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● *Original Contribution*

SONOGRAPHIC AND PATHOLOGIC IMAGE ANALYSIS OF PURE MUCINOUS CARCINOMA OF THE BREAST

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Abstract—The aims of this study were to elucidate sonographic and histologic features of pure mucinous carcinoma (P-MC) of the breast using quantitative analysis and to evaluate the relationship between quantitative analysis and visual qualitative assessment. Eleven P-MCs (nine patients) were evaluated qualitatively and quantitatively. Three experts assessed these sonographic images using the Breast Imaging Reporting and Data System (BI-RADS) lexicon. For assessment of internal echoes and posterior echoes, quantitative measures were determined using ImageJ software. Histologic thin sections were stained for classification into separate parts of the tumor (stroma, mucin and cancer cells) and were digitized. Internal echoes were isoechoic in 7 of 11 (63.6%) tumors and hypoechoic in 4 of 11 (36.4%); all P-MCs were "enhanced" in qualitative evaluation. As internal echoes increased, the proportion of stroma increased and that of mucin decreased. The high level of internal echoes is correlated with reflection and back-scattering, which are caused mainly by the interface between mucin and stroma. (E-mail: kaoku@koto.kpu-m.ac.jp) © 2013 World Federation for Ultrasound in Medicine & Biology.

Key Words: Mucinous carcinoma, Breast, Ultrasonography, Back-scattering, Internal echoes, Posterior echoes, Quantitative analysis, ImageJ.

INTRODUCTION

With recent advances in imaging technology, the resolution and quality of breast ultrasonograms have been markedly improved. Because prognosis, invasive pattern and other factors associated with histologic types vary in breast cancers, sonographic diagnosis is clinically needed not only for cancer diagnosis, but also for histologic diagnosis. Pure mucinous carcinoma is an uncommon carcinoma accounting for about 2% of all breast carcinomas (Bussolati and Sapino 2012) and is reported to be associated with a better prognosis and a lower incidence of axillary lymph node metastasis compared with other invasive carcinomas (Lam et al. 2004; Ranade et al. 2010). Derivation of the histologic diagnosis of mucinous carcinoma on ultrasonography is useful.

The sonographic findings reported for pure mucinous carcinoma (P-MC) are the characteristic high level of internal echoes and accentuated level of posterior echoes compared with other invasive carcinomas (Berg et al. 2006; Lam et al. 2004; Memis et al. 2000). P-MC is often confused with a benign tumor, for example, fibroadenoma. An isoechoic P-MC surrounded by fat tissue is difficult to detect on ultrasonography. Histologically, P-MCs comprise various proportions of cancer cells, mucin and stroma (Clayton 1986; Rosen 2009a; Tavassoli 1999; Tavassoli and Eusebi 2009a). It is still unknown whether these relative proportions influence sonographic findings. Therefore, in this study, we elucidated the sonographic and histologic features of P-MC and objectively evaluated these features using quantitative analysis.

MATERIALS AND METHODS

The process of quantitative and qualitative analysis for the study is illustrated in Figure 1.

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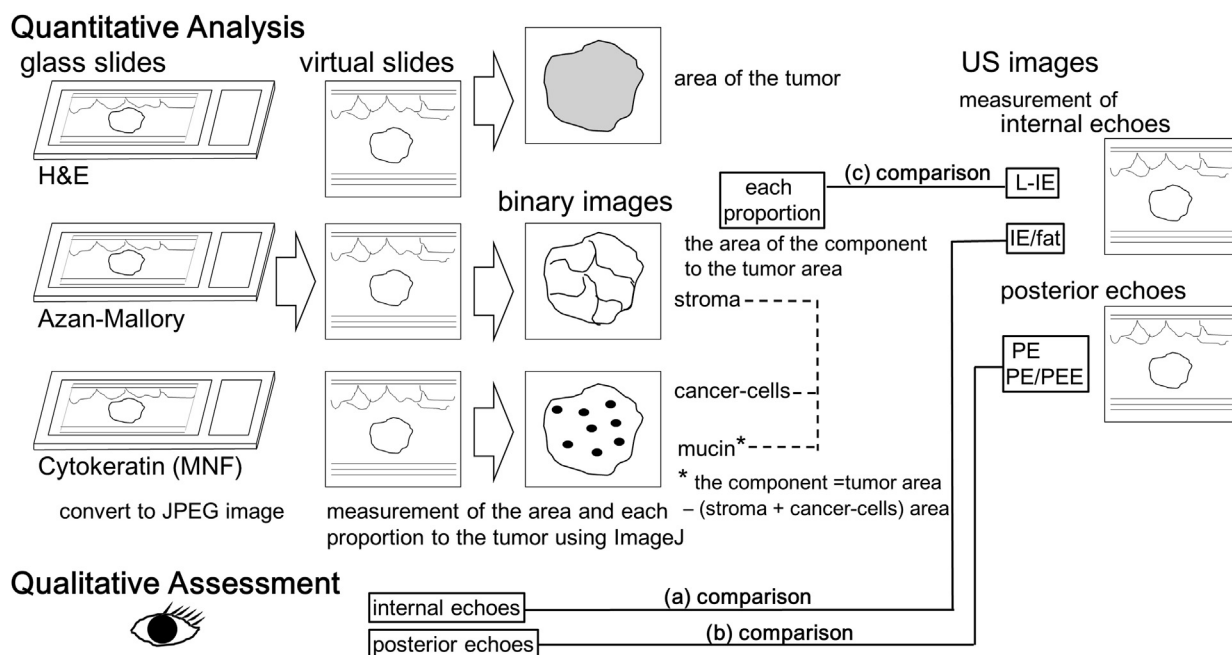
Quantitative Analysis

Fig. 1. Quantitative analysis and qualitative assessment. We made three comparisons: (a) between internal echoes in qualitative assessment and those in quantitative analysis; (b) between posterior echoes in qualitative assessment and those in quantitative analysis; and (c) between internal echoes in quantitative analysis and the proportions of the tumor occupied by stroma, cancer cells and mucin.

Patients

We retrospectively reviewed 11 P-MCs (9 patients) pathologically diagnosed at Kyoto Breast Center, Sawai Memorial Clinic (Kyoto, Japan) between November 2006 and April 2010. All patients were women, and the mean age was 52 years (range, 38–78). The mean tumor diameter was 19.4 mm (range, 11.3–39.4).

This study was approved by the ethics committee of the Kyoto Breast Center, Sawai Memorial Clinic. In accordance with institutional review board guidelines,

all patients provided written, informed consent prior to the study.

ImageJ software

We used ImageJ software for quantitative analyses. This software was developed as an image processing program at the U.S. National Institutes of Health. It is widely used for radiologic image processing, comparisons of multiple imaging system data with automated hematology systems data and other applications (Chou et al.

Table 1. Sonographic visual qualitative assessment using the BI-RADS lexicon*

Tumor No.	Age (years)	Tumor size (mm)	Visual qualitative assessment			
			Echo pattern	Mass shape	Mass margin	Posterior acoustic features
1	78	39.4	Isoechoic	Irregular (L)	Microlobulated	Enhancement
2	46	27.6	Isoechoic	Irregular (L)	Microlobulated	Enhancement
3		17.2	Hypoechoic	Irregular (L)	Circumscribed	Enhancement
4	41	14.8	Isoechoic	Irregular (L)	Microlobulated	Enhancement
5		12.7	Isoechoic	Irregular (L)	Microlobulated	Enhancement
6	38	15.6	Isoechoic	Irregular (L)	Microlobulated	Enhancement
7	77	11.3	Isoechoic	Irregular (P)	Microlobulated	Slight enhancement
8	54	17.4	Hypoechoic	Irregular (L)	Microlobulated	Enhancement
9	39	22.8	Isoechoic	Oval	Circumscribed	Enhancement
10	49	15.1	Hypoechoic	Irregular (L)	Circumscribed	Enhancement
11	45	14.1	Hypoechoic	Irregular (P)	Microlobulated	Enhancement
Mean	52	19.4	—	—	—	—

BI-RADS = Breast Imaging Reporting and Data System; Irregular (L) = lobulated; Irregular (P) = polygonal.
* The reviewers' evaluations revealed four areas of agreement: (a) The level of internal echoes was higher than those of other invasive carcinomas. (b) Posterior acoustic features were enhanced in all cases. (c) All masses exhibited a pushing border. (d) Ten tumors were irregular in shape: eight were lobulated, and two were polygonal.