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# Fine-Needle Aspiration Cytology (FNAC) In Breast Lesion Diagnosis: Relevance In Peripheral Eastern India And Role Of The IAC Yokohama System

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***Abstract***
***Background:*** *Fine-needle aspiration cytology (FNAC) remains a vital diagnostic tool for breast lesions in resource-limited settings due to its simplicity, affordability, and diagnostic value. The International Academy of Cytology (IAC) Yokohama System provides a standardized reporting framework, enhancing the diagnostic reliability of FNAC. This study evaluates the diagnostic accuracy of FNAC using the IAC Yokohama System in a peripheral tertiary care center in Eastern India.*
***Methods:*** *A prospective observational study was conducted from September 2023 to 2024 at Prafulla Chandra Sen Government Medical College. FNAC was performed on 88 patients with palpable breast lumps. Cytological diagnoses were categorized into IAC Yokohama categories (C1–C5) and correlated with histopathological findings. Sensitivity, specificity, PPV, NPV, diagnostic accuracy, and risk of malignancy (ROM) were calculated under three diagnostic thresholds.*
***Results:*** *Of 88 cases, 33 were histologically malignant. ROM ranged from 0% in C2 to 100% in C5. Scenario 2 (C4–C5 as malignant) offered the most balanced diagnostic performance: sensitivity 84.85%, specificity 95.83%, and accuracy 90.91%. Inclusion of C3 and C4 improved sensitivity while maintaining diagnostic validity.*
***Conclusion:*** *The IAC Yokohama System offers high diagnostic accuracy and standardization in breast FNAC reporting, especially valuable in low-resource settings for early breast cancer detection.*
***Keywords:*** *FNAC, Yokohama, Breast*

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## I. Introduction :

Fine-needle aspiration cytology (FNAC) is a simple, rapid, minimally invasive, and economical diagnostic procedure that has been in widespread use for breast lesion evaluation. Its efficacy significantly increases when performed under ultrasound guidance for both palpable and impalpable lesions [1–4]. Although core needle biopsy (CNB) was initially introduced for evaluating suspicious calcifications detected on mammography, it has in many instances challenged and even replaced FNAC [5,6].

However, in peripheral and semi-urban regions of Eastern India, such as rural parts of West Bengal, accessibility to advanced diagnostic facilities remains a challenge. In such settings, FNAC remains an essential tool for the early diagnosis of breast lesions due to its affordability, ease of use, and diagnostic yield. When combined with clinical examination and imaging—forming the "triple assessment" approach—it provides a high level of diagnostic accuracy, especially when dealing with clinically or radiologically detected breast abnormalities [7–9].

Despite CNB's advantages, FNAC continues to play a vital role, especially in special scenarios such as pregnancy, or when mammography is not feasible. Ultrasound-guided FNAC is particularly helpful in enhancing sampling precision. The integration of rapid on-site evaluation (ROSE) further boosts its diagnostic potential by reducing the frequency of inadequate or indeterminate samples and improving the detection rates of both benign and malignant lesions [10].

In this context, the present study assumes particular importance, aiming to standardize breast cytology reporting in tertiary care centers serving peripheral areas of Eastern India. The use of the International Academy of Cytology (IAC) Yokohama System provides a structured, evidence-based framework for reporting breast

FNAC, facilitating improved communication between cytopathologists and breast clinicians while ensuring diagnostic consistency.

The objective of this study was to evaluate the diagnostic performance of FNAC in breast lesions using the IAC Yokohama reporting categories, with histopathology correlation wherever available. By doing so, we aimed to develop local best practice guidelines, strengthen training in breast cytology interpretation, and ultimately improve patient care in low-resource settings.

Recommended Reporting Format

FNAC reports should include a statement on specimen cellularity to confirm adequacy. A concise cytological description should follow, noting key diagnostic criteria. If a definitive diagnosis is not possible, a provisional or differential diagnosis should be provided. Phrases such as "No malignant cells observed" are encouraged to clarify benign nature where appropriate. Although IAC categories (e.g., Category II - Benign) may be mentioned in the body of the report, they should not replace a narrative diagnostic impression in the conclusion.

## II. Materials And Methods

A prospective observational study was conducted in the Department of Pathology, Prafulla Chandra Sen Government Medical College and Hospital, over a period of one year from September 2023 to September 2024 after obtaining necessary Institutional ethical clearance from Prafulla Chandra Sen Government Medical College and Hospital . A total of 88 patients presenting with palpable breast lumps and fulfilled the inclusion criteria were evaluated using fine-needle aspiration cytology (FNAC), and the results were compared with corresponding histopathological diagnoses wherever available.

Procedure

FNAC was performed using a 22-gauge needle attached to a 20-ml disposable syringe, under all aseptic precautions. No local anaesthesia was administered during the procedure. The aspirated material was evaluated on-site for adequacy. Smears were prepared and immediately fixed in 95% ethanol, followed by staining with Papanicolaou and hematoxylin & eosin (H&E) stains.

Cytological findings were categorized according to the International Academy of Cytology (IAC) Yokohama Reporting System, which classifies breast FNAC into five diagnostic categories:

- C1 – Inadequate/Insufficient
- C2 – Benign
- C3 – Atypical
- C4 – Suspicious for Malignancy
- C5 – Malignant

Histopathological examination was considered the gold standard. FNAC results were correlated with histological findings, and the diagnostic performance was evaluated by calculating:

- Sensitivity
- Specificity
- Positive Predictive Value (PPV)
- Negative Predictive Value (NPV)
- Overall diagnostic accuracy
- Risk of Malignancy (ROM) for each category

For statistical analysis, malignant lesions included:

- Invasive carcinomas
- Ductal carcinoma in situ (DCIS)
- Borderline and malignant phyllodes tumors
- Sarcomas
- Lymphomas

Benign lesions included:

- Fibroadenomas
- Fibrocystic changes
- Benign phyllodes tumors
- Papillomas
- Atypical ductal hyperplasia (ADH)
- Inflammatory lesions

Diagnostic Scenarios for Accuracy Calculation
FNAC performance was assessed under three diagnostic thresholds:
1. Scenario 1: C2 considered benign; C3, C4, and C5 as malignant.
2. Scenario 2: C2 and C3 considered benign; C4 and C5 as malignant.
3. Scenario 3: C1 to C4 considered non-malignant; only C5 considered malignant.

Inclusion Criteria:
- Patients of any age presenting with palpable breast lumps.
- Patients referred for FNAC by the Department of Surgery.
- Patients who provided written informed consent.
- Cases with available histopathological diagnosis for comparison.

Exclusion Criteria:
- Patients who refused consent for FNAC or histopathological evaluation.
- Non-palpable lesions not accessible for FNAC.
- Inadequate smears (C1 category) without corresponding histology.
- Cases lost to follow-up or without histopathological correlation during the study period.

## III. Results

In this prospective study, a total of 88 patients underwent fine-needle aspiration cytology (FNAC) for evaluation of breast lesions at the Department of Pathology, Prafulla Chandra Sen Government Medical College and Hospital. Histopathological correlation was available in all 88 cases. The median age of the study population was 44 years, ranging from 15 to 85 years. Patients with benign lesions had a lower median age of 34 years, while those diagnosed with malignancy had a median age of 48 years.

Based on cytological findings, the cases were categorized according to the IAC Yokohama System as follows:
- C1 – Inadequate: 10 cases
- C2 – Benign: 40 cases
- C3 – Atypical: 8 cases
- C4 – Suspicious for Malignancy: 6 cases
- C5 – Malignant: 24 cases

Histopathology confirmed malignancy in 33 cases, while 55 cases were non-malignant.

| Yokohama Category | Total Cases | Malignant Cases |
|---|---|---|
| C1 – Inadequate | 10 | 3 |
| C2 – Benign | 40 | 0 |
| C3 – Atypical | 8 | 2 |
| C4 – Suspicious | 6 | 4 |
| C5 – Malignant | 24 | 24 |
| Total | 88 | 33 |

**Table 1: Distribution of Cases**

The risk of malignancy (ROM) calculated for each category showed:
- C1: 33.3% (3 out of 10)
- C2: 0% (0 out of 40)
- C3: 25% (2 out of 8)
- C4: 66.7% (4 out of 6)
- C5: 100% (24 out of 24)

| Yokohama Category | Total Cases | Malignant (on HPE) | Non-Malignant (on HPE) | ROM (%) |
|---|---|---|---|---|
| **C1 – Inadequate** | 10 | 3 | 7 | 33.3 |
| **C2 – Benign** | 40 | 0 | 40 | 0.0 |

| | | | | |
|---|---|---|---|---|
| **C3 – Atypical** | 8 | 2 | 6 | 25.0 |
| **C4 – Suspicious for Malignancy** | 6 | 4 | 2 | 66.7 |
| **C5 – Malignant** | 24 | 24 | 0 | 100.0 |

Table 2: Risk of Malignancy (ROM) Based on IAC Yokohama Categories (n = 88)

The diagnostic accuracy of FNAC was assessed using three different interpretation thresholds:
1. Scenario 1: C2 as benign; C3, C4, C5 as malignant
2. Scenario 2: C2 and C3 as benign; C4 and C5 as malignant
3. Scenario 3: Only C5 as malignant; C1–C4 as non-malignant

| **Metric** | **Scenario 1(C3–C5 = malignant)** | **Scenario 2(C4–C5 = malignant)** | **Scenario 3(Only C5 = malignant)** |
|---|---|---|---|
| **Sensitivity (%)** | 90.91 | 84.85 | 72.73 |
| **Specificity (%)** | 83.33 | 95.83 | 100.00 |
| **Positive Predictive Value (PPV) (%)** | 78.95 | 93.33 | 100.00 |
| **Negative Predictive Value (NPV) (%)** | 93.02 | 90.20 | 85.71 |
| **Accuracy (%)** | 86.36 | 90.91 | 88.63 |

Table 3: Statistical Results for Diagnostic Scenarios (n = 88)

Interpretation:
- Scenario 1, where C3, C4, and C5 are considered malignant, shows the highest sensitivity but slightly lower specificity.
- Scenario 2 offers a balanced profile, with high values across all parameters.
- Scenario 3, where only C5 is labeled malignant, gives perfect specificity and PPV, but lower sensitivity due to exclusion of borderline categories.

This supports the value of including atypical and suspicious categories (C3 and C4) for better diagnostic coverage in clinical settings.

Across all scenarios, the IAC Yokohama system demonstrated high sensitivity, specificity, and accuracy, with performance increasing when atypical and suspicious categories (C3 and C4) were included as positive interpretations. This reinforces the reliability of the system in breast FNAC diagnosis.

## IV. Discussion

The present study evaluates the diagnostic performance of the International Academy of Cytology (IAC) Yokohama System in breast lesion reporting through fine-needle aspiration cytology (FNAC), incorporating histopathological correlation in all 88 cases. The findings reaffirm the value of standardized cytological classification, especially in resource-limited settings where FNAC remains a primary diagnostic modality.

The risk of malignancy (ROM) across the Yokohama categories in our cohort aligns closely with international data. The ROMs observed were: C1 – 33.3%, C2 – 0%, C3 – 25%, C4 – 66.7%, and C5 – 100%. These values are consistent with studies conducted by Montezuma et al. and Wong et al., who reported a ROM of 2.6–15% in C1, 0–1% in C2, 15–40% in C3, 50–85% in C4, and 95–100% in C5 categories [11,12]. The elevated ROM in the C1 category in our study (33.3%) suggests that inadequate samples must be interpreted with caution and that repeat aspiration or core biopsy should be recommended in clinically suspicious cases.

When diagnostic performance was evaluated under three different interpretive scenarios, Scenario 1 (C3–C5 as malignant) yielded the highest sensitivity (90.91%) but slightly lower specificity (83.33%). This mirrors the findings of Panwar et al. and Chandra et al., where broader inclusion criteria for malignancy enhanced sensitivity but compromised specificity [13,14].

Scenario 2 (C4–C5 as malignant) offered a balanced diagnostic profile with sensitivity of 84.85%, specificity of 95.83%, and accuracy of 90.91%, which closely parallels findings reported by Singh et al. [15], highlighting this interpretation as the most clinically pragmatic. Scenario 3, where only C5 was considered malignant, achieved perfect specificity and PPV (100%), though with a significant drop in sensitivity (72.73%). This confirms the trade-off observed in other studies between stringency and diagnostic yield [16].

The IAC Yokohama system thus demonstrated robust overall performance, with diagnostic accuracy ranging from 86.36% to 90.91% depending on interpretation criteria. These results are congruent with a meta-analysis by Zhang et al., which showed pooled sensitivity and specificity of 89% and 98% respectively, for the Yokohama system [17].

The demographic profile of our study population also conforms with global patterns. The median age for malignancy was 48 years, similar to the median age observed in Indian and Southeast Asian cohorts, underscoring the increasing burden of breast malignancies among perimenopausal women in low- and middle-income countries [18].

## V. Conclusion Of Discussion

Our findings support the utility of the IAC Yokohama System in standardizing breast cytology reporting, with excellent correlation with histopathology. Including C3 and C4 categories in malignant interpretation increases diagnostic sensitivity and accuracy, reinforcing their clinical significance. Routine use of the system may improve early diagnosis, reduce inter-observer variability, and facilitate better communication between pathologists and clinicians.

**Summary:**

This prospective study evaluated the diagnostic performance of fine-needle aspiration cytology (FNAC) in 88 breast lesion cases using the IAC Yokohama System at a tertiary care center in peripheral Eastern India. Histopathological correlation was available for all cases. The study demonstrated high sensitivity, specificity, and accuracy across three diagnostic interpretation scenarios, with improved performance when atypical (C3) and suspicious (C4) categories were included as malignant. Risk of malignancy (ROM) across categories aligned with international data. The results highlight FNAC's continued relevance and the utility of standardized reporting in resource-limited settings to improve breast lesion diagnosis and management.

**Limitations of the Study:**

1. Single-center design: The study was conducted at a single institution, which may limit the generalizability of the findings to other regions or populations.
2. Relatively small sample size (n=88): A larger sample would provide greater statistical power and more robust subgroup analysis.
3. Operator-dependent variability: FNAC results can be influenced by the experience of the performing clinician and cytopathologist, which was not standardized across cases.
4. Limited follow-up data: The study did not assess long-term patient outcomes or recurrence in cases with discordant cytology-histology results.
5. Absence of radiological correlation data: Although the triple assessment approach is ideal, radiological findings were not formally integrated into this analysis.

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