METABOLISM OF INDIVIDUAL PHOSPHOLIPID FRACTIONS IN THE RAT BRAIN DURING THIOPENTAL SLEEP AND AMPHETAMINE EXCITATION

V. Ya. Dvorkin,* G. V. Kiselev, and D. A. Chetverikov

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The intensity of metabolism of the phosphate groups of all rat brain phospholipids studied was considerably reduced during sleep induced by thiopental (100 mg/kg), and distinctly increased during excitation by amphetamine (6 mg/kg). The content of diphosphoinositides rose by 39% during thiopental sleep and fell by 6% in amphetamine excitation. The content of the remaining phospholipid fractions studied was unchanged. Metabolism of the phosphoinositide fractions was more closely connected with the energy metabolism of the brain tissue than with the level of CNS functional activity.

KEY WORDS: brain phospholipids; polyphosphoinositides; thiopental sleep; amphetamine as a stimulant.

The writers showed previously that under the influence of factors modifying the supply of energy to the body tissues the content of only the di- and triphosphoinositides (DPIs and TPIs) of rat brain was changed, and the content of the other phospholipid (PL) fractions studied, including monophosphoinositides (MPIs) remained unchanged [3, 4]. In these situations (hypoxic hypoxia, insulin hypoglycemia, electrical stimulation of the skin) a close parallel was found between changes in the content of the TPI fraction and the intensity of metabolism of all PL fractions, on the one hand, and changes in energy metabolism and changes in the state of the CNS on the other hand [5].

To investigate the closeness of the connection between polyphosphoinositide (PPI) metabolism and changes in the functional activity of the CNS, in the investigation described below the content and intensity of metabolism of individual PL fractions, including the PPI fraction, were studied in the brain of rats during thiopental sleep and amphetamine excitation.

EXPERIMENTAL METHOD

Adult male Wistar albino rats were used. Sleep was induced by subcutaneous injection of thiopental sodium in a dose of 100 mg/kg. A state of excitation was induced in the rats by subcutaneous injection of amphetamine in a dose of 6 mg/kg. After the injection of thiopental or amphetamine, a solution of $Na_2HP^{32}O_4$ was injected subcutaneously in a dose of 5 mCi/kg. The animals were decapitated 2 h after injection of the isotope, the cerebral hemispheres were quickly removed, after which extraction, chromatographic fractionation, and analysis of the PL fractions were carried out by methods fully described earlier [1, 2]. For each PL fraction of the rat brain investigated, the content of lipid phosphorus (in μg phosphorus of the fraction/g wet weight of tissue) and the relative specific radioactivity, or the ratio between the specific radioactivity of phosphorus of each PL fraction and the specific radioactivity of inorganic phosphate of brain tissue ($\times 100$), were determined.

*Deceased.

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TABLE 1. Content and Intensity of Metabolism of Phospholipids in Rat Brain under Normal Conditions and during Thiopental Sleep and Amphetamine Excitation

Experimental conditions	Parameter	Total phospholipid	Diacyl amino-phospho-lipids	Plasmalogen aminophos-pholipids	Phosphatid-ylcholines	Sphingo-myelins	Monophos-phoinositides	Diphospho-inosi-tides	Tri-phospho-inositides
				Content (μg P_i/g wet weight of tissue)					
Control (n = 35)	$M \pm m$	1957±43	442±15	388±11	587±15	124,0±4,0	62,8±0,8	21,3±0,3	35,3±0,5
Thiopental sleep (n = 20)	$M \pm m$	1928±17	461±8	389±8	601±9	120,8±2,2	67,1±2,2	29,5±1,2	36,7±1,6
	% of control	98,5	104,3	100,3	102,4	97,4	107,0	138,5	104,0
	P	>0,1	>0,1	>0,1	>0,1	>0,1	>0,1	<0,001	>0,1
Amphetamine excitation (n = 15)	$M \pm m$	2029±34	460±16	411±8	635±16	133,2±2,9	60,3±1,1	20,1±0,2	33,9±1,8
	% of control	103,7	104,1	105,9	108,2	107,4	96,0	94,5	96,1
	P	>0,1	>0,1	>0,1	>0,1	>0,1	>0,1	<0,01	>0,1
				Relative specific radioactivity					
Control (n = 35)	$M \pm m$	2,01±0,04	1,11±0,07	0,45±0,02	1,21±0,04	0,30±0,01	16,6±0,4	28,9±0,6	34,2±0,8
Thiopental sleep (n = 20)	$M \pm m$	1,20±0,07	0,70±0,05	0,25±0,01	0,58±0,05	0,13±0,03	5,99±0,51	22,9±0,8	25,8±1,6
	% of control	59,7	63,1	55,6	47,9	43,3	36,1	79,3	75,5
	P	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001
Amphetamine excitation (n = 15)	$M \pm m$	2,53±0,05	1,33±0,05	0,56±0,02	1,57±0,05	0,39±0,04	20,3±0,6	35,5±1,3	42,7±1,6
	% of control	125,9	119,8	124,4	129,8	130,0	122,5	123,0	125,0
	P	<0,001	<0,02	<0,001	<0,001	<0,05	<0,001	<0,001	<0,001

EXPERIMENTAL RESULTS AND DISCUSSION

It will be clear from Table 1 that under the experimental conditions used changes were observed in the content of only one of the PL fractions studied in the rat brain, namely DPI. During thiopental sleep, the DPI content increased by 38.5%, whereas during amphetamine excitation it fell slightly but significantly. These changes were similar to changes in the content of this fraction under physiological conditions [3,4]. The intensity of the phosphorus metabolism of all PL fractions studied was significantly reduced during thiopental sleep and distinctly increased during amphetamine excitation. The character of the changes in the intensity of metabolism of the PL fractions studied under the experimental conditions correlated clearly with the character of the changes in the functional state of the CNS.

Under the influence of pharmacological agents modifying the level of CNS function, as in other situations studied previously [3, 4], the PPI thus proved to be labile precursors of the PL of brain tissue; this lability was manifested more clearly in disturbances of energy metabolism (hypoxia, hypoglycemia) in the nervous system than during changes in the functional activity of the CNS induced by specific pharmacological agents inhibiting or stimulating the activity of the nervous system.

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