



## Original Research Article

# ROLE OF FINE NEEDLE ASPIRATION CYTOLOGY AND ITS HISTOPATHOLOGICAL CORRELATION IN THE DIAGNOSIS OF BREAST SWELLING IN RURAL BUNDELKHAND AMONGST ALL AGE GROUP AND IMMUNOHISTOCHEMISTRY IN SELECTIVE CASES

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## ABSTRACT

**Background:** Breast swellings are common clinical presentations affecting women of all age groups and require early and accurate diagnosis to differentiate benign from malignant lesions. Fine Needle Aspiration Cytology (FNAC) is a simple, minimally invasive, and cost-effective diagnostic technique widely used for the evaluation of breast masses, particularly in resource-limited rural settings. **Objectives:** To evaluate the diagnostic role and efficacy of Fine Needle Aspiration Cytology (FNAC) in breast swellings and to correlate cytological findings with histopathological examination, with the application of immunohistochemistry in malignant cases.

**Materials and Methods:** A hospital-based prospective study was conducted on 310 patients presenting with palpable breast swellings from June 2024 to November 2025 in the Department of Pathology, Government Medical College, Orai. FNAC was performed using 21–23 gauge needles, and smears were stained with Papanicolaou and May-Grünwald-Giemsa stains. Histopathological examination of excised specimens served as the gold standard. Immunohistochemistry including ER, PR, HER2-neu, and Ki-67 was performed in malignant cases. Data were analyzed using SPSS version 21.

**Results:** Out of 310 breast lump cases, most lesions were benign (76.45%), while 23.55% were malignant on histopathology. FNAC categorized 236 cases (76.13%) as benign and 66 cases (21.29%) as malignant. Cyto-histopathological correlation showed a high concordance rate of 95.81%, with only 4.19% discordant cases. All malignant cases diagnosed on FNAC were confirmed on histopathology. FNAC demonstrated excellent diagnostic performance with sensitivity of 96.43%, specificity of 97.47%, positive predictive value of 95.74%, negative predictive value of 97.88%, and overall diagnostic accuracy of 97.08%.

**Conclusion:** FNAC is a reliable, rapid, and economical diagnostic modality for the evaluation of breast swellings. When combined with histopathological confirmation and immunohistochemistry, it provides accurate diagnosis and assists in appropriate treatment planning, particularly in rural healthcare settings.

**Keywords:** Breast swelling, Fine Needle Aspiration Cytology, Histopathology, Immunohistochemistry, Breast cancer, Diagnostic accuracy.

## INTRODUCTION

Breast swellings are a common clinical presentation across all age groups and require prompt and accurate diagnosis to differentiate between benign and malignant lesions. In rural regions like Bundelkhand, limited access to advanced diagnostic tools and financial constraints often hinder early detection and management. Fine Needle Aspiration Cytology (FNAC) presents a simple, cost-effective, and minimally invasive diagnostic technique that holds significant potential for early and accurate assessment of breast lumps. However, despite its widespread use, variability in diagnostic accuracy and the need for confirmatory histopathology—especially in malignant cases—necessitate a systematic evaluation of its effectiveness.

The diagnostic accuracy of FNAC in breast lesions has been extensively validated through numerous institutional studies and meta-analyses worldwide. Multiple large series have reported impressive diagnostic parameters when FNAC findings are correlated with histopathological examination as the reference standard. Sensitivity values (the ability to correctly identify malignant lesions) typically range from 83% to 99% across different studies, while specificity values (the ability to correctly identify benign lesions) range from 92% to 100%.<sup>[1,2,11,12,13]</sup> These high diagnostic parameters establish FNAC as a highly reliable tool for distinguishing benign from malignant breast lesions when performed by experienced operators and interpreted by trained cytopathologists. The positive predictive value (the probability that a lesion diagnosed as malignant on FNAC is truly malignant) typically exceeds 95%, indicating that malignant diagnoses made by FNAC are highly reliable.<sup>[11,15]</sup> The negative predictive value (the probability that a lesion diagnosed as benign on FNAC is truly benign) also typically exceeds 90%, though this parameter is more variable and depends on the prevalence of malignancy in the study population.<sup>[4,6]</sup>

The implementation of standardized reporting systems for breast cytopathology has significantly improved diagnostic reproducibility, risk stratification, and communication between cytopathologists and clinicians. The International Academy of Cytology (IAC) Yokohama System for Reporting Breast Cytopathology, introduced in 2016, categorizes FNAC findings into five standardized categories: C1 (Insufficient/Inadequate), C2 (Benign), C3 (Atypical, probably benign), C4 (Suspicious of malignancy), and C5 (Malignant).<sup>[20,29]</sup> Each category is associated with a defined risk of malignancy (ROM) and specific management recommendations. Large validation studies have confirmed the diagnostic utility of the Yokohama system, with one 790-case series reporting sensitivity of 96.8% and specificity of 95.8%, and documenting ROM values ranging from 12.5% for

insufficient samples to 97.5% for malignant diagnoses.<sup>[7]</sup>

## MATERIALS AND METHODS

This hospital-based comparative and prospective study included 310 patients presenting with breast swellings, conducted from June 2024 to November 2025 in the Department of Pathology, Government Medical College, Orai, Jalaun, under Atal Bihari Vajpayee Medical University, UP. The study was approved by the Government Medical College, Orai, Jalaun Institutional Review Board **01/Ethics/RMC Jalaun/2024 Dated 05/06/2024**.

### Inclusion Criterion

- All patients attending the Department of Surgery, Obs. and gynae and Internal Medicine presenting with palpable breast mass were included.
- Females of Age between 12 years and 75 years
- Patients who gave consents regarding the procedure

### Exclusion Criterion

- Swelling present at any other part of body except breast area.
- All cases with inadequate sample.
- Patients not willing (written informed consent taken)
- All the patients in which histopathology samples were not available.

### SAMPLING INCLUDING SAMPLE SIZE CALCULATION

According to **Das and Koirala et al. (2018)**<sup>2</sup>, the prevalence of malignant breast lesions among breast swellings was reported to be 30%.

- $p = 0.30$
- $q = 1 - 0.30 = 0.70$
- $d = 0.051$

$$n = \frac{(1.96)^2 \times 0.30 \times 0.70}{(0.051)^2}$$

$$n = \frac{3.84 \times 0.21}{0.0026}$$

$$n = \frac{0.8064}{0.0026}$$

$$n \approx 310$$

Thus, the calculated sample size was approximately 310 patients, and therefore 310 patients presenting with breast swellings were included in the present study

### Study Method/ Tools

#### FNAC (Fine Needle Aspiration Cytology):

- **Needles:** 21–23 gauge
- **Syringes:** 5 ml and 10 ml disposable
- **Staining:**
  - Papanicolaou (wet-fixed)
  - May-Grünwald-Giemsa (air-dried)
- **Slide preparation:** Minimum 3–4 smears per case

- **Interpretation categories:** Benign, malignant, suspicious, atypia.
- **Cytologist involvement:** All samples assessed by trained pathologist

#### Histopathology:

- Gold standard comparison for FNAC findings
- Performed on biopsied specimens

#### Immunohistochemistry (IHC):

- Applied in malignant cases
- Tissues: Formalin-fixed, paraffin-embedded

#### Data Collection Parameters

- **Demographics:** Age, gender, lesion site.
- **FNAC Findings**
- **Histopathological Reports**
- **IHC Markers (in malignant cases)**

#### Validity in the Study

- The aim of the study was to assess the diagnostic accuracy of FNAC in identifying various types of breast swellings, particularly in comparison to histopathology, which is the gold standard.
- Diagnostic performance metrics reported from similar studies (reviewed in the literature section) include:
  - Sensitivity up to 98%

- Specificity up to 100%
  - Positive Predictive Value (PPV) and Negative Predictive Value (NPV) in the range of 95–99%
- This suggests high validity — FNAC effectively differentiates between benign and malignant lesions when benchmarked against histopathology.

#### Reliability in the Study

- FNAC is described as a repeatable, simple, and low-cost procedure that can be reliably performed even in resource-limited settings.
- Multiple studies cited show consistent results across different samples and settings, which supports its reliability.

#### Statistical Analysis

Data analysis was performed using SPSS version 21. Descriptive statistics summarized patient demographics and lesion characteristics. Chi-square test was used to compare FNAC and histopathology results. Sensitivity, specificity, positive and negative predictive values, and diagnostic accuracy were calculated using 2x2 tables. Kappa statistics assessed agreement between FNAC and histopathology. Immunohistochemistry findings in malignant cases were analyzed descriptively. Results were presented with appropriate charts.

## RESULTS

**Table 1: Age-wise distribution of Patients with Breast Mass/Lump and their correlation with Benign and Malignant Diagnosis (n = 310)**

| Age group   | Number of Cases | Benign (n)   | Malignant (n) | p-value |
|-------------|-----------------|--------------|---------------|---------|
| 12–20 years | 61              | 61 (19.68%)  | 0 (0.00%)     | 0.001   |
| 21–30 years | 108             | 107 (34.52%) | 1 (0.32%)     | 0.001   |
| 31–40 years | 63              | 48 (15.48%)  | 15 (4.84%)    | 0.88    |
| 41–50 years | 37              | 14 (4.52%)   | 23 (7.42%)    | 0.001   |
| 51–60 years | 25              | 4 (1.29%)    | 21 (6.77%)    | 0.001   |
| >60 years   | 16              | 2 (0.65%)    | 14 (4.52%)    | 0.001   |

The age-wise distribution shows that benign breast lumps were more common in younger age groups, particularly 21–30 years (34.52%) and 12–20 years (19.68%), with no malignant cases observed in the

12–20 years group. In contrast, the proportion of malignant lesions increased with advancing age, especially in the 41–50, 51–60, and >60 years age groups.

**Table 2: Distribution of Breast Lump Cases According to Size of Lump in cm and Side of Breast Involved (n = 310)**

| Parameter   | Number of patients | Percentage (%) |
|-------------|--------------------|----------------|
| <b>Size</b> |                    |                |
| < 2 cm      | 108                | 34.84%         |
| 2 – 5 cm    | 168                | 54.19%         |
| 5.1 – 10 cm | 34                 | 10.97%         |
| > 10 cm     | 00                 | 0.00%          |
| <b>Side</b> |                    |                |
| Right       | 143                | 46.13%         |
| Left        | 159                | 51.29%         |
| Bilateral   | 8                  | 2.58%          |

The distribution of breast lump cases shows that the majority of patients presented with lumps measuring 2–5 cm (54.19%), followed by lumps smaller than 2 cm (34.84%), while 10.97% had lumps measuring 5.1–10 cm, and no cases had lumps larger than 10 cm. Regarding the side of breast involvement, the left breast was slightly more commonly affected (51.29%) than the right breast (46.13%), while bilateral involvement was rare (2.58%).

**Table 3: Clinical Characteristics of Breast Mass: Consistency, Fixity to Skin, and Margin Definition (n = 310)**

| Parameter      | Category                       | Number of Cases | Percentage (%) |
|----------------|--------------------------------|-----------------|----------------|
| Consistency    | Firm                           | 239             | 77.10%         |
|                | Hard                           | 68              | 21.94%         |
|                | Firm to Hard                   | 03              | 0.97%          |
| Fixity to Skin | Freely Mobile                  | 243             | 78.39%         |
|                | Fixed                          | 67              | 21.61%         |
| Margins        | Well-defined Borders           | 238             | 76.8%          |
|                | Ill-defined / Diffuse Swelling | 72              | 23.2%          |

The clinical evaluation of breast masses showed that most lumps were firm in consistency (77.10%), while 21.94% were hard and only 0.97% were firm to hard. The majority of lumps were freely mobile

(78.39%), whereas 21.61% were fixed to the skin. Regarding margin definition, most masses had well-defined borders (76.8%), while 23.2% presented with ill-defined or diffuse swelling.

**Table 4: Distribution of Benign and Malignant Breast Masses According to - fixity to skin and Margin Characteristics (n = 310)**

| Fixity to skin-                | Benign (n)   | Malignant (n) | p-value |
|--------------------------------|--------------|---------------|---------|
| Fixed                          | 0 (0%)       | 67 (91.78%)   | 0.002   |
| Freely mobile                  | 237 (100%)   | 6 (8.22%)     | 0.002   |
| Margin -                       |              |               |         |
| Ill-defined / Diffuse swelling | 5 (1.61%)    | 70 (22.58%)   | 0.001   |
| Well-defined borders           | 232 (74.84%) | 3 (0.97%)     | 0.001   |

The distribution shows that all fixed breast masses were malignant (91.78%), while freely mobile lumps were predominantly benign (100%), with only 8.22% malignant cases, indicating a significant

association between mobility and malignancy ( $p = 0.002$ ). Similarly, ill-defined or diffuse swellings were more commonly malignant (22.58%).

**Table 5: Distribution of Breast Masses According to FNAC Cytology Categories and Corresponding Histopathological Findings (n = 310)**

| Diagnostic Category   | Frequency | Percentage |
|-----------------------|-----------|------------|
| <b>FNAC Cytology</b>  |           |            |
| Benign (C2)           | 236       | 76.13%     |
| Atypia (C3)           | 6         | 1.94%      |
| Suspicious (C4)       | 2         | 0.65%      |
| Malignant (C5)        | 66        | 21.29%     |
| <b>Histopathology</b> |           |            |
| Benign                | 237       | 76.45%     |
| Malignant             | 73        | 23.55%     |

Out of 310 breast lump cases, FNAC categorized the majority as benign (C2) with 236 cases (76.13%), while 66 cases (21.29%) were reported as malignant (C5). A small proportion of cases showed atypical cytology (C3) in 6 cases (1.94%) and suspicious

features for malignancy (C4) in 2 cases (0.65%). On histopathological examination, which served as the gold standard, 237 cases (76.45%) were confirmed as benign, whereas 73 cases (23.55%) were diagnosed as malignant.

**Table 6: Immunohistochemical Profile of Breast Cancer Cases Including ER, PR, HER2-neu Status and Ki-67 Index (n = 73)**

| Parameter              | Category | Number of Cases (n) | Percentage (%) |
|------------------------|----------|---------------------|----------------|
| IHC Performed          | Yes      | 73                  | 23.55%         |
|                        | No       | 237                 | 76.45%         |
|                        | Total    | 310                 | 100%           |
| ER Status (n=73)       | Positive | 20                  | 27.4%          |
|                        | Negative | 53                  | 72.6%          |
| PR Status (n=73)       | Positive | 20                  | 27.4%          |
|                        | Negative | 53                  | 72.6%          |
| HER2-neu Status (n=73) | Positive | 23                  | 31.5%          |
|                        | Negative | 50                  | 68.5%          |
| Ki-67 Index (n=73)     | ≤14%     | 36                  | 49.32%         |
|                        | >14%     | 37                  | 50.68%         |
|                        | Total    | 73                  | 100%           |

The immunohistochemical analysis was performed in 73 (23.55%) breast cancer cases, while 237 cases (76.45%) did not require IHC as they were benign. Among the cancer cases, ER and PR positivity were

observed in 27.4% of patients, while 72.6% were negative for both receptors. HER2-neu positivity was seen in 31.5% of cases, with 68.5% being negative. Regarding the Ki-67 proliferation index,

50.68% of tumors showed a high proliferative rate (>14%), while 49.32% had a low index ( $\leq 14\%$ ).

**Table 7: Molecular Subtype Distribution in Malignant Cases**

| Molecular Subtype | Number of Cases | Percentage (%) |
|-------------------|-----------------|----------------|
| Luminal A         | 13              | 4.19%          |
| Luminal B         | 7               | 2.26%          |
| HER2 Enriched     | 16              | 5.16%          |
| Triple Negative   | 37              | 11.94%         |
| Not Available     | 237             | 76.45%         |

Luminal A subtype was identified in 13 cases (4.19%), Luminal B in 7 cases (2.26%), HER2-enriched subtype in 16 cases (5.16%), and Triple Negative subtype in 37 cases (11.94%). Molecular subtype information was not available in 237 cases (76.45%), corresponding to benign lesions where IHC was not indicated.

Among the malignant cases (n = 73), Triple Negative breast cancer constituted the largest proportion, followed by HER2-enriched subtype. Luminal subtypes (A and B) together accounted for a smaller fraction of cases.

**Table 8: Cyto-Histopathological Correlation Between FNAC and Histopathological Diagnosis in Breast Mass Cases (n = 310)**

| Concordance    | Number of Cases | Percentage (%) |
|----------------|-----------------|----------------|
| Yes            | 297             | 95.81%         |
| No             | 13              | 4.19%          |
| Total          | 310             | 100%           |
| *FNAC Category | HPE Benign      | HPE Malignant  |
| Benign (236)   | 231 (74.52%)    | 5 (1.61%)      |
| Atypical (6)   | 4 (1.29%)       | 2 (0.65%)      |
| Suspicious (2) | 2 (0.65%)       | 0 (0%)         |
| Malignant (66) | 0 (0%)          | 66 (21.29%)    |
| Total          | 237 (76.45%)    | 73 (23.55%)    |

*\*HPE p value=0.001*

The cyto-histopathological correlation between FNAC and histopathological examination in breast mass cases demonstrated a high concordance rate, with 297 cases (95.81%) showing agreement between cytological and histopathological diagnoses, while 13 cases (4.19%) showed discordance. Among the FNAC categories, 236 cases were diagnosed as benign, of which 231 (74.52%) were confirmed benign and 5 (1.61%)

were malignant on histopathology. In the atypical category (6 cases), 4 (1.29%) were benign and 2 (0.65%) were malignant on histopathological examination. The suspicious category included 2 cases, both of which were benign on histopathology, while all 66 cases categorized as malignant on FNAC were confirmed malignant on histopathology, indicating excellent diagnostic reliability for malignant lesions.

**Table 9: Diagnostic Performance of FNAC**

| Diagnostic Parameter            | Value (%) |
|---------------------------------|-----------|
| Sensitivity                     | 96.43%    |
| Specificity                     | 97.47%    |
| Positive Predictive Value (PPV) | 95.74%    |
| Negative Predictive Value (NPV) | 97.88%    |
| Diagnostic Accuracy             | 97.08%    |
| Kappa Value                     | 0.94      |

The diagnostic performance of Fine Needle Aspiration Cytology (FNAC) in the present study demonstrated very high accuracy when correlated with histopathological findings. The sensitivity of FNAC was 96.43%, indicating an excellent ability to correctly identify malignant breast lesions. The specificity was 97.47%, reflecting a strong capability to correctly classify benign lesions. The positive predictive value (PPV) of 95.74% suggests that the majority of lesions diagnosed as malignant on FNAC were confirmed as malignant on histopathology, while the negative predictive value (NPV) of 97.88% indicates that most lesions reported as benign on cytology were truly benign.

The overall diagnostic accuracy of 97.08% highlights the high reliability of FNAC as a diagnostic modality for breast swellings. Additionally, the Kappa value of 0.94 indicates almost perfect agreement between FNAC and histopathological examination, confirming a strong concordance between cytological and histological diagnosis.

## DISCUSSION

Breast swellings represent a wide spectrum of pathological conditions ranging from benign lesions to malignant tumors. Early and accurate diagnosis is

essential for appropriate management and improved patient outcomes. Fine Needle Aspiration Cytology (FNAC) has become an important diagnostic tool for evaluating breast lumps because it is simple, rapid, minimally invasive, and cost-effective.

#### **Age Distribution**

In the present study, the highest number of cases of breast swellings were observed in the 21–30 years age group (34.52%), followed by the 12–20 years age group (19.68%). Benign lesions were predominantly seen in younger patients, whereas malignant lesions were more common in patients above 40 years of age. No malignant cases were reported in patients below 20 years.

These findings are consistent with previous studies. **Vijayabharathi et al. (2015),<sup>[1]</sup>** reported that benign breast lesions were most common in women aged 21–30 years, whereas malignant lesions were more frequently observed in older age groups. Similarly, **Shah et al. (2023),<sup>[2]</sup>** observed that the risk of malignancy increases significantly after the age of 35 years.

This age-related pattern emphasizes the importance of careful clinical evaluation of breast lumps in older women, as the likelihood of malignancy increases with advancing age.

#### **Size and Side of Breast Lump**

In the present study, the majority of breast lumps measured 2–5 cm (54.19%), followed by lumps measuring less than 2 cm (34.84%). A smaller proportion of cases (10.97%) had lumps measuring 5–10 cm, while no cases exceeded 10 cm. The left breast (51.29%) was slightly more commonly involved than the right breast (46.13%), and bilateral involvement was rare.

Similar observations were reported by **Das et al. (2018),<sup>[8]</sup>** who found that most breast lumps presented within the 2–5 cm size range. The slightly higher involvement of the left breast has also been noted in other studies, although the exact reason for this remains unclear.

#### **Clinical Characteristics**

Clinical examination remains an important step in the evaluation of breast masses. In the present study, most breast lumps were firm in consistency (77.10%), freely mobile (78.39%), and had well-defined margins (76.8%), which are typical characteristics of benign lesions.

On the other hand, malignant lesions were more frequently hard in consistency, fixed to the skin, and had ill-defined margins. In the present study, all breast masses fixed to the skin were malignant, while most freely mobile masses were benign.

These findings are consistent with those reported by **Shah et al. (2023),<sup>[2]</sup>** who noted that malignant breast lesions commonly present as hard masses with irregular margins and fixation to surrounding tissues.

#### **FNAC Findings and Histopathological Correlation**

In the present study, FNAC categorized 236 cases (76.13%) as benign, 6 cases (1.94%) as atypical, 2

cases (0.65%) as suspicious, and 66 cases (21.29%) as malignant. Histopathological examination confirmed 237 cases (76.45%) as benign and 73 cases (23.55%) as malignant, showing close correlation between cytological and histopathological findings.

These results are comparable with previous studies. **Das et al. (2018),<sup>[8]</sup>** reported that 64.6% of breast lesions were benign and 21.3% were malignant. Similarly, **Vijayabharathi et al. (2015),<sup>[1]</sup>** observed that benign lesions accounted for the majority of breast lumps, while malignant lesions constituted a smaller proportion.

The predominance of benign lesions in the present study reflects the general clinical pattern seen in breast clinics.

#### **Cyto-Histopathological Correlation**

The present study demonstrated a high concordance rate of 95.81% between FNAC and histopathological findings, with only 4.19% discordant cases.

Among the cases diagnosed as malignant on FNAC, all 66 cases were confirmed as malignant on histopathology, indicating excellent reliability of FNAC in diagnosing malignant breast lesions.

Similar findings have been reported by **Khare et al. (2021)<sup>9</sup>**, who demonstrated high cyto-histopathological concordance in breast lesions and emphasized the diagnostic utility of FNAC as a first-line investigation.

#### **Diagnostic Accuracy of FNAC**

The present study demonstrated excellent diagnostic performance of FNAC, with sensitivity of 96.43%, specificity of 97.47%, positive predictive value of 95.74%, negative predictive value of 97.88%, and overall diagnostic accuracy of 97.08%.

Comparable findings have been reported in other studies. **Khare et al. (2021),<sup>[9]</sup>** reported sensitivity of 99.12% and specificity of 98.54%, while **Das et al. (2018),<sup>[8]</sup>** reported sensitivity of 97.16% and specificity of 92.83%.

These results confirm that FNAC is a reliable and effective diagnostic modality for differentiating benign and malignant breast lesions.

#### **Immunohistochemistry and Molecular Subtypes**

Immunohistochemistry was performed in 73 malignant cases in the present study. ER and PR positivity were observed in 27.4% of cases, while HER2 positivity was found in 31.5%. Approximately half of the tumors showed a high Ki-67 proliferation index.

Molecular subtype analysis showed that triple-negative breast cancer constituted the largest proportion of cases, followed by the HER2-enriched subtype.

Similar findings have been reported by **Andola et al. (2024),<sup>[10]</sup>** who emphasized the importance of immunohistochemistry in determining molecular subtypes of breast cancer and guiding targeted therapy.

## CONCLUSION

Breast swellings were found to occur predominantly in younger women, with the highest number of cases observed in the 21–30 years age group, where benign lesions were most common. The majority of breast lumps in the present study measured 2–5 cm in size and most commonly involved the left breast. Clinically, benign lesions were generally characterized by firm consistency, well-defined margins, and free mobility, whereas malignant lesions were more likely to present as hard masses with ill-defined margins and fixation to the skin.

Fine Needle Aspiration Cytology proved to be an effective and reliable diagnostic modality for the evaluation of breast masses. In the present study, The strong cyto-histopathological correlation observed in this study confirms the diagnostic accuracy and reliability of FNAC in distinguishing benign from malignant breast lesions.

FNAC offers several advantages, including simplicity, rapid diagnosis, minimal invasiveness, cost-effectiveness, and the ability to perform the procedure in outpatient settings. These advantages make FNAC particularly valuable in rural and resource-limited healthcare settings, where access to advanced diagnostic techniques may be limited.

Immunohistochemistry performed in malignant cases provided valuable information regarding hormone receptor status and tumor proliferation markers. In the present study, ER and PR positivity were observed in a proportion of breast cancer cases, while HER2-neu expression and Ki-67 proliferation index helped in further characterization of tumor biology. These markers are essential for determining molecular subtypes of breast cancer and guiding targeted therapy, thereby improving treatment planning and patient outcomes.

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