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RESEARCH

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Role of International Academy of Cytology Yokohama reporting system in breast lesions at tertiary care centre in Central India

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Abstract

Background The International Academy of Cytology (I.A.C.) Yokohama System to report breast cytopathology can effectively categorize breast diseases into different cytological groups. Fine needle aspiration (FNAC) from the lesions in the breast has been regarded as a major method of diagnosing breast cancer, particularly in rural settings. The major purpose of this study was to validate the diagnostic accuracy of breast FNA utilizing the IAC Yokohama system in future endurances. Histopathological examination is considered the gold standard for diagnosing benign as well as malignant breast lesions and is compared with FNA results.

Material and methods Research on patients getting a core-needle, incisional, or excisional biopsy of breast lesions between January 1st, 2021, and December 31st, 2021, was conducted at a tertiary care center in central India. 216 breast FNAs were recorded utilizing the IAC Yokohama system, and the most appropriate category was assigned for every case and correlated with histopathology to evaluate the effectiveness of IAC system.

Results The new "International Academy of Cytology (IAC) Yokohama system" was used to categorize 216 patients into five categories based on the cytologic diagnosis.

Those were C1: insufficient material (8.7%), C2: benign (65.7%), C3: atypical (1.8%), C4: suspicious of malignancy (2.7%), and C5: malignant (20.8%). FNACs were associated with ancillary testing and histological diagnosis to examine diagnostic accuracy. The overall Specificity, sensitivity, negative predictive value, positive predictive value, and accuracy were calculated with the risk of malignancy.

Conclusion With high specificity and sensitivity for each type of situation, for all tumors, and for each analyzed BI-RADS category, the IAC Yokohama system provides excellent accuracy for breast FNA .

Keywords Breast cytology, Yokohama system, IAC system

Introduction

Fine needle aspiration biopsy (FNAB) cytology is a quick, minimally invasive, reliable, and affordable breast biopsy procedure with a long history of effectiveness when used with ultrasound guidance for both palpable and impalpable lesions (Ducatman and Wang 2014; Field 2016; Dong et al. 2016; Farras Roca et al. 2017). Core needle biopsy (CNB), first developed to evaluate calcifications and lesions found by mammography, has replaced and, in some circumstances, challenged FNAB (Lieske et al.

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2006; Bukhari and Akhtar 2009). The two procedures are complementary when utilized as part of the "triple test," which consists of a clinical examination, imaging, and biopsy, and this application may vary between women presenting with a clinical or imaging lesion and women coming with a screening-found mammographic lesion (Smith et al. 2012; Wang et al. 2017; Field 2017).

Except in specific situations like pregnancy, it is ideal to evaluate the vast majority of breast lesions clinically first, followed by bilateral mammography, ultrasound, and, if necessary, FNAB, which may be guided by ultrasound. Rapid on-site evaluation (ROSE) of the FNAB direct smears reduces the rate of insufficient, unusual, and suspicious samples. It concurrently increases the rates of benign and malignant diagnoses (Wong et al. 2019). In addition, ROSE permits instant triage of the lesion based on the results of the FNA.

The study's objective was to standardize and enhance the reporting of breast cytology in tertiary care facilities in central India by developing best practice guidelines, improving training in breast cytology performance and interpretation, and enhancing communication between cytopathologists and breast clinicians. So, in this study, by correlating the FNAC with histopathology wherever possible, we tried to evaluate the effectiveness of IAC Yokohama system for reporting breast cytopathology.

Report FORMAT details

The report should include a statement of cellularity that measures the material's adequacy. A *cytological description* includes any diagnostic criteria or feature checklist and a brief discussion of the findings supporting several probable diagnoses. If this is not possible, a quick comment or conclusion must offer the most precise or likely diagnosis with a differential diagnosis. A remark indicating whether or not the tumour is fully benign, such as "No malignant cells are observed," A *category or code* can be included in the body of the report but not in the conclusion.

Material and methods

Between January 2020 and June 2021, a prospective evaluation was done on all breast tumours seen at the Department of Pathology. The best Yokohama category was awarded to 216 breast FNAs, and only 144 of those instances had histopathological correlations. After documenting the pertinent clinical information, FNAC was carried out with informed consent and aseptic precautions using a disposable 20-ml syringe with a 22-needle gauge. Local anaesthesia was not used. The characteristics of the substance were noted. Regular smears were made and fixed with ethyl alcohol. Staining was done with Papanicolaou, haematoxylin, and eosin stain. Recently proposed IAC, the Yokohama reporting method of breast cytology, was used to report the smear results.

The IAC Yokohama System divides patients into five groups based on their cancer risk (ROM) (Table 1).

Previously, C1 was termed as unsatisfactory, but that is now replaced as insufficient or inadequate, which is the more appropriate term. Also, C3, previously termed suspicious and probably benign, has now changed as it creates confusion for clinicians between categories C3 and C4, and thus, C3 is now termed atypical.

The histopathological evaluation, considered the gold standard for diagnosis, was compared to the cytology results. Based on the final histological diagnosis, Specificity, sensitivity, negative predictive value (NPV), positive predictive value (PPV), diagnostic accuracy, and ROM were evaluated.

This study included patients of all ages with breast lumps referred by the Surgery department who were willing to have FNAC performed, as well as cases with a histopathological diagnosis. Cases without a corresponding histological diagnosis were eliminated when determining the risk of malignancy, sensitivity, and Specificity.

For statistical analysis, the present study categorized all sarcomas, invasive carcinomas, Phyllodes tumours (borderline and malignant), DCIS, and lymphomas as malignant. Acute/chronic inflammatory diseases, Benign Phyllodes tumours, papilloma, atypical ductal hyperplasia (ADH), fibroadenomas, fibrocystic changes, and fibroadenoma were all considered benign lesions.

Statistical analysis

For each category, the malignancy risk was estimated. For three diagnostic circumstances (Table 2), the accuracy of breast FNAC in detecting cancer was determined.

Table 1 The IAC Yokohama System divides patients into five groups based on their cancer risk (ROM)

S.No.	Cytological categories	Explanation
1	C1	Insufficient/inadequate
2	C2	Benign
3	C3	Atypical
4	C4	Suspicious of malignancy
5	C5	Malignant

Table 2 Calculation of specificity, sensitivity, PPV, NPV and accuracy in different scenarios

Scenarios	Explanation
First scenario	Only the benign category in FNAC was categorised as benign (non-malignant), whereas atypical lesions, suspected of malignancy, and malignant categories were labelled as malignant
Second scenario	Benign and atypical categories were considered as non-malignant, but suspected of malignancy and malignant categories were considered malignant
Third scenario	Benign, atypical, and suspicious of malignancy categories were all classified as non-malignant, whereas only malignant category was classified as malignant

The overall specificity, sensitivity, negative predictive value and positive predictive value and the diagnostic accuracy were computed for all three cases.

Result

A total of 216 cases were included in this study, for which FNA was done in the pathology department, while 144 cases were correlated by histopathology. The median age of the patients in the present study was 44 years (15–85 years). Patients with benign breast lesions had 34 years as the median age, while malignant cases had a median age of 48 years.

Table 3 shows the risk of malignancy for each of the five IAC Yokohama groups in all instances.

Out of 216 cases, those 144 cases correlated by histopathology were categorized into five categories of the Yokohama system: C1 category included 18 cases, C2 included 75 cases, C3 and C4 had only 9 cases each. In comparison, C5 included 33 cases in total. Most cases were categorized in the C2 category, illustrated in Fig. 1A, B, C, while the malignant category, i.e. C5, is shown in Fig. 1D.

The overall specificity, sensitivity, negative predictive value and positive predictive value and the diagnostic accuracy for each diagnostic scenario are given in Table 4.

The high sensitivity and specificity for each situation examined show that the IAC Yokohama system provides excellent accuracy for breast FNAB. It was seen that specificity, sensitivity, PPV, NPV and accuracy were increased significantly when C3, C4, C5 were considered positive in comparison to when only C5 was considered as positive.

Discussion

Breast Fine needle aspiration cytology (FNAC) is among the most regularly done FNAs worldwide. It had a long history of success, both in palpable and impalpable lesions, using ultrasound guidance (Wong et al. 2019). In underdeveloped nations and developing nations, breast lesions are one of the most frequently sampled areas by FNAC. (Field 2017) Analytical issues were experienced in interpreting breast cytology, particularly with untrained pathologists; hence, cytopathology training is required to remove these errors (Field 2017). In breast FNAC, the "grey zone" contains a wide range of lesions from benign conditions such as proliferative fibrocystic disease to sclerosing adenosis to malignant conditions like carcinoma (Gray and Kocjan 2010). A structured and uniform reporting system was required, with cytological feature checklists for specific lesions based on an analytical approach combining pattern recognition in low-power and high-power cytological characteristics (Field et al. 2017). A "Breast Group" of cytopathologists, surgeons, surgical pathologists, radiologists, and oncologists were established by the "International Academy of Cytology Executive Council" in 2016 to promote the proper use of FNAC in breast lesions, improve the reporting system for breast FNAC, that increase communication between cytopathologist and clinical management team, and helps in further research into breast disease employing FNAC for patient benefit (Agrawal et al. 2021).

The International Academy of Cytology (IAC) categorized breast lesions into five categories, each with a clear definition and description and a specific risk of malignancy (ROM). The ROM is then linked with management recommendations. The system also emphasizes that breast FNAC relies on the expertise of those performing

Table 3 Risk of malignancy of IAC Yokohama system categories for all breast FNAC

	Inadequate	Benign	Atypical	Suspicious for malignancy	Malignancy
Malignant	06	0	03	06	33
Non-malignant	12	75	06	03	00
ROM	33.3%	00%	33.3%	66.7%	100%

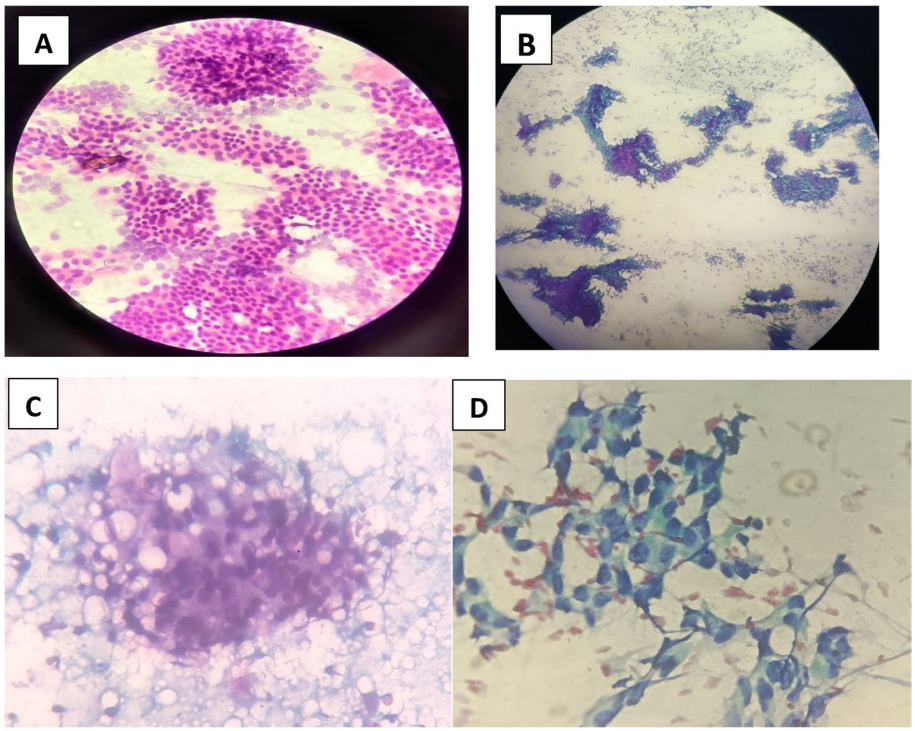

Fig. 1 **A** Apocrine adenosis: Duct epithelial cells scattered singly and in small clusters and sheets with cribriform spaces. The majority of the cells show apocrine differentiation with abundant eosinophilic granular cytoplasm. There is mild nuclear pleomorphism. **B** Fibroadenoma: low-power image showing tight, cohesive clusters of benign duct epithelial cells in a background of abundant bare bipolar nuclei. **C** Granulomatous mastitis: benign duct epithelial cells admixed within granulomatous epitheloid cells and chronic inflammatory cells. **D** Ductal Carcinoma: Dyscohesive clusters of pleomorphic cells having moderate cytoplasm, high nuclear-cytoplasmic ratio, and an irregular nuclear membrane with prominent nucleoli in a hemorrhagic background

Table 4 Specificity, Sensitivity, PPV, and NPV for breast FNAB using the IAC Yokohama system with different scenarios

	Atypical, considered positive	Suspicious for malignancy, considered positive	Malignant, considered positive
Specificity	100%	100%	100%
Sensitivity	87.5%	81.25%	68.75%
PPV	100%	100%	100%
NPV	93.5%	91.18%	86.49%
Diagnostic accuracy	95.56%	93.62%	89.58%

the FNA, making slide smears, and interpreting material on the slides, which requires good training and clear communication with clinicians to manage patients with breast lesions (Tejeswini et al. 2021).

Each of the five categories represents a distinct risk of malignancy—was indicated for care by the breast group, and best-practice procedures were devised for each. The huge contrasts between developed and developing countries in terms of availability of imaging, core needle biopsy (CNB), surgical pathology, and management options were considered while doing this. Considering the wide disparities in medical infrastructure, these best-practice standards will include the FNAC and CNB roles in the management algorithms (Field 2017).

According to the IAC Yokohama reporting system of breast cytology, 216 cases were included in the present study that underwent FNAC for breast lumps and 144 of those who were confirmed by biopsy/ histopathology were divided into the five categories of the Yokohama system.

Slides that are insufficient or inadequate for a cytomorphological diagnosis include those smears that are too

sparsely cellular (do not fulfil the criteria of adequacy) or too badly smeared or badly fixed.

Out of 22 cases of category C1 included in the present study, 12 exhibited a histological link, and six were later found to be malignant. The ROM in our study was 33.3%, which was higher than studies done by Montezuma et al. (2019) which was 4.8%, Wang et al. (2017) (2.6%) and Tejeswini et al. (2021) [22.22%), but similar to Hoda et al. (2019). Technical problems or the nature of the lesion may need more FNAC. It was impossible to establish ROM since the yield, if not representative, would raise the risk of cancer.

Therefore, Wang et al. concluded that expertise with the aspirator, radiographic-guided FNAC, instantaneous cytological assessment, and extra repeated aspirates via the Rapid On-Site Evaluation (ROSE) approach would all work together to reduce incorrect interpretation of insufficient samples (Wang et al. 2017).

Cases included in Category II have unmistakably benign cytological characteristics that may or may not indicate a particular benign lesion. Infections, inflammatory lesions, benign cysts, benign neoplasms, and epithelial hyperplasia fall within this group. This is the most common group in the present study, consistent with Montezuma et al. (2019) and Tejeswini et al. (2021). 142 cases were included in this group. Out of 142 cases, 75 had histopathological correlation and no malignant cases. The ROM was 0%, which is less than mentioned in studies by Montezuma et al. (2019) (1.4%) and Wang et al. (2017) (1.7%) and Hoda et al. (2019) (4.7%) and Tejeswini et al. (2021).

The atypical group consists of cases with cytological characteristics that suggest micropapillary or cribriform proliferation, such as a single cluster of intact cells dispersed widely inside the nucleus, pleomorphism, high cellularity, necrosis, and complicated architecture.

In the present study, only 11 cases were included as atypical, out of which nine cases have histopathological correlation, from which 3 cases were found as malignant. The ROM for this category was 33.3%, which is significantly higher than in the studies done by Montezuma et al. (2019) (13%) and Wang et al. (2017) (15.7%) and Tejeswini et al. (2021) but lower than Hoda et al. (2019) (51.5%). This can be explained by the fact that there were fewer atypical cases in this study.

Triple correlation testing is employed to handle this group. Suppose clinical and imaging data are normal. A review after a few months, preferably 3–6 months with or without FNAC, is advised. In that case, if suspicious or inconclusive, a core needle biopsy or excisional biopsy is suggested.

The cytological features of cells of suspected malignancy, most likely an in situ or invasive carcinoma, exhibit some of the cytological characteristics typically found in malignant lesions but not enough of them, either in quantity or quality, to render a conclusive diagnosis of malignancy. Hence, it is included in the category of suspicious malignancy. There were only 10 cases in this category, nine confirmed by histopathology; six were malignant on histopathological examination with ROM of 66.7%. ROM for this category in the present study could have been higher than the Montezuma et al. study (Montezuma et al. 2019) (97.1%), while ROM of Wang et al. (2017) (84.6%) and Hoda et al. (2019) (85.4%) and Tejeswini et al. (2021). This can be due to the minimal number of instances in this group in the present study.

There are specific cellular characteristics of malignancy in the malignant group. All cases in this category were confirmed by histopathology, and all were malignant. The ROM was 100%, which is comparable to other studies by Tejeswini et al. (2021) (100%), Montezuma et al. (2019) (100%), Wang et al. (2017) (99.5%), and Hoda et al. (2019) (100%) (98.7 percent).

The present study's overall sensitivity, Specificity, positive predictive value, and negative predictive value were comparable to those of investigations by Hoda et al. (2019) Tejeswini et al. (2021) Wang et al. (2017), Montezuma et al. (2019).

A limitation of the traditional FNA smear is the small amount of material that can be used for other diagnostic studies, such as immunocytochemistry. The cell block technique employs the retrieval of small tissue fragments from a FNA specimen which are processed to form a paraffin block. The cell blocks also help to preserve the aspirated material for future reference and immunohistochemistry can also be applied for a more accurate diagnosis.

Limitations

As a tertiary care centre situated in the state's capital, it covers the usual population surrounding, which is usually urban, suburban and near the peripheral areas. However, a huge periphery still needs to be screened under this study. Also, this study had a relatively smaller sample size so that the results may vary with a larger study group. In our setup, cell block facility was not available during the period of study, therefore, FNA could not be combined with cell block for precised diagnosis. Lastly, the COVID-19 pandemic proved to be a hindrance as there was a limited inflow of patients during the study period, and lost follow-up may also cause differences from other studies. Ours is a small study group, resulting in a need for more statistical power. Therefore, further studies with large cohorts, preferably multi-centric, are needed along with proper follow-up to explore the role of the Yokohama system in reporting breast cytology.

Conclusion

In conclusion, the breast FNAC is a reliable test for diagnosing breast lesions, in particular for cancer cases. Sensitivity, Specificity, negative predictive value, positive predictive value, and diagnostic accuracy were all statistically significant in this investigation. Utilizing the IAC Yokohama breast cytology reporting system aids in standardizing writing across numerous institutes and giving doctors clear direction for followup management. Yokohama classification system may be far more useful for reporting breast lesions because each diagnostic category sends specific cancer risk information, giving patients information that may be utilized to determine their treatment strategy.

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Authors' contributions
All the authors have contributed equally in this study.

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Data availability
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Declarations

Ethics approval and consent to participate
Ethical clearance was obtained for the same research with number 637#

Consent for publication
Consent was obtained for each patient involve in this study.

Competing interests
No competing interest.

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