Changes in hematological parameters and immune background in children with congenital heart defects

Sakina Bakhodirovna Tairova
Pokizaxon G'ulomjon qizi Abdusalomova
Malika G'ulom qizi Omonova
Rayxon Kaxor kizi Karimova
Samarkand State Medical University

Abstract: In surgical practice, the presence of comorbid pathology has a significant impact on the course of the postoperative period, the development of complications, and also affects the prognosis. Current standards and approaches in surgery should include an analysis of comorbid diseases when choosing methods of anesthesia, intensive care and tactics of surgical intervention. In surgical interventions in children for congenital heart disease, it is necessary to carry out intensive therapy, including the correction of disorders of all vital organs. In our study, we focused on the correction of some disorders, in particular physical development, hormonal and immune status disorders, neurocognitive disorders. We studied several domestic and foreign literary data on the correction of these disorders.

Keywords: congenital heart disease, cytokine, interleukin, iron deficiency, erythropoietin

The immune system is integrating, along with the central nervous and endocrine systems, and is involved in maintaining homeostasis in the child's body and establishing an optimal balance in its relationships with the environment. Immunological mechanisms are involved in the pathogenesis of the main diseases of the perinatal period, and subsequently, determine the possibility of full rehabilitation of the sick child. The review of world literature provides data that it has now been proven that surgical treatment under IR conditions is accompanied by an increase in the synthesis of cytokines and the formation of a systemic inflammatory response. It has been shown that iron recirculation is disrupted during inflammation and functional iron deficiency develops. Under the influence of proinflammatory cytokines, an inadequate amount of erythropoietin is produced, and bone marrow precursors of erythrocytes become resistant to it. The consequence of this is a decrease in hemoglobin synthesis and inhibition of erythropoiesis. Resistance to erythropoietin correlates with the level of C-reactive protein. Prescription of iron preparations against the background of inflammation does not give the expected result, and blood transfusions prescribed only to improve the quantitative indices of red blood are not

justified, since they have a temporary effect. Transfused erythrocytes quickly disintegrate. Iron from destroyed donor erythrocytes does not compensate for its loss in the recipient and is not included in the synthesis of hemoglobin, but is deposited in the form of hemosiderin in various organs, including the myocardium. It is believed that more than 10 blood transfusions and the introduction of large volumes of donor erythrocytes can lead to hemosiderosis and dysfunction of internal organs. Therefore, postoperative anemia in patients with congenital heart disease has a complex pathogenetic mechanism. Transfusion of red blood cells, the appointment of iron preparations against the background of a systemic inflammatory response or purulent-septic complications do not solve the problem of anemia. In addition, blood transfusions are associated with a high risk of transmission of infectious agents and allosensitization. Anemia is observed in 90% of patients in the immediate postoperative period after major surgery. The main causes are: the presence of preoperative anemia, perioperative blood loss, malnutrition in the postoperative period, frequent blood sampling for laboratory tests.

Recently, the effectiveness of treating anemia with iron preparations and recombinant human erythropoietin has been widely discussed, but many unresolved issues remain, which determines the need to develop therapeutic measures aimed at both preventing anemia and activating natural erythropoiesis after radical correction of congenital heart disease.

According to Khamidova F.K. et al., the functioning of the immune system in children with the natural course of VSD is accompanied by the formation of adaptive immunity, which is realized in the activation of the B-cell link of the immune system against the background of an imbalance in the T-lymphocyte population. The development of immune imbalance in children with cardiovascular diseases leads to increased susceptibility to intercurrent infections, a tendency to develop chronic forms of any diseases, allergic and autoimmune processes. The works of Sh.A. Agzamova provide data on the frequency of occurrence and risk factors for the formation of congenital heart defects in children of the Khorezm region. Risk factors for the development of congenital heart defects have been identified, such as an aggravated obstetric history of mothers of children born with congenital heart defects (spontaneous miscarriages in 25% of mothers, fetoplacental insufficiency in 54.6%, threatened miscarriage in 56.2%), as well as acute viral diseases in the first trimester of pregnancy in 59.3% of mothers and laboratory-confirmed carriage of high titers of IgG to TORCH infections such as herpes, toxoplasmosis and cytomegalovirus in 48.4% of mothers.

Interleukin-6 (IL-6) is a pleiotropic inflammatory cytokine that can be produced by reactivated T cells, B cells, monocytes, and malignant cells. IL-6 has a significant effect on the homeostasis of the immune and neuroendocrine systems, and affects the balance of proinflammatory/antiinflammatory pathways. In a review of the world

literature, IL-6 levels were assessed as a marker of cerebral injury and systemic proinflammatory response and response to surgical treatment in children. They increased immediately after surgery and normalized on the 7th day. According to the literature, Cortexin inhibits the intracellular cascade of the main proinflammatory cytokine IL-6 [32, 42-48]. Clinical data of Ivkin A.A. et al. showed that IL-6 is a marker of systemic inflammatory response with dual pro- and anti-inflammatory action and is characterized by a variety of cells producing it (cardiomyocytes, fibroblasts, endotheliocytes). When analyzing IL-6, a picture of its increase was observed during the CB period with a further increase on the following day. Based on the literature data, according to which the peak marker concentration is reached 24 hours after the start of the operation, in our study the IL-6 values should be the same at the 3rd control point, which was noted during the analysis. IL-10 is an anti-inflammatory cytokine and it is known that its elevated concentrations in the postoperative period are associated with immunosuppression and an increased risk of infectious complications. The highest point of concentration of this marker, according to the author, is the end of CB, which is consistent with the results of other similar studies, with its further rapid decrease after 16 hours almost to the initial preoperative level. Thus, for the studied group of patients, the risk of the described complications and immunosuppression was minimal, which is due to the short time of CPB, with which IL-10 is correlated according to the results of Gorjipour F. et al.

In clinical studies by Stevan Hammer, when studying the systemic inflammatory response in children with congenital heart defects who underwent surgical correction using artificial circulation, interleukin-6 was determined as a component of the systemic inflammatory response syndrome to artificial circulation and the postoperative kinetics of these parameters were assessed in an uncomplicated course. Serum concentrations of interleukin-6 were affected by the systemic inflammatory response syndrome after cardiac surgery using artificial circulation. Even in the case of an uncomplicated course, IL-6 was elevated for at least four days.

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