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Ultrasound-Guided Percutaneous Breast Biopsy

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Ultrasound-guided percutaneous tissue sampling of the breast has positively altered the management of breast lesions, both benign and malignant, since its inception in the 1980s and subsequent widespread acceptance in the 1990s. Its safety, accuracy, and cost-effectiveness have been validated in several studies. However, percutaneous biopsy serves a patient best when performed by an operator with full awareness of patient's salient imaging findings; a knowledge of the benefits, limitations, and technical requirements of breast ultrasound; and a thorough understanding of what constitutes an adequate and concordant pathologic specimen.

This article outlines a general approach to ultrasound (US)-guided percutaneous breast biopsy and discusses indications, potential complications, and technical aspects of the procedure.

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Imaging-Guided Percutaneous Biopsy

Approximately 1.6 million people in the United States require tissue acquisition for definitive diagnosis of a breast problem each year, detected either by imaging or clinically. Any biopsy technique that minimizes patient discomfort, morbidity, time away from routine duties, postbiopsy scarring and deformity, and cost would be the preferred method of tissue retrieval. This demands, of course, that the technique has a comparable record of accuracy and safety when stacked up against other biopsy methods (ie, surgical excision). Imaging-guided percutaneous tissue sampling provides such a technique. Most breast biopsies performed each year (approximately 80%) are benign. Confidence in a benign, concordant imaging-guided needle biopsy averts unnecessary surgery. Parker et al[1] showed an overall 1.5% false-negative rate for percutaneous biopsy, indicating that confidence in a negative biopsy result is warranted. Several authors have also confirmed the accuracy of a malignant biopsy result, with excellent histologic agreement between percutaneous core needle biopsy (CNBx) results and the excised specimen. The accuracy specific to US guidance for biopsy is supported in the literature.[2,3] Histologic underestimates with core biopsy do occur; however, if disciplined and assiduous radiologic-pathologic correlation is performed, with recommendation for excision of lesions known to be prone to upgrade (eg, atypical ductal hyperplasia), accuracy comparable to surgical excision can be achieved. Actually, CNBx has been shown to have a smaller "missed lesion" rate compared with surgical excision of nonpalpable lesions (1.1% for CNBx vs 2.6% for surgery).[4,5]

The safety of image-guided breast biopsies has been confirmed, as well. Parker et al[1] showed a 0.2% rate of clinically significant complications (defined as those that necessitated medical or surgical intervention) in a large multi-institutional population of patients (3765 cases) using both stereotactic and US guidance. The cost-effectiveness of percutaneous breast biopsy provides an additional impetus for its use. This occurs in large part by eliminating the need for surgery if benign, concordant results are returned, resulting in large savings in most cases.[6] However, cost savings are also realized when core biopsy shows malignant results. A patient whose cancer is diagnosed via percutaneous biopsy can expect to undergo fewer surgeries compared with those whose cancer is diagnosed with surgical open biopsy (average of 1.25 surgeries vs 2.01).[7] Owing to its confirmed safety, accuracy, and cost-effectiveness, CNBx is the first-line tool for histologic confirmation of a breast abnormality.

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US-Guided Percutaneous Biopsy

US-guided CNBx offers many advantages over other available methods of imaging-guided tissue retrieval (stereotactic and magnetic resonance imaging [MRI] guidance). For a patient, it allows comfortable supine positioning. Real-time confirmation of sampling accuracy is possible. It is relatively quick in terms of room time and physician requirement.[8] No ionizing radiation is used (as opposed to stereotactic procedures). There are no modality-based contraindications (as compared with MRI and occasionally, stereotactic guidance). Therefore, when a suspicious lesion for which biopsy is warranted can be confidently visualized at US, and its location is reconciled with other imaging techniques, sonographic guidance is the chosen technique. If multiple suspicious findings are present, biopsy of as many targets as needed to outline the full extent of malignant disease and direct appropriate future management should be carried out. For example, if 4 small suspicious masses are present in 1 breast, core of at least 2 of these should be performed, preferably those lying at the greatest distance from each other, to fully establish extent of disease and help determine the need for mastectomy vs breast-conserving surgery.

If suspicious axillary, supraclavicular or infraclavicular, or internal mammary chain lymph nodes have been identified during diagnostic workup in a patient with a suspicious breast finding, these too can be targeted for biopsy, with the understanding that a positive result confirms nodal spread but that a negative result by no means excludes nodal metastases. Suspicious calcifications are usually biopsied with stereotactic guidance. However, with the high-frequency transducers in use today, calcifications can often be confidently identified sonographically, and targeted for core biopsy. This is especially true if there is an associated mass, in which case, biopsy with US rather than stereotactic guidance may actually facilitate sampling of the highest-stage portion of the lesion (eg, invasive tumor rather than just ductal carcinoma in situ, DCIS). Specimen radiography should be obtained in cases where calcifications are expected to be part of the lesion.

If US guidance is being used to biopsy a lesion initially identified by another modality (eg, mammography, MRI, or positron emission tomography), caution must be taken to ensure that the sonographic lesion represents the finding seen on the other imaging technique. This requires a good working knowledge of all other breast imaging modalities, the ability to translate expected lesion position from one modality to another, meticulous radiologic-pathologic correlation when the results are returned, and knowledge to recognize if rebiopsy is required owing to nonconcordance. Identifying surrogate sonographic targets for findings seen with other modalities, especially MRI, can be challenging. If there is any question as to whether an accurate correlate has been chosen, biopsy should proceed guided by the modality that originally detected the lesion. Image-guided biopsies, in general, are best performed by a physician with the aforementioned knowledge and skill set, who, in most cases, is a radiologist or an interventionalist or surgeon working closely with one.

Equipment

High-quality scanning technique and image recording is requisite for accurate US-guided biopsy. According to the American College of Radiology Practice Guidelines, a high-resolution (center frequency at least 10 MHz) linear-array transducer should be used during performance of imaging and biopsy.[9] Once a target for biopsy is identified, notation should be made on the images and in the written report regarding the size (maximal dimension in at least 2 orthogonal planes), location (including side, position in the breast, using the "o'clock" method, and distance in centimeters that the target lies from the nipple), and transducer orientation. This information is vital because the biopsy procedure is often performed on a different day from the workup or by a different examiner. Providing specific detail about the location of the lesion would allow even subtle findings to be reidentified accurately.

The variety of available needles has increased significantly since Parker described the efficacy of the 14-gauge automated biopsy gun in 1993.[2] However, that needle remains a reliable device. Models are now available from many different vendors. Automated biopsy needles come in a variety of gauges, sampling notch lengths, and overall needle lengths. Most commonly used is a 14-gauge needle with a 22-mm throw. The literature supports use of a 14-gauge or larger needle, a longer throw (22 vs 11 mm), and an automated device over a nonautomated cutting needle.[10,11] Knowledge of the "throw" or length of automated travel of the selected device is vital to prevent inadvertent puncture of adjacent tissue. Although the use of a "short throw" device (11 vs 22 mm) is tempting in close anatomical quarters, the volume of tissue obtained is greatly diminished, usually by more than 50%, owing to the lesser degree of needle deflection and tissue entrapment. If the needle approach is planned carefully, the safe deployment of a long-throw device can almost always be assured. In general, 3-6 core samples should be obtained. Fragmented cores or those that float rather than sink in preservative should be viewed as potentially nondiagnostic.[12]

More recently, the use of vacuum-assisted devices, the device of choice for stereotactic and MRI core biopsies, has become accepted for use with US, with hand-held versions available. These systems may require the use of an external vacuum or the vacuum may be self-contained. The external-vacuum systems have been used most extensively. Each system varies in its mechanism of action, but in general, the needle or probe is placed along the deep margin of the lesion in the closed position. On sampling, the vacuum pulls tissue into the notch and the inner cutting cannula transects the tissue. This core is then delivered retrograde for retrieval, either by an assistant using forceps or into a closed chamber for later collection, depending on the device. As opposed to the spring-loaded devices, these vacuum-assisted devices allow multiple contiguous samples to be taken during a single needle insertion, as the tissue is delivered externally while the needle remains positioned for added cores. This biopsy method results in larger core samples.