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DIAGNOSTIC VALUE OF SONOELASTOGRAPHY IN BI-RADS 5 BREAST LESIONS

BI-RADS5 Meme Lezyonlarında Sonoelastografinin Tanısal Yeri

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ABSTRACT

Objective: Sonoelastography is increasingly used in the evaluation of breast lesions in recent years. The aim of our study is to compare the sonoelastography scores found in the sonoelastography examination and histopathological results of Breast Imaging Reporting and Data System (BI-RADS) 5 breast lesions and to determine the usefulness of sonoelastography for identifying the malignancy of the breast tumors.

Material and Methods: Our prospective study evaluated the age, mass location, size, elastography score, and excisional biopsy results of 44 patients assessed as BI-RADS 5 on ultrasonography between December 2014 and February 2015.

Results: The mean age of the study population was 50.02±14.28 years. In 52.3% of the patients, the mass was located in the left breast the masses had a mean length of 16.93±12.96 mm and a mean width of 23.39±14.77 mm. Ninety-seven-point seven percent of the cases were malignant in nature. The most common mass histopathology was invasive ductal carcinoma (86.4%). The sensitivity of sonoelastography was 97.7%. No relationship between the elasticity score and the presence of malignancy in the malignant group (p>0.05).

Conclusion: Sonoelastography, which is a noninvasive, reproducible and easy-to-use imaging method **is a** highly sensitive test for showing malignant breast lesions (BI-RADS 5) **can** be used for distinction of malignant breast lesions.

***Keywords**: BI-RADS5, sonoelastography, malignant breast cancer*

ÖZ

Amaç: Son yıllarda meme lezyonlarının değerlendirilmesinde sonoelastografi giderek daha fazla kullanılmaktadır. Çalışmamızın amacı Meme Görüntüleme Raporlama ve Veri Sistemi (BI-RADS) 5 olan meme lezyonların sonoelastografi incelemesi ile saptanan elastografi skoru ve histopatolojik sonuçlarını karşılaştırmak ve sonoelastografinin meme tümörlerinin malignitesini belirlemedeki kullanılabilirliğini belirlemektir.

Gereç ve Yöntemler: Prospektif çalışmamız Aralık 2014 Şubat 2015 tarihleri arasında yapıldı. Ultrasonografide BI-RADS 5 olarak değerlendirilen 44 hastanın yaş, kitle yeri, büyüklüğü, elastografi skorları ve eksizyonel biyopsi sonuçları değerlendirildi.

Bulgular: Çalışmamızdaki hastaların yaş ortalaması 50.02±14.28 yıl idi. Hastaların %52.3'ünde kitle sol memede idi ve kitlelerin ortalama boyu 16.93±12.96 mm ve ortalama eni 23.39±14.77 mm'idi. Olguların %97.7'si maligndi. En sık rastlanılan kitle patolojik tipi invazif duktal karsinomdu (%86.4). Çalışmamızda elastografinin duyarlılığı %97.7 olarak saptandı. Malign grubun elastikiyet skoru ve malignite varlığı arasında anlamlı ilişki saptanmadı (p>0.05).

Sonuç: Non-invaziv, tekrarlanabilir ve kullanımı kolay bir görüntüleme yöntemi olan sonoelastografi, malign meme lezyonlarının (BI-RADS 5) gösterilmesinde sensitivitesi oldukça yüksek bir test olup, malign meme lezyonlarının ayrımında kullanılabilir.

***Anahtar Kelimeler**: BI-RADS 5, sonoelastografi, malign meme kanseri*

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INTRODUCTION

Breast cancer is the most common malignancy among the female population in the world (1**)** Since early diagnosis and treatment in breast cancer for reducing the mortality rates are very significant, there is a lasting effort to develop new and more effective diagnostic methods (1,2).

Mammography (MM) and ultrasonography (US) are the most commonly used radiological techniques in the diagnosis of breast diseases. However, while both methods have a high sensitivity, they have a low specificity. It is known that MM falls short in dense breasts and US for the distinction of solid lesions. This leads to unnecessary invasive procedures, adverse effects on patient psychology, and increased cost (3). Malignant lesions have a tendency to be significantly firmer than normal tissues (4,5).-However, US appears to be incapable of differentiating firm lesions like fibroadenomas from malignant lesions (1,2). Therefore, false positivity may be higher for biopsies taken from ultrasonographically determined lesions. (6). Sonoelastography is a novel technique that allows to categorizing grayscale images obtained in the B-mode US in color scales by elasticity level with the help of a software run by a single button (4,7). In sonoelastography soft tissues are usually encoded red, moderately firm tissues green, and firm tissues blue (3). It is based on the principle to obtain information about tissue elasticity by measuring the amplitude of longitudinal deformation brought about by a manual or device-set longitudinal force (8). It is superior to B-mode for differentiation of a tissue from fatty tissue and determination of its firmness (3). In our study, which we designed on the hypothesis that BI-RADS 5 lesions with a high suspicion of malignancy have a lower elasticity, we aimed to determine the utility of sonoelastography for determining of malignancy of breast tumors by comparing the sonoelastography score and histopathological results of BI-RADS 5 lesions.

MATERIALS AND METHODS

Patients and study design

Between December 2014 and February 2015, 44 breasts of 44 patients who were diagnosed with BI-RADS 5 breast lesion on the US were included in this prospective study. Written informed consent form for the study was obtained from each participant. The study protocol was approved by the Ethics Committee of the hospital (Date: 22.12.2014; permission no: 2014/926).

All of the patients were female and their age median was 50±14.28 years (age range 20-73 years). While 23 (52.3%) of the patients had mass in the left breast, the remaining cases 21(47.7%) presented with a right breast lump. All patients were examined by a single breast radiologist with an experience of 10 years. MM was performed for the patients over 35 years. All the examinations were performed before any surgery, biopsy, or fine needle aspirations. Patients age, size**,** and localization of the breast lesions, sonoelastography scores, and histopathological findings were recorded. The patients who were under 18 years and had a history of breast surgery or breast cancer were excluded from the study.

Elastographic Technique

Bilateral whole-breast sonographic examinations of all patients included in the study were performed by using a real-time EUB-5500 US (Hitachi Medical Corporation, Tokyo, Japan) equipped with a 10-MHz linear array transducer.

While the conventional B-mode sonographic examination was being performed, the free-hand technique of sonoelastography was performed for the lesions with BI-RADS 5 score in accordance with the criteria for US (9). A perpendicular mechanic wave induced by the ultrasound probe, which distorts the target, was used to obtain the free-hand technique sonoelastography with small movements criteria for US (9). We obtained and displayed an elastogram

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either as a color map, or a size ratio or elasticity ratio measurement.

To standardize the compression level during the intervention the pressure scale of the device was used and elastographic images were obtained under proper compression.

A 256-color scale ranging from red to blue is used to obtain the elastographic images. The lesion softest component was depicted in red color, which showed the greatest strain. The hardest component with no strain was depicted in blue. As normal breast tissue represented intermediate elasticity, it was visualized as green. To categorize the lesion a 5- point scoring method, which was proposed by an Italian multicenter study, was used (10).

By determining the difference between the hardness of the lesion compared to the surrounding of normal-appearing breast tissue, the strain of the lesions was calculated. (Figure 1).

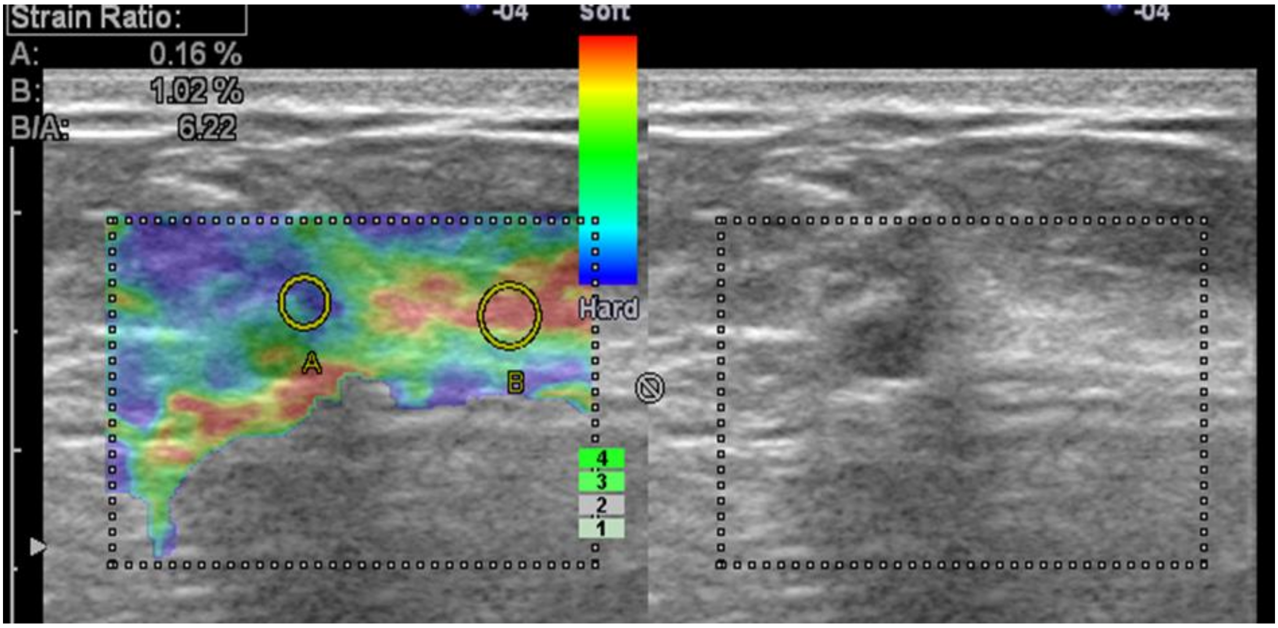

Figure 1: Invasive ductal carcinoma in 50- year- old woman. Left B-mode of our sonographic image that shows a lesion with a poorly defined contour, which was classified as BI-RADS 5 (highly suggestive of malignancy). Right sonoelastographic image showing a predominately blue lesion with random red points and green surrounding areas**.** The sonoelastographic strain index of the lesion was 6.22 at the same breast tissue depth as the reference point.

Histopathologic Diagnosis

While excisional biopsy following ultrasound-guided wire localization was performed for the nonpalpable breast lesions, palpable masses were directly excised without any presurgical localization method. Elasticity scores and strain indices of the lesions were compared with the final histopathologic diagnoses.

Statistical Analysis

Data analysis was performed using SPSS for Windows 15 software. In the descriptive analysis, results are presented as mean ± SD or median for continuous variables and number and percentage for categorical variables. Categorical variables were assessed by using the Fisher Exact Test. The significance level was accepted as $p<0.05$.

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RESULTS

Forty-four breast masses had an average height of 16.93±12.96 mm and an average width of 23.39±14.77 mm. Total excision with wide margins was routinely performed for all patients with BI-RADS 5 breast masses. Forty-three of 44 patients were diagnosed as breast cancer histopathologically. Of those, invasive ductal carcinoma was the most common (38 patients, 86.4%) histopathological type. The other cancer types were; papillary (n=3, 6.8%) and medullary breast carcinoma (n=2, 4.5%). Only one patient was diagnosed as a benign tumor, intraductal papilloma, on final histopathology report. In the present study, the test had a sensitivity of 97.7%. As no false negativity was present, its specificity could not be calculated (Table 1). 13.6% of the patients had a sonoelastography stage of 4 and 86.4% stage 5. No significant relationship could be found between sonoelastography stage and malignancy (p>0.05) (Table 2).

Table 1: Demographic properties, pathologic findings and sonoelastography scores of the patients

			Mean±SD/n (%)
Age			50.02±14.28 (16-76)
Location		Right breast	21 (47.7)
		Left breast	23 (52.3)
Size		Length (mm)	23.39±14.77 (4-76)
		Width (mm)	16.93±12.96 (5-76)
Histopathology	Malignant	Invasive ductal carcinoma	38 (86.4)
		Papillary carcinoma	3 (6.8)
		Medullary carcinoma	2 (4.5)
	Benign	Intraductal papilloma	1 (2.3)
Elastography score	True positive		43 (97.7)
	False positive		1 (2.3)

Table 2: The comparison of elasticity scores between benign and malignant lesions

		Elastography score		p
		4	5	
Final histopathologic diagnosis	Malignant	6 (100%)	37 (97,4%)	0,864
	Benign	0	1 (2,6%)	

DISCUSSION

Although US and MM are the methods commonly used in the evaluation of breast masses, novel radiological techniques, such as sonoelastography, are required in order to reduce unnecessary invasive procedures in determining these lesions (2,11). According to the stromal desmoplastic reaction caused by cancer tissue, functional changes occur in myofibroblast cells, which is a result of increased production of collagen and extracellular matrix protein. This condition increases the stiffness of the tumoral mass and its surrounding tissue. Krouskop et al. reported that the malignant lesions excised from the breast had an irreversible firmness and a reduced elasticity (12). The tension

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degree of the lesion and normal tissue are compared by using these elasticity maps, and then the stiffness or tension index of the target lesion is quantitatively determined (13,15). A difficulty has been reported in distinguishing between the elasticity scores 2 and 3, while the elasticity scores 1, 4 and 5 are easily determined. Lesions with score 1 are almost always accepted as benign; however, lesions graded as 4 and 5 are usually considered to have high malignant potential (2,15). Recent studies showed that sonoelastography is superior to the US in defining the malignant breast tumors, particularly those in small size, and reduce the number of biopsy in BI-RADS 3 and 4 breast lesions (16,17). Türker et al. reported that all of 5 patients with a higher elasticity score and 81.3% of stage 4 patients had malignant lesions (18). In our study all cases were stage 4-5; there was no significant relationship between disease stage and histopathological presence of malignancy. We think that as elasticity is impaired in malignant tumors, and thus patients fell into a higher stage. The absence of malignancy among lesions with a lower sonoelastography stage suggests that the test is both reliable and useful for BI-RADS 5 lesions. Schaefer et al. reported a sensitivity of 96.9% and a specificity of 76% while Moon et al. reported 83.8% and 87.6% and Leong et al. 100% and 76%, respectively (19-21). Moon et al. reported a diagnostic yield of 86.2% while Leong et al. reported 80%, and Yerli et al. reported 87% (14,20,21). Our study demonstrated a sensitivity of 97.7%. As there was no false negativity, its specificity could not be determined. We conclude that sonoelastography had a high diagnostic yield as a result of the absence of false negative results in BI-RADS-5 lesions and unlike the US, as a result of its ability to assess a lesion’s elasticity. We think that false positivity was associated with the dense fibrovascular structure of intraductal papilloma.

As elastography is an integrant technique to B-mode ultrasound. In the ultrasound assessment of breast lesions, as a highly sensitive test for diagnosing malignant breast lesions (BI-RADS 5), it might be used for differentiating malignant breast lesions.

REFERENCES

1. Gerger D, Coşkun ZF, Ertürk A, Uzun Ş. Meme kitlelerinin değerlendirilmesinde elastografi ve difüzyon MRG’nin yeri. Okmeydanı Tıp Dergisi. 2013:29(1):8-14.
2. Yagtu M, Turan E, Turan CO. The role of ultrasonographic elastography in the differential diagnosis of breast masses and its contribution to classical ultrasonographic evaluation. J Breast Health. 2014;10(3):141-6.
3. Yakut ZI, Kurt A, Karabekmez LG, Ogur T. Breast Sonoelastography. Abant Med J. 2015;4(3):309-16.
4. Zhi H, Ou B, Luo BM, Feng X, Wen YL, Yang HY. Comparison of ultrasound elastography, mammography, and sonography in the diagnosis of solid breast lesions. J Ultrasound Med. 2007;26(6):807-15.
5. Zhu QL, Jiang YX, Liu JB, Liu H, Sun Q, Dai Q et al. Real-time ultrasound elastography: Its potential role in assessment of breast lesions. Ultrasound Med Biol. 2008;34(8):1232-8.
6. Gültekin S. Ultrasonografide Yeni Uygulamalar. Türk Radyoloji Derneği Seminerleri. 2014;2:158-70.
7. Balleyguier C, Ciolovan L, Ammari S, Canale S, Sethom S, Al Rouhbane R et al. Breast elastography: the technical process and its applications. Diag Interv Imaging. 2013;94(5):503-13.
8. Garra BS. Imaging and estimation of tissue elasticity by ultrasound. Ultrasound Q. 2007;23(4):255-68.
9. American College of Radiology. Breast imaging reporting and data system (BI-RADS), Ultrasound.

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DOI: 10.24938/kutfd.417857

Accessed date: 8 September 2004: https://www.acr.org/Clinical-Resources/Reporting-and-Data-Systems/Bi-Rads#Ultrasound.

10. Scaperrotta G, Ferranti C, Costa C, Mariani L, Marchesini M, Suman L et al. Role of sonoelastography in nonpalpable breast lesions. Eur Radiol. 2008;18(11):2381-9.
11. Onur MR, Göya E. Ultrason elastografi: Abdominal uygulamalar. Türkiye Klinikleri J Radiol. 2013;6:59-69.
12. Krouskop TA, Younes PS, Srinivasan S, Wheeler T, Ophir J. Differences in the compressive stress-strain response of infiltrating ductal carcinomas with and without lobular features implications for mammography and elastography. Ultrason Imaging. 2003;25(3):162-70.
13. Yi A, Cho N, Chang JM, Koo HR, La Yun B, Moon WK. Sonoelastography for 1786 non-palpable breast masses: diagnostic value in the decision to biopsy. Eur Radiol. 2012;22(5):1033-40.
14. Yerli H, Yilmaz T, Kaskati T, Gulay H. Qualitative and semi-quantitative evaluations of solid breast lesions by sonoelastography. J Ultrasound Med. 2011;30(2):179-86.
15. Thomas A, Kümmel S, Fritzsche F, Warm M, Ebert B, Hamm B et al. Real-time sonoelastography performed in addition to B-mode ultrasound and mammography: improved differentiation of breast lesions? Acad Radiol. 2006;13(12):1496-1504.
16. Stavros AT, Thickman D, Rapp CL, Dennis MA, Parker SH, Sisney GA. Solid breast nodules: use of sonography to distinguish between benign and malignant lesions. Radiology. 1995;196(1):123-34.
17. Yi A, Cho N, Chang JM, Koo HR, La Yun B, Moon WK. Sonoelastography for 1,786 non-palpable breast masses: diagnostic value in the decision to biopsy. Eur Radiol 2012;22(5):1033-40. Doi:10.3348/kjr.2013.14.4.559.
18. Türker MF, Tok US, Akça T, Karabacak T, Esen K, Balcı Y et al. Diagnostic value of ultrasound elastography characterization of solid breast lesions. JAREM 2017;7:74-81
19. Schaefer FK, Heer I, Schaefer PJ, Mundhenke C, Osterholz S, Order BM et al. Breast ultrasound elastography results of 193 breast lesions in a prospective study with histopathologic correlation. Eur J Radiol. 2011;77(3):450-6.
20. Moon WK, Huang CS, Shen WC, Takada E, Chang RF, Joe J et al. Analysis of elastographic and B-mode features at sonoelastography for breast tumor classification. Ultrasound Med Biol. 2009;35(11):1794-802.
21. Leong LC, Sim LS, Lee YS, Ng FC, Wan CM, Fook-Chong SM et al. A prospective study to compare the diagnostic performance of breast elastography versus conventional breast ultrasound. Clin Radiol. 2010;65(11):887-94.