

ULTRASTRUCTURAL ORGANIZATION OF BLOOD CAPILLARY ENDOTHELIOCYTES OF THE ILIAC LYMPH NODES DURING PREGNANCY (MORPHOMETRIC STUDY)

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The appearance of the feto-placental system is known to lead to definite changes in the maternal circulation [4]. However, until recently mainly the arterial section of the cardiovascular system has been studied during pregnancy [4, 6]. The importance of its venous component, and also of the lymphatic system, for the maternal vascular bed during pregnancy has remained unclear.

The aim of this investigation was to determine the morphological equivalents of adaptation of the endotheliocytes of the arterial and venous sections of the capillaries in the iliac lymph nodes (LN) of rats at different times of physiological pregnancy, and to evaluate their role for certain stages of the mother-fetus system.

EXPERIMENTAL METHOD

Female Wistar rats weighing (before pregnancy) 200-220 g (age 2.5-3 months) were used. Material for testing was obtained on the 11th, 17th, and 21st days of pregnancy. In all cases one of the right iliac LN was taken from five rats in each group. The material was fixed in 1% OsO₄ solution in phosphate buffer (pH 7.3) and embedded in Epon. Semithin sections were stained with toluidine blue and used to select the area of cortex containing capillaries (five blocks satisfying the above demand were chosen out of 15 blocks from each animal). Two transverse sections through the arterial (diameter 2-7 μ) and venous (over 7 μ) sections of the capillaries were chosen for morphometry [5] from each block of the LN specimen. The capillaries were photographed under a magnification of 4200. By means of open-square test systems, with a final magnification of 70,000, a morphometric investigation was made of the ultrastructural organization of the endothelial cells of the arterial and venous sections of LN capillaries, taking general recommendations in [2] into account. Differences between mean values were considered to be significant at the $p \leq 0.05$ level (Student's test). The venous pressure in the caudal vena cava was determined in 50 animals (11 of them not pregnant) under ether anesthesia, by the method in [3]. The animals were killed by decapitation.

EXPERIMENTAL RESULTS

During pregnancy the venous pressure in the posterior vena cava rises from 30.2 ± 6.9 mm water in the control to 102.2 ± 26.9 mm water at the end of pregnancy. In the system of the ovarian vein, the broad ligament of the uterus, and the lumbar region collaterals appear and the veins are widely dilated and congested. Definite changes also take place in the extramural lymphatics of the uterus, as the writers described previously [1]. It is evident that during pregnancy changes take place in the blood and lymph circulation in the utero-placental zone. These changes are regularly reflected also in the iliac LN, which are the regional glands for uterus, and in particular in the ultrastructural organization of the endotheliocytes of the blood capillaries of the iliac LN.

Thus the study of the numerical density of mitochondria in the arterial and venous sections of the capillaries in the course of pregnancy revealed no significant difference from

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TABLE 1. Results of Morphometry of Endotheliocytes of Arterial and Venous Sections of Capillaries in Iliac LN of Rats at Different Times of Physiological Pregnancy (M \pm m)

Section investigated	Feature	Control (non-pregnant rats)	Period of pregnancy, days		
			11	27	21
Arterial	Mitochondria numerical density, μ^{-3}	0,51 \pm 0,080	0,41 \pm 0,066	0,39 \pm 0,037	0,54 \pm 0,079
	bulk density, %	3,32 \pm 0,458	2,38 \pm 0,374	3,43 \pm 0,507	3,11 \pm 0,457
	surface density of inner membrane, μ^{-1}	5,96 \pm 0,452	5,40 \pm 0,602	6,57 \pm 0,579	7,70 \pm 0,763*
	Bulk density kg, %	0,26 \pm 0,080	0,28 \pm 0,070	0,74 \pm 0,130*	1,02 \pm 0,100*
	Bulk density of RER, %	7,92 \pm 0,807	10,58 \pm 1,153	9,70 \pm 0,960	14,15 \pm 1,780*
	Ribosomes (numerical density) attached	22,60 \pm 3,17	54,00 \pm 7,45*	63,32 \pm 6,33*	85,40 \pm 7,40*
	free	36,80 \pm 4,59	37,43 \pm 3,33	32,25 \pm 3,54	16,12 \pm 2,19*
Venous	Mitochondria numerical density, μ^{-3}	0,35 \pm 0,063	0,29 \pm 0,042	0,33 \pm 0,061	0,32 \pm 0,037
	bulk density, %	2,62 \pm 0,329	2,62 \pm 0,314	3,74 \pm 0,480*	4,45 \pm 0,440*
	surface density of inner membrane, μ^{-1}	6,64 \pm 0,671	9,10 \pm 0,841*	10,47 \pm 0,947*	14,52 \pm 1,219*
	Bulk density kg, %	0,17 \pm 0,050	0,26 \pm 0,080	0,90 \pm 0,089*	0,75 \pm 0,090*
	Bulk density of RER, %	8,07 \pm 0,985	13,05 \pm 1,813*	13,01 \pm 1,158*	20,54 \pm 1,930*
	Ribosomes (numerical density) attached	17,34 \pm 3,60	51,68 \pm 8,16*	58,31 \pm 5,36*	100,62 \pm 8,45*
	free	36,96 \pm 4,69	31,77 \pm 4,79	18,38 \pm 2,24*	11,52 \pm 1,31*

Legend. Asterisk indicates significant difference from control.

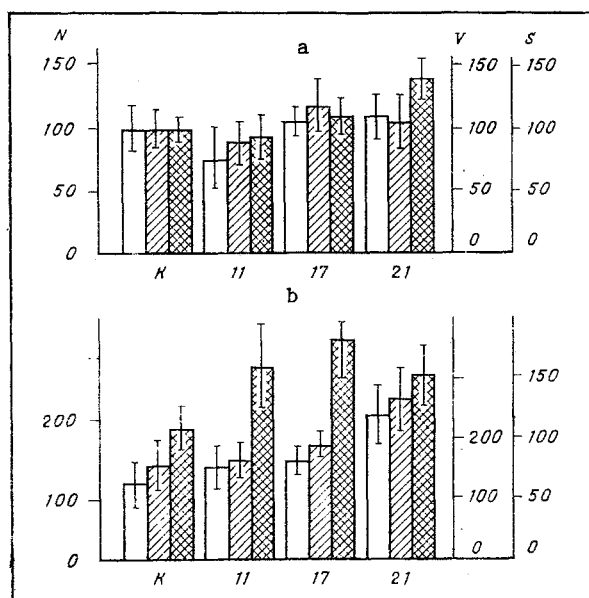


Fig. 1. Results of investigation of total absolute number (unshaded columns - N, %), the total absolute volume (obliquely shaded columns - V, %), and the total absolute area of the inner membrane (cross-hatched columns - S, %) of mitochondria of endotheliocytes of arterial (a) and venous (b) sections of capillaries of iliac LN of rats at different times of pregnancy. Here and in Figs. 2 and 3: abscissa) time of pregnancy (in days); K) control; in all cases value of corresponding parameter in control arterial section was taken as 100%.

the control data (Table 1). The absolute number of mitochondria in endotheliocytes of the arterial and venous sections of the capillaries likewise did not differ significantly from the control, and not until the 21st day of pregnancy did the absolute number of mitochondria in the endotheliocytes of the venous section of the capillary exceed the control value significantly, when it reached 205% of its initial level (Fig. 1). The bulk density and

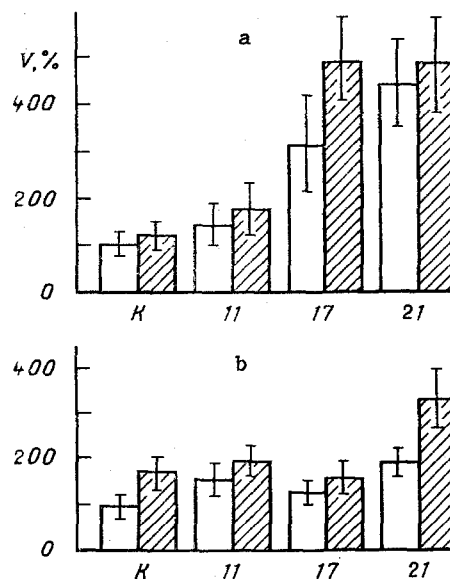


Fig. 2. Results of determination of total absolute volume of GC (a) and RER (b) in endotheliocytes of arterial (unshaded columns) and venous (shaded columns) sections of capillaries of iliac LN of rats at different times of pregnancy (control - nonpregnant rats).

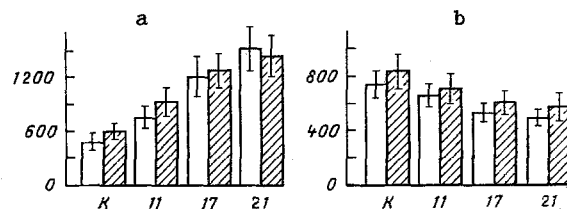


Fig. 3. Number of attached (a) and free (b) ribosomes per area of cross section of endotheliocytes determined in arterial (unshaded columns) and venous (shaded columns) sections of capillaries at different times of pregnancy.

total absolute volume of the mitochondria in endotheliocytes of the venous section of the capillary were increased on the 17th and 21st days of pregnancy, but at other times they did not differ significantly from the control. The corresponding parameters for endotheliocytes of the arterial section of the capillary did not differ significantly from the initial values (Table 1, Fig. 1). The total surface area of the inner membrane of the mitochondria in the endotheliocytes of the venous section of the capillary was increased on the 11th day of pregnancy by 1.38 times, on the 17th day by 1.59 times, and on the 21st day by 1.30 times compared with initially. The value of this parameter in the endotheliocytes of the arterial section of the capillary differed significantly from the control only at the end of pregnancy, when it was 130% of its initial value (Table 1, Fig. 1).

The bulk density of the Golgi complex (GC) in the endothelial cells of the arterial and venous sections of the capillary during pregnancy increased on the 17th-21st day of pregnancy. The absolute volume of GC increased in the endotheliocytes of these parts of the capillaries, to reach a maximum on the 17th-21st day of pregnancy (Table 1, Fig. 2).

The bulk density of the rough endoplasmic reticulum (RER) in the endothelial cells of the arterial section of the capillary at the end of pregnancy was significantly greater than initially, but the absolute volume was significantly increased only after the 11th day of pregnancy. The bulk density and absolute volume of RER in the endotheliocytes of the

venous sections of the capillary were significantly greater than initially starting from the 11th day and until the end of pregnancy (Table 1, Fig. 2). Changes in the number of attached ribosomes correlated with the time course of changes in RER during pregnancy. We found significant changes in the numerical density and absolute number of attached ribosomes in the endothelial cells of the arterial and venous sections of the capillaries during pregnancy. These parameters were significantly higher than the control levels by the 11th day of pregnancy, and they increased even more by its end (Table 1, Fig. 3). These data on changes in numerical density and absolute numbers of free ribosomes in the endothelial cells of the arterial and venous sections of the capillaries are evidence of a gradual decline in the values of these parameters during pregnancy.

Investigation of the ultrastructural organization of capillary endotheliocytes in the iliac LN of animals with a hemochorial type of placentation revealed a combination of adaptive structural changes: an increase in the bulk density and absolute number of mitochondria, the surface density, and the total surface area of the inner membrane of the mitochondria (evidence of increased activity of transmembrane transport by means of carriers), and dilatation of the tubules and cisterns of the endoplasmic reticulum and of GC. Toward the end of pregnancy the area of cross section of the endothelial cells and their nucleus and cytoplasm is increased, microvesicular transport is activated, and transendothelial channels are formed. The ultrastructural changes in the capillary endotheliocytes of LN-regional relative to the uterus during physiological pregnancy in rats are adaptive in character and evidently tend to reduce congestive phenomena in the system of the inferior vena cava, thereby improving the utero-placental circulation.

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ELECTRON-AUTORADIOGRAPHIC DATA ON RNA SYNTHESIS AND CHROMATIN STRUCTURE IN RAT CEREBRAL CORTICAL CELLS

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One of the first electron-autoradiographic studies [5], aimed at determining regions of RNA synthesis in the nucleus more accurately than can be done by light microscopic autoradiography, revealed that synthesis takes place in dispersed (eu-), but not in condensed (hetero-) chromatin. These data were subsequently confirmed by numerous experiments [4, 6]. A detailed study of RNA synthesis in the nucleus by various methods [2] showed that rRNA is synthesized in the nucleolus whereas mRNA and tRNA, used for protein synthesis, are synthesized in dispersed chromatin. The following theoretical hypothesis is based on these findings: cells producing much protein must synthesize RNA intensively outside the nucleolus,

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