Original Investigation

Descriptors of Malignant Non-mass Enhancement of Breast MRI: Their Correlation to the Presence of Invasion

Youichi Machida, MD, PhD, Akiko Shimauchi, MD, PhD, Mitsuhiro Tozaki, MD, PhD, Yoshifumi Kuroki, MD, PhD, Tamiko Yoshida, MD, Eisuke Fukuma, MD, PhD

Abbreviations and Acronyms

ALNM axillary lymph node metastasis

BI-RADS Breast Imaging Reporting and Data System

IEP internal enhancement pattern

MRI magnetic resonance imaging

NME non-mass enhancement

NST carcinoma of no special type

PPV positive predictive values

Rationale and Objectives: This study aims to investigate the clinical significance of malignant non-mass enhancement (NME) descriptors in breast magnetic resonance images by assessing their correlation to the presence of invasion or lymph node metastasis.

Materials and Methods: Three radiologists independently reviewed magnetic resonance images with malignant NMEs between January 2008 and December 2009. Distribution was assessed first, and then each of four internal enhancement patterns—clumped, clustered ring, branching, and hypointense area—was evaluated dichotomously (yes or no). Because clustered rings and hypointense areas were thought to be major structural elements of heterogeneous NMEs, they were also evaluated by integrating them into one collective descriptor we called the "heterogeneous structures." Chi-square test, Fisher exact test, or Student *t* test was used to analyze differences of variables by each reviewer. Positive predictive values (PPVs) of descriptors in predicting presence of invasion or lymph node metastasis were calculated. $P < 0.05$ was considered significant.

Results: We included 131 malignant NMEs (76 in situ and 55 invasive) in 129 patients (two bilateral). All three observers' results showed clustered rings (PPVs 54.5%, 54.5%, 50.0%) ($P = 0.0005$, 0.038, 0.029) and hypointense areas (PPVs 63.6%, 61.5%, 73.9%) ($P = 0.004$, 0.024, 0.0006) to be significantly associated with invasion. When clustered rings and hypointense areas were integrated into heterogeneous structures, they were significantly associated with invasion (PPVs 54.3%, 53.3%, 51.8%) ($P = 0.0003$, 0.016, 0.003).

Conclusions: The NME descriptors clustered rings, hypoechoic areas, and heterogeneous structures, assessed collectively, were associated with invasive breast cancer.

Key Words: Breast; magnetic resonance imaging; non-mass enhancement; descriptor; invasive breast cancer.

INTRODUCTION

Non-mass enhancement (NME) is one of the three lesion morphologies observed in magnetic resonance imaging (MRI) of breasts and is often associated with in situ lesions (1–3). However, NMEs with invasive components reportedly account for 10%–42% of total malignant NMEs (1,2,4). In situ and invasive lesions should be managed differently, especially when recent controversy about overtreatment of in situ breast cancer is taken into account (5–7).

Breast Imaging Reporting and Data System (BI-RADS) descriptors have been investigated in differentiating benign from malignant NME (1,8–14). However, few prior studies have investigated relationships between descriptors of NMEs and significant clinical factors, including invasion within NMEs (4,15). Furthermore, other internal structural patterns within NMEs, which are not widely recognized or have not been adopted into MR lexicon at this point, are also encountered in clinical practice. For example, fine branching structures within NMEs that suggest possible enhancement within or

Acad Radiol 2016; ■:■■–■■

From the Kameda Kyobashi Clinic, Tokyo Square Garden 4F, 3-1-1 Kyobashi, Chuo City, Tokyo 104-0031, Japan (Y.M., A.S., M.T., Y.K., T.Y.); Kameda Medical Center, 929 Higashi-cho, Kamogawa City, Chiba 296-0041, Japan (Y.M., E.F.); Tohoku University Hospital, Sendai City, Miyagi 980-8574, Japan (A.S.); Sagara Hospital Affiliated Breast Center, Kagoshima City, Kagoshima 892-0845, Japan (M.T.). Received November 11, 2015; revised January 14, 2016; accepted January 30, 2016. **Address correspondence to:** Y.M. e-mail: machida.yoichi@kameda.jp

http://dx.doi.org/10.1016/j.acra.2016.01.014

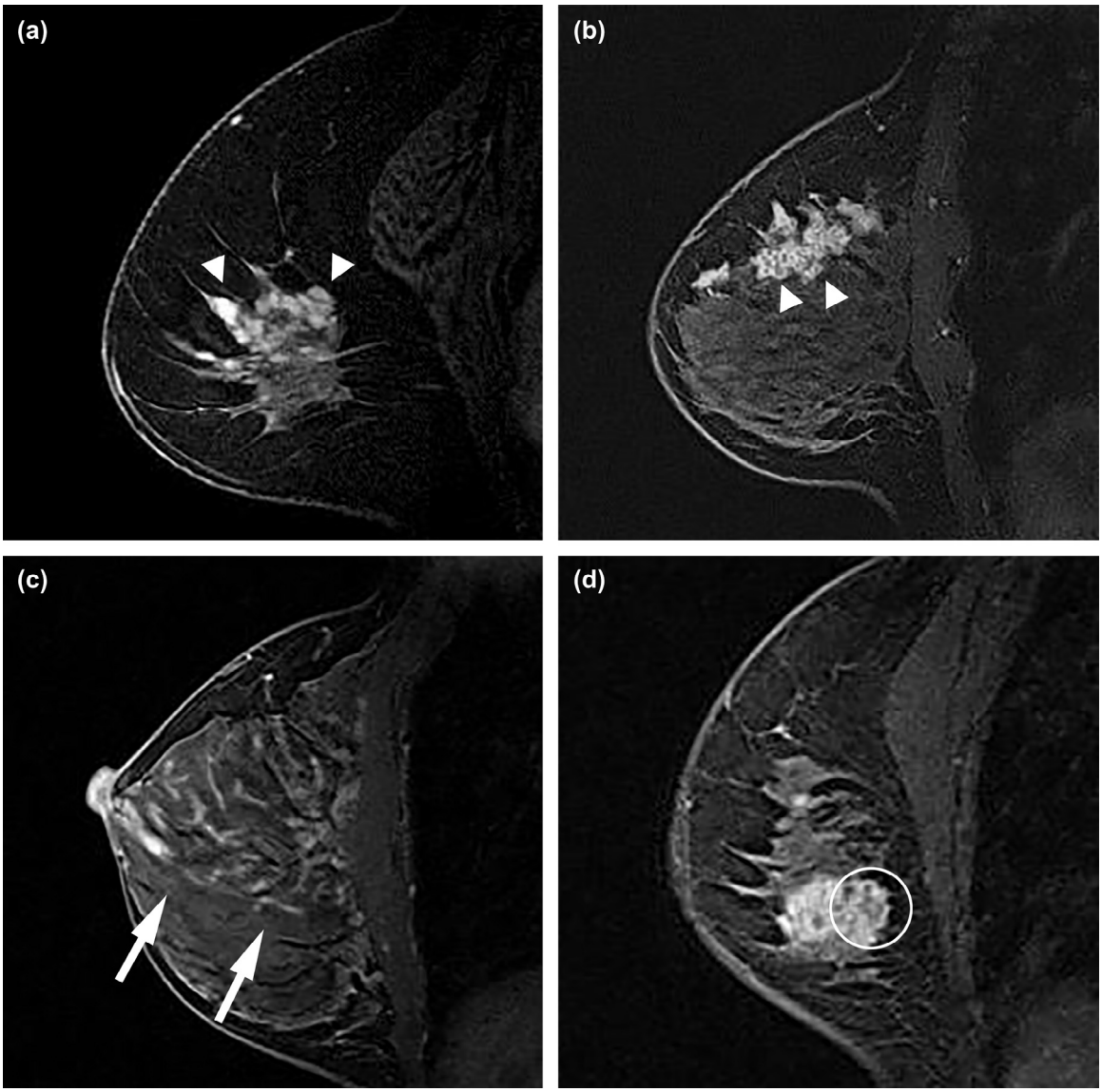

Figure 1. Sagittal contrast-enhanced T1-weighted images showing examples of internal enhancement patterns (IEPs). **(a)** 49-year-old woman with ductal carcinoma in situ (DCIS) of the left breast; non-mass enhancement (NME) includes a clumped IEP (*arrowheads*). **(b)** 38-year-old woman with invasive carcinoma of no special type (NST) of the right breast; NME includes a clustered ring IEP (*arrowheads*). **(c)** 47-year-old woman with DCIS of the right breast; NME includes branching IEP (*arrows*). **(d)** 48-year-old woman with invasive NST of the left breast; NME includes a hypointense area IEP (*circle*).

around ducts and their branches have been associated with malignancy (16) (Fig 1c, called "branching" in this study). In addition, within NMEs, relatively hypointense, confined areas that show fewer enhancements than surrounding areas are occasionally observed (Figs 1d, 3b, 4b, 5b; called "hypointense areas" in this study). We believe that this finding seems to add another major structural element of heterogeneous NMEs in addition to the clustered ring, given that heterogeneous NMEs are supposed to include areas of varying enhancement.

The aim of this study was to investigate the significance of descriptors of malignant NME in breast MRIs in the assessment of presence of invasion or lymph node metastasis.

MATERIALS AND METHODS

Patients

Between January 2008 and December 2009, 4965 breast MRI studies were performed at our institution. All breast MRI examinations had been initially interpreted at the time of clinical care by one radiologist, who had 13 years of experience in breast imaging and had read approximately 8000 breast MRI examinations before January 2008. This radiologist had been informed of patients' clinical information and imaging findings, including those of mammography and breast ultrasound examinations. At the time of initial