ORIGINAL ARTICLE

Diagnostic Accuracy of Fine Needle Aspirates Using International Academy of Cytology Yokohama System in Categorizing and Diagnosis of Lesions of the Breast: A Clinicopathological Experience

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Abstract

Background: International Academy of Cytology (IAC) introduced a breast category to produce comprehensive standardized guidelines for reporting breast cytopathology. IAC Yokohama System for Reporting Breast Cytopathology highlights the indications for getting breast cytology, procedural techniques, preparation of smear, material yielded, uniform system of reporting, use of ancillary investigations and prognostic tests, and correlation with clinical workup algorithms. The triple approach that includes clinical examination, radiological and pathological workup aims to maximize the preoperative detection of malignancy for early, definitive, appropriate treatment to the patient.

Materials and methods: The present study characterized the cytomorphological features of breast lesions ranging from inflammatory, benign to malignant. The lesions encountered were assigned a specific category on the basis of IAC Yokohama System. Histopathological correlation of cytomorphological findings was done wherever possible.

Results: Out of a total of 450 cases included in our study, 98% (441/450) were females, male to female ratio of 1:49, mean age being 32.6 ± 12.5 years. Majority of cases were in Yokohama category benign comprising 345 breast aspirates (76.66%), followed by 40 cases (8.8%) malignant, 28 cases (6.22%) in Yokohama atypical category. Category suspicious for malignancy consisted of 17 (3.7%) cases. A good inter-kappa agreement was found between cytological impression and histopathology diagnosis (>0.5). A sensitivity and specificity of 100 and 92.96% respectively was seen along with positive predictive value (PPV), negative predictive value (NPV), and area under the curve (AUC) of 98.24%, 100%, and 0.98 respectively. Diagnostic accuracy of 98.57% was seen.

Conclusion: The IAC Yokohama System is a high-quality reporting system used for diagnosing breast fine needle aspirates accurately with greater reproducibility of reports and better communication between the pathologist and clinician.

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Introduction

Breast lesions comprise a major chunk of conditions needing thorough pathological, radiological, and surgical intervention. The spectrum is quite wide, varying from inflammatory (nonneoplastic), benign lesions to invasive carcinoma.[1] Benign breast disease is a heterogeneous group of breast lesions more commonly encountered in routine cytology than the neoplastic lesions. The benign lesions of the breast mostly present in patients in their second decade.[2] As per the Globocon 2020 India, breast carcinoma constituted approximately 13.5% of all cancers and 10.6% of overall cancer deaths.[3] Various risk factors influence the overall incidence of breast carcinoma where genetic, lifestyle, and environmental factors play the most determining role, with the associated risk factors like age, gender, menstrual history, parity, lactation, hormonal factors like hormone replacement therapy or use of birth control pills.[4]

Fine needle aspiration cytology (FNAC) is a simpler and highly specific and sensitive procedure in diagnosing benign vs malignant lesions. Breast FNAC provides many advantages, one of them being minimally invasive, eliminating the need for biopsy in most cases. It has negligible physical and psychological discomfort and is well accepted by the majority of patients. However, multiple factors are known to hinder the overall diagnostic accuracy of breast FNAC depending on procedural skills, experience, smear preparation, and interpreting cytology smears.[5,6] With availability of ultrasound-guided techniques, a useful adjunct helping in detection and aspiration of small and deep-seated lesions, the diagnostic utility of FNA has increased significantly.[7,8] The triple approach aims at the preoperative identification of malignancy so that early, definitive, and appropriate management is offered to the patient.[9] In addition, FNAC allows multidirectional passes aiding in sampling broader areas of the lesion and prompt reporting when essential.[10]

As per NCI guidelines, breast FNAC is divided into five major categories: inadequate (C1), benign (C2), atypical, probably benign (C3), suspicious, favor malignancy (C4), and malignant (C5), and Robinson's grading system for breast carcinoma[11,12] includes six cytomorphological features as parameters (cell size, cell dissociation, cell uniformity, nucleolus, nuclear margin, and nuclear chromatin) to grade the tumors. Scores of 1, 2, 3 are given to cytological features and graded as grade I, II, and III depending on the score. Score 6-11: grade I tumor, score 12-14: grade II tumor, score 15-18: grade III tumor.[11,12]

International Academy of Cytology (IAC) in 2016 formed a breast group to produce set guidelines for reporting breast cytopathology. The concept of structured format reporting system improves not only the quality but by giving quality assurance, clarity, and reproducibility of reports interdepartments, interstates, and

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among countries, improvising overall patient management and hence facilitates the reporting quality.[13,14] Use of cell blocks, immunohistochemistry, *in situ* hybridization, and other molecular tests of prognostic and diagnostic markers will improve patient care. The reporting categories are: category 1: insufficient/inadequate, category 2: benign, category 3: atypical, category 4: suspicious of malignancy, category 5: malignant. The Yokohama System for Reporting Breast Cytopathology aids in reciprocating the implied risk of malignancy (ROM) and recommended clinical management.[15,16] The IAC breast group has established a checklist for fine needle aspiration biopsy (FNAB) cytology using an analytical approach based on pattern identification and crisp cytological criteria which can be used by the reporting cytopathologist.[15]

Materials and Methods

The present study was a cross-sectional study conducted over a period of 4 years and 5 months from January 2018 to May 2022 in the department of pathology and surgery at a tertiary care hospital in South Delhi.

This study characterized the cytomorphological features of the spectrum of breast lesions on FNAC ranging from nonneoplastic to neoplastic. The lesions were also evaluated and assigned a category on the basis of IAC Yokohama System. Histopathological correlation of cytomorphological features was also done wherever available. A total of 450 participants were included presenting with breast masses visiting the outpatient department in the department of surgery. Informed consent was taken from all who participated in the study. All the cases with palpable breast lump who gave consent to get enrolled in the study were included in the study. Detailed clinical history and examination was done prior to FNAC procedure. Hematoxylin and eosin stain, Giemsa, and Papanicolaou stains were used to stain cytology smears. Resected/biopsied specimens were received in 10% buffered formalin for histopathological examination. Specimens were oriented, measured, and sections were submitted for processing. Histopathological diagnosis was correlated with cytological grading.

Statistical analysis was done wherever applicable using SPSS.

Results and Observations

A total of 450 cases were included in our study with 98% (441/450) females and 2% (9/450) male patients with male to female ratio of 1:49. On analyzing the age-wise distribution, majority of cases fell in the age-group 21–30 years, contributing 35.12%, followed by age-group 31–40 years, 26% of the cases.

The patients who presented with painless breast lump (60%) and ones associated with pain were 38% of all cases. Breast lumps presenting with nipple discharge were seen in 2% cases. Most of the lesions were lateralized to the left side (51.11%) with 47.55% cases seen on the right side. Only six (1.33%) cases had a bilateral presentation. Majority of the lesions were localized to the upper outer quadrant (30%) followed by upper inner quadrant (22.6%). Involvement of the central zone (nipple and areola) was seen in 13.1% cases while 4% cases had involvement of multiple quadrants. Lower inner and outer quadrants showed 15.1% cases each.

Majority of the lesions were mobile, 64.88%, with tenderness seen in 44.88% of the lumps on palpation. Overlying skin was found to be normal in appearance in 91.11% of the cases with redness seen in 2.66% cases. Nipple retraction was seen in 2.66% cases and 96% cases showed normal appearance (Table 1). Radiological evaluation was done in 369 (82%) of the cases in the present study. Majority of the cases were BIRADS II (54.74%) followed by BIRADS IV (24.3%), BIRADS I, III, V, VI were seen in 2.71, 7.31, 4.87, 5.96% respectively (Fig. 1).

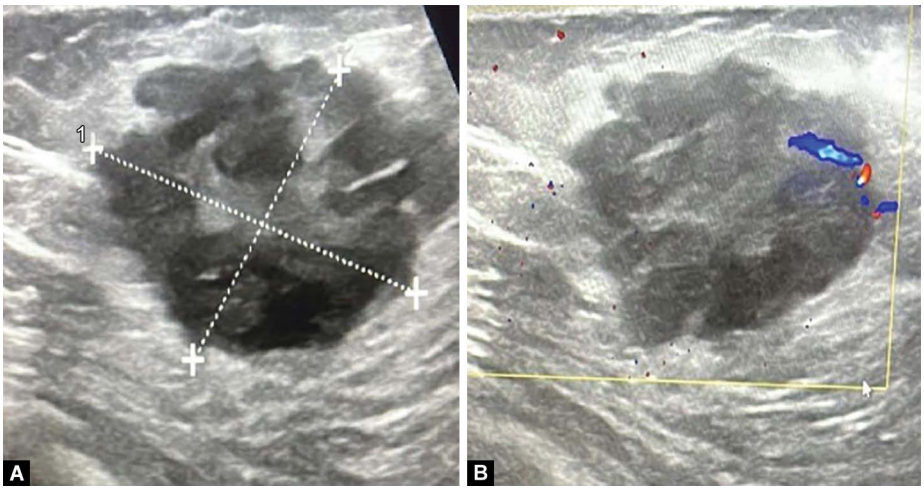
Among the 450 cases, major proportion of cases were seen in Yokohama category benign comprising of 345 breast aspirates (76.66%), this was followed by 40 cases (8.8%) malignant. 28 cases (6.22%) in Yokohama category atypical. Category suspicious for malignancy consisted of 17 (3.7%) cases (Table 2).

Table 1: Distribution of cases according to clinical assessment

Clinical assessment	*Frequency*	*Percentage*
Mobility		
Immobile	158	35.11%
Mobile	292	64.88%
Tenderness		
Nontender	248	55.11%
Tender	202	44.88%
Overlying skin		
Normal	410	91.11%
Atrophied	10	2.22%
Edematous	5	1.11%
Previous surgical scar	5	1.11%
Puckering	8	1.77%
Redness	12	2.66%
Nipple		
Normal	433	96%
Retraction	12	2.66%
Swelling	5	1.11%

Table 2: Distribution of study cases according to "The Yokohama System for Reporting Breast Fine Needle Aspiration"

Yokohama diagnostic category	*Number of cases in each category (n = 450)*	*Percentage (%)*
Insufficient/ inadequate	20	4.44%
Benign	345	76.66%
Atypical	28	6.22%
Suspicious for malignancy	17	3.7%
Malignant	40	8.88%
Total	450	100



Figs 1A and B: (A) Sonogram of breast mass showing a unifocal mass with irregular shape, spiculated margin, echogenic halo with nonparallel orientation, BIRADS 5; (B) Lesion shows internal vascularity on color Doppler

Among the 345 breast FNAC categorized as benign (Fig. 2), 211 cases were categorized as benign breast disease including fibroadenoma. 45 cases were cytologically labeled as cystic lesion. Only 9 cases had fibrocystic change. Inflammatory lesions comprised 37 cases out of which 20 cases were of acute suppurative nature, 15 cases were of granulomatous mastitis, and 2 cases were of chronic mastitis. 23 cases were of gynecomastia, 5 cases were of axillary breast. 15 cases were diagnosed with lactational change/galactocele. A total of 28 cases were categorized as Yokohama category III (atypical, Fig. 3) among 450 aspirates. Of the 28 cases, 57.1% (16 cases) were of proliferative breast disease with atypia while atypical ductal hyperplasia was seen in 8 cases (28.5%) and usual epithelial hyperplasia with focal atypia in 4 cases (14.2%). Out of the 450 breast aspirates, 3.7% (17 cases) were suspicious for malignancy, Yokohama category IV (Fig. 4).

Out of the 450 breast aspirations, 40 were categorized under malignant, category V (Fig. 5). 85% were invasive ductal carcinoma while 5% cases were diagnosed as carcinoma breast with medullary features and 10% were invasive carcinoma of no specific type (NOS).

Association of various parameters with the cytological categories according to the Yokohama System was done and the p value was calculated (Table 3). Significant associations were seen between some of them. On statistically analyzing the association of size of the lesion with cytological categories, a significant association of <0.0001 was seen. Mean size for the malignant cases was 4.63 ± 1.52 cm while the suspicious for malignancy cases had a mean size of 3.8 ± 0.84 cm and the benign lesions had a mean size of 2.25 ± 1.07 cm. The patients presenting to our cytopathology laboratory for FNAC were assessed for clinical presentation such as mobility, tenderness, condition of the overlying skin, and status of the nipple. Statistically significant association was seen in all parameters. *p*-values of 0.0000093 for mobility, 0.0002 for tenderness, and *p*-value was 0 for skin and nipple status. Radiological evaluation and BIRADS scoring are an integral part of breast assessment and the BIRADS score was available in 369 cases presenting with breast lesions. A statistical analysis was done and a significant association (*p*-value 0) was seen between the various cytological categories and BIRADS score.

Histopathological correlation was available in 350 cases (77.7%) (Table 4). In our study, out of 450 cases, 20 cases (9%) were interpreted as inadequate (category I) on cytology, 4 cases underwent further surgical follow-up and were diagnosed as benign (fibroadenoma) on histopathology. A total of 345 cases were diagnosed as Yokohama category II out of which histopathological evaluation was available in 280 cases, 275 out of these cases were diagnosed benign on histopathology while 5 cases were found to be malignant in nature. 28 cases were cytologically categorized as Yokohama category III. Out of 28 cases, histopathological correlation was available in 20 cases. All 20 cases were malignant on histopathological evaluation.

A total of 17 cases were from category IV, with histopathological diagnosis available in 14 cases. All cases were diagnosed as malignant on histopathology. Yokohama category V

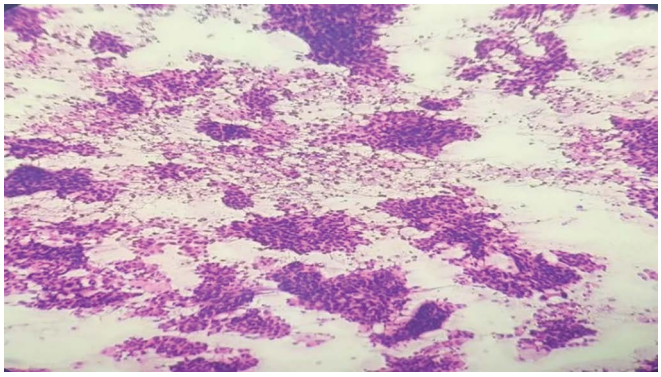
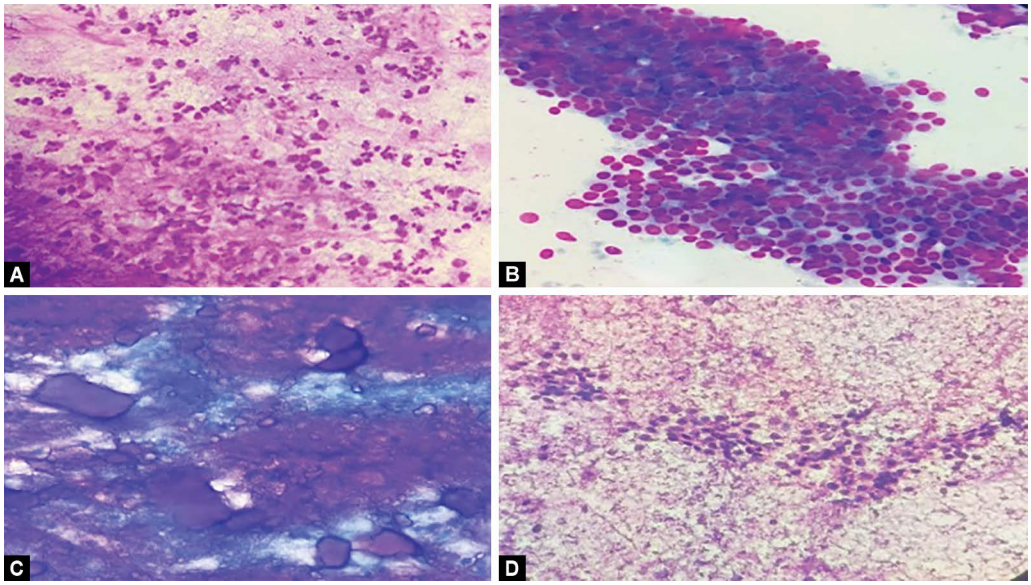


Fig. 3: Category III. FNA smears examined from a case of proliferative breast disease with atypia show A and B—cohesive ductal epithelial cells showing crowding and overlapping of nuclei, mild to moderate nuclear atypia (H&E 10×)



Figs 2A to D: Category II—benign; (A) Tubercular breast abscess shows polymorphs, lymphocytes, eosinophils, cystic macrophages along with ductal epithelial cells (H&E 40×); (B) Fibroadenoma, high-power view (H&E 100×); (C) Crystallizing galactocele shows many crystals of variable shapes and sizes and thin granular amorphous debris, high-power view (H&E); (D) Lactational change, high power (H&E 40×)

(malignant) was assigned to 40 cases on cytology with histopathology available in 32 cases, all were proven to be malignant. Smears obtained on FNAC were evaluated and categorized according to Yokohama System, association of these cytological grades with the histopathologically confirmed categories was assessed. Out of the 450 cases, 350 cases had histopathological follow-up. A significant association was seen between the cytological grade and histopathological diagnosis ($p = 0$) (Table 5).

From the histopathological data, ROM of each Yokohama category was calculated. Out of 450 cases, histopathological evaluation was available in only 280 cases, among which 5 cases were found to be malignant (Table 6).

The risk of malignancy estimated in the benign (Yokohama category II) was 1.8%. Out of 28 cases in the atypical category (Yokohama category III), 20 cases could be followed up on histopathology, all of which were malignant with a risk of malignancy of 100%. Similarly, the risk of malignancy in Yokohama category IV was 100%, where 14 out of 20 cases had follow-up surgery and their histopathology showed malignancy. In category V, 32 out of 40 cases had surgery and all cases turned out to be 100%, ROM 100%.

Table 3: Association of various parameters with cytological categories

Parameter	*p-value*	*Relationship*
Age	<0.5	Significant
Gender	>0.5	Not significant
Breast lump (painful/painless, nipple discharge)	>0.5	Not significant
Lateralization of the lesion (left or right breast)	>0.5	Not significant
Quadrant of involvement	<0.5	Significant
Size of the lesion	<0.5	Significant
Mobility	<0.5	Significant
Tenderness	<0.5	Significant
Overlying skin and nipple	<0.5	Significant
BIRADS score	<0.5	Significant

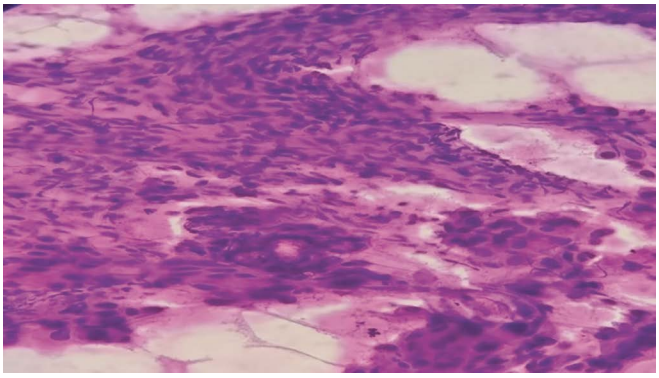


Fig. 4: Category IV. Suspicious for malignancy, probably ductal carcinoma, shows overlapping of nuclei with nuclear atypia (H&E 100×)

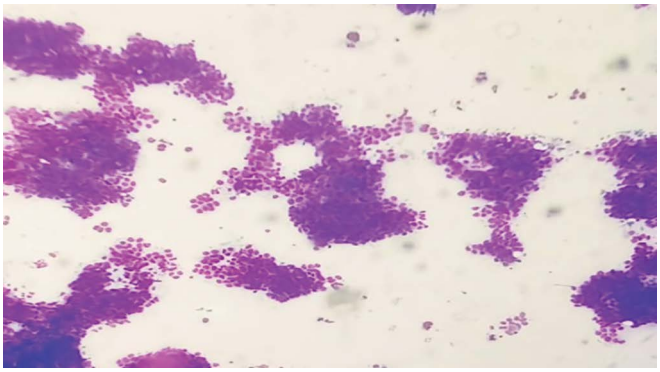


Fig. 5: Category V. FNA smears examined from a case of invasive ductal carcinoma show atypical ductal epithelial cells with high N:C ratio and prominent nucleoli (H&E 40×)

Table 4: Distribution of cases according to histopathological diagnosis of lesions in each cytological category

Yokohama category	*No. of cases*	*Cytological category*	*Histopathology follow-up (n = 350)*	*Histopathological diagnosis*	
				Benign	*Malignant*
1	20	Inadequate	4	4	–
2	345	Benign breast disease/fibroadenoma (211)	280	187	5
		Cyst (45)		30	
		Fibrocystic change (9)		6	
		Granulomatous mastitis (15)		11	
		Acute suppurative lesion/breast abscess (20)		12	
		Lactational change/galactocele (15)		9	
		Gynaecomastia (23)		15	
		Normal/axillary breast (5)		4	
		Chronic mastitis (1)		1	
3	28	Proliferative breast disease with atypia	20		20
		Atypical ductal hyperplasia			
		Usual epithelial hyperplasia with focal atypia			
4	17	Suspicious for malignancy favoring ductal carcinoma	14		14
5	40	Invasive carcinoma, NST	32		32
		Invasive ductal carcinoma			
		Carcinoma with medullary features			
Total	450		350		

On evaluating further, a good inter-kappa agreement was found between cytological impression and histopathology diagnosis (>0.5). In our study, interrater kappa was 0.954, considered to be a very good agreement between the two categories (Table 7).

The sensitivity of cytology was 100%, meaning it correctly identified all true positive cases of cancer. The specificity was 92.96%, indicating that it accurately ruled out cancer in most noncancer cases. The positive predictive value was 98.24%, showing that when cytology indicated malignancy, it was correct nearly most of the time. The negative predictive value was 100%, that is, all cases labeled as nonmalignant by cytology were truly negative. The AUC was 0.98, reflecting good overall test performance. The diagnostic accuracy was 98.57%, confirming that fine needle cytology is a highly reliable tool for predicting malignancy. Table 8 shows that cytology is highly effective in detecting malignancy when compared to histopathology, which is considered the gold standard.

Discussion

Fine needle aspiration cytology of breast lumps is a simple, fast, cost-effective, and safe diagnostic procedure performed to determine the nature of breast masses with a high degree of accuracy and precision. The need for a newer widely accepted reporting system for breast cytology was recognized by IAC, which emphasized that appropriate resources and protocols for breast imaging, biopsy, and treatment would greatly add to the diagnostic workup and management of breast diseases.[16] Breast lesions account for one of the largest chunks of pathological conditions needing thorough diagnostic and surgical intervention.[17]

Breast lumps commonly present with pain, nipple discharge, cysts, and more commonly as a mass. All the patients enrolled in the current study presented with a complaint of lump similar to Bukhari et al. and Farhath et al.[18,19] Jan et al. as well as Chaudhary et al. reported breast lump as the most common clinical presentation in their study, 96.5 and 98%.[20,21] Right-sided lump (46.6%) was reported by Chauhan et al. (52%)[22] and 56% were also observed by Umat et al. and Farhath et al. respectively[23,19] while in the present study left-sided lateralization was seen contributing to 51.11% of cases. The upper outer quadrant was the most common site involved in 30% of cases followed by upper inner quadrant in 22.6% and lower outer quadrant and lower inner quadrant contributing 15.1% each. Our findings were similar to Farhath et al.[19] where upper outer quadrant was the most common quadrant with 46% masses and upper inner quadrant in 20% of lumps. Evaluation of breast masses clinically is a crucial part of the triple assessment.

Lesions were also evaluated on the basis of size that ranged from 1 to 7 cm with a mean

Table 5: Association of cytological Yokohama category with histological subtype

Yokohama category		*Total FNAC (n = 450)*		*FNAC with histopathological follow-up (n = 350)*		*Histopathological categories*		*p-value*
		No.	*%*	*No.*	*%*	*Benign (n = 279)*	*Malignant (n = 71)*	
Category I	Inadequate	0	0%	4	1.1%	4	0	0.0
Category II	Benign	345	76.6%	280	80%	275	5	
Category III	Atypia	28	6.2%	20	71.4%	0	20	
Category IV	Suspicious for malignancy	17	3.7%	14	82.3%	0	14	
Category V	Malignant	40	8.8%	32	80%	0	32	
Total		450	100%	350	56%	279	71	

Table 6: Cytohistological correlation with assessment of risk of malignancy (ROM)

Yokohama category		*Total FNAC (n = 450)*		*FNAC with histopathological follow-up (n = 350)*		*Histopathological categories*		*Risk of malignancy (%)*
		No.	*%*	*No.*	*%*	*Benign (n = 279)*	*Malignant (n = 71)*	
Category I	Inadequate	20	4.4%	4	1.1%	4	0	0
Category II	Benign	345	76.6%	280	80%	275	5	1.8
Category III	Atypia	28	6.2%	20	5.7%	0	20	100
Category IV	Suspicious for malignancy	17	3.7%	14	4%	0	14	100
Category V	Malignant	40	8.8%	32	9.1%	0	32	100
Total		100	100%	350	100%	279	71	

Table 7: Interrater kappa agreement between cytological impression and histopathological diagnosis

Cytological impression	*Histopathological diagnosis*		*Total*	*Kappa*
	Benign (n = 279)	*Malignant (n = 71)*		
Benign	279 (79.7%)	5 (1.4%)	284 (81.1%)	0.954
Malignant	0 (0.00%)	66 (18.8%)	66 (18.8%)	
Total	279 (79.7%)	71 (20.2%)	350 (100.00%)	

size of 2.73 ± 1.43 cm. Marabi et al. in their study concluded the mean size of lesions to be 1.7 cm in maximum dimension ranging from 0.17 to 10.0 cm.[24] A study reported a size range of 2–5 cm.[20] In a study by Chauhan et al., the size of the lumps ranged from 1 to 12 cm in diameter with a mean of 2.4 ± 1.49.[22]

The results of our study of 450 breast FNAC in accordance with IAC Yokohama system were comparable to studies as depicted in Table 9.

In our study, the lesser percentage of cases in category I may be due to the reason that FNAC of breast lesions was performed from multiple sites and often guided FNAC was used; hence aspirate could be procured from the exact pathological site. Relatively limited sample size may also contribute to the lower percentage. The most common diagnosis rendered in category II was fibroadenoma accounting for 61.1% of the benign cases, which is in concordance with various other studies: Chauhan et al. (50%), Sarangi et al. (42.9%), Agrawal et al. (41.3%), and Sundar et al. (30.7%).[22,25–27] Inflammatory lesions accounted for 36 cases (8%) that included lesions such as acute suppurative lesions (4.4%), chronic mastitis (0.2%), and granulomatous mastitis (3.3%). Our numbers were higher than those reported by Agrawal et al., which included inflammatory lesions (47, 6.3%). Fibrocystic disease diagnosed in 2% of cases was lesser as compared to 12.28% (22), 8.2% (33), and 6.5% (31). Galactocele (3.3%), gynecomastia (5.1%), and axillary breast (1.1%) were the other cytological diagnoses in the present study and were comparable to those seen in the above studies.[22,25–27]

Out of a total of 28 cases, 6.2% fell under atypical category III in the present study similar to previous studies being 7, 7.2, and 6.2%.[22,27,28] The majority of the cases (42.8%) in the present study were in the 41 to 50 years age range. Sarangi et al. also reported 29% of cases in this category with 35.4% in the age range of 41–50 years.[25] Histopathological follow-up was available in 20 (4.4%) cases and all were malignant. Chauhan et al. reported 8 out of 10 cases to be malignant on histopathology with 2 cases having atypical features.[22] Montezuma et al. reported 35 cases in this category with histopathology follow-up of which 1 was benign and the rest 34 were malignant.[29]

Category V in the present study made up 40 of the cases; the majority of the diagnoses (28 cases) comprised invasive ductal carcinoma, and 2 cases were reported as carcinoma breast with medullary features. Previous literature revealed cases in category V similar to the present study 8.2% and 11.5%.[25,30] Histopathological correlation was available in 80% of cases and all cases were malignant: invasive ductal carcinoma, invasive carcinoma NOS, and carcinoma with medullary changes. The concordance between malignant cytology and histology was 100%; however, it was reported as 97.5% by Sundar et al.[27] Radiological evaluation was done in 35 out of the 40 cases BIRADS IV, V, and VI with 11.4% of the cases in the BIRADS IV category. BIRADS 4 lesions are not frankly malignant but suspicious enough for a call for biopsy. BIRADS 5 lesions have a higher ROM and always need to undergo biopsy. Spiculated masses and clusters of pleomorphic and microcalcifications are classified in this category.[31]

The false-negative cases are usually acellular, paucicellular, or show few benign ductal epithelial cells. The skill of the procedure and size of the masses were the major reasons for inadequacy reported in breast FNAC. This emphasizes the role of triple tests in patients with breast lump.[24] ROM for category III (atypical) was higher in the present study as compared to the limits proposed by IAC Yokohama system and previously published studies.[7,25] This difference may be attributed to interobserver variability and procedural skills in placing the findings in the atypical category.[27] Kamatar et al. in their study reported a ROM of 66%, higher as compared to other authors, shown in Table 10.[32] The high ROM of the atypical category compared to previous studies can be attributed to possible sampling error which can be overcome by ultrasound-guided FNAC and the fact that not all the cases of this category undergo confirmation with core biopsy.[33]

Category IV (suspicious for malignancy) reported by us as 100% was similar to other studies in literature.[25,26] There were no benign lesions typed as suspicious for malignancy in our study when compared with other studies.[34,35] This could be explained by our routine practice of obtaining a second opinion from intradepartmental colleagues before assigning a category to the cases. ROM for category V malignant cases was concordant with other published reports.[22,30,36]

Specificity and positive predictive value were 100%, similar to studies as seen in Table 11. Diagnostic precision is the ability of a test to discriminate between the target condition and health; it has been variably reported in literature ranging from 95 to 99.5%.[22,30] Diagnostic accuracy of the present study was within this range. The area under the curve (AUC) was 0.98 (0.96 to 1.00), indicating a high level of overall accuracy.

Interrater kappa is defined as a statistical measure of agreement beyond chance. In our study, a kappa value of 0.954 indicated excellent concordance between cytological and histopathological categories.

One of the limitations of our study can be its retrospective nature and hence more prospective studies need to be conducted to enhance the existing database.

Table 8: Sensitivity, specificity, PPV, and NPV of cytology for predicting malignancy taking histopathology as gold standard

Variables (for predicting malignancy)	*Cytology (histopathology, gold standard)*
Sensitivity (95% CI)	100% (98.69–100%)
Specificity (95% CI)	92.96% (84.33–97.67%)
Positive predictive value (95% CI)	98.24% (95.99–99.24%)
Negative predictive value (95% CI)	100% (94.56–100%)
AUC (95% CI)	0.98 (0.96–1.00)
Diagnostic accuracy	98.57% (96.70–99.53%)

Table 9: Comparison of breast cases according to "Yokohama System for Reporting Breast Fine Needle Aspiration" in various studies

Study	*Period of study*	*No. of cytology cases*	*Yokohama category (%)*				
			I Inadequate	*II Benign*	*III Atypical*	*IV Suspicious*	*V Malignant*
Niaz et al.[28]	2008–2019	2133	147 (6.9)	1403 (65.8%)	153 (7.2%)	160 (7.5%)	270 (12.6%)
Dixit et al.[30]	2016–2018	512	38 (7.4%)	379 (74%)	29 (5.7%)	7 (1.4%)	59 (11.5%)
Agnani et al.[35]	2017	603	77 (12.7%)	448 (74.2%)	21 (3.4%)	16 (2.6%)	41 (6.7%)
Makker et al.[37]	Not specified	200	18 (8.9%)	110 (54.4%)	1 (0.9%)	2 (1.48%)	69 (34.1%)
Ahuja et al.[38]	2018	554	20 (3.6%)	385 (69.5%)	35 (6.3%)	13 (2.3%)	101 (18.2%)
Present study	2018–2022	450	20 (4.4%)	345 (76.6%)	28 (6.2%)	17 (3.7%)	40 (8.8%)

Table 10: Comparison of risk of malignancy in each Yokohama category in various studies

Study	*Cases with histopathology follow-up*	*Risk of malignancy in Yokohama category (%)*				
		Inadequate	*Benign*	*Atypical*	*Suspicious*	*Malignant*
Apuroopa et al.[39]	609	5.0	1.2	12.5	93.6	100
Sundar et al.[27]	288	38	0.6	21.9	100	97
Sarangi et al.[25]	400	33.3	0.8	38	98.7	100
De Rosa et al.[7]	1745	49.6	4.9	21	78.7	98.8
Wong et al.[38]	579	2.6	1.7	16	84.6	99.5
Present study	350	0	1.8	100	100	100

Table 11: Comparison of various statistical parameters of FNAC with other studies

Study	*Sensitivity (%)*	*Specificity (%)*	*Positive predictive value (%)*	*Negative predictive value (%)*	*Diagnostic accuracy (%)*
Chauhan et al.[22]	98.9	99.1	99.0	97.8	99.5
Montezuma et al.[29]	97.5	100	100	98.2	99.1
Dixit et al.[30]	95	99.5	98.2	98.6	98.5
Sunitha et al.[40]	100	96.6	94.5	100	97.8
Moschetta et al.[36]	97	94	91	98	95
Present study	100	92.9	98.2	100	98.5

Conclusion

The IAC Yokohama system of reporting breast cytology is an excellent system for accurately diagnosing fine needle aspirates, with an improved system for reporting helping clearer communication between pathologist and clinician. Our study, though limited in terms of being a single institution-based study with a relatively smaller sample size, validates FNAC as a safer and cost-effective test for differentiating benign vs malignant lesions. Hence, FNAC and histopathological along with radiological findings (triple approach) aid together to provide a definitive diagnosis for subsequent management. These newer diagnostic categories by IAC Yokohama system carry an implied ROM increasing from benign to malignant categories. Categorization of the breast FNAB cytology according to IAC Yokohama system of reporting breast lesions helps pathologist in diagnostic clarity and guides clinician in appropriate patient management.

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