



Features of the cardiovascular system in term infants with intrauterine growth restriction

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Newborns with intrauterine growth restriction (IUGR) perinatal hypoxia, the lesion of the cardiovascular system is recorded in a physical and instrumental study in 40-70% of children. In addition to hypoxia, morphofunctional immaturity is an important factor in the development of severe pathological conditions affecting both the organism of the child as a whole and the cardiovascular system in particular. Improvement of modern methods of diagnosing the defeat of the cardiovascular system, treatment and supervision of this category of children was the purpose of our study. We examined 129 full-term newborns from the moment of birth until the end of the first month of life, 89 of them with different variants of IUGR made up a surveillance group and 40 children with normal physical development indicators-a comparison group. As a result of the study, it was revealed that chronic and perinatal hypoxia in newborn children with IUGR causes a violation of adaptation processes, adversely affects central hemodynamics and intracardiac hemodynamics. Thus, the indicators of intracardiac hemodynamics during the early neonatal period indicate a possible reduction in the reserve capabilities of the cardiovascular system and the prolonged nature of hemodynamic adaptation in newborns with IUGR.

Keywords: IUGR, adaptation, cardiovascular system.

Introduction

In the structure of adult mortality, the pathology of the cardiovascular system, of which origin starts from childhood, is the first place. Therefore, early diagnosis of violations from the cardiovascular system remains one of the current problems in medicine. In newborns with perinatal hypoxia, the lesion of the cardiovascular system is recorded in a physical and instrumental study in 40-70% of children [1, 2].

In addition to hypoxia, morphofunctional immaturity is an important factor in the development of severe pathological conditions affecting both the organism of the child as a whole and the cardiovascular system in particular [3, 4]. The organization of the newborn has huge reserve capabilities, but with a delay in intrauterine development, reserve capacity is minimal, which often leads to functional and structural disorders from the heart and nervous system

[5]. Improvement of modern methods of diagnosing the defeat of the cardiovascular system, treatment and supervision of this category of children was the purpose of our study.

Material & Methods

We examined 129 full-term newborns from the moment of birth until the end of the first month of life. 89 of them with different variants of IUGR made up a surveillance group and 40 children with normal physical development indicators as a comparison group. Asymmetrical version of the IUGR had 65 children (73.56%), and symmetric - 24 (26.44%). The comparison group consisted of 40 newborns with normal anthropometric indicators, born at a gestation period of 38-40 weeks, with a body weight of at least 3100 grams, a length of at least 50 cm not higher than the 90th cent for its gestation period. There were no

significant gender differences between the groups ($p > 0.05$).

When collecting anamnestic data, special attention was paid to the obstetric anamnesis. The age of the mother, the number of previous pregnancies, the presence of concomitant pathology, occupational hazards, the features of the current pregnancy, the data of cardiocography and ultrasound examination, the dynamics of blood pressure, the duration of labor and the method of delivery were taken into account.

In the clinical evaluation of newborns, anthropometric data, Apgar scores, feeding patterns, the timing of the first application to the breast and the rejection of the umbilical cord, the maximum weight loss were evaluated. The somatic status of the newborn was assessed daily during the stay in the maternity hospital.

The main quantitative methods for assessing central hemodynamics in newborns were monitoring of blood pressure, ECG, and echocardiography (ECHO-CG). Transthoracic ECHO-CG study was conducted at the 2nd week of life and at the age of one month in 81.2% of the newborns in the observation group and in 74.8% of the children in the comparison group according to the standard method. Neurosonography was conducted on the 7 - 10 days of life and at the age of one month.

Results

In order to find out the main reasons for the formation of the fetal heart failure, we studied the anamnesis and a summary of pathological data in the mothers of the compared groups. The mean age of women in the observation group was 24.56 ± 0.52 years, in the comparison group, 25.80 ± 0.57 years ($p > 0.05$). Of the concomitant pathology in women who gave birth to children with IUGR, 67.82% of the genitourinary and 45.98% of the cardiovascular system were more common, each second had anemia and acute respiratory viral infections ($p < 0.05$). Pregnancy was significantly more often complicated with chronic fetoplacental insufficiency (90.81% vs 37.5%), threat of abortion (68.97% vs. 37.5%) and gestosis (39.08% vs. 22.5%). Signs of intrauterine fetal hypoxia from ultrasound and cardiocography were recorded in 58.6% of the mothers of the main group and 24.4% in the mothers of the comparison group ($p < 0.05$). In 79.32% of women who gave birth to children with IUGR, the carriage of intrauterine infection was found: cytomegalovirus (38%), herpetic (32%), chlamydial infection (27%), mycoplasmosis (22%), toxoplasmosis (11%), every third woman suffered from candidal vulvovaginitis (30%). In the comparison group, the carriers of the above infections were registered in 32.50% of women. Weighed obstetrical anamnesis is also 2 times more often observed in the mothers of the observation group. The average body weight at birth in children with IUGR was $2551, 33 \pm 307$ g, in the comparison group 3547.38 ± 266 g; the length of the body was 49.54 ± 0.22 cm and 54.20 ± 0.27 cm respectively. The average Apgar score at the 1st and 5th minutes of life was significantly lower in children with prenatal hypotrophy, and one in four children was born in a state of asphyxia of one or another degree of severity and needed to carry out active resuscitation measures. There was no asphyxia in the comparison group.

The period of adaptation in newborns with IUGR was char-

acterized by a more frequent occurrence of jaundice (74.26%), toxic erythema (38.10%), significantly greater weight loss ($6.85 \pm 0.25\%$) and slow recovery ($p < 0, 05$). There were no significant differences in the frequency of occurrence of a sexual crisis and a uric acid infarct in children in the compared groups. For newborns of the observation group, the earlier disappearance of the umbilical cord was characteristic - by 3.90 ± 0.05 days, in the comparison group - by 5.23 ± 0.06 days. ($p < 0.01$).

When analyzing the hemograms of newborns with IUGR, a decrease in the total number of leukocytes, an increase in the number of platelets, signs of polycythemia and hypoglycemia ($p < 0.05$) was found. Reduction of leukocytes is due to the oppression of the white germ of hematopoiesis against the background of chronic antenatal stress, and possibly the presence of a persistent viral infection. The increase in the number of platelets is secondary and may be associated with hypercapnia, which is capable of inducing the production of platelets or with infectious factors. By the end of 1 month of life, one in four children with IUGR (24.12%) was diagnosed with hypochromic anemia, and no other blood parameters were changed.

In the structure of morbidity in children of the observation group, the pathology of the central nervous system was the first (82.67%), the second place was occupied by the pathology of the cardiovascular system (48.49%) and the third one by intrauterine infection (31.14%). In the comparison group, the morbidity pattern had a similar pattern, but the incidence of this pathology was significantly lower: central nervous system pathology (31.05%), cardiovascular system pathology (20.07%), and intrauterine infection (12.5%).

Influence of chronic and perinatal hypoxia, violation of adaptation processes has a negative effect on central hemodynamics, and considering that the clinical signs of cardiovascular system lesion in children are polymorphic and nonspecific, instrumental research methods acquire special significance in diagnosis [7,8].

In children with IUGR heart rate and average blood pressure on the first day had a clear tendency to increase. By the end of the first month of life, the mean arterial pressure and heart rate in the compared groups were practically the same.

According to the standard ECG in children with perinatal hypoxia, rhythm and conduction disorders were three times more common. The sinus tachycardia predominated among the rhythm disturbances, and the incomplete blockade of the right leg of the His bundle (21.84%), caused by the increase in pressure in the low circulation system, and non-specific violations of intraventricular conduction (18.39%), were the most typical of the disorders of the rhythm. Low voltage was registered in 5.75% of newborns. Signs of hypoxic damage to the heart muscle were most often characterized by a T wave inversion in the thoracic leads (18.39%), ST segment depression (24.14%), a decrease in the T wave amplitude (11.49%), moderate cardiac overload (25, 29%). At 2.30% of the newborns in the observation group, there was a significant increase in the repolarization time of the ventricles, which was manifested by transient elongation of QT ($p < 0.05$).

At the age of one month, 19.54% of the children of the ECG observation group had signs of an overload of the right heart

in the form of a violation of intraventricular conduction in the right bundle branch system - from complete blockade to non-specific conduction abnormalities. Among these patients, there were mainly children who, in addition to chronic intrauterine hypoxia, suffered acute intrapartum asphyxia (perinatal hypoxia). Sinus tachycardia persisted in 21.84%, and a low voltage was registered in 2.30% of children with an IUGR in the anamnesis. In the comparison group at the age of one month, sinus tachycardia was noted in 7.50% of children, violations of intraventricular conduction were registered in 2 children (5.0%), low voltage was not detected in any child. Differences between the compared groups were statistically significant ($p < 0.05$).

With the help of echocardiographic research in newborns with IUGR, a significant decrease in end-diastolic and end systolic volumes of the left ventricle was revealed, which indicated its decreased blood filling. The main hemodynamic parameters in the children of the observation group lagged significantly behind the growth rates of similar indicators of the comparison group.

One of the most important parameters of a newborn's hemodynamic adaptation to the conditions of extrauterine life is the presence of functioning fetal communications. Circulatory fetal communications play a regulatory role, reducing the hemodynamic load on the right ventricular myocardium. According to the literature, in most infants, the functional closure of fetal communications occurs in the first three days [5, 6]. According to our study, by the end of the early neonatal period, a patent foramen ovale (PFO) was visualized during echocardiography in 48.28% of newborns with IUGR. The patent ductus arteriosus (PDA) was detected in 25.29% and 8.05% of the newborns of the observation group were diagnosed with congenital heart disease (CHD). Among the heart defects, the defect of the interventricular septum was diagnosed in 3 (3.45%) children, the aneurysm of the atrial septum in 2 (2.30%), partial atrioventricular communication and aortic coarctation for one child, respectively (1.15%). The presence of PFO in the comparison group was detected in 9 newborns (22.50%), PDA was visualized in 5 children (12.50%), congenital heart diseases were not found. Differences between the groups were statistically significant ($p < 0.05$). The PFO was preserved in 32.20% of newborns with IUGR, PDA at 6.90% and 8.05% confirmed by congenital heart defect.

Discussion

It should be noted that many changes in hemodynamic and metabolic status in the early neonatal period are compensatory-adaptive [5, 6]. Therefore, the majority of violations that occurred in this period are transitory and reversible. The body of a newborn child has enormous reserve capabilities, but with a burdened perinatal period, a delay in intrauterine development, reserve opportunities are minimal, so there is a need as early as possible, even during the preclinical period of the development of a pathological condition, to suspect it and use the optimal therapeutic tactics to avoid heavy consequences for the newborn child and his family, both in the medical and social sense.

Conclusion

The indicators of intracardiac hemodynamics during the early neonatal period indicate a possible reduction in the reserve capabilities of the cardiovascular system and the prolonged nature of hemodynamic adaptation in newborns with IUGR.

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