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# ROLE OF BREAST ELASTOGRAPHY IN DIFFERENTIATION IF BENIGN AND MALIGNANT LESIONS USING STRAIN RATIO

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## ABSTRACT

**Context:** In recent times, Breast Sonoelastography(SE) is being increasingly used to better characterize the breast lesion. Published studies have shown that it improved specificity of B mode ultrasound and enabled early diagnosis of breast cancer. Quantitative SE, especially with strain ratio (SR) index, improves diagnostic accuracy and decreased number of biopsies.

**Aims:** The purpose of this study was to assess the role of USG SE in the differential diagnosis of breast lesions using Strain Ratio.

**Materials and Methods:** This prospective study was conducted in the Radiology Department, V.S. General Hospital, Ahmedabad. Fifty patients diagnosed with breast lesions between Feb 2017 and July 2017 were included in this prospective study. All the patients were examined in the supine position, and the B-mode USG image was displayed alongside the SE strain image. For obtaining the SE images we used a Samsung RS80A ultrasound system with a 6.5-MHz linear probe..

**Results:** We obtained a Sensitivity of 92% and a specificity of 95.6% for SR (when a cutoff point of 2.5 was used).

**Conclusions:** SE is a fast, simple method that can complement conventional USG examination. This method has the lowest cost/efficiency ratio and it is also the most noninvasive and accessible imaging method, with an accuracy comparable to MRI.

## KEYWORDS :

### Introduction

Mammography and ultrasonography (US) are the diagnostic methods which have shown the highest sensitivity in the detection of breast lesions. However, both methods present some limitations. Mammography performed in dense breasts may often yield false-negative results[1] . US is sensitive in the detection of lesions, but specificity is poor as most solid lesions are benign[1]. In order to obtain an acceptable specificity, various characteristics of the lesions must be evaluated according to the BI-RADS criteria defined by the American College of Radiology (ACR)[2]. Unfortunately, the BI-RADS criteria generate a significant number of false positive results . This limitation leads to an increase in biopsies with a cancer "detection rate" of only 10%–30% [1]. Many biopsies are performed in benign lesions causing discomfort to the patients and increased costs.

To overcome these limitations and obtain a more accurate characterization of breast lesions, US Elastography (SE) was introduced. This technique combines US technology with the basic physical principles of SE. SE is noninvasive and assesses tissue deformability by providing information on the elasticity [3]. It is based on the premise that there are significant differences in the mechanical properties of tissues that can be detected by applying an external mechanical force [4].

SE differentiates between benign and malignant lesions on the basis of their elasticity: benign lesions have an elasticity similar to the surrounding tissue, while malignant lesions are harder than adjacent tissue.[4]

The purpose of this study was to assess the role of SE in the differentiation of benign and malignant breast lesions using strain ratio(SR) .

### Materials and Methods

This prospective study included 50 patients with palpable breast lesions, in the Radiology Department of V.S. General Hospital, Ahmedabad, from June 2016 to May 2017. Written informed consent was obtained from all the patients. A standardized data sheet was completed for all patients, with clinical information, ultrasound findings and histological analysis. The imaging findings of other methods, such as mammography and magnetic resonance imaging, were not analyzed to avoid influence on lesion characterization by US.

The patients were first examined with conventional B-mode USG. Those who were confirmed to have a breast lesion on conventional USG were then assessed with SE. The B-mode US image was displayed alongside the SE strain image to ensure that the assessment was made in the area of interest. We included in the area of interest the lesion and also the subcutaneous layers and the pectoralis muscle, without the costal cartilages.

A Samsung RS80A US system with an SE module and a 6.5 MHz linear probe was used to obtain the B-mode and SE strain images.

For all lesions the strain ratio (SR) was obtained. The average strain of the lesion was determined by selecting a region of interest (ROI) from the lesion and a corresponding ROI of the adjacent adipose tissue. The SR value was automatically calculated by the software and then displayed on a static image as the ratio of tumor-adjusted ROI and the ROI placed in the adjacent normal tissue. The diagnosis of the benign and the malignant lesions was confirmed by fine needle aspiration cytology (FNAC) (n=22) or excision biopsy (n=28).

### Results

The mean age of the 50 included patients was 47 years (standard deviation: 11 years), ranging from 20 to 75 years. Most of the patients were aged less than 40 years (72%).There were 23 (46%) benign and 27 (54%) malignant lesions. Among the benign lesions the commonest lesion was fibroadenoma(11 cases). Among the malignant lesions, the most common lesion was invasive ductal carcinoma(9 cases). Numbers of other pathologically confirmed lesions are mentioned in Table 1.

The cutoff point of SR of the lesion for this study was set at 2.5 to differentiate the lesions as benign or malignant. The lesions with SR ≥ 2.5 were considered malignant and the lesions with SR < 2.5 were considered benign. After FNAC and excision biopsy, three lesions with SR < 2.5 were found to be malignant. These lesions were Phyllodes tumor(1 case) & Invasive ductal carcinoma(2 cases). Also, two lesions with SR ≥ 2.5 turned out to be benign were Granulomatous mastitis(1 case) & Fibroadenoma(1 case).

The average SR for benign lesions was 1.17, which was significantly lower than that for malignant lesions (mean SR: 3.19). We obtained a sensitivity of 88% and a specificity of 91% for SR, when a cutoff point of 2.5 was used.

**Table 1**

| Pathological diagnosis | Number of lesions (%) |
|---|---|
| Fibroadenoma | 11(22%) |
| Cysts | 2(4%) |
| Abscess | 3(6%) |
| Galactocele | 2(4%) |
| Granulomatous Mastitis | 1(2%) |
| Fibrocystic disease | 4(8%) |
| Ductal carcinoma in situ | 3(6%) |
| Invasive ductal carcinoma | 9(18%) |
| Lobular carcinoma in situ | 4(8%) |
| Invasive lobular carcinoma | 6(12%) |
| Mucinous carcinoma | 4(8%) |
| Phyllodes tumor | 1(2%) |

**Table 2**

| Strain ratio | Malignant Lesions | Benign Lesions |
|---|---|---|
| ≥2.5 | 24 | 2 |
| <2.5 | 3 | 21 |
| Total (50) | 27 | 23 |

## Discussion

Breast elastography is being increasingly used to better characterize breast lesions in recent time. SE can differentiate between benign and malignant lesions on the basis of their firmness. The lesion's contours, dimensions, color, SR, and appearance on SE are some of the criteria used for differentiating benign from malignant lesions. In our study breast lesions were differentiated by SE using one of these criteria i.e. Strain Ratio(SR). The SR represents the relative compliance stiffness of lesions compared with surrounding tissues. Malignant lesions, which are very stiff, deform less shows higher SR as compared to benign lesions which are less firm & deform much more easily.[5,13]

In this study, when a cutoff point of 2.5 was used, we found a sensitivity of 88% and a specificity of 91%, results that are consistent with other published data on the use of real-time US SE.[6] A sensitivity of 93.3% and a specificity of 92.9% for SR, when a cutoff point of 3.67 was used, in a study where 58 breast lesions were examined[7]. Another study of 108 lesions by Thomas et al. reported sensitivity of 79.6% and specificity of 84.5%.[13]

As the SR ratio of >3 is generally considered suspicious for malignancy,[6] there is ongoing research for establishing the correct values for better differentiation of benign and malignant lesions. In our study, the mean SR for benign lesions was 1.17 and for malignant lesions it was 3.19, with the cutoff point being 2.5. In comparison, the critical SR value for diagnosing breast cancer was 3.08 in a study by Zhi et al.[8]

It is worth mentioning that SE can also have false-negative and false-positive results[9]. Not all cancers are more rigid than the healthy tissue, and the stiffness is different depending on the type of histological and clinical presentations, such as the association with necrosis, which can make them softer. In our study, 2 cases of invasive ductal carcinoma had <2.5 SR; this is probably due to necrotic areas present within the tumor. Cystic areas within the tumor like in Phyllodes tumor also contributes to low SR. Furthermore, SE has some limitations, such as the size of the lesion: the larger the lesion, the less accurate is the SE, with a higher performance on lesions smaller than 1 cm[11]. SE is less sensitive than standard USG for nonfocal anomalies[12]. SE is also of limited uefulness in very dense fibrous parenchyma and in the case of hematomas or breast implants.[11]

It is important to emphasize that SE is a complementary tool for US examination, and should not be used as a single method; the final diagnosis should always be done in combination with the morphological characteristics. In addition, in patients with lesions of intermediate suspicion in the conventional US, with a benign histological result after the percutaneous biopsy, the SE findings could help in the radio-pathological correlation.

In the clinical scenario SE is useful for deciding whether to follow-up patients with imaging or to intervene.[7,10]

## Conclusion

Breast SE is a very simple and rapid method that can improve the sensitivity and specificity of USG, especially when dealing with BI-RADS 3 or 4 lesions. Conventional USG combined with SE is a rapid technique, with the lowest cost/efficiency ratio of all the modalities; it is the most noninvasive and accessible imaging method, with accuracy comparable with MRI, and can decrease the rate of unnecessary biopsies.

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