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Comparing Conventional and Digital Mammography in Patients With Microcalcifications

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Abstract

Objective: Microcalcifications are the primary mammographic abnormalities in 40% of nonpalpable breast cancers. The aim of this retrospective study is to compare the diagnostic value of conventional and digital mammography (CMG and DMG) by reviewing the histopathological results of microcalcifications evaluated with stereotactic biopsy together with these two methods.

Material and method: The mammography and stereotactic biopsy images and medical records of 464 females who had undergone wire localization for microcalcifications with CMG and DMG between May 2003 and May 2011 were retrospectively evaluated. The histopathology results were compared according to the positive and negative predictive values (PPV and NPV) and the BI-RADS classification.

Results: The histopathology was malignant in 57% (120/207) of the microcalcifications detected with CMG and 22.5% (58/257) of those detected with DMG. The malignant pathologies detected on CMG were infiltrative in 55% and in situ in 45%. The malignant pathologies detected on DMG were infiltrative in 43% and in situ in 56.9%. The microcalcifications detected on CMG were distributed as 30 BI-RADS 3 (PPV: 93.3%); 135 BI-RADS 4 (PPV:39%), and 42 BI-RADS 5 (PPV:100%) lesions and the total PPV was 66%. The microcalcifications detected on DMG were distributed as 1 BI-RADS 3 (PPD: 100%), 249 BI-RADS 4 (PPD: 20%), and 7 BI-RADS 5 (PPD:100%) cases and the total PPV was 22%.

Conclusion: Detecting microcalcifications, which are not visible on CMG, increases the 'false positivity' rate but the increase in the detection rate of in situ cancers with DMG can be accepted as an advantage of this method.

Key Words: Mammography; Digital, Conventional; Microcalcification.

Mikrokalsifikasyonlu Hastalarda Konvansiyonel ve Digital Mammografilerin Karşılaştırılması

Özet:

Amaç: Nonpalpabl meme kanserlerinin yaklaşık %40'ında mikrokalsifikasyonlar primer mammografik anormalliklerdir. Bu geriye dönük çalışmada, konvansiyonel ve digital mamografi (KMG ve DMG) eşliğinde stereotaktik biyopsi yapılan mikrokalsifikasyonların histopatolojik sonuçlarıyla beraber değerlendirilerek her iki yöntemin tanısal değerinin karşılaştırılması amaçlanmıştır.

Gereç ve Yöntem: Mayıs 2003-Mayıs 2011 yılları arasındaki DMG ve konvansiyonel KMG eşliğinde mikrokalsifikasyonlara yönelik tel lokalizasyonu yapılan 464 kadın olgunun mamografi ve sterotaktik biyopsi görüntüleri, radyoloji raporları, hastane iletişim sistemindeki patoloji raporları ve epikrizleri geriye dönük olarak incelenmiştir. Histopatoloji sonuçları, pozitif prediktif değer (PPD) ve negatif prediktif değerleri (NPD), BI-RADS klasifikasyonuna göre karşılaştırılmıştır.

Bulgular: KMG'de saptanan mikrokalsifikasyonların %57'si (120/207), DMG'de saptanan mikrokalsifikasyonların %22.5'i (58/257) malign histopatolojiye sahipti. KMG'de saptanan malign patolojilerin %55'ini infiltratif, %45'ini insitu kanserler oluşturmaktaydı. DMG'de saptanan malign patolojilerin %43'ünü infiltratif, %56.9'unu insitu kanserler oluşturmaktaydı. KMG'de saptanan mikrokalsifikasyonların 30'u BI-RADS 3 (PPD: %93.3); 135'i BI-RADS 4 (PPD: %39), 42'si BI-RADS 5 (PPD: %100) olarak bulundu. Total PPD %66'idi. DMG' de saptanan mikrokalsifikasyonların 1'i BI-RADS 3 (PPD:%100), 249'u BI-RADS 4 (PPD: %20), 7'si BI-RADS 5 (PPD: %100) idi. Total PPD %22 olarak bulundu.

Sonuç: KMG'de göremediğimiz mikrokalsifikasyonların DMG ile saptanabilir olmaları, 'yalancı pozitif' olgu sayısını arttırmaktadır ancak DMG 'nin insitu kanserleri daha fazla sayıda saptayabilmesi yöntemin avantajlarından biri olarak kabul edilebilir.

Anahtar Kelimeler: Mamografi; Dijital, Konvansiyonel; Mikrokalsifikasyon.

INTRODUCTION

Breast cancer is the most common malignant tumour in women. It constitutes 30% of all cancers in female patients while it is also responsible from 18% of cancer deaths in women (1). The life-long risk of breast cancer development in women is 7-10%. The importance of effective use of periodical physical examination and basic diagnostic methods for early diagnosis is unquestionable (1-3).

Mammography (MG) is the most effective imaging method known to detect breast cancer in its early stages. Studies suggest that early diagnosis of breast cancer reduces mortality in patients aged between 40 and 69 by 15-35% (4, 5). Microcalcifications constitute approximately 55% of breast lesions. Microcalcifications may be the first and/or only signs of premalignant conditions like atypical hyperplasia or early-stage malignant lesions like carcinoma in situ. Given that approximately 40% of non-palpable breast cancers are primary mammography abnormalities of microcalcifications, early detection of distribution and

nature of microcalcifications plays a key role in the diagnosis of breast cancer (6).

Until recently, due to its high spatial resolution, conventional mammography (CMG) was the primary imaging modality in breast screening programmes. Allowing practitioners to benefit from the convenience of computer environment with the development of digital systems and creating the basis for advanced technologies, the newly developed digital mammography (DMG) has replaced conventional methods. Studies conducted in the recent years have indicated that there are no major diagnostic differences between CMG and DMG. In this retrospective study, we aim to compare the diagnostic values of CMG and DMG by applying stereotactic biopsy to microcalcifications while also alternately evaluating the histopathologic results of both methods.

MATERIAL AND METHODS

In this study, we have performed a retrospective analysis of the stereotactic wire markings of 1988 patients who have undergone both imaging techniques for 8 years between May 2003 and May 2011 at Ankara Oncology Training and Research Hospital, Department of Radiology. We have excluded cases with missing data records, mammography and stereotactic biopsy images, radiology reports, pathology reports in hospital digital archives along with those who had undergone stereotactic biopsy with ultrasonography (US). At the end of the preliminary research, we have narrowed down the scope of our study to 464 female patients with complete data with regards to their MG guided wire localisation for microcalcifications.

Our department performed wire localisation to 207 patients with microcalcifications between May 2003 and December 2008 with CMG while 257 patients underwent wire localisation with DMG between January 2009 and May 2011. All assessments were simultaneously performed by two radiologists with experience in the field of breast imaging.

Mammographic examinations and stereotactic markings were all performed on a Lorad Selenia digital mammography unit (Hologic) and Flat SE (Metaltronica).

Characteristics of microcalcifications: We have studied all the MG images and reports registered in the hospital data management system. The distribution and morphological characteristics of microcalcifications have been assessed in accordance with the "American College of Radiology" (ACR) criteria and classified based on the "Breast Imaging Reporting and Data System" (BI-RADS).

Wire localisation: Wire localisation in our department is routinely applied as follows. We first inform the patient about the procedures and get their written consent. All patients are questioned about a possible existing anticoagulant therapy; those who are on anticoagulants are referred to related clinics. We start the MG-guided localisation by detecting the point of the lesion that is closest to the skin with the help of craniocaudal and full lateral radiographs. We perform the marking by using a single or multiple-hole compression plate with the mammography equipment. After calculating the lesion coordinates on the plate, we apply the needle parallel to the chest wall and perpendicularly to the skin. Reaching to the previously measured depth of the lesion, we completely, but slowly, reduce the compression on the breast. When the needle is in the desired location, we gently push the hook-tipped wire in and fix its location. At the end, we take a control mammogram that shows the latest breast-needle-lesion relationship.

All the cases that were marked with the needle-wire system at the radiology clinic were sent to surgical clinics on the same day and taken to the operating room at most within1 hour. The field marked with wiring, along with at least 1cm of the surrounding intact tissue, was removed under general anesthesia. Before sending them for pathological examination, the removed sections were first checked by specimen radiography. After confirming with specimen radiography that the desired section has been removed, we notify the surgical team.

The cases with benign histopathology have been invited for routine MG check-up in the 12th month of the treatment. Those with malign results have been referred to surgery.

Statistical Analysis: Categorical variables have been indicated in percentages (%). Positive predictive value (PPV) and negative predictive value (NPV) have been calculated according to the formula presented below:

$$\text{Positive Predictive Value} = \frac{\text{True positives (TP)}}{\text{Total positives (TP+FP)}} \times 100$$

$$\text{Negative Predictive Value} = \frac{\text{True Negatives (TN)}}{\text{Total Negatives (TN+FN)}} \times 100$$

TP value was used for the patients who, after the MG evaluation, were classified as BI-RADS 4 or BI-RADS 5 (very likely to be malignant) with histopathological malignancy while the TN value was used for patients who were classified as BI-RADS 3 (very likely to be benign) after the MG and diagnosed as histopathologically benign. Similarly, FP value was based on the patients who were classified as BI-RADS 4 or BI-RADS 5 following the MG evaluation results (very likely to be malignant) though with histopathologically benign diagnosis while FN value was used for patients who were classified as BI-RADS 3 (very likely to be benign) after the MG evaluation results but with histopathologically malignant diagnosis.

RESULTS

The US and MG-guided wire localisation applications for microcalcifications in our department between May 2003 and December 2008 constitute 20.1% (1032/207) (CMG)

of our patients while 26.8% of (257/956) (DMG) the patients underwent wire localisation between January 2009 and May 2011. 57% (120/207) of the detected microcalcifications (with CMG) and 22.5% (58/257) of the DMG-detected microcalcifications had malignant histopathology. 55% of the malignant pathologies diagnosed with CMG (63 IDC, 3 metaplastic) were infiltrating cancer cases while 45% were in situ cancers. 43% of the malignant pathologies diagnosed with DMG were infiltrating cancers while 56.9% were in situ cancer cases (Figure 1a, 1b).

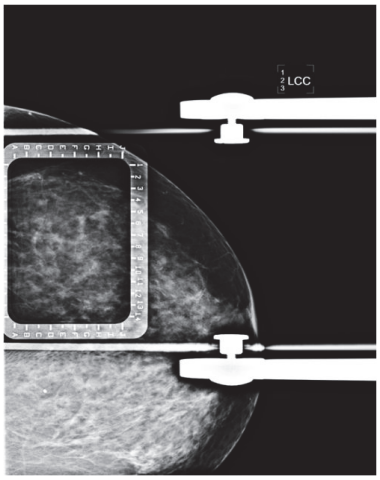

Figure 1a. Pulverulent microcalcifications on the CC graph on the outer frame of the window of the left.

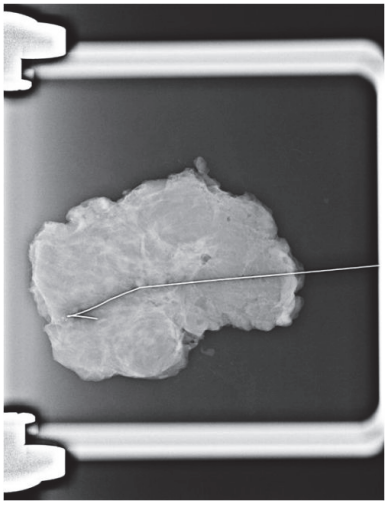

Figure 1b. The excised microcalcifications visible on the specimen MG following the wire localisation of the same patient in Figure 1a; the diagnosis is infiltrating ductal CA Grade 2.

41.3% of the benign pathologies detected with CMG and 45% of the benign pathologies detected with DMG were premalignant (moderate and severe epithelial hyperplasia, atypia) lesions. There were 30 BI-RADS 3 (NPV: 93.3%), 135 BI-RADS 4 (PPV: 39%), and 42 BI-RADS 5 (PPV: 100%) patients with microcalcifications diagnosed with CMG. The total PPV was 66%. There were 1 BI-RADS 3 (PPV: 100%), 249 BI-RADS 4 (PPV: 20%), and 7 BI-RADS 5 (PPV: 100%) patients with microcalcifications diagnosed with DMG. The total PPV was 22% (Table 1).

Table1. The correlation between the BI-RADS–histopathology results of microcalcifications diagnosed with DMG.

MAMOGRAPHY	MALIGNENT	BENIGN	TOTAL
BI-RADS 3	0(FN)	1(TN)	1
BI-RADS 4-5	58(TP)	198(FP)	256
TOTAL	58	199	257

DISCUSSION

Breast cancer is the most common malignant tumour in women and it constitutes about 30% of all cancers in women (1). Breast cancer occurs in one in every 10 women and it is responsible for one in every five of cancer-related deaths. Therefore, early diagnosis of breast cancer is of utmost importance to reduce mortality and morbidity (7). The number of detected non-palpable breast lesions has considerably increased due to the wide use of mammography screening in recent years (8).

Enabling storing, re-creating, and transferring data, DMG has become a valuable alternative to CMG. It is, thus, agreed that, due to its technical advantages, DMG may increase the rate of cancer detection. However, studies indicate that there are not many major diagnostic differences between CMG and DMG (9-11). Lewin et al. have examined 4,489 patients with both CMG and DMG only to find out that there was no significant difference in the rate of cancer detection between the two methods (9). Two large scale studies conducted by Skaane et al. have similarly shown that there was no significant differences in cancer detection between CMG and DMG (10,11). Pisano et al. have also failed to find significant differences between the two methods in terms of overall diagnostic accuracy though they have found some differences in the subgroups of their study. According to their study, women under the age of 50 in premenopausal or perimenopausal periods with dense and heterogeneous breast structures have proved to receive diagnosis significantly more accurately with DMG (12).

In the literature, the most frequent radio-morphologic criteria that can be regarded as an indication for biopsy are reported to be microcalcifications (13, 14). In our study, we have evaluated the microcalcifications that approximately formed 55% of the breast lesions during the screenings. The number of the wire localisation performed to cure microcalcifications and their application rate among other wire localisation applications were similar in CMG, which was used for 5,5 years, and DMG, which was used for 2.5 years. This is due to the rapid screening technology of DMG. We have detected more malignancies with CMG; and CMG was

more successful than DMG in diagnosing in situ cancers. However, considering the fact that microcalcifications are the only mammographic findings that can be detected in the early stages, DMG can be considered superior to CMG.

There were no significant differences between the two methods in terms of identifying premalignant lesions among benign pathologies. This finding is consistent with another study that compares CMG and DMG in terms of cellular atypia (15). The PPV for BI-RADS 4 (with CMG) was 39%; this was an overall of 66% for all categories. Our findings are also in line with other PPVs for microcalcifications (11%, 30%, 43%) (16-18). The PPV for BI-RADS 4 (with DMG) was 20%; this value was 22% for all categories.

In a similar study, in accordance with our reserach, PPVs for DMG were lower compared to CMG values (CMG: 20%; DMG: 12%) (19). This can be explained by the visibility of microcalcifications and higher number of biopsies resulting in high false positivity values. That the patients were not categorised according to breast density can be considered as a limitation of the study since DMG works with higher accuracy on dense breasts.

CONCLUSION

The fact that microcalcifications that are not visible with CMG can be detected with DMG raises the number of "false positive" cases though DMG's ability to identify in situ cancer types more accurately is one of its advantages.

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