Enhancing Breast Lump Diagnostics: A Comparative Study of Histopathological and Cytology

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Abstract: <u>*Introduction*</u>*: The increasing incidence of breast lumps cases represents a significant health challenges, necessitating. The integration of multiple diagnostic modalities, including histopathological and cytological techniques, is imperative. Correlating histopathological findings with cytological evaluation can significantly enhance the accuracy of preoperative diagnosis and contribute to the development of evidence-based guidelines for integrating cytological evaluation into the diagnostic algorithm for breast lumps.* <u>*Methods*</u>*: In a prospective observational study at a tertiary care teaching hospital, female patients aged 18 years and above with palpable breast lumps were enrolled according to the inclusion criteria. Data on demographics and clinical history were collected. Histopathological and cytological evaluations were conducted, assessing concordance, with statistical analysis revealing sensitivity, specificity, PPV, and NPV of cytological evaluation. Ethical considerations, including informed consent and confidentiality, were obtained.* <u>*Results*</u>*: In the cytological evaluation of 290 breast lump cases, benign cases constituted the majority, accounting for 68%, followed by malignant cases at 27.5%. Out of 290 patients, 75 underwent histopathological examination. Among these, 30 cases were diagnosed as benign, while 45 were identified as malignant. The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of the present study were 80.12%, 95.62%, 97.2%, 70.12%, and 84.52% respectively. Among cases, 84% exhibit concordance, while 16% show discordance, suggesting a strong association between the two diagnostic methods in the study.* <u>*Conclusion*</u>*: The demographic characteristics, cytological and histopathological findings, along with the correlation analysis, provide a comprehensive understanding of the diagnostic process of breast lump cases. High concordance and favorable statistics validate diagnostic test reliability; addressing discordance improves breast lump diagnosis accuracy.*

Keywords: Breast lumps, Histopathology, Cytology, Diagnostic correlation

1. Introduction

In recent years, advances in diagnostic imaging and increased awareness have led to a rise in the detection of early-stage breast lesions, necessitating a more nuanced diagnostic approach. The increasing incidence of breast lump cases represents a significant health challenge, as these lesions encompass a spectrum of benign, pre-malignant, and malignant entities.[1]Breast carcinoma is a significant public health concern, being the most common carcinoma among women globally.[2]Early detection and accurate diagnosis are crucial for improving patient outcomes and reducing mortality rates associated with this disease.

As clinicians strive for precision in patient management, the integration of multiple diagnostic modalities becomes imperative. Clinical evaluation of breast lumps often involves a combination of histopathological and cytological techniques to determine the nature of the lesion.[3]Histopathological examination of tissue samples obtained through biopsy is considered the gold standard for diagnosing breast carcinoma and other breast pathologies.[4]On the other hand, cytological evaluation, particularly fine-needle aspiration cytology (FNAC), is a minimally invasive and cost-effective diagnostic tool that can provide rapid preliminary assessment of breast lumps.[5]While clinical examination and imaging techniques provide valuable initial insights, a definitive diagnosis relies heavily on histopathological and cytological examinations.

The correlation between histopathological findings and cytological evaluation in the context of breast lumps has been the subject of extensive research. While both methods have their advantages and limitations, establishing a strong correlation between the two can significantly enhance the accuracy of preoperative diagnosis, offers comprehensive understanding of breast pathology, and enhance treatment planning for patients with breast lumps. Furthermore, such correlation studies can contribute to the refinement of cytological techniques and the development of standardized protocols for interpreting cytological findings in the context of specific histopathological outcomes.

This study is of paramount importance due to its potential implications for clinical practice. A robust correlation between histopathological and cytological findings can streamline the diagnostic process, enhance the diagnostic accuracy, minimize the need for repeat invasive procedures, offer prognostic precision, and expedite the initiation of appropriate treatments for patients with breast lumps.[6]Moreover, it can inform the development of evidence-based guidelines for integrating cytological

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evaluation into the diagnostic algorithm for breast lesions, thereby optimizing resource utilization and healthcare delivery.

The current study aimed to systematically correlate histopathological findings with cytological evaluation in a cohort of patients presenting with breast lumps. By doing so, we aim to evaluate the concordance between these two diagnostic approaches and identify any discordant cases that may warrant further investigation or clinical management. Additionally, the study seeks to assess the sensitivity, specificity, and predictive values of cytological evaluation in detecting malignancies and differentiating various benign and malignant breast conditions, using histopathology as the reference standard.

2. Methodology

Study Design:
A prospective, observational study was conducted at a tertiary care teaching hospital in Northern India over a period of 1.5 years. The study adhered to the principles of the Declaration of Helsinki and received approval from the Institutional Review Board (IRB). All the eligible participants were enrolled as per the inclusion criteria only.

Inclusion Criteria:
- Female patients aged 18 years and above
- Patients presenting with palpable breast lumps at the study site
- Patients who had been advised for a core needle biopsy or excision biopsy

Exclusion Criteria:
- Male patients
- Patients with non-palpable breast lesions
- Patients who had undergone neoadjuvant chemotherapy
- Patients who didn't undergo subsequent histopathological examinations following FNAC

Data Collection:
Demographic and clinical data, including age, family history of breast cancer, and previous breast-related procedures, were collected using a structured questionnaire. Clinical examination findings, imaging results, and any prior cytological evaluations were documented. Biopsy specimens were collected using standard procedures, ensuring representative samples for both histopathological examination and fine-needle aspiration cytology (FNAC)

1) Histopathological Evaluation
   - Tissue samples obtained from a core needle biopsy or excision biopsy were processed and evaluated by experienced pathologists.
   - The histopathological findings, including the diagnosis, tumour type, grade, and other relevant parameters, were recorded.
2) Cytological Evaluation
   - Fine-needle aspiration cytology (FNAC) was performed on the same patients prior to the histopathological evaluation.

- Cytological smears were prepared and interpreted by trained cytopathologists.
- The cytological diagnosis and any ancillary tests, if performed, were documented.

Correlation and Analysis:
The concordance between histopathological and cytological findings was assessed. Discordant cases were further investigated, and the reasons for discordance we reanalyzed.

Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of cytological evaluation in detecting malignancies and differentiating benign and malignant breast conditions were calculated using histopathology as the reference standard.

Ethical Considerations:
Informed consent was obtained from all participants. Patient confidentiality and data protection was strictly maintained throughout the study.

3. Results

This study involved the examination of 290 cases presenting with the breast lumps during the study period. Among these 290 cases, histopathological examination was conducted in 75 cases. Table 1 summarizes the demographic characteristics of the patients.

Table 1: Demographic characteristics of the patients

Characteristics	Values
Total Patients – n	290
Age (years) (mean ± SD)	40.28 ± 8.56
Family History of Breast Carcinoma – n (%)	45 (15.5%)
Previous Breast Procedures – n (%)	51 (17.6%)

Demographic characteristics revealed a mean age of 40.28 ± 8.56 years. The age group most affected was between 41 and 50 years. Additionally, 15.5% had a family history of breast carcinoma, and 17.6% had undergone previous breast procedures, indicating notable factors within the sample population (Table 1).

The current study's observations were examined and documented with respect to age, quadrant of breast involvement, laterality, and clinical presentation. Benign lesions were most frequently observed in patients aged 31-40 years, while malignant breast lesions were most prevalent in the age group of 51-60 years. A total of 138 cases exhibited right breast involvement, while left breast involvement was observed in 131 cases. Additionally, 21 cases demonstrated bilateral involvement, as depicted in Figure 1.

The majority of lumps were observed in the upper outer quadrant, accounting for 139 cases (48%). Lower outer quadrant involvement was observed in 63 cases (21.7%), while the upper inner quadrant and lower inner quadrant accounted for 41 (14.1%) and 29 (10%) cases, respectively. Central involvement was noted in 18 cases (6.2%). Regarding size, the highest number of breast lumps, measuring 2–5 cm, was seen in 162 cases (56%). Lumps measuring less than 2 cm were observed in 110 cases

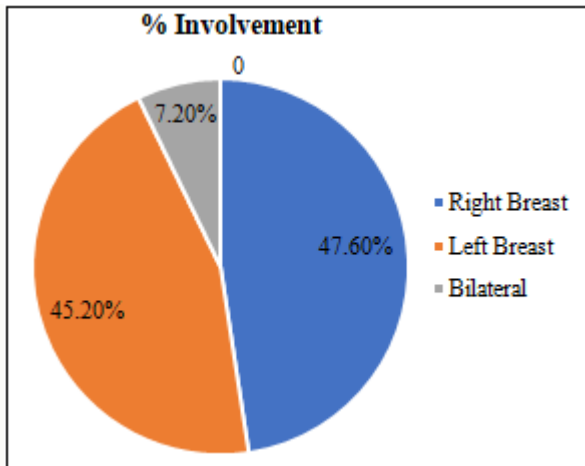(37.8%), while those measuring more than 5 cm were present in 18 cases (6.2%).

Figure 1: Breast side involvement among patients

Table 2 illustrates the distribution of cytological diagnoses for breast lesions.

Table 2: Cytological evaluation of breast lump cases (n=290)

Diagnostic category	Diagnosis	Number of cases: n (%)
C-1	Inadequate	4 (1.4)
C-2	Benign	197 (68)
C-3	Intermediate	8 (2.8)
C-4	Suspicion of malignancy	1 (0.3)
C-5	Malignant	80 (27.5%)
	Total	290 (100)

In the cytological evaluation of 290 breast lump cases, diagnostic categories revealed diverse findings. Benign cases (C-2) constituted the majority at 68%, followed by malignant cases (C-5) at 27.5%. Benign cases included Fibroadenoma, Fibroadenosis, Duct ectasia, Fibrocystic disease of the breast, Proliferative breast lesion, and Lactating adenoma. Fibroadenoma was the most common benign condition observed (156 cases). Infiltrating duct carcinoma emerged as the most prevalent malignant lesion. A total of 58 cases of infiltrating duct carcinoma (NST-Nonspecific type) were identified among these patients. Inadequate cases (C-1) were minimal at 1.4%, emphasizing the significance of categorizing breast lumps for accurate diagnosis and appropriate management in the studied population (Table 2).
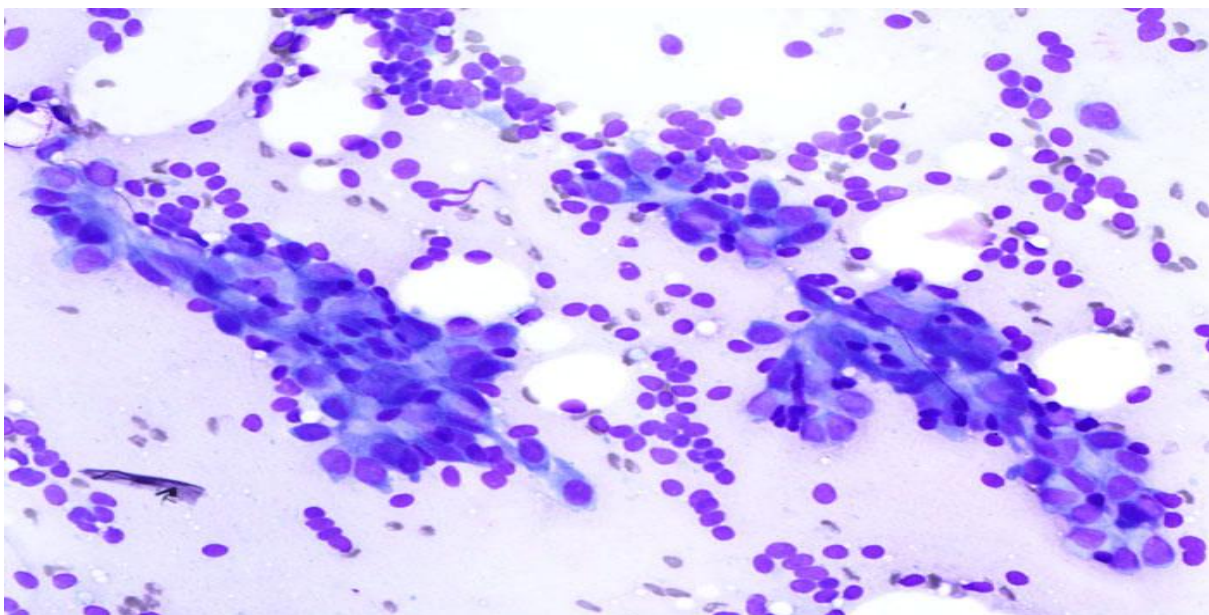

Figure 2: Cytology of Fibroadenoma (A microphotograph displays a densely packed smear with bare nuclei arranged in a honeycomb pattern)

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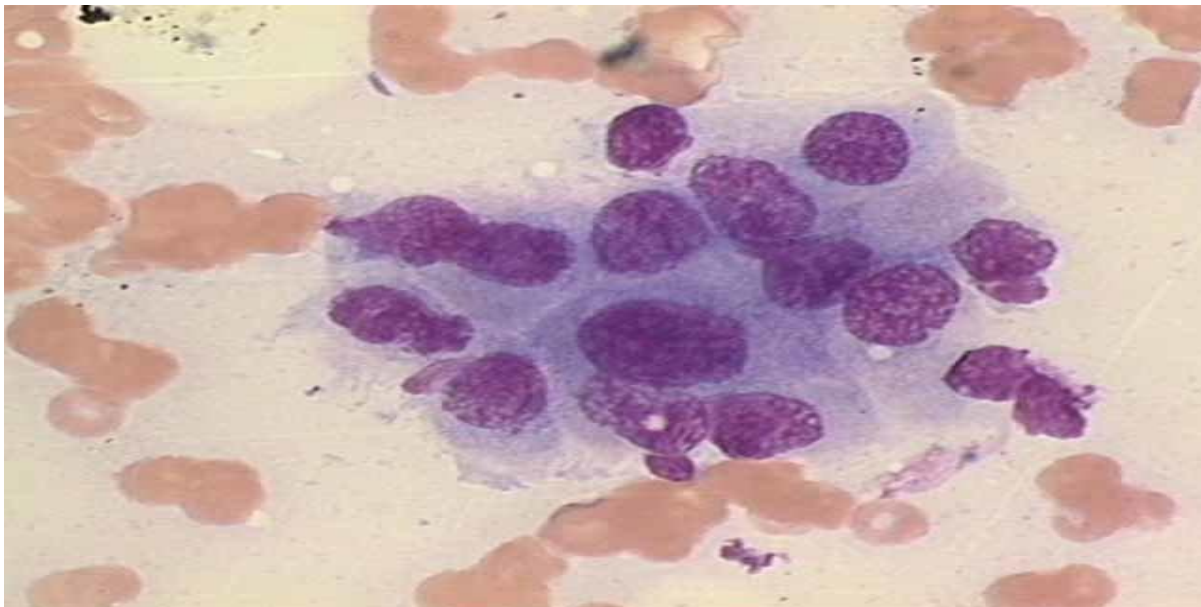
Figure 3: Cytology of Invasive duct carcinoma (A microphotograph illustrates a loosely grouped cluster of malignant cells with nuclei exhibiting pleomorphism)

Histopathological evaluation:

In the present study out of total 290 cytology cases, 75 underwent histopathological examination. Among these, 30 cases were diagnosed as benign, while 45 were identified as malignant upon histopathological analysis. The most prevalent benign lesion was fibroadenoma, with a total of 26 cases identified. The most frequent malignant lesion observed was invasive ductal carcinoma (NST), present in 41 cases.
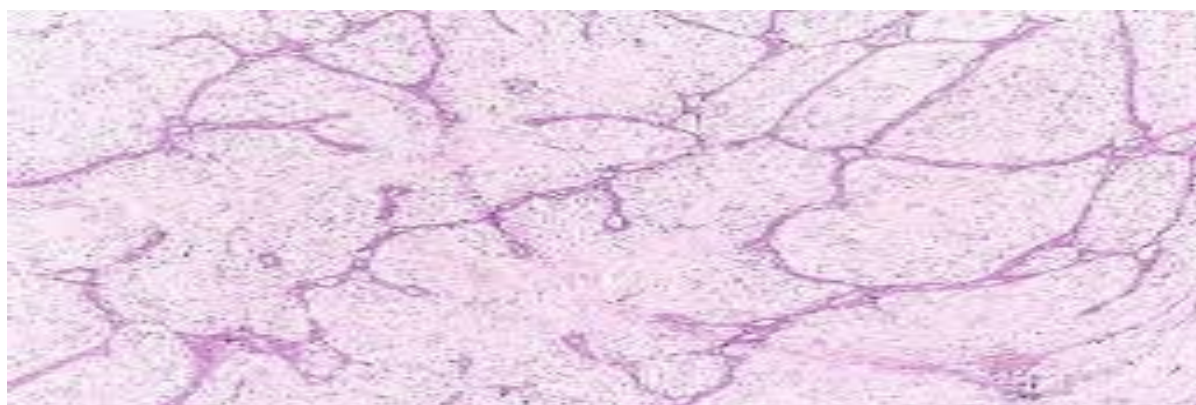

Figure 4: Histopathology of Breast Fibroadenoma (The microphotograph illustrates a fibroadenoma with an intracanalicular pattern, where the ducts are lined by an inner cuboidal layer and an outer layer of myoepithelial cells)
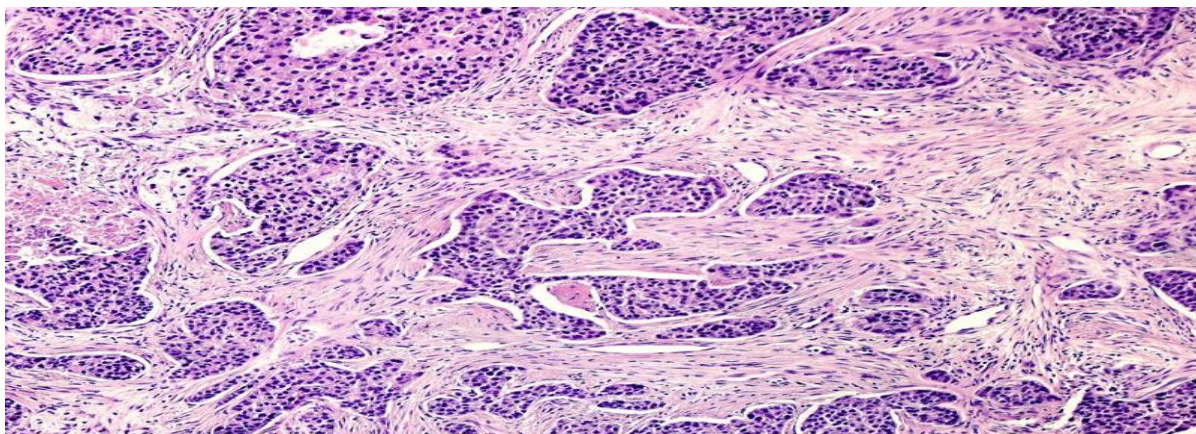

Figure 5: Histopathology of Invasive Duct Carcinoma (The microphotograph depicts invasive ductal carcinoma characterized by solid sheets of tumour cells with invasion into the stromal tissue)

Among these 75 cases, 63 cases (84%) exhibited correlation, while 12 cases (16%) did not show correlation.

Table 3: Statistical Analysis

Parameter	Value
Sensitivity	80.12%
Specificity	95.62%
Positive Predictive Value (PPV)	97.2%
Negative Predictive Value (NPV)	70.12%
Accuracy	84.52%

The study's statistical analysis, as presented in table 3, reveals promising results for a diagnostic test. The parameters include sensitivity (80.12%), specificity (95.62%), positive predictive value (97.2%), negative predictive value (70.12%), and an overall accuracy of 84.52%.

Table 4: Correlation between Histopathological and Cytological Findings

Cases	n (%)
Concordant cases	63 (84%)
Discordant cases	12 (16%)

Table 4 highlights a correlation analysis between histopathological and cytological findings. Among cases, 84% exhibit concordance, while 16% show discordance, suggesting a strong association between the two diagnostic methods in the study. Certain reasons observed for discordant cases were inadequate sample collection, interpretation variability, and technical reasons.

4. Discussion

This findings offer valuable insights into the correlation between histopathological and cytological evaluations in breast lump patients. The demographic characteristics of the 290 patients studied revealed a mean age of 40.28 ± 8.56 years, with the age group of 41-50 years being the most affected. While in a study by Gore et al. the common age group affected was 21-30 years.[7] Family history of breast carcinoma was noted in 15.5% of cases, and 17.6% had undergone previous breast procedures. These findings indicate a potential genetic or familial predisposition to the disease. Additionally, the fact that 17.6% of the cases had undergone previous breast procedures underscores the relevance of considering the medical history and interventions related to breast health in this population. These demographic factors play a crucial role in understanding the context of breast lumps within the studied population. It's noteworthy that the prevalence of breast lesions increases with age, as observed by the higher occurrence of malignant lesions in the 51-60 years age group. Findings of the study by Chandanwale et al. also support this evidence.[8]

Observations related to the location and characteristics of breast lumps provided further insights. Right side of the breast was commonly affected. The upper outer quadrant was the most common site for lumps, and the majority of lumps were in the size range of 2-5 cm. These observations are consistent with findings in a study conducted by Sreedevi et al.[9] These details are essential for clinicians to consider when planning interventions or surgical procedures.

Benign cases constituted the majority, with fibroadenoma being the most common benign condition. In a study done by Gore et al. also the higher cases of Fibroadenoma was observed amongst all the cases evaluated.[7] The low percentage of inadequate cases emphasizes the reliability of cytological evaluation in this study. The microphotographs of cytological findings, such as those depicting fibroadenoma and invasive ductal carcinoma, provide visual representations of the cytological diagnostic process.

Histopathological examination of 75 cases out of the total 290 revealed 30 benign and 45 malignant cases. Fibroadenoma and invasive ductal carcinoma were the most prevalent benign and malignant lesions, respectively. The histopathological images complement the cytological findings, providing a more comprehensive understanding of the tissue characteristics associated with these lesions. Similar findings with respect to histopathology of the lesions were also observed in a study done by Khan et al.[10] This information underscores the significance of understanding the prevalence of these specific breast lesions, which can have important implications for diagnostic and therapeutic strategies in clinical settings.

The correlation analysis between cytological and histopathological findings demonstrated a substantial concordance rate of 84%. This indicates a strong association between the two diagnostic methods in this study. The statistical analysis further supported the reliability of the diagnostic tests, with sensitivity at 80.12%, specificity at 95.62%, positive predictive value (PPV) at 97.2%, negative predictive value (NPV) at 70.12%, and an overall accuracy of 84.52%. In a study conducted by Daramola et al., the sensitivity was reported as 95.24%, with specificity and positive predictive value reaching 88.9% and 99.6%, respectively.[11] Also, Gore et al. in his similar type of study reported the specificity and positive predictive value were 79.16%, 88.9%, and 97.37%, respectively.[7]

The high sensitivity and specificity values indicate that the diagnostic tests employed in this study were effective in correctly identifying both benign and malignant cases. The high PPV suggests that the likelihood of a positive diagnosis being accurate is substantial.[12] The NPV, while slightly lower, still indicates a reliable ability to correctly identify negative cases. The overall accuracy of 84.52% highlights the robustness of the correlation between cytological and histopathological findings in diagnosing breast lumps.

However, it is crucial to acknowledge the 16% discordant cases. Reasons for discordance included inadequate sample collection, interpretation variability, and technical issues. These discordant cases emphasize the importance of addressing pre-analytical and analytical factors to improve the overall accuracy of the diagnostic process.

5. Conclusion

This study contributes valuable information regarding the correlation between histopathological and cytological

evaluations in breast lump patients. The demographic characteristics, cytological and histopathological findings, and the correlation analysis provide a comprehensive understanding of the diagnostic process. The high concordance rate and favourable statistical parameters support the reliability of the diagnostic tests employed, but addressing discordant cases and refining the diagnostic procedures will further enhance the accuracy of breast lump diagnoses. This study lays the groundwork for future research in refining diagnostic methodologies and improving patient outcomes in the context of breast lesions.

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