

Use of Automated Breast Volumetric Sonography as a Second-Look Tool for Findings in Breast Magnetic Resonance Imaging

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ABSTRACT: Breast magnetic resonance imaging (MRI) has an important role in the detection and diagnosis of breast cancer. Suspicious findings on MRI are further evaluated with ultrasound. This case series illustrates the use of automated breast volumetric ultrasound (ABVS) as a tool for second-look ultrasound (SLUS) following MRI. Seven women underwent breast MRI with findings necessitating SLUS. ABVS was used for second look and all MRI lesions were detected. Four cancers, one fibroadenoma and two benign lesions, were diagnosed. This case series shows that ABVS can be used as a tool for SLUS following MRI and in some cases is superior to hand-held ultrasound.

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The diagnosis of breast masses has shifted from surgical biopsy to image-guided percutaneous biopsy. In 2004 over 86% of breast biopsies in the United States were performed by radiologists [1]. This increment in the number of image-guided biopsies can be attributed to its increased accuracy and availability.

Stereotactic vacuum-assisted biopsy (VAB) is used primarily for microcalcification sampling under mammographic guidance. Masses detected by ultrasound can be sampled by core needle biopsy (CNB) for histological assessment, or by fine needle aspiration (FNA) [2]. Ultrasound-guided biopsies have some advantages over biopsies guided by other imaging modalities: it enables real-time visualization of the needle, resulting in a higher yield of accurate samples [3]; it has no radiation exposure risk; it does not require intravenous contrast; and it is well tolerated by patients since it is usually a short procedure with the patient in a supine position requiring no breast compression [2].

Breast magnetic resonance imaging (MRI) is an important tool in the detection and diagnosis of breast cancer. It has high

sensitivity but variable specificity [4]. MRI-guided biopsy is performed for lesions seen on breast MRI only. However, availability is low and there is a lack of radiologists skilled in the procedure [2,5,6]. The workup of findings seen on breast MRI includes second-look ultrasound (SLUS) or mammography. The second look, or targeted ultrasound, is performed in correlation with the MRI findings. Whenever a correlate lesion is seen on ultrasound, ultrasound-guided biopsy is performed instead of MRI-guided biopsy [7].

Hand-held ultrasound is operator dependent [8]. A new modality, automated breast volumetric sonography (ABVS), utilizes a flat transducer promoted in a rectangular frame, which acquires 1 mm thin consecutive axial slices. The patient lies in a supine position and the transducer is applied in three main views: antero-posterior (AP), lateral and medial, and an additional superior and inferior view can be added if specifically required, for example for large breasts. The axial slice information is used for coronal and sagittal reconstruction of the view. This system provides consistent, reproducible, operator-independent ultrasound imaging of the entire breast [9]. It is a relatively new, promising technology, with similar sensitivity (95.3% vs. 90.6%), specificity (80.5% vs. 82.5%), accuracy (85.8% vs. 85.3%), positive predictive value (73.0% vs. 74.0%) and negative predictive value (93.3% vs. 94.1%) compared to hand-held ultrasound [10,11].

In this series we review cases with MRI findings demonstrated on ABVS as a second-look modality.

PATIENT DESCRIPTIONS

We present seven women who underwent breast MRI with positive findings (BIRADS 0) and sent for second-look ultrasound. SLUS was performed with ABVS targeted to the location of the MRI finding. The MRI system used was 1.5 Tesla HDXT by (GE Healthcare, UK); sequences included T1-weighted 3D vibrant multiphase with contrast (TR5.4, TE 2.6), T2 axial without fat suppression (TR 8920, TE 90) and bilateral sagittal T2 with fat suppression (TR 2800, TE 88.6). The ABVS system used was ACUSON S2000™ Automated Breast Volume

Scanner (Siemens, Germany); the scans were antero-posterior, lateral and medial views, with the addition of superior and inferior view when required. In all the presented cases, the MRI-diagnosed mass lesions, ranging in size from 0.5 to 2 cm (average 0.97 cm), were detected by second-look ABVS.

PATIENT 1

A 53 year old woman with known infiltrating lobular carcinoma (ILC) in her left breast was referred to MRI for evaluation of disease extent. Except for the 1.3 x 1.7 cm known tumor in the mid-inner quadrant, another 0.5 cm enhancing focus was detected at the upper inner quadrant [Figure 1A]. The second focus was considered likely to be a lymph node, and SLUS was recommended. The following ABVS included three views: AP, medial and superior. A hypoecogenic 0.5 cm irregular mass was detected at the upper inner quadrant [Figure 1B] with architectural distortion seen on the coronal reconstruction [Figure 1C]. The suspicious lesion was referred for hand-held ultrasound-guided biopsy. Even with exact localization in the supine position and known sonographic appearance, finding this 0.5 cm on the hand-held ultrasound was challenging. A lesion with a similar appearance to the axial view of the ABVS was detected on the hand-held ultrasound [Figure 1D]. Core needle biopsy was performed, and the lesion was found to be another focus of ILC. The patient underwent lumpectomy including preoperative localization and excision of both lesions.

PATIENT 2

This patient was a 62 year old woman with history of lymphoma 4 years prior to a follow-up positron emission tomography-computed tomography (PET-CT) examination, which detected a hypermetabolic 0.5 cm nodule in the lateral aspect of the right breast [Figure 2A]. Sequential mammography and hand-held ultrasound were normal. MRI-detected mass in the outer lower quadrant was compatible to the PET-CT finding [Figure 2B]. A second-look ABVS including AP, lateral and medial views of the right breast detected a 0.8 x 1 cm lesion on the lateral aspect of the right breast [Figure 2C]. A hand-held ultrasound following the ABVS demonstrated the lesion and ultrasound-guided CNB was performed. Pathology showed infiltrating ductal carcinoma (IDC) [Figure 2D].

PATIENT 3

This 43 year old woman was referred to MRI due to suspicious left breast asymmetry seen on mammography. A hand-held ultrasound exam was normal. MRI detected a 2 x 1.6 cm mass in the left breast, and recommendation was made for a second-look ultrasound and MRI-guided biopsy in case the lesion was sonographically occult. The second-look ABVS included AP and lateral views. The coronal reconstruction showed an architectural distortion and shadowing on the axial plane. A hand-

Figure 1. Patient 1: A 53 year old women with known infiltrating lobular carcinoma in the mid-outer part of her left breast. Preoperative breast MRI detected a second 0.5 cm lesion at the inner upper quadrant [A]. The lesion was also detected on second-look ABVS [B], showing architectural distortion in the coronal reconstruction [C]. A lesion with a similar appearance to the axial view of the ABVS was detected in hand-held ultrasound [D]. A CNB was performed, and the lesion was found to be another focus of ILC

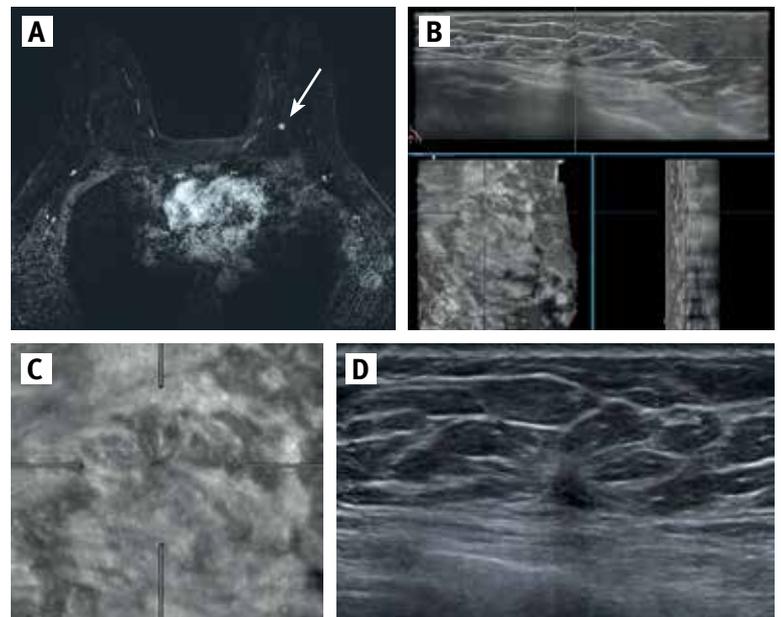
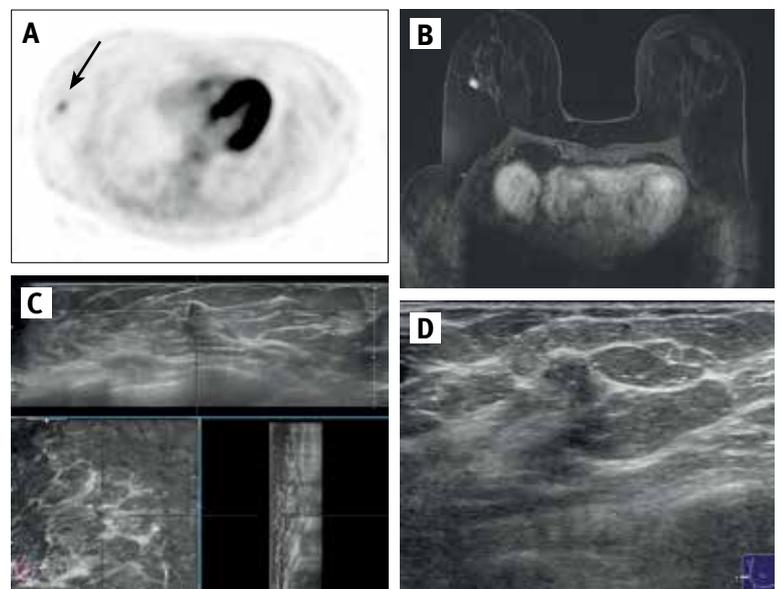


Figure 2. Patient 2: A 62 year old woman with history of lymphoma. Follow-up PET-CT examination detected a hypermetabolic 0.5 cm nodule in the lateral aspect of the right breast [A]. Sequential mammography and hand-held ultrasound were normal. MRI-detected mass in the outer lower quadrant was compatible to the PET-CT finding [B]. A second-look ABVS detected a lesion on the lateral aspect of the right breast [C]. Pathology result of hand-held ultrasound-guided CNB was infiltrating ductal carcinoma [D]



held ultrasound following the positive ABVS demonstrated the lesion. Ultrasound-guided CNB of the lesion diagnosed infiltrating ductal carcinoma (IDC).

PATIENT 4

A 43 year old woman, with a known papillary lesion in her left breast and a family history of a mother with breast cancer at the age of 42, was referred for MRI due to 1.5 cm asymmetric density in the left breast on tomosynthesis mammography, with no compatible findings on hand-held ultrasound. MRI revealed a 1 cm mass in the lower inner quadrant of the left breast, compatible with the mammographic finding. Second-look ABVS detected a 1 cm isoechoic mass, compatible in shape and location with the MRI findings. A hand-held ultrasound following the positive ABVS showed the lesion, and the ultrasound-guided CNB diagnosed atypical apocrine lesion with fibroadenomatoid changes. Excisional biopsy was recommended to exclude cancer. The patient had developed seizures due to previous head surgery for the removal of a meningioma and was therefore not a candidate for surgical excision. The lesion was removed with an intact radiofrequency ultrasound-guided needle (Intact® Breast Lesion Excision System, BLES, manufactured by ELSWOOD for Intact Medical Corporation USA). On pathology a fibroadenoma with atypical apocrine adenosis was found.

PATIENT 5

A 42 year old woman with known IDC of the left breast had a 0.6 cm nodule detected in the outer middle part of the right breast on MRI. Hand-held ultrasound did not detect the nodule in the right breast. A 0.6 cm nodule was detected by second-look ABVS, which included AP and lateral, superior and inferior views, in the upper outer quadrant. The pathology result of hand-held ultrasound-guided CNB was fibroadenoma.

PATIENT 6

A 53 year old woman with a family history of breast cancer had multiple bilateral breast cysts on ultrasound, including a complex cyst with a thick irregular wall, behind the nipple of the right breast, reducing ultrasound sensitivity. MRI performed for evaluation detected bilateral enhancing small foci and bilateral cysts, and a 0.8 x 0.9 cm mass in the outer middle part of the right breast. Recommendations were made for a second-look ultrasound and MRI-guided biopsy in case the lesion was sonographically occult. The lesion was detected by ABVS, which included AP, lateral and medial views of the right breast. A hand-held ultrasound-guided CNB diagnosed cholesterol granuloma with fat necrosis and fibrocystic change.

PATIENT 7

This 81 year old woman had known cancer in the mid-outer part of her left breast. MRI detected another unknown enhancing 0.7 cm mass at 12 o'clock in the left breast. The lesion was

detected on ABVS, which included AP, lateral, medial superior and inferior views of the left breast. The pathology result of hand-held ultrasound-guided CNB was infiltrating carcinoma.

DISCUSSION

Breast magnetic resonance imaging has the highest sensitivity for the detection of breast carcinoma [12]. In a study by Liberman et al. [13], preoperative MRI revealed, in addition, 27% malignant lesions that were not identified by prior mammography or ultrasound. MRI has high sensitivity but variable specificity [4], resulting in detection of lesions necessitating biopsy. In order to divert some of the MRI-guided biopsies to simpler more readily available biopsy methods such as ultrasound-guided biopsy, SLUS is a commonly used modality focused to the approximate location of the MRI finding [7].

In a study by DeMartini et al. [14] 46% of MRI-detected lesions had an ultrasound correlate in the SLUS. Sonographic detection was significantly more likely for MRI lesions characterized as masses (58%) than for findings described as foci (37%) or non-mass-like enhancement (30%). There was no significant difference in sonographic detection based on lesion size [14,15].

Automated breast volumetric sonography (ABVS) is a non-operator-dependent technique which produces a volume image much like MRI, enabling exact distances and size measurements, and its 1 mm thin sections enable high quality multiplanar reconstruction. The coronal reconstructions in particular enable demonstration of architectural distortion. A review of the literature revealed a single report on the clinical utility of ABVS as second-look ultrasound after breast MRI [16], indicating that ABVS might be more rapid and less costly than hand-held SLUS and may help in the decision on the biopsy guidance method (ultrasound vs. MRI) as a replacement tool of hand-held SLUS. In our series of patients we attempted to use these advantages for a second look following MRI.

Five of the seven patients had a hand-held ultrasound prior to or following the breast MRI, which were reported as normal. In all seven patients ABVS detected the MRI finding leading to second-look hand-held ultrasound and ultrasound-guided biopsy instead of MRI-guided biopsy, alleviating patient inconvenience and saving time and money. This procedure is not yet common practice. In order to assess its sensitivity and specificity as compared to hand-held SLUS, a dedicated study should be carried out.

In summary, ABVS can be used as a tool for second-look ultrasound following MRI for detection of lesions as small as 0.5 cm. This series did not evaluate non-mass enhancement lesions. Among the advantages of this technique is that it is operator independent, and acquires thin slices allowing multiplanar reconstruction and a volume image much like MRI, enabling exact distance and size measurements.

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