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Original article

ACR Breast Density: Relationship with Age, and Its Impact on Mammographic and Ultrasound Findings

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ABSTRACT

Breast cancer is a commonest cancer among women. Early detection by screening and diagnostic mammography could be reduced morbidity rate. ACR breast density is a risk factor in diagnosis of breast cancer in women whom have dense breast. ACR density mostly reduced with increasing age. A retrospective study carried on 222 female patients aged between 32-75 years with a mean 49 years, range 43 years, all patient subjected to mammography and complementary ultrasound, aimed to detect relation between ACR breast density and the age and the impact of ACR breast density on mammographic and ultrasound findings. Dense breasts (ACR d) seen only at younger age groups around 16 patients from 31-40 years age group and 14 patients from 41-50 years age group, the sensitivity and specificity of mammography in detection suspicious lesions in fatty breasts (ACR a) around 94.7% and 100 % respectively while the sensitivity and specificity of mammography in detection suspicious lesions in dense breasts (ACR c & d) were around 50% and 100 % respectively. ACR breast density usually has inverse relationship with the age, it could be reduced sensitivity of mammography in early detection of suspicious breast lesion especially in women have dense breasts, Addition of breast ultrasound as complementary imaging tool could be helpful in detection of occult mammographic lesions that could not detected in dense breasts.

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INTRODUCTION

Breast cancer is regarding the commonest type of cancer in women, accounting for 1 of every 3 cancers diagnosed. The rate of developing invasive breast cancer at some is just about 1 in 8 (12%). Breast cancer is one of the main reasons of cancer mortality among women [1]. There are a lots of well-established risk factors for developing breast cancer, including personal features and family history of breast cancer [2]. Investigators have identified mammographic breast density as a novel independent risk factor for breast cancer [2-5], because increased breast density will associated with a four- to six-fold increase in a woman's risk of malignant breast disease [6]. The diagnostic sensitivity of mammography in detecting breast cancer will decreased as the breast density increased that will increase risk for breast cancer [6].
More than 50 % of women between 25 and 49 years of age have dense breasts (> 50% density) while 76% of women >70 years of age had predominantly fatty breasts [7]. Women who had smaller breast tend to have dense parenchymal density [7].
At 1976 John Wolfe was a leader of breast density research, that early assessed breast density and divided it into 4 groups; N1: mostly fatty, P1: less than 25% prominent ducts, P2: more than 25% prominent ducts and DY: dense fibroglandular tissue. In his retrospective research, Wolfe reported 37 times higher in rate of cancer in the "DY" group than the "N1" group, and around 82% of the breast cancers occurred in 33% in the "P2" and "DY" groups [8].

At 1997 Tabar's classification system divided mammographic parenchymal patterns into 5 grades: Grade I (symmetry of all components with slightly greater fibrous tissues), II (bulk of fatty tissue), III (fatty breast with retroareolar residual fibrous tissue), IV (predominantly nodular and linear densities) and V (predominantly fibroglandular) [9,10].
The Breast Imaging Reporting and Data System (BI-RADS™), published by the American College of Radiology (ACR), is the most common classification used for breast density [11]. The last 5th edition of BIRADS published at 2013 in which breast density is divided into four groups: (1) almost entirely fat; (2) scattered fibroglandular tissue; (3) heterogeneously dense; (4) extremely dense [11].

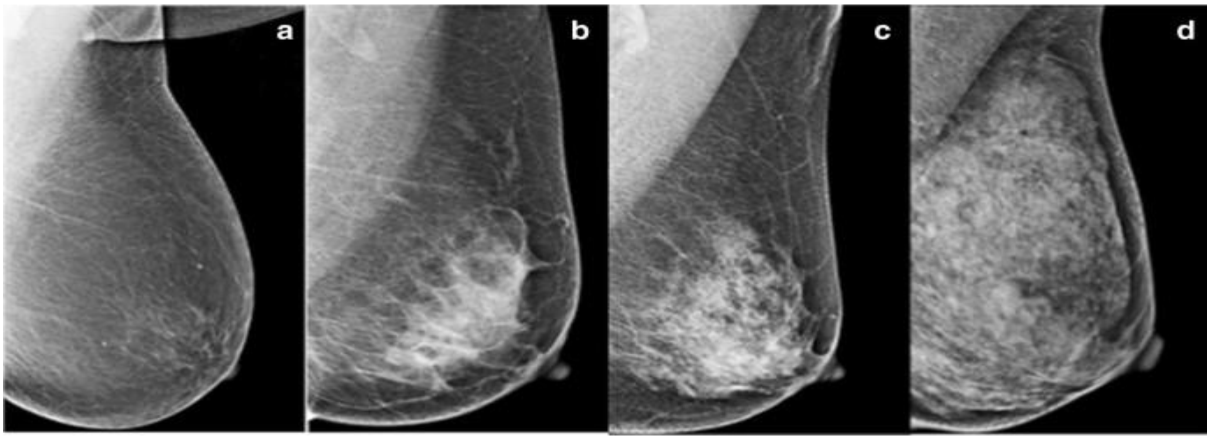

Figure 1. BI-RADS Density Types in Four Types. a) almost entirely fat; b) scattered fibroglandular densities; c) heterogeneously dense; d) extremely dense pattern [11].

The relation between increased breast density and an increased incidence of breast cancer is still unclear [12,16]. Nevertheless, some studies had been shown that increased breast density may decrease the sensitivity of mammography for detection of breast cancer [12,16].
Several researchers proved that age was an important factor for sensitivity and specificity in mammographic screening [13,14]. Most of young women tended to have dense breast tissue as compared to older women, that will limit the diagnostic sensitivity of the mammography [13,14]. There are other risk factors for breast cancer may affecting breast density. It has been reported that after oestrogen and progestin hormone treatment breast density could be increased by 3–5% [15].
Increased frequency of dense breast screening could help in early detection of breast cancer [17]. But in both the USA and Europe, there is much interest in complementary imaging technique in addition to mammography [18-20]. Therefore, there is a concern in the use of ultrasound whatever hand-held or automatic, in addition to mammography in the case of dense breast tissue [20,21].
Ultrasonography has been playing an increasingly important role in the evaluation of breast cancer. In the case of a patient without symptoms, breast ultrasound has a higher sensitivity for detecting breast cancer in women with dense breast tissue, women under the age of 50 and high-risk women [22,23].
Breast ultrasound is useful in many important conditions such as evaluation of a palpable mass that incompletely evaluated by mammography, discrimination between a cystic and a solid lesion, evaluation of palpable lesions which associated mammographic asymmetry, no mammographic findings and for evaluation the implants [22,23].
Ultrasound can be discovered about 10-40 % of mammographically occult cancers depending on the patient's breast density and age [22,23].
In our study, we will assess the relationship between ACR breast density and the age and its impact on mammographic and ultrasonographic findings.

METHODS

Study design

This retrospective study was conducted on 222 female patients and data were collected from 1st January 2022 to 31 May 2023. All patients referred to Tyba imaging center that is a private centre for Radiodiagnosis located at Albaida city at Libya.

Data collection

The patients were referred for further evaluation to their complaints whatever breast mass, mastalgia and/or nipple discharge or referred for breast cancer screening, all patients were subjected to mammography followed by complementary ultrasound. Conventional film-screen mammography was performed with two views per breast, medio-lateral oblique (MLO) and cranio-caudal (CC) views. Breast density grades were also determined according to the BI-RADS on a scale of a-d.

Ultrasound examinations were performed by using a high-resolution unit (Mindray) with a linear array probe centred at 7, 5 MHz. All ultrasound examinations were performed with the patient in a supine position for the medial parts of the breast and in a contra lateral posterior oblique position with arms raised for the lateral parts of the breast. The whole breasts were scanned.

The physical examination of breast, mammographic interpretation and of breast ultrasound were performed by the same radiology specialist. Mammographic and ultrasound findings were interpreted according to the Breast Imaging Reporting and Data system (BI-RADS) diagnostic categories on a six-point scale, with BI-RADS 1 (negative), 2 (benign finding), 3 (probably benign), 4 (suspicious abnormality), 5 (highly suggestive of malignancy), and 6 (known biopsy-proven malignancy).

Statistical analysis

Data analysis was performed using SPSS including frequency and percentage for all variables. The data were interoperated in tables; the numerical data were presented as number and percentage. To find the significant difference between the observed variable studied, Chi–Square test was used to show the statistical significance. P value was taken as level of significance at <0.05.

RESULTS

Our study is carried on 222 female patients aged between 32-75 years with a mean 49 years, range 43 years and standard deviation 8.74. The age of patients was distributed into groups as illustrated in table 1.

Table 1. Distribution of patients according to age groups.

Age group	Frequency	Percentage
31-40	38	17.1
41-50	96	43.2
51-60	64	28.8
61-70	20	9.0
71-80	4	1.8
Total	222	100.0

The largest number of patients were from 41-50 years age group which representing around 43.2 % study group number followed by 51-60 years age group was around 28.8%, where 71-80 years age group was the smallest group in number of patient (around 1.8 %). All patients were subjected to mammography and complementary ultrasound. The breast density of patients was assessed and classified according to BIRADS –ACR breast density classification and the relation between age groups and breast density seen in table (2) and figure (1).

Table 2. The relation between age group and ACR breast density among group study (Chi square value 66.1 and P value were 0.000)

Age group		**ACR breast density**				**Total**
		ACR a	ACR b	ACR c	ACR d	
	31-40	4	6	12	16	38
	41-50	28	31	23	14	96
	51-60	38	13	13	0	64
	61-70	12	5	3	0	20
	71-80	4	0	0	0	4
Total		86	55	51	30	222

Dense breasts (ACR d) seen only at younger age groups around 16 patients from 31-40 years age group and 14 patients from 41-50 years age group. The largest number of ACR c breast density group was from 41-50 years age group (around 23 patients from 51 patients had ACR c breast density). While in 61-70 years age group were 12 of 20 patients (around 60 %) have fatty breasts (ACR a), also all patients of 71-80 year's age group had fatty breast (ACR a). Mammographic findings were interpreted and classified according to their nature into 3 groups (no abnormality could be detected, benign findings and malignant findings).

Mammographic benign findings including well defined oval iso or hypodense lesion, coarse calcification and post-operative or post radiation skin thickening.

Mammographic suspicious findings including irregular speculated or rounded hyperdense lesions, ill-defined borders, skin thickening or/ and retraction, nipple retraction, architectural distortion and pathological lymph nodes enlargement. Nature of lesion in mammography cross tabulated with breast density among the study group to detect the relation to each other as seen in table 3.

Table 3. The relation between ACR breast density and nature of lesion in mammography among group study (Chi square 12.4 and P value 0.053).

ACR breast density		Nature of lesion in mammography			Total
		No abnormality could be detected	Benign nature	Suspicious nature	
	ACR a	50	18	18	86
	ACR b	32	16	7	55
	ACR c	40	8	3	51
	ACR d	23	5	2	30
Total		145	47	30	222

No abnormality could be detected in around 145 patients (40 patients have ACR c and 23 patients have ACR d) while only 30 patients have a suspicious finding in mammography.

Ultrasound performed for all patients and ultrasound finding also classified into 3 groups (no abnormality could be detected, benign findings and malignant findings). Ultrasonographic benign findings including fibrocystic diseases of breast, breast cyst, fibroadenoma, lipoma, hematoma, post-operative seroma, post radiation skin thickening, duct ectasia, mastitis, abscess and reactive axillary lymph nodes enlargement.

Ultrasonographic suspicious findings include hypoechoic speculated lesions, rounded lesions (longer than wider), heterogeneous solid and cystic lesions, microcalcifiction, soft tissue mass within dilated duct, skin thickening with interstitial edema and pathological axillary lymph nodes enlargement. Nature of lesion in ultrasound cross tabulated with breast density among the study group to detect the relation to each other as seen in table 4.

Table 4. Relation between ACR breast density and nature of lesion in ultrasound among group study (Chi square 11.4 and P value 0.075).

ACR breast density		Nature of lesion in ultrasound			Total
		No abnormality could be detected	Benign nature	Suspicious nature	
	ACR a	27	40	19	86
	ACR b	12	32	11	55
	ACR c	11	34	6	51
	ACR d	3	23	4	30
Total		53	129	40	222

Number of patients with no abnormality could be detected around 53 patients (markedly reduced in comparison with the number of same categories in mammographic examination), marked increase in patient number with benign nature of detected lesions (40 patients had ACR a, 34 patients had ACR c and 23 patients had ACR d), increasing in number suspicious lesions detected in ultrasound (around 40 patients) in comparison with suspicious lesions detected by mammography (around 30 patients). Table (5) and (6) showing distribution of groups study according to nature of lesion in mammography and ultrasound respectively.

Table 5. Distribution according to nature of lesion in mammography

Mammography	Frequency	Percentage
No abnormality could be detected	145	65.3
Benign nature	47	21.2
Suspicious nature	30	13.5
Total	222	100.0

Table 6. Distribution according to nature of lesion in ultrasound among study group.

Ultrasound detection	Frequency	Percentage
No abnormality could be detected	53	23.9
Benign nature	129	58.1
Suspicious nature	40	18
Total	222	100.0

Mammographic and ultrasound findings were interpreted according to the Breast Imaging Reporting and Data system (BI-RADS) diagnostic categories on a six-point scale and its relation to age group is illustrated in table 7.

Table 7. The relation between age group and BIRADS classification among study group (Chi square 30.9 and P value 0.055).

Age groups	BIRADS						Total
	BIRADS 1	BIRADS 2	BIRADS 3	BIRADS 4	BIRADS 5	BIRADS 6	
31-40	7	2	24	3	2	0	38
41-50	25	19	39	10	3	0	96
51-60	13	7	32	9	1	2	64
61-70	4	2	6	4	3	1	20
71-80	2	0	1	0	1	0	4
Total	51	30	102	26	10	3	222

Most of patients classified as BIRADS 3 (around 39 patients from 41-50 years age group and 32 patients from 51-60 years age group) and advised for follow up, around 51 patients classified as BIRADS (completely normal imaging for annual routine mammography as respect to age) while around 36 patients had a suspicious finding in mammography and/or ultrasound and further assessment by biopsy is advised. In our study the sensitivity and specificity of mammography in detection suspicious lesions in fatty breasts (ACR a) around 94.7% and 100 % respectively while the sensitivity and specificity of mammography in detection suspicious lesions in dense breasts (ACR c &d) were around 50% and 100 % respectively.

DISCUSSION

Mammographic breast density has been studied for more than 45 years. Greater breast density not only is related to decreased sensitivity of mammograms because of a masking effect bualso is a major independent risk factor for breast cancer [8]. The current study done on 222 female patients aged between 32-75 years with a mean 49 years, range 43 years, aimed to detect the relations between ACR breast density and the age and its impact on mammographic and ultrasonographic findings.

Our study reveals inverse relation between ACR breast density and the age, as dense breasts (ACR d) seen only at younger age groups around 16 patients from 31-40 years age group and 14 patients from 41-50 years age group, while 60% of 61-70 years age group had a fatty breast (ACR a), also all patients of 71-80 year's age group had a fatty breast (ACR a).

Checka et al study also revealed there is inverse relation between ACR breast density and the age [6]. In spite of this, some old patients have dense breast (ACR c or d) and some young patients showing ACR a in our study, the same thing is mentioned in Checka et al study and the aetiology was unknown [6].

In current study the sensitivity and specificity of mammography in detection suspicious lesions in fatty breasts (ACR a) around 94.7% and 100 % respectively while the sensitivity and specificity of mammography in detection suspicious lesions in dense breasts (ACR c &d) were around 50% and 100 % respectively.

Mandelson et al showed a mammographic sensitivity of 80% in women with predominantly fatty breast tissue that decreased to 30% in women with extremely dense breast tissue [24].

Also, Carney et al. studied the effects of breast density and other factors on the accuracy of screening mammography and described a significantly lower sensitivity of screening mammography in women with extremely dense breasts than in those with almost entirely fatty breasts (62.2% vs. 88.2%, respectively). Sensitivity dense groups (68.9%,). In this study, 7.8% of women had breasts that were classified as extremely dense [13].

Decreasing mammographic sensitivity in detection of suspicious lesions in dense breasts could be explained as breast cancer appears white on a mammogram, whether it is a mass, calcifications, distortion, or developing density. The possibility of a cancer being masked by overlying breast tissue is greater in dense breasts than fatty ones [25,26]. Around 10 false negative patients in mammography diagnosed as a suspicious lesion by ultrasound, false negative results in our study could be explained by high density of breast in these patients.

Rebolj et al Studies have consistently shown an increased detection by supplementary ultrasound of predominantly small but invasive breast cancers in women with dense breasts [27].

Some studies provided limited role of mammography in screening for breast cancer, an additional ultrasound examination after a negative mammogram is useful for the detection of primarily invasive cancers in women with mammographically dense breast tissue (ACR types 3 and 4), with the mean size of invasive cancers thus identified being 9.9 mm and in 90% with negative lymph node status [28].

CONCLUSION

ACR breast density usually has inverse relationship with the age, it could be reduced sensitivity of mammography in early detection of suspicious breast lesion especially in women have dense breasts (ACR c and d).

Addition of breast ultrasound as complementary imaging tool could be helpful in detection of occult mammographic lesions that could not detected in dense breasts.

Conflict of Interest

There are no financial, personal, or professional conflicts of interest to declare.

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كثافة الثدي حسب ACR :العلاقة بالعمر وتأثيرها على نتائج التصوير الشعاعي للثدي والموجات فوق الصوتية

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المستخلص

سرطان الثدي هو أكثر أنواع السرطان شيوعًا بين النساء. يمكن أن يؤدي الاكتشاف المبكر عن طريق الفحص والتصوير الشعاعي للثدي التشخيصي إلى تقليل معدل الإصابة بالمرض. تعد كثافة الثدي في ACR عامل خطر في تشخيص سرطان الثدي لدى النساء اللاتي لديهن ثدي كثيف. تنخفض كثافة ACR في الغالب مع تقدم العمر. أجريت دراسة بأثر رجعي على 222 مريضة تتراوح أعمارهن بين 32 و 75 عامًا بمتوسط 49 عامًا ونطاق 43 عامًا، وجميع المريضات خضعن للتصوير الشعاعي للثدي والموجات فوق الصوتية التكميلية، بهدف اكتشاف العلاقة بين كثافة الثدي في ACR والعمر وتأثير كثافة الثدي في ACR على نتائج التصوير الشعاعي للثدي والموجات فوق الصوتية. الثدي الكثيف (ACR d) يُرى فقط في الفئات العمرية الأصغر حوالي 16 مريضة من الفئة العمرية 31-40 عامًا و 14 مريضة من الفئة العمرية 41-50 عامًا، حساسية وخصوصية التصوير الشعاعي للثدي في الكشف عن الآفات المشبوهة في الثدي الدهني (ACR a) حوالي 94.7٪ و 100٪ على التوالي بينما كانت حساسية وخصوصية التصوير الشعاعي للثدي في الكشف عن الآفات المشبوهة في الثدي الكثيف (ACR c & d) حوالي 50٪ و 100٪ على التوالي. عادة ما يكون لكثافة الثدي في ACR علاقة عكسية مع العمر، يمكن تقليل حساسية التصوير الشعاعي للثدي في الكشف المبكر عن آفة الثدي المشبوهة خاصة عند النساء ذوات الثدي الكثيف، يمكن أن يكون إضافة الموجات فوق الصوتية للثدي كأداة تصوير تكميلية مفيدًا في الكشف عن الآفات الماموغرافية الخفية التي لا يمكن اكتشافها في الثدي الكثيف.

الكلمات المفتاحية. سرطان الثدي، التصوير الشعاعي للثدي، كثافة الثدي حسب ACR، BIRADS.