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Tactics of Respiratory Support and Health of Dysmature Children with a Respiratory Distress Syndrome

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ABSTRACT

Respiratory Distress Syndrome (RDS) is one of the leading causes of critical conditions, morbidity and mortality of premature babies. The study has included 261 premature babies with a gestational age of 22-36 weeks. Of these, 26 children have made up a group with ELBM (0.840±0.160g) and 235 children were with a low body mass of 1090.0±410.0g. All children have undergone: clinical, functional and instrumental (NSH, dopplerographic studies of brain, cardiorespiratory monitoring, pulse oximetry, RH diagnostics of the respiratory organs, ECG, EchoCG) and laboratory studies (hemostasiogram, biochemical blood tests, CBS, electrolytes, glucose levels have been determined), analyses of markers of the infectious process with the aim of excluding infectious genesis, etc. have been carried out as well. Premature labour has been noted in 275 cases. Stillbirth has been noted in 14(5.1%) cases. Of these, gestational age of 22-27 weeks - 9(3.44%) cases; 28-36 weeks - 5(1.9%) cases. 261(94.9%) premature babies of various gestational ages have been under observation. Of these: 22-27 weeks were children with ELBM - 26(9.5%) cases; 28-36 weeks - 235(85.5%) cases. The severity of RDS is associated with the gestational age of a child; the smaller the gestational age of a child, the more severe the course of RDS.

INTRODUCTION

According to statistics, the frequency of preterm birth among 184 countries in the world ranges from 5-18%; more than 80% of preterm birth occurs at 32-37 weeks of gestation, and in most, 75% of cases fatal outcome can be prevented if the main neonatal care is available and the respiratory support tactics are adequately implemented [1; 4-8; 10; 12]. Respiratory Distress Syndrome (RDS) is one of the leading causes of critical conditions, morbidity and mortality of premature babies. Despite the availability of numerous studies in this field, use of antenatal and postnatal preventive measures, introduction of modern treatment methods, the frequency of occurrence of RDS among premature babies continues to grow steadily. The groups of premature babies with low and extremely low body mass (ELBM) are of particular relevance in this matter. It is known that mortality with severe forms of RDS varies within 50%. Despite the progress in recent years in treating RDS in children of this category, there are still differences of opinion. There is the most common point of view that development of respiratory function in premature babies occurs in the conditions of morphological and functional immaturity of the respiratory system, which determines the propensity for the frequent development of pathological processes in the lungs. Many methods for stabilizing the status of premature babies at birth are also not based on convincing researches, including oxygen therapy, ventilation with constant positive airways pressure (CPAP) and mechanical artificial lung ventilation (ALV), which is often associated with the occurrence of complications. According to WHO (2014), every year 15 mln newborns are born prematurely, and their chances of survival vary greatly from one country to another [1]; 1.1 mln premature babies die from complications associated with premature birth [1; 2; 7; 8; 11]. In this connection, determination of the tactics of respiratory support and assessment of the health status of premature babies with RDS is an actual problem and determines the purpose of this study.

MATERIALS AND METHODS

The study has included 261 premature babies with a gestational age of 22-36 weeks. Of these, 26 children have made up a group with ELBM (0.840±0.160g) and 235 children were with a low body mass of 1090.0±410.0g. Infants were in the Intensive Care Unit in the couveuse mode. All children have undergone: clinical, functional and instrumental (NSH, dopplerographic studies of brain, cardiorespiratory monitoring, pulse oximetry, RH diagnostics of the respiratory organs, ECG, EchoCG) and laboratory studies (hemostasiogram, biochemical blood tests, CBS, electrolytes, glucose levels have been determined), analyses of markers of the infectious process with the aim of excluding infectious genesis, etc. have been carried out as well. Continuous monitoring of vital signs (SpO_2, pCO_2, etc.) has been carried out. The gestational age of infants has been estimated according to the table Hoepffnes W., Rauntenbach M. (1972); the degree of maturity of the children has been determined by the modified Bollard D. scale (1979). A clinical assessment of the severity of respiratory impairment in children has been performed using a modified Downes/Silverman scale. The tactics of intensive care conducted by us depended on the severity of RDS and was aimed at correcting and maintaining adequate gas exchange, pulmonary blood flow; hemodynamic support using infusion therapy; rational antibiotic therapy, antacids, saluretics, dopamine, adrenaline; nutritional support; surfactant therapy, sedation, etc. Depending on the severity of RDS, children underwent CPAP and ALV. In the acute period of RDS, ALV has been performed to premature babies in the SIMV, ASSIST control mode. Clinical symptoms of the disease, temperature reaction, dynamics of changes in the hemocoagulation system, the state of central hemodynamics, and peripheral circulation, the degree of correction of changes in gas exchange and respiratory biomechanics have served as the control of the therapy.

RESULTS AND DISCUSSION

Premature labour has been noted in 275 cases. Stillbirth has been noted in 14(5.1%) cases. Of these, gestational age of 22-27 weeks - 9(3.44%) cases; 28-36 weeks - 5(1.9%) cases. 261(94.9%) premature babies of various gestational ages have been under observation. Of these: 22-27 weeks were children with ELBM - 26(9.5%) cases; 28-36 weeks - 235(85.5%) cases. Infants have been born from mothers with a burdened obstetric history. In 19(7.28%) women, this pregnancy has proceeded with gestosis, preeclampsia has been noted in 23(8.81%) cases, heart disease has been noted in 3(1.15%) cases, essential hypertension - 27(10.4%), hypothyroidism - 21(8.04%), uterine myoma - 14(5.36%), varicose veins of the lower extremities in 32(22.3%) cases. The infection background of mothers during this pregnancy was presented: salmonellosis in 3(1.15%) cases, ARVI - 27(10.3%) cases, chicken pox in 3(1.15%), ureoplasma - 7(2.7%), chronic pyelonephritis - 11(4.21%) cases, respectively. In 21(8.04%) women in labour, premature rupture of amniotic fluid has been noted. Premature placental abruption in 23(8.81%) cases, the risk of miscarriage in 27(10.3%) cases. The health status of premature babies has been analyzed. *Inclusion criteria*: premature newborns with respiratory disorders requiring respiratory support. *Exclusion criteria*: premature babies with malformations, oedema, haemolytic disease of the newborn.

The causes of respiratory pathology were: RDS - 86(32.9%) cases; congenital pneumonia - 37(14.2%). In 17 premature babies, which accounted for 6.5% of cases, persistent hypertension of the lungs has been observed; meconium aspiration syndrome has been noted in 19(7.3%) cases; IUGR *(intrauterine growth retardation)* - 29(11.11%), ICH of II-III degr. *(intracranial hemorrhage)* - 21(8.04%), PRL (periventricular leucomalacia) - 7(2.7%), PDA *(Patent ductus arterioz)* - 29(11.11%) cases, pneumothorax - 7(2.7%); BDL *(bronchopulmonary dysplasia)* - 6(2.3%), NEC *(necrotizing enterocolitis)* - 3(1.14%) cases *(Fig.1).*

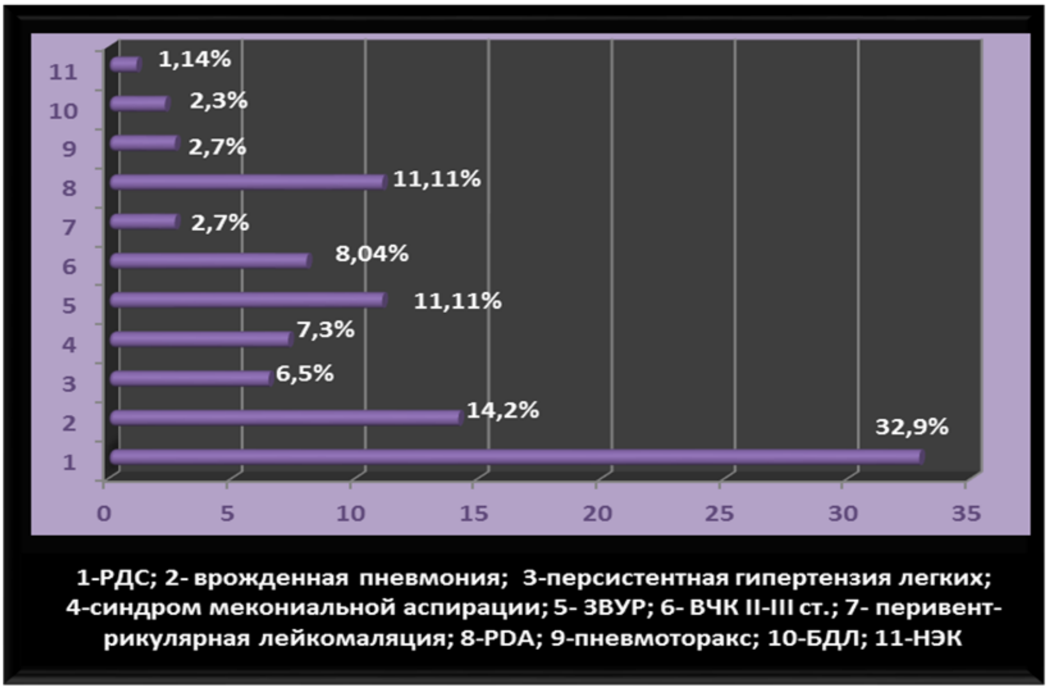

Fig.1. Diagram of the distribution of the causes of respiratory disorders in premature babies

27 babies (10.34%) have suffered from intrauterine hypoxia; 13(6.51%) babies –from birth asphyxia. The X-ray picture of the RDS has depended on the severity of disease — from a slight decrease in pneumatisation to the ‘white lungs’ *(Fig. 2,3,4).*

RDS. Chest roentgenogram in direct projection, in a horizontal position

Fig.1. Decreased pulmonary pneumatisation, aerial bronchograms, heart borders are still visible on the roentgenogram

The upper lobes of the lungs and the middle lobe on the right are inhomogeneously weakly intensely darkened, the roots of the lungs are dilated, not structural. Vascular-interstitial pattern of the lungs is deformed, strengthened, blurred. Mediastinum shadow with a fuzzy contour, projected offset to the left at the expense of the turn.

Fig. 2. A marked decrease in pneumonization of the lungs, air bronchograms, the borders of the heart are almost indistinguishable, erased

Intense small-point darkening of the lung fields – 'frosted glass' syndrome, against which the mediastinal shadow does not differentiate. Linear enlightenments caused by bronchi full of air are visualized – 'air bronchogram.'

Fig. 3. A sharp decrease in pneumonization of the lungs, air bronchograms, the borders of the heart are not distinguishable, 'white lungs'

Evident 'frosted glass' syndrome, Mediastinum shadow does not differentiate. The 'white lungs' are visualized.

The following has been observed in the clinical picture of premature infants with respiratory distress syndrome of various gestational ages: temperature instability with a tendency to hypothermia, shortness of breath (more than 60 breaths per min) occurring in the first minutes - 30(34.9%), in the first hours of life - 33(38.4%); 'grunting breathing' - 23(30.7%); hypoxemia (decrease in blood PaO_2 < 40 mm Hg), secondary apnoea - 35(40.6%); almost all babies had a chest retraction while inhaling: retraction of xiphoid process - in 51(59.3%); of supraclavicular veins, enclosed area - 35(40.7%); perioral cyanosis (with a level of blood PaO_2 up to 30 mm Hg) and acrocyanosis, impaired respiration in the lungs, crackling rales during auscultation *(Fig.4).* Thus, the clinical course of RDS depends on the severity of respiratory disorders. At the same time, the severity of RDS is associated with the gestational age of the child; the smaller the gestational age, the more severe the course of RDS.

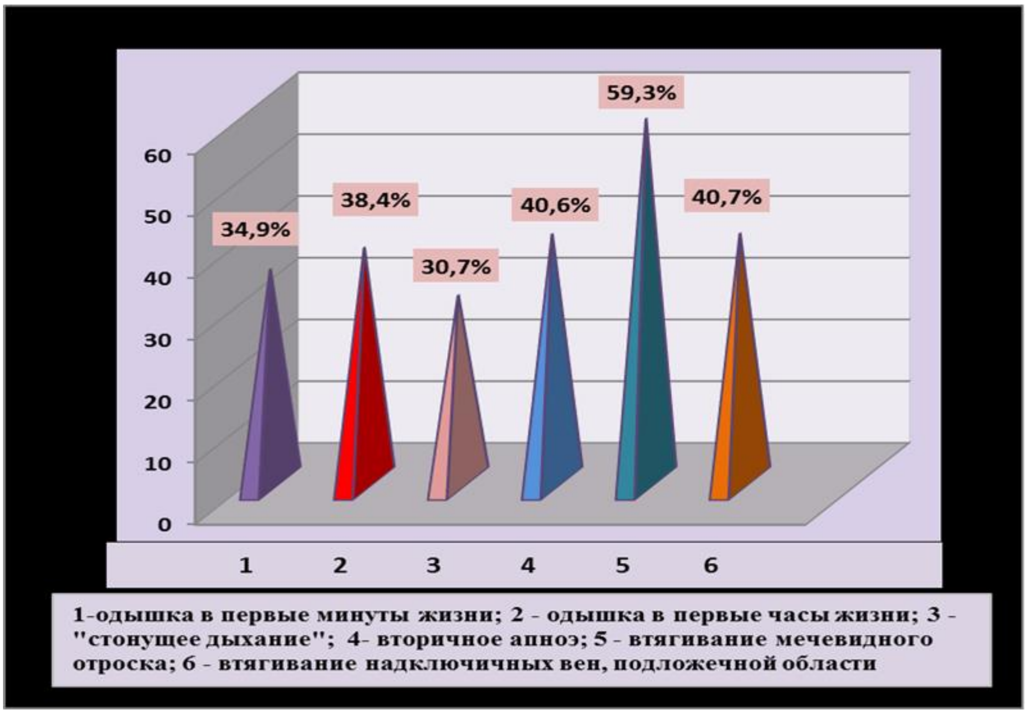

Fig.4 Clinical picture of RDS in premature babies

The tactics of our respiratory support for RDS in premature babies was as follows: in the case of a mild form of RDS (a score of 2-3 points), we have been limited to introducing an oxygen-air mixture into the interior of the incubator, which contributes to an increase in the oxygen content in the airways up to 24-25%; or feeding it through a loosely applied mask. With moderate RDS (4-6 points), premature infants have been ventilated in CPAP mode via intranasal cannulas or through an endotracheal tube. Our research has shown that early using of the constant pressure method, especially in the first 4 hours of life, helps to reduce the severity of respiratory disorders. With severe RDS (score of more than 6 points), ALV has been performed. The laboratory indications for transferring a child to ALV were: respiratory or mixed acidosis ($PaCO_2$ >55 mm Hg and pH<7.25) and refractory hypoxemia ($PaCO_2$<40-50 mm Hg; SpO_2<86-88% with CPAP +5cm of water column). Based on the results obtained, the correction of indicators has been performed, during hypoxemia: PaO_2<50 mm Hg; SaO_2 90%; PEEP was increased by 2cm of water column, Ti was increased by 0.1-0.2 sec; Flow was increased by 2 L/min; FiO_2 was increased by 0.1. With hypercapnia: $PaCO_2$>50mm Hg, $PetCO_2$>40 mm Hg; R was increased by 5-15 breaths per 1 minute; Te was decreased by 0.1-0.2sec; if there was a tendency to hypoxemia, PiP was increased by 2cm of water column; Ti was increased by 0.1-0.2 sec; Flow was increased by 2 L/min. It should be noted that adequately conducted ventilation will avoid occurrence of complications in the health of infants, so it is important to remember that the more CO_2, the lower PO_2; the higher the alveolar PO_2, the higher PaO_2. When ventilation decreases, CO_2 accumulates and PO_2 in the alveoli decreases. If hyperventilation can increase PO_2 for a while, then with inadequate ventilation there is no limit to the fall of PO_2 in the alveoli, and accordingly PaO_2. Removal of CO_2 depends on alveolar ventilation: a violation of ventilation leads to a fall in PaO_2 and a rise in $PaCO_2$. It should also be emphasized that PaO_2 also depends on alveolar ventilation, ventilation-perfusion ratio, and oxygen concentration in the air we breathe. $PaCO_2$ depends on adequate ventilation, so the intensity of ventilation to maintain $PaCO_2$ is regulated within tight limits [3].

CONCLUSION

Despite timely respiratory support (mechanical ventilation, CPAP, nasal ventilation, surfactant therapy), it is important not to forget for a better outcome: maintaining a normal temperature; rational infusion therapy; feeding (breast milk); PDA treatment; tissue perfusion support. The severity of RDS is associated with the gestational age of a child; the smaller the gestational age of a child, the more severe the course of RDS. Thus, the optimization of high-quality perinatal care, timely and correct respiratory support, postnatal use of surfactant preparations (Kurosurf) with RDS improve the nursing rates of premature babies with low birth weight and with ELBM, also helps to reduce neonatal mortality.

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