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● *Original Contribution*

WHAT HELP COULD ULTRASOUND ELASTOGRAPHY GIVE TO THE DIAGNOSIS OF BREAST PAPILLARY LESIONS?

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Abstract—On the basis of results of our previous studies and the findings of other scholars, the most common histologic type of false-positive diagnosis with strain elastography (SE) was papilloma. The objectives of our study were to evaluate whether SE could contribute to conventional ultrasound differentiation between benign and malignant papillary lesions and between papillary lesions and other common benign breast lesions. Data on 89 papillary lesions at our hospital, including 74 benign and 15 malignant papillary lesions, were included in our study. In addition, 198 non-papillary benign tumors were selected as the control group, including 126 fibroadenomas and 72 cases of fibrocystic mastopathy. All patients gave written informed consent. All patients with breast lesions underwent conventional ultrasound and SE examination. Breast Imaging Recording and Data System (BI-RADS) category and SE score were compared with respect to sensitivity, specificity and accuracy in differentiating between benign and malignant papillary lesions. We then explored the possibility of using BI-RADS combined with SE to differentiate papillary lesions from non-papillary benign tumors. For differentiating between benign and malignant papillary lesions, the area under the receiver operating characteristic curve (AUC) of BI-RADS was 0.568, whereas the AUC values of SE score, strain ratio and BI-RADS combined with SE were 0.517, 0.584 and 0.509, respectively ($p > 0.05$). For differentiating between papillary lesions and non-papillary benign lesions, the AUC of BI-RADS combined with SE was 0.835, which was higher than the values for BI-RADS (0.775) and SE (SE score: 0.648, strain ratio: 0.661) ($p < 0.001$). The specificity and accuracy of BI-RADS combined with SE were significantly higher than those for BI-RADS alone without a decrease in sensitivity ($p < 0.05$). SE could not improve the diagnostic efficiency of BI-RADS in differentiating between benign and malignant papillary lesions. However, BI-RADS combined with SE could improve the specificity of BI-RADS without decrease in sensitivity for differentiating breast papillary lesions from non-papillary benign lesions. (E-mail: zhihui18123@163.com) **© 2017 World Federation for Ultrasound in Medicine & Biology.**

Key Words: **Breast papillary lesions, Fibroadenomas, Fibrocystic mastopathy, Conventional ultrasound, Strain elastography, Strain ratio, Breast Imaging Recording and Data System.**

INTRODUCTION

Breast papillary lesions are rare, constituting less than 10% of benign breast lesions and less than 1% of malignant breast neoplasms (Ibarra 2006; Page et al. 1996; Sakr et al. 2008). They are characterized by growth inside the milk ducts and include a broad spectrum of entities. Benign papillary lesions include intraductal papilloma, classified as central, peripheral or atypical. Malignant papillary lesions can be non-invasive (intracystic and intraductal papillary carcinomas, intraductal micropapillary carcinoma) or invasive (invasive papillary and micropapillary carcinomas) (Tan et al. 2015). Different terminologies and criteria have been used to classify papillary lesions. The most important question is whether a lesion is benign or malignant. Although galactography is a useful means of identifying the location of the ductal abnormality (Lamont et al. 2000), it has limitations in patients with nipple inversion. Papillary lesions are also challenging for radiologists because benign and malignant tumors have a wide spectrum of appearance on magnetic resonance imaging (MRI), conventional ultrasound and mammography (Eiada et al. 2012). MRI may help differentiate papillary lesions, but there remains some overlap in MRI findings (Sarica et al. 2014). The role of conventional US is to detect papillary lesions and score

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lesions with the Breast Imaging Recording and Data System (BI-RADS) (American College of Radiology 2003). Sonoelastography is an ultrasound-based imaging modality that measures the stiffness of soft tissue. Two different modes are currently available in tissue elastography: strain elastography (SE) and shear-wave elastography (SWE). SWE uses shear waves to measure the modulus of the tissue (Balleyguier et al. 2013). It works by remotely inducing mechanical vibrations through acoustic radiation force created by a focused US beam. The displacement induced at the focus generates a shear wave that conveys information linked to the local viscoelastic properties of the tissue, thus enabling quantitative measurement of tissue elasticity. In SE, tissue deformation through either manual compression by an operator or physiologic motion is needed to generate a stiffness map. This technique provides only relative stiffness quantitation. It depends on the surrounding organ's compressibility and the operator's ability to correctly apply the compression. Both SE and SWE have been found to improve characterization of breast masses. Here we focused on the diagnostic performance of SE. Several clinical studies have reported that SE has the potential to differentiate between benign and malignant masses, and the most accomplished application of elastography is for breast tissue (Itoh et al. 2006; Leong et al. 2010; Parajuly et al. 2010; Tan et al. 2008; Thomas et al. 2006). SE has also been employed as an auxiliary tool to assess the behavior of some breast lesion types, including fibroadenomas (Fleury et al. 2009), phyllodes tumors (Li et al. 2014) and mucinous carcinoma of the breast (Mori et al. 2012). Based on the results of our previous studies, the most common histologic type of false-positive diagnosis with SE was papilloma (Zhi et al. 2008, 2012, 2013). As we know, there are few studies on the elastographic features of papillary lesions (Choi et al. 2012). We retrospectively studied SE characteristics of breast papillary lesions. One objective of our study was to evaluate whether SE can improve differentiation between benign and malignant papillary lesions. Furthermore, many benign non-papillary tumors may exhibit features overlapping with those of papillary lesions. Fibroadenoma and fibrocystic mastopathy are the most common benign breast lesions. A second objective was to investigate the possibility of using SE with conventional ultrasound to differentiate papillary lesions from fibroadenoma and fibrocystic mastopathy.

METHODS

Patients and breast masses

We retrospectively evaluated the data for 1215 patients with 1366 solid breast lesions from January 2011 to August 2013 at our hospital. Histologic results were available for all of the lesions. Our study was approved by the institutional review board of the ethics committee of our hospital, and written, signed informed consent was obtained from enrolled patients. The entire study was completed in one protocol. First, the lesion was examined with conventional US. Second, SE images were acquired.

All 89 papillary lesions among the solid breast lesions were included in our study. In addition, 198 non-papillary benign tumors were selected as the control group from January 2011 to August 2013, including 126 fibroadenomas and 72 cases of fibrocystic mastopathy.

The mean age of the patients with 74 benign papillary lesions was 46.9 y (range: 18–80 y). The mean age of the patients with 15 malignant papillary lesions was 46.8 y (range: 31–75 y). The mean age of the patients with 72 cases of fibrocystic mastopathy was 39.1 y (range: 18–65 y). The mean age of the patients with 126 fibroadenomas was 33.8 y (range: 19–65 y).

Study design

The BI-RADS category, SE score and strain ratio of benign papillary lesions, malignant papillary lesions, fibrocystic mastopathy and fibroadenoma were recorded. We first compared the sensitivity, specificity and accuracy of the BI-RADS category, SE score, strain ratio and BI-RADS category combined with SE score in differentiating benign from malignant papillary lesions. At a cutoff point of 3.05, which was introduced in our previous study for differentiating between benign and malignant breast lesions, the ability of the strain ratio to differentiate malignant from benign papillary lesions was evaluated using receiver operating characteristic (ROC) curve analysis. The areas under the curves (AUCs) for SE score, strain ratio and BI-RADS category were compared. Because surgical excision is the treatment of choice for papillary lesions, whereas fibroadenomas and fibrocystic changes are managed conservatively, we grouped benign papillary lesions, malignant papillary lesions, fibrocystic mastopathy and fibroadenoma into two groups: papillary lesions (benign papillary lesions and malignant papillary lesions) and non-papillary benign tumors (fibrocystic mastopathy and fibroadenoma). Our second objective was to explore the possibility of using BI-RADS combined with SE to differentiate papillary lesions from non-papillary benign tumors. The best cutoff point for the two groups was obtained.

Equipment

Conventional ultrasound and SE images were obtained and analyzed by one radiologist (more than 10 y of experience in BI-RADS and 5 y of experience in SE) using a Hitachi HV-900 with a 5- to 13-MHz linear transducer (Hitachi Medical, Tokyo, Japan). She was blinded