Breast Imaging

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Objectives

- Review diagnostic breast imaging techniques
  - Diagnostic mammography
  - Ultrasound
- Role of image guided procedures
- Breast MRI & other newer modalities
  - Clinical indications
  - Effect on patient management

Breast Studies

- Film-Screen Mammography: Screening & Diagnostic
- Ultrasound
- Digital Mammography
  Computer Aided Diagnosis
- Nuclear Medicine - Scintimammography
- MR mammography
- CT
- PET CT

Breast Lesions

Benign

- Cyst
- Lipoma
- Fat necrosis
- Fibroadenoma
- Fibrocystic disease
- Abscess
- Galactocele
- Hematoma
- Hamartoma

Malignant

- Ductal Carcinoma in situ
- Lobular Carcinoma in situ
- Invasive Ductal Carcinoma NOS
- Tubular Carcinoma
- Invasive Lobular Carcinoma
- Circumscribed Carcinomas
  - Medullary Carcinoma
  - Mucinous Carcinoma
  - Invasive Lobular Carcinoma
- Intracystic Carcinoma
- Lymphoma
- Second Primary Lesions

FILM SCREEN MAMMOGRAPHY

Principles of Mammography

- Low kVp & High mAS
  - kVp – 16 to 40
  - mAS – 2 to 600

Mammogram Standard Views

- Cranio-caudal View (CC)
- Medial-lateral Oblique (MLO)

Mammography Technique

- Resolution is an important imaging parameter needed to detect microcalcifications
- Contrast is an important parameter needed to detect masses

Mammography Dose Limit

- The FDA dose limit for a single view mammogram is 300mRAD

ACR Guidelines
Screening Mammography

- Baseline Mammogram by age 40
- Mammogram every year after 40
- Clinical Breast Examination every year after 40

Factors associated with an increased risk of breast cancer

- Female
- Age > 35 years
- Early menarche
- Late menopause
- Nulliparity
- Late first pregnancy
- Family history of breast cancer
- Biopsy proof of atypical epithelial proliferation
- Radiation

Diagnostic Mammography

- Patients with breast signs or symptoms (palpable lump, pain, nipple discharge)
- Patients with abnormality detected on screening mammogram
- Performed under the supervision of a radiologist
- Additional specialized mammographic views
  - Spot compression ± Magnification

Sensitivity of Mammography

- 85% - 90% in fatty replaced breasts
- 65% in dense breasts

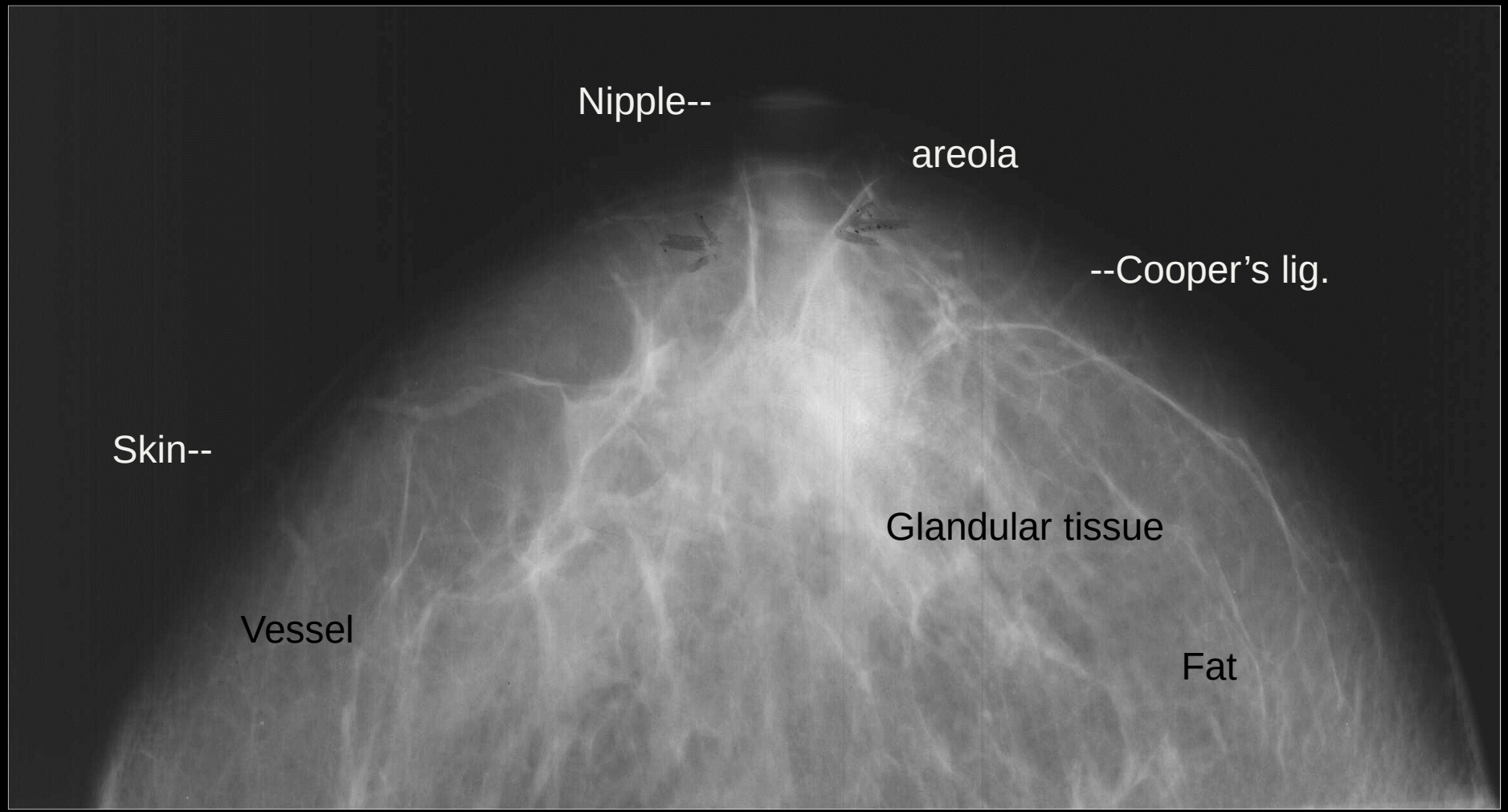
Breast Ultrasound: Indications

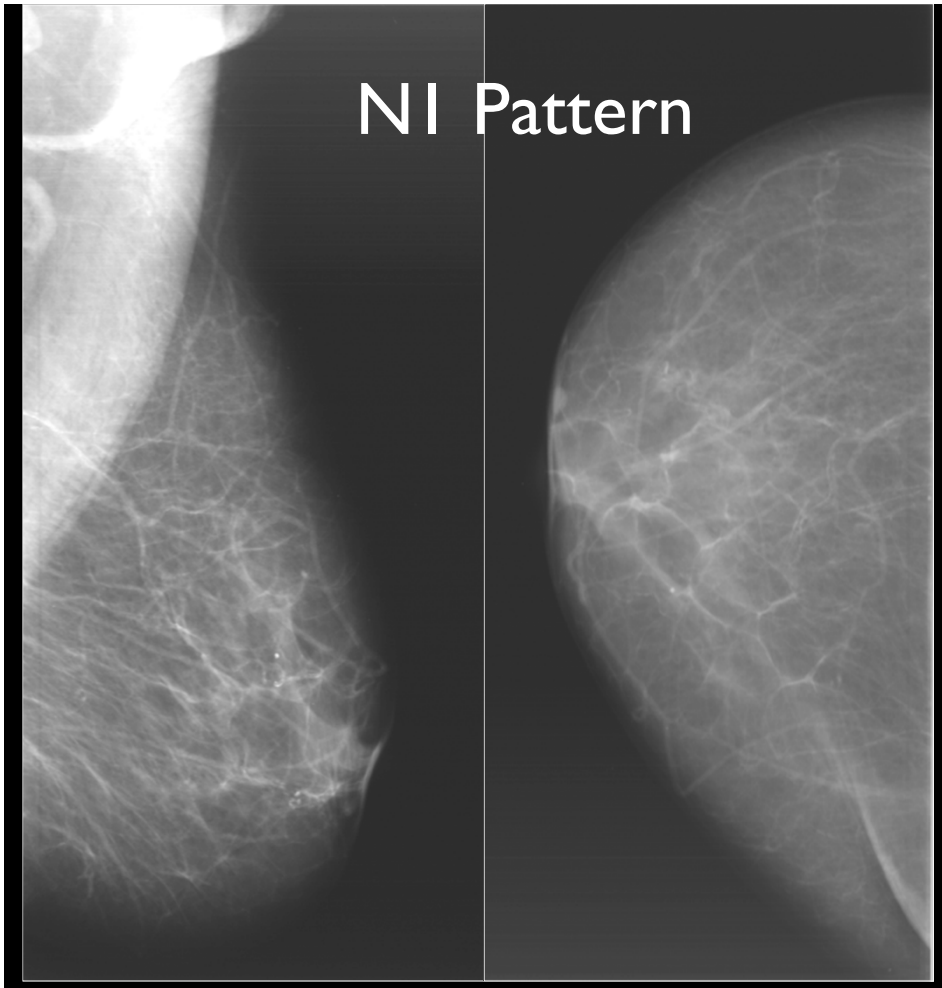
- Initial study for palpable masses
  - Pregnant
  - Lactating
  - Less than age 30
- After mammography for all other palpable and mammographically detected masses
- Cyst versus solid
- Solid masses: benign versus malignant features

USG & Doppler Features Of Malignancy

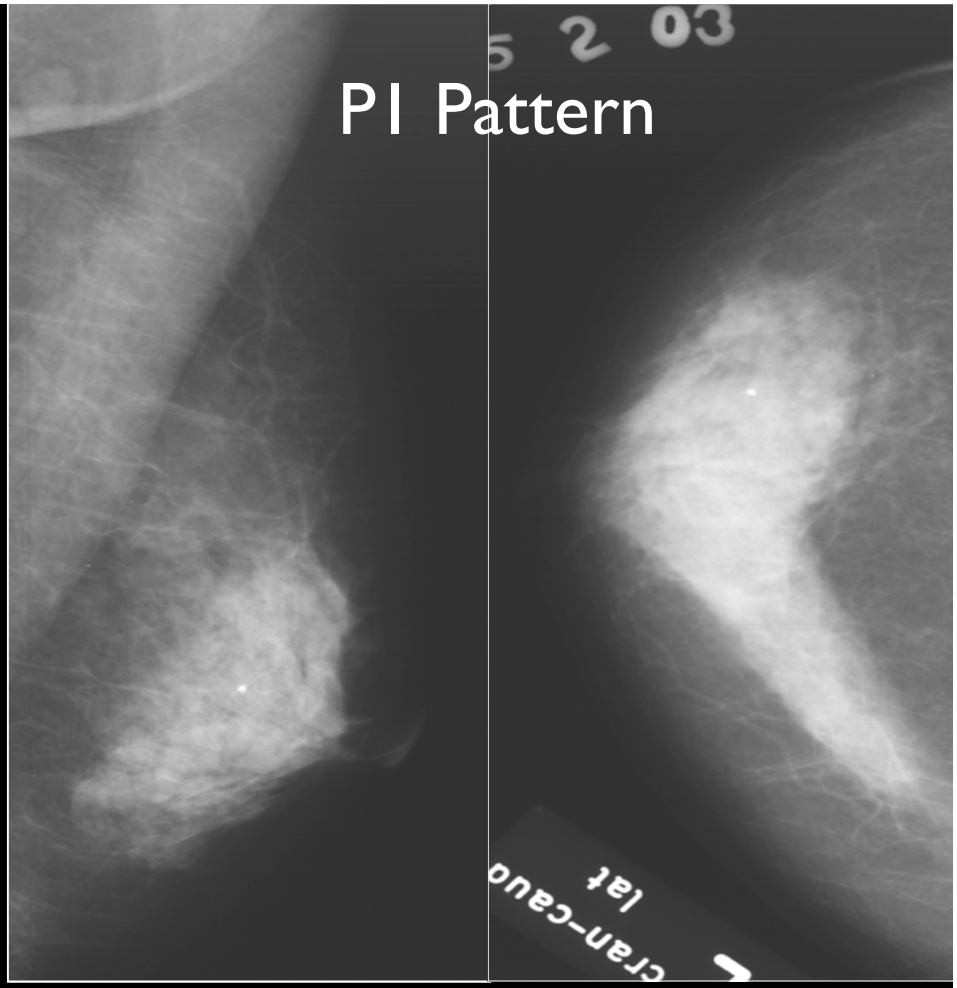
- USG
  - **Nidus** with height more than width and branch pattern
  - **A surrounding highly reflective zone**
  - **Halo and shadow**
  - These signs are present in various permutations and combinations
- DOPPLER
  - Vessels in and around masses with tortuous configuration and low resistance flow pattern.

Normal Breast

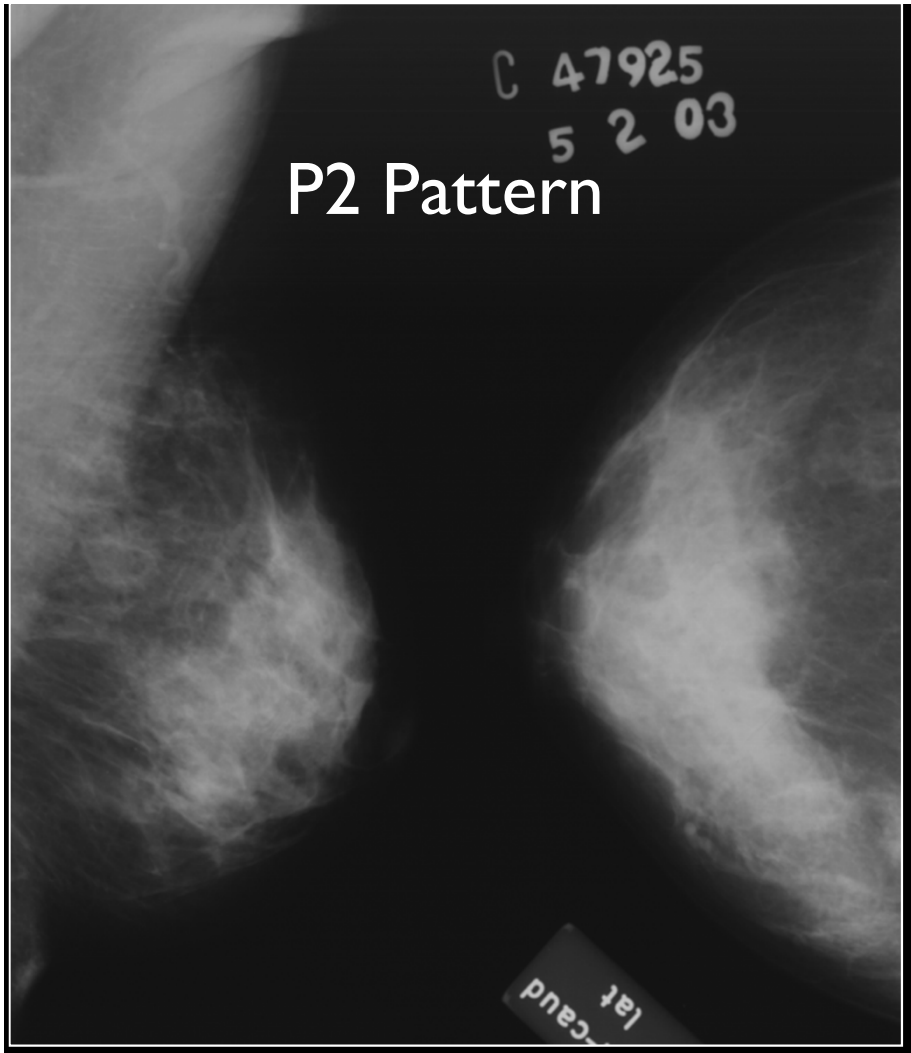




Parenchyma - low density.
A large proportion of fat.
No ducts visible

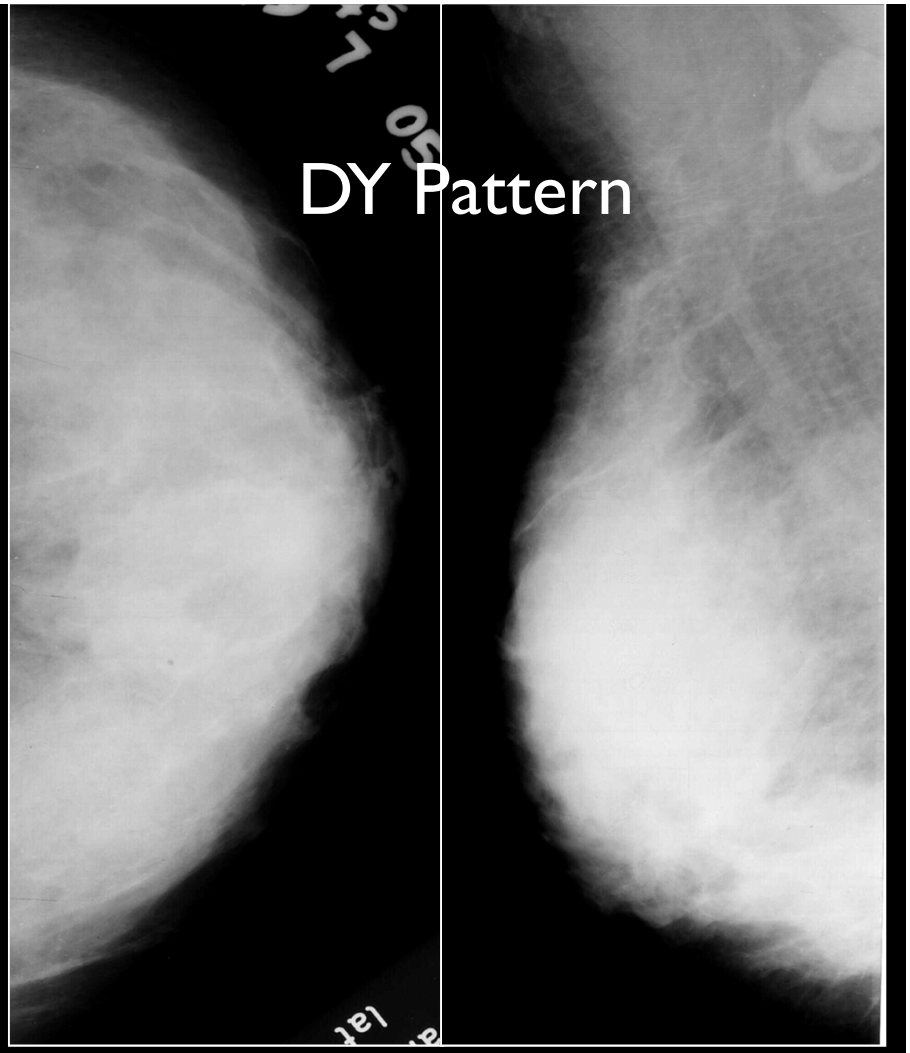


Parenchyma composed chiefly of fat, with a prominent duct pattern in anterior portion of breast but involving < ¼ of breast volume



P2 Pattern

Prominent duct pattern in > ¼ of breast volume & an associated nodular component



DY Pattern

Increased density of breast parenchyma with or without areas of nodularity. The density often obscures underlying duct pattern

Bi-Rads Breast Density Categories

1. Almost entirely fat
2. Scattered fibroglandular densities that "could obscure a lesion"
3. Heterogeneously dense that "may lower the sensitivity of mammography"
4. Extremely dense that "lowers the sensitivity of mammography."

Primary Signs of Cancer on Mammography

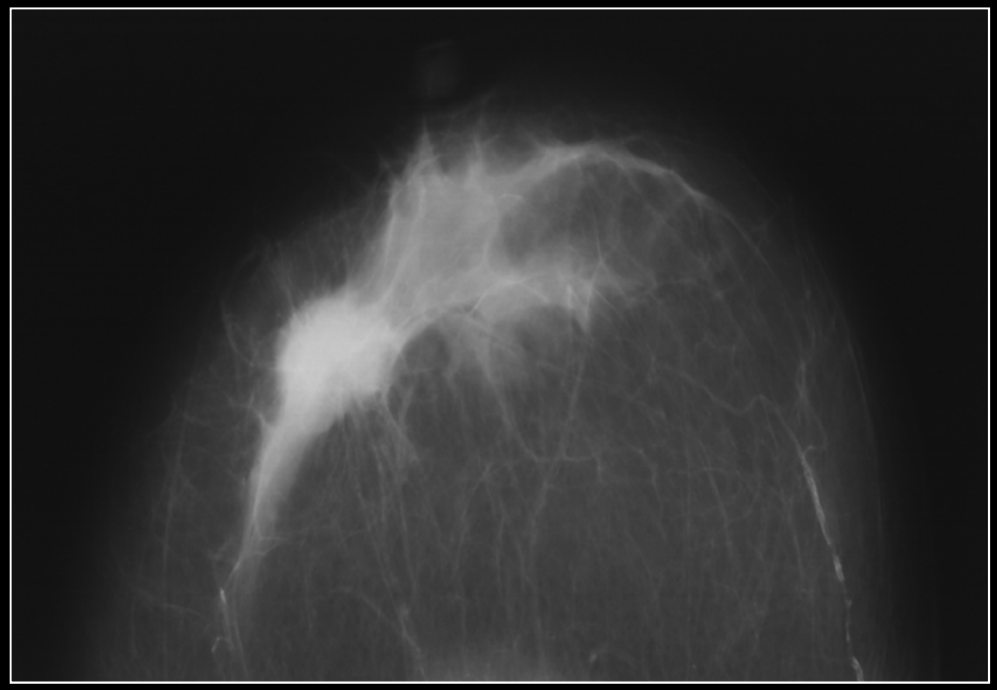
- Mass
- Calcifications

Secondary Signs of Cancer on Mammography

- Nipple Inversion
- Architectural Distortion
- Skin Thickening
- Axillary Adenopathy
- Skin Retraction
- Tissue Asymmetry
- Developing "Neodensity"

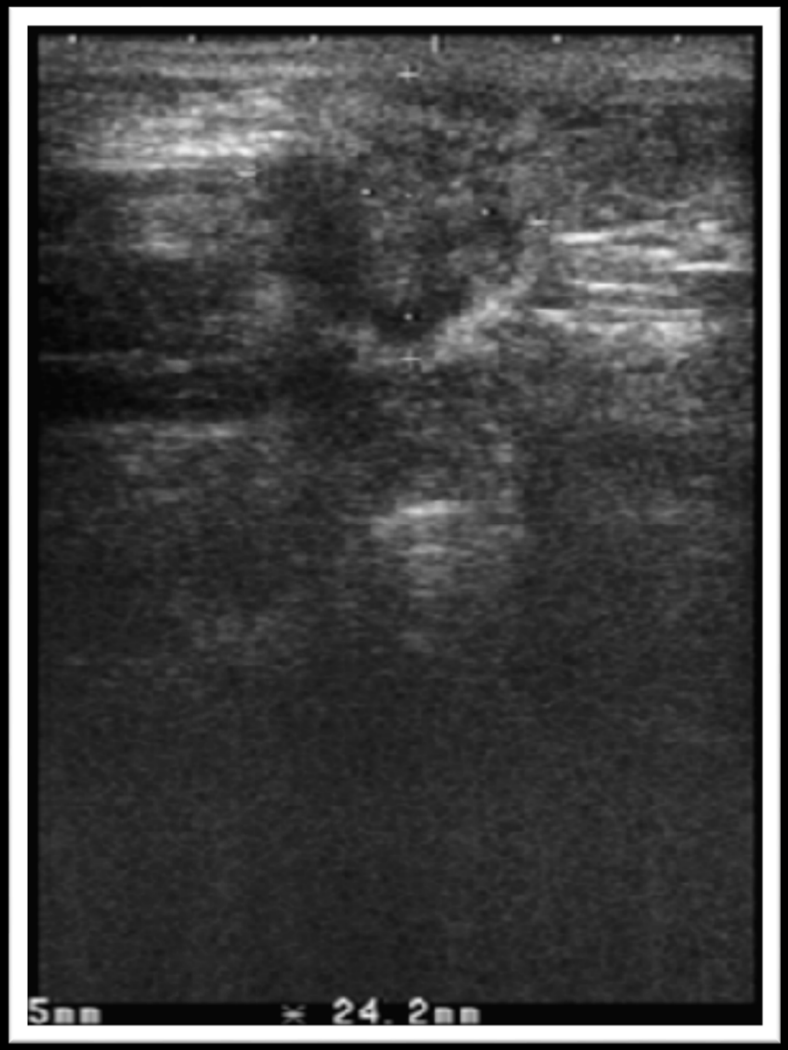
Bi-Rads Assessment Categories

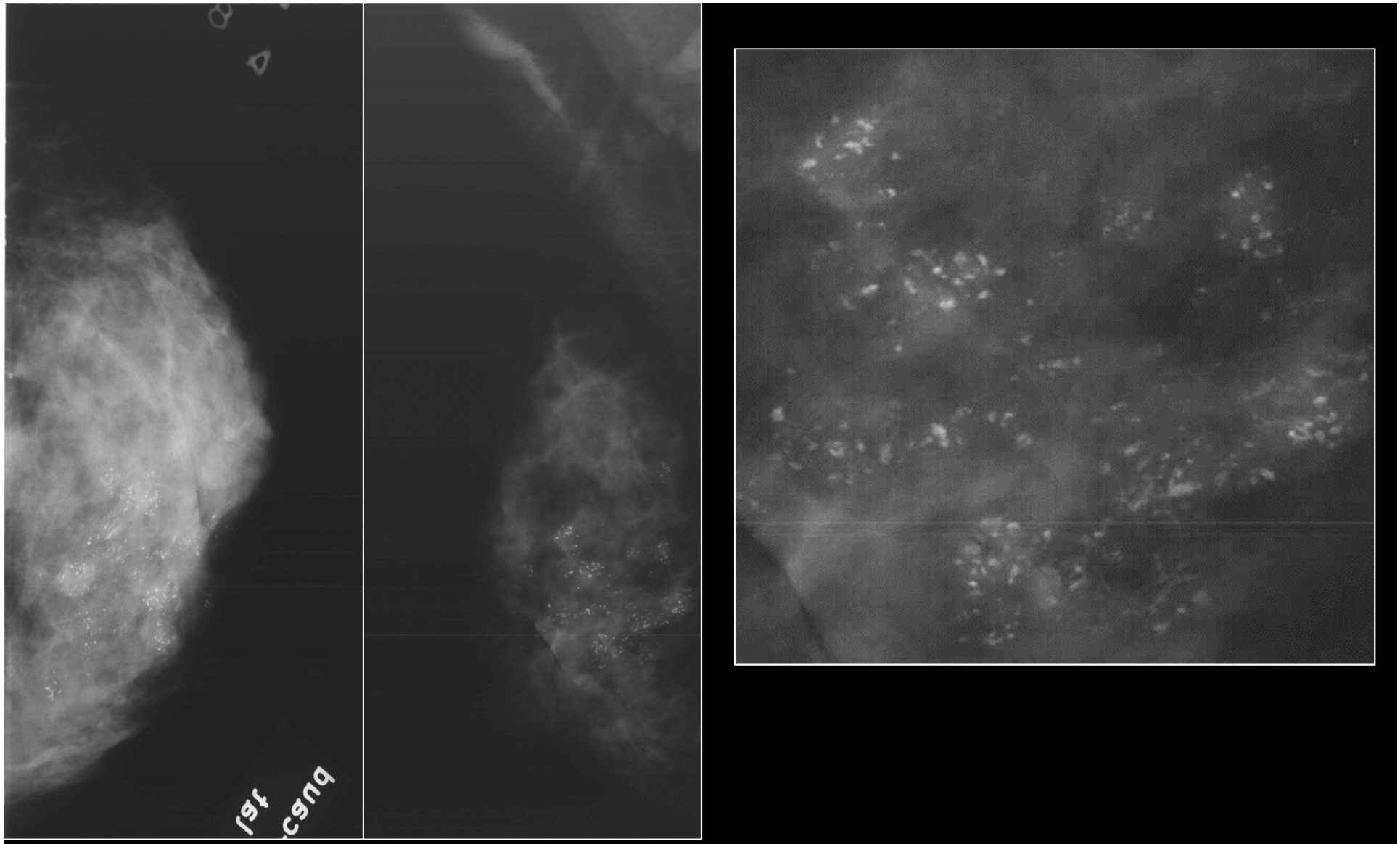
Stage	Result	Management
0	Assessment Incomplete	Need additional Imaging
1	Normal	Routine mammography in a year
2	Benign finding	Routine mammography in a year
3	Probably Benign	Short interval follow-up
4	Suspicious	Biopsy to be considered
5	Highly suggestive of malignancy	Appropriate action required



Stellate soft tissue density mass with perilesional corona
HPE: Invasive Ductal Ca

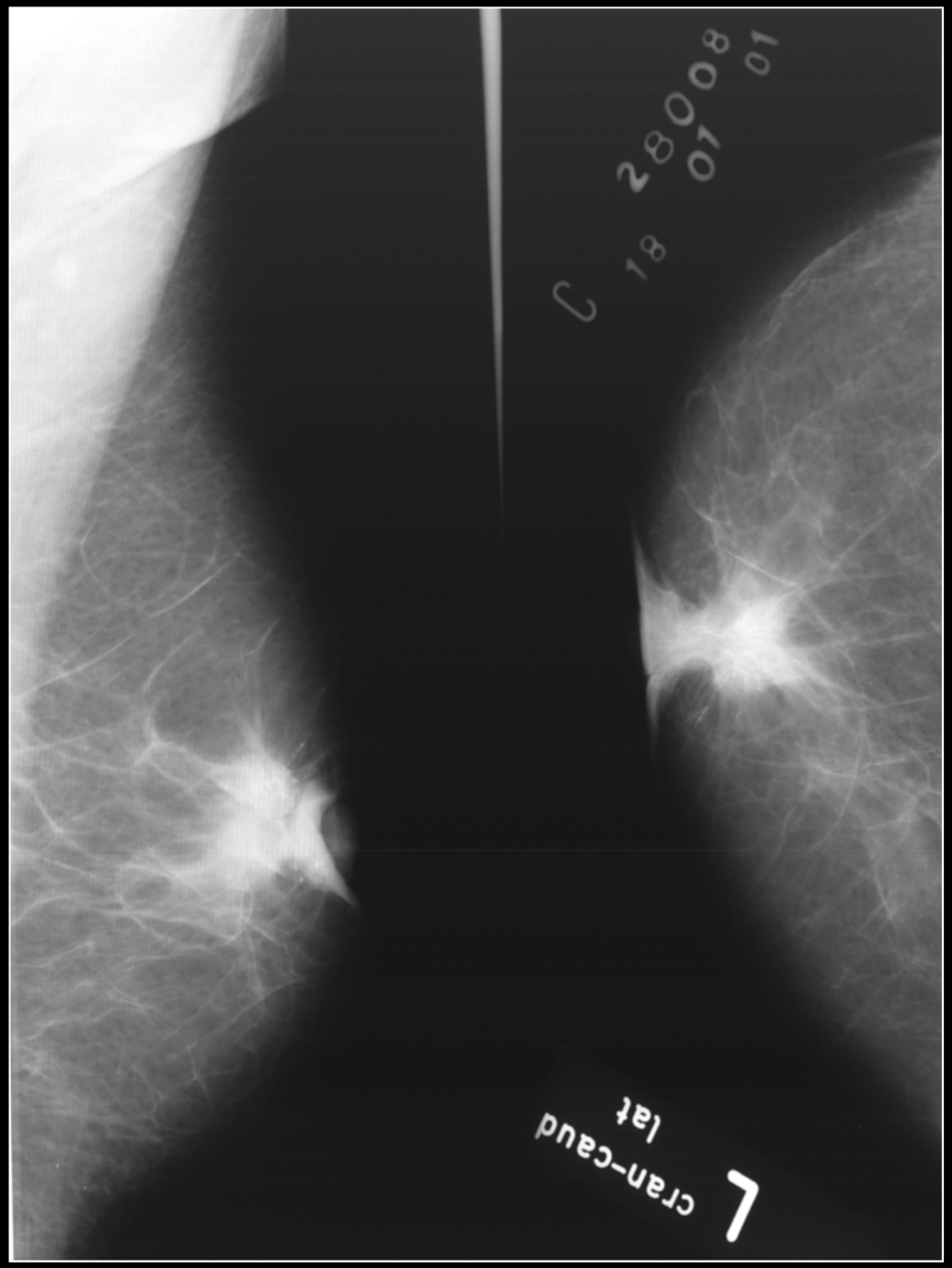
USG-IDC

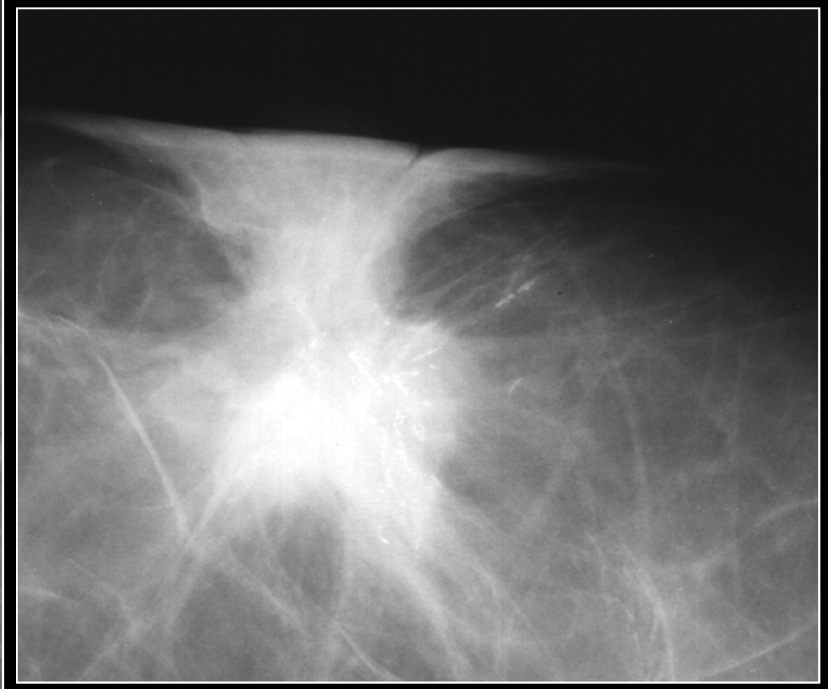




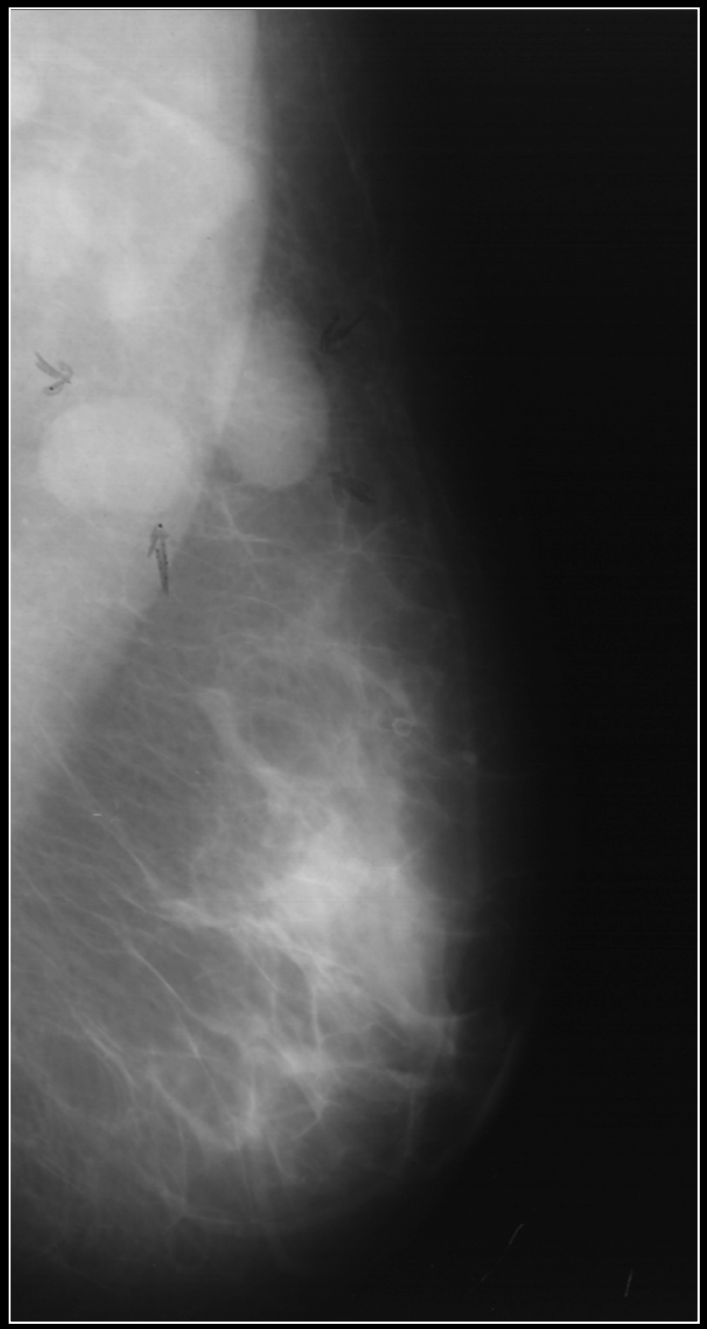
Distorted architecture with branching pattern of microcalcification HPE: Comedocarcinoma

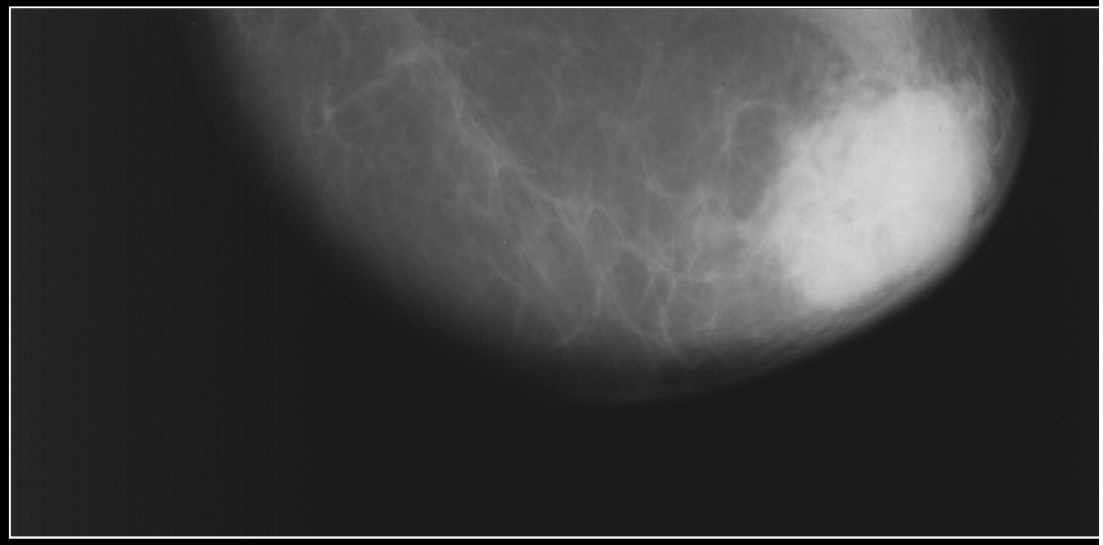
USG-Comedocarcinoma





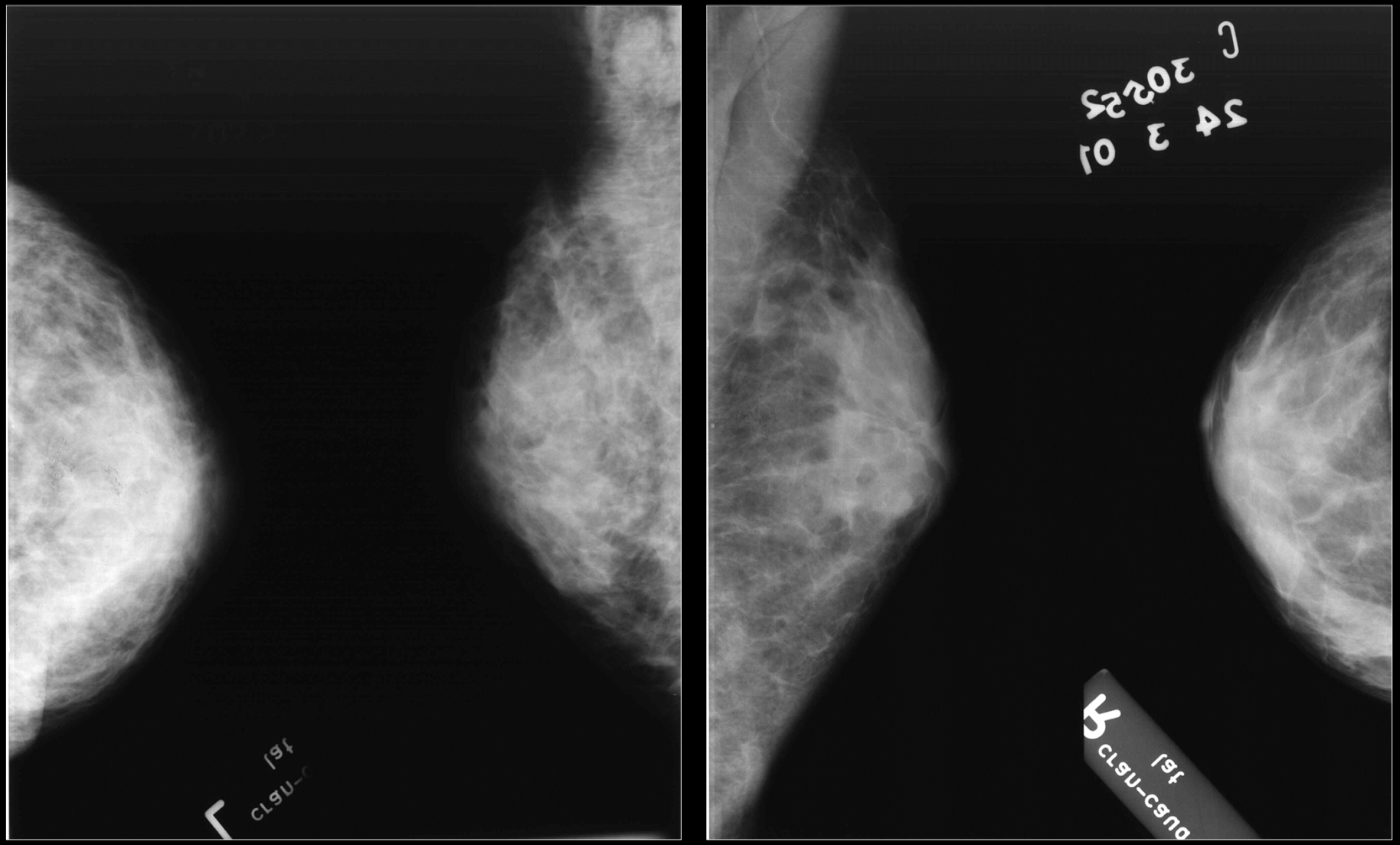
Retroareolar lesion with areolar skin thickening and nipple retraction



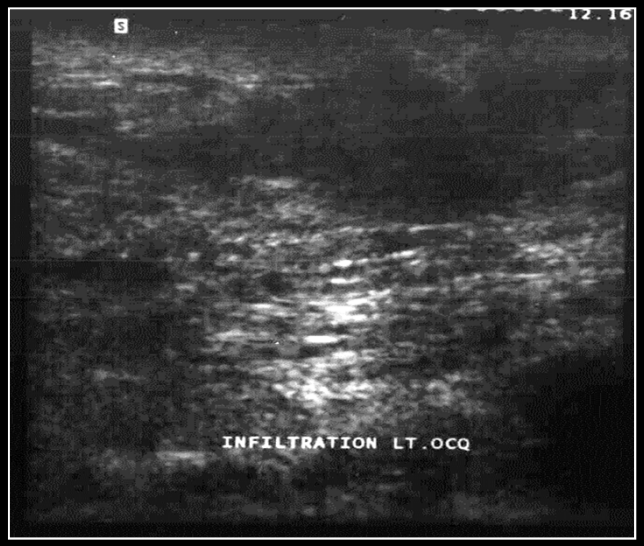


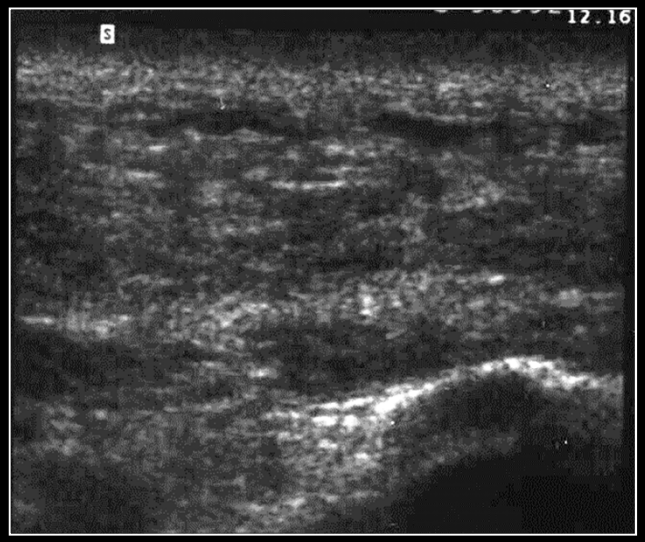
Metastatic axillary nodes in Rt. Breast with Lt. Breast malignancy

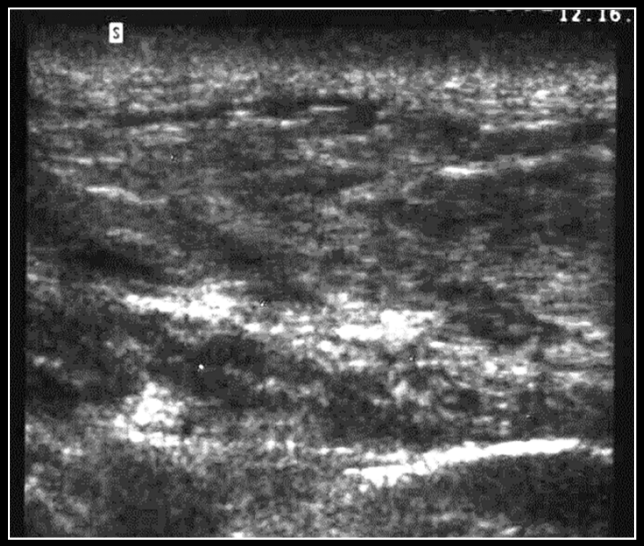
HPE : Invasive duct CA



Lymphoma with distorted architecture, skin thickening and nodal enlargement





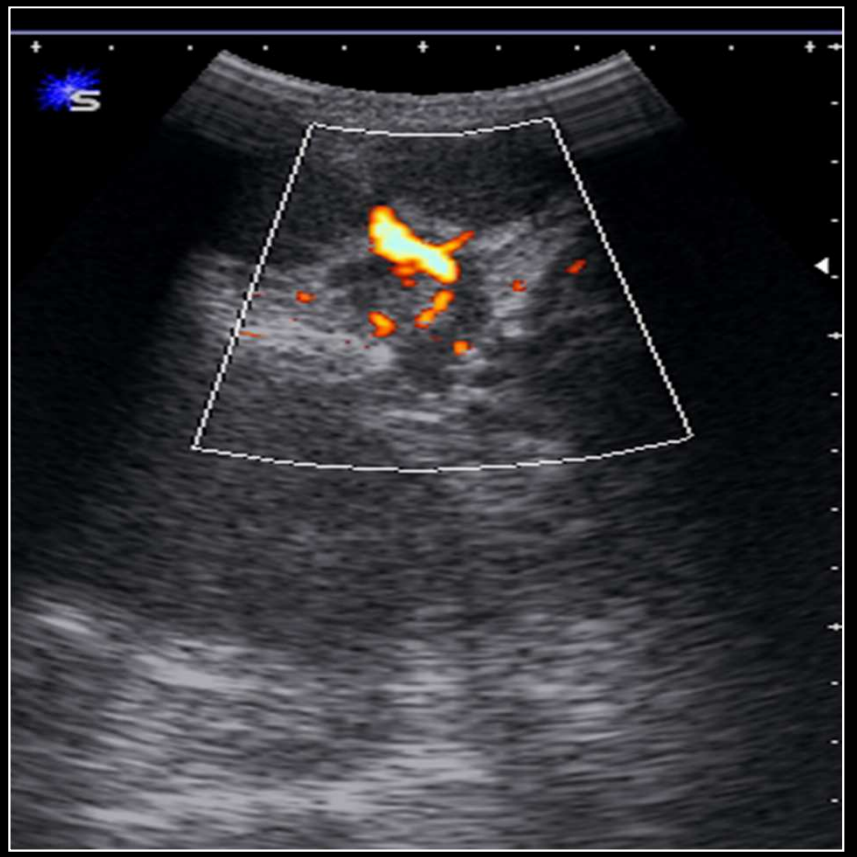


Diffuse skin thickening with distortion of parenchymal pattern

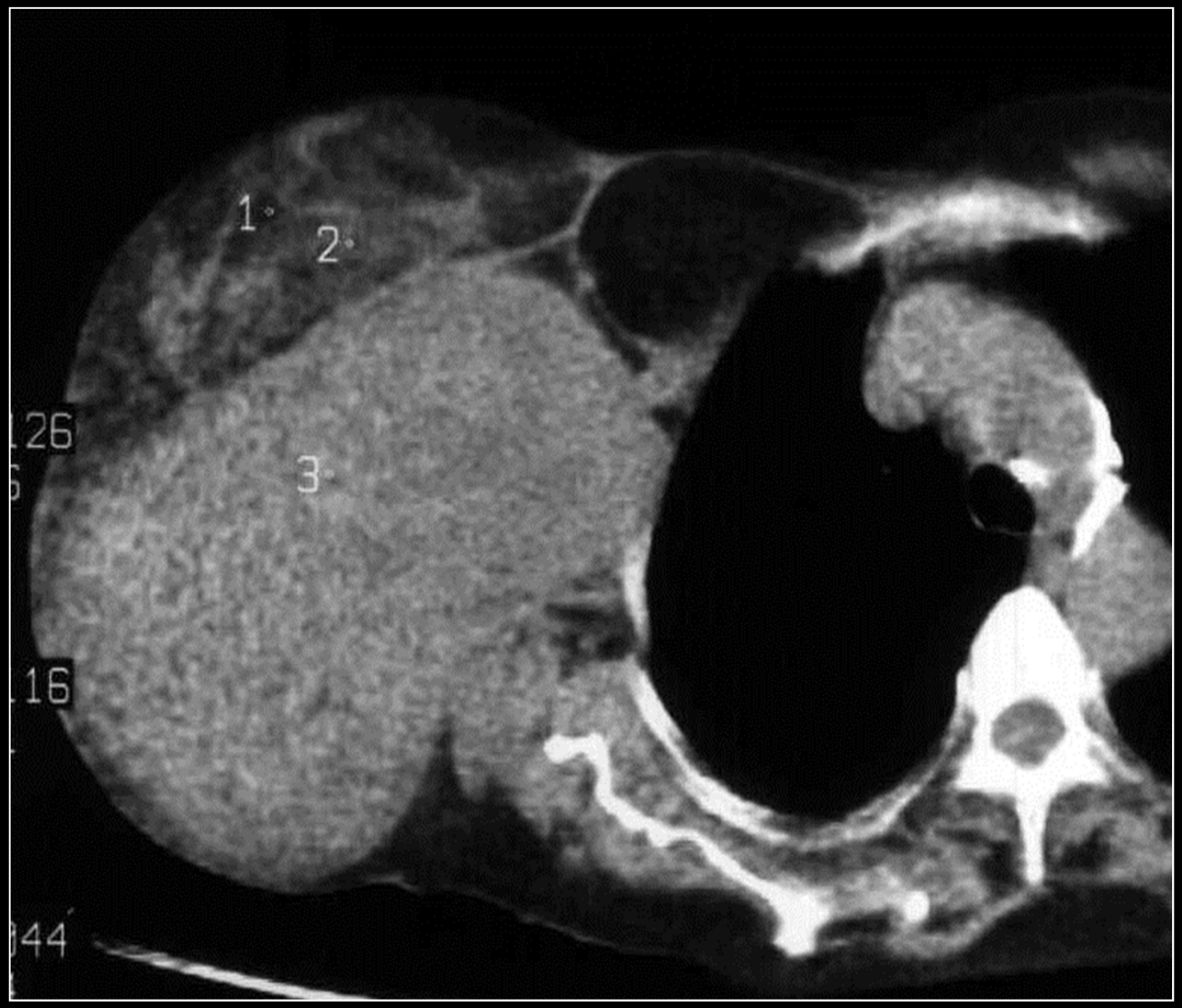
Recurrent lump after twice operated lipoma - heterogeneous mass lesion with fat and soft tissue density in whole breast

HPE : liposarcoma

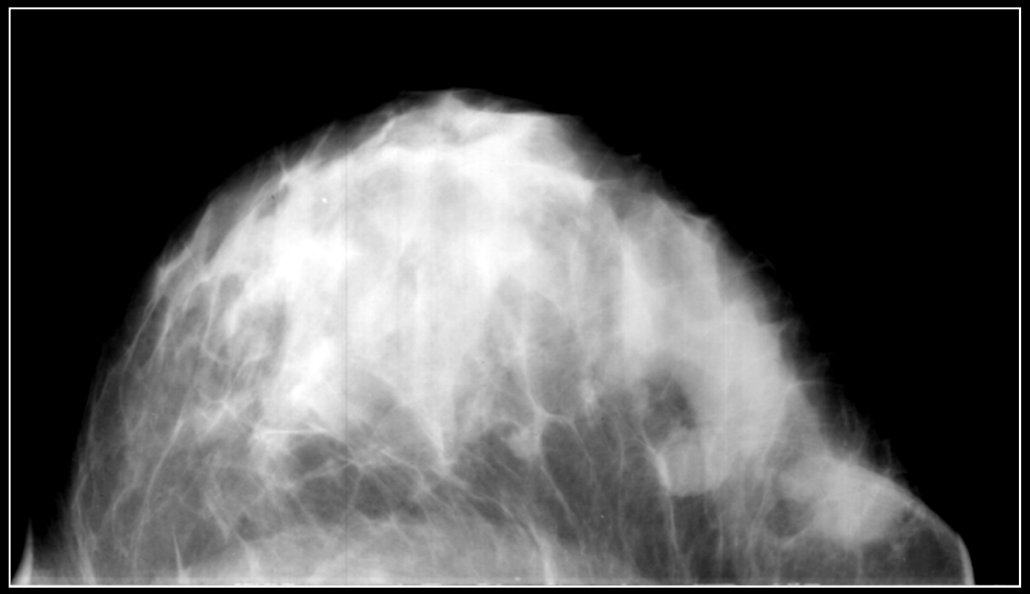
Heterogeneous mass with fat and fluid density



CDI: Vascularity within the mass

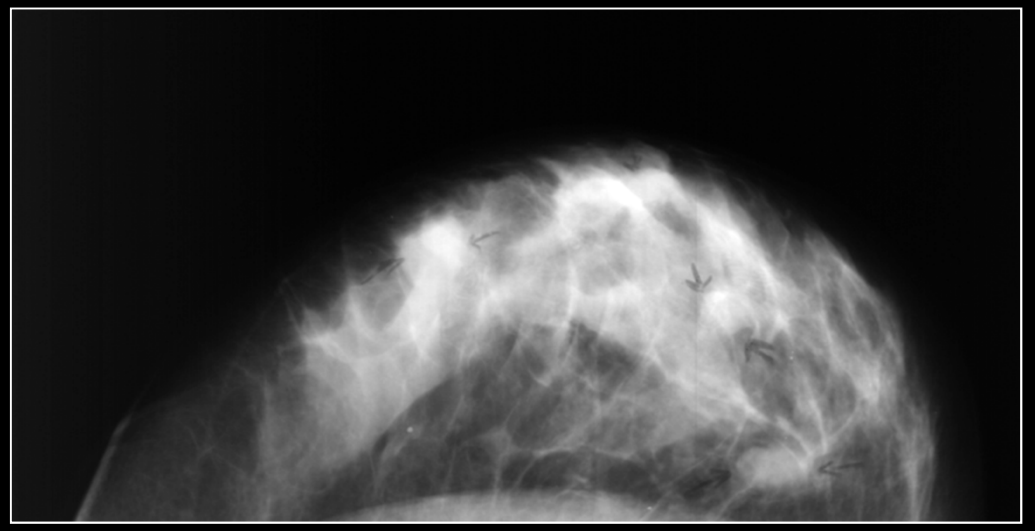


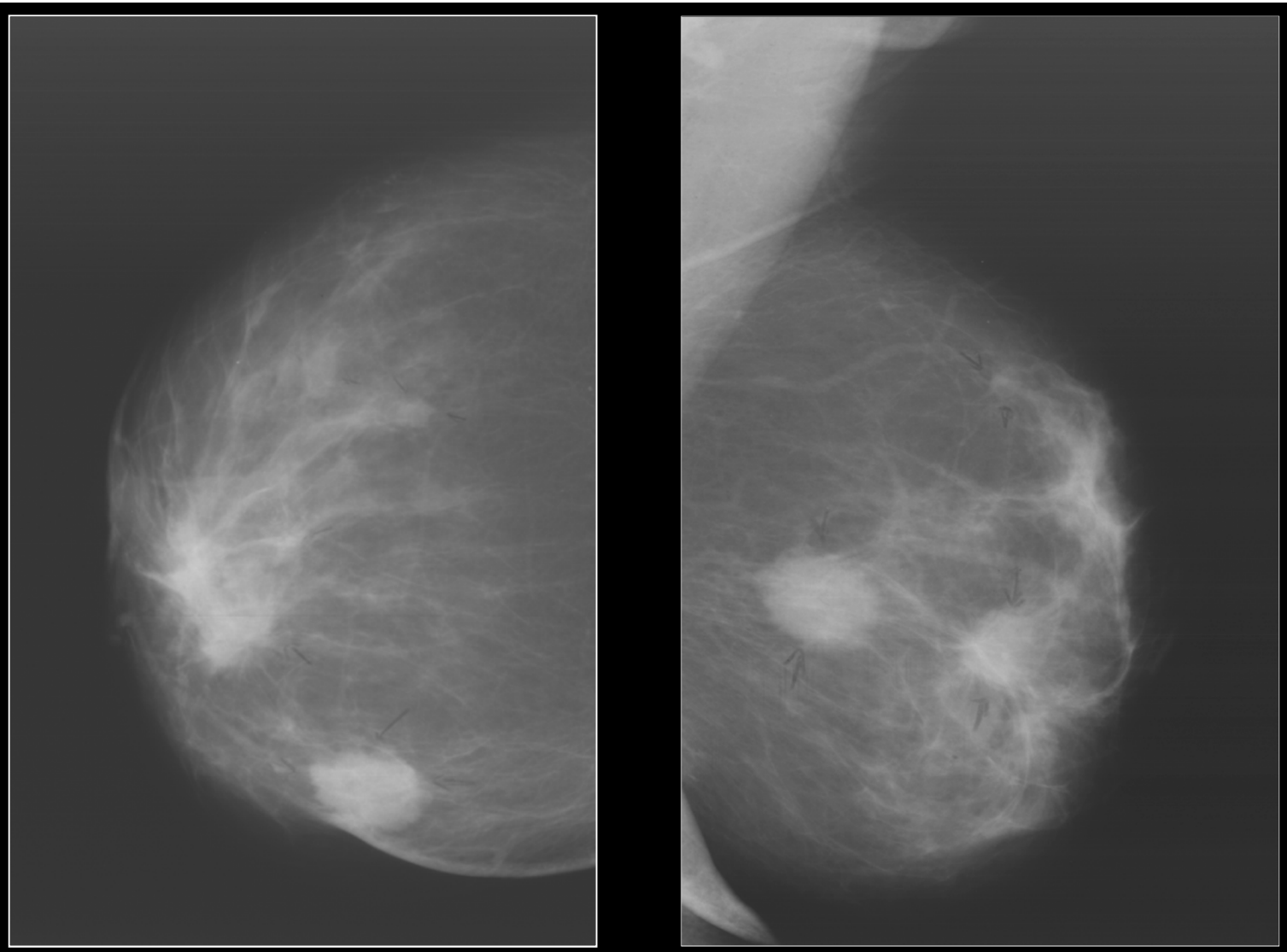
CT: Heterogeneous Breast mass with fat and soft tissue density



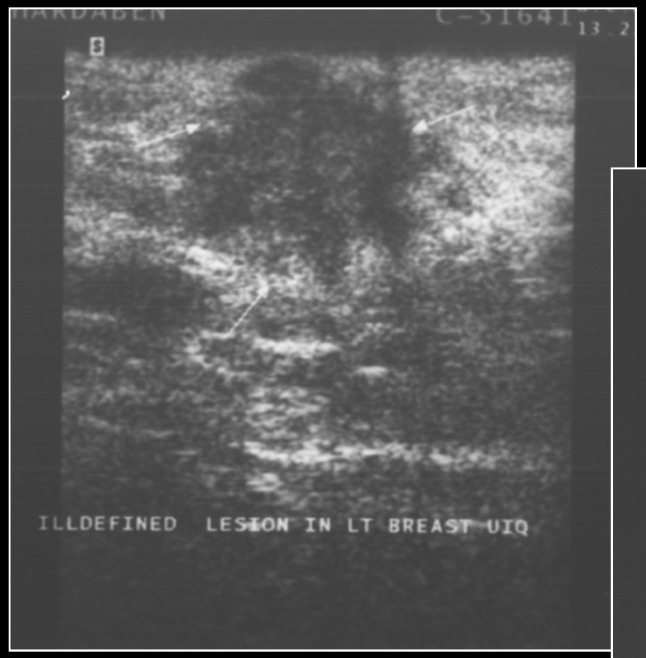
A 30 yrs female
who presented
with bleeding P/R

Bilateral soft tissue
densities noted
HPE : Metastatic Adeno
CA from colon



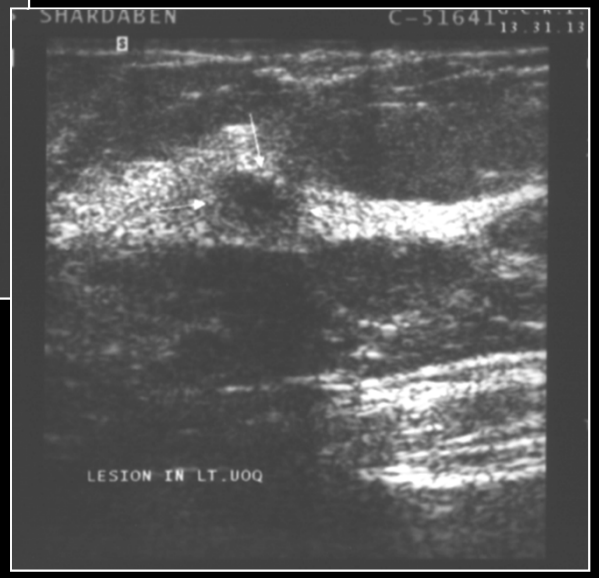


Ill defined soft tissue densities in retro areolar region and upper inner quadrant



UIQ

UCQ



UOQ

Multiple hypoechoic lesions -multicentric malignancy

Pitfalls of screen-film mammography

- Fails to detect 10-20% of palpable breast cancers, particularly in dense breast
- PPV For cancer is less than 50% so more than half of biopsies performed result in benign diagnoses
- If biopsy is not performed excessive recall imaging increases cost and anxiety of the patient
- Inherent drawbacks of observer variability

Procedures

- Needle Placement for Excisional Biopsy
- US-guided Aspirations
- US-guided Core Biopsies
- Stereotactic Core Biopsies
- Ductography
- MR guided Biopsy

Procedures (Contd.)

- Percutaneous minimally invasive procedure
- Mammography, ultrasound or MRI guided
- Accurate, fast, well tolerated outpatient procedure
- Avoids open surgical biopsy for benign lesions
- Decreases number of surgeries in patients with malignant lesions
- Cost-effective alternative to surgery

Digital Mammography

- More inherent contrast than film-screen
- Post-processing will save on patient dose
- Telemammography option is an advantage
- Optical disc storage of images eliminates film loss
- At present time, resolution is better for film screen, but studies have proved equal accuracy

Digital mammography

- Most recent advance in X-ray mammography
- X-rays are used to produce images
- System is equipped with a digital receptor and a computer instead of film screen

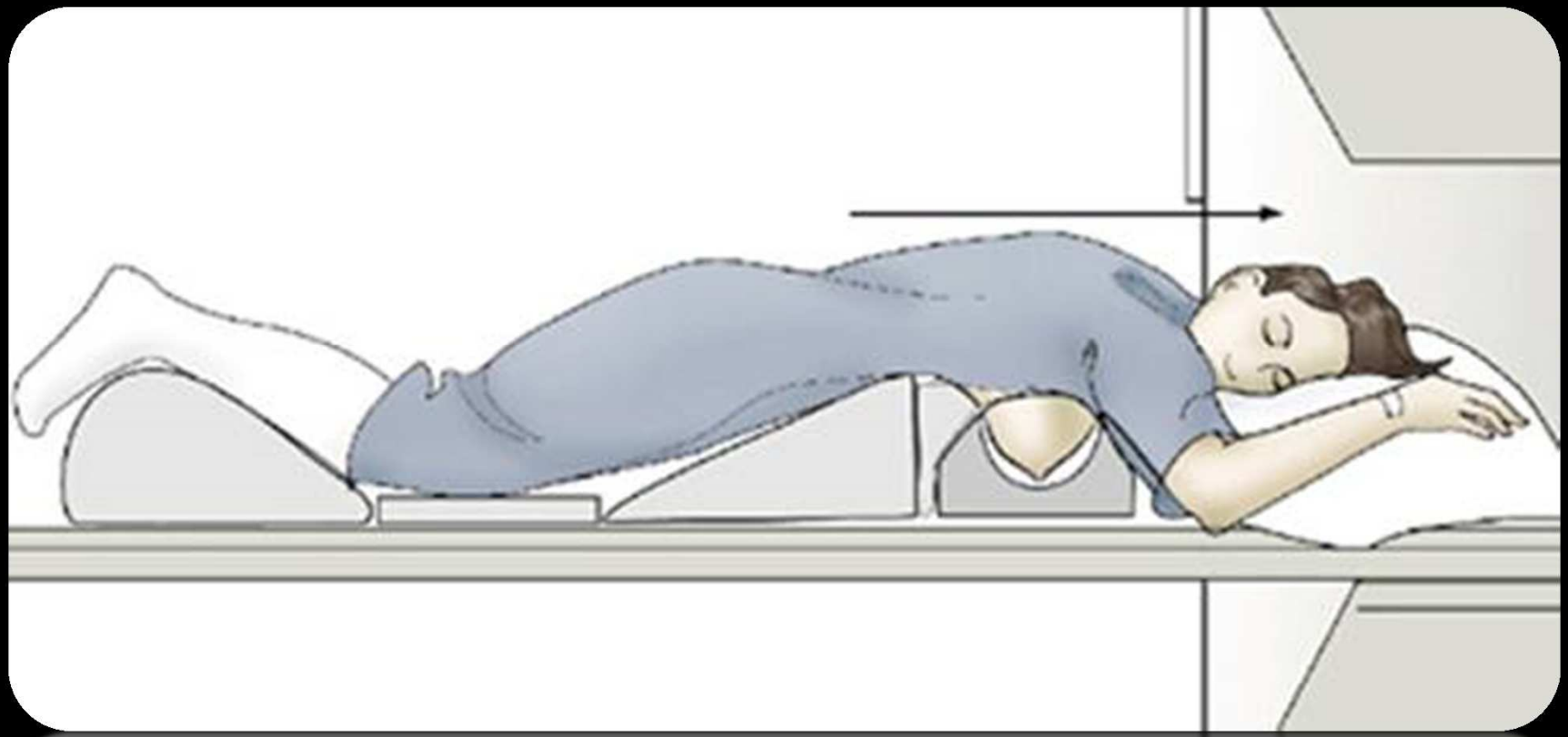
Advanced imaging techniques

- MRI
- Positron emission tomography
- Sestamibi Scintimammography

Breast MR Technique

- Dedicated breast surface coils
- Patient lies prone
- I.V. line should be started before
- Contrast: 0.1mmol/kg followed by 10-20ml saline flush
- Automated injector

Breast MRI- Patient positioning



Breast coil

Indications

- Determine the local extent of malignancy
- Preoperative staging
- For detection of multifocal and multicentric tumor
- Post operative assessment for residual tumor
- MR imaging of invasive lobular carcinoma
- Mammographically dense breast
- Large T_2 and T_3 tumors
- Evaluation of problematic mammogram
- MRI not replacement for mammography or ultrasound

MRI Screening for breast cancer

- Strong family history
- Genetic mutation (BRCA 1 or 2)
- Previous biopsy proved atypia or lobular carcinoma in situ
- Contralateral breast- newly diagnosed with breast cancer

Other Uses

- Rupture of silicon breast implants
- Invasion of pectoralis muscle
- Occult primary in axillary metastasis from breast cancer
- Monitoring response neoadjuvant chemotherapy

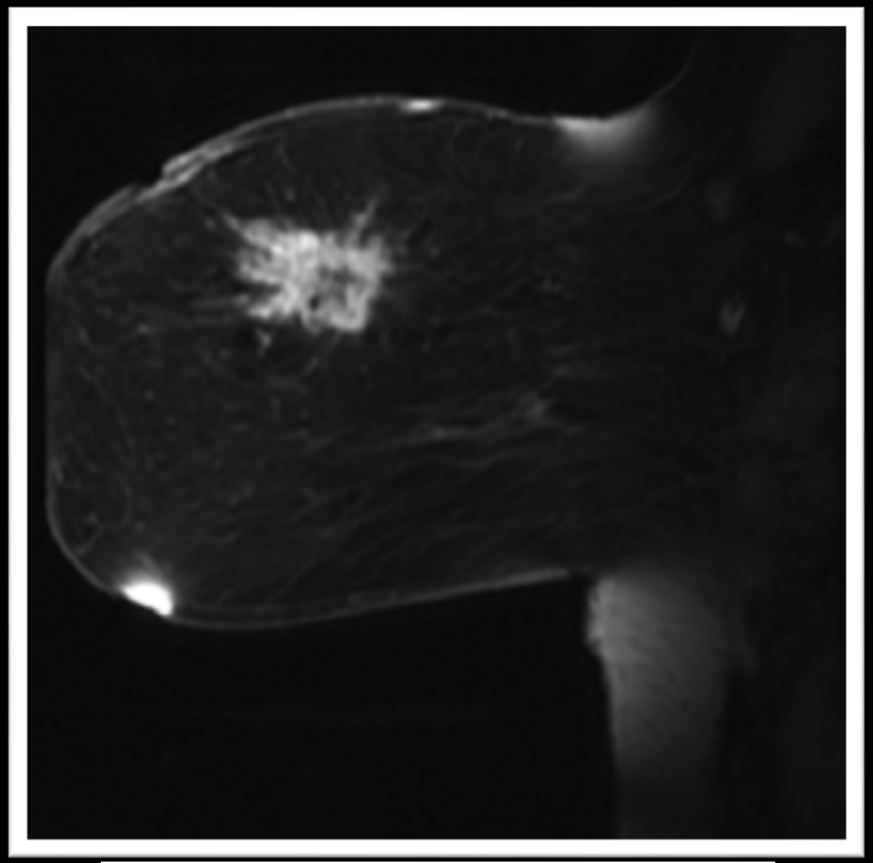
Pitfalls

- Low specificity
- Potential for false-positive examination
- High cost
- Long duration of procedure

Enhancement

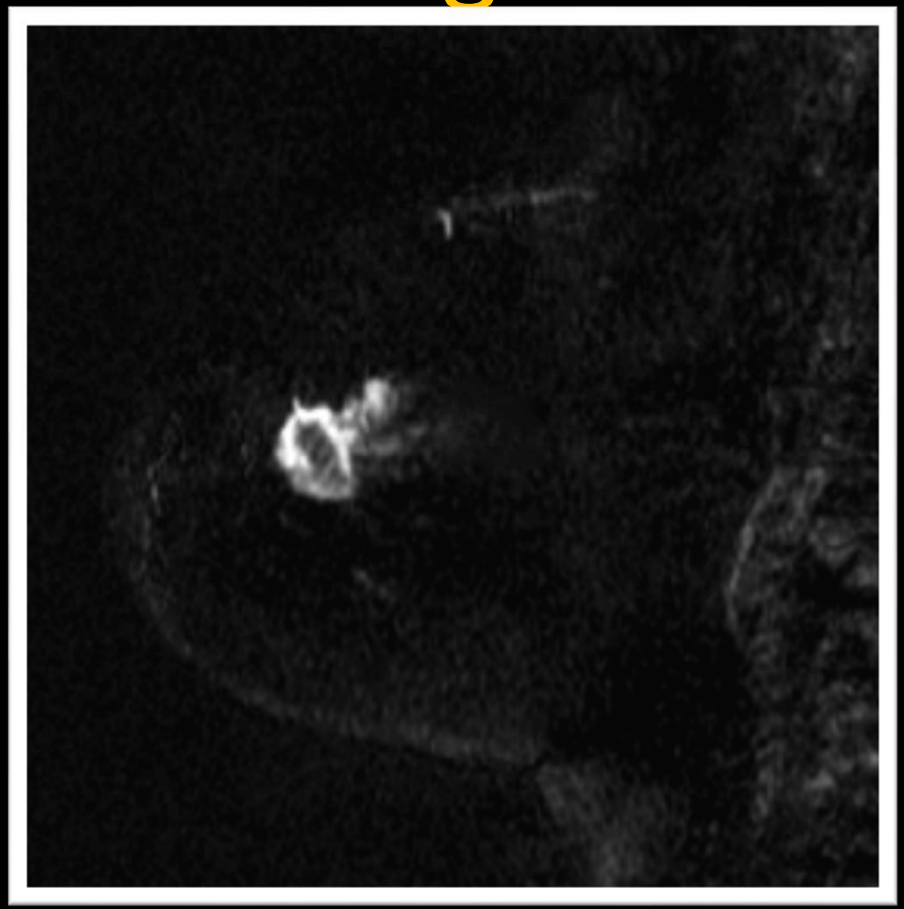
- Type one- Progressive-continued increase in signal with time (80%) benign
- Type two- Plateau-Showing leveling off signal after initial rise (benign and malignant)
- Type Three- Washout-Decrease signal after initial rise-Malignancy (57%)

Mass with spiculated margins



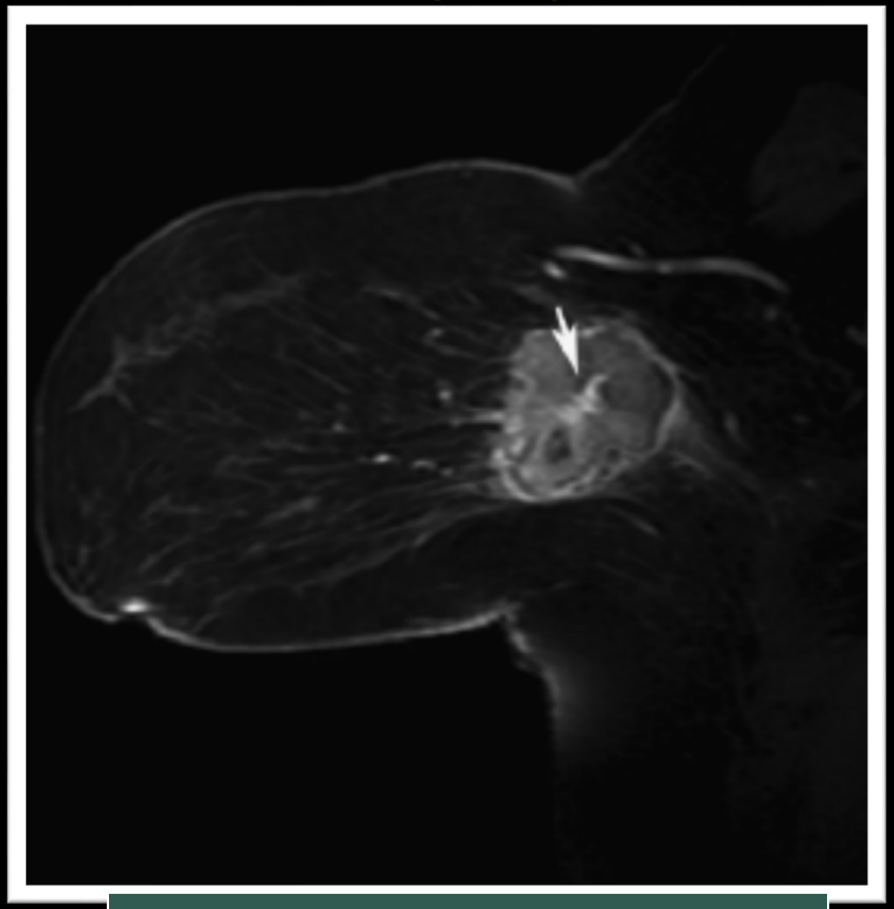
Mass margin spiculated

Internal enhancement- Heterogeneous



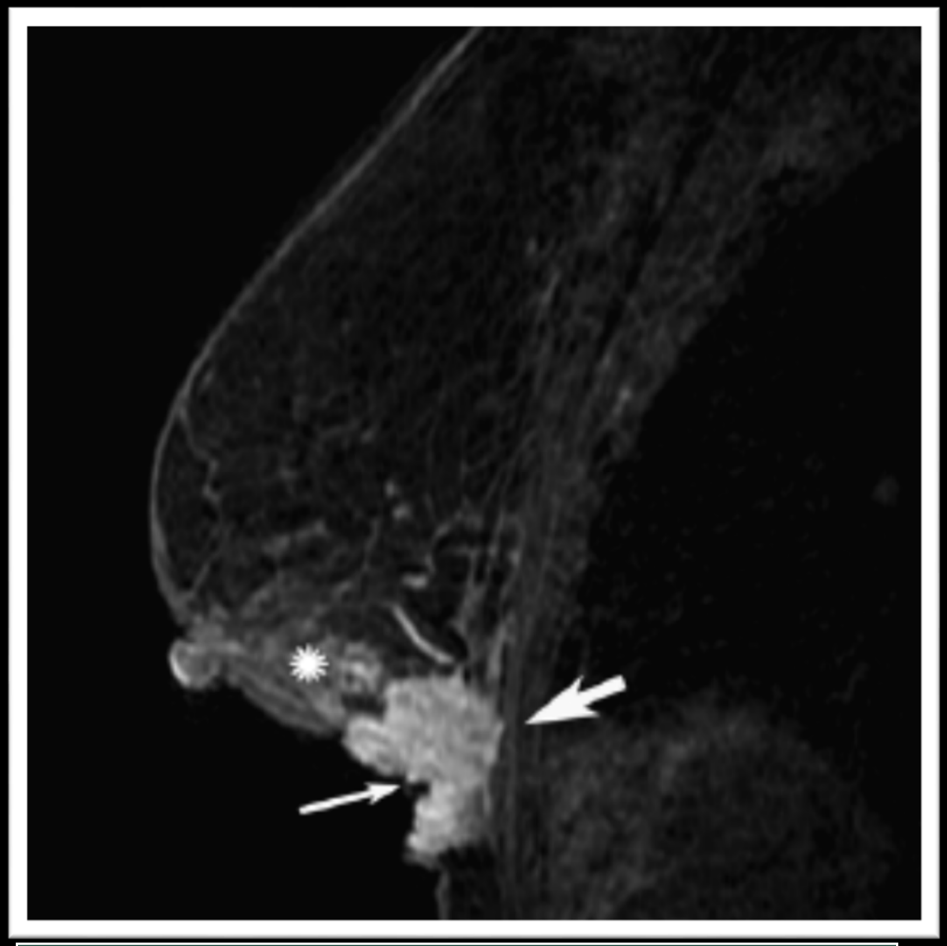
Invasive Ductal cancer

Internal enhancement-Central Nodule



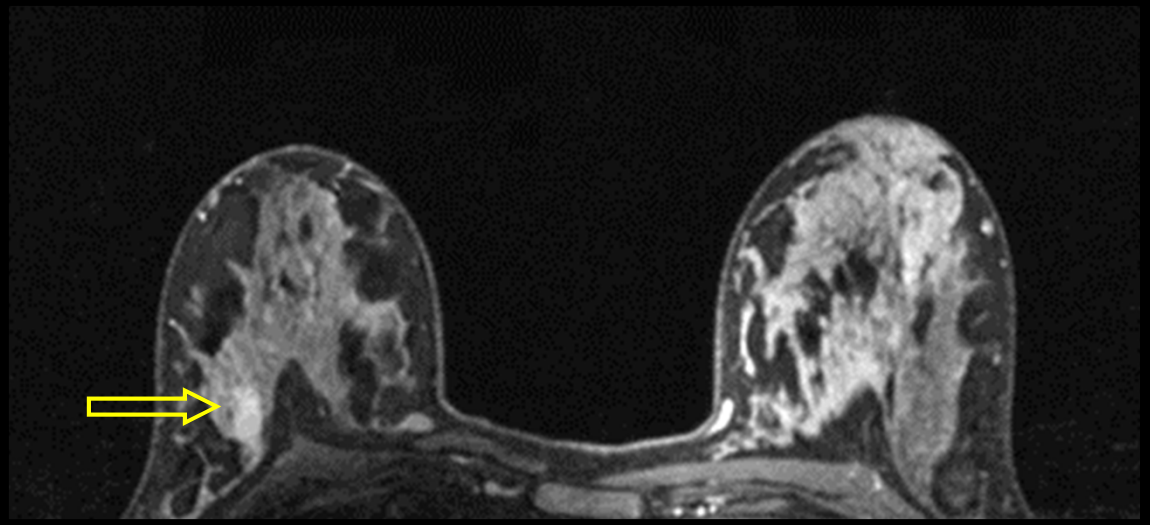
High grade Ductal carcinoma
Enhancing central nodule

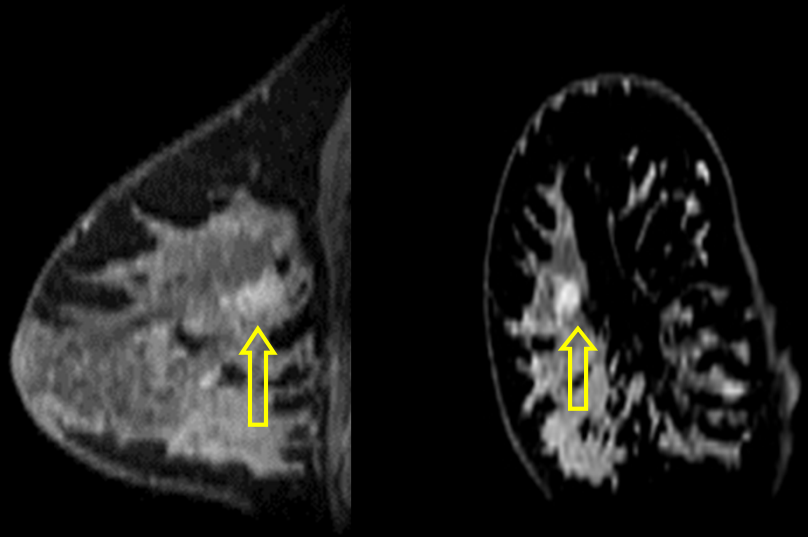
Associated findings



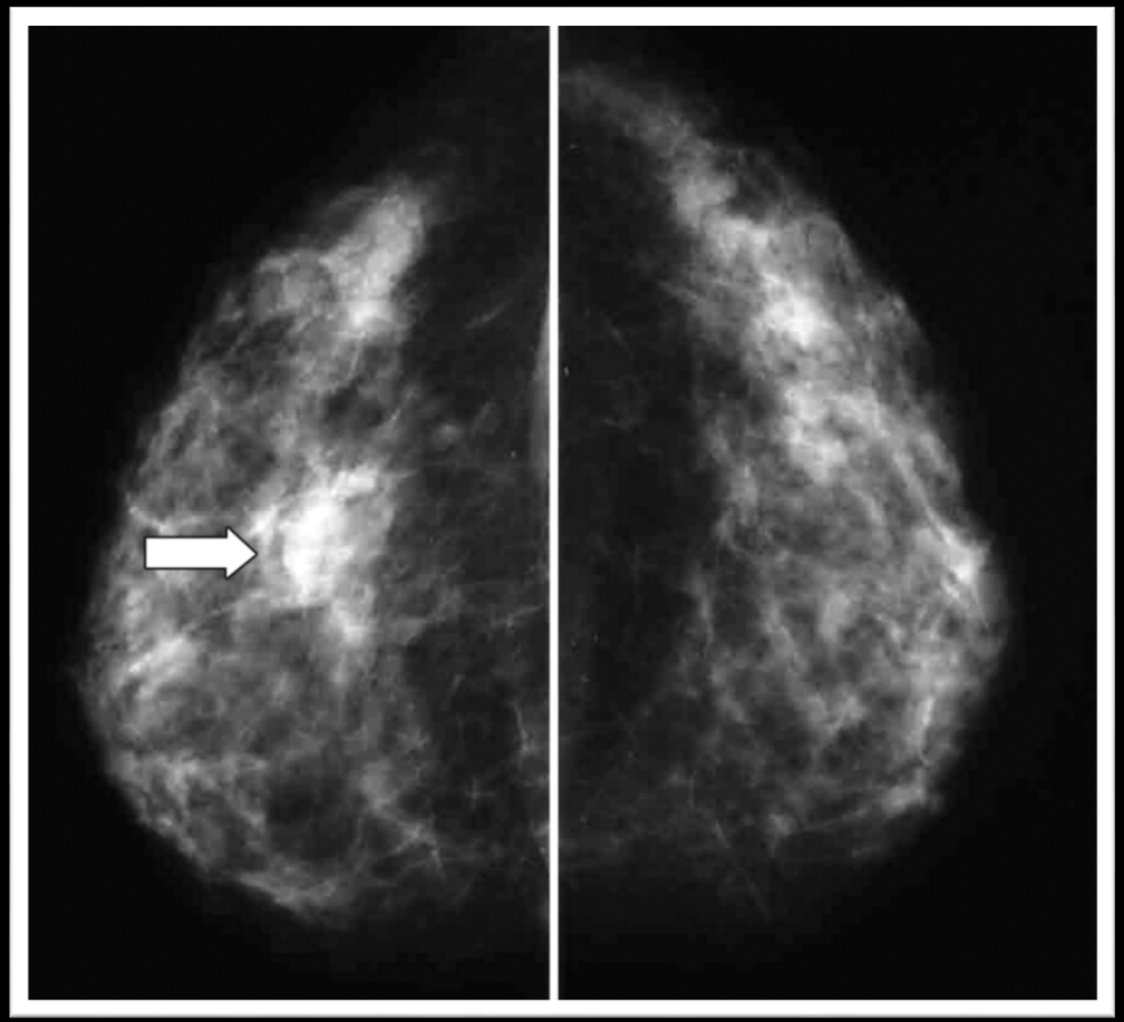
Pectoralis muscle
invasion, skin involvement, reticular enhancement-T4 breast cancer

Occult Breast Cancer

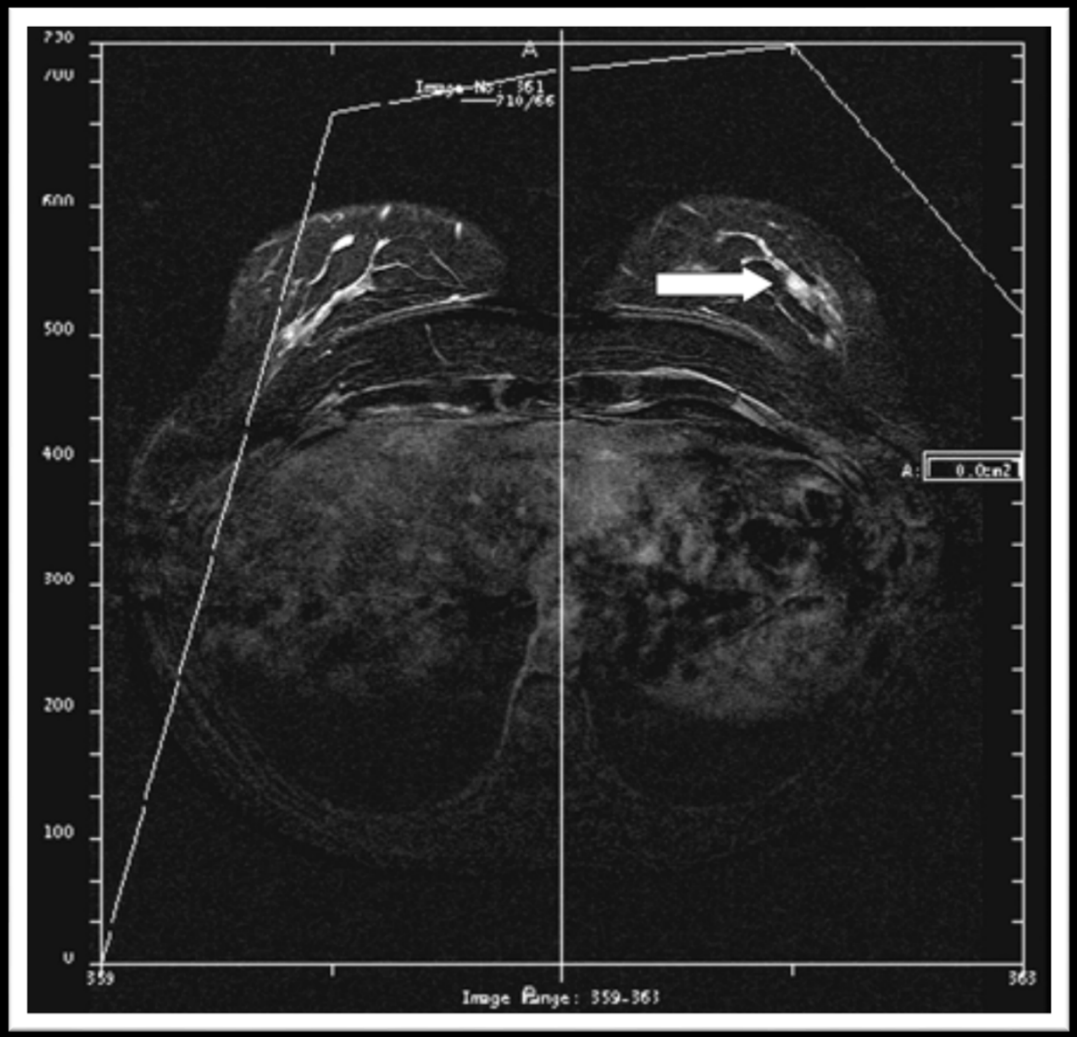




Malignancy Rt Breast

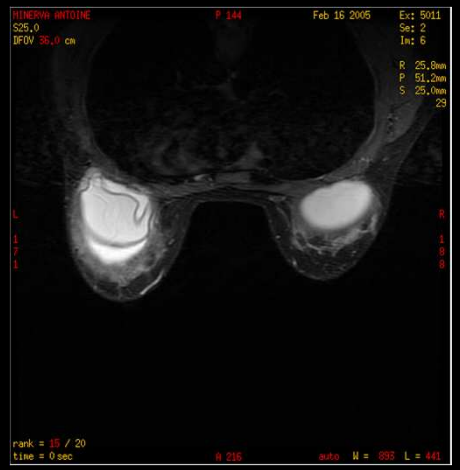


Lesion in Contralateral breast



Breast Implant

Rupture of Breast Implants



PET-Mammography

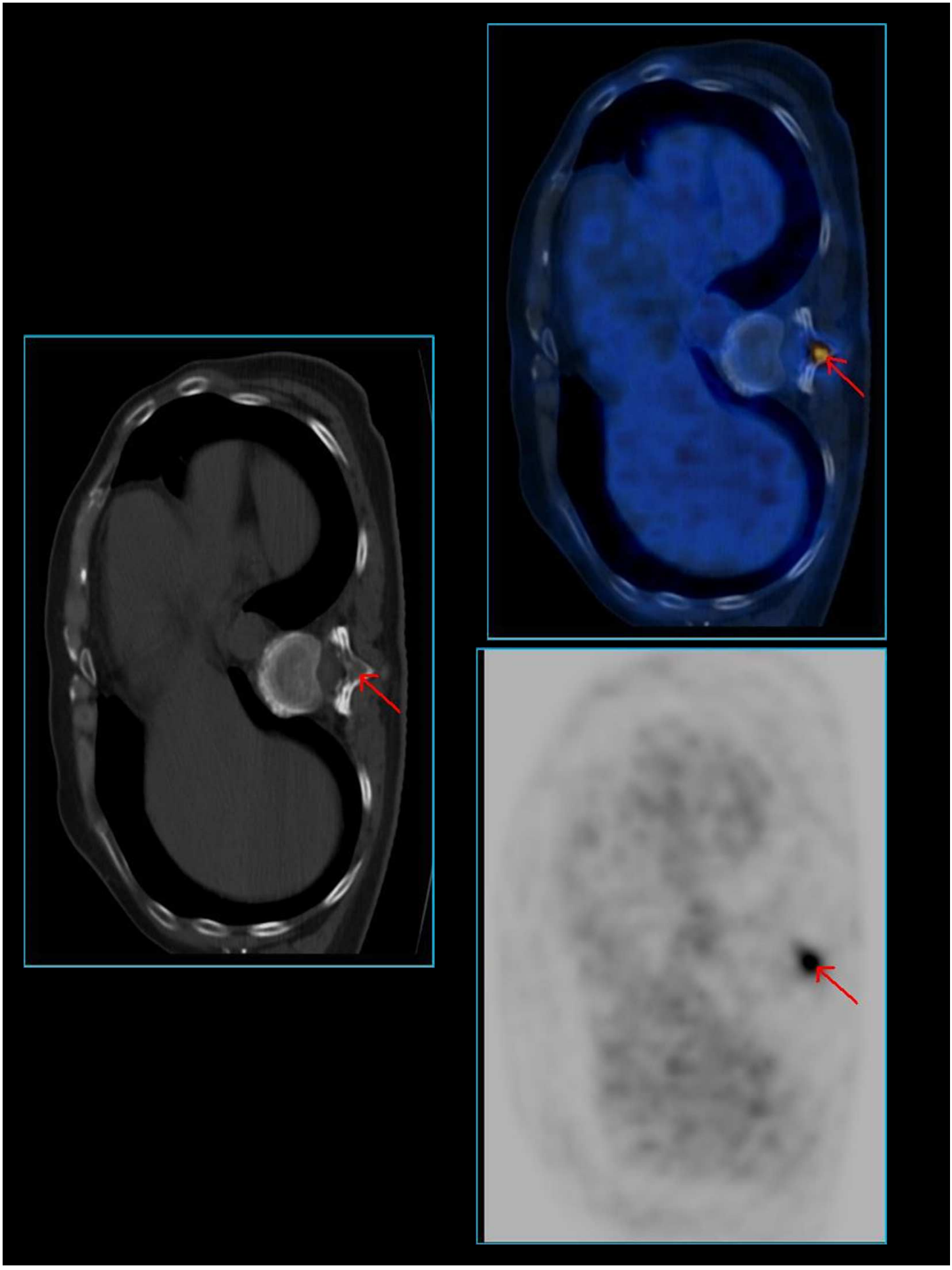
- Nuclear Medicine Technology
- Radioactive sugar molecule-18 fluro-2deoxyglucose(FDG) injected intravenously
- Scanner to detect and generate images that indicates area of high FDG uptake
- Malignant lesions seen as " hot spots"

Indications of PEM

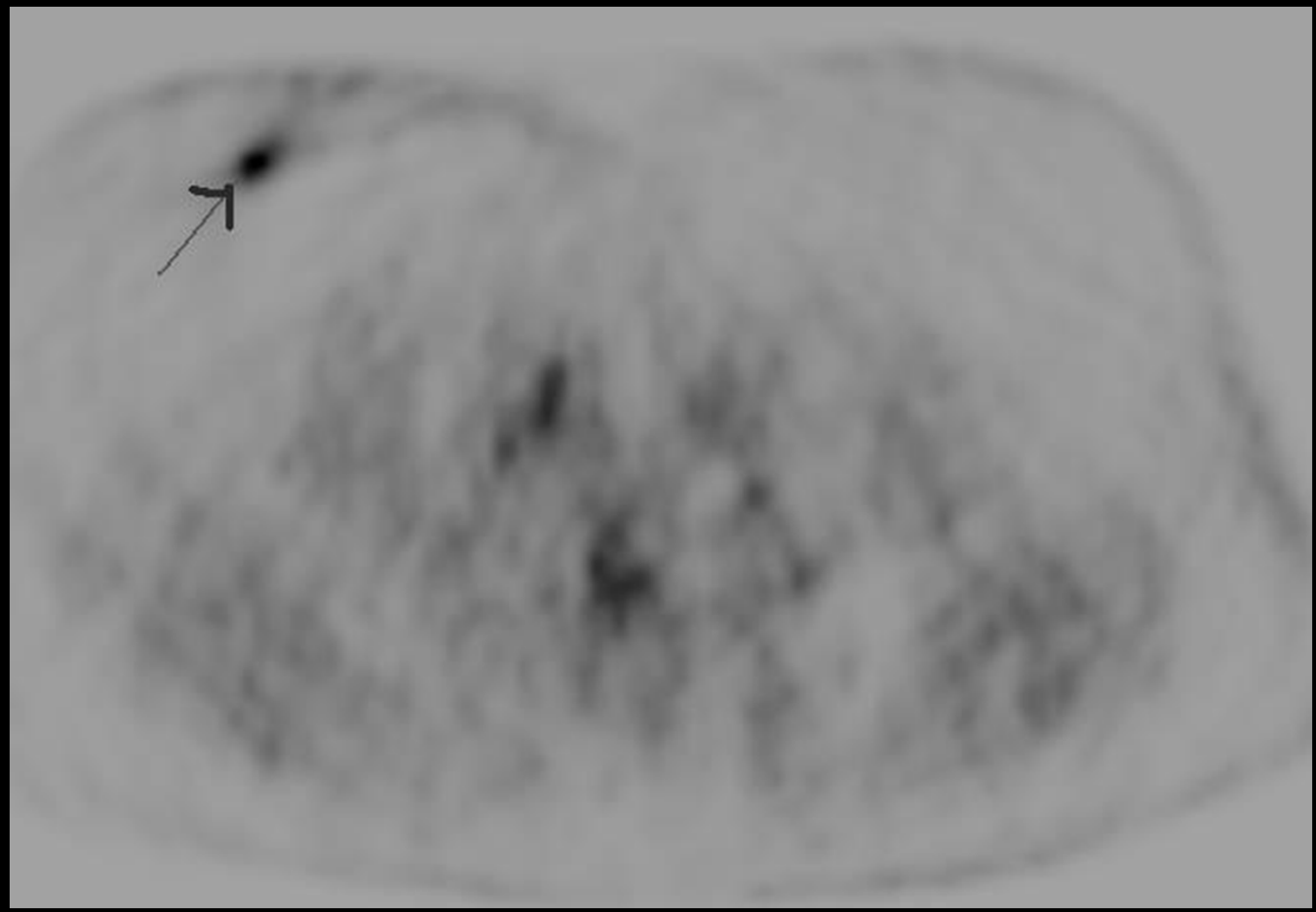
- Adjunct to conventional imaging
- Staging and restaging of disease
- Surgical planning
- Treatment evaluation
- Breast lesions that are difficult to characterize, with dense breast and those at high risk for multifocal or aggressive disease

Limitations

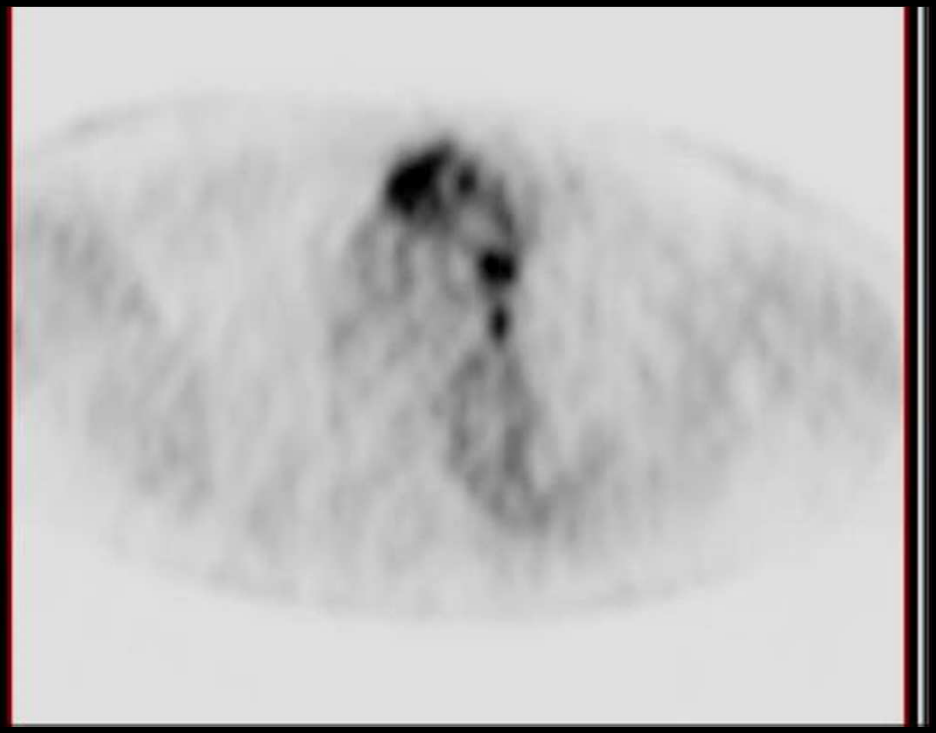
- High cost
- Less availability
- Cannot be used as a screening modality



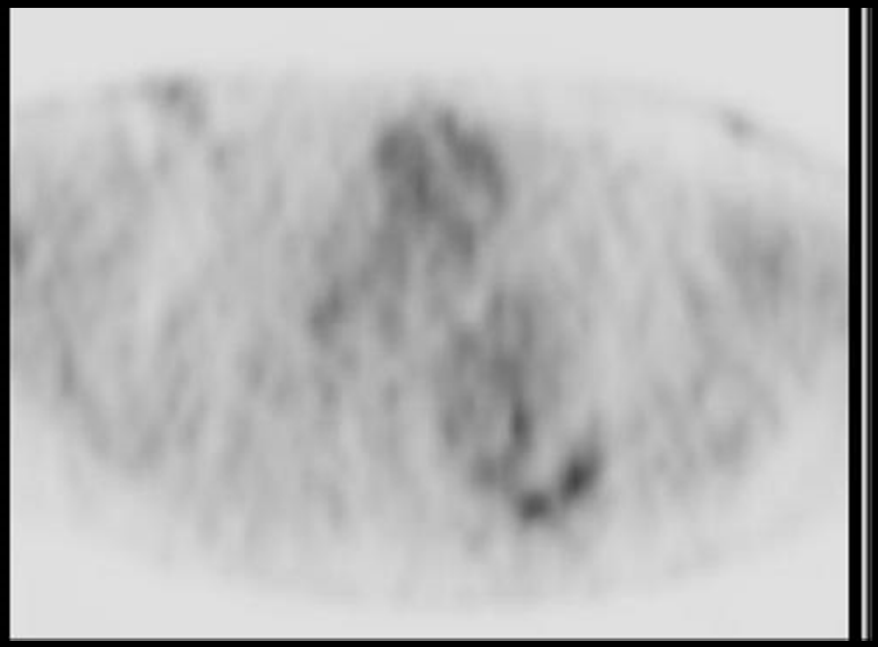
Uptake in Rt. breast- malignancy



Metastatic Ca breast in sternum & mediastinal nodes



Complete response after CT & RT



Scintimammography

- Radioactive tracer T_c-99m Sestamibi tracked by a Gamma camera.
- Tissue uptake varies between malignant and non-malignant tissues

Indications

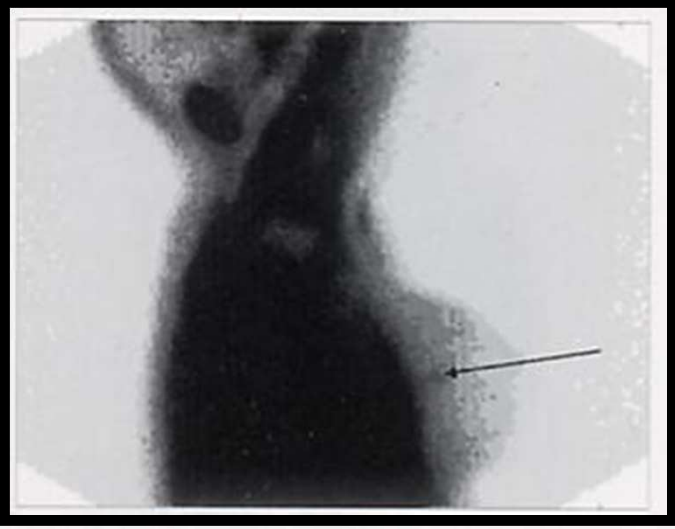
- Supplemental breast imaging for
  - Probably benign lesions
  - Suspicious lesions
- Palpable lesions which cannot be imaged well with Mammography or USG
- Breast implants
- Multiple lesions
- Scar tissue with suspicious recurrence
- Axillary nodes

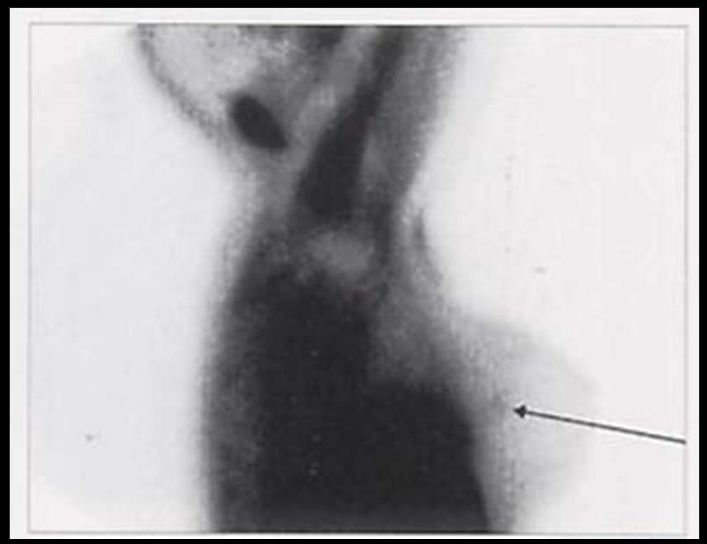
Imaging patient

- At end of acquisition
- Do not move patient
- Use Co-57 or Tc-99m marker (1-2 MBq)
- Place on nipple
- Re-image 1-2 minutes
- Repeat on other breast

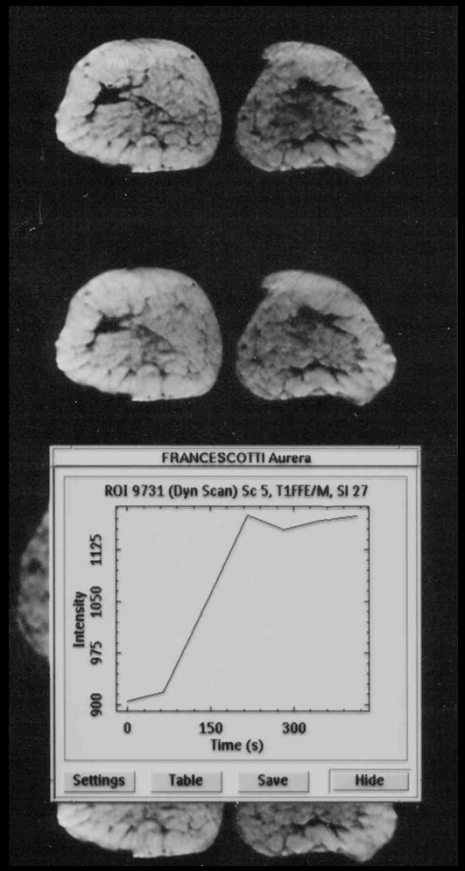
Displaying images

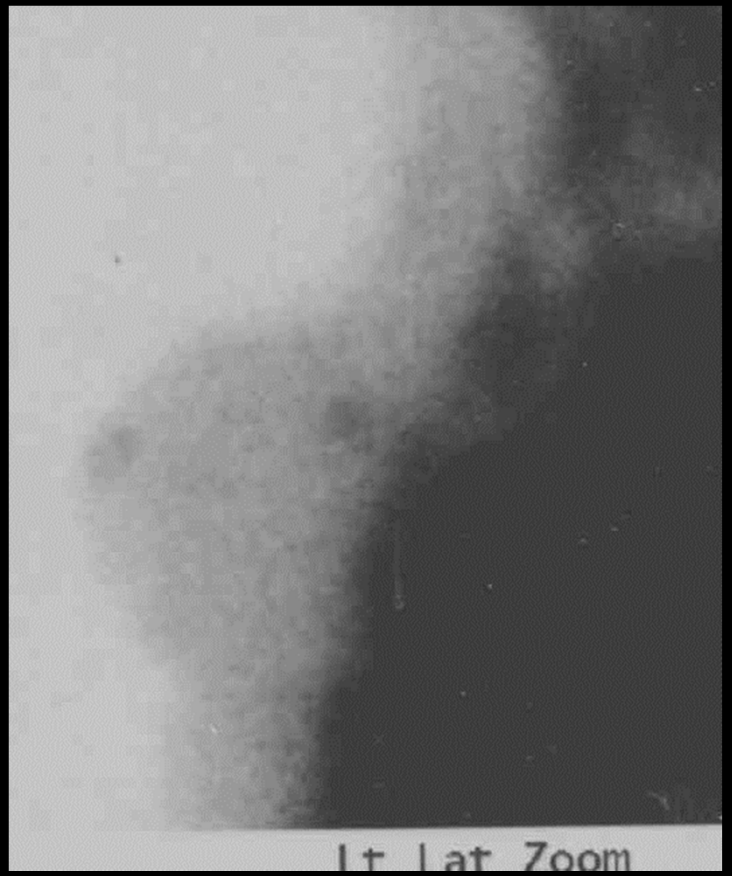
- Need to display images onto film or computer for reading
- Use display that allows good visualisation of breast activity





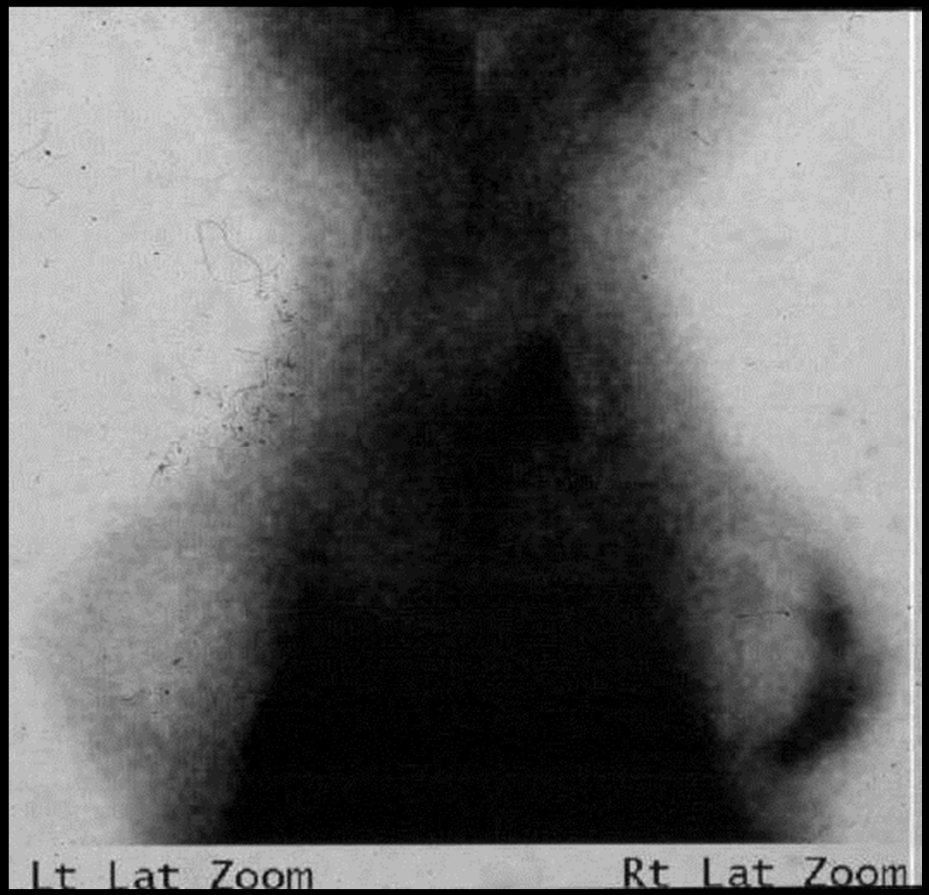
Single cancer MRI , 2 positive on Tc-99m MIBI)





Equivocal lesion in Lt. breast, Positive on Scintimammography

Operated Lt. breast , scar malignancy



Conclusions

- Film screen mammography – modality of choice for screening
- Negative screening mammogram never replaces need for diagnostic mammogram
- Ultrasound essential in majority of (but not all) women for complete work up of palpable abnormality
- MRI & other newer modalities- evaluating extent of disease in women with current breast cancer diagnosis

Thank you