

Ultrasonographic Discrimination of Benign and Malignant Breast Lumps with Histopathological Correlation

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Abstract

Background: A lump in the breast is a cause of great concern. High frequency high resolution ultrasonogram helps in its evaluation. With major advances in ultrasonographic technology during the past 20 years, ultrasonogram can now distinguish benign and malignant solid breast lumps. Knowledge of the specific benign and malignant ultrasonographic characteristics of breast lumps is imperative for accurate diagnosis and optimal patient management. **Objective:** To determine the validity of ultrasound in the assessment of palpable breast lump by detecting the sensitivity, specificity, accuracy, positive predictive value and negative predictive value of ultrasonogram in distinguishing benign and malignant breast lumps. **Materials and Methods:** This cross sectional study was done in the department of Radiology and Imaging of Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka in collaboration with the department of Pathology of BSMMU for histopathological correlation during July 2008 to June 2009. A total of 100 patients who were clinically suspected of having breast lump were included in this study. Data on clinical presentation, ultrasonographic findings including histopathological reports were collected and documented in structured forms. Analysis was done using SPSS 13.0 version. **Results:** The study was done in 100 women of 18–70 years of age with mean age 41.46 ± 11.62 years. Breast lumps were found with associated clinical presentation of pain in 26 (26%) cases, discharge in 12 (12%) cases, skin changes in 28 (28%) cases, nipple retraction in 10 (10%) cases, and palpable lymph nodes in 10 (10%) cases. On ultrasonogram, lesions were diagnosed as benign in 62% cases and malignant in 38% cases. Out of sonographically diagnosed 62 benign lesions 58 (93.5%) were also proved benign histopathologically and 4 (6.5%) as malignant. Out of 38 sonographically malignant lesions, 34 (89.5%) were also proved as malignant histopathologically and 4 (10.5%) as benign. **Conclusion:** Ultrasonographic findings of benign and malignant breast lumps correlated well in most of the cases with the histopathological results. Therefore, it can be concluded that ultrasonogram is a useful imaging tool to discriminate benign and malignant breast lumps and thus we can reduce unnecessary breast biopsies, patient discomfort and anxiety in addition to increase in cost of the patient.

Key words: Benign; Malignant; Palpable breast lumps; Ultrasonogram

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Introduction

Breast lump is the localized swelling, protuberance or mass in the breast. A lump may be a cyst, inflammatory mass, a benign or a malignant tumor. Palpable breast

masses are common and very frequently benign. The most common breast lumps are fibroadenoma in young women, cyst or fibrocystic changes in middle-aged

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women and cancer in older women.¹ Breast cancer is one of the most common cancers in women, accounting for 21% of cancers diagnosed² and second most common cause of cancer-related mortality. The incidence of breast cancer is rising all over the world. Since breast cancer prevention is still theoretical, efforts have focused on early detection. Breast cancer is more easily treated and often curable if it is diagnosed early. But noninvasive diagnosis of breast cancer remains a major clinical problem. The distinction by physical examination of physiological nodularity from abnormal masses can be difficult. The clinical differentiation of a malignant mass from a benign one is difficult and consequences of missing a palpable carcinoma are high.

Recent research on service screening programs suggests that participation in modern, organized service screening may reduce the risk of breast cancer by 40% or more.³ It means that early and sensitive diagnosis represents a better prognosis.

There are many imaging modalities for detecting breast lumps. But mammography and sonography are currently the most sensitive modalities. For early detection of breast cancer, mammography is currently the most widely used screening modality, but it has a low negative predictive value. In patients with palpable abnormalities of the breast, false-negative rate for mammography has been reported to be as high as 18%.⁴ Therefore, many masses referred for breast biopsy on the basis of mammography findings are actually benign.

Because of the higher false-negative rate of mammography, biopsy is still performed for clinically questionable palpable abnormalities. The false-negative rate of mammography for breast cancer between 10–15% is generally accepted.⁵ As clinical breast examination is not absolute, many surgeons liberally performed fine-needle aspiration, core biopsies, open surgical biopsies. But by biopsies we find cancer in only 10% to 30% cases.⁶ This means that 70% to 90% of breast biopsies are performed for benign diseases which induce unnecessary patient discomfort and anxiety in addition to increase in cost to the patient. So, there is a great need for development of additional reliable methods to complement the existing diagnostic procedures to avoid unnecessary biopsy. The initial screening studies^{7,8} with sonography in the 1980s were not as successful as the present study. A decade later favorable results for sonography of palpable breast masses were also noted in more studies.^{9,10} So the purpose of our study is to establish the diagnostic usefulness of ultrasonogram in differentiating benign and malignant breast lumps by evaluating the ultrasonographic findings of benign and malignant breast lumps, comparing the ultrasonographic findings,

correlating the ultrasonographic findings with histopathological findings and thus to determine and validate the diagnostic accuracy, sensitivity and specificity of ultrasonogram in differentiating benign and malignant breast lumps.

Materials and Methods

This cross sectional study was carried out in the department of Radiology & Imaging of Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka in collaboration with the department of Pathology of BSMMU for histopathological correlation during July 2008 to June 2009. This study was carried out on consecutively selected 100 patients ranging from 18–70 years having breast lumps and supported by ultrasonogram.

Ultrasonography was performed with high frequency (7.5 MHz) linear array transducer. Supine oblique or supine position was recommended to reduce breast thickness and to improve visualization of deeper tissues. One or both arms were elevated behind the head or neck to stretch the pectoralis muscles for better fixation and immobilization of the breast. Scanning was done perpendicular to the skin surface. Finally ultrasonographic diagnoses of breast lumps were correlated with histopathological reports.

Following outcome variables were observed

Demographic and clinical variables: Age of the patient. Clinical features—Lump in the breast, pain, discharge, skin change, distortion of nipple, palpable lymph node.

Imaging variables: Size of mass, site of lesion, type of lesion (solid/cystic), shape, echogenicity, margin, pseudocapsule, axial orientation, edge shadows, posterior acoustic phenomena, compressibility and mobility, architectural disruption.

Relevant data of all the patients were recorded in a predesigned structured data sheet. Then all data were checked, edited and analyzed with the help of SPSS (statistical package for social sciences) 13.0 version. For the validity of the study outcome sensitivity, specificity, accuracy, positive and negative predictive values were calculated out after confirmation of the diagnosis histopathologically.

Results

In this study, mean age of the patients was 41.46 ± 11.62 years ranging from 18–70 years. Along with presentation with the complaint of lump in the breast, 26% cases complained of pain, 12% presented with discharge, 28% presented with skin changes, 10% cases with nipple retraction and 10% presented with palpable axillary lymph nodes.

On examination of the breast lump, skin thickening was found in 22% cases, in 10% cases lump was discrete and in 62% cases were single. In 16% cases lump was hard, 62% cases rubbery, 18% soft and 18% cases were painful.

Sonographically diagnosed benign lumps had the following criteria — oval and round shaped in 62% cases, well-circumscribed smooth narrow margin in 52% cases, narrow but jagged border having <3 lobulations in 10% cases, width/AP ratio >1.4 in 62% cases, anechoic in 8% cases, hypoechoic in 14% cases, hyperechoic in relation to fat in 40% cases, 48% cases were homogeneous and 14% cases were intermediate in echotexture, narrow bilateral edge shadow in 52% cases but absent edge shadow in 10% cases, posterior acoustic enhancement in 46% cases but 16% cases were

unremarkable, thin echogenic pseudocapsule were seen in 62% cases, 28% cases compressible and 34% cases were less compressible, 62% cases were mobile and showed no architectural disruption.

Sonographically lumps were diagnosed as malignant having following criteria — irregular shape with ill defined margin in 38% cases, width/AP ratio <1.4 in 38% cases, 38% cases were heterogeneous and more hypoechoic, broad unilateral edge shadow was seen in 8% cases and no edge shadow was found in 30% cases, posterior acoustic attenuation was in 34% cases and 4% cases were unremarkable, 34% cases were unencapsulated and 4% cases had thick echogenic halo, 38% cases were noncompressible, fixed and showed architectural distortion (Table I).

Table I: Distribution of the respondents by ultrasonographic findings (N=100)

USG findings	USG diagnosis	Frequency	Percentage
Shape			
Oval and round	Benign	62	62
Irregular	Malignant	38	38
Margin			
Well-circumscribed smooth narrow border	Benign	52	52
Narrow but jagged border having <3 lobulations	Benign	10	10
Ill defined border	Malignant	38	38
Width/AP ratio			
>1.4 (wider than taller)	Benign	62	62
<1.4 (taller than wider)	Malignant	38	38
Echogenicity			
Anechoic	Benign	8	8
Hypoechoic	Benign	14	14
Hyperechoic in relation to fat	Benign	40	40
More hypoechoic	Malignant	38	38
Internal echoes			
Homogeneous	Benign	48	48
Intermediate	Benign	14	14
Heterogeneous	Malignant	38	38
Edge shadow			
Narrow bilateral	Benign	52	52
No edge shadow	Benign	10	10
No edge shadow	Malignant	30	30
Broad unilateral shadow	Malignant	8	8
Posterior acoustic phenomena			
Enhanced	Benign	46	46
Attenuated	Malignant	34	34
Unremarkable	Benign	16	16
Unremarkable	Malignant	4	4
Pseudocapsule			
Thin echogenic pseudocapsule	Benign	62	62
Uncapsulated	Malignant	34	34
Thick echogenic halo	Malignant	4	4
Compressibility			
Compressible	Benign	28	28
Less compressible	Benign	34	34
Noncompressible	Malignant	38	38
Mobility			
Mobile	Benign	62	62
Fixed	Malignant	38	38
Architectural disruption			
Absent	Benign	62	62
Present	Malignant	38	38

On ultrasonography, lesions were diagnosed as benign in 62% cases and malignant in 38%. Among benign lesions fibroadenoma was found in 44%, breast abscess in 6%, benign cyst in 8%, galactocele in 4% cases (Table II). Sonographic appearances of carcinoma and fibroadenoma of breast are given in Figures 1 and 2.

Table II: Distribution of the respondents by ultrasonographic diagnoses (N=100)

USG diagnoses	Frequency	Percentage
Fibroadenoma	44	44.0
Breast abscess	6	6.0
Benign cyst	8	8.0
Galactocele	4	4.0
Malignant mass	38	38.0

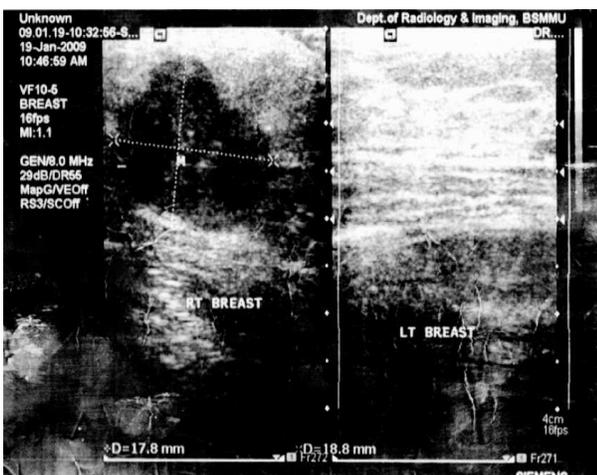


Fig 1. Carcinoma of right breast

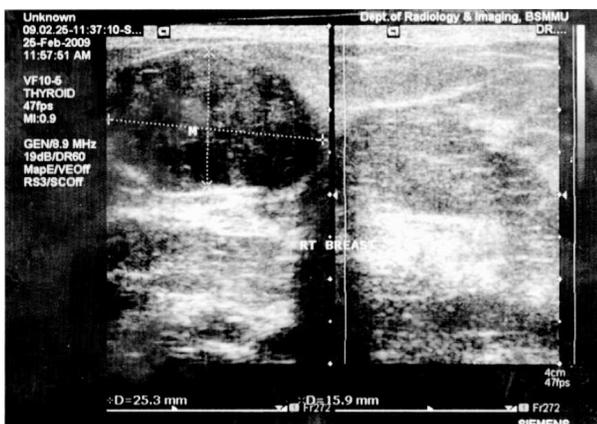


Fig 2. Fibroadenoma of right breast

On histopathology, lesions were diagnosed as benign in 62.0% cases and malignant in 38.0%. Among benign lesions fibroadenoma was found in 44.0%, breast abscess in 6.0%, benign cyst in 8.0%, galactocele in 4.0% cases, invasive carcinoma in 34.0% cases and medullary carcinoma in 4.0% cases (Table III).

Table III: Distribution of respondents by histopathological findings (N=100)

Histopathological diagnoses	Frequency	Percentage
Fibroadenoma	44	44.0
Breast abscess	6	6.0
Benign cyst	8	8.0
Galactocele	4	4.0
Invasive carcinoma	34	34.0
Medullary carcinoma	4	4.0

Sonographically 62 lesions were benign, out of these 58 (93.5%) were also proved benign histopathologically, and 4 (6.5%) as malignant. Out of 38 cases who were sonographically diagnosed as malignant, 4 (10.5%) were diagnosed as benign and 34 (89.5%) were proved that these were malignant (Table IV). In diagnosis of benign lesions by ultrasonogram, sensitivity was 93.5%, specificity 89.5%, positive predictive value (PPV) 93.5%, negative predictive value 89.5% and accuracy was 92.0% (Table V). In diagnosis of malignant lesions by USG, sensitivity was 89.5%, specificity 93.5%, PPV 89.5%, NPV 93.5% and accuracy 92.0% (Table VI).

Table IV: Distribution of benign and malignant lesions by ultrasonographic and histopathological diagnoses (N=100)

Ultrasonographic findings	Histopathological findings		
	Benign	Malignant	Total
Benign (62)	58 (93.5%)	4 (6.5%)	62 (62.0%)
Malignant (38)	4 (10.5%)	34 (89.5%)	38 (38.0%)
Total	62 (100.0%)	38 (100.0%)	100 (100.0%)

Table V: Validity test for ultrasonographic findings for benign lesions (N=100)

	Values	95% CI
Sensitivity	93.5	87.9–96.7
Specificity	89.5	80.3–94.6
PPV	93.5	87.9–96.7
NPV	89.5	80.3–94.6
Accuracy	92.0	85.1–95.9

PPV, Positive predictive value; NPV, Negative predictive value

Table VI: Validity test for ultrasonographic findings for malignant lesions (N=100)

	Values	95% CI
Sensitivity	89.5	80.3–94.6
Specificity	93.5	87.9–96.7
PPV	89.5	80.3–94.6
NPV	93.5	87.9–96.7
Accuracy	92.0	85.1–95.9

PPV, Positive predictive value; NPV, Negative predictive value

Discussion

Despite advancement and multifold improvement in scientific knowledge, at present there is no known method for primary prevention of breast cancer. Under the present circumstances, early detection and treatment of breast cancer as a secondary preventive measure seems to be the most appropriate approach for reducing mortality due to breast cancer and for improving quality of life. Breast imaging is most routinely used for screening and diagnostic tool to detect and manage breast cancer. Benign breast lesions are vastly more common than malignant lesions and often require accurate diagnosis to rule out cancer and determine the best treatment and for this at first a breast lump should be differentiated as either benign or malignant.

The current study was performed to explore the sonographic discrimination of benign and malignant breast lumps with histopathological correlation. One hundred women who attended department of Radiology & Imaging, BSMMU with breast lumps were enrolled in the study. USG and histopathology were done and correlated.

Rahbar et al¹¹ found that the features most likely to predict a benign diagnosis in solid masses were round or oval shape, had a circumscribed margin, and had a width-to-anteroposterior ratio greater than 1.4. Denis et al¹² also found that the characteristic sonographic findings of benign tumors include a round or oval, slightly hypoechoic lesion with smooth borders or a pseudocapsule, homogeneous internal echoes, no central posterior acoustic shadowing, and normal surrounding tissue. In our study the ultrasonographic features most predictive of a benign diagnosis were oval and round shaped in 62% cases, well circumscribed smooth narrow margin in 52% cases and width/AP ratio >1.4 in 62% cases, thin echogenic pseudocapsule was seen in 62% cases, posterior

acoustic enhancement in 46% cases, 28% cases were compressible and 34% cases were less compressible, 62% cases were mobile and showed no architectural disruption, 40% cases were hyperechoic in relation to fat, anechoic in 8% cases and hypoechoic in 14% cases, 48% cases were homogeneous in echotexture.

Rahbar et al¹¹ also found that features most predictive of malignancy were irregular shape, microlobulated or spiculated margin, and width-to-anteroposterior ratio of less than or equal to 1.4. These results were also in conformity to the results obtained by Kailash et al.¹³ The typical features of malignancy include irregular shape, irregular contour, hypoechogenicity, a surrounding echogenic rim due to compression and distortion of the surrounding tissue, and posterior acoustic shadowing.^{14,15} In our study, sonographically most predictive malignant features were irregular shape with ill defined margin in 38% cases, width/AP ratio <1.4 in 38% cases, 38% cases were heterogeneously more hypoechoic, broad unilateral edge shadow were seen in 8% cases and no edge shadow was found in 30% cases, posterior acoustic attenuation was in 34% cases, 34% cases were uncapsulated and 4% cases having thick echogenic halo, 38% cases were noncompressible, fixed and showed architectural disruption.

According to Pande et al¹⁶ shape, margins, vascularity, surrounding tissue character, sound transmission through the lump are more significant in the diagnosis of benign vs malignant lumps. Echogenicity and echotexture are less significant.¹⁶ Mass margin is a critical feature for determining whether a lesion is benign or malignant according to Stavros et al¹⁴. A brightly reflected zone corresponding to posterior margin of the tumor may suggest the presence of a fibroadenoma rather than carcinoma where posterior shadowing is present.¹⁷ Edge or lateral shadowing, considered to be a characteristic of benign tumor, has also been reported in some malignant tumors and was recorded in 10% of carcinomas in one series.¹⁸

In a study by Zhi et al¹⁹ of 296 lesions, 87 were histologically malignant, and 209 were benign. In our study, sonographically 62 lesions were benign; out of these 58 (93.5%) were also proved benign histopathologically, and 4 (6.5%) malignant. Out of 38 cases, which were sonographically diagnosed as malignant, 4 (10.5%) were diagnosed as benign and 34 (89.5%) were proved malignant.

The study by Pande et al¹⁶ had a sensitivity value of 95%, specificity of 94.10%, positive and negative predictive values of 95.50% and 93.75%. Zhi et al¹⁹ found that sonography (B-mode) revealed sensitivity of 71.2 %, specificity 73.2%, accuracy 72.6%, PPV 52.5% and NPV 86.0%. In our study, in diagnosis of benign lesions by ultrasonogram, sensitivity was 93.5%, specificity 89.5%, PPV 93.5%, NPV 89.5% and accuracy 92.0%. In diagnosis of malignant lesions by ultrasonogram, sensitivity was 89.5%, specificity 93.5%, PPV 89.5%, NPV 93.5% and accuracy 92.0%.

In our study although there is an overlap between the sonographic appearances of benign and malignant lesions, we found significant sensitivity, specificity, accuracy, positive predictive value and negative predictive value in the diagnosis of both benign and malignant breast lumps. So, we can conclude that ultrasonography is a sensitive imaging tool to differentiate benign and malignant breast lumps. Therefore, ultrasonography can be used as an initial investigation that may guide other subsequent investigations.

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