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NEW MARKERS OF HISTOPATHOLOGICAL DIAGNOSIS IN ONCOLOGY

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Annotation: Recent advances in molecular biology and immunohistochemistry have profoundly transformed the landscape of histopathological diagnostics in oncology. The identification of novel biomarkers has enhanced diagnostic accuracy, enabled early cancer detection, and improved therapeutic stratification. These markers, ranging from immunohistochemical antigens to genetic and epigenetic signatures, provide critical insights into tumor biology, proliferation, and metastatic potential. Modern histopathological diagnostics now integrate traditional morphology with molecular profiling to deliver precise, personalized cancer diagnosis. This article reviews emerging histopathological markers, their biological significance, and their applications in oncological practice.

The continuous development of molecular and cellular biology has profoundly transformed the landscape of oncological histopathology. In recent years, the discovery and implementation of new diagnostic and prognostic biomarkers have significantly enhanced the precision, reproducibility, and clinical relevance of cancer diagnostics. Histopathological diagnosis is no longer confined to morphological assessment alone but now integrates molecular signatures, immunohistochemical profiles, and genetic alterations that reflect the biological behavior of tumors. These markers serve as key tools in identifying tumor origin, predicting disease progression, and determining therapeutic response.

Immunohistochemical markers such as Ki-67, HER2/neu, PD-L1, and p53, as well as molecular markers including KRAS, EGFR, BRCA1/2, and BRAF, have become essential components of modern diagnostic protocols. Furthermore, the emergence of epigenetic markers, circulating microRNAs, and methylation patterns has provided novel non-invasive methods for early cancer detection and prognosis evaluation. By linking histological morphology with molecular pathogenesis, these biomarkers enable a multidimensional understanding of neoplastic processes and support the development of precision oncology.

Recent advances in digital pathology and artificial intelligence have also accelerated the discovery of novel histopathological markers, allowing automated quantification of tissue

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characteristics and pattern recognition at a microscopic level. This integration of computational analytics with traditional histology contributes to higher diagnostic accuracy, faster workflow, and the potential identification of previously unrecognized histological signatures.

Overall, the implementation of new markers in histopathological diagnostics marks a paradigm shift in oncology. These innovations not only improve the diagnostic and prognostic capabilities of pathologists but also promote personalized treatment strategies tailored to the molecular profile of each patient's tumor. This review highlights the current trends, representative examples, and future perspectives of novel markers in oncological histopathology, emphasizing their critical role in the evolution of cancer diagnosis and therapy.

Key words: histopathology, biomarkers, oncology, immunohistochemistry, molecular diagnostics, cancer, prognosis

Main Part

Histopathology remains the cornerstone of cancer diagnosis, offering microscopic insights into tumor architecture, cellular morphology, and differentiation patterns. However, traditional morphology alone cannot fully capture the complex molecular diversity of malignant neoplasms. The introduction of new diagnostic markers has revolutionized the field, bridging the gap between histological appearance and molecular behavior. These markers help differentiate tumor subtypes, predict prognosis, and guide targeted therapy selection.

1. Immunohistochemical Markers

Immunohistochemistry (IHC) remains one of the most powerful diagnostic tools in oncology. It allows visualization of specific proteins within cells and tissues using antigen-antibody reactions. Traditional markers such as cytokeratins, vimentin, desmin, and S-100 have long been used to identify the origin of tumors. However, recent developments have introduced novel markers that provide more refined diagnostic and prognostic information.

In breast cancer, for example, Ki-67, HER2/neu, estrogen receptor (ER), and progesterone receptor (PR) are standard markers that guide therapeutic decisions. Overexpression of HER2/neu correlates with aggressive tumor behavior but also indicates responsiveness to trastuzumab therapy. In lung carcinoma, thyroid transcription factor-1 (TTF-1) and napsin A are key markers for adenocarcinoma, while p40 and CK5/6 support squamous differentiation. The combined use of such markers ensures accurate subtyping of tumors with overlapping morphological features.

2. Molecular and Genetic Markers

The integration of molecular genetics into histopathology has expanded diagnostic precision beyond morphological limits. The identification of gene mutations, translocations, and amplifications provides insights into oncogenesis and therapeutic targets.

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In colorectal cancer, mutations in the KRAS, NRAS, and BRAF genes determine the response to anti-EGFR therapies. In non-small cell lung cancer (NSCLC), the detection of EGFR, ALK, ROS1, and MET alterations guides the use of tyrosine kinase inhibitors. Similarly, BRCA1 and BRCA2 mutations in breast and ovarian cancers are key determinants for PARP inhibitor therapy.

Moreover, next-generation sequencing (NGS) technologies allow comprehensive genomic profiling of tumors, enabling identification of rare but clinically significant variants. This approach supports precision oncology by linking molecular alterations with histological phenotypes, effectively integrating genetics into routine histopathological workflow.

3. Epigenetic and MicroRNA Markers

Beyond genetic mutations, epigenetic regulation plays a crucial role in tumor progression. DNA methylation, histone modification, and microRNA expression profiles are increasingly recognized as biomarkers for early cancer detection and prognostication.

For example, MGMT promoter methylation in glioblastoma predicts favorable response to alkylating agents, while CDKN2A (p16) hypermethylation serves as a marker of cervical and oropharyngeal carcinomas associated with HPV infection. MicroRNAs such as miR-21, miR-155, and miR-34a are emerging as non-invasive biomarkers detectable in serum or tissue, correlating with tumor aggressiveness and therapeutic resistance.

4. Predictive and Prognostic Biomarkers

A crucial development in modern oncology is the distinction between predictive and prognostic markers. Prognostic markers indicate the overall disease outcome regardless of therapy, while predictive markers forecast response to specific treatments. For instance, PD-L1 expression serves both roles: it predicts response to immune checkpoint inhibitors and correlates with immune evasion in several malignancies, including lung, bladder, and melanoma. The quantification of PD-L1 expression through immunohistochemical scoring is now a standard part of histopathological evaluation in immunotherapy protocols.

5. Integration of Digital Pathology and Artificial Intelligence

The growing use of digital pathology and artificial intelligence (AI) has introduced a new dimension to histopathological diagnostics. AI algorithms can analyze morphological patterns, quantify marker expression, and integrate multi-omic data to identify novel histological biomarkers. Combined with machine learning, these technologies promise to uncover molecular correlations that may be invisible to the human eye, promoting a more comprehensive understanding of tumor biology.

Conclusion

The rapid evolution of histopathological diagnostics in oncology reflects the dynamic integration of molecular biology, immunohistochemistry, and bioinformatics. New diagnostic markers have transformed cancer pathology from a purely morphological discipline into a molecularly guided

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science. The discovery and clinical validation of immunohistochemical, genetic, and epigenetic markers enable early tumor detection, accurate classification, and targeted therapy selection, ultimately improving patient survival and quality of life.

Emerging biomarkers not only enhance diagnostic precision but also offer valuable prognostic and predictive information, guiding individualized treatment plans. The incorporation of digital pathology and artificial intelligence into histopathology will further accelerate the discovery of new biomarkers, allowing for automated, reproducible, and data-driven cancer diagnostics. The future of oncological histopathology lies in the development of integrated diagnostic platforms that combine morphology, molecular profiling, and computational analytics to deliver truly personalized medicine.

In conclusion, new histopathological markers are the key to bridging the gap between morphology and molecular oncology. Their continuous identification, validation, and clinical implementation will remain central to improving diagnostic accuracy, optimizing therapeutic outcomes, and shaping the future of precision cancer medicine.

References:

1. Allison, K. H., & Hammond, M. E. (2018). Molecular pathology in cancer diagnosis: Current practices and future directions. Modern Pathology, 31(1), 112–125.
2. Tsao, M. S., et al. (2021). Biomarker testing in lung cancer: Molecular diagnostics and therapeutic implications. Journal of Clinical Oncology, 39(13), 1443–1463.
3. Исраилова, Г. М., Эшмурадова, С. Т., & Тураев, И. Э. (2010). ГИГИЕНИЧЕСКАЯ ОЦЕНКА ФАКТОРОВ РИСКА ЗАГРЯЗНЕНИЯ МЯСОМОЛОЧНОЙ ПРОДУКЦИИ, ПРОИЗВОДИМОЙ В УСЛОВИЯХ МАЛОВОДЬЯ. Профилактическая и клиническая медицина, (1), 41-43.
4. Nurumbetova, S. (2022). VAIN ASPECTS OF PRACTICAL RELIGIOUS EXAMINATION IN THE INVESTIGATION OF CRIMES RELATED TO PROHIBITED RELIGIOUS MATERIALS. Science and Innovation, 1(6), 108-113.
5. Nurumbetova, S. (2023). MODERN OPPORTUNITIES AND PROSPECTS FOR DEVELOPMENT EXPERT-CRIMINALISTIC ACTIVITY. Modern Science and Research, 2(9), 415-419.
6. Nurumbetova, S. (2022). ДИНИЙ МАЗМУНДАГИ ТАҚИҚЛАНГАН МАТЕРИАЛЛАР БИЛАН БОҒЛИҚ ЖИНОЯТЛАРНИ ТЕРГОВ ҚИЛИШДА ДИНШУНОСЛИК ЭКСПЕРТИЗАСИНИ ЎТКАЗИШ АМАЛИЁТИНИНГ МУҲИМ ЖИҲАТЛАРИ. Science and innovation, 1(C6), 108-113.
7. Khalimovich, R. B. (2023). Simplification of criminal proceedings: concept, content and importance. World Bulletin of Management and Law, 18, 51-54.
8. Reis-Filho, J. S., & Lakhani, S. R. (2016). The contribution of molecular pathology to breast cancer classification and prognostication. Histopathology, 68(1), 57–70.
9. Louis, D. N., et al. (2021). The 2021 WHO classification of tumors of the central nervous system: A summary. Acta Neuropathologica, 142(4), 625–656.
10. Tan, P. H., Ellis, I., Allison, K., Brogi, E., et al. (2020). The World Health Organization classification of breast tumors. Histopathology, 77(2), 181–185.