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THE ROLE OF IMMUNO-BIOCHEMICAL MARKERS IN THE ACTIVE STAGE OF CHRONIC RHEUMATIC HEART DISEASE IN CHILDREN

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Abstract

Chronic rheumatic heart disease (CRHD) remains one of the most important acquired cardiovascular diseases in children and adolescents. The disease develops due to autoimmune inflammatory reactions after group A beta-hemolytic streptococcal infection and is characterized by progressive valvular damage, myocardial inflammation, and chronic cardiac insufficiency. The present study investigated serum levels of interleukin-10 (IL-10), tumor necrosis factor-alpha (TNF-α), C-reactive protein (CRP), and procalcitonin (PCT) in children with CRHD. Elevated TNF-α, CRP, and PCT together with reduced IL-10 were observed during active inflammatory stages. These biomarkers demonstrated high diagnostic and prognostic significance.

Introduction

Chronic rheumatic heart disease continues to represent a major clinical and social problem in pediatric cardiology worldwide. Despite advances in antibiotic therapy and preventive medicine, rheumatic fever and its chronic cardiac consequences remain common in developing countries.

The pathogenesis of CRHD is associated with autoimmune inflammatory processes initiated by molecular mimicry between streptococcal antigens and myocardial proteins. Persistent inflammation gradually leads to fibrosis of cardiac valves and chronic hemodynamic disturbances.
Inflammatory cytokines play a central role in disease progression. Tumor necrosis factor-alpha is considered one of the main pro-inflammatory mediators responsible for endothelial dysfunction, activation of macrophages, and progression of myocardial injury. In contrast, interleukin-10 acts as an anti-inflammatory cytokine limiting excessive immune activation.
Acute phase proteins such as CRP and procalcitonin are also valuable indicators of inflammatory activity and may help evaluate disease severity and recurrence risk.

Aim of the Study

To evaluate the diagnostic and prognostic significance of IL-10, TNF-α, CRP, and procalcitonin in children with chronic rheumatic heart disease during active inflammatory stages.

Materials and Methods

A prospective clinical study was carried out between 2022 and 2025 at the Bukhara Regional Multidisciplinary Children's Medical Center and the SOFIMED private clinic.
A total of 60 children aged 10–17 years participated in the study. Patients were divided into three groups:
- Active CRHD group (n=20)
- Remission CRHD group (n=20)
- Healthy control group (n=20)

Venous blood samples were collected in the morning under fasting conditions. IL-10 and TNF-α were measured using ELISA methods. CRP was determined by immunoturbidimetric analysis, while procalcitonin levels were assessed by immunoluminescent techniques.

All patients additionally underwent electrocardiography and echocardiography. Statistical analysis was performed using SPSS Statistics 23.0 software.

Results

Children with active CRHD demonstrated significantly elevated TNF-α concentrations compared with remission and healthy groups. Mean TNF-α values reached 42.6 ± 5.8 pg/mL in active disease.

IL-10 levels were markedly reduced during active inflammatory stages, reflecting impaired anti-inflammatory regulation.

CRP values were significantly increased in active CRHD and correlated with severity of valvular damage. Procalcitonin levels were also elevated and associated with severe inflammatory activity.

Strong positive correlations were identified between TNF-α and CRP, as well as between TNF-α/IL-10 ratio and echocardiographic severity of valvular lesions.

Discussion

The obtained findings confirm the important role of cytokine imbalance in the pathogenesis of pediatric chronic rheumatic heart disease.

Elevated TNF-α contributes to activation of inflammatory cascades, endothelial dysfunction, and progressive fibrosis of cardiac tissue. Persistent cytokine activation may promote recurrent inflammatory attacks and worsening of valvular pathology.

Reduced IL-10 concentrations indicate insufficient suppression of autoimmune inflammation. Since IL-10 inhibits macrophage activation and excessive T-cell responses, its deficiency may intensify myocardial injury.

CRP remains a highly sensitive marker of systemic inflammation and reflects activity of acute-phase immune responses. Increased procalcitonin concentrations may indicate severe inflammatory activation and risk of complications.

Combined assessment of TNF-α, IL-10, CRP, and PCT provides greater diagnostic accuracy compared with routine laboratory tests alone

Clinical Importance

Implementation of immunobiochemical monitoring into pediatric cardiology practice may significantly improve early diagnosis and management of CRHD.

The TNF-α/IL-10 ratio may serve as an important prognostic indicator predicting recurrent disease activity and progression of valvular fibrosis.

Regular laboratory monitoring may also help optimize anti-inflammatory treatment and reduce

disability associated with chronic cardiac complications.

Additional Analysis Section

Chronic rheumatic heart disease remains highly relevant due to the persistence of streptococcal infections among school-aged children. Recurrent autoimmune inflammation progressively damages cardiac valves and leads to chronic hemodynamic disturbances. Modern studies emphasize the importance of inflammatory cytokines and acute-phase proteins as predictors of disease severity and progression.

Monitoring immunobiochemical markers may provide opportunities for personalized therapeutic approaches in pediatric cardiology.

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Further multicenter studies involving larger patient populations are necessary to establish standardized biomarker thresholds and optimize clinical protocols.

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Conclusion

The conducted study showed that immunobiochemical markers play an important role in the pathogenesis, diagnosis, and prognosis of chronic rheumatic heart disease in children. The results obtained indicate a pronounced imbalance between pro- and anti-inflammatory cytokines during the active stage of the disease.

It has been established that TNF-α levels increase significantly in children with active chronic rheumatic heart disease. An increase in this indicator reflects the intensity of the autoimmune inflammatory process, the degree of valvular apparatus damage, and the severity of myocardial damage. High TNF-α levels correlate with the severity of clinical manifestations and the risk of heart failure progression.

Simultaneously, a significant decrease in the level of IL-10, which possesses anti-inflammatory properties, was identified. Insufficient production of IL-10 contributes to the preservation of chronic inflammation and the further development of fibrous changes in heart tissues.

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