

Clinical and Neurophysiological Features of Children Born Prematurely

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Abstract One of the risk factors for failure to develop the central nervous system in children is prematurity - a child born at less than 37 full weeks of gestation. Extremely important for determining the nature of prematurity, it is in preterm birth division of premature babies by body weight. But, the modern approach to the problem, dividing children only by gestational age or only by birth weight may be insufficient. Thus, a complicating factor (cytomegalovirus infection, toxoplasmosis in the mother) or current viral diseases (influenza, covid, infection of the genitourinary system) play a role in not fully mature children. Chronic background (diabetes mellitus; hypothyroidism) comorbid condition of a pregnant woman, is equally important to maintain a healthy gestational age and correspondingly full development of the child's body.

Keywords Neurophysiological features of children, Premature infants, Brain

1. Introduction

In the pathogenesis of insufficient brain formation, blood circulation problems during pregnancy (severe anemia, hepatitis) are considered. According to the scientific hypothesis, decay products of extravasated red blood cells cause narrowing of blood vessels in the arterial channel, causing vasospasm, which results in depletion of blood supply, further leading to neuronal death, causing brain tissue damage and persistent neurological disorders. Thus, the multifactorial nature of adverse neurological outcomes in premature babies [3,8,11], is beyond doubt, but a thorough analysis of the leading etiological factors in premature babies requires.

Purpose of the study: To study risk factors leading to premature birth, on the basis of indicators of clinical, neurological, neurophysiological data at birth and in 6 (7) months, to determine unfavorable prognosis, severe neurological symptoms.

2. Material and Methods

The use was carried out on the basis of MKSAMS, Department of Neonatology from 2021 to 2023, 69 premature infants were examined, children were divided into two groups depending on their birth weight: 1) children weighing from 2 to 2.5 kg (40 children), 2) children

weighing from 1.5 to 2 kg (29 children). All children had gestational ages of 34-36 weeks. The main methods of investigation in the work were standard examinations by a neonatologist and neurologist, at the birth of the child and observation in dynamics; the rules of diagnosis using scales to identify developmental limitations were followed. Additional research methods, as the gold standard, are neurosonography. Amplitude-integrated EEG (AEG) was performed selectively on the patients. All research methods were performed with the parents' (or mother's) written permission. Need for proof of this study, a group of children (healthy) who were born at term and had no problems during delivery, a group of children was selected according to the same pattern of standard examination and scales to detect complete well-being of the infant 2- (26). The outcome of children born prematurely, various neurological complications are possible, to clarify the effect of low birth weight and underdevelopment of the brain and the body as a whole, the objectives of this study included follow-up of the same children (6-7 months later), according to the same indicators (clinical and neurological examination, NSG, aEEG). Standard deviation set was used for statistical analysis, t-test (Student's t-criterion) was used to compare the groups. Differences were considered statistically significant at $p < 0.05$; all parameters were calculated on an individual computer.

3. Results

The initial stage of the study was to find out which factors led to premature pregnancy and preterm birth. For this

purpose, a thorough interview was conducted to collect the pregnancy history (the course of this pregnancy and labor). The anamnesis (survey) revealed a significant difference between the groups in the presence of factors that aggravated the period of normal pregnancy. Group 1 included threatened termination of pregnancy in 93%, fetoplacental insufficiency in 27%, ARI in 26.6%, water shortage in 10.8%, and arterial hypertension in about 9%. The nature of delivery in the greater percentage through natural childbirth, it is -89%, the rest were born by cesarean section (placenta adherence, not the correct position of the head) - 11%, where p equals 0.05. Body length at birth was on average 4.5 cm lower relative to the healthy child group ($p < 0.001$). Apgar score at the first minute of life was 5. Apgar score at the fifth minute of life was 6.

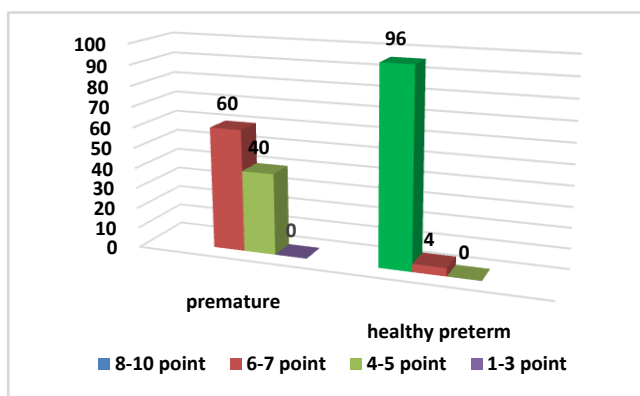


Figure 1. Apgar scores in the study groups

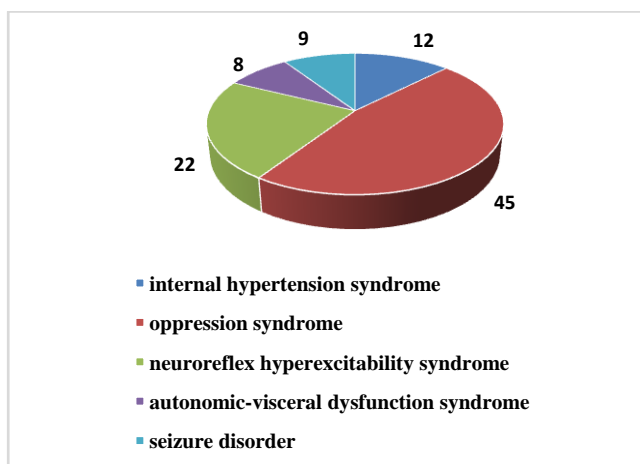
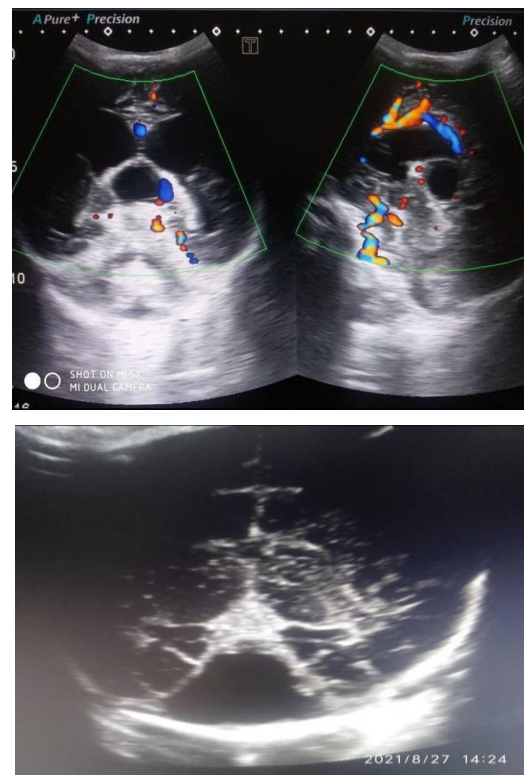


Figure 2. Clinical characteristics of premature infants

Asphyxia in labor occurred in the first group of premature infants. Early rupture of amniotic fluid occurred in 55% of pregnant women, the group of premature babies, a complication was a detachment of the normally located placenta, occurred in 17.7%. TORCH infection (mainly cytomegalovirus) occurred in 13% of cases. Neurological syndromes in the neonatal period were evaluated, the most important of which were motor disturbance syndrome in 73% and oppression syndrome, in 52% of cases in the first main group. In addition, arousal syndrome comparable to neonatal seizure syndrome was detected in 38.8% on average,

where ($p < 0.001$):

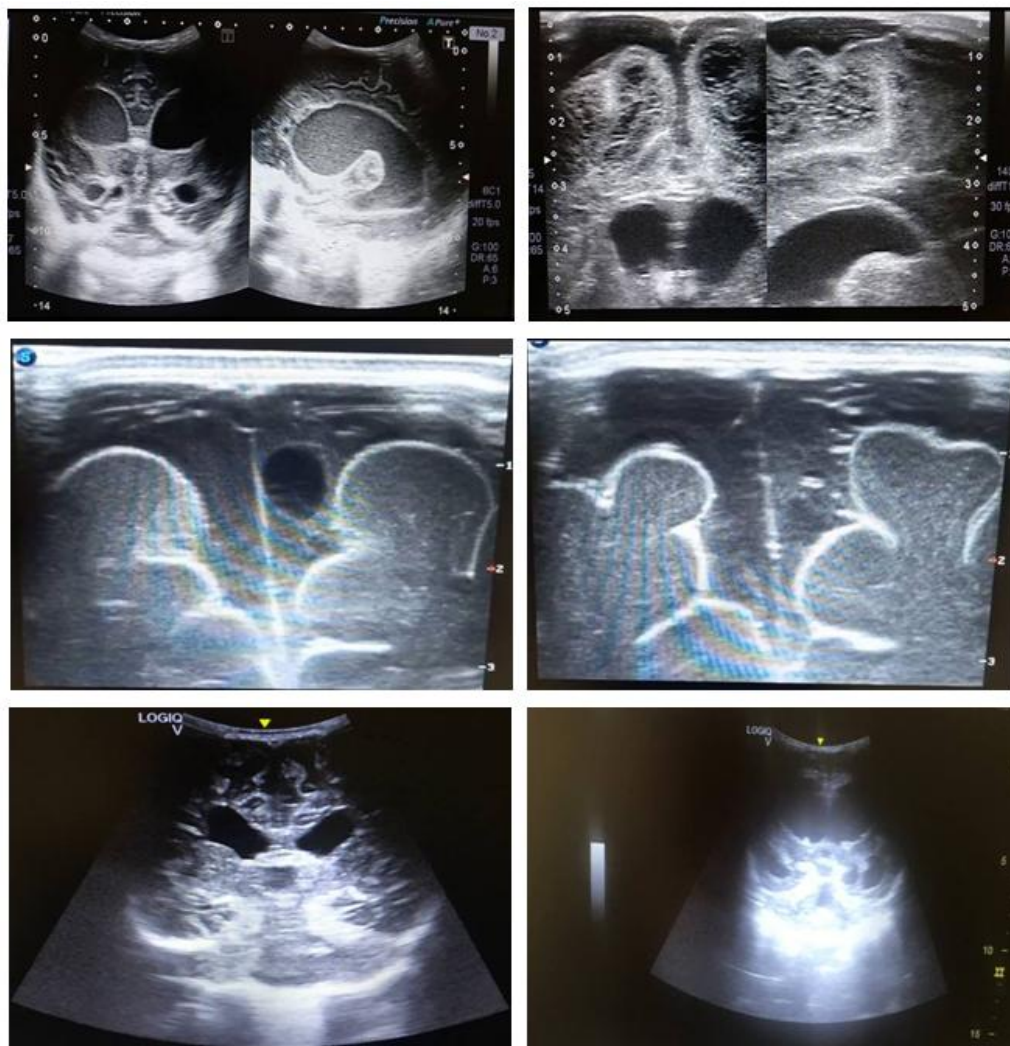


Evaluating the results of the analysis of structural abnormalities, according to the NSG data, noted different cerebral abnormalities, compared with healthy children. Thus, antenatal and postnatal VVCs in group 1 were found in 29.5% of cases. Subarachnoid hemorrhage was diagnosed in only one child. Porencephalic cyst was diagnosed in one case. Periventricular leukomalacia was detected in 4 children. Evaluating the results of the analysis of structural abnormalities, according to NSG data, different abnormalities of the cerebral structure were noted in comparison with healthy children. Thus, antenatal and postnatal VVF in group 1 was found in 29.5% of cases. Subarachnoid hemorrhage was diagnosed in only one child. Porencephalic cyst was diagnosed in one case. Periventricular leukomalacia was detected in 4 children.

When analyzing EEG data, as noted this method of research was conducted selectively, where the main indicator was a diffuse change in bioelectrical activity and a decrease in the threshold of seizure activity, so of the examined children (41 patients), only 20% noted seizure activity, and in the case of seizure pattern on AEEG indicator was changed in 17%. In accordance with the set goals and objectives, a repeated study of children born prematurely (premature babies). Dynamics of neurological outcomes, children of the main group, are represented in the form of changes on the CNS side, it is a syndrome of muscular dystonia and a syndrome of motor disorders. Muscular dystonia syndrome was diagnosed significantly more often in preterm infants (born with a birth weight of 1.5-2 kg) versus infants with a birth weight of up to 2.5 kg (47.9% and 26.9%, $p = 0.007$). It should be noted that in several

children the signs of motor impairment (motor disorders), corresponded to the signs of children with cerebral palsy, this high tone denoted spastic diplegia, spastic hemiplegia. Spastic diplegia reliably prevailed in the group of children with lower weight (18%), the occurrence of spastic hemiplegia was in the group of children born with slightly higher weight (7.5%), where $p < 0.05$. Signs of seizure activity did not reach statistical significance. NGS and EEG parameters were compared in dynamics. The results of the NSG study revealed subependymal cysts (one patient); dilation of the ventricular system of the brain (ventriculodilation) 32.8%, $p = 0.006$, in comparative groups by weight (significantly in children with lower weight); dilation of the external liquor space, PVL, porencephalic cysts, hemodynamic disorders. At 6 months, dilation of the external cerebrospine was found in 54% of children in the lower weight group and in 33% of children in the higher weight group, where $p < 0.001$. Porencephalic cysts were found in only one patient, in the lowest weight group. The variant of age normality according to the NSG data was detected at 6 months in 22% of children of the whole main

group of premature children (which coincides with the literature data); in such children no structural changes of the brain were diagnosed. Delayed formation of age-related cortical rhythms according to EEG data, revealed the following changes. Delayed formation of age-related rhythms was significantly more often detected in the group of children with less weight, in 18%, with more weight only in 11%, where $p < 0.05$. Seizure activity after 6 (7) months was found among all preterm infants, in 3.5%. Given the data of indicators at birth and in the dynamics after 6 (7) months, it is possible to control the prognosis, changes in the CNS side, or so-called, the definition of the risk scale. The modern approach to determining the risk of development, aimed at the graphical representation by ROC curves, which reliably clearly indicate the values for assessing the condition of patients. Thus, the sensitivity and specificity of the scale were conducted using ROC-analysis, where, the sensitivity of the scale was 92%, specificity - 88.2%, the predictive value of a positive result - 60%, the predictive value of a negative result - almost close to 100%.



Figures 3-5. Premature infants (main group), 32–34 weeks. According to the neurosonogram, dilated lateral ventricles, periventricular leukomalacia, verified dilation of external cerebral spaces (interhemispheric cleft, subarachnoid space)

4. Conclusions

Thus, children born prematurely, with low birth weight, with a low Apgar score, with the consequence of intrauterine asphyxia, constitute a high risk group for perinatal CNS lesions and the formation of adverse neurological outcome in the remote period, due to which, the birth of such children leads to an increase in neurological deficit. Premature infants, are a multifactorial disease, in the development of which the degree of maturity of the whole organism and the degree of prematurity, anatomical and physiological features of the brain, the level of hypoxia suffered, the combination of all the stressful aspects for the child, determines the features of the clinical picture, the severity of the course and the prognosis of the disease are important. The leading factors of neurological disorders in children are the threat of termination of pregnancy, low gestational age, severe asphyxia at birth, low Apgar score in the first minutes of birth. Children born with lower birth weight were significantly more likely to show delayed motor and psycho-speech development, as confirmed by the study after 6 (7) months. In addition, diagnosis according to the NSG, reveals abnormalities of cerebral structures, in most cases of premature birth, and is one of the important indicators of adverse neurological outcome. Currently, neuroimaging parameters of the brain of children born with low birth weight and prematurely, which requires further research in this direction, remain incompletely studied (because of the difficulty of conducting).

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