BLOOD AND LIVER PHOSPHOLIPIDS OF ALBINO RATS AT VARIOUS STAGES OF DEVELOPMENT OF EXPERIMENTAL PANCREATITIS

K. G. Karagezyan, P. S. Simavoryan, S. S. Ovakimyan, and Yu. V. Babok

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A marked decrease in the content of neutral phospholipids in the plasma and blood cells of albino rats with experimental pancreatitis was observed, especially on the 3rd-7th day of the disease. With the development of pancreatitis no polyglycero-phospholipids – an important faction of acid phospholipids participating in the formation of oxidative enzyme systems – could be found in the liver. The phenomena described are regarded as essential pathogenetic factors leading to the development of fatty infiltration of the liver in pancreatitis.

KEY WORDS: experimental pancreatitis; rat liver and blood; phospholipids.

The role of phospholipids (PL) in oxidative enzyme reactions of the mitochondria [10, 14-16] and in the pro- and antioxidant function of the liver [1] attracts ever-increasing attention. Interconversion of triglycerides (TG) and PL in the liver plays an essential role in the normal transport of fat from this organ and the prevention of its fatty infiltration. The deacylation of TG is accompanied by the formation of non-esterified fatty acids (NEFA) and diglycerides (DG), which are transformed by transferase conversions into PL, especially lecithins and ethanolamine phospholipids. On the other hand, further deacylation of DG is completed by the formation of free glycerol, which is converted by a kinase reaction into L-α-glycerophosphate (L-α-GP), a key compound in the biosynthesis of phosphatidic acids and other phospholipid-glycerides. The L-α-GP balance is largely dependent on activity of L-α-glycerophosphate dehydrogenase and the reaction of desmolysis of fructose-1,6-diphosphate, leading to the formation of precursors of L-α-GP. A definite regulatory role in this process belongs to lipocaic [3]. Information of the lipidemia in pancreatitis [8, 9, 11, 12] and in degenerations of the liver [4] is very scanty.

The considerations described above served as the starting point for a study of changes in the PL content in the blood and liver in acute forms of experimental pancreatitis, which is evidently one of the chief pathogenetic factors in the development of fatty infiltration of the liver.

EXPERIMENTAL METHOD

Acute pancreatitis was induced in albino rats by cooling the pancreas with ethyl chloride [5]. The possibility of a side-effect of the operative trauma on the actual picture of pancreatitis was ruled out by experiments on control animals. The PL were fractionated chromatographically by the method of Marinetti and Stotz [13] with some modifications [2, 7].

EXPERIMENTAL RESULTS

At different periods of development of experimental pancreatitis (Table 1) the content of individual PLs varied differently. The content of sphingomyelins in the plasma was changed as early as on the first day of the disease, the content of lecithins in the plasma and blood cells not until the 3rd day. On the 30th day of development of pancreatitis the total PL content in the blood plasma was almost back to its initial

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TABLE 1. Changes in Content of Total PLs and Their Fractions (in μg lipid phosphorus/ml fresh material or /g tissue) in Plasma, Blood Cells, and Liver during Course of Experimental Pancreatitis (M ± m)

Lipids	Plasma						Blood cells			
	control	day of observation					control	day of observation		
		1st	3rd	7th	14th	30th		1st	3rd	7th
Lysolecithin (LL)	2,7±0,1	2,5±0,1	2,3±0,1	2,2±0,1*	2,0±0,1*	2,1±0,1*	4,7±0,1	4,0±0,1*	4,3±0,1	4,2±0,1*
Monophospho-inositide (MPI)	3,6±0,2	3,0±0,1*	3,1±0,1*	3,4±0,2	3,3±0,2	3,4±0,1	2,2±0,1	2,0±0,1	1,9±0,1	1,9±0,1
Sphingomyelin (SPM)	8,0±0,3	6,5±0,1*	7,1±0,2	6,5±0,1*	6,4±0,1*	7,1±0,3	12,4±0,1	11,3±0,3*	11,7±0,3	11,4±0,3
Phosphatidylcholine (PC)	26,6±0,2	26,5±0,2	16,2±0,3*	21,3±0,3*	21,4±0,6	26,3±0,8	51,7±0,4	47,6±0,6*	40,3±0,1*	43,4±0,4*
Phosphatidylserine (PS)	2,4±0,1	2,2±0,1	2,2±0,1	2,2±0,1	2,1±0,1*	2,2±0,1	3,3±0,1	3,0±0,1	3,1±0,1	3,0±0,1
Phosphatidyleth-anolamine (PEA)	3,2±0,1	2,7±0,1*	2,6±0,2*	2,7±0,1*	2,7±0,1*	2,9±0,1	6,1±0,1	5,8±0,1	5,6±0,2	5,6±0,1*
Polyglycerophos-pholipids (PGPL)	—	—	—	—	—	—	—	—	—	—
Total PL	46,5±0,8	43,4±0,3*	33,5±1,1*	38,3±0,5	37,9±0,6*	43,4±1,1	80,5±0,4	73,8±0,7*	66,4±0,7*	69,3±0,4*
Total neutral PL	40,6	38,2	28,2	32,7	32,5	38,4	74,9	68,7	61,9	64,6
Total acid PL	6,0	5,2	5,3	5,6	5,4	5,6	5,5	5,0	4,9	4,9
K	6,7	7,2	5,3	5,8	6,0	6,9	13,6	13,7	12,6	13,0

Lipids	Blood cells		Control	Liver				
	day of observation			day of observation				
	14th	30th		1st	3rd	7th	14th	30th
Lysolecithin (LL)	4,2±0,1*	4,2±0,1*	—	—	—	—	—	—
Monophospho-inositide (MPI)	2,0±0,1	2,1±0,1	110,7±3,3	107,3±2,4	132,8±3,2*	124,7±7,1	107,0±2,7	96,8±3,1*
Sphingomyelin (SPM)	11,2±0,3*	11,3±0,3*	62,0±2,9	64,5±5,2	59,7±3,0	59,7±4,0	64,7±1,7	65,7±1,8
Phosphatidylcholine (PC)	43,3±0,4*	43,3±0,2*	588,0±10,7	548,3±4,8	294,5±7,1*	432,6±13,2*	485,4±15,3*	514,2±8,0
Phosphatidylserine (PS)	2,7±0,1	2,8±0,1	64,7±1,8	81,3±5,8	51,7±3,5*	74,7±4,5	51,1±3,0*	48,8±4,3*
Phosphatidyleth-anolamine (PEA)	5,7±0,1	5,6±0,1*	248,2±6,1	255,5±8,8	339,7±12,0*	224,4±9,5	257,6±5,6	245,5±5,0
Polyglycerophos-pholipids (PGPL)	—	—	80,1±1,1	45,4±0,7*	Traces	Traces	Traces	Traces
Total PL	68,6±0,4*	70,0±0,4*	1103,7±12,3	1102,3±10,5	877,4±5,8*	916,1±23,0*	965,8±13,4*	971,0±17,5*
Total neutral PL	63,4	64,4	848,2	868,3	693,9	716,7	807,7	825,4
Total acid PL	4,7	4,9	255,5	234,0	183,5	199,3	158,1	145,6
K	13,5	13,0	3,3	3,7	3,7	3,6	5,0	5,7

Legend. Control – operation under ether anesthesia with exposure of the pancreas but without its subsequent cooling with ethyl chloride. Total neutral phospholipids: LL + SPM + PC + PEA. Total acid phospholipids: MPI + PS + PGPL. K) ratio between total neutral phospholipids and total acid phospholipids.

*$P \leq 0.05$ (compared with control).

value, but in the blood cells it remained comparatively low. The mechanism of these effects can evidently be explained by the rapidly achieved balance in the content of the compounds, especially neutral PLs, between the liquid phase of the blood and the tissues. The ratio between the total neutral PLs and the total acid PLs (K) the plasma and blood cells in pancreatitis fell (because of the decreased content of neutral PLs).

It also follows from Table 1 that in pancreatitis there is a marked decrease in the PL content, especially acid PL, in the liver. As a result, on the 14th and 30th days of development of pancreatitis, the proportion of neutral PL among the total PL rose appreciably. It will be wrong to suggest activation of phosphatide synthesis or of "equilibrium" between the content of PG and PL. Conversely, fatty infiltration of the liver in pancreatitis suggests the accumulation of TG, a decrease of PL, and, consequently, inhibition of activity of the corresponding enzyme systems catalyzing PL biosynthesis. Disturbances of the biogenesis of choline and ethanolamine, the kinase reactions connected with them, and certain stages of protein–amino-acid metabolism [6] may lead to serious abnormalities in the biosynthesis of neutral PLs and, consequently, to the blocking of the regular transport of fat from the liver, with the development of fatty infiltration of that organ. Meanwhile, the deficiency in acid PL in the liver in experimental pancreatitis leads to a disturbance of the high oxidative potential of that organ, thus favoring the development of lipostasis in it and the accumulation of large quantities of incompletely oxidized products of lipid metabolism.

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