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Contrast Biopsy in the Mammography Suite: Clinical and Workflow Considerations

Implementation Guide

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Diagnostic use of Contrast-Enhanced Mammography

Contrast-enhanced mammography (CEM) has been demonstrated in numerous studies to have improved diagnostic performance compared to Full Field Digital Mammography (FFDM) with a sensitivity similar to Magnetic Resonance Imaging (MRI).[1,2] Additionally, Sidhir et al. demonstrated CEM to be more sensitive than Digital Breast Tomosynthesis (DBT) (96.5% vs. 82.8%, $p<0.0001$).[3] CEM is gaining popularity in the USA as a breast MR alternative, allowing mammography centers to perform diagnostic contrast exams using existing mammography systems. CEM will likely become more widely used with the introduction of Contrast-Enhanced Biopsy (CEBx), using familiar biopsy systems and techniques.

One barrier to CEM adoption is the perceived lack of biopsy capability for a lesion found only on the recombined (digital subtraction) images.[1] If a FFDM, DBT, or ultrasound (US) correlate cannot be found, the only option for biopsy was MRI guidance.

Introducing MRI into the workflow can be challenging or impossible for many reasons, some of which include implanted devices, body habitus, anxiety, and/or cost. Even if MRI were possible, there is the inherent risk that the lesion may not be seen, which introduces confusion in the workflow and a lack of patient-radiologist confidence.

CEBx allows for successful access to enhancing lesions not seen on low energy images or targeted US and facilitates the use of CEM as a viable diagnostic tool in a modern breast center. With the advent of systems capable of rapid acquisition and processing to generate recombined images, the ability to perform CEBx is now possible. Dual energy images can be acquired quickly, and the recombined images can now be displayed near-instantaneously on the biopsy suite workstation. This allows performing a CEBx procedure despite the time constraints imposed by the kinetics of the iodinated contrast agent.

Aside from the recombined images used to target the lesion of concern, CEBx is fundamentally identical to the core tenet of mammographic stereotactic biopsy. Two off-axis stereopair images (± 15° off-axis) are acquired and displayed for review and targeting. When a target is selected on both stereopairs, the depth of the needle (z-axis) is calculated using a mathematical formula. These coordinates are displayed on the workstation and simultaneously sent to the upright biopsy unit. At this point, CEBx is identical to a traditional stereotactic biopsy via an upright biopsy unit.

Which patients are good candidates for CEBx?

Important considerations to keep in mind when recommending a patient for CEBx are patient physical stamina and background parenchymal enhancement (BPE). Physical stamina is a factor for two reasons: (1) the patient cannot move as images are acquired and (2) vasovagal reactions after contrast administration. As recombined images are digital subtractions of successive images, minor motion during the acquisition of the two exposures which create the recombined image, can impart artifacts, and degrade lesion conspicuity.[4] Vasovagal reactions are a known complication during stereotactic biopsy, reported in 2–20% of upright positions.[5,6] Vasovagal reactions are problematic as they can delay positioning of the patient into the biopsy unit or cause delays during the biopsy both of which can decrease lesion conspicuity due to contrast washout. Unlike traditional stereotactic biopsy where a patient can be removed from the unit to recover and attempt the biopsy again, once contrast is administered there is a finite narrow window of time to complete targeting and biopsy.

Finally, BPE needs to be considered when performing a CEBx. Several studies on BPE at MRI have demonstrated increased abnormal MRI interpretation rates in breast cancer detection due to difficulty differentiating normal BPE from abnormal enhancement.[7,8] Moderate and marked BPE can decrease lesion conspicuity and traditional landmarks as seen on FFDM images are not present. As time elapses following contrast administration, BPE becomes more apparent and can further reduce confidence in lesion targeting.

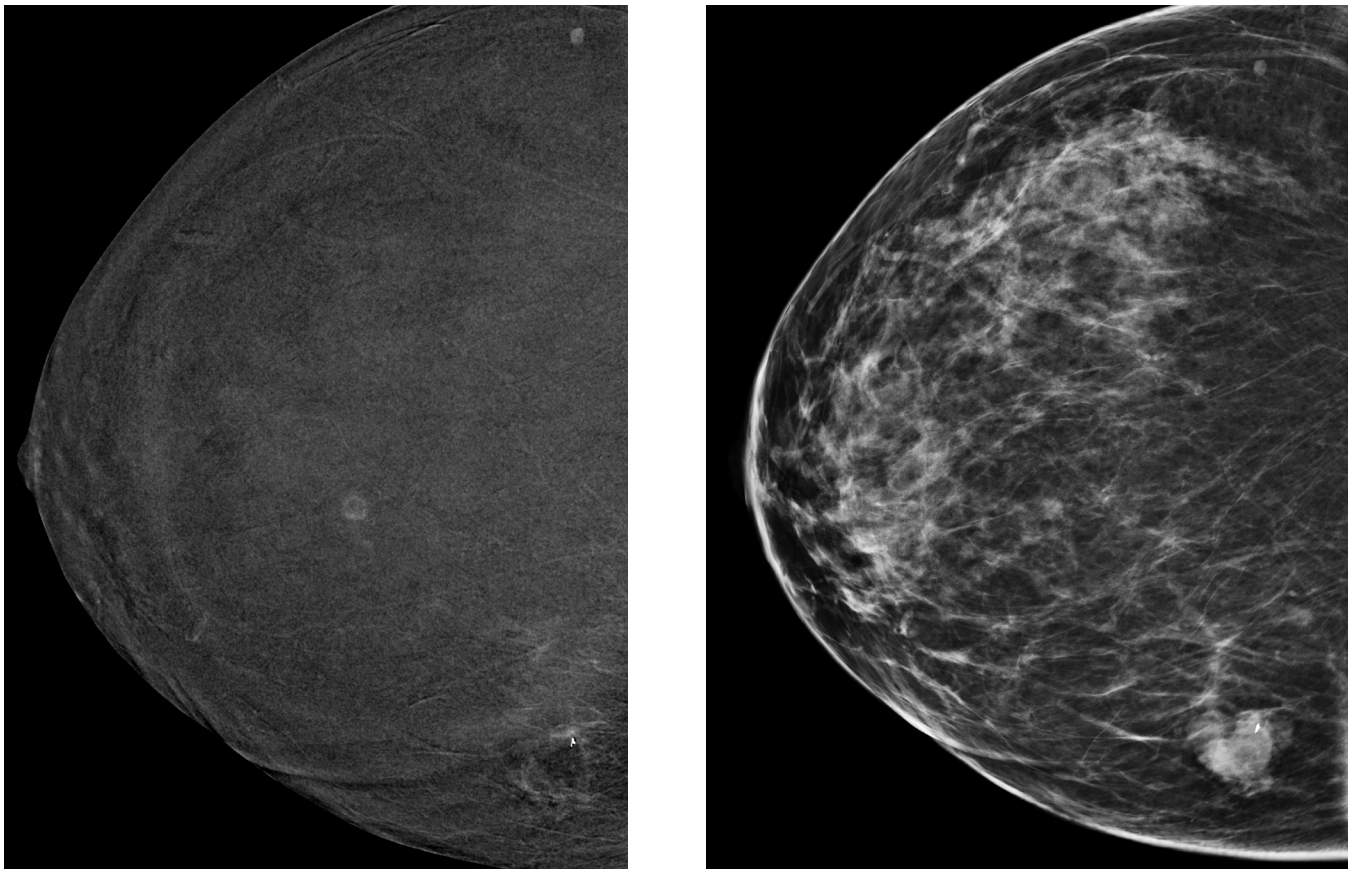

Figure 1: *Pre biopsy CEM CC full paddle of the right breast. The image demonstrates a rim enhancing mass at 12:00 in the right breast. The biopsy marker in the posterior, medial aspect of the breast with an associated small hematoma, is the site of known DCIS. Image review with the technologists is helpful for positing to reduce time. The rim enhancing mass proved to be invasive ductal carcinoma.*

CEBx Workflow

Pre-biopsy

At scheduling, the navigator or scheduler reviews the procedure and screens the patient for contraindications and allergies (see previous section). Many patients who have been recommended for CEBx have had a CEM; therefore, contraindications and allergies have likely been reviewed.

Upon arrival at the breast center, the patient completes the necessary pre-procedure paperwork. The technologist reviews the patient information and, again, screens for contraindications and allergies. Once the patient is cleared for contrast administration, an IV is placed by a trained technologist or nurse. Depending on facility requirements, renal function may need to be obtained if not up to date.

It is important for the radiologist to communicate the biopsy plan with the technologist(s) assisting in the biopsy (Figure 1). As the biopsy is under a time constraint, pre-procedure discussion and image review regarding approach, location, and landmarks are critical to reduce the time positioning the breast in the biopsy window after contrast has been administered.

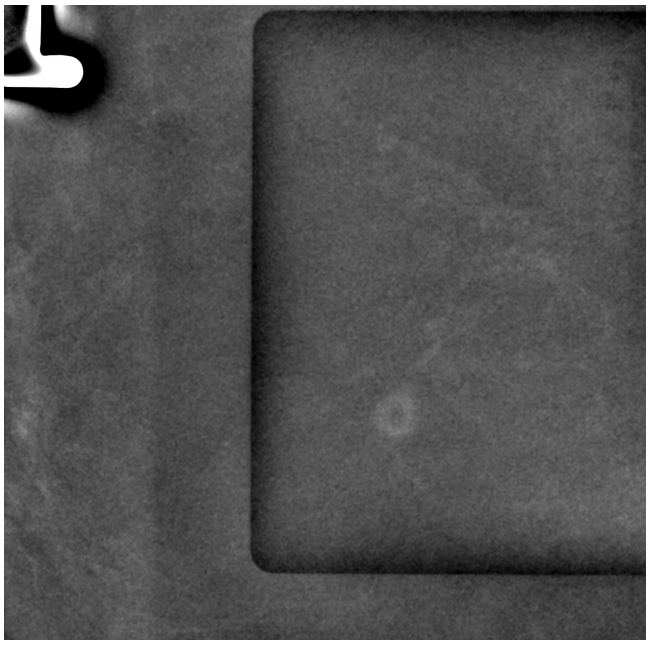

Figure 2: *Scout image. Rim enhancing mass at 12:00 in the right breast detected in a patient with suspicious finding on preoperative breast MRI.*

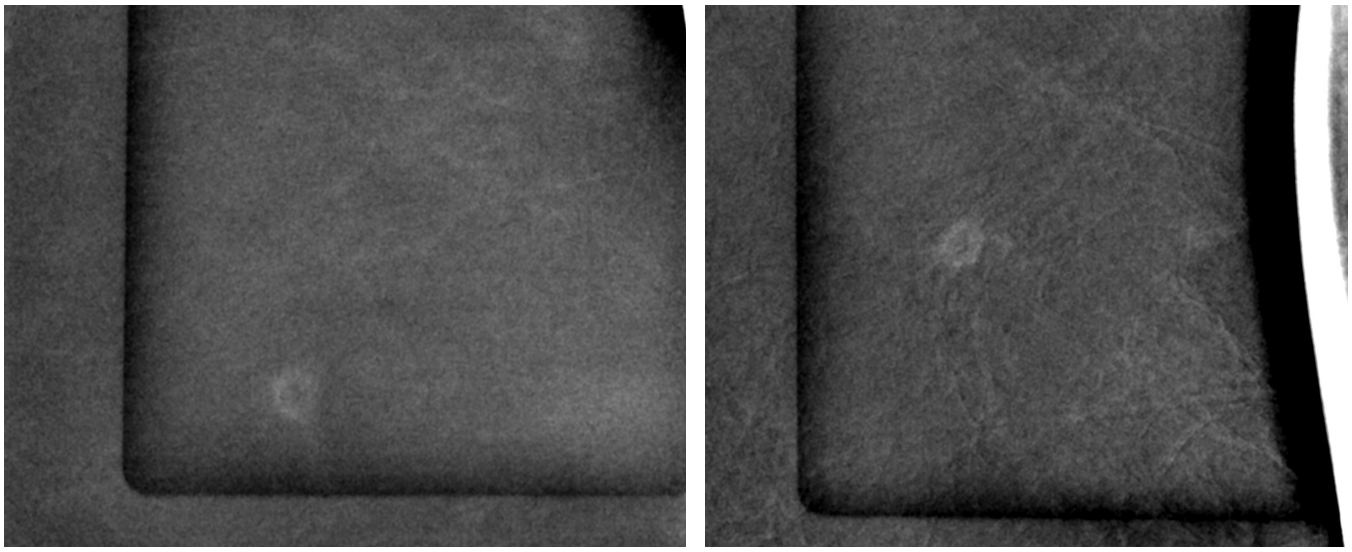

Figure 3: *Stereo pair images. Rim enhancing mass at 12:00 in the right breast. Both images depict the lesion in the biopsy window. These images are adequate for biopsy targeting.*

Biopsy

At this point, CEBx workflow diverges from CEM workflow. For CEBx, the patient is brought into the biopsy suite where she meets with the radiologist. The radiologist finalizes the pre-procedure paperwork and confirms the procedure side and site per facility protocol. It is good practice to inform the patient of the side effects of iodinated contrast if she has not experienced it previously. Typical side effects include warmth, a sensation of urination, and a metallic taste that can last for a few minutes. Prior knowledge of side effects can alleviate patient anxiety.

Using the standard CEM injection protocol on the power injector, the line is first flushed with saline following which 100mL of iodinated contrast is administered. As contrast is injected, the technologist and radiologist evaluate for signs of IV infiltration and contrast reaction. When the contrast injection is complete, the line is flushed again and then the technologist disconnects the patient from the power injector.

The technologist then prepares the patient for the scout image. Ideally, the scout image should be obtained two (2) minutes post the initiation of the injection; however, earlier positioning and imaging may allow for longer visualization of the lesion throughout the procedure (Figure 2). Once the radiologist confirms the target on the recombined scout image, stereo pairs are immediately obtained (Figure 3). The stereo pairs presented for review are also recombined images which are used for targeting and calculation of the needle depth. Following confirmation of the target and appropriate depth of the needle, the breast is cleaned, and local anesthesia is administered.

Following local anesthesia, the biopsy needle is inserted into the breast and advanced to the pre-fire position. With the needle in the pre-fire position, a second stereo pair is obtained showing the lesion in proximity to the needle (Figure 4). Once an appropriate position is confirmed, the needle is deployed to the post-fire position. At this time, optional post-

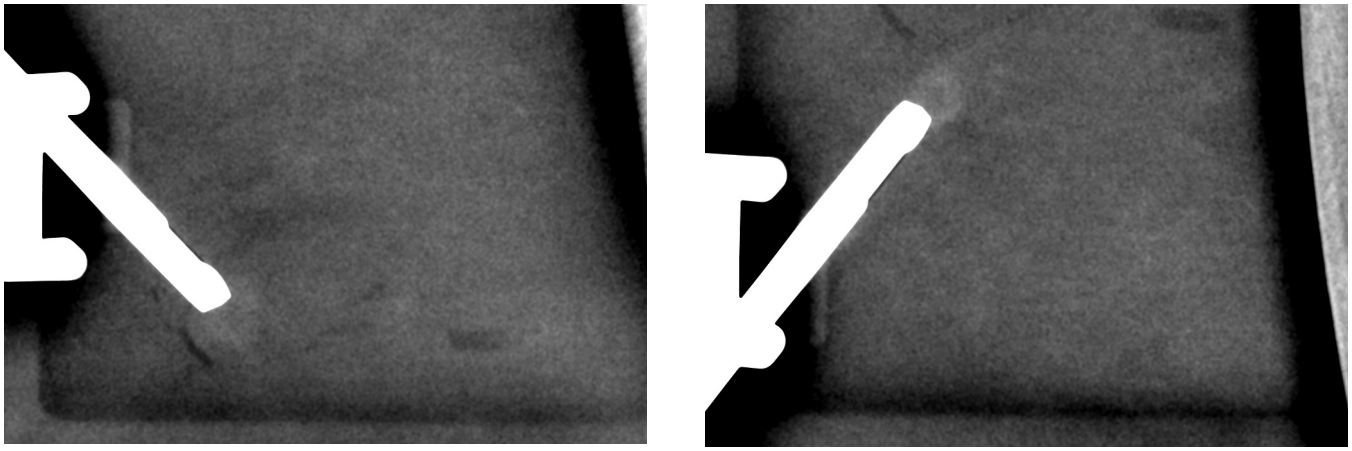

Figure 4: *Pre-fire stereo pair images. The images depict the needle in the pre-fire position at the edge of the mass. The position of the needle is adequate for deploying the needle to the post-fire position.*

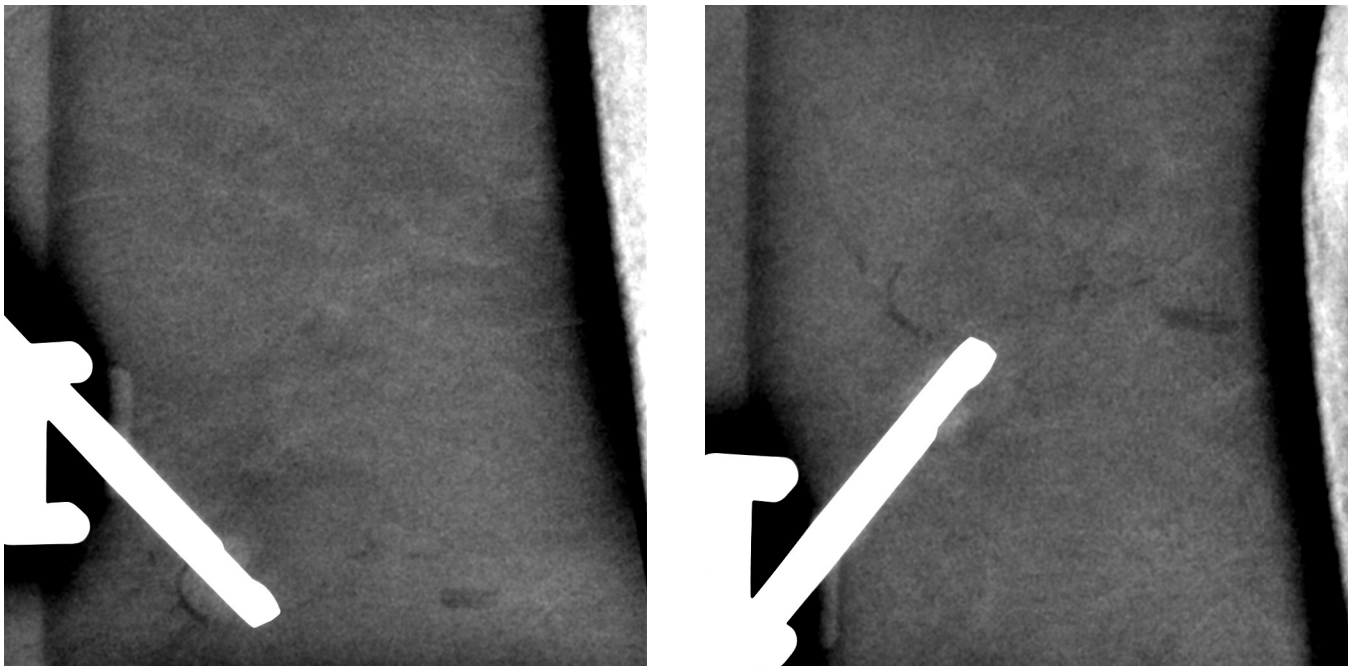

Figure 5 *Post-fire stereo pair images. The images depict the needle in the post fire position. The mass is located within the trough. The targeting and needle position is adequate for lesion sampling. Note is made of the decreased lesion conspicuity due to contrast washout.*

fire stereo pair images may be acquired (Figure 5). Following confirmation of accurate needle placement on post-fire images, samples are obtained. The number of core samples obtained is radiologist preference; however, 12 samples at all clock intervals are recommended to prevent under-sampling as specimen radiographs cannot confirm the presence of the lesion.

Following sampling, the biopsy needle is withdrawn, and the biopsy marker is placed through the retained sheath. Confirmatory post-clip 2D images are obtained (Figure 6). Once the clip is confirmed to be in the breast, the needle sheath is removed from the breast and the patient is released from compression. Manual compression is held on the breast to achieve hemostasis.

Post-procedure

Post-procedure mammogram images should be performed with CEM. Given the post-procedure mammogram is obtained at least 8–10 minutes following the initial injection of contrast, lesion conspicuity may be minimal. With CEM imaging, FFDM images are provided and available for review (Figure 7).

Typical post-procedure instructions are given to the patient per radiologist/facility preference. It is good practice to also review additional instructions typical for post-contrast administration such as oral hydration and temporary metformin cessation if applicable to the patient.

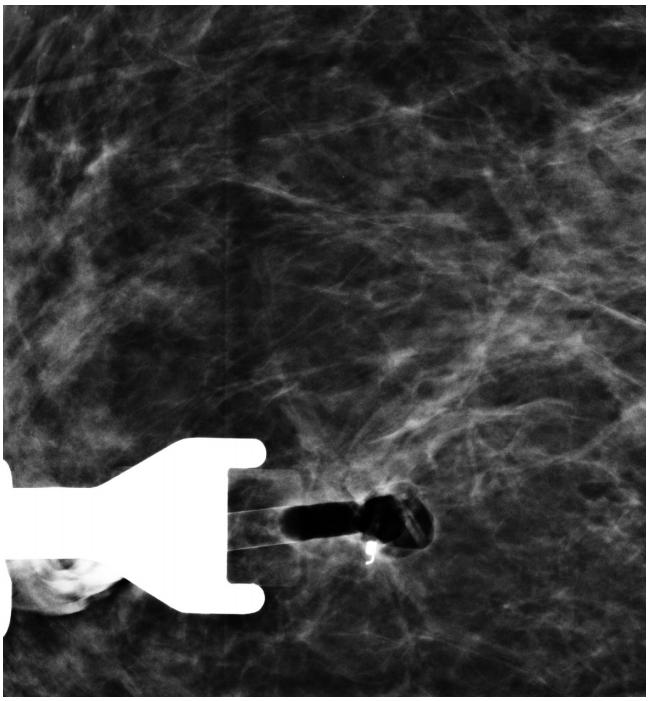

Figure 6: *Post-clip image. The image confirms the coil biopsy marker is within the breast.*

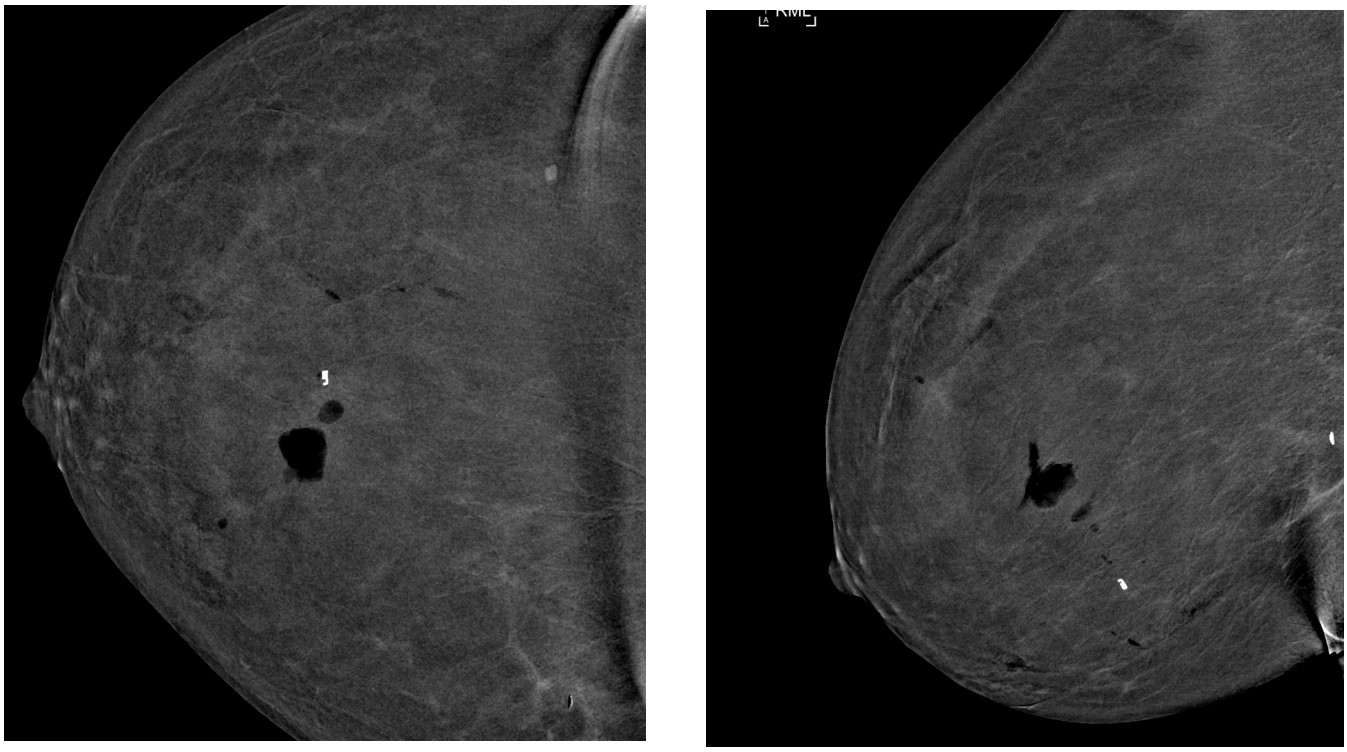

Figure 7 *Post procedure mammogram CC and ML views. Post procedure CEM demonstrates accurate position of the coil biopsy marker. The biopsied lesion is no longer visualized.*

Considerations for CEBx

Contrast agent dose needs to be considered during any contrast-enhanced study. Commonly, 100mL of iodinated contrast are used for a diagnostic CEM, and the same dose is recommended for CEBx to maintain consistency and lesion reproducibility. Therefore, daily contrast dose restrictions are a limiting factor for when a CEBx can be performed. Ideally, CEBx should not be performed on the same day as a CEM.

Another consideration is background parenchymal enhancement (BPE). BPE will become greater the longer one waits to image from initial contrast administration. As BPE becomes more apparent, lesion conspicuity lessens, which can decrease confidence in lesion targeting.

Biopsy of multiple lesions on the same day with CEBx is not recommended. For similar reasons stated above, contrast dosing limits would likely be exceeded, and BPE might be prominent if a second biopsy was performed immediately after the first.

At this time, smaller doses of contrast have not been used for CEBx for concern of decreased lesion conspicuity.

Future Utilization of CEBx

Until now, MRI has been the primary method to biopsy a suspicious enhancing lesion found under MR. Second look ultrasound has been an adjunct to MRI biopsy with a reported correlate identification of 56-86%.[4,5,6] With the introduction of CEBx, MR-enhancing lesions may be biopsied outside of the MRI suite with an even greater chance of success. In the traditional setting of second look ultrasound, if the lesion is not detected at US, the patient is then scheduled to have an MRI biopsy, usually on a different day. However, CEBx can be scheduled on the same day as second look ultrasound to improve the probability that a lesion can be seen and biopsied in the breast center should ultrasound fail to identify a correlate. In addition, second look ultrasound may be eliminated altogether, and the patient may be scheduled only for CEBx.

In comparison to ultrasound-guided biopsy or CEBx, MRI-guided biopsy has many disadvantages. MRI biopsy is uncomfortable for the patient, expensive, and time-consuming for the radiologist.[9-12] CEBx can provide a reasonable alternative to MRI-guided biopsy for MR-enhancing single lesions that are also visible following iodine contrast administration. Further studies are needed to validate the utility of CEBx for MR-detected lesions.

About the author

Dr. Ryan T. Gabriel is a Board-Certified Breast Radiologist who graduated from the Virginia Commonwealth University/Medical College of Virginia, Richmond, VA.

His main area of interest is in Breast Imaging, and he has extensive experience in Hologic 3Dimensions™ and Selenia® Dimensions® Mammography Systems with I-View™ 2.0 CEM and the Affirm® Upright biopsy system, from which the images in the figures were acquired. Dr. Gabriel has been using CEM in his practice at the Advanced Diagnostic Breast Center at Henrico Doctors' Hospital in Richmond, VA since 2019 and has done initial work on Affirm CEBx beginning in July 2021.

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