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Relation of peritumoral, prepectoral and diffuse edema with histopathologic findings of breast cancer in preoperative 3T magnetic resonance imaging

Preoperatif 3T manyetik rezonans görüntülemede tümör çevresi, pektoral kas önü ve yaygın ödemin meme kanserinin histopatolojik bulguları ile ilişkisi

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Abstract

Aim: Preoperative breast magnetic resonance imaging (MRI) findings can provide rich information about the prognosis of the disease. Morphologic and dynamic features are especially used for it. We aimed to compare peritumoral, prepectoral, and diffuse edema identified in MRI with histopathologic findings, and to show how prognostic information can be gathered from the identification of edema.

Methods: We conducted a retrospective cohort study with forty-six women who underwent breast DCE-MRI as part of the pre-surgical evaluation between January and August 2018 were included in the study. Signal enhancements similar to water that were localized to the prepectoral or peritumoral areas or diffuse enhancements on T2A-weighted sequences were considered as edema. The presence of edema was compared with clinicopathologic parameters such as cancer type, tumor size, histologic grade, ER-PR receptor positivity, Her2 positivity, Ki-67 labelling index and lymphovascular invasion.

Results: The mean age of the participants was 53.15±11.75 (range, 27-80) years. Eleven patients had diffuse edema, 27 patients had peritumoral edema, and 5 patients had prepectoral edema. Nineteen luminal A cancers, 17 luminal B, 9 triple-negative, and 1 Her2 cancer were seen. Peritumoral edema was associated with lymphovascular invasion positivity (p=0.002). Tumor size and the level of Ki-67 was associated with peritumoral edema (p=0.001, p=0.009). The odds of observing prepectoral edema showed no statistically significant difference in the presence of lymphovascular invasion positivity and other parameters. The presence of diffuse edema showed significant differences depending on tumor size measurements (p=0.026).

Conclusion: Edema in breast MRI can provide information about histopathologic findings, particularly about lymphovascular invasion. The authors suggest that different edema types could be mentioned in radiology reports as a matter of routine given that such findings can provide information about the prognosis.

Keywords: Breast cancer, Edema, Magnetic resonance imaging, Lymphovascular invasion

Öz

Amaç: Preoperatif meme manyetik rezonans görüntüleme (MRG), meme kanserinin prognozu konusunda zengin bilgiler sağlar. Bunun için özellikle morfolojik ve dinamik özellikler kullanılır. Çalışmamızda meme MRG'de peritümöral, prepektoral, diffüz ödemin meme kanserinin histopatolojik prognostic parametreler ile ilişkisin araştırmayı ve meme MRG'den prognoz ile ilgili edinilen bilgileri değerlendirmeyi amaçladık.

Yöntemler: Ocak-Ağustos 2018 tarihleri arasında hastanemizde meme kanseri tanısı almış ve ameliyat öncesi değerlendirmede kontrastlı dinamik meme MRG çekilen 46 hasta çalışmaya dahil edildi. T2A sekansta tümör çevresinde, pektoral kas önünde ya da tüm memede izlenen su ile benzer sinyal ödem lehine değerlendirildi. Her bir ödem tipi; kanser tipi, tümör boyutu, histolojik evre, ER-PR reseptör pozitifliği, Her2 reseptör pozitifliği, Ki67 proliferasyon indeksi ve lenfovasküler invazyon gibi klinikopatolojik parametreler ile değerlendirildi.

Bulgular: Ortalama yaş 53.15±11.75 (aralık 27-80) idi. Meme MRG'de 11 hastada diffüz, 27 hastada peritümöral, 5 hastada prepektoral ödem bulgusu izlenmekteydi. 19 lüminal A, 17 lüminal B, 9 üçlü negatif, 1 Her2 kanser mevcuttu.Peritümöral ödem LVI pozitifliği ile ilişkili bulundu (p=0.002). Tümör boyutu ve Ki-67 indexi peritümöral ödemle ilişkilidir (p=0.001, p=0.009).Prepektoral ödem ile değerlendirilen parametreler arasında ilişkili görülmedi. Diffüz ödem tümör boyutuna göre farklılık gösterir (p=0.026).

Sonuç: Meme MRG'de görülen peritümöral ödem LVI pozitifliği açısından bilgi vericidir. Farklı ödem tipleri prognoz açısından bilgiler taşıdığından rutin raporlamalarda belirtilmelidir.

Anahtar kelimeler: Meme kanseri, Ödem, Magnetik rezonans görüntüleme, Lenfovasküler invazyon

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Introduction

Magnetic resonance imaging (MRI) of the breast is the most accurate method for the detection of breast cancer, and the specificity of the method has increased with the introduction of diffusion models suggested in recent studies, which allow the acquisition of radiomics data [1,2]. MRIs have been used to establish the diagnosis, determine the treatment options, and monitor the treatment course in patients who receive oncologic therapy. A combination of clinicopathologic data with MRI findings can provide rich information about the prognosis of the disease [3]. Studies showed that rim enhancement in a mass lesion observed in breast MRI could be associated with aggressive tumor biology, and background parenchymal enhancement other than the mass was associated with a poor prognosis [4,5]. There are studies in the literature that showed a relationship between immunohistochemical subtypes and MRI findings [6,7]. To our knowledge, the first study in the literature that associated focal-diffuse breast edema observed on the T2A-weighted sequences was published by Takayoshi Uematsu in 2014, and peritumoral edema has been regarded as an indicator of poor prognosis [8]. The aim of the present study was to compare peritumoral, prepectoral, and diffuse edema identified in preoperative breast MRI with histopathologic findings, and to show how prognostic information can be gathered from the identification of edema.

Materials and methods

This study was approved by our institutional review board, and conducted according to The Declaration of Helsinki. An informed consent was obtained from all the participitants.

Patient cohort

Women with a recent diagnosis of breast cancer who underwent DCE-MRI as part of the pre-surgical evaluation between January and August 2018 were included in the study. In premenopausal patients, DCE-MRI examinations were made between days 7 and 14 of the menstrual cycle. All patients underwent a Tru-Cut biopsy before undergoing a DCE-MRI in our department.

Breast DCE-MRI protocol

All breast DCE-MRIs were performed using a 3T scanner (Verio, Siemens Healthcare, Erlanger, Germany) with a phase-array eight-channel bilateral breast receive coil. An intravenous catheter was inserted into the left or right arm before the examination. First, prior to the administration of the contrast material, axial turbo-spin echo inversion recovery fat-sat T2-weighted sequences were acquired using the following parameters: TR = 3000-3500 ms, TE = 79 ms, field of view (FOV) = 20-24 cm, matrix = 288 × 192, slice thickness = 4 mm with no gap, flip angle = 90°, and number of excitations (NEX) = 2. Finally, dynamic contrast-enhanced sequences that contained axial T1-weighted 3D fast spoiled gradient recall echo sequences (TR = 5.3, TE = 2.5, FOV = 20-24 cm, matrix = 256 × 256, slice thickness = 4 mm) were acquired. The DCE-MRI included one precontrast acquisition and five postcontrast acquisitions after the injection of gadolinium diethylenetriaminepentaacetic acid (Magnevist; Bayer HealthCare, Wayne, NJ). The contrast was injected at a dose of 0.1 mmol/kg body weight using an automated pump, followed by a 20 mL saline flush, both at a rate of 2 mL/s.

Image analysis

All DCE-MRI intensity characteristics and morphology and kinetic features were analyzed by two breast radiologists with 3-5 years' experience. After observing the malignant masses on a contrast-enhanced dynamic series, signal enhancements similar to water that were localized to the prepectoral or peritumoral areas or diffuse enhancements on T2A-weighted sequences were considered as edema. When disagreement occurred between the two readers, consensus was reached. The presence of edema was compared with clinicopathologic parameters such as cancer type, tumor size, histologic grade, ER-PR receptor positivity, Her2 positivity, Ki-67 labelling index, and lymphovascular invasion (LVI).

Pathologic Evaluation

The histologic type and grade, invasive tumor size, and lymph node status were determined through an examination of surgical specimens by a pathologist with ten years' experience in breast pathology. LVI was assessed on hematoxylin and eosin-stained sections and defined as carcinoma cells in a definite endothelial-lined space in the peritumoral breast surrounding the invasive carcinoma. Expressions of ER, PR and HER2 were assessed using immunohistochemical staining, and expressions of ER and PR were quantified using the Allred score, considering a total Allred score of greater than 2 as positive for ER or PR [9]. An HER2 value of 0 or 1 was considered to be negative, and a value of 3 was considered to be positive. An HER2 value of 2 was considered equivocal; silver-enhanced in situ hybridization was performed for equivocal cases. An HER2/chromosome enumeration probe 17 (CEP17) ratio of 2.0 or greater, or an HER2/CEP17 ratio of less than 2.0 with an average HER2 copy number of 6.0 or greater, was considered positive [10]. Hormone receptor (HR)-positivity was defined as the presence of tumors that expressed ER and/or PR. For the Ki-67 expression status, immunohistochemical nuclear staining was performed [11].

Statistical Analysis

The Number Cruncher Statistical System (NCSS) 2007 (Kaysville, Utah, USA) software package was used for the statistical analysis. Along with descriptive statistical methods (mean, standard deviation, median, frequency, ratio, minimum, maximum) to evaluate the study data, the Mann-Whitney U-test was used to make paired comparisons of quantitative data without normal distribution. Pearson's Chi-square test, Fisher's exact test, and the Fisher-Freeman-Halton test were used to compare qualitative data. In multivariate analyses, the effects of other factors on the types of edema were analyzed using backward stepwise logistic regression analysis. The level of significance was set at $p<0.05$.

Results

The study was conducted in 46 women in our university hospital between January and August 2018. The mean age of the participants was 53.15±11.75 (range, 27–80) years. The descriptive statistics are shown in Table 1. Table 2 shows the relationships between different edema types and histopathological parameters.

Table 1: Distribution of general characteristics

Pathology	IDC	40 (87.0)
	ILC	2 (4.2)
	Invasive micropapillary carcinoma	1 (2.2)
	Mixed carcinoma	1 (2.2)
	Mucinous carcinoma	1 (2.2)
	Pleomorphic carcinoma	1 (2.2)
Type of Edema	Diffuse	11 (23.9)
	Peritumoral	27 (58.7)
	Prepectoral	5 (10.9)
ER	Absent	10 (21.7)
	Present	36 (78.3)
PR	Absent	16 (34.8)
	Present	30 (65.2)
HER2	Absent	39 (84.8)
	Present	7 (15.2)
Ki-67	Min-Max (Median)	2-60 (20)
	Mean±SD	22.26±16.24
	≤15	21 (45.7)
	16-40	19 (41.3)
	>40	6 (13.0)
Histologic grade	Grade 1	12 (26.1)
	Grade 2	24 (52.2)
	Grade 3	10 (21.7)
Perineural invasion	Absent	37 (80.4)
	Present	9 (19.6)
In situ	Absent	15 (32.6)
	Present	31 (67.4)
Lymphovascular invasion	Absent	29 (63.0)
	Present	17 (37.0)
Postoperative tumor size	Min-Max (Median)	1-16 (2.5)
	Mean±SD	2.75±2.26
T stage	T 1	18 (39.1)
	T 2	26 (56.5)
	T 3	1 (2.2)
	T 4	1 (2.2)
Cancer subtype	Luminal A	19 (41.3)
	Luminal B	17 (37.0)
	Triple-negative	9 (19.6)
	Her2	1 (2.2)

IDC: invasive ductal carcinoma, ILC: invasive lobuler carcinoma, ER: estrogen receptor, PR: progesterone receptor, HER2: human epidermal growth factor receptor 2

Table 2: Evaluation based on the type and presence of edema

	Diffuse edema		Peritumoral edema		Prepectoral edema	
	Present n (%)	Absent n (%)	Present n (%)	Absent n (%)	Present n (%)	Absent n (%)
ER						
Negative	3 (27.3)	7 (20)	5 (18.5)	5 (26.3)	2 (40)	8 (19.5)
Positive	8 (72.7)	28 (80)	22 (81.5)	14 (73.7)	3 (60)	33 (80.5)
[a]p	0.682		0.719		0.295	
PR						
Negative	5 (45.5)	11 (31.4)	10 (37)	6 (31.6)	3 (60)	13 (31.7)
Positive	6 (54.5)	24 (68.6)	17 (63)	13 (68.4)	2 (40)	28 (68.3)
[a]p	0.477		[b]0.702		0.325	
HER2						
Negative	9 (81.8)	30 (85.7)	24 (88.9)	15 (78.9)	5 (100)	34 (82.9)
Positive	2 (18.2)	5 (14.3)	3 (11.1)	4 (21.1)	0 (0)	7 (17.1)
[a]p	0.999		0.424		0.999	
Ki-67						
≤15	3 (27.3)	18 (51.4)	8 (29.6)	13 (68.4)	2 (40)	19 (46.3)
16-40	8 (72.7)	11 (31.4)	16 (59.3)	3 (15.8)	2 (40)	17 (41.5)
>40	0 (0)	6 (17.2)	3 (11.1)	3 (15.8)	1 (20)	5 (12.2)
[c]p	0.056		0.009*		0.832	
Histologic grade						
Grade 1	2 (18.2)	10 (28.6)	5 (18.5)	7 (36.8)	1 (20)	11 (26.8)
Grade 2	5 (45.5)	19 (54.3)	15 (55.6)	9 (47.4)	2 (40)	22 (53.7)
Grade 3	4 (36.4)	6 (17.1)	7 (25.9)	3 (15.8)	2 (40)	8 (19.5)
[c]p	0.426		0.391		0.683	
In situ						
Negative	5 (45.5)	10 (28.6)	10 (37)	5 (26.3)	4 (80)	11 (26.8)
Positive	6 (54.5)	25 (71.4)	17 (63)	14 (73.7)	1 (20)	30 (73.2)
[a]p	0.462		[b]0.445		0.033*	
Lymphovascular invasion						
Negative	6 (54.5)	23 (65.7)	12 (44.4)	17 (89.5)	3 (60)	26 (63.4)
Positive	5 (45.5)	12 (34.3)	15 (55.6)	2 (10.5)	2 (40)	15 (36.6)
[a]p	0.722		[b]0.002**		0.999	
Postoperative tumor size						
Min-Max (Median)	1.5-16 (3)	1-5 (2)	1.1-16 (3)	1-3.5 (1.5)	1.5-4.8 (2.5)	1-16 (2.5)
Mean±SD	4.15±4.03	2.32±1.09	3.40±2.72	1.84±0.76	3.02±1.34	2.72±2.36
[d]p	0.026*		0.001**		0.348	
Cancer type						
Luminal A	4 (36.4)	15 (42.9)	11 (40.7)	8 (42.1)	2 (40)	17 (41.5)
Luminal B	4 (36.4)	13 (37.1)	11 (40.7)	6 (31.6)	1 (20)	16 (39)
Triple-negative	3 (27.3)	6 (17.1)	5 (18.5)	4 (21.1)	2 (40)	7 (17.1)
HER2	0 (0)	1 (2.9)	0 (0)	1 (5.3)	0 (0)	1 (2.4)
[c]p	0.864		0.726		0.468	

ER: estrogen receptor, PR: progesterone receptor, HER2: human epidermal growth factor receptor 2, [a] Fisher's Exact Test, [b] Pearson Chi-square Test, [c] Fisher Freeman-Halton Test, [d] Mann-Whitney U Test, *p<0.05, **p<0.01

Peritumoral edema was strong related with higher tumor size (p=0.001). Also there was a strong correlation between peritumoral edema and lymph node positivity (p=0.004).

Peritumoral edema according to the Ki-67 classification showed the significant difference (p=0.009; p<0.05). In paired comparisons performed to find out the source of the difference, peritumoral edema were significantly lower in cases with a Ki-67 value of 15 and lower (p<0.05), and significantly higher (p=0.003) in cases with a Ki-67 value of 16–40 (p<0.05). Peritumoral edema in cases with a Ki-67 value above 40 did not show a significant difference (p>0.05) as shown in Figure 1.

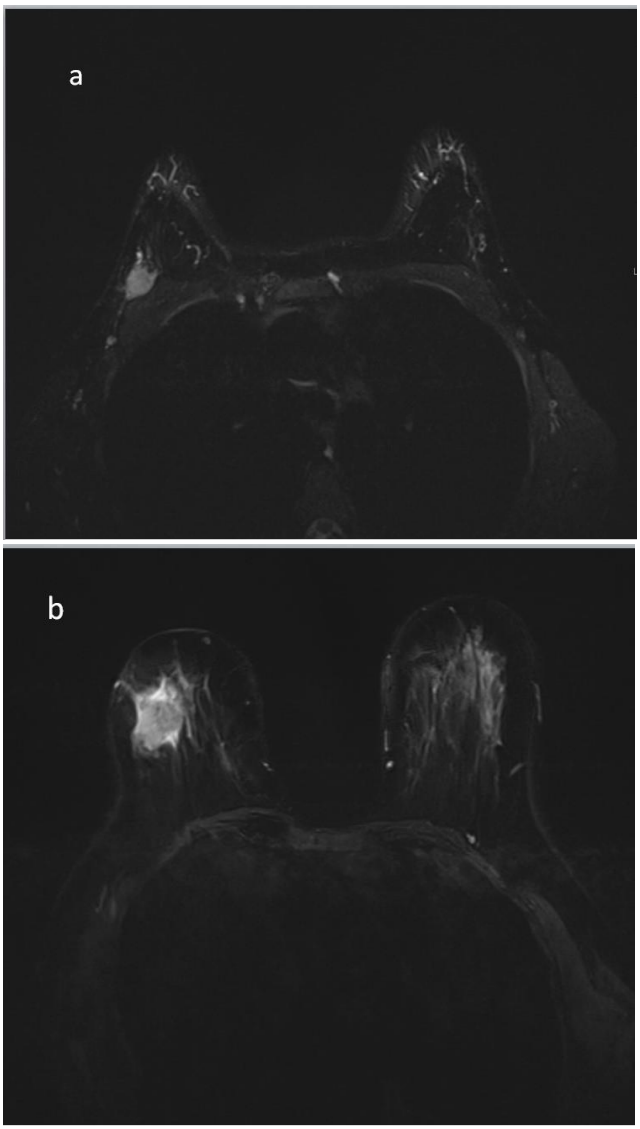

Figure 1: a,b. Fat-suppressed T2-weighted axial breast MR image in a 45-year-old woman with triple- negative invasive ductal carcinoma. Ki67 labelling index was 60 and no peritumoral edema was shown (a). Fat-suppressed T2-weighted axial breast MR image in a 35-year-old woman with triple- negative invasive ductal carcinoma. Ki67 labelling index was 35 and presence of peritumoral edema was shown (b).

The presence of diffuse edema showed significant differences depending on tumor size measurements (p=0.026; p<0.05). The tumor sizes in patients with diffuse edema were significantly higher than in patients without diffuse edema.

Prepectoral edema were significantly higher in the event of an in-situ positivity (p=0.032). The presence of prepectoral and diffuse edema did not show a significant difference in the presence of lymphovascular invasion positivity or other parameters (p>0.05).

When we evaluated the effects of Ki-67, lymphovascular invasion, tumor size and T stage on peritumoral

edema with a Backward Stepwise logistic regression analysis, the model was found to be significant (p=0.001; p<0.05) with an explanatory coefficient of 80.4%. The odds ratio of the effect of positive lymphovascular invasion was 9.422-fold higher (95% Cl: 1.467-60.525), while the odds ratio of the effect of tumor size was 3.806 (95% Cl: 1.448-10.003) higher (Table 3).

For the presence of diffuse edema, Ki-67, tumor size and T-stage were included in the logistic regression analysis. The model was found to be significant (p=0.012) with an explanatory coefficient of 76.1%. The effect of a T-stage being 2 or higher was significant in the model, with an odds ratio of 9.444-fold (95%Cl: 1.089-81.882) higher (Table 4).

Table 3: Multivariate analysis of risk factors that affect peritumoral edema

	p	ODDS	95% CI	
			Lower	Upper
Ki-67	0.611	1.013	0.964	1.065
Lymphovascular invasion	0.018*	9.422	1.467	60.525
Tumor Size	0.007**	3.806	1.448	10.003
T stage (≥2)	0.582	2.126	0.145	31.210

*p<0.05, **p<0.01

Table 4: Multivariate analysis of risk factors that affect diffuse edema (Logistic regression analysis)

	p	ODDS	95% CI	
			Lower	Upper
Ki-67	0.709	0.989	0.933	1.049
Tumor Size	0.331	1.268	0.786	2.046
T stage (≥2)	0.042*	9.444	1.089	81.882

*p<0.05

Discussion

We should highlight that the pathophysiology of peritumoral, prepectoral, and diffuse edema in women with a mass lesion in the breast is not clear. Baltzar et al. [12] suggested that peritumoral edema might arise from tumor angiogenesis and cytokine release around the mass. Research suggested that increased levels of a substance called hyaluronan in the peritumoral stroma could increase T2 relaxation [13]. In recent literature, the increased peritumoral signal intensity in T2A-weighted sequences was mostly related to LVI positivity. Some studies reported the presence of edema by providing its grade, and there are more published studies that assessed the frequency of the presence of breast edema as absent or present [3]. Mori et al. [14] compared ADC values in the peritumoral area with the presence of LVI and performed a quantitative and easily reproducible assessment. The presence of edema in the present study was evaluated as absent or present on T2A-weighted sequences, and a significant relationship was found between LVI and peritumoral edema among other types of edema.

LVI is a pathologic finding that points to the presence of tumor embolisms within the vascular structures around the tumor [15]. No clear relationship has been established between LIV positivity and any radiologic findings. The MRI appearances of LVI resemble in-situ ductal carcinoma, but these two entities could be differentiated by an immunohistochemical examination [16]. Van Goethem et al. [17] claimed that perilesional findings observed in the mass lesion might arise from in-situ component positivity, although Cheon et al. [18] ruled out this possibility by excluding patients with an in-situ component when creating their patient groups, and assumed that perilesional findings arose from the tumor itself, suggesting that peritumoral edema could be related to LVI in patients with lymph node-negative breast cancer. In our series, patients with in-situ component positivity were not excluded, and there were 31 patients (67.4%) with in-situ cancer that accompanied invasive cancer. No significant relationship was found between the probability of observing peritumoral and diffuse edema in these patients. In contrast to the literature, the present study found a significant relationship between in-situ positivity and prepectoral edema, which was attributed to insufficient randomization; there was only one patient with in-situ component positivity and prepectoral edema.

Beside this, no relationship was identified between prepectoral edema and the parameters that were evaluated in our study. However, in a study with 589 patients, Uematsu et al. [8] showed that prepectoral edema was associated with LVI, mass size, presence of in-situ carcinoma, and axillary lymph node status, and that the finding of edema had 12% sensitivity and 100% specificity to indicate LVI positivity. In our patient group, five (10.9%) patients had prepectoral edema, and of these, two patients had luminal A cancer, two patients had luminal B, and one patient had triple-negative breast cancer. We attribute this finding to the small number of patients with prepectoral edema.

Bae et al.'s study, which was about pretreatment MR imaging features of triple-negative breast cancer, concluded that peritumoral edema was observed in triple-negative cancers more commonly and it provided information about the patient's response to chemotherapy [19]. In our study, we observed no relationship between edema and tumor subtype. Also, receptor positivity is not related with all three edema types. Peritumoral edema is found specific to invasive ductal cancer because ILC does not often give rise to edema due to its growth pattern [20]. No edema was identified in two patients with ILC in our study group.

A significant relationship was found between the presence of peritumoral edema and Ki-67, as one of the prognostic markers in breast cancer (p=0.009; p<0.01). Edema was not observed in tumors with Ki-67 values of less than 15, whereas the prevalence of edema was higher in tumors with a Ki-67 value of between 15 and 60. The likelihood of observing edema was significantly lower in six patients (four triple-negative, two luminal B) with Ki-67 values greater than 60, which we attributed to the rapid growth of the mass lesion, and the subsequent lack of sufficient time for the development of edema prior to diagnosis. There is a paucity of data in the literature related to this subject. The relationship between tumor size and edema was also studied in the literature, although it has been reported that edema is rarely observed in tumors larger than 10 cm [21]. The only exception to this finding was a patient with a tumor larger than 10 cm with mucinous cancer with a diameter of 16 cm, who also had peritumoral edema. In our patient group, there were no patients with ductal or lobular cancers with a diameter larger than 10 cm.

Diffuse edema in breast cancer is observed in cases of inflammatory cancer. Increased skin thickness is observed in inflammatory breast cancer, with or without accompanying mass lesions. Patients with diffuse edema in our study were not evaluated for skin thickness radiologically and clinically. There may have been patients with inflammatory cancer in our study group. We found that the presence of diffuse edema was

significantly higher in patients with large tumors sizes. No relationship with other clinicopathologic parameters was found.

Limitations

The main limitation of the present study is related to the small number of patients in the sample, and the evaluation of edema was based on visual assessment rather than quantitative values. But we should mention that the power of our study sample in predicting peritumoral edema presence of lymphovascular invasion is more than 80%.

Conclusion

Peritumoral edema observed during preoperative breast MRI can provide information about histopathologic findings, particularly about LVI. Our study shows that MRI sign of edema could give early and/or additive information about the prognosis. Still detailed further studies are needed in this field.

References

1. Kim KW, Kuzmiak CM, Kim YJ, Seo JY, Jung HK, Lee MS. Diagnostic Usefulness of Combination of Diffusion-weighted Imaging and T2WI, Including Apparent Diffusion Coefficient in Breast Lesions: Assessment of Histologic Grade. Acad Radiol. 2018 Jan 12. pii: S1076-6332(17)30489-0. doi: 10.1016/j.acra.2017.11.011.
2. Mazurowski MA. Radiogenomics: What it is and why it is important. J Am Coll Radiol. 2015 Aug;12(8):862-6. doi: 10.1016/j.jacr.2015.04.019.
3. Cheon H, Kim HJ, Kim TH, Ryeom HK, Lee J, Kim GC, et al. Invasive breast cancer: Prognostic value of peritumoral edema identified at preoperative MR imaging. Radiology. 2018 Jan 9:171157. doi: 10.1148/radiol.2017171157.
4. Schmitz AM, Loo CE, Wesseling J, Pijnappel RM, Gilhuijs KG. Association between rim enhancement of breast cancer on dynamic contrast-enhanced MRI and patient outcome: impact of subtype. Breast Cancer Res Treat. 2014.148(3):541–51.
5. Choi JS, Ko ES, Ko EY, Han BK, Nam SJ. Background parenchymal enhancement on preoperative magnetic resonance imaging: association with recurrence-free survival in breast cancer patients treated with neoadjuvant chemotherapy. Medicine (Baltimore). 2016 Mar;95(9):e3000.
6. Li SP, Makris A, Beresford MJ, Taylor NH, Ah-See ML, Stirling JJ, et al. Use of dynamic contrast-enhanced MR imaging to predict survival in patients with primary breast cancer undergoing neoadjuvant chemotherapy. Radiology. 2011 Jul;260(1):68-78. doi: 10.1148/radiol.11102493.
7. Youk JH, Son EJ, Chung J, Kim JA, Kim EK. Triple-negative invasive breast cancer on dynamic contrast-enhanced and diffusion-weighted MR imaging: comparison with other breast cancer subtypes. Eur Radiol. 2012 Aug;22(8):1724-34. doi: 10.1007/s00330-012-2425-2.
8. Uematsu T. Focal breast edema associated with malignancy on T2-weighted images of breast MRI: peritumoral edema, prepectoral edema, and subcutaneous edema. Breast Cancer. 2015 Jan;22(1):66-70. doi: 10.1007/s12282-014-0572-9.
9. Allred DC, Harvey JM, Berardo M, Clark GM. Prognostic and predictive factors in breast cancer by immunohistochemical analysis. Mod Pathol. 1998;11(2):155–168.
10. Wolff AC, Hammond ME, Hicks DG, Dowsett M, McShane LM, Allison KH, et al; American Society of Clinical Oncology; College of American Pathologists. Recommendations for human epidermal growth factor receptor 2 testing in breast cancer: American Society of Clinical Oncology/ College of American Pathologists clinical practice guideline update. Arch Pathol Lab Med. 2014 Feb;138(2):241-56
11. Cheang MC, Chia SK, Voduc D, Gao D, Leung S, Snider J et al. Ki67 index, HER2 status, and prognosis of patients with luminal B breast cancer. J Natl Cancer Inst. 2009;101(10):736–750.
12. Baltzer PA, Yang F, Dietzel M, Herzog A, Simon A, Vag T, et al. Sensitivity and specificity of unilateral edema on T2w-TSE sequences in MR-mammography considering 974 histologically verified lesions. Breast J. 2010;16:233–9.
13. Auvinen P, Tammi R, Parkkinen J, Tammi M, Agren U, Johansson R, et al. Hyaluronan in peritumoral stroma and malignant cells associates with breast cancer spreading and predicts survival. Am J Pathol. 2000; 156(2):529–36.
14. Mori N, Mugikura S, Takasawa C, Miyashita M, Shimauchi A, Ota H, et al. Peritumoral apparent diffusion coefficients for prediction of lymphovascular invasion in clinically node-negative invasive breast cancer. Eur Radiol. 2016 Feb;26(2):331-9. doi: 10.1007/s00330-015-3847-4.
15. Rosen PP. Tumor emboli in intramammary lymphatics in breast carcinoma: pathologic criteria for diagnosis and clinical significance. Pathol Annu. 1983;18(Pt 2):215–32.
16. Sanders LM, Dardik M, Modi L, Sanders AE, Schaefer SS, Litvak A. Macroscopic lymphovascular invasion visualized on mammogram and magnetic resonance imaging: Initially misidentified as ductal carcinoma in situ but properly diagnosed by immunohistochemistry. SAGE Open Med Case Rep. 2017 Apr 21;5:2050313X17705803. doi: 10.1177/2050313X17705803.
17. Van Goethem M, Schelfout K, Kersschot E, Colpaert C, Verslegers I, Biltjes I, et al. Enhancing area surrounding breast carcinoma on MR mammography: comparison with pathological examination. Eur Radiol. 2004;14:1363–70.
18. Cheon H, Kim HJ, Lee SM, Cho SH, Shin KM, Kim GC, et al. Preoperative MRI features associated with lymphovascular invasion in node-negative invasive breast cancer: A propensity-matched analysis. J Magn Reson Imaging. 2017 Oct;46(4):1037-44. doi: 10.1002/jmri.25710.
19. Bae MS, Shin SU, Ryu HS, Han W, Im SA, Park IA, et al. Pretreatment MR imaging features of triple-negative breast cancer: association with response to neoadjuvant chemotherapy and recurrence-free survival. Radiology. 2016;281: 392–400.
20. Dietzel M, Baltzer PA, Vag T, Gröschel T, Gajda M, Camara O, et al. Magnetic resonance mammography of invasive lobular versus ductal carcinoma: systematic comparison of 811 patients reveals high diagnostic accuracy irrespective of typing. J Comput Assist Tomogr. 2010;34:587–95.
21. Kawashima H, Kobayashi-Yoshida M, Matsui O, Zen Y, Suzuki M, Inokuchi M. Peripheral hyperintense pattern on T2-weighted magnetic resonance imaging (MRI) in breast carcinoma: correlation with early peripheral enhancement on dynamic MRI and histopathologic findings. J Magn Reson Imaging. 2010 Nov;32(5):1117-23. doi: 10.1002/jmri.22279.