IMAGING OF THE BREAST

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Introduction:

Breast cancer is the most common non-skin malignant neoplasm affecting 1 in 8 women. It is the second leading cause of cancer death in women. Successful treatment of breast cancer depends on early detection, which can be achieved through routine mass screening. Unfortunately, in the Arab world no mass screening programs are available. In survey conducted in the United Arab Emirates women lacked adequate knowledge about breast cancer screening and only 10.3% of women had mammography screening examination on yearly basis. In Lebanon, no national mass screening program exists, but rather awareness campaigns in the media and mammographic examinations are offered by the Ministry of Health.

Mammography remains until today the gold standard for breast cancer screening. This technique, however, is not 100% accurate and several imaging tools are used as complementary modalities.

Mammography:

Mammography is currently the only exam approved by the U.S. Food and Drug Administration to screen breast cancer in women who do not show any sign or disease (screening mammography).

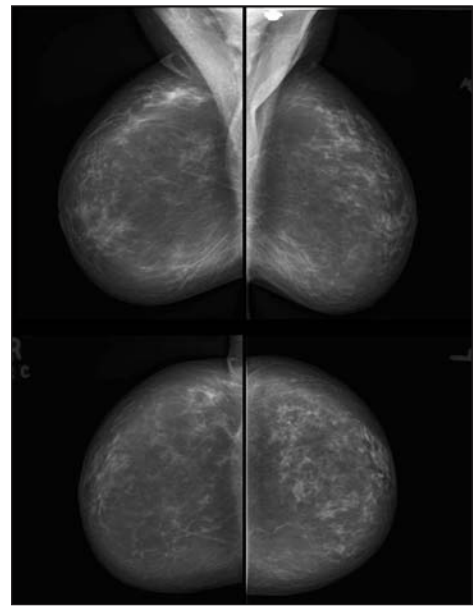
Women from the age of 40 should start having an annual mammogram as recommended by the American Cancer Society (ACS), the American Medical Association (AMA) and the American College of Radiology (ACR). However, in women at higher risk with positive family history of breast cancer screening should start at an earlier age. Research has shown that annual screening mammography leads to early detection of breast cancer in almost 85% of screened individuals. They are mostly curable i.e. with small infracentimetric in-situ non palpable lesions reducing breast cancer mortality by 20-30%.

Mammography utilizes low dose x-ray to obtain high quality images of the breast. The effective radiation dose is 0.7 msv from a mammography which is about the same as the average a person receives from background radiation in 3months. Thus, the benefits of mammography far outweigh the risk and inconveniences.

The best time for a mammogram is one week following the woman's period during which the breasts are non tender.

It is very important that every woman would inform her doctor or the radiographer if there is any possibility that she might be pregnant. She should also describe any problem or symptom, since some cancer may be clinically overt without having any mammographic evidence.

A mammogram is also like a finger print, appearances vary between women. It is extremely helpful for the radiologist to have films from previous examinations for comparison, since subtle changes may indicate an abnormality. It is preferable to have double checking and reading of mammograms in order to improve accuracy of lesion detection.



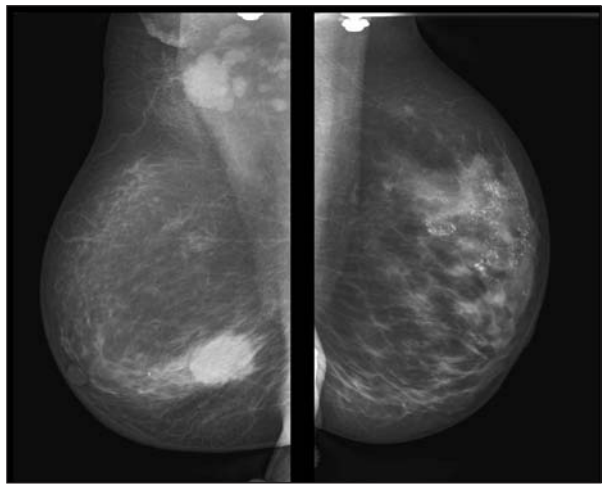
Optimal positioning and compression are crucial in identification of a lesion. Four basic views are obtained (2 of each breast), Craniocaudal and Mediolateral Oblique (MLO) (Figure 1). In some cases, special mammography techniques are used to make small area of breast tissue or suspected lesions easier to evaluate: These include the spot compression, magnification views.

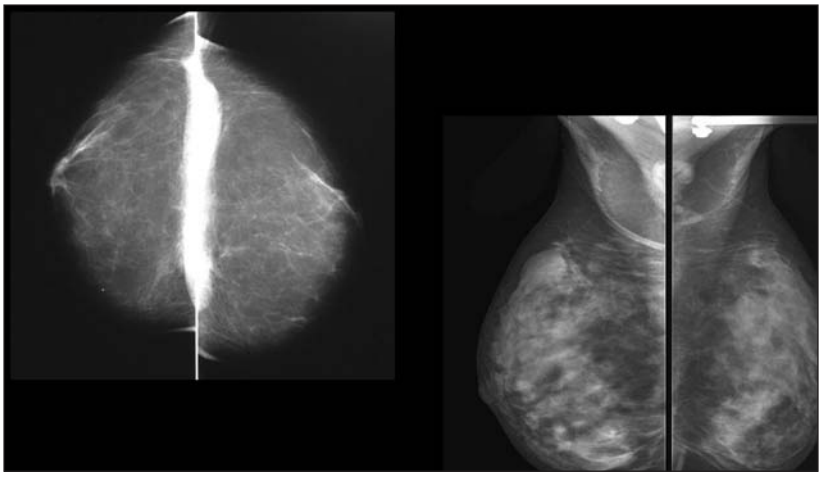
The breasts are usually compressed between paddles. The compression may cause discomfort and women may feel some pressure but no significant pain if appropriately done.

Cancer usually manifests itself as microcalcification or masses (Figure 2), but not all microcalcifications or masses are malignant.

Screening mammography can detect most of breast cancer but it can

miss up to 15% of cancer. These cancers may not be visible on a mammogram because they are very small, they are in an area that cannot be easily imaged or cancer is obscured by other shadows and there is high density of breast.





Breast density represents the glandular tissue that is usually predominant in young women and decreases with age due to fat replacement of the glandular tissues (Figure 3). In order to improve on the accuracy of mammography in non-invasive breast cancer diagnosis several imaging techniques have emerged.

Full Field Digital Mammography:

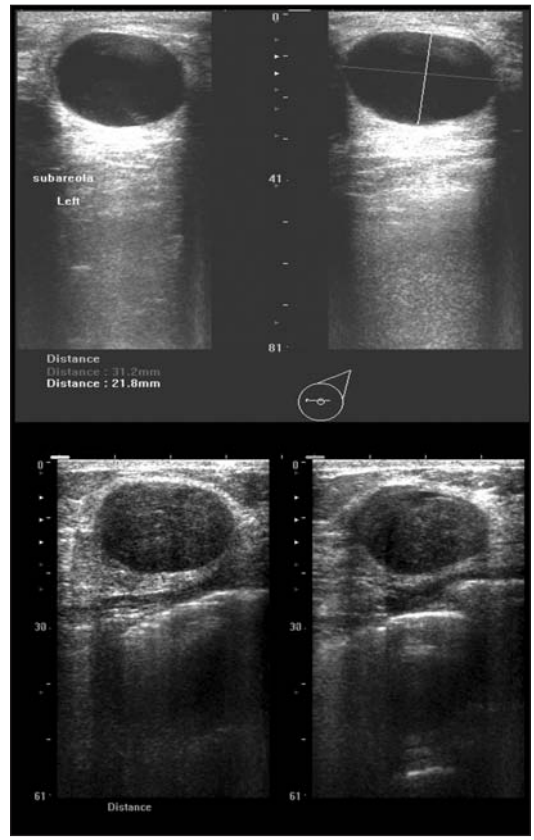
A novel approach is Full Field Digital Mammography. It is similar to standard film screen mammography in that it uses x-ray and the breast has to be compressed. However, the radiation dose is reduced as well as the need for repeated images as these can be computer manipulated. It allows faster image acquisition, improved contrast between dense and non-dense tissue and the exam time is shorter. One of the largest cancer screening trial Digital Mammography Screening Trial (DMIST) found that digital and standard film mammography have similar accuracy rates. However, digital mammography was significantly better at screening of women:

- under age of 50, regardless of level of breast density
- of any age with dense or extremely dense breast
- pre- or perimenopausal women of any age

Digital imaging still utilizes x-rays and has some of the limitations of film screen imaging; other imaging techniques are being utilized to help in early detection of breast cancer, such as Ultrasound (US), MRI and metabolic imaging by Positron Emission Tomography (PET).

Ultrasound (US):

Ultrasound is frequently used to evaluate breast abnormalities that are found in screening or diagnostic mammography or during physician's performance of clinical breast examination. Ultrasound is excellent at differentiating solid versus cystic lesions (Figure 4), at clarifying an area of high density and is especially important in dense breasts. Moreover, it is an invaluable tool for guiding biopsy i.e. needle sampling of breast cancer tissue for microscopic examination. It



utilizes high frequency sound waves to image the breast. No radiation is involved and it is pain free. It also has an excellent contrast resolution, but low spatial resolution and is highly operator dependent. These factors make ultrasound not very feasible as a screening tool for breast cancer detection.
It is worth mentioning that current sonographic equipments have excellent spatial resolution and outstanding image contrast which make this modality an indispensable adjunct to conventional mammography.

MRI:

Since 1991, MRI has been approved as a supplemental tool to mammography for diagnosis of breast cancer, and over the past 5 years there has been increase in the use of MRI of the breast. It is an excellent problem solving technology.
MRI uses powerful magnetic fields and radiowaves to create cross sectional images of breast. A dedicated breast coil should be available and a contrast agent is administered intravenously.

Indications for MRI of the breast:
- Assessing extent of disease in patient with a recent diagnosis of breast cancer to detect multifocal or multicentric cancers
- In case of malignant adenopathy with unknown primary
- Evaluation of response to neoadjuvant chemotherapy
- Imaging of augmented breast

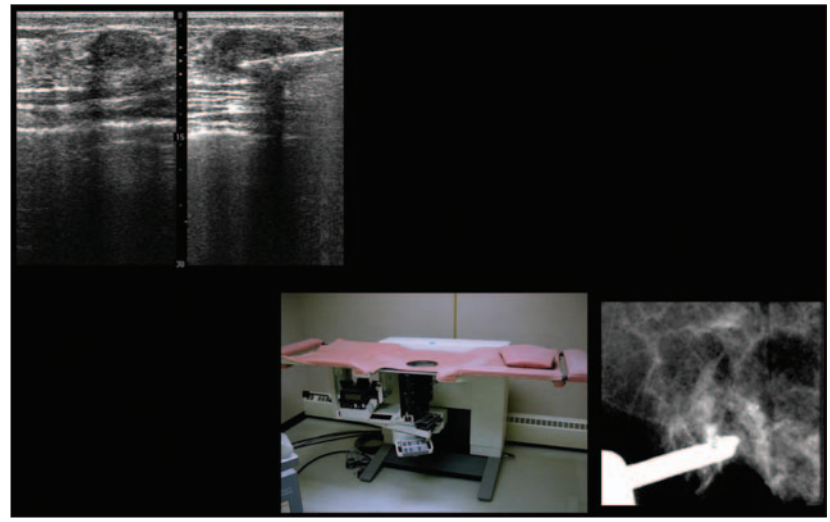
However, MRI though very sensitive it is still not recommended as a screening tool because of its low specificity estimated at 40% and positive predictive value for biopsy. In other terms, although MRI can detect cancer that may be undetectable by mammography and ultrasound, it does so at the expense of more false positive results increasing the need for biopsy and anxiety to the patient. Moreover, the impact on breast cancer recurrence or mortality has not been studied yet.

PET

Newer techniques based on metabolic activity of breast tumor also have been developed including Scintimammography and Positron Emission Tomography (PET). The latter is a powerful tool that is used in the diagnosis, staging, and restaging of various cancers. A small amount of radioactivity is injected intravenously and the body is imaged. PET can differentiate between benign and malignant breast lesions and is the most accurate tool available to diagnose metastatic breast cancer and more recently it has been used for staging of breast cancer, to measure effectiveness of treatment and monitor any recurrence. Because of its higher specificity, hybrid or fusion imaging by a combination of PET-MRI has been recently developed but not yet in widespread use.

Despite the usefulness of all these imaging techniques in the detection of breast cancer, biopsy and pathological analysis is the only definitive way to determine if cancer is present. It is important to note that 65-80% of the breast biopsies result in benign diagnosis.

Several biopsy methods are available ranging from fine needle aspiration (FNA) for cysts, core biopsy under ultrasound guidance for masses, stereotactic biopsy under mammographic guidance for microcalcifications and MRI guided biopsy for lesions only visible by MRI (Figure 5).



Conclusion:

Despite all these advanced technologies, mammography remains till now the modality of choice for early detection of breast cancer. No single method is 100% accurate and all imaging modalities complement each other. The approach to breast cancer should be multidisciplinary where the woman herself plays a major role.

Annual screening mammography starting at the age of 40 years in highly recommend for early detection of subclinical non palpable breast cancer, yielding a much better cure rate reaching almost 100%.

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