LIPOLYTIC ACTIVITY OF THE LUNGS AND LIVER AFTER FAT LOADING

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UDC 621.215.3.612.35]015.14-06 :612.397

The importance of the lungs in lipid metabolism is that when an excess of fat enters through the thoracic ducts, part of it is retained in this organ as a result of the lipopexic function of the lung [1, 3, 8]. The lung thus plays the role of a "sponge" or buffer, regulating the arrival of lipids into the arterial blood [2]. Partial hydrolysis of the neutral fat retained in the lungs takes place in these organs, with the liberation of higher fatty acids [1, 2, 6, 7].

The lipolytic function of the lung is evidently associated with the activity of lipoprotein lipase [6] and its cofactor heparin, the content of which in the lung is fairly high.

Besides the lungs, the liver also performs a lipopexic function, but this is exhibited in relation to the chylomicrons and the higher free nonesterified fatty acids (NEFA), circulating in the arterial blood [5]. In these circumstances the resynthesis of triglycerides from MEFA and formation of complexes between these substances and proteins, with the formation of β-lipoproteins, take place in the liver. No lipoprotein lipase is present in the liver. To examine the relationships between the lungs and liver during the development of alimentary lipemia, experiments were carried out on rats receiving a single fat load, after which the content of lipids and the lipolytic activity in the liver and lungs were investigated at intervals of 5 and 18 h.

EXPERIMENTAL METHOD

Experiments were carried out on albino rats weighing 250-300 g. Some animals were loaded with sunflower oil, others with margarine in a dose of 1 g/100 g body weight. The rats were decapitated 5 h and 18 h after loading, depending on the series of experiments. The content of total lipids in a powder of the liver and lungs, dried to constant weight, was investigated by extraction with dichloroethane in a Soxhlet apparatus.

The lipolytic activity was determined from the increase in the concentration of free fatty acids after incubation of minced liver and lung tissue (100 mg) for 150 min at 37° in 3 ml of a 4% solution of albumin in Krebs-Ringer phosphate buffer (pH 7.4; autolipolysis); the esterolytic activity was determined from the increase in the concentration of NEFA during incubation of lung and liver tissue (100 mg) in the same conditions, using as substrate a 2.5% solution of Tween-60 (the stearic ester of polysorbitol) in an ammonia buffer with 0.01 M $CaCl_2$ (pH 7.4). The concentration of ketone bodies in the blood was determined by Natelson's method [4].

EXPERIMENTAL RESULTS

As the results given in the table show, 5 h after loading both with sunflower oil and with margarine, the content of total lipids in the lungs increased while their content in the liver remained unchanged. The increase in lipolytic activity of the lungs, determined relative to the autolipolytic index and the substrate Tween-60, followed a parallel course. In the liver, autolipolysis remained unchanged, while the esterolytic activity (as Tween-60) increased. The content of ketone bodies in these circumstances increased after loading.

No changes in the investigated indices could be found in either the liver or the lungs 18 h after loading.

However, after fat loading, the lipopexic function of the lung is the most prominent feature; it was easily manifested in relation to triglycerides containing unsaturated fatty acids (sunflower oil) and in relation to triglycerides containing hydrogenated fatty acids (margarine). A parallel increase was observed in the lipolytic activity in the lung, i.e., lipodieresis developed.

Department of Pathological Physiology, Central Postgraduate Medical Institute, Moscow (Presented by Active Member of the Academy of Medical Sciences of the USSR N. I. Grashchenkov). Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 63, No. 2, pp. 47-49, February, 1967. Original article submitted May 19, 1965.

Content of Total Lipids and Changes in Autolipolysis and Esterolytic Activity of Lung and Liver Tissues 5 h and 18 h after Loading with Sunflower Oil and Margarine (M ± m)

Interval between loading and estimation (in h)	Organ and tissue	Total lipids*			Autolipolysis†			Esterolytic activity†			Ketone bodies in serum (in mg %)		
		Control	Loading with sunflower oil	Loading with margarine	Control	Loading with sunflower oil	Loading with margarine	Control	Loading with sunflower oil	Loading with margarine	Control	Loading with sunflower oil	Loading with margarine
5	Lung	18,7± ±0,42 (13)	21,6± ±0,54 $P<0,01$ (13)	20,5± ±0,56 $P<0,01$ (13)	3,4±0,34 (13)	5.12± ±0,32 $P<0,01$ (13)	5,18± ±0,52 $P<0,01$ (13)	32,9±0,68 (16)	39,3±1,26 $P<0,01$ (16)	37,9±1,36 $P<0,01$ (16)			
	Liver	18,4± ±0,58 (9)	18,4± ±0,94 $P>0,05$ (9)	21,1± ±1,09 $P>0,05$ (9)	3,9±0,23 (9)	4,06± ±0,34 $P>0,05$ (9)	4,37± ±0,29 $P>0,05$ (9)	32,9±1,13 (9)	43,4±2,35 $P<0,01$ (9)	37,3±1,35 $P<0,05$ (9)			
	Blood										1,46±0,14 (12)	2,49±0,28 $P<0,01$ (12)	2,19±0,16 $P<0,01$ (12)
18	Lung	20,5± ±0,32 (9)	21,3± ±0,48 $P>0,1$ (9)	21,5± ±0,58 $P>0,1$ (9)	5,5±0,32 (9)	6,44± ±0,76 $P>0,1$ (9)	6,3±0,65 $P>0,1$ (9)	35,0±1,4 (9)	36,8±2,4 $P>0,1$ (9)	36,8±2,15 $P>0,1$ (9)			
	Liver	18,5± ±0,76 (7)	18,6± ±0,88 $P>0,1$ (7)	18,5± ±1,12 $P>0,1$ (7)	8,2±1,1 (7)	9,46± ±1,0 $P>0,1$ (7)	9,10± ±0,52 $P>0,1$ (7)	36,1±2,13 (7)	36,9±2,0 $P>0,1$ (7)	39,2±1,47 $P>0,1$ (7)			
	Blood										3,4±0,41 (7)	2,0±0,16 $P>0,05$ (7)	2,9±0,41 $P>0,05$ (7)

*Calculated per dry weight of tissue.

†Difference between content of nonesterified fatty acids in μ eq/ml/g tissue before and after incubation.

Note: Control—intact animals without loading; number of experiments in parentheses.

The liver is more passive to fat loading: its lipid content was not increased and its autolipolysis was unchanged, and only its esterolytic activity was increased. The increase in ketone bodies observed in these circumstances may be associated with activation of the oxidation of the fatty acids set free in the liver as a result of its increased esterolytic activity.

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