

The effectiveness of Power Doppler vocal fremitus imaging in the diagnosis of breast hamartoma

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Abstract

Objectives: To evaluate the usefulness of power Doppler vocal fremitus (PDVF) breast sonography for differentiation of hamartomas from other breast (malign or benign) masses. **Material and methods:** Two hundred and six breast masses in 180 women were evaluated. The breast lesions were scanned first by mammography (MG), then by ultrasonography (US) with PDVF imaging. Finally, biopsy was performed on lesions suspicious for malignancy (n=172). We used PDVF imaging to evaluate whether the Power acoustic Doppler artifact existed in all breast lesions. **Results:** Pathology results of 172 biopsied lesions showed that 83 were malignant and 89 masses were benign. Totally 39 breast hamartomas were diagnosed radiologically (n=25) or histopathologically (n=14). All hamartomas (n=39) produced the power acoustic Doppler artifact as the surrounding tissue at the same depth in PDVF imaging. On the other hand, none of the malignant or benign lesions, apart from hamartomas, evidenced a similar vibrational artifact as the surrounding tissue at the same depth in the PDVF imaging. **Conclusion:** PDVF imaging during breast sonography is an invaluable technique in the identification of breast hamartomas from other benign or malignant breast masses.

Keywords: breast sonography, power Doppler vocal fremitus, hamartoma, breast masses

Introduction

Breast hamartomas, also known as lipofibroadenomas, fibroadenolipomas, and adenolipomas, are benign lesions composed of fibrous, glandular, and fatty tissue [1]. Hamartomas account for 0.1–0.7% of all benign mammary masses and are most commonly reported among middle-aged women [2-4].

The diagnosis of hamartomas is generally based on a visual assessment of the fat content in the lesion which can be seen by a mammography (MG). When using ultrasonography (US) hamartomas appear in a wide spec-

trum of variation, with a general heterogeneous internal echo pattern. Due to the differing ratios of tissue elements, the broad range appearances of hamartomas in a US, restricts the diagnostic role of US [5]. Thus, contributions of other modalities to the diagnosis of hamartomas are important.

Power Doppler vocal fremitus (PDVF) imaging is a controlled manipulation of power acoustic Doppler artifacts. In the literature, there is a consensus that PDVF imaging can distinguish breast lesions (malign or benign) from normal breast tissue [6-8]. PDVF can be a useful imaging method when other better performing ultrasonographic techniques, such as sonoelastography, are not available. The value of the PDVF is due to its availability and low cost. To our knowledge, the usefulness of PDVF imaging in diagnosing hamartomas has not yet been studied. In the current study, we have investigated the utilization of a PDVF test, during a breast US in order to differentiate hamartomas from other malignant or benign breast masses.

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Materials and methods

A prospective study was conducted in 206 breast lesions found in 180 women who came to our outpatient clinic for a routine breast screening or for an evaluation of palpable breast masses. We included breast masses, where a histopathological or a radiological diagnosis was available, and performed PDVF imaging. The mean age of the participants was 44.2 with a range of 18 to 72 years. The mean size of the lesions was 18.6 mm, ranging from 4 to 59 mm.

Initially, 143 lesions in women, who were older than 35 years old, were evaluated by MG (Mammomat Inspiration, Siemens, Erlangen, Germany) in standard cranio-caudal (CC) and mediolateral oblique (MLO) views. In addition, 9 lesions in women younger than 35 years old, but with a suspicion of malignancy, were evaluated by MG.

Following the MG evaluations, and before a biopsy, all lesions were first evaluated by US, and then by PDVF imaging. US and power Doppler examinations were performed with a 5-14 MHz transducer (Antares, Siemens, Erlangen, Germany). Patients were scanned in a contralateral posterior oblique position, with the ipsilateral hand behind the head, in order to minimize breast tissue thickness. Initially, clockwise radial and anti-radial US scans were performed on all breasts and axillae. For optimal imaging, the focus was placed at the same level as the lesion or in a minimally posterior position. B-Mod features of all breast masses were examined and recorded. After the patient was scanned with an US, the patient was told to vocalize the vowel 'eee' as the breast masses (benign and/or malign) were examined with a power Doppler sonography for 5 to 10 seconds. Breast parenchyma and mass vibrations due to the fremitus, were demonstrated with a Doppler box around the mass. To optimize the contrast between the lesion and the surrounding parenchyma in PDVF imaging, a pulse repetition frequency of approximately 500 was used. Additionally, a low wall filter, both a small and a large sampling box, and the default or appropriate gain and focal zones were utilized. We did not include the patients with chronic pulmonary disease or obese patients that were not able to fully create the Doppler artifact.

Breast imaging was performed by an experienced breast radiologist (SY). The images were evaluated on a high-bright 5 MP Grayscale radiology monitor by two radiologists. All images were analyzed according to ACR (American College of Radiology) BI-RADS (Breast Imaging-Reporting and Data System) classification by consensus [9]. The shape, orientation, margin, boundary, calcification content, and the largest measurement of

the lesions were determined by the US and MG. Also, internal echo patterns, posterior acoustic properties, and tumor compressibility were evaluated via US.

Finally, 172 lesions with a suspicion of radiological and/or clinical malignancy were evaluated by a 14-gauge US-guided core biopsy, and 3 samples were obtained. Among the lesions examined using a biopsy, 131 of them were BI-RADS 4 and 5 lesions on the radiologic evaluation, and 41 were BI-RADS 3 lesions in patients with a personal or family history of breast and/or ovarian cancer. BI-RADS category 2 lesions were not biopsied.

The institutional review board of our university approved the study, and participants provided a written informed consent at the beginning of the study.

Results

The pathology results of the 172 biopsied lesions, showed that 83 were malign: 53 invasive ductal carcinoma, 12 invasive lobular carcinoma, 7 invasive papillary carcinoma, 6 mucinous cancer, 3 invasive micropapillary carcinoma, and 2 ductal carcinoma in situ. The remaining 89 biopsied masses were benign: 43 fibroadenoma, 23 papilloma, 14 hamartoma, 5 phylloides tumor, and 4 sclerosing adenosis.

Among the 34 unbiopsied lesions that were diagnosed radiologically 25 were interpreted as hamartomas on the MG, based on their significant fat content and 9 were diagnosed as simple cysts on the US. The sonographic features of breast hamartomas are listed in table I.

Vibratory defect sizes of all malign or benign lesions, except for hamartomas, during PDVF imaging

Table I. Sonographic features of breast hamartomas

Ultrasonography findings	Patients number (n=39)
Shape	
Oval	39 (100%)
Margin	
Circumscribed margin	39 (100%)
Internal echogenicity	
Heterogeneous	35 (89.7%)
Dominant hypoechoic	2 (5.1%)
Dominant hyperechoic	2 (5.1%)
Cyst formation	
Yes	3 (7.6%)
No	36 (92.4%)
Retrotumour phenomenon	
None	31 (79.5%)
Enhanced	6 (15.4%)
Shadowing	2 (5.1%)
Tumor compressibility	
Yes	39 (100%)

were the same as, or larger than the corresponding sizes in B-mode images (fig 1, fig 2). Of the lesions that were diagnosed malign, 12 showed spiculated margins with a thick echogenic halo. In the PDVF images of these lesions vibratory defect sizes were larger than the corresponding hypoechoic areas of the gray-scale image. Malign lesions which contained microcalcifications (n=11) showed vibratory artifacts within the microcalcification areas. Benign lesions that were pathologically

confirmed as fibroadenoma (n=13) also showed vibratory artifacts. Fibroadenomas with microcalcifications (n=5) displayed internal vibratory artifacts in the microcalcification areas. The fibroadenomas, which have linear echogenic streaks due to fibrosis (n=8), showed vibrational artifacts in a linear configuration. Comparisons of the vibratory defect sizes in malign or benign lesions, to the corresponding B-mode image sizes, are listed in table II.

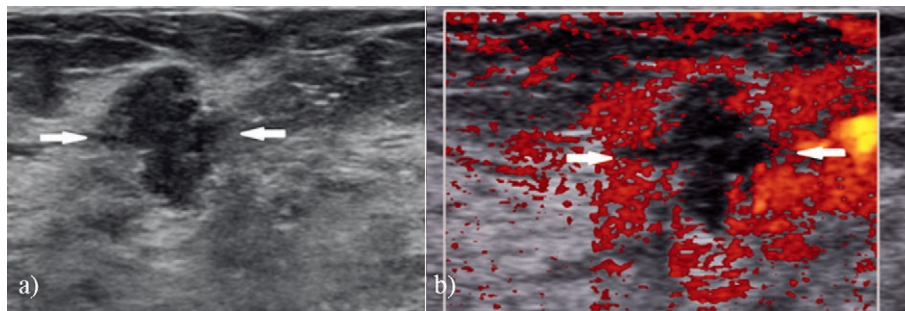


Fig 1. In a 43-year-old woman, core needle biopsy proved an invasive ductal carcinoma. a) B-mode image shows a hypoechoic mass with spiculated margins and an irregular shape (arrows). b) Power Doppler vocal fremitus image shows vibratory defect in the malignant lesion that was identical in size and shape to the B-mode image (arrows).

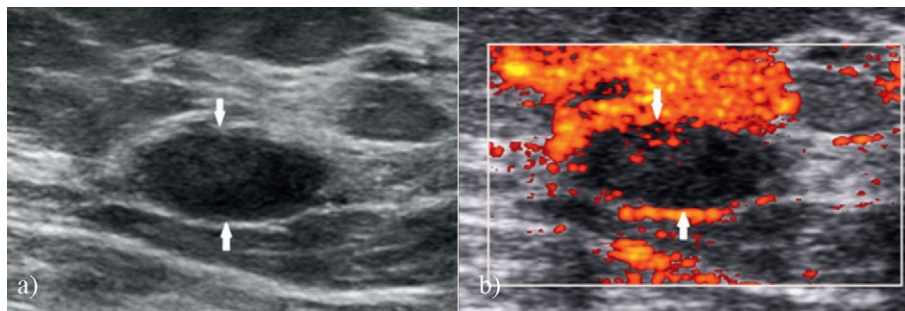


Fig 2. In a 45-year-old woman, core needle biopsy proved an fibroadenoma. a) B-mode image shows an oval, circumscribed, hypoechoic lesion (arrows). b) Power Doppler vocal fremitus image shows vibratory defect (arrows) in fibroadenoma that was identical in size and shape to the B-mode image.

Table II. Comparisons of malign or benign lesions vibratory defect sizes to the corresponding B-mode image sizes

Breast lesions (except hamartomas)	Vibratory defect sizes (compared to B-mode image sizes)	Patients number (n=167)
Malignant lesions		
Spiculated margins with a thick echogenic halo	Larger	12
Include microcalcifications	Same	11
Other	Same	60
Benign lesions		
Fibroadenomas with microcalcifications	Same	5
Fibroadenomas with linear echogenic streaks	Same	8
Other	Same	71

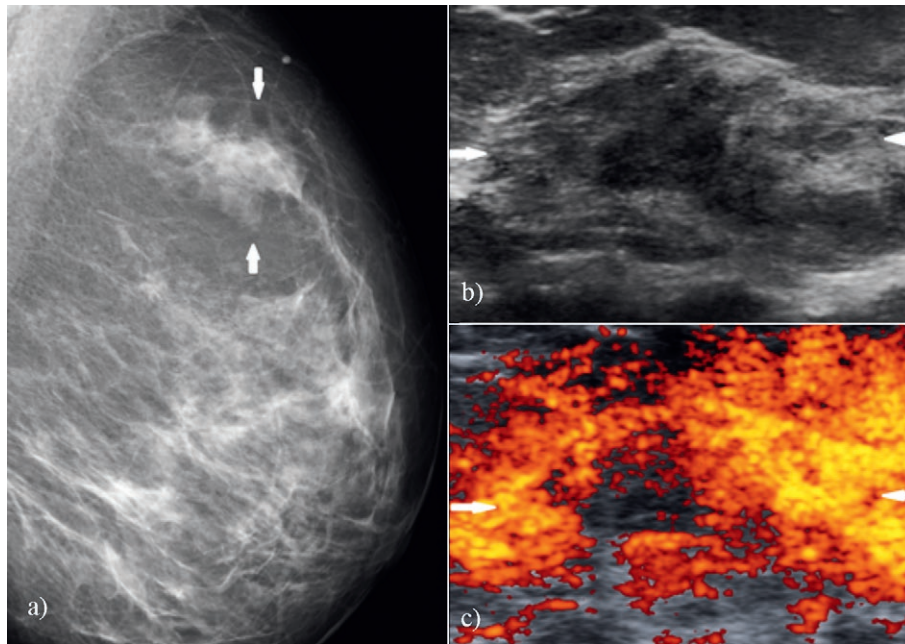


Fig 3. In a 42-year-old woman, proven with mammography a hamartoma (arrows) (a). b) B-mode image shows an oval, circumscribed, mixed internal echo pattern lesion (arrows). c) Power Doppler vocal fremitus image shows a vibratory artifact in the lesion that produced enhancement similar to the surrounding parenchyma (arrows).

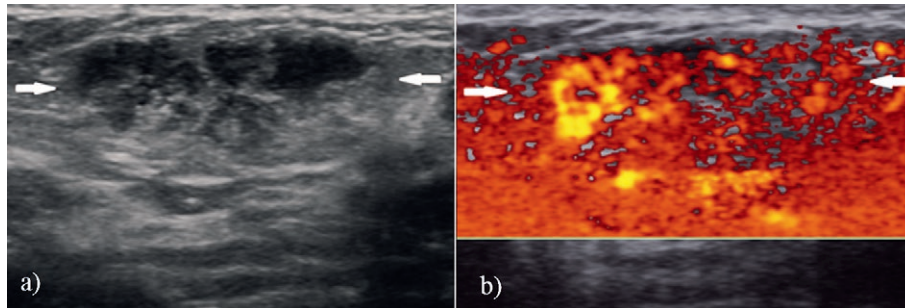


Fig 4. Hamartoma, diagnosed with core needle biopsy, because of clinical suspicious malignancy, in a 21-year-old woman. a) B-mode image shows an oval, well-circumscribed, mixed internal echo pattern lesion (arrows). b) Power Doppler vocal fremitus image shows vibratory artifact in hamartoma that produced enhancement similar to the surrounding parenchyma (arrows).

Table III. Power Doppler vocal fremitus image descriptions of breast hamartomas

Internal echogenicity	Location of vibrational artifact	Patients number (n=39)
Heterogeneous	throughout	35
Dominant hypoechoic	peripheral	2
Dominant hyperechoic	peripheral	2

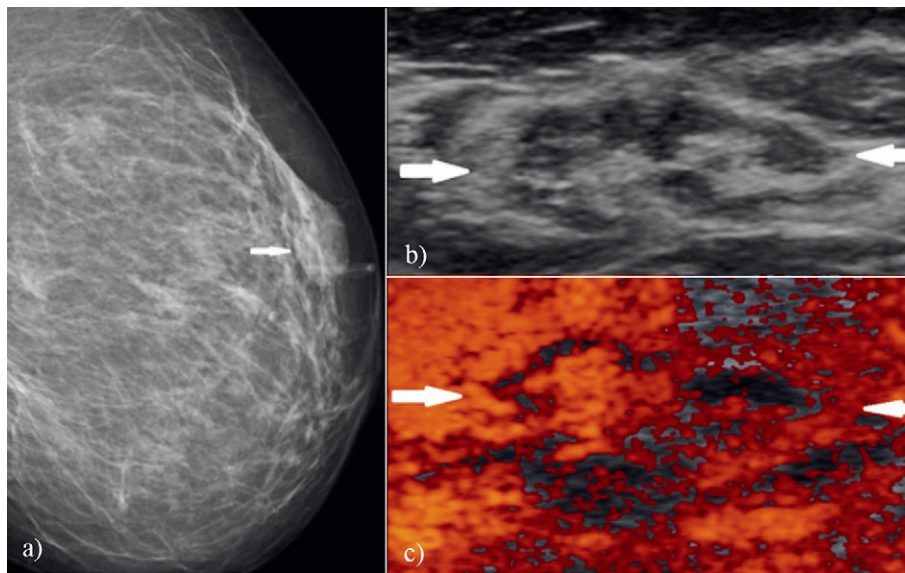


Fig 5. Hamartoma, diagnosed with core needle biopsy, because of fatty tissue is not recognized in the mammography (arrow), in a 60-year-old woman (a). b) B-mode image shows an oval, well-circumscribed, mixed internal echo pattern lesion (arrows). c) Power Doppler vocal fremitus image shows power acoustic Doppler artifact in hamartoma that produced enhancement similar to the surrounding parenchyma (arrows).

On the other hand, all hamartomas ($n=39$) produced a power acoustic Doppler artifact, similar to the surrounding tissue at the same depth in PDVF imaging. Whereas hamartomas with heterogeneous internal echo patterns ($n=35$) produced power Doppler artifacts throughout the lesion, the other 4 hamartomas (two predominantly hypoechoic and two mainly hyperechoic) produced a peripheral power Doppler artifact (fig 3-5). PDVF image descriptions of breast hamartomas are listed in table III.

Discussion

Hamartomas are benign disorganized tissue overgrowths, histologically characterized by variable amounts of fatty, glandular, and fibrous tissue. Pseudoangiomatous stroma and cystic changes may also be present in hamartomas [10]. Hamartomas represent between 0.1–0.7% all benign breast lesions. In our series, hamartoma incidences were 0.05% and to our knowledge, our series was the largest one in the literature.

Hamartomas usually appear as painless, well-defined, and mobile soft tissue masses, in the breast [2,3,11]. Imaging features of hamartomas have been well described in the literature. The MG findings are generally considered diagnostic for hamartomas [2,4,12]. A diagnostic feature of hamartomas on the MG is a lucent component, which is related to the presence of fatty content. Further-

more, densities of hamartomas vary on the MG, based on the amount of fibrous and epithelial contents. The mixed density appearance of hamartomas on the MG, which is similar to breast parenchyma, with a surrounding thin radiopaque pseudo-capsule, is referred to as a ‘breast in breast’ sign [4,9,12]. Lobulated opacities that are dispersed within radiolucent fatty tissue have been described as a ‘slice of salami’ [11]. In our study, 34 out of 39 breast hamartomas were evaluated with the MG (the MG was not performed on the remaining five hamartomas because the patients were under 35 years old). MG was diagnostic in only 25 lesions, and in 9 breast lesions, dense breast tissue did not allow for visualization of fat densities. In the MG images, the ‘breast in breast’ sign was observed in 22 hamartomas, a thin radiopaque pseudocapsule was observed in 22 hamartomas, and a ‘slice of salami’ sign was observed in only 3 hamartomas.

Hamartomas are generally oval shaped and well-circumscribed on US [5,9,10,13]. Due to differing amounts of internal structural elements, US images of hamartomas displayed varied internal echo patterns (i.e., heterogeneous, hyperechoic, or isoechoic) [13]. Besides, hamartomas may sometimes appear as homogeneous hypoechoic lesions in the US, especially when fatty tissue is not recognized on the MG [14]. Hamartomas may contain cystic areas or intratumour calcifications and may demonstrate posterior enhancement or shadowing [5,13,14]. Tumor

compressibility is another sonographic feature of breast hamartomas [5,13]. Such a wide spectrum of US appearances restricts the role of US in making the diagnosis of the hamartoma [2,3]. Park et al [13] found that 87.5% of hamartomas had a heterogeneous internal echo structure, and suggested that this finding was a typical sonographic feature. In our study, all hamartomas were oval shaped and well-circumscribed. A heterogeneous internal echo pattern was present in 35 hamartomas, whereas 2 hamartomas had predominantly hypoechoic, and another 2 hamartomas had mainly hyperechoic internal echo patterns. Also, 3 hamartomas contained cyst formations. Retrotumour phenomenon was not observed in 31 hamartomas, posterior acoustic enhancement was seen in 6 hamartomas, and shadowing was seen in only 2 hamartomas. Tumor compressibility was seen in all hamartomas.

The use of PDVF in the differential diagnosis of breast lesions, has been studied by few researchers [6-8,15]. Stavros et al [6] suggested that the vibrational defect could be useful for distinguishing benign or malign breast masses, from normal tissues. Kim et al [7,8] reported that PDVF imaging can be useful in discriminating isoechoic tumors from fatty and isoechoic glandular tissues, and also for detecting multifocal isoechoic disease. They also showed that vibratory defect sizes, of benign and circumscribed malignant lesions on PDVF imaging, could be the same as the lesion sizes on B-mode imaging. Thus, PDVF imaging cannot distinguish between benign and circumscribed malignant lesions. The vibrational artifacts in the middle of all the benign and malign lesions was also observed in their study, which included lesions with calcifications, fibrosis, marked vascularity, or mural nodules in cystic portions. It was concluded that this could lead false-negative PDVF results [7].

In our study, the vibratory defect sizes of all malign or benign lesions, except for hamartomas, during PDVF imaging, were the same as or larger than the corresponding sizes in gray-scale images. In the malign tumors with a thick echogenic halo, we observed a large vibratory artifact covering the mass and the echogenic boundary. On the other hand, during PDVF imaging we observed that benign or malign masses with microcalcifications or linear echogenic streaks due to fibrosis, except for hamartomas, showed internal vibratory artifacts in the middle of the lesions.

Hamartomas, together with the heterogeneous internal echo patterns, showed power Doppler vibrational artifacts throughout the lesion, which prevented distinguishing such hamartomas from the surrounding breast tissue on the PDVF image. We think the reason for the power Doppler vibrational artifact, observed in hamartomas during the vocal fremitus test, is that hamartomas do not have a real capsule formation, and they display a similar tissue pattern, as the

surrounding breast parenchyma. Our findings show that on PDVF imaging, color defects are observed in benign and/or malign lesions, except in hamartomas. This suggests that PDVF imaging is very useful in differentiating hamartomas from other breast lesions even if they are millimetric in size.

We acknowledge that the current study is limited by the fact that PDVF images were evaluated by only one experienced breast radiologist. The level of experience that a radiologist has may influence the performance and the evaluation.

In conclusion, we believe that the use of PDVF imaging during an US, besides the typical heterogeneous internal echo pattern appearance, contributes to the differential diagnosis of the hamartoma. PDVF imaging can be especially useful for women for whom a MG is not recommended or for hamartomas, where fatty tissue is not recognized by the MG.

Conflict of interest: none

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