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Original Research Article

Breast fibroadenoma: diagnostic performance of gray-scale sonography and sonoelastography: a prospective observational study

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ABSTRACT

Background: Elastography is a new technique that can be especially helpful when used as an adjunct to conventional B-mode ultrasound in evaluating breast lesions. The aim of this study was to evaluate the diagnostic performance of interpretation criteria for conventional sonography and sonoelastography in characterising fibroadenoma breast with pathological correlation.
Methods: 50 breast fibroadenomas were prospectively evaluated by ultrasound as well as by strain elastography followed by FNAC//Histopathology correlation. The criteria used in breast elastography were Elastography Score and Strain Ratio. The sensitivity, specificity, accuracy, positive predictive value and negative predictive value were calculated for each modality.
Results: The elastography score was found to have the best performance among the 2 criteria used with a sensitivity, specificity and accuracy of 95.83%, 50% and 94% respectively.
Conclusions: While conventional ultrasound remains the primary modality for the characterization of breast masses, elastography has the potential to improve the sensitivity, specificity and accuracy of conventional ultrasound and, thus avoiding unnecessary biopsy.

Keywords: Breast tumor, Lump, Fibro-epithelial tumors, Ultrasonography

INTRODUCTION

Benign lesions of the breast are common; but usually neglected in comparison to cancer even though they account for nearly 90% of the clinical presentations related to breast.

A useful classification system for benign breast disease has been described by Love and colleagues and is based on symptoms and physical findings. Six general categories are identified which include physiological swelling and tenderness, nodularity, mastalgia, dominant lumps, nipple discharge and inflammation.[1]

It is one of the most common diseases in the females of any society. Up to 30% of women suffer from benign breast disease in anytime of their life compelling them to take treatment.[2]

Fibroadenoma is a common cause of benign breast lumps in premenopausal women. Fibrocystic disease is a histological term referring to large group of syndromes presenting as lump or lumpiness in breast. Fibroadenomas are the most common cause of benign breast lumps.

They usually present as solitary, firm, rubbery and non-tender lumps. Studies have shown us that there is a relationship between benign breast disease and breast cancer. Risk of cancer varies according to the histological grading of benign breast disease.[3] In women between adolescence and the mid-20s, the lobules and stroma in

the breast respond to hormonal stimuli in an exaggerated fashion with the development of single and multiple palpable fibroadenomas.[4] On ultrasonography they are typically elliptical or lobulated, and are "wider than tall." Most measure less than 3 cm in size. A fibroadenoma larger than 6 cm is referred to as a giant fibroadenoma, and must be distinguished from a phyllodes tumor. Unlike fibroadenoma, phyllodes tumors may enlarge quickly and can visibly distort the breast.[5] Fibroadenomas are benign solid tumors developing from a terminal duct lobular unit due to uncoordinated proliferation of the epithelial and stromal component (presumably due to estrogen stimulation) which involves part of the surrounding tissues.

These tissues are partially compressed by the expansive growth, leading to creation of a pseudocapsule.[6] Fibroadenomas have an internal structure consisting of stromal and epithelial elements.

The stromal element may undergo a myxoid degeneration, such as sclerosis, hyalinization and calcification, whereas the epithelial element may present all possible proliferative and non-proliferative aspects of the breast parenchyma, such as apocrine metaplasia, ductal hyperplasia, sclerosing and florid adenosis.[7]

Ultrasound elastography was introduced to obtain a more accurate characterization of breast lesions. By offering additional information about tissue stiffness, real-time tissue elastography can improve visualisation of tumours and facilitate differentiation between benign and malignant disease.

METHODS

Collection of Data

This prospective study was conducted with approval by the Institutional Legal Ethical Committee. 50 Cases were analyzed from March 2016 to September 2017. Patients included were in the age group of 16 to 60 yrs. Real time ultrasound followed by strain elastography was performed with the Hitachi Aloka Arietta S70 with 5-18 MHz linear array transducer.

Conventional sonographic examination

Each lesion was analyzed as per ultrasound descriptors i.e. shape, orientation, margin, lesion boundary, echo texture, posterior acoustic features.

Technique

Once the optimum B mode image was obtained, elastograms were acquired taking due care that the lesion remained in the imaging plane. The images from conventional sonography and sonographic elastography were displayed side by side as a single image.

A Region of Interest (ROI) box was set to include the area from the subcutaneous fat layer to the superficial portion of the pectoralis muscle and to focus on the target mass, taking due care that the lesion occupied no more than a third of the ROI box.

Interpretation criteria for sonographic elastography

Two interpretation criteria i.e. elastography score, and strain ratio were recorded for evaluation of sonographic elastography.

Elastography score

The elasticity scores of the target lesions were assessed using the following Tsukuba scoring system described by Itoh et al.[8]

Tsukuba scoring system

A score of 1 indicated even strain for the entire hypoechoic lesion (i.e., the entire lesion was evenly shaded in green). A score of 2 indicated strain in most of the hypoechoic lesion, with some areas of no strain (i.e., the hypoechoic lesion had a mosaic pattern of green and blue), A score of 3 indicated strain at the periphery of the hypoechoic lesion, with sparing of the centre of the lesion (i.e., the peripheral part of lesion was green, and the central part was blue). A score of 4 indicated no strain in the entire hypoechoic lesion (i.e., the entire lesion was blue, but its surrounding area was not included. A score of 5 indicated no strain in the entire hypoechoic lesion or in the surrounding area (i.e., both the entire hypoechoic lesion and its surrounding area were blue). BGR represents typical artifactual three layered aspect (blue-green-red) encountered with cystic lesions.

Strain ratio

Strain ratio measurement

A semi quantitative method of lesion assessment, referred to as strain ratio (SR) measurement, has also been developed. Calculation of the SR value is based on determining the average strain measured in a lesion and comparing it to the average strain of a similar area of fatty tissue in the adjacent breast tissue.

Using proprietary software, the average strain of the lesion is determined by selecting a region of interest (ROI) encompassing the lesion; the ratio value increases as a function of the relative stiffness of the target lesion. As the Strain Ratio increases, the likelihood of invasive breast cancer also increases.[9]

Pathological diagnosis

In all 50 cases included in the study diagnosis was established by FNAC, or histopathology.

RESULTS

Table 1: Symptoms.

Symptoms	No. of patients
Lump	42
Nipple discharge	nil
Lump + Pain	8

Table 2: Location.

Location	No. of patients
Right breast	28
Left breast	10
Bilateral breast	12

Table 3: Number of lesions.

Number of lesions	No. of patients
Solitary	36
Multiple	14

Table 4: USG features.

USG features	Number	%
Shape		
Round	9	18
Oval	39	78
Lobulated	2	4
Margins		
Well defined	44	88
Encapsulated	42	84
Irregular	6	12
Echogenicity		
Isoechoic	5	10
Hypoechoic	42	84
Hyperechoic	3	6
Internal echoes		
Homogeneous	46	92
Non-homogeneous	4	8
US beam transmission		
Beyond the lesion unaltered	46	92
Acoustic shadows on both sides of nodule	4	8
Echotexture of nodule		
Solid	41	82
Solid with calcification	4	8
Cystic changes in solid nodule	5	10

In our study, fibroadenomas were more common in right breast as compared to left breast. Solitary fibroadenomas were more numerous than multiple fibroadenomas. In USG features, 78% fibroadenomas were oval in shape; 88% were well defined and 84% were encapsulated. Only 12% were irregular in outline.

In comparison to breast tissue 84% fibroadenomas were hypoechoic. 92% fibroadenomas showed homogeneous internal echoes; 82% were solid; 10% showed cystic changes and 8% had calcifications.

In elastographic evaluation, 90% of fibroadenomas showed tsukuba score of 2 while majority (54%) had strain ratio between 1 and 2. The most common site of fibroadenoma in breast was upper lateral quadrant. Majority of fibroadenomas (78%) were less than 3cm in size.

DISCUSSION

In our study, most (64%) of the patients diagnosed as fibroadenoma were in 2nd and 3rd decades (10-30Years). The mean age of presentation was found to be 28years.In the study by Abhishek Vijaykumar et al, the majority (66%) of cases diagnosed as fibroadenoma were in their second and third decades (16-30 years).[10] These finding were consistent with that of Hanna and Ashebu.[11]

Further, the mean age of incidence of fibroadenoma among teenagers in India as reported in the literature is 14 years compared to 11 years in Germany according to Stehr et al.[12] Fibroadenomas were more numerous in right breast (56%) in our study, in contrast to Rimsten's observation that the incidence of breast lesions is higher in the left breast than in the right.[13]

Table 5: Elastography evaluation.

Tsukuba elastography score	Number	%
1	4	8%
2	45	90%
3	1	2%
4	nil	-
5	nil	-
Strain ratio		
Upto 0.5	1	2%
0.5-1	4	8%
1-2	27	54%
2-3	15	30%
3-3.5	2	4%
3.5-4	1	2%

Table 6: Based on gray-scale USG features.

Gray-scale USG features	Number
True positive (TP)	42
True negative (TN)	1
False positive (FP)	3
False negative (FN)	4

Table 7: Based on USG + elastography scoring.

USG + elastography scoring	Number
True positive (TP)	46
True negative (TN)	1
False positive (FP)	1
False negative (FN)	2

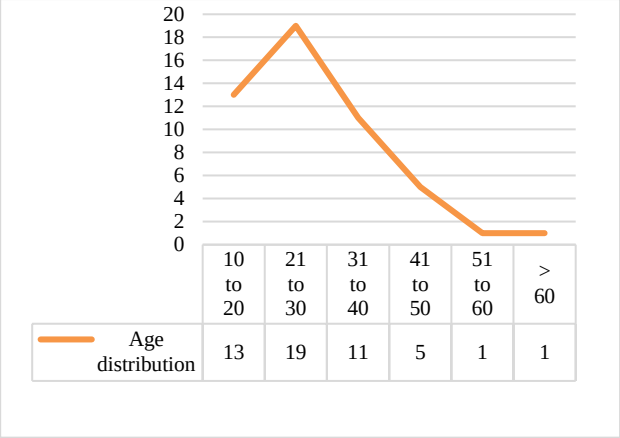

Figure 1: Age distribution.

Upper lateral quadrant (48%) was the most common location of fibroadenoma, which is in accordance with the findings of Ajao.[14] Fibroadenomas >5 cm (about 4% of the total) are commonly defined as giant fibroadenomas; however, this terminology is not universally accepted. Giant fibroadenomas are usually encountered in pregnant or lactating women. When found in an adolescent girl, the term juvenile fibroadenoma is more appropriate. Fibroadenomas are rapidly growing masses that cause asymmetry of the breast, distortion of the overlying skin, and stretching of the nipple. Histologically, they appear to be more cellular and have less lobular components than do simple fibroadenomas. However, giant fibroadenomas are benign lesions that do not undergo transformation into malignancy.[15] In our study, only one giant fibroadenoma was found in young girl who constituted 2% of all fibroadenomas. From 10-16% of patients with multiple fibroadenomas have 2-4 in a single breast, which may present initially or be discovered over several years. Unlike women with a single fibroadenoma, most of the patients with multiple fibroadenomas have a strong family history of these tumors.[16] In our study, multiple fibroadenomas were seen in 28% cases.

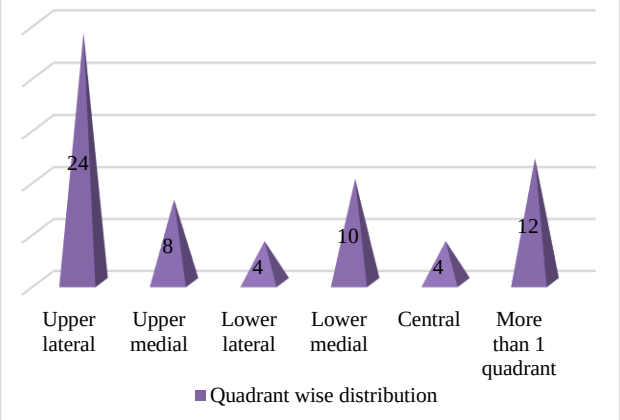

Figure 2: Quadrant wise distribution.

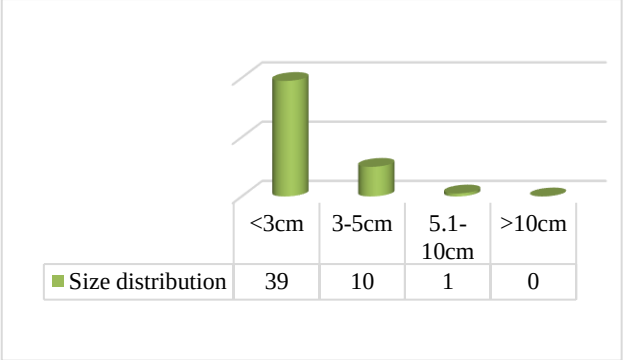

Figure 3: Size distribution.

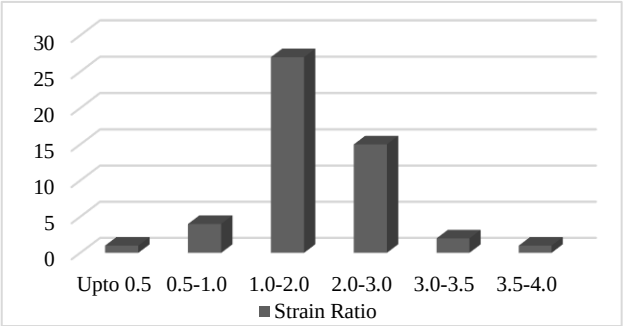

Figure 4: Strain ratio.

Figure 5: Typical fibroadenoma oval, encapsulated, well defined hypoechoic mass with homogenous internal echoes showing posterior acoustic shadowing on both sides of nodule.

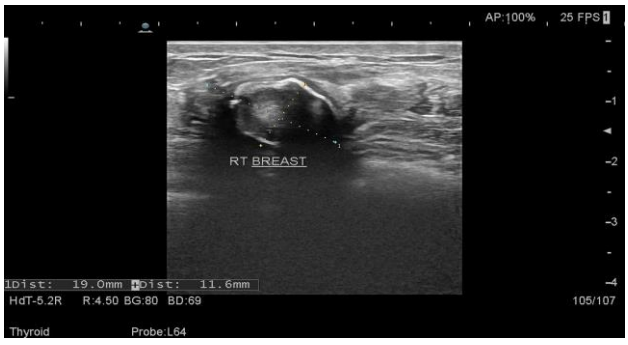

Figure 6: Calcified fibroadenoma showing peripheral eggshell type calcification.

Figure 7: Oval hypoechoic fibroadenoma showing tiny flecks of calcification.

Fine needle aspiration cytology is used to sample and diagnose mammary fibroadenoma. In most cases a confident diagnosis is possible with this.[17] On sonography, the major descriptive criteria for 100 of the imaged biopsied fibroadenomas were a solid mass lesion (83%), a round (48%) or oval (37%) shape, a smooth contour (75%) and 25% with irregular margins. These latter lesions were interpreted as suspicious for malignancy, although breast mass biopsies confirmed benign. The differential diagnosis of solid breast masses includes circumscribed malignancies; infiltrating duct, metastatic breast, and medullary carcinomas; cystosarcoma phylloides; and fibroadenomas.[18]

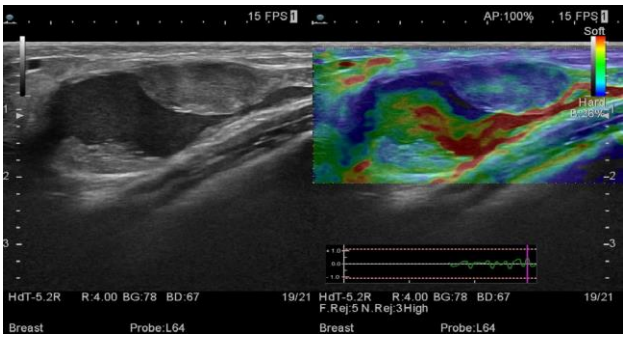

Figure 8: Fibroadenoma showing cystic changes and strain ratio of 2.03. BGR appearance is seen in cystic part.

Figure 9: Fibroadenoma showing irregular margins.

Figure 10: Giant fibroadenoma in a teenager showing strain ratio of .75 confirming its benign nature.

In our study, 90% were solid, most of them (78%) were oval in shape, 88% had well defined margins and 12% were irregular in shape. As compared to breast parenchyma 84% were hypoechoic in echogenicity. Homogenous internal echoes were seen in 92% cases. Acoustic shadows were seen on both sides of nodule in 8% cases. Calcification was noticed in 8% cases, while cystic changes in 10%. On US images, fibroadenoma appears as a well-circumscribed elliptic mass that is either hypoechoic or isoechoic and has uniform echogenicity. The lesion is typically larger in the transverse than in the anteroposterior direction and has very well-demarcated margins. A fibroadenoma may have no effect on ultrasound transmission, or acoustic enhancement or shadow may be observed on US images.[19]

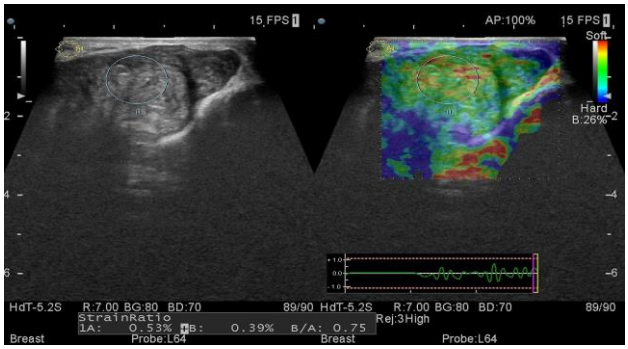

Figure 11: Giant fibroadenoma in a teenager showing strain ratio of .75 confirming its benign nature.

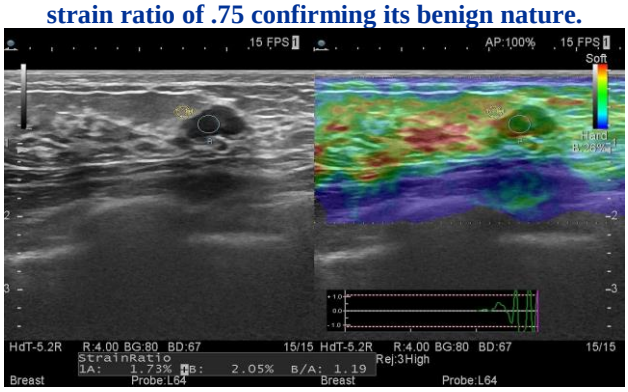

Figure 12: Small fibroadenoma showing elastography score 1(Entire lesion shaded in green colour) and strain ratio of 1.19.

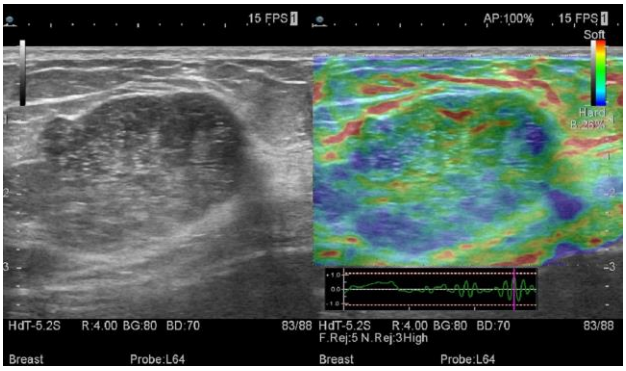

Figure 13: Fibroadenoma showing elastography score of 2. (Mosaic pattern of blue and green).

Aly AM et al concluded that in elastography elasticity score according to the degree and distribution of the strain induced by light compression was between 1-3 and strain ratio cut off point was 4.8 below this level is considered benign.[20] Adile Balçık et al found the: The threshold value for strain ratio in the differentiation of benign and malignant masses was detected as 4.52, and a significant intraobserver difference was not observed in this study. The diagnostic value of sonoelastography in distinguishing benign from malignant breast masses was higher in comparison to conventional ultrasound.[21]

In our study elasticity score for 90% fibroadenomas was 2 and strain ratio of 54 % was between 1 and 2. The only false negative case seen on elastography was of poorly differentiated epithelial malignancy of breast (on FNAC) which showed strain ratio of 1.21 and reported as fibroadenoma on sonoelastography.

Figure 14: False negative case of poorly differentiated epithelial malignancy breast reported as conglomerated fibroadenoma.

There were two isoechoic lesions which were missed on sonoelastography and were later recognised on FNAC as fibroadenoma. This may be due to the similar echogenicity to normal breast parenchyma and small size of lesion. The sensitivity, specificity, accuracy, PPV and NPV based on gray-scale USG features alone was found to be 91.30, 25.00%, 86.00%, 93.33% and 20.00% respectively. After the Tsukuba elastography score parameters were taken into consideration, the sensivity, specificity, accuracy, PPV and NPV increased to 95.83%, 50%, 94%, 97.87% and 33% respectively. Also, the strain ratio was helpful in majority of cases and was found to be less than 3 and the maximum strain ratio value in one case was 3.8.

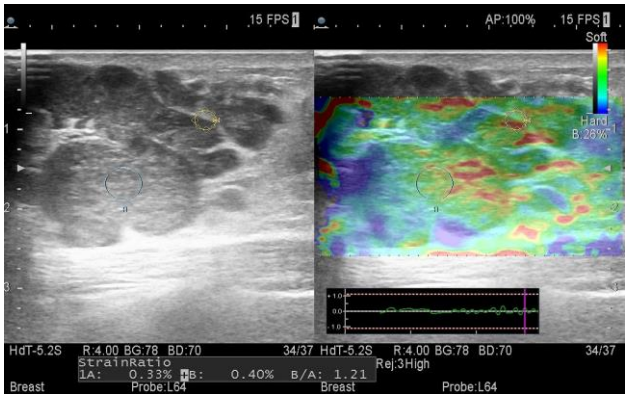

Figure 15: False negative case of poorly differentiated epithelial malignancy breast reported as conglomerated fibroadenoma with strain ratio of 1.21.

The main limitation of this study was that the acquisition of elastograms as well as analysis is observer dependent. The magnitude of initial compression could affect the elasticity map. Hence inter and intra observer variability is another factor which needs to be studied. Future research and further technical, will ultimately determine the usefulness of elastography in clinical practice

CONCLUSION

In conclusion, fibroadenomas are one of the most common benign diseases of the breast. They are predominantly found in women aged 10-40years, of varying number and size in all quadrants of the breast. Diagnosis by FNAC is reliable, yet confirmation by biopsy is required in women >35years and with unusual presentation. Among the two interpretation criteria used for interpretation of elastography images, elastography score was found to be the most useful. Our results corroborate those of other studies, that elastography has the potential to improve the sensitivity, specificity and accuracy of conventional ultrasound and, thus avoiding unnecessary biopsy.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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