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● *Original Contribution*

ULTRASOUND IMAGE CLASSIFICATION OF DUCTAL CARCINOMA *IN SITU* (DCIS) OF THE BREAST: ANALYSIS OF 705 DCIS LESIONS[1]

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Abstract—The Japan Association of Breast and Thyroid Sonology (JABTS) proposed, in 2003, a conceptual classification system for non-mass abnormalities to be applied in addition to the conventional concept of masses, to facilitate detecting ductal carcinoma *in situ* (DCIS) lesions. The aim of this study was to confirm the utility of this system and to clarify the distribution of these findings in DCIS lesions. Data on 705 surgically treated DCIS lesions from 16 institutions in Japan were retrospectively reviewed. All 705 DCIS lesions could be classified according to the JABTS classification system. The most frequent findings were hypo-echoic areas in the mammary gland (48.6%), followed by solid masses (28.0%) and duct abnormalities (10.2%) or mixed masses (8.1%). Distortion (1.3%), clustered microcysts (1.4%) and echogenic foci without a hypo-echoic area (2.5%) were uncommon. These results suggest that the concept of non-mass abnormalities is useful in detecting DCIS lesions. (E-mail: Tak@snh.go.jp)

Key Words: **Breast cancer, Ductal carcinoma *in situ*, Ultrasound, Diagnosis, Multicenter study.**

INTRODUCTION

Because of the widespread use of screening mammography, detection of ductal carcinoma *in situ* (DCIS) has increased. DCIS accounts for approximately 15% of newly diagnosed breast cancers in Japan (Kosaka 2012). Furthermore, in the United States, DCIS accounts for 20% to 25% of all breast cancers (Ernster and Barclay 1997; Siziopikou 2013).

With advances in device-related technologies, breast ultrasound has become a more important modality in the diagnosis of breast cancer. Ultrasound is useful for the diagnosis not only of invasive breast cancer, but also of DCIS. However, as DCIS can appear in a wide variety of forms, an understanding of the variations is important for ultrasound detection and diagnosis. The ultrasound features of DCIS have been described in the literature. In general, the ultrasound findings of DCIS are classified into masses, ductal change (ductal abnormalities), calcification alone and architectural distortion (Izumori et al.

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[1] Japan Association of Breast and Thyroid Sonology (JABTS) BC-02 study.

2010; Park et al. 2010; Wang et al. 2013; Yang and Tse 2004). However, in recent reports, non-mass abnormalities (or lesions) have also been described as a finding in DCIS (Jin et al. 2015; Lee et al. 2013; Shin et al. 2008).

The Japan Association of Breast and Thyroid Sonology (JABTS) published guidelines for breast ultrasound in 2003 and proposed a conceptual classification system that incorporates both non-mass abnormalities (non-mass image-forming lesions) and the conventional concept of masses, mainly to facilitate DCIS detection (Endo et al. 2005; JABTS 2003). The non-mass abnormalities are of five subtypes, including abnormalities of the ducts, hypo-echoic areas in the mammary gland and architectural distortion. These descriptions refer to the variations in ultrasound images of DCIS, in addition to masses. As this JABTS classification system has been widely used in Japan, we conducted a multicenter, retrospective observational study (JABTS BC-02 study) to confirm the utility of the JABTS classification system for DCIS image classification and to clarify the distribution of these findings in DCIS lesions.

METHODS

Study design

This was a retrospective observational multicenter study. Clinical data and static ultrasound images of DCIS patients who underwent surgery from January 2008 to December 2012 were collected. Patient DCIS data were collected even for cases in which DCIS lesions were not detectable by ultrasound. Collected images were evaluated by a Centralized Image Interpretation Committee.

JABTS classification

The JABTS classifies breast lesions primarily as masses and non-mass abnormalities. Non-mass abnormalities are defined as lesions that are not recognized as a mass.

Masses. Masses are further classified into the subtypes cystic (simple cyst), mixed and solid (Fig. 1). A mixed mass contains both cystic and solid components.

Non-mass abnormalities. Duct abnormalities usually refer to ductal dilation accompanied by filling of the duct with a solid component (Fig. 2).

Hypo-echoic areas in the mammary gland differ from the surrounding tissue and cannot be recognized as masses (Fig. 3). Because typical DCIS lesions that appear as hypo-echoic areas possess 3-D segmental or focal distributions, where *focal* means less than a breast segment, we consider the distribution of lesions to be the most important difference between hypo-echoic areas and masses. In contrast, masses usually do not possess such segmental or focal distributions. As with the concept of non-mass enhancements on magnetic resonance imaging (MRI), lesion distribution is the most important factor to consider when applying the concept of hypo-echoic areas in the mammary gland on ultrasound.

Architectural distortion is a term describing a lesion that distorts the breast tissue, but without mass formation (Fig. 4). Architectural distortion is often difficult to visualize on static images, but can easily be recognized at the time of hand-held ultrasound examination because the image moves in real time.

Multiple small cysts are defined as multiple tiny or small cysts existing in the mammary gland. The distribution of such small cysts is important, in that a diffuse distribution suggests the lesion is benign, whereas a clustered or segmental distribution raises a small possibility of malignancy. The term *clustered microcysts* is used when multiple small cysts are observed clustered together (Fig. 5).

Echogenic foci without a hypo-echoic area are lesions in which only microcalcifications are visible (Fig. 6). Because not all echogenic foci on ultrasound are ultimately confirmed to be microcalcifications on mammography or by histology, we herein employ the term *echogenic foci*, which is an ultrasound finding,

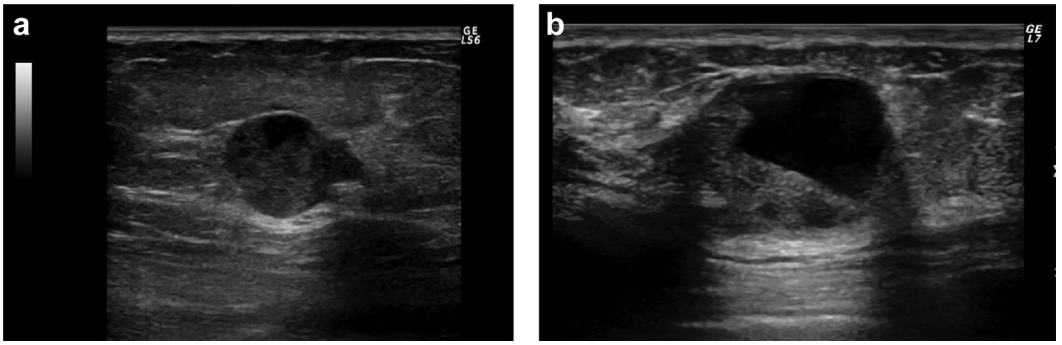

Fig. 1. Typical solid mass and mixed mass images. (a) Solid mass. (b) Mixed mass. Both lesions are ductal carcinoma *in situ*.