DYNAMICS OF SERUM CYTOKINE PROFILES IN CHILDREN WITH ACUTE AND CHRONIC ALLERGIC CONJUNCTIVITIS DURING TREATMENT

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Introduction

Allergic conjunctivitis is one of the clinically significant manifestations of allergic disease in childhood and is characterized by inflammatory changes in the conjunctiva associated with hypersensitivity reactions. The clinical course of the disease may vary considerably, ranging from acute episodes with pronounced ocular symptoms to persistent chronic inflammation. In pediatric patients, recurrent or prolonged allergic inflammation may negatively affect visual comfort, daily activity, sleep, school performance, and overall quality of life.

Although the clinical manifestations of allergic conjunctivitis are relatively well described, the immunological mechanisms determining the severity, course, and transition from acute to chronic inflammation remain of considerable scientific interest. Particular attention is currently paid to cytokines as mediators coordinating inflammatory and regulatory immune responses. Pro-inflammatory cytokines, including interleukin-6 (IL-6) and interleukin-8 (IL-8), participate in the initiation and maintenance of inflammatory reactions, whereas IL-4 and IL-10 are involved in regulation of allergic and anti-inflammatory immune responses. The dissertation data indicate that the concentrations of these cytokines differ substantially between acute and chronic forms of allergic conjunctivitis and change during treatment.

Assessment of cytokine dynamics may therefore provide additional information about the immunological activity of the disease and the effectiveness of therapeutic interventions. The present study was aimed at evaluating serum cytokine profiles in

children with acute and chronic allergic conjunctivitis and determining their changes during treatment.

Materials and Methods

The study included 90 children aged 3–18 years with allergic conjunctivitis who received outpatient treatment at the Bukhara Branch of the Republican Specialized Scientific and Practical Medical Center for Eye Microsurgery during 2023–2025. The patients were divided into two clinical groups: 45 children with acute allergic conjunctivitis (AAC) and 45 children with chronic allergic conjunctivitis (CAC). The overall control group consisted of 40 apparently healthy children without allergic conjunctivitis or ophthalmological pathology; serum cytokine reference values presented in the immunological analysis were obtained from 20 healthy children.

Clinical, ophthalmological, immunological, and statistical methods were used. Serum concentrations of the pro-inflammatory cytokines IL-6 and IL-8 and the regulatory/anti-inflammatory cytokines IL-4 and IL-10 were assessed. Cytokine parameters were compared between healthy children and patients with acute and chronic allergic conjunctivitis. In addition, cytokine levels were evaluated before and after treatment to determine the immunological response to therapy. Differences were considered statistically significant according to the statistical criteria used in the dissertation, with treatment-related differences reported at $P<0.05$.

Results

Marked differences in serum cytokine concentrations were identified between healthy children and patients with allergic conjunctivitis. In the acute allergic conjunctivitis group, the serum IL-6 concentration reached 76.63±3.38 pg/mL, compared with 8.32±1.24 pg/mL in healthy children. Thus, IL-6 was increased approximately 9.21-fold. Serum IL-8 also increased significantly from 6.19±0.08 pg/mL in healthy children to 16.78±0.19 pg/mL in children with acute allergic conjunctivitis, corresponding to a 2.71-fold increase.

A different cytokine pattern was observed in chronic allergic conjunctivitis. IL-6 concentration was 43.12±2.23 pg/mL, while IL-8 reached 12.28±0.09 pg/mL. These values were significantly higher than those in healthy children but lower than the respective concentrations recorded in the acute form. Thus, activation of pro-inflammatory cytokines was more pronounced during acute allergic inflammation.

The regulatory cytokines showed another pattern. IL-4 concentrations were 7.15±0.28 pg/mL in healthy children, 9.98±0.25 pg/mL in AAC, and 11.76±0.33 pg/mL in CAC. The most pronounced difference was observed for IL-10. Its concentration increased from 6.85±0.99 pg/mL in healthy children to 42.12±2.32 pg/mL in acute allergic conjunctivitis and reached 89.42±2.56 pg/mL in chronic allergic conjunctivitis. Therefore, while IL-6 and IL-8 predominated more markedly in acute disease, increased IL-4 and particularly IL-10 concentrations were more characteristic of the chronic form.

Treatment was accompanied by a significant decrease in all studied cytokines in children with acute allergic conjunctivitis. IL-6 decreased from 76.63±3.38 to 54.13±2.64 pg/mL, IL-8 from 16.78±0.19 to 12.45±0.14 pg/mL, IL-4 from 9.98±0.25 to 7.98±0.19 pg/mL, and IL-10 from 42.12±2.32 to 31.72±1.44 pg/mL. The reductions corresponded approximately to 1.42-, 1.35-, 1.25-, and 1.33-fold decreases, respectively, compared with pretreatment values, and were statistically significant.

Positive cytokine dynamics were also observed in children with chronic allergic conjunctivitis, although the magnitude of change was generally less pronounced. IL-6 decreased from 43.12±2.23 to 32.89±1.35 pg/mL, IL-8 from 12.28±0.09 to 10.76±0.12 pg/mL, IL-4 from 11.76±0.33 to 11.04±0.20 pg/mL, and IL-10 from 89.42±2.56 to 81.95±1.74 pg/mL. These changes were statistically significant compared with pretreatment values.

Despite the observed improvement, post-treatment cytokine concentrations did not completely reach the values recorded in healthy children. This finding indicates

persistence of immunological activity after clinical improvement and suggests that cytokine normalization may require a longer period than regression of the main clinical manifestations. The dissertation also demonstrated an association between attenuation of clinical symptoms and reduction of serum cytokine concentrations.

Discussion

The obtained results demonstrate that acute and chronic allergic conjunctivitis in children are characterized by distinct cytokine response patterns. A substantial elevation of IL-6 and IL-8 in acute disease reflects pronounced inflammatory activity, whereas the comparatively high levels of IL-4 and especially IL-10 in chronic allergic conjunctivitis may reflect prolonged immunoregulatory activation associated with persistence of the allergic process.

The significant reduction of all four cytokines during treatment confirms that immunological parameters respond to therapeutic interventions and may complement conventional clinical assessment. At the same time, incomplete normalization of cytokine concentrations indicates that disappearance or reduction of ocular symptoms does not necessarily mean complete resolution of the underlying immune-inflammatory process. Therefore, monitoring IL-6, IL-8, IL-4, and IL-10 may be useful not only for characterizing disease activity but also for evaluating treatment response and identifying patients at risk of prolonged or chronic disease. The dissertation recommends these cytokines, together with local tear-fluid parameters, as potential biological markers for assessing severity, outcome, and progression of allergic conjunctivitis.

Conclusion

Children with acute and chronic allergic conjunctivitis demonstrate significant alterations in serum cytokine profiles. Acute allergic conjunctivitis is characterized predominantly by a marked increase in IL-6 and IL-8, whereas chronic disease is associated with relatively higher IL-4 and particularly IL-10 concentrations. Treatment

results in a statistically significant decrease in all investigated cytokines, although complete normalization is not achieved during the observation period.

Assessment of IL-6, IL-8, IL-4, and IL-10 can therefore provide additional objective criteria for differentiating the immunological activity of acute and chronic allergic conjunctivitis and for monitoring therapeutic effectiveness in pediatric patients.