

# Preoperative breast ultrasound and Doppler velocimetric findings in patients with breast cancer

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## Summary

**Purpose:** To evaluate the role of ultrasound and Doppler velocimetry in the diagnosis of breast cancer.

**Methods:** Thirty breast cancer patients, diagnosed by clinical examination, mammography and fine needle aspiration, or trucut biopsy were assessed by breast ultrasound including Doppler velocimetry to evaluate blood flow in the axillary and lateral thoracic arteries. Postoperative histopathological examination proved malignancy in all cases. This cohort was compared to another group of 30 patients with proven benign breast disease and a cross-matched control group of 30 asymptomatic women with no breast disease.

**Results:** In the 30 cancer patients, the size of masses ranged from 1-4 cm ( $2.51 \pm 1.13$ ), the mean axillary artery resistance index (RI) ranged from 0.8-0.88 ( $0.84 \pm 0.03$ ), and the lateral thoracic artery RI ranged from 0.45-0.59 ( $0.55 \pm 0.106$ ). However, power Doppler did not detect any increased perfusion. In the benign group, the lateral thoracic artery RI ranged from 0.78-0.86 ( $0.85 \pm 0.8$ ) and the axillary artery RI ranged from 0.81-0.89 ( $0.81 \pm 0.05$ ), while in the control group, the mean lateral thoracic artery RI ranged from 0.85 to 0.89 ( $0.87 \pm 0.082$ ), and the axillary artery RI ranged from 0.84-0.9 ( $0.88 \pm 0.16$ ). Statistical analysis revealed only a high statistical significance ( $p < 0.01$ ) for the lateral thoracic artery indices between the malignant group as compared to the benign and normal groups. There was no statistical significant difference in the axillary artery RI between the three groups.

**Conclusion:** It is suggested that a marked decrease in the lateral thoracic artery RI with a cut-off value less than 0.6 is highly suggestive of malignancy. Taking the pilot nature of the results, further studies with much larger numbers are needed to corroborate such findings.

**Key words:** Breast ultrasonography, Doppler velocimetry, Breast cancer.

## Introduction

Breast ultrasound is an important investigative tool for the evaluation of breast lesions and is complementary to mammography [1-7]. Ultrasound is superior to mammography in the assessment of radiodense breasts, peripheral breast lesions and the evaluation of mammary cysts particularly in premenopausal patients and women receiving hormone replacement therapy [8]. The aim of this study was to evaluate the role of ultrasound and Doppler velocimetry in the diagnosis of breast cancer.

## Methods

Thirty breast cancer patients admitted to the Gynecologic Oncology Unit, Ain Shams University from October 2004 to April 2005 were included in the study. A full history was taken from all of them; cancer was diagnosed by clinical examination, mammography and fine needle aspiration or trucut biopsy [9, 10]. Distant metastases were excluded by appropriate metastatic work-up.

Breast ultrasound was done for all cases complemented by Doppler velocimetry to assess blood flow in the axillary and lateral thoracic arteries. Size of the mass, consistency, borders, structural breaks, axillary lymph nodes, and the lateral thoracic artery and axillary artery resistance index (RI) were assessed on both sides [11-13]. Postoperative histopathological examination was done for all cases. This cohort was compared to another group of 30 patients with proven benign breast disease and a cross-matched control group of 30 asymptomatic women with no breast disease.

## Results

In the breast cancer group, age ranged from 36-59 years ( $50.16 \pm 5.5$ ). Twenty cases had the mass in the upper lateral quadrant, seven in the retroareolar area, and three in the lower outer quadrant. Ultrasound revealed hypoechoic masses, heterogenous in consistency with irregular borders, structural breaks and positive compression signs in all cases. No retraction sign was noticed in any of the cases in this study (Figure 1). The size of masses ranged from 1-4 cm ( $2.51 \pm 1.13$ ). The tumor size assessed by ultrasound was similar to the gross pathological size. Axillary lymph nodes were detected in 12 cases, and confirmed histopathologically (Figure 1).

Power Doppler ultrasound signal did not detect any increased perfusion in all malignant masses. Using Doppler velocimetry, the axillary artery RI values ranged from 0.8-0.88 ( $0.84 \pm 0.03$ ) while those of the lateral thoracic artery RI ranged from 0.45-0.59 ( $0.55 \pm 0.106$ ) (Table 1 and Figure 2). Astonishingly, all RI values were less than 0.6 (Figure 3).

Modified radical mastectomy or lumpectomy with axillary clearance was done for all cases. Histopathological examination revealed 29 cases of invasive duct carcinoma not otherwise specified, and one case of medullary carcinoma.

Concerning the benign group, complaints were premenstrual mastalgia, inflammatory conditions, galactorrhea, or lumps proven by fine needle aspiration to be benign [14]. The age ranged from 42-50 years ( $46.1 \pm 3.2$ ). Ultrasound revealed either a fibrocystic echogenic-

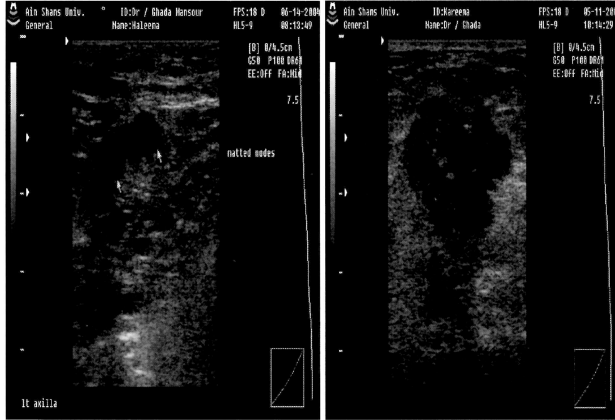


Figure 1. — Breast cancer and malignant axillary lymph nodes.

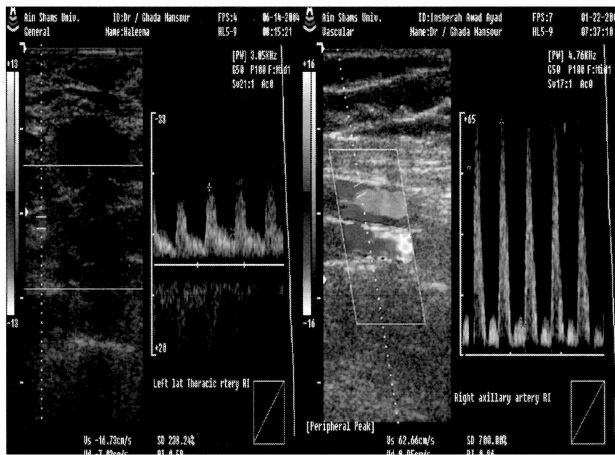


Figure 2. — Axillary artery RI and lateral thoracic artery RI.

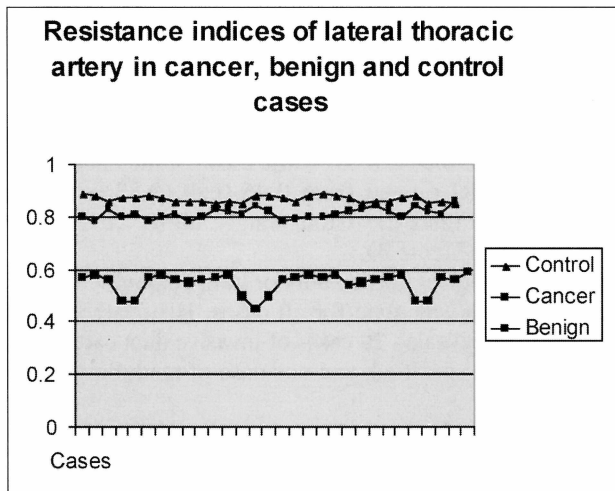


Figure 3. — RI values of lateral thoracic artery in cancer, benign and control cases.

ity in cases of mastalgia or dilated ducts. Benign lumps were regular in outline, circular, or oval in shape with sonolucent consistency, which reflects the clear fluid inside with minimal vascularity by power Doppler ultrasound. The lateral thoracic artery RI ranged from 0.78-0.86 ( $0.85 \pm 0.8$ ) (Figure 3) and the axillary artery RI ranged from 0.81-0.89 ( $0.81 \pm 0.05$ ).

In the control group, age ranged from 35-55 ( $46.1 \pm 3.09$ ). Ultrasonographic findings revealed normal sonograms and Doppler velocimetry revealed a lateral thoracic artery RI ranging from 0.85-0.89 ( $0.87 \pm 0.082$ ) (Figure 3) while the axillary artery RI ranged from 0.84-0.9 ( $0.88 \pm 0.16$ ).

Statistical analysis using t test for comparison between the three groups revealed a high statistical significance at ( $p < 0.01$ ) for the lateral thoracic artery indices between the malignant group as compared to the benign and normal groups. There was no statistically significant difference in the axillary artery RI values between the three groups (Table 1).

Table 1. — t-test results.

Comparison	t-test
Lateral thoracic artery RI (malignant and benign)	14.2 Significant at $p < 0.01$ (Highly significant)
Lateral thoracic artery RI (malignant and control)	12.5 Significant at $p < 0.01$ (Highly significant)
Axillary artery RI (malignant and benign)	0.3 Non Significant at $p < 0.05$
Axillary artery RI (malignant and control)	1.3 Non Significant at $p < 0.05$
Lateral thoracic artery RI (benign and control)	1.18 Non Significant at $p < 0.05$
Axillary artery RI (benign and control)	0.7 Non Significant at $p < 0.05$

p value for significant t-tests at a degree of freedom of 30 at  $< 0.05 = 2.04$  and at  $< 0.01 = 2.75$ .

**Discussion**

Breast examination is a part of gynecological examination. Common breast conditions facing a gynecologist are mastalgia, nipple discharge including galactorrhea, lactational problems, and breast lumps. Breast cancer is the most common neoplasm in women. One of every nine to ten women will develop breast cancer by age 70. The most important aspect in combating the disease is diagnosis at an early stage when the prognosis for cure with appropriate therapy is excellent [6, 14].

Diagnosis at an early stage depends on proper screening. The most accepted non invasive investigation used is mammography. However, mammography has its limitations, especially in echodense breasts, as in premenopausal and menopausal women on hormone replacement therapy [1, 7, 8].

Breast ultrasound is one of the new investigative tools for screening and diagnosing breast lesions. Ultrasound helps in the assessment of breast lumps, and by introduc-

ing the Doppler signal, assessment of the perfusion of masses is possible. Ultrasound is superior to mammography in assessment of radiodense breasts, mammary cysts, and peripheral breast lesions including the axilla [2-5, 7, 11].

In this study, ultrasound revealed hypoechoic masses, heterogeneous in consistency with irregular borders, structural breaks and positive compression signs in all cases. No retraction sign was noticed in any of the cases in this study (Figure 1). Re-evaluation of the retraction sign as a necessary sign of malignancy is recommended according to our results, because also cases with positive lymph nodes did not show retraction sign by ultrasound.

Power Doppler ultrasound signal did not detect any increased perfusion in all masses that can be explained by the avascular trend of breast cancer. It should be mentioned that we used unenhanced Doppler, whereas some authors have reported an increased perfusion to breast cancer using contrast medium [15, 16]. Tumor vascularization detected by Doppler ultrasound was found to be an independent predictor of overall survival in women with early breast cancer by Watermann *et al.* and according to them, the degree of perfusion by unenhanced power Doppler did not predict the behavior of the mass whether malignant or benign.

Using Doppler velocimetric assessment, the axillary artery RI ranged from 0.8-0.88 ( $0.84 \pm 0.03$ ), lateral thoracic artery RI ranged from (0.45-0.59) ( $0.55 \pm 0.106$ ) with all values being remarkably less than 0.6 (Figures 2 & 3). Identification and detection of the lateral thoracic artery was mentioned by Obwegeser *et al.* but resistance indices for these arteries have not been mentioned or measured in the literature before, hence, the nature of the pilot study.

Statistical analysis using the t-test for comparison between the three groups revealed a high statistical significance at  $p < 0.01$  for the lateral thoracic artery indices between the malignant group as compared to the benign and normal groups. There was no statistical significant difference in the axillary artery RI between the three groups (Table 1). Taking the pilot nature of the results, further studies with much larger numbers are needed to corroborate such findings concerning a cut-off value less than 0.6 for the lateral thoracic artery RI for prediction and diagnosis of breast cancer.

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