The Diagnosis Value of Breast Cancers with Different Sizes by Ultrasonic Elastography Technology and Mammography

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Abstract: This study was conducted to explore the diagnostic value of ultrasonic elastography technology and mammography for breast cancers with different sizes, and discuss the accuracy and feasibility of the combined diagnosis for breast cancers.Divide the 137 cases of breast malignant nidi that are proved by pathological mechanism into three groups according to the sizes. Analyse the imaging manifestations that are carried out by ultrasonic elastography technology and mammography before surgery and compare the diagnosis accuracy. The results indicate that **:** (1) The detection rate of breast cancers with diameters less than or equal to 10mm and diameters between 11 to 20mm by ultrasonic elastography technology is higher than that of the breast cancers with diameters more than 20mm. The differences have statistical significance (P<0.05). (2) The detection rate of breast cancers with diameters between 11 to 20mm and diameters more than 20mm by mammography is higher than that of the breast cancers with diameters less than and equal to 10mm. The differences have statistical significance (P<0.05). (3) The detection rate of breast cancers with diameters less than or equal to 10mm by elastography technology is higher than that by mammography (P<0.05); As for the detection rate of breast cancers with diameters between 11 to 20mm and diameters more than 20mm, the differences have no obvious statistical significance (P＞0.05).In conclusion,the diagnosis of ultrasonic elastography technology and mammography for breast cancers with different sizes has their own advantages. The combination of both diagnosis methods can enhance the detection rate of malignant nidi, and reduce the rate of missed diagnosis. It deserves clinical popularization and application.
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Key words: Breast cancer; Elastography; X-ray mammography

1.Introduction

Breast cancer is one of common malignant tumors in women, and ultrasound elastography technique which measures the mechanical properties of tissues to identify the nature of the lesions, has been achieved good results in the diagnosis of benign and malignant tumors. Molybdenum target X-ray photography is recognized as a reliable and effective imaging method for diagnosis of early breast cancer ,especially for carcinoma in situ, most of which can be found for showing calcification,but there is less relevant reports about whether lesion sizes have an impact on the diagnostic value of both methods. This study analyzes 137 cases of breast lesions preoperatively elastography and X-ray mammography imaging studies to explore the diagnostic value of the two methods for different sizes of malignant breast lesions.

2.Materials and Methods

2.1 Study subjects

112 cases of breast cancer patients,whom between 2009 and 2013 in our hospital been performed preoperative breast ultrasound elastography and molybdenum target X-ray examination, and postoperative pathologically confirmed, with 137 lesions totally, all the patients were women, aged 20 to 70 years, and the mean age was 45 ± 12 years.

2.2 Apparatus and methods

Group 137 lesions into three group by sizes of the lesion axis: 36 cases in S1group with lesions ≤10mm, 42 cases in S2group with lesions between 11 ~ 2 0mm, 59 cases in S3 group with lesions > 20mm.

Ultrasound machines are HITACHI HV900 color Doppler ultrasound, with real-time high-frequency linear array probe which frequency is 6 ~ 10MHz. For each patient first perform routine preoperative ultrasound check and record lesions size, shape, boundaries, internal and posterior echo, calcification, blood flow characteristics, etc. and elastography score.According to different colors of lesions, evaluate with five-point : 1 point: the whole or most of the lesion showed green; 2point: lesion showed blue-green; 3point: lesion center is blue, and the surrounding tissue is green. 4point: the whole lesion showed blue; 5point: whole lesion and surrounding tissue are blue.Score≥ 3 is evaluated as malignant, the number of these cases needed to be

examined by elastography for breast cancer.

Mammography machines are GE Mammography cameras. Routine for breasts axial and oblique, if necessary, perform local pressure radiography. Mammography images make mass as the main performers, and record tumor size, edge, shape, etc; make calcification as the main performers and record the shape of calcified lesions, distribution methods and quantity, etc.Diagnosis according to RSNA breast imaging and reporting data system (BI-RADS) diagnostic classification: BI-RADS diagnosis class 1: no exception; class 2: benign; class 3: benign possibility; class4: suspicious malignant; class 5: malignant possibility. Makes malignant class 4-5 as diagnostic criteria,and the number of these cases needed to be examined by molybdenum target X-ray for breast cancer.

2.3 Statistical Methods

Using SPSS13.0 statistical software to analyze the resulting data, calculating by chi-square test, comparing in the group by paired χ^2test, and P<0.05was considered statistically significant.

3. Results and discussions

3.1 Clinical symptoms

Before operation, mass in 59 cases; discharge in 19 cases;nipple desquamation, nipple or areola erosion in 4 case each; pain and discomfort in 6 cases; axillary lymph nodes in 16 cases; 17 cases without any signs found in physical examination.All patients underwent surgery and confirmed by pathology.

3.2 Pathological findings

Invasive ductal carcinoma in 89 cases, ductal carcinoma in situ in 26 cases, invasive lobular carcinoma in 13 cases, medullary carcinoma in 6 cases, and mucinous carcinoma in 3 cases.

3.3 Elastography Performance

In the study, 137 lesions in elastography showed:point 1 for five cases, point 2 for 21 cases, point 3 in 41 cases, point 4 in 39 cases, and point 5 in 31 cases.

3.4X-ray mammography Performance

Mammography examination showed: mammary gland atrophy for 23 cases of, glands and fat coexistence for 32 cases, glandular rich for 35 cases, and dense glandular for 47 cases. Clustered micro-calcifications for 81 cases, in which 47 cases with soft tissue density nodules or masses; only soft tissue density nodules or masses for 31 cases; 12 patients without clear lesions; due to rich or dense glands, 13 cases cannot be judged lesion.

3.5 .Diagnosis comparison for different size of breast cancer by two imaging methods(Table1)

3.6 *Conventional ultrasound , X-ray mammography and elastography Performance of breast ductal carcinoma in situ (DCIS)*

In all the cases of the study, 26 of them were DCIS pathological results after operations, conventional ultrasound and elastography performances of 26 cases of DCIS :(1)11 cases (42.3%) showed tumor types, 3 cases in which were solid and cystic, 8 cases were substance type, 2 cases were with fine calcification, and 7 cases were with rich blood flow. The symptom of cystic in mass was clear border, mass without echo, irregular wall thickening, local showed hypoechoic broke into the lumen, blood flow could be measured within a constant signal, and echogenic behind the mass. Substantial mass type lesions showed less clear boundaries, hypoechoic mass with less regular or irregular shape, uneven distribution of most internal echoes, sometimes visible clusters of small hyperechoic, decay behind the mass, and the majority rich blood flow signals could be detected within the mass. (2)5 cases (19.2%) showed local structural disorder type with the border clear, and no envelope, 4 cases in which were with fine calcification , 1 case was with coarse calcifications, and for most of them, there was no obvious acoustic shadow, and no significant blood flow measured. (3)7 cases (26.9%) showed dilatation catheter type, with or without low weak echo, for this type, cannot palpable mass, morphology is not specific, and it was difficult due to identify with dilatation caused by inflammation, intraductal papilloma, etc.; (4) 3 cases (11.5%) were simple calcification type. In this study, for 26 lesions elastography score, score 1 in 1 case, 2 in 3 cases, 3 in 7 cases, 4 in 10 cases, and 5 points in 5 cases. In elastography, 22 cases of DCIS were detected, and the total accordance rate of diagnostic was 84.6% (22/26).

Mammography performance of 26 cases of DCIS: (1) mass as the main performers in11cases(42.3%), the shape could be oval, round, lobulated for 1 case and irregular, in which equal density for 6 cases; high density for 5 cases; sharp edges for 1 case, fuzzy edges for 3 cases, leaf for 1 case, and infiltration for 6 cases.(2) X-ray mammography detected out 20 cases of calcification (76.9%). The calcification descriptions: benign calcification for 2 cases, intermediate calcification for 4 cases, malignant for 14 cases. (3)Calcification quantity: Patient with calcification number<5 was 1 case, ones with number between 5 to10 were 3 cases, and ones with number > 10 were 16 cases. (4)calcification size: diameter <0.5mm for 15patients (75.0%), diameter>5mm for 5 cases (25.0%).BI-RADS diagnose: class1 for 1 case, class two for 3 cases, class 3 for 3 cases, class 4 for 12 cases, and class 5 for 7 cases. X-ray mammography detected a total of 19 cases of DCIS and the total coincidence rate of diagnosis was 73.1%(19/26).

Table 1:Breast malignancy diagnosis rateby ultrasound elastography and molybdenum target X-ray for three groups of cases (%)

Diagnostic methods	The number of cases diagnosed as malignant			
	Group S1	GroupS2	GroupS3	Total
elastography	32(88.9)	37(88.1)	42(71.2)	111 (81.0)
X-ray mammography	17 (47.2)	30 (71.4)	43 (72.3)	83 (65.7)

Comparison between groups: (1) for elastography,diagnosis rates of malignant breast lesions in S1, S2 groups were higher than S3 group, the difference was statistically significant (χ^2= 4.069, P <0.05;χ^2=P4.117, P<0.05); difference between the S1 and S2 groups is not statistically significant (χ^2= 0.012, P>0.05).(2)For X-ray mammography,diagnosis rates of malignant breast lesions in S2, S3 groups were higher than S1 group (χ^2= 4.743,P<0.05;χ^2=4.094,P<0.05); difference between the S2 and S3groups is not statistically significant(χ^2= 0.026, P> 0.05).

Inner group comparisons: for S1 group,diagnosis rates of malignant breast lesions by elastography was higher than X-ray mammography, and the difference was statistically significant (P <0.05); for S2 and S3 groups, the diagnostic accuracy by both methods showed no statistically significant (P> 0.05).

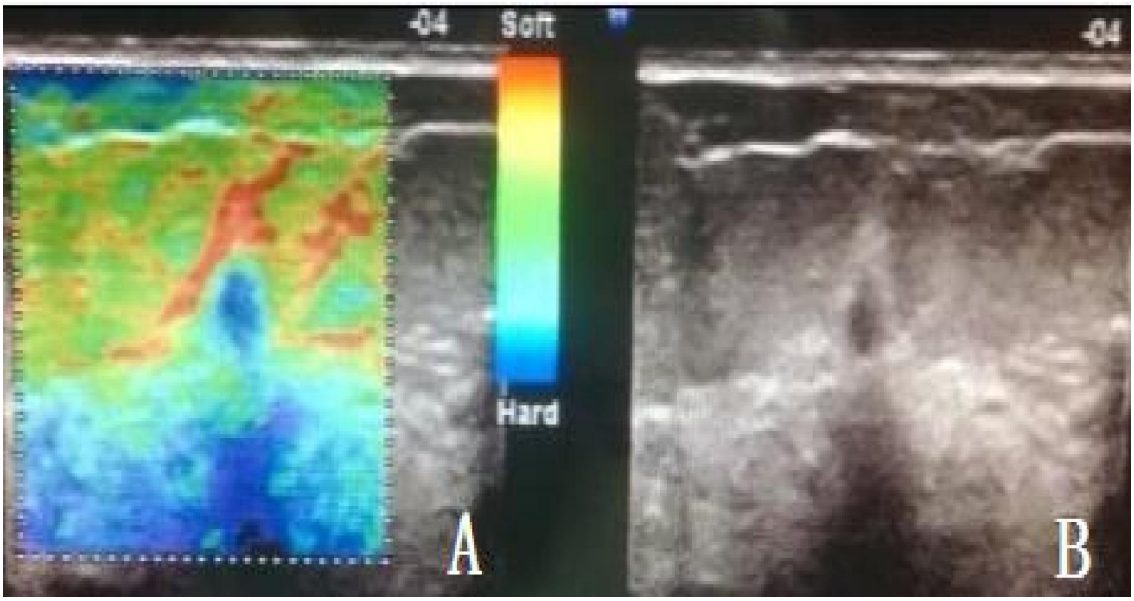

Figure 1.A patient with focal sclerosing adenosis with breast intraductal carcinoma, female, 36 years old, right breast nodules detected by ultrasound, no abnormality detected by X-ray. A.elastography clearly showed high hardness of lesion, and there was clear difference in hardness with the surrounding tissues, with elasticity score 4 points; B.Conventional ultrasound showed lesion shape was irregular, with hypoechoic and fuzzy boundaries,remove the tumor in the operation, and pathological result showed: breast sclerosing adenosis, hyperplasia of some atypical ducts, and ductal carcinoma in visible focal.

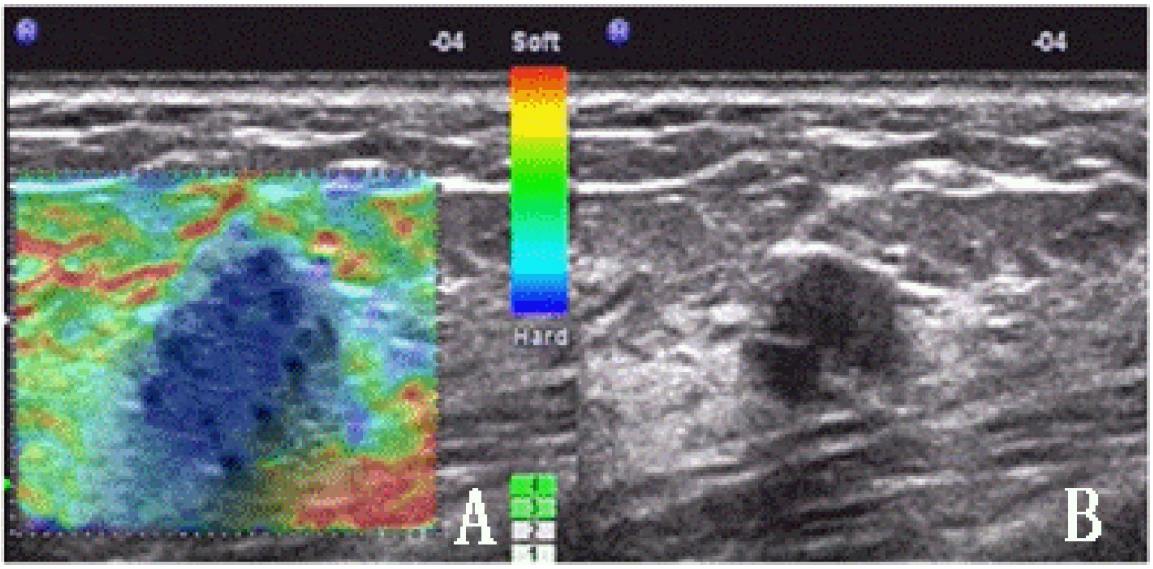

Figure 2.A patient with focal sclerosing adenosis with breast intraductal carcinoma, female, 36 years old, right breast nodules detected by ultrasound, no abnormality detected by X-ray. A.elastography clearly showed high hardness of lesion, and there was clear difference in hardness with the surrounding tissues, with elasticity score 4 points; B.Conventional ultrasound showed lesion shape was irregular, with hypoechoic and fuzzy boundaries,remove the tumor in the operation, and pathological result showed: breast sclerosing adenosis, hyperplasia of some atypical ducts, and ductal carcinoma in visible focal.

3.7 Discussions

Recent years, by the increasing of breast diseases, the incidence rate of breast cancer in women of our country rise to the first, and age of patients tends to be younger, so early detection and early diagnosis are important for treatment and prognosis for patients.

In this study, breast cancer sono-graphic features with positive findings by conventional ultrasound can be divided into two categories: mass type (67%) and local structural disorder type (33%), of which 41% of the lesions were associated with multiple micro-calcifications. As part of the malignant lesions and normal tissues (or with the existence of adenosis organization) exist together, so it showed the following signs: the segmental structural disorder, without the explicit form lumps, lesions with or without calcification, greater extent of disease affecting multiple quadrants, color Doppler machines showing moderate or abundant flow signal sin the region, or penetrate the blood stream. If the routine ultrasound scan failed to detect these signs, it often led to miss diagnosis.

The different point of elastography is that to detect the tissue mechanical properties to identify the hardness of lesions and the normal regions for identification of lesions. In this study, ultrasound elastography for groups with different sizes of breast cancer showed that diagnosis rates of ultrasound elastography for breast cancer with diameter <10mm and 10-20mm are higher than which with diameter of ≥ 20mm. The reasons might be that the elastography techniques identify the relative hardness, and it needs surrounding normal tissue for comparison, for lesions with diameter≤20mm, because of their smaller size, the surrounding normal tissues for comparison can be easily obtained for satisfactory elastography map, and smaller malignant lesions are less prone to liquefaction necrosis, so a relatively smaller chance of false negative. For larger nodules, it relatively lacks of surrounding normal tissue for comparison, elastography is difficult to obtain a satisfactory image, and the greater tuberosity probe is more difficult to make uniform pressure, complex organizational structure within the lesion, the elasticity score cannot detect the hardness of an ingredient, because of the larger lesions, some lesions can occur liquefaction necrosis, resulting in lesions decrease in hardness, to make elastography prone to false-negative results, so diagnosis value by elastography for breast cancer with small lesions is higher than large nodules. In addition,in the study there are some misdiagnosis rate by elastography, partly related to lesion analysis pathological type, such as for 3 cases of medullary carcinoma,caused of less stroma, bleeding and necrosis, and soft texture, it reduced the elasticity score; 5 cases of invasive ductal carcinoma, caused of larger size, infiltrative tumor growth, and tumor tissue and normal tissue exist together, it reduced the elastic scores; 4

cases of ductal carcinoma in situ, caused of soft texture of invasive cancer, the elastic score were between benign and malignant lesions, it resulted in misdiagnosis.

X-ray photography is a commonly used imaging method for the key target diagnosis of breast malignant lesions, it can show characteristic changes of breast cancer, and has a strong overall sense, but weak display for the fine structure. For part of the breast lesions with amorphous or sand-like calcification, molybdenum target X-ray photography can make a diagnosis by calcification shape. Studies have reported that when the lesion is small molybdenum target X-ray diagnostic accuracy is higher, but this study showed that in clinical study, the diagnosis rate of X-ray mammography for breast malignant lesions ≤ 10mm was not high. The reasons might be that X-ray mammography mainly analyzes X-ray mass and calcification or other signs to determine the nature of the lesion, but its diagnosis depends on the extent of lesion size and breast density, for dense breast, the lesions effect poor. For Asian women denser breast glands with lesions between 10-20mm, most of the patients at the age of 50 with type glands due to glandular substance and interstitial tissue, it led to irregular image dense nodules and glandular thickening shadow, to block mass and calcification display, to confuse with lobular nodules and cause missed. And for lesions ≥ 10mm, because the relatively larger size, the calcification and internal features can be easily to detect, so the diagnostic value X-ray mammography for it is higher.

The study also showed that when malignant lesions were ≤ 10mm, the elastic imaging diagnosis rate is higher than X-ray mammography, in the study,X-rays for 9 cases in the group with lesions ≤ 10mm were negative, in which 6 cases with clinically not palpable mass in 6 cases, 3 cases with ductal carcinoma in situ, and reasons might be high density glands masked and missed, but the 6 cases were detected by elastography(Figure 1). So when the lesion diameter is small, elastography for dense mammary glands has its own value, so when X-ray mammography was negative, apply elastography to make up the defects of X-ray mammography and improve diagnostic accuracy. When the lesions were ≥ 10mm, the diagnostic accuracy of elastography are slightly higher than X-ray mammography, but the difference was not statistically significant, so combination application of the two methods can supple to avoid misdiagnosis.

Ductal carcinoma in situ (DCIS) were derived from the malignant lesions of epithelial cells in ductal system, and because lesions did not break the basement membrane.Early detection and treatment can make patients cured, so the diagnosis has important clinical significance.,In the large-scale census of malignant breast lesions, more than 82% of DCIS were found by means of images, mainly by mammography, and the diagnosis was still based on more meaningful fine calcification, which was the specific characteristics of DCIS, because conventional ultrasound has a weak calcification sensitive than X-ray, previously it considered that ultrasound has a little value for the diagnosis of DCIS. In this study, use mammography to find calcifications accounted for 76.9% (20/26), and in the 20 cases, use ultrasound to find 12 cases with calcification, accounting for 60.0% (12/20). Obviously, ultrasound diagnostic calcification has the lower sensitivity than molybdenum target X-ray, Conventional ultrasound has some value in detecting DCIS, but with a less detection rate than mammography(63.9%), because of the dense breasts of Asian women, mammography imaging mainly gained overlapping images, so before the discovery of clearly malignant calcification, it could use partially pressurized radiography, and no mass show found, it may be related to the structure of the tumor tissue, it needed further study. However, 17% of lesions lacked pathological evident of fine calcification, mammography showed no or only partial structural disorder, and nodular mass or non-specific density shadow. Fine calcification appeared as mammography sometimes also needed to differentiate benign calcifications.

Conventional ultrasound had no high accuracy rate in the diagnosis of DCIS, and elastography could identify ambiguous lesions on routine sono-graphic, and told the hardness difference between the lesions and normal regions. In the group, 1 case of breast focal sclerosing adenosis with intraductal carcinoma, use X-ray to gain false negative result, use conventional ultrasound to show lesions irregular, fuzzy boundaries, and use elasticity imaging to clearly show lesions with high hardness, and clear hardness differences between lesions and surrounding tissues(Figure 2). In this study, for elastography of DCIS lesions, we observed 13 cases of ductal carcinoma in situ lesion in hardness distribution with a certain characteristic, which was: in DCIS lesions, it could be seen high-hardness zones distribution in groups, wherein normal tissues with soft hardness, so we called this phenomenon as "beach pebbles levy." This was because for DCIS the tumor had not worn base membrane, interstitial tissue between the catheters were not involved, no fibroblast reaction, and evolvement catheter scattered in normal (or adenosis) of the breast tissues. This pattern was different with 3-5 grade of Itoh, etc. elastography hardness grading standards, which were mostly invasive breast cancers of pathological findings, infiltrating into the surrounding interstitial tissues, causing degrees of

stromal reactions, tumor cells and stromal tissues are inseparable, without obvious boundaries, so hardness distribution of lesions tended to be more uniform. Therefore, we believed that this kind of unique elasticity imaging, compared with conventional ultrasound, could provide possible new diagnostic information for accurate identification of DCIS lesions involving and the scope, and for identifying DCIS and breast and adenosis areas. At the same time, we believed that elastography may also identify the difference of hardness between normal and DCIS tissues to find the lesions could not be identified by conventional ultrasound.

In all the cases of the study, ultrasound elastography detected 4 abnormal cases which conventional mammography and ultrasound did not detect, so the detection rate of three combined diagnosis for DCIS was 92.3% (24/26), significantly higher than single detection of three. But this study had applied to less DCIS cases, there should be studies larger sample sizes to conform the diagnosis values differences of the three methods for DCIS with different sizes.

4.Conclusionsions

In this study,the conclusions are as follows:the diagnostic accuracy rate of X-ray mammography for small lesions of the breast cancer is not high, and the elastography diagnosis of breast cancer in a small lesion has a strong clinical value, combination application can provide a more accurate basis for the clinical diagnosis of breast malignancy Lesions, can improve the diagnostic accuracy, reduce clinical biopsy rate and reduce the rate of misdiagnosis.

In addition, the specificities of conventional ultrasound and X-ray mammography in the diagnosis of DCIS were not high, and elastography could accurately recognize organizations hardness, with the first two methods find negative results, it was significance for early detection and additional diagnosis of DCIS, the combination of the three could significantly increase the intraductal carcinoma detection rate.It is worth promotion and application in the clinical diagnosis.

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