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Analyzing the Role of Spectral Indices in Differentiating Benign and Malignant Breast Lesions

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Abstract
Background: *Breast cancer being the most commonly diagnosed malignancy among females, there is a significant role for screening techniques. Mammography and ultrasonography plays a major role in screening and diagnosing lesions of the breast. The number and pattern of vascularization within the lesion helps in differentiating benign and malignant lesions. The present study aims to evaluate the spectral indices in breast pathology*
Materials and Methods: *Designed as diagnostic test evaluation, among the patients with palpable breast lesions who came for Mammography in department of Radiodiagnosis. Fifty patients were evaluated and the findings were plotted to find out the range of Resistive index (R I), Pulsatility ratio (P I) and Systolic Diastolic ratio (S/D).*
Results: *RI Values of benign lesions with vascularity was in the range 0.5- to 0.69 and that of malignant lesions of 0.6 to 0. 89. The PI values of malignant lesions were also found to be higher being 1.32 to 1.56 when compared to benign 0.6-1.2. Similarly S/D ratio of benign were 2-3.5 while those of malignant were in the range of 3.5-5.3.*
Conclusion: *The findings showed that higher RI, PI, and S/D value were more in favour of malignancy*
Keyword: *Breast, Doppler, Spectral pattern, Resistive Index, Pulsatility Index and Systolic/ Diastolic ratio.*

Introduction

Characterisation of breast lesions into benign and malignant is always a matter of concern, Breast Ultrasound plays a role in women with dense breast and in differentiating cystic and solid lesions. Colour Doppler evaluation of the lesions assist in further characterization into benign and malignant.

The principle of doppler imaging is based on Tumor angiogenesis and gradient of vascularity of the mass. Vascularity is important in elucidating tumor growth because a tumor cannot grow more than 1-2 mm without recruitment of new capillary blood vessels. It was shown that many malignant tumours have increased blood flow with high velocity toward the periphery of lesion[1]. Colour doppler signal in an otherwise benign lesion was

considered as an indication for biopsy, as per Cosgrove et al[2].

Angiogenesis factors help in enabling the malignant cell to grow beyond a particular point. These factors stimulate the formation of new vessels (tumor neovascularity) to supply nutrients to tumor. The formation of neovascularity is typically most pronounced in the periphery of the tumor mass.

There is a complex interrelationship among angiogenesis, hyaluronic acid, and certain enzymes,[3] Presence of higher-than normal amounts of hyaluronic acid facilitates the growth and spread of the tumor in several ways. It is extremely hydrated, facilitating the passage of nutrients into and wastes from tumor cells until the tumor reaches the critical size at which passive diffusion is no longer enough. It promote angiogenesis and assist in tumour Third, it offers a path of low resistance for growth and motility of tumor cells.

Detecting and characterizing breast cancer neovascularity is the goal of Doppler assessment of breast lesions. Blocking the development of these vessels is the goal of angiogenesis inhibitors. Lesions with abundant flow on Doppler studies was found to be associated with lymph node and hematogenous metastases more often than those that do not[4].

Thus, the most significant role for Doppler in breast was to determine the patients that may benefit from antiangiogenesis therapy and to monitor the success of such treatments.

Materials and Methods

A cross sectional study was conducted in fifty patients with palpable breast lesion, who came for mammography in Dept. Radiodiagnosis, Medical College Thrissur, during the period September 2010 to November 2011. Those patients with sonographically detectable lesions were included in further Doppler studies. Patients who didn't give consent and those with recurrences/distant metastasis were excluded from study

Study Instrument

Mammogram were taken using LORAD, A HOLOGIC COMPANY,M-IV and sonographic examinations were done with PHILIPS, EN VISOR HD, VERSION C. High frequency linear probe was used for the sonomammography

Study Procedure and Analysis

After obtaining the ethical clearance from the Human Ethical Committee of the institution the study was commenced. Mammography and correlative breast ultrasound with colour doppler was performed in fifty patients and the findings were analysed statistically. Findings were then compared with histopathology, which was considered as the Gold standard.

Data Collection and Analysis

Details of each patient was collected in a proforma and entered in MS Excel. All the data coded and entered in MS Excel, and analysed using SPSS 16. The range of spectral indices was calculated and a cutoff point was calculated by plotting ROC curve

Results

By combined mammography and sonographic evaluation it was seen that 25 cases had benign morphology and 25 had malignant morphology. 7 out of 25 cases with benign morphology proved to be malignant on histology.

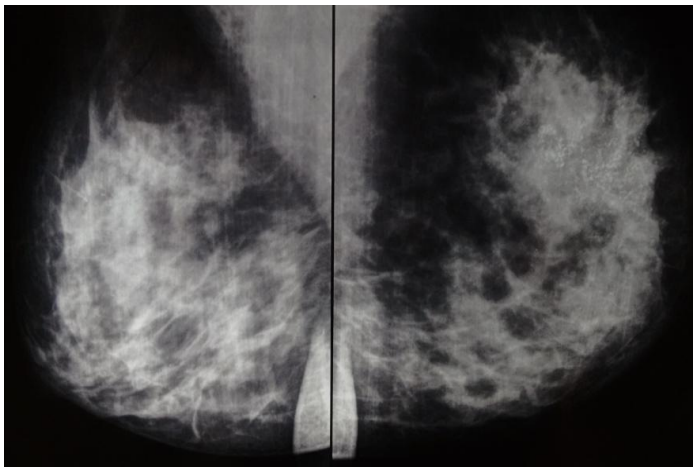

Figure 1: Mediolateral oblique view of mammogram showing regional pleomorphic calcification in left breast lateral aspect

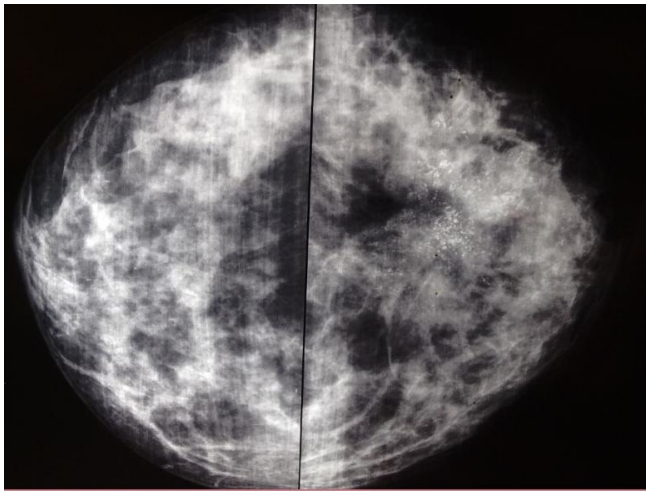

Figure 2: Craniocaudal view of same patient showing regional pleomorphic calcification in left breast outer aspect

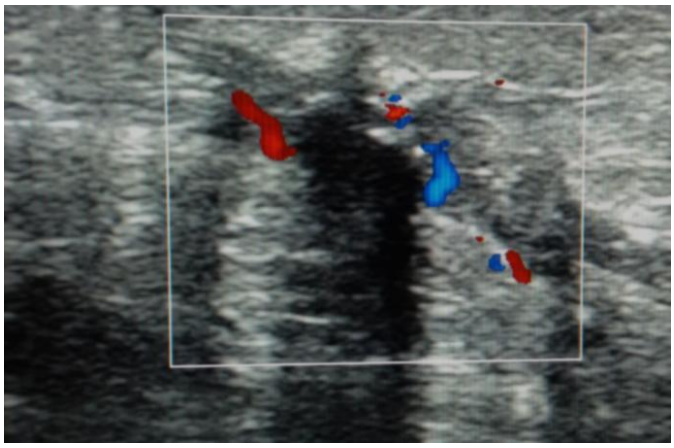

Figure 3: Colour doppler sonography showing irregular lesion with posterior acoustic shadowing and peripheral vascularity

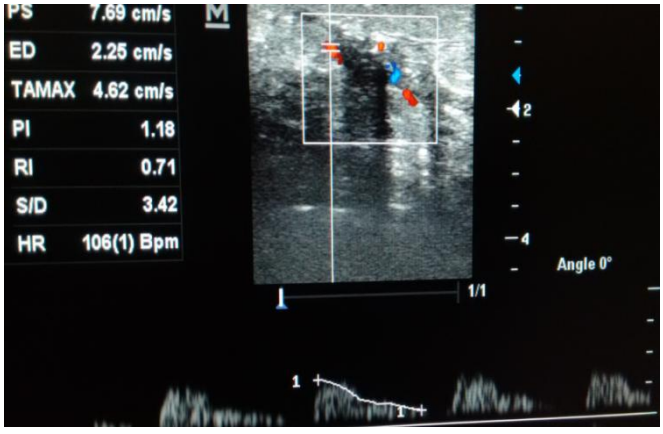

Figure 4: Spectral pattern with doppler indices in the same lesion

Statistical Analysis revealed the following findings

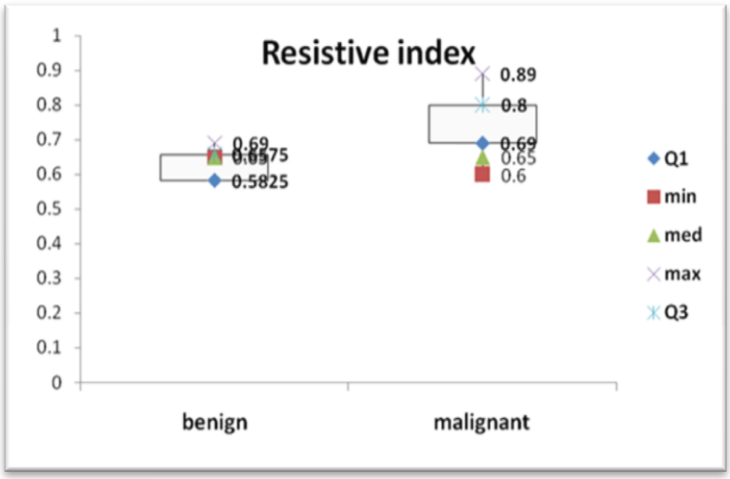

Figure 1: Range of Resistive index in benign lesions was found to be 0.5-0.69 and in malignant lesions were 0.6 to 0.89.

By plotting the Reciever Operating Characteristic curve (ROC), a cut off value of Resistive index was obtained as 0.67 , with an expected sensitvity of 81% and specificity of 88%.

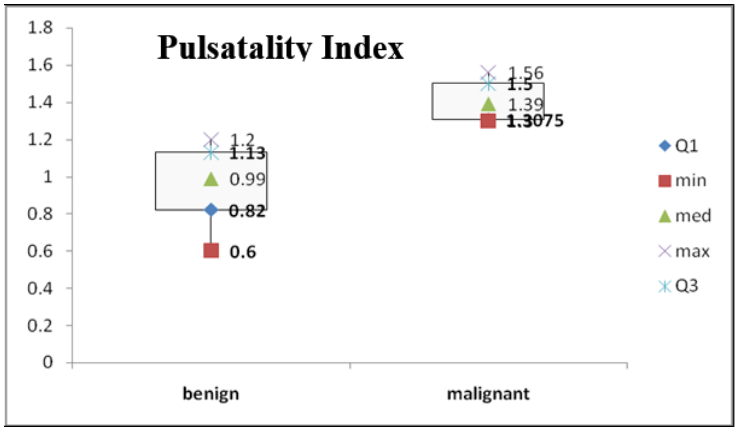

Figure 2: showing the range of PI values of malignant lesions and benign lesions

The PI values of malignant lesions were also found to be higher being 1.32 to 1.56 when compared to benign 6-1.2. From Receiver Operating Characteristic curve a cut off value of 1.2 was obtained with an expected sensitivity of 90.8% and specificity of 88%

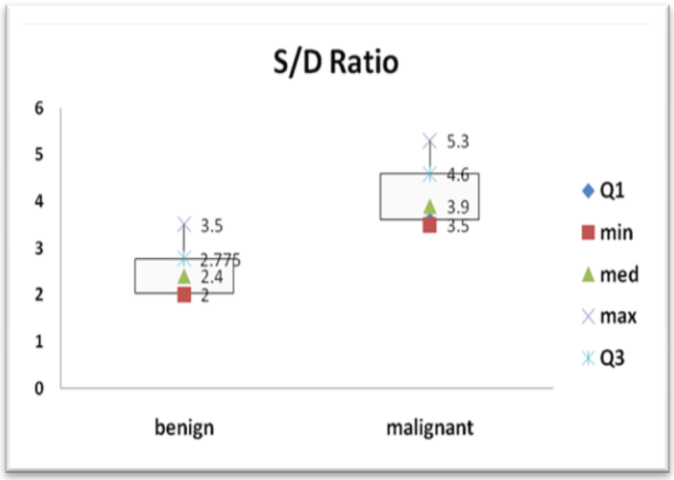

Figure 3: showing the range of S/D ratio of benign lesions were 2-3.5 while those of malignant were in the range of 3.5-5.3.

Discussion

The analysis of spectral doppler in breast lesions showed that the malignant lesions were associated with an increased value of PI, RI, and S/D. when compared to benign lesions. This finding is consistent with the study conducted by Shaheen et al[5].

Studies conducted by Hollerwerger et al[6] found that the RI and PI values in malignant lesions were more than 0.8 and 1.4 respectively. Due to the conflicting reports several authors consider spectral analysis as a complimentary tool to greyscale sonography Mehta et al[7]. The range of resistive indices and pulsatility indices in breast lesions in benign lesions and malignant lesions were found out to be overlapping in our study, consistent with the study by Mehta et al[7].

The size of the lesion plays a role in determining the colour doppler uptake. Larger lesions show more vascularity when compared to small sized lesions. In our study we included palpable lesions only, hence the number of lesions with vascularity was more. Another limitation was the small sample size. The relationship between echogenicty of lesion and vascularity was not assessed statistically in the present study.

Conclusion

Doppler findings and spectral indices were complimentary to grey scale sonography. They have to be analysed in conjunction with other characteristics of lesion like shape, margin, echohenicy, size, presence of calcifications and changes in adjacent structures.

The malignant lesions were associated with higher spectral indices like RI,PI and S/D

A cut off value of 0.67 and 1.2 were obtained for RI and PI respectively, with a predictive sensitivity of 81% and 90.8 % respectively

The predictive specificity calculated was 88% for both RI and PI from ROC curve

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