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## Ultrasound-guided vacuum-assisted breast biopsy in the diagnosis of cancer recurrence at the surgical scar: a report of three cases

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### Keywords

ultrasound guided  
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core needle biopsy

### Abstract

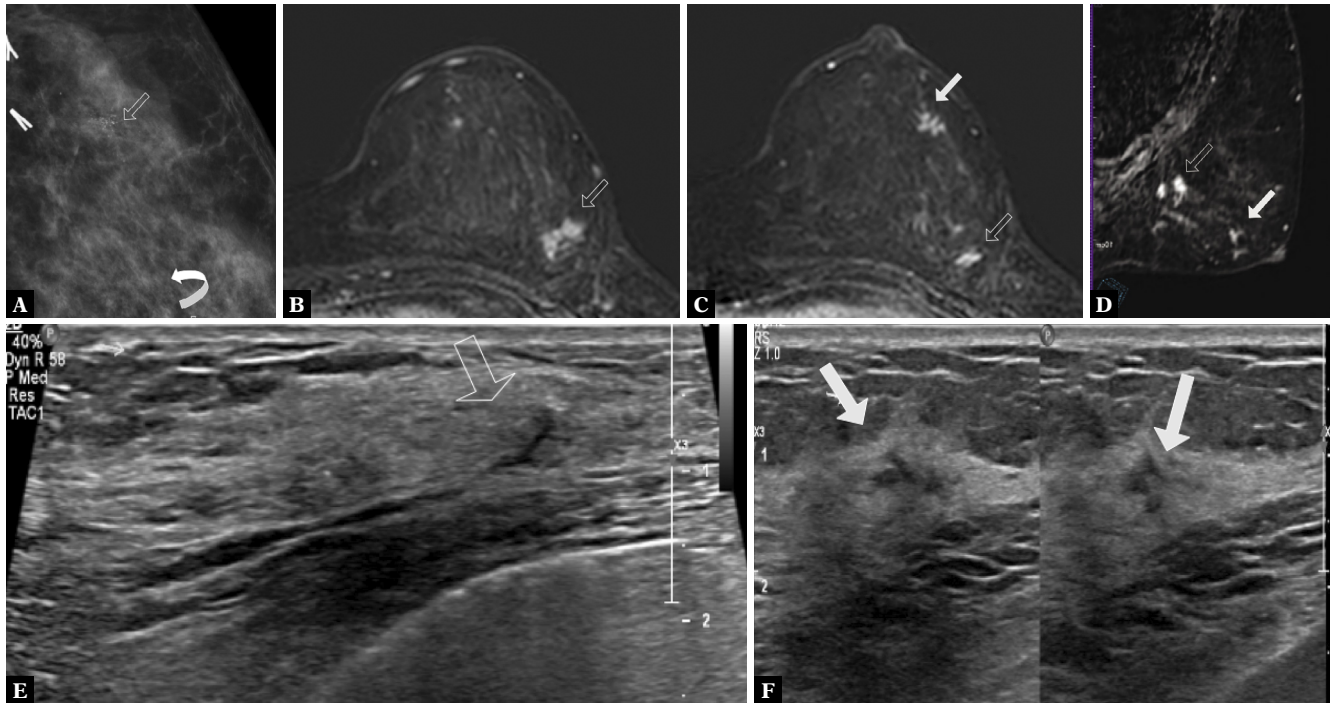
**Aim of the study:** Ultrasound-guided vacuum-assisted biopsy is being increasingly used in the diagnosis of breast lesions. The advantages of vacuum-assisted biopsy over core needle biopsy include large sample and higher diagnostic accuracy. Indications for ultrasound-guided vacuum-assisted biopsy include suspicious calcifications visible on ultrasound, architectural distortion, and very subtle or insinuating lesions. **Case description:** We present three patients treated for breast cancer with breast-conserving surgery who developed suspicious findings on mammogram and MRI at or near the surgical scar. The findings were subtle, small, or atypical lesions on ultrasound. Ultrasound-guided vacuum-assisted biopsy was performed, and recurrence was diagnosed. The technique was advantageous due to real-time imaging, ability to control the path of the needle, obtaining multiple cores with a single skin puncture and single pass, supine position, no radiation, and no IV contrast. **Conclusions:** Ultrasound-guided vacuum-assisted biopsy should be considered in cases involving multiple suspicious findings at or near the surgical scar, with subtle or atypical sonographic correlates. Vacuum-assisted biopsy is indicated; yet ultrasound guidance is more comfortable, no radiation and no contrast.

## Introduction

Ultrasound-guided vacuum-assisted biopsy (USVAB) is being increasingly used in the diagnosis of breast lesions. The advantages of VAB over core needle biopsy (CNB) include large sample and higher diagnostic accuracy<sup>(1)</sup>. Current indications for USVAB include suspicious calcifications visible on ultrasound when stereotactic biopsy is not feasible, architectural distortion without mass, and very small, subtle, or insinuating lesions<sup>(2)</sup>.

The current era of advanced multimodality breast imaging allows early detection of small breast cancers. Therefore, breast-conserving surgery (BCS) is being increasingly used in the proper clinical settings. When BCS is followed by radiotherapy, it is called breast-conserving therapy (BCT). We present three patients who had breast cancer and were treated with BCS/BCT, and developed suspicious imaging findings at or near the region of the surgical scar during follow-up. The findings were subtle, small, or atypical lesions

on ultrasound correlating with suspicious calcifications on mammogram or enhancement on MRI. The suspicious findings were identified at the region of the scar or close to it. USVAB was performed, and breast cancer recurrence was diagnosed. In our case series, the decision for USVAB was made because a diagnostic advantage was expected for the patients. In the first two cases, ultrasound showed subtle small lesions correlating with suspicious calcifications on mammogram and enhancement on MRI at the region of the scar. In the last case, ultrasound examination showed a large heterogeneous echogenic atypical lesion close to the scar. The diagnosis of breast cancer recurrence was made. Heywang-Köbrunner *et al.* described USVAB experience with 51 patients, of whom five had findings at the scar, but no details were given regarding the findings and pathology results specific to the scars<sup>(3)</sup>. Other studies have reported experience with USVAB in the assessment of variable breast lesions but, to our knowledge, none provided any details and possible advantages in relation to the assessment of suspicious findings at or near the surgical scar<sup>(4-6)</sup>.



**Fig. 1.** **A.** Mammogram LMCC shows surgical clips at the surgical scar in the upper outer left breast. Group of suspicious calcifications anterior to surgical clips (arrow). Multiple other groups of suspicious linear calcifications in the lower inner left breast (curved arrow). **B.** Breast MRI axial subtraction post-contrast image shows a suspicious enhancing mass measuring 1.4 x 0.9 cm at the scar posteriorly. Another adjacent tiny enhancing mass seen inferiorly in the posterior third of the mid-outer left breast (image C). **C.** Focal non-mass enhancement at 3:00 in the anterior third of the left breast (solid arrow). **D.** Sagittal MR MIP rotated image shows enhancing masses at the region of the scar posteriorly (arrow) and non-mass enhancement (solid arrow). **E.** Ultrasound showed post-operative scar in the upper outer left breast. Subtle hypoechoic lesion anterior to the scar may correlate with suspicious calcifications on mammogram (arrow). **F.** Heterogeneous non-specific lesion may represent ductal abnormality in the mid-outer periareolar left breast correlating with non-mass enhancement on MRI (solid arrow)

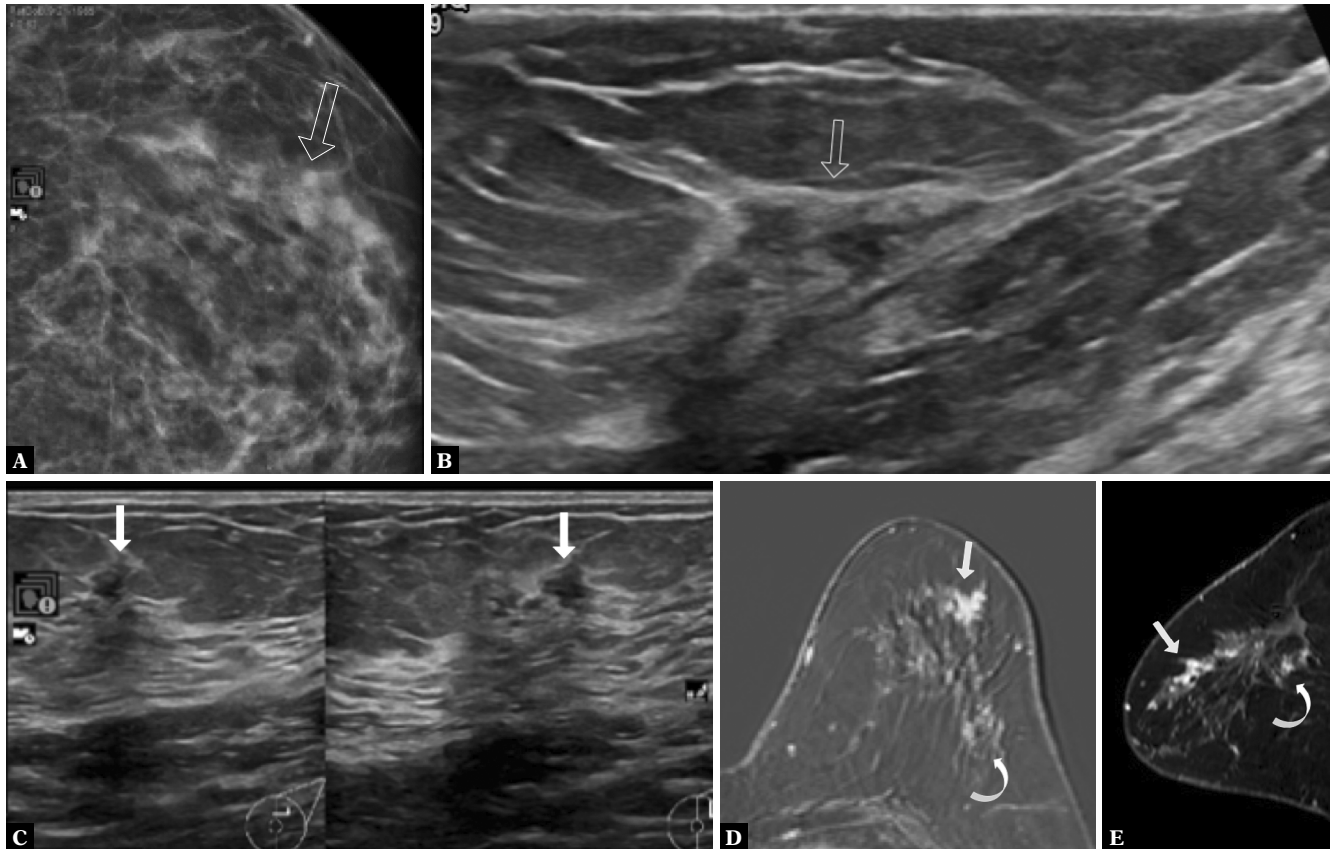
## First case

A 42-year-old woman was treated for left breast cancer three years previously with neoadjuvant chemotherapy, followed by left breast wide local excision and radiation therapy. Pathological findings revealed invasive ductal carcinoma, grade II, ypT1cN2a, ER negative, PR positive and HER-2/neu negative. Her family history was negative, and she was heterozygous for BRCA1 variant of unknown significance. Follow-up mammogram showed post-operative changes in the upper outer left breast. Interval development of suspicious calcifications anterior to surgical clips and multiple other groups of suspicious linear calcifications in the lower outer left breast. MRI showed multiple enhancing small masses at the scar and non-mass enhancement in the mid-outer periareolar left breast. Ultrasound showed scarring in the left upper outer breast. Subtle nonspecific hypoechoic lesions just anterior to the scar may correlate with calcifications. Heterogeneity in the mid-outer left breast and mid-upper left breast may correlate with enhancement on MRI likely representing ductal abnormality (Fig. 1).

## Procedure

A decision was made to biopsy two sites of suspicious findings on ultrasound. First, subtle hypoechoic lesions

close to the scar that correlated with calcifications on mammogram. Second, heterogeneous nonspecific hypoechoic findings correlating with non-mass enhancement on MRI in the mid-outer left breast. USVAB was performed from two lesions with one puncture. All procedures were performed using ATEC® vacuum machine and Philips Affinity 50 ultrasound machine. The patient was lying in supine oblique position, on her right side, with the left hand above the head. An appropriate single skin puncture was made at 4:00, the needle (ATEC®12 gauge) was introduced; the more inferior lesion was sampled (10 cores) using vacuum machine. Then the needle was introduced cranially toward the second lesion close to the scar, and a total of 10 cores were obtained. Specimen radiograph showed no calcifications. Hydromark® tissue marker (clip) was placed at the site of biopsy at the end of the procedure. Post-procedure mammogram showed the clip close to the calcifications. Pathological examination revealed invasive ductal carcinoma, grade 2 and high-grade and low-grade ductal carcinoma in situ, cribriform, solid and micropapillary patterns with comedo necrosis. The invasive component was located mainly at the region of the scar. DCIS was at the two sites. The results are concordant: ER positive weak, PR negative, HER-2/neu negative. The patient underwent left nipple-sparing mastectomy: residual ductal carcinoma in situ, ypT(is). No definite invasive carcinoma was seen, which



**Fig. 2.** **A.** Mammogram LMCC showed post-operative scarring in the upper outer left breast. Developing asymmetry with suspicious linear calcifications at and just anterior to the scar, measuring  $1.2 \times 0.4$  cm. **B.** Ultrasound showed post-operative changes in the upper outer left breast with a subtle small hypoechoic lesion close to the surgical scar in the upper outer left breast (2:00–3:00) measuring less than  $1 \times 1$  cm (arrow). **C.** Another subtle irregular hypoechoic mass with adjacent shadowing and a few tiny hypoechoic lesions (abnormal duct-like appearance) at periareolar 1:00, may correlate with mammographically seen calcifications and measures  $1 \times 0.5$  cm. **D.** MR showed non-mass enhancement at 1:00 in the left breast (solid arrow) and non-mass enhancement at the scar in the posterior third of the upper outer left breast (curved arrow). **E.** Reconstructed sagittal MR image shows non-mass enhancement in the upper outer left breast (solid arrow) and few enhancing foci close to the scar in the deep upper outer breast (curved arrow)

may be explained by inadequate sampling of mastectomy specimen or complete excision of small invasive component by VAB.

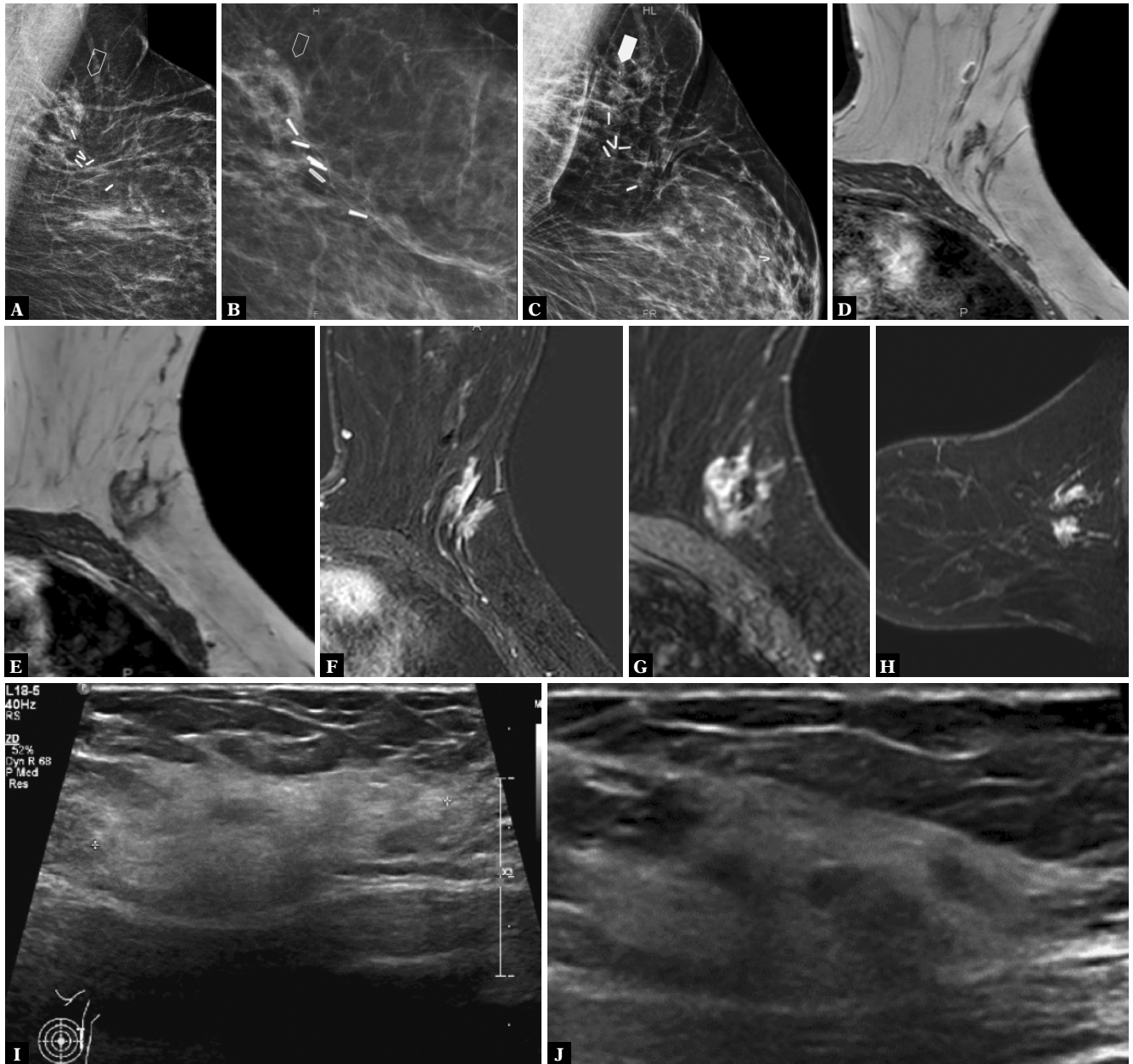
## Second case

A 55-year-old woman had left breast DCIS five years previously. She was treated by wide local excision with wire localization. Intermediate grade ductal carcinoma in situ (solid and cribriform), in a background of extensive sclerosing adenosis, was diagnosed. Strongly hormonal positive ER 99% and PR 99% were found. The patient stopped tamoxifen due to side effects after 12 months. No radiotherapy was performed. Mammogram showed post-operative scarring in the upper outer left breast. Interval development of suspicious clusters of few linear calcifications with underlying asymmetry just anterior to the surgical scar in the upper outer left breast. Ultrasound showed a subtle small hypoechoic mass close to the surgical scar in the upper outer left breast (2:00–3:00) measuring less than  $1 \times 1$  cm. Another subtle irregular hypoechoic mass with adjacent shadowing

and tiny cystic lesions/abnormal duct-like appearance at 1:00 medial to the above-mentioned mass was noted. This mostly correlates with suspicious calcifications on mammogram (Fig. 2).

## Procedure

The decision was to biopsy the two sites with suspicious findings on ultrasound: first, a subtle hypoechoic mass close to the scar, correlating with abnormal enhancement on MR and part of developing asymmetry on mammogram; and second, an irregular mass at 1:00 correlating with non-mass enhancement on MR. USVAB was performed from two lesions with one puncture. The patient was lying in supine position, on her right side, with the left hand above her head. An appropriate skin puncture was made at around 4:00 in the left breast, Standard ATEC® 9 gauge biopsy needle was introduced. First, the inferomedial subtle mass at 1:00 in the left breast was targeted (with a total of 10 cores obtained). Then, the needle was introduced superiorly and laterally toward the subtle mass close to the scar in the upper outer left breast

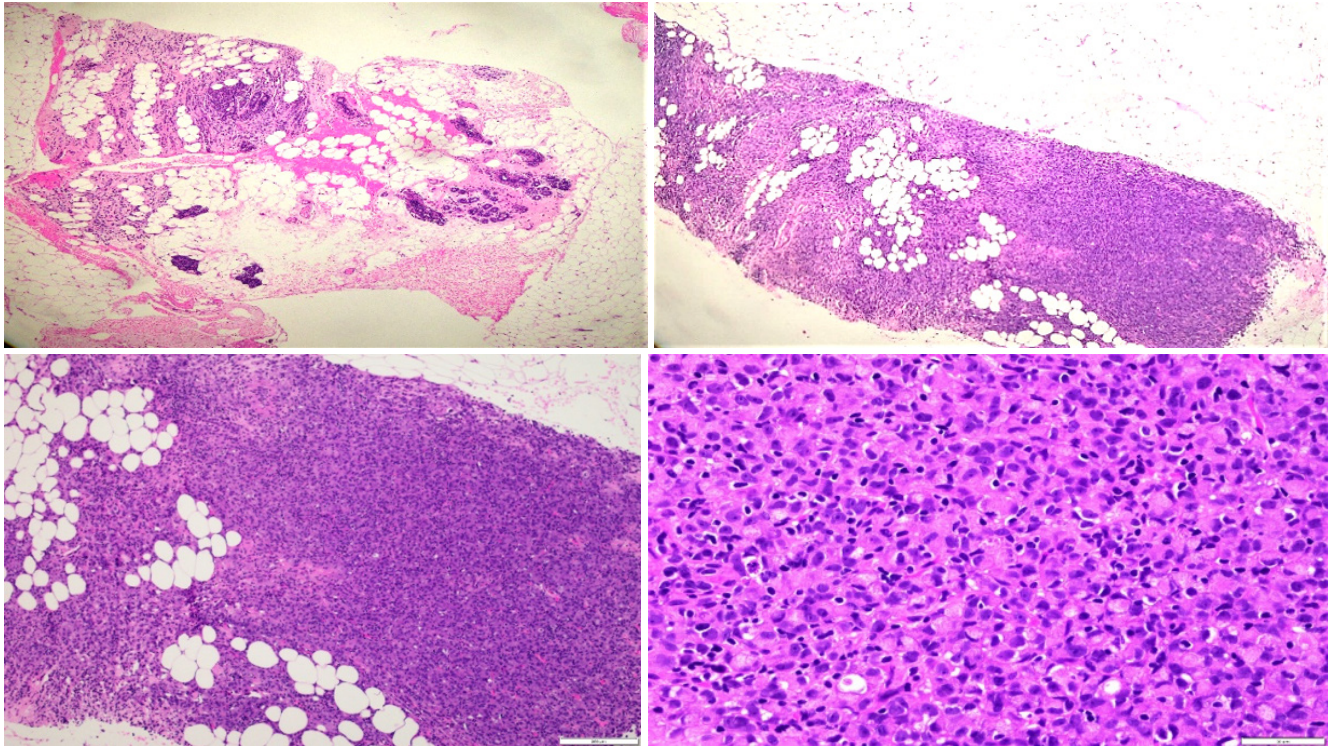


**Fig. 3.** **A.** MLO mammogram. **B.** Magnification views shows post-operative scarring in the upper outer left breast with surgical clips. New developing focal asymmetry at (arrow) just lateral to the scar. **C.** Post biopsy mammogram shows the clip (solid arrow). MR images T1W axial images (**D**, **E**), MR axial subtracted post-contrast images (**F**, **G**) and reconstructed sagittal post-contrast MR image (**H**) show post-operative surgical clip and adjacent architectural distortion with enhancement (**I**, **J**). Ultrasound image shows a large heterogeneous hyperechoic mass in the outer mid and upper left breast, with visible small regions of hypoechoic shadowing

(2:00–3:00), and 10 cores were obtained. Specimen radiograph showed no calcifications; however, post-procedure mammogram showed the clip close to the calcifications. Pathological examination revealed that the mass at 1:00 in the left breast was low grade and intermediate grade ductal carcinoma in situ with sclerosing adenosis, and the mass at the scar site was a focus of intermediate and high grade ductal carcinoma in situ, with solid subtype and no necrosis. ER and PR positive. The results were concordant. The patient is still reluctant about being referred for definitive surgical treatment.

### Third case

A 43-year-old lady had left breast DCIS five years ago treated by wide local excision with wire localization. Pathological examination revealed DCIS, GII, ER/PR positive, with extensive lobular carcinoma in-situ. The patient was on hormonal therapy (Tamoxifen). Follow-up mammogram two years after surgery showed focal asymmetry in the mid-outer left breast 2 cm inferior to the scar, and ultrasound guided core biopsy showed fat necrosis. Recent follow-up mammogram showed subtle developing asymmetry just



**Fig. 4.** Pathological examination revealed multifocal nodular aggregates of high grade tumor cells with pleomorphic nuclei and prominent nucleoli. Typical single file pattern and targetoid growth are seen infiltrating around ducts and between fat lobules. Pathological examination confirmed invasive pleomorphic lobular carcinoma

lateral to the surgical clips at the region of the scar. Breast MRI showed interval development of non-mass enhancement with architectural distortion adjacent to the surgical scarring. Ultrasound showed a heterogeneous mainly hyperechoic mass with regions of subtle hypoechoic shadowing in the upper outer/mid-outer left breast. This was very close and indistinguishable from the surgical scar (Fig. 3).

## Procedure

The decision was to biopsy this heterogeneously echogenic mass in the outer left breast using USVAB. The same procedure was performed, a skin incision was made at 4:00 left breast. A standard ATEC® 9 g biopsy needle was introduced within the heterogeneous mass, the needle was mainly at the superficial part of the mass and multiple cores were obtained. Pathological examination revealed invasive pleomorphic lobular carcinoma with negative E-cadherin immunostain. ER and PR positive and HER-2/neu negative. Adequate cores were provided to the pathologist, which enabled proper diagnosis (Fig. 4). The patient underwent left mastectomy, and pathological examination revealed multifocal invasive pleomorphic lobular carcinoma, grade 3, stage pT2(m)N0.

## Discussion

Breast imaging has significantly advanced over the past decades and has enabled the detection of subtle and tiny breast lesions. However, tissue sampling and

histopathological examination is essential for definitive pathologic diagnosis<sup>(7)</sup>.

There are two methods for needle biopsy: core needle biopsy (CNB) and vacuum-assisted biopsy (VAB). Worldwide, CNB is the most commonly used method, given its high accuracy, cost efficiency, low complication rate (hemorrhage or infection), and convenience. However, CNB is also associated with certain limitations such as false-negative findings and underestimation of disease, which are inevitable because the procedure samples only parts of the target lesion rather than the entire lesion<sup>(8-10)</sup>. CNB collects one sample at a time, thus one sample can be obtained with each needle insertion. On the other hand, VAB combines needle biopsy with vacuum suction to collect multiple samples with just one needle insertion and ensures that tissue samples are taken from different parts of the lesions. Therefore, VAB provides larger tissue samples and thus allows more accurate diagnosis, reducing the rate of underestimation of disease or false negative results<sup>(11,12)</sup>.

Percutaneous image-guided biopsy is the mainstay in the diagnosis of breast abnormalities whether detected on diagnostic or screening breast imaging<sup>(13,14)</sup>. The approach for image guidance can be either under ultrasound, stereotactic or MR guidance. Ultrasound guidance is the preferred first-line approach for most breast lesions. It has the advantage of convenience, supine patient position, availability, low cost, and no radiation exposure. Stereotactic guidance is indicated for suspicious

calcifications, subtle asymmetries/masses or architectural distortions that are mammographically detectable but not visible on ultrasound. Stereotactic biopsy can be performed with upright mammography machines or with a dedicated prone table. The prone table is a more comfortable solution, with less likelihood of patient movement and vasovagal reaction as compared with the upright position. It provides both a psychological and physical barrier between the patient and the procedure, despite a slightly higher cost. MRI-guided technique is appropriate for evaluating suspicious lesions detectable only by MRI; the patient lies prone and intravenous gadolinium (contrast) injection is necessary<sup>(15,16)</sup>.

Initially, VAB was mainly used under stereotactic-guidance and MR guidance because it enables an adequately larger tissue sample and even complete removal of target lesion, while CNB was used under ultrasound guidance<sup>(17,18)</sup>. Recently, the role of ultrasound-guided VAB has become well recognized in the diagnosis of breast lesions. It is worth mentioning that vacuum-assisted excision (VAE) is performed under ultrasound guidance in the therapeutic excision of certain high-risk lesions<sup>(19)</sup>. Current indication for US-guided VAB include lesions that will benefit from obtaining larger tissue samples<sup>(2)</sup>. These include *a)* suspicious calcifications visible on US when stereotactic biopsy is not feasible e.g., patient cannot lie prone, overweight exceeding permissible limits, pregnant, ventral hernia, very thin breast (usually <20 mm), very posterior lesion, or other issues precluding the positioning on prone stereotactic table and upright stereotactic biopsy not available; *b)* architectural distortion without mass; *c)* very small, subtle, or insinuating lesions (small spiculated masses less than 5 mm may be difficult to sample adequately by CNB); *d)* small mural nodule in cystic mass (if there are concerns that the mass will not be visible after aspirating the cyst fluid), alternatively, standard CNB can be performed, usually after aspirating the fluid<sup>(2)</sup>.

In our series, two patients had undergone BCS and one had BCT. They presented with suspicious imaging findings at or near the region of the surgical scar for which USVAB was performed, and the diagnosis of recurrence was made. In the first two cases, suspicious findings were present in two locations in the breast, one involving the scar. The findings were mammographically evident suspicious calcifications at/near the scar and/or suspicious non-mass enhancement at/near the scar. Ultrasound findings were subtle or nonspecific correlate. The decision was to biopsy suspicious findings in two locations in the breast. VAB would give larger tissue samples and more accurate diagnosis than CNB in these settings of subtle findings. Using ultrasound-guidance for VAB allowed sampling the lesions at two locations by making a single skin puncture. The trajectory of the needle enabled sampling two sites through a single puncture and single pass. Also, the two lesions were close enough from each other (less than 5 cm apart). The puncture was made at an appropriate level close to the more inferior lesion in both cases. In the third case, the rationale for USVAB was different. The patient had a newly developed suspicious focal asymmetry close to the scar, with tiny regions of

intervening fat lobules and extensive suspicious non-mass enhancement on MR highly suggestive of malignancy just close to the scar. However, ultrasound showed a heterogeneously echogenic mass in the mid-outer and upper outer left breast, indistinguishable from the scar with small regions of hypoechoic shadowing. USVAB was considered due to the lack of a typical hypoechoic mass usually seen at the site of suspected recurrence, the presence of fat within the lesion on MR and mammogram, history of previous benign biopsy (fat necrosis) from focal asymmetry inferior to the scar, and large heterogeneous echogenic appearance on ultrasound. VAB would provide an adequate number of larger cores compared to smaller cores obtained with CNB, and thus be representative of the underlying pathology insinuating within the fat tissue.

In all cases, the US approach was preferred to the stereotactic approach due to the supine position of the patient rather than the prone position, no radiation dose, and possibility to avoid multiple targets and multiple passes. The US approach was preferred to MR guidance again due to the patient's supine position, lack of contrast administration, and the fact that multiple targets and multiple passes could be avoided. In all three cases, the results were concordant. In the third case, the pathologist could give the diagnosis of invasive pleomorphic lobular carcinoma because the cores were adequate. The exact results may not have been obtained with fewer smaller cores that would be provided by the routinely used 14-gauge CNB. No significant bleeding was noted, and there were no other complications. The main difficulty was the relatively heavy weight of the needle and its tubing.

Contraindications to VAB include women on anticoagulants or women with bleeding disorders. Also, lesions in subcutaneous locations, or within the skin or immediately adjacent to implants, represent contraindications<sup>(2)</sup>. Heywang-Köbrunner *et al.* described the USVAB experience with 51 patients, of whom five had findings at the scar, but no details were given regarding the findings and pathology results specific to the scars<sup>(3)</sup>. Other studies have reported experience with USVAB in the assessment of variable breast lesions but, to our knowledge, none provided any details about possible advantages in relation to the assessment of suspicious findings at or near the surgical scar<sup>(20-22)</sup>.

Breast radiologists should consider this approach in cases involving multiple suspicious findings at or near the surgical scar on mammogram and MRI with subtle or atypical heterogeneous echogenic correlates on ultrasound. VAB is indicated; yet an ultrasound approach will be more comfortable to the patient, allows multiple targets and cores through single puncture and pass, avoids radiation with stereotactic biopsy and avoids IV contrast administration with MRI-guided approach.

#### Conflict of interest

*The authors do not report any financial or personal connections with other persons or organizations, which might negatively affect the contents of this publication and/or claim authorship rights to this publication.*

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