RESEARCH ARTICLE

Imperfect Correlation of Mammographic and Clinical Breast Tissue Density

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Abstract

Background: Clinicians determine degree of mammographic density based on tissue firmness on breast examination. The study aimed to compare breast density in mammography and clinical breast examination. Materials and Methods: Six-hundred sixty three women 40 years of age or older were studied. The breast exam density was graded from 1 to 4 by two expert surgeons and the mammographic parenchymal density by two expert radiologists. Then for practical reasons, grades 1 and 2 were considered as low-density and grades 3 and 4 as high-density. Results: High and low densities were detected in 84.5% and 15.5% of clinical breast examinations and 59.7% and 40.3% of mammographies, respectively. The statistical analysis showed a significant difference between the breast tissue densities in breast examination with those in mammography. Conclusions: A clinically dense breast does not necessarily imply a dense mammographic picture.

Keywords: Breast - density - clinical examination - mammography - neoplasm

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Introduction

Breast examination is an essential component of breast cancer screening and diagnosis (Corbex et al., 2012; Bryan and Snyder, 2013). During the examination, the physician assumes an opinion about the degree of tissue firmness and unconsciously interprets it as equal to breast density in mammographic images. However, literature contains no documented evidence to validate this belief. The subject needs to be investigated because if the relation is true, it will allow optimization of the mammography technique based on the exam result (Swann et al., 1987; Boren et al., 1990). On the other hand, the breast examiner would probably request other studies such as sonography or magnetic resonance mammography based on the result of palpation. If the relation is incorrect, then planning for imaging studies regarding the physical examination could be misleading and unsafe for the patient.

The aim of this study was to compare the breast density detected in clinical breast examination with that in mammography.

Materials and Methods

This cross-sectional investigation was part of a large study conducted in a university hospital (Arash Women's Hospital, Iran) between the years 2010 to 2012. Six-hundred sixty three 40 years old or more participated in this study. Exclusion criteria were women with a history of any kind of breast operation or breast cancer, abnormal breast exam, having a mammogram within the previous 12 months, pregnancy, and a mammogram with grade III or IV Breast Imaging-Reporting and Data System (BIRADS) classification.

As a rule, in the breast clinic of Arash Women's Hospital, mammography is done in 2 standard cephalocaudal and mediolateroblique views for all normal-risk patients 40 years of age or more. The mammograms are classified according to the BIRADS classification of the American College of Radiology (ACR). In order to undertake this study, a grading system was described for the density of breast examination. According to this system, breast density is divided to four grades from 1 to 4 based on the firmness and thickening of the tissue on palpation. Two expert surgeons in breast diseases examined 30 patients separately to assimilate their grading of breast density with each other and according to the determined system. Then all the patients with normal breast exam and other inclusion criteria were entered in the study. The breast exam density was determined by one of two surgeons. The mammographic density was graded by two expert radiologists who were not aware of the exam into classes 1 to 4 of the parenchymal mammographic classification system of ACR. The clinical and mammographic density grading results were compared. Statistical analysis was performed using SPSS version 16. Statistical significance was analyzed using χ^2 test as appropriate. $P<0.05$ was considered statistically significant. The ethics institutional

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Table 1. General Characteristics of Patients

Characteristics		n (%)	mean±SD	Min	Max
Age			48.81+6.41	40	78
BMI			33.99+5.4	18.5	58
Age at first birth			20.22+4.17	13	38
Pariety	Nulliparous	7 (1.1%)			
	Parous	618(93.2%)			
	Unknown	38 (5.7%)			
Menopausal status					
	Premenopous	385(58.1%)			
	Postmenopous	257(38.8%)			
	Unknown	21 (3.2%)			

Density	BIRADS breast density in mamography	Clinical examination N (100%)
1	85(12.8%)	218(32.9%)
2	311(46.9%)	342(51.6%)
3	221(33.4%)	103(15.5%)
4	46 (6.9%)	0

review board of Tehran University of Medical Sciences approved the study and informed consent was obtained from all participants.

Results

Overall 663 patients were illegible for the study. General characteristics (age, BMI, parity, menopausal status, age at first birth) of patients are shown in Table 1.

In this study the most common grade of breast tissue density according to the parenchymal mammographic classification system of ACR was grade 2 (Table 1). In order to have a practical comparison, grades 1 and 2 of both of the clinical and radiologic assessments were considered as low-density cases and grades 3 and 4 as high-density. Analysis of the mammography results shows that low-densities were detected in 396 (59.7%) of the participants and high-densities in 267 (40.3%) of them. In clinical examination, high- and low- densities were identified in 560 (84.5%) and 103 (15.5%) of the participants, respectively. The statistical analysis shows a significant difference between the breast tissue densities in breast examination with the parenchymal densities in mammography ($p<0.002$). The final analysis of the results shows that there is no significant relationship between the density of the breast tissue in mammography and the breast density on physical examination.

Discussion

Breast tissue includes glandular and fatty tissue, their distribution determines the density of mammographic pictures. Besides the reverse relation between age and breast density, developmental and physiologic hormonal changes affect breast composition bilaterally. As well, genetic predisposition and weight alterations have influence on density (Garcia-Manso et al., 2013).

Mammographic density is a term used to describe the amount of dense and lucent areas in the mammograms. This depends on breast tissue composition; whereas fibrous and glandular structures produce mammographic density and fat causes lucency (Brisson et al., 2003; Zulfiqar et al., 2011; Garcia-Manso et al., 2013). Several techniques are used for the assessment of density in mammography, including Wolfe's method, BI-RADS classification, and computer-assisted planimetry (Galukande and Kiguli-Malwadde, 2012).

Mammographic breast density has important impacts on breast cancer science. Small lesions and microcalcifications can be missed in high density mammograms, warranting additional imaging modalities to complete the diagnosis. (Garcia-Manso et al., 2013). Actually, the sensitivity of cancer detection in mammography depends highly on its density. Accordingly, the sensitivity varies from 36% in dense breasts to 98% in very low density mammograms. In the former situation, clinical breast exam may find tumors which are not detected in mammography (Drukteinis et al., 2013). Moreover, high density breasts in mammography are at a higher risk for breast cancer (McCormack and dos Santos Silva, 2006; Vachon et al., 2007; Heine et al., 2008; Zulfiqar et al., 2011; Phipps et al., 2012). When using breast density as a predictor of breast cancer risk, the majority of the studies report 2- to 6-fold increased risks for the highest group in comparison with the lowest risk categories (McCormack and dos Santos Silva, 2006; Vachon et al., 2007; Galukande and Kiguli-Malwadde, 2012). Density in mammography has been accepted as one of the strongest risk factor for the cancer (Hanna and Diorio, 2013), stronger than nulliparity and early menarche, implying some independency to estrogen mediated effects in its carcinogenesis (Galukande and Kiguli-Malwadde, 2012). In a study including 1028 breast cancer cases and 1,780 controls in the Nurses' Health Study, Yaghjyan et al have shown that the direct association between mammographic density and breast cancer risk remains valid till 10 years later (Yaghjyan et al., 2013). Nevertheless, this is mostly unknown to patients; a research undertaken among 77 black and white women demonstrated that women were not aware that dense breasts carried a higher risk of breast cancer. White women were more alert about the amount of density of their breasts than their black counterparts in this study (Manning et al., 2013).

Each mammographic exam exposes the patient to some radiation, and although the absorbed dose of radiation is very low, the possibility of cancer induction has been declared in studies and revealed in mass media, inspiring anxiety in women in screening ages. Different approaches have been planned to overcome the feared harmful effects of radiation; spectral imaging, low-dose photoncounting mammography, contrast-enhanced digital mammography and digital breast tomosynthesis are some of these innovative technologies (Drukteinis et al., 2013). Considering the significance of density assessment and the disadvantages of ionizing radiation, Kim et al. (2013) compared the intermodality and interobserver agreements of full-field digital mammography and ultrasonography in 41 participants. Densities were graded in the latter by 8 radiologists blinded to the results of the former. The intermodality agreement was 68% overall and 86% in dense breasts while the difference between densities assigned by radiologists in the two modalities was non-significant.

Every screening and diagnostic imaging entails some costs for the health system. This has triggered many arguments regarding the cost-effectiveness of screening, the issue has been debated further in developing countries where alternative approaches as opportunistic screening and screening by clinical or even self breast exam have been proposed (Corbex et al., 2012).

If the amount of breast density in mammography is based on its fatty and glandular composition, one should assume that the density in examination would be the equivalent, because the above composition should have comparable consistency in palpation. Hence, one important issue is the correlation between mammographic and clinical breast density. A positive association would encourage ordering studies other than mammography from the very first visit of the patient based on tissue thickness, while this behavior could be a hazard for women would the contrary be proved. Besides and more particularly, in the former case, the patient would be spared of the potential and feared hazards of radiation; and the utmost encouraging consequence of a positive association between mammographic and clinical density would observe breast cancer risk prediction, assuming a higher risk in clinically dense breasts.

In the present study, the analysis was done after grouping the exam and mammographic grades in high- and low-density classes. The rational for this classification is that in practice, the breast is regarded overall as “dense” or “non-dense”. Nonetheless, this was not applied in the initial grading because of the wide range of breast tissues thickness in clinical examination and the standard grading systems in mammography. The results show a significant difference between the breast tissue densities in breast examination with the parenchymal densities in mammography.

In a study conducted by Boren et al, 909 patients aged 19 to 85 years who had undergone physical breast examination and mammography were compared regarding the density. The breast exam was undertaken by two expert nurses and the density was graded 1 to 4 based on the examiner’s overall subjective impression about the breast consistency, influenced by the compressibility, heaviness and lumpiness. The mammographs were rated by board certified radiologists according to the amount (percent) of parenchyma tissue in the breast, ensuing grades 1 to 4 densities. Each group was blinded to the other’s rating. The study showed little correlation between breast exam and mammography density (Boren et al., 1990).

Swann et al. (1987) undertook a similar study on 200 women aged 26 to 86 years. The breast exam was assessed by technologists in the radiology suite. They graded the compressibility based on tissue firmness in palpation, the size of the breast according to the bra cup size, and thickness of the breasts by measuring the distance between the upper and lower compression plates of the mammography device when the breast was compressed in the craniocaudal projection. These values were then compared with mammographic density based on the parenchymal patterns graded by two radiologists. They showed that the breast density cannot be predicted by this method.

Our study had several advantages over previous ones. All the patients entering the study were 40 years and older, thus eliminating the bias induced by very dense mammographic parenchymal patterns of young or very young breasts. The clinical examination was done by breast surgeons with a 10 year experience of practicing in breast clinics, which has a great reliability and contradicts the probable objection to the possible modest experience of radiology technologists or even nurses in breast exam. The grading of the clinical densities by the two surgeons had been matched before study. This certainly does not eliminate completely the bias but can lessen it. The breast volume has not been considered in our study because it can be falsely regarded as voluminous according to the amount of adiposity or parenchymal tissue, and not their proportions.

Despite of its superior design, the study shows no relation between breast density in clinical and mammographic evaluations, confirming previous results.

The clinicians should realize that a dense breast in the clinic would not imply a dense mammographic picture; this can have a substantial impact on their practice. The sample size was acceptable in our study but it seems that verifying the results in very large cohorts would be useful.

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