ORIGINAL ARTICLE

DOPPLER SONOGRAPHY IN THE DIAGNOSIS OF BREAST MASSES

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ABSTRACT

Sonography is currently one of the main diagnostic methods for diagnosing breast diseases. Using this technique has become common practice since the introduction of high frequency probes. **OBJECTIVES:** Differentiate between benign and malignant lesions on the basis or RI and PI value on color Doppler and to compare it with surgical outcome in cases with solid breast mass. **STUDY DESIGN:** Case series descriptive study. **SUBJECTS & METHODS:** One hundred patients with breast mass suspected clinically were included in this study. Values of RI from 0.32 to 0.62 considered as benign and malignant lesions were 0.7 to 1 while values of PI from 0.7 to 1.15 considered benign and malignant lesions were assumed from 1.7 to 3.7. **RESULTS:** Doppler sonography (resistive index) had high sensitivity i.e 94.2% and the high NPV 93.4%. Specificity was found to be 89.5%, high PPV 90.7% and diagnostic accuracy was found to be 92%. Doppler sonography (Pulsatility index) had high sensitivity (identification of malignant lesions; 96.1%) and the high NPV (identification of true negative findings in disease-free patients; 95.5%). Specificity was found to be 89.5%, high PPV 90.9% and diagnostic accuracy was found to be 93%. **CONCLUSION:** This study proves the efficacy of ultrasound as a method of choice to evaluate breast masses in patients avoiding the need of biopsy.

Keywords: Ultrasound, Doppler, Breast Diseases

Introduction

Sonography is currently one of the main diagnostic methods for diagnosing breast diseases since the introduction of high frequency probes, now-a-days it is included in most routine procedures to detect and identify the breast lesion. Similarly sonography is one of the most widely used imaging techniques for guiding breast interventional procedures such as needle biopsy or marking lesion for surgery.[1] Tumour angiogenesis is essential for tumour growth, because a tumor cannot grow > 1-2mm without recruitment of new capillary blood vessels. Angiogenesis, lymph node metastasis and tumour size are useful indicators in prognosis of breast cancer. The vascularity observed by Doppler ultrasound is important in elucidating tumour growth, and this technique may reveal a close relationship between lymph node metastasis and tumour size.[2] The pulsatility index (PI) found to increase when the impedence of the supplied vasculature is higher possibly due to increasing interstitial fluid pressure, the existence of encasement, stenosis or increased vessel tortousity. In contrast PI lower when there is a shunt or partial smooth muscle coat in tumour vessels.[2] The colour Doppler ultrasound imaging is another method to detect and quantify tumour related vessels. It is a non invasive, repeatable procedure and available at most medical centers. In a large number of studies neo-angiogenesis has been correlated to tumour growth and metastasis and became a major focus of interest as a prognostic factor in breast cancer. Doppler ultrasound has a stronger prognostic impact on overall survival than most established factors, e.g. tumour size, age or grading.[3] High frequency ultrasound probes with improved spatial and contrast resolution have been used to study both breast cancer and superficial nodes. US is valuable in the detection of enlarged nodes, while morphology is useful in the differentiation of benign from malignant disease. Furthermore tumour vascularity, particularly in the breast, can be assessed in vivo with current techniques

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of colour Doppler US. The morphological and haemodynamic changes of tumour vessels have been used to differentiate benign from malignant tumour by duplex US.[4] Ultrasound features that most reliably characterize masses as benign are round or oval shape, circumscribed margins and a width to AP dimension ratio greater than 1.4. Features that characterized masses as malignant included irregular shaped, spiculated margins and width to AP dimension ratio of 1.4 or less.[5] Ultrasound of breast is very useful in evaluating breast lump when combined with clinical evaluation and mammographic studies, a subset of patients can be identified which do not require biopsy.[6] Imaging plays an important role in the diagnosis of breast diseases. This includes MRI of breast, colour Doppler ultrasound, contrast ultrasound, digital mammography etc.[7] The purpose of our study was to investigate the general applicability and interobserver variability of US features in differentiating benign from malignant solid breast masses.

Material and Methods

Setting: Study was conducted in the Department of Diagnostic Radiology, Mayo Hospital, Lahore. The study was completed in six months, from 8-06-2006 to 7-12-2006.One hundred patients with breast mass suspected clinically were included. Women between age group 15-80 years, who presented with history of breast mass, pain, discharge from nipple and palpable axillary lymph nodes. Patients name, age, sex and history of pain, discharge, palpable mass and skin involvement were noted. Gray scale ultrasound was done to evaluate margins of the lesion, surrounding halo, echogenicity and calcification. Axilla was examined for enlarged lymph nodes. Doppler ultrasound was also performed to see the blood flow in the lesion and calculate resistive index and pulsatility index by applying formula. The collected data entered into SPSS version 11 and analyzed through its statistical package.All breast masses were evaluated regarding signs and symptoms like, pain, discharge, palpable masses and skin involvement. These variables presented in the shape of frequency and percentages. On gray scale, margins, surrounding halo, echogenicity, calcification and enlarged lymph nodes were noted and presented as percentages. PI and RI values were also noted. Mean and standard deviation was calculated for age. The outcome of specific investigations was presented as types and proportions. The comparison of sonography and histopathology was made by constructing a 2 x 2 table. This enabled to calculate the sensitivity, specificity, diagnostic accuracy, negative predictive value and positive predictive value.

Results

A total of 100 patients were included in this cross sectional comparative study.Age of the patients included ranged from 16 to 70 years. *In the age group of 21-30 year there majority of cases 32 (32%) and minimum cases 2 (2%) were between 60-70 years of age Mean age was 36.4±13.9.Signs and symptoms were studied. There were 32 patients (32%) having pain ($P < 0.001$), two patients (2%) having nipple discharge ($P < 0.001$), 100 patients (100%) had palpable masses and 10 patients (44%) having skin involvement ($P < 0.001$)..On grey scale ultrasound, regarding margins, in 48 patients (48%) margins were regular while in 52 patients (52%) margins were found to be irregular. Results were statistically insignificant ($P = 0.68$) Surrounding halo were found in 12 patients (12%). Results were statistically significant ($P < 0.001$) .Regarding echogenicity, there were 80 cases (80%) of hypo echogenicity while 20 cases (20%) of hyper echogenicity ($P < 0.001$). Calcification was found in two patients (2%) ($P < 0.001$). Enlarged lymph nodes were present in 24 patients (24%) ($P < 0.001$). Doppler ultrasound showed 86 cases (86%) of blood flow ($P < 0.001$).Resistive index (RI) showed 54 malignant cases (54%) while 46 benign cases (46%). The results were statistically insignificant ($P = 0.42$).Pulsatility index (PI) showed 55 malignant cases (55%) while 45 cases (45%) were benign. The results were statistically insignificant ($P = 0.31$).The results of histopathology showed 52 malignant cases (52%) while 48 cases (48%) were found to be benign ($P = 0.68$).Sensitivity of Doppler ultrasound (resistive index) was 94.2% and specificity as 89.5%. Diagnostic accuracy was found to be 92%.Positive predictive value of Doppler ultrasound (resistive index) was 90.7% and negative

predictive value was 93.4% .Sensitivity of Doppler ultrasound (pulsatility index) was 96.1% and specificity as 89.5%. Diagnostic accuracy was found to be 93%.Positive predictive value of Doppler ultrasound (pulsatility index) was 90.9% and negative predictive value was 95.5%.

Discussion

The role of US in breast imaging has evolved over the years. In most clinical practices, the use of breast US has been restricted to differentiation of cysts versus solid masses. Today, US also plays an important role in guiding interventional procedures such as needle aspiration, core-needle biopsy, and prebiopsy needle localization. Recently, screening US has also been advocated for the dense breast. The investigators in several studies in the past have described specific US findings to determine if a solid mass is benign or malignant. The features of masses that are usually analyzed are shape, margins, and echogenicity.For an individual US characteristic to be deemed to have practical applicability in the differentiation of benign from malignant lesions, we concluded that it must (a) be present frequently, (b) help reliably distinguish benign from malignant lesions, and (c) have high interobserver agreement. For example, although a hyperechoic lesion was a reliable predictor of benignity if present, it was infrequently observed in our cases and therefore not generally applicable. The effect of a mass on posterior echoes was not reliable for differentiating benign from malignant masses. The identification of a pseudocapsule lacked utility because of high interobserver variability. Our study confirms that Doppler sonography (resistive index) had high sensitivity (identification of malignant lesions; 94.2%) and the high NPV (identification of true negative findings in disease-free patients; 93.4%). Specificity was found to be 89.5%, high PPV 90.7% and diagnostic accuracy was found to be 92%. Doppler sonography (Pulsatility index) had high sensitivity (identification of malignant lesions; 96.1%) and the high NPV (identification of true negative findings in disease-free patients; 95.5%). Specificity was found to be 89.5%, high PPV 90.9% and diagnostic accuracy was found to be 93%. In a large series of patients, Stavros et al reported 98.4% sensitivity, 67.8% specificity, 38% PPV, 99.5% NPV, and 72.9% accuracy. In their study, the PPV was considerably lower than ours, probably in relation to the different prevalence of breast cancer and to the different patient selection criteria. Predictive values were highly influenced by the sensitivity, specificity, and prevalence; particularly, the prevalence increase led to a PPV increase. In our study, the sonographic accuracy (RI=92.% and PI=93%) in differentiating benign from malignant lesions was persistent to the results of Stavros et al.In the current study, RI and PI in malignant lesions were 0.7-1 and 1.7-3.7, respectively, which did not correspond to previous study regarding PI (4 and > 4). RI values were corresponding.[2]

The reason of this may be the fact that PI in my study was calculated manually and in study of Okuyama et al[2] was calculated automatically by machine. In this study, values of RI in benign lesions were 0.32 to 0.62 and malignant lesions were 0.7 to 1 while values of PI in benign lesions were 0.7 to 1.15 and malignant lesions were 1.7 to 3.7, which were found to be consistent with the study of Cura et al.[1] The Doppler parameter (RI, PI) were of higher values in malignant lesion and lower values in benign lesion. These results were corresponding to the study carried out by Yang et al.[4] In my study, the malignant cases were more than benign cases i.e 52% and 48%, respectively which compatible with the study of Okuyama et al.[2]

Conclusions

This study proves the efficacy of ultrasound as a method of choice to evaluate breast masses in patients avoiding the need of biopsy. Significant difference was found between the flow patterns for malignant and benign lesions, the former having much higher resistive index (RI) and pulsatility index (PI) values than the latter. This increase in resistance is related to the existence of occlusions and stenosis in the tumour vessel network structure produced by vascular encasement due to tumour growth. The data confirm that certain ultrasound features can help differentiate benign from malignant masses. However, practice and interpreter variability should be further explored before these criteria are generally applied to defer biopsy of solid masses.

References

1. Del Cura JL, Elizagaray E, Zabala R, Legorburu A, Grande D. The use of unenhanced Doppler sonography in the evaluation of solid breast lesions. AJR 2005; **184:** 1788-94.

2. Okuyama N, Murakuni H, Ogata H. The use of Doppler ultrasound in evaluation of breast cancer metastasis to axillary lymph nodes. Oncol Rep 2004; **11:** 389-93.

3. Waterman D, Madjar H, Sauerbrei W, Hirt V, Prompeler H, Stickleler F. Assessment of breast cancer vascularization by Doppler ultrasound as a prognostic factor of survival. Oncol Rep 2004; 905-10.

4. Yang WT, Chang J, Metreweli C. Breast imaging: Patients with breast cancer - differences in color Doppler flow and gray-scale US features benign and malignant axillary lymph nodes. Radiology 2000; **215:** 568-73.

5. Murad M, Bari V. Ultrasound differentiation of benign versus malignant solid breast masses. J Coll Physicians Surg Pak 2004; **14:** 166-9.

6. Shahid R, Gaffar A, Bhati AM. Role of grey scale ultrasound in benign and malignant breast lesions. J Coll Physicians Sug Pak 2005; **15:** 193-5.