosphorylation led to AMP formation, for the concentration of this compound rose while the ADP concentration in the liver tissue remained unchanged. The increase in the inorganic phosphate concentration was greater than that calculated theoretically from the decrease in the content of phosphorylated compounds.

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TABLE 1. Concentrations of Adenosine Phosphates, Creatine Phosphate, and Inorganic Phosphate in Liver, Skeletal Muscles, and Brain of Rats with Thyrotoxicosis (in μmoles/g tissue)

	ATP	ADP	AMP	ATP+ADP+AMP	CP	IP
			Liver			
Normal	1,47±0,09	1,61±0,08	1,10±0,07	4,18±0,17	—	4,7±0,3
n	17	17	17	17		13
Thyrotoxicosis	0,73±0,04	1,50±0,07	1,30±0,06	3,53±0,10	—	7,5±0,4
n	16	15	15	15		16
			Skeletal muscle			
Normal	4,50±0,16	0,73±0,05	0,32±0,04	5,55±0,17	13,7±0,45	6,6±0,3
n	29	29	26	26	30	30
Thyrotoxicosis	4,60±0,19	0,77±0,02	0,37±0,02	5,74±0,10	13,2±0,36	6,9±0,3
n	31	30	29	29	34	35
			Brain			
Normal	1,80±0,09	0,67±0,11	0,60±0,03	3,07±0,10	2,30±0,13	5,2±0,2
n	20	20	20	20	24	26
Thyrotoxicosis	1,62±0,06	0,70±0,03	0,41±0,02	2,73±0,09	2,30±0,10	5,5±0,3
n	17	17	17	17	19	18

No significant changes were found in the concentrations of ATP, ADP, AMP, CP, and inorganic phosphate in the skeletal muscles and brain. It can be concluded from these results that the character of the effect of toxic doses of thyroid hormones on the concentrations of high-energy compounds in the liver, brain, and skeletal muscles is not identical. The differences may be connected with differences in the blood supply to these organs. The concentration of thyroid extract was highest in the liver, where the thyroid hormones are partially destroyed. Smaller doses of thyroid hormones reached the skeletal muscles and, in particular, the brain, which is separated from the systemic blood flow by the blood-brain barrier. The possibility cannot be ruled out that these differences reflect differences in the mechanism of action of the thyroid hormones. Some workers consider that stimulation of synthetic processes [7] is the cause of the increase in basal metabolism in thyrotoxicosis and the increased oxygen consumption [7]. This could explain why a decrease in the reserves of high-energy compounds in thyrotoxicosis is observed in the liver, where active protein synthesis takes place.

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