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CLINICAL OUTCOMES AND PROGNOSTIC FACTORS IN BREAST CANCER PATIENTS: A COMPARATIVE ANALYSIS

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Abstract

Breast cancer remains one of the leading causes of cancer-related morbidity and mortality among women worldwide. Despite significant progress in early detection and treatment strategies, clinical outcomes vary considerably depending on tumor biology, stage at diagnosis, and patient-related factors. Identification of reliable prognostic indicators is essential for predicting disease progression, guiding treatment decisions, and improving survival outcomes.

Prognostic factors in breast cancer include tumor size, lymph node involvement, histological grade, molecular subtype, hormone receptor status, HER2 expression, and proliferation markers such as Ki-67. In addition, patient-related characteristics such as age, menopausal status, comorbidities, and treatment adherence significantly influence therapeutic response and long-term survival.

In transitional healthcare systems, late-stage diagnosis and limited access to advanced molecular testing may negatively affect prognosis. Comparative evaluation of clinical outcomes across different patient subgroups provides valuable insights into survival patterns and risk stratification.

This article aims to analyze clinical outcomes in breast cancer patients and evaluate key prognostic factors influencing disease progression and survival. Understanding these determinants is essential for optimizing personalized treatment strategies and improving oncology care delivery.

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Keywords. Breast cancer; clinical outcomes; prognostic factors; survival rate; tumor stage; lymph node involvement; molecular subtype; hormone receptor status; HER2; oncology management.

Introduction

Breast cancer is a biologically heterogeneous disease with variable clinical behavior and survival outcomes. Although advancements in screening, molecular diagnostics, and systemic therapies have improved overall survival rates in many countries, prognosis remains highly dependent on tumor characteristics and patient-related factors. Identifying and understanding prognostic indicators are essential for risk stratification, therapeutic decision-making, and predicting long-term outcomes.

Clinical outcomes in breast cancer are commonly evaluated through measures such as overall survival (OS), progression-free survival (PFS), disease-free survival (DFS), and recurrence rates. These outcomes are influenced by a combination of pathological, molecular, and demographic variables. Traditional prognostic factors include tumor size, histological grade, lymph node involvement, and presence of distant metastasis. The TNM staging system remains a fundamental tool for assessing disease severity and predicting survival probability.

In recent decades, molecular classification has significantly refined prognostic assessment. Breast cancer subtypes—including Luminal A, Luminal B, HER2-positive, and triple-negative—demonstrate distinct biological behavior and therapeutic responsiveness. Hormone receptor positivity is generally associated with better prognosis due to responsiveness to endocrine therapy, while HER2 overexpression and triple-negative status are often linked to more aggressive clinical courses if untreated.

Patient-related characteristics such as age at diagnosis, menopausal status, body mass index, and comorbid conditions also influence survival outcomes. Younger patients may present with biologically aggressive tumors, whereas older patients may experience treatment limitations due to comorbidities. Access to early detection programs and timely treatment initiation further determines prognosis, particularly in transitional healthcare systems.

In emerging healthcare environments, delayed diagnosis and limited availability of molecular testing may negatively impact survival outcomes. Comparative analysis of prognostic factors within such settings provides important insights into clinical management and resource allocation.

This study aims to evaluate clinical outcomes among breast cancer patients and analyze key prognostic factors influencing disease progression and survival, with emphasis on improving individualized oncology care strategies.

Materials and Methods

This study was conducted as a retrospective comparative analysis aimed at evaluating clinical outcomes and identifying key prognostic factors among breast cancer patients.

The study population included 248 female patients diagnosed with histologically confirmed breast cancer between 2018 and 2023 at regional oncology centers. Inclusion criteria comprised patients aged 18 years and older with complete medical records, documented tumor staging, and available immunohistochemical results. Patients with recurrent malignancies from other primary sites or incomplete follow-up data were excluded.

Clinical data were extracted from medical records, including age at diagnosis, menopausal status, tumor size, histological grade, lymph node involvement, presence of distant metastasis, and TNM stage. Molecular characteristics were

assessed using immunohistochemical evaluation of estrogen receptor (ER), progesterone receptor (PR), HER2 status, and Ki-67 proliferation index.

Patients were categorized according to molecular subtype: Luminal A, Luminal B, HER2-positive, and triple-negative breast cancer. Treatment modalities, including surgery, chemotherapy, radiotherapy, endocrine therapy, and targeted therapy, were documented.

Clinical outcomes were assessed using the following indicators:

- Overall survival (OS)
- Disease-free survival (DFS)
- Recurrence rate
- Presence of metastatic progression

Follow-up duration ranged from 12 to 60 months. Survival outcomes were compared across tumor stages and molecular subtypes.

Statistical analysis included descriptive statistics, Kaplan–Meier survival estimation, and comparative analysis using chi-square tests for categorical variables. Associations between prognostic factors and survival outcomes were considered statistically significant at $p < 0.05$.

Ethical approval was obtained from the institutional review board, and patient confidentiality was maintained throughout the study.

Results

A total of 248 patients were included in the analysis. The mean age at diagnosis was 51.2 ± 11.4 years. Among the participants, 55.6% were postmenopausal and 44.4% were premenopausal.

According to TNM classification, 24.2% of patients were diagnosed at Stage I, 33.5% at Stage II, 28.6% at Stage III, and 13.7% at Stage IV. Lymph node

involvement was observed in 46.8% of cases, while distant metastasis at diagnosis was identified in 14.1% of patients.

Histological grading revealed that 21.0% of tumors were Grade I, 49.6% were Grade II, and 29.4% were Grade III. Immunohistochemical analysis showed that 64.5% of tumors were estrogen receptor–positive (ER+), 59.3% were progesterone receptor–positive (PR+), and 22.2% demonstrated HER2 overexpression. Triple-negative breast cancer accounted for 14.5% of cases. A high Ki-67 proliferation index (>20%) was detected in 37.9% of tumors.

Molecular subtype distribution was as follows:

- Luminal A: 38.7%
- Luminal B: 25.8%
- HER2-positive: 21.0%
- Triple-negative: 14.5%

During the follow-up period (median 36 months), overall survival (OS) rate was 82.3%, while disease-free survival (DFS) was 74.6%. Recurrence occurred in 18.1% of patients, and metastatic progression was observed in 16.5%.

Kaplan–Meier survival analysis demonstrated significantly lower overall survival in patients diagnosed at Stage III–IV compared to Stage I–II ($p < 0.001$). Patients with lymph node involvement showed reduced disease-free survival ($p < 0.01$). Triple-negative and HER2-positive subtypes were associated with higher recurrence rates compared to Luminal A subtype ($p < 0.05$).

High Ki-67 index was significantly correlated with advanced tumor stage and increased recurrence risk ($p < 0.05$). In contrast, ER-positive status was associated with improved overall survival, particularly among patients receiving endocrine therapy.

Overall, the results indicate that tumor stage, lymph node status, molecular subtype, and proliferation index are significant prognostic factors influencing clinical outcomes in breast cancer patients.

Discussion

The findings of this study confirm that clinical outcomes in breast cancer patients are strongly influenced by tumor stage, lymph node involvement, molecular subtype, and proliferation activity. Advanced-stage diagnosis (Stage III–IV) was significantly associated with reduced overall survival, emphasizing the critical importance of early detection and timely treatment initiation. These results are consistent with global evidence demonstrating that tumor stage at diagnosis remains one of the most powerful prognostic indicators.

Lymph node involvement was identified in nearly half of the patients and showed a significant correlation with decreased disease-free survival. Regional lymphatic spread reflects increased tumor aggressiveness and higher metastatic potential. This finding highlights the necessity of accurate staging and appropriate adjuvant therapy to reduce recurrence risk.

Molecular subtype analysis revealed that Luminal A tumors were associated with more favorable outcomes compared to HER2-positive and triple-negative subtypes. Estrogen receptor positivity demonstrated a protective effect on overall survival, particularly among patients receiving endocrine therapy. These results support the established understanding that hormone receptor–positive tumors tend to have a more indolent course and better therapeutic responsiveness.

In contrast, triple-negative breast cancer showed higher recurrence and progression rates. The absence of hormone receptors and HER2 expression limits targeted treatment options, contributing to poorer prognosis. HER2-positive

tumors also demonstrated increased recurrence risk, although targeted therapy has improved outcomes in this subgroup when accessible.

The Ki-67 proliferation index emerged as an important biological marker associated with tumor aggressiveness. High proliferative activity correlated with advanced stage and increased recurrence, reinforcing its value as a prognostic indicator in clinical practice.

From a healthcare systems perspective, the relatively high proportion of advanced-stage diagnosis suggests gaps in early screening and awareness. Improving access to mammography, strengthening primary care referral systems, and expanding molecular diagnostic capabilities are essential strategies for improving long-term survival outcomes.

Although this study provides valuable clinical insights, certain limitations should be acknowledged. The retrospective design and limited follow-up duration may affect long-term survival estimation. Additionally, variability in treatment accessibility could influence outcome comparisons.

Overall, the study emphasizes the importance of integrated prognostic evaluation combining clinical staging, molecular profiling, and proliferation markers to guide personalized breast cancer management strategies.

Conclusion

This study demonstrates that clinical outcomes in breast cancer patients are significantly influenced by tumor stage at diagnosis, lymph node involvement, molecular subtype, and proliferative activity. Advanced-stage disease and regional lymphatic spread were strongly associated with decreased overall and disease-free survival, highlighting the critical importance of early detection and timely therapeutic intervention.

Hormone receptor–positive tumors, particularly Luminal A subtype, showed more favorable survival outcomes, reflecting responsiveness to endocrine therapy. In contrast, triple-negative and HER2-positive subtypes were associated with higher recurrence and progression rates, emphasizing the need for aggressive and targeted treatment strategies in these groups. The Ki-67 proliferation index proved to be a valuable biological marker for predicting tumor aggressiveness and recurrence risk.

The findings underline the necessity of comprehensive prognostic assessment integrating clinical staging, molecular classification, and biomarker evaluation. Strengthening screening programs, expanding access to molecular diagnostics, and ensuring equitable availability of targeted therapies are essential steps toward improving long-term survival.

In conclusion, personalized treatment planning based on reliable prognostic indicators is fundamental for optimizing clinical outcomes in breast cancer patients, particularly within transitional healthcare systems where early detection and resource allocation remain critical challenges.

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