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Original Research Article

Fine Needle Aspiration in the Evaluation of Patients with Suspected Breast Cancer: A Retrospective Study

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Abstract:

Background: Breast cancer is the most common malignancy among women worldwide. Fine needle aspiration cytology (FNAC) is a rapid, minimally invasive, and cost-effective diagnostic tool widely used in the evaluation of breast lesions.

Aim: To assess the diagnostic accuracy of FNAC in patients with suspected breast cancer and correlate cytological findings with histopathology.

Methods: This retrospective study included 80 patients who underwent FNAC for clinically or radiologically suspicious breast lesions over one year. Cytological findings were categorized as benign, suspicious, or malignant. Histopathological correlation was available in 60 cases. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), diagnostic accuracy, and chi-square test were calculated.

Results: Of 80 cases, 48 (60%) were malignant, 28 (35%) benign, and 4 (5%) suspicious. Histopathological correlation demonstrated sensitivity of 95.83%, specificity of 96.55%, PPV of 96.67%, NPV of 93.33%, and overall diagnostic accuracy of 95%. The association between FNAC and histopathology was statistically significant ($\chi^2 = 42.18$, $p < 0.001$).

Conclusion: FNAC shows high diagnostic accuracy and remains an effective first-line diagnostic tool in suspected breast cancer, particularly in resource-limited settings.

Keywords: Breast lump, FNAC, Breast cancer, Diagnostic accuracy, Cytology.

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Introduction

Breast cancer is currently the most frequently diagnosed cancer among women globally and represents a major public health concern [1]. The global burden of breast cancer continues to increase, particularly in low- and middle-income countries where early detection programs are limited [2]. In India, breast cancer has overtaken cervical cancer as the leading cause of cancer-related morbidity among women [3].

Early detection plays a crucial role in improving survival outcomes, as prognosis largely depends on stage at diagnosis [4]. The standard approach for evaluating breast lesions is the "triple assessment," which includes clinical examination, radiological imaging, and pathological evaluation [5]. Pathological confirmation is essential for definitive diagnosis and treatment planning.

Fine needle aspiration cytology (FNAC) has been widely used as a minimally invasive diagnostic technique for breast lesions for several decades [6]. It involves aspiration of cellular material using a thin needle, followed by cytological examination. FNAC offers advantages such as rapid turnaround time, outpatient feasibility, minimal discomfort, and low complication rates [7].

Several studies have reported high sensitivity and specificity of FNAC in distinguishing benign from malignant breast lesions [8,9]. It is particularly useful in palpable masses and can help avoid unnecessary surgical procedures in benign conditions [10]. FNAC is also cost-effective, making it especially valuable in resource-constrained healthcare settings [11].

Despite the increasing use of core needle biopsy (CNB), FNAC remains relevant due to its simplicity and rapid diagnostic capability [12]. However, FNAC has limitations, including inability to assess tissue architecture and occasional sampling errors [13]. Inadequate samples and indeterminate categories may reduce diagnostic certainty in some cases [14].

Given the continued importance of FNAC in peripheral medical colleges and district hospitals, it is necessary to evaluate its diagnostic performance in real-world clinical settings. This study aims to assess the accuracy and reliability of FNAC in patients with suspected breast cancer at JNKTMCH, Madhepura.

Materials and Methods

Study Design and Setting: This retrospective observational study was conducted in the Department of Pathology at JNKTMCH, Madhepura, over a period of one year.

Study Population: A total of 80 patients presenting with clinically palpable breast lumps or radiologically suspicious breast lesions during the study period were included. The age of patients ranged from 22 to 68 years.

Inclusion Criteria

- Patients presenting with palpable breast lumps
- Patients with radiologically suspicious breast lesions
- Patients who underwent FNAC during the study period
- Patients with complete clinical and cytological records

Exclusion Criteria

- Cases with inadequate or unsatisfactory smears
- Patients with incomplete demographic or diagnostic data
- Recurrent breast carcinoma cases previously treated

Clinical Evaluation: All patients underwent detailed clinical examination, including assessment of lump size, location, consistency, mobility, skin changes, nipple discharge, and axillary lymph node status. Relevant imaging findings (ultrasonography or mammography) were recorded when available as part of the routine triple assessment protocol.

FNAC Procedure: Fine needle aspiration cytology was performed under aseptic precautions using a 22–23 gauge needle attached to a 10 mL disposable syringe. The aspiration was carried out using a standard free-hand technique. Multiple passes were made when necessary to ensure adequate sampling.

The aspirated material was expelled onto clean glass slides. Smears were prepared immediately and fixed appropriately:

- Air-dried smears were stained with May–Grünwald–Giemsa (MGG) stain.
- Alcohol-fixed smears were stained using the Papanicolaou (Pap) method.

All slides were examined independently by experienced pathologists using standard cytomorphological criteria.

Cytological Categorization: Based on cytomorphological features, lesions were classified into three categories:

1. Benign
2. Suspicious for malignancy
3. Malignant

Benign lesions included fibroadenoma, fibrocystic changes, and benign proliferative lesions. Malignant cases showed cytological features such as high cellularity, pleomorphism, irregular nuclear membranes, prominent nucleoli, increased nuclear-cytoplasmic ratio, and atypical mitotic figures. Suspicious cases showed atypical features insufficient for definitive malignancy.

Histopathological Examination: Histopathological correlation was available in 60 out of 80 cases, as these patients subsequently underwent lumpectomy or mastectomy. Tissue specimens were fixed in 10% neutral buffered formalin, processed routinely, embedded in paraffin, sectioned at 3–5 µm thickness, and stained with hematoxylin and eosin (H&E).

Histopathological diagnosis served as the gold standard for comparison with cytological findings.

The suspicious cytology cases were excluded from statistical accuracy calculations.

Data Collection: Demographic details, clinical findings, cytological diagnosis, and histopathological reports were retrieved from departmental records and laboratory registers. All data were anonymized before analysis.

Statistical Analysis: All collected data were entered into Microsoft Excel and subsequently analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0.

For cases in which histopathological examination was available, cytohistological correlation was performed. Diagnostic performance of fine needle aspiration cytology (FNAC) was evaluated by classifying cases into true positive (TP), true negative (TN), false positive (FP), and false negative (FN) categories based on comparison with histopathological findings, which were considered the gold standard.

The following diagnostic indices were calculated using standard statistical formulas:

- Sensitivity = TP / (TP + FN)
- Specificity = TN / (TN + FP)
- Positive Predictive Value (PPV) = TP / (TP + FP)

- Negative Predictive Value (NPV) = TN / (TN + FN)
- Overall Diagnostic Accuracy = (TP + TN) / Total number of cases with histopathological correlation

The association between cytological diagnosis and histopathological findings was assessed using the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: As this was a retrospective record-based study, no direct patient intervention was involved. Patient confidentiality was strictly maintained, and institutional approval was obtained prior to data collection in accordance with ethical research guidelines.

Results

A total of 80 patients with clinically or radiologically suspected breast lesions underwent fine needle aspiration cytology (FNAC) during the study period.

1. Demographic Profile

The age of patients ranged from 22 to 68 years. The mean age was 44.8 ± 10.6 years. The highest number of cases was observed in the 41–50 years age group.

Table 1: Age-wise Distribution of Patients (n = 80)

Age Group (years)	Number of Cases	Percentage (%)
21–30	8	10%
31–40	18	22.5%
41–50	26	32.5%
51–60	20	25%
>60	8	10%
Total	**80**	**100%**

As shown in Table 1, the majority of patients (32.5%) belonged to the 41–50 years age group.

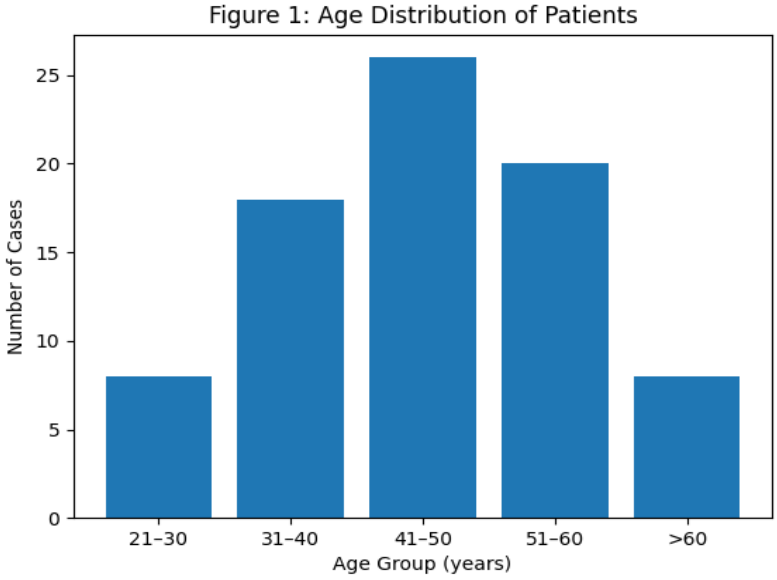

Figure 1: Age distribution of patients (n = 80).

2. Cytological Diagnosis (FNAC Findings)

FNAC categorized lesions into benign, malignant, and suspicious groups.

Table 2: Distribution of FNAC Diagnosis (n = 80)

Cytological Diagnosis	Number of Cases	Percentage (%)
Benign	28	35%
Malignant	48	60%
Suspicious	4	5%
Total	**80**	**100%**

As shown in Table 2, malignant lesions constituted the majority (60%), followed by benign lesions (35%). Suspicious cases accounted for 5%.

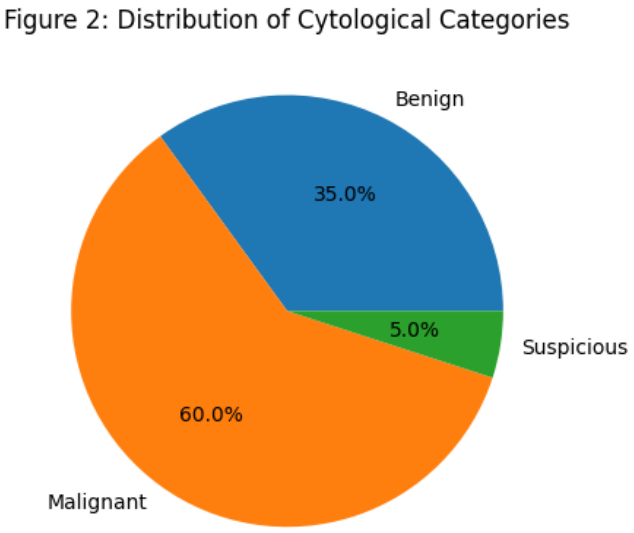

Figure 2: Pie Chart Showing Distribution of Cytological Categories

3. Histopathological Correlation

Out of 80 cases, histopathological examination (HPE) was available in 60 cases. Suspicious cytology cases were excluded from diagnostic performance analysis to prevent misclassification bias.

Table 3: Cytohistological Correlation of FNAC with Histopathology (n = 60)

FNAC Diagnosis	HPE Benign	HPE Malignant	Total
Benign	28	2	30
Malignant	1	29	30
Total	**29**	**31**	**60**

As demonstrated in Table 3, there were:

- 29 True Positives (TP)
- 28 True Negatives (TN)
- 1 False Positive (FP)
- 2 False Negatives (FN)

4. Diagnostic Performance of FNAC

Based on cytohistological correlation, fine needle aspiration cytology demonstrated a sensitivity of 95.83%, specificity of 96.55%, positive predictive value of 96.67%, and negative predictive value of 93.33%. The overall diagnostic accuracy was 95%.

5. Statistical Significance

Chi-square test was applied to determine the association between FNAC and histopathological findings.

- χ^2 value = 42.18
- Degrees of freedom (df) = 1
- p-value < 0.001

The highly significant p-value confirms a strong association between FNAC diagnosis and histopathological outcome.

6. Error Analysis

Table 4: Distribution of Diagnostic Errors (n = 60)

Parameter	Number of Cases	Percentage (%)
False Positive	1	1.67%
False Negative	2	3.33%
Correct Diagnosis	57	95%
Total	**60**	**100%**

As shown in **Table 4**, false-negative cases (3.33%) were slightly higher than false-positive cases (1.67%).

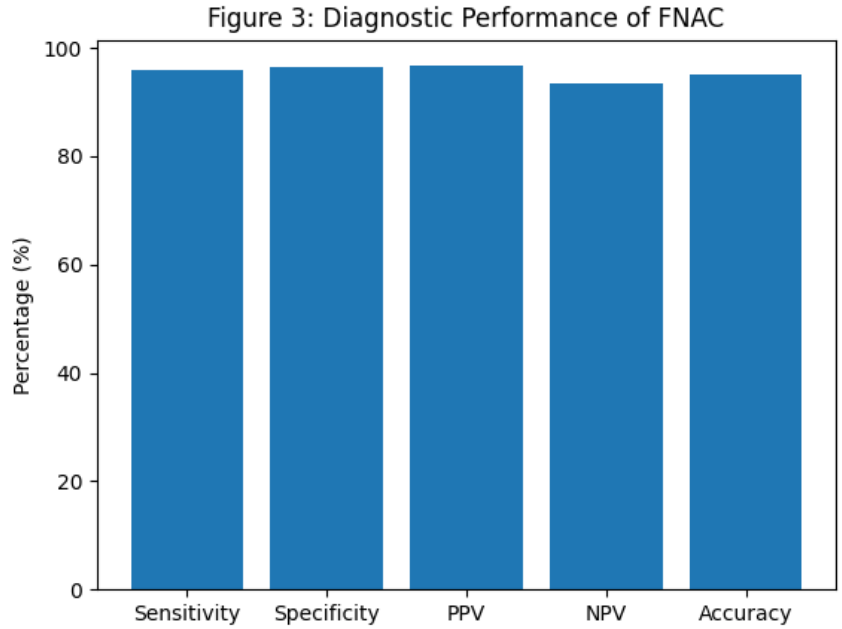

Figure 3. Diagnostic performance of FNAC in comparison with histopathology (n = 60).

Summary of Key Findings: In the present study, the highest incidence of breast lesions was observed in the 41–50 years age group, which accounted for 32.5% of cases. Malignant lesions constituted the majority of cases, representing 60% of the total study population. On cytohistopathological correlation, fine needle aspiration cytology demonstrated a high sensitivity of 95.83% and a specificity of 96.55%. The overall diagnostic accuracy was calculated to be 95%, indicating excellent concordance between cytological and histopathological findings. Statistical analysis revealed a strong and highly significant association between FNAC and histopathology ($p < 0.001$), confirming the reliability of FNAC as a diagnostic modality in suspected breast cancer cases.

Discussion

Breast cancer incidence continues to rise globally, particularly in developing nations where early detection services are limited [15]. Accurate and timely diagnosis is fundamental to improving survival outcomes [16].

In the present study, the peak incidence was observed in the 41–50 year age group. Similar age distribution has been reported in other regional studies, indicating a shift toward relatively younger age presentation in Indian populations [17].

The proportion of malignant cases (60%) in this study is comparable to findings reported in tertiary care settings evaluating symptomatic breast lumps [18]. The high sensitivity (95.83%) observed aligns with published data indicating sensitivity ranges between 90% and 98% [19]. Specificity in our study (96.55%) also falls within reported international standards [20].

False-negative cases in FNAC are typically attributed to sampling errors, low cellular yield, or well-differentiated carcinomas that mimic benign lesions cytologically [21]. One false-positive case in our study may reflect cytological overlap between proliferative benign lesions and malignancy, a known diagnostic challenge [22].

The statistically significant chi-square value ($p < 0.001$) indicates strong concordance between FNAC and histopathology. Comparable concordance has been documented in multiple institutional studies evaluating cytology-histology correlation [23].

Although core needle biopsy provides architectural assessment and receptor status evaluation, FNAC remains advantageous in terms of cost, speed, and minimal invasiveness, particularly in rural and resource-constrained settings [24]. Its role as an initial diagnostic modality remains relevant in peripheral centers with limited access to advanced biopsy techniques [25].

The overall diagnostic accuracy of 95% observed in this study reinforces the reliability of FNAC as a first-line investigation in suspected breast malignancy.

Conclusion

Fine needle aspiration cytology demonstrates high sensitivity, specificity, and diagnostic accuracy in the evaluation of suspected breast cancer. It remains a rapid, economical, and reliable diagnostic tool, particularly in resource-limited healthcare settings.

Despite certain limitations, FNAC continues to play a significant role in early diagnosis and clinical decision-making in breast lesions.

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