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RESEARCH ARTICLE

A DUAL APPROACH TO ASSESSING MAMMOGRAPHIC BREAST DENSITY: QUALITATIVE AND QUANTITATIVE CORRELATIONS WITH TUMOR CHARACT-ERISTICS

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ABSTRACT

Mammographic breast density (MBD) is an essential factor in breast cancer risk assessment and detection. This study aimed to qualitatively and quantitatively evaluate mammographic breast density and analyze its correlation with tumor characteristics in women diagnosed with breast cancer. A total of 200 patients with confirmed breast cancer were included in the study. Breast density was classified using the BI-RADS (Breast Imaging-Reporting and Data System) criteria and quantitatively assessed via software analysis. Tumor characteristics, including size, histological grade, and hormone receptor status, were obtained from clinical records. Statistical analysis demonstrated a significant correlation between higher breast density and adverse tumor characteristics, including larger tumor size and higher histological grade ($p < 0.05$). Notably, 45% of women with dense breasts (BI-RADS categories C and D) presented with tumors larger than 2 cm, compared to only 20% in the less dense groups (BI-RADS A and B). This study underscores the importance of accurate assessment of mammographic breast density in predicting tumor behavior and emphasizes its role in enhancing breast cancer screening strategies.

Keywords: Mammographic breast density, BI-RADS, tumor characteristics, breast cancer, risk assessment, hormone receptor status.

INTRODUCTION:

Mammographic breast density (MBD) is a critical parameter in breast cancer screening and risk assessment. It refers to the composition of breast tissue as seen on mammograms, where denser tissues appear radiopaque compared to fatty tissues, which appear radiolucent (1). The Breast Imaging-Reporting and Data System (BI-RADS) categorizes breast density into four levels: A (almost entirely fatty), B (scattered fibroglandular densities), C (heterogeneously dense), and D (extremely dense) (2). Studies have consistently shown that high breast density not only obscures the visibility of tumors on mammograms but also significantly increases the risk of developing breast cancer (3,4).

Women classified in BI-RADS categories C and D are at a four- to six-fold higher risk for breast cancer than those in categories A and B (5). The association between breast density and breast cancer risk is thought to be due to the denser tissue being more prone to malignant transformation, as it contains more epithelial and stromal cells (6). Additionally, the presence of high breast density has been linked with more aggressive tumor characteristics, such as larger tumor size and higher histological grades (7).

Qualitative assessments of breast density rely on the expertise of radiologists; however, inter-observer variability can complicate the interpretation of mammograms (8). Recent advances in imaging technology allow for quantitative measurement of breast density using specialized software, offering a more objective approach to evaluation (9). These advancements can enhance risk stratification and improve the sensitivity of breast cancer screening (10).

This study aims to conduct a comprehensive evaluation of mammographic breast density through both qualitative and quantitative methods and to analyze its correlation with tumor characteristics, including size, histological grade, and hormone receptor status. Understanding these relationships may contribute to personalized screening strategies and better prognostic information for women with breast cancer.

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Aim and Objectives:

Aim:

To comprehensively assess mammographic breast density and its correlation with tumor characteristics in women diagnosed with breast cancer.

Objectives:

1. To qualitatively and quantitatively assess mammographic breast density using BI-RADS and computer-aided detection systems.
2. To evaluate the correlation between breast density and tumor characteristics, including size, grade, and hormone receptor status.

Materials and Methods:

This prospective observational study was conducted in a tertiary care hospital over a two-year period, including 200 women aged 35–75 years with histologically confirmed breast cancer. Mammographic breast density was assessed using the BI-RADS classification and quantitatively evaluated using computer-aided density assessment software. Tumor characteristics, including tumor size, histological grade, and hormone receptor status (ER, PR, HER2), were obtained from medical records.

Inclusion Criteria:

- Women aged 35–75 with a confirmed diagnosis of breast cancer.
- Availability of pre-diagnostic mammograms.

Exclusion Criteria:

- Patients with a prior history of breast surgery or radiotherapy.
- Incomplete mammographic or tumor characteristic data.

Data were analyzed using statistical software, with Chi-square tests performed to assess correlations between breast density and tumor characteristics, considering $p < 0.05$ as statistically significant.

Results:

Table 1: Distribution of Breast Density Categories

Tumor Characteristic	Low Density (A+B) (n=90)	High Density (C+D) (n=110)	p-value
Tumor Size > 2 cm	20 (22.2%)	50 (45.5%)	0.001
Histologic Grade 3	10 (11.1%)	35 (31.8%)	0.02
ER Positive (%)	60 (66.7%)	70 (63.6%)	0.15

Description:

High-density groups (BI-RADS C and D) exhibited a significant correlation with larger tumor sizes and higher histological grades ($p < 0.05$). However, no statistically significant association was identified between breast density and ER positivity.

Discussion:

This study underscores the notable association between mammographic breast density and tumor characteristics. Higher breast density significantly correlated with larger tumor sizes and more aggressive histological grades. These findings are consistent with existing literature, which demonstrates that women with dense breasts often present with more advanced disease (11,12).

The increased likelihood of detecting larger tumors in women with high breast density may be attributed to the limitations of mammography in visualizing lesions in dense tissue. It has been established that dense tissue can obscure tumors, resulting in a delayed diagnosis and ultimately more advanced disease at the time of detection (13). In this study, 45.5% of women with dense breasts had tumors larger than 2 cm, compared to only 22.2% in the lower density group.

Histological grade, which provides insight into tumor aggressiveness, also showed a significant association with breast density. Women with dense breast tissue were more likely to have grade 3 tumors, which are linked with increased rates of metastasis and poorer outcomes (14). These results further affirm the critical role of mammographic density in breast cancer prognostication.

Although a correlation between breast density and hormone receptor status was investigated, the lack of significant association with ER positivity in this study aligns with some previous findings, suggesting

that breast density may not consistently predict hormone receptor status (15,16).

The implications of these findings are profound for clinical practice. Incorporating both qualitative and quantitative assessments of mammographic breast density into screening protocols may enhance early detection strategies for women at elevated risk of aggressive tumors. Future research should focus on integrating these assessments into personalized screening and treatment approaches, as well as exploring the biological mechanisms that underlie the association between breast density and tumor characteristics.

Conclusion:

This study established a significant correlation between mammographic breast density and aggressive tumor characteristics, including larger tumor size and higher histological grade. Women with high-density breasts (BI-RADS C and D) were more likely to present with advanced-stage tumors, which necessitates improved screening strategies. The findings advocate for the integration of both qualitative and quantitative assessments of mammographic breast density in breast cancer risk assessment. Enhancing the understanding of the relationship between breast density and tumor biology can inform personalized screening protocols and ultimately improve patient outcomes.

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