Original Research Article

Role of elastography in evaluation of benign Vs malignant breast lesions

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Abstract

Objectives: The objective of this study was to evaluate the role of elastography in differentiating benign and malignant breast lesions and to compare elastography findings with conventional ultrasonography. **Materials and methods:** 19 patients presenting with breast lump were assessed first with conventional ultrasonography and subsequently with shear wave elastography. Conventional ultrasonographic findings were classified according to BIRADS (Breast Imaging Reporting and Data System) grading. Elastography findings were given an elasticity score of 1 to 5. Final diagnosis made by histopathological findings either by fine needle aspiration cytology or biopsy, were used as standards. Sensitivity, specificity, positive predictive value and negative predictive value of both B-Mode sonography and elastography were obtained and compared. **Results:** B-mode sonography had sensitivity of 87.5%, specificity of 63.6%, a positive predictive value of 63.6% and a negative predictive value of 87.5%. Elastography had sensitivity of 62.5%, specificity of 91%, a positive predictive value of 83.3% and a negative predictive value of 76.9%. Thus, elastography showed less sensitivity but higher specificity than B-Mode Sonography. **Conclusions:** Elastography when used as complementary technique with B-mode sonography increases specificity for characterisation of breast lesions there by reduces unnecessary biopsy, false-positive rate and morbidity.
Key Word: Breast, Breast lesions, Elastography, Sonography.

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INTRODUCTION

Conventional sonography or B-Mode sonographyis initial investigation for the assessment of patients with breast disease. With use of advanced technology and Breast Imaging Reporting and Data System (BIRADS) sonographic criteria, better differentiation between benign and malignant lesions has been possible. However, some lesions show sonographic features of both benign and malignant lesion, such lesions require biopsy to get the final diagnosis.[1,2] Elastography is a non-invasive imaging procedure which assesses the strain of soft tissues and provides structural information other than the morphologic features shown by conventional sonography[3,4]. Physical features are the basis of breast palpation and also elastography and are related to elasticity coefficient[5]. First clinical study showing the potential of elastography in the detection and characterization of breast lesions was published in 1997 by Garra *et al*[6]. Ueno andcolleague[7,8] described a 5-score system classification for elastography findings which can be correlated to the 5-score classification of American College of Radiology Breast Imaging Reporting and Data System (BI-RADS) for B-modesonography[3]. The purpose of this study was to evaluate the role of elastography in differentiating benign and malignant breast lesions and to compare elastography findings with B-Mode ultrasonography.

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MATERIALS AND METHODS

This prospective study was conducted at the Department of Radiodiagnosis, M.P. Shah govt. Medical college and Shri Gurugobind Singh Government Hospital, Jamnagar, Gujarat during September and October 2019. After taking informed consent, 19 female patients presenting with breast lump were assessed first with conventional B-Mode ultrasonography and subsequently with shear wave elastography. All patients were of age ranging from 23 years to 67 years. B-Mode ultrasonographic findings were classified according to BIRADS (Breast Imaging Reporting and Data System) grading, in which categories 2and 3 were considered benign and categories 4 and 5 were considered malignant. Elastography findings were classified based on 5-score system of Ueno and colleagues and were given an elasticity score of 1 to 5, which is as below:

- Score 1: even strain for entire lesion. The lesion is green in colour.
- Score 2: strain in most of the lesion with some areas of no strain. Mosaic colour pattern of green and blue.
- Score 3: strain at the periphery of the lesion with sparing of the center. Lesion appears green at the periphery and blue at the center.
- Score 4: no strain in the entire lesion, the whole lesion appears blue in colour.
- Score 5: no strain in the entire lesion and the surrounding area so both the lesion and surrounding area appear blue in colour.

Colour coding varies between manufacturers. In our elastography machine, red indicates soft tissues stiffness, green indicates medium tissue stiffness and blue indicates harder tissue. Score 1 to 3 were considered benign whereas 4 and 5 malignant. Final diagnosis made by histopathological findings either by fine needle aspiration cytology or biopsy, were used as standards. Sensitivity, specificity, positive predictive value and negative predictive value were calculated for both B-Mode ultrasonography and Elastography.

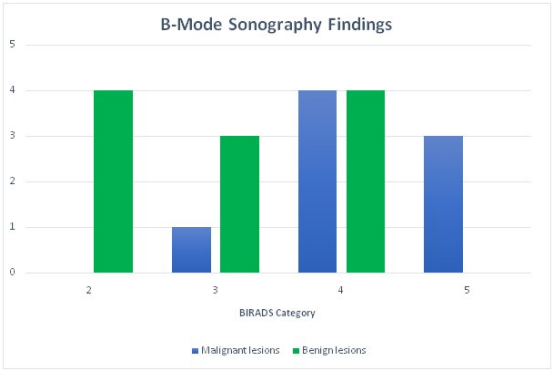
OBSERVATIONS AND RESULTS

Histopathological findings: Out of 19 lesions, 11 lesions were found to be benign and 8 lesions were malignant. Among 11 benign lesions10 were fibroadenoma whereas among malignant lesions 6 were invasive ductal carcinoma.

B-Mode Sonography findings: All category2 lesions were benign. Among 4 category 3 lesions, 1 was histopathologically malignant (False Negative). Among 8 category 4 lesions 4 were histopathologically benign (False Positive) and 4 were malignant. All category 5 lesions were malignant [Table 1]. Considering BI-RADS categories 2 and 3 as benign and 4 and 5 as malignant, B-mode sonography had sensitivity of 87.5%, specificity of 63.6%, a positive predictive value of 63.6% and a negative predictive value of 87.5%.

Table 1: Results of B-Mode sonography (BIRADS) in Relation to Histopathologic and Cytologic Diagnosis.

BIRADS Category	Malignant lesions	Benign lesions	Total
2	0	4	4
3	1	3	4
4	4	4	8
5	3	0	3
Total	8	11	19

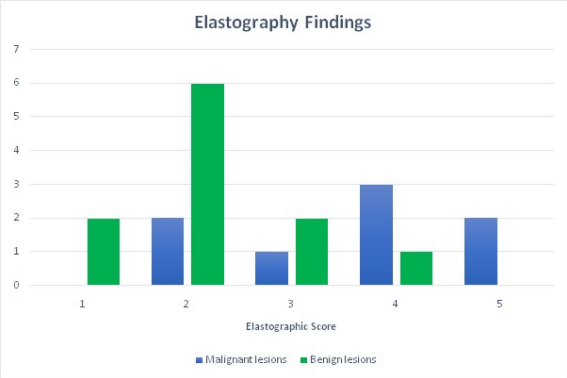


Graph 1: Results of B-Mode sonography (BIRADS) in Relation to Histopathologic and Cytologic Diagnosis.

Elastography findings: All elastographic score1lesions were benign whereas all score 5 lesions were malignant. Out of11 lesions with elastographic score 2 or 3, 3were histopathologically malignant (False Negative). Out of4lesions with elastographic score 4, 1 was histopathologically benign (False Positive) [Table 2]. Considering scores of 1 to 3 as benign and 4 and 5 as malignant, elastography had sensitivity of 62.5%, specificity of 91%, a positive predictive value of 83.3% and a negative predictive value of 76.9%.

Table 2: Results of Elastography in Relation to Histopathologic and Cytologic Diagnosis.

Elastographic Score	Malignant lesions	Benign lesions	Total
1	0	2	2
2	2	6	8
3	1	2	3
4	3	1	4
5	2	0	2
Total	8	11	19

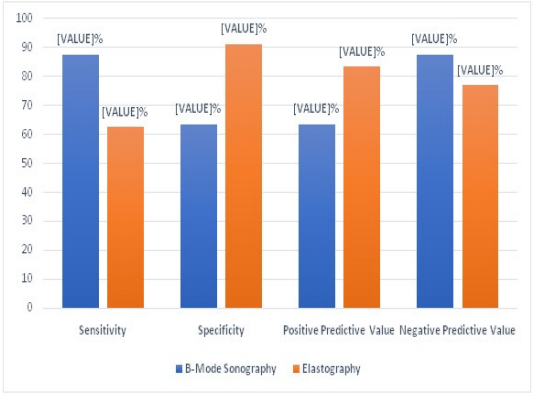


Graph 2: Results of Elastography in Relation to Histopathologic and Cytologic Diagnosis.

Comparison: On comparison, Elastography showed less sensitivity but higher specificity than B-Mode Sonography. Thus, it reduces false positive rate.

Table 3: Comparison of parameters of B-Mode Sonography and Elastography

Parameter	B-Mode Sonography	Elastography
Sensitivity	87.5%	62.5%
Specificity	63.6%	91%
Positive Predictive Value	63.6%	83.3%
Negative Predictive Value	87.5%	76.9%



Graph 3: Comparison of parameters of B-Mode Sonography and Elastography

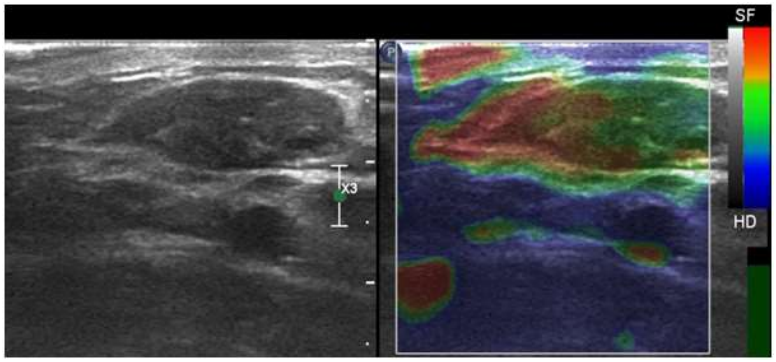


Figure 1:

B-Mode ultrasonography showing well-circumscribed, oval shaped, solid, hypoechoic, wider than taller lesion compatible with fibroadenoma, BIRADS category 2 lesion. On Elastography, entire lesion is green to red, even strain (score 1). Cytologic diagnosis: fibroadenoma.

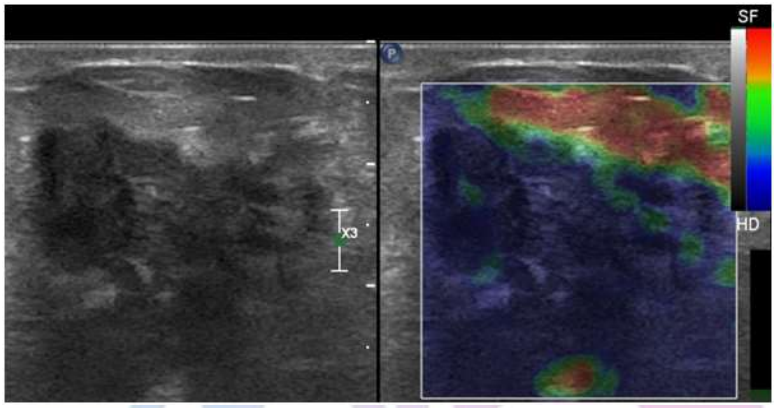


Figure 2:

B-Mode ultrasonography showing ill defined, irregular shaped, solid, heterogeneous hypoechoic lesion with surrounding architectural distortion highly suspicious of malignancy, BIRADS category 5 lesion. On Elastography, entire lesion as well as surrounding parenchyma is blue (score 5). Cytologic diagnosis: Invasive ductal carcinoma.

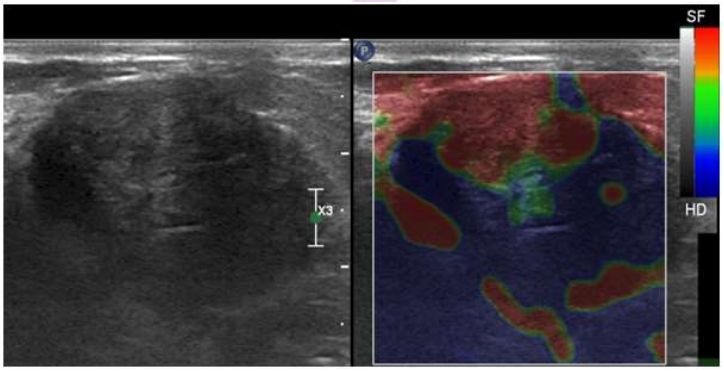


Figure 3:

B-Mode ultrasonography showing well defined solid, heterogeneous hypoechoic lesion with irregular margin compatible with BIRADS category 4 lesion. On Elastography, lesion shows mosaic pattern (score 2). Cytologic diagnosis: Fibroadenoma.

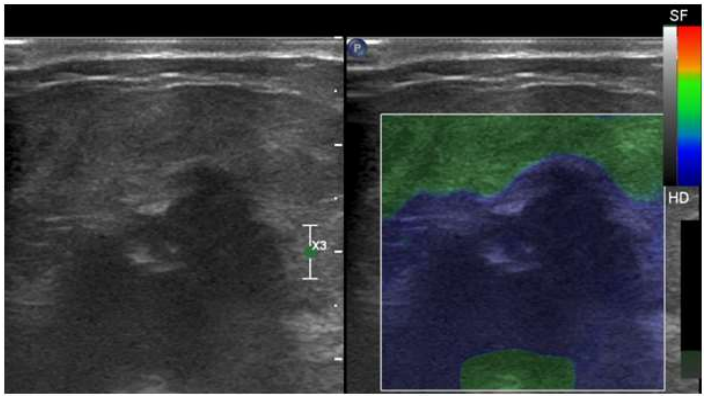


Figure 4:

B-Mode ultrasonography showing ill-defined, irregular shaped, solid, hypoechoic lesion compatible with BIRADS category 4 lesion. On Elastography, entire lesion is blue however surrounding parenchyma is green (score 4). Cytologic diagnosis: Invasive ductal carcinoma

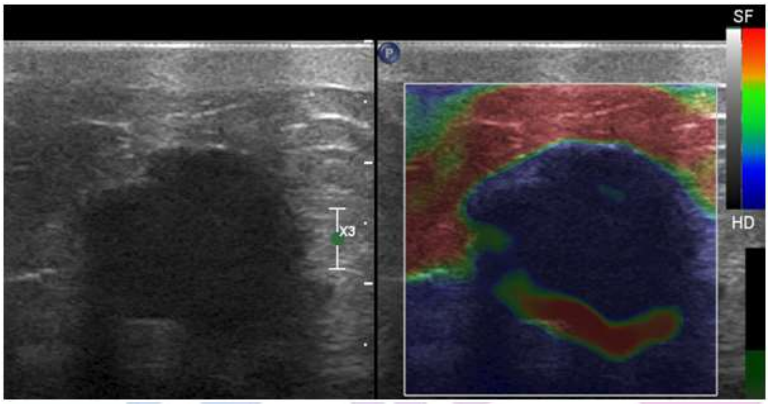


Figure 5:

B-Mode ultrasonography showing well defined, irregular shaped, hypoechoic lesion compatible with BIRADS category 4 lesion. On Elastography, lesion appears blue in center with green periphery (score 3). Cytologic diagnosis: Fibroadenoma.

DISCUSSION

Elastography is a new non-invasive technique which can be used along with B-mode sonography for characterisation and differentiation of breast lesions into benign and malignant[7,8]. On B-mode ultrasonography differentiation of breast lesions is done by Breast Imaging Reporting and Data System (BIRADS)criteria which are mainly based on morphological characteristics. Whereas in elastography, differentiation of benign and malignant lesions is based on their firmness or elasticity. B-mode sonography depends on shape, margin, orientation, echotexture and presence of calcification. Elastography additionally determines mechanical properties of tissues by means of strain and stiffness[9]. Usually breast cancer is significantly harder than fibroadenoma or benign lesion and normal tissues [5,6].However, both can show variable features. Carcinoma with central necrosis are softer than carcinoma with desmoplastic reaction[8,10,11], such necrotic carcinoma gives false negative result on elastography. Calcification in fibroadenoma makes it harder which gives false positive result on elastography[12]. Other limitations include technique, interobserver variation and extremely high or low density of the surrounding parenchyma[13]. Important use of elastography is in BIRADS category 3 and 4 lesions in which based on elastography score, unnecessary biopsies can be reduced and patients with low radiologic and sonographic risk can be allowed to follow up[13]. Many studies comparing diagnostic accuracy of conventional sonography and elastography have been performed[10,19]. Most of these studies confirmed elastography had higher specificity and less sensitivity than conventional sonography. Our results are consistent with most studies.

CONCLUSIONS

Elastography is fast, easy and non-invasive technique when used as a complementary technique in addition to B-mode sonography, it increases the diagnostic

specificity for characterisation of breast lesions. Thus, Elastography helps in reducing unnecessary biopsy and false-positive rate there by reduces morbidity

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