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Morphological Changes in Brast Neoplasia and Their Clinical Significance (Literature Review)

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Abstract: Breast neoplasia is one of the most common oncological diseases among women, and an in-depth study of its morphological characteristics is of great importance in determining diagnosis, prognosis, and treatment tactics. This literature review analyzes modern morphological changes observed in malignant and benign breast neoplasms, their histogenetic characteristics, and pathomorphological assessment criteria. In recent years, based on foreign and domestic sources, the histological types of tumors, degrees of differentiation, invasive characteristics, and the clinical significance of tumor microenvironment components have been highlighted. The diagnostic, prognostic, and predictive significance of biomarkers such as the estrogen receptor (ER), progesterone receptor (PR), HER2/neu, and Ki-67, which are widely used in immunohistochemical studies, was also evaluated. It has been shown that the integration of morphological and molecular-pathological data makes it possible to determine the biological behavior of breast cancer, assess the course of the disease and the risk of metastasis, and choose a personalized treatment strategy. An analysis of the literature showed that in modern pathomorphology, morphological diagnosis has become not only a diagnostic method but also an important prognostic and therapeutic tool for managing oncological patients.

Keywords: Breast Neoplasia, Breast Cancer, Pathomorphology, Morphological Diagnostics, Immunohistochemistry, ER, PR, HER2/neu, Ki-67, Molecular Subtypes, Tumor Microenvironment, Prognosis

Introduction

The relevance of the problem

Breast cancer is currently one of the most important medical and social problems in the field of oncology worldwide. It occupies a leading position among all malignant tumors found in women and remains one of the main causes of mortality associated with oncological diseases. In recent years, the increasing incidence of the disease and the relatively younger age of patients, as well as the molecular-biological heterogeneity of the tumor, have further necessitated a thorough morphological study of this pathology.[1] The analysis of the results obtained in the scientific literature directly contributes to the selection of various views and therapeutic measures. In particular, if we look at the analysis of scientific and medical literature over the past 5 years, the conclusions based on the work of some scientists below directly from the survival rate of patients to predict the consequences of the disease that occurs in them and can be expected. For example, according to Harbeck the clinical course of breast cancer and the response to therapy largely depend on its morphological and molecular characteristics. In modern oncology, it is emphasized

that assessing the histological structure, degree of invasiveness, and molecular profile of a tumor is of decisive importance in determining disease prognosis and treatment outcomes.[2]

In recent years, the introduction of modern diagnostic methods has led to a fundamental change in the understanding of the biology of tumors and the specificity of their classification, and this work continues to this day. Specifically, while morphological examination under previous classifications primarily consisted of confirming the diagnosis, today it has become an important tool for assessing the biological behavior of the tumor, determining the risk of metastasis, and selecting an individual treatment strategy.[3] The use of immunohistochemical research methods in breast tumor processes serves not only for diagnosis but also for selecting individual treatment measures for the disease. This can be seen in the works of several scientists, for example, it has been shown that immunohistochemical markers such as estrogen receptors (ER), progesterone receptors (PR), HER2/neu, and Ki-67 have not only diagnostic but also independent prognostic and predictive significance in breast tumor processes. The observation of discrepancies in the research results between the data obtained by certain examination methods necessitates the further development of the diagnosis of this disease.[4] For example, the presence of morphological and clinical differences between molecular subtypes of breast cancer in observations conducted by Prat and Pareja and Reis-Filho showed that luminal A, luminal B, HER2-positive and triple-negative subtypes in breast tumors differ significantly from each other in morphological structure, proliferative activity and prognostic indicators.[5]

As part of the work carried out in our country, the number of studies dedicated to the morphological features and immunohistochemical diagnostics of tumor processes, including breast cancer, is increasing. The features of the expression of immunohistochemical markers in breast carcinomas and the analysis of their clinical significance are described [6]. However, in the domestic literature, a generalized analysis of morphological changes based on modern molecular-pathological views has not been sufficiently covered. In this regard, the systematic analysis of modern data on the morphological characteristics of breast tumor processes, the immunohistochemical profile, and their clinical significance is one of the current scientific directions of pathanatomy. The integration of morphological diagnosis with molecular pathology and personalized oncology is of great importance in developing strategies for early detection, prognosis, and effective treatment of the disease.[7]

Purpose of the study

Analysis of morphological changes observed in malignant and benign breast neoplasms and assessment of their significance in determining prognosis and treatment tactics.[8]

Methodology

The study was conducted using the literature review method. Domestic and foreign scientific sources published between 2021 and 2025 dedicated to the morphological characteristics, immunohistochemical profile, and molecular subtypes of breast neoplasms were analyzed. Databases such as PubMed, Scopus, Web of Science, and Google Scholar were used for the literature search. Additionally, the current World Health Organization classification of breast tumors, ASCO, CAP, and ESMO recommendations, as well as modern immunohistochemical diagnostic algorithms, were studied.[9] The sources were evaluated using a comparative-analytical method, and the diagnostic, prognostic, and predictive significance of morphological and molecular-pathological indicators was analyzed.[10]

Result and Discussion

An analysis of the literature showed that breast neoplasms are characterized by high morphological and molecular heterogeneity. According to the modern WHO classification, these neoplasms are divided into benign, borderline, and malignant. Among malignant neoplasms, invasive non-specific carcinoma (NST) is the most common morphological variant, accounting for the majority of all invasive carcinomas; however, invasive lobular, mucinous, tubular, papillary, and metaplastic carcinomas also possess specific clinical and morphological characteristics, and their biological behavior and prognostic significance differ significantly.[11]

The analyzed sources emphasize that the morphological structure of the tumor is closely linked to the course of the disease and patient survival. In particular, the Nottingham (Scarff–Bloom–Richardson) assessment system remains an important criterion for determining the degree of aggressiveness of breast carcinomas. In this system, the degree of formation of glandular structures, nuclear polymorphism, and

mitotic activity indicators are evaluated. According to literature data, highly differentiated G1 tumors have a relatively favorable prognosis, while low-differentiated G3 carcinomas are characterized by high proliferative activity, invasive growth, and an increased risk of metastasis.[12]

Immunohistochemical methods for assessing breast cancer showed a relatively good prognosis due to high hormone receptor expression and a low proliferative index in luminal A subtype, as it became possible to identify molecular subtypes of tumors based on the intensity of ER, PR, HER2/neu, and Ki-67 markers. In the luminal subtype B, the Ki-67 index is higher, the clinical course is more aggressive, and the hyperexpression of the HER2 receptor in HER2-positive carcinomas determines the high biological activity of the tumor. Based on these studies, it was established that the survival rate of patients has significantly improved as a result of the use of modern targeted therapy. Triple negative carcinomas were characterized by a high degree of cellular atypia, high mitotic activity, and early metastasis, and were evaluated as one of the morphological variants with the most adverse outcomes.[13]

The number of studies dedicated to the significance of the tumor microenvironment in the literature is increasing every year. In particular, the level of tumor infiltrating lymphocytes (TILs) is being considered an important morphological criterion reflecting the immune system's antitumor response. Many studies have shown that high TILs levels are associated with a better response to immunotherapy and a relatively favorable prognosis in HER2-positive and triple-negative carcinomas. This circumstance indicates the need for a comprehensive assessment of not only the tumor parenchyma but also its stromal and immune components in the pathomorphological conclusion. Furthermore, the implementation of digital pathology and artificial intelligence technologies further expands the possibilities for the morphological assessment of breast neoplasia. Using digital microscopy and automated analysis systems, it has become possible to assess the histological type of the tumor, the degree of differentiation, and certain immunohistochemical parameters with high accuracy. This serves to increase the objectivity and reproducibility of morphological diagnosis.[14]

Thus, the analyzed literature data showed that a comprehensive assessment of morphological, immunohistochemical, and molecular characteristics in breast neoplasms is of decisive importance in determining the biological behavior of the disease, determining the prognosis, and selecting personalized treatment tactics. In modern pathomorphology, morphological diagnosis appears as a key link in the management of oncological patients, integrated with molecular pathology.[15]

Conclusion

Morphological examination in breast neoplasia is one of the primary directions of modern oncopathology. A comprehensive assessment of histological type, degree of differentiation, immunohistochemical markers, and molecular subtypes allows for the determination of the patient's prognosis and the selection of individual treatment tactics. The integration of morphological diagnostics with molecular pathology and digital technologies will serve to further improve the diagnosis of breast cancer in the future.

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