ORIGINAL ARTICLES

Comparative sonographic review of benign and malignant breast masses

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ABSTRACT

Complex breast masses may appear as suspicious ultrasound findings that usually warrant biopsy. Ductal Cell Carcinoma In-Situ (DCIS) is a form of breast cancer with a non-uniform appearance and malignant potential. A longitudinal review of mammary gland ultrasound (with high frequency transducer) within a three-year period was conducted. Differential diagnosis of fibroadenoma, lactating adenoma, mastitis, galactocele, breast cancer, abscess and "general" masses greater than 16 mm in diameter was stratified. Based on the Breast Imaging Reporting in Data System (BIRADS), lesions were classified as benign or malignant and recommendations of cytology made in cases of observed overlap findings. Image sonomorphologic information on mass-echogenic halo and non-uniform orientation were documented; while malignant factors like scar tissue, focal fibrosis and papillomas may be associated with a false positive (conclusion) result. Doppler studies on further mass evaluation is encouraged.

Key Words: Breast, Ultrasound, Malignant, Benign

1. INTRODUCTION

1.1 General feature normal breast ultrasound

Mammography is a common tool used for screening breast-related abnormalities; however, the diseased conditions presented in this case were found through ultrasonography only. In a normal breast sonogram, the skin surface appears thin when viewed in a (near-field knobology) with subcutaneous fat deposition in the hypoechoic zone. A normal full mammary gland tissue may display low-level echoes (see Figure 1), show branched dilated acinar, because the higher the echogenicity of the stroma, the more percentage of total fibrous tissue.

1.2 Ultrasound as a preferred choice

Mammography use is a dominant diagnostic modality in evaluating breast masses, its accuracy is reduced in a radiological dense breast.[1–3] For over 30 years ultrasound has been an indispensable substitute to mammography.[2] "Suspension and Compression" volumetric ultrasound scan has been suggested as a complementary medium for breast cancer screening. Though BI-RADS method is mostly used

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in breast radiology worldwide, the sonologist can use his discretion outside this unified classification.

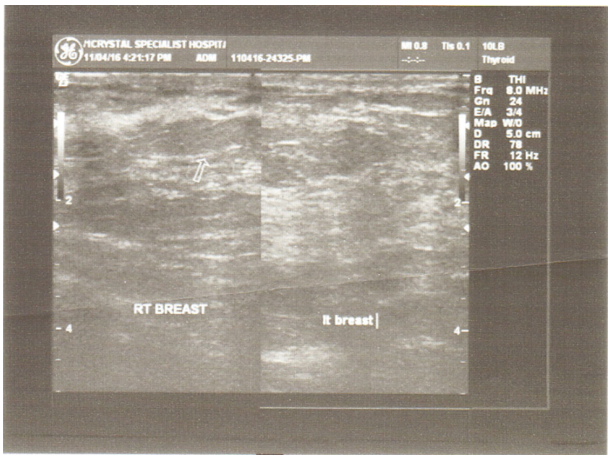

Figure 1. Normal breast tissue in sagittal plane with high level echoes, with no change to surrounding architecture (mass-free). Note the Doppler exposure on "B" (right) arrowed. More (breast) fibrous tissue in the parenchyma seems to generate higher echogenicity.

2. Materials and Methods

Ultrasound scans were performed using 7-10 MH_{ε} linear-array transducer on a Logic 3 Pro ultrasound (General Electric Healthcare, 4401 Booth Calloway Rd, North Richland Hills, TX 76180, USA). Part of patients composed of subjects with previously confirmed breast cancer; excluding results from MRI investigation. Ethical approval was granted by CSH; and informed consent of patients obtained in-line with the 1975 Helsinki Declaration of patients' rights. For mammary gland calcification, mammography is a more accurate diagnostic tool. "Micro" non-calcified masses cannot be identified by ultrasound alone, therefore simultaneous radiologic modalities provides sound clinical judgment. Some patients were referred for histo-pathological biopsy of the primary lesion.

3. Results

3.1 Criteria for ultrasound breast mass identification I

Sonographic features of benign nodules reviewed in literature gives a sharply demarcated border (see Figure 2); as opposed to malignant masses that invade rather than "displace" surrounding breast tissue. Other distinct features are halo echoes and ultrasound transmission in benign masses/cases (see Figure 3). Contradicting established observation above, some malignancies with uniform internal cellular compaction always show good ultrasonic transmission as stated in benign masses. Specifically, a galactocele presents as well circumscribed cystic mass with a "wavy line" sometimes separating it into strata of different echogenicities. When the fat content is high, pseudolipoma is the name given when the fat content is very high. It should be noted that ultrasound sometimes affirms MRI findings in breast cancer thereby demonstrating obscure lesions of BI-RADS grade 3 and 2 as stated by Carbognin et al. when suspicion level in high.[4] Irrespective of were the masses are located, recommendation of mastectomies is left for general surgeons, beyond the scope of this review.

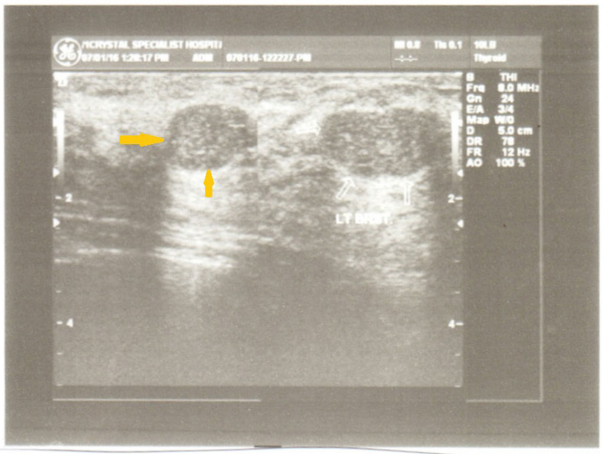

Figure 2. Fibro-adenoma in a 45 years old woman, appearing bright-gray with ovoid shape. It contrasts with a harmartoma (fat-containing tumor) with heterogeneous pattern. Benign (non-malignant) lesion with roundish/oval margin. Histological follow-up was recommended.

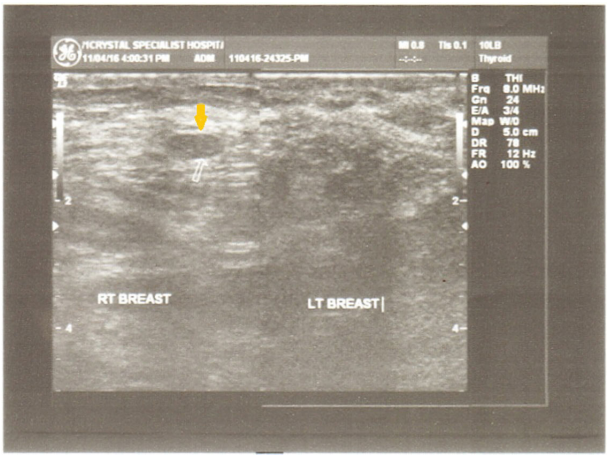

Figure 3. Note lateral external fibrocystic change that was poorly demonstrated in an earlier mammograph

3.2 Criteria for ultrasound breast mass identification II

BI-RADS[5] criteria employed in classification was obtained from evidence based on frozen sonograms. Sonogram patterns based on Chen et al.[6] focused on (a subset of) external architectural changes (ductal dilation, or no-change)

Border/wall-regularity (irregular or smooth); Texture and homogeneity (homogenous or heterogeneous); and brightness/intensity scale (dark, dark-gray, gray, bright-gray or dispersed). Shape features (oval, round or irregular); margin (spiculated, micro-lobulated, non-circumscribed, angular) boundary of the lesion (whether abrupt interface or echogenic halo); orientation (non-parallel, parallel); and posterior acoustic view (posterior acoustic shadowing or no posterior acoustic shadowing).[7] Atypical lobular hyperplasia is associated with a spiked five-fold increased risk for breast malignancy. In-situ lobular carcinoma is linked with a nine-fold risk for breast cancer.

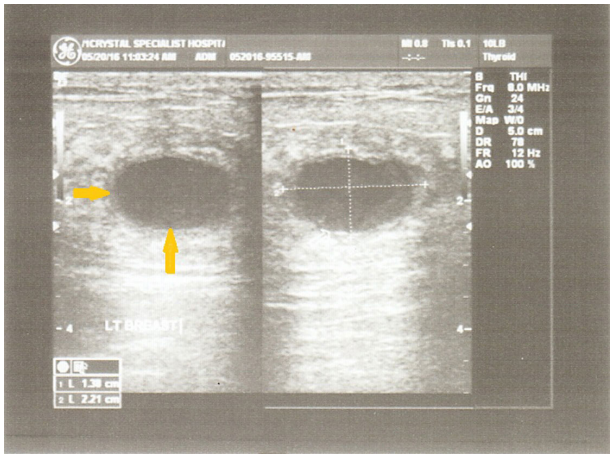

Figure 4. Image pattern of a circumscribed carcinoma (arrowed) measuring 1.7 cm (17 mm). Note the bright and minimal demoplastic reaction, compared to benign ovoid fibroadenoma (see Figure 2).

Infiltrating lobular carcinoma may have an oval-complex cystic appearance as described by Berg et al.[2] High risk lobular hyperplasia correlates with susceptibility (quadruple fold) for breast cancer (see Figure 4)[8,9] .

3.3 Breast sonogram comparison on both types (benign and malignant) masses

Five months follow-up "rescans" even in benign lesions is advised for reevaluation, to minimize consequences of sonographer intra-observer judgment.[10] A palpable mass is not synonymous to advanced cancer and DCIS may occur as a palpable mass. Our review is parallel to the assumption of McCormack and dos-Santos-Silva[11] on firm, non-pendulous breasts having a five-fold risk of developing cancer than other women. Our sonogram results (see Figures 5 and 6) are compatible with Yao et al.[12] who affirmed high level of vascularity amid breast masses implying high tumor grade. Current ultrasound volumetric technologies can provide higher rates of solid mass lesion detections. Non-uniform heterogenous echopatterns are characteristic of carcinomas and some abscesses display gray-scale on sonograms and up to 56% have indistinct margin with micro invasion if they are DCIS.[6]

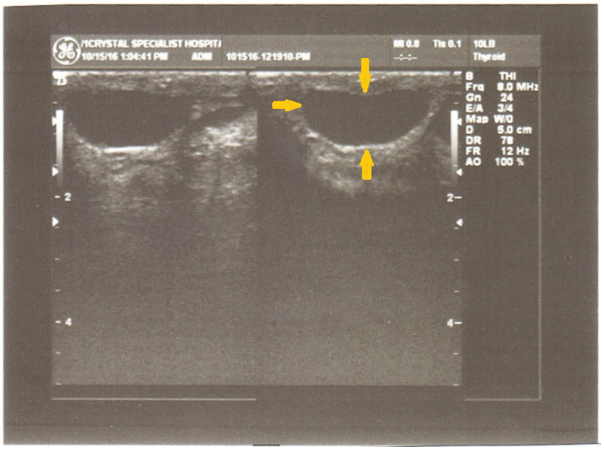

Figure 5. Ultrasound image demonstrates a type 3 complex breast mass. In homogenous sonopenic lesion with a micro-lobulated margin and "cloud" echo appearance. Multiple carcinomas in a single breast viewed through a hand-held 8.0 MH_{ε} transducer/probe.

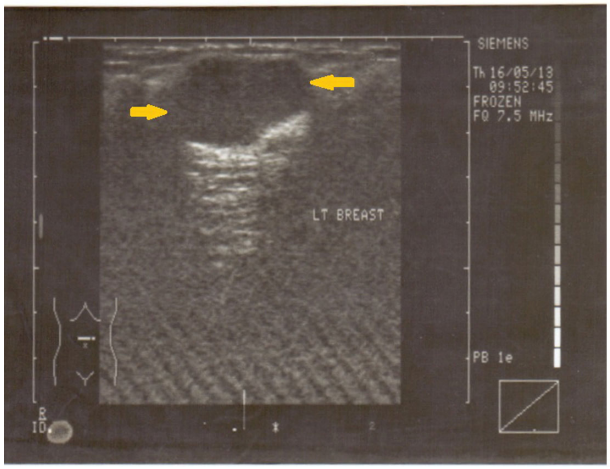

Figure 6. Observe the abrupt interface in the lesion boundary mimicking a fat lobe. In observation of breast lesions, emphasis on corrective malignant "red-flags" where enumerated in contrast to findings in benign breast secondary characteristics. This include: skin-thickening and distortion, breast architectural disruption, increased thickness of Cooper's ligament and contour-changes in mammary gland (see normal tissue, Figure 1). Other contrasts are: blockage of the retromammary space of Spénce and the pectoralis-minor musculature, inconsistent subcutaneous fat-layer and adenopathy of the axillary region.

This can be further confirmed with color doppler study. Reliance solely on sonogram findings (in normal cases, see

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Figure 1) may not be advisable for certain lesions (see Figures 2-6) even after aspiration and cytology; as residual mass may represent malignancy. Breast ductal carcinoma with heterogeneous hypoechoic pattern, irregular margin, posterior acoustic shadow may be further associated with micro calcifications and distal ultrasound attenuation. Causes of complex (benign) cystic masses may include intra-ductal papilloma without atypia and fibro-adenoma. When a sonar doubt on breast hematoma occurs, follow-up elective ultrasound in 10 weeks is suggestive to evaluate registration and re-evaluate finding (see Figures 3 and 4). Repetition of breast ultrasound with high frequency transducers coupled with sound anatomic and pathologic knowledge will complement (other imaging modalities) in confirmatory declaration of masses as benign or malignant. This in agreement with Nothacker et al.,[13] with a summarized cohort study on the role of ultrasound in the framework of malignant cancer screening. Our observations are parallel with Abe et al.[14] in which not all breast masses were declared cancerous. Ultrasound is blamed for many wrong diagnoses in confirmed (earlier termed: suspicious) masses.[15,16]

A major limitation of these sonograms is that it excludes color Doppler analysis to further evaluate vasculature around the breast, pectoral and axillary region. Also several mass details are visible when mammography and ultrasound are combined, demonstrating global breast anatomy; making wire-localization easier when either modality is used for biopsy guidance. Without supportive ultrasound, examining the existence of a lesion or tumor cannot be ruled-out. Another limitation is ultrasound use is operator and a skilled-dependent technique, color-doppler flow-mode was not used. Our ultrasound observation confirms the assertion by Tot[17] that DCIS are active tumors growing along pre-existing line of breast ducts, which sometimes exclude disintegration of the basement membrane. It is unanimously accepted that breast ductal hyperplasia and papilloma are referred for surgical intervention.[2,18]

4. Conclusion

The BI-RADs method improves patient care as a standard diagnostic classification enabling effective judgment; ultrasound aided percutaneous (histo-pathological) biopsy would be indispensable in extracting, guiding, diagnosing and overall management of complex breast-cystic masses.[19] Worldwide, breast cancer is the most common malignancy in women and up to 65% are non-palpable at diagnosis, therefore recognizing intra-observer limitation and re-scanning for a 2nd opinion would improve accuracy and competence of early breast malignant detection.

Conflicts of Interest Disclosure

The authors declare that there is no conflict of interest statement.

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