The Correlation Between Ultrasonographic Findings and Pathologic Features in Breast Disorders

Kentaro Tamaki1,2,3,* , Hironobu Sasano2, Takanori Ishida1, Kazuyuki Ishida2, Minoru Miyashita1, Motohiro Takeda1, Masakazu Amari1, Narumi Harada-Shoji1, Masaaki Kawai1, Toshiyuki Hayase4, Nobumitsu Tamaki3 and Noriaki Ohuchi1

1Department of Surgical Oncology, Tohoku University Graduate School of Medicine, 2Department of Pathology, Tohoku University Hospital, Sendai, Miyagi, 3Department of Breast Surgery, Nahanishi Clinic, Naha, Okinawa and 4Institute of Fluid Science, Tohoku University, Sendai, Miyagi, Japan

*For reprints and all correspondence: Kentaro Tamaki, Department of Surgical Oncology, Tohoku University Graduate School of Medicine, 1-1 Seiryo-machi, Aoba-ku, Sendai, Miyagi 980-8574, Japan.
E-mail nahanisikenta@yahoo.co.jp

Received January 9, 2010; accepted April 7, 2010

Objective: Breast ultrasonography has gained widespread acceptance as a diagnostic tool for the evaluation of human breast disorders. It is important to evaluate the correlation of ultrasonography findings with the corresponding histopathological features.

Method: We retrospectively reviewed the 154 cases of breast disorders. We evaluated the correlation the ultrasonography findings and carcinoma cells extension with their corresponding histopathological findings. In addition, we also studied the information on estimation of histological types and cancer extension used by the other modalities such as computed tomography and magnetic resonance imaging.

Results: The concordance rate for margins between ultrasonography findings and histopathological features was 91.6% (P < 0.001) and that for boundary zone was 87.0% (P < 0.001). Histopathological correlation of internal and posterior echoes demonstrated that internal low echo masses were composed of fibroblastic cells with marked collagenization in the stroma, or the cases in which carcinoma cells proliferated in a monotonous, solid and/or expanding manners. Attenuation of posterior echo was detected in the cases associated with hyperplasia of collagenized fibroblastic stroma. An increased cellularity in the mass with prominent large tumor nests and little fibrous stroma demonstrated the accentuation or no alterations of the posterior echo. The concordance rate of borders was 84.4% (P < 0.001). The correlation between estimated histological type by ultrasonography diagnosis and actual histological types was 87.0%. An overall detection rate of carcinoma extension by ultrasonography was 86.4%. In addition, an overall detection rate of carcinoma extension by ultrasonography, magnetic resonance imaging and computed tomography was 93.8%.

Conclusion: These results demonstrated correlation between histopathological and ultrasonographic findings of the breast lesions is cardinal for quality control or improving the quality of ultrasonography.

Key words: breast ultrasound – histopathologic findings – carcinoma extension

INTRODUCTION

Breast cancer has become one of the leading causes of death among women. Early clinical detection of breast cancer through screening has led to the detection of the tumor at a relatively earlier clinical stage, which definitely reduced its mortality. The mammographic appearance of breast carcinoma has been well known to vary greatly (1). On the other
hand, breast ultrasonography (US) has gained widespread acceptance as a diagnostic tool for the evaluation of breast disorders (2). It is true that some breast diseases that are obscured by dense breast tissue at mammography can be detected with US. US has been in general proposed to serve better in the detection of breast cancer if the patient is young or the masses are small (3,4). Results of many previously published studies have demonstrated the diagnostic benefits in differentiating benign from malignant breast disease in the evaluation using US (5). It was well known that carcinomas are classically described as irregular solid masses with a heterogeneous texture and reduced sound transmission in the US, resulting in what is called ‘shadowing’ behind the lesion (5,6). In addition, a vertical orientation of the lesion is described more often in breast carcinoma in US evaluation (5,6). It is also true that not all carcinomas fulfill these criteria and some do only partially (5). In general, an accurate correlation of US findings with their corresponding histopathologic features is considered most important in US evaluation in this setting.

Breast-conserving surgery is being widely applied in the treatment of early breast cancer. In order to perform conserving surgery, it is very important to detect carcinoma extension and determine the excision area as accurately as possible in the preoperative setting for the benefits of the patients (7,8). Complete removal of a breast tumor with tumor-negative surgical margins is considered most important for avoiding local recurrence in breast-conserving surgery. With high-resolution equipment available, US can detect smaller non-palpable cancers not necessarily detected on high-quality mammography. Excellent visualization of extended intraductal component has been reported using US in some institutions (9,10). However, few have demonstrated the limitation of the US to detect small lesions. Therefore, we attempted to evaluate carcinoma infiltration based on US findings, through revealing histopathologic features of the carcinoma cells infiltration which cannot be detected by US. In addition, in order to overcome these possible limitations, magnetic resonance imaging (MRI) and computed tomography (CT) are being increasingly utilized for the preoperative evaluation of carcinoma extension (11–13). Therefore, we also evaluated the information regarding the detection of cancer infiltration by US in conjunction with MRI and CT.

It is very important to evaluate the correlation of US findings with the corresponding histopathological features. The purpose of this study is therefore, to evaluate the correlation of the US findings including shape, boundary zone, internal and posterior echo, anterior and posterior borders, estimated histological types and carcinoma infiltration with their corresponding histopathological findings of the same lesions. In particular, for internal and posterior echoes, attenuation has been considered to be provided by a highly cellular fibroblastic proliferation (2,14). However, none has ever reported that internal and posterior echo were indeed based on the ratio of intratumoral carcinoma cells and fibroblastic stroma, and histological stromal characteristics of the same lesions. We therefore indicated that anterior and posterior echoes were indeed caused by the ratio of intratumoral carcinoma cells and fibroblastic stroma, and histological stromal characteristics. In addition, some histological types demonstrated low concordance rates between estimated or the histological types estimated by ultrasonographic findings and actual histological types. Therefore, we also discussed this particular discordance between estimated US findings and histologic types, in detail.

### PATIENTS AND METHODS

#### Patients

We retrospectively reviewed the US findings and the histopathologic features of 154 breast lesions for which surgery was performed in Tohoku University Hospital from 1 January 2006 to 31 December 2007 and in which the patients were initially detected by US. The cases treated with neo-adjuvant chemotherapy were excluded from this study of correlating preoperative US findings with histopathological analyses. We received informed consents from the patients and the protocol for this study was approved by the Ethics Committee at Tohoku University School of Medicine. The median age of the patients was 57 years (range, 27–85). Of the remaining consecutive 154 patients, 132 were diagnosed histopathologically as invasive ductal carcinomas (IDC), 7 with ductal carcinoma in situ (DCIS), 10 with invasive lobular carcinomas (ILC) and 5 with mucinous carcinomas (Table 1).

<table>
<thead>
<tr>
<th>Histological types of examined cases</th>
<th>154</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invasive ductal carcinoma (IDC)</td>
<td>132</td>
</tr>
<tr>
<td>Ductal carcinoma in situ (DCIS)</td>
<td>7</td>
</tr>
<tr>
<td>Invasive lobular carcinoma (ILC)</td>
<td>10</td>
</tr>
<tr>
<td>Mucinous carcinoma</td>
<td>5</td>
</tr>
</tbody>
</table>

#### US AND HISTOPATHOLOGIC ANALYSES

The US were assessed by one of experienced eight breast surgeons of Tohoku University Hospital. They got the consensus meeting of US for a week to standardize the US exam. In addition, two surgical oncologists independently evaluated the US findings in a retrospective manner, without the knowledge of subsequent histopathological diagnosis. These two investigators were also blinded to the clinical outcome of the patients. The US examination was carried out using the following mechanical scanners: Aloka SSD 3500 (Aloka Co., Tokyo, Japan) with a 10-MHz transducer.

Surgical specimens had been fixed in 10% formaldehyde solution and cut into serial 5-mm thick slices. Histopathological slides in each tumor were reviewed by two pathologists independently without knowledge of the breast US findings. They used Olympus (Tokyo, Japan) BX50 and 20X objectives for the analysis.
Of two or more hardcopy transverse and sagittal plane images of breast lesions, only the largest lesion was analyzed in this study. In the patients with multiple breast lesions, only the largest lesion was evaluated. US findings were subsequently analyzed according to the American College of Radiology Breast Imaging Reporting and Data System (BI-RADS) sonographic classification (2) and the Japan Association of Breast and Thyroid Sonology (JABTS) breast sonographic classification (14). The presence of a mass, margin, boundary zone, internal echoes, posterior echoes and associated findings were each recorded. Histopathological evaluations were based on the Japanese Breast Cancer Association (2008) (15), World Health Organization (WHO) histological classification of tumors of the breast (1) and Rosen’s Breast Pathology (16). (i) Margin was tentatively classified into circumscribed or not and also histopathologically classified into these two categories above. (ii) For boundary zone, we analyzed the presence or absence of halo in US. Ultrasonographic ‘Halo’ corresponded to the histopathologic features in which carcinoma cells invade into fat tissue admixed with adipocytes and elastic fiber (14). We termed the histopathologic feature ‘histopathologic halo’ and evaluated the existence of ‘histopathologic halo’ (Fig. 1). (iii) Internal echo was tentatively classified into low and equal/heterogenous, and posterior echo was tentatively classified into accentuating, no change and attenuating (14). Histopathologic features corresponding to internal and posterior echoic findings were defined by the ratio of carcinoma cells to stroma and the following characteristics related to stromal architecture; collagenization or poor collagenization. We analyzed the intratumoral stroma in five representative fields per case (×200) (Fig. 2). (iv) We analyzed relevant findings about interruption of the anterior and posterior borders of the mammary gland. Interruption of the borders demonstrated extension in adipose tissue, whereas non-interruption demonstrated extension in gland (Fig. 3). (v) We examined the concordance between the estimated and actual histological types. We estimated histological types as followings; IDC, DCIS, ILC and mucinous carcinoma by US without knowledge of histopathological diagnoses.

US, CT and MRI were performed prior to breast-conserving surgery. A 16-row detector CT system (Somatom Sensation Cardiac; Siemens Medical Solution, Erlangen, Germany) was used with CT skin marker, consisting of a paper seal and seven 75-mm non-lead lines with an open window between each line, over the location of the target (13). The breast MRI was obtained using a 1.5 tesla MRI clinical scanner (Magnetom Vision, Siemens, Erlangen, Germany) (17). The histopathologic diagnosis and the carcinoma extension in all slices were determined by the two pathologists. The surgical margin was defined as positive margin when there were malignant cells at the surgical margin and within 5 mm of the surgical margin. The accurate ratio between the cancer extension detected by the US and the histopathologic cancer extension was evaluated. We also studied the information on detecting cancer extension used by the other modalities such as CT and MRI. In addition, the histopathological characteristics of the cases which could not to be detected by the US were also evaluated. If there were discrepancies of carcinoma extension and estimated histological types among these modalities, we returned to examine the discrepant lesions by US again. When the US findings of the lesions represented desmoplastic change or stromal reaction, we accepted the diagnoses by MRI and CT. On the other hand, when the US findings represented normal variations, we accepted the US diagnoses.

Statistically analysis, such as the one-factor ANOVA and simple regression analysis, were performed using StatMate III for Windows ver. 3.18 (ATMS, Tokyo, Japan). The results were considered significant at \( P < 0.05 \).

RESULTS

EVALUATION OF THE MARGINS OF THE LESION

Twenty-six out of the 154 were circumscribed masses. Of the 26 circumscribed tumors detected by US, 18 cases...
were also histopathologically circumscribed. Not circumscribed masses were 128 tumors in our present study. One hundred and sixteen out of these 128 tumors (90.6%) were also histopathologically ’not circumscribed’. The rate of concordance between US and histopathological findings was 87.0% (P < 0.001).

Figure 2. Representative illustrations of internal echoe and posterior echoe. (A) Shows internal echo is heterogenous and posterior echo is accentuating. The histologic type is mucinous carcinoma in which intratumoral structure is heterogenous and constructed by mucin. (B) Shows internal echo is low or heterogenous and posterior echo is no change. The intratumoral histopathologic feature is heterogenous and poor collagenized stroma. Whereas (C) shows internal echo is low and posterior echo is attenuation. The intratumoral histopathologic feature is heterogenous but the stroma is marked collagenized.

Figure 3. Representative illustrations of interruption and not interruption of the mammary borders. (A) Shows interruption of the anterior border. Histopathologically, carcinoma cells extend to fat. (B) Shows not interruption of the borders. Histopathologically, carcinoma cells extend in the mammary gland.
BOUNDARY ZONE (HALO)

Eighty-nine out of these 154 tumors were recognized with halo using US. Seventy-eight out of these 89 tumors with halo were defined as ‘histopathologic halo’ (Table 2). The rate of concordance was 87.6%. Sixty-five out of the 154 tumors turned out to be the masses without halo. Fifty-six out of the 65 non-halo tumors (86.2%) were also non-histopathologic halo tumors. The rate of concordance for boundary zone between US and histopathologic findings was 87.0% ($P < 0.001$).

<table>
<thead>
<tr>
<th>US findings</th>
<th>No. of cases</th>
<th>Rate of concordance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Margin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circumscribed</td>
<td>26</td>
<td>69.2</td>
</tr>
<tr>
<td>Not circumscribed</td>
<td>128</td>
<td>90.6</td>
</tr>
<tr>
<td>Boundary zone (halo)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>halo (+)</td>
<td>89</td>
<td>87.6</td>
</tr>
<tr>
<td>halo (−)</td>
<td>65</td>
<td>86.2</td>
</tr>
<tr>
<td>Associated findings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( Interruption of the mammary borders)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interruption</td>
<td>112</td>
<td>83.0</td>
</tr>
<tr>
<td>Non-interruption</td>
<td>42</td>
<td>88.1</td>
</tr>
</tbody>
</table>

**Table 2.** US findings, the number of cases and the ratio of accuracy between US findings and histopathological features, of margin, boundary zone and associated findings.

INTERNAL AND POSTERIOR ECHOES

About 59.7% of the tumors in which internal echoes were equal/heterogeneous histopathologically were associated with poor collagenized stroma and heterogenous intratumoral structure (the ratio of carcinoma cells to stroma was 3:1–1:3) (Fig. 4A). However, tumors associated with low echo levels demonstrated marked collagenized stroma and the higher fibroblastic stromal ratio. As for posterior echo, accentuating tumors histopathologically demonstrated carcinoma cells proliferated in pushing, encapsuled and monotonous fashions, and were also demonstrated in all mucinous carcinoma examined. About 76.1% of the tumors classified as ‘no changes’ also demonstrated the patterns of marked intratumoral heterogeneity. In addition, ultrasonographically attenuating cases (43 out of the 153 tumors, 28.1%) were associated with marked collagenized stroma and higher fibroblastic stromal ratio (Fig. 4B).

HISTOPATHOLOGICAL CORRELATIONS WITH OTHER ULTRASONOGRAPHIC FINDINGS (INTERRUPTION OF THE ANTERIOR OR POSTERIOR BORDERS OF THE MAMMARY GLAND)

Interruption of anterior and posterior borders tumors were detected in 112 out of the 153 tumors. Ninety-three out of the 112 tumors (83.0%) were also histopathologically interpreted as extension into adipose tissue. Non-interruption tumors were seen in 42 cases. Thirty-seven out of the
42 tumors (88.1%) were histopathologically infiltration in mammary gland or non-invasive carcinomas. The rate of concordance of these borders was 84.4% ($P < 0.001$).

**The Correlation Between Final US and Histopathological Diagnoses**

The ratio of the correlation between estimated histological types by US diagnosis and histopathological types was 91.6% (141 out of the 154 tumors). The concordance rates between US findings and the following histologic types; IDC, DCIS, ILC and mucinous carcinoma were 98.5% (130 out of the 132 tumors), 14.3% (1 out of the 7 tumors), 60.0% (6 out of the 10 tumors) and 80.0% (4 out of the 5 tumors), respectively (Table 3). US was limited in its ability to detect the lesions with <1 mm in diameter. The concordance rate of combined modalities was 96.1% (148 of 154 tumors) with US, CT with CT skin marker and MRI; IDC, DCIS, ILC and mucinous carcinoma were 99.2% (131 out of the 132 tumors), 57.1% (4 out of the 7 tumors), 80.0% (8 out of the 10 tumors) and 100% (5 out of 5 tumors), respectively.

**Table 3. The concordance rates between US diagnosis and the histological types**

<table>
<thead>
<tr>
<th>Histological types</th>
<th>Concordance</th>
<th>Not concordance</th>
<th>Rate of concordance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDC</td>
<td>130</td>
<td>2</td>
<td>98.5</td>
</tr>
<tr>
<td>DCIS</td>
<td>1</td>
<td>6</td>
<td>14.3</td>
</tr>
<tr>
<td>ILC</td>
<td>6</td>
<td>4</td>
<td>60.0</td>
</tr>
<tr>
<td>Mucinous</td>
<td>4</td>
<td>1</td>
<td>80.0</td>
</tr>
</tbody>
</table>

**Correlation Between Ultrasonographic and Histopathological Carcinoma Extension**

The overall detection rate of carcinoma extension by US was 86.4% (133 out of the 154 tumors). Seventeen out of the 21 tumors (81%) in which US could not detect carcinoma extension demonstrated low-grade intraductal components (Fig. 5A and B), and these lesions were also <1 mm in diameter. Three out of these 21 cases turned out to be invasive ILC in which carcinoma cells invaded with forming single cell pattern (Fig. 5C) and small LCIS extension (Fig. 5D). One was the infiltrated lesion of IDC. This tumor was invaded with forming single cell pattern with poor stromal reaction, similar to ILC. The detection rate of combined modalities was 93.8% (144 of 154 tumors) with US, CT with CT skin marker and MRI.

**Figure 5.** Representative illustrations of the carcinoma extensions which could not be detected by ultrasonography (US). (A) and (B) are low-grade intraductal components. (C) Is invasive lobular carcinoma extension and (D) is LCIS lesion.
DISCUSSION

Previous studies demonstrated that the following ultrasonographic features such as oval or round shape, parallel orientation, circumscribed margins, abrupt interface, enhancement or absence of posterior acoustic features, absence of surrounding tissue alterations represented a benign breast lesion, whereas, irregular shape, non-parallel orientation, echogenic halo, posterior acoustic shadowing and abnormalities of the surrounding tissue regardless of echo pattern were considered to be consistent with a malignant lesion (5,18). It is also true that not all carcinomas fulfill these criteria and some do only partially (5). We therefore examined the details of preoperative US findings and compared these findings to their corresponding histopathological features of the surgical specimens.

It has been well known that circumscribed masses are usually detected in the cases in which carcinoma cells proliferated in both solid and expanded fashion. On the other hand, not circumscribed masses are detected in the cases in which carcinoma cells are arranged in cords, clusters and/or trabeculae, and/or are associated with mixed intraductal component and invasive areas. Halo is generally defined as one of back scattering in US (14). Reflection and scattering are detected and are considered to be caused by the structure which is heterogenous and smaller than sound wave, such as cellular tissue (14). Such opposite sound wave of incident element is generally defined as back scattering (19). Results of our present study demonstrated that halo was indeed characterized by the following histopathologic features, carcinoma cells infiltrated into fat tissue, mixed fat tissue, carcinoma cells and fibroblastic stroma.

Results of previous studies demonstrated that the degree of internal hypoechogenicity determines its sensitivity in predicting malignancy of the lesion (6,20,21). In addition, posterior shadowing has been also reported as one of the important US features suggestive of malignant nature of the lesions (6,20,22). It has been known that shadowing is provided by a highly cellular fibroblastic proliferation (2,14). This is the first study which demonstrated that anterior and posterior echoes were caused by the ratio of intratumoral carcinoma cells and fibroblastic stroma, and histological stromal characteristics. Results of our present study demonstrated that internal echoes and posterior echoes were defined by histopathological intratumoral construction. The acoustic characteristic impedance of the medium becomes larger, reflection subsequently becomes bigger and low internal echo and attenuation of posterior echo finally occur (14). In addition, low internal echo are also detected in the cases histopathologically associated with poor fibroblastic stroma, and carcinoma cells proliferating monotonously, solidly and confluence. Internal and posterior acoustic shadowing is considered the direct result of US beam attenuation by the desmoplastic reaction to breast cancer (23). Results of our present study of histopathological correlation therefore demonstrated that internal low echoic masses represented the high ratio of fibroblastic stroma and the stroma in these lesions turned out to have marked degrees of interstitial collagenization or the tumors in which carcinoma cells proliferated monotonously, solidly and pushingly. In addition, attenuation of posterior echo was detected in the tumors histopathologically associated with hyperplasia of collagenized fibroblastic stroma. However, it is also true that increased cellularity in the mass with prominent large tumor nests and very little fibrous stroma demonstrated the accentuation or no change of the posterior echo. In addition, poor collagenized fibrous stroma exhibits high acoustic impedance. Histopathological intratumoral construction is important for internal and posterior echoes.

Results of our present study demonstrated that the concordance rate between the US findings and the histopathologic features was 91.6%. According to the comparison between the US findings in details and histopathologic features, we could reasonably postulate histological types from the US findings. Our results demonstrated that DCIS and ILC were lower concordance rates between estimated and actual histological types than the other types. As for DCIS, in some cases, intraductal components were gathered and formed nodule histopathologically. Therefore, the US findings of some DCIS cases were similar to some invasive carcinomas. On the other hand, some IDC tumors such as T1mic which have microinvasion 0.1 cm or less in greatest dimension were similar to DCIS because we proved that US is limited to detect the lesions with <1 mm in diameter. On the other hand, ILC is classified in the following types, classical pattern, solid pattern, alveolar pattern, pleomorphic lobular carcinoma and mixed type carcinoma (1). Therefore, US findings of ILC showed various features and US is limited in its ability to diagnose as ILC correctly. Previous study demonstrated that MR imaging has been shown to be particularly useful in the evaluation of ILC and DCIS (24). Our study also demonstrated the concordance rate of combined modalities was 96.8% (149 of 154 cases) with US, CT with CT skin marker and MRI. Especially, the concordance rate of ILC and DCIS were up to 57.1% (4 out of 7 cases) and 80.0% (8 out of the 10 cases), respectively. It is therefore very important to use a variety of imaging modalities for examining histological types of breast lesions.

Breast conservation therapy has become the treatment standard for the great majority of breast carcinoma (13,25). Several investigations reported the association of higher tumor recurrence rates with positive or close margins than with negative margins following breast-conserving therapy (25,26). It therefore becomes very important to precisely evaluate carcinoma extension preoperatively and determine the excision areas for performing breast-conserving surgery as accurate as possible (13). Results of our study clearly demonstrated the detection rate of carcinoma extension was 86.4% by US. Many tumors in which US could not appreciate carcinoma extension corresponded to DCIS following histopathological evaluations, especially DCIS associated with low-grade malignancy. In such low-grade malignant
DCIS, intraductal components are very small, similar to non-pathologic breast ducts or lobes, the differentiation between low-grade malignant DCIS and non-pathologic breast tissue is generally defined only in cell or nuclear pleomorphism. In addition, such DCIS were rarely detected in stromal desmoplastic reaction. As for ILC, ILC can be insidious and difficult to detect on routine physical examination and/or imaging including US. Histopathologically, ILC is generally characterized by a proliferation of small cells, which lack cohesion and appear individually dispersed through a fibrous connective tissue or arranged in single file linear cords (1). There is often little host reaction or disturbance of the back-ground architecture (1). In addition, this is the first study demonstrated that US is limited to detect the lesions with less than 1 mm in diameter. The results of this study demonstrated that the combined modalities such as US, CT and MRI increase the accuracy of detection from 86.4 to 93.8%. Therefore, it has become very important that a variety of imaging including US. Histopathologically, ILC is generally characterized by a proliferation of small cells, which lack cohesion and appear individually dispersed through a fibrous connective tissue or arranged in single file linear cords (1). There is often little host reaction or disturbance of the back-ground architecture (1). In addition, this is the first study demonstrated that US is limited to detect the lesions with less than 1 mm in diameter. The results of this study demonstrated that the combined modalities such as US, CT and MRI increase the accuracy of detection from 86.4 to 93.8%. Therefore, it has become very important that a variety of imaging modalities has been used for examining tumor extension and multifocality in breast cancer patients.

CONCLUSION

We clarified the histopathological features of the breast lesions of the tumors in which carcinoma extension could not be preoperatively detected using US. The results of this study demonstrated correlation between histopathological and ultrasonographic findings of the breast lesions is cardinal for quality control or improving the quality of US.

Conflict of interest statement

None declared.

References