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Original Article

Breast lesions with resistive and pulsatility index by ultrasound in region Faisalabad

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Abstract

Aim: Breast cancer is the second leading cause of death in women. This study sought to evaluate the role of ultrasonography in identifying benign from malignant breast tumors using the Resistive Index and Pulsatility Index values.
Materials and Methods: The data were collected from 60 patients having breast cancer between the ages of 20-60 who visited the Allied Hospital for breast imaging by close-ended questionnaire. The data were analyzed by correlation with the help of SPSS V22.
Results: Patients were divided into two groups; benign (35 cases) and malignant (25 cases). Fibroadenoma was the most common benign tumor while invasive ductal carcinoma was the most common malignant tumor. There was no obvious difference in the location of benign and malignant breast lesions, but the majority of lesions (40%) were located in the upper outer quadrant. After combining all benign and malignant lesions, the correlation coefficient, or r value, was 0.399 (P=0.066). The resistive index revealed 25 malignant cases (41%) and 35 benign cases (58%) which were not statistically significant (P=0.16). However, Pulsatility Index revealed 34 benign cases (57%) and 26 cancer cases (43%) which were statistically insignificant (P=0.13). However, ultrasound's sensitivity, specificity, and positive and negative predictive values were 93.8%, 86.5%, 86.9%, and 93.8% respectively.
Conclusion: This study showed that malignant lesions had higher values for the Doppler parameters (RI, PI), while benign lesions had lower values while benign lesions are more common than malignant ones. RI helps radiologists when to perform a biopsy.

Keywords: Breast cancer, benign breast lesions, malignant breast lesions, resistive Index, pulsatility index

INTRODUCTION

One of the most critical health problems facing humanity today is breast cancer. The most common form of cancer among women is breast cancer (1,2). The second leading cause of death, after cardiovascular disease, is breast cancer (3). About 12% of women in the United States and Europe experience this illness at some point in their lifetime (4). The risk of breast cancer is increased by several factors; smoking, being overweight, not exercising, drinking, being infected, and molecular and genetic processes (5). Breast cancer symptoms include breast or nipple discomfort, swollen breast tissue, immovable lumps with irregular borders, and skin changes like thickness, pigmentation, dimpling, and nipple discharge (6).

A localized infiltrating mass of fibroblasts and collagen distinguishes fibromatosis presenting as a single, palpable, non-tender mass, occasionally connected to the aponeurotic fascia of the pectoral muscle (7-10). Breast focal fibrosis (stromal development accompanied by acini and duct atrophy or hypoplasia) is common in premenopausal women (11). Granulomatous breast lobule infection caused by an unidentified source is known as idiopathic granulomatous mastitis (IGM), a rare disorder that mostly affects expectant mothers between the ages of 22-42 ruled out using mammography and ultrasound (12,13). One in seven breast tumors is benign breast tubular adenomas, which is extremely uncommon (14). Tubular adenomas are an uncommon type of fibroadenoma (pericanalicular variant),

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which is frequently found in premenopausal women (32.2 to 62 years old) with Type 1 diabetes. They differ from fibroadenomas in that they contain more acinar units and less extensive ducts with an epithelial component, producing a posterior shadow of lesions is the main US observation (15-17).

Infiltrating ductal carcinoma's rarest subtype is breast-invasive micropapillary carcinoma (IMC) (9). Hypoechoic, micro-lobulated irregular masses with or without posterior acoustic attenuation are examples of homogeneously found US results (18). Massive osteoclasts breast carcinoma is a very uncommon type of breast tumor that cannot be radiologically separated from other malignant conditions (9). However, osteoclastic giant cell breast carcinoma is not chondro-osseous like metaplastic carcinomas, these tumors can be categorized as benign conditions like cysts or fibroadenomas (19).

A fibroadenoma may occasionally develop into cancer. Fibroadenomas are thought to have a cancer rate of 0.02 percent. In fibroadenoma, lobular carcinoma in situ (66.9%) predominates over ductal carcinoma in situ (12.4%), invasive ductal carcinoma (11%), and invasive lobular carcinoma (3.4%) (20). Metaplastic breast carcinoma is the term used to describe adenocarcinoma with homogenous or heterogenous metaplastic components. They are categorized as ductal carcinomas with non-glandular proliferation-induced metaplastic changes (21). Such tumors are frequently palpable masses that are grown quickly. Both a palpable mass and a swollen axillary lymph node are present in the patients (22). Metaplastic carcinomas frequently exhibit high-density, multilobulated, or ill-defined masses on mammography, either with or without microcalcifications (23).

Breast cancer is diagnosed using the following techniques; Sonography, Automatic Breast Ultrasound (ABUS), Contrast-Enhanced Ultrasound (CEUS), Three-Dimensional Ultrasound, Color Doppler, Power Doppler, Tissue Elasticity Imaging, Stress Elastography, and Shear Wave Elastography (SWE) (24-31).

This study focuses on the evaluation of breast masses by ultrasonography by measuring the resistive index (a measure of the resistance of blood flow through a vessel calculated as the difference between the peak systolic velocity and the end-diastolic velocity, divided by the peak systolic velocity) and pulsatility index (a measure of the pulsatility of blood flow through a vessel calculated as the difference between the peak systolic velocity and the end-diastolic velocity, divided by the mean velocity) as little study has been conducted in this regard.

MATERIALS AND METHODS

Study design and setting: A cross-sectional study was conducted in the Department of Radiology of Allied Hospital, Faisalabad, Pakistan for a total duration of six months.

Study group and sampling technique: Using a convenient sampling strategy, 60 individuals (all female) between the ages of 20 to 60 were chosen. These patients had been referred by oncologists expressly for breast ultrasonography.

Equipment and method: The 18L-6 HD (Siemens) probe linear array transducer with a frequency range of 6MHz-18MHz was used for breast imaging.

Gray-scale imaging was used to assess the location of lesions/tumors while Doppler ultrasound was used to assess vascularization and to calculate the resistive and pulsatility index by applying the formula.

Data collection and analysis: After obtaining patient consent, data were gathered using a closed-ended self-modified questionnaire. Data were analyzed by correlation through the statistical package for social sciences (SPSS) version 22.

Age was expressed in mean. However, the correlation was used to measure the association between benign and malignant lesions combined and separately while $p<0.05$ was considered to be statistically significant.

Ethical issues: This study had no ethical issues because the client was not put in the experiment and no medication was given during the study. Informed consent was obtained from the patients after explaining the procedure. Moreover, the study was duly approved by the ethics committee of Faisal hospital (FIHS), Faisalabad, Pakistan dated 16/06/2022, numbered FIHS/22/14.

RESULTS

Patients were divided into two groups based on the results of the pathology; benign (35 cases, 59%) and malignant (25 cases, 41%) (Figure 1).

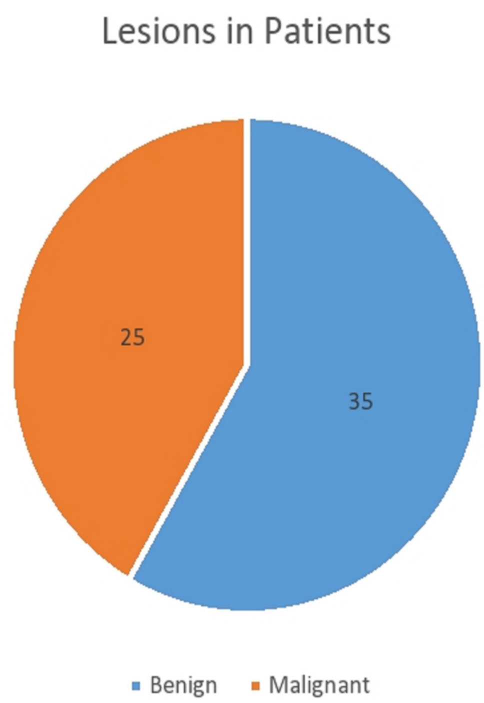

Figure 1. Distribution of lesions in patients

Out of 35 benign cases, 25 (71%) were identified as fibroadenoma and 10 (29%) were classified as lipoma (Figure 2). However, out of 25 malignant cases, 18 (72%) were identified as invasive ductal carcinoma and 7 (28%) were identified as invasive lobular carcinoma (Figure 3).

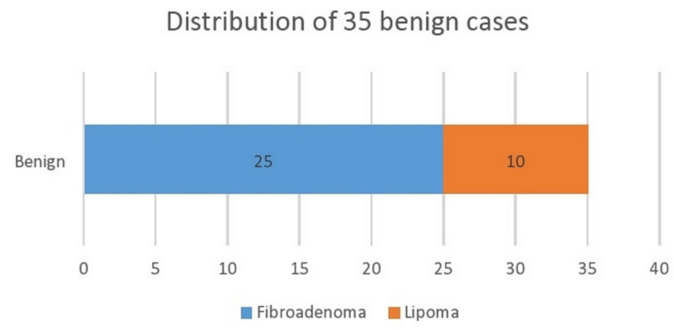

Figure 2. Distribution of 35 benign cases according to identified types

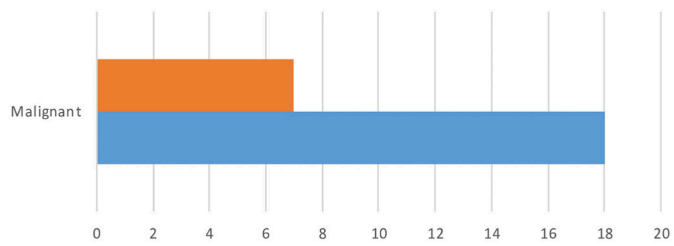

Figure 3. Distribution of 25 malignant cases into identified types

In most of the cases; 50 out of 60 were between the ages of 30-40 years while 10 of the cases were between the ages of 50-60 years with a mean of 36.8 years.

There was no obvious difference between benign and malignant lesions in terms of their location or side. The majority of lesions (40%) were located in the upper outer quadrant. Benign lesions were bigger than benign tumors. The maximum diameter of 55% of benign lesions was 2cm (P=0.004) compared to 29% of benign lesions.

When all benign and malignant lesions were combined, the correlation coefficient, or r value, was 0.3999 (P=0.66). When we examined benign and malignant lesions individually the association between the size and Resistive Index (RI) for benign lesions was r=0.133 (P=0.777), while for malignant lesions it was r=0.319 (P=0.246).

The resistive index detected 25 cancerous cases (41%) and 35 benign cases (59%). Statistics revealed that the findings were not significant (P=0.16).

According to the Pulsatility Index (PI), 26 cancer cases (43%) and 34 benign cases, out of which (57%) were not dangerous. Results were statistically insignificant (P=0.13).

The lesions' Doppler characteristics in the two groups were compared. When compared to the tissue in the usual surrounding area, 23 (92%) of the 25 malignant lesions that were discovered showed vascularity and were all hyper-vascularized. Just 6 lesions (17%) of the 35 benign group demonstrated vascularization of which, three had hypervascularity and three displayed hypo vascularity (Figure 4).

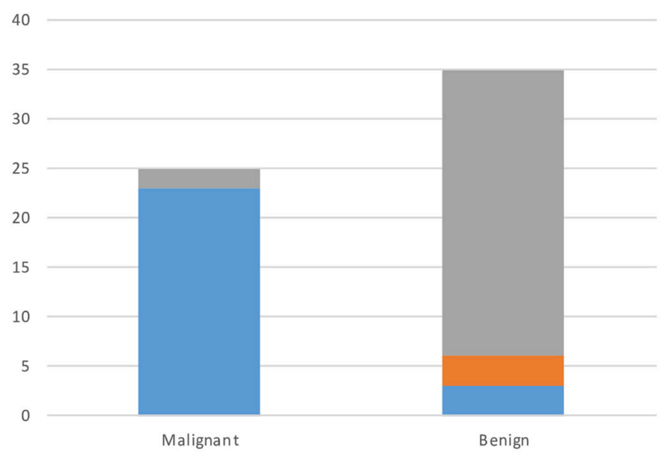

Figure 4. Shows vascularity of benign and malignant lesions in 60 cases

Resistive index (RI) values between 0.32 and 0.62 were deemed benign and malignant lesions between 0.7 and 1. However, for the Pulsatility index (PI), values between 0.7 and 1.15 were classified as benign, and 1.7 to 3.7 for the malignant lesions.

The ultrasound had a sensitivity and specificity of 93.9% and 86.5%, respectively, as well as positive and negative predictive values of 86.9% and 93.8%.

Table 1 shows the characteristics of different variables (types of tumor, fertility status, and tumoral cases) of all 60 cases.

Table 1. Characteristics of different variables in 60 patients

Variables	Characteristics	Number = 60 (%)
Types of Tumor	Benign	35 (58.3 %)
	Malignant	25 (41.6 %)
Fertility Status	Fertility	50 (90%)
	Menopause	10 (10 %)
Tumoral	Yes	38 (63 %)
	No	22 (36%)

DISCUSSION

The way ultrasound works for breast imaging has evolved. In clinical settings, breast ultrasound is frequently only used to differentiate between cysts and other breast diseases. Today, ultrasound plays a crucial role in guiding interventional methods like needle localization and core-needle biopsy. The researchers have previously described specific ultrasound findings to determine whether a solid lump is benign or malignant. Typically, the shape, edges, and echogenicity of masses are examined.

A study conducted by Riyaz et al. in 2019 on 317 females concluded that the most common type of benign breast tumor in females was fibroadenoma (51%) followed by a lipoma (15%) (33). The results are well-articulated with the given study, 71% fibroadenoma, and 29% lipoma.

A study conducted by Tariq et al. in 2016 showed that ultrasonography is an effective method for assessing breast masses in patients, having a specificity of 89.5%, high PPV of 90.9%, and diagnostic accuracy of 93%, thus, obviating the need for a biopsy (34). The results were well-articulated with the given study, ultrasound had sensitivity and specificity of 93.9% and 86.5% to identify benign and malignant lesions, respectively.

Tariq et al. in 2016 did a study to distinguish benign from malignant lesions using the RI and PI values. PI values between 0.7 and 1.15 were assumed to be benign, and RI values between 0.32 and 0.62 were assumed to be benign (34). These values were well related to the given study values of RI and PI for benign and malignant breast lesions.

A study by Özdemir et al. (2001) to differentiate solid breast lesions with mammography and grey scale sonography on 121 lesions. The sensitivity and specificity of the mammography-gray scale sonography combination are 98.6% and 76.2% respectively (35). The results of the given study demonstrate that Doppler sonography is a good adjunct to mammography and grey-scale sonography for solid breast lesions larger than 10 mm and less than 10mm.

Cho et al. (2005) investigated the image quality and diagnostic efficacy of 2D ultrasound in solid breast masses. In 202 pathologically confirmed cases, the sensitivity, specificity, positive predictive value, negative predictive value, and false negative rate for breast cancer detection in 2D ultrasonography were assessed (36). This study is well related to the given study in terms of sensitivity, specificity, positive predictive value, and negative predictive value.

According to a 1995 study by Lee et al. two groups of people with breast nodules were examined. It was considered that a breast nodule was cancerous if flow signs were found inside or close to its margin. Malignant breast cancers were detected with Doppler imaging with sensitivity, specificity, and accuracy of 77.3%, 94.5%, and 83.3%, respectively (37). These findings are well-articulated with the study findings having sensitivity and specificity of 93.9% and 86.5%, respectively.

A study by Iranmakani et al. (2020) evaluated the fact that breast cancer is now the second leading cause of death. If breast cancer is detected early, the survival rate is very high. Various imaging techniques were extracted to increase breast cancer detection and the gold standard modality turned out to be ultrasonography (38). This finding is well co-related with the given study that ultrasonography is the best modality to detect breast lesions with high sensitivity and specificity.

This study showed that malignant lesions had higher values for the Doppler parameters (RI, PI), while benign lesions had lower values. For determining which breast lesions are cancerous, Doppler analysis is a useful tool.

In addition to the physical requirements, this study showed that elevated RI indications of malignancy in Doppler ultrasonography and hypervascularity are the most reliable indicators of a breast mass. RI helps radiologists differentiate between benign and malignant breast lesions to guide whether to perform a biopsy.

CONCLUSION

This study found that the upper outer quadrant of the breast contained the majority of the lesions. There were 35 benign cases and 25 malignant cases, according to the resistive index. Doppler parameters (RI and PI) were also used to compare the vascularity of lesions. The study showed that ultrasound had a sensitivity and specificity of 93.9% and 86.5%, respectively, as well as positive and negative predictive values of 86.9% and 93.8%. The study concluded that the best way to ascertain the nature, location, and vascularization of breast masses is through ultrasound.

LIMITATIONS

Our study has some limitations

- First of all, due to the small sample size, the study may not fairly reflect a vast number of people.
- Additionally, this study is restricted to ultrasound examination only, and may not represent clinical features.

Conflict of interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical approval
Consent of ethics was properly followed. Study was approved by the ethical committee of Faisal Hospital (FIHS) dated 16/06/2022 numbered FIHS/22/09.

Patient informed consent
Informed consent was obtained from the patients after explaining the procedure.

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