



**Categorization of Breast Fine Needle Aspirates Using the International Academy of Cytology Yokohama System Along with Assessment of Risk of Malignancy and Diagnostic Accuracy in a Tertiary Care Centre in Rajkot, Gujarat**

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**Abstract**

**Background:** The International Academy of Cytology Yokohama System has developed a standardized system of reporting breast cytology by classifying them into five categories – insufficient, benign, atypical, suspicious, and malignant and supplies guidance within a management algorithm for every category.

**Aims:** The main objectives of our study were to classify breast fine needle aspirates according to the IAC Yokohama system and assess the risk of malignancy (ROM), sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy for all categories.

**Material and Methods:** It was a retrospective study done over a period of 1 year from August 2021 to July 2022. All breast FNAs carried out at cytopathology department, P.D.U. Medical College, Rajkot in the above period were retrieved and classified into five categories according to the Yokohama system. Histopathological

diagnosis was also retrieved wherever available. Using histopathological diagnosis as the gold standard, ROM, sensitivity, specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV) and accuracy of Breast FNAC were calculated.

**Results:** Out of the 348 breast fine needle aspirates, 258 had histopathological correlation. The risk of malignancy for insufficient, benign, atypical, suspicious, and malignant categories were 0%, 0%, 33.30%, 100% and 100%, respectively. Maximum sensitivity (100%) was achieved when atypical, suspicious, and malignant cases were considered as positive test results. The highest specificity and (100%) was observed when malignant cases and malignant together with suspicious cases were considered as positive test results, whereas maximum diagnostic accuracy (99.6%) was noted when the malignant and suspicious category was included in positive test results.

**Conclusion:** IAC Yokohama system is an excellent system for accurately diagnosing breast fine needle aspirates with greater reproducibility of reports and better communication between the pathologist and clinician and helps with diagnostic clarity and appropriate patient management.

**Keywords:** Breast carcinoma, Fine needle aspiration cytology, IAC Yokohama system, risk of malignancy.

### Introduction

Breast carcinoma is the most common cancer in females worldwide. It is the most common cause of cancer-related deaths in women in developing countries.

In India, breast carcinoma has overtaken cervical cancer with the incidence rate being 26 per 100,000 women population and mortality rate of 13 per 100,000 women population.[1] Fine needle aspirate is a simple, rapid, cost-effective, and minimally invasive test for both palpable and impalpable (under ultrasonographic guidance) breast lumps. For the diagnosis of breast cancer, FNAC has a high sensitivity of 90%–95% and a high positive predictive value ~100%.[2] Using ultrasonography (USG) guidance and rapid on-site evaluation (ROSE) optimizes the usage of FNAC.

The International Academy of Cytology (IAC) Breast Group was brought together in 2016 at the Yokohama International Congress of Cytology with the aim of developing a standardized reporting system to improve the interpretation of breast cytology. It also aims at improving communication between the cytopathologist and clinician by linking reporting system with management options.[3]. The IAC Yokohama system has 5 categories that may be stratified by their risk of malignancy (ROM) and supply guidance within a management algorithm for every category. The categories defined are insufficient/inadequate; benign;

atypical, probably benign; suspicious of malignancy; and malignant.

The cytological findings should be interpreted along with clinical and radiological findings in the “triple test.” With the triple test parameters, the sensitivity and specificity of FNAC is comparable to core needle biopsy.[4]

The present study aims at classifying the breast FNACs according to the IAC Yokohama system and evaluating the risk of malignancy and diagnostic accuracy of different categories. The sensitivity, specificity, PPV, and NPV were also assessed.

### Materials & Methods

It was a retrospective study in which all the breast fine needle aspirates done at Cytopathology department, P.D.U. Medical College and Hospital, Rajkot, Gujarat from 1<sup>st</sup> August 2021 to 31<sup>st</sup> July 2022 were retrieved (348 FNACs). The final reporting was done on smears stained with May Grunwald Giemsa and Papanicolaou stains.

The clinical details were also retrieved, and all cases were categorized according to the IAC Yokohama reporting system into five categories –

- C1. Insufficient
- C2. Benign
- C3. Atypical
- C4. Suspicious of Malignancy
- C5. Malignant.

Histological diagnosis, which was considered the gold standard, was available in 258 cases (74.1%).

### Statistical analysis

The risk of malignancy (ROM) was calculated for each category as below –

Risk of malignancy (ROM) = number of malignant cases confirmed histologically/total number of cases in the diagnostic category.

The cases in the insufficient category were excluded from further statistical analysis, as they could not be included in either negative or positive for malignancy. Using the histological diagnosis as the gold standard, the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were calculated.

Sensitivity = True positive/ (True positive + False negative)

Specificity = True negative/ (True negative + False positive)

PPV = True positive/ (True positive + False positive)

NPV = True negative/(True negative + False negative)

Diagnostic accuracy = (True positive + True negative)/All analyzed cases

The above ratios were calculated for the following groups–

- Group A- Only the “malignant” category (C5) was regarded as a positive report.
- Group B- All cases in the “malignant” and “suspicious of malignancy” category (C5 and C4) were regarded as positive for malignancy.
- Group C- All cases in the “malignant,” “suspicious of malignancy,” and “atypical” categories (C5, C3 and C4) were regarded as positive for malignancy.

**Results**

A total of 348 fine needle aspirates from breast lesions were carried out in the period from August 2021 to July 2022. The age group of patients ranged from 13 years to 80 years with the majority of cases belonging to the 3rd and 4th decades. Bilateral lesions were seen in 10 (2.9%) cases, whereas the remaining had unilateral lesions.

The 348 breast FNAs were categorized according to the IAC Yokohama System as follows:

- C1. Insufficient- 27 cases (7.8%)
- C2. Benign- 241 cases (69.2%)

C3. Atypical- 8 cases (2.3%)

C4. Suspicious of malignancy- 2 cases (0.5%)

C5. Malignant- 101 cases (20.2%).

Histopathological correlation was available in 258 cases (74.13%). The histopathological diagnoses for the breast lesions in different cytological categories were evaluated and are summarized in Table 1.

Table 1: Distribution of cases across IAC Yokohama System categories with matched his to patho logical diagnosis.

Total no. of cases (FNAC)		Matched HPE cases		
IAC Yokohama Category	No. of cases	No. of cases	Benig n	Maligna nt
C1	27	5	5	0
C2	241	180	180	0
C3	8	3	2	1
C4	2	2	0	2
C5	70	68	0	68

The risk of malignancy in each category was calculated and summarized in Table 2:

Table 2: Risk of malignancy (ROM) for each category

IAC Yokohama Category	Risk of malignancy
C1	0%
C2	0%
C3	33.30%
C4	100%
C5	100%

Thus the ROM for insufficient, benign, atypical, suspicious, and malignant categories were 0%, 0%, 33.3%, 100%, and 100%, respectively.

The sensitivity, specificity, PPV, NPV, and diagnostic accuracy of the three groups are summarized in Table 3.

Table 3: Sensitivity, specificity, PPV, NPV, accuracy of IAC Yokohama System

	Group A (Category Malignant Considered positive)	Group B (Category Malignant and Suspicious considered positive)	Group C (Category Malignant, Suspicious, and Atypical considered positive)
Sensitivity	95.8%	98.6%	100%
Specificity	100%	100%	98.9%
PPV	100%	100%	97.2%
NPV	98.3%	99.4%	100%
Accuracy	98.8%	99.6%	99.2%

Maximum diagnostic accuracy is achieved (99.6%) when malignant and suspicious of malignancy are considered positive, whereas highest sensitivity is achieved (100%) when malignant, suspicious, and atypical are considered positive for malignancy.

Among the suspicious and malignant categories, invasive ductal carcinoma was the most common histological diagnosis, whereas in the benign category, fibroadenoma was the most common.

**Discussion**

In the present study, 348 fine-needle aspirates from breast were retrospectively categorized according to the IAC Yokohama Reporting System. Our study had 7.8% insufficient, 69.2% benign, 2.3% atypical, 0.5% suspicious, and 20.2% malignant lesions, respectively. This distribution is similar to the results obtained by Kamatar et al. [6] who had 5% C1, 71% C2, 1% C3, 2% C4, and 21% C5 lesions, respectively [Table 4].

The ROM for various categories in the present study was 0% for C1, 0% for C2, 33.3% for C3, 100% for C4, and 100% for C5. These results are similar concordance with the studies by Wong et al. [4], with the variation possibly

accounted for by the vast difference in the sample size of the studies.

Table 4: Distribution of breast lesions according to IAC Yokohama System in various published studies

	C1 Insufficient	C2 Benign	C3 Atypical	C4 Suspicious of Malignancy	C5 Malignant
Wong et al. [4] (n=2696)	11.20%	72%	4.30%	2.20%	10.30%
Agarwal et al. [5] (n=1205)	19%	50.20%	6.60%	3.80%	20.40%
Kamatar et al. [6] (n=470)	5%	71%	1%	2%	21%
Present study (n=348)	7.80%	69.20%	2.30%	0.50%	20.20%

Table 5: Risk of malignancy of different categories of IAC Yokohama System in various published studies

	C1 Insufficient	C2 Benign	C3 Atypical	C4 Suspicious of Malignancy	C5 Malignant
Wong et al. [4] (n=2696)	2.60%	1.70%	15.70%	84.60%	99.50%
Agarwal et al. [5] (n=1205)	60.90%	8.30%	17.20%	77.80%	100%
Kamatar et al. [6] (n=470)	0%	4%	66%	83%	99%
Present study (n=348)	0%	0%	33.30%	100%	100%

In the present study, the risk of malignancy for insufficient category was 0%. The ROM for this category

varied across different studies with Agarwal et al. [5] reporting it to be 60.9% in their study and Kamatar et al. [6] reporting it to be 0%. The ROM for insufficient category being 0% in this study could possibly be attributed to the small sample size of this study.

In the present study, maximum sensitivity (100%) was achieved when atypical, suspicious, and malignant cases (Group C) were considered positive test results. However, the inclusion of atypical cases in positive results resulted in decreased specificity. The highest specificity (100%) was seen when malignant cases (Group A) and malignant and suspicious cases (Group B) were included in positive test results, whereas maximum diagnostic accuracy (96.4%) was observed when malignant and suspicious (Group B) cases were included in positive results. Wong et al. [4], Agarwal et al. [5] demonstrated similar findings, although the similar results obtained in this study for Group A and Group B could be explained due to a significantly smaller sample size of this study than previously published studies; and patients coming from periphery converging towards our tertiary Centre, often presenting late and with a higher majority of malignant cases seen.

Table 6: Comparison of diagnostic accuracy of breast FNAC in diagnosis of malignancy using Yokohama system in various studies

Category included		Wong et al. [4] (n=2696)	Agarwal et al. [5] (n=1205)	Present study (n=348)
Only malignant category taken as positive	Sensitivity	75.40%	86.70%	95.80%
	Specificity	100%	100%	100%
	PPV	100%	100%	100%
	NPV	80.70%	71.20%	98.40%
	Accuracy	87.90%	90.00%	98.80%
Suspicious of	Sensitivity	92.00%	96.00%	98.60%
	Specificity	97.80%	91.90%	100%

malignancy and malignant taken as positive	PPV	97.60%	97.30%	100%
	NPV	92.70%	88.30%	99.40%
	Accuracy	95.00%	95.00%	99.60%
Atypical, suspicious and malignant category taken as positive	Sensitivity	98.90%	98.20%	100%
	Specificity	62.10%	59.50%	98.90%
	PPV	71.70%	88.00%	97.20%
	NPV	98.30%	91.70%	100%
	Accuracy	80.20%	88.60%	99.20%

**Conclusion**

Thus the IAC Yokohama Reporting System for breast cytology provides a uniform reporting platform with better reproducibility of reports similar to the Milan system of reporting salivary gland lesions and the Bethesda system for reporting thyroid cytopathology. The ROM of different categories are similar to the ROMs suggested in the original publication of the Yokohama system.

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