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Original Research Article

Diagnostic Accuracy of Ultrasonographic Strain Elastography in Differentiating Benign and Malignant Breast Lesions

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Abstract

Introduction: *Breast cancer is the most common cancer and the leading cause of cancer death in women which accounts for 23% of all female cancers. A new, palpable mass is the most common presenting sign or symptom of breast cancer. Biopsy remains the gold standard for definitive diagnosis. Biopsy is an invasive procedure and to reduce the necessity for performing it, ultrasound elastography, a newer noninvasive imaging modality employed in ultrasound imaging to characterize lesions based on their stiffness.*

Objectives: *Our aim was to find out the diagnostic value of ultrasound strain elastography in differentiating between benign and malignant breast lesions in comparison with histopathological analysis, which was taken as the gold standard.*

Methods: *Our study was a diagnostic test evaluation study involving 116 study subjects with palpable breast lumps who underwent ultrasound strain elastography examination in Department of Radiodiagnosis, Government Medical College, Thrissur from January 2016 to June 2017. B mode ultrasound and Strain elastography were performed and the breast lesions were given scores from 1 to 5 according to the Tsukuba elasticity score developed by Itoh and Ueno. Score 1,2&3 were taken as benign and scores 4&5 were taken as malignant. The results were compared with histopathological results. The data was managed in Microsoft Office Excel. The sensitivity, specificity, positive and negative predictive values were obtained.*

Results: *Ultrasound elastography had a sensitivity of 85.3%, specificity of 87.8%,accuracy of 86.2%, a positive predictive value of 92.7% and a negative predictive value of 76.5 % and were statistically significant (p value <0.001).*

Conclusion: *Ultrasound strain elastography has a good diagnostic accuracy in differentiating between benign and malignant breast lesions.*

Keywords: *breast; breast cancer; strain elastography; ultrasound elastography.*

Introduction

Breast cancer is the most common cancer and the leading cause of cancer death in women which accounts for 23% of all female cancers globally.In India the incidence of breast cancer has overtaken the cervical cancer and has become the most common malignancy in women[1][2]. Most common presenting symptom in women is palpable breast lump self detected or on clinical examination. Its

high incidence led to researches aimed at detecting malignant breast lesion early and improving patient mortality rate.

Breast strain ultrasonographic elastography is a noninvasive imaging modality employed to characterize lesions based on their stiffness. The elastogram, which reflects the relative elasticity of the tissues, is created as a color coded map. The elastograms are given different scores from 1 to 5 in the increasing order of probability of malignancy.

This provides higher diagnostic accuracy compared with conventional B-mode ultrasonography in differentiating benign and malignant breast lumps, helps avoid breast biopsies and eventually helps to reduce false-positive results[3][4] [5].

This study was aimed to assess the diagnostic accuracy of strain ultrasonographic elastography to differentiate benign and malignant breast masses.

Materials and Methods

Our study was a diagnostic evaluation study conducted in the department of Radiodiagnosis, Govt. medical college Thrissur, during a period of 18 months between January 2016 to June 2017. All patients with newly detected palpable breast lump were included in the study. Study was started after getting approval from the institutional ethics committee. Informed consent was obtained from all the patients and confidentiality was maintained.

The ultrasound examination was started with B-mode imaging, followed by elastography. Both were done with the linear probe (5-12 MHz) of LOGIQ S8/V1 ultrasound machine. Plenty of gel applied and the transducer held lightly just in contact with the skin.

After switching the elastography mode on, images were obtained by applying light compression on the targeted breast lesions, with the probe positioned perpendicular to the skin while applying compression. The images were presented in split screen mode with the conventional B mode images on the left hand side and the colour scale elastograms superimposed on the grey scale image on the right hand side of the screen.

A rectangular region of interest was set for elastography acquisition. The superior margin was set to include the subcutaneous fat and the inferior margin was set to include pectoralis muscle. The lateral margins were set to include more than 5mm of breast parenchyma adjacent to the lesion. The profile of tissue deformation was converted to an elastic modulus from which an image called elastogram was derived.

We used the cut off value between score 3 and 4.The elastography images were scored according to the Tsukuba elasticity score developed by Itoh and Ueno. In case of multiple lesions in the same or the opposite breast, all the lesions were studied, but the entry was made for the one that had highest elastography score.[6][7]

The reference standard was the histopathological diagnosis. Each lesion was assigned as either benign or malignant by elastography and they were compared with the histopathological diagnosis.

The sensitivity, specificity, positive predictive value and negative predictive value of strain elastography were also calculated based on elastogram findings.

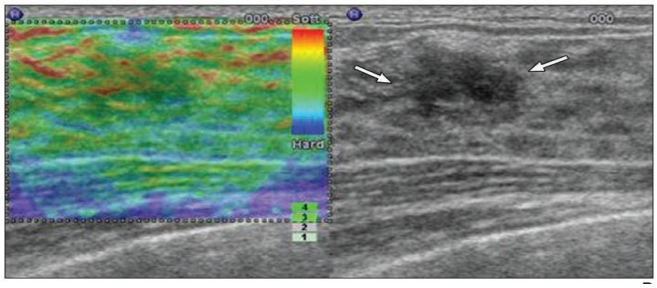

Figure 1 ill-defined hypoechoic lesion (*arrows*) with strain elastography, entire hypoechoic lesion was evenly shaded green, as was surrounding breast tissue- elasticity score of1.[4]

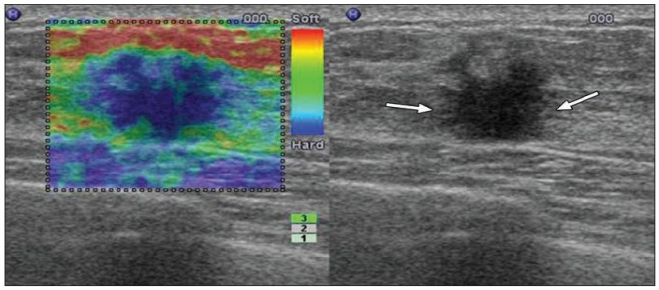

Figure 2 Ill-defined hypoechoic lesion (*arrows*) with strain elastography, both entire hypoechoic lesion and its surrounding area were blue - elasticity score of 5.[4]

Result

In our study, Of the 116 patients studied, there were 115 females (99%) and 1 male (1%). The age of the patients ranged from 17 to 87 years. 41 patients (35.3%) had benign breast lesions and 75 patients (64.7%) had malignant lesions. The percentage o f malignancy was seen to increase significantly with advancing age. Among the malignant lesions, all of them were infiltrating duct carcinoma which is the most common type of breast cancer accounting for 70-80% of all invasive carcinoma[8]except one which was found to be colloid carcinoma. Among the benign lesions, most common was fibroadenoma, accounted for 58.6% of benign lesions. Second most common was fibrocystic disease (19.5%).

The sensitivity, specificity and accuracy of our study were obtained as 85.3%, 87.8% and 86.2% respectively using the 5 level scoring system .The positive and negative predictive values of our study were 92.7 %and 76.59% respectively. The p value <0.005.

In our study, 4 patients (3.4%) had elastography score 1, 19 (16.4%) had score 2,24 (20.7%) had score 3, 52(44.8%) had score 4 and 17(14.7%) had score 5. The positive predictive values for Score 1,2,3,4 and 5 were 100 %, 89.5 %, 58.35, 90.2% and 100% respectively.

Table 1 Percentage of cases in each elastography score

SL.NO	ELASTO SCORE	NUMBER OF CASES	PERCENTAGE	POSITIVE PRED.VALUE
1	1	4	3.4	100
2	2	19	16.4	89.5
3	3	24	20.7	58.3
4	4	52	44.8	90.2
5	5	17	14.7	100

Table 2 Elastogram – HPR correlation

		HPR DIAGNOSIS		TOTAL
		Malignant	Benign	
ELASTOGRAPHY DIAGNOSIS	Malignant	64(TP)	5(FP)	69
	Benign	11(FN)	36(TN)	47
TOTAL		75	41	116

Discussion

In our study, out of 116 patients studied, there were 115 females (99%) and 1 male (1%), with a male: female ratio of 99: 1. It was comparable with the study by Timothy et al[6]

The age of the patients ranged from 17 to 87 years. The mean age was found to be 49 years. In a study conducted by Beatriz Navarro et al involving 122 patients, the age ranged from 21 to 84 years and the mean age was 46 years[9].

The sensitivity, specificity and accuracy of our study were obtained as 85.3%, 87.8% and 86.2% respectively using the 5 level scoring system. We used the cut off value between score 3 and 4. The positive and negative predictive values of our study were 92.7 % and 76.59% respectively. The p value <0.005.

In the study conducted by Itoh et al[7] involving 111 patients and using similar cut off between scores 3 and 4, they obtained a sensitivity of 86.5% , specificity of 89.8% and an accuracy of 88.3%. These results were very much comparable with our study.

Okar Atabey et al[10] evaluated 96 patients with 110 lesions by the same method and their sensitivity, specificity, positive and negative predictive values were 89%, 83%, 79% and 91 % respectively.

Limitations of our Study

It is operator dependent. Light compression should be applied without lateral or angulated movement to get an acceptable image. Strong initial compression changes the Ueno score in case of stiff lesions leading to false negative results. It is also important to have enough normal tissue surrounding the lesion for correct assessment. Elastography works best when the lesion is surrounded by normal breast tissue. Placement and sizing of elastography box is also important. Lesions that are too large or too deep may not allow good quality elastograms.

Conclusion

Strain Ultrasound elastography is a simple, rapid and non invasive technique with high sensitivity and specificity which provides information on breast lesionsin differentiating benign and malignant breast masses and with its high accuracy it can decrease the rate of unnecessary biopsies.

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