



**INTERPRETATION OF HEMATOLOGICAL INDICATORS AND IMMUNE
BACKGROUND IN CHILDREN WITH CONGENITAL HEART DEFECTS**

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SUMMARY: The article presents an overview of modern data on changes in hematological parameters and immune background in children with congenital heart defects. The main etiological factors, pathogenesis, clinical and laboratory diagnostic methods, as well as current approaches to the treatment of congenital heart defects are considered. Particular attention is paid to the development of therapeutic measures aimed at both the prevention of anemia and the activation of natural erythropoiesis after radical correction of congenital heart defects. The importance of the fact that interleukin-6 has both proinflammatory and anti-inflammatory effects is also emphasized, and an increase in interleukin-6 proves the predisposition of children with congenital heart defects after surgery to inflammatory processes and cerebral damage.

Key words: congenital heart defect, anemia, interleukin-6, inflammation, surgery.

**ИНТЕРПРИТАЦИЯ ГЕМАТОЛОГИЧЕСКИХ ПОКАЗАТЕЛЕЙ И ИММУННОГО
ФОНА У ДЕТЕЙ С ВРОЖДЕННЫМИ ПОРОКАМИ СЕРДЦА**

РЕЗЮМЕ: В статье представлен обзор современных данных изменения гематологических показателей и иммунного фона у детей с врожденными пороками сердца. Рассмотрены основные этиологические факторы, патогенез, клинические и лабораторные методы диагностики, а также актуальные подходы к лечению врожденных пороков сердца. Особое внимание уделено разработке лечебных мероприятий, направленных как на профилактику анемий, так и на активизацию собственного эритропоэза после радикальной коррекции врожденного порока сердца. Также акцентирована важность того, что интерлейкин-6 оказывает как провоспалительное, так и противовоспалительное действие, а повышения интерлейкина-6 доказывает предрасположенность детей с врожденными пороками сердца после операции к воспалительным процессам и церебральным повреждениям.

Ключевые слова: врожденный порок сердца, анемия, интерлейкин-6, воспаление, операция.

**TUG‘MA YURAK NUQSONLARI BO‘LGAN BOLALARDA GEMATOLOGIK
KO‘RSATKICHLAR VA IMMUN FONDAGI INTERPRITATSIYA**

ANNOTATSIYA: Tug‘ma yurak nuqsonlari (TYuN) pediatriyada jiddiy muammo bo‘lib, ularning keng tarqalganligi va bola salomatligi va nogironligiga olib keladigan og‘ir buzilishlar tufayli erta jarrohlik tuzatishni talab qiladi. Muammoning ijtimoiy ahamiyati shundaki, nogironlikka olib keladigan tug‘ma rivojlanish nuqsonlari orasida yurak nuqsonlari taxminan 50% ni tashkil qiladi. Jahon sog‘liqni saqlash tashkiloti (JSST) ma‘lumotlariga ko‘ra, TYuN har 1000 yangi tug‘ilgan chaqaloqdan 7–17 tasida uchraydi. O‘zbekistonda har 1000 tirik tug‘ilgan boladan 5 tadan 15 tagacha tug‘ma yurak nuqsoni bilan tug‘iladi. Hozirgi vaqtda, TYuN bilan bog‘liq kasalliklar o‘zib borayotganligini hisobga olib, ularning patogenetik mexanizmlari, klinik



kechish xususiyatlari, og‘ir asoratlarning yuzaga kelishi, tashxis va davolash choralarini belgilash pediatriyada hal qilinishi zarur bo‘lgan muammolardandir.

Kalit so‘zlar: tug‘ma yurak nuqsoni, anemiya, interleykin-6, yallig‘lanish, jarrohlik.

Relevance. Congenital heart defects (CHDs) are a serious issue in pediatrics due to their high prevalence and the severe impairments they cause to children's health and disability, necessitating early surgical correction. The social significance of this issue lies in the fact that heart defects account for approximately 50% of all congenital developmental anomalies leading to disability. According to the World Health Organization (WHO), CHDs occur in 7–17 out of every 1,000 newborns. In Uzbekistan, 5 to 15 out of every 1,000 live births are born with CHDs. Given the increasing incidence of CHD-related conditions, it is essential in pediatrics to study their pathogenetic mechanisms, clinical characteristics, the development of severe complications, as well as diagnostic and treatment approaches.

Introduction. The nature of CHDs and the early survival of patients are influenced by the severity of associated extracardiac congenital pathologies, which occur in 23–30% of CHD patients. In the presence of such pathologies, the mortality rate can reach up to 89%. In some unfavorable cases, even minor hemodynamically compensated defects that do not require correction can lead to the development of infectious endocarditis due to superimposed infections, and may worsen the course of rheumatologic diseases. Current views on immunopathological conditions consider the neuroendocrine and immune systems to be components of a unified homeostatic control mechanism. The immune system, together with the central nervous system and endocrine system, is an integrated system that maintains the body's homeostasis and optimal balance with the environment.

Immunological mechanisms play a role in the pathogenesis of major perinatal diseases and determine the possibilities for complete rehabilitation of the child in the future.

According to scientific literature, cardiac surgery under conditions of cardiopulmonary bypass (CPB) is accompanied by an increase in cytokine synthesis and a systemic inflammatory response. During inflammation, iron metabolism is disrupted, leading to functional iron deficiency. Under the influence of pro-inflammatory cytokines, erythropoietin production decreases, and bone marrow erythroid progenitor cells become resistant to it. This suppresses hemoglobin synthesis and erythropoiesis. Erythropoietin resistance is associated with elevated C-reactive protein levels. Inflammation reduces the efficacy of iron supplements, and red blood cell transfusions only temporarily improve red cell indices. Transfused erythrocytes are quickly destroyed, and their iron accumulates in the myocardium and other organs as hemosiderin. More than 10 transfusions and large volumes of erythrocyte mass can lead to hemosiderosis and dysfunction of internal organs.

Thus, postoperative anemia in CHD patients has a complex pathogenesis. Iron supplementation or red cell transfusion does not eliminate anemia during inflammation or septic complications. Moreover, blood transfusions carry the risk of infectious transmission and alloimmunization.

In the postoperative period following major surgery, anemia is observed in 90% of patients. The main causes include pre-existing anemia, intraoperative blood loss, postoperative inadequate nutrition, and frequent blood sampling for tests.

Iron therapy during inflammation is ineffective, and blood transfusions have only a temporary effect. In such cases, transfusions are associated with infection risk and alloimmunization.

In recent years, the efficacy of treating anemia with iron supplements and recombinant human erythropoietin has been widely discussed. However, due to many unresolved issues, it is



necessary to develop treatment strategies aimed at preventing anemia and activating endogenous erythropoiesis after radical CHD correction.

According to Hamidova F.K. and colleagues, in the natural course of ventricular septal defect in children, immune function is characterized by the formation of adaptive immunity involving activation of the B-cell axis and imbalance in the T-lymphocyte population. In children with cardiovascular diseases, immune imbalance leads to increased susceptibility to intercurrent infections, chronic disease tendencies, allergic and autoimmune processes.

In the work of A'zamova Sh.A., data are presented on the incidence of CHDs and associated risk factors in the Khorezm region. Risk factors include: severe obstetric history in mothers of children with CHD (25% had spontaneous abortions, 54.6% had fetoplacental insufficiency, 56.2% had pregnancy termination threats), acute viral infections in 59.3% of mothers during the first trimester, and elevated IgG titers for TORCH infections (herpes, toxoplasmosis, cytomegalovirus) in 48.4%.

Interleukin-6 (IL-6) is a pleiotropic pro-inflammatory cytokine produced by various cells (T and B cells, monocytes, malignant cells). IL-6 significantly influences the homeostasis of the immune and neuroendocrine systems and regulates the balance of pro- and anti-inflammatory pathways. Literature shows that IL-6 levels increase post-surgery and normalize by the 7th day. Cortixin has been shown to inhibit intracellular IL-6 signaling pathways.

IL-10 is an anti-inflammatory cytokine whose elevated postoperative levels are associated with immunosuppression and an increased risk of infectious complications. Its peak level is observed immediately after CPB and returns to preoperative levels after approximately 16 hours.

Conclusion. Congenital heart defects are a serious condition requiring a comprehensive approach. Assessing hematologic parameters and immune system status with modern diagnostic and treatment tools, and applying appropriately directed therapy, significantly increases the chances for a healthy life in children with CHD.

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