

COMMENTARY

THE DETECTION AND BIOPSY OF BREAST DISEASES: ROLE OF IMAGING

Saba Sohail

ABSTRACT

Advances in the imaging of breast have paralleled the increased detection of carcinoma breast. Although mammography remains the gold standard with a phenomenal backup by ultrasound; the natural architectural variations along with the discomfort of compression and intrinsic radiation hazard led to a quest for further avenues. This article is a commentary regarding the trend changes in the conventional film-screen mammography reporting; its variations with digital, radio-nuclear, magnetic resonance (MR) and CT laser (CTLM) techniques and the breast ultrasound complemented by Doppler and image guided biopsy systems. Current uses, limitations and potentials are discussed. **KEY WORDS:** Breast imaging biopsy, digital mammography, magnetic resonance mammography, ultrasound CT laser mammography, scintimammography.

INTRODUCTION

Breast is a special type of soft tissue that requires dedicated imaging equipment; mammography being the dominant modality. Although it was started as early as 1940's, it has made rapid advances in the technique during the last quarter of the 20th century, from xeromammography to fast film-screen mammography to digital MR mammography^{1,2}. Today, mammography equipment is an essential part of the routine armamentarium of any decent x-ray department. These technical advances and dependability are a direct result of increase in the detection of breast malignancy. The speed and flow of these advances and their leading avenues are nearly bewildering. Conventional film screen mammography, also called x-ray mammography, remains a primary imaging modality extensively backed up and complemented by ultra sound. The aim of this commentary is to present an outline of these innovations in the imaging of female breast with particular reference to imaging of malignancy and a view to highlight their current applications.

A- THE IMAGING TECHNIQUES

1- Film screen mammography:

Also called x-ray mammography, it remains the gold standard of diagnosis and evaluation of breast disease^{3,4}. It has an established role in the diagnosis as

well as screening of malignancy because it is cost-effective, non invasive, easy to evaluate and reproducible. Effective mammography requires a high quality image with optimum contrast resolution and minimal radiation exposure to the patient. All these objectives are achieved by the modern dedicated mammography unit. This utility led to the need for developing a uniform reporting and documentation with emphasis on management strategies. This uniform lexicon was developed by various committees of the American College of Radiology in the 1990's and is termed as BIRADS (Breast Imaging, Reporting And Data Systems) lexicon. It uses a standardized, specifically defined terminology and final assessment categories which are six in number and quantify the likelihood of cancer. The categories are described as under :

- Category 0: Incomplete assessment- needs additional imaging evaluation.
- Category 1: Negative mammogram- nothing to comment on
- Category 2: Benign findings
- Category 3: Probably benign findings - short interval follow-up suggested.
- Category 4: Suspicious abnormality probably malignant - biopsy should be considered.
- Category 5: Highly suggestive of malignancy - appropriate action should be taken.

All these categories are generally found to be clinically relevant and consistent except for the probably benign^{5,6}. The inherent disadvantages associated with conventional mammography are exposure to ionizing radiation (albeit minimal being equal to 0.11 m Sv);

Department of Radiology, Dow University of Health Sciences and Civil Hospital, Karachi.

Correspondence: Dr. Saba Sohail, Assistant Professor, Department of Radiology, Dow University of Health Sciences and Civil Hospital, Karachi, Pakistan.

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uncomfortable compression; inability to distinguish between solid and cystic tissue characteristics and inadequate imaging of the younger or denser breast as seen in those of hormone replacement therapy etc. (Fig. 1).

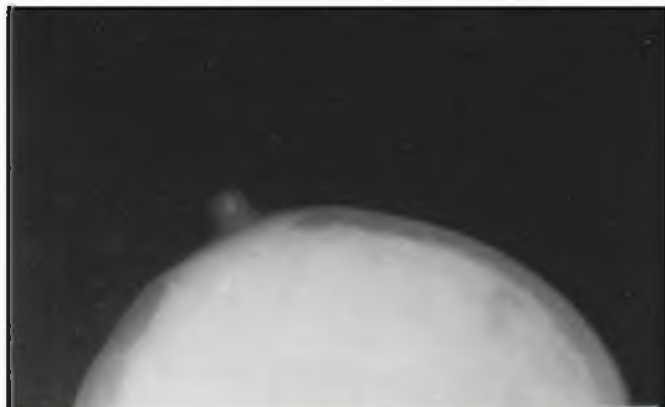


Figure 1: Young/dense breast on mammography hides finer details.

Moreover, the sensitivity of mammography is 90%. Despite being reasonably high, it still means that upto 10% cancers may be missed. This may be due to dense breast, the type and the growth pattern of the tumour compared to adjacent soft tissues or both. Moreover, the most reliable diagnostic feature of carcinoma i.e. the micro-calcification patterns, is seen in only 30-40% invasive non ductal carcinoma. One out of every 5-10 mammographically suspicious lesions turns out to be malignant⁹. The true positive (surgical) biopsy rate remains fixed at 20-30%¹⁰. These limitations lead to the use of adjuncts, the objective being confirmation of the mammography and/or clinically suspicious lesion and characterize the lesion to the extent of obviating biopsy¹⁰. The adjunct imaging techniques are:

1- Ultrasound:

The main utility of high resolution ultrasound lies in the evaluation of the young patient, the pregnant, the lactating and those with intrinsically dense breast tissue. It also discriminates between the solid and the cystic lesion and settles discrepant mammography findings compared to physical examination. It also examines the anatomically difficult areas, such as high placed axillary lymph nodes as well as the lesions adjacent to silicon implants. The role of ultrasound in biopsy guidance is discussed later.

The use of color and power Doppler has provided further insights to the indeterminate solid lesions¹¹. Detection of Doppler signals concordant with

neovascularity may prompt biopsy (Fig. 2).

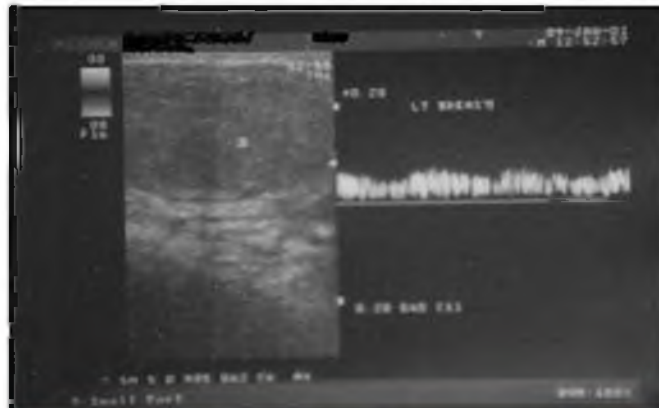


Figure 2: Ultrasound evaluation of a breast lesion using color and spectral Doppler imaging.

Injection of micro bubble contrast agents enables accurate differentiation of the benign from malignant lesion since the latter enhances more and for a longer duration¹². Florid vascularity with tortuously and shunt formation (also called basket vascularity) is diagnostic of carcinomas.

The technique is limited by operator dependence, lower contrast than X-ray mammography and poor visualization of non-invasive ductal carcinoma. Ultrasound is not a screening modality but using high-definition ultrasound improves the accuracy of mammograms¹³.

2. Magnetic resonance (MR) mammography:

Contrast enhanced MR mammography holds strong potential because of more than 90% sensitivity to detect carcinoma¹⁴ and helps in treatment planning. Its particular role is in evaluation of a clinically suspicious mass when mammography and sonography are not corresponding with clinical findings. The technique involves T-1 weighted 2-D or 3-D gradient sequencing with dedicated breast coils before and after contrast administration. Invasive carcinoma is of low signal on T1 W1, intermediate-to-low signal on T2 W1 (Fig. 3)



Figure 3: MR Mammography showing signal changes in the left breast following contrast enhancement.

and enhances faster and more intensely after contrast administration¹. Silicon implants in the reconstructed breast can also be evaluated for leakage or rupture. Normal implant has high signal on T2-W1.

The specificity of the technique is rather low with more false positive rates which is a disadvantage. False-negative MR is usually seen with ductal CA-in-situ, invasive lobular CA, tubular CA and some colloidal mucinous CA¹⁴.

The disadvantages of MR include high cost, complexity of equipment, more false positive and failure to detect early carcinoma which does not improve survival¹⁵. A variation is MR spectroscopy that identifies the amount of choline in malignant tissue of breast for non-invasive diagnosis³.

3. Scintimammography:

Radionuclide or scintimammography is conducted by injecting the radiotracer Tc-99m-Sesta MIBI and tetrofosmin, and detecting the tracer deposition with scintillation camera (Fig. 4).

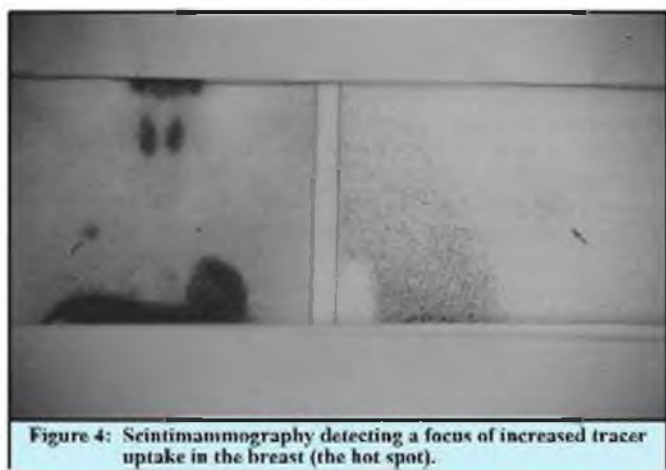


Figure 4: Scintimammography detecting a focus of increased tracer uptake in the breast (the hot spot).

It has demonstrated a negative predictive value of 94% for palpable lesion with sensitivity of 80%¹⁶. It is also good for post-operative evaluation. However the sensitivity is generally poor for small, non-palpable and medially located lesions.

A variation of the technique is physiological imaging with PET scanners which is showing promise for evaluating axillary lymph node metastasis¹⁷ and lymphoscintigraphy¹⁸.

4. Digital mammography:

Digital mammography is direct imaging with electronic recording of x-rays transmitted through breast followed by tomosynthesis which allows multiple projections with improved image resolution in shorter time. Digitisation also helps in archiving and retrieval of record as well as telediagnosis. However calcifications may be missed¹⁹. Presently the technique is mainly utilized coupled with stereotactic biopsy systems.

A. ADVANCED MODALITIES IN EVOLUTION:

Further imaging modalities which are still under clinical testing include computerized thermal imaging²⁰, CT laser mammography (CTLM), breast bio-physical examination and utilization of micro-wave technology. The main advantages prompting this research are reduced need for compression as required in conventional mammography, shorter time required for completion of procedure and multi-dimensional visualization of the lesions. However these modalities are still in evolution without established roles as described above. Their wide spread use is limited by the cost and availability of equipment.

Invasive diagnostic techniques like galactography and pneumocystography have become obsolete after the introduction of high frequency, high resolution ultrasound.

B. BIOPSY OF BREAST LESIONS:

Screening tests detect 05 cancers/1000 cases and 40 indeterminate lesions requiring biopsy and histology²¹. Once a lesion is rendered visible, particularly on mammography categorized as BIRADS-4 onwards, it has to be biopsied either by fine needle aspiration or preferably by taking core of the tissue²².

Currently core biopsy is used to get a sample adequate enough for detailed cytologic examination and special studies such as estrogen receptors, flow cytometry and tumour markers²¹.

1. Conventional: Until the 1980's, biopsy was done by the surgeon after mammographic localization using a perforated compression plate, with wire, contrast or dye injection. Wire localization was and is the commonest for this purpose. Risk of anesthesia is added to the disfiguring scar, which may cause diagnostic disturbance on

follow-up mammograms. Co-ordinate grid technique is a simple, satisfactory, mammography-dependent technique where only one film is used for localization of lesion.

2. Stereotactic biopsy: In 1988, stereotactic biopsy was first introduced for patients whose lesions were not visible on ultrasound²¹ and is now performed for obviously malignant nonpalpable lesion and indeterminate likely benign lesion (BIRADS-3) This utilizes a digital mammographic unit with state-of-art machines providing a near real time display. The suspicious lesion is localized by two mammographic views; patient is placed prone on the stereotactic table with breast hanging through an aperture. Skin is cleansed, anesthetized and a core biopsy is taken with an automated biopsy gun. The procedure takes 45 minutes to one hour²². It is a sensitive and cost effective technique often used as a single stage surgical procedure for excision of smaller lesions, radial scar and superficial lesions²³. The main draw-back is often complete removal of the mammographically visible microcalcifications in the larger lesion.

3. Ultrasound-guided biopsy: Ultrasound remains an important popular and cost-effective image provider to guide the biopsy of suspicious lesion. After sonographic localization and standard aseptic precautions, either fine needle aspiration (FNA) or core biopsy (either with hand-held automated gun or mammotome-assisted) can be carried out. The latter is more traumatic.

FNA remains more popular being quicker, cost-effective and less traumatic. However, the technique is critical requiring fixation of the target tissue and sufficient amplitude of needle strokes. It may also under-sample the lesion and has a false negative rate of 5-14%. The possible sources of error are isoechoic lesions, mobile and improperly fixed lesion and technique errors.

CONCLUSION

X-ray mammography remains the standard technique of imaging and screening breast lesions with a powerful support provided by ultrasound as an adjunct technique. The latter is also helpful in providing guidance for intervention. Newer techniques are also in the process of evolution and refinement to be used in a particular suitable clinical situation.

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