SONOGRAPHY OF BREAST

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Breast ultrasound has established itself as a first line diagnostic modality which is complimentary to x-ray mammography and in the appropriate clinical setting has proven to increase the overall diagnostic accuracy of breast imaging. It should never be used in any age group to screen for carcinoma breast.

BREAST ULTRASOUND EQUIPMENT

1. One of the primary functions of sonography is its ability to determine whether a mass is cystic or solid. This can be established in the breast using any available ultrasound equipment. In recent years automated, dedicated machines have been introduced which allow total and systematic reproducible scanning of the breast. The entire examination may be done by a single sonographer with the advantage of systematic recording of all data. Detection of non palpable lesions is possible. The disadvantages of automated equipment is cost, longer examination time and the additional training that it entails both for the sonologist and sonographer.

2. Standard real time or sector scanners with hand held probes are available in most ultrasound departments, which can be used for cyst-solid determination of a breast mass with no extra cost or additional training. A single duct anatomy can be examined easily. The disadvantages are: the detection of non palpable lesions is unlikely, examinations are poorly reproduced, data cannot be recorded systematically, it is difficult to standardize examination and usually requires a sonologist/radiologist to carry out the procedures.

3. High resolution grey scale ultrasound machines with the ability to obtain simultaneous Doppler information are being made available. Thus parenchymal information will be coupled with real time blood flow data which will improve the diagnostic capability.

INDICATIONS FOR BREAST SONOGRAPHY

1. Cyst-solid determination in a breast mass.
2. To scan patients with equivocal x-ray mammogram.
3. When there is superimposition of data.
4. Imaging of breasts that contain prosthesis.
5. Clinical breast problems in an adolescent.
1. CYST VS SOLID DETERMINATION

Using strict criteria the positive predicative value for cysts by ultrasound is close to 100%. Usually anything other than an unequivocally simple cyst will be dealt with in a different way and, therefore, an accurate diagnosis is vital. This can be achieved in the vast majority of the patients using ultrasound4.

2. EQUIVOCAL X-RAY MAMMOGRAM

A mass clinically present which cannot be imaged by x-ray mammography is an indication for a sonomammogram. This situation exists in 6% of patients; the mass can usually be defined by ultrasound and thus a delay in biopsy be avoided10,11,12.

The evaluation of unilateral gynaecomastia in the male can be difficult with x-ray mammography. Ultrasound examination may be helpful in this clinical situation; but as in the female breast the sonographic findings must be read in correlation to x-ray mammogram13,14.

3. SUPERIMPOSITION OF DATA

An ultrasound examination produces a tomographic image while an x-ray mammogram produces a summation image with superimposition of structures. Because of superimposition a potential for error exists in interpreting x-ray mammograms. Ultrasound may be particularly helpful in the clinical situation of multiple masses in the breast when individual tumours may be identified and characterized15.
Fig. 2. Large hypoechoic irregular mass with acoustic shadowing — Ductal Carcinoma.

4. BREAST WITH PROSTHESIS

Supine scanners do not produce optimal images in patients with breast prosthesis, because such a breast would not respond to auto compression. Prone scanners in this situation will produce excellent images in the uncompressed breast.²⁶

5. CLINICAL BREAST PROBLEMS IN AN ADOLESCENT

Masses in this age group are usually juvenile fibroadenomas, cysts or abscesses. Ultrasound is an ideal modality in this situation and offers an accurate diagnosis. These patients should not be exposed to x-ray mammograms.²⁷

SIMPLE CYSTS U.S. CHARACTERISTICS:

- Smooth well defined borders
- Echo free with good thorough transmission
- Posterior enhancement with lateral shade sign
- Negative doppler signals

COMPLICATED CYSTS U.S. FEATURES

- Irregular border
- Thick wall

Fig. 3. Mammogram of the same patient as in Fig. 2 showing Large irregular dense mass.

- Lack of good thorough transmission
- Septae
- Debris level/occasional scattered echoes
- Intra luminal papillary projections

SOLID MASSES U.S. FEATURES

- May or may not have smooth borders
- Contain variable echoes
- Do not exhibit through transmission
- Some masses produce attenuation of the beam and thus shadow
- Distinction between benign and malignant masses cannot be made reliably using ultrasound.
- Positive Doppler signals in infiltrative ducted carcinomas
- Negative Doppler signals in benign but positive in 10%
Carcinomas U.S. Features
(Mass Imaged)\textsuperscript{18}

- Irregular margins
- Usually solid
- Hypoechoic
- Acoustic shadowing is produced by a variable number
- Positive Doppler signals in infiltrative ducted carcinomas

No Mass Imaged

- Architectural disruption
- Asymmetry
- Shadowing
- Abnormal Cooper’s ligament: thickened, straight or angulated
- Skin: thickened, irregular or retracted
- England lymph nodes > 1.0 cm
- Positive Doppler signal\textsuperscript{19,20,21}

Sonographic Criteria for Benign Mass

- Shape: round, oval or lobulated
- Boundary: smooth, well defined
- Internal echo:
  - Cysts: minimal
  - Fibroadenosis: intermediate, uniform distribution
- Shadowing: a few benign masses shadow (See Gomut)\textsuperscript{22,23}

Breast Cystic Mass With Intraluminal Projections

- Macro cyst with blood clot
- Intracystic papilloma
- Intracystic carcinoma
- Infarcted cystadenofibroma\textsuperscript{24,25}

Acoustic Shadowing Form A Solid Breast Mass

Acoustic shadowing deep to a solid breast mass in a important sonographic criterion for malignancy, which may be demonstrated with both low-frequency automated and high frequency hand held equipment. Fibrous tissues within a malignant breast tumour contribute directly and significantly to the production of an acoustic shadow.

Although important acoustic shadowing is clearly not a sign specific for breast malignancy, shadowing has been reported in a variety of benign processes. In fact in one series 29% of solid benign breast masses exhibited moderate to marked acoustic shadowing\textsuperscript{26,27}

Differential Diagnosis\textsuperscript{28}

- Carcinoma
- Fibrocystic disease
- Fat necrosis
- Foreign body response
- Galactocele
- Myoblastoma
- Cystosarcoma phylloides

Diagnostic Dilemmas

1. The most difficult type of ultrasound interpretation involves the diagnosis of infiltrating breast neoplasms where a definite demarcated mass is not present and the abnormality is diffuse. The higher the resolution the easier it becomes to detect architectural alteration, but it still remains the most difficult diagnosis to make.\textsuperscript{29}

2. Between 1-2% carcinomas will mimic a cyst. Necrotic ducted tumours and lymphomas may also produce cystic lesions. All complicated cysts should be aspirated/biopsied.\textsuperscript{30}

3. Indurative mastopathy is a benign condition which on mammography presents as a dense central nodule with a peripheral stellate appearance and mimics a carcinoma, sonography does
not offer any additional information to obviate a biopsy.

4. Fat necrosis, a benign entity, may present as an irregular spiculated mass with microcalcification on x-ray mammograms. Sonography has not been able to discriminate this entity from true carcinoma consistently.31,32

5. Medullary carcinomas will often show smooth borders and may not produce acoustic shadowing. These tumours are difficult to characterise by the usual ultrasound criteria for malignancy.

6. Lymphomas and metastasis may produce hypoechoic masses which may be confused with primary carcinomas.

7. Doppler signals are positive in infiltrative ducted carcinoma but may also be positive in 10% of benign tumours.33

8. Normal intramammary lymph nodes are detected by high resolution sonography and present as echo poor masses with echogenic centre and should not normally present diagnostic difficulties.34

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