ISSN 2181-

LABORATORY DIAGNOSTICS IN ONCOLOGY. CURRENT ADVANCES AND FUTURE PERSPECTIVES

Nabieva Farangiz Sadriddinovna
Senior lecturer of the Department of Clinical Laboratory Diagnostics and with a course in clinical laboratory diagnostics PGF
Zhuraeva E'zoza Nodir kizi
Cadet of the Department of Clinical Laboratory Diagnostics and with a course in clinical laboratory diagnostics PGF
Shukurova Sevilya Xasanovna
Student of the Samarkand State Medical University

Abstract. *This article analyzes the current state and development trends of laboratory diagnostic methods in oncology based on contemporary scientific literature. Within the framework of a literature review, the diagnostic and prognostic significance of biochemical laboratory parameters, tumor markers, immunological, and molecular genetic diagnostic methods used in the diagnosis of oncological diseases is discussed.*

Keywords: *oncology, laboratory diagnostics, tumor markers, biochemical analysis, immunological diagnostics, molecular genetic methods, liquid biopsy.*

Introduction. Oncological diseases represent one of the most pressing challenges in modern medicine. According to the World Health Organization, malignant neoplasms rank among the leading causes of mortality worldwide, following cardiovascular diseases. Delayed diagnosis of oncological processes, prolonged latent disease progression, and the manifestation of clinical symptoms at advanced stages necessitate continuous improvement of diagnostic efficiency. In this context,

laboratory diagnostics plays a decisive role in early cancer detection, differential diagnosis, assessment of tumor activity, prognosis, and monitoring of treatment efficacy. Advances in molecular biology, immunology, and genomics in recent years have significantly expanded the capabilities of laboratory diagnostics [5].

This literature review analyzes the main laboratory diagnostic methods applied in oncology, their clinical significance, advantages, and limitations based on contemporary scientific sources [6].

Biochemical laboratory parameters play an important role in assessing metabolic alterations in oncology patients, determining the extent of tumor progression, and identifying complications. Even though these parameters are not tumor-specific, they provide valuable insight into the underlying pathophysiological mechanisms of malignancies. An elevated level of lactate dehydrogenase (LDH) in serum is associated with increased anaerobic glycolysis and high metabolic activity of tumor tissue. LDH is considered a prognostic biomarker in lymphoproliferative disorders, melanoma, and germ cell tumors. Scientific studies indicate that high LDH levels correlate with aggressive disease progression and reduced survival rates. Changes in liver function indicators, including alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase, and bilirubin, may indicate hepatic metastases or involvement of the hepatobiliary system in the tumor process. In particular, elevated alkaline phosphatase levels are characteristic of bone metastases [2].

Additionally, parameters such as total protein, albumin, electrolytes, and creatinine are essential for evaluating the general condition of oncology patients, assessing cancer-associated cachexia, and monitoring renal function during chemotherapy. Due to their low specificity, biochemical markers are not used as independent diagnostic criteria but rather as integral components of comprehensive laboratory assessment [4].

Tumor markers are among the most extensively studied and widely used laboratory indicators in oncological practice. They are substances produced either by tumor cells or by the host organism in response to tumor growth and are primarily

detected in blood serum. The most commonly used tumor markers include alpha-fetoprotein (AFP), carcinoembryonic antigen (CEA), CA-125, CA-19-9, CA-15-3, and prostate-specific antigen (PSA). For example, elevated AFP levels are characteristic of hepatocellular carcinoma and germ cell tumors, while PSA is widely used for screening and monitoring prostate cancer [3].

Contemporary literature emphasizes the limited value of tumor markers in early cancer detection. Their primary clinical utility lies in evaluating treatment response, monitoring remission, and early detection of recurrence. It is also important to consider that inflammatory processes, liver diseases, and certain physiological conditions may influence tumor marker levels, which should be carefully interpreted by clinicians [2].

Recent studies highlight the development of multibiomarker panels, which allow simultaneous assessment of several tumor markers and significantly improve diagnostic sensitivity.

Immunological laboratory diagnostics plays a crucial role in identifying tumor antigen profiles, immune response characteristics, and sensitivity to therapy. One of the most widely used methods is enzyme-linked immunosorbent assay (ELISA), which enables highly sensitive detection of tumor markers, cytokines, and tumor-associated antigens [1].

Immunohistochemical analysis allows visualization of antigen expression in tumor tissues, facilitating determination of tumor histogenesis, differential diagnosis, and selection of patients for targeted therapy. For instance, expression of HER2/neu, estrogen receptors (ER), and progesterone receptors (PR) is a decisive factor in determining treatment strategies for breast cancer [8].

Flow cytometry is primarily applied in hematological malignancies and enables accurate classification of leukemias and lymphomas by identifying immunophenotypic characteristics of cell populations. Immunological methods thus play a key role in implementing personalized approaches in oncology [3].

Molecular genetic laboratory diagnostics is one of the fastest-growing fields in oncology and provides insight into the genetic basis of tumor development.

Technologies such as polymerase chain reaction (PCR), real-time PCR, fluorescence in situ hybridization (FISH), and next-generation sequencing (NGS) enable detection of oncogenes, tumor suppressor genes, and driver mutations. Identification of mutations in BRCA1/2, TP53, KRAS, EGFR, and BRAF genes is essential not only for diagnosis but also for determining optimal treatment strategies. Molecular analyses allow prediction of response to targeted and immunotherapies [2,4].

In recent years, the rapidly developing liquid biopsy approach-based on detection of circulating tumor DNA (ctDNA) or circulating tumor cells in blood-has gained considerable attention as a minimally invasive monitoring method. This technique enables real-time assessment of treatment response and early detection of disease recurrence [7].

In **conclusion**, laboratory diagnostics plays a pivotal role in early detection, treatment planning, and prognostic evaluation of oncological diseases. The combined application of biochemical, immunological, and molecular genetic methods significantly enhances diagnostic accuracy. Advances in modern laboratory technologies continue to expand diagnostic capabilities and contribute to improved quality of life and outcomes for oncology patients.

LITERATURE:

1. Abeloff M.D., Armitage J.O., Niederhuber J.E. et al. Abeloff's Clinical Oncology. – 6th ed. – Philadelphia: Elsevier, 2020. – 2350 p.

2. Bray F., Laversanne M., Sung H. et al. Global cancer statistics 2022 // CA: A Cancer Journal for Clinicians. – 2024. – Vol. 74, No. 3. – P. 229–263.

3. Duffy M.J. Tumor markers in clinical practice: A review focusing on common solid cancers // Medical Principles and Practice. – 2013. – Vol. 22. – P. 4–11.

4. Hanahan D., Weinberg R.A. Hallmarks of cancer: The next generation // Cell. – 2011. – Vol. 144. – P. 646–674.

5. Ludwig J.A., Weinstein J.N. Biomarkers in cancer staging, prognosis and treatment selection // Nature Reviews Cancer. – 2005. – Vol. 5. – P. 845–856.

6. Rossi G., Ignatiadis M. Promises and pitfalls of using liquid biopsy for precision medicine // Cancer Research. – 2019. – Vol. 79. – P. 2798–2804.

7. Pantel K., Alix-Panabières C. Liquid biopsy in cancer patients // Cancer Research. – 2019. – Vol. 79. – P. 540–543.

8. Siegel R.L., Miller K.D., Jemal A. Cancer statistics, 2023 // CA: A Cancer Journal for Clinicians. – 2023. – Vol. 73, No. 1. – P. 17–48.