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Antigen-Binding Lymphocytes as Potential Biomarkers of Exogenous and Endogenous Endophthalmitis

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Abstract Despite advances in medicine over the past 100 years, endophthalmitis is still a serious vision-threatening complication. The aim of the study is to investigate the role of some immunological indicators in the early diagnosis of eye structure damage in exogenous and endogenous endophthalmitis. The study was conducted on 101 patients. To study organ damage and the effectiveness of the therapy, a method of quantitative registration of antigen-binding lymphocytes (ABL) specifically sensitized relative to tissue antigens (TA) of the cornea, sclera, retina and choroid was used. In the conducted comparative analysis of the dynamics of antigen-binding lymphocytes (ABL) to tissue antigens of eye structures in patients with inflammatory diseases of exogenous and endogenous nature, significant features of the course of the inflammatory process and the effectiveness of the treatment were revealed.

Keywords Endophthalmitis, Antigen-binding lymphocytes, Tissue antigens, Intracellular processes, Exogenous and endogenous

1. Introduction

The relevance of studying endogenous and exogenous inflammatory processes in the structures of the eye is due to their significant impact on vision and quality of life of patients. Inflammatory eye diseases are among the leading ophthalmic pathologies, as they can lead to serious complications such as decreased visual acuity, glaucoma, cataracts, or even blindness [1,2].

Endogenous inflammation occurs as a result of internal factors such as autoimmune reactions, systemic diseases, or infections within the body, which requires a deep understanding of the mechanisms of their development for timely diagnosis and adequate treatment [5]. Exogenous inflammation is associated with external influences — trauma, infections, allergens — and requires the development of methods for prevention and rapid response [3,4].

Studying these processes is important for identifying pathogenetic mechanisms, determining risk factors, and developing new therapeutic approaches. This helps to reduce the frequency of complications, preserve visual function, and improve the quality of life of patients. In the context of modern medical developments, such research helps to improve methods of diagnosis, prevention, and treatment of inflammatory eye diseases [6,7].

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The **objective** of our study was to examine the role of certain immunological indicators in the early diagnosis of endogenous and exogenous damage to eye structures.

2. Methods and Materials

We carried out our research on 101 patients who were treated at the Republican Clinical Ophthalmological Hospital under the Ministry of Health of the Republic of Uzbekistan from 2022 to 2024 for inflammatory eye diseases of an endogenous (n=60) and exogenous (n=41) nature. hospitalized with a diagnosis of endophthalmitis. All patients complained of pain, redness of the eyes, discharge from the eyes, and blurred vision upon admission.

To study organ damage and the effectiveness of the therapy, we used a method of quantitative registration of antigen-binding lymphocytes (ABL) specifically sensitized to tissue antigens (TA) of the cornea, sclera, retina, and choroid, based on the use of the indirect rosette formation reaction (IRFR) according to the method of Garib F.Yu. (1995). All patients underwent ABL testing for TA during the course of the disease at the following time points: upon admission, and at 5, 14, and 30 days of observation.

The essence of the method for determining the ABL to TA of various organs is that when an organ of any origin is damaged, intracellular processes are disrupted and destruction develops in its cells. Molecules or fragments of structural and functional proteins with organ specificity enter the internal

environment. Tissue proteins and molecules that are "foreign" to the internal environment acquire the status of tissue antigens (TA), triggering an immune response aimed at their neutralization and elimination.

In the presence of TA in the internal environment, antigen-binding lymphocytes (ABL) differentiate and circulate in the blood, capable of specifically binding to TA only of a given organ. The level of ABL to TA reflects the intensity of the processes of destruction and necrosis of structures in the organ: an increase in ABL over time indicates an increase, and a decrease in ABL indicates a decrease in the intensity of these processes, which allows one to assess the degree of organ damage, as well as the effectiveness of the therapy being carried out. The value of the method for determining ABL to TA is its high sensitivity and specificity: the ABL content reaches a diagnostic level in the early stages and long before the manifestation of clinical signs of organ damage, which makes it possible to predict the risk of organ failure at an early stage. The determination of ABL with TA in several organs allows the detection of multiple organ damage in the development of pathology.

3. Research Results

A comparative analysis of the dynamics of antigen-binding lymphocytes to tissue antigens of eye structures in endogenous and exogenous inflammatory processes showed that with a unidirectional nature of the body's response to the treatment, there are differences in the severity and intensity of the decrease in ABL indicators to TAG structures of the eye at different observation times.

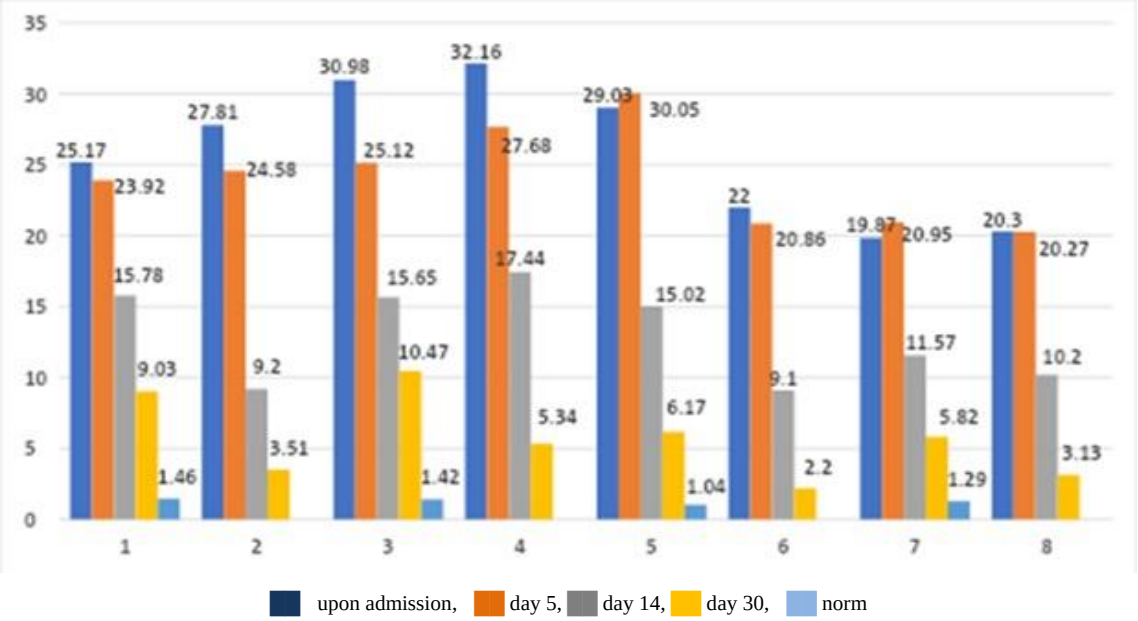

Figure 1. Dynamics of antigen-binding lymphocytes to TAG in patients with inflammatory diseases of the eye structures of exogenous and endogenous nature

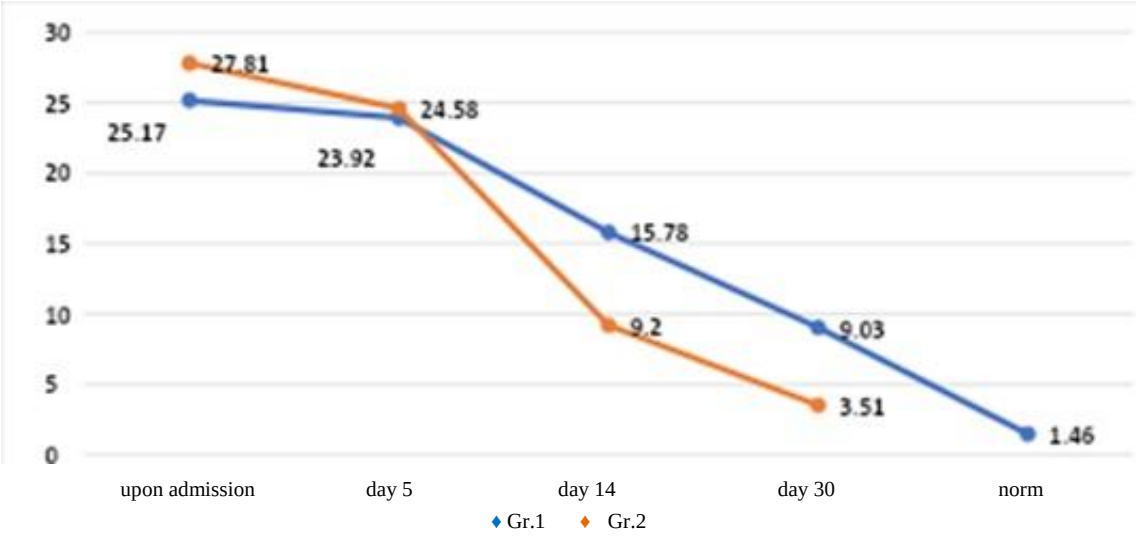

Figure 2. Dynamics of antigen-binding lymphocytes to corneal TAG in patients with inflammatory diseases of exogenous and endogenous nature

The analysis of the dynamics of ABL to TAG of the cornea at admission in the patients we examined showed equally high levels of values (25.17±0.73% and 27.81± 1.22%, respectively), significantly exceeding the control values by 17.2 and 19.04 times, respectively. On the 5th day of observation, a decrease in the ABL to TAG ratio of the cornea was noted with the same intensity by 1.1 times (23.92±0.76% and 24.58±0.69%, respectively). On the 14th day of treatment and observation in group 2, there was a more expressed decrease (2.3 times, 10.42±0.48%) relative to the previous value than in patients with endogenous inflammation (1.5 times, 15.78±0.55%, respectively) (Fig. 1).

Subsequently, by the 30th day of observation, against the background of the treatment, patients with endogenous inflammation showed a 1.7-fold decrease in the level of ABL to TAG of the cornea, averaging 9.03±0.32%), while in patients with exogenous inflammation, it decreased 2.6 times, averaging 3.51±0.23%, respectively) (Fig. 2).

Analysis of the dynamics of the inflammatory process in the vascular membrane of the eyes in the patients we examined showed more pronounced disorders, as evidenced by higher ABL indicators to TAG of the vascular membrane. Thus, upon admission, the ABL to the TAG of the vascular membrane of the eyes in the patients we examined with endogenous inflammatory diseases averaged 30.98±0.63%, which is 21.8 times higher than the control values. Patients with exogenous inflammation also had high ABL to TAG values of 32.16±1.05%, which is 22.6 times higher than the control values (Fig. 3).

Subsequently, in the dynamics of the disease at 5 and 14 days of observation, the intensity of the decrease in both observation groups did not differ significantly, showing a pronounced pathological process in the vascular membrane of the eyes (Fig. 4). By day 30 of observation, analysis of the results obtained shows greater effectiveness of the treatment in group 2 with exogenous inflammatory process, decreasing 3.3 times relative to the previous period (17.44±0.63 and 5.34±0. 19%, respectively), than in group 1, where the ABL level decreased only 1.5 times and amounted to 10.47 ±0.27 compared to the values on the 14th day of treatment, 15.65±0.64%.

A comparative analysis of the dynamics of ABL to TAG of the retina in groups 1 and 2 shows an average of 19.87±0.58% upon admission in patients with endogenous inflammation, increasing 15.4 times relative to the control values, Patients with exogenous inflammation also had high ABL to TAG values of 20.3±0.73%, which was 15.7 times higher than the control values.

By the fifth day of treatment, patients in group 1 showed a slight increase (up to 20.95±0.45%), while patients with exogenous inflammation showed virtually no dynamics of ABL to TAG of the retina (20.27±0.71%). The results obtained indicate that the treatment carried out at this stage of the disease is not effective in relation to inflammatory phenomena in this structure of the eye. By the 14th day of observation, there was a marked decrease in the level of ABL to TAG of the retina in patients with endogenous inflammation (11.57±0.40%, decreasing 1.8 times relative to previous indicators) and in patients with exogenous inflammation (10.2±0.37%, decreasing 2.0 times relative to previous indicators). By the end of the observation period and on the 30th day of treatment, a further decrease in ABL to TAG of the retina was observed, more pronounced in patients with exogenous inflammation (from 10.20±0.37 to 3.13±0.18%, decreasing 3.3 times relative to previous indicators), significantly closer to the control values than in the group with endogenous inflammation (from 11.57±0.40 to 5.82±0.18%, decreasing by 2 times relative to previous values, which are significantly higher than the control values) (Fig. 4).

Analysis of the studies conducted and the results obtained on the dynamics of ABL to TAG of the sclera show that profound inflammatory changes also occur in this eye structure, which are reflected in high values of this indicator. Thus, in endogenous inflammation, ABL to TAG of the sclera shows an average of 29.03±0.68% upon admission, increasing 27.9 times relative to the control values. Patients with exogenous inflammation also show high ABL to TAG values of 22.0±0.79%, which is 21.2 times higher than the control values. By day 5, both endogenous and exogenous inflammation show insignificant changes in the ABL to TAG sclera ratios (increasing slightly in group 1 from 29.03±0.68 to 30.05±0.56%, $P>0.05$, and decreasing slightly in group 2 from 22.0±0.79 to 20.86±0.72%, $P>0.05$).

By the 14th day of observation, there was a marked decrease in the level of ABL to TAG of the sclera in both patients with endogenous inflammation (15.02±0.25, decreasing by 2.0 times relative to previous indicators) and patients with exogenous inflammation (9.10±0.32%, decreasing by 2.2 times relative to previous indicators).

By day 30 of treatment, a further decrease in ABL indicators to TAG sclera was observed, more pronounced in patients with exogenous inflammation (from 9.10±0.32 to 2.53±0.12, decreasing 3.6 times relative to previous indicators), approaching the control values significantly more than in the group with endogenous inflammation (from 15.02±0.25 to 6.17±0.17%, decreasing 2.4 times relative to previous values, which differ significantly from the control values (Fig. 5).

In the comparative analysis of the dynamics of antigen-binding lymphocytes (ABL) to tissue antigens of the eye structures in patients with inflammatory diseases of an exogenous and endogenous nature, significant features of the course of the inflammatory process and the effectiveness of the treatment were revealed.

Thus, at the initial stage (upon admission), all patients have high levels of ABL to TAG in various structures of the eye, indicating a pronounced immune response and active inflammation. During treatment, there is a tendency for ABL levels to decrease, indicating positive dynamics and the effectiveness of therapy.

In the cornea, the level of ABL to TAG decreases more significantly in patients with exogenous inflammation, especially by the 30th day of observation (up to 3.51%), compared to the group with endogenous inflammation (up to 9.03%). This

indicates a faster and more effective suppression of the inflammatory process in the cornea in cases of exogenous causes. In the vascular membrane and retina, a more pronounced decrease in ABL is also observed in patients with exogenous inflammation, especially by the end of the observation period, which indicates a more favorable dynamic in cases of external causes of inflammation. In the sclera, ABL levels remain high in both groups throughout the observation period, but in patients with exogenous inflammation, the decrease is faster and more noticeable.

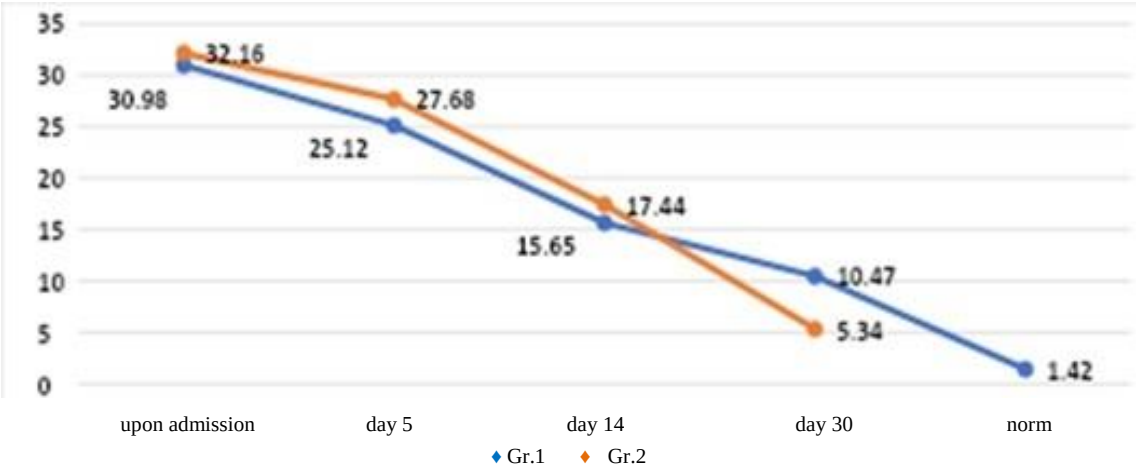

Figure 3. Dynamics of antigen-binding lymphocytes to TAG of the vascular membrane in patients with inflammatory diseases of exogenous and endogenous nature

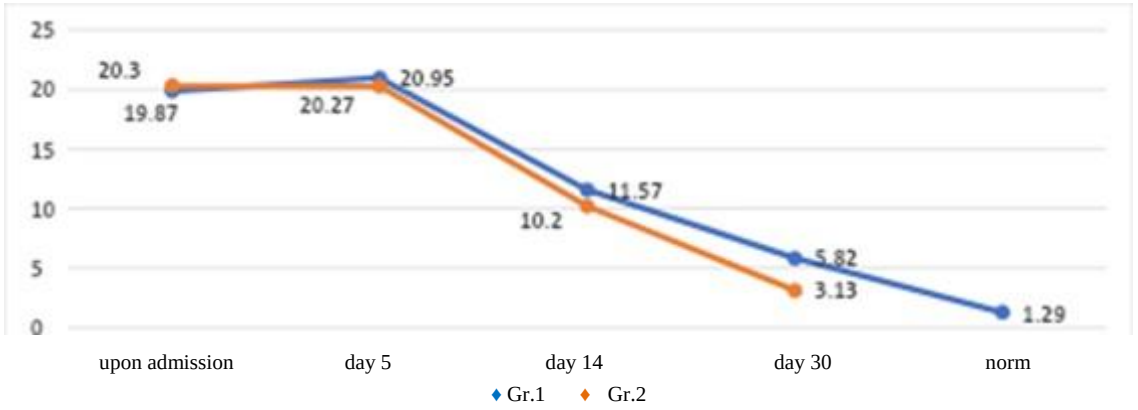

Figure 4. Dynamics of antigen-binding lymphocytes to retinal TAG in patients with inflammatory diseases of exogenous and endogenous nature

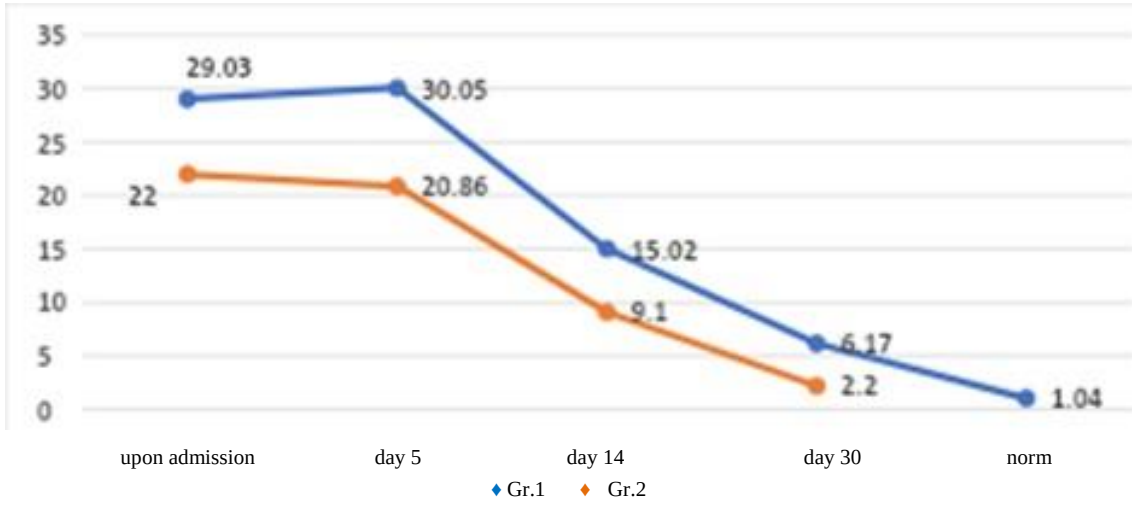

Figure 5. Dynamics of antigen-binding lymphocytes to TAG of the sclera in patients with inflammatory diseases of exogenous and endogenous nature

4. Conclusions

1. Inflammatory processes in the eye structure in endogenous diseases are characterized by more persistent immune response activity and a slower rate of regression of inflammatory changes compared to exogenous causes.
2. The effectiveness of treatment is higher in patients with exogenous inflammation, which is manifested in a more significant reduction in ABL levels to tissue antigens of the eye structures.
3. The dynamics of ABL changes can serve as an objective marker for assessing the effectiveness of therapy and the prognosis of inflammatory eye diseases.

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