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Original Research Article

Ultrasound elastography evaluation of breast masses with FNAC and/or histopathological correlation

Shyam Chhadi[1], Tulsi Chhadi[2]*, Kamlesh Bagde[1]

[1]Department of Radiology, Government Medical College & Hospital, Nagpur, Maharashtra, India
[2]Department of Pathology, Indira Gandhi Government Medical College & Hospital, Nagpur, Maharashtra, India

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***Correspondence:**
Dr. Tulsi Chhadi,
E-mail: drtulsichhadi@yahoo.com

ABSTRACT

Background: Breast cancer is the most frequently diagnosed cancer amongst women worldwide. Ultrasound elastography is a non-invasive method for determining tissue mechanical properties and seems to be compensating for the deficiencies of conventional USG. We aimed to evaluate the sensitivity and specificity of ultrasound elastography in detection and characterization of various breast masses and study its role in differentiating benign and malignant breast masses with FNAC and/or histopathological correlation.
Methods: A total of 126 patients with breast lesions confirmed on USG were enrolled for the study, out of which 10 were lost to follow-up and excluded. Consecutive patients presenting with palpable breast lesions were assessed with conventional B-mode USG. Those confirmed to have breast lesion were then assessed with Strain Elastography (SE). FNAC was used for histopathological confirmation of malignant lesions. The benign lesions were diagnosed by a combination of FNAC and biopsy and were followed up for 6 months.
Results: There were 56 (48.3%) malignant and 60 (51.7%) benign lesions. A sensitivity of 83.9% and a specificity of 91.7% was obtained for elasticity score when cut-off value of 3.5 was used (area under the curve- 0.924, 95% CI- 0.869 to 0.979, p-0.0001). Sensitivity of 91.1% and specificity of 88.3% was obtained for SR scores, when a cut off of 2.94 was used (area under the curve- 0.969, 95% CI- 0.943-0.995, p-0.0001). The Pearson correlation coefficient for elasticity scores and SR values was 0.936, indicating very good agreement (correlation) between the two methods.
Conclusions: Ultrasound elastography is a simple and rapid method that can improve the sensitivity and specificity of USG and can decrease the rate of unnecessary biopsies.

Keywords: Breast mass, FNAC, Histopathology, Ultrasound elastography

INTRODUCTION

Breast cancer is the most frequently diagnosed cancer as well as the leading cause of cancer death in women worldwide.[1] As it is progressively affecting more women in productive age group, it is of utmost importance to help diagnose the disease at the earliest.

Currently, palpation, mammography and ultrasonography (USG) are the common diagnostic tests performed to detect breast cancer, with varying degree of accuracy and predictive value.[2] Clinical palpation is the easiest examination method; but has limited value due to poor sensitivity and limited accuracy. Mammography can detect early breast cancer via indirect signs, such as sand-like calcifications. But researchers have reported its limitations when trying to detect lobular cancer, intraductal cancer without characteristic micro-calcifications, multifocal cancer, locally invasive cancer and recurrent cancer after hormone replacement therapy.[3] USG seems more suited as a screening method owing to advantages like simplicity, real time dynamic imaging

and non-invasive nature of the procedure; but the specificity is poor as most solid tumours are benign. To obtain acceptable specificity, various characteristics of the tumours must be evaluated according to the Breast Imaging Reporting and Data System (BIRADS) criteria defined by the American College of Radiology (ACR).[4] Unfortunately, reporting even according to these criteria may not help in differentiation of some tumours, which leads to undue increase in the number of breast lesion biopsies.[5,6]

Ultrasound elastography is a non-invasive method for determining tissue mechanical properties. It technically seems to be compensating for the deficiencies of conventional USG, in the sense that it can clearly identify and locate breast tumours in the E-mode (Elasticity mode).

With this study, we aimed to evaluate the sensitivity and specificity of ultrasound elastography in detection and characterization of various breast masses and study its role in differentiating benign and malignant breast masses with FNAC and/or histopathological correlation of its findings.

METHODS

It was a hospital based prospective observational study. The study was conducted at a tertiary care government teaching hospital. The study period was two years (October 2012- September 2014).

Patients referred to the radiodiagnosis department presenting with breast swelling which was confirmed by USG formed the study population. In all, a total of 116 patients were studied.

Inclusion criteria

- Patients with breast swelling which got confirmed by USG were included.
- Patients presenting with incidentally detected lesions on mammography were also included.

Exclusion criteria

- Patients who have already been diagnosed were excluded.
- Patients lost to follow-up were excluded.
- Patients not consenting for USG, FNAC or Histopathology were also excluded.

Patients presenting with suspected breast swelling in the OPD/emergency were referred to the department of radiodiagnosis for further evaluation. Consecutive patients presenting with palpable breast lesions were assessed with conventional B-mode USG. Those confirmed to have breast lesion were then assessed with Strain Elastography (SE) after informed written consent. Conventional ultrasound images and real-time elastographic data sets were obtained using 12-MHz linear transducer (Philips iU22).

Tissue diagnosis was conducted by the co-investigator (who was blinded to the radiological finding and had access to the clinical notes provided with the requisition) in the department of pathology, Government Medical College and Hospital, Nagpur.

Fine Needle Aspiration Cytology (FNAC) was used for histopathological confirmation of malignant lesions. The benign lesions were diagnosed by a combination of FNAC and biopsy and were followed up for 6months.

All statistical analysis were undertaken with calculation of sensitivity and specificity for SR values and elasticity score was calculated. A p- value of <0.05 was considered statistically significant. SPSS (Version 16) was used for data analysis.

RESULTS

A total of 126 patients with breast lesions confirmed on USG were enrolled for the study, out of which 10 had to be excluded out of loss to follow-up. So, 116 participants were considered for subsequent analysis. Majority (38, 32.8%) of the participants were in the age group 31-40 years, followed by 41-50 years age group (32, 27.6%), with 20 (17.2%) patients in the 21-30 years age group and only 5 (4.3%) in the 61-70 age group. Mean age of participants was 41.9 years.

There were 56 (48.3%) malignant and 60 (51.7%) benign lesions. Most of the malignant lesions were observed between 30-60 years of age; while most of the benign lesions were noted in the 20-50 years age group.

Among the benign nodules, fibroadenoma (22, 19%), fibrocystic disease (21, 18.1%) and benign cystic lesions (15, 12.9%) were the commonest ones. Among the malignant lesions, ductal carcinoma (invasive) (34, 29.3%) was by far the commonest entity, followed by the ductal carcinoma in situ (18, 15.5%) (Table 1).

Table 1: Histopathological diagnoses of lesions (n= 116).

Histopathology	Frequency	%
Ductal carcinoma (invasive)	34	29.3
Fibroadenoma	22	19
Fibrocystic disease	21	18.1
Ductal carcinoma in situ	18	15.5
Benign cystic lesions	15	12.9
Infiltrating ductal carcinoma	2	1.7
Lobular carcinoma (invasive)	2	1.7
Fibroadenoma (calcified)	1	0.9
Infected benign cystic lesion	1	0.9
Total	116	100

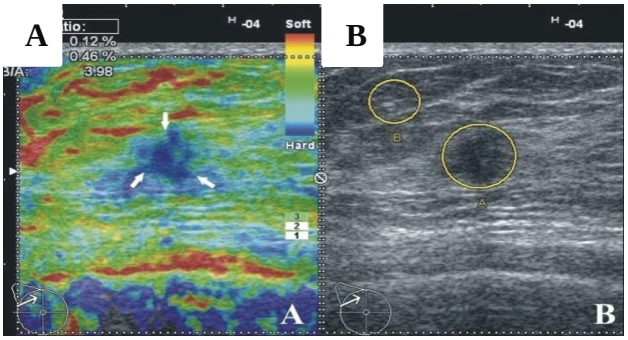

Figure 1: (A, B) SE image (A) and B-mode USG image (B) Reveal a small, suspicious, stiff lesion (arrows). The lesion appears to be larger on the elastographic image due to the accompanying desmoplastic reaction with elasticity score of 5.

Fibroadenoma appeared either softer than or had the same elasticity as adjacent granular tissue. Breast cysts had an elasticity score of 1 with a characteristic three-layered appearance: blue-green-red (BGR), blue being the superficial colour and red the deep one, even in large dimension sections. Fibrocystic nodules had elasticity similar to surrounding parenchyma. Breast carcinoma appeared larger on the elastography image because of better visualisation of the surrounding desmoplastic reaction (Figure 1).

The mean elasticity score for benign lesions was 1.90. Breast carcinomas showed an average elasticity score of 4.21. The maximum frequency (27, 23.3%) was seen with elasticity score 1 and 5 both (Table 2).

Table 2: Elasticity scores for benign and malignant lesions (n= 116).

Type		Elasticity Score					Total
		1	2	3	4	5	
Benign	N	25	23	7	3	2	60
	%	41.7	38.3	11.7	5.0	3.3	100.0
Malignant	N	2	0	7	22	25	56
	%	3.6	0	12.5	39.3	44.6	100
Total	N	27	23	14	25	27	116
	%	23.3	19.8	12.1	21.6	23.3	100.0

To calculate the sensitivity and specificity of ultrasound elastography, lesions with elasticity scores of 1-3 were classified as benign; while those with scores of 4 or 5 were classified as malignant.

The average Stain Ration (SR) for benign lesions was 2.2, which was significantly lower than that for malignant lesions (5.8). For assessment of the role of Strain Elastography in the differential diagnosis of breast lesions, a receiver operator characteristic (ROC) analysis was performed. A sensitivity of 83.9% and a specificity of 91.7% was obtained for elasticity score when cut-off value of 3.5 was used (area under the curve- 0.924, 95% CI- 0.869 to 0.979, p-0.0001). Sensitivity of 91.1% and specificity of 88.3% was obtained for SR scores, when a cut off of 2.94 was used (area under the curve- 0.969, 95% CI- 0.943-0.995, p-0.0001) (Table 3).

Table 3: Coordinates of the ROC curve (elasticity score and strain ratio-SR).

Test result variables (s): elasticity score		
Positive if greater than or equal to	Sensitivity	1-Specificity
0	1	1
1.5	0.964	0.583
2.5	0.964	0.2
3.5	0.839	0.083
4.5	0.446	0.033
6	0	0
Test result variables (s): Strain Ratio (SR) score		
Positive if greater than or equal to	Sensitivity	1-Specificity
0.05	1	1
1.08	1	0.983
1.94	1	0.517
2.03	1	0.483
2.85	0.946	0.133
2.91	0.911	0.133
2.94	0.911	0.117
2.96	0.911	0.1
2.98	0.893	0.1
2.99	0.875	0.1
3	0.875	0.1
4.44	0.821	0.083
5.06	0.821	0.083
5.94	0.589	0
6.04	0.554	0
6.91	0.107	0
7.03	0.089	0
7.65	0.018	0
8.85	0	0

The Pearson correlation coefficient for elasticity scores and SR values was 0.936, indicating very good agreement (correlation) between the two methods.

DISCUSSION

The interpretation of breast nodule detected on B-mode USG relies mainly on morphological criteria. To improve the accuracy of USG, additional techniques can be used, including Doppler and harmonic imaging.[7,8] Strain Elastography (SE) is known to help differentiate between benign and malignant breast lesions.

Results of the clinical use of SE were initially published in 1990-91, but it was only in 2003-2004 that USG equipment was developed that had incorporated software for real-time processing of elastography images and routine USG examinations.[9,10]

In this study, when a cut-off point of 3.5 was used, a sensitivity of 83.9% and a specificity of 91.7% was obtained for elasticity score; an observation that is consistent with available literature on the use of real-time USG elastography.[11-14]

Although SR of >3 is generally considered suspicious for malignancy, there is considerable ongoing research for establishing the correct values for differentiation of benign and malignant lesions.[15] In the present study, the mean SR for benign lesions was 2.2 and for malignant lesions it was 5.8, with the cut-off point being 2.94. The sensitivity of 91.1% and specificity of 88.3% was obtained, results that are consistent with other published data from previous similar studies.[14,16-18]

Routine USG examination detects many non-palpable lesions and is not very specific for screening cases.[19] The recent introduction of SE, especially quantitative elastography with SR, has increased the specificity of USG and enabled early diagnoses of sub-centimetre breast cancer and decreased the need for biopsies.[20] In the clinical setting, SE is useful for deciding whether to follow-up patients with imaging or to intervene.[20]

This study showed good correlation between qualitative and quantitative elastography methods (elasticity score and SR) and by performing both the techniques a more confident diagnosis can be made.

Some limitations of SE are worth mentioning; like it is less sensitive than standard USG when dealing with non-focal anomalies and is not indicated for the evaluation of postoperative changes, diffuse lesions, or large ones that exceed the probe length or field of view. It is also of limited usefulness in very dense fibrous parenchyma and in the cases of hematomas or breast implants.[21]

CONCLUSION

We conclude by summarizing that ultrasound elastography is a simple and rapid method that can improve the sensitivity and specificity of USG and can decrease the rate of unnecessary biopsies.

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