



**ORIGINAL RESEARCH PAPER**

**Radiology**

**Sonomammography Made Easy**

**KEY WORDS:**Sonomammography , shear wave elastography, breast elastography

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**ABSTRACT** While mammography has become a routine method both for the screening and preoperative assessment of breast disease, sonomammography, especially when compared with newer techniques of breast imaging, needs continued assessment. Breast elastography is a new sonographic imaging technique which provides information on breast lesions in addition to conventional ultrasonography (US) and mammography. Elastography provides a noninvasive evaluation of the stiffness of a lesion. Today, two technical solutions are available for clinical use: strain elastography and shear wave elastography. This paper highlights the technique and various advantages of elastography.

**Introduction**

Sonomammography or breast ultrasound is a non-invasive procedure performed to assess the breasts and the blood flow to areas inside it. This test allows quick visualization of the breast tissue. The examination is often done along with mammography (x-ray of breast tissue) to study a mass or lump.

**Indications of Sonomammography**

- When a breast lump (mass) or a general lumpiness is felt in the breast
- To determine if the abnormality detected through mammography or a palpable lump is a fluid-filled cyst or a solid tumour
- Breast tissue is too dense to be assessed accurately by mammography
- In high risk patients with family history of breast cancer, past history of breast cancer or in females older than 35 years of age as a preventive measure to screen for breast cancer
- Additional method to evaluate the breast, when mammo graphy is not so clear

**Procedure**

- Unlike mammography, sonomammography can be performed anytime during the menstrual cycle with no special preparation.
- Being a simple ultrasound procedure, it does not require much groundwork. The person to be examined lies down on examining table. Radiologist applies a gel on the breast area and with uses a special probe (linear, high frequency probe) to scan the whole chest area and armpits for any lump or mass.

**Advantages**

There are several plus points to this test, such as it is

- Quick & non-invasive
- Painless
- Inexpensive
- Does not require any prior preparation
- Useful for evaluating breast masses
- Identifies if a suspicious mass is a cyst (fluid-filled sac) without even placing a needle into it to aspirate fluid

**Ideal modality for breast imaging**

- Should lead to early detection of cancer
- Should be capable of differentiating the benign from the malignant masses, thereby avoiding unnecessary biopsies
- Should be cost effective
- Should be free from adverse effects

**Breast Imaging Reporting and Data System (BI-RADS)** The lexicon includes:

- Breast parenchymal patterns

- Features of masses and calcifications
- Associated findings
- Final assessment categories

**BI-RADS. ASSESSMENT CATEGORIES**

Stage	Result
0.	Assessment incomplete. Need additional imaging evaluation
1.	Negative. Routine mammogram in 1 yr recommended
2.	Benign finding. Routine mammogram in 1 yr recommended
3.	Probably benign finding. Short interval follow up suggested
4.	Suspicious. Biopsy should be considered
5.	Highly suggestive of malignancy. Appropriate action should be taken

**Ultrasonogram: Current Status**

- Further evaluation of clinical & mammographic findings
  - Differentiate cystic from solid lesions
  - Differentiate benign from malignant lesions
- Initial imaging technique for young (under 30), pregnant and lactating women
- Guidance of interventional procedures
- Breast implant imaging
- Supplemental screening for women with dense breasts
- on mammogram

**Additional Indications**

- Second look US after breast MRI
- Abnormal nipple discharge
- Suspected Gynecomastia in men
- Suspected breast abscess/infection
- Screening for breast cancer

**Characteristics of masses on gray scale USG**

Benign	Malignant
Spiculation, Angular margins	Intensely or uniformly hyperechoic
Ellipsoid shape with thin echogenic capsule	Microlobulation
Wider than tall	Markedly hypoechoic
2-3 gentle lobulations	Acoustic shadowing
Absent malignant features	Taller than wide
	Duct extension
	Calcifications, Branching pattern

**Fig 1a Simple cyst**



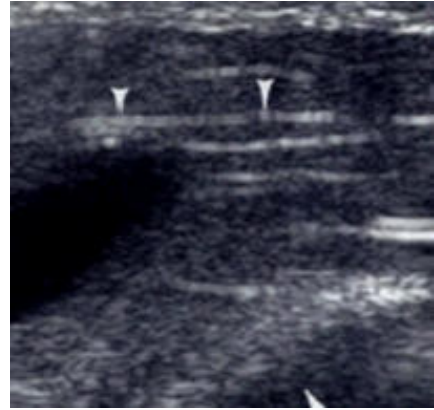
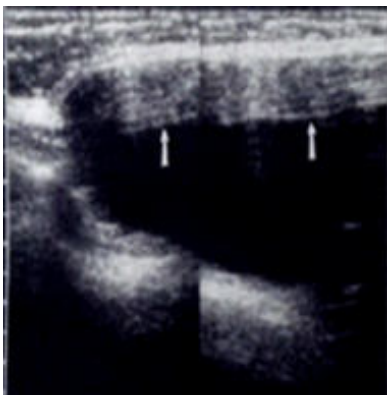
Fig1b Fibroadenoma



Fig 1c Invasive Ductal carcinoma



Fig 2 Implant imaging – USG



**Clinical trials for USG**

In women < 50 yrs with dense breasts USG was 79% sensitive while mammogram was only 50% sensitive. When mammography and targeted USG are negative, the negative predictive value of tumor is 99.8%.

**Color Power Doppler: Current Status**

- Adjunct to gray scale USG: Evaluation of masses with indeterminate features
- To assess the aggressiveness of lesion by demonstrating the increased vascularity
- To assess the lymphnodes

**Technique of Color Power Doppler**

- 5 MHz probe with maximum sensitivity setting optimized to detect even weak signals from small vessels with low velocity flow
- Minimum probe pressure to avoid obliteration of color signals
- Perfusion assessed by color signals and vessels counted
- By pulsed Doppler gate tracing arterial signals are recorded
- Peak systolic, end diastolic velocities and pulsatility index calculated

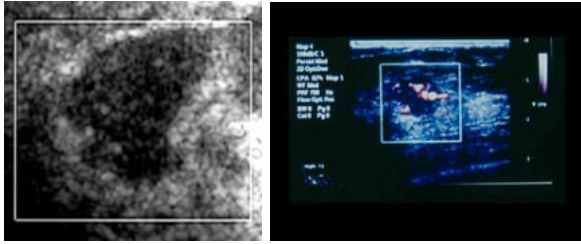
**Assessment on Color Power Doppler**



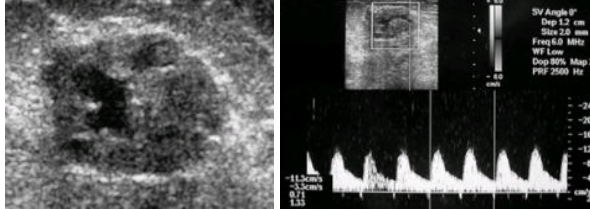
Vascular

Spectral pattern

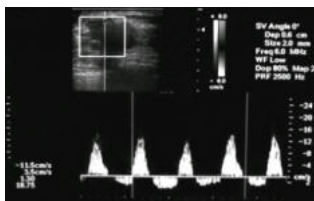
**Fig 3 Vascularity: Breast lesions**



**Fig 4 Low resistance flow on Doppler**



**Fig 5 High resistance flow on Doppler**



**Role of Color power Doppler**

- specificity of 64% for the diagnosis of malignancy
- Pulsatility index > 4 had a specificity of 99%
- Positive study on colour Doppler is more valuable than negative study Vascularity in Breast Lesions

**Benign lesions :**

- No evidence of vascularity : 81.2% of lesions
- Peripheral vessels : 14% of lesions
- Penetrating vessels : nil

**Malignant lesions :**

- Vascularity : 85% of lesions
- Penetrating vessels : 57% of lesions
- One was avascular (Ductal carcinoma in situ)

**Contrast enhanced Color Power Doppler**

- Encapsulated bubbles or solid particles in the 5 to 7-micron range are injected intravenously
- Produce a marked increase in backscatter and make it easy to visualize flowing blood.
- They also produce moderate tissue enhancement usable for dynamic perfusion studies
- Malignant lesions show significant increase in vascularity
- The use of contrast-enhanced power Doppler sonography has managed to detect vessels in up to 95% of malignant tumor

**3 Dimensional USG**

- 3D images are reconstructed from data obtained with a single sweep of the US beam across the involved organ.
- Infinite number of viewing planes are possible showing the exact relationship between anatomic structures
- Surface rendering, volume rendering, and multiplanar reformatting are the algorithms used for reconstruction
- Can demonstrate lesion margins and topography
- Can facilitate needle localization and guidance during biopsy

**Limitations**

- More cumbersome than conventional US techniques.
- Compressing the area being imaged and altering the

patient's position and breathing pattern are difficult.

- The larger data sets produced make data archiving and communication more challenging.
- Waiting for the 3D image can be frustrating to users who are accustomed to real time USG

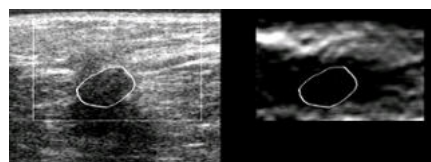
**Elastography**

Breast elastography is a new sonographic imaging technique which provides information on breast lesions in addition to conventional ultrasonography (US) and mammography. Elastography provides a noninvasive evaluation of the stiffness of a lesion.

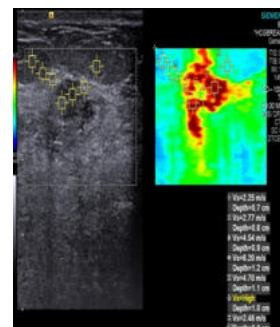
- Small amount of deformation (0.2 – 0.6 mm) is applied to the tissues. Pre and post deformation map of the anatomy are compared
- Displacement each small portion of tissue undergoes is calculated
- Strain images can be produced in real time with free hand screening technique
- Can be integrated into clinical USG system with only software changes
- Benign lesions appear of equal size in B mode and elasticity image
- Invasive ductal carcinoma appears almost twice larger
- ARFI – A promising Elastography technique
- Provides information about elastic properties
- ARFI is useful in the characterisation of cystic lesions
- Operator independent
- More reproducible than conventional elastography
- The interactions between waves and transducer can be varied to produce a (VTI)
- Brightness indicate softer tissues VTQ
- Stiffer tissues produce greater shear wave velocities.
- Shear wave elastography improves specificity of Breast US as the shear wave velocity of malignant breast lesion was significantly higher than the benign lesion
- By adding consideration of mass softness, as determined by quantitative value of SW elastography could reduce unnecessary biopsies of low-suspicion BI-RADS category 4 masses.
- Stiffness on SW elastographic images also helped in identifying the new malignancies among BI-RADS category 3 lesions which would have been otherwise missed.



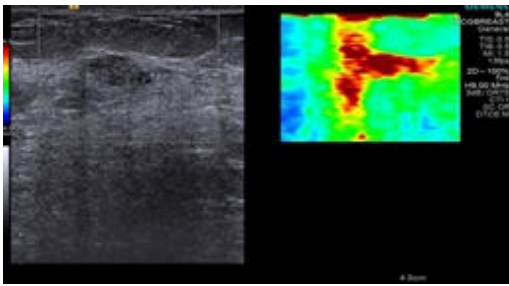
**Fig 6 Fibroadenoma**



**Fig 7 Invasive ductal carcinoma**



**Fig 8 Elastography**



**Take home message**

- Sonomammography is specific
- ARFI – Promising New Technique
- USG – Interventional Procedures
- Younger Patients - Dense Breasts – Modality of Choice mammography

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