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Case Series

Isolated architectural distortion on 3D tomosynthesis: Is ultrasound guided biopsy feasible?

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ABSTRACT

Isolated architectural distortion (AD) detected on mammography is a suspicious abnormality in patients with no prior history of surgery or trauma and mandates tissue sampling. When AD is detected on routine screening and only on tomosynthesis, stereotactic/tomosynthesis guidance is needed for performing biopsy, as often there is no correlate identifiable on ultrasound. This facility is not widely available, especially in developing countries, leading to referral, delay in the diagnosis, and loss of patients to follow-up. Through this case series, we highlight the simple tips and tricks to identify the ultrasound correlate to confirm them prior to biopsy so that the correlate is accurate, thus avoiding false negative histopathology. In this series, two cases had benign results, three had a focus of ductal carcinoma in situ, and one was invasive ductal carcinoma, and the histopathological results were concordant in all these cases.

Keywords: Architectural distortion, Biopsy, Non-mass abnormality, Tomosynthesis, Ultrasound

INTRODUCTION

Architectural distortion (AD) is defined by the Breast Imaging Reporting and Data System (BI-RADS) as "parenchymal distortion with no definite mass visible."[1] AD comprises 6% of abnormalities detected on screening mammography and is the third most common abnormality after mass and calcifications for an invasive cancer.[2] AD has also accounted for 12–45% of the missed cancers on 2D digital mammography.[3,4] Pathologies varying from benign, high-risk lesions to malignancies can all result in AD. Benign causes include radial scars, complex sclerosing lesions, sclerosing adenosis, fat necrosis and posttraumatic changes. Malignant causes include invasive cancers and ductal carcinoma in situ.

With the incorporation of tomosynthesis into the routine screening protocol, more cases of subtle AD can be identified that are occult on 2D mammography and ultrasound. In the absence of any history of prior surgery or trauma corresponding to the site of AD, the next step is to perform the targeted ultrasound and look for the feasibility of performing Ultrasonography (USG)-guided biopsy. Most of the tomosynthesis-detected non-palpable isolated AD that are occult on 2D mammogram are expected to be occult on ultrasound as well.[4] In such sonographically occult cases, one has to resort to the tomosynthesis-guided vacuum assisted biopsy (TVAB).[5]

However, because of the limited availability of these facilities in developing countries, patients are being referred to tertiary centers. This leads to delays in the diagnosis, loss of patients for further work-up, and increased workload at tertiary care centers. We present six cases of screen-detected isolated AD seen only on tomosynthesis with no mass correlate on USG; however, they could still be biopsied by identifying subtle non-mass abnormalities and confirming the sono-mammographic correlation prior to performing the biopsy in order to avoid false negative results.

CASE SERIES

All six patients attended the breast clinic for screening mammography. As a routine protocol at our institution, both 2D mammogram and 3D tomosynthesis views were acquired in all the patients. 2D mammograms were normal, and AD was detected only on tomosynthesis as an isolated finding with no mass or microcalcifications associated with it.

None had a prior history of breast biopsy, surgery, or trauma to explain the finding. As a next step, targeted ultrasound of the triangulated zone was performed on the Supersonic Imagine ultrasound machine using a high-frequency linear probe (4–15 MHz).

Technique of Triangulation and Confirmation

Finding the sonographic correlate: No obvious mass could be identified in any of these patients; however, on careful scrutinization of the triangulated zone, the AD was seen as thin linear echogenic strands/radiating spicules emanating from a point that could either be appreciated or became prominent only in one plane on 2D greyscale imaging.

To make sure that this non-mass abnormality was actually representing the AD identified on MG and not just a shadowing from the Cooper's ligament, we utilized interrogation with real-time shear wave elastography. Real-time shear wave elastography (SWE) was switched on with dual view screen mode, and the area was scanned with minimal pressure while maintaining skin contact with the probe throughout. This showed a change in the elasticity as we moved from normal to the suspected area.

Another feature that proved useful was the 3D linear volumetric probe (5–16 MHz). The probe was held stable over the area, and 3D mode on the machine was switched on. The ability to see the area in a coronal view helps in identifying these subtle ADs. On coronal views, radiating echogenic spicules with or without a central hypoechoic area were seen mimicking the mammographic picture.

Other tips that have been described in the literature and could be useful are summarized in Table 1.

Confirming the triangulation: We confirmed our findings by injecting 0.1–0.2 ml of iodinated contrast in the perilesional area using a 24G needle under USG guidance in five lesions. One view of tomosynthesis was performed postinjection that confirmed the sono-mammographic correlation and increased our confidence prior to performing an ultrasound-guided biopsy.

USG-guided biopsy was done in five patients using a 14G automated biopsy gun, and four samples were taken, orienting the sampling notch every time in a different direction and sent for the histopathological examination that revealed ductal carcinoma in situ (DCIS) in two patients [Figures 1 and 2] and invasive ductal cancer in another [Figure 3] and benign results with no atypia in the fourth and fifth patients with fibrocystic changes, oncocytic metaplasia, mild adenosis, and stromal sclerosis in one patient and apocrine metaplasia in another patient [Figures 4 and 5]. One patient [Figure 6] underwent preoperative wire localization under USG guidance without prior biopsy as she had a history of treated contralateral breast cancer. Histopathological examination revealed 3 × 1 mm of DCIS. One of the patients with benign histopathology

Table 1: Tips that help in performing USG-guided biopsy for mammography-only abnormalities.

Pre-biopsy identification
Triangulating the area on mammography and performing targeted ultrasound. Use features like 3D linear probe to identify subtle architectural changes. Make use of elastography, especially the real-time elastography to depict the changes in elasticity in real time. Using nearby landmarks, for example, presence of a cyst or sonographically visible calcifications.
Pre-biopsy confirmation
Marking the overlying skin with a marker and acquiring a check mammogram. Injecting iodinated contrast into the suspected correlate and acquiring a check mammogram.
Postbiopsy confirmation
Check MG for immediate biopsy changes like the presence of hematoma and air. Biopsy clip insertion and a check mammogram.

USG: Ultrasonography, MG: Mammogram.

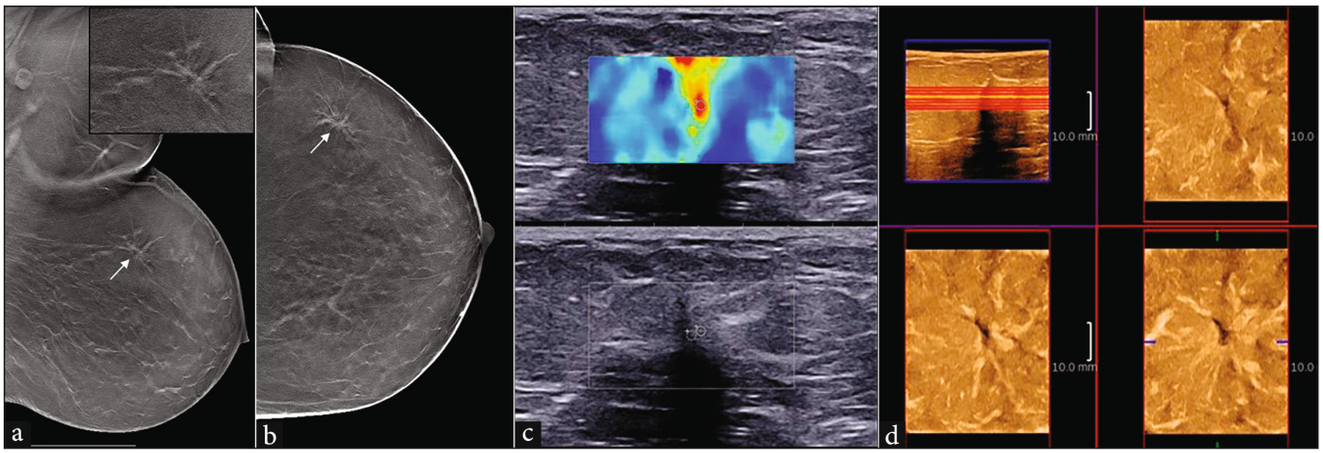

Figure 1: A 58-year-old female with DCIS: 3D (a) MLO and (b) CC views show AD in the upper outer quadrant of the left breast (white arrows) and zoomed in the inset. (c) Targeted dual view 2D shear wave elastography shows subtle posterior acoustic shadowing at the 2 o'clock position with areas of stiffness (coded as red). (d) Tomographic coronal slices obtained using a volumetric linear probe unmasked the abnormality causing AD. DCIS: Ductal carcinoma in situ, MLO: Mediolateral oblique, CC: Craniocaudal, AD: Architectural distortion.

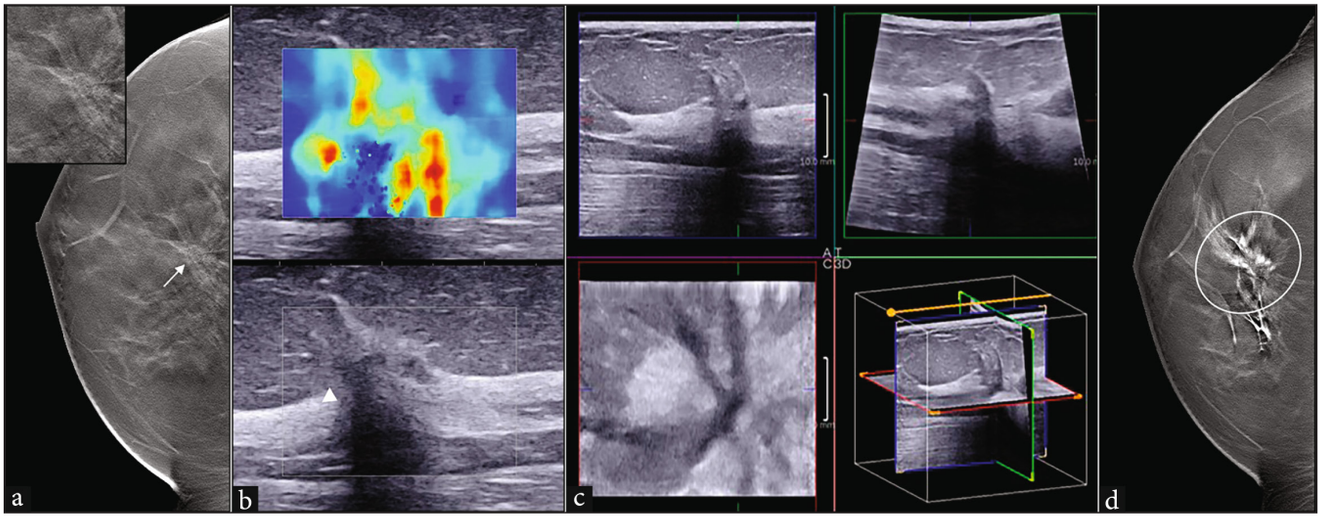

Figure 2: A 48-year-old female with DCIS: (a) Tomosynthesis in CC view shows AD (white arrow), zoomed in the inset image. (b) Targeted dual view 2D shear wave elastography shows subtle posterior acoustic shadowing (white arrowhead) with peripheral hard areas (coded as red). (c) 3D linear probe depicting the AD similar to the mammographic image. (d) The tomosynthesis image in CC view after injecting the iodinated confirmed the sono-mammographic correlation (white circle). DCIS: Ductal carcinoma in situ, CC: Craniocaudal, AD: Architectural distortion.

[Figure 4] was advised follow-up at 6 months post biopsy and annually thereafter. The other patient with benign histopathology [Figure 5] underwent surgical excision as per her choice, and the final histopathology was apocrine metaplasia with radial scar.

DISCUSSION

AD includes spiculations radiating from a point with focal retraction or distortion at the edge of the parenchyma. Usually, it is seen as a secondary finding in association with a mass. However, an increasing number of ADs are now found as isolated findings on screening mammography, especially with the advent of digital breast tomosynthesis (DBT).[6]

Parenchymal distortion resulting from prior surgery, trauma, or fat necrosis is assigned as BI-RADS 2. In the absence of such history corresponding to the site of AD, it is assigned as BI-RADS 4 and needs a biopsy.

Benign, high-risk lesions and the malignancies can cause parenchymal distortion. Though there are no specific imaging features that can predict malignancy, the reported rates of malignancy are significantly lower in AD detected only on tomosynthesis without USG

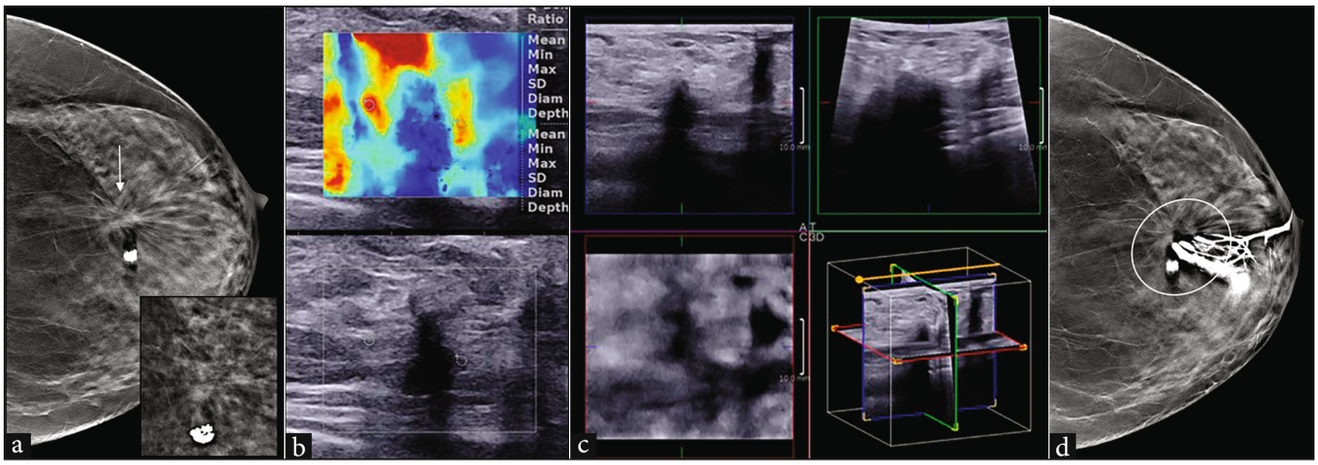

Figure 3: A 46-year-old female with invasive ductal carcinoma: (a) Craniocaudal (CC) view shows architectural distortion (AD) (white arrow); inset image shows zoomed spot compression view with no mass. (b) Targeted tomosynthesis dual view 2D shear wave elastography shows subtle non-mass abnormality with posterior acoustic shadowing with peripheral hard areas (coded as red). (c) Volumetric linear probe illustrated the AD. (d) Tomosynthesis image in CC view after injecting the iodinated contrast confirmed the sono-mammographic correlation (white circle).

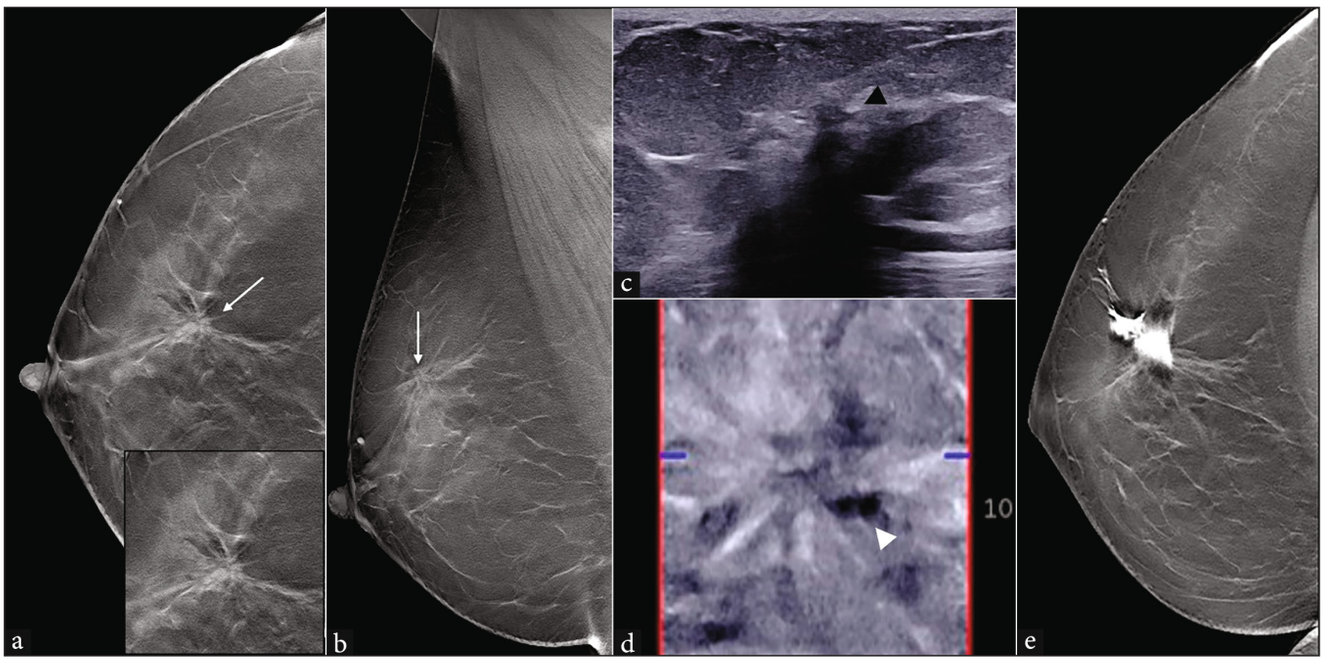

Figure 4: A 52-year-old prospective kidney donor with fibrocystic changes. (a) 3D CC and (b) 3D MLO mammography view shows isolated AD in the upper outer quadrant (white arrows), zoomed in the inset image. (c) Greyscale targeted ultrasound shows subtle posterior acoustic shadowing (black arrowhead). (d) 3D ultrasound shows radiating echogenic spicules with a simple anechoic cyst (white arrowhead) in the vicinity. (e) 3D CC view after injecting the iodinated contrast confirmed the sono-mammographic correlation. CC: Craniocaudal, AD: Architectural distortion, MLO: Mediolateral oblique.

correlate compared to those that are palpable, seen on 2D mammography, and have mass correlate on USG (27.9% versus 82.9%, respectively).[4] The meta-analysis of thirteen retrospective observational studies by Choudhary *et al.* showed a positive predictive value (PPV) of 34.6% for underlying malignancy, thus warranting biopsy. They also concluded that USG mass correlate may not be seen in 21.7% of the ADs with malignant outcome.[7] Bansal *et al.* reported malignancy rates of 42.3%, respectively, for AD detected on DBT only.[8] Above studies show that even for AD

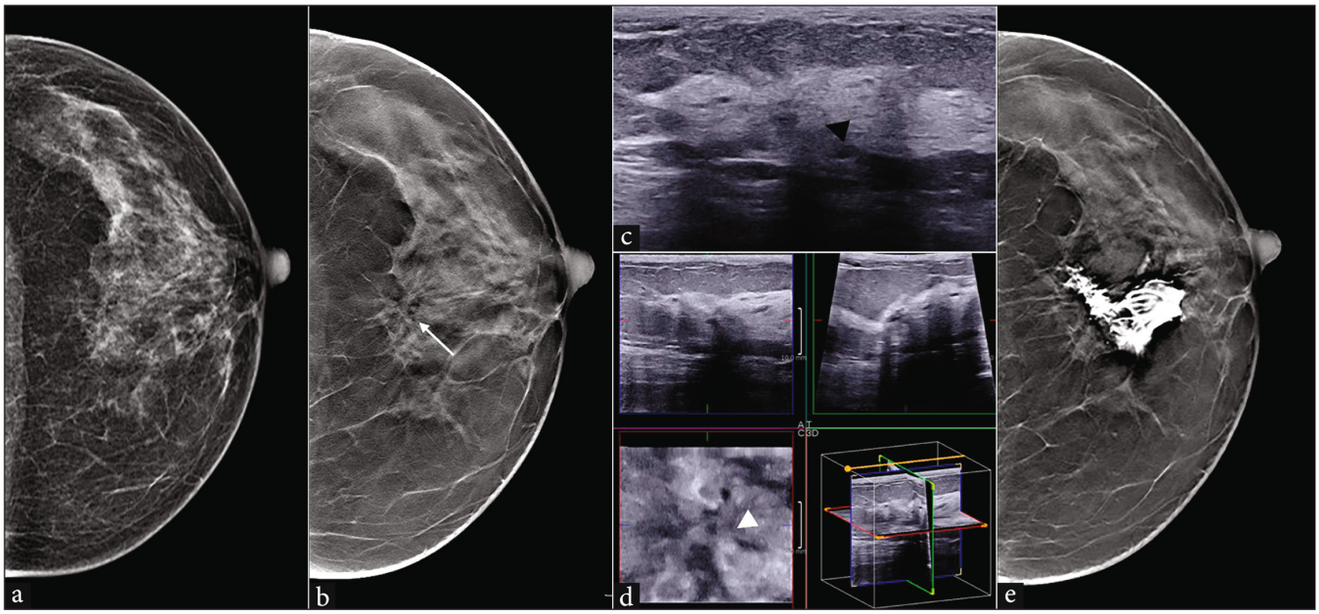

Figure 5: A 50-year-old female with apocrine metaplasia on biopsy. (a) 2D CC and (b) 3D CC mammography views of the left breast show isolated AD in the central quadrant only on tomosynthesis (white arrow in b). (c) Greyscale targeted ultrasound at 12 o'clock shows subtle posterior acoustic shadowing (black arrowhead). (d) 3D ultrasound shows radiating echogenic spicules with a simple anechoic cyst (white arrowhead) in the vicinity. (e) 3D CC view after injecting the iodinated contrast confirmed the sono-mammographic correlation. CC: Craniocaudal, AD: Architectural distortion.

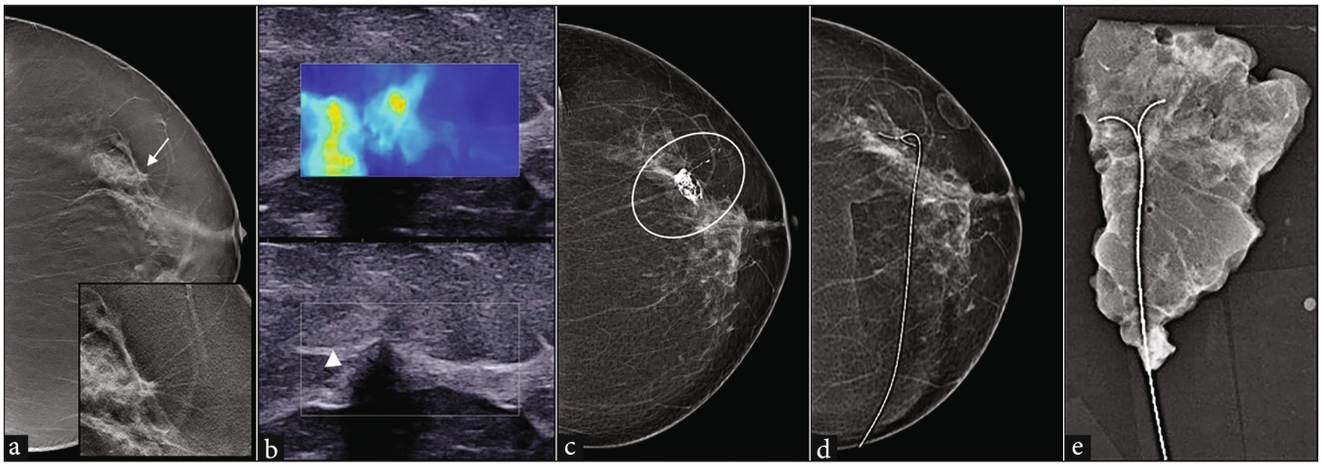

Figure 6: A 55-year-old female with DCIS. (a) 3D mammography CC view shows AD in the outer quadrant of the left breast (white arrow), zoomed in the inset. (b) Targeted dual view shear wave elastography depicted peripheral areas of increased stiffness (coded as yellow) around the area of posterior acoustic shadowing (white arrowhead). (c) 2D mammogram CC view after injecting the iodinated contrast confirmed the sono-mammographic correlation (white circle). (d) Check mammogram shows correctly positioned preoperative wire localization done under ultrasound guidance. (e) Lumpectomy specimen radiograph shows complete removal. DCIS: Ductal carcinoma in situ, CC: Craniocaudal, AD: Architectural distortion.

seen only on DBT, the malignancy rate is high enough to warrant a biopsy.[7,8]

There are no specific imaging criteria or a non-invasive method to distinguish malignant AD from non-malignant ones so as to avoid a biopsy. Although there are studies evaluating the utility of contrast-enhanced Magnetic resonance imaging (MRI) and contrast-enhanced mammography in isolated AD, where biopsy could be avoided for cases that show no enhancement, more such studies are needed to have evidence-based guidelines before a biopsy can be deferred.[9,10]

Moreover, the management of ADs with biopsy outcomes as benign pathologies and pathologies without atypia remains controversial, and there are studies concluding imaging surveillance is a better option for such patients rather than surgical excision. Hence, it is of immense importance that one targets the actual area and takes as many samples as possible to avoid false negative results.[11]

As per the USG BI-RADS lexicon, AD is only described as an associated finding; however, when it is the primary MG abnormality with no sonographic correlate, non-mass abnormalities may be identified on ultrasound, making the USG-guided biopsy feasible. The non-mass abnormality is subtle and often seen as posterior acoustic shadowing, thin linear echogenic lines emanating and converging to a point with or without a central hypoechoic area. AD is included as a separate entity under the conundrum of non-mass abnormalities by many authors and also the Japanese Society of Ultrasound. These subtle abnormalities are missed on 2D greyscale imaging as the normal breast structures, like Cooper's ligaments, also cast similar linear shadows.

Although TVAB is the ideal way to sample mammographically and sonographically occult AD, it's out of the reach of many clinics. Through our series of six cases, we emphasize that one may identify the focal non-mass correlates on ultrasound by evaluating the suspected region carefully, utilizing additional tools/features like real-time elastography and volumetric linear probes. The 3D evaluation is especially useful, as it provides the coronal view, the anatomical plane along which the normal breast parenchymal structures are oriented, and any distortion is readily picked up. This advantage is also utilized in the recent automated breast ultrasound technology for screening purposes. AD is visible on coronal view as a hypoechoic area with radiating echogenic spicules, also known as the retraction phenomenon.[12]

Further, we describe a simple, inexpensive technique of injecting iodinated contrast into the suspected area of AD on USG, followed by a check mammogram to confirm the target area prior to biopsy before it is being sampled to avoid false negative results. Our sample size in detailing these techniques is from a single institute and is small. However, we believe that this can be applied in larger volumes in different centers.

CONCLUSION

Isolated AD detected on mammography needs further evaluation to plan the mode of biopsy. A dedicated and a carefully performed ultrasound along with the use of additional tools such as 3D ultrasound and elastography may help one to find subtle non-mass abnormalities on ultrasound and attribute these to the mammographic AD with confidence. The simple technique of injecting contrast decreases the possibility of sampling error and hence the radiopathological discordance.

Ethical approval

The research/study approved by the Institutional Review Board at Kovai Medical Center and Hospital Institutional Ethics Committee, number EC/AP/864/11/2021, dated 30/11/2021.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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