Original Research Article

Radiological study of ultrasound elastography in the evaluation of breast lesions at a tertiary hospital

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Abstract

Background: Ultrasound elastography is used for measurements of tissue stiffness (elasticity). Two techniques are now available for clinical use: strain (compression based) and shear wave elastography. The lesions are quantified according to the colour scale in Sonoelastogram. 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 single-center, prospective observational study conducted in female patients with suspected breast lesions on ultrasound/ clinical examination, referred for breast elastography.**Results:** 90 female underwent ultrasound elastography examination followed by core needle/surgical biopsy for histopathological study. On histopathological study 78.89 % lesions were benign, while 21.11 % were malignant. On ultrasound elastography score examination, scores of 1 (40%), 2 (23.56 %), 3 (12.22 %), 4 (8.89 %) and 5 (13.33%) were noted. Scores 1 to 3 were considered benign and 4 and 5 malignant. On statistical analysis we calculated sensitivity (86.05 %), specificity (93.60 %), positive predictive value (88.1 %), negative predictive value (92.86 %) and accuracy (91.27 %) 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: breast tumor, ultrasound elastography, diagnostic modality, malignancy

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INTRODUCTION

Cancer breast has emerged as leading site of cancer in most urban populations of India. It is rapidly replacing cancer of cervix as most important leading site of cancer among women.[1,2] Several etiological factors, such as age, genetics, family history, diet, alcohol, obesity, lifestyle, physical inactivity, endocrine factors, are implicated in pathogenesis of disease.[3] 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.[4] 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.[5] Two techniques are now available for clinical use: strain (compression based) and shear wave elastography.[6] The lesions are quantified according to the colour scale in Sonoelastogram. Among various scoring methods, the Tsukuba elasticity score is the most known and commonly used scoring systems in elastography.[7] Because malignant tumors predominantly are harder than benign tissues, this technique significantly improves the differentiation between benign and malignant tissues. In present study we evaluated role of ultrasound elastography in the evaluation of breast lesions at a tertiary hospital.

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MATERIAL AND METHODS

Present study was single-center, prospective observational study conducted in Department of Radio- Diagnosis, Dr Ulhas Patil Medical College And Hospital, Jalgaon. Study period was 1 year (January 2020 to December 2020). Institutional ethical committee approval was taken.

Inclusion criteria: Female patients with suspected breast lesions on ultrasound/ clinical examination, referred for breast elastography.

Exclusion criteria: Already diagnosed cases, history of breast malignancy, recurrent lesions. Patients not underwent core-needle biopsy or surgical biopsy with conclusive histopathologic diagnosis. Inconclusive histopathology reports. Not willing to participate.

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. 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:[7,8]

Table 1: 5-score system for Elastography images

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

Patients clinical details and final histopathology reports were collected from general surgery and pathology department respectively. Elastography findings were correlated with histopathologic diagnoses obtained from core-needle biopsy, or surgical biopsy, depending on the case. Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Statistical analysis was done using descriptive statistics.

RESULTS

90 female underwent ultrasound elastography examination followed by core needle/surgical biopsy for histopathological study. On histopathological study 78.89 % lesions were benign, while 21.11 % were malignant.

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

Diagnosis	No. of cases (n=90)	Percentage
Benign	71	78.89%
• Fibroadenoma	41	45.56%
• Fibrocystic changes	12	13.33%
• Cyst	5	5.56%
• Galactocele	4	4.44%
• Mastitis	4	4.44%
• Abscess	2	2.22%
• Duct ectasia	1	1.11%
• Lactating adenoma	1	1.11%
• Phylloid tumor	1	1.11%
Malignant	19	21.11%
• Invasive ductal carcinoma (IDC)	13	14.44%
• Mucinous carcinoma	3	3.33%
• Invasive papillary carcinoma (IPC)	3	3.33%

On ultrasound elastography score examination, scores of 1 (40%), 2 (23.56 %), 3 (12.22 %), 4 (8.89 %) and 5 (13.33%) were noted. Scores 1 to 3 were considered benign and 4 and 5 malignant.

Table 3: Elastography score and histopathological diagnosis

Elastography score	Benign	Malignant	Total (n=90)
1	36 (40 %)	0	36 (40 %)
2	23 (23.56 %)	0	23 (23.56 %)
3	9 (10 %)	2 (2.22 %)	11 (12.22 %)
4	3 (3.33 %)	5 (5.56 %)	8 (8.89 %)
5	0	12 (13.33 %)	12 (13.33 %)
Total	**71 (78.89 %)**	**19 (21.11 %)**	**90**

On statistical analysis we calculated sensitivity (86.05 %), specificity (93.60 %), positive predictive value (88.1 %), negative predictive value (92.86 %) and accuracy (91.27 %) of ultrasound elastography with histopathological report.

Table 4: Statistical values

Sensitivity	86.05 %
Specificity	93.98 %
Positive Predictive Value	88.10 %
Negative Predictive Value	92.86 %
Accuracy	91.27 %

DISCUSSION

All detected breast lesions are not malignant and all the benign masses do not progress to cancer; nevertheless the precision of the final diagnosis can be greatly increased by radiological imaging (mammography, ultrasonography) and pathological diagnosis.[9] Invasive duct carcinoma has a high mortality rate due to localized invasion, lymph node spread, and distant metastasis. Prognosis is usually poor with invasive type carcinoma.[10] Age standardized cancer mortality trends was found highest for breast cancer when compared to all other cancers in India.[11] Strain elastography (SE) and shear-wave elastography (SWE) are the two most frequently used ultrasound elastography techniques in the breast. In Strain elastography (SE), stress is applied by repeated manual compression of the transducer, which provides a measurement of the deformed lesion relative to the surrounding normal tissue with a color display.[7] The other technique, shear-wave elastography (SWE), uses an acoustic radiation force impulse created by an ultrasound beam, which allows for the measurement of the propagation speed of shear waves within the tissue and quantifies the stiffness in either kilopascals or meters per second.[12] 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. Sinha R *et al.*,[15] studied 120 breast lump patients, sensitivity of 97.0% and specificity of 86.7% was observed when a cut off value of 3 was used for elasticity score. A specificity of 95.5% and a sensitivity of 93.3% was observed when a cut off of 3.8 was used for strain ratio (SR). In all cases, the extent of the pathology, the local or contiguous spread and vascular involvement, predicted by ultrasound elastography examination corroborated well with the cytological findings. Jishan.Ahmed[16] studied 106 patients, 74(70.48%) benign and 31(29.52%) malignant lesions were found on HPE. Sensitivity, specificity, positive and negative predictive values of USE and FNAC in diagnosing malignant breast lump were 88%, 98.57%, 95.65%, 95.79% and ..,89.28%, 100%, 100%, 96.05% respectively. Similar findings were noted in present study. Among diagnostic modalities, ultrasound elastography method is a superior method for the detection of breast cancer. Compared to biopsies, ultrasound elastography had 0.9907 and contrast ultrasound had 0.9 sensitivities.[17,18] Elastography improved the AUC value of breast cancer ultrasound screening, starting from 0.77 for classical ultrasound and improving to 0.86 when adjusting the classical ultrasonography BIRADS score by upgrading or downgrading based on both qualitative and semiquantitative elastographic results ("BIRADS TM").[19] Itoh *et al.*[7] reported a good correlation between real-time ultrasound elastography and histologic analysis, with high sensitivity and specificity for classifying benign versus malignant masses. Limitations of elastography are, as it is influenced by the extent of tissue compression. Strong pressure can lead to misdiagnosis, hence light pressure should be maintained for tissue diagnosis. Large malignant lesions can cause necrosis, hemorrhage or sarcomatous components which can affect the elasticity score.

CONCLUSION

An early and accurate recognition of breast tumor with poor prognosis will, therefore, be beneficial for preoperative planning and outcome improvement. 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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