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ROLE OF MAMMOSONOGRAPHY AND ELASTOGRAPHY IN EVALUATION OF BREAST MASSES

Radiology

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ABSTRACT

OBJECTIVE: To evaluate the new method of sonoelastography which could improve the differentiation and characterization of benign and malignant breast lesions in comparison with the Mammosonography.

METHODS AND MATERIALS: From January 2016 and December-2017, 50 consecutive patients were diagnosed as benign or malignant by mammosonography and further analyzed with sonoelastography. The diagnostic results were evaluated with histopathologic findings. The sensitivity, specificity, positive and negative predictive values were calculated for each modality and the combination of sonoelastography and mammosonography.

RESULT: Of 50 lesions, 17 were histologically malignant, and 33 were benign. On the examination of benign and malignant lesions, the shape of the mass was described as oval or round (57.5% and 70.5%), margin as circumscribed (69.6% and 58.8%). Fibroadenoma was the most common benign lesion and ductal carcinoma was the most common malignant lesion noted in our study. The sensitivity, specificity of mammosonography was 69.7%, 70.59%, and sensitivity, specificity of with sonoelastography was 81.82%, 88.24% in our study.

CONCLUSION: Using elastography, a more accurate preoperative diagnosis can be made, thereby, obviating the need for aggressive biopsy in cases of benign lesions and improve the number of positive breast biopsies.

KEYWORDS

Breast mass; Sonoelastography, Mammosonography

INTRODUCTION

Breast cancer is the most common neoplasm in the female population, comprising about 16% of all tumors affecting women and the second-most common cause of cancer-related mortality.[1] Recent research on service screening programs suggests that participation in modern, organized service screening may well reduce the risk of death caused by breast cancer by 40% or more.[2] That is, early, sensitive and accurate diagnosis signifies a better prognosis.

Non- invasive diagnosis of breast cancer remains a stimulating task to the clinician.

Mammography and sonography are currently the most sensitive modalities for detecting breast cancer. This especially comprises the acquisition of two basic views, namely, craniocaudal and mediolateral oblique views. Supplementary views may be acquired whenever the presence of a suspected lesion is detected.[3]In practice, sonography is chosen as the primary workup tool for young females. However, the sonographic findings should be documented in two orthogonal planes longitudinal and cross-sectional) to allow the visualization of all their characteristics.[4]

Because of various limitations of mammography and sonography and the great desire of not missing a malignant lesion in the early stage of the disease lead to the aggressive biopsy, but only 10%-30% biopsy results are found to be malignant.[5,6] This means that 70%-90% of breast biopsies are performed for benign diseases leading to unnecessary patient anxiety in addition to increasing burden of costs to the patient. Therefore, it clearly denotes that there is a great need for the development of additional reliable methods in order to complement the existing diagnostic procedures to avoid unnecessary biopsy.

In the early 1990s, a technique called elastography was described by Ophir *et al*.,[7] Elastography is a procedure of diagnostic imaging, similar to the ultrasound imaging, which helps doctors distinguish between malignant tumors and normal body tissue. For the detection of the presence of cancerous tumors in the breast & other parts of the body, elastography has been used on an outpatient patient basis since the 1990s.

Elastography is effective because it can clearly distinguish between elastic tissue and stiff cancerous lumps. Itoh *et al*.[8] first used the US elastography for the detection of breast lesions and a 5-point scoring system were proposed. When imaging scans reveal darker, harder spots among a lighter, flexible background, it is most likely to indicate a tumor. Images can usually be viewed in real-time on a computer monitor. Advances in the ultrasonic technology are making it possible for doctors to make confident diagnoses without the need for invasive tissue biopsies. The goal of this study is to compare mammo sonography and sonoelastography to differentiate and characterize benign & malignant breast lesion.

METHODS AND MATERIALS

This prospective study was conducted on 50 patients with palpable breast lumps, who were admitted in the Department of Radiology, GCRI, Asarwa, Ahmedabad between January 2016 and December-2017. The study was approved by the Ethics Committee of the Hospital and informed consent was taken from each patient. Patients under 30 years of age or with a present or past history of radiotherapy or chemotherapy were excluded from the study.

All these cases were subjected to a thorough clinical examination besides sonography, elastography, and pathological diagnosis. The resected tissues in patients undergoing surgery were sent for histopathological examination for the confirmation of the diagnosis.

Conventional USG of the breast lump

Conventional US (ultrasonography) images of the breast were primarily taken and in the course of this conventional examination, obtaining B-mode images were given priority. Subsequently, in order to evaluate the vascularity of the mass, which was one of the BI-RADS criteria for US, color Doppler US was performed in the patients with breast lumps. Lesion size was defined as the diameter of the hypoechoic lesion at B-mode US.

The classification of mammographic findings comprises seven categories directly related to the approach recommendations, as follows: [9]

- **Category 0** – Currently utilized in cases whose results depend upon comparison with the previous results or a recall for technical error. Such a category may also be utilized in those cases requiring further investigation by means of US or magnetic resonance imaging (MRI), for diagnosis clarification.
- **Category 1** – Refers to images negative for malignancy, with no evidence of significant focal radiographic alterations.
- **Category 2** – Utilized in situations where the mammographic findings are characteristically benign.
- **Category 3** – Mammographic findings with the high probability of benignity, with positive predictive value (PPV) ≥ 98%.
- **Category 4** – Lesions presenting the probability of malignancy, but with no typical characteristic of carcinoma.
- **Subcategory 4a** – Lesions with intermediate malignancy suspicion, with the indication for biopsy for histological

correlation.

- **Subcategory 4b** – Amorphous calcifications, nodules with partially circumscribed and partially indistinct contours.
- **Subcategory 4c** – Lesions under moderate suspicion of malignancy, with the expectation of histological result positive for malignancy.
- **Category 5** – Lesions whose malignancy probability is high (PPV > 95%).
- **Category 6** – Lesions whose malignancy has already been previously histopathologically confirmed and that have not been submitted to any definitive treatment yet.

Elastography of the breast lump

Next stage was to obtain elasticity images as motion images on the same day. It was performed on the patient in supine position, and with the stabilizer-equipped probe oriented perpendicular to the chest wall. The probe was applied to the breast and was moved slightly inferior and superior, and normal breast tissue was included to obtain the elasticity images. The probe was applied with just a light pressure in order to obtain the images, which were appropriate for analysis and a higher level of pressure was simply passed up.

Before and after soft compression of tissues, an image was taken in which color coding was used to evaluate deformation. Moderate vertical compressions were applied with the probe, three to five times, over the lump and elasticity images were displayed on a computer monitor. The lump was compressed manually.

Color coding

- Red - Tissues with the greatest strain (softest component).
- Blue - Tissues with no strain (hardest component).
- Green - Tissues with average strain.

The color pattern of images was evaluated for classification of elasticity images both in the hypoechoic lesion [i.e. the area that was hypoechoic or isoechoic relative to the subcutaneous fat (except for echogenic halo) on B-mode images] and in the surrounding breast tissue. Each image was assigned an elasticity score on a five-point scale based on the overall pattern.

- A score of 1 indicates even strain for the entire hypoechoic lesion (i.e., the entire lesion was evenly shaded in green).
- A score of 2 indicates 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 indicates strain at the periphery of the hypoechoic lesion, with sparing of the center of the lesion (ice, the peripheral part of the lesion was green, and the central part was blue).
- A score of 4 indicates 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 indicates 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).

Statistical Analysis

Statistical analysis was performed for all variables with the McNemar test and the Pearson X^2 test. P <0.05 was considered statistically significant. All the statistical analyses in this study were carried out with SPSS for Windows software (SPSS Inc, Chicago, IL).

RESULT

50 breast lesions were identified in female patients by means of mammography with US and sonoelastography (Figure-1). The histological result was obtained for all patients, with the identification of 33 benign and 17 malignant lesions measuring, on average, 14.7 ± 9.8 mm and 19.3 ± 7.6 mm, respectively. In order to quantify the lesions detected by the imaging methods under study, the frequencies were calculated according to their classification.

Out of 50 patients, the maximum number of lesions was seen in the right breast accounting for 58% and none of the lesion was seen bilaterally. Benign lesions were common in the right breast accounting for 61.2% of total lesions. Malignant lesions were in the left breast accounting for 23.8 % of cases. Out of the 50 cases enrolled in the study, 33(66%) were benign breast lesions and 17(34%) were malignant lesions.

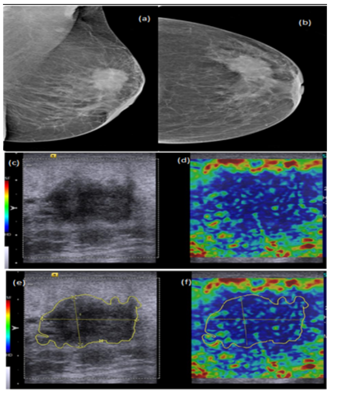

Figure 1: Mammography (a and b) Shows ill defined spiculated mass lesion in UOQ. On USG (c &e) ill defined hypoechoic mass lesion is noted (BIRAD-V). On Elastography (d& f) same lesion appears stiff and extends outside the boundary showing surrounding infiltration. (Score 5)

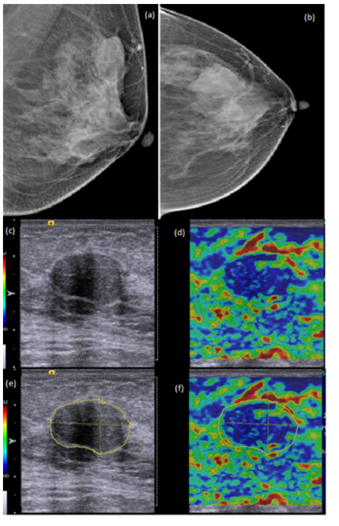

Figure-2: This patient on mammography (a & b) Shows well defined lesion in UOQ. On USG (c & e) well defined hypoechoic lesion, suggestive of fibroadenoma (BIRAD-2). On Elastography (d&f) same lesion shows loss of elasticity at the center but intermediate pattern at the periphery of the lesion.(Score 3)

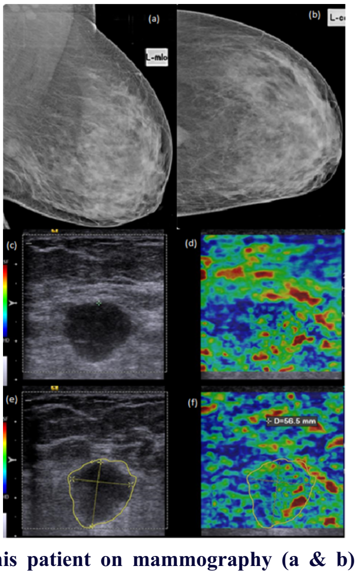

Figure 3: This patient on mammography (a & b) Shows well defined lesion in deep retroareolar region. On USG (c & e) well defined hypoechoic lesion, s/o benign lesion appears more likely (BIRAD III). On Elastography (d & f) same lesion appears well deformable. (Score 2)

Fibroadenoma was the most common benign breast lesion accounting for 27.2% of total benign lesions followed by inflammatory lesions accounting for 15.1% of total benign lesions. Of the malignant lesions, intraductal carcinoma was the most common malignant lesion contributing to 47.05 % of cases followed by invasive ductal carcinoma accounting for 17.6% of total malignant lesions. The only single case of Invasive Lobular carcinoma was seen in our study accounting for 5.8% of malignant lesions. In 50 patients, Oval shaped lesions were seen in 22 cases accounting for 44%, and irregular lesions were seen in 20 cases accounting for 40% and round lesions were seen in 8 cases accounting for 16%. Oval shaped lesions were most common benign lesions accounting for 57.5% and irregularly shaped lesions were most commonly malignant accounting for 70.5% cases. Most (64%) of the breast lesions were hypoechoic and malignancy was most commonly seen in lesions with hypoechoic echo pattern (76.4%). Out of 50 patients, circumscribed margins were seen in 33 lesions accounting for 66%, indistinct margins in 7 cases accounting for 14%, microlobulated margins in 5 lesions accounting for 10%, and spiculated margins in 3 cases accounting for 6%.

Of 50 patients, no calcifications were seen in 40% of cases, microcalcifications were seen in 61.53% of cases of malignancy, macrocalcifications were seen in 58.82% of cases Benign lesions.

Enlarged axillary lymphnodes were seen in 9 malignant lesions accounting for 52.9%. Most of the benign lesions did not show enlarged axillary lymphnodes accounting for 91.3%. In our study with 50 patients, mammography was done for 40 patients aged above 40 years.

Mammography with US identified 14 lesions classified as BI-RADS 3; four lesions classified as BI-RADS 4a; Nine lesions as BI-RADS 4b; and seven lesions as BI-RADS 4c. Sonoelastography on its turn detected 13 lesions quantified as level 2; 16 lesion as level 3; and 12 lesions as level 4 and 9 lesions as level 5. With the objective of identifying the number of benign and malignant lesions correctly diagnosed by the imaging methods, with basis on the histological results, the frequencies were calculated Thus, in order to better understand the diagnostic accuracy of the imaging methods under study, their respective sensitivities, specificities, PPVs and NPVs were calculated **(Table 1).**

Table 1 Sensitivity, specificity, PPV and NPV for the imaging methods under study.

	Mammography + Ultrasonography	Elastography
Sensitivity	69.70%	81.82%
Specificity	70.59%	88.24%
PPV	82.84%	93.10%
NPV	54.55%	71.43%
Accuracy	70.00%	84.00%
P value	**0.0021**	**<0.0001**

DISCUSSION

Breast cancer is the most common malignancy among women worldwide.1 In the absence of a known preventable cause of breast cancer, the single most important factor in reducing death from breast cancer and the extent of treatment required is early detection through screening. To identify and detect lesions in the breast ultrasound elastography is now a days used as new screening modality. It can provide the investigator with another characteristic, stiffness, of the lesion. Through lightly compressing the target lesion, UE can non invasively determine strain and elasticity distributions inside objects scanned and map the elasticity of the lesion by using a standardized color scale, with blue indicating regions with low elasticity (harder tissue areas) and red indicating regions with high elasticity (soft tissue).

The mean age of women with benign lesions in our study was 43.78 and the malignant lesions were 47.4 years which were lower to the study conducted by Dobruch- Sobczak K et al.[10] in which the mean age of women with malignant neoplasms was 55.07 years.

In our study with 50 patients, 61.53% micro calcifications were seen in malignancy. Our results are similar to the study conducted by Sadowsky et al. [11] which concluded that presence of micro calcifications on ultrasound, serves as a useful prediction to evaluate the degree of malignancy for patients with invasive breast carcinoma.

Our study showed the very low incidence of breast cancer in young women less than 30 years of age and this is consistent with the study conducted by Ha R et al.[12], which concluded that low incidence of breast cancer in women less than 30 years of age.

In our study with 50 patients, 33 lesions were benign and 17 were malignant confirmed by histopathology. In all 19 (57.5%) benign lesions were Oval in shape and 23 (69.6%) of benign lesions had circumscribed margin. This is consistent with the study conducted by Ha R et al., which proved the benign nature of lesions as an oval shape, circumscribed margins, and parallel orientation.[12] These findings support that Ultrasound features can distinguish benign lesions from malignancy and only follow-up can be performed rather than invasive needle biopsy.

Itoh A et al., used ultrasound elastography to detect breast lesions and proposed 5 point Tsukuba scoring system. They concluded that breast elastography has higher sensitivity than conventional ultrasonography. The authors accomplished that Mammography, Sonography, and elastography achieved a sensitivity and specificity 72.4%, 71.2%, 70.1% and 87.1%, 73.2%, 95.7% respectively.[13] In our study ultrasound, Mammosonography and Elastography had a sensitivity of 69.7%, 81.82%, and specificity of 70.59%, 88.24% and positive predictive value of 94.2% and diagnostic accuracy of 89.7%. which concluded that addition of elastographic findings to the BIRADS lexicon improve the diagnostic efficacy of ultrasound in the characterization of breast masses.[13]

Beside own limitations of elastography, we recognize some limitations of our study. These include the fact that the sample size is relatively small, and patients with a present or past history of radiotherapy or chemotherapy are excluded from the study. Patients who had a history of radiotherapy or chemotherapy did not undergo elastography or US which could have resulted in relatively fewer malignant masses in our study.

CONCLUSION

It was concluded that US elastography is more sensitive, specific, and accurate than mammosonography. Using sonoelastography, a more accurate preoperative diagnosis can be made, thereby, obviating the need for aggressive biopsy in cases of benign lesions.

REFERENCES

1. Jemal A, Murray T, Ward E, Samuels A, Tiwari RC, Ghafoor A, et al. Cancer statistics, 2005. CA Cancer J Clin 2005;55:10-30.
2. Tabar L, Yen MF, Vitak B, Chen HH, Smith RA, Duffy SW. Mammography service screening and mortality in breast cancer patients: 20-year follow-up before and after introduction of screening. Lancet 2003;361:1405-10
3. Kopans DB. Imagem da mama. 2ª ed. Rio de Janeiro: Medsi; 2000.
4. Fleury EFC, Rinaldi JF, Piato S, et al. Apresentação das lesões mamárias císticas à ultra-sonografia utilizando a elastografia. Radiol Bras. 2008;41:167–72.
5. Duncan JL 3 rd , Cederbom GJ, Champaign JL, Smetherman DH, King TA, Farr GH, et al. Benign diagnosis by image-guided core-needle breast biopsy. Am Surg 2000;66:5-9.
6. Chiou SY, Chou YH, Chiou HJ, Wang HK, Tiu CM, Tseng LM, et al. Sonographic features of nonpalpable breast cancer: A study based on ultrasound-guided wire-localized surgical biopsies. Ultrasound Med Biol 2006;32:1299-306.
7. Ophir J, Cespedes I, Ponnekanti H, Yazdi Y, Li X. Elastography: A quantitative method for imaging the elasticity of biological tissues. Ultrason Imaging 1991;13:111-34.
8. Itoh A, Ueno E, Tohno E, Kamma H, Takahashi H, Shiina T, et al. Breast disease: Clinical application of US elastography for diagnosis. Radiology 2006;239:341-50.
9. Camps J, Sentis C. Elastosonografia mamaria. Rev Chil Radiol. 2008;14:122–7.
10. Dobruch-Sobczak K. The differentiation of the character of solid lesions in the breast in the compression sonoelastography. Part I and II. J Ultrason. 2013;13(54):353-5.
11. Sadowsky N, Kopans DB. Breast cancer. RadiolClin North Am. 1983;21(1):51-65
12. Ha R, Kim H, Mango V, Wynn R, Comstock C. Ultrasonographic features and clinical implications of benign palpable breast lesions in young women. Ultrasonography. 2015;34(1):66-70.
13. Zhi H, Ou B, Luo BM, Feng X, Wen YL, Yang HY. Comparison of ultrasound elastography, mammography, and sonography in the diagnosis of solid breast lesions. Journal of ultrasound in medicine. 2007;26(6):807-15.