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MORPHOMETRIC PARAMETERS OF THE THYMUS OF NEWBORNS WHO DIED IN THE NEONATAL PERIOD

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Abstract:

The article presents the pathomorphological and morphometric characteristics of thymus tissue in antenatal mortality of newborns. According to research results, the difference in the cellular composition of the thymus in the early and late neonatal period is a sign of the rapid development of the immune system. Using the example of morphometric measurements, it is shown that stress factors affect the thymus, cortical hyperplasia of the adrenal gland as a result of hyperproduction of cortisol, a sharp decrease in the number of cells that make up the morphofunctional structure of the thymus, and a decrease in its parameters.

Keywords: Newborns, Neonatal Period, Death, Thymus Gland, Morphometry.

RELEVANCE. Prevention of newborn mortality in the early neonatal period in mothers with preeclampsia and eclampsia is one of the urgent problems of modern neonatology [2,4].

Effective care for newborns with very low birth weight depends on the morphofunctional maturity of the hypothalamic-pituitary-adrenal and immune systems that ensure the postnatal adaptation of children [5,6,10].

The fetal immune system develops and works in difficult conditions. On the one hand, it supports the internal homeostasis of the fetus, and on the other, being exposed to the antigenic effects of the maternal organism, it must quickly adapt and respond to these effects [3,7,9]. It has been established that processes such as proliferation, differentiation, migration, cooperation, and apoptosis in the immune system are genetically determined [1,8,11,12].

In our country, the protection of mothers and children constantly requires consideration of the political and economic needs of the State, as well as any other aspects.

The aim of the study was to study the pathomorphological and morphometric features of thymus tissue during antenatal death of newborns.

RESEARCH MATERIALS AND METHODS. The thymus tissue obtained from the autopsy material of 30 newborns who died in the early and late neonatal periods was examined by macromorphological methods and scanned with a NanoZoomer device. At least 10 slices were taken from each case and average sizes were obtained with a confidence coefficient of at least R<0.01, with an average error of 5 microns lost between consecutive slices. The main aspects of the structure of the thymus are obtained: cells, fibrous structures, the thickness of the cortical and medullary layers, the area occupied by each given structure, and other indicators.

Variation indicators and nonparametric statistical methods were used, taking into account the arithmetic mean (M), mean square deviations (σ), average standard errors (m), and the relative sizes (frequency of occurrence, %) of the studied indicators.

The statistical significance of the measurements obtained by comparing the average sizes was determined using the Student's criterion (t), calculating the probability of error (P) when checking the total variance (G-Fischer criterion) and the norms of variance (using the redundant test). Statistical processing was carried out in order to determine the arithmetic mean and the standard deviation of the obtained quantitative data, the confidence index (P<0.05, P<0.001). The statistical significance of qualitative variables was calculated using the criteria χ2 (chi-squared) and z.

The analysis of the obtained results was carried out using the generally accepted method of statistical analysis of the variation series, and the intensity of its indicators was determined using the following formulas:

Arithmetic mean (M): (1), where:

M is the arithmetic mean, n is the number of observations in the variation series.;

X is the value of individual observations; i is the number of observations;

and standard errors (yom): (2), where: yom is a standard error,

P is an intensive indicator in groups, showing the contribution of the number of observations of a species to the overall sample.

$s = \sqrt{(((X1-M)+\cdots+(Xn-M).)/(n-1))}$ where: σ is the standard deviation, x1 is the value of individual

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observations; M is the arithmetic mean; n is the number of observations in the variation series. The results are considered reliable if the degree of agreement on the studied indicators does not exceed 5% (P<0.05).

The results of the study and their discussion. Thus, judging by the morphological changes in newborns who died in the early and late neonatal period, the specifics of the morphometric changes in the thymus are small, and the indicators of different values compared with the control group are presented in the following tables (Tables 1,2,3).

The average thymus mass in newborns born with preeclampsia in the early neonatal period was 7.16±1.12 g, whereas in the control group this indicator was 13.46±1.82 g. It was found that infants born during this period had an adrenal gland mass of 7.75±0.02 g, while in the control group it was 4.11±0.17 g. This indicator means that the weight coefficient of the adrenal glands in newborns born with preeclampsia increased by 1.71-1.88 times.

From a morphological point of view, this was also manifested in the appearance of clear signs of thymus gland involution, a sharp change in the ratio of cortical and cerebral layers (Fig. 1,2,3,4,5).

Table 1.

Morphometric parameters of the anatomical layers of the thymus in comparison with the control group

	The cortical layer	The brain layer	The area of blood vessels сосудов	Thickness of septa	Interstitial tissue	The Taurus of Ghassal
Control	141,19±1,11*	11,13±0,65**	6,55±0,16**	13,11±0,91**	12,46±0,65**	48,88±5,35**
Early neonatal period	121,16±3,12*	46,11±1,96*	8,23±0,66**	1,76±0,31**	5,33±0,23**	24,31±4,13*
Late neonatal period	151,25±5,16*	29,22±2,35*	18,21±1,23*	14,21±1,33*	16,11±0,89**	75,89±5,36*

Note: P<0.05* , P<0.001**

Table 2.

Organometric causative agents of the early and late neonatal period of the thymus of babies born and died against the background of preeclampsia and eclampsia

	weight, g	volume, cm3	length, cm	thickness in width, cm	side height, cm
The control	13,46±1,82	4,05±1,01	3,41±0,13	1,83±0,08	0,65±0,02
group	7,16±1,12	1,83±1,01	2,16±0,11	1,66±0,04	0,51±0,01
Early neonatal period	15,11±0,43	9,95±1,01	4,51±0,22	2,48±0,08	0,89±0,01
The control	6,01±0,12	1,09±0,88	2,11±0,32	1,44±0,01	0,36±0,03

Примечание: P≤0,05* , P≤0,001**

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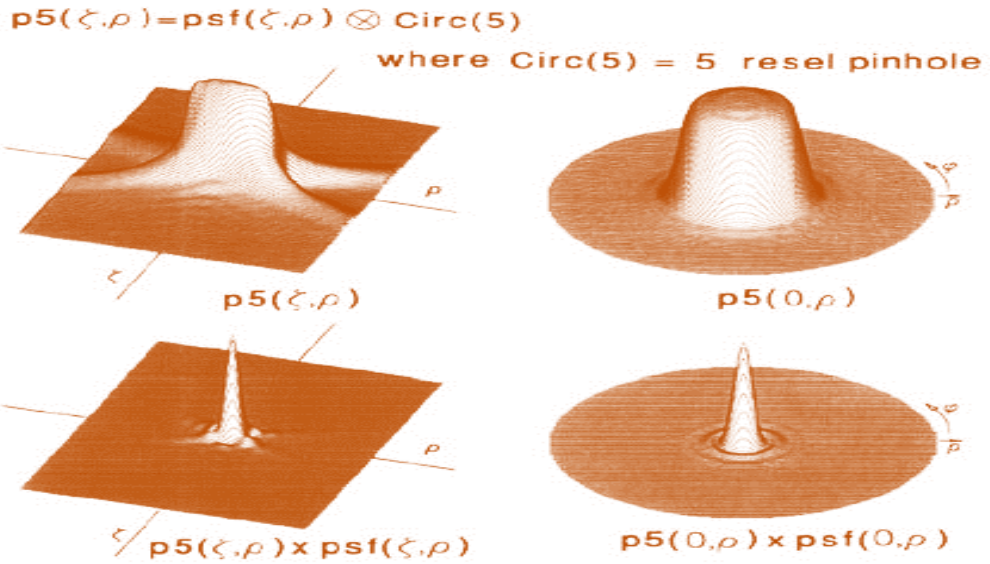

Fig. 1. A confocal image is created using the examples shown in this image to create a three-dimensional spatial image of the thymus tissue.

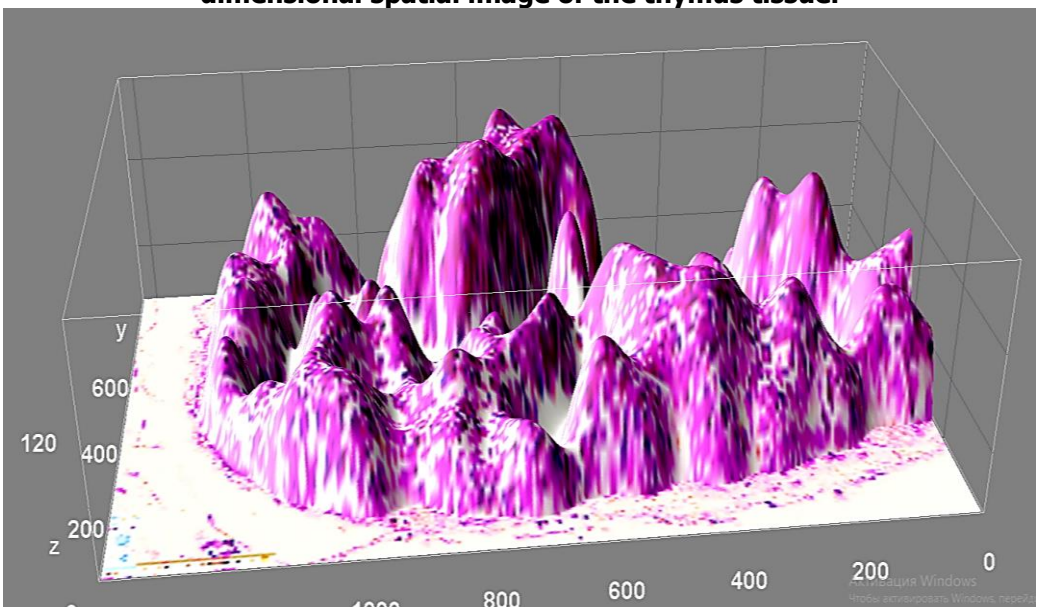

Fig. 2. A confocal dot image and a volumetric projection of the area occupied by the vascular cavity of the thymus of a newborn who died in the early neonatal period are presented. Scanned by the NanoZoomer device (REF C13140-21.S/N000198/HAMAMATSU PHOTONICS/431-3196 JAPAN). Uploaded to the QuPath-0.5.0-ImageJ program and the spatial structure was measured.

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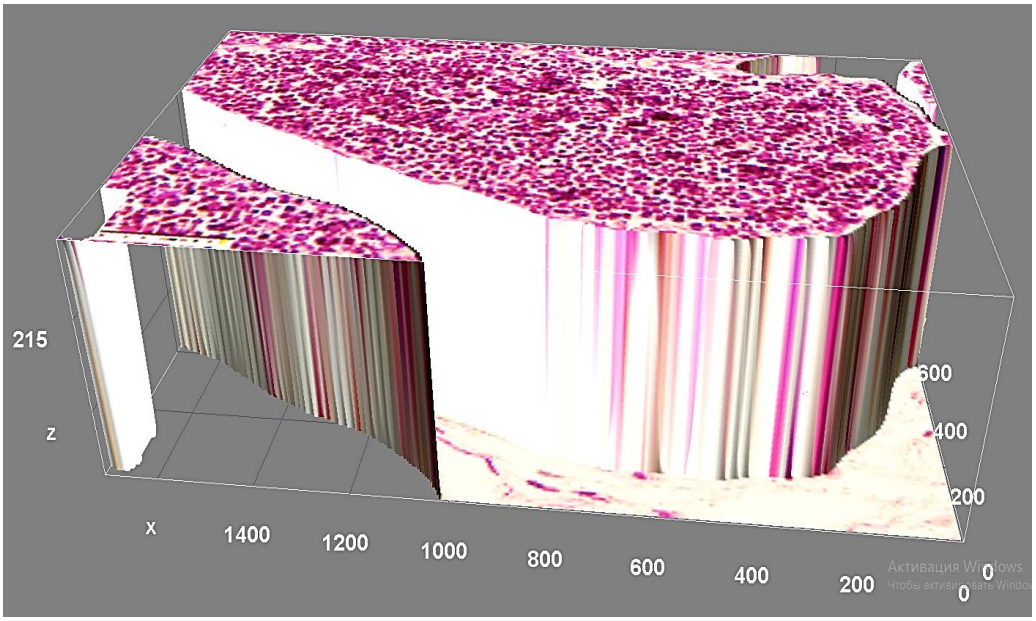

Fig. 3. A confocal dot image and a volumetric projection of the area occupied by the vascular cavity of the thymus of a newborn who died in the early neonatal period are presented. Scanned by the NanoZoomer device (REF C13140-21.S/N000198/HAMAMATSU PHOTONICS/431-3196 JAPAN). It was loaded into the QuPath-0.5.0-ImageJ program and the spatial structure was measured.

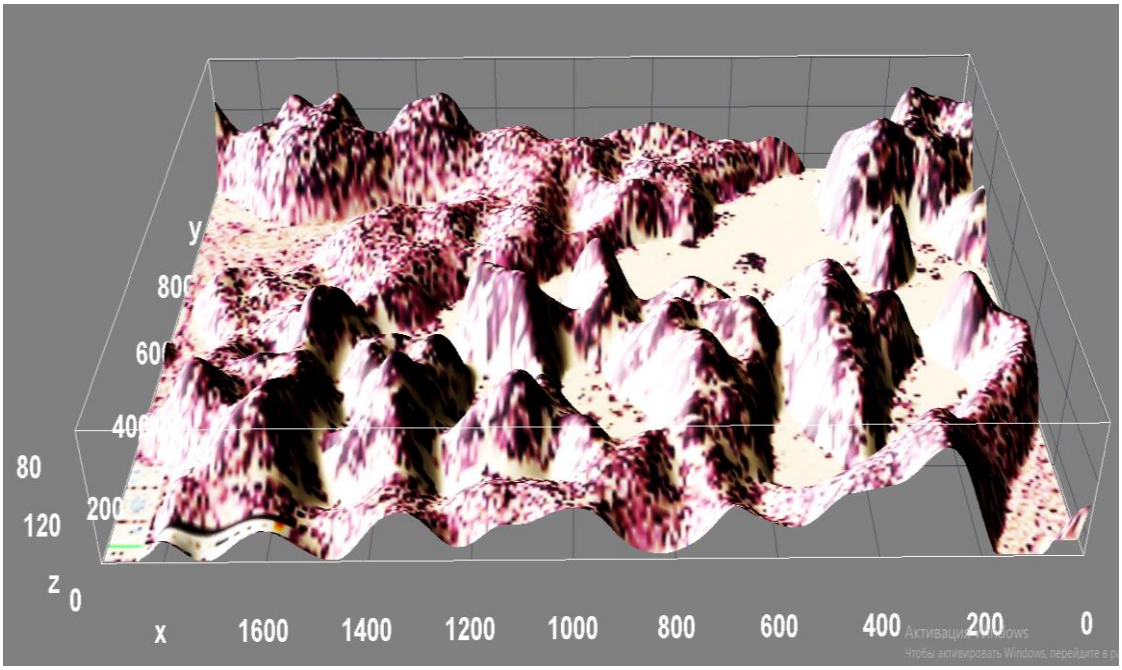

Fig. 4. A confocal dot image and a volumetric projection of the area occupied by the vessel cavity of the thymus of a newborn who died in the late neonatal period are presented. Scanned by the NanoZoomer device (REF C13140-21.S/N000198/HAMAMATSU PHOTONICS/431-3196 JAPAN). It was loaded into the QuPath-0.5.0-ImageJ program

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and the spatial structure was measured.

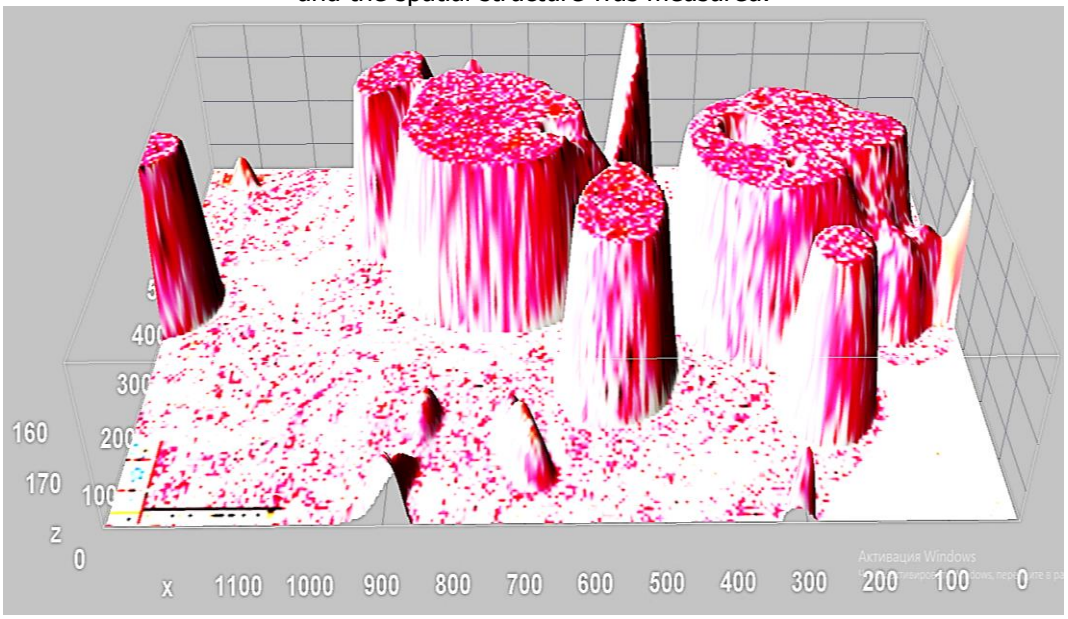

Fig. 5. A confocal dot image and a volumetric projection of the area occupied by the vessel cavity of the thymus of a newborn who died in the late neonatal period are presented. Scanned by the NanoZoomer device (REF C13140-21.S/N000198/HAMAMATSU PHOTONICS/431-3196 JAPAN). It was loaded into the QuPath-0.5.0-ImageJ program and the spatial structure was measured.

Table 3 shows a decrease in the number of cells that make up the morphofunctional structure of the thymus and its parameters.

Table 3.
The areas occupied by the components of the thymus are indicated in %.

№	groups / cellular composition	controlя	early neonatal period	late neonatal period
	subcapsular area			
1	lymphocytes	44,6±4,21	40,3±3,71	32,2±2,38 **
2	foci of mycosis	1,66±0,21	1,75±0,15	1,38±0,11 **
3	epithelioreticular cells	2,93±0,04	1,86±0,10	1,04±0,21
4	macrophages	0,88±0,16	0,99±0,10	1,64±0,08
	corticomedullary area			
1	lymphocytes	62,3±2,06	44,6±2,01	39,9±1,99
2	foci of mycosis	1,54±0,04	1,64±0,16	1,79±0,11
3	epithelioreticular cells	2,22±0,10	1,19±0,10	0,81±0,10
4	macrophages	0,33±0,10	0,47±0,08	0,64±0,09
	the center of the cerebral layer			
1	lymphocytes	48,6±2,16	47,2±4,57	45,8±4,92
2	foci of mycosis	1,58±0,11	1,64±0,14	1,76±0,08
3	epithelioreticular cells	4,2±0,28	1,96±0,17	1,44±0,17
4	macrophages	0,44±0,08	0,84±0,16	0,92±0,10

Примечание: P≤0,05* , P≤0,001**

CONCLUSION. Based on these data, the difference in the cellular composition of the thymus in the early and late neonatal periods indicates an acceleration of the period of formation of the immune system. Using the example of morphometric measurements, it is shown that stress factors affect the thymus, cortical hyperplasia of the adrenal gland as a result of hyperproduction of cortisol, a sharp decrease in the

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