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Analysis of Correlation Interrelation of Bronchopulmonary Dysplasia in Late-Preterm Children

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Abstract: Bronchopulmonary dysplasia (BPD) is a special condition that develops in premature infants, which can become chronic, manifesting itself as a disease, since it is formed against the background of morphological changes in the lung tissue. As the child grows, clinical manifestations may reverse, but morphological changes may be persistent, contributing to the development of respiratory dysfunction that persists for a long time [8]. Known factors contributing to the development of this disease are gestational age (GA) and low birth weight. The development of respiratory distress syndrome (RDS) and long periods of artificial ventilation (ALV) complicate the course of the disease.

Key points: bronchopulmonary dysplasia, extremely premature babies, gestational age, maternal antenatal history.

Introduction.

BPD contributes to the development of complications such as protein-energy and respiratory failure, forming pulmonary hypertension in patients. This condition is characterized by the reverse development of clinical symptoms as the child grows older, however, disorders of the external respiratory function (ERF) caused by morphological changes in the lung tissue can persist for a long time [9]. BPD has a long-term adverse effect on the development of the nervous system, physical development, and also contributes to early mortality. The incidence of BPD in recent years has not decreased, but even increased, which is associated with an increase in the survival of extremely premature infants with a gestational age of less than 28 weeks [2,5]. In this regard, early prediction of long-term outcomes of BPD continues to be relevant, since it allows identifying high-risk groups, which will facilitate the correction of treatment tactics and, ultimately, help reduce concomitant chronic pathology and improve the quality of life of patients with BPD [6,7].

The definition of bronchopulmonary dysplasia and related terms is still the subject of ongoing debate, and new criteria are being considered to improve the prediction of outcomes in the group of extremely preterm infants.

The population incidence of neonatal bronchopulmonary dysplasia in the Russian Federation is generally unknown, since there is no single BPD registry, presumably it is about 0.13–0.28% among all newborns. It is generally accepted today that there is a direct relationship between gestational age and birth weight, which determine the risk of developing BPD later. The European Registry for Effective Perinatal Intensive Care (EPICE) determines the incidence of BPD in extremely premature infants from 12.1 to 47.3%, with the severe form accounting for up to 42.6% among all newborns with BPD. According to EA Jensen, EM Edwards, about 50% of infants born at 22 to 29 weeks in the USA had BPD. Most of them developed grade 1 or 2 BPD, and grade 3 BPD in 3.7% of cases [1,7]. According to researchers from the Asian region, the incidence of BPD in extremely premature infants in this region ranges from 25 to 56%. Over the past three decades, significant

advances in neonatal care have resulted in increased survival of preterm infants, while the incidence of BPD has not decreased and remains the most common serious complication of prematurity, affecting 10.8–37.1% of preterm infants born at 24 completed weeks to 31 weeks and six days of gestation , with a birth weight of less than 1500 g .

Pre- and postnatal inflammation plays a critical role in the development of BPD. BPD is associated with increased levels of proinflammatory and decreased anti-inflammatory cytokines, activation of macrophages in lung tissue and infiltration with neutrophils and monocytes. Risk factors for BPD include multiple types of prenatal inflammation, including chorioamnionitis, fetal inflammatory response syndrome, and leukemoid reaction of the newborn.

The aim of the study is to develop an algorithm for predicting clinically significant bronchopulmonary dysplasia in extremely premature infants in the early neonatal period.

Materials and methods. A total of 60 children with a gestational age of 22 to 37 weeks and a birth weight of 512 to 2250.0 g (EBMW), born in the period 2023-2024, were prospectively studied in the intensive care unit of the Bukhara Regional Perinatal Center. The main group consisted of 30 extremely premature children born at 22-27 weeks with a birth weight of 512-995.0 g. The comparative group consisted of 30 premature children born at 28-32 weeks with a birth weight of 1003-1450.0. The Apgar scale was assessed (three times: after 1 - A1, 5 - A2 and 10 min - A3), morpho-functional maturity was determined by comparing the values with the Ballard scale, the degree of respiratory failure was assessed using the Silverman scale. The need for surfactant administration after birth was taken into account. The following indicators were recorded on the 1st, 3rd and 7th days of life: the need for respiratory support (invasive, non-invasive ventilation), ventilation parameters: ventilation mode (A/C, SIMV), respiratory rate of the device, peak inspiratory pressure, inspiratory time, expiratory pressure, fraction of supplied oxygen (FiO2). Enteral and parenteral nutrition, duration and combination of prescribed antibacterial drugs were assessed.

The maternal history was studied: number of pregnancies, maternal age, parity of births, their nature (physiological or operative delivery), diseases suffered during pregnancy, concomitant somatic pathology (arterial hypertension), complications of this pregnancy, the presence of prophylaxis of respiratory distress syndrome with glucocorticoids, the duration of the anhydrous period were studied. The diagnosis of BPD was determined according to the criteria of RD Higgins (2018), diagnosed on the basis of oxygen dependence at the age of 28 days of life and / or 36 weeks of PCA. The need for respiratory therapy to maintain blood oxygen saturation SpO2 over 90% was considered a criterion for oxygen dependence. Radiological criteria of BPD included alternating interstitial edema with areas of increased transparency of lung tissue, fibrosis, band-like seals.

Results of the study. The number of premature births in 2023 was 547 (84.8%) children, in 2024 - 597 children, which was 82.4% of the total number of newborns admitted to the neo-intensive care unit of the Bukhara Perinatal Center with a continuing trend towards an increase in the number of premature babies. The proportion of children born with ELBW in 2023 - 56 children is 41.1% and in 2024 - 66 children is 51.5% of survival.

Table 1. Structure of the studied groups

Year	Total number of admissions to the department neoreanimatology	Premature birth	ENMT	% survival rate	Deceased EMT
2023	645	547	56	41.1	33
2024	725	597	66	51.5	32

The main causes of death in children with ELBW are congenital pneumonia, intraventricular hemorrhage (IVH) and sepsis. The incidence of bronchopulmonary dysplasia among children with

ELBW remains high and amounts to 53–80%, however, severe forms tend to decrease – to 27.5% in 2024.

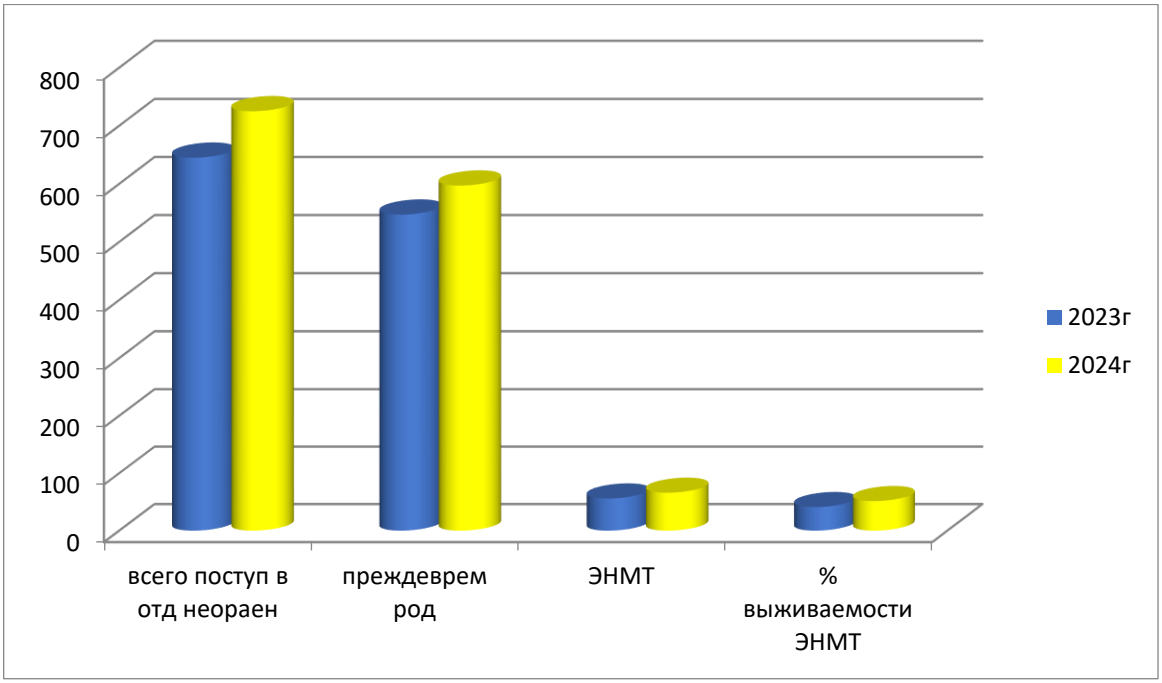

Figure 1. Number of study groups

Of the 30 children in the main group, there were 11 boys (36.6%) and 18 girls (60.0%); in the comparison group, there were 14 boys (47.0%) and 16 girls (63.1%). The average gestational age of children in the main group (26.1 ± 1.8 weeks) was significantly different from that in the comparison group (30.8 ± 1.5 weeks) ($p < 0.001$).

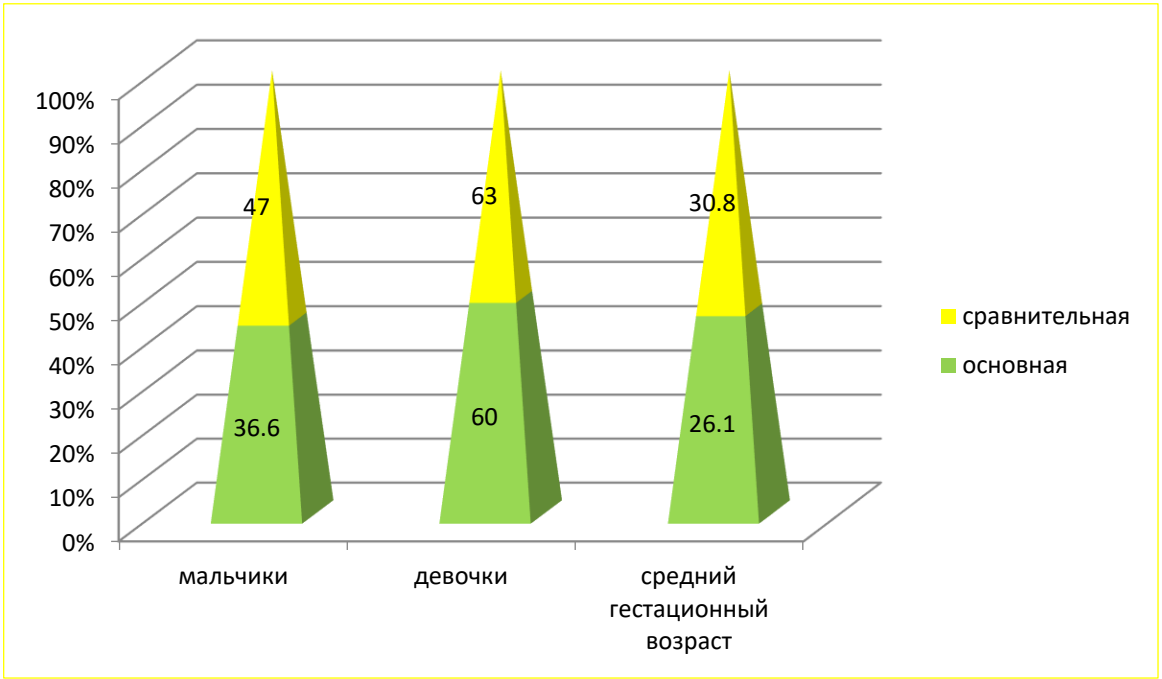

Figure 2. Gender differences and mean gestational age of preterm infants

The lowest indicators of length and body weight at birth were noted in the group of patients where BPD developed, which indicates that weight and height characteristics are associated with the development of BPD in extremely premature infants.

In order to prevent the development of ARD, all children in both groups were given endotracheal administration of exogenous surfactant preparations.

Apgar score at 5 min (A2) was significantly lower in premature infants of the main group: 6 points [5;6], in the comparison group – 7 points [6;8] (p <0.001). *The* Silverman score (severity of respiratory disorders) was 6 points [6;7] in the main group, and 5 points [4.75;7] (p <0.001) in the comparison group , indicating a greater severity of respiratory disorders in children of the main group.

When studying the prenatal history, it was found that the pregnancy of mothers in both groups proceeded against an unfavorable background.

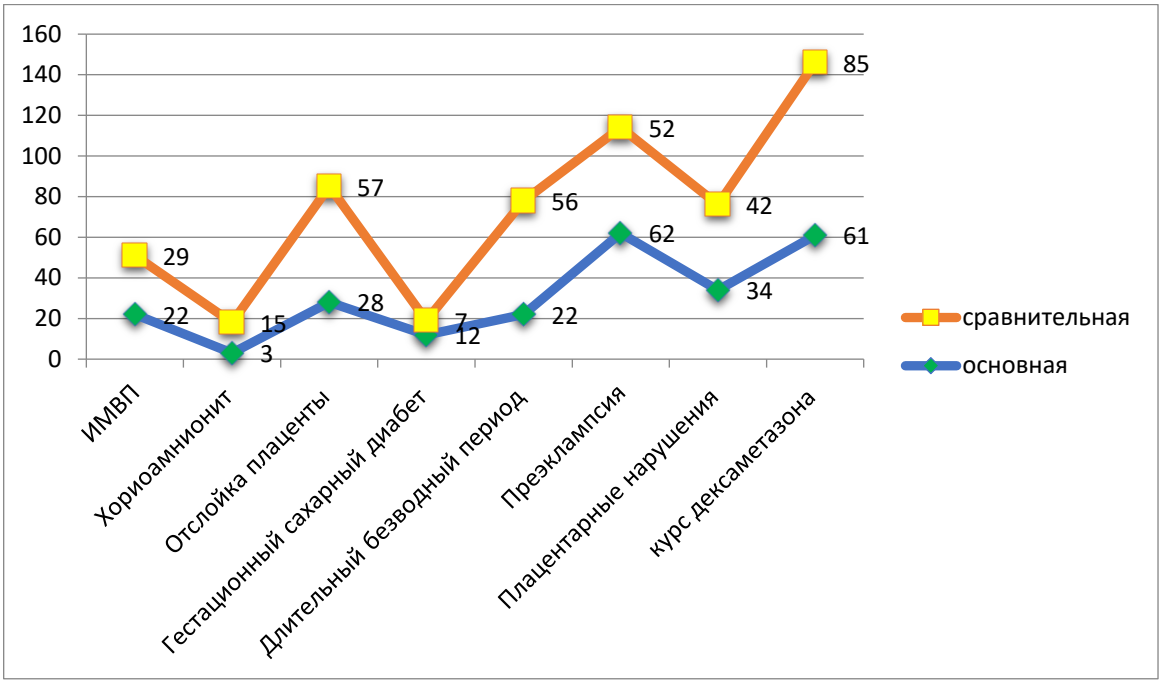

Figure 3. Perinatal diseases of mothers.

Analysis of correlation dependencies showed a negative correlation between the incidence of UTI in the mother during pregnancy (r = -0.45; p < 0.001) and the presence of chorioamnionitis (r = -0.26; p < 0.001) and BPD, placental abruption (r = 0.41; p < 0.001) and BPD. The presence of gestational diabetes mellitus had a direct weak correlation with the development of BPD (r = 0.19; p < 0.001). Of note was the presence of a moderate negative correlation between the prophylactic course of dexazone (r = -0.39; p < 0.001) and the development of BPD. This may indicate a potential protective role of the dexazone course in reducing the risk of BPD in newborns.

Thus, the analysis of correlation dependencies shows that various conditions of the mother during pregnancy can affect the probability of developing bronchopulmonary dysplasia in newborns, gestational diabetes mellitus can slightly increase the risk of developing BPD, and the absence of a course of dexamethasone can increase it. According to the results of the correlation analysis, it was established:

BPD and the number of pregnancies have a weak negative correlation r = -0.15 (p < 0.001), it is possible that a smaller number of previous pregnancies may slightly reduce the risk of developing BPD;

- BPD and maternal age have a weak positive correlation r = 0.23 (p < 0.001), thus older maternal age may be associated with an increased risk of BPD;
- BPD and the number of births have a weak positive correlation r = 0.31 (p < 0.001), so a lower number of births may possibly increase the risk of BPD;
- BPD and birth weight of the baby have a moderate negative correlation r = -0.47 (p < 0.001), possibly meaning that lower birth weight of the newborn is associated with an increased risk of developing bronchopulmonary dysplasia;

- BPD and gestational age have a moderate negative correlation r = -0.48 (p <0.001), that is, late pregnancy may possibly reduce the risk of developing BPD in newborns;
- BPD and the Apgar score have a moderate negative correlation r = -0.42 (p <0.001), possibly low Apgar scores at 5 minutes may indicate an increased risk of developing BPD;
- BPD and the Silverman scale have a moderate positive correlation: r = 0.42 (p < 0.001), that is, high values on the Silverman scale , indicating respiratory disorders, may be associated with an increased risk of developing BPD

Conclusion. The conducted correlation analysis of data from the entire cohort of newborns included in the study showed that the shorter the gestational age , the greater the risk of developing BPD in premature infants.

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