

IMMUNE STATUS IN PATIENTS WITH BENIGN PROSTATIC HYPERPLASIA

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Annotation. *The purpose of the study was to conduct a comparative analysis of the immune status of patients with benign prostatic hyperplasia (BPH) after various surgical interventions: endoscopic ablation of the prostate (EAP), transurethral resection of the prostate (TUR) and traditional adenectomy. Eighty patients were included in the study: 20 underwent EAP, 20 underwent TUR, and 40 underwent traditional adenectomy. The indices of cellular and humoral immunity in the preoperative and postoperative periods were studied. Differences in the immune response of the organism depending on the applied method of treatment were revealed.*

Key words: *benign prostatic hyperplasia, immune status, adenectomy, cellular immunity, inflammation.*

Relevance. Benign prostatic hyperplasia (BPH) is a polyetiologic disease of predominantly elderly and older men, which is caused by the growth of adenomatous tissue in the transitional zone of the prostate gland. The consequence of this pathologic growth is the occurrence of lower urinary tract obstruction [4]. In the decompensation stage, the disease leads to a number of serious complications, including the inability to urinate independently, which requires the installation of urethrovessical drainage for permanent urine diversion. In recent years, there has been a search for alternative methods of surgical interventions to overcome the existing problems [3,7,10]. At the same time, none of the methods is universal, they often require high-tech equipment, are invasive and need anesthesia assistance

Epidemiologic data note the frequency of occurrence of BHP in men 50-60 years old in 50%, and at the age of over 80 years - up to 90%. According to one study, the prevalence of urinary disorders in men aged 20 to 80 years in Russia is 59.9% [6]. Complicating the situation is the fact that most patients turn to a urologist late, when the prostate is already significantly enlarged in size, and conservative treatment is ineffective [1,5]. The reason for this was the widespread use by patients of symptomatic drugs, a group of alpha-1-adrenoblockers that do not slow the progression of prostate growth. Long-term use of 5a-reductase drugs (5ARI) preventing the progression of nodule growth is often accompanied by low continuity of treatment in patients due to their side effects, delayed effect, or high cost of the drugs [2,8].

By managing with symptomatic drugs, patients only postpone the need for surgical treatment, and the growth of the gland volume continues during all these years of inactivity. By the time of the need for surgical treatment, the somatic status is usually aggravated, and the choice of surgical intervention with a large gland volume becomes a serious problem [2,9].

Purpose of the study.

To evaluate the immune system of patients after EAP, traditional adenectomy and TUR

Materials and methods.

The study included 80 patients with clinically and morphologically confirmed BHP hospitalized in the urology department between 2020 and 2024. Patients were categorized into three groups:

Group 1 (n=20): endoscopic prostate ablation (EAP)

Group 2 (n=20): transurethral resection of prostate (TUR)

Group 3 (n=40): open traditional adenectomy

Before the operation and on the 7th day after the intervention, venous blood was collected from all patients to analyze immunological parameters. The following parameters were studied:

Number of lymphocytes, subpopulations of T-cells (CD3+, CD4+, CD8+), NK-cells (CD16+/CD56+), B-cells (CD19+)

Levels of circulating immunoglobulins (IgA, IgM, IgG)

Concentrations of pro-inflammatory cytokines (IL-6, TNF- α , IL-1 β)

Immunophenotyping was performed by flow cytometry. Statistical processing of data was performed using the package [SPSS 26.0], significance level – $p < 0.05$.

Results. We performed a detailed comparative phenotypic characterization of lymphocytes infiltrating the prostate tissue in BPH (PIL) and the corresponding cells derived from peripheral blood (PB). In addition, soluble factors present in prostate tissue were analyzed to identify pro-inflammatory components potentially affecting the microenvironment of hyperplastic foci. The main objective of the study was to investigate the role of the immune system in the progression of BPH by comparing local immune activity with clinical characteristics of the disease.

Comparison of peripheral blood mononuclear cells (PBMCs) with PILs in patients with BPH revealed significant differences in the composition of the analyzed immune cell subtypes (Fig. 1, and Table 1).

The frequency of CD3+ cells was increased in BPH tissue compared to MCPC, but the frequency of B-cells and natural killer cells (NK-cells) was decreased (Table 2). Separation of CD3+ T cells into CD4+ and CD8+ T cells revealed a significantly reduced CD4:CD8 ratio in prostate adenoma tissue compared to peripheral blood mononuclear cells (0.6 vs. 1.7) (Table 2). In approximately 75% of the prostate adenoma tissue samples obtained ($n = 23$), more CD8+ T cells were present than CD4+ T cells.

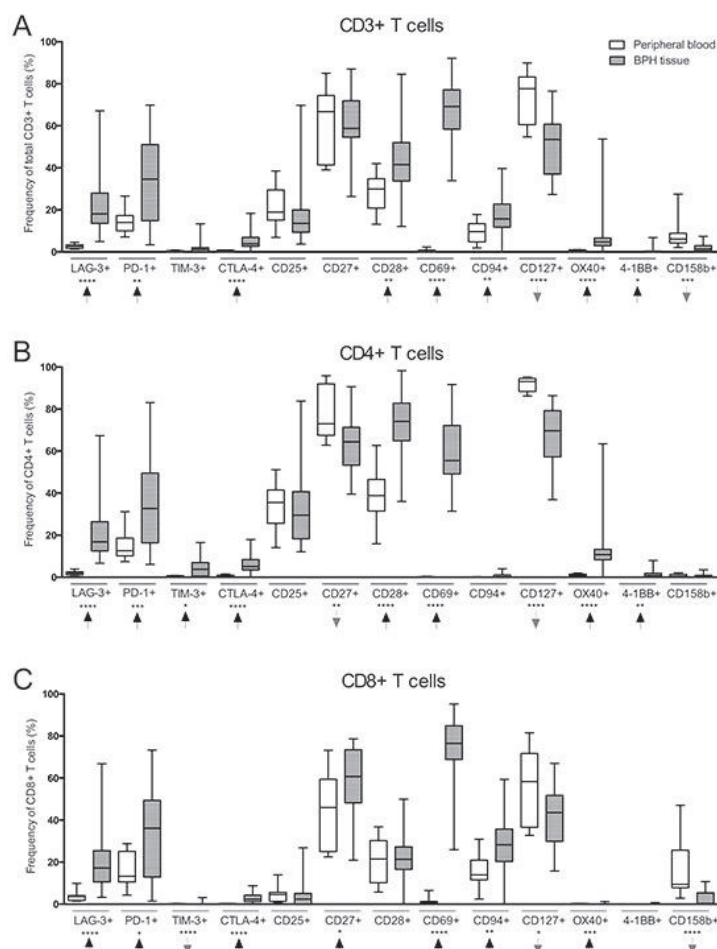


Fig 1. Comparison of T-cell subtype frequencies in peripheral blood and in benign prostatic hyperplasia (BPH) tissue obtained from patients with BPH.

Table 1

Comparison of the composition of immune cells in PBMCs and BPH tissue (PIL)

Indicator	PBMCs (peripheral blood)	PIL (BPH tissue)	Distinction
CD3 cells	Low frequency	Increased frequency	Predominance in the tissue of the PIL
B-cells (CD19 ⁺)	Higher	Below	Reduced presence in PIL
NK cells (CD16 ⁺ /CD56 ⁺)	Higher	Below	Immunosuppression of innate immunity in tissue
CD4 ⁺ : CD8 ⁺ ratio	~1.7	~0.6	Significant reduction in BHT tissue
CD8 ⁺ T cells	Less than CD4 ⁺	Predominant in 75% of samples	Suppression of CD4 ⁺ /prevalence of cytotoxic cells

Note:

- - CD4:CD8 data (1.7 in ICPC vs. 0.6 in PIL) demonstrates a marked shift toward a cytotoxic response in the hyperplasia tissue.
- - The increase in CD3 cells in the PIL may include innate lymphoid cells or other nonspecific populations.
- - n = 23 is the number of tissue samples in which CD4⁺ and CD8⁺ cells were evaluated.

An increased frequency of T-cells was observed in prostate tissue affected by benign prostatic hyperplasia compared to peripheral blood mononuclear leukocytes

We conducted studies of immune status in patients after different types of surgery for BPH.

Table 2

Changes in immune parameters in patients with BPH after different methods of surgical treatment

Indication	EAP (n=20)	TUR (n=20)	Adenectomy (n=40)
IL-6 (pg/mL)	Moderate increase	Boost	Significant increase
TNF- α (pg/mL)	(up to 1.5 \times)	(up to 2 \times)	(up to 3-4 \times)
CD4 ⁺ (T-helpers)	Slight increase	Moderate increase	Significant increase
CD8 ⁺ (T-killers)	Slight decrease	Moderate decrease	Significant decrease
CD4 ⁺ /CD8 ⁺ ratio	Slight increase	Increase	Increase
NK cells (CD16 ⁺ /CD56 ⁺)	Almost no change	Decrease to the lower limit of normal	Decrease
Immunoglobulins (IgG, IgM, IgA)	No significant change	Slight decrease	below normal
Total inflammation activity	Within normal range	Slight decrease	Decrease

Note:

- All indicators are indicated on the 7th day after surgery.
- "Increase"/"decrease" reflect deviations from the preoperative level (average values for the group).

Preoperative indicators

At the preoperative stage, no significant differences in the immunologic status between the three groups were found ($p>0.05$), indicating comparability of the initial data.

Postoperative changes

In the EAP group, there was a slight and short-term increase in IL-6 and TNF- α levels with normalization by day 7. The increase in CD8+ lymphocytes was minimal. In patients after TUR there was a more pronounced, but still moderate increase in pro-inflammatory cytokines and decrease in CD4+/CD8+ ratio. The most significant activation of the inflammatory response and decrease in the number of T-helper cells (CD4+) were observed in the group after open adenomectomy, accompanied by an increase in IL-6, IL-1 β and TNF- α ($p<0.01$ compared to other groups).

The results demonstrate that the degree of immune activation after surgical treatment of BPH depends on the invasiveness of the method. EAP has the least impact on the immune system, which may indicate its more sparing nature. Open adenomectomy is accompanied by a pronounced inflammatory response, potentially increasing the risk of postoperative complications and delaying recovery.

Thus, the choice of treatment method should take into account not only clinical indications and gland volume, but also individual peculiarities of the patient's immune response, especially in case of concomitant diseases affecting immunity.

Conclusion. In conclusion, prostate adenoma tissue is a proinflammatory, chemotactically attractive site in which chronic activation can deplete T cells infiltrating the prostate. The method of surgery for BPH has different effects on the patient's immune system. Endoscopic prostate ablation is characterized by the lowest degree of immune stress, while open adenomectomy is characterized by the most pronounced immunosuppression and inflammatory response. The obtained data can be taken into account in the choice of optimal treatment tactics and in the development of postoperative rehabilitation programs.

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