



MODERN PROBLEMS IN EDUCATION AND THEIR SCIENTIFIC SOLUTIONS

ASSESSMENT OF THE MORPHOLOGICAL ACTIVITY OF LYMPHOCYTE SUBPOPULATIONS (CD4, CD8, CD20) IN HIV-ASSOCIATED TUBERCULOSIS

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Abstract. *This scientific study was conducted between 2021 and 2024 at the Departments of Phthysiology and Pathomorphology of the Fergana Region. A total of 90 patients were examined — 60 with HIV-associated tuberculosis and 30 HIV-negative tuberculosis cases. The primary aim was to assess the morphological and immunohistochemical activity of the main lymphocyte subpopulations — CD4+, CD8+, and CD20+ cells — in HIV-associated tuberculosis.*

According to the results, the number of CD4+ T-helper lymphocytes significantly decreased, the number of CD8+ cytotoxic lymphocytes increased, and the activity of CD20+ B-lymphocytes declined. In patients with a CD4/CD8 ratio below 0.4, granuloma maturity was low (1.1 ± 0.3 points), and the necrotic area was extensive ($42.6 \pm 3.8\%$). This immune imbalance reflects the morphological mechanisms underlying the severe course of HIV-associated tuberculosis.

Keywords: *HIV, tuberculosis, CD4, CD8, CD20, immunohistochemistry, granuloma, morphological analysis.*

Introduction

Tuberculosis (TB) and human immunodeficiency virus (HIV) infection together constitute a dual global health problem with high mortality risk [1]. According to WHO, in 2023, 10.6 million new TB cases were identified, 7% of which were among people living with HIV [1]. HIV infection depletes CD4+ lymphocytes, disrupts immune balance, prevents classical granuloma formation, promotes caseous necrosis, and leads to atypical morphological patterns [2, 3].

Recent studies (Huang S., 2024; Kacprzak A., 2022) have revealed that HIV-associated TB is characterized by disruption of granulomatous reactions, a reduced CD4/CD8 ratio, and macrophage dysfunction [2, 4]. In Uzbekistan, this issue remains relevant: in 2022, more than 19,000 TB cases were registered, 5.7% of which were HIV-related; in Fergana Region, the rate reached 6.1% [6].

Therefore, studying the morphological activity of lymphocyte subpopulations (CD4, CD8, CD20) in HIV-associated tuberculosis is of great scientific importance for improving immunomorphological diagnostics and early detection strategies.

Materials and methods

The study was conducted from 2021 to 2024 at the Fergana Regional Phthisiatry Center with the participation of 90 patients: 60 HIV-positive and 30 HIV-negative TB





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cases. The mean age was 39 ± 7.2 years. Most patients presented with weight loss, fever, and chronic cough.

Histological (H&E, Ziehl–Neelsen) and immunohistochemical (CD4, CD8, CD20) analyses were performed on biopsy and autopsy specimens. Granulomas were evaluated on a 0–3 point scale, and morphometric analysis determined necrosis percentage, granuloma diameter, and cell density. Electron microscopy revealed mitochondrial damage and phagolysosomal dysfunction in macrophages.

According to statistical analysis (SPSS 25.0), CD4 lymphocytes decreased to $155\pm 27/\text{mm}^3$, CD8 increased to $437\pm 31/\text{mm}^3$, and the CD4/CD8 ratio dropped to 0.36 ± 0.05 (control: 1.7 ± 0.2). CD20 cells appeared twice less frequently in the granuloma periphery. Granuloma maturity averaged 1.1 ± 0.3 points (control: 2.6 ± 0.4), while necrotic surface area was $42.6\pm 3.8\%$. CD4 correlated positively with granuloma maturity ($r=0.78$), CD8 correlated negatively with necrosis ($r=-0.64$), and CD20 correlated positively with humoral response ($r=0.72$). These findings demonstrate a direct relationship between immune imbalance and morphological immaturity in HIV-associated TB.

Results

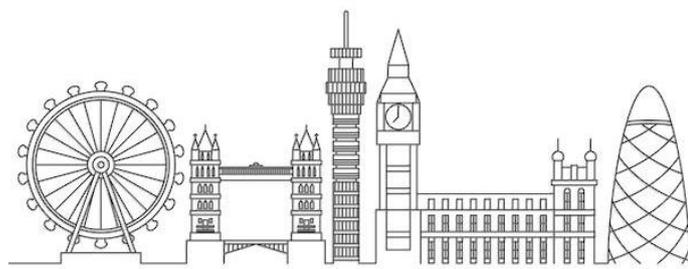
The study results revealed a severe disturbance in lymphocyte balance in HIV-associated tuberculosis. CD4 lymphocytes decreased ($155\pm 27/\text{mm}^3$), CD8 cells increased ($437\pm 31/\text{mm}^3$), and the CD4/CD8 ratio fell to 0.36 ± 0.05 (control: 1.7 ± 0.2 ; $p<0.01$), indicating a weakened cellular immune response. CD20 lymphocytes were reduced 2.3-fold, suggesting a diminished humoral immune response.

Granulomas were poorly formed (1.1 ± 0.3 points), while necrotic areas were extensive ($42.6\pm 3.8\%$). Electron microscopy revealed mitochondrial damage and phagolysosomal dysfunction in macrophages. Positive correlations were observed between CD4 and granuloma maturity, negative correlations between CD8 and necrosis, and positive correlations between CD20 and humoral response. These findings confirm a close link between immune imbalance and tissue destruction.

Conclusion

The study demonstrated significant immune dysregulation in HIV-associated tuberculosis. CD4 lymphocytes decreased, CD8 lymphocytes increased, and CD20 activity declined. In patients with a CD4/CD8 ratio below 0.4, granulomas were incompletely formed and necrotic foci were expanded. Reduction in CD20 levels weakened humoral immunity, contributing to a protracted disease course. Electron microscopy confirmed mitochondrial damage and phagolysosomal dysfunction in macrophages.

The correlations between CD4/CD8 ratio, granuloma maturity, and necrosis percentage confirm a direct relationship between immune imbalance and morphological alterations.





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