"CATEGORISATION OF BREAST LESIONS ON FINE NEEDLE ASPIRATION CYTOLOGY USING INTERNATIONAL ACADEMY OF CYTOLOGY YOKOHAMA SYSTEM, FOR RISK ASSESSMENT AND MANAGEMENT – A CROSS SECTIONAL STUDY AT TERTIARY CARE CENTRE, BELAGAVI."

Submitted by

REG. NO. BN0122004

Dissertation

Submitted to

KAHER, Belagavi, Karnataka,

In partial fulfilment of the requirements for the degree of

M. D. (Doctor of Medicine)
In
PATHOLOGY

DEPARTMENT OF PATHOLOGY
JAWAHARLAL NEHRU MEDICAL COLLEGE,
BELAGAVI, KARNATAKA

SEPTEMBER /OCTOBER 2025

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Sub: Institutional Ethical Clearance for the study.

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LIST OF ABBREVIATIONS USED

S.No	Abbreviation	Expansion
1.	WHO	World Health Organization
2.	NCRP-ICMR	National Cancer Registry Programme - Indian Council of Medical Research
3.	FNAC	Fine needle aspirate cytology
4.	FNAB	Fine needle aspiration biopsy (used interchangeably with FNAC)
5.	IAC	International Academy of Cytology
6.	ROM	Risk of Malignancy
7.	ROSE	Rapid On-Site Evaluation
8.	USG	Ultrasonography
9.	UK	United Kingdom
10.	NBSS	National Breast Screening System
11.	Sn	Sensitivity
12.	Sp	Specificity
13.	DA	Diagnostic Accuracy
14.	PPV	Positive Predictive Value
15.	NPV	Negative Predictive Value
16.	IDC	Invasive Ductal Carcinoma
17.	HPE	Histopathological Examination

ABSTRACT

TITLE:

CATEGORIZATION OF BREAST LESIONS ON FINE NEEDLE ASPIRATION CYTOLOGY USING THE INTERNATIONAL ACADEMY OF CYTOLOGY YOKOHAMA SYSTEM FOR RISK ASSESSMENT AND MANAGEMENT - A CROSS SECTIONAL STUDY AT A TERTIARY CARE CENTRE, BELAGAVI

BACKGROUND AND OBJECTIVES:

Breast cancer is one of the most prevalent malignancies worldwide, accounting for a 10.6% of cancer-related deaths. Early detection and accurate risk assessment are crucial for effective management. Fine Needle Aspiration Cytology (FNAC) plays a key role in diagnosing breast lesions. The International Academy of Cytology (IAC) Yokohama System was introduced to standardize FNAC reporting, improve risk assessment and management. This study aims to categorize breast lesions using the IAC Yokohama system, determines the risk of malignancy (ROM) and correlates FNAC findings with histopathology.

METHODOLOGY:

This is a hospital-based, cross-sectional study conducted at KLE's Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi, over one year (January 2024 - December 2024). A total of 150 patients presenting with breast lumps underwent FNAC. Smears were stained using Giemsa, Papanicolaou, and Hematoxylin & Eosin stains. The FNAC results were categorized based on the IAC Yokohama classification into five groups: Inadequate (C1), Benign (C2), Atypical (C3), Suspicious of Malignancy (C4) and Malignant (C5). Cases were followed up

with histopathology for confirmation. Statistical analysis included sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and calculation of diagnostic accuracy (DA) and ROM.

RESULTS:

The study included 150 cases with a mean age of 40.71 years (range: 14-79 years). The distribution of cases were as follows: C1 - 4.67%, C2 - 68.67%, C3 - 2.67%, C4 - 3.33%, and C5 - 20.67%. Histopathological correlation was available for 67 cases. Sensitivity, specificity, PPV, NPV, and diagnostic accuracy were 84%, 95.2%, 91.3%, 90.91%, and 91.04%, respectively. ROM increased progressively across categories: C1 - 66.67%, C2 - 2.7%, C3 - 25%, C4 - 50%, and C5 - 100%.

CONCLUSION:

The IAC Yokohama System demonstrated high diagnostic accuracy, specificity, and correlation with histopathology, making it a reliable tool for breast lesion evaluation. FNAC remains a valuable first-line investigation. Incorporating Rapid On-Site Evaluation (ROSE) and image-guided FNAC could further enhance accuracy. Future research should explore multi-centre validation and the integration of advanced cytological techniques.

KEYWORDS:

Breast Cancer, Fine Needle Aspiration Cytology (FNAC), IAC Yokohama System, Risk of Malignancy (ROM), Histopathology Correlation, Cytology Reporting

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INTRODUCTION

Breast cancer ranks among the most common cause of death, contributing to 6,70,000 deaths all over the world, with the World Health Organization recording 2.3 million new cases in a year 2022.[1,2] It is the most prevalent malignancy in Indian women according to 2020 statistics given by National Cancer Registry Programme (NCRP) under the Indian Council of Medical Research (ICMR), contributing to 14.8% of all cases. Approximately 2,00,000 new cases are reported annually, and one in two women succumb to the disease.[3] This emphasizes the importance of improved detection and management requirements.

As a component of triple assessment, fine needle aspiration cytology (FNAC) plays a vital role in diagnosis. Rapid on-site evaluation (ROSE) and ultrasound (USG) guidance improves the use of FNAC.[4] Numerous reporting techniques have been implemented for breast FNAC in the past.[5–7] In breast cytology, the use of the International Academy of Cytology (IAC) Yokohama reporting system optimizes reporting and makes it possible to evaluate Risk of Malignancy (ROM).[8] The primary goals of IAC Yokohama Reporting system are to improve the diagnostic accuracy and to standardize reporting.

OBJECTIVES OF THE STUDY

- To categorize breast lesions according to Yokohama reporting system, for risk assessment and management.
- To correlate FNAC and histopathological findings.

REVIEW OF LITERATURE

EMBRYOLOGY:

The male and female breast originate from the ectoderm and mesenchyme, where the ectoderm develops into ducts and alveoli, while the mesenchyme forms connective tissue and blood vessels. The milk line, stretching from the axilla to the inguinal region, gives rise to mammary primordia in the pectoral area.[9] As the ectoderm thickens, it extends into the dermis, generating 16–24 cords that later transform into lactiferous ducts and alveoli. Initially, the nipple appears as a shallow depression but everts near term. Each mammary lobe contains a lactiferous duct that extends from the nipple to the superficial fascia, classifying the breast as a glandular structure of epidermal origin.[9]

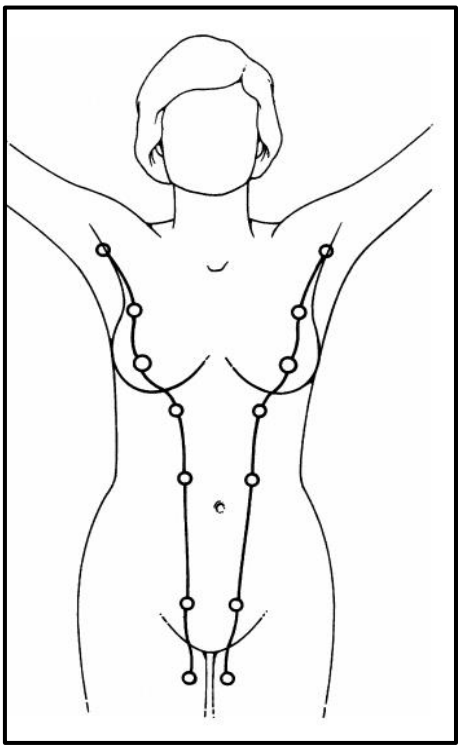


Fig. no. 1 -The milk line. The line's pectoral region is typically where mammary glands grow. Additional mammary structures could arise from different places down the line.[8]

Between the 4th and 6th weeks of fetal development, milk lines or mammary ridges emerge along the body. By the 10th week, the outer segments of these lines recede, leaving the central portion intact for breast formation. Around the 5th month of gestation, the areola develops, along with 15 to 20 solid cell cords, which later transform into lactiferous ducts. These milk lines give rise to the mammary glands. After birth, the nipple becomes distinct, and during puberty, the ducts expand, forming acini at their ends, preparing the mammary glands for future functionality.[9]

ANATOMY:

Breast shapes vary and can be piriform, conical or pendulous. It spans from the second to the sixth rib on the chest wall. It extends laterally, reaching up to the mid-axillary line.[10] This positioning defines its anatomical boundaries across the thoracic region. The superolateral quadrant extends toward the axilla along the pectoralis major, forming the axillary process also known as axillary tail of Spence, which may extend to the apex of the axilla.

Fascia:

The glandular breast tissue is enclosed by anterior and posterior laminae of the superficial fascia, with fat layers on both its superficial and deep surfaces. The circummammary ligament, a circular adhesion zone, connects the fascial laminae to the deep fascia of the trunk, allowing the passage of lymphatic, blood, and nerve vessels. [11]

Nipple:

The position of the nipple varies significantly. In females, its location depends on breast size and shape, typically aligning with the fourth intercostal space in

prepubescent girls. In males, it is usually found at the fourth intercostal space along the mid-clavicular line, though it does not serve as a fixed anatomical landmark.

Vascular Supply

Arterial Supply:

The breasts receive blood from branches of the internal thoracic, axillary and anterior intercostal arteries. The axillary artery supplies the breast through multiple branches. These include the lateral thoracic, thoraco-acromial and subscapular arteries. The internal thoracic artery gives rise to medial mammary branches. The superior part and medial side of the breast gets blood from anterior intercostal arteries. Additionally, the second perforating artery supplies blood to the areola, upper breast, and adjacent tissues.[12]

Venous Drainage:

Venous blood from the glandular breast tissue and the venous plexus surrounding the areola follows a structured drainage pathway. It primarily drains into the axillary, internal thoracic, and intercostal veins, ensuring efficient circulation.[12] This drainage occurs through veins that run parallel to their corresponding arteries, maintaining a close anatomical relationship. The axillary veins play a significant role in collecting blood from the upper regions of the breast. Meanwhile, the internal thoracic and intercostal veins contribute to deeper and systemic venous return.

Lymphatic Circulation:

The breast's lymphatic system primarily drains through the subareolar plexus. From there, the lymphatic fluid travels towards the axillary lymph nodes, while dermal lymphatics extend deeper behind the clavicle through the pectoralis major

muscle. On the left side, lymph drains into the thoracic duct and left subclavian vein, whereas on the right side, it empties into the right subclavian vein. Medial lymphatics drain into the parasternal nodes and can cross the sternum, allowing for potential contralateral spread. Inferiorly, lymphatic drainage may extend toward the inguinal nodes via epigastric pathways.[13]

More than 75% of the lymphatic fluid from the breast is directed towards the axillary lymph nodes, making them a primary drainage site. These axillary nodes are systematically categorized into five groups: anterior (pectoral), posterior (subscapular), lateral (humeral), central, and apical, each playing a distinct role in lymph filtration and immune defense.[13]

Surgically, axillary lymph nodes are classified into three levels based on their position relative to the pectoralis minor muscle: Level I (lateral), Level II (behind), and Level III (medial near the clavicle). This classification is essential for cancer staging and treatment planning, guiding procedures like sentinel lymph node biopsy and axillary dissection.

BREAST PATHOLOGY

Breast cancer is the most common cancer in India, accounting for 13.5% of newly diagnosed cases and 10.6% of all cancer-related deaths.[14] Breast tumors in women can be benign, borderline, or malignant. Benign conditions include fibrocystic changes, fibroadenomas and abscesses more commonly, while breast carcinoma is the most frequent malignant condition. Patients presents with complaints of lump, associated pain, nipple discharge and skin changes.[15]

TRIPLE ASSESSMENT

It has a crucial role in the assessment and management of breast carcinoma. It consists of clinical breast examination, imaging techniques such as mammography and/or ultrasonography and pathological analysis using FNAB or Core Needle Biopsy (CNB).[16] With the introduction of this comprehensive approach, the Fine Needle Aspiration Biopsy (FNAB) is now essential for evaluating breast lesions.[17]

Breast cancer is frequently diagnosed at advanced stages, making early detection through screening essential for effective management. Mammography is a highly reliable screening tool for detecting breast abnormalities, particularly in women over 40 years of age.[18] It has a sensitivity of 97%, meaning it can accurately identify most cases of breast cancer. With a specificity of 64.5% and an overall diagnostic accuracy of 89.3%, it remains an essential method for early detection and diagnosis.[17] However, its high cost limits access in low and middle income countries, where self-examination and clinical breast examination by a trained health worker is often relied upon.[19]

REPORTING OF BREAST FNAC

There are several reporting systems showing the guidelines to report breast FNACs, starting from Bethesda like reporting system for breast, RCPath guidelines, Robertson criteria, Masood Cytology Index (Masood Scoring System), Tavassoli's Classification (WHO System for Breast FNAC) to the latest IAC Yokohama Reporting system.

Bethesda System:

The initial Bethesda-like system for breast FNAC was proposed by Abati et al. in 1997 and later updated in 2005.[6] This system tried to form uniformity in reporting breast fine-needle aspiration biopsy (FNAB) with well-defined diagnostic categories. Initially, FNAB cases were categorized simply as benign or malignant, but challenges arose in distinguishing certain cases, leading to the introduction of atypical and suspicious for malignancy categories.

The original classification system by Abati et al. included:

- Unsatisfactory/Inadequate – Insufficient material for diagnosis.
- Benign – Fibrocystic changes, fibroadenomas, and other non-cancerous lesions.
- Atypical/Indeterminate – Some cytologic abnormalities but not clearly malignant.
- Suspicious/Probably Malignant – High probability of malignancy, requiring further evaluation.
- Malignant – Clearly cancerous features.[6]

Variability in classification criteria among cytopathologists led to inconsistent diagnoses. The Bethesda-like system for breast FNAC was not officially standardized globally

Robinson Cytological Grading System:

Introduced by Robinson et al in 1994, is a semi-quantitative scoring method used for breast FNAC to assess malignancy potential based on six cytological features: cell dissociation, nuclear size, cell uniformity, nucleoli, nuclear margin, and

chromatin pattern. Each feature is assigned a score from 1 to 3, with higher scores indicating greater malignancy potential. The total score categorizes FNAC findings as Grade I (Well-differentiated, 6-11 points), Grade II (Moderately differentiated, 12-14 points), or Grade III (Poorly differentiated, 15-18 points).[20] This system is widely used for grading breast cancer cytology, helping predict tumor behavior and aiding in treatment planning.

This system has limited predictive value, overlapping features in atypical cases and there is lack of standardized cutoff for prognosis.

Masood Cytology Index for Breast FNAC:

The Masood Cytology Index introduced by Dr. Shahla Masood in 1990. It is a semi-quantitative scoring system used in breast FNAC to differentiate benign, atypical, and malignant lesions. It evaluates six cytological features: cellular arrangement, pleomorphism, nucleoli, mitosis, chromatin pattern, and cellularity, with each feature scored from 1 to 4. The sum of total score categorizes cases as benign (≤10 points), indicating non-malignant conditions like fibroadenoma or fibrocystic changes; atypical (11-14 points), suggesting a higher risk of malignancy requiring further monitoring; and malignant (≥15 points), likely indicating carcinoma, necessitating immediate confirmation and intervention.[21] This system helps in risk stratification and early detection of suspicious breast lesions. It categorizes lesions as benign, atypical, or malignant, focusing on grading and early risk detection.

It is mainly used for research and risk assessment. It does not assess the tumour architecture which is crucial for tumor classification and prognosis and is not widely standardised.

Royal College of Pathologists (RCPath) Guidelines for Breast FNAC Cytology Reporting:

RCPath is primarily used in the UK, aligning with the National Breast Screening System (NBSS). In 2001, structured guidelines for the reporting of FNAC for breast published, ensuring diagnostic consistency.[7] This system categorizes findings into five distinct groups , B1 to B5 which is based on histology and C1 to C5, based on cytological evaluation. C1 (Inadequate) refers to cases with insufficient cellular material for a reliable diagnosis. C2 (Benign) includes lesions with clear non-malignant features. C3 (Atypia, probably benign) covers cases with mild atypical changes but a higher likelihood of being benign. C4 (Suspicious of malignancy) indicates cytological features that strongly suggest malignancy but lack definitive confirmation. Lastly, C5 (Malignant) is assigned when cytology reveals definitive features of malignancy. This classification system aligns with other standardized FNAC reporting methods, aiding in clinical decision making and patient management.

The RCPath System is less specific in defining the Risk of Malignancy (ROM). This makes it less structured, especially when dealing with borderline cases where a more precise classification is needed.

Tavassoli Classification:

The Tavassoli Classification is a histopathology based system for breast FNAC, developed by Dr. Fatima Tavassoli under the WHO in 2003. It categorizes breast cytology findings into three broad groups: Benign, which includes non-cancerous conditions like fibroadenoma, fibrocystic changes, and inflammatory lesions; Atypical, representing borderline lesions that require further evaluation; and Malignant, which includes clearly cancerous cytological findings indicative of breast

carcinoma. This system offers a simplified and broad classification, making it easy for clinicians and pathologists to interpret. However, it lacks detailed risk stratification for atypical and suspicious cases, which is crucial for guiding patient management and treatment decisions.[22]

Tavassoli uses a three-tier system (Benign, Atypical, Malignant), offering broad categorization without sub-classification and is mainly used in histopathology-based FNAC reporting.

GREY ZONES IN BREAST LESION DIAGNOSIS LEADING TO DEVELOPMENT OF IAC YOKOHAMA REPORTING SYSTEM

A report was classified as inadequate when the aspirated material was insufficient, lacked cellularity or was affected by technical issues that prevented an accurate assessment.[23] A benign diagnosis was made only if the sample was adequate and showed clear benign cytomorphological features, whereas a malignant diagnosis required sufficient material with definitive malignant characteristics. Categories C3 (Atypical) and C4 (Suspicious) were considered borderline, highlighting diagnostic challenges and the potential for errors in breast smear interpretation.[17] These ambiguous categories often led to confusion among clinicians, raising concerns about malignancy risk and its impact on patient management.[24] Due to these limitations, the classification system was revised, leading to the development of the Yokohama International Academy of Cytology Breast Reporting System in 2016, which aimed to enhance diagnostic clarity and improve clinical decision making.

IAC YOKOHAMA SYSTEM:

The newly developed Yokohama system for reporting breast fine needle aspiration cytology (FNAB), endorsed by the International Academy of Cytology (IAC), was created through collaboration among experts in cytopathology, radiology, surgery, and medical oncology in 2016 an was published in 2019. Its primary objective is to provide a standardized and structured framework for conducting and reporting breast cytology, ensuring a consistent and globally applicable approach for the accurate diagnosis of breast lesions using FNAC.[25]

Advantages of Yokohama system

The Yokohama system provides a standardized framework that improves consistency in reporting and enhances communication among healthcare professionals. It categorizes various cytological findings, aiding in accurate malignancy risk assessment. By focusing on specific cytological features, it helps pathologists make precise diagnoses.[26] Additionally, it integrates clinical and imaging findings with cytological results for a more comprehensive patient evaluation. Clear categorization and risk assessment support clinicians in making informed patient management decisions. The system also facilitates research and education by promoting data collection and advancements in breast cancer diagnostics and treatment.

Comparison of Yokohama system of reporting with other systems:

Reporting System	Classification Categories	Key Features
Bethesda (Adapted for Breast FNAC)	Benign, Atypical, Suspicious, Malignant	Adapted from thyroid cytology but not standardized for breast FNAC
RCPath (UK)	C1-C5 (Inadequate to Malignant)	Standardized reporting widely used in Europe
Robinson Cytological Grading System	Cytomorphology-based classification	Less commonly used but follows similar principles as RCPath
Masood Cytology Index	Score-based system (≤10 Benign, 11-14 Atypical, 15-18 Suspicious, ≥19 Malignant)	A **semi-quantitative** system evaluating **nuclear features, cellularity, and mitotic activity**
Tavassoli Classification (WHO System)	Benign, Atypical, Suspicious, Malignant	WHO-endorsed classification used in **histopathology and FNAC interpretation**
IAC Yokohama (2019)	C1-C5 (Insufficient to Malignant)	Globally standardized, ensures diagnostic consistency

Table no. 1 – Breast FNAC reporting systems

Yokohama System: Comprises of five-tier classification (C1-C5), with ROM findings aligning with international data. The strong agreement between FNAC and histopathology reinforces its applicability in clinical practice.

Masood Cytology Index: A scoring system (6-24 points) for grading malignancy but lacks structured categories like C1-C5, which Yokohama offers.

Tavassoli Classification: A three-tier system (Benign, Atypical, Malignant) that did not mention about risk stratification and guide to patient management compared to Yokohama.

RCPath System (UK): Similar to Yokohama, but less specific in defining ROM, making it less structured for borderline cases and is UK- specific.

Categories under IAC Yokohama reporting system:

Category 1: Inadequate

Inadequate or insufficient cytopathology, such as smears that are too poorly smeared or fixed, or that are too sparsely cellular, to enable a cytomorphologic diagnosis. The report should always include a detailed explanation of the deficiency. A repeat FNAB or CNB is advised when smears on the slide are unable to correspond with the imaging. Also when not correlating with clinical symptoms and findings as a part of triple examination. "Non-diagnostic" is not the appropriate term to use.[27]

Category 2: Benign

When the cytomorphological features are definitely benign, even if they are not indicative of a particular lesion, the FNAB diagnosis is made of benign lesion.

Acute mastitis and breast abscess are characterized by a necrotic, pus filled background with abundant neutrophils, scattered foamy histiocytes and little to no inflammatory ductal or apocrine epithelial segments.

Granulomatous Mastitis: This disorder manifests as multinucleated large cells, epithelioid granulomas, and variable necrosis.[28] It may be linked to foreign body reactions, like silicone exposure or infections, like mycobacterial infections.[29]

Fat Necrosis: Characterized by necrotic debris, occasional fragments of anucleate fat tissue, and few macrophages or multinucleated histiocytes, with little to no epithelial cells.

Cyst: The aspirated fluid consists of varying quantities of epithelial cells, individual cells showing apocrine changes. Also seen are foamy macrophages or histiocytes, all suspended in background containing cholesterol crystals, proteinaceous material and cellular debris.

Normal breast tissue has a clean the background with a few naked nuclei dispersed throughout.[30] It is formed of small cohesive fragments of terminal ductal epithelium made up of uniform epithelial and myoepithelial cells.

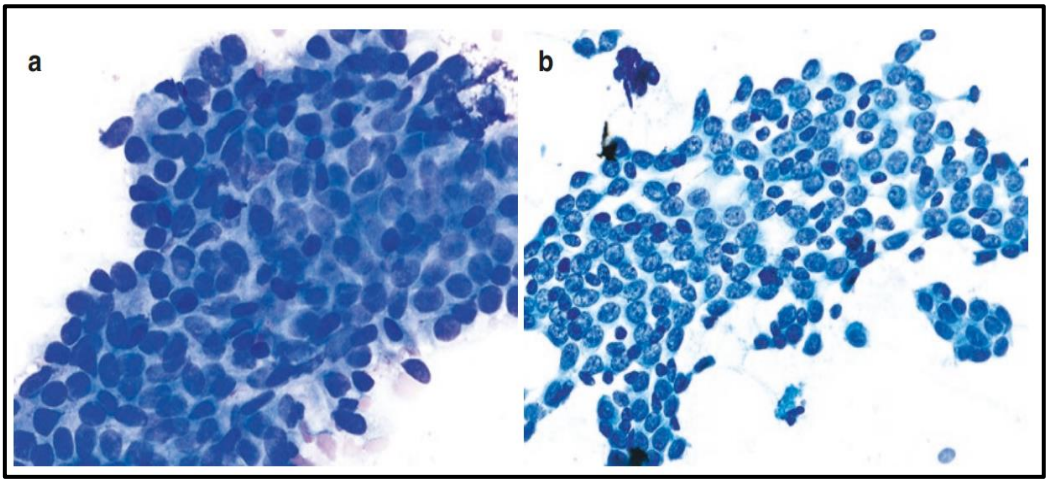


Fig. no. 2- a and b show myoepithelial cells having dark, oval nuclei surrounding the ductal epithelial cells.

Moderately to highly cellular smears with a considerable number of cohesive epithelial fragments and a few tiny ones with bland nuclei are indicative of epithelial hyperplasia.[31] The tissue fragments contain myoepithelial cells, while the background shows bare bipolar nuclei.

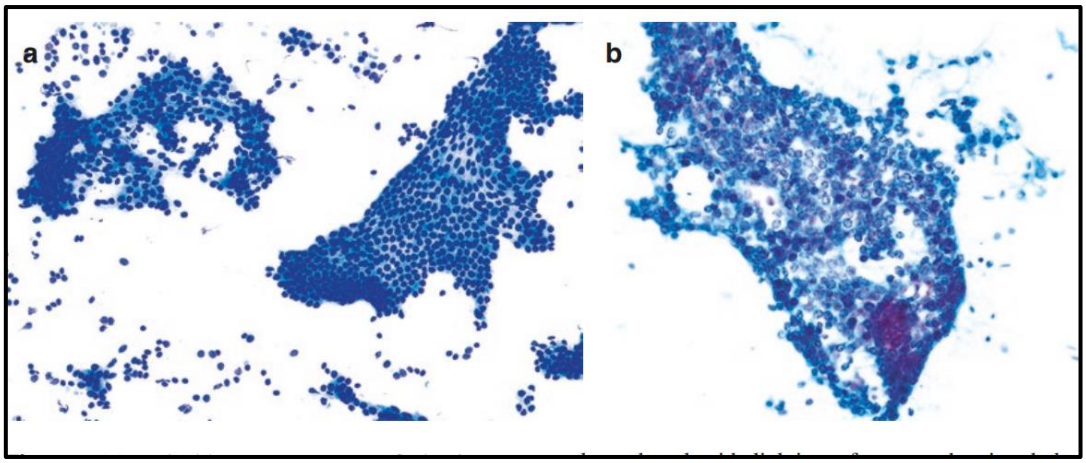


Fig. no. 3- a and b – Epithelial Hyperplasia

Moderately to highly cellular smears of fibroadenoma are characterized by cohesive, occasionally branched "staghorn" epithelial fragments that contain myoepithelial nuclei, fibrillary, rounded, or scalloped fibromyxoid stromal fragments. The background shows plenty of naked bipolar nuclei.

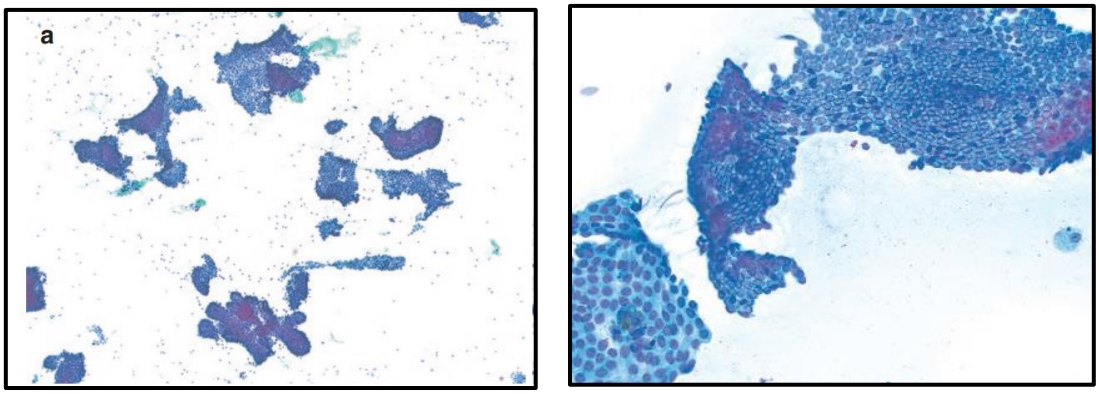


Fig. no. 4 – Fibroadenoma (low and high power)

Diffusely scattered clusters of ductal epithelial fragments are characteristic of an intraductal papilloma, which has varying cellularity.[32] The cytological smear reveals a proteinaceous background with intersperse apocrine epithelial sheets and histiocytes. Additionally, there are papillary or stellate architecture. The presence of fibroelastotic stromal cores further indicates stromal involvement, supporting a structured tissue organization.[33]

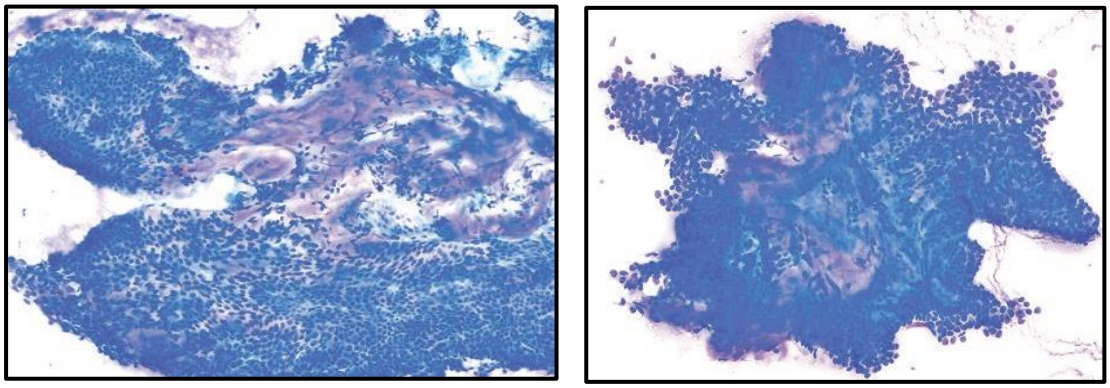


Fig. no. 5 – Papilloma with sheets of ductal and myoepithelial cells.

Change during lactation: Smears display varying levels of cellularity, with tiny epithelial sheets containing cells that have small nucleoli, moderately expanded spherical nuclei, and micro-vacuolated cytoplasm. The nucleus is round with prominent nucleoli, isolated intact acinar cells, thin proteinaceous material, and fat globules make up the milky background.[34]

Adenosis and sclerosing adenosis: The cytological smears exhibit small clusters of ductal epithelial fragments. These clusters are accompanied by myoepithelial cells and compactly arranged stromal fragments, suggesting moderate to high cellularity. The background contains naked nuclei, which are dispersed throughout the smear. Additionally, sporadic solitary epithelial cells are observed. These findings contribute to the overall cytological architecture.[35]

Gynecomastia: Usually shows low cellularity with some fibrillary stromal fragments. Foci of ductal cells comprised of both myoepithelial and bare nuclei.[36]

Abscesses contain sheets of neutrophils with fibrinous proteinaceous background, or "pus." As the lesion ages, there are also different amounts of histiocytes and granulation tissue.[37]

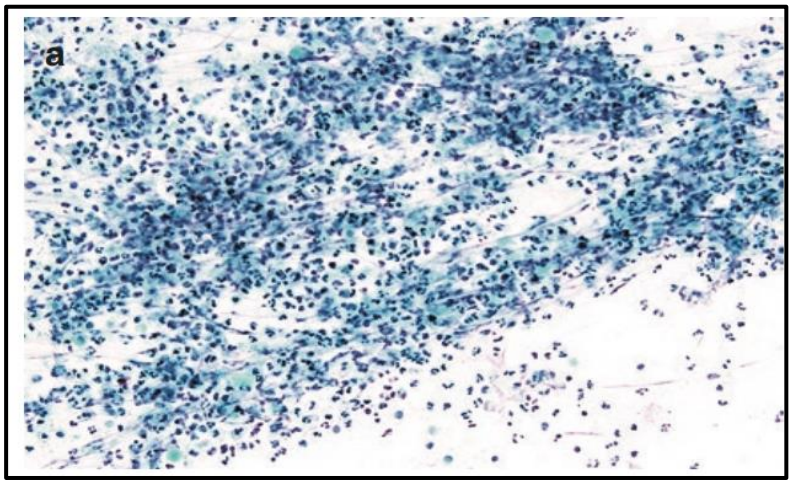


Fig. no. 6 – Pap stain – Acute suppurative inflammation (Abscess)

Granulomatous mastitis is characterized by lymphocytes in a background of proteinaceous material and ductal cells having mild atypia, giant cells and an abundance of histiocytes forming granulomas.[38]

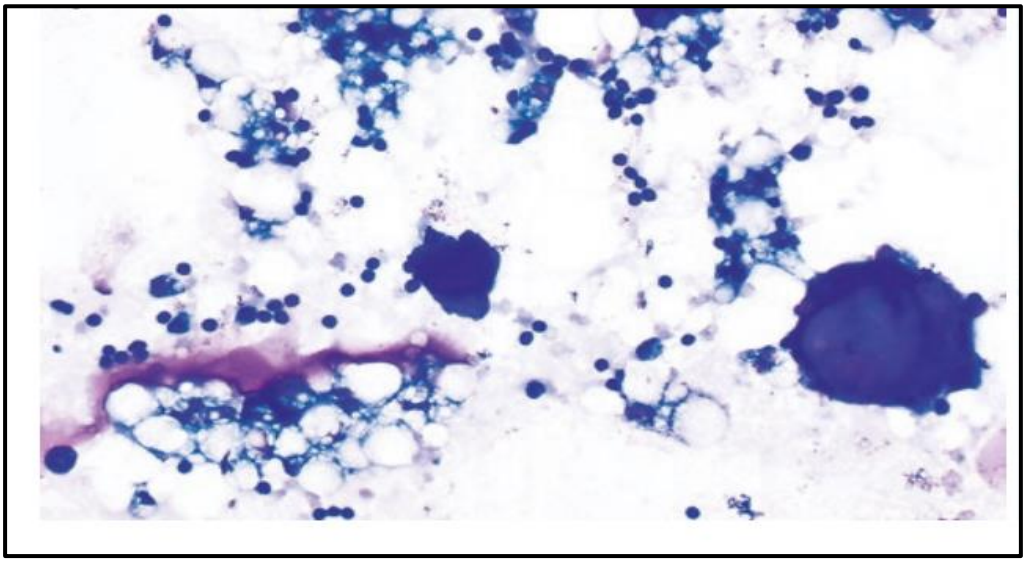


Fig. no. 7 – Histiocytes (Epithelioid and multinucleated) and calcification

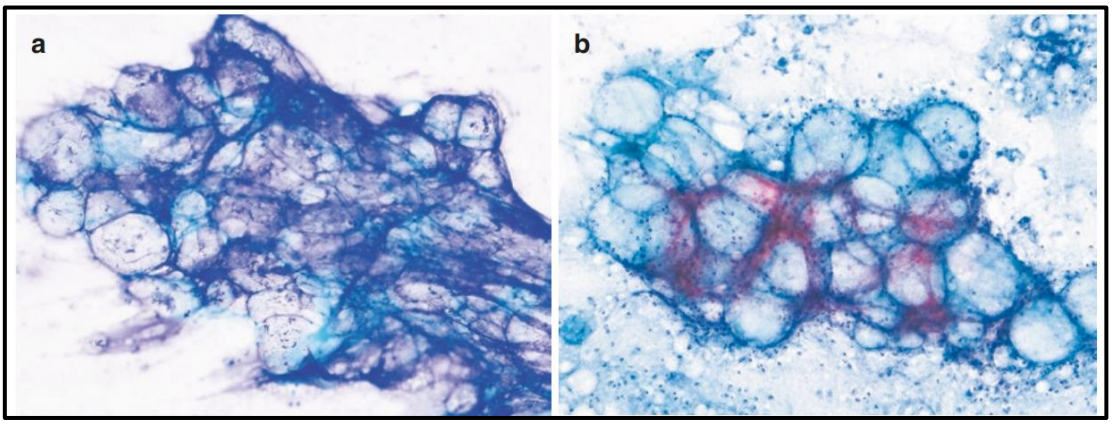


Fig. no. 8 (a and b) – Fat necrosis with inflammatory cells

Category 3: Atypical

"Atypical" category is denoted when there are cytological features which are typically observed in benign lesions, along with a few additional characteristics which are usually not found in benign conditions and can be seen in malignancy.[25]

The most frequent cause of suspicious and the main cause of false positive diagnosis on FNAC is when fibroadenoma shows high cellularity, varying degree of nuclear enlargement, pleomorphism and presence of nucleoli favoring fibroadenomas but are also seen in carcinomas.[23,39] High cellularity is seen in intraductal papilloma , radial scars and fibrocystic disease with epithelial hyperplasia leading to suspicion of malignancy.

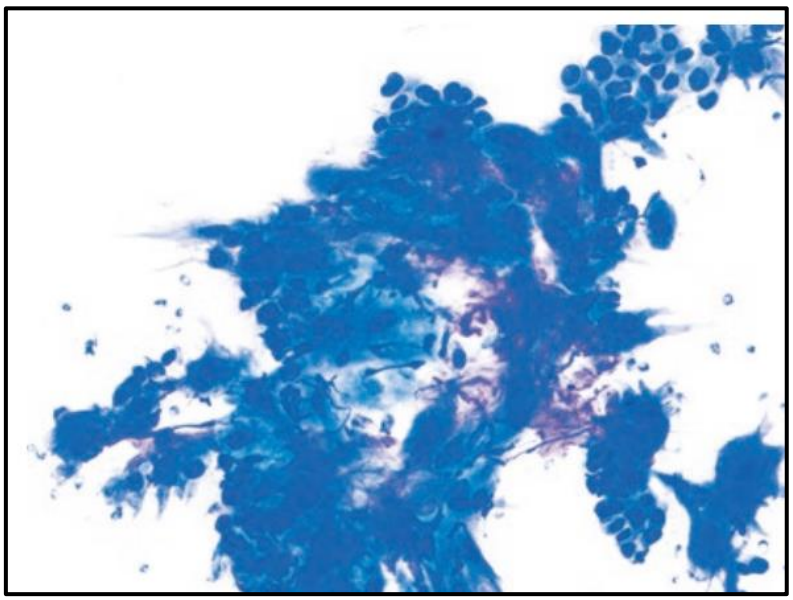


Fig. no. 9 – Papilloma showing crowded ductal cells with atypia

Papillomas can be linked to a variety of stromal fragments showing nuclear atypia, fine branches of dispersed epithelial strands ,raising the differential diagnosis of papillary DCIS.

On the other hand, micropapillary or perhaps cribriform pattern is not well appreciated in low-grade DCIS but naked bipolar nuclei and few myoepithelial cells are seen, making it challenging to identify.

Low-grade DCIS or invasive cancer may arise from conditions like "usual" ductal hyperplasia or sclerosing adenosis. The smears show high cellularity. There is enlarged nuclei along with atypia. A key characteristic of epithelial hyperplasia is the streaming pattern of epithelial cells, which are seen surrounding irregular slit-like spaces, commonly referred to as "secondary lumina". Additionally, the presence of naked bipolar nuclei scattered in the background is another important cytological feature associated with this condition. These findings, when observed together, strongly suggest epithelial hyperplasia and help differentiate it from other proliferative and neoplastic breast lesions.

In cases of paucicellular smear with scattered epithelial cells, lobular neoplasm can be a differential diagnosis, having eccentric cytoplasm in the cells and may show intracytoplasmic vacuoles. The vacuoles contain mucin present in the cytoplasm. These characteristics are thought to be somewhat atypical.[40] In contrast to lobular neoplasia, a scant tissue of proliferative lesion will show small cluster ductal epithelial cells which is cohesive in nature. Along with fragments of bland and myoepithelial nuclei in a background of naked nuclei.[41]

DCIS of low grade commonly gets reported in atypical category. This is because of papillary or cribriform pattern of arrangement with addition to compactly arranged ductal cells along with diffusely scattered cells seen singly.[42]

On FNAB, fibroepithelial lesions like cellular fibroadenomas and low-grade phyllode are often indistinguishable as they depend on cellularity and stroma showing minimal atypia.[43,44] One can consider high cellularity of stroma to be atypical.

Cases of adenomyoepithelioma can be reported under atypical category showing hypercellular smear with densely arranged two population of epithelial cells. Prominent feature seen is spindled myoepithelial cells in such cases.[45]

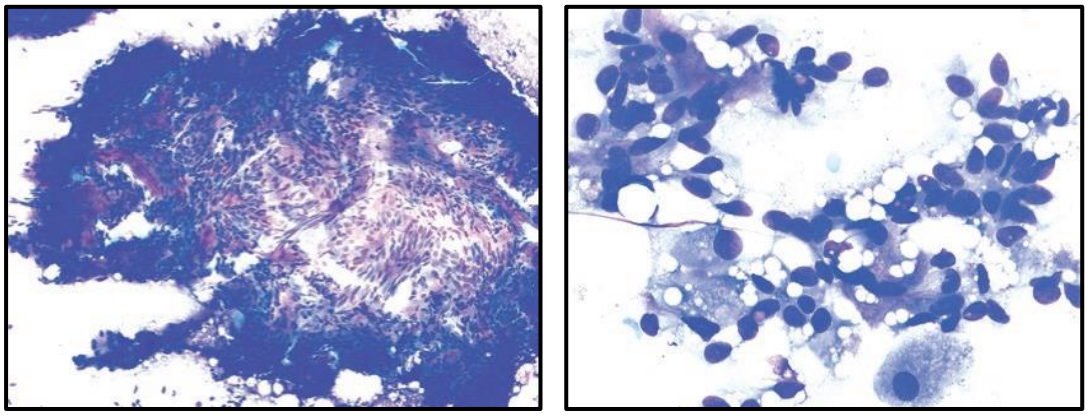


Fig. no. 10 – Adenomyoepithelioma showing biphasic population of cells.

Lesions in spindle cells, a fibromatosis may appear on imaging as malignancy and often results in smears with varied stromal components and low cellularity.[46]

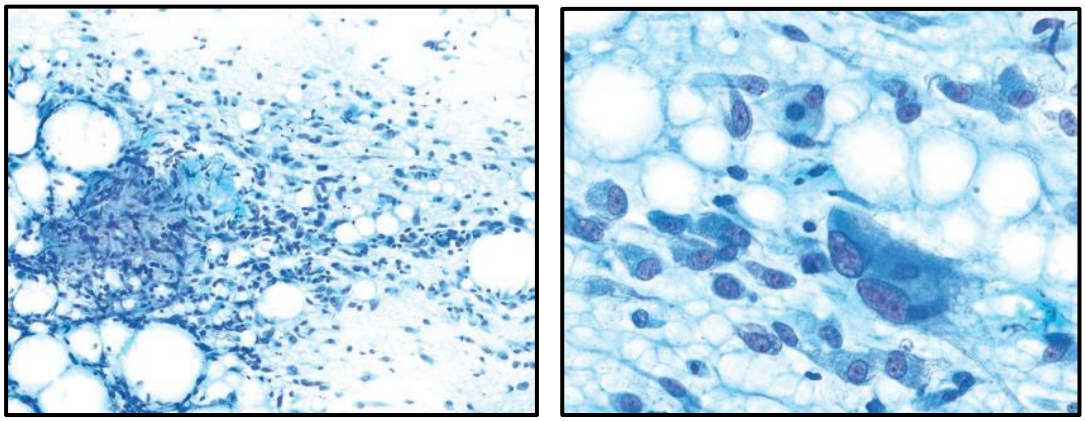


Fig. no.11 - Nodular fasciitis in low power and high power showing 'ganglion-like' cells with plump spindle shaped cells

Category 4: Suspicious of Malignancy

Some cytomorphological features that are usually found in malignant lesions are observed but are not sufficient for its definitive diagnosis. This condition is referred as suspicious of malignancy in breast FNAC. However, if possible the type of suspected malignancy should be mentioned.[25]

Ductal Carcinoma In Situ (DCIS)

Skilled cytopathologists differ in their diagnostic approaches. This variation affects the FNAC evaluation and classification of low-grade and high-grade DCIS. As a result, distinguishing these categories can be challenging. Invasive carcinoma cannot be completely ruled out if present along with DCIS. However, on histopathology and molecular studies low-grade can be differentiated from high-grade DCIS.[47]

Low-Grade Ductal Carcinoma In Situ (Low-grade DCIS)

Proliferated ducts having small monomorphic epithelial cells which are evenly distributed, slightly enlarged and pleomorphic nuclei are features favoring low-grade DCIS. They show patterns like that of "Roman" bridges, micropapillae and can have sieve-like appearance making it cribriform pattern meeting the criteria as defined by WHO on histopathology.[48] Some cases can be differentiate it from benign epithelial proliferations having no uniform pattern in the lumina. They are not uniformly distributed. Additionally, the nuclei are small and randomly distributed, contributing to the high degree of variability in cellular arrangement. Another key characteristic is the cells are arranged in line, which creates a distinct pattern different from usual ductal hyperplasia.[49]

Luminal necrosis may occasionally be seen in DCIS of intermediate grade. Favouring features include relatively larger atypical nuclei, may vary in shape and size. Patterns of architecture are same as seen in low-grade DCIS. In comparison to high-grade DCIS, which shows coarse, granular calcifications, microcalcifications are typically smaller and more spherical in low grade DCIS.

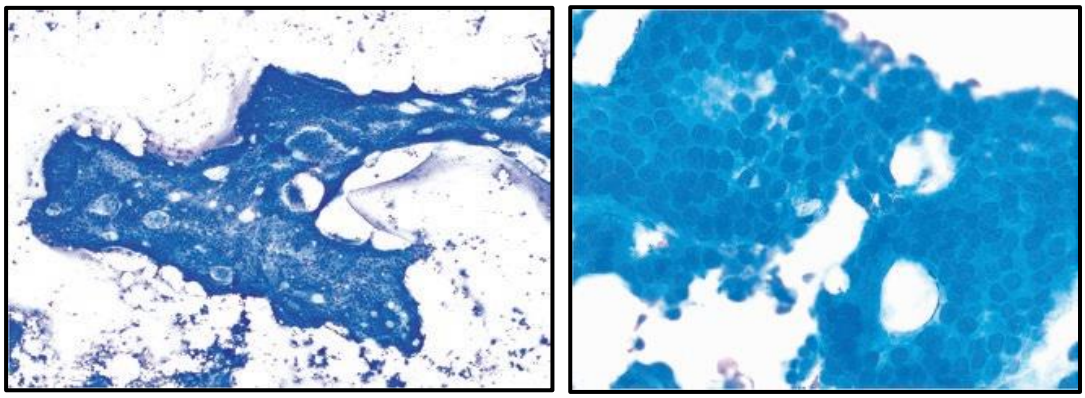


Fig. no.12 – Low grade DCIS

The histological diagnosis of "atypical ductal hyperplasia" can be made in some cases; however, cannot be commented on FNAC. The primary objective is to avoid underdiagnosing low-grade DCIS as proliferative breast disease. It is equally important to prevent overdiagnosing it as invasive malignancy. Low-grade DCIS typically does not present as a palpable clinical mass.[50] Its distinct cytological features can be subtle and challenging to identify. Accurate evaluation is crucial to ensure proper diagnosis and management.

Category 5: Malignant

Cytopathological features of malignancy are enough to denote into this category. Specific type of malignancy should be clearly identified, wherever possible.

Invasive Carcinoma of No Special Type

Smears are usually hypercellular. Large irregular 3D epithelial cells and few scattered single cells forms the pattern of low-grade carcinomas, whereas high-grade carcinomas have cohesive cluster of neoplastic cells with numerous scattered cells.[51]

Low-grade carcinoma tissue fragments are comparatively solid and densely packed with some nuclear overlap. While the pieces of high grade carcinomas are less cohesive, they can be tubular or 3D, and sometimes cribriform in architecture. The periphery of the tumour shows nuclear overlapping, crowding, and a loss of nuclear polarity.[25,52]

In high-grade carcinoma, the cells are typically larger in size and show significant pleomorphism. These cells often have dense cytoplasm and exhibit a high nucleus-to-cytoplasm (N:C) ratio. In contrast, low-grade malignancies contain cells that appear more uniform and monotonous in shape and size. Although these cells are enlarged compared to normal cells, they lack the marked pleomorphism seen in high-grade carcinomas.[53]

The nuclear features of high grade exhibits pleomorphism, clumped chromatin, prominent large stippled nucleoli with irregular nuclear border. They also show perinuclear halo. In contrast, low grade carcinoma typically has monotonous nuclei having mild to moderate enlarged nuclei. The shape of the nucleus is usually round. However, pleomorphic nucleus with some degree of hyperchromasia and prominent nucleoli is not uncommon. Few foci contain nuclear debris in high grade carcinomas.

Absence of naked nuclei in the background points more towards malignancy, as they are evidence of a benign breast disease.

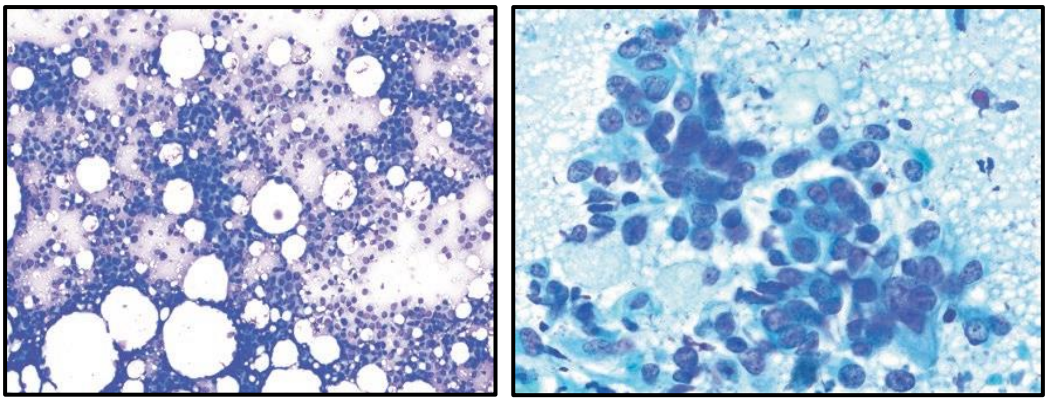


Fig. no.13 – High grade ductal carcinoma (Low and high power)

Breast Lesions Under Each Cytology Category

Category	Lesions
Category 1: Inadequate	Scant cellular material, Poorly smeared/fixed samples
Category 2: Benign	Normal breast tissue Acute mastitis and breast abscess Granulomatous mastitis Cystic lesion, Cyst, Fibrocystic change Usual epithelial hyperplasia Fibroadenoma Lactational change Adenosis and sclerosing adenosis Fat necrosis Intramammary lymph node
Category 3: Atypical	Intraductal papilloma Fibrocystic change with usual epithelial hyperplasia Usual epithelial hyperplasia and sclerosing adenosis Atypical ductal hyperplasia Lobular neoplasia (non-pleomorphic) Fibroepithelial tumour Columnar cell change with hyperplasia Lactational change with atypia Mucocele-like lesion Adenomyoepithelioma Spindle cell stromal proliferations
Category 4: Suspicious of Malignancy	Ductal carcinoma in situ (low or high grade) Low-grade invasive carcinoma Lobular carcinoma in situ Carcinoma admixed with benign elements
Category 5: Malignant	Invasive carcinoma of no special type High-grade ductal carcinoma in situ Invasive lobular carcinoma Tubular carcinoma Mucinous carcinoma Metastatic tumors to the breast

Table no. 2 - Breast Lesions Under Each Cytology Category[25]

While significant progress has been made in breast cytopathology, discrepancies among classification systems highlight the need for improved method of reporting. The IAC Yokohama System presents a promising standardized approach, but its effectiveness in clinical practice remains under-explored. This study seeks to address these gaps by evaluating the role of Yokohama reporting system in enhancing accuracy, risk assessment and patient management, ultimately contributing to more reliable and globally acceptable cytology reporting system.

MATERIALS AND METHODS

Study design: It is a hospital based cross sectional study which is prospective longitudinal descriptive study

Source of data: This study includes patients with breast lump who underwent FNAC at Hi-tech laboratory, KLE's Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi.

Study period: One year (1stJanuary 2024 – 31st December 2024).

Sample size derivation:

The following formula is used to calculate the size of the required sample

$n = (z)^2 p (1 – p) / d^2$

So, the sample size according to this is 76.

The present study includes 150 cases.

Sampling technique: Universal sampling

Inclusion Criteria: All patients irrespective of age and sex with breast lump reporting to Department of Pathology, JNMC, Belagavi

Exclusion Criteria:

- Patient does not give consent
- Lactating breast
- Patient having nipple discharge and no palpable lump.

Data collection procedure: From January to December 2024, all patients with complain of breast lump presented at the Pathology Department of KLE's Dr. Prabhakar Kore Hospital and Medical Research Centre were included. After documenting the clinical information, FNAC is carried out with informed consent and aseptic precautions using 22 or 23 gauge needles of suitable type and length. Trocar needles were preferred for their rigidity and reduced risk of blockage or contamination during insertion. Suction was applied using a 10 or 20 ml syringe, often connected to the needle via a short extension tube for image-guided procedures. A syringe holder improves ease of use by allowing simultaneous manipulation and suction.

Air dried Giemsa-stained direct smear, alcohol fixed Papanicolaou stained and hematoxylin and eosin stained slides were prepared.

Informed consent was taken from all patients before FNAC. At least two passes were done from each breast lump and the adequacy of smears was assessed using rapid onsite evaluation with Toluidine blue stain.

Evaluation: The IAC Yokohama System divides patients into five groups based on their malignancy risk (ROM).

Cytology reporting category	
C1	Inadequate
C2	Benign
C3	Atypia, probably benign
C4	Suspicious of Malignancy
C5	Malignant

*Annexure I – Procedure of Rapid Papanicolaou stain

*Annexure II – Procedure of Giemsa stain

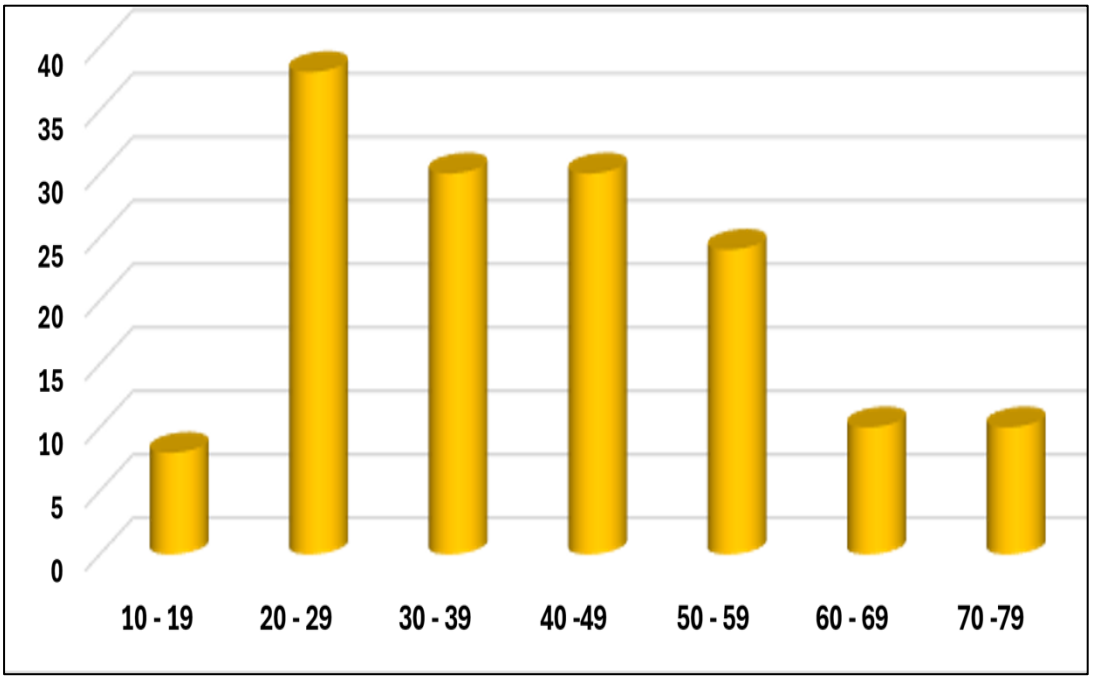
*Annexure III – Procedure of H&E stain

*****Annexure IV – Informed consent form

*****Annexure V – Master Chart

RESULTS

The study shows classification of 150 breast FNAC cases based on cytological findings. It includes wide age range, from 14 years to 79 years. Majority cases are of female patients and very few male patients. These cases are classified into five categories of IAC Yokohama system for breast lesions and further Sensitivity (Sn), Specificity (Sp), Positive Predictive Value (PPV), Negative Predictive Value (NPV), Diagnostic Accuracy (DA) and Risk of Malignancy (ROM) are calculated in order to correlate with histopathology.



	MEAN	S.D.	MIN	MAX
AGE	40.71	16.00	14	79

Fig no. 14 – Graphical presentation of age distribution

The age distribution of breast FNAC cases is presented in the chart, showing a total sample size of 150 with an average (mean) age of 41 years. The standard deviation (SD) of 16.00 indicates the extent of variability in the ages of patients, reflecting a broad range of cases from younger to older individuals. The minimum age recorded is 14 years, while the maximum is 79 years, highlighting that breast FNAC cases occur across all age groups.

The highest number of cases are observed in the 20-29 age group, followed by 30-39 and 40-49, suggesting a peak incidence in younger and middle aged individuals. The number of cases gradually decreases in older age groups, with the lowest frequency in the 60-79 range.

AGE	NUMBER	%
10 - 19	8	5.33
20 - 29	38	25.33
30 - 39	30	20.00
40 -49	30	20.00
50 - 59	24	16.00
60 - 69	10	6.67
70 -79	10	6.67
TOTAL	150	100.00

Table no. 3 – Age distribution of the study

The highest prevalence is in the 20-29 age group (25.33%), followed by 30-39 and 40-49 (20% each). Cases decline with age, 50-59 (16%) and 60-79 (6.67% each). The 10-19 group has the lowest (5.33%). This trend suggests a higher occurrence of breast conditions in younger and middle-aged women, peaking in the 20-49 age range.

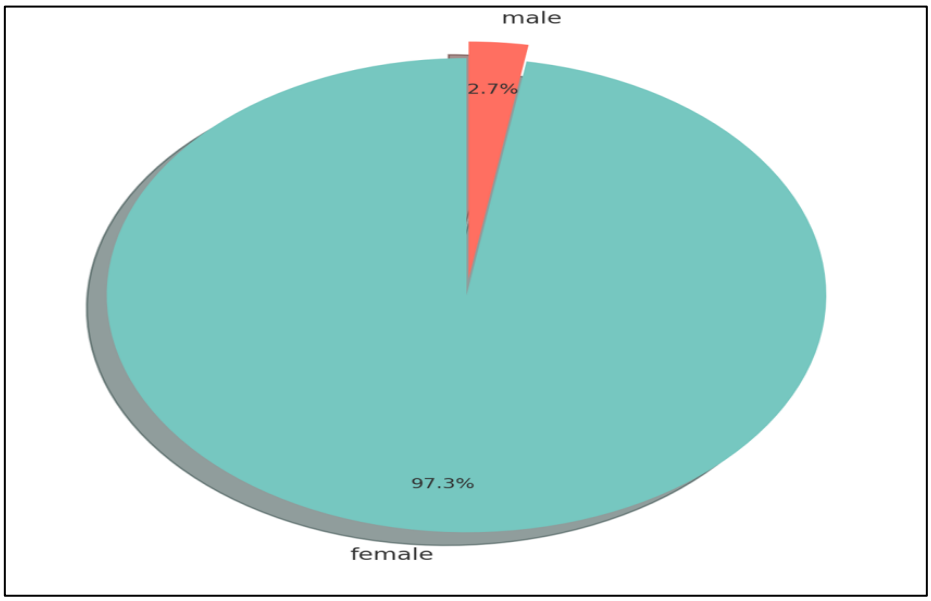


Fig no. 15 – Gender distribution of the study

Females constitute 97.3% of the participants, shown by the large teal section of the chart. Males make up 2.7%, represented by the small coral-colored slice.

CATEGORY	NUMBER	%
1 – Inadequate	7	4.67
2 – Benign	103	68.67
3 – Atypical	4	2.67
4 – Suspicious of malignancy	5	3.33
5 - Malignant	31	20.67
TOTAL	150	100.00

Table no. 4 – Number of cases in each category

The table presents the classification of 150 breast FNAC cases based on cytological findings. The majority of cases (68.67% or 103 cases) were categorized as benign. Malignant cases accounted for 20.67% (31 cases), reflecting a significant proportion of breast FNAC findings.

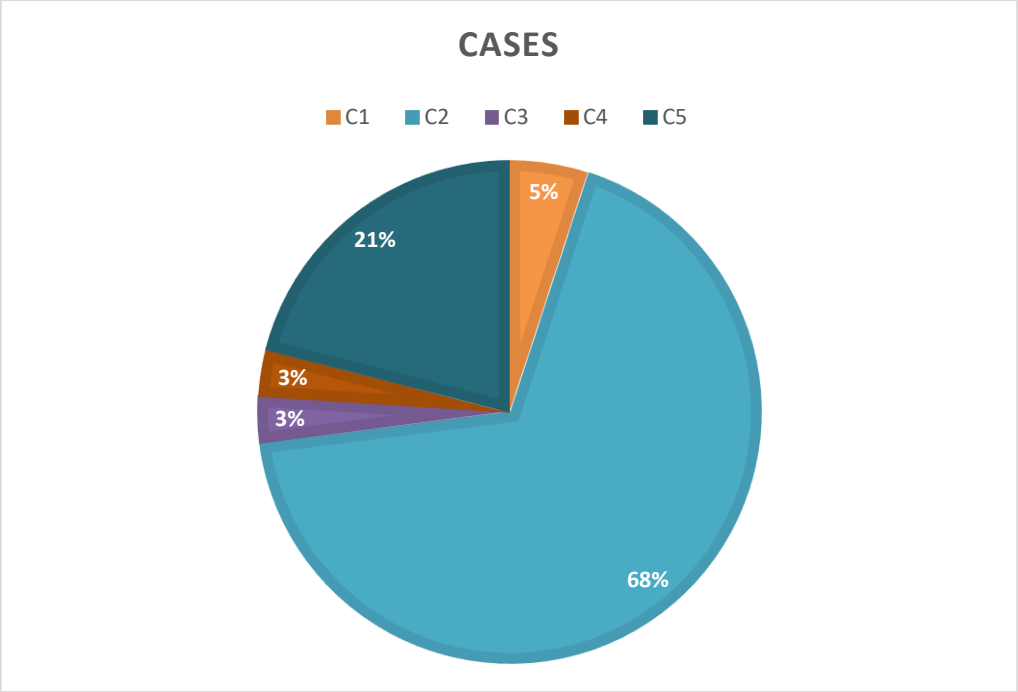


Fig no. 16 – Case distribution in each category in a pie chart

A smaller percentage (3.33% or 5 cases) were classified as suspicious of malignancy, requiring further evaluation, while atypical category cases, which may show uncertain cellular changes, comprised 2.67% (4 cases). Additionally, 4.67% (7 cases) were under inadequate category, that is they lacked sufficient cellular material for a conclusive diagnosis.

QAGE GROUP	**C1- Inadequate**	**C2- Benign**	**C3- Atypical**	**C4-Suspicious of malignancy**	**C5- Malignant**
10-19	0	8	0	0	0
20-29	0	33	0	2	3
30-39	0	25	0	2	3
40-49	3	19	2	0	6
50-59	1	7	1	1	14
60-69	2	3	0	0	5
70-79	1	8	1	0	1

Table no. 5 – Distribution of cases in each category as per the age group

The majority of benign cases (103) were found across all age groups, with the highest occurrence in the 20-29 and 30-39 age groups. Malignant cases (31) were mostly seen in older age groups, particularly 50-59 and 40-49. Inadequate samples were minimal (7), primarily in the 40-49 and 50-59 age groups. Suspicious and atypical cases were rare, with only a few scattered across different age groups.

	HISTOPATH		
	MALIGNANT	BENIGN	TOTAL
MALIGNANT	21	2	23
BENIGN	4	40	44
TOTAL	25	42	67

Table no. 6 – Histopathology follow up and correlation

Sensitivity (Sn)	84 %
Specificity (Sp)	95.2 %
Negative Predictive Value (NPV)	90.91 %
Positive predictive value (PPV)	91.30 %
Diagnostic Accuracy (DA)	91.04 %

Table no. 7 – Statistical analysis of the study

The table presents the diagnostic performance includes a sensitivity of 84%, specificity of 95.2%, negative predictive value (NPV) of 90.91%, positive predictive value (PPV) of 91.30%, and an overall diagnostic accuracy (DA) of 91.04%.

	Sensitivity	**Specificity**	**PPV**	**NPV**	**DA**
C1	0	100%	Not possible	33.3%	33.33%
C2	0	100%	Not possible	97.3%	97.3%
C3	0	100%	Not possible	75%	75%
C4	100%	0	50%	Not possible	50%
C5	100%	Not possible	100%	Not possible	100%

Table no. 8 – Calculated Sn, Sp, PPV, NPV and DA of each category

The table presents the diagnostic performance of different cytological categories (C1-C5) based on sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy (DA).

Key Observations:

- C1 (Inadequate): Shows 0% sensitivity but 100% specificity, that is it does not detect malignancy but correctly identifies benign cases.
- C2 (Benign): Has 100% specificity and 97.3% NPV, that is it correctly classifies benign cases and rarely misses malignancies, confirming its reliability in identifying true benign lesions.
- C3 (Atypical): With 100% specificity, it accurately identifies benign cases.
- C4 (Suspicious for Malignancy): Has 100% sensitivity but 0% specificity, that is it correctly identifies all malignant cases. The PPV of 50% indicate a high probability of malignancy, necessitating further histopathological confirmation.
- C5 (Malignant): Has 100% PPV, that is all cases in this category are confirmed malignant. Since it includes only positive cases, specificity and NPV are not applicable.

Categories C3 and C4 show a significant ROM (25% and 50%), suggesting a need for closer monitoring. C2 is the most reliable benign category with high specificity and NPV. C5 is definitive for malignancy. C1 cases have a high malignancy risk despite being classified as inadequate, requiring additional investigation.

		HPE		
CATEGORY	**NUMBER**	**BENIGN**	**MALIGNANT**	**ROM**
1	3	1	2	66.67%
2	37	36	1	2.70%
3	4	3	1	25.00%
4	4	2	2	50.00%
5	19	0	19	100.00%
TOTAL	67	42	25	37.31%

Table no. 9 – Histopathology follow up of each category and their ROM

Calculation of ROM:

$$ROM(\%) = \left(\frac{\text{Number of Malignant Cases}}{\text{Total Cases in that Category}} \right) \times 100$$

The table shows the correlation between cytological categories, histopathological examination (HPE) outcomes, and the risk of malignancy (ROM) for each category. Among 67 cases, 42 were benign and 25 malignant. ROM was highest in Category 5 (100%) and lowest in Category 2 (2.7%). Category 1 had a 66.67% ROM despite inadequate samples, while Category 3 (25%) and Category 4 (50%) indicated varying malignancy risks.

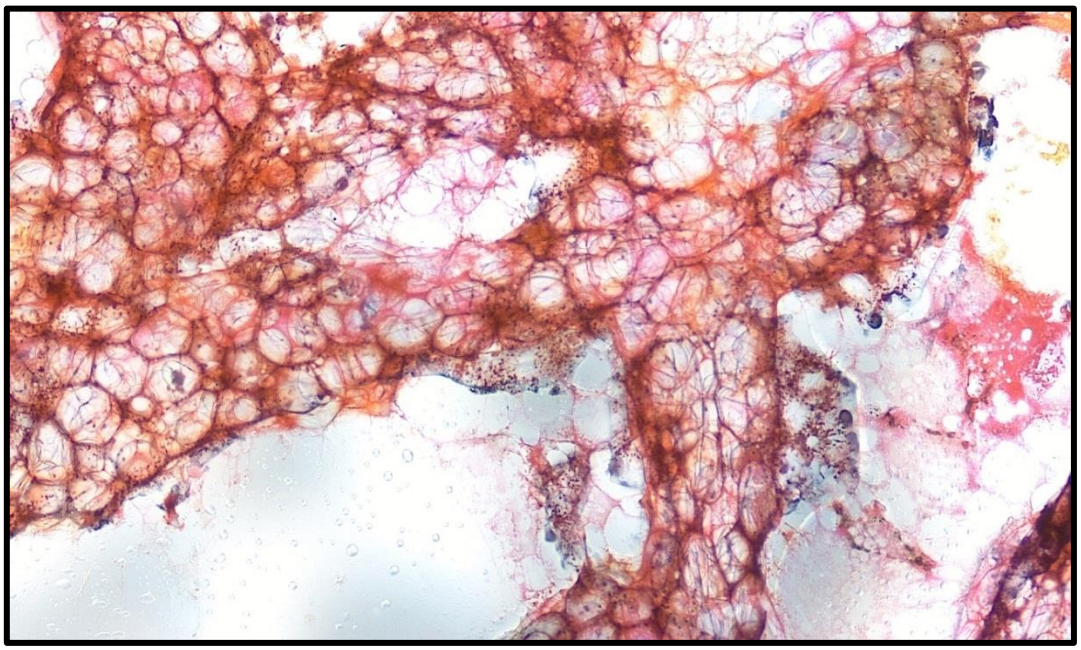
List of lesions reported under each category:

Category	Lesions
Category 1: Inadequate	• Scant cellularity, no definitive diagnosis - 2 cases • No definitive opinion - 3 cases • No cellular material - 2 case
Category 2: Benign	• Fibroadenoma - 46 cases • Fibrocystic disease of breast - 13 cases • Fibroadenoma with cystic change - 4 cases • Acute suppurative mastitis - 2 cases • Fat necrosis - 3 cases • Cystic lesion - 2 cases • Benign cystic lesion - 2 cases • Benign breast disease - 2 cases • Granulomatous mastitis - 2 cases • Acute mastitis - 3 case • Benign cystic lesion of the breast - 1 case • Mastitis with fibrocystic disease - 1 case • Gynecomastia - 1 case • Cystic lesion of breast - 1 case • Sebaceous cyst - 1 case • Fibroadenoma with acute mastitis - 1 case • Fibroadenoma with fibrocystic change - 1 case • Benign proliferative disease - 1 case • Antibioma - 1 case • Fibroadenoma with acute suppurative mastitis - 1 case • Fibroadenoma and fibrocystic disease - 1 case • Fibroadenoma with cystic and apocrine change - 1 case • Infected galactocele - 1 case • Infected epidermal cyst - 1 case

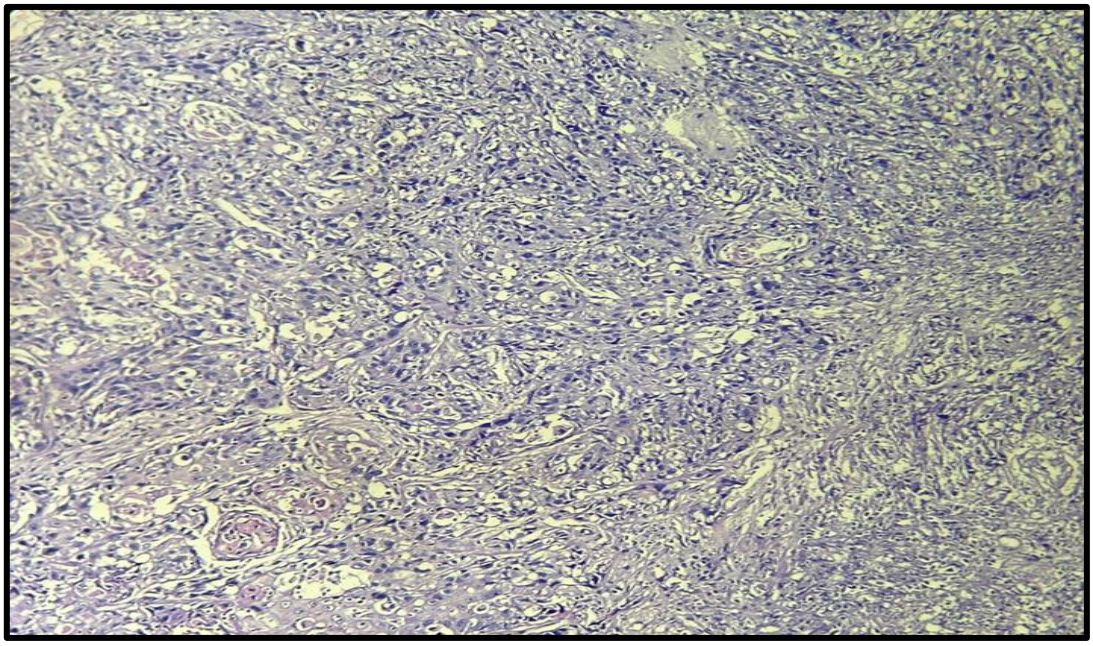
	• Gynecomastia, no e/o atypia - 1 case • Benign proliferative breast disease: Benign phyllodes, giant fibroadenoma - 1 case • Acute suppurative breast lesion - 1 case • Acute on chronic mastitis - 1 case • Granulomatous mastitis with acute inflammatory response - 1 case • Fibrocystic disease - 1 case • Fibroadenosis - 1 case • Possibility of adipose tissue component of a hamartomatous lesion - 1 case • Fibrocystic disease of breast with mastitis - 1 case • Lipoma - 1 case
Category 3: Atypical	• Papillary lesion with atypia - 2 cases • Fibrocystic change with atypical ductal hyperplasia - 1 case • Presence of atypical cells - 1 case
Category 4: Suspicious of Malignancy	• Suspicious but not conclusive of malignancy - 3 cases • Neoplastic lesion - 1 case • Suspicious of malignancy - 1 case
Category 5: Malignant	• Ductal carcinoma - 23 cases • Papillary neoplasm of breast - 2 cases • Recurrent ductal carcinoma - 2 case • Metastatic adenocarcinoma - 1 case • Poorly differentiated neoplasm - favours lymphoma - 1 case • IDC vs mucinous carcinoma - 1 case

Category 1 - Inadequate

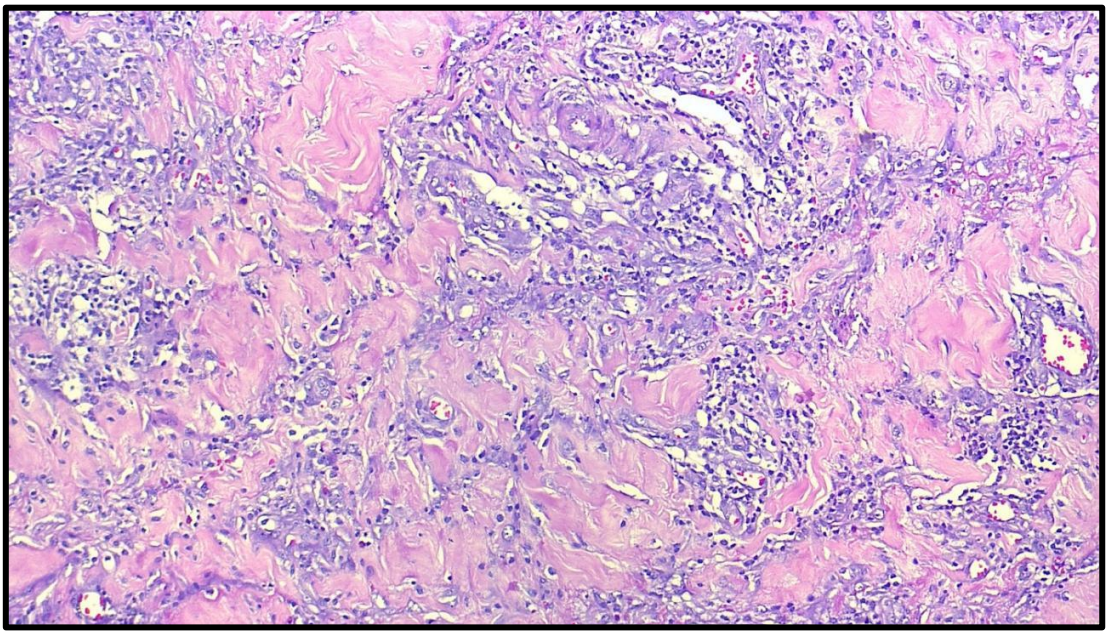
It includes seven cases, of which histopathological examination confirmed two as invasive ductal carcinoma and one as acute suppurative mastitis.



Photomicrograph 01 – Pap stain (100X) Fibrofatty tissue fragments - Inadequate to report



Photomicrograph 02 – H & E stain (200X), Invasive ductal carcinoma

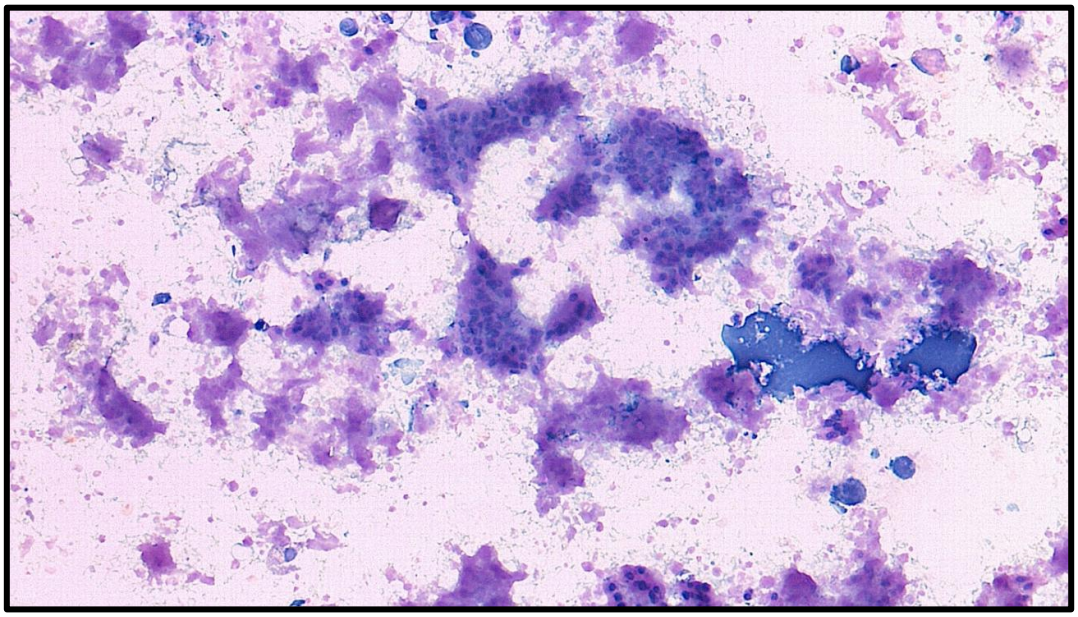


Photomicrograph 03 – H & E stain (200X), Acute Suppurative Mastitis

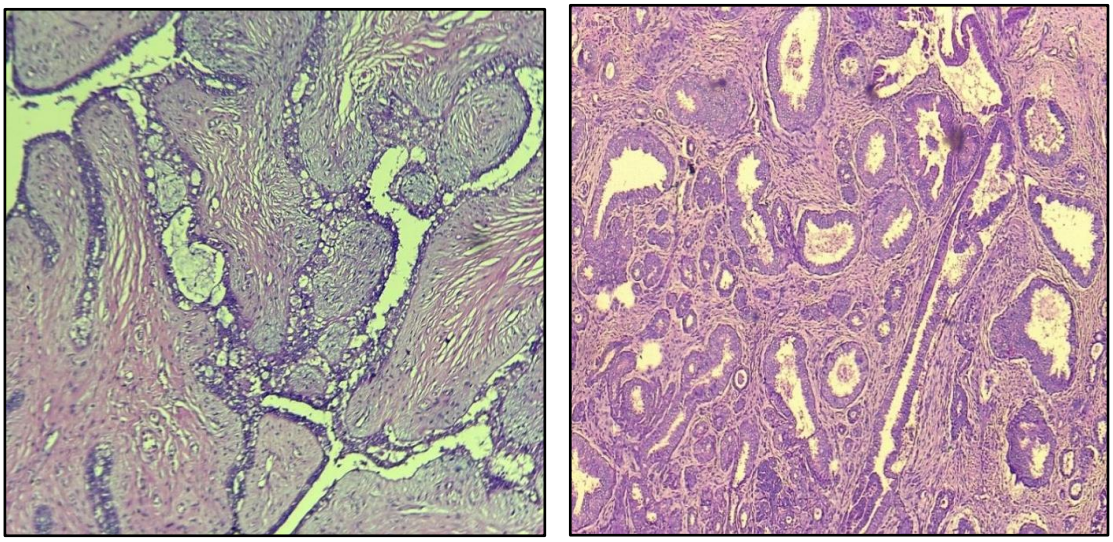
Category 2 – Benign

In Category 2, a total of 103 cases were recorded, with 37 cases having follow-up histopathological examination. The majority of fibroadenoma cases showed concordance with histopathology, as did cases of acute suppurative mastitis. However, some discrepancies were observed:

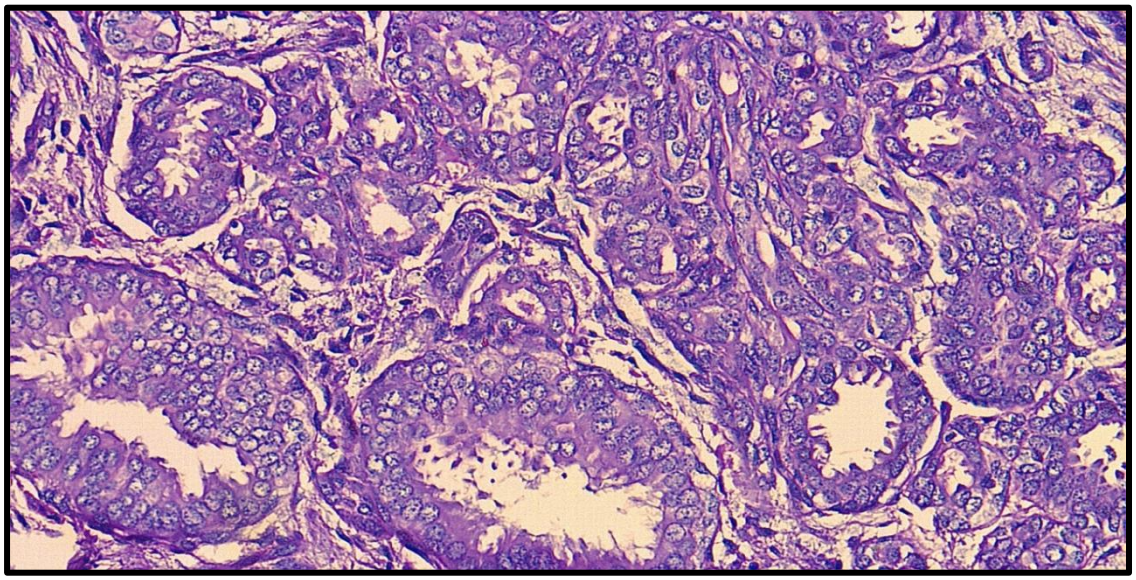
- One case diagnosed as fat necrosis on cytology was found to be fibroadenoma with focal epithelial hyperplasia on histopathology.
- One case initially reported as fibroadenoma on cytology was later identified as a premalignant condition of sclerosing adenosis on histopathology.
- One case of granulomatous mastitis was revealed to be fibroadenosis with duct ectasia.
- One case of acute mastitis was found to be fibroadenosis with duct ectasia.
- One case diagnosed as cystic lesion turned out to be fibrocystic disease of the breast with chronic mastitis.



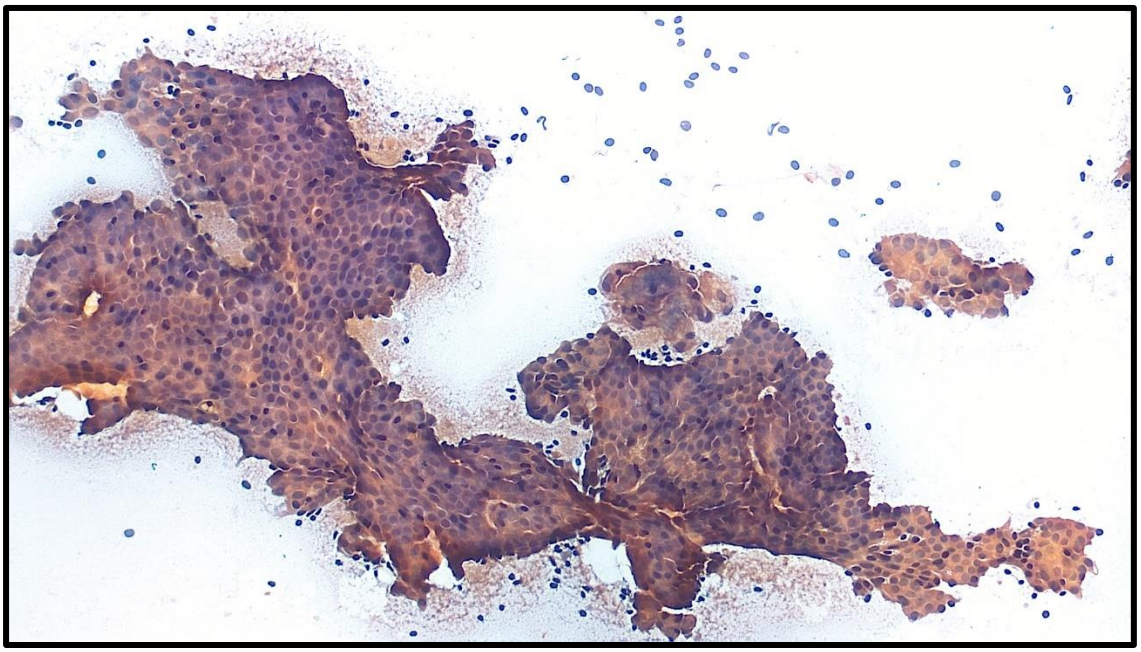
Photomicrograph 04 – Giemsa stain (200X), Fat Necrosis



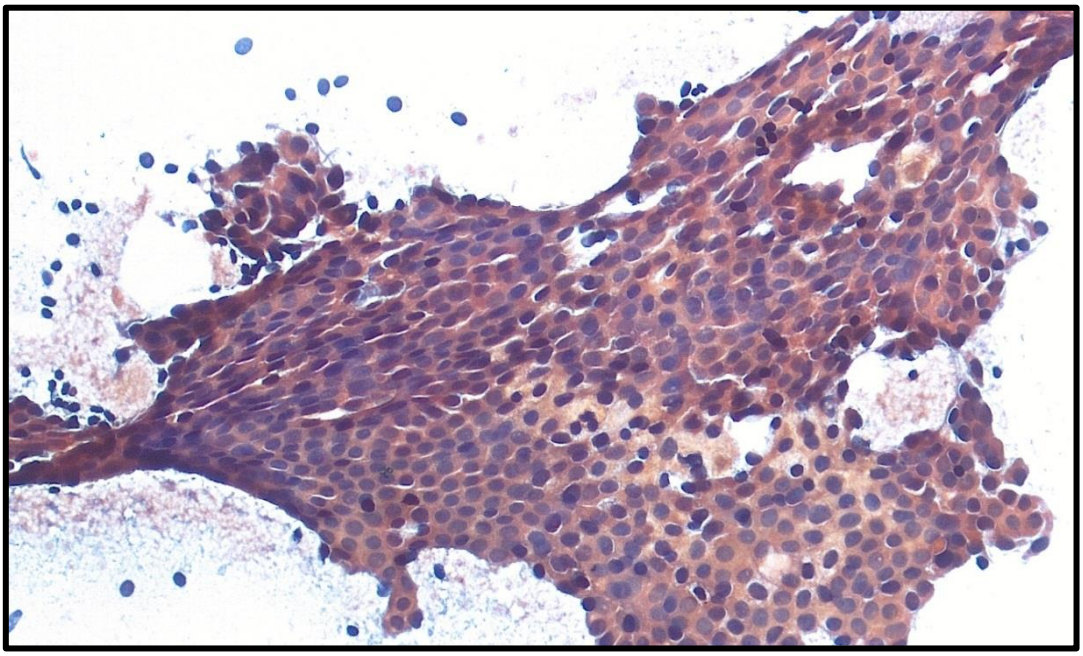
Photomicrograph 05 – H & E stain (200X) – Fibroadenoma with focal epithelial hyperplasia



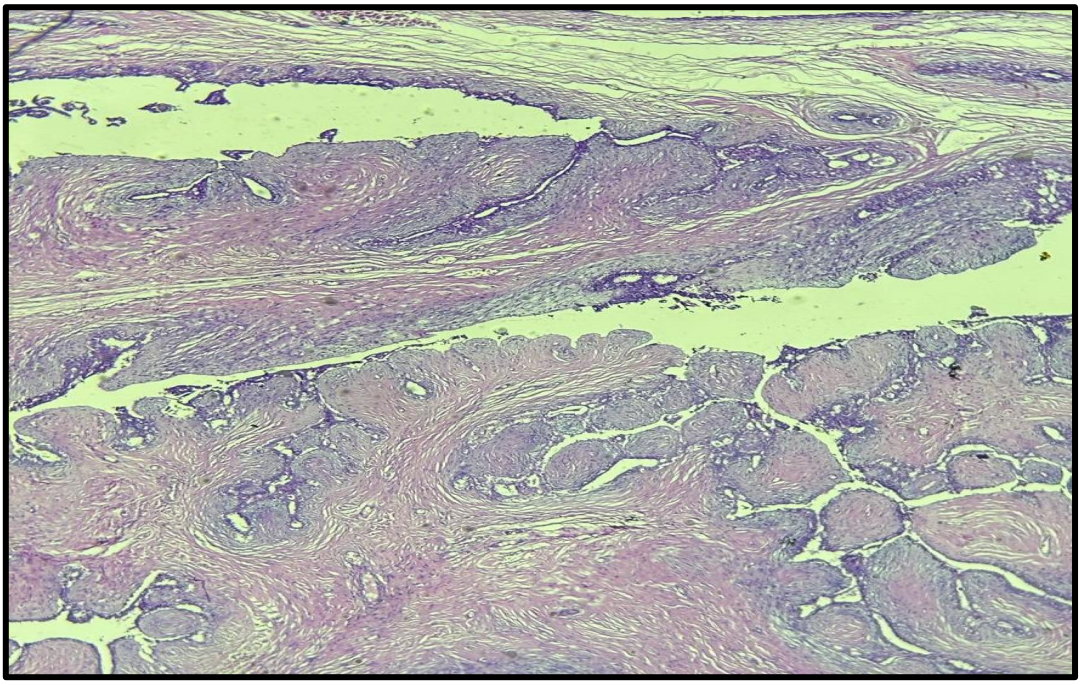
Photomicrograph 06– H & E stain (400X) – Focal epithelial hyperplasia



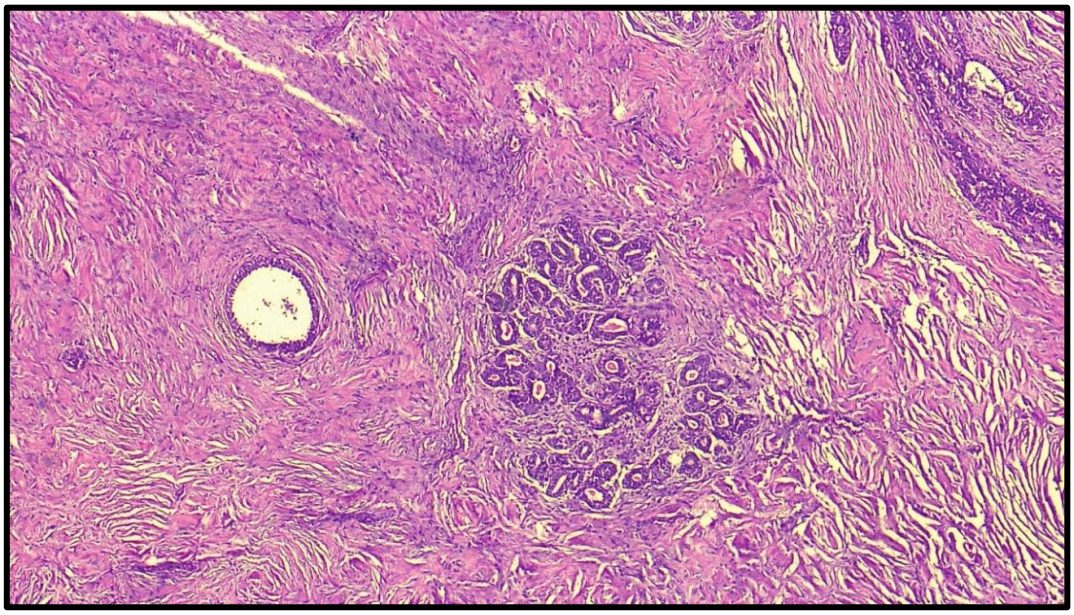
Photomicrograph 07 — Pap stain(200X), Fibroadenoma



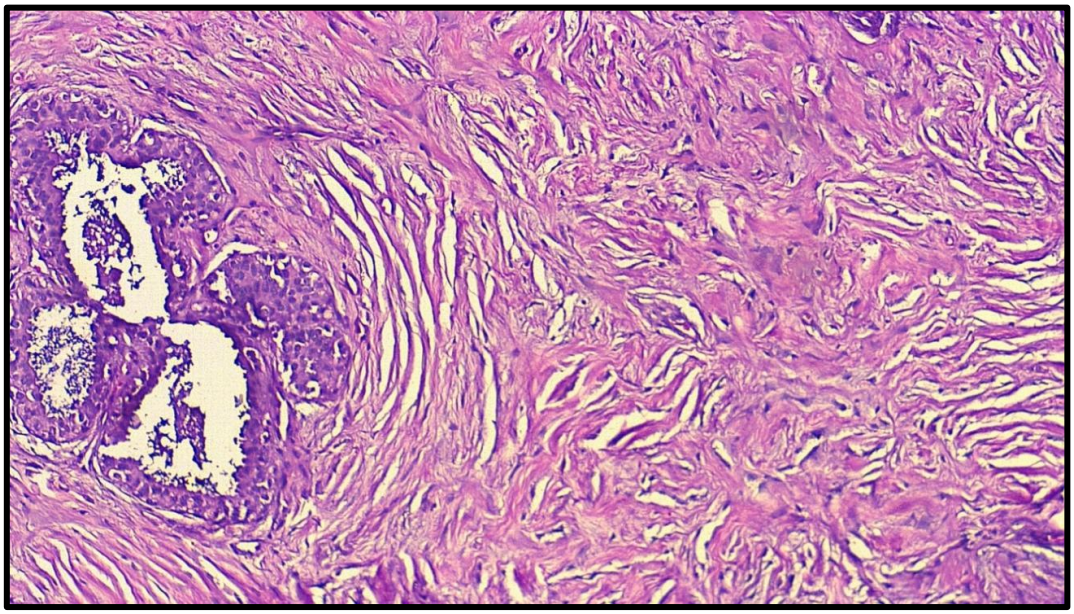
Photomicrograph 08 – Pap stain (400X), Fibroadenoma



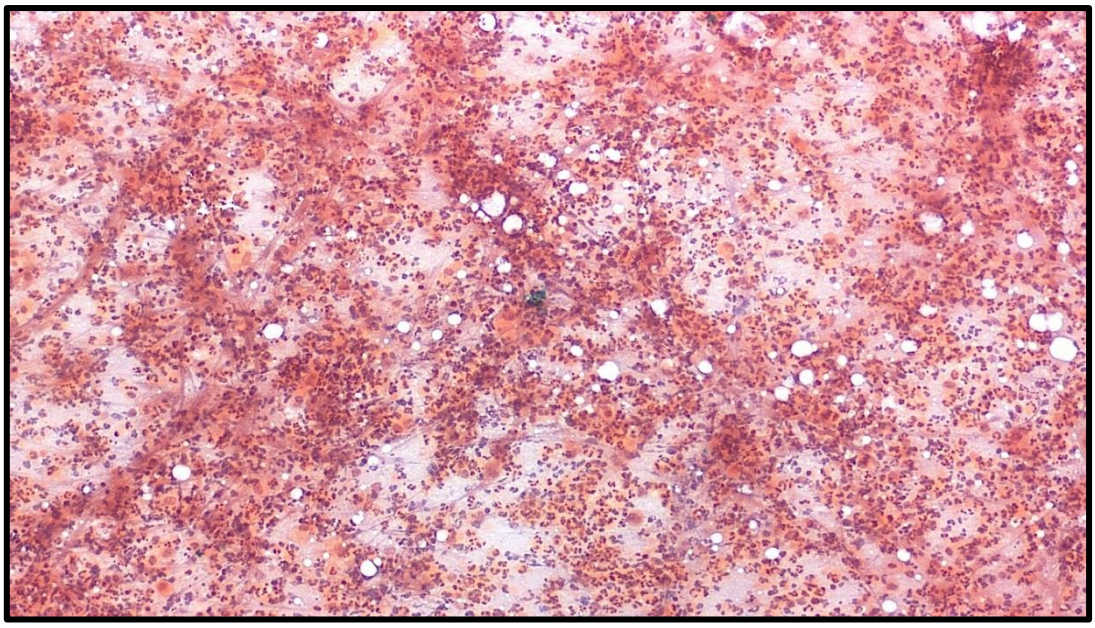
Photomicrograph 09 – H & E stain(100X), Fibroadenoma



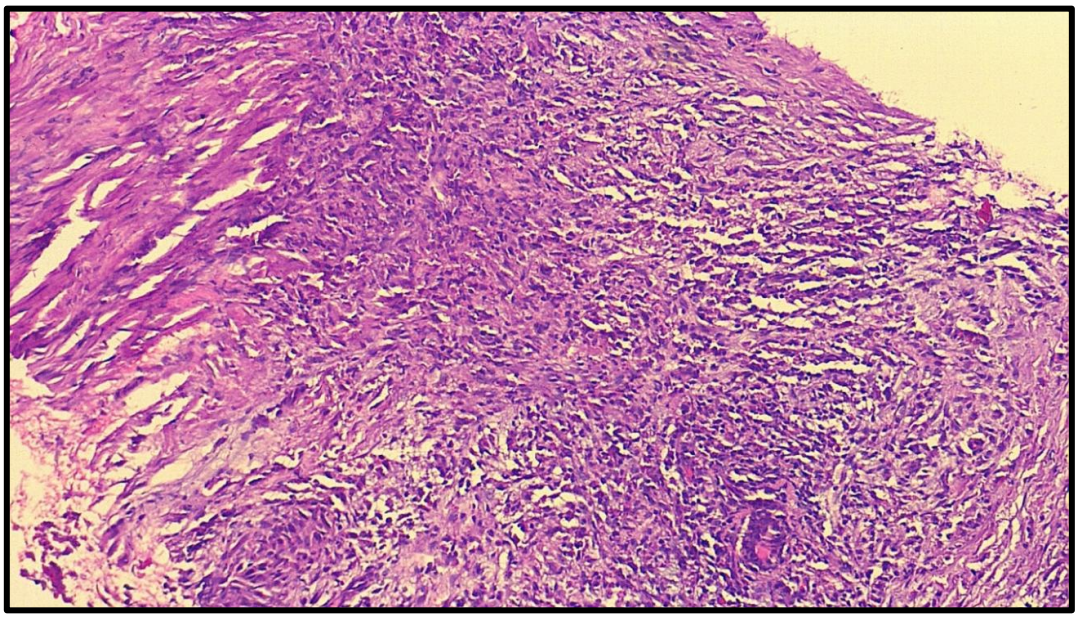
Photomicrograph 10 – H & E stain (100X), Sclerosing Adenosis



Photomicrograph 11 – H & E stain (400X), Sclerosing Adenosis



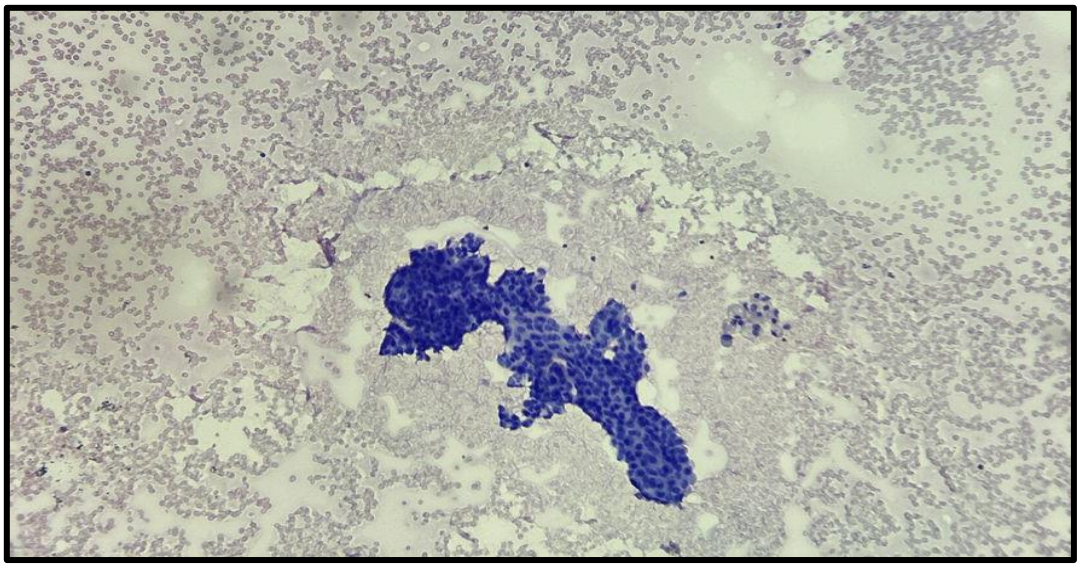
Photomicrograph 12 – Pap stain(100X), Acute Suppurative Mastitis

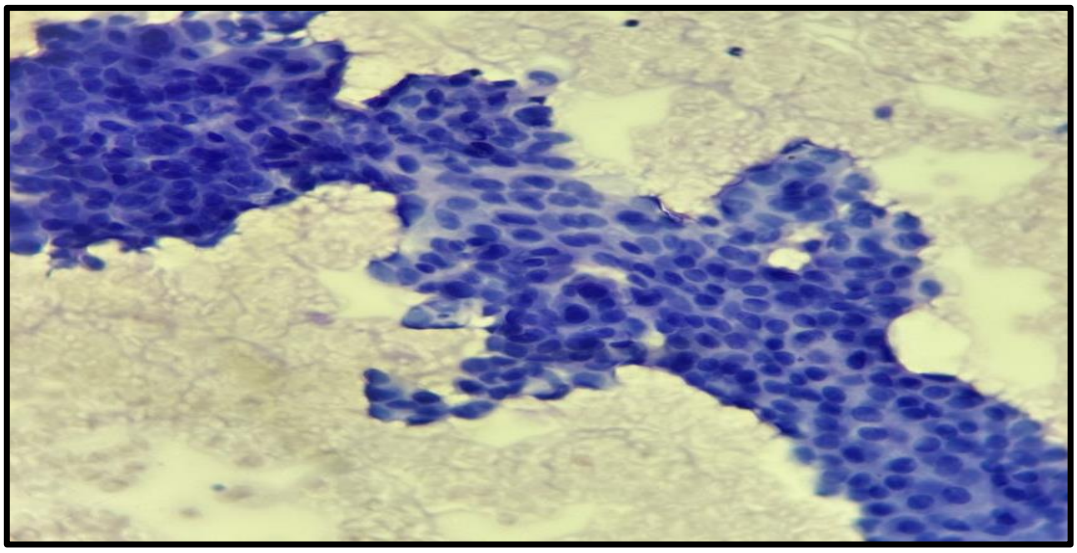


Photomicrograph 13 – H & E stain (200X), Acute Suppurative Mastitis

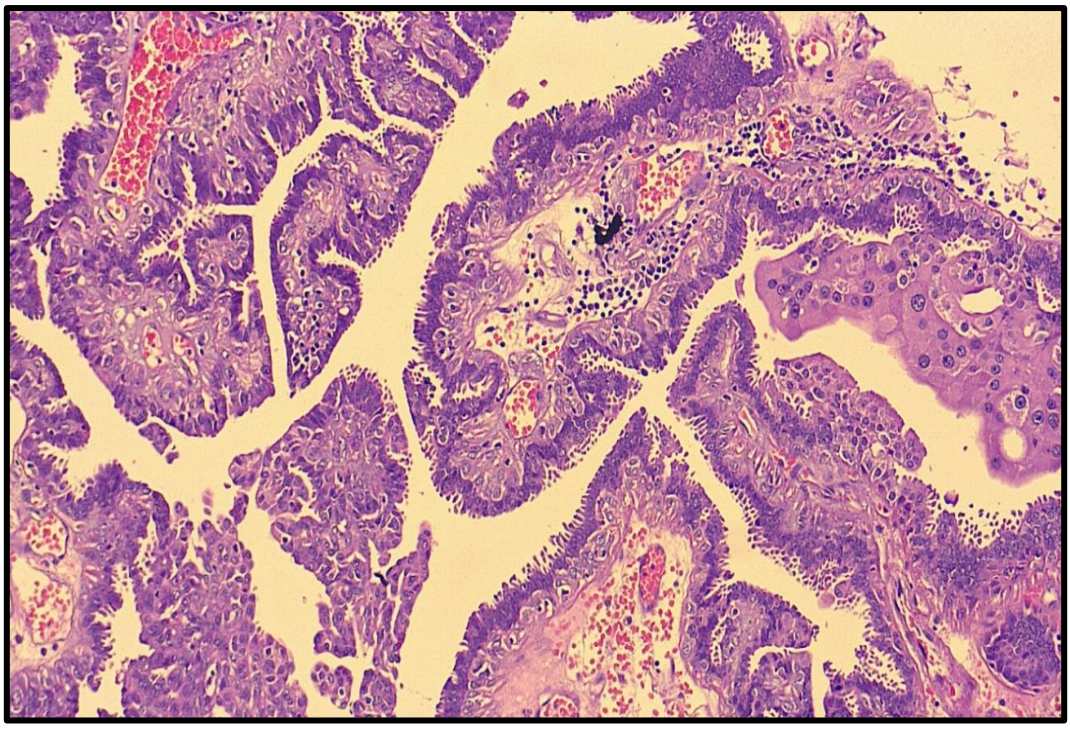
Category 3 – Atypical

In Category 3, three cases diagnosed as papillary lesions with atypia on cytology were confirmed as intraductal papilloma on histopathology, showing correlation. However, one case initially reported as fibrocystic change with atypical ductal hyperplasia on cytology was later identified as invasive ductal carcinoma on histopathology.

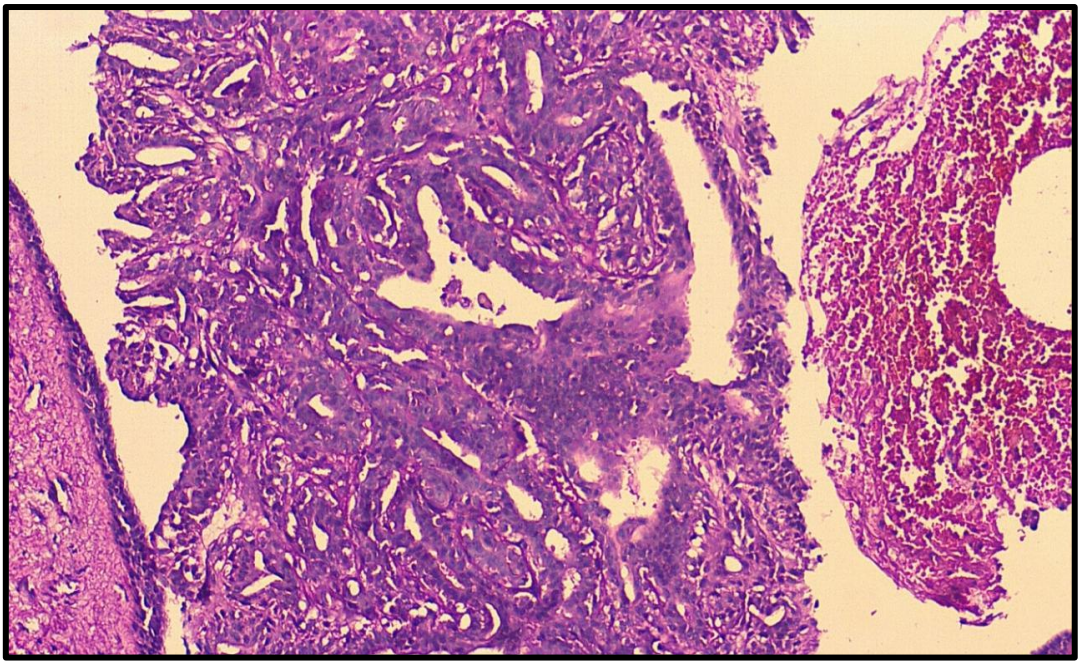




Photomicrograph 14 and 15 – Giemsa stain (200X and 400X) Papillary lesion with atypia



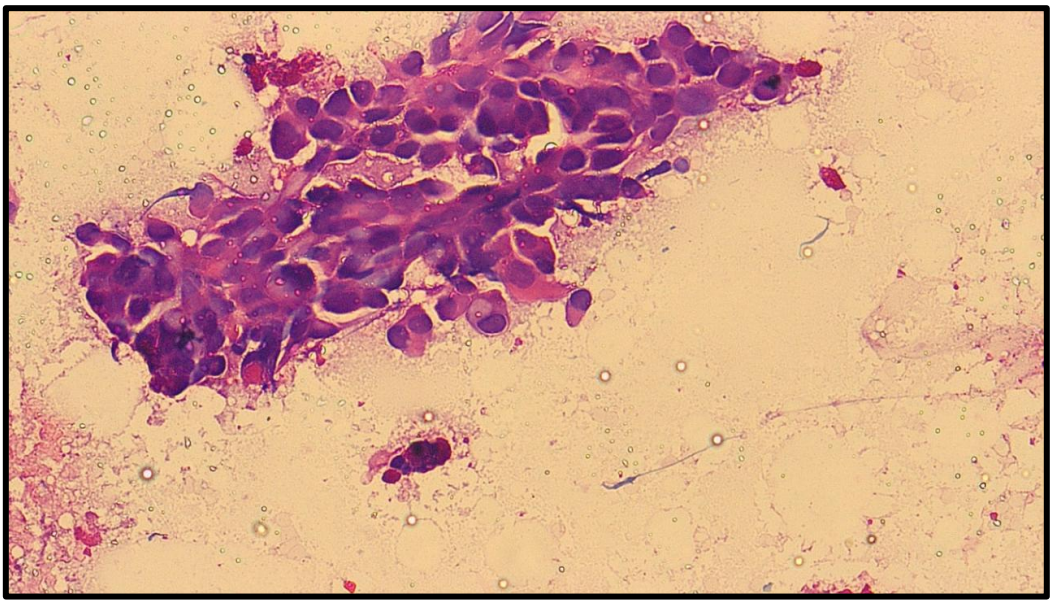
Photomicrograph 16 – H & E stain (400X), Intraductal papilloma



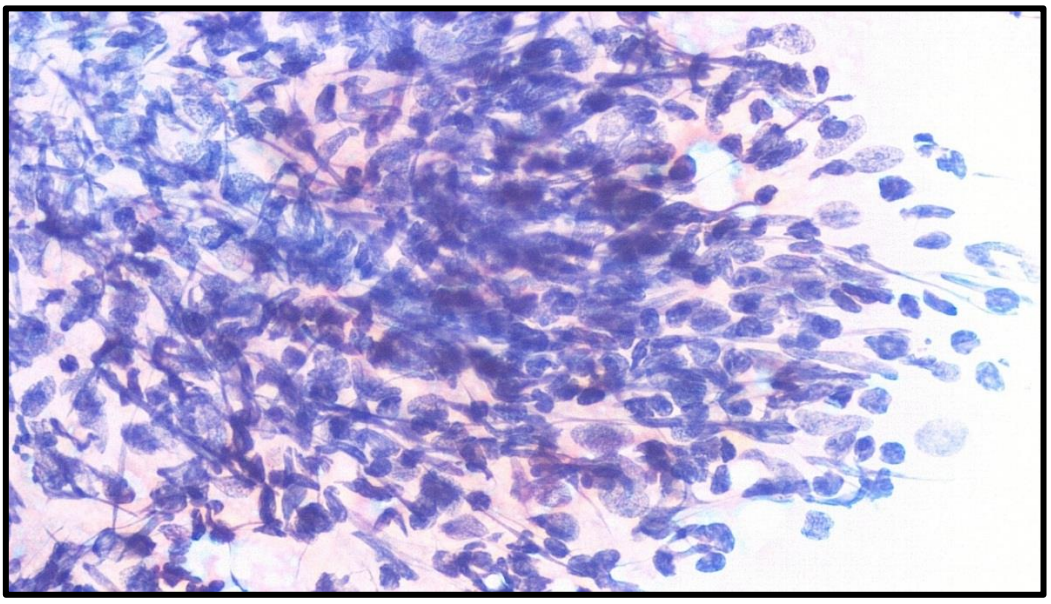
Photomicrograph 17 – H & E stain (400X), Intraductal papilloma on trucut biopsy

Category 4 – Suspicious

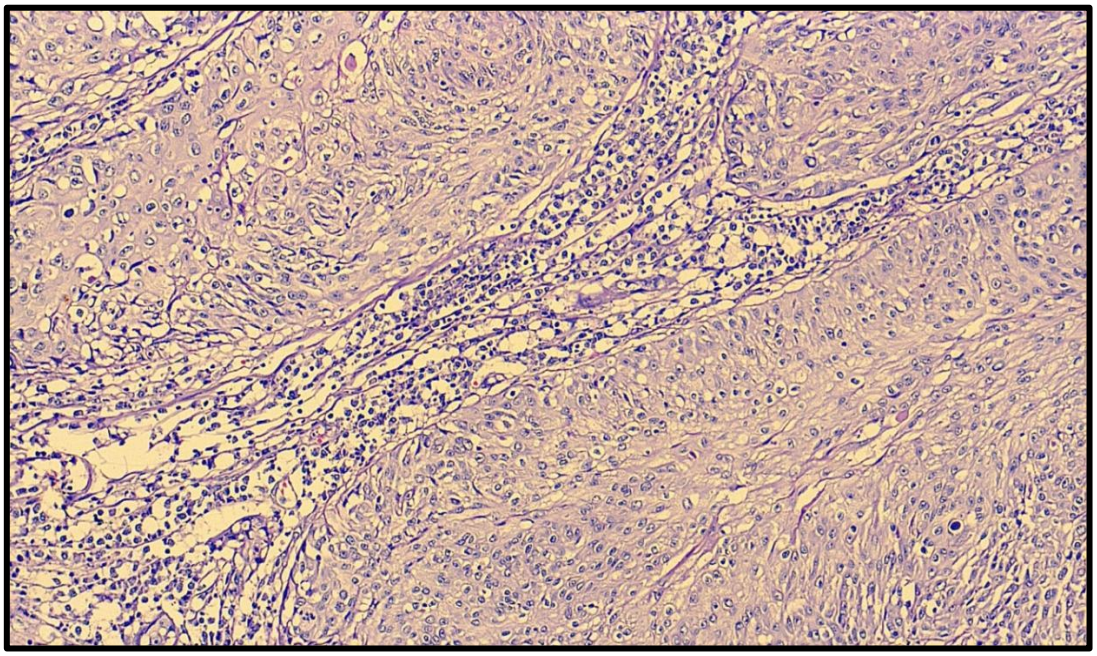
In Category 4, one case initially suspected of malignancy was confirmed as atypical ductal hyperplasia with invasive ductal carcinoma (IDC) on histopathology. Another case, considered suspicious but not conclusive for malignancy, was later identified as gynecomastia.



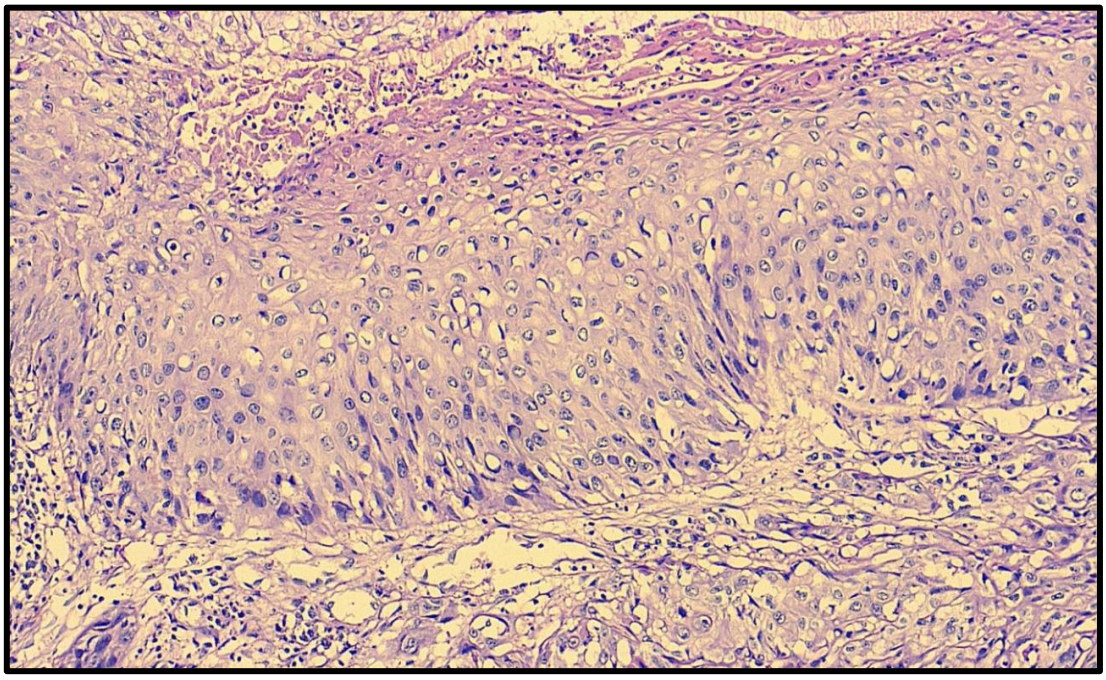
Photomicrograph 18 – H & E(400X), Suspicious of malignancy



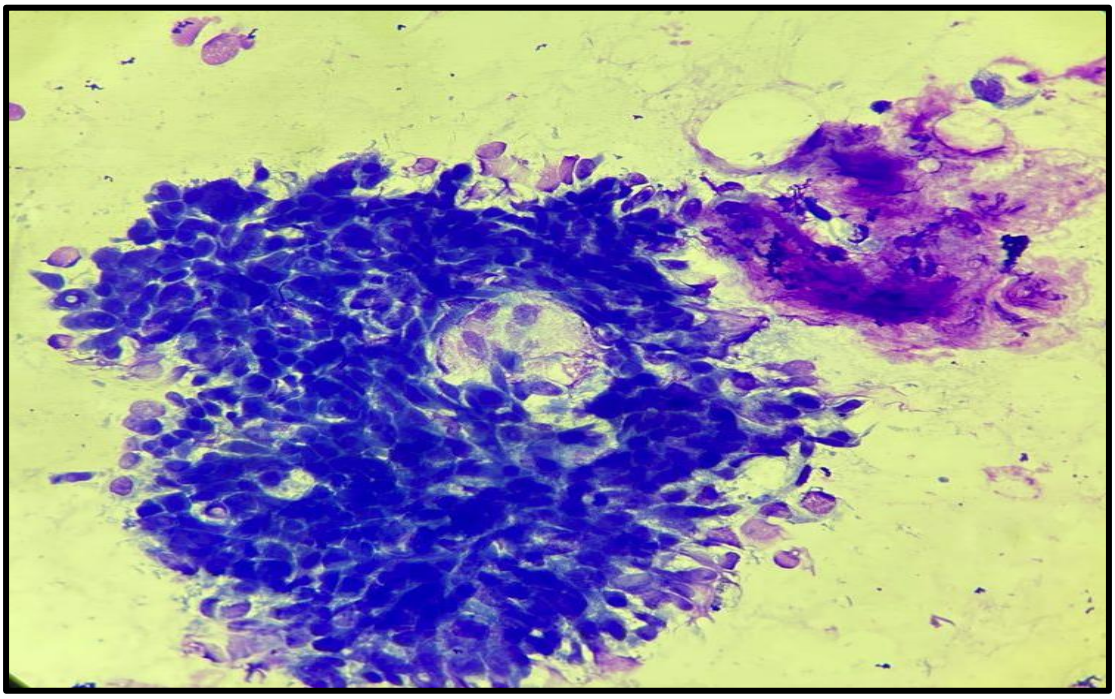
Photomicrograph 19 –Pap stain(400X), Suspicious of malignancy



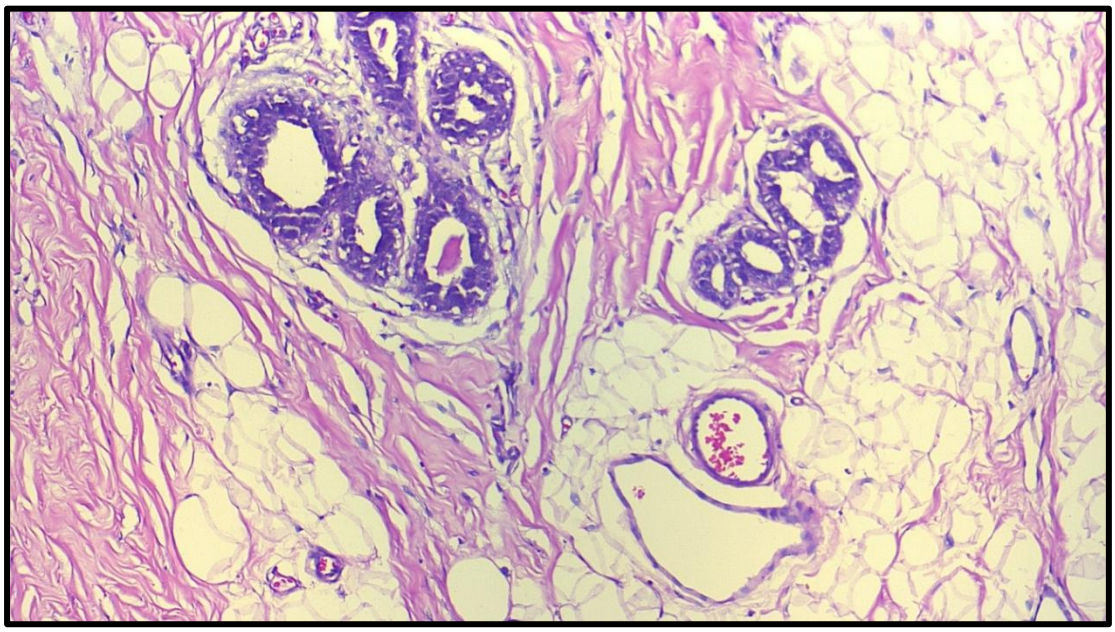
Photomicrograph 20 – H & E stain (200X), Atypical ductal hyperplasia



Photomicrograph 21 – H & E stain (400X), Atypical ductal hyperplasia



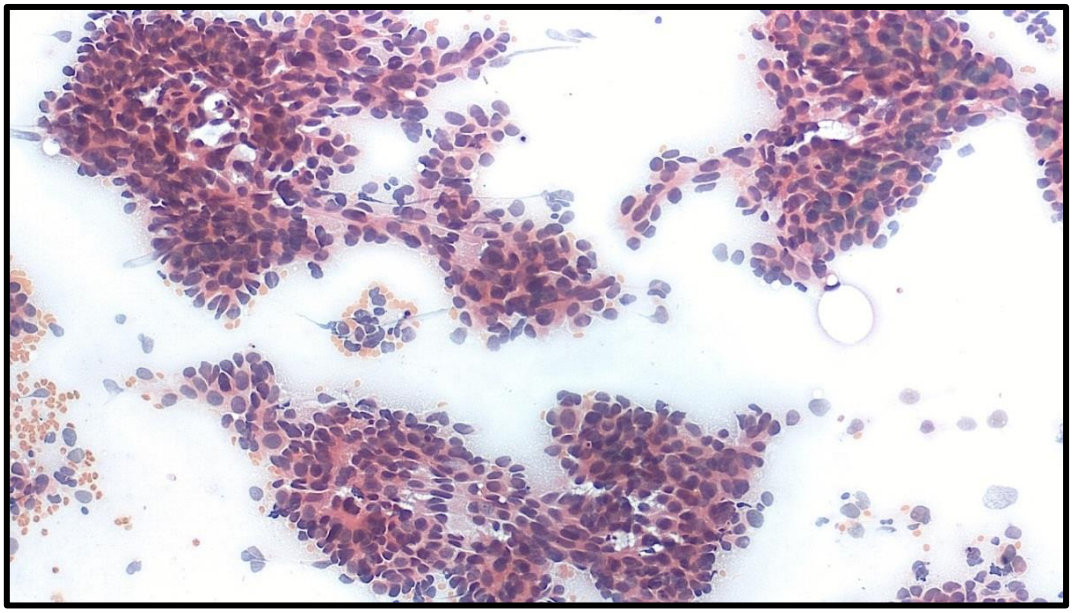
Photomicrograph 22 – Giemsa stain(400X), Suspicious of malignancy



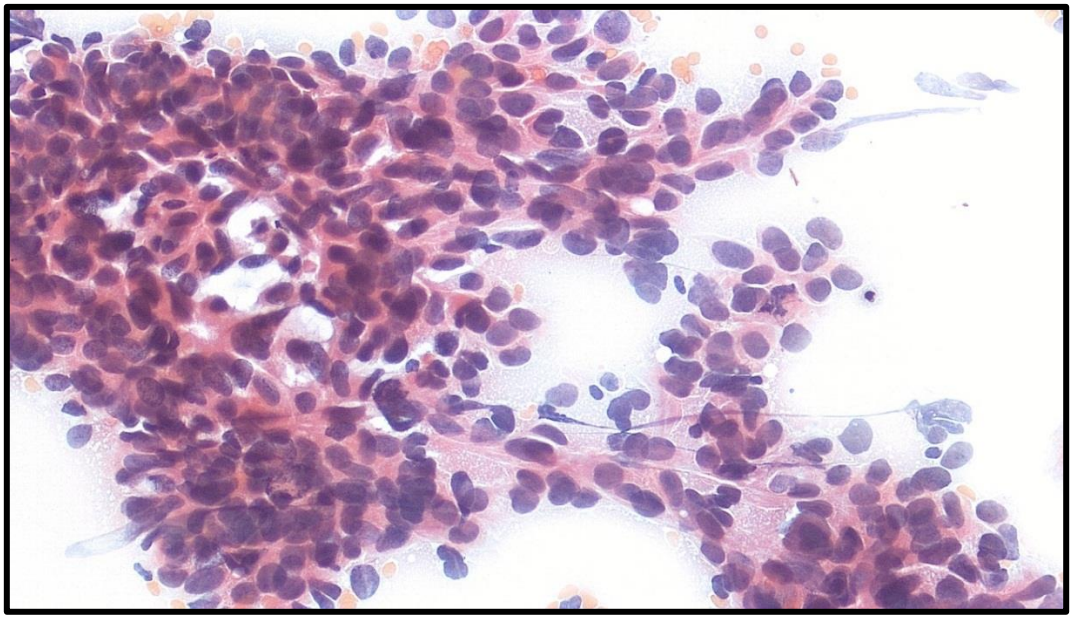
Photomicrograph 23 – H & E stain (200x), Gynaecomastia

Category 5 – Malignant

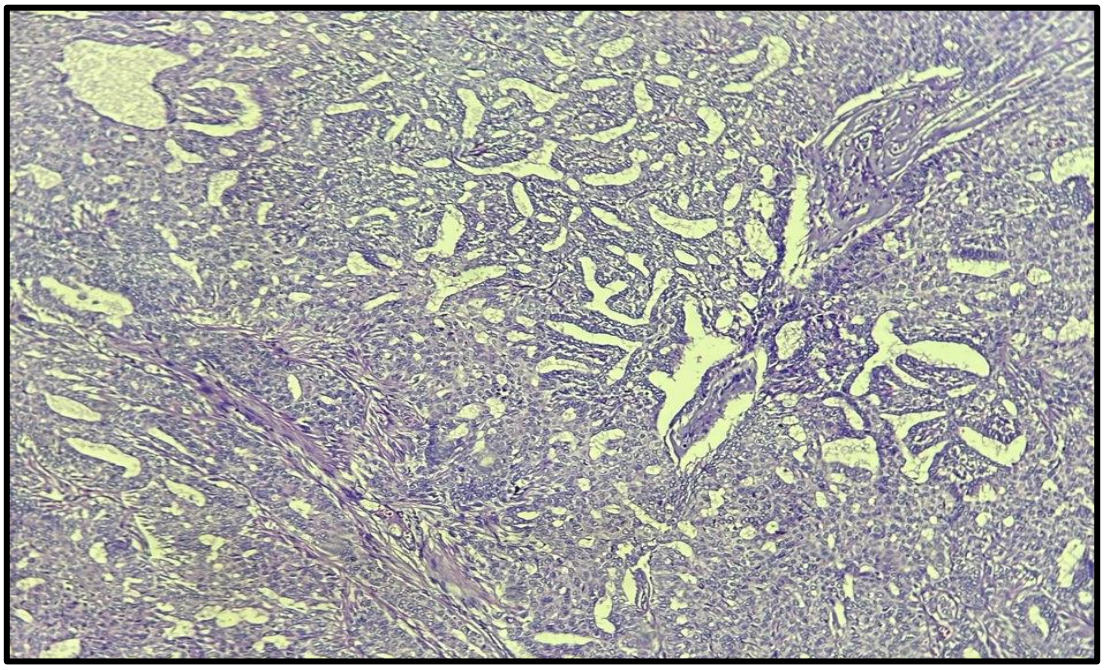
In Category 5, 31 cases were diagnosed as ductal carcinoma, with the majority showing correlation on histopathology.



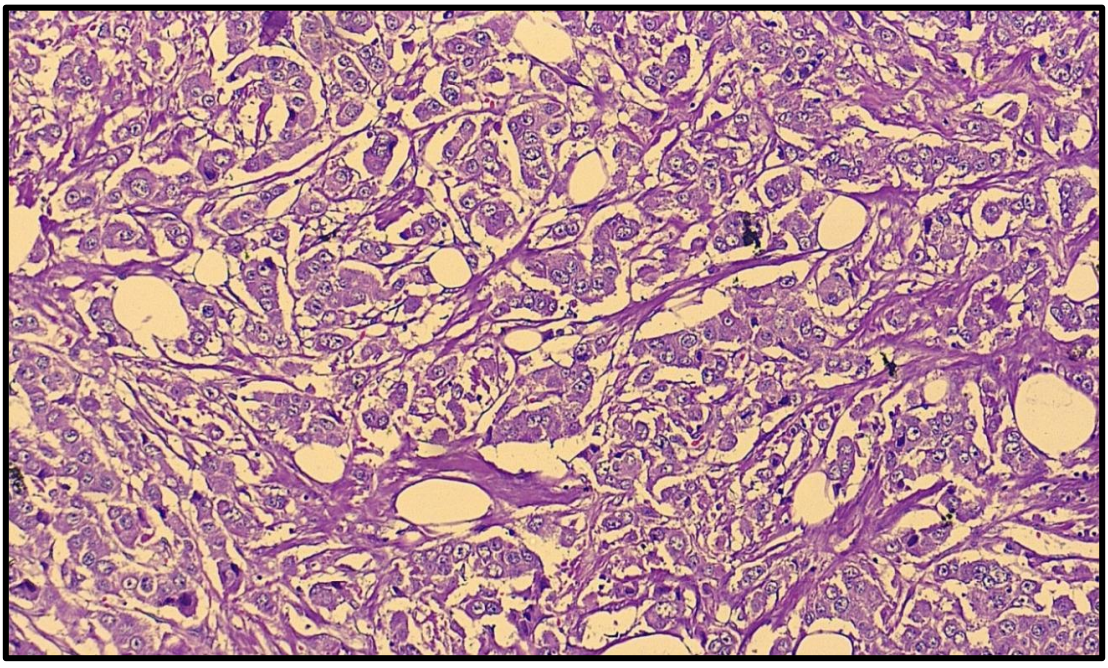
Photomicrograph 24 – Pap stain(200X), Ductal carcinoma



Photomicrograph 25 – Pap stain(400X), Ductal carcinoma



Photomicrograph 26– H & E stain(200X), Infiltrating Ductal Carcinoma



Photomicrograph 27 – H & E stain (400X), Infiltrating Ductal Carcinoma

DISCUSSION

Breast cancer is the most common malignancy among women globally. Its early diagnosis reduces the mortality. Fine Needle Aspiration Cytology (FNAC) is a minimally invasive, cost-effective and widely used diagnostic tool for evaluating breast lesions.[54,55] Many reporting systems for reporting of breast cytology have been described and published in the past. The introduction of the International Academy of Cytology (IAC) Yokohama System has standardized the reporting of breast lesions by FNAC, improving diagnostic accuracy and risk assessment.[56]

The present study aimed to optimize the diagnosis of breast lesions by FNAC using the Yokohama classification. The findings were compared with previously established studies to assess its reliability and clinical utility. The results were analysed based on sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), diagnostic accuracy, and risk of malignancy (ROM), providing valuable insights into the reliability of FNAC in breast lesion diagnosis.

In the present study the mean age of patients was 40.71 years (range: 14-79 years), with the highest incidence observed in the 20-29 age group (25.33%), followed by 30-39 (20%) and 40-49 (20%). These results align with previous epidemiological data, such as the NCRP-ICMR report, which indicates a peak prevalence of breast cancer among women in their 40s and 50s in India.[57] However, studies from Western countries have shown a slightly higher mean age of diagnosis, typically around 50-55 years, suggesting regional and genetic variations in disease onset.[58]

In our study, benign lesions were much more common comprising 68% cases in contrast to 20% cases diagnosed as malignancy or suspicious of malignancy. Similar to our study, Dennsion G et al also found that out of 143 cases, 73.4% were benign compared to 26.6% malignant cases. This correlates well with other studies by Harirchi I, Brathwaite A, Medina Franco H, and Place R, where majority of the lesions were benign.[59]

According to cytological category distribution 68.67% of cases were benign (C2), 20.67% were malignant (C5), 3.33% were suspicious of malignancy (C4), and 2.67% were atypical category (C3). When compared to studies such as Marabi et al. (2021) and Wong et al. (2021), our findings show a similar trend, where C2 remains the most frequently reported category, followed by C5. However, the proportion of C3 and C4 cases varied among different studies, reflecting differences in diagnostic criteria, sample collection techniques, and interpretation of borderline lesions.[60]

In our study, we encountered six cases that were initially classified as "suspicious" or "with atypia" based on FNAC. Following this preliminary diagnosis, a biopsy was conducted.[61] The FNAC findings in these cases displayed clusters of loosely arranged cells, with some showing irregular nuclear features suggestive of atypia. When histopathological analysis was performed, it revealed that four of these cases were diagnosed with ductal carcinoma, while the remaining two were identified as atypical ductal hyperplasia. A retrospective review of the four confirmed malignancies indicated that the primary reason for the initial failure to detect cancer was the presence of hemorrhagic aspirates, which resulted in a low number of cellular components for evaluation.[62] This limitation made it challenging to make a conclusive diagnosis solely based on FNAC.

Globally, ductal carcinoma remains the most frequently occurring form of breast cancer.[63] Consistent with worldwide trends, our study also observed that 37 out of 41 malignant cases, accounting for 90.2%, were classified as the ductal subtype, aligning with findings from previous research and supporting the widespread prevalence of this type of breast carcinoma.[64]

The sensitivity of our study is 84%, indicating a marginally higher rate of false negatives. The specificity of 95.2% closely aligns with findings from other studies, which range from 95.2%-99.3%.[65] The positive predictive value (PPV) of 91.3% is slightly lower than the reported range of 95.2%-98.0%, suggesting a minor decrease in correctly identifying malignant cases. The negative predictive value (NPV) is 90.91% and the overall diagnostic accuracy came out to be 91.04%.

The risk of malignancy (ROM) was assessed across FNAC categories, showing a progressive increase from C1 to C5. In the C1 (Inadequate) category, the ROM was 66.67%, higher than the 55% reported by Marabi (2021), highlighting the significant malignancy risk in inadequate samples and emphasizing the need for repeat FNAC or core biopsy. The C2 (Benign) category had a ROM of 2.7%, which correlates with Agrawal's (2020) study (3%), confirming FNAC's high specificity for benign cases. For C3 (Atypical) cases, the ROM was 25%, comparable to the 22-27% range reported by Field (2020), reinforcing the necessity for careful follow-up. The C4 (Suspicious of Malignancy) category had a ROM of 50%, which is in line with 52% in Wong's (2021) study, indicating that half of the C4 cases were malignant and require histopathological confirmation. Finally, the C5 (Malignant) category had a 100% ROM, a finding consistent across all studies, confirming FNAC as a highly reliable tool for diagnosing malignancies.

67 cases showed histopathology correlation. C5 (malignant) showed 100% correlation, confirming FNAC's accuracy in diagnosing cancer. C2 (benign) had 97.3% correlation, reinforcing FNAC's reliability in ruling out malignancy. However, C3 and C4 showed moderate correlation, highlighting the need for biopsy confirmation.[66] Compared to studies by Agrawal (2021) and Field (2020), which reported 70-75% correlation for C3 and C4, our study found a slightly higher correlation.

Findings of the study conducted by Agarwal et al. indicated that the system provided an effective classification approach, improving the reliability of breast cytology reporting. Agarwal et al. reported a high specificity (97.32%) and PPV (99.19%), which aligns with the findings of our study, where specificity and PPV were observed to be 95.2% and 91.3%, respectively. However, their reported negative predictive value (NPV) was lower (66.06%), compared to our study's 90.91%. Their study also highlighted challenges in diagnosing atypical and suspicious cases, which aligns with our observation of lower ROM in C4 and C5 categories.[67]

The study by Field et al. indicated that inadequate samples (C1) should be minimized, as their study found that insufficient sampling accounted for 6-8% of cases, leading to diagnostic challenges. This aligns with our study, where C1 cases had a 66.67% risk of malignancy (ROM), highlighting the need for improved sample collection techniques to reduce misclassification.[68]

In contrast, Wong et al. explored the application of FNAC in detecting non-palpable breast lesions using ultrasound-guided FNAC. Their study found that C2 (benign) had an extremely low ROM of approximately 1.7%, supporting its reliability for ruling out malignancy. Our study's findings align with this observation, with a C2-

ROM of 2.7%. Wong et al. emphasized the need for rapid on-site evaluation (ROSE) to improve FNAC sample adequacy, better sampling techniques and high specificity.[69]

Another significant study by Verma et al., who conducted a prospective evaluation of breast FNAC cases, classifying them into the five IAC Yokohama categories. Their study had a total specificity of 97.3% and a sensitivity of 86.75%, closely matching our study's specificity of 95.2% and sensitivity of 84%. Verma et al. also found that the C4 category (Suspicious of malignancy) had a ROM of 66.7%, which is comparable to our study's ROM of 50%. This suggests that while FNAC is highly effective, suspicious cases should ideally undergo additional histopathological correlation before a definitive diagnosis.[70]

Marabi et al. studied the implementation of this system in South Indian cohort. Their study found similar distribution trends, with C2 being the most common category (68.67% of cases), which closely matches our study's benign category (C2) comprising 68.67% of cases.[71] Additionally, their reported C5 malignancy ROM was 100%, identical to our findings, reinforcing the system's effectiveness in classifying malignant cases.

Poornima et al. calculated ROM for each category and compared it to previous studies. Their study reported higher ROM values for atypia and suspicious categories compared to our study. However, their findings also indicated that the Yokohama system improved diagnostic clarity, making it easier for clinicians to manage patients effectively.[72]

Hoda & Brachtel reviewed the predictive values of the IAC Yokohama system and emphasized its importance in reducing diagnostic uncertainty. Their study highlighted that high ROM values in C4 and C5 categories are essential for guiding clinical management. Compared to our study, their ROM values for suspicious and malignant categories were slightly higher, emphasizing the importance of enhancing cytopathological diagnostic accuracy.[73]

Montezuma et al. also emphasized the importance of ROSE (Rapid On-Site Evaluation) in reducing inadequate samples. Since our study reported a high inadequacy rate (33.6%), incorporating ROSE or better FNAC training could help address this issue.[74,75]

Dr. Patricia Pariza's study at Groote Schuur Hospital, South Africa, reported 83.10% sensitivity, 93.01% specificity, and 80.85% overall accuracy with ROM values aligning with previous studies.[17] However, it identified a high inadequacy rate under category 1 (33.6%), much higher than the 5-11% reported in other studies. Malignant cases were more than benign cases (292 vs. 202), suggesting late-stage presentation.[76]

The findings of our study highlights that C3 and C4 categories require careful interpretation, as they carry substantial malignancy risks.[77] Compared to earlier reporting systems that considered only C5 as positive for malignancy, the Yokohama classification provides better risk stratification, ensuring earlier intervention for high-risk cases. This approach improves diagnostic accuracy by recognizing malignancy risk from Category 3 onward, enabling better patient management, early detection, and timely treatment.[78]

This study demonstrates a higher Risk of Malignancy (ROM) for categories 3 (Atypical), 4 (Suspicious), and 5 (Malignant) when compared to traditional reporting systems that previously considered only category 5 as positive.[79] This change aligns with recent advancements in breast FNAB cytology and has shown improved sensitivity and specificity.

According to risk of malignancy (ROM), further management is given by IAC Yokohama system.

Category	ROM (%)	Management	Comment
Insufficient (Category 1)	**66.67**	Assess clinical and imaging findings; if uncertain or suspicious, repeat FNAB or opt for CNB. If benign, consider repeating FNAB.	Despite inadequate samples, a high malignancy risk suggests careful evaluation and follow-up.[80] Repeat FNAB up to 3 times if needed.
Benign (Category 2)	**2.70**	If the "triple test" (clinical, imaging, cytology) is benign, no further biopsy is needed. If indeterminate or suspicious, repeat FNAB or proceed to CNB.	Lowest ROM confirms a strong benign nature. Follow-up depends on lesion type.
Atypical (Category 3)	**25.00**	Review clinical and imaging findings; if atypia is likely due to a technical issue, repeat FNAB. If persistent, consider CNB or excisional biopsy.	Indicates some malignancy risk, requiring further assessment to differentiate between reactive and neoplastic changes.
Suspicious (Category 4)	**50.00**	CNB is mandatory for confirmation. If CNB is unavailable, proceed with excisional biopsy.	Significant malignancy risk necessitates definitive histological evaluation. Further imaging may assist in assessment.
Malignant (Category 5)	**100.00**	CNB to confirm diagnosis if discrepancies exist; if "triple test" is concordant and malignant, proceed with definitive management.	All cases confirmed malignant. Immediate intervention required based on clinical staging and treatment guidelines.

Table no. 10 – Showing the management and treatment modalities according to each category

SUMMARY

- The study included 150 breast FNAC cases, covering a wide age range (14-79 years), with a mean age of 40.71 years.
- The majority of cases were female patients (97.3%), with very few male cases (2.7%).
- Cases were classified using the IAC Yokohama system, with 68.67% categorized as benign (C2), 20.67% as malignant (C5), and smaller percentages in C1 (4.67%), C3 (2.67%), and C4 (3.33%).
- Histopathological correlation was available for 67 cases, validating FNAC findings.
- Sensitivity (84%), specificity (95.2%), positive predictive value (91.3%), negative predictive value (90.91%), and overall diagnostic accuracy (91.04%) were calculated.
- Risk of Malignancy (ROM) was highest in C5 (100%) and lowest in C2 (2.7%), with C1 showing an unexpectedly high ROM (66.67%), emphasizing the need for careful evaluation of inadequate samples.
- The study demonstrated FNAC's high diagnostic accuracy and specificity, reinforcing its role as a valuable and minimally invasive tool for breast lesion evaluation.
- Challenges leading to inadequacy in C1 and diagnostic uncertainty in C3 and C4 underlines the need for better sampling techniques, USG-guided FNAC

procedures and improved cytopathologist training to ensure accurate classification and diagnosis.

- This study confirms the IAC Yokohama System as an effective FNAC reporting tool, with strong histopathology correlation in C2 and C5 cases.

CONCLUSION

The study reaffirms the diagnostic reliability of Fine Needle Aspiration Cytology (FNAC) using the IAC Yokohama System for breast lesion evaluation. It successfully categorizes and assesses the Risk of Malignancy (ROM) demonstrating its effectiveness in standardizing FNAC reporting of breast lesions. The ROM progressively increases from C1 to C5, confirming the system's predictive value. The study confirms high specificity (95.2%) and diagnostic accuracy (91.04%) of Yokohama system, making FNAC of breast lesions, a reliable first-line investigation.

The Yokohama classification's risk stratification offers better predictive value, ensuring timely intervention for high-risk cases while minimizing unnecessary biopsies for benign lesions. Rapid On-Site Evaluation (ROSE) and histopathological confirmation for borderline cases can further enhance the clinical utility of FNAC in breast lesions.

Future research can focus on machine learning integration in FNAC interpretation, multi-centre validation studies and exploring the role of liquid-based cytology to improve sample adequacy.

The study reaffirms the role of FNAC in breast cancer diagnosis, particularly in resource-limited settings, while advocating the refinements to improve accuracy and patient management strategies.

LIMITATIONS

- Interobserver Variability – The interpretation of C3 (Atypical category) and C4 (Suspicious) cases may vary between cytopathologists. Some cases in C1 and C3 required repeat FNAC or biopsy due to inadequate sample quality.

- Challenges in Low-Resource Settings – In regions with limited access to advanced diagnostic tools, applying the system effectively can be challenging.

FUTURE ASPECTS

- Multi-Centre Studies – Expanding research across multiple hospitals or regions will help validate FNAC's accuracy and consistency in diverse populations.
- Future research can explore machine learning integration to enhance FNAC interpretation and diagnostic accuracy.
- Studies can focus on the role of liquid-based cytology in improving sample adequacy and reducing inadequate samples

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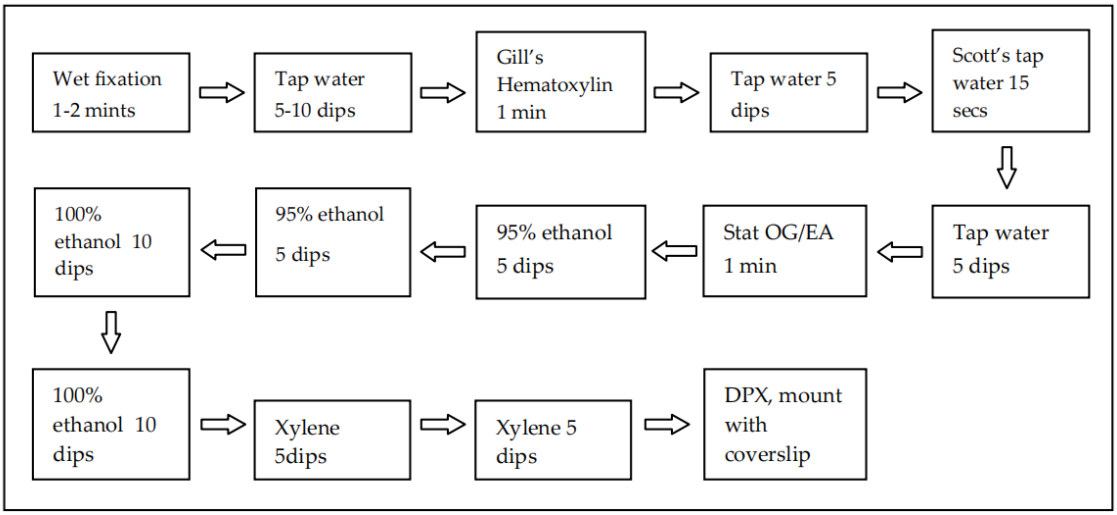
ANNEXURES

ANNEXURE I

RAPID PAP STAINING PROCEDURE -



1. **Fixation:** Immediately fix the smear in 95% ethanol for 10 seconds.
2. **Rinsing:** Dip the slide in distilled water 10 times, with each dip lasting about 1 second.
3. **Hematoxylin Staining:** Immerse the slide in hematoxylin for 10 to 60 seconds, depending on the desired intensity.
4. **Rinsing:** Repeat the distilled water dips to remove excess stain.
5. **Dehydration:** Dip the slide in 95% ethanol 10 times.
6. **Counterstaining:** Stain the slide with EA65 for 1 to 3 minutes.
7. **Rinsing:** Perform another series of distilled water dips.
8. **Dehydration:** Dip the slide in 95% ethanol followed by 100% ethanol, 10 times each.
9. **Clearing:** Place the slide in xylene until it becomes clear.
10. **Mounting:** Apply a coverslip using a suitable mounting medium.

ANNEXURE II

PROCEDURE OF GIEMSA STAINING

Preparation of 10% Giemsa Working Solution:

- **Buffered Water Preparation:** Prepare buffered water at pH 7.2.
- **Mixing:** Pour 9 mL of the buffered water into a clean container. Add 1 mL of Giemsa stock solution to the container.
- **Stirring:** Gently mix the solution to ensure thorough blending.
- **Usage:** Use the prepared 10% Giemsa working solution within 15 minutes of preparation. Discard any unused stain after this period.

Giemsa Staining Procedure:

- **Fixation:** Fix air-dried blood smears in absolute methanol for 3 minutes.
- **Staining:** Immerse the fixed smear in the freshly prepared 10% Giemsa working solution for 10 minutes.
- **Rinsing:** Gently rinse the slide with buffered water to remove excess stain.
- **Drying:** Allow the slide to air dry in an upright position.

ANNEXURE III

H&E STAINING PROCEDURE FOR CYTOLOGY SMEARS:

1. Fixation
    - Air-dried smears should be fixed in 95% ethanol or methanol for 15–30 minutes.
    - Alternatively, wet fixation can be done immediately after smear preparation.
2. Washing
    - Rinse slides in running tap water for 30 seconds to remove excess fixative.
3. Hematoxylin Staining (Nuclear Staining)
    - Dip the slides in hematoxylin solution for 1–5 minutes depending on the required intensity.
4. Rinsing
    - Wash the slides in running tap water for 30 seconds to 1 minute.
5. Differentiation (Acid Alcohol Treatment)
    - Dip the slides in 1% acid alcohol (1-3 seconds) to remove excess hematoxylin and prevent overstaining.
6. Bluing
    - Immerse slides in ammonia water or Scott's tap water for 30 seconds to enhance nuclear staining.
7. Rinsing
    - Wash with tap water for 30 seconds.
8. Eosin Staining (Cytoplasmic Staining)
    - Dip the slides in eosin stain for 30 seconds to 2 minutes, depending on the desired intensity.

9. Dehydration

- Dehydrate by passing slides through 95% ethanol and then 100% ethanol (5 dips each).

10. Clearing

- Dip slides in xylene (5–10 dips) to remove excess alcohol and make the slides transparent.

11. Mounting

- Mount with DPX and cover with a coverslip.

ANNEXURE IV

INFORMED CONSENT FORM

"CATEGORISATION OF BREAST LESIONS ON FINE NEEDLE ASPIRATION CYTOLOGY USING INTERNATIONAL ACADEMY OF CYTOLOGY YOKOHAMA SYSTEM, FOR RISK ASSESSMENT AND MANAGEMENT – A CROSS SECTIONAL STUDY AT TERTIARY CARE CENTRE, BELAGAVI"

Name of Student/Principal Investigator: BN0122004

Name of Guide/Co Investigators:

Objective: To categorize breast lesions according to IAC Yokohama reporting system, for risk assessment and management and to correlate FNAC and histopathological findings.

Introduction: Early detection and accurate risk assessment are crucial for effective management. Fine Needle Aspiration Cytology (FNAC) plays a key role in diagnosing breast lesions. The International Academy of Cytology (IAC) Yokohama System was introduced to standardize FNAC reporting, improve risk assessment and management. This study aims to categorize breast lesions using the IAC Yokohama system, determines the risk of malignancy (ROM) and correlates FNAC findings with histopathology.

Explanation of procedure: After documenting the clinical information, FNAC is carried out under aseptic precautions using 22 or 23 gauge needles of suitable type and length. Smears were stained using Giemsa, Papanicolaou, and Hematoxylin & Eosin stains. The FNAC results were categorized based on the IAC Yokohama

classification into five groups: Inadequate (C1), Benign (C2), Atypical (C3), Suspicious of Malignancy (C4) and Malignant (C5). Cases were followed up with histopathology for confirmation. Statistical analysis included sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and calculation of diagnostic accuracy (DA) and ROM.

Withdrawal from participation in the study: Participation in this study is voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will/will not have nor get any benefits by participating in this study. The data gathered will help the population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person from identifying you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purposes and or presented to scientific groups. However, your identity will never be revealed.

Questions: In case of any questions with regard to this study, you are free to contact: "BN0122004, **********, **********"gmail.com" If you have any question or complaints with regard to your right as study participant you may contact Dr Harsha Hegde, Chairperson, Ethical committee of JNMC, 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights.

CONSENT STATEMENT

I am making a voluntary decision to participate in the study **"CATEGORISATION OF BREAST LESIONS ON FINE NEEDLE ASPIRATION CYTOLOGY USING INTERNATIONAL ACADEMY OF CYTOLOGY YOKOHAMA SYSTEM, FOR RISK ASSESSMENT AND MANAGEMENT – A CROSS SECTIONAL STUDY AT TERTIARY CARE CENTRE, BELAGAVI"**. My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator: **BN0122004**

Signature of the investigator:

ANNEXURES V-MASTER CHART

Sr. No:	sample No .	Histopath	on histopath- Benign- 0, malignant -1	category 1 :C1- Insufficient	category 2 :C2- Benign	category 3 :C3- Atypical	category 4 :C4- Suspicious of malignancy	category 5 :C5- malignancy	Age	Sex
1	24001053	no			Acute suppurative mastitis				33	female
2	24003097	no			Benign proliferative breast disease : Benign phyllodes , giant fibroadenoma				21	female
3	24005085	yes - Invasive ductal carcinoma grade 1	1		fibrocystic disease of breast with mastitis				43	female
4	24005063	no						ductal carcinoma	57	female
5	24009381	no			fibroadenoma				48	female
6	24014405	yes - fibroadenoma	0		fibroadenoma				25	female
7	24014970	no			cystic lesion				46	female
8	24030173	yes - Invasive ductal carcinoma grade 2	1					ductal carcinoma	47	female
9	24032771	yes- acute suppurative mastitis	0		Acute suppurative mastitis				35	female
10	24032942	yes - sclerosing adenosis	0		fibroadenoma				79	female
11	24043975	no						ductal carcinoma	52	female
12	24054726	yes - Invasive ductal carcinoma grade 2	1					ductal carcinoma	55	female
13	24054165	yes - Invasive ductal carcinoma grade 2	1					ductal carcinoma	61	female
14	24054235	yes - fibroadenoma with focal epithelial hyperplasia	0		fat necrosis				29	female
15	24055902	no			possibility of adipose tissue component of an hamartomatous lesion				28	female
16	24065217	yes - Invasive ductal carcinoma grade 2	1			fibrocystic change with atypical ductal hyperplasia			77	female
17	24070117	no			fibroadenosis				38	female

18	24083502	yes Invasive ductal carcinoma grade 3	1					ductal carcinoma	52	female
19	24083503	no			fibrocystic disease				47	female
20	24089312	yes fibroadenoma	0		fibroadenoma				24	female
21	24092210	yes intraductal papilloma	0			papillary lesion with atypia			47	female
22	24095390	no			benign-fibroadenoma with fibroadenosis/ cystic change, ductal papilloma				28	female
23	24096808	no			benign breast disease				75	Male
24	24097006	yes- intraductal papilloma	0			papillary lesion with atypia			47	female
25	24099642	yes- benign phyllodes tumor	0		fibroadenoma				64	female
26	24108522	no			fibroadenoma				20	female
27	24110088	yes - granulomatous mastitis with acute suppurative mastitis	0		granulomatous mastitis with acute inflammatory response				36	female
28	24110462	no			acute on chronic mastitis				23	female
29	24110463	no			acute suppurative breast lesion				38	female
30	24122630	yes - Invasive ductal carcinoma grade 2	1	definitive opinion cannot be given					71	female
31	24122733	no						ductal carcinoma	53	female
32	24062414	no		no cellular material					68	Male
33	24129845	no			fibroadenoma				76	female
34	24130257	yes- invasive ductal carcinoma (no special type)	1					ductal carcinoma	53	female
35	24133308	no			fibroadenoma				34	female
36	24137203	no			fibrocystic disease of breast				55	female
37	24137332	no			fibroadenoma				30	female
38	24138083	no			fat necrosis				32	female
39	24142143	no						ductal carcinoma	39	female
40	24142646	no			fibroadenoma				17	female
41	24147161	yes- Fibroadenosis with duct ectasia	0		granulomatous mastitis				36	female

42	24170383	no			fibroadenoma with cystic change				40	female
43	24189484	no			fibroadenoma with cystic change				24	female
44	24200754	no					neoplastic lesion		27	female
45	24202826	yes - Invasive ductal carcinoma grade 2	1					ductal carcinoma	67	female
46	24203783	no			benign cystic lesion				47	female
47	24205415	yes- fibroadenoma	0		fibroadenoma				29	female
48	24214458	no			fibroadenoma				24	female
49	24217221	yes- fibroadenoma	0		fibroadenoma				20	female
50	24221421	no			fibrocystic disease of breast				29	female
51	24221784	no			fibroadenoma				22	female
52	24231807	no			fibrocystic disease of breast				74	female
53	24245695	no						ductal carcinoma	57	female
54	24252169	no			fibroadenoma with cystic and apocrine change				24	female
55	24257142	yes- acute suppurative mastitis with focal areas of granulomatous mastitis	0		granulomatous mastitis				39	female
56	24257148	no			fibroadenoma				24	female
57	24268700	yes- fibroadenoma	0		fibroadenoma				32	female
58	24262149	no			fibrocystic disease of breast				37	female
59	24262434	yes- fibroadenoma	0		fibroadenoma				30	female
60	24271444	no			acute suppurative mastitis				42	female
61	24278373	yes- fibroadenoma	0		fibroadenoma				39	female
62	24278291	yes- acute suppurative mastitis	0	scant cellularity, no definitive diagnosis					48	female
63	24280673	no		no definitive opinion					64	female
64	24287200	no			fibroadenoma				30	female
65	24289051	no			fibrocystic disease of breast				28	female
66	24292262	no			gynaecomastia , no e/o atypia				63	male
67	24295976	no						ductal carcinoma	55	female
68	24309201	no						recurrent ductal carcinoma	38	female

69	24311098	yes- multiple fibroadenoma	0		fibroadenoma				21	female
70	24311377	no			fibroadenoma				22	female
71	24311889	no						ductal carcinoma	50	female
72	24318100	no			fibroadenoma				24	female
73	24320589	yes- ductal carcinoma grade 1	1					ductal carcinoma	50	female
74	24322559	yes- fibroadenoma	0		fibroadenoma				14	female
75	24337787	yes- metastatic adenocarcinoma with extracapsular extension	1					ductal carcinoma	53	female
76	24341647	yes-intraductal papilloma	0			papillary lesion with atypical ductal cells			51	female
77	24345949	no			fibroadenoma				40	female
78	24347367	no			fibrocystic disease of breast				35	female
79	24353187	no			fibrocystic disease of breast				31	female
80	24353424	yes- fibroadenoma	0		fibrocystic disease of breast				42	female
81	24369897	yes- invasive ductal carcinoma grade 2	1					ductal carcinoma	42	female
82	24377477	no		no definitive opinion can be made					52	female
83	24388369	yes- invasive ductal carcinoma grade 2	1					ductal carcinoma	62	female
84	24397633	no			acute suppurative mastitis				36	female
85	24398487	no			fibroadenoma				27	female
86	24400557	no			fibroadenoma				19	female
87	24405886	no						metastatic adenocarcinoma	40	female
88	24411390	yes- invasive ductal carcinoma grade 2	1				suspicious but not conclusive of malignancy		35	female
89	24411342	no			fibroadenoma				22	female
90	24421042	yes- papillary neoplasm of breast	1					ductal carcinoma	65	female
91	24479382	no			fibrocystic disease of breast				54	female
92	24480868	yes- atypical ductal hyperplasia with IDC	1				suspicious of malignancy		55	female

93	24486452	yes - fibroadenoma	0		fibroadenoma				17	female
94	24486770	no		scant cellularity, no definitive diagnosis					44	female
95	24498383	no			benign cystic lesion				53	female
96	24502397	yes - Acute suppurative mastitis	0				suspicious but not conclusive of malignancy		30	female
97	24505882	no			fat necrosis				27	female
98	24508187	no			fibroadenoma				18	female
99	24510150	yes - fibroadenoma	0		fibroadenoma				46	female
100	24510220	no						ductal carcinoma	58	female
101	24523112	yes- fibrocystic disease	0		fibrocystic disease of breast				32	female
102	24525303	yes- fibroadenosis	0		fibroadenoma				30	female
103	24525357	no			infected epidermal cyst				50	female
104	24525590	no			infected galactocele				33	female
105	24525922	yes- epidermal cyst	0		sebaceous cyst				41	female
106	24527754	yes- invasive ductal carcinoma (NOS)	1					Ductal carcinoma	45	female
107	24532314	no			fibroadenoma				38	female
108	24535671	no			fibroadenoma and fibrocystic disease				49	female
109	24536317	yes- fibroadenosis with duct ectasia	0		Acute mastitis				34	female
110	24538006	no						papillary neoplasm of breast	51	female
111	24538215	no			fibroadenoma				24	female
112	24545726	yes - fibrocystic change with chronic mastitis	0		benign cystic lesion of the breast				49	female
113	24547941	yes- Invasive ductal carcinoma grade II	1	no definitive opinion					45	female
114	24547941	yes- fibrocystic disease of breast	0		fibroadenoma				26	female
115	24551226	yes- fibrocystic disease of breast - gynaecomastia	0		gynaecomastia				73	female
116	24554599	yes - papillary neoplasm of breast	1					ductal carcinoma	25	female
117	24562646	no			fibroadenoma with cystic change				79	female
118	24559201	yes- poorly differentiated	1					poorly differentiated	54	female

		neoplasm						neoplasm - favours lymphoma		
119	24598171	no			cystic lesion				35	female
120	24602700	no			mastitis with fibrocystic disease				51	female
121	24613232	yes - fibrocystic disease of breast	0		fibrocystic disease of breast				18	female
122	24622567	no			fibroadenoma with acute mastitis				21	female
123	24627791	no			fibroadenoma				18	female
124	24617919	yes - fibroadenoma	0		fibroadenoma				40	female
125	24638613	yes- fibroadenoma with apocrine metaplasia	0		fibroadenoma				20	female
126	24644083	yes- granulation tissue , foreign body giant cell, no residual tumor seen	1					ductal carcinoma	40	female
127	24644593	yes- fibroadenoma	0		fibroadenoma				24	female
128	24652630	yes - IDC grade II	1					Ductal carcinoma	65	female
129	24655171	no			fibroadenoma				22	female
130	24655619	yes- Invasive car - Mucinous carcinoma	1					IDC v/s mucinous	22	female
131	24660470	yes- fibroadenoma	0		fibroadenoma				42	female
132	24661900	no			fibrocystic disease of breast				24	female
133	24666958	yes- fibrocystic breast disease with fibroadenoma	0		benign breast disease				48	female
134	24669631	no			fibroadenoma				61	female
135	24671659	no			fibroadenoma with fibrocystic change				73	female
136	24670316	yes- acute mastitis with fibrocystic disease and intraductal papilloma	0		Acute suppurative mastitis				21	female
137	24676725	yes- gynaecomastia	0				featues are suspicious but not conclusive for malignancy		25	female
138	24678780	no			fibroadenoma				41	female
139	24678808	no			fibroadenoma				48	female
140	24683685	no			benign proliferative disease				29	female
141	24684079	yes- fibrocystic benign disease with chronic	0		Antibioma				56	female

		mastitis								
142	24684461	no			fibroadenoma				43	female
143	24687277	yes - recurrent IDC with foci of high grade DCIS	1					Recurrent ductal carcinoma	42	female
144	24698076	yes- benign phyllodes tumor with myxoid change	0		fibroadenoma				56	female
145	24712760				fibroadenoma with acute suppurative mastitis				72	male
146	2471497	yes - IDC grade II	1					ductal carcinoma	23	female
147	24723777	no						ductal carcinoma	39	female
148	24724106	no			lipoma				17	female
149	24724496	no			fibrocystic disease of breast				36	female
150	24724684	yes- fibroadenoma	0		fibroadenoma				29	female