for their role in transmitting the influence of the hypothalamus; second, these fibers are perhaps feedback channels in the neuronal net of the eyes and hypothalamus, in agreement with modern views on two-way connections between an organ and the CNS.

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EFFECT OF HYPOTHYROIDISM ON METABOLIC MATURATION OF HIPPOCAMPAL PYRAMIDAL NEURONS IN RATS

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KEY WORDS: hypothyroidism; protein metabolism; hippocampus.

The effect of hypothyroidism on developing nerve tissue has been investigated in the greatest detail, chiefly by biochemical methods, with respect to the cerebral cortex and cerebellum [3]. The main effect of hypothyroidism has been shown to be marked depression of synthetic processes in developing nerve tissue. From this aspect, the limbic region of the brain, with which learning, memory, and emotions are connected, has received comparatively little study [6].

The aim of this investigation was to study, by interference microscopy, the time course of growth of neurons and accumulation of protein products in the pyramidal cells of hippocampal areas CA1 and CA3, as the major part of the limbic region of the rat brain.

EXPERIMENTAL METHOD

Hypothyroidism was induced by intraperitoneal injection of methylthiouracil (MTU) into a lactating Wistar rat in a dose of 100 mg in 0.5 ml physiological saline daily during the first week of life of the progeny, and thereafter on alternate days throughout the period of lactation (1 month). The brain of animals aged 14 and 21 days and 2 months was studied under normal conditions and in hypothyroidism. Animals with hypothyroidism for 2 months thus did not receive MTU in the 2nd month of life. After decapitation, pieces of brain containing the anterior hippocampus were fixed in formalin–alcohol–acetic acid (9:3:1) mixture. The thickness of frontal paraffin sections for interference microscopy was measured by the method in [1]. Parallel sections were stained with cresyl violet. The concentration of dry substances ($\Delta\phi$), and the area of the nucleus and perikaryon of the neurons (S) in areas CA1 and CA3 of the hippocampus were measured for 100 cells from each animal (2-3 animals in each age group). The area of the nucleus and perikaryon was determined by the formula $S = \pi Rr$; the radii were measured on projections drawn with the RA-6 drawing apparatus or by means of an ocular micrometer. The dry weight of the neurons was calculated for an area of section 5 μ thick. The numerical results were subjected to statistical analysis, the significance of differences between means being assessed by the t test.

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TABLE 1. Concentration of Dry Substances ($\Delta\varphi$), Area (S) of Nucleus and Cytoplasm, and Dry Weight (M) of Neurons of Hippocampal Areas CA1 and CA3 of Control and Hypothyroid Animals of Different Ages

Age of animals	Test object	Experimental conditions	CA 1			CA 3		
			$\Delta\varphi$, deg	S, μ^2	M, pg	$\Delta\varphi$, deg	S, μ^2	M, pg
14 days	Nucleus	Control	24,7±2,3	90,0±2,4	37,6±3,1	24,2±2,1	121,2±3,5	49,8±3,5
		Hypothyroidism	32,2±1,8	87,5±2,5	47,7±2,9	30,7±1,9	114,7±1,6	49,3±3,5
	Cytoplasm	Control	94,7±2,1	77,8±3,5	125,4±6,3	87,8±2,6	103,5±6,7	154,1±11,0
		Hypothyroidism	93,5±3,4	50,6±5,4	80,3±8,9	93,1±2,4	60,6±3,0	94,6±2,4
21 days	Nucleus	Control	33,0±1,8	92,7±1,9	51,7±2,8	31,5±2,1	110,2±3,4	58,9±3,9
		Hypothyroidism	35,2±2,7	86,7±1,9	52,3±4,1	38,4±2,3	104,3±2,3	68,0±4,5
	Cytoplasm	Control	86,4±2,6	91,3±4,7	136,2±8,2	86,6±2,6	150,0±7,2	220,3±12,5
		Hypothyroidism	91,0±2,4	40,4±3,6	62,2±5,7	87,5±2,5	79,5±4,6	117,8±7,2
2 months	Nucleus	Control	35,1±3,5	102,0±2,3	59,3±6,0	35,8±1,9	182,9±4,4	104,1±7,9
		Hypothyroidism	28,9±2,0	81,4±1,1	39,3±2,9	29,3±2,1	120,6±2,5	59,5±4,5
	Cytoplasm	Control	114,1±4,7	48,9±2,7	94,2±3,8	115,2±4,2	100,2±6,2	193,4±14,1
		Hypothyroidism	97,4±3,8	31,8±2,3	52,2±4,3	105,1±3,3	70,5±3,7	125,5±8,1

EXPERIMENTAL RESULTS

Hypothyroidism led to considerable slowing of growth of the animals. Despite withholding of MTU, hypothyroid animals at the age of 2 months had not reached the weight of the control rats (control 140.0 ± 8.0 g, hypothyroidism 75.0 ± 5.0 g). The results of interference microscopy and of measurement of the area of the nucleus and perikaryon are given in Table 1.

The interferometric investigation clearly revealed inhibition of growth of the pyramidal neurons of the two hippocampal areas in hypothyroidism. By the age of 2 months, the nucleus and perikaryon of neurons of the hypothyroid animals had not reached the size of those in the control group despite withholding of MTU. This effect was most marked in area CA3. The fact will be noted that the dimensions of neurons of hypothyroid animals did not increase with an increase in weight of the animals themselves and did not correspond to the dimensions of neurons of control animals of similar weight. Meanwhile, in hypothyroidism a marked decrease was found in the dry weight of the cytoplasm of neurons in areas CA1 and CA3 throughout the duration of the experiment compared with the control. The dry weight of the nucleus was reduced in neurons in areas CA1 and CA3 only in the group of hypothyroid animals aged 2 months. The decrease in dry weight of the pyramidal neurons was due chiefly to delay in "maturation" of the cytoplasm, and in the 2-month-old animals, of the nucleus of the neurons also. It must be pointed out that inhibition of metabolic maturation of hippocampal neurons induced by hypothyroidism is irreversible in character, for even 1 month after withholding MTU, the normal dry weight of the neurons in the experimental animals had not been restored. These findings are in agreement with results [7] showing that in hypothyroidism induced by administration of propylthiouracil to a lactating animal during the first 35 days of life of the progeny irreversible inhibition of growth of the hippocampus along both longitudinal and transverse axes, took place. The strongest effect was observed in the anterior part of the hippocampus. Thyroid function is known to be restored quickly to normal immediately after withholding of MTU [2]. At the same time, reception of thyroid hormone by nerve tissue is known to be greatest during the first 3 weeks of life of rats. It can accordingly be postulated that irreversible inhibition of growth of hippocampal neurons during hypothyroidism, despite withholding of MTU, can be explained by a lower level of hormonal reception later in life.

A decrease in the content of protein products in hypothyroidism was observed previously in ganglion cells in the cerebral cortex and Purkinje cells of the cerebellum [4, 5]. In the cerebral cortex this decrease affected both nucleus and cytoplasm of the neurons, it was found in hypothyroid animals as early as on the 14th day after birth, and it was due to a decrease both in the concentration and in the size of the nucleus and cytoplasm of the neurons. In the cerebellum, the dry weight only of the cytoplasm of the Purkinje cells was reduced, and this was due to a marked decrease in area of the perikaryon of the neurons while the concentration of protein products was higher than in the control. Consequently, hypothyroidism has the same effect on the development of different parts of the CNS. Meanwhile, in each concrete case, this effect extends to different degrees to processes of growth and metabolic maturation of the neurons of these parts of the brain. The results of the present investigation suggest that a disturbance of metabolic maturation of the neurons takes place in the hippocampus along with delayed growth.

It can thus be concluded from the results of this investigation that irreversible disturbances of growth of hippocampal neurons and of their metabolic maturation due to hypothyroidism in the early postnatal period may be one stage in the pathogenesis of functional disorders of the CNS.

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SYSTEMIC RELATIONS OF KINETICS OF BLOOD LEUKOCYTES AND INFLAMMATORY INFILTRATION CELLS IN A ZONE OF INFARCTION OF THE RAT HEART

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KEY WORDS: leukocytes; infiltrate; infarct.

The fundamental ideas of the character of the inflammatory infiltrate in a zone of myocardial infarction during its healing have been described in many publications [3, 8, 10, 12, 14, 15]. However, no special study has yet been undertaken with the aim of establishing systemic relations between the kinetics of the blood leukocytes and the kinetics of inflammatory infiltrate cells in a zone of myocardial infarction. Since the view has become established that cells of a focus of aseptic inflammation are hematogenous in origin [9, 16], the study of these problems may be not only of theoretical, but also of practical importance.

In connection with the facts described above, the aim of the present investigation was to determine correlation between the kinetics of blood leukocytes and the kinetics of inflammatory infiltrate cells in a zone of myocardial infarction in rats during healing.

EXPERIMENTAL METHOD

Experiments were carried out on 266 male rats weighing 183 ± 17 g. Myocardial infarction was produced by ligation of the lateral artery of the left ventricle under sterile conditions and under general anesthesia with controlled respiration. The animals were killed between 5 min and 30 days after the operation, in accordance with prevailing instructions. In sections cut through the zone of myocardial infarction and stained with hematoxylin and eosin, by Van Gieson's, Weigert's, and Brachet's methods, and using the "fields" method of Glagolev [2] with modifications, the packing density of polymorphonuclear leukocytes (polymorphs), macrophages, lymphocytes, fibroblasts, eosinophils, plasma cells, and mast cells was determined. The relative number of granulocytes and agranulocytes was determined at various times of the experiment during the life of the animals, on blood films stained by the Romanovsky–Giemsa method, and the ratio between them was calculated and called the blood leukocyte shift index (BLSI).

To estimate the effect of operative trauma on the kinetics of the blood leukocytes in myocardial infarction, similar investigations were carried out on 29 rats undergoing a mock operation, which was limited to pericardiotomy.

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