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Full Length Research Paper

Adeptness of digital mammography set against ultrasound in early detection of malignant breast masses with correlation to biopsy results

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ABSTRACT

Breast cancer is the most common cancer and the second most common cause of death from cancer in women. The aim of this study is to determine which is a more accurate imaging test, mammography, or ultrasound for the diagnosis of small malignant breast masses based on the women's age and breast density. The 30 patients were examined by clinical examination, screening mammography and ultrasound. A total of 30 breast lesions were examined by histopathology analyses. Sensitivity varied significantly with age and breast density. Of the 30 women who had both tests, ultrasound had a higher sensitivity than mammography in women younger than 45 years, whereas mammography had a higher sensitivity than ultrasound in women older than 50 years. The sensitivity according to age was 60.0% for mammography and 36.4% for an ultrasound. Comparing the sensitivity of mammography and ultrasound according to the breast density indicates that mammographic sensitivity was 87.5% among women with predominantly fatty breasts, but 25.0% in women with heterogeneously dense breasts, with the increase of fibro glandular density the level of sensitivity with mammography decreases, while ultra-sonographic sensitivity was 12.5% among women with predominantly fatty breast and 60.0% for heterogeneous dense breasts. The data indicate that sensitivity of ultrasound was statistically significantly greater than mammography in patients with breast symptoms for the detection of malignant breast masses particularly in dense breast and in young women.

Keywords: Breast masses, mammography, breast ultrasound, breast biopsy.

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INTRODUCTION

Breast cancer is the second most common cancer in the world and, by far, the most frequent cancer among women with one estimated 1.67 million new cases diagnosed in 2012 (25% of all cancers). (Ferlay et al., 2015). Breast cancer ranks as the fifth cause of death from cancer overall (522,000 deaths) and while it is the most frequent cause of cancer death in women in less developed regions (324,000 deaths, 14.3% of total), it is now the second cause of cancer death in more developed regions (198,000 deaths, 15.4%) after lung cancer. The range in mortality rates between world regions is less than that for incidence because of the more favourable survival from breast cancer in (high-incidence) developed regions (Ferlay et al., 2015).

Diagnosis of breast cancer is done by mammography, ultrasound and biopsy (fine needle aspiration cytology FNAC and core needle biopsy CNB) (Kooistra et al., 2010). Breast ultrasonography (US) is currently considered to be a first line examination in young female below 35years and in pregnant female, with a role in both detection and characterization of breast masses. As are other breast imaging techniques, breast US is plagued by

a lack of reproducibility regarding lesion characterization, particularly for a small lesion. (Abdullah et al., 2009). Ultrasonography does not expose a patient to ionizing radiation which is particularly important for pregnant and young patients, because in these patients the breast is more sensitive to radiation, this would mean that in compassion with ultrasound, mammography would be associated with a slight increase in the small risk of acquiring radiation-induced neoplasm. Young women's breasts tend to appear dense on mammograms which reduce the diagnostic sensitivity of mammogram in this group (Willems et al., 2012).

Ultrasound has a key role in guiding biopsy procedures: fine needle aspiration biopsy (FNAB) and core needle biopsy (CNB), the difference between the two techniques is that (CNB) is used when FNAB is unable to give precise results, when there is a discordance between clinical, instrumental examination and cytology, or when it's preferable to obtain a histological examination of the lesion rather than a simple cytological examination. (Willems et al., 2012). Mammography is the current standard breast screening technique, but it is less effective for subjects under 40 years old and dense breasts less sensitive to small tumors (less than 10 mm about 100,000 cells), and does not provide any indication of eventual disease outcome (Onega et al., 2016). Digital mammography has established itself as the most appropriate technique for diagnosing breast cancer, evidence suggests that digital technology offers benefit specifically related to breast density. Digital mammography has a considerable advantage in women <50 years, premenopausal women, and women with heterogeneously or extremely dense breasts. (AL Mousa et al., 2013). Contrast-enhanced (CE) digital mammography offers a more accurate diagnosis than mammography and ultrasound in dense breasts; it is not widely available due to the fact it is expensive and involves high radiation levels. (Kooistra et al., 2010). Previous studies have suggested that early breast cancer detection with suitable treatment could reduce breast cancer death rates significantly in the long term (Migowski, 2015).

MATERIALS AND METHODS

Patients

A prospective research was performed on thirty female patients with a mean age of 48.4 years ranging between 20 and 79 years and radiological classifications of BIRADS 4 (a, b, c) and 5. The patients were given a thorough history of family breast cancer, abnormality found on previous mammogram or ultrasound, Short interval follow up of probably benign, Patient identified breast lump. Women with suspicious mass apparent on mammography and sonography. Contraindications to mammography such as pregnant women and breastfeeding. Each patient had extensive data collected on them, including their name, age, marital status, and the number of children, address and phone number, diagnosis, length of illness, previous medical history, and family history, the presence of any other disease, any other medications taken by the patient, mammography and ultrasonography.

BI-RADS classification of mammography

BI-RADS was a system of quality assurance intended to homogenize the data collection and quality of mammographic reports. The system allows homogenization of the radiological language between the radiologist themselves and also between them and the clinicians. The existence of a definite guide facilitates reproducibility and comparison. It facilitates also the analysis and evaluation of the results of breast cancer screening programs (Lehman et al, 2002).

Ultrasound of breast cancer

Employs the use of high-frequency sound waves to create an image. It was found that 28% more breast cancers were found if mammography and sonar were used together than with mammography on its own. So, additional ultrasound considerably improves sensitivity in the screening setting, most notably in women with dense glandular tissue where mammography has limitations (Duijm et al., 2007). Ultrasound-guided needle aspiration requires the following equipment and materials: disposable needles (21 to 27 gauge); a disposable 20-ml syringe; skin disinfectant; ground glass slides; slide holders; and fixatives (Pagani et al., 2011).

Mammography system

Patients were examined by using general electric full field digital mammography machine. Standard two views done for each breast craniocaudal and mediolateral oblique (CC and MLO) views were performed by technologists. Both patients had their ultrasounds done with a high-frequency probe on a General Electric Logic 7 system (GE health care, Tokyo, Japan) (7.5MHZ). Scanning and calculation were performed in two orthogonal planes (longitudinal and transverse).

RESULTS

In this study, it was found that the age of the patients

ranged from 20 years to 74 years with a mean age of 48.9 years and a standard deviation of ±10.32. The highest frequency of cases occurs between 50 and 60 years (Figure 1).

The early detection of malignant breast masses in the 30 patients was by mammography in 18 (60%), ultrasound in 11 (36.7%) and biopsy in 1 (3.3%) (Table 1, Figure 2).

The results of cancer and BI-RADS correlation are shown in Table 2 and Figure 3.

The systematic search yielded studies in which breast ultrasound was used as a supplemental examination following mammographic interpretation. The ACR classification in the 30 patients was ACR A in 8 (26.7%), ACR B in 13 (43.3%), ACR C in 5 (16.7%) and 4 in ACR D (13.3%) (Table 3, Figure 4).

The sensitivity of mammography was significantly higher than that of ultrasound. Table 4 shows the different sensitivity between mammography and ultrasound in different age groups.

Table 5 show that sensitivity for mammography and subsequent ultrasound for dense breast was 25.0% (1 of 4) and 50.0% (2 of 4) and 25.0% to biopsy, for heterogeneous dense breasts 40.0% (2 of 5) and 60.0% (3 of 5), for scattered fibro glandular dense breast 68.5% (8 of 13) and 31.5% (5 of 13) and entirely fatty breast 87.5% (7 of 8) and 12.5% (1 of 8). The sensitivity of ultrasound for dense and heterogeneously dense breasts was significantly higher than mammography ($P < 0.01$)

The pathology results for the 30 patients showed that 26 (86.7%) were invasive duct carcinoma, 3 (10%) were duct carcinoma *in situ,* and 1 (3.3%) mixed invasive duct and lobular carcinoma (Table 6, Figure 5).

The grade of tumor in the 30 patients was Grade 1 in 3 (10%), Grade 2 in 24 (80%) and Grade 3 in 3 (10%) (Table 7).

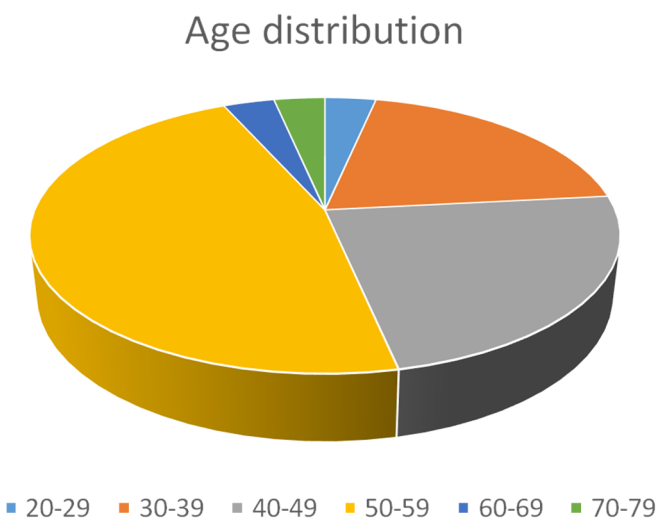

Figure 1. Age distribution in the breast cancer cases.

Table 1. The early detection of malignant breast masses.

Technique	Frequency	Percentage (%)
Mammography	18	60.0
Ultrasound	11	36.7
Biopsy	1	3.3

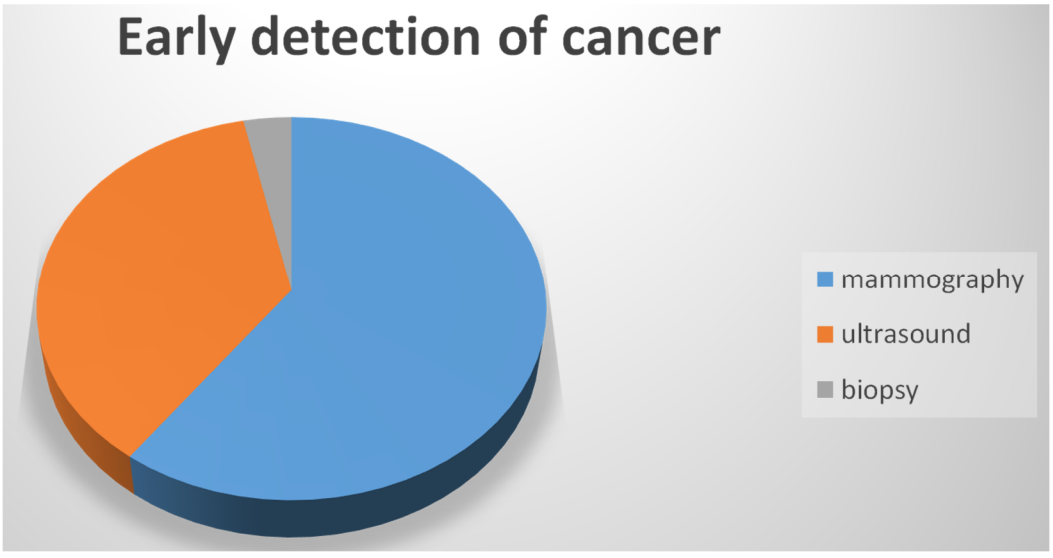

Figure 2. The early detection of malignant breast masses.

Table 2. Cancer and BI-RADS correlation.

BI-RADS	Frequency	Percentage (%)
BI-RADS 3	1	3.3
BI-RADS 4	17	56.7
BI-RADS 5	12	40.0
Total	30	100.0

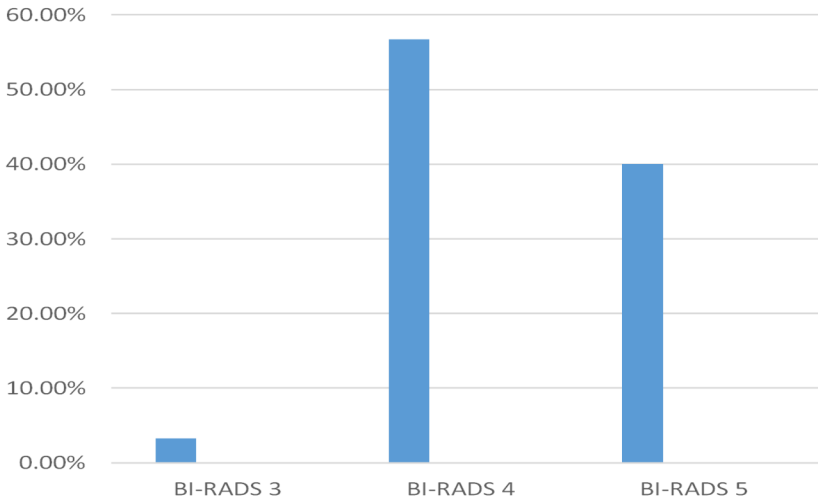

Figure 3. Cancer and BI-RADS correlation.

Table 3. Cancer diagnosed according to breast density.

ACR	Frequency	Percentage (%)
ACR A	8	26.7
ACR B	13	43.3
ACR C	5	16.7
ACR D	4	13.3
Total	30	100.0

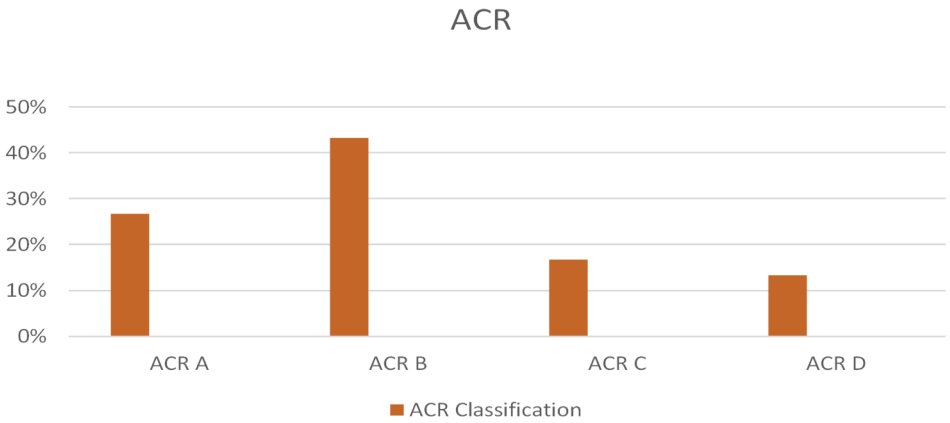

Figure 4. Cancer diagnosed according to breast density.

Table 4. Comparative sensitivity of ultrasound and mammography in all subjects in different age groups.

Age group	No. of patient	Mammography	Percentage (%)	Ultrasound	Percentage
20-29	1	0	0.0	0	0.0
30-39	6	3	50.0	3	50.0
40-49	7	2	28.6	5	71.4
50-59	14	11	78.6	3	21.4
60-69	1	1	100.0	0	0.0
70-79	1	1	100.0	0	0.0
Total	30	18	60.0	11	36.7

Table 5. Comparative sensitivity of mammography and ultrasound in a patient with different breast density.

Breast density	No. of patients	Mammography	Percentage (%)	Ultrasound	Percentage (%)
ACR A	8	7	87.5	1	12.5
ACR B	13	8	61.5	5	38.5
ACR C	5	2	40.0	3	60.0
ACR D	4	1	25.0	2	50.0
Total	30	18	60.0	11	40.0

Table 6. Total numbers and percentage of biopsy pathology diagnoses.

Type of tumor	Frequency	Percentage (%)
IDC	26	86.7
DCIS	3	10.0
Mixed lobular and IDC	1	3.3
Total	30	100.0

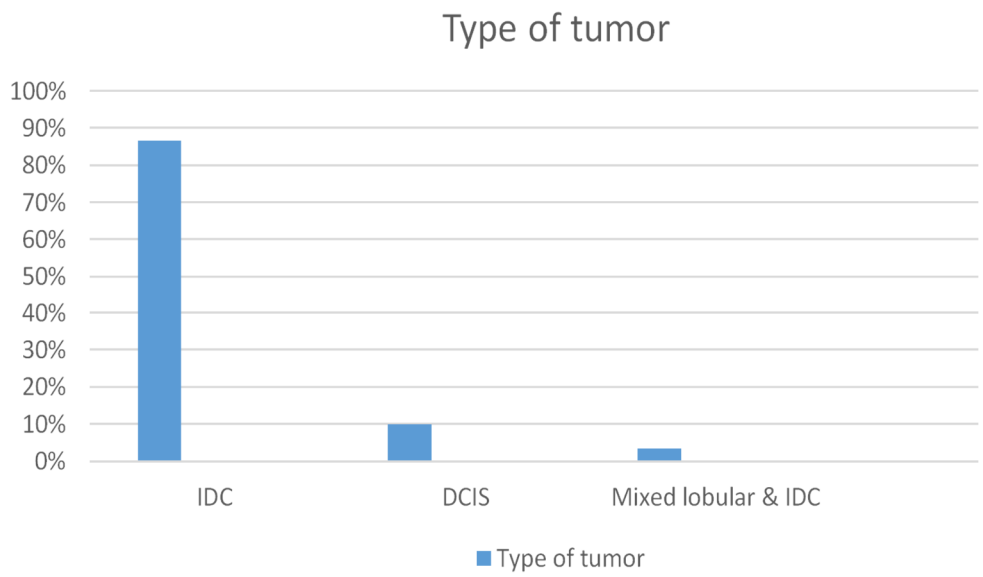

Figure 5. Total numbers and percentage of biopsy pathology diagnoses.

Table 7. Total numbers and percentage of different grades of tumor.

Grade	Frequency	Percentage (%)
Grade 1	3	10.0
Grade 2	24	80.0
Grade 3	3	10.0
Total	30	100.0

DISCUSSION

In our study, most of the cases of breasts with categories ACR A and ACR B proved to be diagnosed by Mammography. Two studies analyzed mammographic results of breasts in categories ACR C to ACR D (Houssami at el., 2005), and the other studies evaluated the mammograms of ACR B to ACR D breast tissue (Boyd et al., 2005). Sensitivity of both tests in relation to age has variability. In our study, the sensitivity of mammograms increased after the age of 50 years, the sensitivity of mammograms was 60% and ultrasound sensitivity was 36.4%. In other studies the sensitivity of mammography increases substantially after age 60, ultrasound was more sensitive than mammography in women younger than 45 years. The ultrasound sensitivity was 35%, and the mammography sensitivity was 65%. (Houssami at el., 2005).

Ultrasonography is more sensitive than mammography in detecting lesions in women with dense breast tissue. In young women and women with dense breasts, ultrasound appears superior to mammography. Dense fibro glandular tissue is the most important inherent limitation of mammography in the diagnosis of breast cancer. Bilateral whole-breast US can be an effective adjunct imaging examination in the evaluation of women with dense breast tissue and small-sized lesion. (Boyd et al., 2005). Comparing the sensitivity of mammography and ultrasound according to the breast density indicates that mammography is more sensitive in the dominant fat tissue (87.5%) and at the scattered fibro glandular density (61.5%). With the increase of fibro glandular density the level of sensitivity with mammography decreases, while with the ultrasound the level of sensitivity increase to the higher breast density 50.0% and hetero-geneously breast density 60.0%. The differences between these two diagnostic methods are significant. In the last decades, there is little increase in knowledge and development of breast cancer management, which resulted in increased mortality rates from breast cancer. All women are at risk for developing breast cancer. The older a woman is, the greater her chances of developing breast cancer. Approximately 77% of breast cancer cases occur in women over 50 years of age. The most important factor in reducing death from breast cancer is early detection. Early detection and treatment is a key to preventing breast cancer from spreading. Mammography and ultrasound are the standard imaging techniques for the detection and evaluation of breast disease (Schonberg at el., 2006).

The majority of cases (86.7%) studied here were diagnosed as invasive duct carcinoma close to the results of Masroor et al., 2015 who stated that 88% of the cases were Invasive duct carcinoma. The majority of our patients had stage 2 breast cancer. In accordance with our study, Harirchi et al. (2007) reported that about 96% of the patients had stage 2 breast cancer. The reasons why FNAC is preferred over core needle biopsy in many places in the developing countries is because of the perceived less cost of the procedure and the relative ease with, which procedure is carried out (Mendoza at el., 2011). It also does not require histological processing and therefore results are available much more quickly. So FNAC continues to be the most common method of choice for evaluating breast lesions (Vargas at el., 2003).

Women with dense breasts suffer from an increased risk of breast cancer combined with decreased sensitivity of mammography alone. The size of the lesion detected by ultrasound in a dense breast was less than 3 mm. Adding ultrasound screening can increase breast cancer detection rates by 1.9 to 4.2%, depending on the population. The majority of cancers were detected in breast tissue of ACR types A and B. Women with breasts of types ACR C or ACR D proved to have the highest proportion of breast cancers diagnosed by ultrasound screening. Comparing the sensitivity of mammography and ultrasound according to the breast density indicates that mammography is more sensitive for the fat tissue dominant and at the scattered fibro glandular density. With the increase of fibro glandular density the level of sensitivity with mammography decreases, while with the ultrasound the level of sensitivity increase to the higher breast density and heterogeneously breast density. The differences between these two diagnostic methods are significant.

Conclusion

The results indicate that breast density and age are important predictors of the efficiency of mammography and ultrasound. Breast ultrasound is more accurate than

mammography in symptomatic women 45 years or younger, mammography has progressive improvement in sensitivity in women 50 years or older. The accuracy of mammograms increased as women's breasts became fattier and less dense. In young women and women with dense breasts, ultrasound appears superior to mammography and may be an appropriate initial imaging test in those women. Biopsy detected one case of breast cancer in our results.

Consent for publication

All patients included in this research gave written informed consent to publish the data contained within this study.

Competing interests

The authors declare that they have no competing interests.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

Declarations of ethics approval and consent to participate

All study procedures were carried out in accordance with the Declaration of Helsinki regarding research involving human subjects. The committee's reference number is not available at this time. All patients included in this research gave written consent to participate in this research.

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