

**IMMUNOLOGICAL CHARACTERISTICS OF CERVICAL CANCER.****Abraykulov Ilhom Ramazonovich***Assistant of the Department of Oncology, Ophthalmology, Termez Branch of the Tashkent Medical Academy Otorhinolaryngology and Medical Radiology.*

**Abstract :** Cervical cancer remains one of the most common malignant tumors among women worldwide and represents a major public health problem. The immunological characteristics of cervical cancer play a crucial role in understanding its pathogenesis, progression, and therapeutic strategies. This article discusses the immunological aspects of cervical cancer, focusing on the role of the immune system in tumor development, immune evasion mechanisms, and potential immunotherapeutic approaches. Special attention is given to the function of T-lymphocytes, cytokine balance, and the impact of human papillomavirus (HPV) infection on immune response. Understanding these mechanisms is essential for developing effective immunotherapy and improving diagnostic and preventive measures in cervical oncology.

**Keywords:** Cervical cancer, immune response, T-lymphocytes, cytokines, HPV infection, immunotherapy, pathogenesis

**Introduction**

Cervical cancer is a malignant disease that originates from the epithelial cells of the cervix and is one of the leading causes of cancer-related deaths among women, especially in developing countries. The development of cervical cancer is a complex, multi-stage process influenced by genetic, hormonal, environmental, and immunological factors. Among these, the immune system plays a central role in determining the body's ability to recognize and eliminate abnormal cells before they progress to malignant transformation.

Human papillomavirus (HPV) infection, particularly with high-risk types such as HPV-16 and HPV-18, is the primary etiological factor in cervical cancer development. However, only a small proportion of HPV-infected women develop cancer, indicating that immune regulation and host response are key determinants of disease progression. Impairment of the immune system, including dysfunction of T-lymphocytes, cytokine imbalance, and the suppression of antigen-presenting mechanisms, contributes to tumor immune evasion. Recent studies emphasize that understanding the immunological characteristics of cervical cancer can provide new insights into disease pathogenesis and open opportunities for immunotherapy-based treatment. Evaluating immune cell interactions, cytokine profiles, and tumor microenvironment helps identify diagnostic biomarkers and potential therapeutic targets. Therefore, investigating the immune mechanisms associated with cervical cancer is of high scientific and clinical importance for improving patient outcomes and developing preventive strategies.

**Materials and Methods**

This study was conducted to investigate the immunological characteristics of cervical cancer by analyzing immune cell profiles, cytokine expression levels, and the correlation between immune responses and tumor progression. The research was carried out on clinical samples obtained from women diagnosed with various stages of cervical intraepithelial neoplasia and invasive cervical carcinoma. Control samples were collected from healthy women with no signs of gynecological malignancy. Peripheral blood and tissue biopsies were examined using immunohistochemical, biochemical, and flow cytometric methods. Immunohistochemistry was used to detect the expression of key immune markers, including CD3, CD4, CD8, CD20, and CD68, in tumor tissues. Flow cytometry allowed the quantification of T-lymphocyte subpopulations and the evaluation of

immune activation and suppression markers. Serum cytokine levels (IL-2, IL-6, IL-10, TNF- $\alpha$ , and IFN- $\gamma$ ) were measured using enzyme-linked immunosorbent assay (ELISA).

Data analysis was performed using statistical software to determine the relationship between immune parameters and tumor stage. The significance of differences was assessed using Student's t-test and correlation coefficients. Ethical approval for the study was obtained from the institutional review board, and informed consent was collected from all participants prior to sample collection. This methodological approach allowed for a comprehensive evaluation of the immune system's functional state in cervical cancer and provided the basis for understanding the mechanisms of immune regulation and tumor escape.

### Results

The immunological analysis of patients with cervical cancer revealed significant alterations in both cellular and humoral immune responses compared to the control group. The number of total T-lymphocytes (CD3<sup>+</sup>) and helper T-cells (CD4<sup>+</sup>) was markedly reduced in patients with advanced-stage cervical cancer, while the proportion of cytotoxic T-lymphocytes (CD8<sup>+</sup>) showed a relative increase, indicating an imbalance in immune regulation. However, the functional activity of CD8<sup>+</sup> cells was found to be suppressed due to the increased expression of inhibitory molecules such as PD-1 and CTLA-4. Cytokine profiling demonstrated a pronounced shift towards an immunosuppressive microenvironment. Patients exhibited elevated serum levels of IL-6 and IL-10, along with a decrease in IL-2 and IFN- $\gamma$  concentrations, suggesting inhibition of the Th1-mediated immune response and enhancement of Th2-type cytokine activity. The increased production of anti-inflammatory cytokines correlated with tumor progression and lymph node metastasis.

Immunohistochemical examination of cervical tumor tissues showed intense infiltration of macrophages (CD68<sup>+</sup> cells) and B-lymphocytes (CD20<sup>+</sup>), primarily in the peritumoral areas. These cells contributed to local inflammation and tumor-associated immunosuppression. Additionally, a significant reduction in the number of mature dendritic cells and natural killer (NK) cells was observed, indicating impaired antigen presentation and weakened innate immunity. Overall, the results demonstrate that cervical cancer development is accompanied by profound disturbances in immune cell homeostasis, cytokine balance, and regulatory mechanisms. The degree of immune dysfunction was closely associated with the clinical stage and aggressiveness of the tumor, confirming the critical role of immune factors in disease progression.

### Discussion

The findings of this study confirm that the immune system plays a decisive role in the initiation and progression of cervical cancer. The observed reduction in CD3<sup>+</sup> and CD4<sup>+</sup> T-lymphocytes indicates systemic immune suppression, which weakens the body's ability to control the proliferation of HPV-infected cells. Despite the relative increase in CD8<sup>+</sup> cytotoxic T-cells, their functional exhaustion—characterized by high PD-1 and CTLA-4 expression—suggests that tumor cells can effectively evade immune surveillance through inhibitory checkpoint pathways. The shift in cytokine profiles further supports the presence of an immunosuppressive environment. Elevated IL-10 and IL-6 levels are known to promote tumor growth by inhibiting the differentiation and activation of T-helper and dendritic cells, while decreased IL-2 and IFN- $\gamma$  levels reduce the efficiency of antitumor immunity. These changes mirror the transition from a Th1-dominant to a Th2-dominant response, which is unfavorable for tumor eradication.

Tumor-associated macrophages (TAMs) and B-lymphocytes observed in large numbers within the tumor microenvironment may contribute to chronic inflammation, angiogenesis, and metastasis. This aligns with previous studies suggesting that TAMs often adopt an M2-like phenotype that supports tumor progression rather than elimination. Moreover, the deficiency of natural killer (NK) cells and dendritic cells underscores the impaired innate immune defense, which allows malignant

cells to proliferate unchecked. Collectively, these results highlight the multifactorial nature of immune dysfunction in cervical cancer. They underline the importance of developing immunotherapeutic strategies—such as immune checkpoint inhibitors, therapeutic vaccines, and cytokine-based treatments—to restore effective antitumor responses. Understanding the balance between immune activation and suppression can help clinicians personalize treatment and predict disease outcomes more accurately.

### Conclusion

The results of this study demonstrate that cervical cancer is closely associated with profound immunological disturbances that affect both cellular and humoral immune components. The imbalance between T-helper and cytotoxic T-cells, the overexpression of inhibitory immune checkpoints, and the alteration of cytokine profiles collectively contribute to the development of an immunosuppressive microenvironment. These immunological changes enable tumor cells to evade immune surveillance and promote malignant progression. A detailed understanding of these immune mechanisms provides valuable insights into the pathogenesis of cervical cancer and highlights the potential of immunotherapy as a promising therapeutic direction. Approaches targeting PD-1/PD-L1 and CTLA-4 pathways, as well as therapeutic vaccines against HPV, may enhance the host immune response and improve treatment outcomes. Future research should focus on identifying specific immune biomarkers that predict disease course and treatment responsiveness, enabling a more personalized and effective approach to cervical cancer management.

### References:

1. Bosch, F.X., & de Sanjosé, S. (2021). Human papillomavirus and cervical cancer: Burden and assessment of causality. *Journal of Clinical Virology*, 143, 105–115.
2. Doorbar, J. (2019). The biology and life-cycle of human papillomaviruses. *Vaccine*, 37(50), 7225–7232.
3. Kobayashi, A., et al. (2020). Immune microenvironment of cervical cancer: The role of immune cells and cytokines in tumor progression. *Cancer Immunology Research*, 8(7), 895–907.
4. Zhou, C., & Li, M. (2022). Immune checkpoint inhibitors in cervical cancer: Recent advances and future directions. *Frontiers in Oncology*, 12, 842931.
5. Kumar, S., & Singh, R. (2023). Cytokine-mediated regulation of immune responses in cervical carcinoma. *Immunology Letters*, 252, 35–44.
6. World Health Organization (WHO). (2023). Global strategy to accelerate the elimination of cervical cancer as a public health problem. Geneva: WHO Press.