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ÖZGÜN ARAŞTIRMA / RESEARCH STUDY

The Contribution of MRI to the Mammographic Findings in Patients with Elevated Risk of Malignancy

Yüksek Risk Grubu Olgularda Meme MR Görüntülemenin Mamografik Bulgulara Katkısı

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ABSTRACT

Objective: We aimed to examine the contribution of breast magnetic resonance imaging (MRI) to mammography in high-risk patients with partial mastectomy, and/or with a family history.

Material and Methods: 80 patients were scanned with mammography and MRI at our hospital. 30 of the patients had partial mastectomy due to the diagnosis of breast cancer. 52 patients had family history of breast cancer. Mammography scannings were performed under normal circumstances in standard craniocaudal (CC) and mediolateral (MLO) positions or in some special circumstances, scanings were performed using spot and magnification graphies. MRI scannings were performed using 1.5 Tesla MRI scanner with dual breast coil.

Results: Fifty two of the patients enrolled in this study had a relative with breast cancer. 30 (37,5 %) out of 80 patients had history of breast cancer before. In 12 (15 %) out of 80 patients, the advantage of breast MRI to mammography could not be proven. In 54 (67,5 %) of the patients breast MRI had an advantage over mammography. In 5 (6,5 %) of the patients MRI had false negative results when compared with the pathology results. When compared with the pathology results in 9 (19 %) patients MRI scanning results were false positive.

Conclusion: In this study, it was concluded that breast MRI scanning has reasonable advantage when compared to mammography for the patients who had breast cancer diagnosis or who has a first degree relative with breast cancer.

Keywords: Breast cancer; mammography; magnetic resonance imaging.

ÖZET

Amaç: Meme kanseri nedeniyle parsiyel mastektomi veya aile öyküsü gibi, meme kanseri için yüksek risk grubu olgularda, meme manyetik rezonans görüntüleme (MRG)'nin mamografik görüntülemeye katkısını değerlendirmeyi amaçladık.

Gereç ve Yöntem: Seksen olgu, bölümümüzde mamografi ve MRG ile değerlendirildi. 30 olgu, meme kanseri tanısı ile parsiyel mastektomi geçirmişti. 52 olgu, birinci derecede akrabada meme kanseri öyküsüne sahipti. Mamografik görüntüleme, standart kraniokaudal ve mediolateral pozisyonlarda elde olundu. Gerekli durumlarda spot ve magnifiye grafiler eklendi. MR görüntüleri, 1,5 Tesla MRG cihazında, dual meme koili ile elde edildi.

Bulgular: Elli iki olguda aile öyküsü mevcuttu. 30(% 37,5) olguda daha önce geçirilmiş meme kanseri ve tedavi öyküsü vardı. 80 olgudan, 12'sinde (% 15), meme MRG görüntülemenin mamografi bulgularına herhangi katkısı veya ek bulgu saptanmadı. 54 (% 67,5) olguda, MRG, mamografi bulgularına ek bulgu ve tanıya katkı sağladı. Patoloji sonuçlarıyla kıyaslandığında, 5 (% 6,5) olguda MRG'de yanlış negatif, 9 olguda (% 19) yanlış pozitif bulgular saptandı.

Sonuç: Bu çalışmada, birinci derece akrabalarında meme kanseri öyküsü veya geçirilmiş meme kanseri tanı ve tedavi öyküsü bilinen, yüksek riskli olgu grubunda, meme MRG görüntülemenin, mamografik bulgulara katkı sağladığını saptadık.

Anahtar Kelimeler: Meme kanseri; mamografi; manyetik rezonans görüntüleme.

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INTRODUCTION

Breast cancer is the most common cancer in women, and the second most common malignancy causing mortality after lung cancer. Benign breast lesions are seen quite often in women, in order to diagnose and to differentiate them from malignant lesions, breast imaging is very important (1- 3).

In breast imaging, mammography and ultrasound are the basic imaging methods among various algorithms and are indicated in screening and follow-up (2, 3). Due to some imaging limitations of the mammography method, magnetic resonance imaging (MRI) has become important in breast imaging (4). The appropriate indication being provided, breast MRI substantially stands in the breach in breast imaging (4).

Breast MRI provides significant benefits when it is used for the indications such as evaluation of implant rupture, preoperative staging of cancer patients who are scheduled for breast-conserving treatment, the detection of residual disease and recurrences in the postoperative period, the investigation of a primary tumor in patients with axillary metastasis, and the evaluation of responses to neoadjuvant chemotherapy (4). In addition, MRI can be used for further examination of patients in which there is a discrepancy between clinical, mammographic and ultrasonographic findings (4, 5). In breast imaging, MRI should be regarded as complementary method to mammography and ultrasonography (US), and as a problem-solving method for the appropriate indications (4, 5).

In our study, the contribution of breast MRI to mammography was examined in high-risk patients with previous partial mastectomy, and/or with a family history.

MATERIAL and METHODS

Eighty patients with first degree family or personal history of breast cancer were retrospectively evaluated, who were scanned with mammography, US and breast MRI during the period of May 2007- February 2009. Thirty of these patients had partial mastectomy due to breast cancer diagnosis, 52 had a first degree family history of breast cancer. MRI of premenopausal patients was performed between the 7th and 13th days of the menstrual cycle in order to avoid false-positive tissue enhancement. MRI was performed after at least 1 year from the completion of radiotherapy.

Mammography screening was performed with GE 600T Mammography AQ in the standard CC and MLO positions, and under special circumstances by using spot and magnification views. Also, US imaging was performed in all patients.

MRI examinations were carried out by using double-stranded breast coil in a 1.5 Tesla MRI unit (Philips). In examinations, for both breasts, fat-suppressed TSE (turbo spin echo), T1-and T2-weighted axial, 3D FFE T1-weighted axial, and after the injection of 0.1 mmol/kg contrast, dynamic 3D FFE T1-and post-contrast 3D FFE T1-weighted axial images were obtained. During dynamic examination, imaging was performed eight times during seven minutes (30 sec, 1 min, 1.40 min, 2.30 min, 3.30 min, 4.30 min, 5.30 min, and 7 min). Subtraction images were obtained by removing pre-contrast images from all post-contrast images after the examination. First of all, sizes of lesions and signal characteristics were determined on T1-and T2-weighted images. In order to avoid incorrect results as a consequence of insufficient spatial resolution and partial volume artifacts, lesions smaller than 4 mm were excluded from the study. Then, morphological and dynamic properties, quantitative analysis of contrast enhancement of the lesions, and enhancement kinetics of the parenchyma were evaluated. MRI findings were classified to the Breast Imaging Reporting and Data System (BI-RADS) categories. When a focal mass was identified with smooth borders and internal septa was classified as benign BI-RADS category 2. The lesions with smooth contour and continuous or plateau enhancement at dynamic images were identified as BI-RADS category 3. If the lesion had irregular contour, it was considered as BI-RADS category 4. Non-mass-related segmental or ductal enhancement was classified as BI-RADS category 4 or 5. When both morphologic and kinetic criteria suggested malignancy, the lesion was classified as BI-RADS category 5.

The chi-square test was utilized for the statistical analyses. All analyses were carried out with SPSS for Windows (SPSS, Inc., Chicago, IL, USA), and 95 % confidence intervals were calculated.

RESULTS

Eighty patients with an age range of 25-75 (mean age 49.9) were included in our study. The mean dimensions of the detected lesions were between 0.7-4 cm (mean; 1.8 cm).

Patients were divided into five groups according to the following mammographic findings; asymmetric and focal density (first group), density around operation area with breast cancer history (second group), parenchymal distortion (third group), diffuse density increase (fourth group), and microcalcification (fifth group). In 27 patients; there was asymmetric and focal density, in 21 patients with breast cancer history; there was density increase around the post opera tive location, in 12 patients; there was tissue distortion, in 10 patients; there was diffusely density increase almost the entire breast, and there was microcalcification cluster in 10 patients at mammography.

The breast parenchymal pattern was classified as 4 types; extremely dense in 21 (26,25 %) patients, heterogeneously dense in 29 (36,25 %) patients, scattered fibroglandular elements in 22 (27,5 %) patients, fat containing in 8 (10 %) patients based on mammographic findings and according to the BI-RADS classification method.

The patients with asymmetric and focal density at mammography; two fibroadenomas were detected at US and also which were verified with MRI. 2 complicated cysts that detected at US showed benign findings on MRI. One fibroadenoma that could not be detected with US was shown with MRI. In another patient, BI-RADS 3 hypoechoic lesion detected with US, showed malignant character on MRI. Histopathological result was invasive ductal carcinoma. In four patients, there was no ultrasonographic finding, but at MRI, malign lesions with type 3 dynamic enhancement; pathology results revealed invasive ductal carcinomas (BI-RADS 5) In another case, multiple focal density was detected as simple cyst at US, but other areas that not visualized by US. At MRI multifocal malignant lesions were detected which were patholocically results as invasive ductal and lobular carcinoma. One asymmetric density; BI-RADS 3 mammographic lesion was seen as hypoechoic lesion with irregular contour at USG in another patient. At MRI, lesion had malign characteristics and histopathology revealed invasive ductal carcinoma. At mammography of five cases, there was BI-RADS 5 lesions that dimensions ranged from 1,5 to 4 cm. US and MRI findings were similar with mammography. In two patients, lesion's dimensions were larger at MRI than US and mammography. In one patient, there was one lesion on mammography and US, but MRI showed 2 lesions. The other 7 patients with asymmetric and focal density increase showed no abnormality at US and MRI. Figure I shows mammography and MRI findings of invasive ductal carcinoma. Also Figure II shows MRI findings of benign lesion.

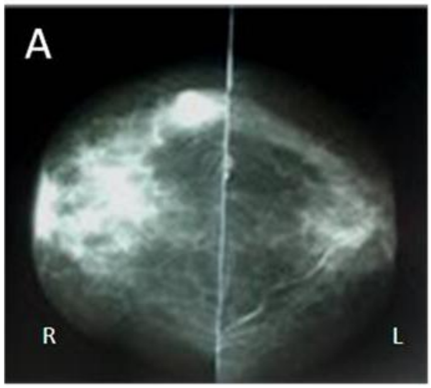

Figure I A: Shows craniocaudal mammographies; at right breast upper outer quadrant, there is an asymmetric density; a mass about 2 cm diameter. MRI was performed to evaluate the multicentricity of the tumor, but no other lesion was observed.

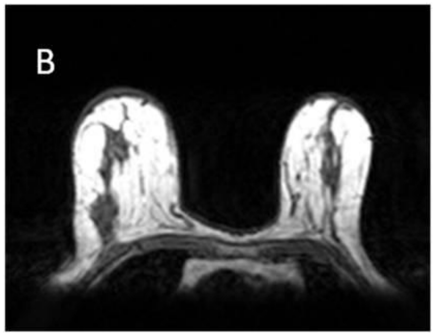

Figure I B: T1 weighted.

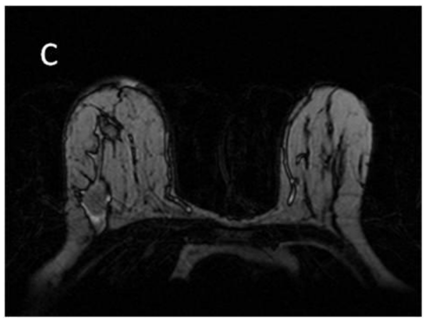

Figure I C: Fat-suppressed T2 weighted.

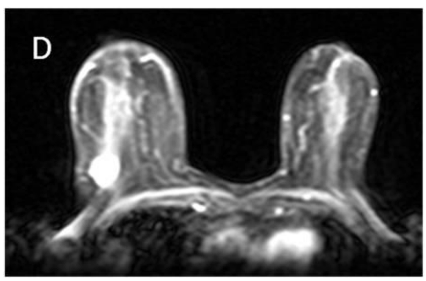

Figure I D: Fat-suppressed TSE, post contrast (iv Gd-DTPA) T1 weighted.

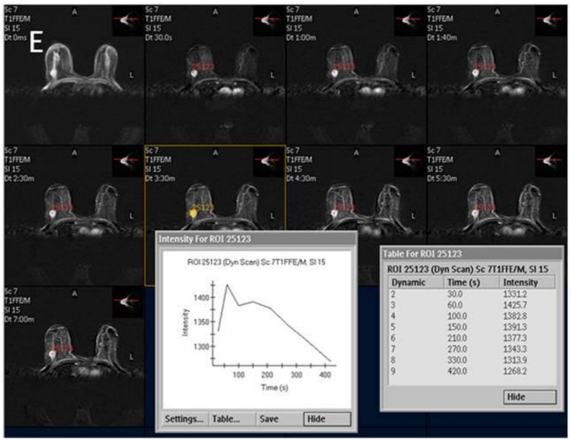

Figure I E: Dynamic studies show type 3 curve that support malignancy with peritumoral spread and wider boundaries compared to mammographies. Histopathologic diagnosis was invasive ductal carcinoma.

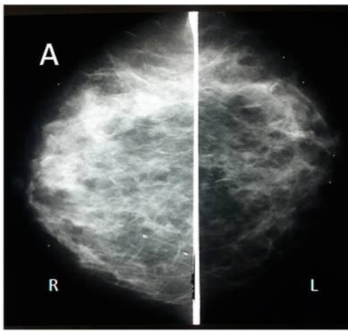

Figure II A: Craniocaudal (R: right breast, L: left breast).

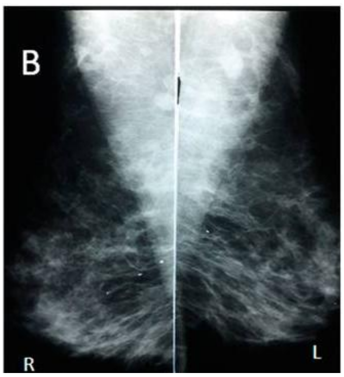

Figure II B: Mediolateral mammographies show asymmetric retroareolar density at right breast.

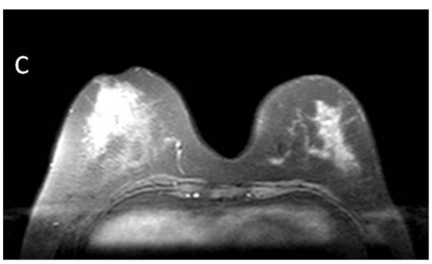

Figure II C: Fat-suppressed TSE, post contrast (iv Gd-DTPA) T1 weighted.

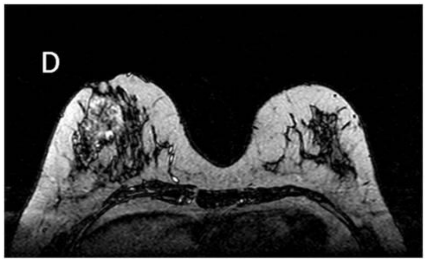

Figure II D: Fat-suppressed T2 weighted MRI images show retroareolar structures that prominently enhance compared to the normal glandular tissue at right breast.

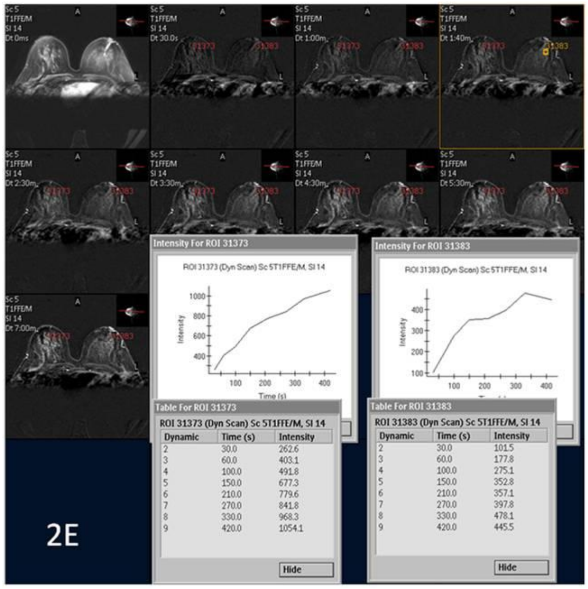

Figure II E: Type 1 dynamic curve support benign lesion; histopathologic diagnosis is intraductal papilloma.

In group with density increase around surgical site at mammography; 9 cases did not show any ultrasonographic and MRI findings and evaluated as granulation tissue. In four cases, US showed no abnormality but MRI findings supported scar and granulation tissue. In two cases, there was no ultrasonographic finding. But at MRI, there were two separate areas, scar tissue and another lesion that showed malignant dynamic enhancement in one case and in the other one, a malignant lesion at 7 mm diameter was detected with MRI. In two cases, suspicious hypoechoic lesions detected at US, but there was not lesion on MRI. Also, in two cases, hypoechoic lesions which were consistent with benign lesions revealed as fibroadenoma at dynamic MRI. In one case, there was BI-RADS 4 lesion at US. MRI showed malignant dynamic curves, and histopathology was invasive ductal carcinoma. In another case, BI-RADS 4 lesion was detected at US.

Dimensions of the lesion was 2,5x2,5 cm. At MRI, dimensions of the lesion was larger (4x4,5 cm).

In 10 patients with diffuse density increase in one breast; 3 of the patients, there was no ultrasonographic and MRI finding. 2 of the patients showed inflammatory changes ultrasonographically, but at MRI, there was tumoral lesion with malignant dynamic enhancement. One of the lesions was 5 cm, and the other was 2,5 cm in diameter. In one patient, there were inflammatory changes, but MRI did not show any specific finding. 3 of the patients, there was no ultrasonographic finding but at MRI, malignant lesions were detected. One patient had two lesions in 2,4 cm and 1 cm diameters. In the other patient, MRI showed 3 lesions with malignant findings in 5 cm, 3 cm and 1 cm diameters. In one patient, there was no ultrasonographic finding but at MRI, there was a lesion with irregular contours and benign dynamic enhancement, and evaluated as granulation tissue.

In 12 patient with tissue distortion at mammography, 9 of them, there was no ultrasonographic or MRI finding. At MRI, one of the patients had focal granulation tissue in the distorted area. In one patient, there was a hypoechoic, heterogeneous lesion in 2,2 cm diameter at US. The lesion showed malignant character at MRI (BI-RADS 4) and dimensions of the lesion was larger than the US. In one patient, a complicated cyst was detected at US, but lesion showed malignant dynamic enhancement in MRI. Histopathologically, all of the malignant lesions were invasive ductal carcinoma.

When we evaluated microcalcifications seen at mammography, 2 patients with BI-RADS 3 microcalcification showed no abnormality on US and MRI. In 3 patients with BI-RADS 3 lesions; 1 compli cated cyst and 2 fibroadenomas, MRI results were correlated with US findings. In another patient with two BI-RADS 4 microcalcification cluster at mammography, there were two BI-RADS 4 lesions in 2 cm and 1,5 cm dimensions at US. Also, at MRI, lesions evaluated as BI-RADS 4, similar to US and mammography and histopathological result was invasive ductal carcinoma. In one case, there was multifocal BI-RADS 3 and BI-RADS 4 microcalcification cluster. At US, there was two separate hypoechoic focus, but at MRI, there was only one BI-RADS 4 lesion. In another case, there was BI-RADS 4 microcalcification. At US, only one lesion detected as 1,8 cm dimension. But at MRI, the lesion was larger (2,5 cm) and there was two focus as multifocal BI-RADS 4 lesions. Lesions histopathologic result was invasive ductal carcinoma. In another case, there were multifocal BI-RADS 4 microcalcifications; US and MRI findings were similar to mammography. In one case with BI-RADS 3 microcalcification, there were multiple cysts at US. But, at MRI intraductal papilloma was shown. Also, Figure II shows MRI findings of intraductal papilloma.

In 12 (15 %) of the 80 patients, breast MRI did not show any new finding. In 54 (67,5 %) patients it was demonstrated that MRI contributes to mammography. MRI was found to be significantly superior in showing multicentricity and the spread to the surrounding tissue in malignant lesions in 20 (25 %) patients. In 9 (11,3 %) patients, MRI had a false positive contribution, and in four of these cases the tumoral tissue dimensions were evaluated larger than the real dimensions and the size detected by mammography. In the remaining 5 (6,3 %) patients, it was observed that MRI contributed false negatively to mammography. The cases in which MRI contributed to mammography summarized in Table I and Figure III.

When breast MRI's contribution to mammography was analyzed, it was found that MRI provided a statistically significant contribution ($p=0.000$). In cases with a family history of breast cancer, the breast MRI's specificity for detecting a suspicious lesion was found to be 52,84 %, and its sensitivity was found to be 92,5 %. In cases with previous breast cancer, its specificity for detecting lesions was found to be 86,5 %, and sensitivity was found to be 93,3 % (Table II).

Table I: Classification of patients according to previous history of breast cancer and family history.

		n	%
Family History		28	35,0
	No	52	65,0
	Yes		
Previous Breast Cancer			
	No	50	62,5
	Yes	30	37,5

Table II: The contribution of MRI to mammography in two separated groups with a family history of breast cancer and a prior history of breast cancer.

Contribution of Breast MRI		No n (%)	Yes n (%)	False(+) n (%)	False(-) n (%)	P
Family History						0.005*
	No	1 (3,6)	26 (92,9)	1 (3,6)	—	
	Yes	11 (21,2)	28 (53,8)	8 (15,4)	5 (9,6)	
Previous Breast Cancer						0.002*
	No	11 (22,0)	26 (52,0)	8 (16,0)	5 (10,0)	
	Yes	1 (3,3)	28 (93.3)	1 (3,3)	—	

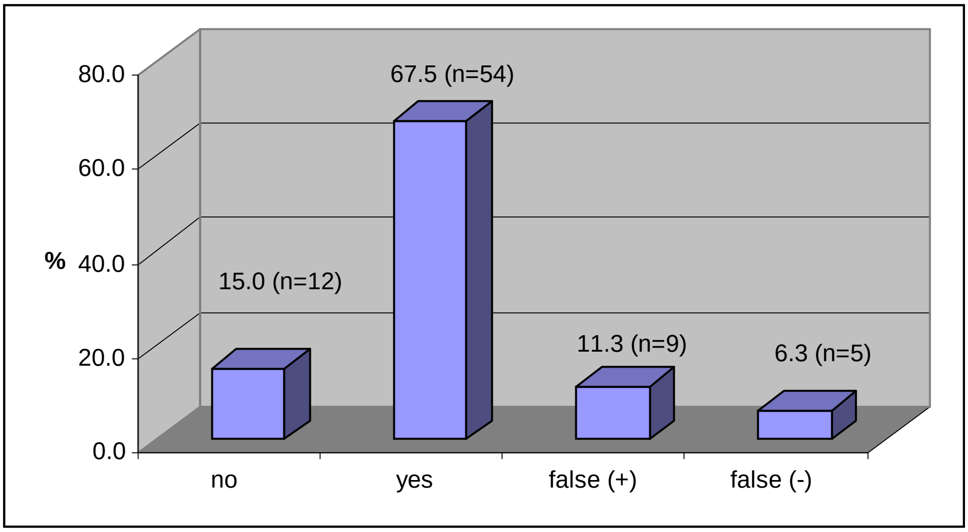

Figure III: The contribution of MRI to mammography.

DISCUSSION

Mammography, with advancing technology, is still the most valuable diagnostic method in screening. Diagnostic errors which are caused by the geometric resolution failure of mammography sometimes can create problems. Breast MRI provides radiologically important information in terms of diagnosis and differential diagnosis of many lesions, because of its feature of high resolution in soft tissues and also its capability of multiplanar imaging (4- 11). MRI, recently, has been accepted to be superior to mammography, sonography and physical examination in demonstrating the full size of the tumor, as well as multifocal/multicentric disease (6- 9).

In addition, it is difficult to assess the breast with mammography and US in patients who have had breast-conserving surgery and radiotherapy because of parenchymal distortion and edema. MRI is recommended as the screening modality for these and high-risk patients with genetic predispositions (6, 11- 23). For mammography the false-negative diagnosis rate which is up to 15 % in the general population is even higher for this group (14, 15).

MRI appears to be highly sensitive and may detect mammographically occult disease in women with BRCA1 or BRCA2 gene mutations who have an increased risk of developing breast cancer or at high familial risk (12, 13). The accuracy of MR imaging is higher than that of conventional imaging, but still insufficient by a lower specificity (12, 13).

Our study was conducted to assess the need to add MRI to mammography in yearly follow-up of patients who had a high risk factor of breast cancer, had undergone partial mastectomy due to breast cancer, or had first-degree relatives with the diagnosis of the breast cancer. MRI is important in terms of following these cases more accurately, providing convenience in postoperative radiological assessment, and providing a possibility to detect recurrent disease more easily. In MRI examinations, performed in the early postoperative period, the seroma cavity is monitored in the operation area. In the literature, there is conflicting information about the timing of the MRI examinations performed in the postoperative period. Some researchers state that the examination can be done 28 days after the operation , and some state that it should be done within the first two weeks (9- 18). During this time, contrast enhancement due the postoperative changes does not cause an important diagnostic problem.

While MRI has been used for further examination of some breast lesions in which ultrasonography and mammography had failed, it is still insufficient for some lesions such as mastitis and inflammatory breast cancer (24).

We found that MRI is significantly superior to mammography in evaluating the size and dissemination of malignant lesions. There are also some studies stating that MRI has not contribution to the diagnosis and resulted in false negative results (12). Lee et al. (21) did not indicate any statistically significant difference between MRI and mammography in terms of early diagnosis in women with an increased risk of breast cancer, and concluded that both methods were important for early diagnosis. Also, Wiberg et al. (16) reported that MRI and mammography determined the size of invasive breast cancer almost equally.

Recently, there are also a lot of studies about MRI screening in women with BRCA1 or BRCA2 mutations (10- 18, 22, 23). In this group of patients, MRI appears to be very sensitive and may detect mammographically occult disease (13). The accuracy of MR imaging is higher than that of conventional imaging but the technique is flawed by a lower specificity (13). In a study; Granader et al. concluded that MRI was far superior to mammography in detecting lesions in subjects with high risk (BRCA gene +) and they concluded, MRI to be the primary modality in breast imaging (22). In our study, we didn't assess BRCA positivity. In our study, in cases with a family history of breast malignancy, the specificity of MRI in detecting lesions was found to be 52,84 %; sensitivity was found to be 92,5 %.

A number of recent studies showed that, in order to avoid unnecessary biopsies, the combination of MRI and conventional imaging is useful in screening women with high risk groups with breast cancer (13). US, still preserves its importance as first line imaging (13). Also, after MRI, second look US has been demonstrated to be of critical importance in detecting false positive MRI results and in guiding biopsies (13).

CONCLUSION

As a result of these findings, in subjects with a family history of breast cancer, and previous history of breast cancer, breast MRI provides significant contributions to mammography and ultrasonography in detecting lesions and solving conventional imaging problems especially for suspicious lesions.

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