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Role Of Ultrasonography In Assessment Of Breast Pathologies With Histopathological Correlation

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Abstract:
Background: *Breast pathologies, ranging from benign to malignant conditions, are commonly encountered in clinical practice. Early and accurate diagnosis plays a critical role in determining appropriate treatment and improving patient outcomes. Ultrasonography (US) is a widely used, non-invasive imaging modality that aids in the evaluation of breast lesions. However,* ***its diagnostic accuracy is often enhanced when correlated with histopathological findings,*** *offering a comprehensive approach for precise diagnosis.*
Objective: *This study aims to evaluate the role of ultrasonography in the assessment of various breast pathologies and correlate the sonographic features with histopathological results to determine the reliability and diagnostic accuracy of ultrasound in clinical decision-making.*
Methods: *A Cross-sectional observational study was done in 50 patients ,was conducted on patients suspected breast pathology were included in this study. All patients underwent breast ultrasonography, followed by either fine needle aspiration (FNA) or core needle biopsy (CNB) for histopathological examination. Sonographic characteristics such as lesion size, shape, margin, echogenicity, and internal vascularity were documented. Histopathological diagnosis were compared with ultrasound findings to assess the sensitivity, specificity, and predictive value of ultrasonography.*
Results: *Ultrasonography demonstrated high sensitivity and specificity in identifying benign and malignant breast lesions. Benign lesions, such as fibroadenomas and cysts, typically exhibited well-defined margins and uniform echogenicity, while malignant lesions showed irregular borders, heretogenous hypo-echoic regions, and increased blood flow on Doppler. Histopathological correlation confirmed the diagnostic accuracy of ultrasound, with a significant concordance between sonographic features and tissue diagnosis. The study found that certain sonographic features, such as irregular margins and vascularity, were highly predictive of malignancy.*
Conclusion: *Ultrasonography is an invaluable tool in the initial evaluation of breast pathologies, offering high diagnostic accuracy when correlated with histopathological findings. The combination of imaging and histological analysis provides a more comprehensive understanding of breast lesions, aiding in appropriate management and reducing the need for invasive procedures.*

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I. Introduction:

Ultrasonography (US) plays a critical and complementary role in the **diagnosis, evaluation, and management of breast diseases**. It is especially valuable in patients with dense breasts, young women, pregnant or lactating women, and in guiding interventional procedures.

1. Adjunct to Mammography:

Ultrasonography is often used in conjunction with mammography, particularly in women with **dense breast tissue**, where mammography sensitivity is limited.
It improves **detection and characterization** of lesions that may not be visible on mammograms.

2. Characterization of Breast Masses:
Ultrasound helps distinguish between:

Cystic vs solid lesions
Benign vs suspicious features
- **Benign features**:Anechoic, well-circumscribed cysts.
Thin walls, posterior acoustic enhancement

- **Suspicious features**:
Hypoechoic mass
Irregular margins
Taller-than-wide orientation
Microcalcifications (sometimes visible)

3. Evaluation of Palpable Lumps:
- In women under 30, ULTRASONOGRAPHY is the **first-line imaging tool** for palpable breast lumps.
- It can confirm benign entities like **fibroadenomas or cysts**, reducing unnecessary biopsies or surgeries.

4. Guidance for Interventions:
Ultrasonography provides **real-time guidance** for:
- Fine-needle aspiration cytology (FNAC)
- Core needle biopsy
- Abscess drainage
- Preoperative localization (wire or clip placement)

5. Screening Tool:
- **Supplemental screening tool for high-risk patients or those with dense breasts.**
- Improves cancer detection rates when combined with mammography.

6. Evaluation of Inflammatory and Infectious Conditions:
Ultrasound is valuable in detecting:
- **Mastitis**
- **Breast abscesses**
- **Duct ectasia**

It helps differentiate between diffuse inflammation and collections requiring drainage.

7. Assessment of Axillary Lymph Nodes:
- Crucial in evaluating **nodal involvement in breast cancer staging**.
- Suspicious nodes (round shape, cortical thickening, loss of hilum) can be targeted for biopsy.

8. Implant Evaluation:
- Useful in detecting **implant rupture**, especially intracapsular rupture ("stepladder sign").
- Also assesses **peri-implant fluid collections or masses**.
- **Common Benign and Malignant Findings on USG:**

Pathology	Sonographic Features
Simple cyst	Anechoic, thin-walled, posterior enhancement
Fibroadenoma	Oval, well-defined, hypoechoic, parallel to skin
Abscess	Irregular fluid collection with internal debris
Invasive ductal carcinoma	Irregular, hypoechoic, angular margins, posterior shadowing
DCIS (Ductal carcinoma in situ)	May appear as ductal changes or microcalcifications

BIRADS:
- The **BI-RADS** (Breast Imaging Reporting and Data System) is a standardized system used by radiologists to classify mammography, ultrasound, and MRI findings in breast imaging. The goal is to provide a **uniform language** for reporting results, helping clinicians make consistent, evidence-based decisions for patient management.
- The **BI-RADS** score ranges from **0 to 6**, each representing a different level of suspicion for malignancy. Below is an outline of the **BI-RADS classification** and its meanings:
- **BI-RADS Categories:**

BI-RADS Score	Description	Action/Implication
BI-RADS 0	**Incomplete**	**Additional imaging needed** (e.g., extra views, ultrasound, or MRI) to evaluate the breast tissue further.
BI-RADS 1	**Negative**	**Normal findings**: No signs of malignancy. Routine screening in the future as per the usual schedule.
BI-RADS 2	**Benign**	**Benign findings** (e.g., cysts, fibroadenomas, benign calcifications). No further action needed unless clinically indicated.
BI-RADS 3	**Probably Benign**	**Low risk** of malignancy (usually less than 2%). Follow-up imaging in 6 months to confirm stability.
BI-RADS 4	**Suspicious Abnormality**	**Moderate risk** of malignancy (between 2% and 95%). Biopsy or further diagnostic evaluation is usually recommended to rule out cancer.
BI-RADS 5	**Highly Suspicious of Malignancy**	**High risk** of malignancy (greater than 95%). Immediate biopsy or intervention is typically required.
BI-RADS 6	**Known Biopsy-Proven Malignancy**	**Cancer is confirmed** by biopsy. This category is used to report imaging findings in patients with known malignancy who are being monitored for treatment response or recurrence.

Detailed Breakdown of BI-RADS 4 Subcategories
BI-RADS 4A: **Low suspicion** for malignancy (2%–10% risk). Biopsy is still recommended, but the likelihood of cancer is low
BI-RADS 4B: **Moderate suspicion** for malignancy (10%–50% risk). Biopsy is strongly recommended
BI-RADS 4C: **High suspicion** for malignancy (50%–95% risk). Biopsy is highly recommended.

II. Conclusion:

BI-RADS is a **crucial tool** in **breast cancer detection**, helping radiologists provide a **clear report** on the **likelihood of malignancy**, ensuring that the appropriate clinical actions are taken. Regular follow-up and timely interventions, especially in cases of **suspicious or highly suspicious findings**, are critical for **early detection** and **effective treatment** of breast cancer.

➢ **ABOUT FNAC AND BIOPSY :**

❖**Ultrasound guided fine Needle Aspiration Cytology (FNAC)**

FNAC is a minimally invasive technique that uses a fine-bore needle to obtain cellular material for cytological evaluation.

Role of Ultrasound in FNAC
- Ensures accurate localization of small, deep, or non-palpable lesions.
- Helps avoid vascular structures and ensures correct entry point.
- Allows real-time monitoring of needle position within the lesion.

Indications (General)
- Cystic lesions requiring aspiration.
- Solid masses suggestive of benign pathology.
- Preoperative assessment of suspicious axillary lymph nodes.

Advantages
- Quick, inexpensive, and well-tolerated.
- Minimal complications.

Limitations
Provides only cytological—not architectural—information.
Higher rate of non-diagnostic or indeterminate results compared to core biopsy.

❖**Ultrasound-Guided Core Needle Biopsy (CNB)**

Core needle biopsy obtains tissue cores that preserve architecture for histopathological diagnosis, allowing more definitive characterization of lesions.

Role of Ultrasound in CNB
Facilitates precise targeting of suspicious masses (BIRADS 4–5).
- Allows sampling of multiple areas within heterogeneous lesions.
- Enables documentation of needle path and specimen retrieval points.

Indications (General)
- Solid lesions with suspicious ultrasonographic features.
- Lesions requiring receptor testing (ER, PR, HER2).
- Architectural distortion or non-mass lesions visible on ultrasound.
- Follow-up biopsies in cases of discordant imaging and cytology.

Advantages
- Higher diagnostic yield and accuracy.
- Allows distinction between in-situ and invasive lesions.
- Enables ancillary testing (IHC, molecular analysis).

Limitations
- Slightly higher risk of bleeding compared to FNAC.
- Requires sterile protocol and trained personnel.

General Considerations for Procedure (High-Level Overview Only)
All procedures should be performed by trained clinicians using appropriate aseptic precautions.
Lesions are characterized sonographically prior to sampling, focusing on margins, vascularity, and depth.
Post-procedural monitoring is essential for detecting complications such as hematoma.
Adequate communication between radiologist and pathologist is crucial for correlation and accurate reporting.

Importance of Histopathological Correlation

Histopathology remains the gold standard for diagnosis. Correlating findings from ultrasound, FNAC, and CNB ensures:
High diagnostic accuracy.
Early detection of malignancy.
Proper management planning, including surgical and oncologic pathways.
Identification of discordant results requiring further investigation.

Information to Be Given to Patients Before Breast Biopsy and FNAC

Before performing FNAC or a core needle biopsy, it is essential to ensure that the patient is appropriately informed and understands the nature of the procedure. The following points are typically communicated during counselling and informed consent.

1. Purpose of the Procedure
The test is performed to obtain cells (FNAC) or small tissue samples (biopsy) from a breast lesion.
The goal is to determine whether the lesion is benign, malignant, or requires further evaluation.
Results guide further treatment and management.

2. Nature of the Procedure (General Explanation Only)
FNAC uses a thin needle to collect cells; a biopsy uses a slightly larger needle to remove small tissue cores.
Ultrasound guidance helps the doctor accurately target the area of concern.
The procedure is very common and generally well-tolerated.

3. Possible Sensations During the Procedure
Mild discomfort or a brief stinging sensation from the local anaesthetic (for biopsy).
A feeling of pressure—not pain—when the needle is inserted.
Some patients may feel anxious, and reassurance is provided.

4. Risks and Possible Complications (Overall, Low Risk)
Minor bruising or tenderness at the site.
Very small risk of bleeding or hematoma formation.
Rare risk of infection.
Extremely low likelihood of significant complications.
Patients should be informed that these procedures **do not cause spread of cancer**, as this is a common concern.

5. After-Procedure Expectations
Mild soreness for 1–2 days is normal.
A small dressing may be applied; basic care instructions are provided.

Heavy lifting or strenuous activity might be avoided for a short time based on clinician advice.
They should report excessive pain, swelling, fever, or prolonged bleeding.

6. Results and Follow-Up

FNAC results may be descriptive, while biopsy results provide more detailed information including receptor status if necessary.
Results typically require a few days to be processed.
The patient will be informed about the result and the next steps in management.

7. Medications and Allergies

Patients should inform the doctor about:
Blood thinners (e.g., aspirin, warfarin, antiplatelets).
Known allergies, especially to local anaesthetics or antiseptics.
Medical conditions like bleeding disorders.

8. Consent and Patient Questions

Informed consent is obtained after explaining the purpose, risks, and benefits.
Patients are encouraged to ask questions or express concerns.
Emotional reassurance is important, as the procedure can cause anxiety.

Requirements: Blood Reports and "Triple H" Before Biopsy

1. Required Blood Reports

The following laboratory results must be available and reviewed:

Complete Blood Count (CBC)

Hemoglobin
Platelet count(should be more than 75000)

Coagulation profile

PT/INR(should be less than 1.5)
aPTT

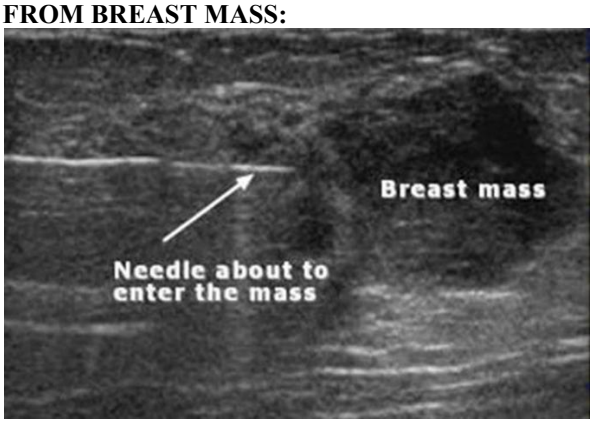
Triple H Reports:

Hbsag antibody,
HIV andtibody 1 & 2
Anti HCV antibody

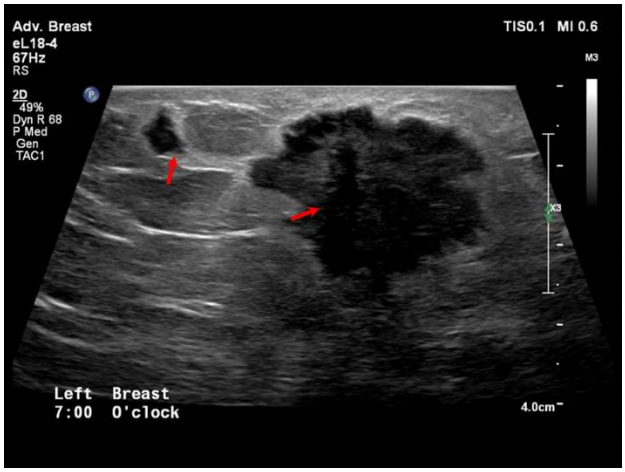
FNAC NEEDLE (22 gauge):

Core Needle Biposy Gun
(AUTOMATIC GUN):14 gauge:

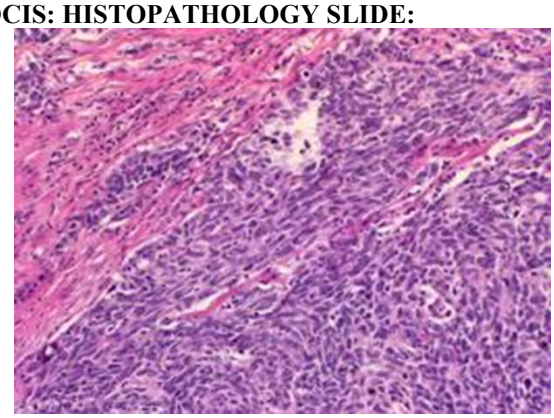
CORE NEEDLE BIPOSY FROM BREAST MASS:



BREAST CARCINOMA:



BREAST CARCINOMA: DCIS: HISTOPATHOLOGY SLIDE:



III. Methods And Material:

The study comprised of 50 patients referred to the department of Radio-diagnosis at a tertiary care hospital who had presented with symptoms below included in the study:

- Pain in breast
- Pus draining from breast
- A round, smooth and firm breast lump.
- A lump that feels firm and moves easily under the skin.
- A hard breast lump with irregular edges.
- An area of skin that has changed color.
- Skin dimpling like an orange.
- New changes in breast size or shape.
- Fluid leaking from the nipple.

Study was performed on GE VERSANA ULTRASONOGRAPHY MACHINE at GCS Hospital, Ahmedabad over a period of 12 months from August 2024 to August 2025.

Inclusion criteria:

Patient with the symptoms below included in the study:

- Pain in breast
- Pus draining from breast
- A round, smooth and firm breast lump.
- A lump that feels firm and moves easily under the skin.
- A hard breast lump with irregular edges.
- An area of skin that has changed color.
- Skin dimpling like an orange.
- New changes in breast size or shape.
- Fluid leaking from the nipple.

Exclusion criteria:

- Patients refused the radiological and histopathological examination
- Patient with the raw area at site of examination

Patient preparation:

Ultrasound (USG) of the breast is a **non-invasive** imaging technique commonly used to evaluate breast lumps, cysts, or other abnormalities that may be detected during a clinical breast exam or routine screening. Proper patient preparation ensures **optimal imaging quality** and a smoother experience for both the patient and the healthcare provider.

Here's a detailed guide on **patient preparation** for **breast ultrasound (USG)**:

1. Timing of the Exam

Menstrual Cycle Consideration: It is generally recommended to schedule the ultrasound during the **first two weeks of the menstrual cycle** (i.e., the follicular phase) for premenopausal women. During this phase, the breast tissue is less dense, which can enhance imaging quality.

Postmenopausal Women: For postmenopausal women, there is no specific time within the cycle that needs to be considered.

2. Clothing and Comfort

Wear a Comfortable Top: It is best for the patient to wear a **loose-fitting top** or **two-piece clothing**. This allows easy access to the breast area without the need for full disrobing.

Undressing Upper Body: The patient will typically need to **remove their top** and **bra** for the procedure. Gowns are provided for patient modesty, though some centers may allow patients to simply lift their shirt to expose the breast area.

Avoid Tight Clothing: Tight or restrictive clothing should be avoided as it may make the ultrasound procedure uncomfortable.

3. Avoid Lotions, Deodorants, and Oils

No Lotions or Creams: Patients should be advised **not to apply any lotions, deodorants, or oils** to the breast area before the ultrasound. These substances can interfere with the **ultrasound gel** and the quality of the images.

Clean Skin: Ensure that the skin over the breast area is clean and free from any cosmetic or topical products. This ensures that the ultrasound gel adheres well to the skin, improving the quality of the images obtained.

4. Hydration
Drink Water if Needed: Unlike other imaging tests (e.g., CT scan), there is no specific hydration requirement for breast ultrasound. However, if the examination includes the **axillary area** (underarm), it's a good idea for the patient to be **well-hydrated**, as it can assist in better imaging of the lymph nodes.

5. Pre-Exam Instructions for Specific Conditions
For Breast Masses or Lumps: If the ultrasound is being performed to investigate a **specific lump or mass**, the patient may be asked to mark the location of the lump with their fingers or note any **symptoms** like tenderness or changes in the mass.
For Follow-Up Imaging: If this ultrasound is a follow-up after a mammogram or biopsy, patients may be asked to bring any **previous imaging reports** or **films** to assist the radiologist in interpreting the results.

6. Informed Consent
Discuss the Procedure: Ensure the patient understands that the procedure is **painless** and that there will be no injections or contrast involved (in most cases). If contrast is used, it will be clearly explained.
Duration: The patient should be informed that the procedure typically takes **15-30 minutes**, depending on the complexity of the examination.
Purpose of the Exam: Explain the reason for the ultrasound, whether it's for **screening**, **diagnosis**, or **follow-up** of a known condition.

7. Special Considerations
Pregnancy: Ultrasound is considered **safe during pregnancy**, so no special preparation is required unless it is a **diagnostic concern** related to pregnancy. However, the clinician may want to evaluate whether ultrasound is the most appropriate imaging modality during this time.
Nursing or Lactating Women: Breast ultrasound is commonly performed in **lactating women** (e.g., to evaluate mastitis or abscesses), and there are generally no special preparation requirements other than ensuring **comfort during the exam**.

8. After the Procedure
No Recovery Time: The patient can resume normal activities immediately after the ultrasound, including driving and work, as there are no sedatives or invasive procedures involved.
Follow-Up: If the ultrasound results are abnormal, the healthcare provider will discuss next steps, which may include biopsy, further imaging, or surgical consultation. It's important for the patient to follow any **additional recommendations** for follow-up care.

Summary of Key Instructions for the Patient
Wear loose-fitting clothing for easy access to the breast area.
Avoid applying lotions, deodorants, or creams to the breast or underarm area.
Clean the breast area before the exam to ensure better image quality.
Prepare to undress from the waist up, and wear a gown if required.
If the ultrasound is for a specific **lump or mass**, try to mark the area or note changes in symptoms.
The procedure is **non-invasive, safe**, and typically takes **15-30 minutes**.

Technique:
Breast ultrasound (US) is a **non-invasive imaging technique** used to evaluate the **anatomy and pathology of the breast tissue**, particularly for detecting **masses**, **cysts**, and other abnormal findings. The procedure uses **high-frequency sound waves** to produce images of the internal structures of the breast. It is commonly used to **further evaluate abnormalities found during mammography**, **guide biopsies**, and **assess cysts, fibroadenomas**, or **infections** like **mastitis**.

Here's a step-by-step guide on the **technique** for performing breast ultrasonography:
1. Patient Positioning
- **Supine Position**: The patient is typically positioned in a **supine (lying on the back)** position on the examination table.
- **Arms Raised**: The patient should raise their **arm on the side being examined** and place it behind their head. This position helps to spread the breast tissue more evenly across the chest wall and improves the visibility of the underlying structures.
- **Alternative Positions**: If the lesion is more **lateral** (towards the outer side of the breast) or in the **axillary region**, the patient may be asked to **turn slightly** to facilitate better access.

● **Contralateral Breast**: For comparison and to check for abnormalities in both breasts, the opposite arm is positioned down by the patient's side.

2. Application of Gel
● **Ultrasound Gel**: A **thin layer of ultrasound gel** is applied to the breast. This gel acts as a medium for the sound waves to travel through, allowing for better contact between the transducer (ultrasound probe) and the skin, ensuring clear transmission of sound waves
● The gel is **warm** and usually **not uncomfortable**, but it can be **wiped off** after the procedure is completed

3. Use of Transducer
● **High-Frequency Linear Array Transducer**: A **linear-array transducer** is typically used for breast ultrasound. This type of transducer provides high-resolution imaging of superficial structures, which is ideal for evaluating breast tissue.
● **Frequency**: The transducer typically operates at a frequency between **7.5 MHz and 15 MHz**. Higher frequencies provide better resolution but have limited penetration depth, which is ideal for superficial breast tissue.
● The radiologist or technician moves the transducer **gently over the breast tissue**, applying moderate pressure to obtain high-quality images of the breast structures.

4. Scanning Technique
● **Systematic Scanning Approach**: The breast is typically divided into a **grid pattern** or a **clock-face pattern** to ensure that all areas of the breast are thoroughly examined.
● **Medial to Lateral (ML)**: The transducer moves from the **midline** (near the sternum) toward the **lateral aspect** of the breast.
● **Superior to Inferior (SI)**: The transducer moves from the **top of the breast** toward the **bottom**.
● **Rotational Motion**: The probe may be rotated in small circles to ensure that all angles of the breast tissue are captured.
● **Scanning Planes**:
Sagittal (Vertical) Plane: Helps visualize **vertical structures** and **depth** of the breast tissue.
Transverse (Horizontal) Plane: Provides a better view of the **width** of the mass and any anatomical variations
Depth and Focus: The **depth** of the imaging is adjusted to ensure proper visualization of structures at various levels, from the skin surface to the deeper tissues of the breast. The **focus** of the ultrasound may be adjusted based on the area of interest to provide optimal resolution

5. Doppler Imaging
● If there is a need to assess **blood flow** or vascularity (e.g., to evaluate **tumor vascularity** or **inflammation**), **Color Doppler** or **Power Doppler** can be used.
● **Color Doppler** helps visualize the **direction and flow of blood vessels** in or around a lesion, providing important information about whether a mass is benign or potentially malignant.

6. Assessment of Findings
● During the examination, the radiologist or sonographer will look for **normal and abnormal findings**, which may include:
● **Cysts**: These appear as **anechoic (dark)** areas with **well-defined borders**.
● **Fibroadenomas**: These typically appear as **solid, hypoechoic (darker)** lesions with smooth, regular borders.
● **Malignant Tumors**: Suspicious masses may have **irregular borders**, **heterogeneous internal structure**, **posterior shadowing**, and **increased vascularity**.
● **Abscesses**: These appear as **fluid-filled structures** with **debris** inside.
● **Calcifications**: Although **mammography** is more sensitive for detecting **microcalcifications**, large calcifications can sometimes be visualized on ultrasound as **bright spots**.

7. Documentation and Interpretation
The sonographer or radiologist will capture a series of images of the abnormal findings (if present) from different angles and depths.
Images are typically stored in the system for later review and comparison. A **report** will be generated, detailing the **findings**, and it may suggest further investigations (e.g., biopsy, mammogram, or follow-up imaging).

8. Post-Procedure Care

Patient Comfort: Once the procedure is completed, the gel will be wiped off, and the patient can dress and resume normal activities immediately, as there are no side effects or recovery periods associated with the ultrasound.

IV. Results:

A total of 50 patients were evaluated using high-resolution ultrasonography, followed by histopathological examination.

❖**On ultrasonography:**

- 29 lesions (58%) were classified as benign based on well-defined margins, oval shape, homogenous echotexture, and posterior acoustic enhancement.
- 21 lesions (42%) were categorized as suspicious or malignant, exhibiting irregular margins, heterogenous echotexture, posterior acoustic shadowing, and increased vascularity on color Doppler.

❖**Histopathological examination confirmed:**

- 30 benign lesions (60%), most commonly fibroadenomas (17 cases), simple cysts (10 cases), and fibrocystic changes (3 cases).
- 20 malignant lesions (40%), with invasive ductal carcinoma being the most prevalent subtype (16 cases), followed by invasive lobular carcinoma (2 cases), and others (2 cases).

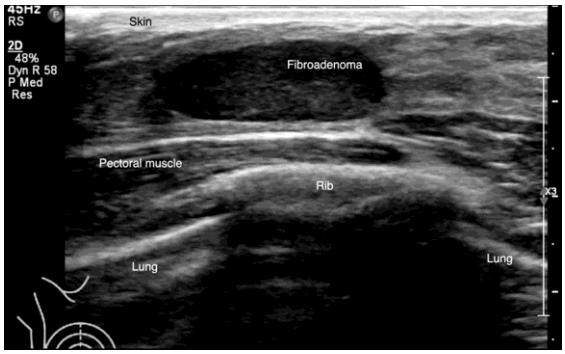
❖**Comparison between USG findings and histopathology showed:**

- True positives (USG and histopathology both malignant): 19 cases
- True negatives (USG and histopathology both benign): 28 cases
- False positives (USG malignant, histopathology benign): 2 cases
- False negatives (USG benign, histopathology malignant): 1 cases

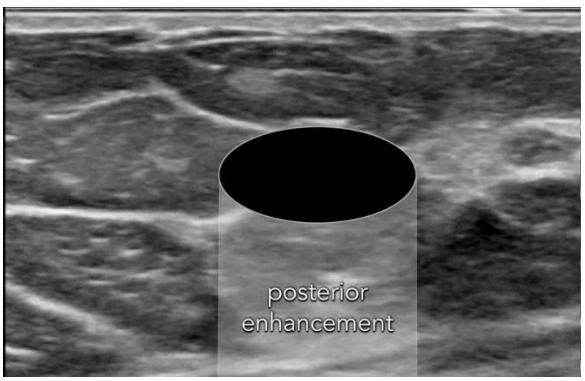
❖**Based on these findings:**

- Sensitivity of ultrasonography: 95%
- Specificity: 93.3%
- Positive Predictive Value (PPV): 90.5
- Negative Predictive Value (NPV): 96.5%
- Overall diagnostic accuracy: 94%
- A statistically significant correlation ($p < 0.001$) was observed between sonographic features and final histopathological diagnosis, affirming the reliability of ultrasonography as a primary imaging modality in the assessment of breast lesions.

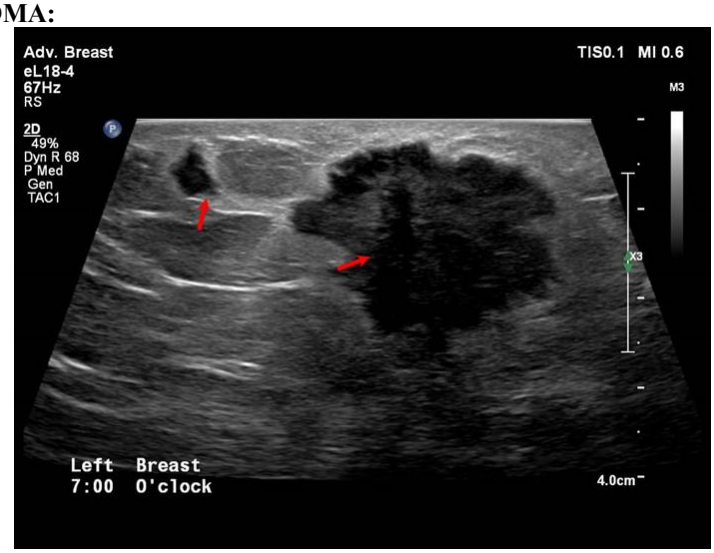
FIBROADENOMA ON USG



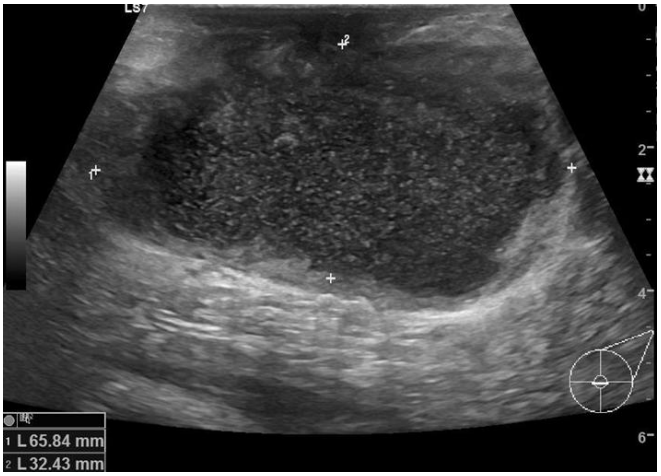
SIMPLE CYST ON USG



BREAST CARCINOMA:



BREAST ABSCESS ON USG



Advantage And Limitations Of Ultrtasonography Breast:

Advantages of Breast Ultrasonography (USG) Over Other Modalities

Radiation-Free Imaging

Unlike mammography, USG uses no ionizing radiation, making it safer for younger patients and pregnant women.

Superior in Dense Breast Tissue

USG is more effective than mammography in detecting lesions in women with dense breast tissue, where mammograms may miss small or subtle abnormalities.

Distinguishing Solid vs. Cystic Lesions

USG reliably differentiates between cystic (fluid-filled) and solid masses, which is critical for clinical management.

Real-Time Dynamic Imaging

Allows real-time evaluation of lesion mobility, compressibility, and vascularity (with Doppler).

Guidance for Interventional Procedures

Provides accurate, real-time guidance for fine needle aspiration (FNA), core needle biopsy, and cyst aspiration.

Portable and Accessible

More widely available and less expensive than MRI; can be used in low-resource settings and for bedside imaging.

Patient Comfort
No compression is required (unlike mammography), and the exam is generally more comfortable.

Complementary to Mammography
When used as an adjunct, USG improves the sensitivity of breast cancer detection, especially in dense breasts or in symptomatic women.

Limitations of Breast Ultrasonography Compared to Other Modalities
Operator Dependency
Image quality and diagnostic accuracy heavily depend on the skill and experience of the operator.

Limited in Detecting Microcalcifications
USG is not sensitive to microcalcifications, which are often early signs of ductal carcinoma in situ (DCIS); mammography is superior in this regard.

Limited Field of View
Unlike mammography or MRI, USG provides a localized field of view and may miss multifocal or multicentric disease unless a whole-breast protocol is used.

Not Ideal for Screening Alone
USG is not recommended as a standalone screening tool for average-risk women due to lower sensitivity for some types of cancer.

Inconsistent Standardization
While protocols like BI-RADS exist, USG interpretation may vary more than mammography or MRI.

False Positives
Can lead to unnecessary biopsies due to overestimation of benign findings, lowering specificity.

Limited Evaluation of Deep or Posterior Lesions
Lesions near the chest wall or very deep within large breasts may be missed or incompletely visualized.

Feature	**Ultrasonography**	**Mammography**
Radiation exposure	❌ None	✅ Present
Dense breast evaluation	✅ Excellent	❌ Limited
Microcalcification detection	❌ Poor	✅ Good
Cost	✅ Low	✅ Moderate
Availability	✅ Widely available	✅ Widely available
Operator dependence	❌ High	✅ Low
Use in interventional guidance	✅ Yes	❌ No

V. Conclusion:

Ultrasonography of the breast is a valuable, non-invasive diagnostic tool with high sensitivity for the detection and characterization of breast lesions, particularly in women with dense breast tissue. When correlated with histopathological findings, USG demonstrates good diagnostic accuracy in differentiating benign from malignant lesions, thereby playing a critical role in early detection and management planning. However, due to certain limitations such as operator dependency and inability to detect microcalcifications, histopathological confirmation remains the gold standard for definitive diagnosis. The integration of USG findings with clinical evaluation and histopathology significantly enhances diagnostic confidence and guides appropriate patient management.

Reference:

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