Clinical Significance of Ductal Dilatation on Breast Ultrasonogram

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Background: With the advent of high-resolution ultrasound (US), dilatation of the lactiferous ducts can be easily demonstrated at routine breast US examination. The purpose of this study was to prospectively evaluate the clinical significance of ductal dilatation detected on breast US study.

Patients and Methods: During a period of 12 months, we examined 16,336 nonlactating women referred for breast US; about 2.5% of them had a known history of nipple discharge. Routine whole breast US examinations were performed by using high-resolution US scanners. More attention was paid to detect and document the dilated ducts in the breasts. Among the 16,336 nonlactating women, 478 (2.9%) had duct dilatation (defined as duct diameter > 2.0 mm). Patients with dilated ducts were either followed-up for at least 2 years or were aspirated or biopsied according to their US findings.

Results: Of the 478 women with duct dilatation, 387 (81.0%) had no significant internal echoes in the dilated ducts, 48 (10.0%) had low-level internal echoes inside the ducts, and 39 (8.2%) had medium-level to relatively high-level internal echoes. Solid nodules in the ducts were demonstrated in 26 (5.4%) women, and calcified material in five (1.0%). For patients with intraductal echoes, US-guided aspiration or biopsy was performed to determine the duct contents; 18 of 26 intraductal nodules were shown to be intraductal papilloma cytologically and/or histopathologically, two were shown to be intraductal carcinoma in situ, and five were epithelial hyperplasia or atypical ductal hyperplasia. The majority of the other 61 women with internal echoes were found to have inspissated secretions (50/61, 82.0%), while the remaining 11 showed no cellular component inside, but the findings were inconclusive.

Conclusion: Multiple dilated ducts depicted on US are rarely associated with intraductal tumors (p < 0.001). If US can demonstrate solid nodules in the dilated duct, the possibility of intraductal tumor, especially papilloma, should be considered first. Routine and cautious evaluation of the dilated duct may depict intraductal tumor even in women without nipple discharge, and may facilitate surgical intervention without unnecessary delay.

KEY WORDS — breast ultrasound, carcinoma, duct ectasia, papilloma

Introduction

Galactography (also called ductography) has shown its capability to depict small intraductal masses partly or completely obstructing a contrast-opacified duct, lesions not identified by either clinical examination or mammography [1–4]. This technique has been suggested to investigate the cause of nipple discharge which occurs at least intermittently in up to 10% of women who seek medical help for breast problems [5,6]. The primary value of galactography is not to determine whether surgery is indicated or not, but to locate the precise site of the intraductal lesions, and to aid the choice of appropriate surgery [7]. However, demonstration of pathological duct or intraductal tumor in the affected ductal system might be technically unsuccessful. Recent advances in high-resolution ultrasonography (US) enable the clear demonstration of retroareolar ducts and frequently depict small solid nodules within the dilated ducts. It is therefore reasonable to obtain US images of small intraductal tumors without the need for iodinated contrast or X-ray mammography. Lactiferous ducts are often observed in normal breasts by high-resolution US [8]. Most ducts visualized on US examination are less than 2 mm in diameter; a caliber of greater than 2 mm can be considered unusual or dilated. Lactiferous duct dilatation is not an uncommon finding on breast US using state-of-the-art US scanners. The purpose of this study was to prospectively evaluate the clinical significance of dilated ducts detected on breast US study.

Patients and Methods

During a period of 12 months, we examined 16,336 nonlactating women referred for breast US study. This prospective study was conducted to demonstrate any ductal dilatation in the breast during routine US examination and to document the morphology of the dilated ducts. Of the 16,336 women examined, 407 (2.5%) had symptoms or signs of nipple discharge.

At our institution, routine whole breast US examinations are performed by using US scanners with high-resolution broadband probes, including two HDI 5000 scanners (Philips-ATL, Bothell, WA, USA) and one Logiq 9 scanner (GE Health Care Systems, Milwaukee, WI, USA), equipped with L12-5 and M12L linear array transducers. The women’s breasts were first scanned by two experienced technologists and then confirmed by two experienced radiologists with more than 10 years’ experience in breast imaging and interventional procedures. A radial scanning protocol was applied in both breasts, and the axillas were routinely checked. For every abnormality detected, an orthogonal scan plane on the region of interest was obtained. All suspicious lesions or abnormalities were labeled (as clock position and distance from the nipple). For abnormalities located in the subareolar region, oblique scans were usually done to achieve better visualization and better sonomorphologic evaluation.

The sonographic appearances of the breast lesions were described according to the BI-RADS US Lexicon [9] with respect to shape, margin, echotexture, sound transmission characteristics, and architectural pattern [10–12]. A dilated duct was defined as one with a diameter greater than 2.0 mm. Dilated ducts were documented with their diameter, number, internal echoes, and adjacent anatomy or possible abnormalities. The strength of the internal echoes was classified as very weak, low-level, medium-level, relatively high-level, and high-level, with respect to the echogenicity of the subcutaneous fat and breast parenchyma. Echogenicity that was merely seen, a little more than “anechoic”, was classified as very weak; echogenicity similar to or equivalent to that of the subcutaneous fat was classified as low-level; echogenicity similar to or equivalent to that of breast parenchyma was classified as relatively high-level; echogenicity higher than that of breast parenchyma was defined as high-level; and echogenicity between that of fat and breast parenchyma was defined as medium-level.

The US transducer was oriented radial to the nipple to optimize visualization of the duct and possible intraluminal structures during the procedure.
Graded compression (dynamic study) was applied to all dilated ducts. Fine needle aspiration cytology or core needle biopsy was performed if there were significant formed focal internal echoes in the dilated ducts, especially if there were demonstrable nodules inside. Women with dilated ducts and without demonstrable intraluminal lesions were scheduled for follow-up US studies at 1-year intervals for at least 2 years.

Results

Of the 16,336 nonlactating women who received breast US examinations, 478 (prevalence of 2.9%) were found to have dilated ducts on their sonograms. Their mean age was 44 years (range, 21–82 years). Of these 478 women, 258 (54.0%) were asymptomatic at presentation to the outpatient clinic, and about one-third (167/478, 34.9%) had symptoms of recent nipple discharge; 240 women had a remote history of nipple discharge.

Of the 407 women with a history of symptoms or signs of nipple discharge, 41% were found to have ductal dilatation. Less than 20% were referred for US examinations because of palpable breast nodules with or without nipple discharge (Table 1). About four-fifths of patients with ductal dilatation were noted to have multiple dilated ducts, most commonly bilateral (Table 2). The diameters of the ducts investigated ranged from 2.0 mm to 15 mm, but most were between 2.0 mm and 4.0 mm. The majority of them were anechoic or associated with very weak internal echoes (90.8%) (Figs. 1 and 2). In about 8.5%, there were formed echogenic structure(s) or nodule(s) in the lumen, and there were

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<th>Table 1. Clinical manifestations in 478 patients with ductal dilatation</th>
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<tr>
<td><strong>n (%)</strong></td>
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<tr>
<td>Asymptomatic at presentation</td>
</tr>
<tr>
<td>Suspicious or palpable nodules</td>
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<td>Suspicious or palpable nodules</td>
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<td>with nipple discharge</td>
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<th>Table 2. Number of dilated ducts</th>
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<td>Single duct*</td>
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<td>Multiple ducts†</td>
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<td>Unilateral</td>
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*Fifteen papillomas and two in situ carcinomas were associated with single duct dilatation (tumor: 17/110, 15.5%); † two papillomas were associated with unilateral multiple duct dilatation, and one papilloma was associated with bilateral multiple duct dilatation (tumor: 3/368, 0.8%).
tiny strongly echogenic spots in the lumen representing calcified material, crystals or microcalcifications in 1% (Fig. 3) (Table 3). When the echogenic nodule in a dilated duct was located in the subareolar region, the focal lesion was most likely due to intraductal papilloma (52.9%), and occasionally due to intraductal carcinoma (5.9%). Invasive ductal carcinoma might be associated with adjacent ductal invasion and, in turn, cause ductal dilatation (18 patients); however, because the major US findings in these instances were chiefly related to an intraparenchymal tumor and the dilated ducts were not so prominent in the central portion, they were not included in the analysis of the histologic results. Intraductal nodules could be caused by concrete secretion (Fig. 4).

In 52 patients, core needle biopsies or surgical interventions were performed. Eighteen patients with obvious parenchymal tumors on US examinations were excluded. Histologic or histopathologic results in the remaining 34 patients showed duct ectasia, sclerosing adenosis, epithelial hyperplasia, atypical ductal hyperplasia, and intraductal papillomas or carcinomas (Table 4). The most common pathologies were papillomas (52.9%), which were most commonly located in the subareolar region.
Dilated ducts, one of which is filled with formed low-level internal echoes, representing a tumor arising from a branch (arrows). The lesion turned out to be an intraductal carcinoma.

Discussion

The breast is made up of milk-producing lobular units that are connected to the nipple by a system of collecting ducts. There are about 15–20 collecting ducts arranged in a radial pattern. The diameter of normal ducts varies according to their location; ducts are most prominent in the lactiferous sinus (usually 2–3 mm), followed by the collecting duct (<1–2 mm), with a progressive dichotomic division into 1st, 2nd and 3rd orders with their diameters being progressively reduced [8,13]. Normal ducts on high-resolution US, when not dilated and surrounded by fibroglandular tissue, show a thin hypoechoic linear structure that represents the closely adjacent anterior and posterior ductal walls. If the lumen of the duct is relatively wide, the anechoic lumen separates the ductal walls and the lumen is measurable on US.

Ductal dilatation in association with nipple discharge is a condition that is commonly seen in...
patients aged 30 onwards. Also known as secretory disease, duct ectasia is usually bilateral and characterized by obstruction ducts, frequently due to epithelial hyperplasia. The associated proximal dilatation may be cystic. The dilated and tortuous bead-appearing ducts are often visible on mammograms, particularly in the subareolar region. The bilateral nature of the condition aids in its diagnosis [14]. Ductal ectasia or ductal dilatation is characterized by progressive dilatation of the mammary duct system, usually commencing beneath the nipple. The condition has been considered to be associated with an inflammatory process of the breast, and has therefore been referred to as periductal mastitis, plasma cell mastitis, comedo mastitis, or obliterative mastitis [5]. In the earliest stages, the dilated ducts are surrounded by chronic inflammatory cells including a high proportion of plasma cells. In the later stage, the duct wall is fibrotic and the epithelium may be entirely missing. Tenacious green material may be present within the lumen of the ducts. Calcification of the duct, either inside the lumen or on the walls, may occur and sometimes mimic ductal carcinoma in situ on mammogram.

Mammography might demonstrate the calcifications that develop in duct ectasia, which are located within inspissated secretions or within the duct walls. They can be either tubular or circular with a lucent center. Most of the calcifications are greater than 1 mm in diameter, and they are frequently arranged in a linear fashion; occasionally, intraductal calcifications can be recognized by the branching format. Calcification of inspissated secretions in or immediately adjacent to benign dilated ducts produces a typical mammographic appearance: linear, oval or round calcification, usually bilateral and often asymmetric in distribution. The calcifications are substantially larger in both length and caliber than those associated with malignancy. The typical mammographic pattern of calcifications related to inspissated secretion in dilated ducts help distinguish this benign condition from other malignant pathologies with microcalcification [14]. However, mammographic visualization of dilated ducts may not be successful in women with dense breasts. In the present 478 cases with ductal dilatation, 93 (19.5%) had had mammographic study within 1 month available for comparison, and only 27 (29.0%, 27/93) had mammographically demonstrable ductal dilatation in the subareolar region. Typical calcifications suggestive of ductal ectasia were noted in six (6.5%) patients. Nipple retraction can be noted occasionally in some patients with ductal ectasia. Nipple retraction is commonly secondary to congenital anomaly secretory disease and carcinoma, and care must be taken to exclude evidence of malignancy.

Fig. 7. (A) A single dilated duct measuring 3.7 mm in diameter with diffuse low-level internal echoes (arrows). (B) At the 1- and 2-year follow-up ultrasound studies, the dilated duct shows a decreased diameter of 2.8 mm and also decreased strength of internal echoes (arrows).
deep within the nipple, particularly if the sign is unilateral.

US examination has a demonstrable role in detecting dilated ducts as well as intraductal content. Secretions within dilated ducts may be anechoic, nearly anechoic, minimally echogenic, isoechoic with the subcutaneous fat, or even solid appearing. The echogenicity of the secretions depends on the fatty content and the duration of stasis. Medium-level, relatively high- or high-level internal echoes may appear solid in the ductal lumen. Solid appearing secretions typically represent inspissated, highly fatty secretions which have a cheesy appearance at needle aspiration. Fluid–debris (or oil) level within a dilated duct may simulate an intraductal papilloma. Graded compression of the duct with the transducer may cause the echogenic secretions to float or swirl within the intraductal fluid, distinguishing the debris from a true intraductal tumor. Changing the patient’s position to observe the debris change to the new dependent position within the duct may help distinguish these two conditions. Fine needle aspiration or core needle biopsy can be a method of choice to solve the problem if there is difficulty in differentiating inspissated concrete secretion from intraductal tumor. The procedure can be carried out on an outpatient basis [15].

The ultrasound characteristics of a tumor within or adjacent to a dilated duct may be more informative than mammography [16]. US is definitely preferred because this investigation does not carry ionizing radiation hazard, and it adds to the diagnostic accuracy in younger women or in women with dense breasts [16]. On the basis of the present study, routine breast US can depict ductal dilatation at a prevalence of 2.9% of women referred for breast US examination. The multiplicity of the nature of duct ectasia carries very low risk for intraductal tumor (0.8%), while single duct dilatation is frequently associated with papilloma (13.6%) or carcinoma (1.8%).

Intraductal papilloma frequently presents as a solitary papillary lesion growing in one of the main ducts close to the nipple. It usually presents with a serous or blood-stained discharge from a single duct underneath the nipple. Galactography can help to demonstrate and diagnose intraductal abnormalities and their extent in the ductal system. It is valuable in planning surgical intervention. Many studies have stressed that the diagnosis can be best made by galactography prior to excision of the affected duct and segment of breast tissue [17–19]. However, the procedure may have to be repeated because of technical failure, mainly due to leakage of contrast medium out of the duct system into the surrounding tissue. The technique is also relatively invasive, and mastitis is the most common complication, although it is unusually seen [20–23]. With the recent advent of high-resolution US, more and more intraductal papillomas are being diagnosed during routine breast US examinations. The results of this present study suggest that single duct dilatation carries a 13.6% possibility of intraductal papilloma.

In some patients, the dilated ducts were associated with cysts or fibrocystic change. The histopathologic examination showed ductal epithelial hyperplasia and atypical ductal hyperplasia in some of the representative specimens. These pathologies are of clinical significance because they are at risk of developing into breast carcinoma [24]. The real prevalence of epithelial hyperplasia and atypical ductal hyperplasia in patients with dilated ducts is unknown. In this study, only 10% of patients underwent biopsy and/or surgical intervention, however, for ductal dilatation without a pattern of intraluminal solid nodule (usually suggestive of papilloma), the prevalence of epithelial hyperplasia and atypical ductal hyperplasia can be as high as 20%. It is therefore worthwhile to recommend regular US follow-up for women with ductal dilatation demonstrated on US, especially in patients with single duct dilatation.

In conclusion, with modern high-resolution US, dilated lactiferous ducts can be detected and the intraluminal echoes can be demonstrated well. Special care should be taken to evaluate intraductal nodules. Special expertise is required to interpret the images, and operators should accumulate more experience with the US examination technique.
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References