BLOOD SERUM AND LIVER PHOSPHOLIPIDS OF RATS WITH CHRONIC CHOLINE – PROTEIN DEFICIENCY

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The phospholipid content in the blood serum and liver tissue was studied for a period of eight months in rats kept on a cirrhosis-inducing diet with a high fat content and deficient in protein and choline, in animals receiving the same diet but with the addition of choline, and in control rats. Depending on the duration of its administration, the cirrhosis-inducing diet led to fatty infiltration of the liver, fibrocysts, and cirrhosis. At all stages of the pathological process there was a marked decrease in the phospholipid content in the blood serum and liver. In rats with developed nodular cirrhosis a tendency was observed for the phospholipid level to rise, possible on account of "newly formed" liver tissue. Choline prevented the development of fatty infiltration but did not completely prevent the fall in the phospholipid concentration in the liver.

KEY WORDS: fatty infiltration of the liver; cirrhosis; phospholipids; choline.

A deficiency of choline and protein in the diet quickly leads to the development of fatty degeneration of the liver. Under these circumstances the phospholipid content falls both in the liver itself and in the blood serum [3, 8].

The object of this investigation was to study changes in the phospholipids in chronic choline–protein deficiency at various stages of the pathological process in the liver leading to the development of alimentary cirrhosis.

EXPERIMENTAL METHOD

Experiments were carried out on male albino rats weighing initially 60-90 g. For eight months 77 rats received a cirrhosis-inducing diet with a high fat content and deficient in protein and choline [4], 59 rats received the same diet but with the addition of choline chloride (400 mg/100 g body weight), and 75 rats (control) received a balanced diet of natural products. The phospholipid content in the liver and blood serum was estimated from the lipid phosphorus level [6], determined on the 14th, 30th, 70th, 150th, and 210-240th day of the experiments. At each of these times 11-15 rats were killed. Total lipids also were determined in the liver [7] and its morphological structure was investigated.

EXPERIMENTAL RESULTS AND DISCUSSION

A decrease in the phospholipid content in the liver and blood serum was found after 14 days in the rats kept on the cirrhosis-inducing diet (Table 1). Morphologically, fatty infiltration was present, mainly around the central veins, and the total lipid content was considerably increased. After 30 days, when diffuse fatty infiltration was present, and after 70 days when fibrosis with initial regenerative and proliferative substitution had developed in the liver, the total lipid content still remained high but the phospholipid content continued to decline both in the liver and in the blood serum.

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TABLE 1. Content of Lipid Phosphorus in Liver Tissue and Blood Serum and of Total Lipids in Liver of Rats with Chronic Choline–Protein Deficiency (M ± m)

Experimental conditions	Day of experiment	Liver		Blood serum
		lipid phosphorus (in mg/100 g)	total lipids (in g/100 g)	lipid phosphorus (in mg %)
Cirrhosis-inducing diet	14 th	70,0±0,96*	27,9±1,7*,†	4,9±0,3*
	30 th	71,6±0,1*	35,7±2,0*,†	4,6±0,3*
	70 th	67,5±4,4*	31,1±1,6*,†	3,6±0,1*
	150 th	41,3±5,8*,†	29,1±3,8*,†	3,4±0,4*,†
	210—240 th	77,8±6,0*	23,8±3,2*,†	3,6±0,4
Cirrhosis-inducing diet + choline	14 th	74,2±3,0	4,9±0,8	5,4±0,2
	30 th	86,4±2,1*	6,6±1,2	5,4±0,4
	70 th	82,4±2,2*	5,3±0,3	5,2±0,3*
	150 th	82,0±3,2	6,9±1,6	4,8±0,3*
	210—240th	84,0±3,4*	8,6±1,2	5,3±0,4
Control	14th	88,5±4,7	4,5±0,3	6,1±0,3
	30 th	115,4±9,1	5,2±0,3	6,2±0,3
	70 th	110,4±8,9	5,2±0,3	6,3±0,3
	150 th	96,8±8,9	5,8±0,1	6,3±0,1
	210—240 th	93,2±1,5	6,3±0,3	6,1±0,3

*$P < 0.05$ compared with control.
†$P < 0.05$ compared with group of rats receiving cirrhosis-inducing diet and choline.

On the 150th day of the animals' stay on the cirrhosis-inducing diet 63% of the rats developed nodules of hyperplasia of liver tissue. The total lipid level was high, although a little lower than previously. By this time the phospholipid content both in the liver and in the serum had fallen to its minimal level. By the 210-240th day of the experiment, when most of the rats had developed marked nodular cirrhosis of the liver, the phospholipid content showed a definite tendency to rise.

In the rats receiving added choline, the liver retained its normal trabecular structure throughout the period of investigation, and tiny droplet inclusions of fat were present in only a few hepatocytes. Although the phospholipid content in these rats was lower than in the controls, it was considerably higher than in the rats not receiving choline in their diet.

At all stages of the pathological process induced by chronic choline and protein deficiency and a high fat content of the diet, the phospholipid content in the liver and blood serum of the rats was thus reduced. This confirms the important pathogenetic role of phospholipids in the mechanism of development of fatty degeneration [5, 9, 10]. The tendency toward an increase in the phospholipid level in the liver of the rats with developed nodular adenomatous cirrhosis in the late stages of the pathological process can evidently be explained by the development of "newly formed" tissue in the liver resistant to fatty degeneration [2] and, possibly, capable of synthesizing phospholipids.

The addition of choline to the cirrhosis-inducing diet did not completely prevent the decrease in the phospholipid concentration, evidence of an important role of protein (methionine) deficiency in this process. S-Adenosylmethionine has been shown to be a universal donor of methyl groups, whereas choline plays only an unimportant role in methylation processes.

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