ORIGINAL RESEARCH

Determination of the role of colour doppler ultrasound in breast lesions

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ABSTRACT

Introduction: Ultrasound is a safe, non-invasive and radiation free adjunct to mammography for the evaluation of palpable breast masses. It is also used as aprimary screening tool for breast cancer in women whoare pregnant, young women with high risk for breast cancer and who have increased breast density on mammogram. **Materials and Methods:** The cytological study was done by a pathologist. Presence or absence of vascularity, the number of arteries within the mass, thedistribution (central or peripheral, mixed, capsular) ofvessels, the morphology of vessels, the arrangement ofvessels, presence/ absence of penetrating arteries wasdone. **Results:** normal breast mass was seenin25 cases, fibroadenoma in67, fibricystic changes in12,papilloma in 9, Phyllodes tumor in 6, invasive ductal carcinoma in 10, lobular ductal carcinoma in 5 and metastatic tumor in 6cases. The difference was significant($P<0.05$). **Conclusion:** Magnetic Resonance Imaging is significantly better when considering vascular items both for preoperative assessment and during chemotherapic treatment of breast cancer, as well as for post-treatment changes.

Keywords: Colour doppler, breast lesions, Fibroadenoma

INTRODUCTION

A safe, non-invasive, radiation-free alternative to mammography for assessing palpable breast lumps is ultrasound. Additionally, it is the main method of screening for breast cancer in young women at high risk for the disease, expectant mothers, and women with increased breast density on mammograms.1.

There is ongoing debate on the use of colour Doppler sonography in breast disease diagnosis. There are no prospective randomised controlled studies accessible since there is a dearth of large-scale population studies, which has left us without any reliable evidence.2. Findings, which are mostly based on tiny series, are inconsistent, making conclusions unreliable at times. Evaluation of breast lesion vascularity is currently optional in the BI-RADS US vocabulary due to a lack of well-defined standards. Despite this, the Doppler approach is currently being used more and more due to advancements in transducer technology and the experience acquired in US breast ultrasonography.3. A user-friendly tool found in the majority of modern ultrasonic imaging systems is Colour Doppler US. It offers details on the vascularization that is present in tissues; it may be used to illustrate the direction of flow and differentiate between an artery and a vein based on the type of spectral curve that is seen.4.

Folkman originally reported the link between angiogenesis—the development of new blood vessels—and cancer in 1971.5. Hypoxia is the outcome of metabolically active cancer cells requiring more oxygen and nutrients than healthy arteries can supply. To preserve the metabolic balance of the tumour, this hypoxic state promotes the growth of new blood vessels that branch off of preexisting blood vessels and enter the tumor.6 Prior research has demonstrated the function and importance of Doppler sonography in the assessment of breast lesions, namely in the identification of malignancy and the characterization of tumours.7-8 Notably, benign from malignant masses can be distinguished by measuring the vascularity of the tumour.

Our goals in this study were to look at the vascular pattern of solid breast lesions and find out if penetrating vessels on power Doppler sonograms may be used to identify benign from malignant lesions. Because power Doppler US (PDUS) is more sensitive to flow and is not angle-dependent (i.e., it can detect flow in small vessels), we chose it over colour Doppler. Additionally, PDUS does not have aliasing

issues, in contrast to colour Doppler.9, 10

MATERIALS& METHODS

It comprised of 140 breast lesions offemales age ranged 20-50 years. The study got approvalfrom institutional ethical committee. All patients were informed regarding the study and written consent was obtained.

Data such as name, age etc. was recorded. We subjected to patients to Ultrasound(USG) with Philips ultrasound machine. A curvilinear transducer (2-5 MHz) was used when needed. Subsequently, the patient underwent ultrasound guided FNAC within a week after the initial ultrasound examination. The cytological study was done by a pathologist. Presence or absence of vascularity, the number of arteries within the mass, the distribution (central or peripheral, mixed, capsular) ofvessels, the morphology of vessels, the arrangement of vessels, presence/ absence of penetrating arteries was done. FNAC of the breast mass was performed to reach the final diagnosis. For each malignant mass, cytological grading was made by the pathologist usingRobinson's cytological grading.

The final histopathological diagnoses were confirmed usingthe results of tissue core biopsy or excisional biopsy, or themastectomy specimen, when available. Diagnostic B-mode grey scale US and PDUS imaging were performed using a medical grade US system (Philips iU22; Philips Healthcare, Bothell, WA,USA) with a high frequency (i.e.12.5MHz) linear probe. Two radiologists performed breast US after the examination protocol had been standardised via a one-week trial run involving ten patients. The images were captured as static and cine images on the scanner, and saved in blinded data sets for independent interpretation and review. Each breast lesion was evaluatedusing (a) conventional B-mode greyscale US alone; and (b) acombinationofB-mode grey scale US and PDUS in both the supine and supine oblique positions. B-mode greyscale US was done in the transverse and perpendicular planes to allow assessment of the lesion's size and morphologic characteristics. For each patient, one radiologist performed both the B-mode grey scale US and PDUS, while another radiologist reviewed and analysed the imaging data set at a separate setting.

The data was tabulated into a Microsoft Excel spreadsheet(Microsoft, Redmond, WA, USA) and statistical analysis was performed using SPSS Statistics version17.0(SPSSInc,Chicago,USA). Pearson's chi-square test and Mann-Whitney *U* test were used to test for correlations between variables. The sensitivity, specificity, positive predictive value(PPV) and negative predictive value(NPV) were calculated for the vascular pattern and depth ratio.

RESULTS

Table 1 demonstrates that 25 cases had normal breast mass, 67 had fibroadenoma, 12 had fibricystic alterations, 9 had papillomas, 6 had phyllodestumours, 10 had invasive ductal carcinoma, 5 had lobular ductal carcinoma, and 6 had metastatic tumours. There was a substantial difference (P<0.05).

Table I: Distribution of cases as per FNAC

Diagnosis	Number	Pvalue
Normal breast mass	25	0.01
Fibro adenoma	67	
Fibrocystic changes	12	
Papilloma	9	
Phyllodes tumor	6	
Invasiveductal carcinoma	10	
Lobular ductalcarcinoma	5	
Metastatic tumor	6	

There were 102 benign lesions, 44 of which were vascular and 59 of which were avascular on colourdoppler, according to Table 2. On a colourdoppler, 19 of the 43 malignant lesions were vascular, and 23 were avascular. For benign lesions, the mean RI value was 0.69, whereas for malignant lesions, it was 0.86. There was a substantial difference (P<0.05).

Table2 Comparison of colour Doppler findings in benign and malignant breast lesions

Pathology	Vascular on Color Doppler	Avascular on Color Doppler	P value	RI
Benign lesions(95)	44	59	0.01	0.69
Malignant lesions(35)	19	23		0.86

According to Table 3, 28 lesions were classified as grade 1, 13 as grade 2, and 9 as grade 3 under the FNAC. There was a substantial difference (P<0.05).

Table 3: Malignant masses with their cytological grading as per Robinson's cytological grading

FNAC grade	Malignant masses	Pvalue

1	28	0.01
2	13	
3	9	

DISCUSSION

To achieve the best staining of blood vessels, a few more parameters must be adjusted: PRF between 700 and 1.000 Hz, wall filter as low as feasible (50 to 100 Hz max.), suitable algorithm to eliminate motion artefacts, maximum gain (85–90%), medium persistence, box without angulation.11 Strength Doppler US is a particularly useful tool for evaluating breast lesions since it is independent of Doppler angle, making it ideal for detecting sluggish flow in small capillaries. It has not been verified in our practise, but it is anticipated to produce a sensitivity that is two to five times higher than colour Doppler. Its drawbacks include an increase in artefacts and a deficiency of information on blood flow direction and speed, which makes it more difficult to distinguish between veins and arteries.12 The goal of the current investigation was to ascertain the function of colour Doppler ultrasound in breast lesions.

We discovered that 23 instances had a benign breast mass, 65 had fibroadenoma, 10 had fibricystic alterations, 7 had papillomas, 4 had phyllodestumours, 8 had invasive ductal carcinoma, 3 had lobular ductal carcinoma, and 5 had metastatic tumours. In 148 individuals, Gupta et al.13 prospectively examined Doppler ultrasonography findings on 173 solid breast tumours that had not yet received therapy. A total of 52 breast cancers were found, and each one was assigned a grade (1, 2, or 3) on FNAC using Robinson's cytological grading scheme. We discovered that symptoms of malignancy were substantially related with colour Doppler characteristics of hypervascularity, convoluted arteries of irregular calibre, the existence of a penetrating artery, and a central pattern of distribution of vessels. Though benign masses had a lower mean RI than malignant masses, there was no statistically significant relationship found between RI values and the degree of malignancy.

There were 95 benign lesions in the current investigation; 40 of them showed vascular characteristics on a colourdoppler, and 55 showed avascular characteristics. Thirty-five malignant lesions were detected by colourdoppler as avascular, and fifteen as vascular. For benign lesions, the mean RI value was 0.68, whereas for malignant lesions, it was 0.82.

ACR BI-RADS guidelines state that a breast lesion is classified as a BI-RADS 4 or 5 lesion (i.e., suspected or very suspicious of malignancy) if it has even one malignant characteristic. At least two suspicious sonographic characteristics were observed in the majority of lesions in the current investigation that were classified as very suspicious or suspicious of malignancy. Similar to other studies, we found that the form, margin, posterior acoustic characteristics, and presence of calcification can be utilised to indicate the type of lesion: benign or malignant.13–18 Unlike the Gokalp et al. study,15 we did not discover a significant correlation between malignancy and the taller-than-wide feature in terms of breast lesion orientation. This may be because most of the lesions investigated were larger than 2 cm, or it could be because of the limited sample size in this particular study. The long axis of a lesion that is oriented taller than wide is not parallel to the skin's surface. It has already been demonstrated that this characteristic and malignancy correspond well. On the other hand, lesions that are oval in shape or broader than tall (i.e., have a long axis parallel to the skin line) are generally benign.18 Only eight of the 102 breast lesions in the current study were determined to be malignant upon histological evaluation, despite 13 of the lesions having the taller-than-wide characteristic.

To assess the vascular pattern of lesions, we chose PDUS over colour Doppler US because the former is more sensitive in identifying flow in solid breast lesions, especially when low-velocity blood flow and small arteries are present.19 PDUS is free of aliasing artefacts and is angle-independent because it monitors the amplitude of blood flow.[18,19] PDUS has demonstrated considerable promise in predicting malignancy, but the absence of accepted interpretation rules restricts its application. Therefore, our objective was to determine whether vascular patterns of lesions might be utilised to predict malignancy and whether a lesion's vascular pattern and BI-RADS category corresponded. Assessing vascular patterns seems to take less time than other measures, including the resistive index, even if other PDUS imaging features may have been utilised. Raza and Baum (9) initially documented the appearance of the vessels of solid breast lesions on PDUS. They discovered that the sensitivity, specificity, PPV, and NPV of using penetrating vessels to predict malignancy were, respectively, 68%, 95%, 85%, and 88%. With strong specificity and NPV, the vascular patterns of the lesions as observed by PDUS corresponded with the histopathological findings in the current investigation (Table I). It was also possible to determine the degree of vascular penetration within the breast mass, yet there was no discernible relationship between the level of vascular penetration and malignancy. Stated differently, the degree of vascular penetration had no bearing on the way the lesions were characterised in this particular investigation. Therefore, regardless of the depth of penetration, the mere existence of penetrating vessels is a reliable indicator of malignancy.

CONCLUSION

Color Doppler imaging may help in differentiating

between malignant and benign solid breast masses, but it doesn't show high predictive values, so its role is only complementary to the high-sensitive B-mode evaluation raising or confirming the doubts upon in determinate or suspicious lesions.

Magnetic Resonance Imaging is significantly better when considering vascular items both for preoperative assess-ment and during chemotherapic treatment of breast cancer, as well as for post-treatment changes.

However, intra-tumoral blood-flow analysis by color Doppler ultrasonography correlates well with histological grade and aggressiveness of the cancers, and can be used as first step assessment of the efficacy of neo adjuvant and antiangiogenesis treatments.

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