MAMMOGRAPHY

M. Shuja Tahir, Mahnaaz Roohi

Abstract: Mammography is the low dose radiological visualization of the soft tissue structure and architecture of the breast. It is performed at various stages of its life. It is also called screen film mammography (radio mammography). A normal mammogram does not guarantee that breast cancer is not present. Most abnormalities found during mammography are not cancerous. However, many women who have regular screening mammograms need additional tests to investigate abnormalities found during mammography. Mammograms for women younger than age 40 may be difficult to interpret because young breast tissue are usually dense. An abnormal growth , lump or other type of tissue may be seen. A cancerous (malignant)or noncancerous (benign) tumor may be seen. One or more fluid filled pockets (cysts) may be seen.

Key words: Mammography, Calcifications, Screening, Spiculated mass

Mammography is the low dose radiological visualization of the soft tissue structure and architecture of the breast. It is performed at various stages of its life. It is also called screen film mammography (radio mammography).

Every 5th to 8th woman may suffer from breast cancer during her life time. It is a very high risk. It definitely warrants diagnosis at the earliest. Breast cancer can be considered as a disease of aging with 80%-85% cases found in women above 50 years of age. It should be detected much before it is palpable.

It has been suggested that the average doubling time for breast cancer growth is about 100 days and it takes nearly 6-7 years or longer before it becomes potentially detectable by mammography or physical examination.

Imaging of the breast using different modalities given below;

- Radiological examination of the breast using dedicated machines.
- Ultrasound examination of breast
- Magnetic resonance imaging of breast

PHYSIOLOGICAL BASIS FOR MAMMOGRAPHY

The breast tissue (mammary gland) is a collection of glands surrounded by connective tissue.

The glands and connective tissue vary in size and shape during different physiological stages such as neonatal period, childhood, adolescence, adulthood, pregnancy, lactation, menopause and later on.

Both glands and connective tissue have same density as of water and its radiological differentiation is not very clear.

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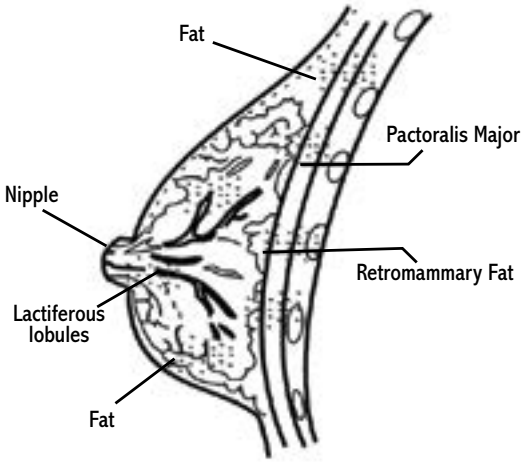
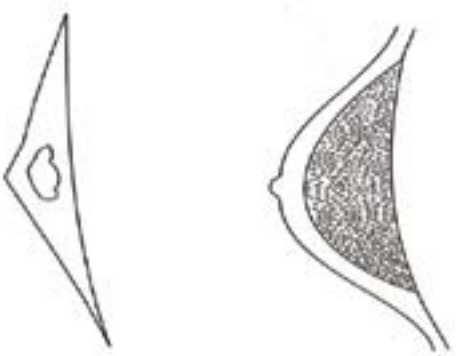
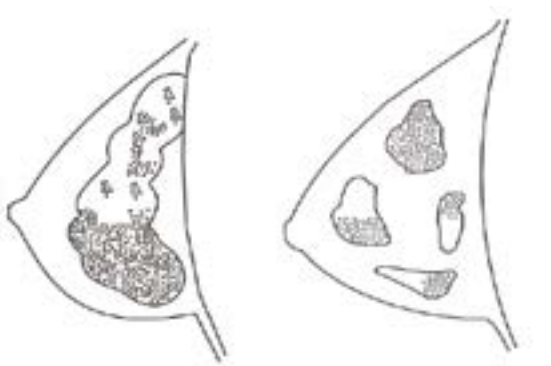


Diagram of breast



Adolescent Breast Pregnant Breast



Reproductive Breast Menopausal Breast

It appears white. These show dense homogeneous radiographic shadow which is not very helpful in diagnosis of pathological lesions.

It is the radiologic differentiating ability of fat which helps in the diagnosis, differentiation and study of the internal structure of the breast tissue.

The amount of fat present in and around the breast varies from person to person. It is the presence of fat in breast tissue which shows the soft tissue differentiation radiologically. The increase in glandular content doesn't improve the differentiation of breast tissue as it is also water dense.

The fat content is present between the glands, lobules, lobes, sub-mammary space and sub cutaneous space. It is usually not present under the nipple and is minimally present under the areola.

The breast has dense connective tissue and normally developed mammary glands at puberty. It shows dense homogenous picture on mammography.

During pregnancy, the glands and ducts hypertrophy but these are again of water density. The mammographic picture remains homogeneously dense and becomes extremely radio-opaque and clearly radiographic differentiation is seen.

The glands and the ducts involute after delivery and lactation. The parenchymal involution is followed by some degree of fat deposition. It gives good radiographic differentiation to breast tissue.

TYPES OF MAMMOGRAPHY

Screening Mammography

It is done in asymptomatic women early detection of small breast cancers is done by screening mammograms.

A screening mammogram consists of 2 images of each breast in the cancer candla (CC) and mediorateral oblique (MLD) projection that are viewed together.

Diagnostic Mammography

It is performed in symptomatic women with breast lump or nipple discharge. A Diagnostic mammogram consists of supplemental views tailored to the specific CC, magnification, spot compression and others.

RISKS OF MAMMOGRAPHY

There is always a slight risk of damage to cells or tissue from being exposed to any radiation, including the low levels of radiation used for this test. However, if this test is really needed, the risk of damage from the x-rays is very low compared with the potential benefits of the test.

Newer x-ray techniques have dramatically reduced radiation (exposure) during mammography. The dose of radiation used for a mammogram is similar to that used for a dental x-ray.

PREPARATION FOR MAMMOGRAPHY

No special preparation is required other than having the patient dressed in an open front gown for adequate exposure of the breast during mammographic examination. A female chaperon must accompany the patient throughout the examination. The patient should be explained about the procedure briefly and precisely.

A careful physical examination should be conducted and all findings must be noted. Scars, lump, induration, eczematous lesion, ulcers and pigmentation should be drawn on the diagram.

No feature should be missed, no matter how trivial. Both breasts should be examined and compared, findings are recorded for future reference.

The patient sits or stands in front of mammography machine and puts her breast over the movable compression device.

Dedicated mammographic machines have been developed which help to achieve better resolution and use very low dose of x-ray irradiation.

Structures upto 1 mm size can be picked up by these machines and patient is exposed to minimum x-ray irradiation. These machines result in less than 2 rads exposure per examination.

The machines use low kilovolt peak x-ray technique which enhances the radiographic contrast of fat and water content of the breast and give best radiographic view of the inside of the breast. The screen film mammogram gives maximum information. It can be used to put markers at the suspected lesions to help the surgeon during surgery.

Sometimes radio-opaque dye or methylene blue is infiltrated in the area of mammographically suspected lesion to help the surgeon while taking biopsy. but may not be very helpful while performing fine needle aspiration cytology or tru-cut needle biopsy. Guide wire can also be inserted in the lesion mammographically.

The compression device has two plates. One of these is mobile and x-rays can pass through these. The breast is compressed between these plates before exposure to x-rays. The compression of breast may be

uncomfortable to the patient but is rarely painful. It helps in uniform differentiation of the internal structure of the breast.

The compression is avoided in inflammatory lesions of the breast and examination is postponed till the inflammation has resolved. The compression device is used for minimizing the irradiation and achieving good contrast for easy interpretation of the mammogram. Compression is one of the most important aspect of mammography. It helps to achieve;

- Good picture resolution which separates the overlapping structures.
- A sharp image due to immobilization.
- Exposure under automatic control.
- Uniform and smooth resolution.
- Use of minimum irradiation.

Each breast is examined separately. Maximum breast tissue is compressed to avoid missing peripheral lesions.

Both breasts are exposed in two or more views separately. The mammographic examination is usually satisfactory in two dimensions;
Cranio-caudal[1,4,5]
Medio-lateral or oblique medio-lateral
Oblique views and cone views may be required in highly suspicious lesions for better resolution and detection.

INDICATIONS FOR MAMMOGRAPHY

- To screen asymptomatic women.
- To assist in evaluation of symptomatic breasts for management decisions.
- To detect the unsuspected lesion in same and opposite breasts having palpable mass.
- To serve as baseline for comparison with subsequent mammography for accurate and early detection.
- To evaluate breast status before starting harmonereplacement therapy (HRT) in menopausal women.

The films are examined very carefully keeping in mind the age of the patient and status of the breast. An amplifying lens is used for proper examination and interpretation.

A normal mammogram does not guarantee that breast cancer is not present. Most abnormalities found during mammography are not cancerous. However, many women who have regular screening mammograms need additional tests to investigate abnormalities found during mammography.

Mammograms for women younger than age 40 may be difficult to interpret because young breast tissue are usually dense.

Although breast cancer can occur in men yet it is rare. About 99% of all breast cancer is found in women.

GUIDE LINES FOR SCREENING MAMMOGRAPHY[8]

It is the mammography of female population of selected age group in a selected setting. Screening reduces mortality from breast cancer upto 40% in those who attend[2].

Patients with mutations in one of the breast cancer susceptibility gene, face about 90% life time risk to develop breast cancer. More than half of the patients develop cancer before 50 years of age and a significant number even before 35 years of age[1].

Both breasts are always examined and compared before this investigation is performed. It can be performed both on

symptomatic and asymptomatic patients. Mammography has shown the ability to detect breast cancer with high sensitivity and specificity1. It is the only means to detect non-palpable cancers. It also helps in the early detection of breast lesions.

Screening of 100% population may not always be easily feasible. Breast screening program in UK aims to screen 70% of target population with built in quality assurance. At present the UK breast screening programme achieves 50 lesions per 10,000 women[2].

One of the goals of National Cancer Institute (NCI)that is to reach more than 80%of eligible women in mammography screening by year 2000.

The failure to achieve this goal is; Complex and lengthy examination process. It is not available to majority of women living in remote areas[2].

It is recommended that screening for familial breast cancer should start at the age of 30 years as it accounts for 10% of all breast cancer.

The screening mammography should be performed in all women between 40-70 years of age to achieve optimal results[2].

95% screen detected cancers are smaller in size, better differentiated and node negative when compared with symptomatic cancers[3].

40% reduction in mortality from breast cancer can be anticipated by screening women above 50 years of age. 5% reduction is achieved by screening younger women[4]. Two views of mammography (cranio caudal and oblique medio lateral) and double reading of films performed every 2-3 years achieves maximum detection of small malignant lesions (smaller than 1.5 cm size).

Detection of 36 invasive lesions and 4 DCIS lesions every 10,000 women of 50-52 years of age screened for first time is acceptable.

Detection of at least 40 invasive and 05 DCIS lesions every 10,000 women during second screening programme is acceptable.

SCREENING FOR NORMAL RISK POPULATION

Women should have yearly or bi-yearly mammography between 40-70 years of age depending upon physical examination and risk factors.

The frequency can be reduced to three yearly if two consecutive mammograms are normal.

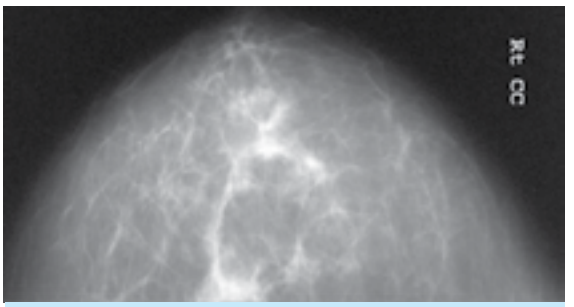
SCREENING FOR HIGH RISK POPULATION

Pre-menopausal women with strong family history and familial breast cancer should start mammography as early as 35 years of age or 5 years younger than youngest affected family member[2,6,7].

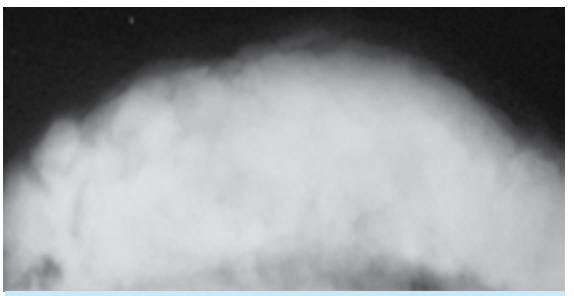
Women should have a base line mammography between the ages of 35-39 years in high risk patients (familial breast cancer). For women at high risk, screening may be started at age 30-35. Again, the definition of high risk is variable but a common definition would be a greater than 8% risk by age 50 or greater than 30% life time risk. Such high-risk women should ideally be managed in a specialist setting. Women must be advised about the limitation of screening at young age.

NORMAL MAMMOGRAM

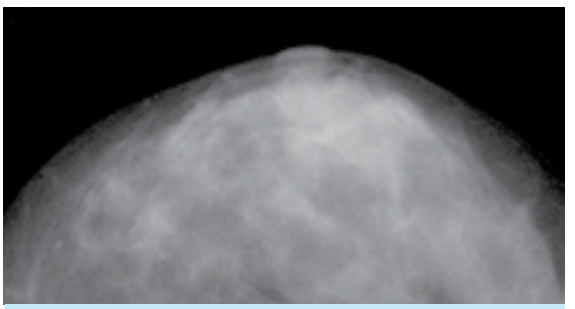
Breast shadow looks normal. No unusual growth, lumps or other types of abnormal tissues are seen. The glands that produce milk for breast feeding and the tubes (ducts) through which milk flows appear normal.



Normal mammography



Lactating Breast (Normal mammography)



Normal mammography (young patient)

ABNORMAL MAMMOGRAM

A mammogram that does not show all areas of the breast tissue clearly requires a repeated test to obtain clear pictures of those areas.

An abnormal growth , lump or other type of tissue may be seen. A cancerous (malignant) or noncancerous (benign) tumor may be seen. One or more fluid filled pockets (cysts) may be seen.

Sign	PPV %
Well defined mass	<1
Ill defined mass	35-50
Spiculated mass	50-90
Architectural distortion	20-40
Assymetrical density	<2
Clustered micro calcification	15

Positive predictive value for malignancy for mammography sign (PPV %)

The mamogram must be interpreted in systemic fasion.

The breast symmetry, size, general density and glandular distribution are observed. Following Features are checked.

- Masses
- Densities
- Calcifications
- Architectural Distortions

Masses

The shape, margin and density of mass are analyzed. Benign masses are often round or oval with circumscribed margins. Malignant lesions tend to have irregulat, indistinct, or spiculated margins. Malignant lesions tend to havegreater density. The presence of very low density fat in a lesion often indicator benign findings such as cysts, lipomas etc.

Calcifications

Calcifications can be the first sign of cancer. Benign calcifications are usually larger, larger.

Calcifications associated with malignancy are usually small (<0.5 mm). They tend to tissue fine gramlar, fine leaear or branding shape.

Bites of calcium (calcifications) may be seen. Calcifications are most often non cancerous. Tiny calcifications (micro-calcifications) often occur in areas where cells are growing very rapidly (such as in a cancerous tumor). Larger calcifications (macro-calcifications) are usually normal in women over the age of 50.

Density

Breast density is strictly a mamographic finding. It represents the ratio of glandulat tissue (white on mamogram) to fat (dark on mamogram). The density is categorised in 4 catagories A, B, C, D. A represent breast conynsed of fat entirly and D represents a breast that is conposed autinely of glandnlar tissue.

A mammogram is not usually performed for a pregnant woman, because the radiation could damage her developing fetus. If a mammogram is absolutely necessary, a lead apron is placed over the woman's abdomen.

A mammogram is usually not performed for a woman who is breast feeding, because breast that contains milk shadow, homogenous opacities and diseased area cannot be differentiated.

Deodorants, perfumes, powders or ointments on the breast may interfere with the x ray pictures.

Breast implants or scar tissue from previous breast surgery may make a mammogram more difficult to interpret due to radiographic abnormal shadows.

BENIGN LESIONS

Benign calcifications are larger and uniform in size and shape.

FIBROADENOMA

It appears as well defined rounded or oval mass with smooth margins. These may be multiple and bilateral. Coarse and peripheral calcification is usually seen.

BREAST CYST

It appears as circumscribed mass. Ultrasound scanning helps to differentiate it from a solid lesion. It appears as a compressible mass with smooth back wall and no internal echoes and hypo-echoic pattern.

DUCT ECTAZIA

It usually presents in perimenopausal women as nipple discharge. It is dilatation of lactiferous ducts with presence of thickened milk or secretions in the ducts. The nipple discharge could be milky, green, blue in color or blood stained. It is a benign condition.

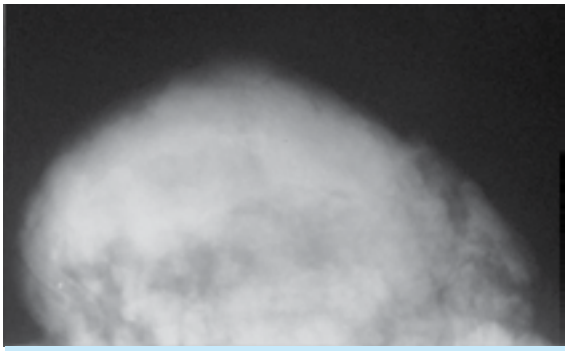
BREAST ABSCESS

The clinical picture is usually suggestive of diagnosis. Radio mammography is painful and less helpful.

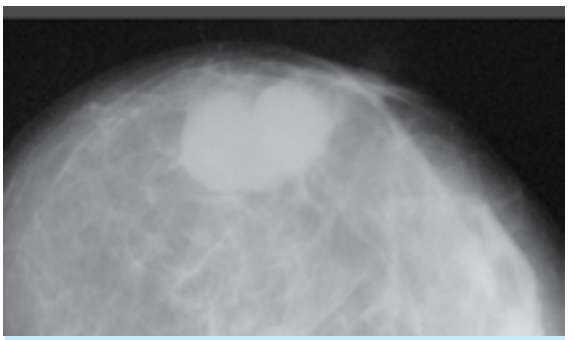
It should not be performed. The diagnosis may be confirmed by sonomammography which is more acceptable to the patient and helpful in diagnosis by showing hypo echoic area of fluid or pus collection.

CARCINOMA OF BREAST

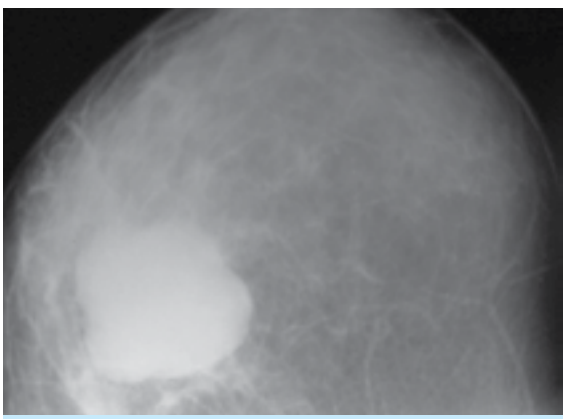
It appears as a spiculated mass. The irregular margins are clearly seen. It can be easily diagnosed. Sometimes well circumscribed mass can be seen and irregular margins may not be clear.



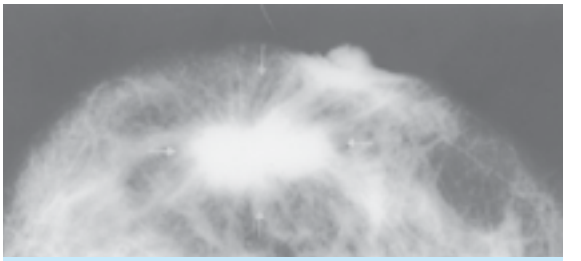
Lactating breast (mammography)



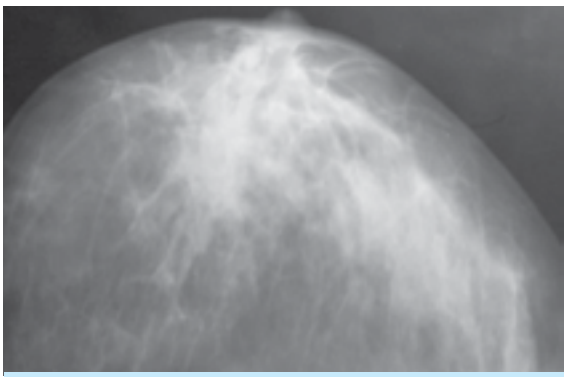
Fibroadenoma breast (mammography)



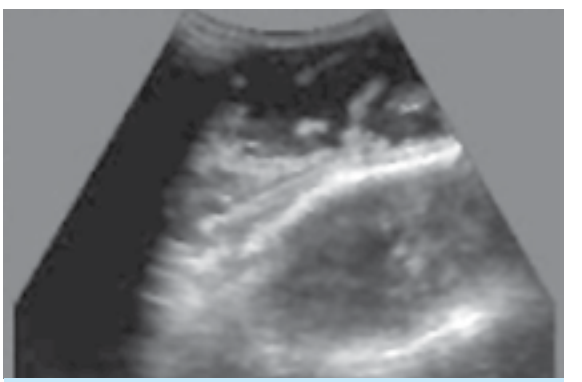
Fibroadenoma breast (mammography)



Mammography showing spiculated mass behind the nipple (carcinoma of breast)



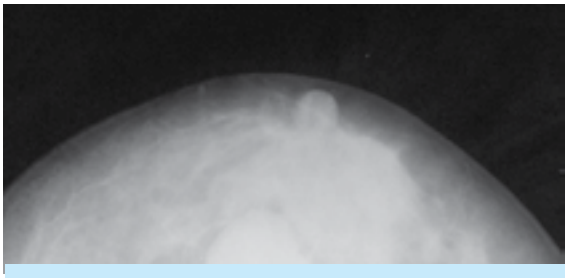
Duct ectazia breast (mammography)



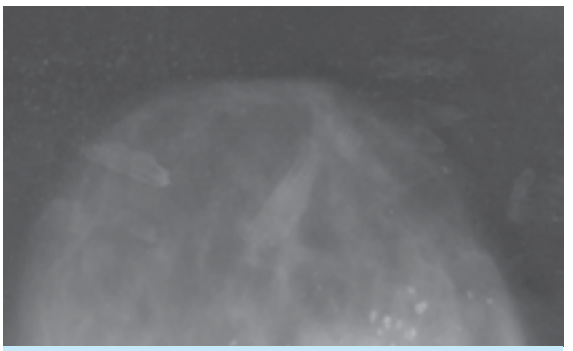
Breast abscess (sono-mammography)

(Medullary carcinoma) The masses may be multiple sometimes the mass may not be seen but calcification may be seen. The calcification clusters are typical of malignancy. The greater number of clusters, the greater chances of malignancy.

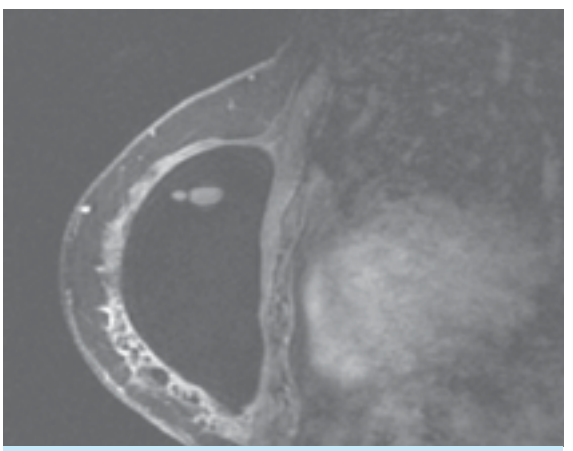
Mammography is currently the most accurate test for detecting breast cancer. However, other tests, such as magnetic resonance mammography(MRM) and nuclear scanning tests can also be performed to detect breast cancer.



Fibroadenoma breast (mammography)



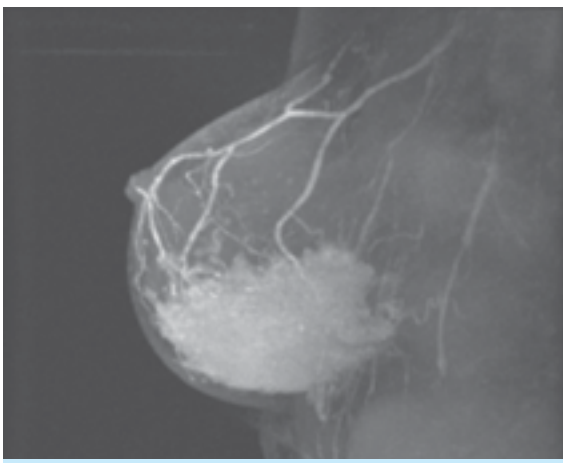
Mammography of breast showing calcification of lactiferous ducts (DCIS?)



MRI mammography showing bubble in implant

MRM can detect suspicious areas in the breasts, but many suspicious areas turn out to be normal (false positive results). MRM is useful when a diagnosis is difficult to make due to previous surgery using other methods. MRM is much more expensive than x-ray mammography and is not used very often to examine the breasts.

Nuclear scanning tests use a radioactive tracer(called a radionucilide scan) that is injected into a vein. The tracer travels through the blood vessels and can accumulate in many types of tumors. The location of the tracer is detected by gamma camera that scans the body for areas where the tracer has accumulated. Nuclear scanning tests are useful when a diagnosis is difficult to make using other methods.



MRI mammography of patient with nipple discharge

MR MAMMOGRAPHY

Magnetic imaging for breast lesion is not one of the first line investigation. It is expensive and not available easily and at all places.

MRM is the most sensitive technique for detection of breast cancer approaching 100% for invasive cancer and 80% for DCIS, but it has high false positive rate.

It is non invasive. It has great value in detection of vertebral body metastasis and musculo-skeletal pathology related to breast cancer.

Both MRM & CT are expensive and less easily available. These are rarely helpful in staging carcinoma breast. However chest CT scan improves detection of pulmonary metastasis. In selected cases, it is used to detect the breast lesions with improved specificity and sensitivity[6].

ADVANCEMENTS IN MAMMOGRAPHY XEROMAMMOGRAPHY

Xeromammography is a specialized radiological processing system using dry electrophotographic technique. A charged aluminium plate coated with selenium powder is used instead of traditional screen film in this investigation. The image is then transferred to the photographic paper plate. Whole of this process is performed by an automatic processor machine.

The xeromammographic image gives less overall information than radiological mammogram. It definitely demonstrates the important features and resolution is sufficient to show micro calcification.

DIGITAL MAMMOGRAPHY

It is a mammographic imaging system that acquires mammograms directly in digital form. It has the ability to display finest details and improve the performance of mammography.

It allows to view different parts of the breast without taking additional images. Image from digital mammography can be magnified and stored electro-nically more easily than images from standard mammography. Digital mammography is not yet widely available.

COMPUTER AIDED DETECTION & DIAGNOSIS (CAD)

It is a type of digital mammography which can facilitate computer aided detection and diagnosis which is otherwise not easily possible. It helps to detect lesions which might be missed by the examiner. It, in fact increases the detection sensitivity. It can further help in the correct diagnosis due to availability of large data bank for comparison and correct diagnosis. It is almost similar to second specialist opinion and improves the detection rate by 9-10%.

TELE MAMMOGRAPHY

It is the transmission of digitally stored mammo-graphic images to far locations for better and expert interpretations9.

DUAL ENERGY MAMMOGRAPHY

Two separate digital images are obtained and combined to produce hybrid images. Unwanted images are removed and relevant structures are preserved and interpreted.

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