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MRI-Guided Breast Biopsy

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Introduction:

- Magnetic Resonance Imaging (MRI) creates cross-sectional images of the body. MRI does not use ionizing radiation. The images are created by magnetic fields and radiofrequencies reacting with biologic tissues.
- “MRI is able to distinguish very small differences in contrast among tissues by manipulating biologic tissue with magnetic fields and radio waves.” MRI’s ability to distinguish contrast between tissues makes it a top modality to image the breast.
(Long, Rollins, & Smith, 2019, p. 246)

Breast MRI:

- Should be performed on days 3 through 14 of the 28-day menstrual cycle.
- The images are taken on 1.5T or 3T magnetic field strength machines. The patient is prone with breast pendent in the breast coil.
- Contrast media is needed to enhance any lesions on the images. The most common sequences are T2 fat-suppressed, pre-contrast T1 no-fat-suppressed, pre-contrast T1 fat-suppressed, and post contrast T1 images.
- All breast images are read using the breast imaging reporting and data system or BI-RADS.
(Gao et al., 2020, pp. 4672-4673)

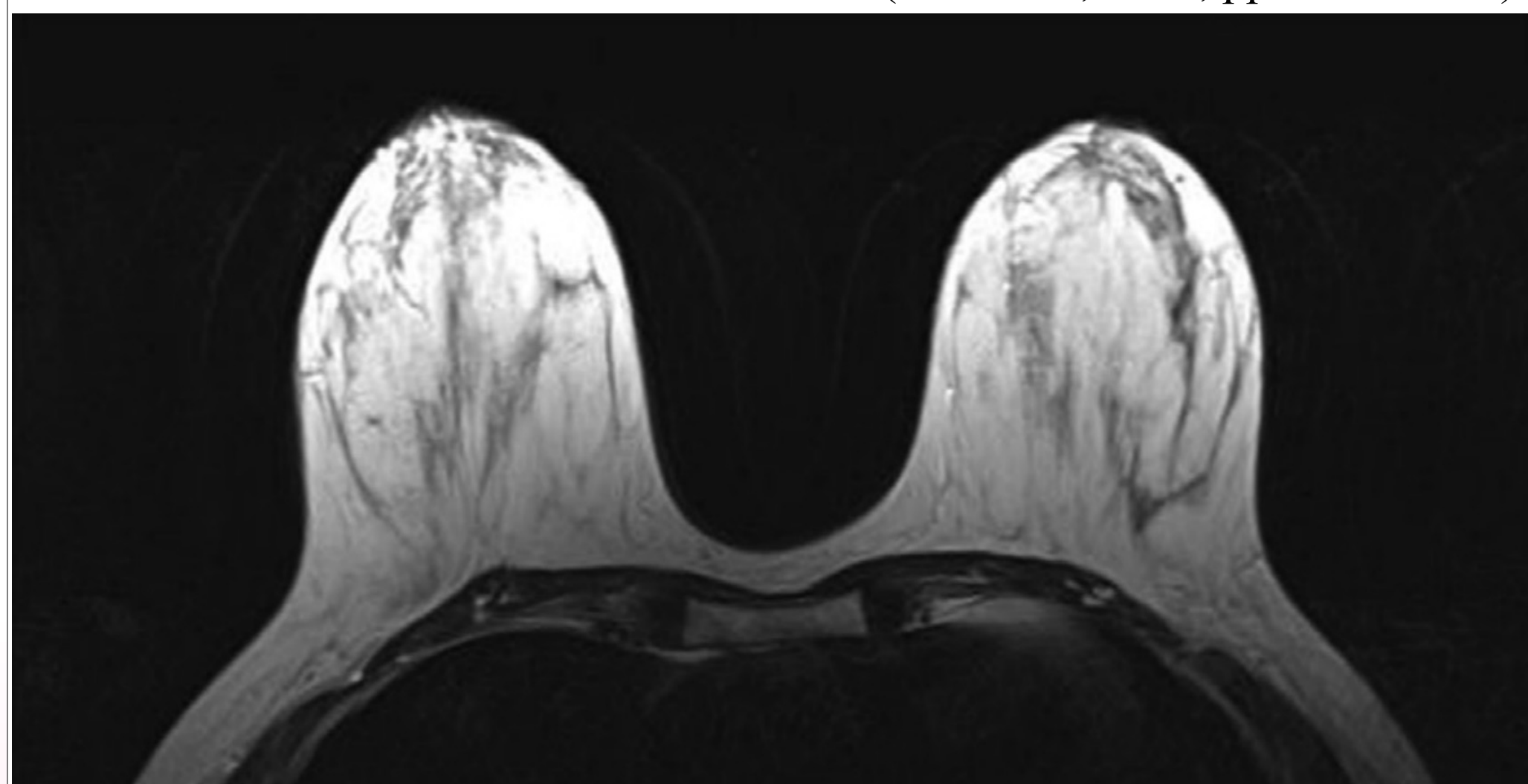


Figure 1. Unenhanced T-2 weighted image (Papalouka et al., 2018, p. 908e23)

Indications and Contraindications:

Indications

- Lesions found on imaging identified as BIRAD 3, 4, or 5 would indicate a breast biopsy.

Contraindications

- Include claustrophobia, metallic implants that are not MRI safe, and individuals allergic to contrast media. Patients with deranged clotting function, anticoagulation, when the target lesion cannot be reidentified on pre biopsy images, and not being able to access the lesion.

(Papalouka, Kilburn-Toppin, Gaskarth, & Gilbert, 2018, p. 908e18)

Equipment for the Biopsy:

- Breast Coil
- Medial and lateral paddles for compression
- Fiducial markers to identify the outer portion of the breast
- Sterile tray: two syringes with lidocaine, two syringes with lidocaine and epinephrine, gauze pads, scalpel, and grid
- Localization device: small grid, introducer including plastic sheath with numeric grading, metallic styllet, and blunt tip plastic introducer, vacuum-assisted breast biopsy (VABB) apparatus and needle, and localization marker clip

(Papalouka et al., 2018, pp. 908e19-21)

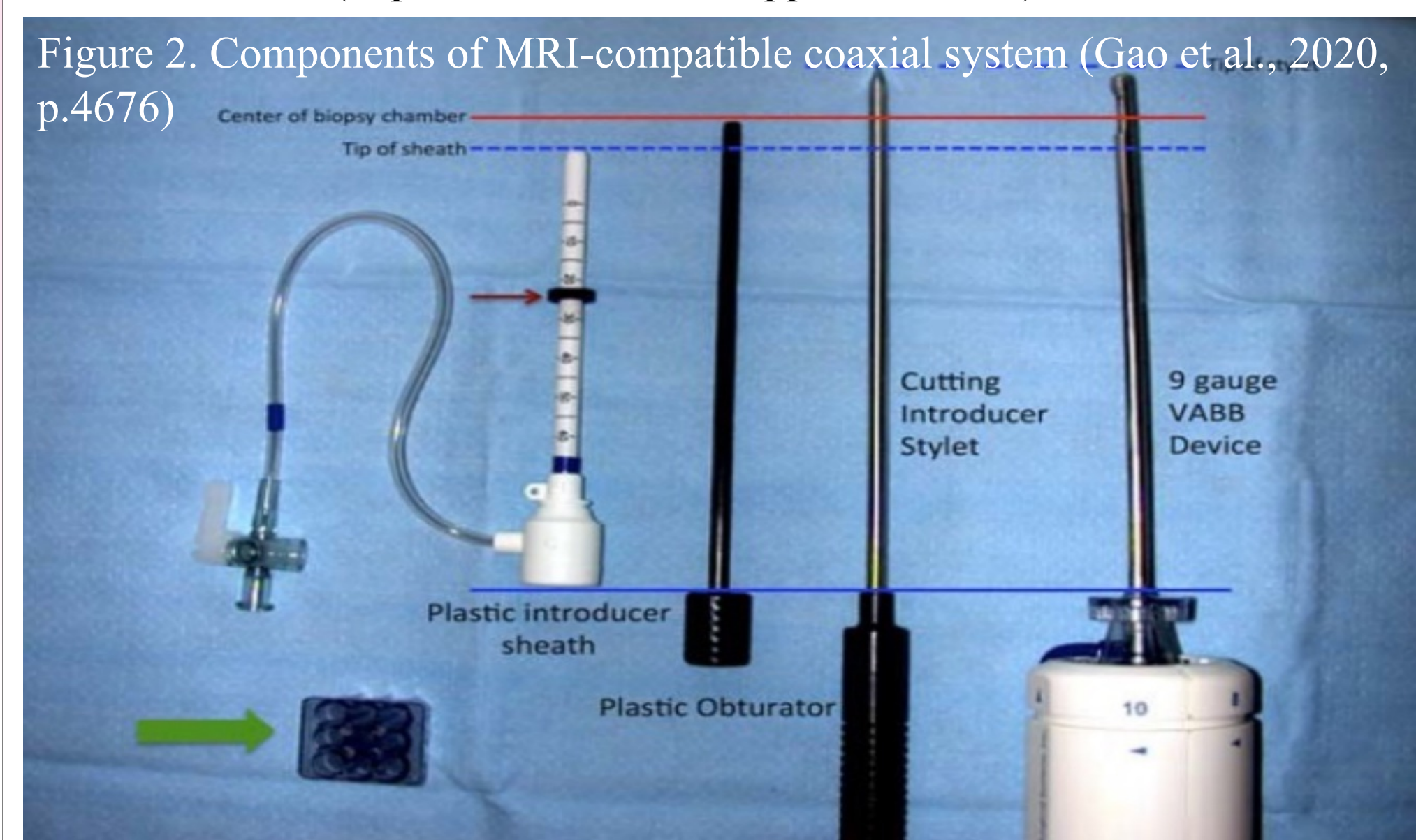


Figure 2. Components of MRI-compatible coaxial system (Gao et al., 2020, p.4676)

MRI-Guided Breast Biopsy Procedure:

- An IV is started. The patient is prone with breasts pendent in the coil. Compression is applied with grid fixed to the breast affected. The patient is imaged to relocate the lesion.
- Axial T1-weighted 3D fat-saturated images are taken to relocate the lesion. Then the contrast is injected and post contrast dynamic T1 3D fat-saturated images are taken. The images are reviewed by the technologist and the radiologist to measure the location in the grid of the lesion. Once the lesion is located, the biopsy can be performed.
- The radiologist confirms the lesion placement within the grid and numbs the breast. The localizer is placed in the breast and the patient is put back into the machine to confirm the localizer is in the region.
- The biopsy begins and the VABB apparatus is inserted into the localizer. The radiologist will turn the VABB apparatus clockwise around the lesion collecting 10 samples from the breast. The VABB apparatus is removed, and a marker clip is placed in the breast to confirm the site of the biopsy on future imaging.
- A final image is taken in the MRI to confirm clip placement. Then the patient receives a same day soft compression mammogram. (Papalouka et al., 2018, p. 908e21)

Case Study:

- This case study follows a 62-year-old women with known primary Non-Hodgkin's Lymphoma.
- In November of 2016, the patient had an MRI of the breast that indicated a 13 mm lesion in her upper left breast. A needle biopsy revealed a proliferation of small atypical lymphocytes with a diffuse growth pattern and small eosinophils.
- The patient was started on chemotherapy followed by radiotherapy treatments localized to the left breast. No significant uptake was found, and the patient was diagnosed in remission.
- In 2018, a breast MRI demonstrated a non-mass enhancement measuring 33mm that was not demonstrated on ultrasound or mammography.

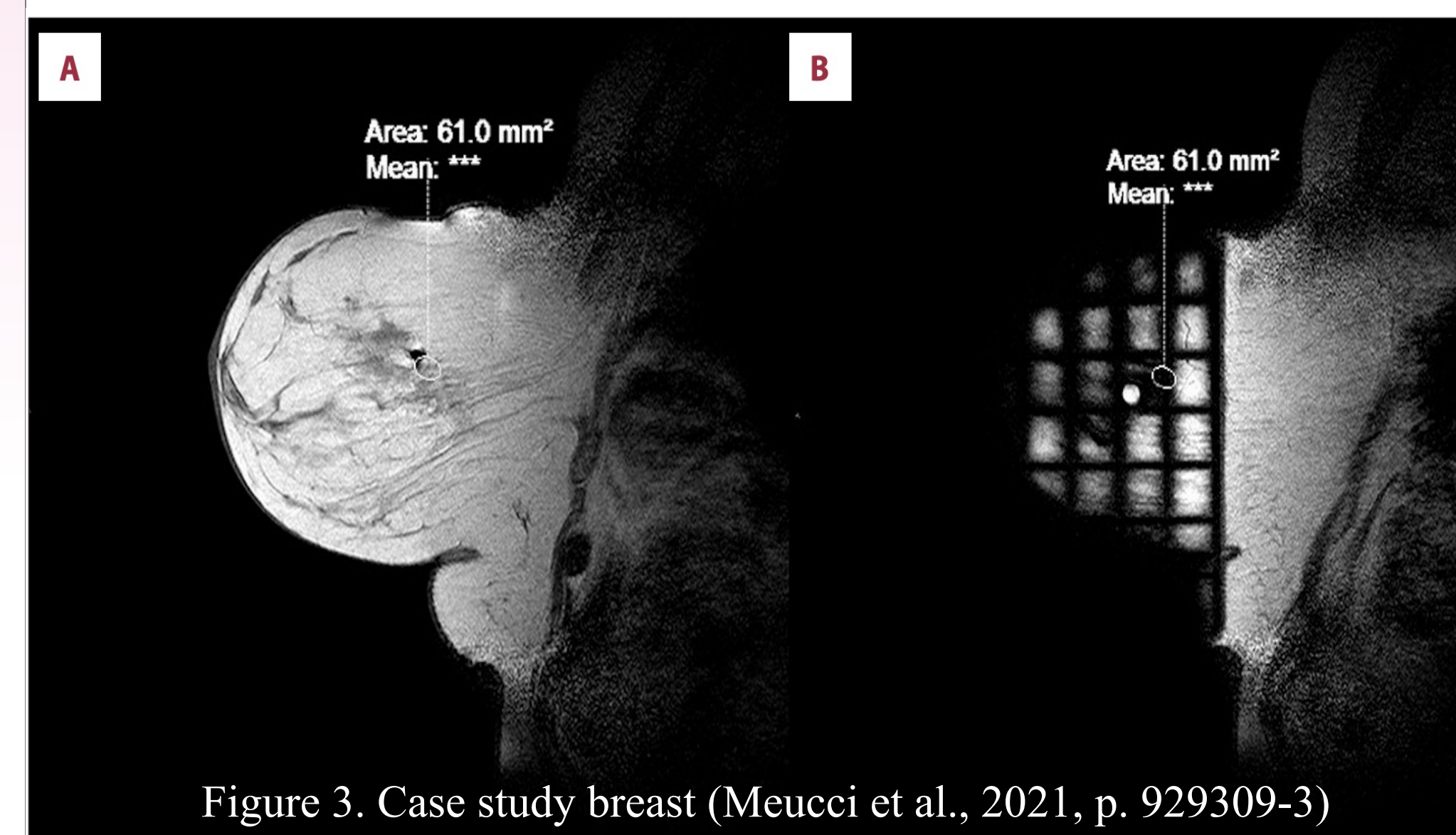


Figure 3. Case study breast (Meucci et al., 2021, p. 929309-3)

- Since the lesion was only identified on MRI, an MRI-guided breast biopsy was scheduled. The biopsy was accessed with an 8-gauge VAB with lateral access to the breast in 30 minutes time. Twelve samples were taken. The results of her biopsy revealed the patient had ductal carcinoma in-situ. Two-weeks later the patient underwent a lower external quadrantectomy of the breast on the lesion. The tumor was completely removed, and the patient was discharged in good health. (Meucci et al., 2021, pp. 2-5)

Advantages and Disadvantages of MRI-Guided Breast Biopsy:

Advantages

- The procedure requires the use of contrast media to enhance lesions resulting in better visualization and higher sensitivity than other modalities for imaging of the breast. (Gao et al., 2020, p. 4679)
- “It has been shown that MR-guided vacuum-assisted breast biopsies (VABB) are a fast, safe, and accurate method that cause only minimal scarring and no consecutive breast deformity compared to surgical breast biopsy” (Spick et al., 2016, p. 3908)

Disadvantages

- The lesion may not enhance during the biopsy resulting in the study being canceled.
- The risk of rupture of implants.
- Cancer detection, false-negative, and underestimation rates vary among previously published studies using MR-guided vacuum-assisted breast biopsy. (Spick et al., 2016, p. 3908)

New Technology in MRI-Guided Breast Biopsy:

- MRI is always changing which requires equipment that evolves with it. Imaging sequences are being developed using diffusion-weighted imaging to eliminate the use of contrast media. Other researchers are developing an MR-compatible needle intervention robotic system that can approach tumors from the side with a bendable needle to allow better access. Other researchers are developing a coil to have the patient supine rather than prone on the MR table. (Gao et al., 2020, p. 4679)



Figure 4. MRI-guided biopsy position (Gao et al., 2020, p. 4674)

Conclusion:

- MRI provides high visualization of breast lesions and is used along with mammography and ultrasound to detect and monitor lesions. If a lesion is only visualized on MRI, it would indicate the lesion needs be biopsied. MRI requires the use of the breast coil and biopsy equipment including a grid and VABB apparatus. The lesions are located by experienced breast radiologists and MR technologists. Once the lesion is targeted on quick prebiopsy breast scans, the biopsy is commenced. Following the biopsy, the patient receives a soft compression mammogram. The patient will also have follow-up imaging six months later. MRI gives patients superior imaging and allows for better visualization of lesions.