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Optimizing Success and Avoiding Mishaps in the Most Difficult Image-guided Breast Biopsies

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Breast cancer is an increasing challenge in developed and limited resource areas of the world. Early detection of breast cancer offers the best chance for optimal care and best outcomes. A critical step in early detection is to obtain efficient and accurate tissue diagnoses. Although image-guided core needle breast biopsies are usually straightforward for experienced breast imagers, there are some not uncommon scenarios that present particular challenges. In this review article we will discuss these difficult situations and offer our tried and true methods to ensure safe and successful biopsies, while using stereotactic, ultrasound, and MRI guidance.
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Introduction

The latest estimates from the International Agency for Research on Cancer (IARC) and the World Health Organization project 252,710 new invasive breast cancer diagnoses in the United States of America in 2017.[1] Whether the cancers manifest themselves with symptoms, or are detected on screening mammograms, efficient tissue sampling is necessary for a definitive histopathologic diagnosis before treatment. Current highly sensitive imaging techniques detect many breast lesions of varying levels of suspicion, with overlapping benign and malignant features. In fact, the majority of breast biopsies performed in the USA reveal benign pathologies. Historically such biopsies had been performed primarily as surgical excisional or incisional operative procedures. In 1990 Dr. Steve Parker published a report of 103 patients who underwent stereotactic breast biopsy with 18-, 16-, and 14-gauge biopsy needles, followed by wire localization and surgical biopsy of the same sites, showing 89%-97% agreement between pathologic diagnoses by the 2 methods. Use of larger-gauge needles was correlated with higher agreement.[2] Parker and multiple subsequent researchers and practitioners showed that using a spring-loaded large core biopsy device and image guidance, tissue diagnosis could be performed efficiently, safely and with diagnostic accuracy ranging from 95%-100% using only local anesthesia.[3-6] While in 1993, Dr. Daniel Kopans[7] was suggesting that breast interventionalists exercise caution in embracing needle biopsy too fast over the well-established and proven surgical diagnostic techniques, by 1998 Dr. Ellen Shaw de Paredes[8] was writing that percutaneous breast biopsy had revolutionized histologic diagnoses of nonpalpable breast lesions. At the turn of the century, Dr. Laura Liberman[9] wrote a Centennial dissertation on the use of this safe technique for breast tissue diagnosis.

Throughout the 1990s improved models of automated large core needle biopsy devices were developed and improved for stereotactic guidance (Stereo-CNB); several handheld devices for ultrasound-guided core needle biopsy (US-CNB) had come into use; and most significantly the vacuum-assisted biopsy device had been invented. This further increased accuracy by obtaining larger sample size, and decreased the number of cases in which re-biopsy was necessary for definitive diagnosis. Equipment has continued to improve and a wide range of devices are now commonly used, which permit rapid sampling of sufficient tissue for diagnosis. Specialized needles have been developed to permit safe sampling in tricky locations, such as the thin breast, or axillary lymph nodes. As the use of breast magnetic resonance imaging (MRI) became widespread MRI-compatible equipment was designed and made available for MRI-guided core needle biopsy (MR-CNB) for lesions visible on MRI only. This also proved to be a safe and efficient biopsy method.[10,11]

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Currently, therefore, in the USA, of the approximately 1.6 million breast biopsies performed annually, about half are done using image-guided percutaneous techniques.[12] These procedures are routinely performed utilizing all 3 commonly used breast-imaging modalities of mammography, ultrasound (US), and MRI. Most of these procedures are straightforward and carried out smoothly. However, particular cases frequently present special challenges, which may derive from the anatomy of the particular patient or breast; the appearance of the breast on imaging; the type, visibility, and location of the lesion to be biopsied; the imaging features (subtlety or small size) of the target lesion; the patient's comorbidities and other specifics, as well as the particular modality used for guidance.

This article aims to review some of the more common challenges faced in performing image-guided core needle biopsy of the breast. We will focus on these challenges based on imaging modality used. In addition a brief section will also review management of patient-specific issues.

Stereotactically guided Biopsy

Most commonly used for biopsy of microcalcifications, this technique is sometimes also used for small masses seen on mammography (1 or 2 view findings) but without definite US correlates. Additionally, now with digital breast tomosynthesis (DBT) revealing areas of architectural distortion and other subtle findings not seen on 2D full field digital mammography (FFDM) or US, stereotactic guidance also provides a way to perform core needle biopsy of such lesions using DBT guidance.[13-15]

General principles observed habitually will allow advance planning and help avoid mis-steps once the procedure has commenced:

1. Careful review of the diagnostic imaging that led to biopsy recommendation to confirm the target lesion and plan an optimal approach; this is usually the shortest path.
2. In the case of a thin breast, planning ahead to use various measures to "build up" breast thickness and use of a petite needle will make for an efficient procedure.
3. The same is true when the target is a faint group of calcifications. Magnification views can be performed in a regular mammography room and using a localization alpha-numeric grid, a BB marker can be placed over the calcifications as seen from the desired approach. This can guide the technologist when positioning the breast in the stereo machine.
4. It is also important to confirm that superficially located calcifications are not actually skin calcifications. If this is suspected a skin localizing procedure performed ahead of time will obviate the need for biopsy and avoid much confusion during an attempted biopsy procedure.
5. On a prone stereo table, very posterior lesions against the chest wall may require that the patient's arm is brought down along with the breast, through the opening in the table, to allow the most posterior tissues to become accessible. Such lesions are easier to access on an upright stereo unit.

Challenges encountered during Stereo-CNB procedures are illustrated in Figs. 1-4.

US-guided Biopsy

Developing skills in US-guided procedures is as basic for most radiologists as interpreting X-rays. There are challenges for performing these procedures in each subspecialty of radiology, with unique factors affecting the breast since it is a relatively mobile external organ.[16,17] A vast body of literature covers many aspects of this topic, with a relatively recent review providing a good overview.[18]

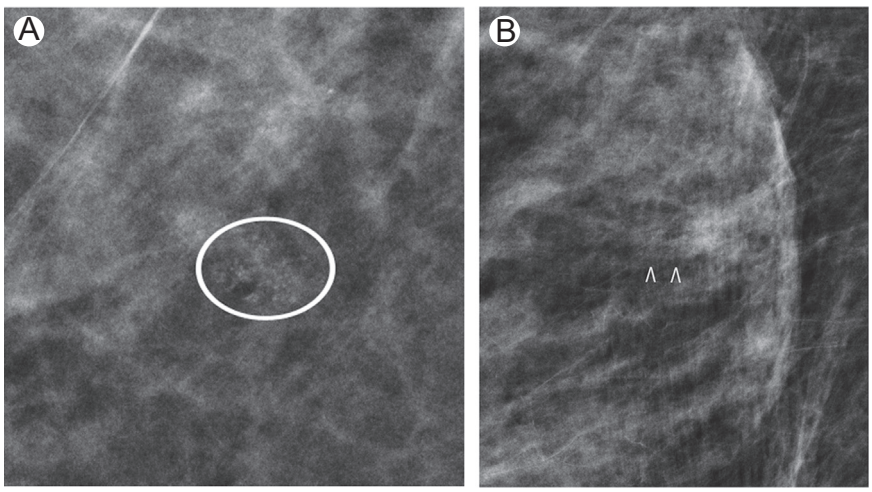

Figure 1 Faint grouped calcifications at posterior medial breast on CC magnification view (A, circle) were less well-visualized on routine MLO (not shown) or lateral magnification view (B, arrowheads) due to superimposed parenchyma, precluding biopsy from the shortest approach. Biopsy may be performed from the projection in which a target is best visualized, but precise assessment of postbiopsy clip position is essential.