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MORPHOMETRIC INDICATIONS OF LUNG TISSUE STRUCTURAL UNITS OF BABIES BORN WITH RESPIRATORY DISTRESS SYNDROME

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Resume

In this scientific study, an analysis of the morphometric parameters of the structural units of the lung tissue in premature infants with hyaline membrane disease was carried out.

The lung tissue of premature babies aged 22-37 weeks was taken as a material. Morphometric study of the structural units of the lung tissue was carried out by modifying the method of "counting points" by transferring it to a computer screen.

Key words: respirator distress syndrome, baby, prematurity, lung, structure, alveolus, hyaline membrane, morphology, “scoring - test system”, light interval.

The urgency of the problem. One of the main problems in neonatology is respiratory distress syndrome (RDS) and the appearance of bronchopulmonary dysplasia and hyaline membranes (hm) as its morphological signs. Hyaline membranes of the lungs are the most basic and severe form of RDS. The urgency of this problem depends on the growing number of premature births in the world. For example, in Russia, it is 5-10%, including the birth of children with extremely low body weight, which occurs in 0.2-0.4%. According to foreign authors, their survival is on average 50%, and if intensive therapy is used, it decreases to 25%. The cause of death of such children is mainly respiratory distress syndrome and hyaline membranes.

The purpose of conducting this study is to determine the specificity of the morphological changes that develop as a result of HMD in the lungs of premature babies.

Material and methods. As a material, lung tissue was taken from premature babies between 22-37 weeks of age. Morphometric examination of structural units of lung tissue was carried out by modifying the "counting points" method by transferring it to the computer screen.

Morphometric examination of lung tuahmasining structural units of G.G. Avtandilov (1984) adapted the method of “counting points”.

This method is based on the fact that the author uses a grid of 200 layers on histological preparations of histological preparations of the author's stomach and tissues. In order to ensure a reliable distribution of the data, 8-10 samples from each teacher of the material were counted and averaged.

We modified this method by transferring it to the computer screen, that is, we took 10 pictures from different areas of the histological preparations prepared for each group of the examined material, and placed a linear grid of 200 cells on the computer monitor corresponding to these pictures, and marked the points where the lines intersected, which structure of the tissue We counted according to the structure. It is known from the essence of this method that the points of the mesh placed on the tissue cross-section are uniformly spaced, so that it corresponds to the tissue structures indiscriminately. G.G. It corresponds to the law of relativity that the checkered grid points of Avtandilov are distributed non-uniformly in all areas of the surface of the tissue image. The area of all existing structural units in the picture is taken as Vv, i.e. 100%, the area of

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each of the structural units to be calculated is determined by putting the name of this structure, for example: Vafac (space of air-filled alveoli), Vhmca (space of alveoli with hyaline membrane), Vahm (hyaline membrane area), Vact (interstitial tissue of alveoli). In this regard, the relative area of the studied structural units in the tissue is calculated as a result of counting the points. The results show the volume unit of each structural unit in the studied tissue.

So, if the area occupied by all structural units in the studied tissue is Vv, i.e. 100%, the evenly distributed points in it are denoted by z, and if the ratio of each point to the structural unit is taken as R, its formula is as follows: P = Vv/100.

Correspondence of points to other structural units is determined by the following formula: Q = 100-Vv/100.

If we take the points corresponding to the studied structural units as x, then its error rate is calculated by this formula: x/z – P, the percentage indicator of the absolute error is calculated by this formula:

$$e = (x/z – R) . 100 = 100 x/z – Vv$$

The error rate of calculation according to the theory of relativity - x/z – R, is calculated as follows in a different formula: = t . √Rq/z.

In this formula: x is the number of points corresponding to the studied structural units; z is the total number of all points in the test system; R is the unit of relativity of the points falling on the studied structures; q is the unit of relativity of the points falling into the bled structural units; t is the normalized difference of indicators from each other.

Based on the above, the absolute error of quantitative indicators is calculated by this formula: e= t √Vv (100 – Vv) / z.

Result and discussion.

G.G. 3 levels of preterm infants with lung hyaline membrane disease using the morphometric method of Avtandilov: 2) 28-32 weeks, 3) 33-37 weeks. To compare the quantitative indicators of these groups, the lung tissue structures of children who died from non-pulmonary brain injury were counted as a control group. In these groups, hematoxylin and eosin-stained histological sections of lung tissue were taken, and points corresponding to the structural units indicated below were counted. Points were counted on the average of 10 images from each group:

- Air-filled alveolar cavity - Rafac;
- Hyaline membrane is the cavity of the alveoli - Rhmca;
- Area of hyaline membranes - Rahm;
- Alveolar connective tissue - Ract;

For each structural unit, 10 points numbered in the picture were added, the average was calculated, and the occupied area (V) of the structural unit was calculated based on the following formula, for example: the area occupied by the alveolar space where air entered - Vafac = Rafac/R x100. In this regard, the areas occupied by all structural units of the lung tissue were calculated: Vafac, Vhmca, Vahm, Vact.

The following coefficients can be calculated based on the quantitative data obtained on these indicators:

1) The ratio of the area of the alveolar cavity to the area of the hyaline membrane is the coefficient of activity of the alveolar cavity (CAAC);

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1) 22-27 weeks

Microphoto no	Number of points				Total number of points
	Rafac	Rhmca	Rahm	Ract	
1	36	19	15	130	200
2	32	20	17	127	
3	34	18	15	130	
4	44	17	14	128	
5	38	20	13	129	
6	41	19	16	130	
7	33	18	17	131	
8	35	22	15	128	
9	34	21	16	127	
10	39	20	14	128	
∑	366	194	152	1288	2000
M ± m %	**18.3 ± 1.72**	**9.7 ± 1.32**	**7.6 ± 1.18**	**64.4 ± 2.14**	

Vafac= Pafac/P x 100 = 366 / 200 0 x 100 = 18.3 %,
εafac = 2.0 x √ 18.3 (100 – 18.3) / 200 0 = 1.72 % (P = 0.05)
V hmca = P hmca /P x 100 = 194 / 200 0 x 100 = 9.7 %
ε hmca = 2.0 x √ 9.7 (100 – 9.7) / 200 0 = 1.32 % (P=0.05)
V ahm = P ahm / P x 100 = 152 / 2000 x 100 = 7.6 %
ε ahm = 2.0 x √ 7.6 (100 – 7.6) / 200 0 = 1.18 % (P = 0.05)
V act = P act /P x 100 = 1288/ 200 0 x 100 = 64.4 %
εact = 2.0 x √ 64.4 (100 – 64 .4) / 200 0 = 2 .14 % (P=0.01)

CAAC – 18.3 : 7.6 = 2.4 (coefficient of activity of the alveolar cavity)

2) 28-32-week

Microphoto Sony	Points sony				Points common sony
	Rafac	Rhmca	Rahm	Ract	
1	57	34	23	84	200
2	62	36	25	88	
3	54	36	22	82	
4	54	39	25	81	
5	58	27	24	79	
6	61	29	24	84	
7	63	36	23	86	
8	55	38	25	82	
9	56	35	22	88	
10	54	38	23	88	
∑	574	348	236	842	2000

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M±m %	**28,7±2,02**	**17,4±1,68**	**11,8±1,44**	**42,1±2,2**	

Vafac= Px ab / P x 100 = 574 / 200 0 x 100 = 28.7 %,
εafac = 2.0 x √ 28.7 (100 – 28.7) / 200 0 = 2.02 % (P=0.05)
V hmca = P hmca / P x 100 = 348 / 200 0 x 100 = 17.4 %
ε hmca = 2.0 h √ 17.4 (100 – 17.4) / 200 0 = 1.68 % (R=0.05)
V ahm = R ahm /R h 100 = 236/ 2000 h 100 = 11.8 %
ε ahm = 2.0 h √ 11.8 (100 – 11.8) / 200 0 = 1.44 % (R=0.05)
V act = R act /R x 100 = 842/ 200 0 x 100 = 42.1 %
eact = 2.0 x √ 42.1 (100 – 42.1) / 200 0 = 2.2 % (R=0.01)

CAAC – 17.4 : 11.8 = 1.47 ↓ (coefficient of activity of the alveolar cavity)

3) 33-37 weeks

Photomicrograph number	Number of points				Total number of points
	Rafac	Rhmca	Rahm	Ract	
1	28	44	19	108	200
2	29	48	17	118	
3	31	42	21	102	
4	26	43	19	101	
5	28	47	18	109	
6	31	44	20	114	
7	33	42	17	106	
8	25	41	18	112	
9	28	45	22	108	
10	29	43	19	106	
∑	630	332	354	684	2000
M±m %	**31,5±2,07**	**16,6±1,61**	**17,7±1,70**	**34,2±2,12**	

Vafac= Px ab / P x 100 = 630 / 200 0 x 100 = 31.5 %,
εxab = 2.0 x √ 31.5 (100 – 31.5) / 200 0 = 2.07 % (P=0.05)
V hmca = P hmca / P x 100 = 332 / 200 0 x 100 = 16.6 %
ε hmca = 2.0 h √ 16.6 (100 – 16.6) / 200 0 = 1.61 % (R=0.05)
V ahm = R ahm /R h 100 = 354/ 2000 h 100 = 17.7 %
ε ahm = 2.0 h √ 17.7 (100 – 17.7) / 200 0 = 1.70 % (R = 0.05)
V act = P act /P x 100 = 684/ 200 0 x 100 = 3 4.2 %
εact = 2.0 x √ 34.2 (100 – 34.2) / 200 0 = 2.12 % (P=0.01)

CAAC – 16.6 : 17.7 = 0.93 ↓ (coefficient of activity of the alveolar cavity)

Qualitative indicators of lung disease with hyaline membrane "respiratory distress syndrome" are evaluated based on the color, size, degree of differentiation from lung tissue, whether they are filled with air or not. 3 periods of hyaline membrane development are distinguished by patho- and morphogenetic signs: I-period - the "light interval" period lasts several

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hours (4-6) and in it the general condition of the baby is manifested due to premature birth, but no breathing disorders are observed. During this period, the prematurely formed surfactant is used up and replaced by a hyaline membrane. **During this period, a protein substance in the form of a net appears in the space of the alveoli.**

Characteristic for the II period is the "manifestation of clinical manifestations", which lasts 48 hours and the following specific clinical symptoms appear: nervous system excitation and damage, tachypnea lasting 72 hours, the appearance of sound during exhalation, the involvement of additional muscles during breathing, acrocyanosis, cyanosis of the skin and the increase of this sign during the exacerbation of HMD, the appearance of apnea, the appearance of crepitation-friction and small moist strangulations on auscultation, spasm of peripheral vessels in the cardiovascular system, an increase in arterial pressure, tachycardia 180-220 per minute, the appearance of systolic noises, a decrease in diuresis , sometimes oliguria and anuria are observed, symptoms of DIC syndrome appear. **As a characteristic morphological sign of the second period, it is observed that eosiophil-stained fibrous protein appeared in the alveolar space.**

III - period - "recovery period" lasts 3-10 days. Symptoms of respiratory disorders disappear, changes in the central nervous system subside, and peripheral blood circulation is restored. This period can sometimes be in a "terminal" state, in which the child becomes weak, the skin becomes completely cyanotic, has a marble appearance, breathing becomes paradoxically apnoea and bradypnoea, and is severely disturbed. Wheezing and slight suffocation appear in the lungs on the basis of a decrease in breathing. Blood pressure drops, systolic murmur appears, bradycardia, cardiomegaly is observed. Deficiency of polyorgans and DIC syndrome, anuria develops. **In the III period, eosinophil-stained homogenous hyaline protein covering the alveolar wall appears in the alveolar cavity.**

The hyaline membranes that develop in the lungs of infants may be congenital or acquired during the early postnatal period. Their location has not been studied to the end, according to the data of our investigations, it was confirmed that hyaline membranes develop more in the upper seahments of the right lung and in the middle intermediate seahments of the left lung.

In our study, we performed morphometric examinations of premature babies into 3 groups according to gestation periods.

Table 1

Anthropometric indicators of premature babies, M±m

No	Group of premature babies	n	Average gestational age	Body weight, g	Height, cm
1	22-27 weeks	12	25.2±0.4	654±24.3	29.5±1.6
2	28-32 weeks	19	29.8±0.6*	1067±84.7*	38.4±4.6*
3	33-37 weeks	24	35.3±0.7**	1986±124.6**	43.2±8.5**

Appendix: * - R≤0.05 – gestation period, body weight and height in group 2 compared to group 1 reliability difference.

** - R≤0.05 – reliability difference of gestation period, body weight and height in group 3 compared to group 1.

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Table 2. Indicators of area occupied by lung tissue structural units, M±m % and coefficient of CAAC in premature children with hyaline membrane.

Groups	structural units , %				CA AC
	Chapter V	Chapter V	V ahm	V act	
Week 22-27	**18.3 ± 1.72**	**9.7 ± 1.32**	**7.6 ± 1.18**	**64.4 ± 2.14**	**2.24**
28-32 weeks	**28.7 ± 2.02***	**17.4 ± 1.68***	**11.8 ± 1.44***	**42.1 ± 2.2***	**1.47**
33-37 weeks	**31.5 ± 2.07****	**16.6 ± 1.61****	**17.7 ± 1.70****	**34.2 ± 2.12****	**0.93**

Addendum: * - P≤0.05 - reliability indicator compared to the control group
** - P≤0.01 - reliability indicator compared to the control group

Along with the assessment of any pathological process, including the hyaline membrane disease of the lungs, in terms of qualitative criteria, the criteria for evaluating pathological changes will have a higher level of reliability if they are assessed by their quantitative indicators. We calculated and analyzed the structural changes characteristic of the disease with hyaline membrane developed in the lungs, dividing them into 3 groups according to the gestation periods of premature babies. Group 1, the lungs of children who were born prematurely and died of respiratory failure at 22-27 weeks of gestation were taken. For morphometric calculation, the area occupied by the following structural units present and developed in the lung tissue was calculated by Avtandilov G.G. (1994) by the "point test" method. These were as follows: 1) Rafac - sign - space of alveoli where air entered, 2) Rhmca - sign - air filled space of alveoli where hyaline membrane appeared, 3) Rahm - sign - area occupied by hyaline membrane, 4) Ract - sign - alveoli range of tissue area. In group 1, it became clear that the area of the alveolar cavity occupied only 18.3±1.72 percent of the lung tissue. It was found that the area of the alveoli filled with air is relatively small, i.e. 9.7±1.32 percent. It was confirmed that the area occupied by hyaline membranes appeared in relatively few alveoli in this late gestational week and occupied a small area (7.6±1.18). In these early weeks of the gestational period, due to the immature development of the lung tissue, most of the alveoli have not yet opened and the lung tissue is in a dense state, it was confirmed that the area occupied by the interstitial tissue of the alveoli is large and occupies more space than all other structural units, i.e. it is equal to 64.4%.

In group 2, the percentages of all the structural units we studied differed from those in group 1. If we study each of them separately, it is observed that the space of the alveoli where the air has entered is 1.6 times larger compared to the 1st group. It is determined that the alveoli, where the hyaline membranes have appeared, have expanded, and the area of the space filled with air has also expanded, reaching 2 times, that is, 17.4%, compared to the previous group. It is observed that the area of hyaline membranes was 7.6% in group 1, while in group 2 it increased slightly and reached 11.8%. Due to the expansion of air-filled alveoli and alveoli with a hyaline membrane, it is determined that the area of interstitial tissue of alveoli has significantly decreased compared to group 1, occupying 42.1% of the area.

The 3rd group of our study was the 33-37th week of gestation, and in this group, all the structural units we studied increased compared to the previous groups. Of these, it was found that the space of alveoli filled with air increased 1.7 times compared to the first group, 1.1 times compared to the 2nd group and made up 31.5% of the area. It was found that the area occupied by hyaline membranes increased by 2.3 times compared to group 1 and 1.5 times compared to group 2, that is, it occupied 17.7% of the area. At the same time, it was observed that the air-filled cavity of the alveoli, where the hyaline membrane appeared, did not expand compared to the previous group. Due to the fact that the alveoli are relatively expanded and filled with air, it was observed that the area occupied by the interstitial tissue of the alveoli was significantly reduced, that is, it occupied 34.2% of the space, which is confirmed to be 2 times less than the 1st group and 1.5 times less than the 2nd group.

Summary

It was confirmed that the area of the air-filled alveolar cavity, which indicates the degree of lung tissue filling with air or respiration, morphometrically occupies 18.3% of the lung tissue, and the area of the alveolar interstitial tissue is 64.4%.

As the gestation period increases, the area occupied by the hyaline membranes in the lung tissue expands, and the area of the air-filled alveoli space also increases.

the activity coefficient of the alveolar space was 1.63 in the 22-27th week of gestation, and it decreased sharply in the later periods of gestation and was 1.47 and 0.93, respectively.

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