Breast Ultrasound: Benign vs. Malignant Lesions

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Breast Anatomy

[Diagram of the mammary gland with labels for anatomical structures such as arteries, veins, muscles, and glands.]

Atlas of Human Anatomy – Frank H. Netter
Case Presentation-Patient 1

62 year old woman with a normal mammogram in 2/04 who presents with a two week history of focal left breast pain and an associated palpable nodule just inferior to the nipple of the left breast.
The patient underwent a unilateral digital diagnostic mammogram for evaluation...
Unilateral Left Diagnostic Mammogram

Left CC

Ill-defined density in middle inferior left breast

Left MLO

PACS, BIDMC
A closer look at the density on LCC view

Note spiculated irregular margins
Mammographic Findings

- Heterogeneously dense parenchyma
- 1.2 cm focally prominent ill-defined density in the lower middle left breast that had increased in size from the prior examination 2/04
- No architectural distortion or clustered microcalcifications
- BIRADS 4-suspicious
Given these suspicious mammographic findings, the patient was referred for further evaluation with a unilateral breast ultrasound...
Indications for Breast Ultrasound

- Differentiation of both palpable and mammographic lesions as either cystic or solid
- Subsequent characterization and classification of solid nodules according to certain sonographic features
- Evaluation of palpable breast mass in patient younger than age 30
- Interventional procedures (FNA, CNB)

Left Breast Ultrasound-Patient 1

- Hypoechoenic lesion
- Skin-thin echogenic line
- Mixed echogenicity of breast parenchyma
- Fat
- Pectoralis fascia-thin echogenic line
Left Breast Ultrasound with Power Doppler - Patient 1

Peripheral vascularity
A brief word on Power Doppler

- Measures amplitude of blood flow rather than direction or velocity as in color doppler.
- The pattern of vascularity of a breast lesion on ultrasound may help to predict the likelihood of malignancy when used with other sonographic criteria.

Power Doppler

- A study by Raza and Baum assigned patterns of vascularity of power doppler for a series of 86 breast lesions on ultrasound.
- Patterns included peripheral and penetrating vascularity, or no vascularity.
- These breast lesions were subsequently biopsied.
- They found that 68% of biopsy-proven breast cancers in this study showed penetrating pattern of vascularity on breast ultrasound (sensitivity 68%, specificity 95%).
- They concluded that the pattern of vascularity of breast lesions should be considered with other sonographic characteristics to help predict the possibility of malignancy.

Patient 2 - An Example of Penetrating vascularity on power doppler imaging in lesion later found to be invasive ductal carcinoma.

Note: Penetrating vascularity within lesion.
Now back to Patient 1, Left Breast Ultrasound

- Skin
- Fat
- Mixed echogenicity of breast parenchyma
- Pectoralis fascia
Left Breast Ultrasound Results

- **Hypoechoic** lesion in the area of palpable abnormality, measures 1.1x1.1x0.9cm
- Macrolobulated with some **microlobulation**, incompletely circumscribed
- Increased through transmission
- Increased peripheral vascularity on power doppler imaging
- **Angular margins**
- Taller than wide in areas
- **BIRADS 4**-suspicious
Two Key Questions

How can we interpret these ultrasound findings?

How will our interpretation help to guide further management?
A differential diagnosis of hypoechoic breast lesions on ultrasound will be helpful...
Differential Diagnosis of Hypoechoic Breast Lesions on Ultrasound

- Fibroadenoma
- Carcinoma
- Abscess
- Cyst
- Fibrocystic changes
- Intramammary lymph node
- Intraductal papilloma
- Sebaceous cyst

What is the next step?

- Next we will need a method of classifying lesions on breast ultrasound. Using this classification it will be possible to make further decisions about patient management...
Landmark study by Stavros, et al

Prospectively classified 750 breast nodules sonographically

- Benign
- Indeterminate
- Malignant

Purpose of the Stavros study

- **Distinguish benign solid breast nodules from indeterminate or malignant nodules**
- **Use this classification as a model to either recommend follow-up imaging for benign appearing nodules or biopsy for both indeterminate and malignant appearing nodules**

Methods: Identification of Malignant Features

- First, they identified lesions with any of the following malignant features:
  - Spiculation
  - Angular margins
  - Hypoechogeticity
  - Shadowing
  - Calcification
  - Duct extension
  - Branch pattern
  - Microlobulation

Methods:

If a single malignant feature was present on breast ultrasound, the nodule was excluded from the benign classification…

Patient 3-Example of two breast nodules with malignant features on ultrasound

Angular margins

Hypoechoic

Spiculations

Microlobulations

PACS, BIDMC
Patient 4 - Example of breast nodule with malignant features on ultrasound

- Internal Calcification
- Posterior acoustic shadowing
Methods:
Next they classified lesions as benign if they fit into any of 3 classifications:

Classification of Lesions as Benign in the Stavros study

- Intense and uniform hyperechogenicity
- Ellipsoid shape and thin echogenic capsule
- 2 or 3 gentle lobulations thin echogenic capsule

Patient 5-Example of benign fibroadenoma on ultrasound

Most common benign solid mass of the breast

Smith, DS. *Radiologic clinics of North America* May 2001; 39(3)
Patient 6-Example of simple cyst on breast ultrasound

- Anechoic
- Smooth margins
Methods:

A lesion was classified as indeterminate if it had no malignant features, yet it did not fit any of the benign combinations.

Results of the Stavros study

All of the breast nodules were subsequently biopsied.

The sonographic classification for each nodule was then compared with the final biopsy results.

Results of the Stavros study cont’d

750 Breast nodules

426 benign on US
  424 benign histology
  2 malignant histology

324 indeterminate or malignant on US
  123 malignant histology
  201 benign histology

Results of the Stavros study cont’d

- Sensitivity of breast ultrasound 98.4% (123 out of 125 malignant lesions were correctly classified as indeterminate or malignant)

- Negative predictive value of 99.5% (2 lesions out of 426 classified as benign on US showed malignant histology)

Conclusions of study:

Given the results of the Stavros study and both the high sensitivity and negative predictive value, sonography can be used to accurately classify some solid lesions as benign. This classification permits imaging follow-up rather than biopsy for benign lesions on ultrasound.

Given the suspicious findings on our patient’s ultrasound and multiple malignant features, she was referred for an ultrasound guided core needle biopsy…
Core Needle Biopsy revealed Infiltrating Ductal Carcinoma
Conclusions

- Breast ultrasound not only helps in differentiating cystic from solid lesions, but also plays an important role in characterizing solid nodules.
- Sonographic features suggestive of malignancy include spiculations, hypoechochogenicity, microlobulations, internal calcifications, shadowing, taller than wide, angular margins among others.
- Sonographic features suggestive of benignity include smooth margins, thin echogenic capsule, ellipsoid shape, macrolobulations, hyperechogenicity.
- The ability to characterize lesions on breast ultrasound helps to determine the next step in patient care.
References

Acknowledgements

A special thank you to Larry Barbaras, Dr. Gillian Lieberman, Pamela Lepkowskii, Dr. Carla Rothaus, Dr. Phyllis Kornguth, Dr. Janet Baum, Dr. Tejas Mehta, and Dr. Ferris Hall.