PICTORIAL REVIEW

Characterisation of breast papillary neoplasm on automated breast ultrasound

Q-L ZHU, MD, J ZHANG, MD, X-J LAI, MD, H-Y WANG, MD, M-S XIAO, MD and Y-X JIANG, MD

Department of Ultrasound, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences, Beijing, China

Address correspondence to: Professor Yuxin Jiang
E-mail: yuxinjiangxh@yahoo.com.cn

ABSTRACT

Intraductal papillary neoplasms of the breast form a wide spectrum of pathological changes with benign intraductal papilloma and papillary carcinoma. They can occur anywhere within the breast ductal system. This review illustrates some characteristic appearances of breast papillary neoplasms on coronal planes reconstructed by automatic breast volume scan. Such manifestations are not uncommon in papillary neoplasms, and familiarity will enable confident diagnosis.

Papillary lesions of the breast are a heterogeneous group of breast lesions, including intraductal papilloma, atypical papilloma and intraductal papillary carcinoma [1,2]. Although the management of intraductal papillomas is varied, surgical excision is generally recommended as a precaution against the risk of a subsequent carcinoma [3,4]. Recently, some studies have suggested that patients with a tumour measuring <1.5 cm and an ultrasound Breast Imaging—Reporting and Data System (BI-RADS) category of 3 or 4a can be potentially selected for vacuum-assisted biopsy, but only if the tumour does not extend into the branching ducts [5,6]. Ueng et al [2] recommended that localised papillary lesions should be excised completely with a small rim of uninvolved breast tissue without any prior needle instrumentation if and when the papillary nature can be determined by imaging. Therefore, a careful imaging evaluation is necessary because it could help to identify the papillary neoplasm nature and select the high-risk lesions for proper treatment.

Ultrasound has a greater sensitivity for detecting all papillary lesions than mammography [7]. Recently, automated breast ultrasound scanners have been developed, and the ultrasound volume data set of the whole breast can be acquired in a standard manner [8]. They have already shown potential for characterisation of breast tumours [9,10]. However, these studies did not detail the ultrasound features of intraductal papillary neoplasms on automated breast ultrasound. The reconstructed coronal views are also expected to provide more information and thus help to differentiate these lesions from other focal breast anomalies.

AUTOMATED BREAST VOLUME SCANNER IMAGING

The authors prospectively evaluated 239 consecutive lesions in 213 females who were treated at the Peking Union Medical College Hospital, Beijing, China, between August 2010 and December 2010. In this group of patients, 85 lesions were histologically confirmed as malignant and 154 lesions were benign. Of the benign lesions, 26 lesions were papillomas.

Automatic breast volume scan (ABVS) was performed using the ACUSON S2000 ultrasound system (ABVS; Siemens Medical Solutions®, Mountain View, CA). The ABVS module consists of flexible arms, touch screen monitor and scanner (scan box, a wide aperture of 5–14-MHz linear array transducer, and screen membrane for contact) (Figure 1). Patients underwent ABVS examination in the supine position. It automatically acquires 15.4×16.8×6 cm maximum volume data of breast in one sweep. The slice interval is 0.5 mm. The optimised presets were used to optimise the depth, gain, frequency and view based on the estimated size of the breast. For each breast, anteriorposterior, lateral and medial scans were obtained for complete coverage of the breast. The scan direction was from the inferior to the superior margin of the mammary gland. The volume data set was automatically sent to the ABVS workstation. By reconstruction, it can present the organisation of the full ductal system of the whole breast in transverse, sagittal and coronal views.
Figure 1. A picture of the automatic breast volume scan (ABVS) machine in use. ABVS module consists of flexible arms and a scanner (scan box, a 5-14-MHz linear array transducer and screen membrane for contact). Patients underwent ABVS examination in the supine position. The module automatically acquires 15.4×16.8×6 cm maximum volume data of breast in one sweep.

Figure 2. Intraductal papillary carcinoma in a 57-year-old female with a palpable mass. Automatic breast volume scan images of the transverse plane (upper right), sagittal plane (lower right) and coronal reconstruction plane (left). The square mark represents the position of the nipple. The coronal plane demonstrates an oval circumscribed complex cystic mass containing solid nodular projection (arrow). Neither the transverse nor the sagittal plane shows a cystic component. Excisional biopsy revealed intraductal papillary carcinoma.

Figure 3. Papilloma in a 60-year-old female with a palpable mass. Automatic breast volume scan images of the transverse plane (a) and coronal reconstruction plane (b). The square mark represents the position of the nipple. The transverse plane shows a complex mass near the areolar region. The coronal plane reveals a duct (arrow) connecting the mass to the nipple. (c) Mammograms show the lesion as having a round shape and circumscribed margin. Excisional biopsy revealed intraductal papillomas.

Figure 4. A 32-year-old female with left-sided non-bloody nipple discharge. Automatic breast volume scan images of the transverse plane (upper right), sagittal plane (lower right) and coronal reconstruction plane (left). The square mark represents the position of the nipple. The transverse plane shows multiple solid nodules in the areolar region. Between the nodules there are mildly dilated ducts. The coronal plane clearly demonstrates multiple solid masses (arrows) locating in a dilated duct. Excisional biopsy revealed intraductal papilloma.
Figure 5. Papilloma in a 60-year-old female with left-sided bloody nipple discharge. Automatic breast volume scan (ABVS) images of coronal reconstruction plane (lower) and transverse plane (upper). The square mark represents the position of the nipple. In the transverse plane, the lesion is a slightly dilated duct with an irregular shape (arrow). The coronal plane clearly shows multiple dilated ducts (arrow) connecting to a main duct, which is a ductal configuration extending towards the nipple, representing multiple papillary lesions. Note that ABVS precisely shows the extent of masses in multiple ducts. This new ultrasound sign, or coral pattern, provides a more understandable representation of the breast’s lesion. Excisional biopsy revealed multiple intraductal papillomas.

Figure 6. Intraductal papilloma carcinoma in a 46-year-old female with left-sided bloody nipple discharge. Automatic breast volume scan images of transverse plane (upper) and coronal reconstruction plane (lower). The square mark represents the position of the nipple. The transverse plane shows two slightly dilated duct connected to the nipple (arrow). The coronal plane reveals multiple dilated ducts and intraductal masses in the areolar region (arrow). All these ducts connected to a main duct (arrow). Excisional biopsy revealed multiple intraductal papillomas associated with intraductal papillary carcinoma.

ULTRASOUND FEATURES ON AUTOMATIC BREAST VOLUME SCAN

Solitary papillary lesions
The breast papillary neoplasms were often classified into three echo patterns on ultrasound: solid mass (Figure 2), intracystic mass (Figure 3) and dilated duct with or without associated mass inside the duct (Figure 4). The presence of dilatation of ducts associated with a mass is a good indicator for a papilloma [11], and a useful sign for differentiating intraductal papillary lesions from other benign lesions, such as fibroadenoma and fibrocystic diseases [12]. ABVS coronal view is a satisfactory plane for most breast papillary neoplasms because it could demonstrate duct dilation more frequently (Figures 2–4). One of the possible explanations is that fluid within the ducts readily collects in the lower portion of the duct owing to gravity, especially when patients are in a supine position. In addition, the distribution of breast ducts is approximately coronal. By dragging the mouse, radiologists can reconstruct optimal coronal planes for the duct system.

MULTIPLE PAPILLARY LESIONS
Classic multiple papilloma is characterised by papillary proliferations within multiple terminal duct-lobular units or simultaneous proliferation of several papillae in the distal branches of the duct system. Patients with multiple papillomas have a higher relative risk of breast cancer than patients with a single papilloma; multiple papillomas with atypia had an even higher relative risk [1]. As described by Ueng et al [2], intraductal papillomas extending into branches of ducts may recur because of incomplete excision of microfoci. Thus, determination of the multiplicity and its margins is very important in pre-operative imaging evaluation.

The ABVS coronal plane may offer new perspectives for correctly classified multiple papillary lesions that are not available for conventional ultrasound planes. A new “coral” pattern, a unique sign on the coronal view, was found in breast papillary neoplasms (Figure 5). It displayed multiple hypoechoic nodules extended along the dilated ducts or into their branches for several centimetres continuously, which formed a cone shape directed towards the nipple. Moreover, smooth or irregular hypoechoic nodules inside the ducts presented as a tortuous...
contour, resembling coral in appearance. The star or retraction pattern in the coronal plane of three-dimensional ultrasound is highly suggestive of malignancy [13]. This feature represents the reactions of the surrounding tissue of a tumour [14]. It usually presents in the invasive breast carcinomas, such as invasive ductal carcinomas and invasive lobular carcinomas. However, intraductal papillary lesions often show well-circumscribed margins that may be attributed to the papillary fronds of the lesion that were well encapsulated in the duct wall. Thus, we consider this new sign to be a distinctive entity of breast papillary neoplasms. It also helped to identify (1) the long diameter of the mass, (2) whether the mass extended into the branch duct or not and (3) the number of involved ducts and locations (Figure 6).

CONCLUSIONS

The ABVS technique is helpful for identifying duct sections in breast papillary lesions because it provides a coronal representation of the ductal system of the whole breast. It facilitates detection of ductal dilatation associated with a mass, which helps to characterise the breast papillary neoplasm. In addition, a new coral sign, presented as a distinctive entity of breast papillary neoplasm, enables accurate assessment of lesion margins and the size of multiple papillary lesions.

FUNDING

This work is supported by the National Natural Science Foundation of China (81201112).

REFERENCES