

STRAIN ELASTOGRAPHIC EVALUATION OF CARCINOMA BREAST WITH PATHOLOGICAL CORRELATION.

Radiodiagnosis

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ABSTRACT

Aim & Objective: To evaluate the diagnostic accuracy of ultrasound strain elastography for diagnosis of malignant breast lesions.

Material and methods: A cross sectional prospective study was carried out in the Department of Radiology, AVBRH Sawangi (meghe) wardha from April 2016 till November 2017. Eighty patients were selected according to predefined inclusion and exclusion criteria. Arietta 70S ultrasound machine was used for evaluation of patients. Pathological correlation was done by FNAC/ Biopsy/Histopathology.

Results: 98.75% patients (n=79) were females; 1.25% patient (n=1) was male. Sensitivity, specificity and diagnostic accuracy of ultrasound strain elastography was calculated to 93.6%, 50%, and 92.5% respectively.

Conclusion: ultrasound strain elastography is an accurate, reliable and non invasive technique in the assessment of malignant breast lesions.

KEYWORDS

breast lumps, ultrasound, strain elastography, malignant breast lesions

Introduction

Breast cancer is the most common cancer among women worldwide with nearly 1.7 million cases diagnosed in the year 2012 [1] Breast cancer has ranked number one cancer among Indian females with age adjusted rate as high as 25.8 per 1, 00, 000 women and mortality of 12.7 per 100,000 women. Breast cancer projection for India during time periods of 2020 suggests the number to go as high as 17, 97,900. Young age has been found as a major risk factor for breast cancer in Indian women. [2] Live events constitute important risk factors for breast cancer include early menarche, late natural menopause, not bearing children and first pregnancy over age of 30 as they all increase lifetime exposure to Estrogen and Progesterone and risk of breast cancer. [1] Breast cancer is the most-common cancer among women worldwide and over one-third of all cases diagnosed annually are nonpalpable at diagnosis. Evolving sonographic technology with high-frequency transducers and evolving knowledge has established breast US in the past few years as an important imaging procedure to supplement mammography screening [3] Ultrasound elastography was introduced to obtain a more accurate characterization of breast lesions. By offering additional information about tissue stiffness, real-time tissue elastography can improve visualisation of tumours and facilitate differentiation between benign and malignant disease. The rationale of carrying out this study was to find the diagnostic accuracy of ultrasound elastography for malignant breast lesions using FNAC/biopsy and histopathology as the gold standards.

MATERIALS AND METHODS

Collection of Data

This prospective study was conducted with approval by the Institutional Legal Ethical Committee. A total of 80 patients referred for ultrasound were analyzed from April 2016 till November 2017 with clinical diagnosis of carcinoma breast. Real time ultrasound followed by strain elastography was performed with Arietta 70S Aloka Hitachi machine with 5-18 MHz linear transducer.

Conventional Sonographic Examination

Each lesion was assessed with ultrasound descriptors i.e. shape, orientation, margin, lesion boundary, echo texture, posterior acoustic features. Axilla was examined for lymph node involvement.

Sonographic Elastography

After optimum B mode image was obtained, elastograms were acquired taking due care that the lesion remained in the imaging plane. As precompression is a critical factor to obtain images adequate for analysis, due care was taken to apply minimal precompression by using a liberal amount of coupling gel and by ensuring that the subcutaneous fat in the elastogram was soft.

The images from conventional sonography and sonographic elastography were displayed side by side as a single image. A Region of Interest (ROI) box was set to include the area from the subcutaneous fat layer to the superficial portion of the pectoralis muscle and to focus on the target mass, taking due care that the lesion occupied no more than a third of the ROI box.

Interpretation Criteria for Sonographic Elastography

Three interpretation criteria i.e. elastography score, strain ratio, and elasticity imaging/B mode imaging ratio were recorded for evaluation of sonographic elastography.

Tsukuba scoring system

A score of 1 indicated even strain for the entire hypoechoic lesion (i.e., the entire lesion was evenly shaded in green). A score of 2 means strain in most of the hypoechoic lesion, with some areas of no strain (i.e., the hypoechoic lesion had a mosaic pattern of green and blue). A score of 3 implies that strain at the periphery of the hypoechoic lesion, with sparing of the center of the lesion (i.e., the peripheral part of lesion was green, and the central part was blue). A score of 4 shows no strain in the entire hypoechoic lesion (i.e., the entire lesion was blue, but its surrounding area was not included). A score of 5 indicated no strain in the entire hypoechoic lesion or in the surrounding area (i.e., both the entire hypoechoic lesion and its surrounding area were blue). BGR represents typical artifactual three layered aspect (blue-green-red) encountered with cystic lesions. In strain patterns, score 1, 2 and 3 emphasized benign features whereas masses with scores of 4 and 5 were considered as malignant. [4]

Strain Ratio Measurement

A semi quantitative method of lesion assessment, termed as strain ratio (SR) measurement, has also been developed. Calculation of the SR value is based on determining the average strain measured in a lesion and comparing it to the average strain of a similar area of fatty tissue in the adjacent breast tissue. Using proprietary software, the average strain of the lesion is determined by selecting a region of interest (ROI) encompassing the lesion; the value of strain ratio increases as a function of the relative stiffness of the target lesion. As the Strain Ratio increases, the likelihood of invasive breast cancer is also higher. [5]

Ratio of elasticity imaging / B-Mode Imaging

The size criterion denotes the difference in the measurement of the longest diameter on the corresponding B-mode image and the elastogram. Structures those are less compressible than surrounding tissues measure larger on the elastogram than they do on the corresponding B-mode image, resulting in size discordance. Therefore, cancers will be larger on the elastogram than on the conventional US image [6] In our study due to technical causes like very large masses it was not possible to take a correct ratio in all patients as many patients present in advance stage in our hospital. We have measured this ratio in 56 cases.

Pathological Diagnosis

In all 80 cases included in the study diagnosis was established by FNAC/biopsy, or histopathology.

RESULTS

As mentioned earlier a total of 80 patients were included in the study, 79 of them were female patients. One male patient was included in study. Their ages ranged from 21 to 70 years with a mean age of 50 years. Out of 80, 76 females (95%) were married and 03 females (3.75%) were unmarried. Breast feeding history was positive in all married patients. Eight patients (10%) had bilateral palpable breast lesions while the rest had single palpable breast lump. Multifocal breast cancer (lump in more than one quadrant) was seen in 4 patients. Axillary lymph nodes were positive in 72 patients (90% %). Out of these, 60(75%) were malignant looking on ultrasonographic examination with loss of fatty hilum and abnormal morphology. Rest of 12 patients had the fatty hilum and normal morphology was intact on B mode ultrasound.

Out of a total of 80 patients, 73 were true positives when correlated with histopathological results while 05 were false negatives. 1 case was found to be false positive and 1 case was found to be true negative. Out of these 5, 2 were medullary carcinoma, 2 ductal carcinoma and 1 was lobular carcinoma.

Sensitivity, specificity and diagnostic accuracy of ultrasound strain elastography was calculated to be 93.6 %, 50 %, and 92.5% respectively.

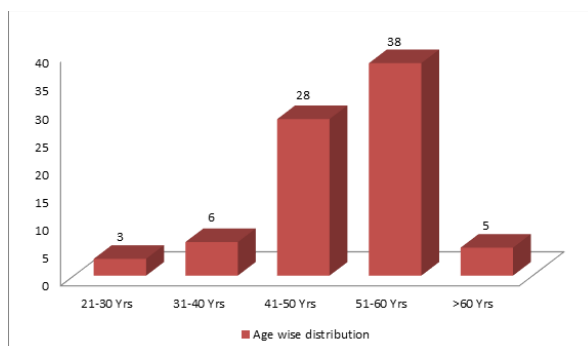


Table 2: Sex wise distribution of patients

Female	79	98.75%
Male	1	1.25%

Table 3: Bilateral breast masses

Pathology	No. of patients	Percentage
Carcinoma	2	2.5%
Carcinoma in one breast and fibroadenoma in other	6	7.5%

Sex wise distribution

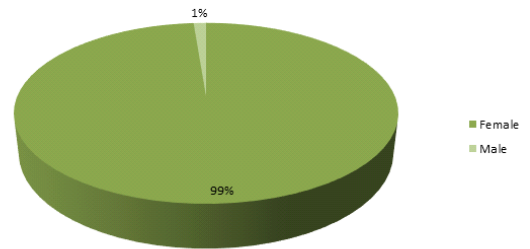


Table 4: Multifocal breast cancer

4

Table 5: Strain ratio

value	No. of patients	Percentage
4-10	28	35%
10-20	14	17.5%
20-30	10	12.5%
30-40	11	13.75%
40-50	5	6.25%
50-60	2	2.5%
>60	10	12.5%

Strain Ratio

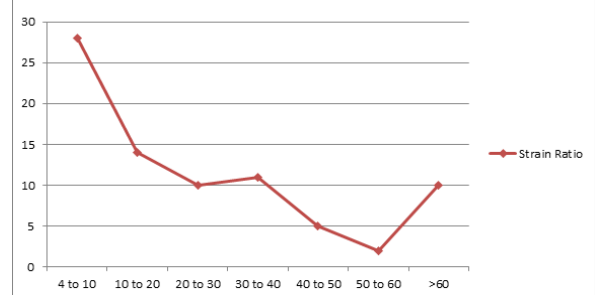


Table 6: Tsukuba Elastography score on colour scale.

Score	Number of Patients	Percentage
Score 1	Nil	
Score 2	Nil	
Score 3	Nil	
Score 4	2	2.5%
Score 5	78	97.5%

Table 7: Elasticity imaging / B-Mode Imaging ratio.

Measured in	More than 1.1	No. of patients	Percentage
56		56	100%

Table 8: Pathological correlation

Histological type	Number of Patients	Percentage
Invasive ductal carcinoma	71	88.75%
Invasive lobular carcinoma	2	2.5%
Lobular and invasive ductal carcinoma	1	1.25%
Undifferentiated carcinoma	1	1.25%
Medullary carcinoma	2	2.5%
Invasive ductal carcinoma with areas of metaplastic squamous cell carcinoma	1	1.25%
Malignant skin adnexal tumor of sweat gland carcinoma	1	1.25%
Inflammatory ductal carcinoma	1	1.25%

Discussion:-

Over the past decade, research has been ongoing to discover the potential of elastography to further improve the accuracy of conventional sonography. Various criteria have been studied to analyse elastography images and thereby characterize lesions based on their strain imaging characteristics. It is essential that criteria used for evaluation be accurate, while at the same time simple to perform so as to enable their incorporation into routine clinical practice.

Itoh et al conducted a landmark study wherein a new 5 point scoring system was suggested. This Tsukuba elasticity score has yielded reproducible results in multiple studies [4, 7, 8,]. In our study 97.5% patients had a score of 5 and 2.5% had score of 4 on elastography colour scale.

Strain ratio was introduced in an attempt to Semiquantitative the measurements and was found to provide an objective quantification of strain within a lesion compared to that of the surrounding normal tissue [5]. Yerli et al presented a study of 78 lesions to evaluate if the combination of elastography score and strain ratio was useful in the differentiation of benign from malignant lesions [9]. Thomas A et al concluded that calculation of strain ratio contributes to standardization of sonoelastography with high sensitivity and allows significant differentiation of benign and malignant breast lesions. [10] Jung et al evaluated size ratio, strain ratio and elastography score and concluded that strain ratio showed the best diagnostic performance among these criteria. [11] In our study, majority (35%) of cases had strain ratio between 4-10.

Work by Barr et al., and others has proved that benign and malignant lesions may be distinguished by differences in the size of the lesion on B mode and elastography images. [12] The semi-quantitative assessment with strain ratio and width ratio in elastography were the most useful parameters in differentiating between benign and malignant breast lesions. Cut-off point values for width ratio of more than 1.1 and strain ratio of more than 5.6 showed a high predictive value of malignancy with specificities of 84% and 76%, respectively ($p < 0.001$). [13] Joseph R Grajo et al concluded that the elasticity imaging/B-mode ratio on strain elastography is related to the tumor grade. [14] In our study elasticity ratio/B mode ratio was more than 1.1 in all cases where it was measured.

In the current study for malignant breast lesions, it was seen that mean age of patients presenting with palpable breast lesion 50yrs. This was similar to one study conducted by Itoh et al, [4] mean age was calculated to be 49 years. According to Zhao et al, mean age was 50 years in their population. [15]

Diagnostic accuracy of ultrasound strain elastography in current study was calculated to be 92.5%. It is comparable to the studies previously conducted internationally. According to a study conducted by Hui Zhi et al in Japan [16], diagnostic accuracy of ultrasound strain elastography was calculated to be 88.2%. Adile Balcık et al showed that accuracy of elastography in distinguishing benign from malignant breast masses was 85.2%. [17]

Xia Gong et al concluded that the accuracy of elastography in the diagnosis of breast lesion was 89.89%. [18]

Limitation

One of the main limitations of this study is that the acquisition of elastograms as well as analysis is observer dependent. The magnitude of initial compression could affect the elasticity map. Hence inter and intraobserver variability is another factor which needs to be studied.

Conclusion

It can be concluded that ultrasound strain elastography is quite accurate in identifying malignant breast lesions with a high true positive rate. It can thus reliably be used to accurately identify malignant breast lesions. Such lesions can then be biopsied for further confirmation.

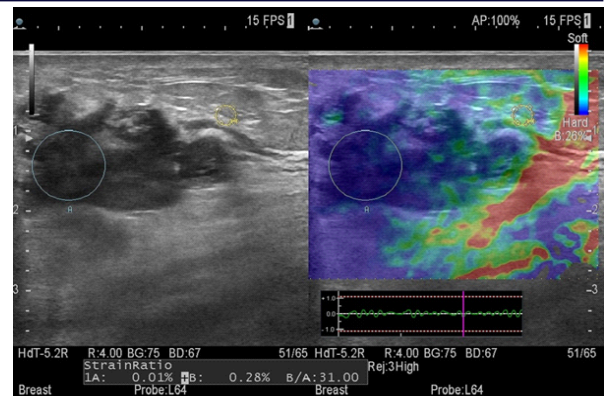


Fig 1: Spiculated hypoechoic breast mass showing dark blue colour on elastography scale (score 5) showing strain ratio of 31 indicating malignancy.

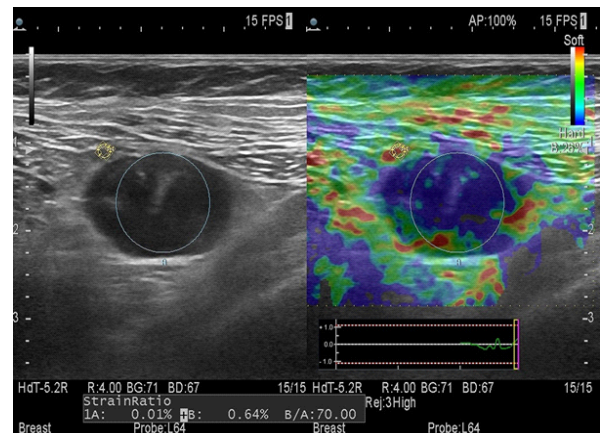


Fig 2: Roundish metastatic axillary lymph node showing mostly stiff tissue within (dark blue) and strain ratio of 70.



Fig 3a] Width of B mode image of ca. breast measuring 20.3 mm

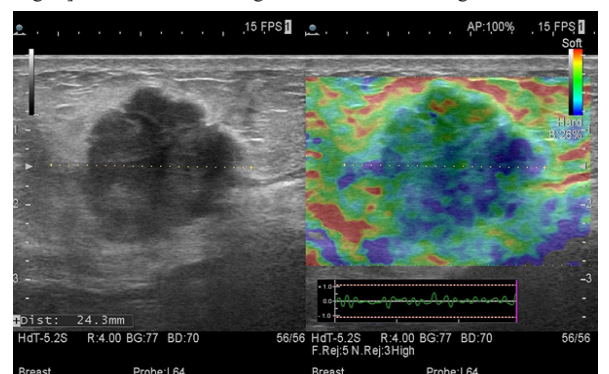


Fig 3b: Width on elastogram is 24.3 mm. Elasticity imaging /B mode ratio is 1.19 indicating high grade carcinoma.

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