"EVALUATION OF MAMMOGRAPHY AND SONOMAMMOGRAPHY IN CORRELATION WITH FINE NEEDLE ASPIRATION OF BREAST LUMPS"

By

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DISSERTATION SUBMITTED TO

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH, KOLAR, KARNATAKA

In partial fulfillment of the requirements for the degree of

DOCTOR OF MEDICINE

IN

RADIODIAGNOSIS

Under the Guidance of

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I hereby declare that this dissertation entitled ***"EVALUATION OF MAMMOGRAPHY AND SONOMAMMOGRAPHY IN CORRELATION WITH FINE NEEDLE ASPIRATION OF BREAST LUMPS"*** *is a bonafide and genuine research work carried out by me under the guidance of* **Dr. ANIL KUMAR SAKLECHA** M.D , *Associate Professor, Department of Radiodiagnosis and co-guidance of* **Dr. C.S.B.R. PRASAD,** M.D , *Professor , Department of Pathology*.

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Dr. JAYADEVA PHURAILATPAM

LIST OF ABBREVIATIONS

CA	**Carcinoma**
CT	**Computed tomography**
DCIS	**Ductal carcinoma in situ**
FA	**Fibroadenoma**
FCC	**Fibrocystic disease**
FNAC	**Fine needle aspiration cytology**
HPE	**Histopathological examination**
MRI	**Magnetic resonance imaging**
PET	**Positron emission tomography**
SPECT	**Single positron emission tomography**
SMG	**Sonomammography**
USG	**Ultrasonography**

ABSTRACT

OBJECTIVES

1. To evaluate the role of mammography and sonomammography independently and in combination and correlating with FNAC for early diagnosis of breast lesions.
2. To study the characteristics of mammography and sonomammography in detecting breast lesions and differentiating benign from malignant lesions

METHODS

75 female patients attending Department of Radiodiagnosis with breast lumps From January 2012 to August 2013 were assessed using mammography, sonomammography and compared with FNAC findings.

RESULTS

A total of 75 patients were included in the study, with age ranging from more than 30 yrs. Benign diseases (64 %) were more common than malignant (36 %), of which fibroadenoma constituted 42.6 % of cases.

The sensitivity, specificity, positive and negative predictive values of mammography is 92.3%, 91.8%, 85.7%, 95.7%; Sonomammography is 80.7%, 100%, 100%, 90.7%; Combined imaging modality is 92.3 %, 100 %, 100 % and 96.0% respectively.

CONCLUSION

Combined imaging modalities of mammography and sonomammography play an important role in diagnosing palpable breast lesions.

Its applications help:

a) Better characterization of the breast lesions.

b) Avoiding unnecessary investigations or surgical procedures in which imaging findings are unequivocally benign.

c) Negative findings on combined mammographic and sonomammographic imaging studies have very high specificity and are reassuring to the patient**.**

KEY WORDS: Mammography, sonomammography, FNAC, combined imaging modalities.

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INTRODUCTION

One of the commonest complaints with which the patients present is 'Lump in the breast'. This requires early diagnosis, work up and treatment.

There has been significant increase in incidence of breast cancer in India since the past few years, both in rural and urban set up.

Global breast cancer incidence increased from 641,000 (95% confidence intervals 610,000 -750,000) cases in 1980 to 1,643,000 (1,421,000—1,782,000) cases in 2010, an annual increase of 3·1%.[1] Over 100,000 new breast cancer patients are estimated to be diagnosed annually in India.[2] Much concern is given to malignancy, though benign lesions of the breast are far more frequent than malignant ones.

With the use of mammography, sonomammography, MRI of the breast and needle biopsies, the diagnosis of a benign disease can be accomplished without surgery in the majority of patients.

As many of the benign lesions are not associated with an increased risk for breast cancer, unnecessary surgery should be avoided.

Radiologist, pathologists and oncologists are required to recognize benign lesions from malignant breast lesions and to assess a patient's risk of developing breast cancer, so that the most appropriate treatment modality for each case can be established.

Any palpable mass in a woman's breast is potentially serious lesion and evaluation is required by history taking, physical examination and digital mammography.

Mammography is cost efficient and widely accepted technique to evaluate clinically suspected breast lesions and used for screening of breast cancer.[3]

High resolution sonomammography is a useful adjunctive modality and helps in characterizing a mammographically non detected palpable abnormality, especially in dense breast.[4]

Sensitivity and specificity of sonomammography or mammography is higher if sonomammography and mammography are combined.[5]

The first attempt to use radiography for diagnosing breast abnormalities were developed in late 1920's ,but mammography as we understand it nowadays, using dedicated X-ray units, was developed in 1960's.[6]

During the past few years a number of additional imaging techniques for assessing breast lesions have been investigated and came into practice. These include thermography, radioisotope scanning, elastography, dynamic MRI, etc.

NEED FOR THE STUDY

'Lump in the breast' is one of the commonest presenting complaints in these patients, which requires early diagnosis, work up and treatment.

Breast lump is the clinical presentation of various breast diseases that range from benign cyst to malignant lesions. Differentiation of benign from malignant is the most important aspect for patient care and proper management. There has been abrupt increase of incidence in breast cancer in India from a few years, both in rural and urban set up.[7] Breast cancer is the most common site specific cancer in women and is the leading cause of death from cancer for women of age group 40 to 44 years.[9.10] It accounts for 33% of all female cancers and is responsible for 20% of cancer related deaths in women.[9] Breast cancer deaths can be greatly reduced by screening of women.

Misdiagnosed breast cancers account for a large number of malpractice claims for errors in diagnosis. Litigation often involves younger women whose physical examination and mammographic findings may be misleading.[9] Combined mammography and sonomammography and correlating with FNAC study have been used to reduce the false-negative diagnosis and give accurate early detection of cancer.[11]

The study assesses the usefulness of cost efficient and early accurate diagnosis of breast pathology with women presenting with breast lumps and thereby reducing the morbidity and mortality rate. Breast carcinomas are often detected in late stages, especially in rural population.[12]

Many breast lesions presented to clinician are often difficult to differentiate clinically.

Normal structures in the breast can sometimes be mistaken for a mass, and using an improper examination technique, such as pinching of the tissue, can create the impression of a mass.[13] Imaging plays a major role in work up of breast pathologies. A scientific imaging approach is required for early detection of malignancy.

Mammography and sonomammography offer excellent mode of imaging. Combined with FNAC, the detection rate of malignancy and other breast lesions are increased many folds.[11] Thus, there is a dire need for developing a method for establishing the diagnosis pre-operatively, which is cost effective, least invasive and least disturbing to the patient with accuracy comparable to that of open biopsy.

AIMS AND OBJECTIVES

- To evaluate the role of mammography and sonomammography independently and in combination and correlating with FNAC for early diagnosis of breast lesions.

- To study the characteristics of mammography and sonomammography in detecting breast lesions and differentiating from benign and malignant lesions

REVIEW OF LITERATURE

Detection of breast cancer in its earliest possible stage is the ultimate goal in imaging the breast and the role of the radiologist is therefore vital. Donegan[14] stated that most breast cancers are presented as the palpable masses usually found by patients. However, all the palpable abnormalities do not represent discrete masses. This is true for women younger than 40 years of age in whom normal glandular nodularity may be mistaken for masses.

The incidence of breast cancer deaths can be reduced by 30% by screening with mammography. This is because breast changes like asymmetry, neodensity, distortion of fibroglandular architecture and microcalcifications are picked up earlier.[15]

Imaging evaluation of the breast is established as an essential part of modern multidisciplinary approach for effective investigation and management of breast lumps.

This includes sonomammography and Doppler scanning, conventional digital mammography and recently MRI and contrast enhanced sonomammography.[16]
Diagnostic mammography is the first imaging modality employed to evaluate breast abnormalities and as opposed to screening mammography which is performed when a breast abnormality is absent.[17]

To promote uniformity and standardization of mammographic interpretation, American College of Radiology (ACR) and other international organizations with mutual consensus have adopted and recommended universal implementation of Breast Imaging Reporting and Data System (BIRADS).[18]

Sonomammography is an important method of resolving equivocal mammographic findings in defining cystic lesions and demonstrating the echogenic qualities of specific solid abnormalities.[19]

Adjunctive ultrasound assessment improves breast cancer detection in women of all ages and should be routinely used in symptomatic breast clinics.[20]

Sonomammography detects early stage cancers in women with mammographically negative dense breasts, with higher contribution in women younger than 50 years .[21]

It is useful in the evaluation of palpable masses not visible in mammographically dense breasts, abscesses and masses that are not completely evaluable with mammography and in young patients who are susceptible to radiation.[22]

FNAC is easily performed and accuracy ranges from 80-95% and false positive aspirates are seen in less than 1% of cases. False negative results are seen in 4-10% and are most common in fibrotic or well differentiated tumors.[23]

'Triple assessment' approach, i.e., clinical, mammography and FNAC are used in diagnosing breast lumps in screening and symptomatic populations.[22]

Interpretation of sonomammography in the triple assessment of palpable breast masses can result in a reduction of total costs for the diagnosis and treatment of breast cancer.[24]

Best results are achieved by combination of both techniques (mammography and sonomammography).[25]

The accuracy of clinical evaluation of a palpable abnormality of the breast is limited; signs of breast cancer are not distinctive. Moreover, cysts cannot be reliably

distinguished from solid masses on physical examination. Imaging evaluation is indicated to characterize the palpable lesion and to screen each breast for additional lesions.[26]

Sonomammography is recommended in initial imaging modality of women younger than 30 years for characterizing a palpable breast lump. Primarily Mammography is performed in women older than 35 years to evaluate the breast for clinically occult lesions and secondarily to characterize the palpable lumps.[27]

In these patients, Sonomammography is useful as adjunctive modality and helps characterize a mammographically detected palpable abnormality, and in patients with dense breast tissue, Sonomammography identifies mammographically occult palpable lesions.

A negative sonographic finding may provide additional reassurance to patients with palpable abnormalities for whom mammographic findings were also negative.[25] Differentiating masses as cystic or solid has been accepted as the traditional role of ultrasound in workup of breast masses.

Further evaluation of solid masses has been done either by FNAC, large core percutaneous technique or excisional biopsy.[28]

The combination of sonomammography and mammography is significantly more sensitive than either modality used alone. Its advantages being the ease of use, relative low cost, lack of additional radiation, acceptability to the patient and ability to sample tissue for diagnostic and therapeutic purposes. Using both sonomammography and mammography results in more breast cancers detection than using mammography alone.

False negative rate of mammography has been reported to be as high as 16.5%. Multiple studies have shown that the false negative rate for a combined

mammographic and sonomammographic evaluation varies from 0 to 2.6% and together these imaging modalities can be reassuring if follow up is planned when clinical assessment is not highly suspicious.[29]

With 8 or 9 breast cancers missed in every 100 patients, "triple assessment" is no longer adequate for the investigation of breast disease. [29]

Best practice in breast cancer detection therefore dictates that sonomammography and mammography must be used together, as part of a "*Quadruple assessment*," in all breast clinics.

The increased diagnostic accuracy afforded by such a quadruple assessment benefits the patient by improving breast cancer detection and decreasing patient uncertainty and anxiety.[30]

Taking into study the role of mammography and sonomammography in diagnosing and early detection of breast pathology and by correlating with FNAC findings will be giving much lesser false negative diagnosis compared to single imaging modality or cytopathological examinations.[31] Considering the other newer techniques, which are much expensive and may not be affordable in rural population, this technique proves reliable.

Furthermore it can be applied as a single stage diagnostic approach, decreasing the deleterious psychological effects on the patients from delay in diagnosis.[32]

ANATOMY OF BREAST

EMBRYOLOGY:

The breast is a tubule-acinar type of modified apocrine sweat gland. A primitive embryonic ectodermal milk line runs from the base of forelimb to the region of hind limb. During 5th – 7th weeks of intrauterine fetal development, the thoracic section will specialize and thicken to form the mammary ridge. A number of epithelial cords penetrate the underlying mesenchyme, giving rise to 15-20 solid out buddings. At term these canalize to form a branching system of ducts, representing the future lobes of the breast. The ducts open onto a surface pit, which undergoes mesenchymal proliferation and aversion to become the nipple.

TOPOGRAPHIC ANATOMY:

The breasts lie entirely within the superficial fascia of the chest wall, separated from the deep fascia by the potential retromammary space. It extends from the second rib superiorly to the sixth or seventh costal cartilage inferiorly and medially from the sternal edge as far as the mid axillary line. The breast is divided arbitrarily into quadrants extending peripherally from the nipple. The upper quadrant contains the greatest proportion of the fibro-glandular tissue and gives rise to the axillary tail of Spence which passes supero-laterally to the axilla.

The medial two thirds of the breast overlie the Pectoralis Major muscle and lateral aspect of the gland overlies the Serratus Anterior and External Oblique muscles.

The fibrous strands or extensions of the superficial fascia pass through the breast towards the skin and nipple and are known as suspensory ligaments of Cooper. The nipple is surrounded by a circular zone of pigmented skin, the Areola, which contains numerous specialized sebaceous glands know as Montgomery's tubercles. The secretion of these glands protects the nipple during suckling.

BLOOD SUPPLY:

Arterial supply: - The Lateral Thoracic artery branches from Axillary artery and supplies the upper outer quadrant of the breast. The perforating branches of Internal Mammary artery supply the central and medial portions of the breast. The branches of Intercostal arteries provide blood to the lateral breast tissues with some branches from Subscapular and Thoracodorsal arteries**.**

Venous drainage: - Drains via the Internal Thoracic, Axillary, Sub-clavian and the Azygos veins.

LYMPHATIC DRAINAGE

Majority of the lymph drains towards the Axillary nodes but some passes to the Inter- costal and the Internal Thoracic chains, with nodes arranged in groups. Axillary nodes are divided into three levels according to their relationship to the Pectoralis Minor muscle. Level-I nodes are infero-lateral, level-II nodes are deep and level III nodes are supero-medial to this muscle.

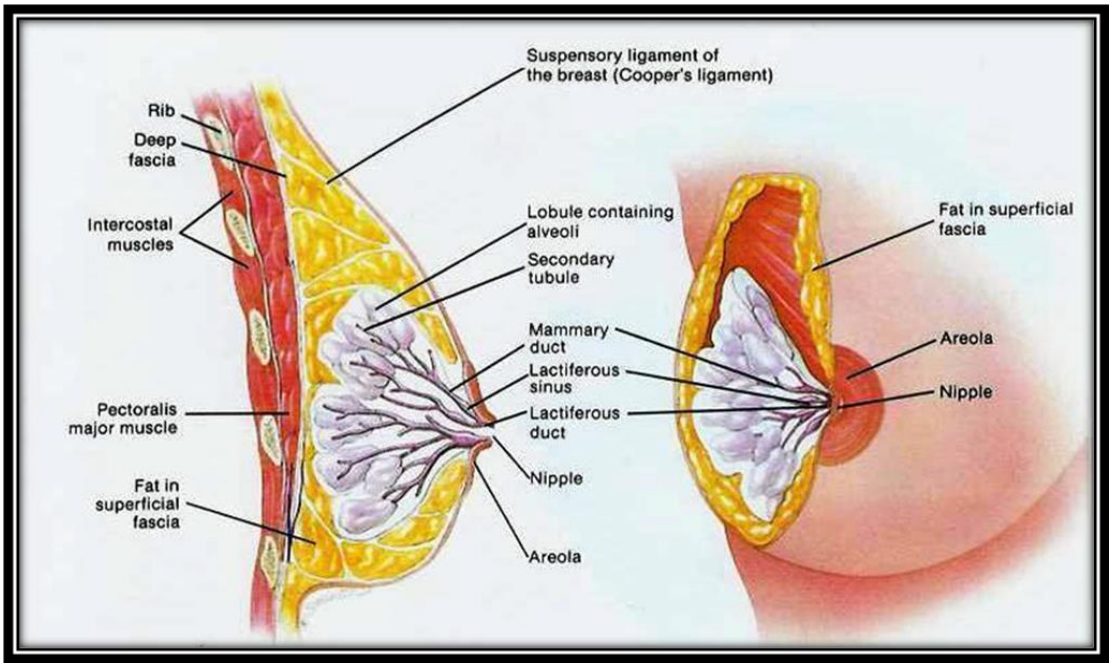


Fig No.1: Normal breast anatomy

DIGITAL MAMMOGRAPHY

Mammography has become the most efficient, reliable and cost effective imaging modality for detecting breast cancer. It is gaining popularity all over the world and is gaining popularity in this country also. Mammography was being used since 1960's and it was modified and improved to deliver best imaging quality.

It allows images to be enhanced and transmitted electronically. The ability to alter contrast and brightness permits further evaluation of abnormal areas to identify features diagnostic of benign and malignant disease.[32,33,34,35]

Modern mammography examinations are safe and mean glandular radiation dose to the breast is approximately 2 mGy (0.2 rad) per exposure. With present mammographic equipment, there is little or no radiation related risk to the women over 40 years of age.[36]

Screening mammography is used to detect asymptomatic women or with family history of breast cancer.

In mammography, two basic views are taken, the cranio-caudal (CC) and the medio-lateral oblique (MLO). Other supplementary views are also taken which will be discussed later.

MAMMOGRAPHY PROCEDURE [37]:

a) Prerequisites:

- Avoid using perfumes and powder as it creates artifacts.
- Should be examined before her periods (document LMP).
- Patients are explained about the procedure.
- Clean the examination region with towel or tissue to avoid artifacts.

b) Technique:

- Routinely two standard views are taken, craniocaudal view (CC) and mediolateral oblique (MLO).
- During the procedure, the breast is compressed using a dedicated mammography unit. Parallel-plate compression evens out the thickness of breast tissue to increase image quality by reducing the thickness of tissue that X-rays must penetrate, decreasing the amount of scattered radiation, reducing the required radiation dose, and holding the breast still.

c) Views in mammography:

Screening or diagnostic mammography consists of at least two standard views: Craniocaudal (CC) and Mediolateral oblique (MLO). These views demonstrate the fibroglandular breast tissue.

Right and left views are examined side by side so that asymmetries can be observed.

MLO images greater volume of the breast tissue, including the upper outer quadrant and the axillary tail of Spence.

Compared to the MLO view, the CC view provides better visualization of the medial aspect of the breast and permits greater breast compression.

Schematic representation of standard views and special views is shown in Fig 2

Other special views used in mammography are:

- Magnification view
- Detailed compression view
- Extended CC view
- Extended MLO view
- 90^{O} lateral view
- Cleavage view
- Post mastectomy view
- Axillary view

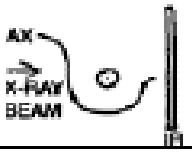
CRANIO-CAUDAL VIEW		EXAGGERATED CRANIO-CAUDAL VIEW	
ELEVATED CC VIEW OR PUSHED UP VIEW		CAUDO-CRANIAL VIEW	
MEDIO-LATERAL VIEW		LATERO- MEDIO-LATERAL VIEW	
SUPERO-MEDIAL INFERO-LATERAL OBLIQUE VIEW		SUPERO-MEDIAL INFERO-LATERAL OBLIQUE, 20° – 30°	
INFERO-LATERAL to SUPERO-MEDIAL OBLIQUE VIEW		SUPERO-LATERAL to INFERO-MEDIAL OBLIQUE VIEW	

Fig No 2: Schematic representation of standard views and special views

Radiological anatomy of breast [38]

Schematically, the radiological examination may show the following normal anatomical structure:

- Skin
- Nipple and areola
- Fatty tissue
- Breast proper, or corpus mammae
- Blood vessels

Skin

The skin appears as a thin, continuous, radio-opaque rim, homogenous in density approximately 1 mm thick and readily visible against the radiolucency of the underlying subcutaneous premammary fatty tissue. If the breast is very dense, because of the higher density of the underlying parenchymal structure, however, the skin may occasionally not show up clearly even on a correctly exposed mammogram.

Nipple and areola

The skin surrounding the nipple – the areola – can be upto 3-5 mm with a central opacity, roughly cylindrical in shape and of variable size and density, corresponding to the nipple.

Posteriorly, there is a generally triangular heterogeneous trabecular area, the retroareolar region, which is of particular interest on account of the difficulty of detecting any focal abnormalities that may be there. Under normal conditions the lactiferous ducts and sinuses are not seen.

If they are enlarged they resemble ribbon like opacities of varying thickness running in parallel or divergent lines.

Fatty tissue:

Varying amounts of fatty tissue may be present, forming anything from a thin subcutaneous layer to 'islets' of various sizes that may occupy the whole breast, depending on the characteristics and age of individual women.

The parenchymal cone is surrounded by fatty tissue which constitutes the premammary fat anteriorly and retromammary fat posteriorly. Anteriorly, subcutaneous fat appears as a radiolucent layer of variable thickness, traversed by planer sheets of fibrous tissue, the islets of Duret, which accommodate Cooper's ligaments.

The superficial extensions of Cooper's ligaments come to peak attached to the skin, which anchor the body of the breast to the subcutaneous tissue, known as reticula cutis. Posteriorly, adipose tissue outlines the retromammary space (the bursa of Chassaignac) which separates the breast from the prepectoral fascia overlying the pectoralis major muscle.

Breast tissue proper or corpus mammae

The body of the mammary gland is roughly cone shaped, with the floor resting on the chest wall and the tip projecting toward the nipple. The shape and density of the breast structures vary from individual, and are influenced by specific sensitivity to hormonal stimuli, which affect the relation between the various tissue components and hence the morphology of the breast. The concept of mammographic density as density strictly related to advancing age is obsolete, so adipose tissue is not synonymous with a senile breast and similarly, the so called 'dense breast' does not establish a link, in terms of pathogenesis and symptoms, between breasts that are patchy and dense at mammography and coalitions such as dysplasia or fibrocystic disease.

These terms have given rise to much confusion among clinicians and radiologist; not only are they well and truly outdated but they are in fact inappropriate with modern radiology, since they belong to the realm of pathology.

The variety in the mammographic appearance of the 'individual' types of mammary structures is in all likelihood related to differences in the normal processes of development and involution, more than to pathological conditions.

For teaching purposes, it may be useful to classify mammographic structures into six main groups reflecting the most frequently encountered breast tissue patterns.

1. **Fibro-adipose structure** - total absence of fibroglandular tissue. Only traces of stromal network may remain. (Fig 3)
2. **Fibro glandular structure** – typical triangular fibro glandular configuration showing the tip of triangle in the retro areolar region and the peri-mammary spaces. The parenchymal component is planar in appearance or slightly nodular. The texture of the stroma is readily recognized with the crests of Duret outlining the adipose areas between the retinacula cutis. (Fig 4)
3. **Micro nodular structure** – less adipose tissue is seen. The fibro glandular component is abundant, most of it forming a 'cobblestone' effect made of small radio-opaque nodular opacities measuring up to 3 mm diameter. (Fig 5)
4. **Parvinodular structure** – similar to micro nodular structure, but the elementary radio-opaque nodules are larger, some reaching 6-7 mm in diameter. (Fig 6)
5. **Irregularly nodular structure** – the fibro glandular component is heterogeneous, featuring nodules of various sizes, either solitary or clustered in 'patches'. The stroma may be more or less marked. (Fig 7)
6. **Dense structure** – virtually fatty tissue is present. The mammogram shows an intensely and uniformly radio-opaque glandular and stromal 'block' which the structures of the breast cannot be distinguished (Fig 8).

Fig No. 3: Fibro - adipose

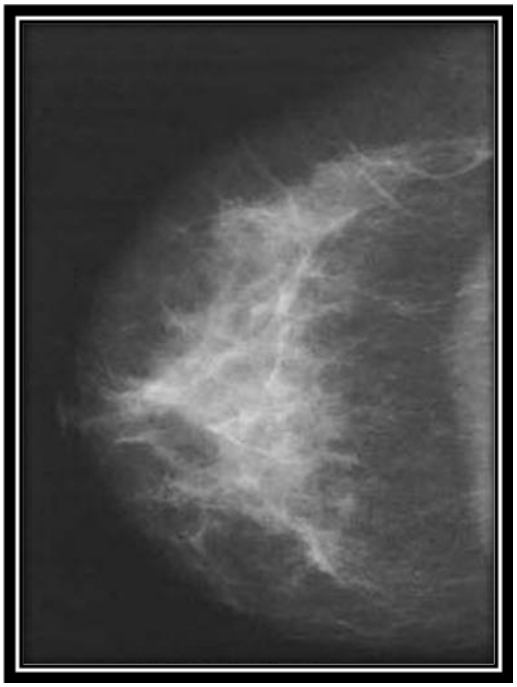


Fig No. 4: Fibro-glandular

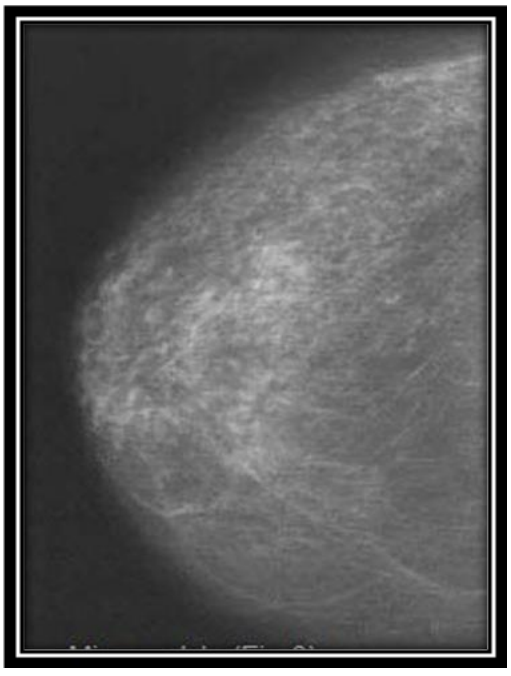


Fig No. 5 : Micronodular

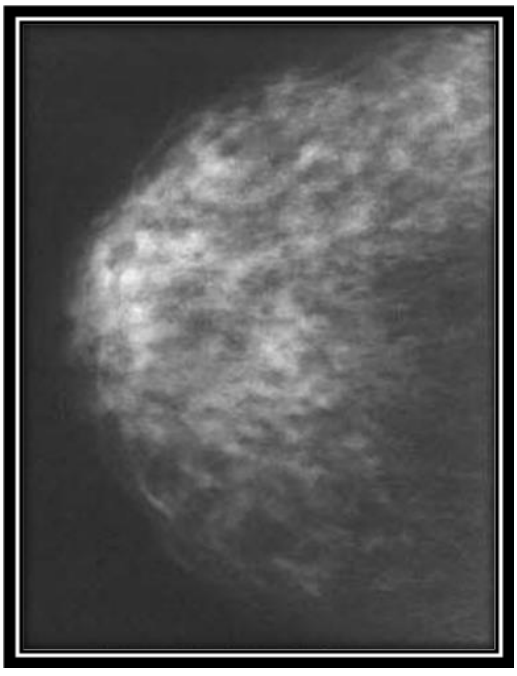
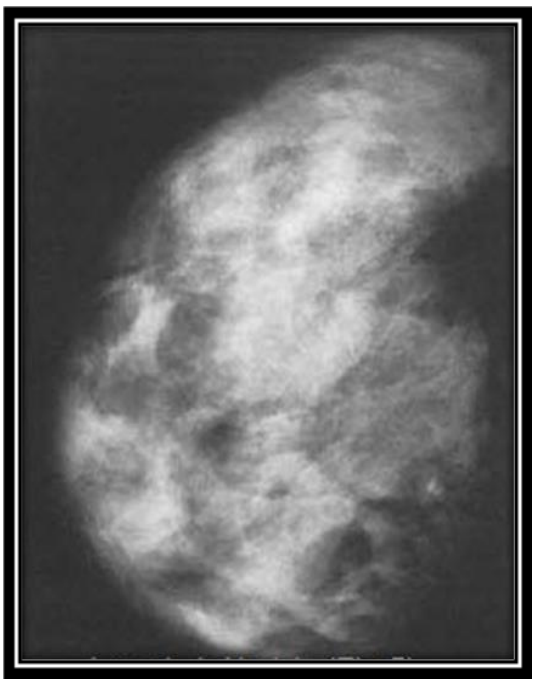


Fig No. 6: Parvinodular



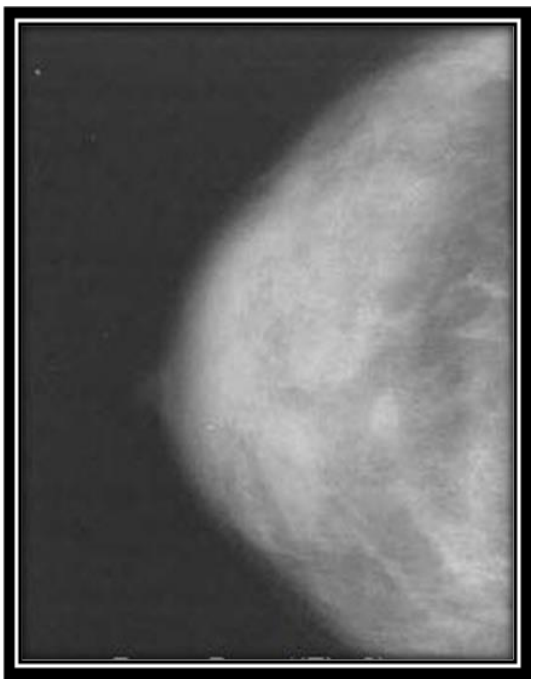


Fig No. 7: Irregularly nodular **Fig. No. 8: Dense breast**

Pectoralis muscle:

The pectoralis muscle is homogenously radio-opaque; it is located in front of the chest wall and is shaped like an upside down triangle in the lateral and mediolateral oblique views.

In the craniocaudal view it is crescent shaped and variety depending on the anatomy of the chest and the position and compression of the breast.

In a very small proportion of cases (1%) one can see medially a small triangular or flame shaped portion of muscle adjacent to the sternum, which must not be misinterpreted as a mass.

Generally, a correctly executed mediolateral oblique projection shows the lower margin of the pectoralis muscle following and imaginary line that run anteriorly through the nipple.

Blood vessels:

Vessels are more readily visible in limits that certain plentiful fatty tissue and appear as thin ribbon –like opacities that may be more or less tortuous; vessels walls may be calcified, in which case they have typically "railway line" images. In the early stages of calcification, only scattered elongated "casts" are seen, in a linear pattern, reflecting partial fragmentary calcification of the vascular wall.

The detection and identification of elementary mammographic signs form the basis for correctly interpreting breast pathologies and describing them accurately in the mammographic report.

The specific features are the basis for classifying the lesions as benign or malignant. These features define the positive predictive value, i.e., the odds that a mammographic sign is associated with or actually shows a cancerous lesion.

Mammographic signs can be described in terms of [38]:

- Shape
- Margins
- Asymmetry
- Architectural distortion
- Calcification
- Radiolucency
- Skin thickening and retraction
- Edema and trabecular thickening
- Asymmetrically dilated ducts

Shape: The shape and size of the lesion is very important in narrowing down the differentials. *Round* are commonly seen in benign masses (exceptions being sarcoma, lymphoma and mucinous carcinoma). *Oval* lesions are typical of fibroadenoma. *Lobular* mass are seen both in benign and malignant conditions. *Irregularly* shaped masses are commonly seen in malignant lesions.

Margins: A well *circumscribed* mass are commonly seen in benign lesions. However, few exceptions are medullary and mucinous carcinoma. *Lobulated* margin are seen in both benign and malignant lesions. *Ill defined/ poorly defined* lesions seen in both malignant and benign lesions but predominantly found in malignant lesions. *Obscure* margins are seen generally due to fibroglandular tissue. *Spiculated* margins are commonly seen in malignant conditions.

Asymmetry: Any asymmetrical density seen on mammogram in the absence of mass should arouse suspicion. Unlike mass lesion, it lacks outward borders and usually contain interspersed fat.

Architectural distortion: In absence of mass lesion, architectural distortion could be an important mammographic finding. *Lobular carcinoma* is usually presented as architectural distortion. *Radial scar* which is a benign condition is also presented as architectural distortion.

Calcification: Calcifications are seen both in benign and malignant lesions.

It can be classified according to ***morphology*** as:

- Benign /coarse heterogeneous
- Indeterminate
- Malignant
  - Pleomorphic
  - Granular /clustered
  - Fine branching /casting.

It can be classified according to ***distribution*** as:

- Diffuse
- Regional
- Clustered
- Lobar
- Linear – normally seen in malignant situation

Disadvantages of mammogram:

- Harder to detect a mass in dense breast, as the sensitivity is dependent on density, plus the age and hormone status of the patient.
- Tends to understate the multifocality of a lesion.
- Positioning is very important, as cancer can be missed because of poor positioning.
- Static examination technique.
- Poor soft tissue discrimination.
- Superimposition of fibroglandular tissue.
- Ionizing radiation.

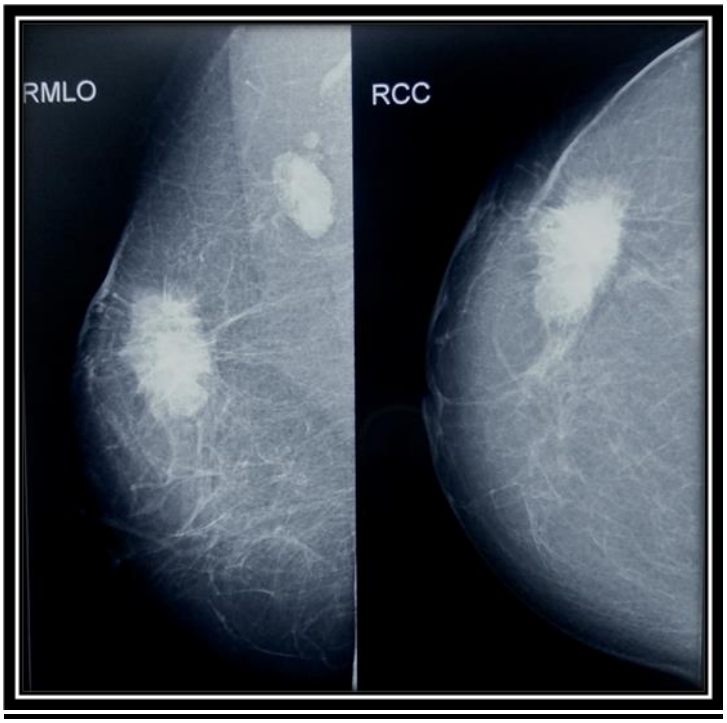


Fig No. 9: Medio-lateral oblique and cranio-caudal views of right breast show a dense lesion with spiculated margin in the upper outer quadrant with an axillary lymph node – suggestive of malignancy.

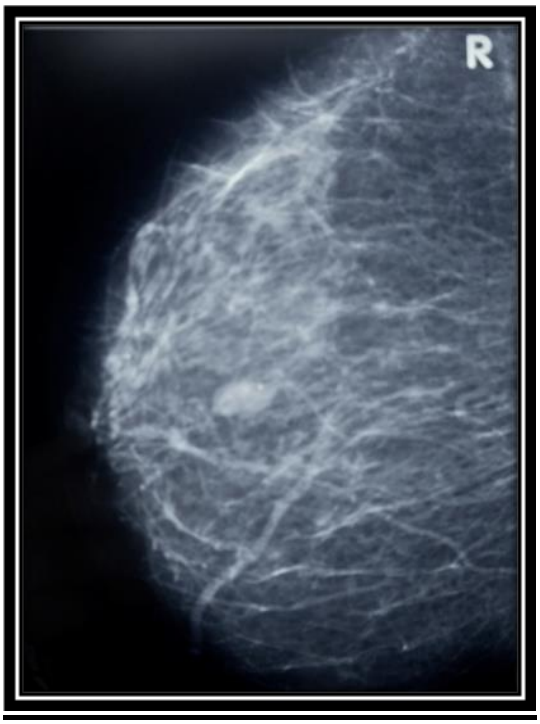


Fig No.10: Medio-lateral view showing an oval shaped well defined dense lesion in upper inner quadrant – suggestive of benign lesion.

Sonomammography:

Wild and Neal first described the use of USG to examine the breast in 1951.[39] However, clinical application of breast sonomammography was limited by relatively poor quality of the available USG equipment.

At that time, USG could only visualize gross lesions, huge cysts and massive carcinomas.

In recent years, however, advances in USG technology including high resolution imaging with Doppler along with improvement in image quality have rekindled interest in USG of the breast.

The appeal of USG has been further holstered by concerns about the radiation exposure associated with mammography and the fact that USG is less cumbersome to the patient.

The primary use of USG in the evaluation of breast disease is to distinguish between solid and cystic breast lesions. These include non-palpable lesions detected with mammography as well as vaguely palpable lesions. USG is extremely accurate in determining the fluid filled nature of most simple cysts (Basic aspect of USG and diagnostic features on USG).[40]

Sonomammography can be particularly useful when mammography is contraindicated or produces non-specific results. In pregnant women, because of the need to avoid radiation exposure and the tendency to have increased breast density, USG is the modality of choice for evaluating masses. Even palpable masses may not be visible on radiography in a dense breast. Normal fibro glandular tissue may partly or completely obscure masses on mammography; USG however, can determine if these masses are cystic or solid.

Peripheral masses in thin women may be difficult to visualize on mammography. In these cases, sonomammography is indicated for evaluation.

Sonomammography can further help in the controversial area of evaluating a palpable mass in a woman under the age of 30.[41] Radiologic procedures such as mammography are not routinely recommended. Sonomammography however, is an ideal first line test for evaluating a symptomatic breast. For example, a galactocele, which usually present as palpable doughy mass is commonly found in lactating or pregnant women.

On sonomammography, a cystic or hypoechoic oval or rounded structure can be seen with multiple floating internal echoes.

Chronic or acute breast abscess occur most in younger women, especially those who are lactating. They are generally found in subareolar region.[42]
Sonomammography is the initial investigation of choice in the evaluation of a possible breast abscess. It is particularly effective in detecting breast abscess that may be causing an acute mastitis. The abscess usually presents as a hyperchoic lesion with multiple internal echoes and increased through transmission. Debris within the abscess may layer out in a dependent fashion forming a fluid/debris level.

Technique: Patient is examined supine with a linear high frequency probe (5-10 MHz) with Doppler facility. The patient should lie supine and elevate the side being scanned with a wedge under the shoulder. She should raise the ipsilateral arm over her head. The scanning technique initially is done by using the grid scanning pattern, followed by radial (clockwise) technique.

Normal ultrasonography - breast anatomy:

For adequate interpretation of sonomammography, the normal breast ultrasonographic anatomy must be clearly understood. The skin of the breast, usually 1 to 3 mm thick is imaged as 2 hyperechoic lines with a very thin hypoechoic zone between them. These lines correspond to the interface between the transducer and the skin and between the skin and the subcutaneous tissue.

Immediately, beneath the skin are prominent round or oval fat lobules, which appear as relatively homogenous hypoechoic structures. These are interrupted by echogenic Copper's ligaments that extend to the chest wall and insert on the undersurface of the dermis.

The breast parenchyma varies widely in its echogenicity with thin curvilinear bands of connective tissue extending through it. The juvenile breast is composed mainly of dense glandular tissue with very little fat and therefore appears as diffusely hyperechoic parenchyma.

The post-menopausal, partly involuted breast has slightly increased subcutaneous fat with fat lobules distributed throughout the breast parenchyma.

The post-menopausal breast has very little parenchyma with prominent cooper's ligament. During pregnancy and lactation the appearance is similar to that of the juvenile breast.

Beneath the breast parenchyma is a zone of hypoechoic sheets of pectoralis muscle fibers.

As the examiner moves the transducer, several structures will become readily apparent. Medially, the costal cartilages can be seen as curvilinear hypoechoic bands or well defined oval structures, dependency on the orientation of the transducer.
As we move laterally, the ribs can be imaged.

The ribs appear as semilunar hyper-reflective structures with strong posterior ducts can occasionally be seen as areas that vary from hypoechoic to anechoic.

Usually, they not visible when of normal caliber, but they can be seen even when minimally dilated.

Ultrasonographic breast pathology:

USG of the breast is used mainly to differentiate cysts from solid masses. Cystic lesions are overwhelmingly benign in nature.

Sonomammography has been found to be extremely accurate in differentiating cystic and solid lesions, whether the masses were found by palpation or mammography.

Because almost 25% of all palpable masses are cysts, the ability to recognize when a mass is cystic is an important feature.[43]

The diagnosis of sonomammography visualized mass can be based on several characteristics including margins, echogenicity , internal echo pattern, retro-tumoral phenomenon, compressibility and the lateral antero-posterior dimension ratio.

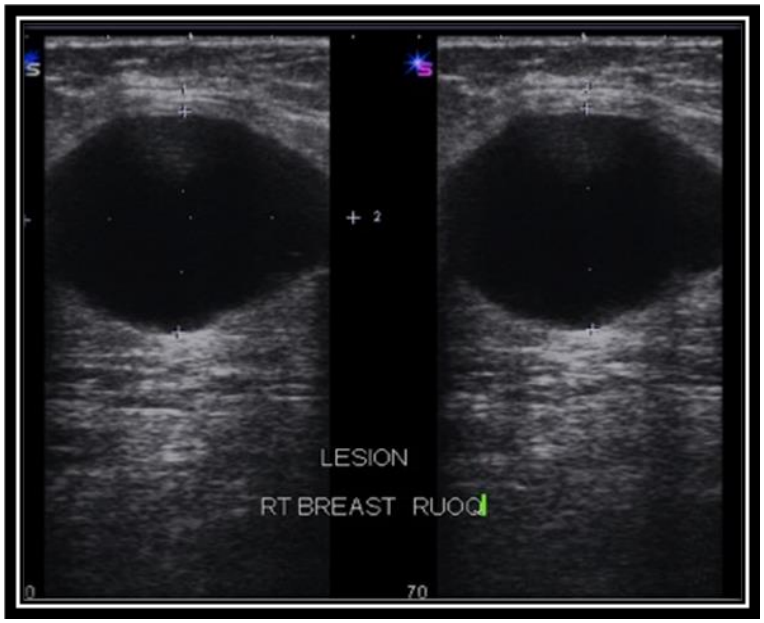


Fig No.11: A well-defined anechoic lesion with posterior acoustic enhancement with no Septations/solid component- suggestive of benign breast lesion – simple cyst

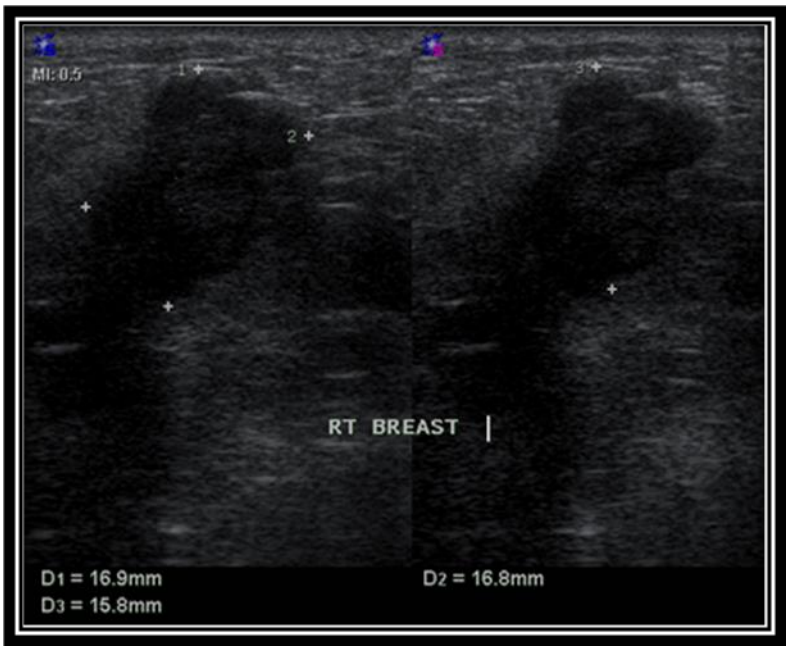


Fig No.12: An ill-defined lobulated hypoechoic lesion with posterior acoustic shadowing. Note the height of the lesion is more than the width - suggestive of malignancy.

BIRADS CLASSIFICATION [38]:

The mammographic findings are categorized from BI-RADS 0 to BIRADS 6, which are primarily aimed for communication of significance of the mammographic findings to the referring physician and to recommend the most appropriate management.

Category 0: Incomplete evaluation. It requires further imaging evaluation like sonomammography.

Category 1: Negative – there is nothing to comment on.

Category 2: Benign findings. Lesions which come under this category includes involuting calcified fibroadenomas, multiple secretory calcifications, fat-containing lesions such as oil cysts, lipomas, galactoceles and mixed density hamartomas.

Category 3: Probably benign finding – initial short interval follow up suggested. A finding placed in this category should have less than a 2 percent risk of malignancy.

Category 4: Suspicious abnormality – biopsy should be considered. Probability of malignancy in this category is very large, from 5 to 95 percent.

BI-RADS 4A - Very low probability of malignancy.

BI-RADS 4B - Intermediate probability of malignancy.

BI-RADS 4C - Moderate concern for malignancy, but not classical finding for Malignancy.

Category 5: Highly suggestive of malignancy – appropriate action should be taken. The category shows more than 95 % likelihood for malignancy.

Category 6: Known biopsy proven malignancy –appropriate action should be taken.

OTHER IMAGING MODALITIES [38]:

- ***CONTRAST ENHANCED USG***: During the last few years, ultrasound contrast agents have been developed that increased blood echogenity and improve ultrasound image quality by detection of slow and low volume blood flow in small tumor vessels (<5 mm) within the focal lesions in the breast. Commonly used contrast agents are Sonovue (sulfur hexafluoride microbubbles coated with phospholipids) and Levovist (galactose microparticles coated with palmitic acid).

- ***ULTRASOUND ELASTOGRAPHY***: USG elastography explores the principle of tissue response to a given amount of external pressure; a harder tissue (Breast malignancies tend to be schirrhous and harder) shows less distortion to externally applied pressure than softer tissue (normal breast tissue and benign breast masses tend to be softer).

- ***DYNAMIC CONTRAST ENHANCED BREAST MRI***: Neoangiogenesis by the malignant tumour serves as the basis for breast cancer detection by MR imaging. The neovascularity of cancers does not resemble blood vessels found in normal tissue or benign lesions.

  Dedicated breast MR coil are used and performed at 1.5 T or higher MRI. Kinetic curve assessment is analyzed by measuring the signal intensity in a small area of the lesion and tracking its course over the dynamic series. Detection of invasive breast carcinoma is extremely reliable on MR imaging as the sensitivity approaches

100 percent. But breast MRI is expensive and time consuming; it is used in selected situations.

- ***PROTON MR SPECTROSCOPY***: The hallmark of breast MR spectroscopic examination is the detection of choline and its derivatives, at 3.2 ppm. Elevated tCho has been showing more frequently in malignant than in benign enhancing breast lesions.

- ***DIFFUSION WEIGHTED IMAGING***: Invasive breast cancers demonstrate restricted diffusion (lower apparent diffusion coefficient) relative to normal breast tissue or benign breast lesions. This restricted diffusion of water in invasive cancers, renders these lesions bright on diffusion weighted images**.**

- ***BREAST SPECIFIC GAMMA IMAGING*:** BSGI addresses the limited tumor visibility of large field of view sestamibi imaging. It provides optimal spatial resolution and sensitivity and is targeted at 95 percent detection rate of lesions 5 mm in diameter.
- ***POSITRON EMISSION TOMOGRAPHY:*** The ^{18}F-FDG positron emission tomography (PET) has emerged as another imaging tool for many malignancies, including breast cancer. Rapidly dividing neoplastic cells have higher glucose metabolism compared with nonmalignant cells and hence, show preferential uptake of ^{18}F-FDG. It is useful in detection breast cancers in mammographically dense breast, loco regional staging of breast cancer, detection of unsuspected distant metastases, detecting of recurrence in soft tissues and differentiation of scar tissue from cancer recurrence.

- ***POSITRON EMISSION MAMMOGRAPHY:*** PEM is a high spatial resolution (2mm), dedicated breast positron emission tomography device that can provide anatomical and functional information. PEM and MRI had comparable sensitivity, although MRI more accurately detected the need for mastectomy. PEM had greater specificity. Integration of PEM and MRI increased cancer detection to 74 percent versus 60 percent identified with MRI alone.

FINE NEEDLE ASPIRATION CYTOLOGY:

Breast carcinoma is the most common malignant tumor and the leading cause of death from cancer in women. A large number of patients have been suffering from breast cancer. Fine needle aspiration cytology (FNAC) is being performed as a pre-operative test to evaluate breast lump.[44] FNAC is cost effective and can prevent unnecessary surgery.

Technique:

Needles - 23/22 gauge 30-50 mm needle

Syringes - 5-10ml, good quality plastic disposable syringes that provide good negative suction.

Slides thoroughly cleaned dry glass slides free of grease to be used. The aspirate can be smeared between two standard microscope slides.

Fixative - 90% ethanol.

Patient preparation

Procedure was explained and patient must be placed in a comfortable position. For breast lumps simple spirit swab provides disinfection and local anesthesia is not usually required except in apprehensive patients.

Technique

The needle connected to a syringe is introduced into the lesion. A vertical approach is less painful and gives better perception of depth. Negative suction is applied and multiple passes are made within the lesion. Negative suction is released before the needle is withdrawn.

Processing the sample

The sample is expelled onto a slide. Aspirate can be 'dry' (numerous cells in small amounts of tissue fluids) or 'wet' (small number of cells suspended in fluid or blood). A dry aspirate is smeared with the flat of a microscopy slide.

A wet aspirate is smeared in two steps, first move the smearing slide from one end of the specimen slide holding it at a blunt angle and second smear cellular component with the flat of the slide. Smear is fixed with alcohol and subjected to Geimsa, Pap/H&E staining.[45]

BREAST PATHOLOGIES:

Benign lesions [38]

- ***FIBROADENOMA:*** Most common benign tumor of the breast in women of child bearing age group. It develops from the overgrowth of stromal connective tissue within the lobule. It may be single or multiple, unilateral or bilateral, vary in size from few millimeter to a very large size, though usually less than 3 cm in diameter. On mammography, it is seen as well-defined round to oval mass with smooth margins. On USG, they are typically solid, round or oval, well circumscribed, homogenously hypoechoic masses that are wider than taller.

- ***FIBROCYSTIC DISEASE:*** FCD are the most common benign lesion in symptomatic women. It is non-specific term which includes variations in the breast that histologically range from normal physiological changes to premalignant proliferative conditions. Imaging findings are also variable. These include increased mammographic density or heterogeneous echo texture of the breast.

- ***ADENOSIS:*** Adenosis represents enlargement of the lobule secondary to a benign proliferation of the blunt ending intralobular ductules. Mammographically, adenosis rarely forms a visible mass. On occasions, it may be the cause of isolated cluster of uniform microcalcifications. Adenosis is not visible on ultrasound.

- ***CYSTS:*** Breast cysts develop when the lamina of ducts or acini become dilated and lined by atrophic epithelium. Cysts are benign lesions and may remain stable for many years or spontaneously resolve. On mammography, a cyst is typically seen as well-defined round or oval mass. The cyst may be of variable size, solitary or may

occur in clumps. USG has an important role in diagnosis of cysts. They are seen as anechoic well circumscribed masses.

- ***INTRADUCTAL PAPILLOMA:*** Papilloma results from the ductal epithelium. Benign papilloma is the most common cause of unilateral nipple discharge. On mammography, most papillomas are not seen, On USG, it is shown as solid round or oval intraluminal mass.

- ***LIPOMA:*** Most lipomas are superficial and form a palpable mass. They are freely mobile and generally soft. On mammography, they are lucent. On USG, they are hypoechoic just like normal breast.

- ***FAT NECROSIS:*** Fat necrosis is an inflammatory process related to prior trauma or surgery. Mammographically, there is a wide spectrum of appearances. Most lesions are superficial in location. Calcifications are commonly seen. Post – traumatic oil cyst may show varying echogenicity on USG.

- ***GALACTOCELE:*** It is a cyst filled with inspissated milk. Mammographic features vary with the fat content of the cyst. It may be well defined dense lesion like a cyst or radiolucent mass surrounded by dense lactating breast parenchyma.

- ***RADIAL SCAR:*** Also known as sclerosing duct hyperplasia, is a lesion of unknown etiology, possibly related to chronic inflammatory process or obliterative changes in blood vessels. Mammographically, it is a speculated lesion that cannot be

differentiated from cancer. USG findings are also similar to cancer. MRI is diagnostic.

- ***HAMARTOMA:*** Hamartoma or fibrolipoma is an uncommon lesion which results from fibrous and adenomatous proliferation. Mammographically seen as sharply defined mass containing admixture of both fatty and soft tissue density. USG shows hypoechoic and hyperechoic areas within a well-defined lesion.

- ***DESMOID TUMOUR:*** Also known as fibromatosis, is a locally invasive, benign spindle cell tumor. It usually occurs in abdominal wall but may rarely be seen in the breast. It tends to develop deep in the breast, along the pectoralis fascia. Mammographically seen as round or irregular mass with ill-defined or speculated margins.

- ***DIABETIC MASTOPATHY:*** It is rare fibrous tumor that is found in young woman with type 1 diabetes. They are presented as hard palpable breast mass. Mammographic appearance is usually that of asymmetric density. USG shows an ill-defined hypoechoic mass with posterior shadowing.

Inflammatory & related disorders:

- ***DUCTAL ECTASIA:*** There is non-specific dilatation of one or more ducts. It is generally associated with periductal inflammation. The distended duct is filled with secretion and cellular debris. On mammography, the dilated ducts may be not appreciated. USG shows one or more dilated ducts without intraluminal mass.

❖ ***MASTITIS:*** Acute mastitis may progress to from an abscess. It is a painful condition and mammography is difficult to perform. USG is preferred in this case. An abscess can be seen as a complex irregular mass with solid / cystic components.

Malignant lesions of the breast:

❖ ***DUCTAL CARCINOMA In Situ:*** DCIS lies along a spectrum of pre invasive lesions of the breast tissue, with histologic progression to invasive ductal cell carcinoma. On mammography, DCIS is characterized by microcalcifications, usually of linear branching type. USG is unsuitable for microcalcifications but associated soft tissue component may be appreciated as hypoechoic mass.

❖ ***INVASIVE DUCTAL CARCINOMA:*** It is undifferentiated and has no specific histologic pattern. Most commonly presented as a hard mass on palpation and speculated mass on mammography. Malignant calcifications, architectural distortion or any combination of these can be seen.

❖ ***LOBULAR CARCINOMA In Situ:*** It is high risk or pre malignant conditions rather than true cancers. These are asymptomatic and incidentally detected on breast biopsy.

❖ ***INVASIVE LOBULAR CARCINOMA:*** Second most common invasive breast cancer. Clinically presented as ill-defined mass, non-specific induration and tenderness. Mammographically, asymmetric breast density is the commonest finding. Calcification is indistinctly or rare. USG is useful to detect underlying mass in an asymmetric density seen on mammography.

- ***Other less common malignant lesions are medullary carcinoma, mucinous carcinoma, tubular carcinoma and papillary carcinoma.***

Miscellaneous lesions of the breast:

- ***PAGET'S DISEASE:*** Centrally located ductal carcinoma that grows along the ducts into the nipple with eczematous changes at the summit of nipple. The disease is usually unilateral. On mammography and sonomammography, underlying malignant mass or calcification is seen in most patients. Nipple and areolar thickening is also present with malignant type of calcifications.

- ***PHYLLODES TUMOR:*** It is a stromal tumor composed of the epithelial elements of connective tissue stroma, similar to fibroadenoma however, stromal component predominates. Its malignant potential is variable from benign to fully malignant sarcoma. On mammography and sonomammography, they are indistinguishable from fibroadenomas.

- ***SARCOMA:*** They are rare tumor of breast. These include phyllodes tumor, angiosarcoma, fibrosarcoma, liposarcoma, malignant fibrous histocytoma and osterosarcoma. Their imaging features are non-specific.

- ***METASTASES TO BREAST:*** Metastases to breast from other sites are rare. Usual primary sites of cancer are melanoma, lung, stomach, cervix and ovary. On mammography, metastases to breast are usually multiple and bilateral. These are seen as well-defined or ill-defined masses. Spiculations and calcifications are not commonly seen. USG shows single or multiple nonspecific solid masses.

MATERIALS AND METHODS

SOURCE OF DATA

All patients with complaint of lump in the breast referred to Department of Radiodiagnosis, Sri R.L. Jalappa hospital and Research centre, attached to Sri Devaraj Medical College, Kolar, during January 2012 to August 2013.

METHOD OF COLLECTION OF DATA

A Proforma drafted for the study of all patients with breast lumps.

Evaluations were done by mammography, sonomammography and FNAC.

Sample size: 75 patients

Sampling method: Simple random sampling.

Inclusion criteria: All patients with clinically palpable breast lumps

Exclusion criteria:

1. Women below 30 years of age.
2. Women with advanced malignancy, fungating mass per breast and fixed lumps to the chest wall where performing mammography will be difficult.
3. Pregnant women
4. Male patients.

INVESTIGATIONS

1. Mammography of both breasts
2. Sonomamography of both breasts
3. Fine needle aspiration cytology of breast lesion.

Mammography was performed with GE ZMX70-M. Both cranio-caudal and medio-lateral views are taken and the image was assessed and scored using the BIRADS.

Sonomammography examination was performed with SIEMENS ACUSON X 300, SEIMENS G 50 and SEIMENS G 40 with 5-10 Mhz linear transducer. Both the breasts were scan radially and by grid scanning technique. The results were analyzed and categorized according to BIRADS (Breast Imaging Reporting and Data System) score.

FNAC were performed under ultrasound guidance in the most suspicious lesions and at least two sites were taken. FNAC was done with Giemsa stain, Papanicolaou stain and H & E stain. Core biopsy was done when FNAC was inconclusive. Imaging studies were done for patients before FNAC.

RESULTS

- The patients presenting with complaints of lump in the breast and who expressed consent for the study were and investigations were done as outlined in method of study.
- 75 patients entered the study and all patients were subjected to all investigations.
- The results of the study are shown in the following tables.
- The sensitivity, specificity, positive and negative predictive values of each investigation was calculated individually.

TABLE 1: Age distribution of breast lesions

Sl.No.	Age groups (in years)	No. of cases	Percentage
1.	30-39	16	21.3
2.	40-49	29	38.6
3.	50-59	17	22.6
4.	>60	13	17.3
Total		**75**	**100**

Graph 1: Age distribution of breast lesions

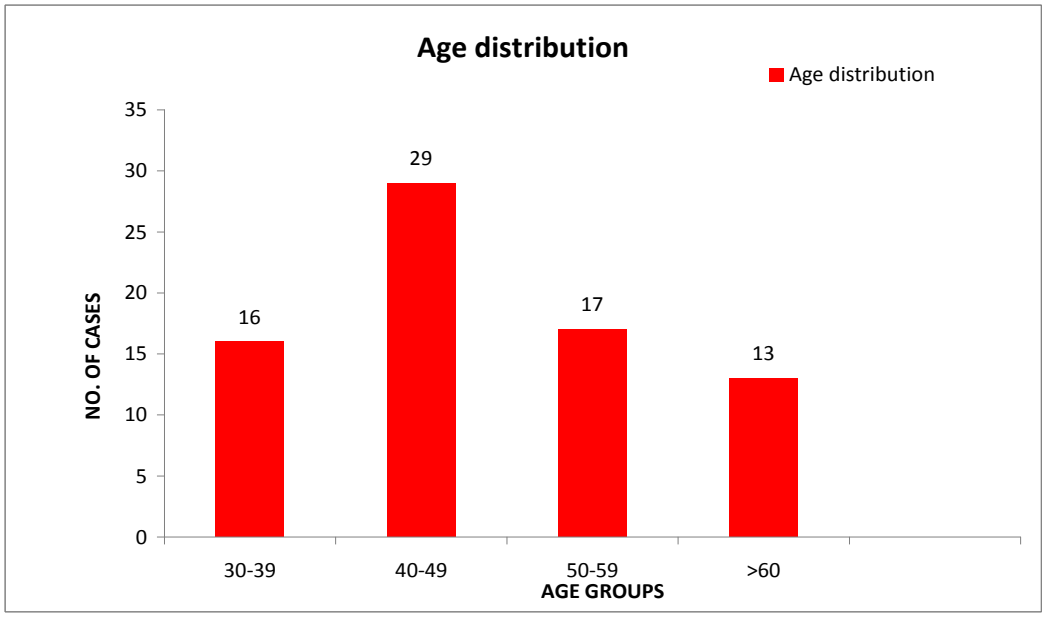


TABLE 2: Distribution of breast lesions according to the side of involved breast

Sl. No.	Side	No. of cases	Percentage
1.	Right	30	40
2.	Left	33	44
3.	Bilateral	12	16

Graph 2: Distribution of breast lesions according to the side of involved breast

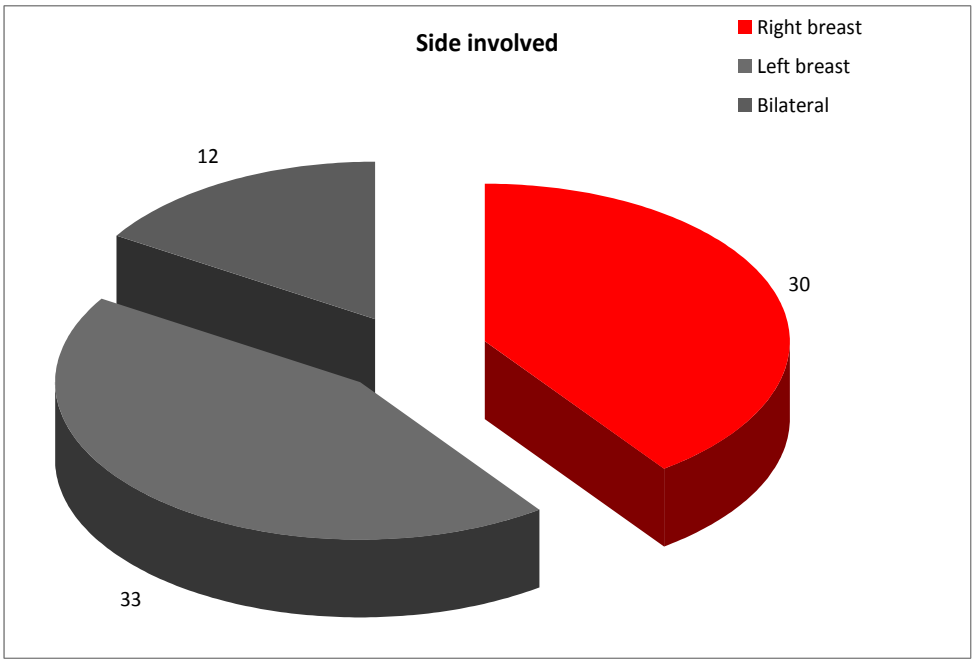


Table 3: Distribution of breast lesions according to quadrant involved

Sl. No.	Quadrant involved	No. of cases	Percentage
1.	Upper outer (UO)	23	30.6
2.	Upper inner (UI)	09	12.0
3.	Lower outer (LO)	06	8.0
4.	Lower inner (LI)	05	6.6
5.	Central (C)	11	14.6
6.	> One quadrant (>1)	21	28.0
Total		**75**	**100**

Graph 3: Distribution of breast lesions according to quadrant involved

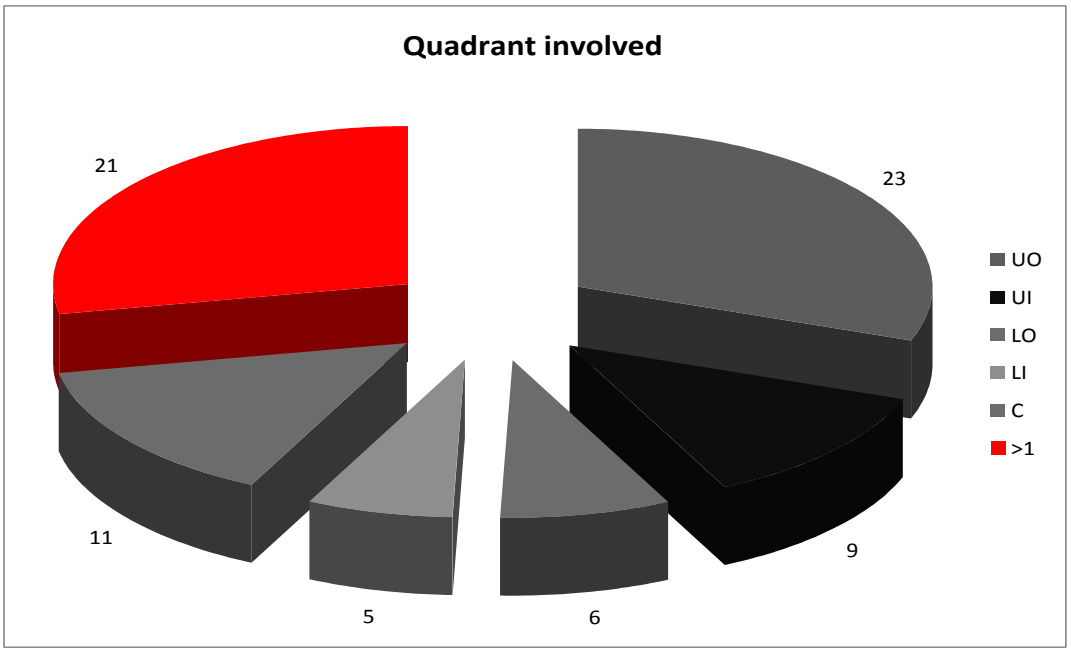


TABLE 4: Distribution of cases diagnosed by mammography according to BIRADS classification

Sl. No.	Mammographic diagnosis (BIRADS)	No. of cases	Percentage
1.	0	06	8
2.	1	-	-
3.	2	42	56.0
4.	3	03	4.1
5.	4	20	26.6
6.	5	04	5.3
Total		**75**	**100**

Graph 4: Distribution of cases diagnosed by mammography

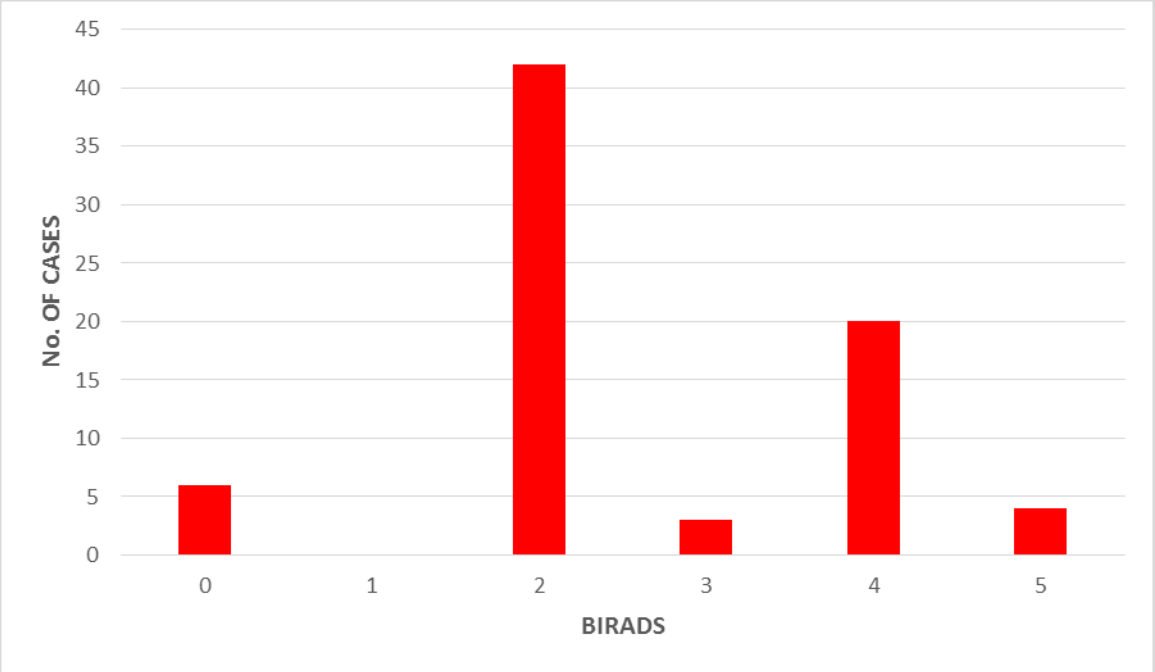


TABLE 5: Distribution of benign and malignant cases on mammography

Sl. No.	Lesions	No. of cases	Percentage
1.	Benign	45	60
2.	Malignant	24	32
3.	Inconclusive	06	08
Total		**75**	**100**

Graph 5: Distribution of benign and malignant cases on mammography

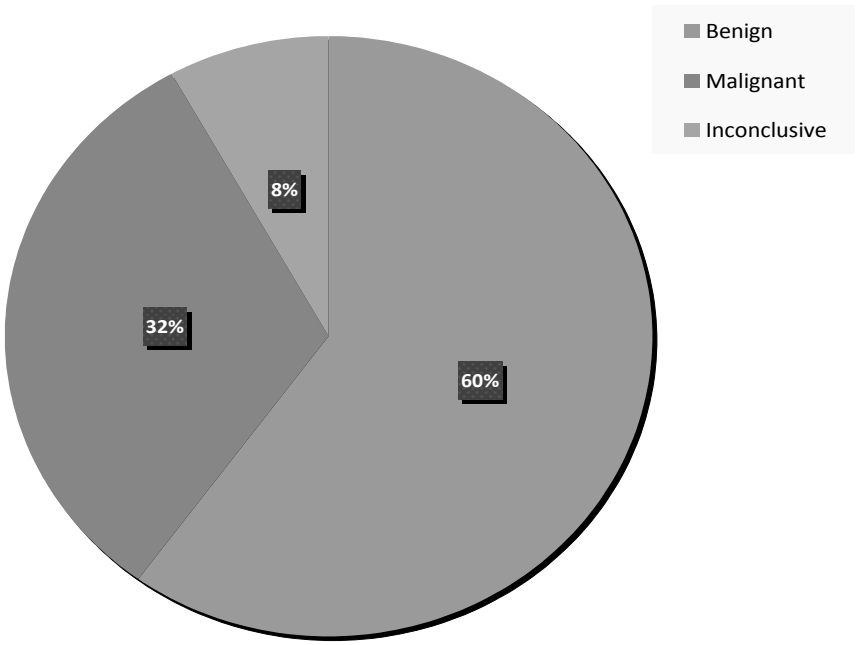


TABLE 6: Distribution cases in sonomammography according to BIRADS classification

Sl. No.	USG BIRADS	No. of cases	Percentage
1.	0	-	-
2.	1	-	-
3.	2	49	65.3
4.	3	05	6.6
5.	4	19	25.3
6.	5	02	2.6
TOTAL		**75**	**100**

Graph 6: Distribution of cases in sonomammography

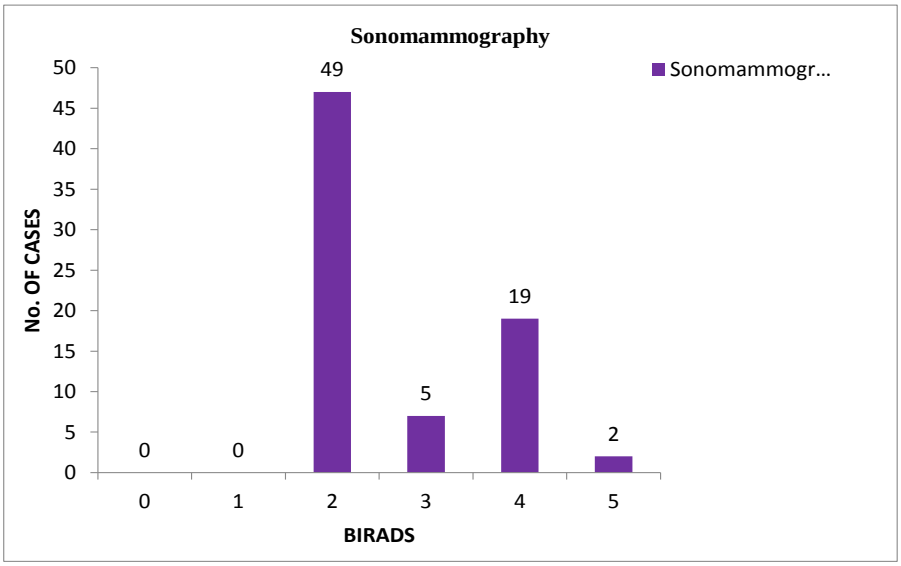


TABLE 7: Distribution of benign and malignant cases in sonomammography

Sl. No.	Lesions	No. of cases	Percentage
1.	Benign	54	72
2.	Malignant	21	28
Total		75	100

Graph 7: Distribution of benign and malignant cases in sonomammography

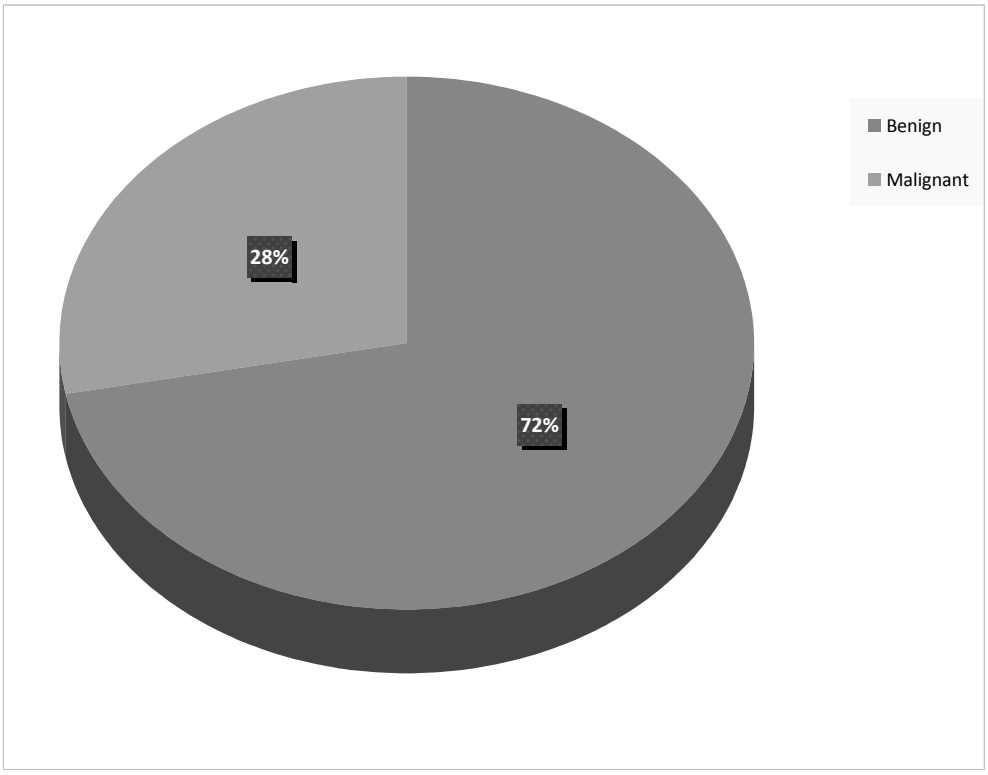


TABLE 8: Distribution of benign and malignant cases in FNAC

Sl. No.	Lesions	No. of cases	Percentage
1.	**Benign**	49	65.5
2	**Malignant**	26	34.6
	Total	**75**	**100**

Graph 8: Distribution of benign and malignant cases in FNAC

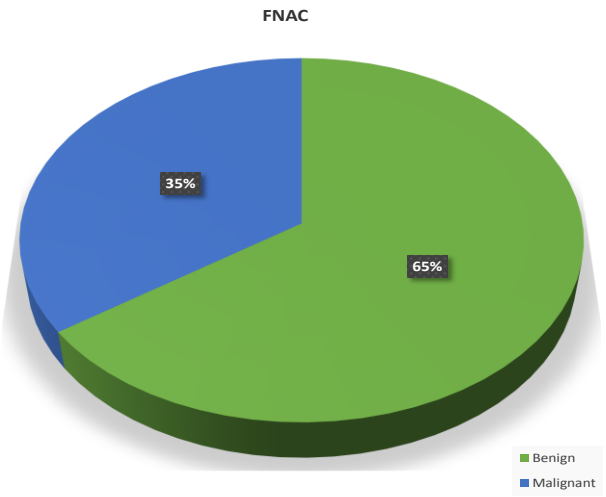


TABLE 9: Distribution of cases diagnosed by combined mammography and sonomammography according to BIRADS classification

Sl. No.	BIRADS	No. of cases	Percentage
1.	0	-	-
2.	1	-	-
3.	2	47	62.6
4.	3	04	5.3
5.	4	20	26.7
6.	5	04	5.3
		75	**100**

Graph 9: Distribution of cases diagnosed by combined mammography and sonomammography

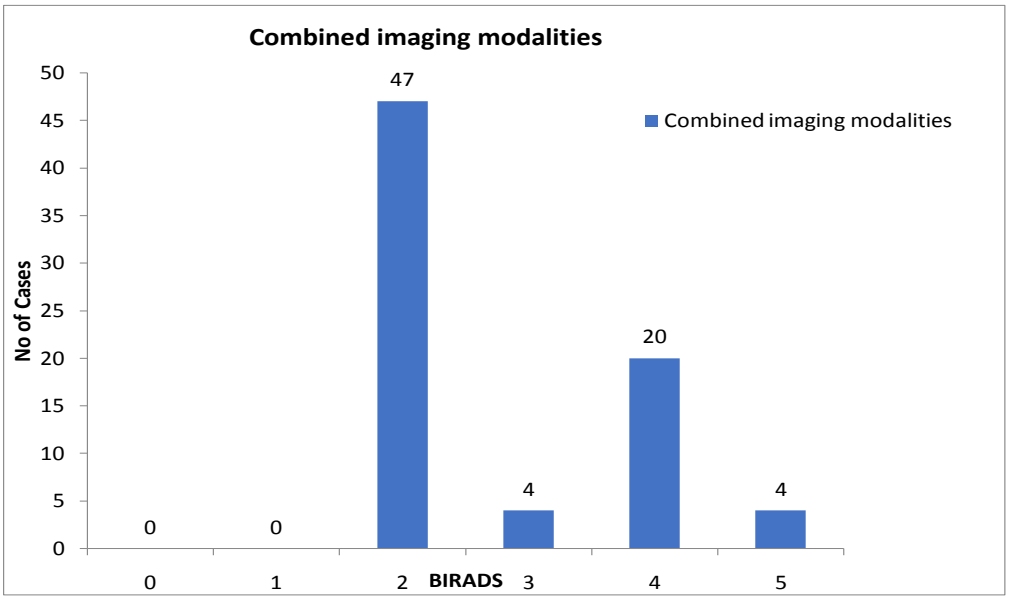


TABLE 10: Distribution of benign and malignant cases in combined mammography and sonomammography

Sl. No.	Lesions	No. of cases	Percentage
1.	Benign	51	68
2.	Malignant	24	32
		75	100

Graph 10: Distribution of benign and malignant cases in combined mammography and sonomammography

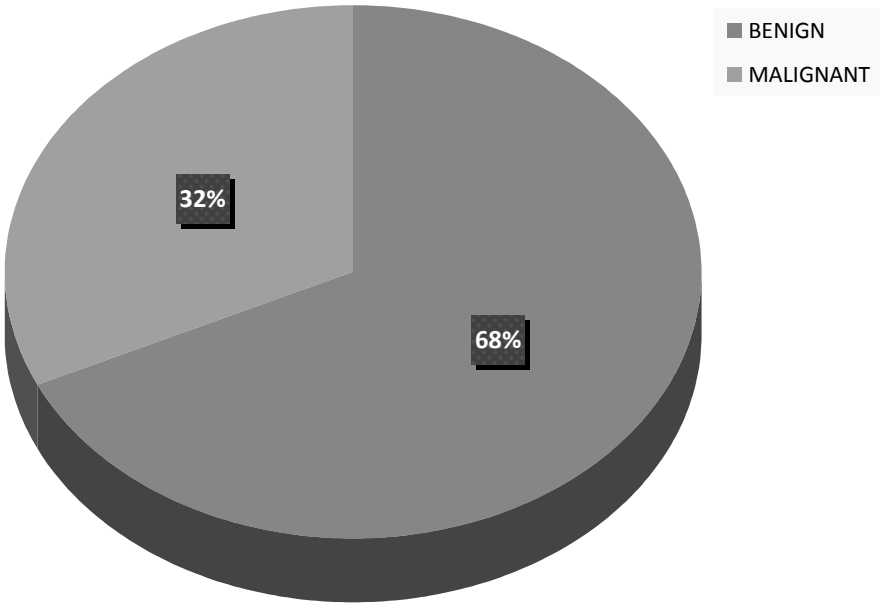


TABLE 11: Distribution of diagnostic modalities with FNAC

Sl.No.	Investigation	Benign	Malignant	Incon.	Total
1.	Mammography	45	24	06	75
2.	Sonomammography	54	21	-	75
3.	FNAC	49	26	-	75
4.	Combined imaging modalities	51	24	-	75

Graph 11: Distribution of diagnostic modalities with FNAC

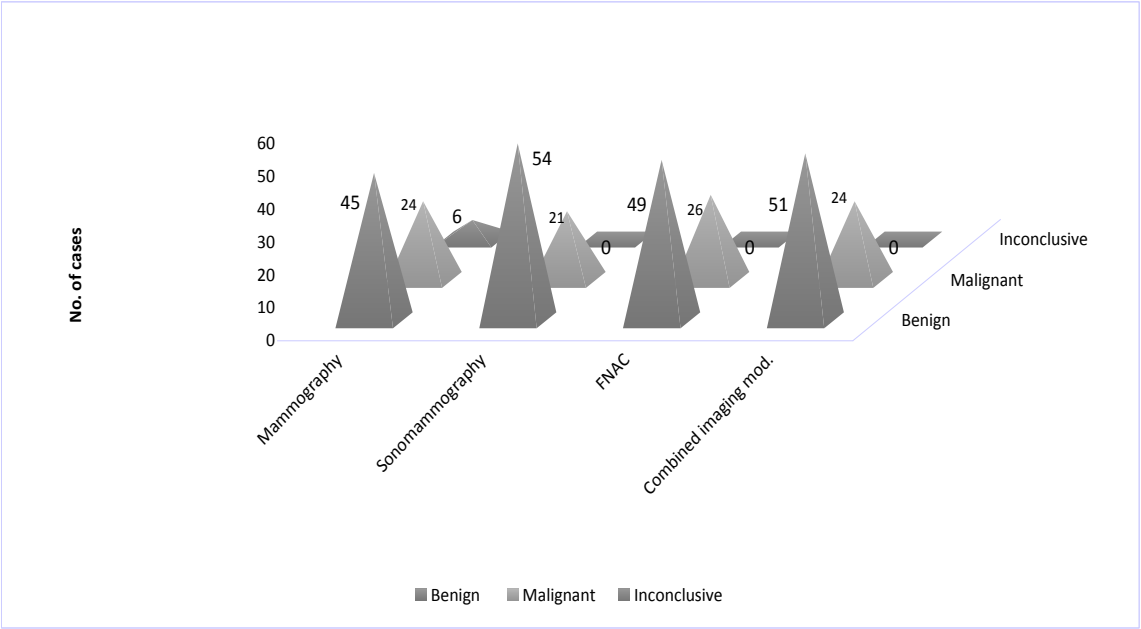


TABLE 12: Comparison of mammographic diagnosis with FNAC

Sl.No.	Mammography Diagnosis	FNAC diagnosis		Total
		Malignant	Benign	
1.	**Malignant**	24	04	**28**
2.	**Benign**	02	45	**47**
		26	49	**75**

Sensitivity - 92.3%

Specificity – 91.8%

Positive predictive value – 85.7%

Negative predictive value – 95.7%

TABLE 13: Comparison of sonomammography diagnosis with FNAC

Sl.No.	Sonomammography Diagnosis	FNAC diagnosis		Total
		Malignant	Benign	
1.	**Malignant**	21	0	**21**
2.	**Benign**	05	49	**54**
		26	49	**75**

Sensitivity – 80.1 %

Specificity – 100%

Positive predictive value – 100%

Negative predictive value – 90.7 %

TABLE 14: Comparison of combined imaging modalities with FNAC

Sl.No.	Combined Diagnosis	FNAC diagnosis		Total
		Malignant	Benign	
1.	**Malignant**	24	-	**24**
2.	**Benign**	02	49	**51**
		26	49	**75**

Sensitivity – 92.3 %

Specificity – 100 %

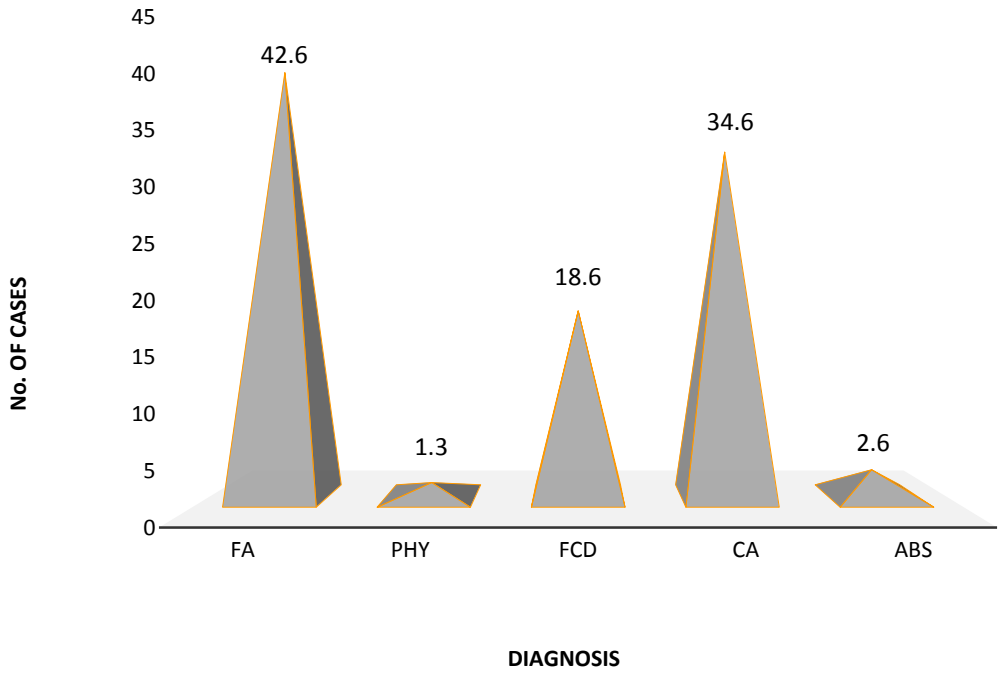
Positive predictive value – 100%

Negative predictive value - 96.0%

TABLE 15: Distribution of cases based on FNAC

Sl. No.	FNAC diagnosis	No. of cases	Percentage
1.	Fibroadenoma	32	42.6
2.	Phyllodes	01	1.3
3.	Fibrocystic disease	14	18.6
4.	Carcinoma	26	34.6
5.	Abscess	02	2.6

Graph 12 : Distribution of cases based on FNAC



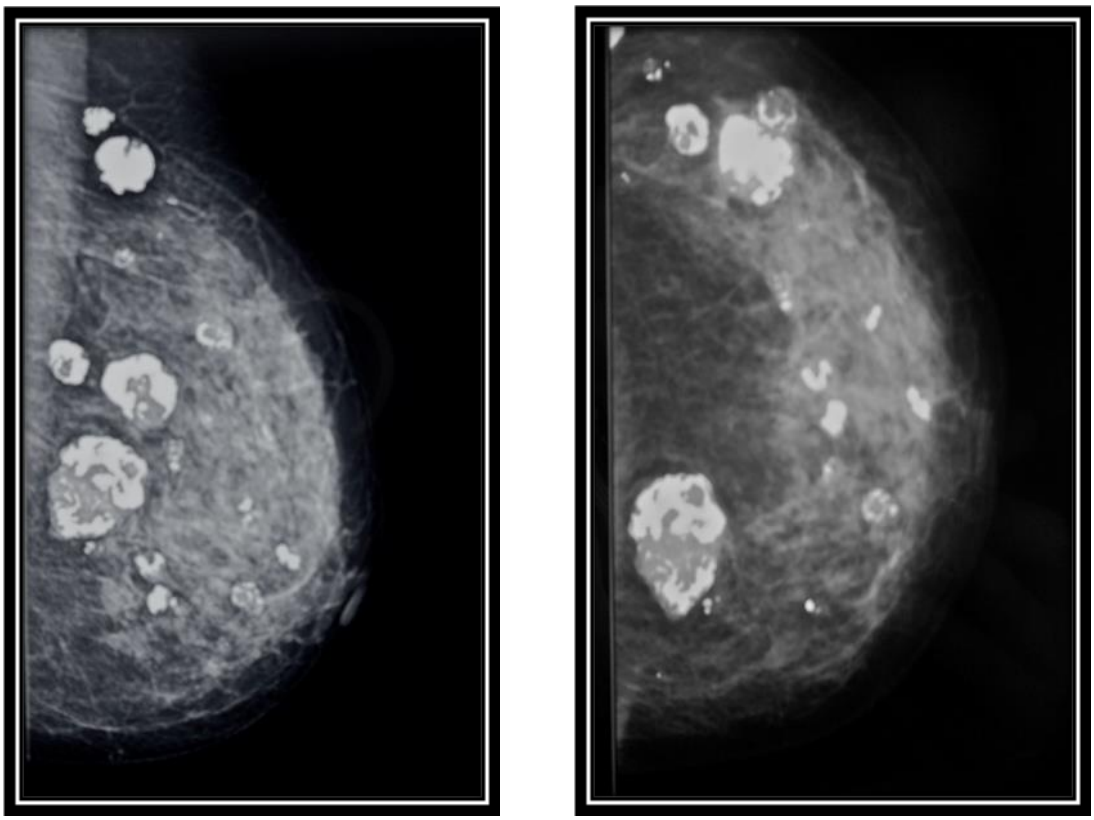


Fig No. 13: Medio-lateral oblique and cranio-caudal views showing multiple well defined lesions with popcorn calcifications - Involuting fibroadenoma

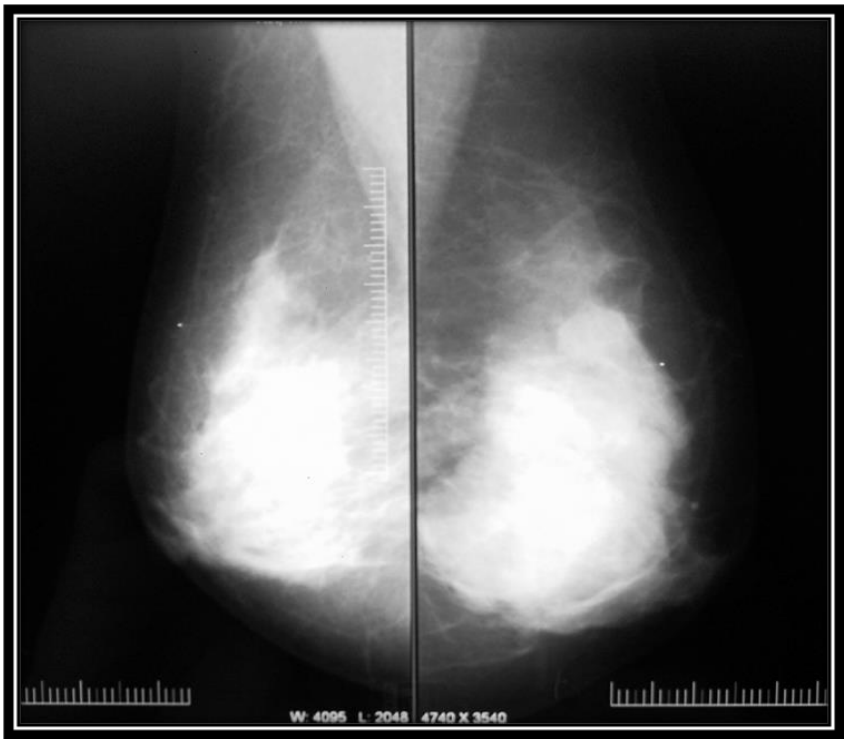


Fig No. 14: Mammographic image of a dense breast

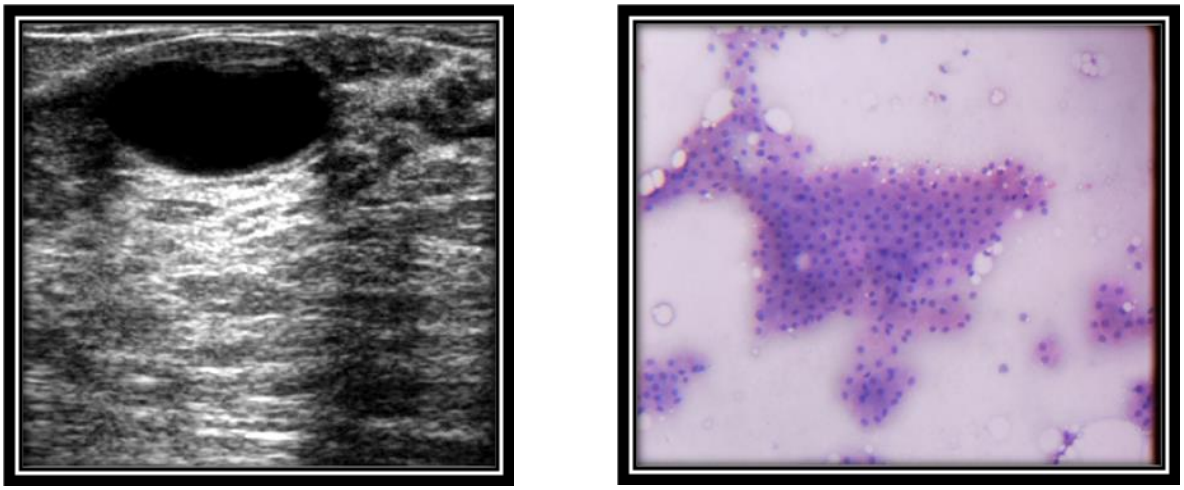


Fig No. 15: (a) USG image of a cyst not seen on mammographically dense breast with (b) FNAC showing sheets of apocrine cells.

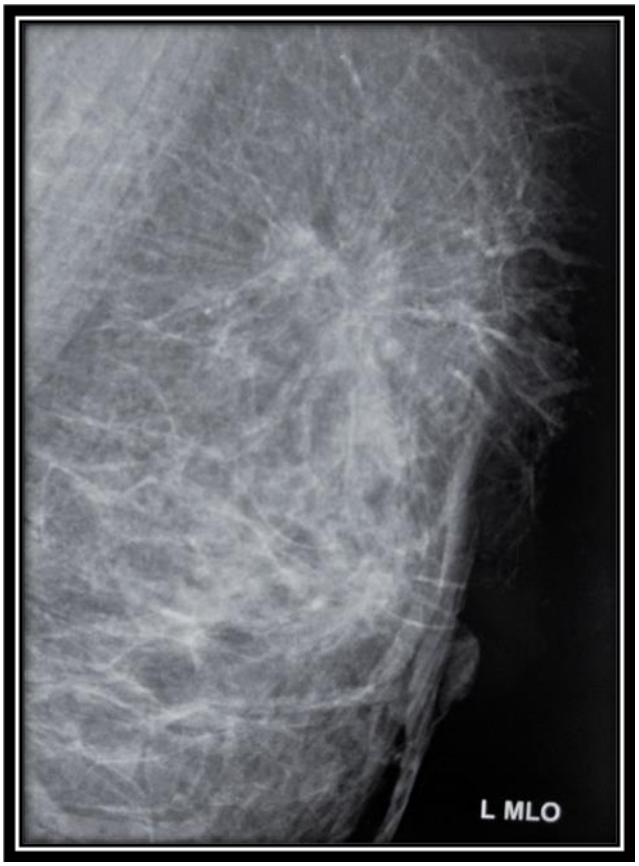


Fig No. 16: Mammographic image showing spiculated lesion which is consistent with carcinoma breast.

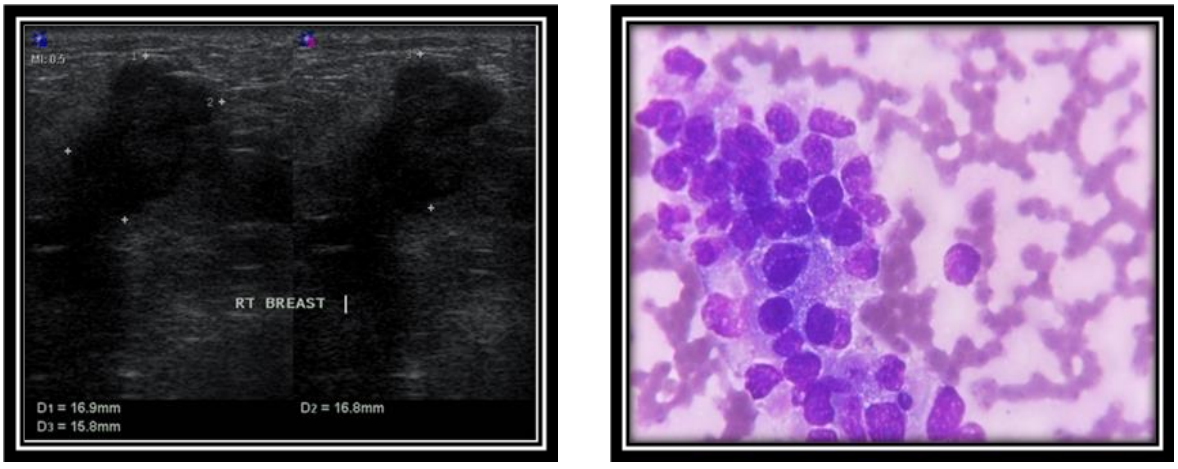


Fig No.17: (a) USG image of malignant lesion of breast with (b) FNAC showing anisokaryosis, irregular nuclear membrane and high n/c ratio - s/o neoplastic change.

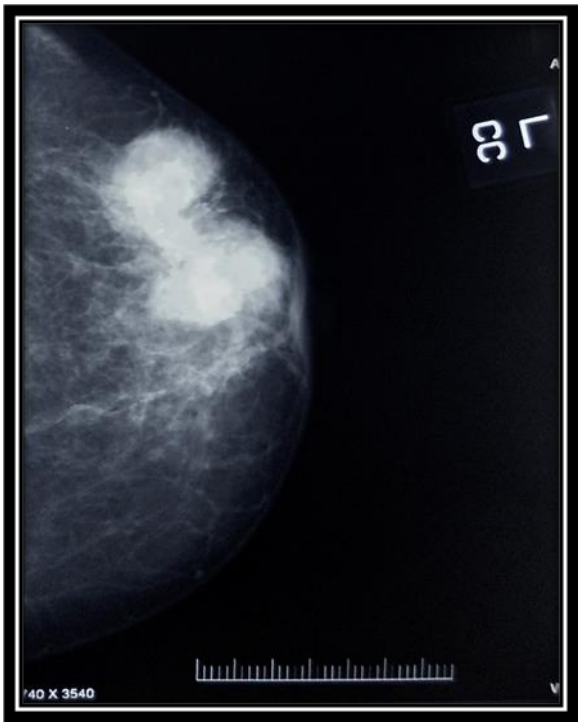


Fig No. 18: Cranio-caudal view of left breast showing bilobed mass lesion – BIRADS 5.

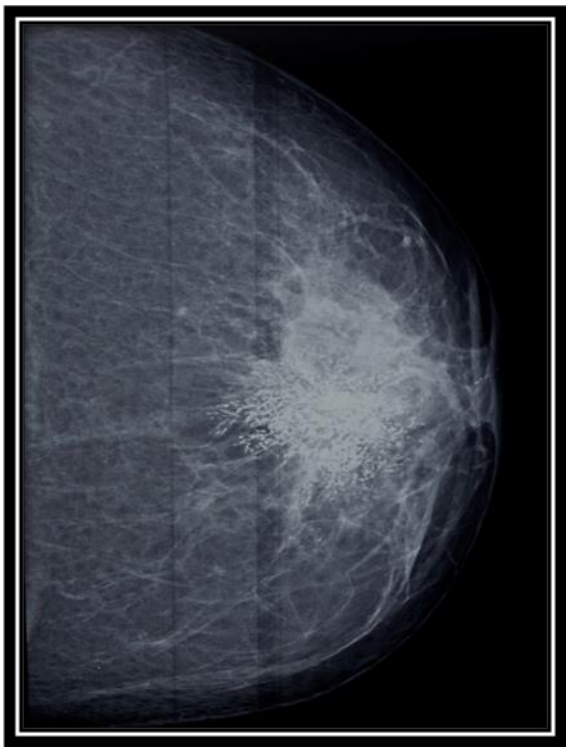


Fig No. 19: Cranio-caudal view showing ill-defined dense lesion with microcalcifications – carcinoma breast.

DISCUSSION

Breast carcinoma has been reported in only 4% of patients with breast symptoms, and even among palpable lesions undergoing biopsy, a large number of lesions turned out to be benign. [46,47]

The role of mammography in patients with palpable breast lumps is to rule out malignancy for any palpable abnormality and to avoid further intervention. It help in earlier intervention for a mass with malignant features along with screening for additional lesions in the ipsilateral and contralateral breast. It is also useful in assessing the extent of malignancy when cancer is diagnosed. [48]

Mammography is the only screening modality, which has been proven to reduce mortality from breast cancer through early detection.[49]

Sensitivity of mammography in detection of breast cancers in the screening set up ranges from 83 to 95 percent.[50]

However, the false negative rate of mammography for breast cancer in patients with palpable abnormalities of the breasts has been reported to be as high as 16.5%.[51] Mammographic sensitivity for breast cancer declines significantly with increasing breast density and is independently higher in older women with dense breasts.[52] It decreases to as low as 30 to 48 percent in patients with mammographically dense and glandular breasts.[53]

Multiple studies have shown that the false negative rate for a combined mammographic and sonographic evaluation varies from 0% to 2.6%. [54,55,56,57]

In this study, 75 patients with age ranging from 30 years to maximum of 72 years are seen with median age of 47 years, presented with breast lesions and these patients were evaluated using mammography and sonomammography.

The results from each investigation were compared with - fine needle aspiration report**.**

Investigations	**Sensitivity**	**Specificity**	**Positive predictive value**	**Negative predictive value**
Mammography	**92.3**	**91.8**	**85.7**	**95.7**
USG	**80.7**	**100**	**100**	**90.7**
Combined imaging	**92.3**	**100**	**100**	**96.0**

Out of 75 patients, 38.6 % belonged to age group ranging from 40-49 years followed by age group of 50-59 years with 22.6 %.

The lesion involved the left breast (44%) more commonly.

The distribution of breast lesions are seen more in the upper and outer quadrant (30.6 %) closely followed by lesions involving more than one quadrant (28%).

Benign diseases (65.5%) were more common than malignant (34.5%), of which fibroadenoma constituted 42.5% of cases.

The sensitivity, specificity, positive and negative predictive values of each investigation was calculated individually. Combined imaging studies had highest specificity and positive predictive value (100%) and mammography alone and combined imaging studies had highest sensitivity (92.3%) for all palpable lesions.

Sonomammography have become a very important tool when a situation arises where mammogram could not differentiate a solid tumor from a cyst.

Similar studies evaluating the components of triple assessment are taken and the results of the present study compared with those studies.

Moss et al [57] reported that sonomammography increased cancer detection by 14% in symptomatic patients who were evaluated with both mammography and sonomammography. In retrospective analysis of 293 palpable malignant lesions, sonomammography detected all cancers; 18(6.1%) of these 293 cancers were mammographically occult.[58]

Table 14 : Comparison of Mammography results with other Studies

Study	Al-Muhim et al(59)	Philip J et al(60)	**Present study**
Sensitivity	87.5%	87.6%	**92.3%**
Specificity	97.3%	86.5%	**91.8%**
Positive predictive value	87.5%	-	**85.7%**

Table 15 : Comparison of Sonomammography results with other Studies

Study	Ashley et al (61)	Ghazala et al (62)	**Present study**
Sensitivity	65%	67%	**80.7%**
Specificity	95%	92.4%	**100%**

In a study done by Philip J Drew et al[60] to compare the sensitivity and specificity of the traditional triple assessment of symptomatic breast lesions with contrast-enhanced dynamic magnetic resonance imaging, they found the sensitivity of mammography 87.6%, and specificity of 86.5%. The results of this study were similar to the results of the present study.

Al-Muhim et al [59] in a study to assess accuracy of the "triple test" in the diagnosis of palpable breast masses in Saudi females, found that Mammography showed 87.5% sensitivity, 97.3% specificity and 87.5% positive predictive value. They concluded that the triple test was 100% accurate in the diagnosis of palpable breast lesions when all three elements were concordant.

Combined imaging evaluation leads to fewer unnecessary biopsies.[68] Perdue et al [63] reported that only 11.1% of 623 excisional biopsy specimens of palpable breast revealed carcinoma. In this study only 7 of the 50 palpable abnormalities underwent biopsy on the basis of imaging findings and only 2 (4%) showed malignancy.

The value of combined mammographic and sonographic imaging in symptomatic patients has been studied previously.

Moss et al reported sensitivity of 94.2% and specificity of 67.9% in 368 patients.[57]

Shetty MK and Shah YP reported a sensitivity of 100% and specificity of 80.1%. [65] Barlow et al reported a sensitive of 87% and specificity of 88% and positive predictive value of 22 % [66]

When a patient presents with a lump in breast, combined imaging studies can distinguish benign from malignant lesions.[69, 70]

Inclusion of sonomammography to mammographic studies adds up to the diagnosis in patients with breast lesions.

CONCLUSION

- Benign neoplasms of the breast are more common than malignant ones.
- Commonest age group for breast lesions ranges from 40-49 years.
- Upper outer quadrant of breast is the most common site for breast lesions.
- Combined imaging modalities of mammography and sonomammography play an important role in diagnosing palpable breast lesions. It helps in :
    a) Better characterization of the breast lesions.
    b) Avoiding unnecessary investigations or surgical procedures in which imaging findings are unequivocally benign.
    c) Negative findings on combined mammographic and sonomammographic imaging studies have very high specificity and are reassuring to the patient.

SUMMARY

The majority of the breast lesions that we encounter are benign. Lot of concern is given to malignant lesions of the breast because breast cancer is the most common malignancy in women in Western countries and rising increasingly in our country. A majority of benign lesions are not associated with an increased risk for subsequent breast cancer, so unnecessary surgical procedures should be avoided.

Diagnosis of breast cancer under a single imaging modality, namely mammography has higher sensitivity and lesser specificity than specificity and has high diagnostic error. When combined imaging modality is performed, a definitive diagnosis can be made, suggesting that the combined imaging study has a high sensitivity, specificity, positive predictive value and negative predictive value.

The output of the combined imaging study is reproducible, making it a valid and reliable diagnostic approach to diagnosis of breast cancer.

In this study the patients with breast lumps were evaluated with Mammogram, Sonomammogram and both combined modalities, later to be compared with FNAC findings.

The sensitivity, specificity, positive and negative predictive values were calculated for each of the modalities and compared.

A total of 75 patients were included in the study, with age more than 30 years. Benign diseases (64 %) were more common than malignant (36 %), of which fibroadenoma constituted 42.6 % of cases.

The sensitivity, specificity, positive and negative predictive values of mammography is 92.3%, 91.8%, 85.7%, 95.7%; Sonomammography has 80.7%, 100%, 100%, 90.7%; Combined imaging modality is 92.3 %, 100 %, 100 % and 96.0% respectively.

Combined imaging modality is very useful tool in evaluating and characterizing the breast diseases.

In patients with lump, combined imaging modality alone may be sufficient to rule out malignancy and this may be cost-effective and easily available than other modalities.

Thus, it avoids unnecessary investigations or surgical procedures in which imaging findings are unequivocally benign.

The negative findings on combined mammographic and sonomammographic imaging studies have very high specificity and are reassuring to the patient.

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ANNEXURES

CONSENT FORM

Mrs/Ms ----------

Age----------years

Address ----------

Hereby give consent to **Dr. JAYADEVA PHURAILATPAM** , for performing the procedure related to the study as explained to me and any other procedure necessary or advisable to complete the study.

I have completely understood the purpose of the procedure and the associated possible complications.

I also agree to co-operate with him and agree by my own free will and in complete consciousness without any influence give my consent.

Signature of the patient

ANNEXURES

PROFORMA

SL NO. -

Name - **Hosp. no. -**

Sex – Female **Age -**

Marital status - married / unmarried **Address -**

PRESENTING COMPLAINTS:

a) **Lump -**
b) **Pain –**
c) **Nipple discharge –**
d) **Nipple retraction –**
e) **Others –**

HISTORY OF PRESENT ILLNESS –

a) **Onset**
b) **Progression**
c) **Associated complaints, etc.**

PAST HISTORY – Old case of breast ca / post-operative / any breast lesions

PERSONAL HISTORY –

a) **Menstrual history**
b) **Marital status**
c) **Lactational history**

FAMILY HISTORY: Ca breast **Yes/No**

LOCAL EXAMINATION:

INSPECTION – Nipple retraction **Yes/No**

Skin over the surface **Peau de orange** **Yes/No**

PALPATION OF LUMP -

a) **Hard/ Soft/ Firm**
b) **Lobulated**
c) **Adherent overlying skin**
d) **No. of lesion**
e) **Multiple/single**
f) **Axillary lymph nodes**

INVESTIGATIONS:

a) **Mammography**
b) **Sonomammography**
c) **Fine needle aspiration cytology**
d) **Histopathology (wherever applicable)**

MAMMOGRAPHY:

PARENCHYMAL DENSITY

a) **Fatty**
b) **Scattered fibro glandular**
c) **Dense**
d) **Heterogeneously dense**
e) **Asymmetric density –**

MASS

a) **Number** **Single/multiple**
b) **Size**
c) **Margins - Circumscribed/ lobulated/ ill-defined/ poorly defined/ obscured margins/**
Spiculated margins
d) **Shape - Oval / round /lobular /irregular**
e) **Architectural distortion**
f) **Calcifications - present/absent**

If present, whether

i. **Macro calcifications** **present/absent**
ii. **Micro calcifications** **present/absent**

Others

a) **Location of mass - LI / LO/ CEN / UO / UI/ more than 1 quadrant**
b) **Associated findings**
    1. **Skin retraction**
    2. **Skin thickening**
    3. **Nipple retraction**
    4. **Axillary lymphadenopathy**
c) **Interval change**
d) **Others**
    1) **Edema of the breast**
    2) **Accessory breast /breast tail lesion**
    3) **Breast implants, etc.**

MAMMOGRAPHIC DIAGNOSIS - BIRADS SCORING:0/ I/ II/ III/IV/V

SONOMAMMOGRAPHY :

1. **Solid/Cystic mass**
2. **Location - LI / LO/ CEN / UO / UI/ more than 1 quadrant**
3. **Cyst**
    a. **Number** **single/multiple**
    b. **Round/ oval**
    c. **Width**
    d. **Internal echoes** **yes/no**
    e. **Septations** **yes/no**
    f. **Posterior enhancement** **yes/no**
    g. **Compressibility** **yes/ no**
    h. **Calcifications** **present/absent**
    i. **Wall –**
4. **Solid**
    a. **Shape**
    b. **Height - width ratio**
    c. **Margins**
    d. **Sound absorption**
    e. **Compressibility**
    f. **Calcification**
    g. **Vascularity of lesion**

SONOMAMMOGRAPHIC DIAGNOSIS - BIRADS SCORING: 0/ I/ II/ III/IV/V

CYTOLOGICAL FINDINGS:

GROSS:

a. **Amount of aspirate:**
b. **Nature of aspirate:**

MICROSCOPY:

a. **Adequacy of smear: adequate/ inadequate**
b. **Cellularity: poor/ moderate/ high**
c. **Cohesiveness: loose/tight**
d. **Pattern of arrangement:**
e. **Type of cells:**
f. **Other cells:**
g. **Cell size: small/ normal/ large**
h. **Cytoplasm: scanty/ moderate/ abundant**
i. **Nuclear features: size: small/ normal/ large**
    i. **N/c ratio: normal/ increased**
    ii. **Nuclear membrane: regular/ irregular**
    iii. **Nuclear overlapping: yes/ no**
    iv. **Chromatin pattern: fine/ coarse/ vesicular/bland/hyperchromatic**
    v. **Mitosis: present/ absent**
    vi. **Nucleoli: present/absent**
j. **Back ground: Proteinacious/ mucin/ fat globules/ RBCs/ necrosis/others**

FNAC DIAGNSOSIS:

FINAL DIAGNOSIS: BIRADS SCORING 0/I/II/III/IV/V

KEY TO MASTER CHART:

1)	**L**	**Lump**
2)	**P**	**Pain**
3)	**D**	**Discharge**
4)	**UI**	**Upper Inner**
5)	**UO**	**Upper Outer**
6)	**LI**	**Lower inner**
7)	**LO**	**Lower outer**
8)	**CEN**	**Central**
9)	**>1**	**More than one quadrant**
10)	**BENIGN**	**Benign breast lesion**
11)	**MALIGNANT**	**Malignant breast lesion**
12)	**HOM DEN**	**Homogenously dense**
13)	**HET DEN**	**Heterogeneously dense**
14)	**ANE**	**Anechoic**
15)	**HYPO**	**Hypoechoic**
16)	**HYPER**	**Hyperechoic**
17)	**MIXED**	**Mixed echoic**
18)	**NIL**	**Lesion not detected**
19)	**MC**	**Microcalcification**
20)	**PC**	**Popcorn calcification**
21)	**CC**	**Coarse calcification**
22)	**0**	**BIRADS 0**
23)	**1**	**BIRADS 1**
24)	**2**	**BIRADS 2**
25)	**3**	**BIRADS 3**
26)	**4**	**BIRADS 4**
27)	**5**	**BIRADS 5**

SI NO.	NAME	HOSPITAL NO.	AGE	COMP	SIDE	QUADRANT	MAMMO		USG	MAMMO DIAG (BIRADS)	USG DIAG (BIRADS)	COMB. DIAG (BIRADS)	FNAC DIAG
							MARGIN	DENSITY	ECHOGENICITY				
1	Mubashira	815918	37	L, P	Left	UO	WD	HOM DEN	HYPO	2	2	2	BENIGN
2	Parvathamma	761953	45	L	Bilateral	>1	WD	HOM DEN	HYPO	2	2	2	BENIGN
3	Shaheeda begum	770946	35	L	Bilateral	>1	WD	HOM DEN	HYPO	2	2	2	BENIGN
4	Savitha SV	770138	39	L	Bilateral	CEN	WD	HET DEN,CC	HYPO	2	2	2	BENIGN
5	Sudha	769746	47	L,P	Left	>1	WD	HET DEN	HYPO	2	2	2	BENIGN
6	Rathna	768204	60	L	Right	UO	WD	HOM DEN	HYPO	2	2	2	BENIGN
7	Shanaz	766121	40	L	Bilateral	>1	NIL	NIL	ANE	0	2	2	BENIGN
8	Gayathri devi	784592	48	L, P	Right	UO	ID	HET DEN,MC	HYPO	3	2	3	MALIGNANT
9	Pilamma	784592	56	L	Bilateral	LO	WD	HOM DEN	HYPO	2	2	2	BENIGN
10	Rani	783078	46	L,P,D	Left	CEN	ID	HET DEN	HYPO	4	3	4	MALIGNANT
11	Ramaka	798855	60	L	Left	LI	WD	HOM DEN	HYPO	2	2	2	BENIGN
12	Lalithamma	805522	60	L	Left	>1	NIL	NIL	ANE	0	2	2	BENIGN
13	Venkatama	549422	45	L	Right	>1	WD	DENSE	HYPO	2	2	2	BENIGN
14	Mageshwori	795926	37	L	Left	UO	ID	HET DEN	HYPO	5	4	5	MALIGNANT
15	Suthama	794570	35	L,P,D	Bilateral	CEN	ID	HET DEN,MC	HYPO	4	3	4	MALIGNANT
16	Avathi	794441	35	L	Right	CEN	WD	HOM DEN	HYPO	2	2	2	BENIGN
17	Veeruthi	805191	45	L	Right	UO	NIL	NIL	HYPO	0	2	2	BENIGN
18	Suvarna	805606	46	L	Right	LO	WD	HOM DEN	HYPO	2	2	2	BENIGN
19	Usha	804933	57	L	Right	UI	WD	HOM DEN	HYPO	2	2	2	BENIGN
20	Zaidunissa	815307	50	L	Left	UO	ID	HET DEN	HYPO	4	4	4	MALIGNANT
21	Jayamma	813061	45	L,P	Right	UO	WD	HOM DEN	HYPO	2	2	2	BENIGN
22	Gokulla	898489	58	L	Right	UO	WD	HOM DEN,CC	HYPO	2	2	2	BENIGN
23	Mary	811777	50	L	Left	UO	WD	HOM DEN	HYPO	2	2	2	BENIGN
24	Munilakshamma	716828	62	L	Left	UO	NIL	NIL	HYPO	0	2	2	BENIGN
25	Shantabai	889535	62	L,P	Right	CEN	WD	HOM DEN	HYPO	2	2	2	BENIGN

26	Sudha	819033	45	L,P	Bilateral	CEN	NIL	NIL	ANE	0	2	2	BENIGN
27	Santha	831831	35	L	Right	LO	WD	HOM DEN	HYPO	2	2	2	BENIGN
28	Byramma	830889	45	L,P	Left	UO	ID	HET DEN	HYPO	3	3	3	MALIGNANT
29	Gowramma	829742	50	L	Right	>1	WD	HOM DEN	HYPO	2	2	2	BENIGN
30	Munirathnamma	823875	59	L	Right	UI	WD	HET DEN	HYPO	2	2	2	BENIGN
31	Ruby agnes	827149	71	L,P	Left	CEN	ID	HET DEN	HYPO	5	4	5	MALIGNANT
32	Sowbhagyamma	827513	60	L	Bilateral	>1	WD	HOM DEN,PC	HYPO	2	2	2	BENIGN
33	Leelamma	823404	45	L,P,D	Left	CEN	ID	HET DEN	HYPO	5	4	4	MALIGNANT
34	Hemavathy	845808	56	L,P	Left	UO	ID	HET DEN,MC	HYPO	4	3	4	MALIGNANT
35	Vijayalakshmi	781356	72	L,P	Right	CEN	ID	HET DEN	HYPO	4	4	4	MALIGNANT
36	Bhagyalakshmi	793039	50	L	Right	LO	WD	HOM DEN	HYPO	2	2	2	BENIGN
37	Subhalakshmamma	742363	35	L	Right	UO	ID	HET DEN	HYPO	4	4	4	MALIGNANT
38	Shantha	857997	65	L,P,D	Right	RA	ID	HET DEN,MC	HYPO	5	5	5	MALIGNANT
39	Kanthamma	857541	37	L	Left	LI	NIL	NIL	HYPO	0	2	2	BENIGN
40	Rupal Mehta	862388	32	L,P	Left	LO	ID	HET DEN	HYPO	4	4	4	MALIGNANT
41	Radhamma	857140	47	L,P	Right	>1	ID	HET DEN	HYPO	4	4	4	MALIGNANT
42	Jayaprabha	817349	39	L,P	Left	LO	WD	HOM DEN	HYPO	2	2	2	BENIGN
43	Lakshmidevamma	738156	58	L,P,D	Right	CEN	ID	HET DEN	MIXED	4	3	3	MALIGNANT
44	Lakshmi	819120	44	L	Left	UI	ID	HET DEN	MIXED	3	4	3	BENIGN
45	Syeda banu	822378	42	L	Left	LI	WD	HOM DEN	HYPO	2	2	2	BENIGN
46	Esther	840896	35	L	Right	UI	WD	HOM DEN,CC	HYPO	2	2	2	BENIGN
47	Nagaveni	841785	43	L	Left	>1	WD	HOM DEN	MIXED	2	2	2	BENIGN
48	Nelamma	843983	45	L	Left	UO	WD	HOM DEN	HYPO	2	2	2	BENIGN
49	Munirarayananna	837841	45	L,P	Left	>1	ID	HET DEN,MC	MIXED	4	4	4	MALIGNANT
50	Ramadevi	855921	30	L,P	Right	LI	ID	HET DEN	MIXED	4	4	4	MALIGNANT
51	Arunamma	851125	35	L	Left	UI	WD	HOM DEN	HYPO	2	2	2	BENIGN
52	Gowramma	851459	50	L	Left	CEN	WD	HOM DEN	HYPO	2	2	2	BENIGN
53	Prameela	853668	47	L	Right	LU	ID	HET DEN	HYPO	4	4	4	MALIGNANT
54	Vijaya	732618	57	L	Right	UO	WD	HOM DEN	HYPO	2	2	2	BENIGN
55	Sidamma	865299	45	L	Left	UI	ID	HET DEN	MIXED	5	5	5	MALIGNANT
56	Sarojamma	868865	72	L,P	Left	UO	WD	HOM DEN	HYPO	2	2	2	BENIGN
57	Leelavati	871140	45	L	Left	UO	ID	HET DEN	HYPO	4	4	4	MALIGNANT

58	Zareen taj	871717	56	L	Right	UO	ID	HET DEN	HYPO	4	4	4	MALIGNANT
59	Radhamma	872522	45	L,D	Left	UI	WD	HOM DEN	HYPO	2	2	2	BENIGN
60	Godavari bai	872784	68	L,D	Left	UO	ID	HET DEN	HYPO	4	4	4	MALIGNANT
61	Langeshwori	875130	38	L	Left	>1	ID	HET DEN	HYPO	4	4	4	MALIGNANT
62	Muniyamma	87469	60	L	Left	>1	WD	HOM DEN	ANE	2	2	2	BENIGN
63	Tulashamma	876376	47	L	Bilateral	>1	WD	HOM DEN	HYPO	2	2	2	BENIGN
64	Venkatama	878577	53	L	Left	LI	WD	HOM DEN,CC	HYPO	2	2	2	BENIGN
65	Venkatama	885277	60	L	Right	UI	WD	HOM DEN	HYPO	2	2	2	BENIGN
66	Lakshamma	707567	55	L	Right	LO	WD	HOM DEN	ANE	2	2	2	BENIGN
67	Krishnamma	889235	56	L,P	Right	UO	ID	HET DEN,MC	HYPO	4	4	4	MALIGNANT
68	Meenakshi	894827	57	L,P	Right	UO	ID	HET DEN	HYPO	4	4	4	MALIGNANT
69	Padma	785869	36	L	Right	UI	WD	HOM DEN	HYPO	2	2	2	BENIGN
70	Lakshmi	874974	40	L,P	Bilateral	>1	WD	HOM DEN	HYPO	2	2	2	BENIGN
71	Parvathamma	874086	45	L	Left	>1	WD	HOM DEN	HYPO	2	2	2	BENIGN
72	Rathnamma	887873	30	L	Left	>1	WD	HOM DEN	ANE	2	2	2	BENIGN
73	Lakshamma	887275	55	L	Right	LI	WD	HOM DEN	HYPO	2	2	2	BENIGN
74	Sakarama	905163	47	L,P	Bilateral	>1	WD	HOM DEN	HYPO	2	2	2	BENIGN
75	Lakshmamma	844930	65	L,P,D	Right	CEN	ID	HET DEN	MIXED	4	4	4	MALIGNANT