Original Research Article

Study of role of elastography in the evaluation of breast lesions

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Abstract

Background: Real-time ultrasound elastography is a noninvasive dynamic imaging technique that assesses the strain of soft tissues and provides structural information other than the morphologic features shown by conventional B-mode US. In present study we evaluated role of ultrasound elastography in the evaluation of breast lesions at a tertiary hospital. **Material and Methods:** Present study was a prospective observational study conducted in female with suspected breast lesions on ultrasound/ clinical examination, later underwent core-needle biopsy or surgical biopsy with conclusive histopathologic diagnosis. Elastography findings were correlated with histopathologic diagnoses obtained from core-needle biopsy/surgical biopsy. **Results:** During study period total 96 patients underwent ultrasound elastography examination followed by core needle/surgical biopsy for histopathological study. On histopathological study 77 % lesions were benign, while 23% were malignant. Fibroadenoma (36%), fibrocystic changes (16%), galactocele (5%) and mastitis (6%) were common benign findings. While invasive ductal carcinoma (17%), mucinous carcinoma (3%) and invasive papillary carcinoma (3%) were malignant lesion findings. On ultrasound elastography score examination, scores of 1 (23%), 2 (38%), 3 (17%), 4 (8%) and 5 (15%) were noted. Scores 1 to 3 were considered benign and 4 and 5 malignant. On statistical analysis we calculated sensitivity (95.89 %), specificity (82.60 %), positive predictive value (94.59 %), negative predictive value (86.36 %) and accuracy (92.70 %) of ultrasound elastography with histopathological report. **Conclusion:** Ultrasound elastography is a useful non-invasive diagnostic modality in differentiating benign from malignant breast lesions thereby reduces waiting, cost, discomfort and anxiety of a biopsy.

Keywords: Ultrasonography breast, elastography, biopsy, Breast Malignancy

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INTRODUCTION

Breast cancer is the most common cancer in women worldwide and second most common after cervical cancer in India. The incidence of this disease has been consistently increasing especially in the younger age group and in developing countries.[1] Age standardized cancer mortality trends was found highest for breast cancer when compared to all other cancers in India. Detection of cancer in the early stage can improve the survival of patients and cancer control can be achieved.[2] Real-time ultrasound elastography (RTE) is a noninvasive dynamic imaging technique that assesses the strain of soft tissues and provides structural information other than the morphologic features shown by conventional B-mode US.[3] Ultrasound elastography is used for measurements of tissue stiffness (elasticity). It is the foremost widely used imaging modality, because of low cost, feasibility, accessibility, and easy fast technique. Shear wave elastography measurements can be acquired by ultrasound in few seconds.[4] Because malignant tumors predominantly are harder than benign tissues, this technique significantly improves the differentiation between benign and malignant tissues. Itoh *et al.*[5] reported a good correlation between real-time ultrasound elastography and histologic analysis,

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with high sensitivity and specificity for classifying benign versus malignant masses. In present study we evaluated role of ultrasound elastography in the evaluation of breast lesions at a tertiary hospital.

MATERIAL AND METHODS

Present study was a prospective observational study conducted in Department of Radiodiagnosis, Bharti Vidyapeet Deemed University. Study period was from June 2019 to June 2020 (1 year). Institutional ethical committee approval was taken.

Inclusion criteria

- Female with suspected breast lesions on ultrasound/ clinical examination, later underwent core-needle biopsy or surgical biopsy with conclusive histopathologic diagnosis

Exclusion criteria

- Already diagnosed cases, history of breast malignancy, recurrent lesions
- Inconclusive histopathology reports
- Not willing to participate

Patients were referred from department of general surgery for ultrasonography evaluation and department of pathology helped to get final histopathology reports.

Procedure was explained and a written informed consent was taken from patients. Demographic, clinical details were noted. Elastography examinations were performed using an Antares ultrasound system (Siemens Medical Solutions, Mountain View, CA) with integrated elastography software (eSie Touch elasticity imaging) and a multifrequency linear transducer (VFX13-5). Elastography image acquisition was performed by single radiologists with more than 10 years of experience in breast sonography and previously trained on breast elastography. For the elastography examination, the region of interest was superimposed semitransparently on the B-mode image, trying to ensure that the lesion occupied less than one-third of this area so that there was enough surrounding breast tissue. Elastography images were assessed by a color scale, which assigns a particular color according to the degree of elasticity of the lesion components. Elastography images were classified according to the 5-score system of Ueno and colleagues:[5,6]

Table 1: 5-score system for Elastography images

Score	Characteristic
1	Even strain over the whole mass
2	Strain over most of the mass
3	Strain at the periphery of the mass
4	No strain over the whole mass
5	No strain over the whole mass or in the surrounding area

Scores 1 to 3 were considered benign and 4 and 5 malignant. Elastography findings were correlated with histopathologic diagnoses obtained from core-needle biopsy, or surgical biopsy, depending on the case. Details were noted in Microsoft excel sheet. Statistical analysis was done using descriptive statistics.

RESULTS

During study period total 96 patients underwent ultrasound elastography examination followed by core needle/surgical biopsy for histopathological study. On histopathological study 77 % lesions were benign, while 23% were malignant. Fibroadenoma (36%), fibrocystic changes (16%), galactocele (5%) and mastitis (6%) were common benign findings. While invasive ductal carcinoma (17%), mucinous carcinoma (3%) and invasive papillary carcinoma (3%) were malignant lesion findings.

Table 2: Final diagnosis of core needle/surgical biopsy results

Diagnosis	No.	Percentage
Benign	74	77%
Fibroadenoma	35	36%
Fibrocystic changes	15	16%
Mastitis	6	6%
Galactocele	5	5%
Cyst	5	5%
Abscess	4	4%
Duct ectasia	2	2%
Lactating adenoma	1	1%
Phylloid tumor	1	1%
Malignant	22	23%
Invasive ductal carcinoma (IDC)	16	17%
Mucinous carcinoma	3	3%
Invasive papillary carcinoma (IPC)	3	3%

On ultrasound elastography score examination, scores of 1 (23%), 2 (38%), 3 (17%), 4 (8%) and 5 (15%) were noted. Scores 1 to 3 were considered benign and 4 and 5 malignant.

Table 3: Elastography score and histopathological diagnosis

Elastography score	Benign (n=74)	Malignant (n=23)	Total (n=96)
1	22 (30%)	0	22 (23%)
2	36 (49%)	0	36 (38%)
3	13 (18%)	3 (14%)	16 (17%)
4	3 (4%)	5 (23%)	8 (8%)
5	0	14 (64%)	14 (15%)
Total	**74 (77%)**	**22 (23%)**	**96**

On statistical analysis we calculated sensitivity (95.89 %), specificity (82.60 %), positive predictive value (94.59 %), negative predictive value (86.36 %) and accuracy (92.70 %) of ultrasound elastography with histopathological report.

Table 4: Statistical values

Sensitivity	TP/(TP/FN)	95.89 %
Specificity	TN/(TN/FP)	82.60 %
Positive Predictive Value	TP/(TP+FP)	94.59 %
Negative Predictive Value	TN/(TN+FN)	86.36 %
Accuracy	(TP+TN)/(TP+TN+FP+FN)	92.70 %

DISCUSSION

Ultrasound elastography (UE) has been introduced as an additional modality for improving lesion classification. This is an emerging technique that is considered equivalent of clinical manual palpation.[7] Elasticity is one of the important characteristics of tissues that may change under the influence of pathologic processes, such as inflammation and tumor development. Usually, a malignant lesion tends to be harder than a benign lesion because of its high cellularity and surrounding tissue desmoplasia.[8,9] Benign lesions on SE appear similar to the adjacent tissue and have a smaller diameter than on B-mode USG images.[10] Malignant tumours have reduced elasticity and also display larger dimensions on elastography due to accompanying desmoplastic reaction.[11]Aysar S K[12] studied 80 patients, 31 breast lesions were malignant and 49 were benign. B-mode ultrasound was performed, and the lesions were categorized agreeing to the (BI-RADS) where chi-square statistical test uncovered that BI-RADS categories were essentially expanded among malignant cases ($P < 0.001$). While the elastography classified concurring to altered Ueno and Ito elasticity score framework which benign lesions had elastography score 1, 2, 3 and 4 whereas malignant breast lesions had elastography score 4 and 5. Annapurna S *et al.*,[13] noted that sensitivity, specificity, PPV and NPV of sonomammography were 92.00%, 73.1%, 76.67% and 90.4% respectively. the sensitivity, specificity, positive predictive value and negative predictive value for detecting malignant lesions in elastography were 84%, 96.1%, 95.4% and 86.2% respectively. Elastography has more specificity and positive predictive value compared to mammography and ultrasonography. Similar findings were noted in present study. While Kumar AMS[14] noted that sensitivity, specificity and diagnostic accuracy of B-mode USG was calculated to be 71.74%, 90.91% and 81.11% and that for elastography was 95.65%, 68.18% and 82.22% respectively. They concluded, elastography may complement conventional B-mode USG to improve the diagnostic performance, which helps to reduce false-positive results and therefore is useful in avoiding unnecessary breast biopsy. Ultrasound has been proven to improve diagnostic sensitivity when added to screening mammography in high-risk women with dense breasts. However, the downside was an increased false-positive rate and lower positive predictive value.[15] Given the common occurrence of breast cancer and the importance of accurately diagnosing a clinically palpable breast lump, with non-invasive techniques without routinely resorting to formal biopsy which is much invasive, elastography is a simple, fast, and noninvasive technique, which can be performed immediately after conventional sonography. Used as a complementary technique in addition to B-mode sonography, it increases the diagnostic specificity for breast lesions, thus reducing the false-positive rate.[16] Although elastography is easy to perform, training and technical knowledge are required in order to obtain images permitting a correct interpretation. [17] Magnetic resonance elastography has the advantage of its ability to assess the speed, propagation of stimuli and measure tissue deformation in any direction with equal sensitivity. Magnetic resonance imaging is expensive, not appropriate to be used in all clinical settings, and needs long acquisition time compared to real-time ultrasound.[18]

CONCLUSION

Ultrasound elastography is a useful non-invasive diagnostic modality in differentiating benign from malignant breast lesions thereby reduces waiting, cost, discomfort and anxiety of a biopsy.

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