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FREQUENCY OF PHYSICAL AND NEUROPSYCHOLOGICAL DEVELOPMENTAL DISORDERS IN INFANTS WITH CONGENITAL SEPTAL HEART DEFECTS

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Abstract: In recent years, there has been a significant increase in congenital septal heart defects in children, despite major advancements in medicine. Congenital septal heart defects are characterized not only by impaired cardiac hemodynamics but also by their negative impact on the normal physical development of the child. Unstable cerebral hemodynamics also adversely affects neuropsychological development.

A comprehensive approach to the treatment of congenital septal heart defects should include not only the correction of hemodynamic disturbances but also the management of physical and neuropsychological developmental issues.

This article presents not only the clinical features of congenital septal heart defects in infants during their first year of life but also describes the nature of physical and neuropsychological developmental disorders in this group of children.

Key words: Congenital heart defects, cardiac hemodynamics, physical development, neuropsychic development, ventricular septal defect, atrial septal defect.

Relevance. Among cardiovascular diseases in children, congenital heart defects (CHDs) occupy a leading position, with their formation beginning during the embryogenesis stage [5,6,8]. Despite many years of research, this issue remains highly relevant, as CHDs continue to be a major cause of morbidity and mortality in the pediatric population, and many aspects of their pathogenesis and management remain unresolved [3,8].

Currently, the term “congenital heart defects” is interpreted broadly, as CHDs are considered anatomical abnormalities of the heart or great vessels that develop in utero, regardless of the time at which they are diagnosed [1,4]. Moreover, a further increase in the incidence of congenital heart anomalies is anticipated, possibly due to advancements in diagnostic techniques and improvements in imaging technology [7,8].

Among the wide spectrum of congenital heart defects (CHDs), the most common forms diagnosed during infancy are septal defects, specifically ventricular septal defect (VSD) and atrial septal defect (ASD), which together account for approximately one-third of all congenital heart anomalies [1,7,10].

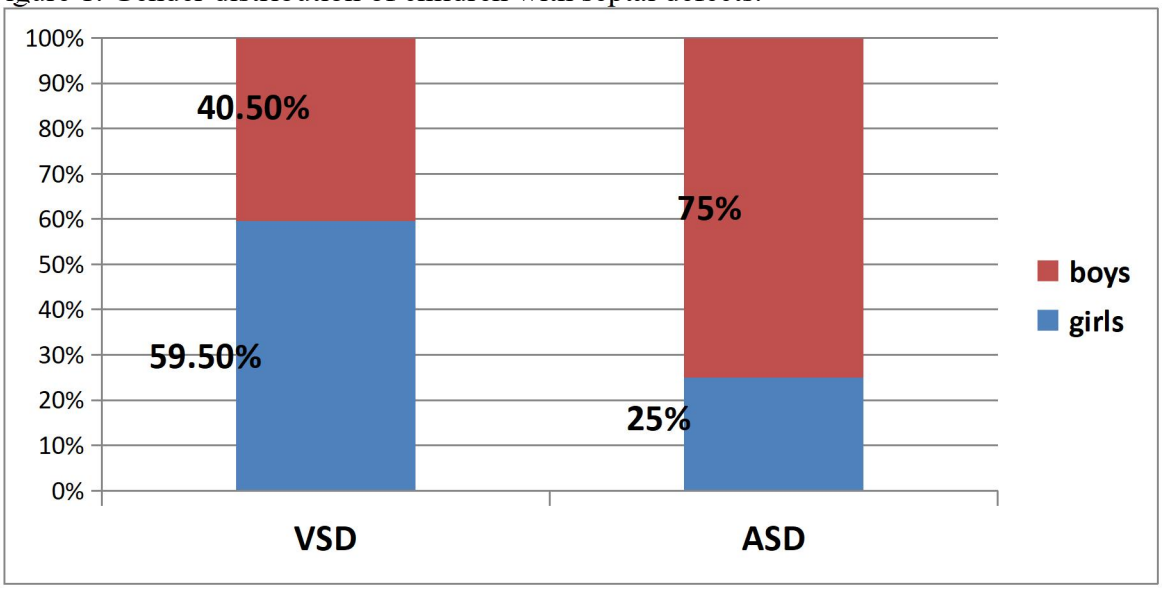
The hemodynamic disturbances associated with these defects are primarily due to left-to-right shunting, which sequentially leads to volume overload—initially of the left, and subsequently of the right ventricle—followed by pulmonary hypercirculation and the eventual development of pulmonary hypertension. The end stage of this cascade is heart failure, which can result in severe, and in some cases irreversible, consequences [1,2,3].

The hemodynamic alterations seen in ASD, and especially in VSD, have a detrimental effect on a child’s health, particularly during early childhood—a critical period for the formation of adaptive mechanisms to environmental conditions, as well as for the development of physical and neuropsychological health [3,7,9].

Hypoxic disorders resulting from congenital septal defects lead to multiorgan dysfunction, exacerbate an already compromised perinatal background, and represent one of the main causes

of impaired physical and neuropsychological development in this category of children [2,4,10].
Objective. To determine the frequency of hemodynamic disturbances in infants with congenital septal defects during the first year of life and to assess their impact on physical and neuropsychological status.
Materials and methods. The study was conducted at the Regional Children's Multidisciplinary Medical Center in Andijan. A total of 50 children under the age of one year with congenital septal heart defects were observed. The majority of cases involved ventricular septal defect (VSD), accounting for 84% (n=42). Atrial septal defect (ASD) was identified in 16% of the cases (n=8).
In terms of gender distribution, girls predominated among children with VSD (n=25), while boys were more frequently affected by ASD (n=6).

Figure 1. Gender distribution of children with septal defects.



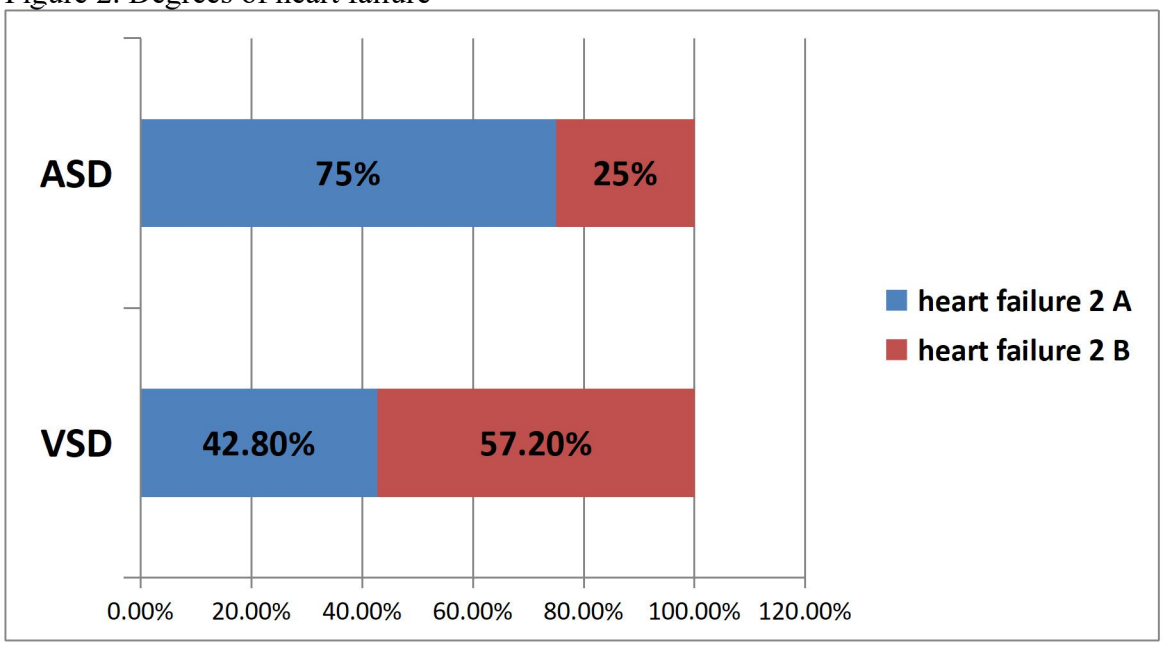
A comprehensive diagnostic approach was employed in the course of the study. Particular attention was paid to the course of the ante- and perinatal periods in the mothers, as well as to the development of motor and neuropsychological functions in each child during the first year of life. Central nervous system damage was assessed based on the results of neurosonography (NSG).
The evaluation of the cardiovascular system included not only standard physical examination methods but also data from electrocardiography (ECG) and two-dimensional echocardiography (2D EchoCG) with Doppler imaging to detect pulmonary hypertension.
Assessment of physical development was based on the WHO (2014) guidelines "Growth and development of children under five years of age", using anthropometric indicators such as body length and weight.
Research Results. Analysis of maternal risk factors revealed that the majority of children were exposed to a combination of two or more adverse factors during the ante- and perinatal periods, which may have contributed to the development of congenital heart defects (CHDs). Pathological pregnancy was observed in all mothers.
Among gynecological conditions during pregnancy, the most common was colpitis, occurring in 28% of cases. Extragenital pathologies included anemia (100%), acute respiratory infections during the first trimester (56%), and pyelonephritis (14%).
TORCH screening in mothers yielded positive results in 38% of cases: cytomegalovirus (CMV) was detected in 8 women, a combination of CMV and herpes simplex virus in 9 women, and toxoplasmosis in 2 cases.

Among the adverse obstetric history factors identified were: threatened miscarriage (42%), gestosis (34%), fetoplacental insufficiency (32%), and labor dysfunction (22%). Four

women had a history of pregnancy loss. The majority of children (72%) were born from the second pregnancy.
The gestational age at birth was 37 weeks in 32% of cases, 38 weeks in 52% of cases, and 8 children were born at 39 weeks' gestation.
Perinatal asphyxia was noted in 46% of children with CHDs. Birth weight of 3000 grams or more was recorded in 56% of cases.
In the majority of children (86%), the general condition at the time of hospital admission was assessed as severe due to significant hemodynamic disturbances caused by volume overload in the pulmonary circulation.

Based on the combination of parental complaints (tachycardia, tachypnea, weakness, and hyperhidrosis during any natural physical activity of the child), as well as clinical symptoms and physical examination findings, all children were found to have stage II circulatory insufficiency. Specifically, in the "A" period, this condition was observed in 6 children with ASD and 18 with VSD; in the "B" period, it was present in 2 children with ASD and 24 with VSD.

Figure 2. Degrees of heart failure



Hepatomegaly, ranging from 2,0 to 4,0 cm, was observed in all examined children.
The most characteristic ECG changes in 62,,5% of children with ASD were signs of right atrial overload, diagnosed by a high-amplitude P wave in leads II, III, and aVF, and an increased first positive (right atrial) phase of the P wave in lead V1. In one child, right atrial overload was combined with right ventricular hypertrophy and an incomplete right bundle branch block.
Significant ECG abnormalities were observed in children with VSD. The most characteristic findings included: rightward deviation of the electrical axis in 42,8% of cases and leftward deviation in 9,5%; atrial overload with left ventricular hypertrophy (14,2%); atrial overload with right ventricular hypertrophy (16,6%); isolated left ventricular hypertrophy (19%); isolated right ventricular hypertrophy (21,4%); and biventricular hypertrophy in 3 children.
Rhythm disturbances included: incomplete right bundle branch block (19%), intraventricular conduction delay (11,6%), and first-degree atrioventricular (AV) block (4,7%).
Echocardiographic findings in children with ASD revealed dilatation of the right ventricle and right atrium. In children with VSD, the defect was visualized as enlargement of the right ventricular cavity, left ventricle, and left atrium, along with hyperkinesis of the interventricular septum.

Figure 3. EchoCG - patient K., 10 months old, diagnosis "ASD"

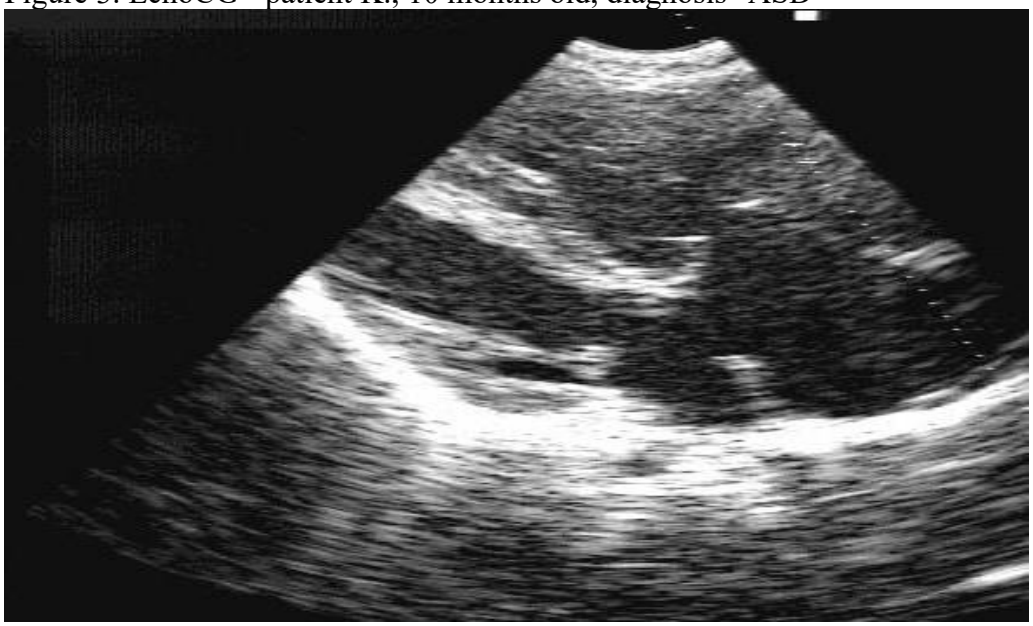
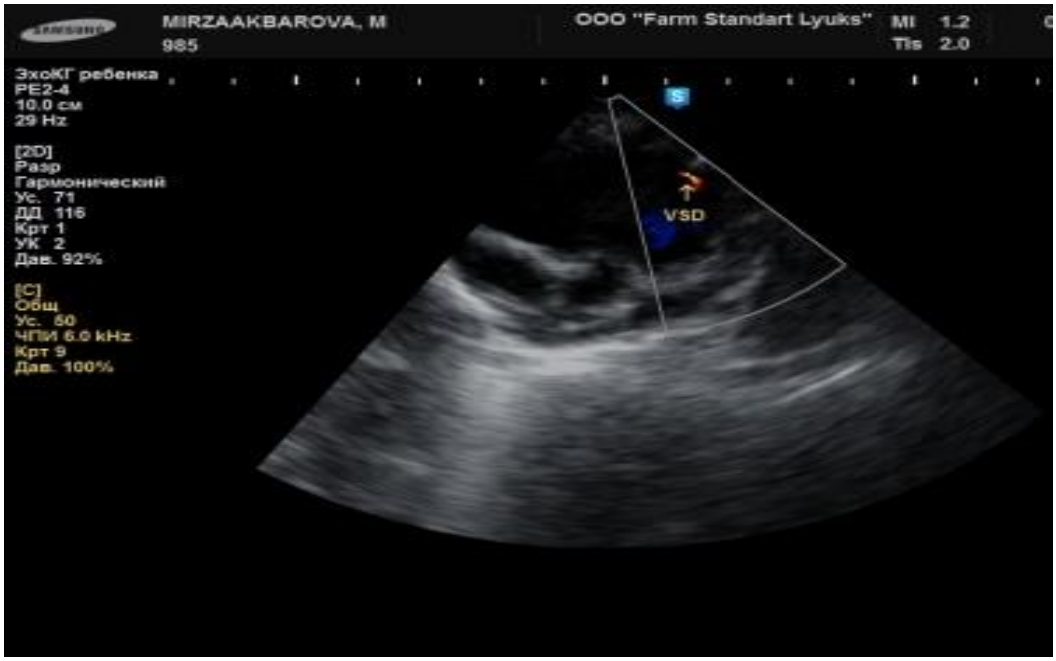


Figure 4. EchoCG - patient M., 12 months old, diagnosis "VSD"



Radiological signs of septal defects identified in our study included increased and enhanced pulmonary markings, cardiomegaly (cardiothoracic index ranging from 58% to 66%), and bulging of the pulmonary artery arch.

To assess the physical development of children with septal defects, we used the indices: weight-for-age, length-for-age, and weight-for-length. The body length of the observed children corresponded to the average level; however, significant deviations were noted in weight indicators.

Values below -2Z scores (−2 SD) were observed in 14,3% of children with VSD; −1 SD in 78,5% of children with VSD and in 2 children with ASD. Due to insufficient body weight, 88%

of the children were assessed as having a disharmonious morphofunctional status.
As part of the comprehensive examination of children with septal defects, we included an assessment of neuropsychological development relative to age-specific norms. In 92% of the examined children, delays and disturbances were observed in the acquisition of key motor skills: head control, independent sitting, crawling, standing, walking, as well as in general motor development. Speech development delays were classified as mild in one-third of the children and moderate in two-thirds.
Anamnesis revealed that during the neonatal and early postnatal periods (up to 6 months), the children experienced motor disturbances (36%), hyperexcitability (46%), muscle tone abnormalities (32%), and autonomic dysfunction (22%). These clinical signs were confirmed by neurosonography (NSG) findings.
According to NSG results, 84% of children were diagnosed with hypoxic central nervous system (CNS) damage, and 16% with hypoxic-ischemic CNS injury.

Conclusions. The results presented in this study confirm the relevance of the problem of congenital heart defects in children. An unfavorable somatic status, combined with unstable cardiac and cerebral hemodynamics, places these children in a high-risk group not only in terms of congenital cardiovascular pathology but also regarding their physical and neuropsychological development.
The treatment of children with congenital septal heart defects and hypoxic CNS injury must in volve a comprehensive approach, taking into account the degree of circulatory insufficiency and the need for correction of both physical and neuropsychological development. Active involvement of parents and continuity of care through outpatient and primary healthcare services are essential, as they significantly improve the quality of life for this patient population.

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