US-guided Core Needle Biopsy of the Breast: Technique and Pitfalls

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When core needle biopsy of the breast is performed with ultrasound (US) guidance, the curvature of the breast is used to advantage. The breast is entered from the periphery; this approach allows one to avoid chest wall injury and improves needle visualization. Bringing the needle to the lesion by using a sweeping motion while keeping the transducer position relatively fixed will expedite the biopsy. Standard techniques are modified for evaluation of difficult lesions. Mobile lesions can be fixed with the palm of the operator’s hand. Deep lesions can be lifted away from the chest wall with the tip of the needle. For lesions in large breasts, a steeper angle of approach may be necessary but can be matched with the transducer to improve needle visualization. Careful correlation with the mammogram will ensure that the corresponding sonographic abnormality is sampled. Although complications are uncommon, hematoma or infection may occur after the procedure. With practice, application of standard and modified techniques can result in efficient and accurate US-guided core needle biopsy of the breast.

INTRODUCTION

Core needle biopsy of the breast is becoming a common procedure, replacing diagnostic surgical biopsy at many institutions. Whether performed with stereotactic guidance or ultrasound (US) guidance, breast core needle biopsy is accurate (sensitivity, 94%–100%) (1–3). However, use of US for biopsy guidance is variable, probably due to lack of experience or confidence. In a recent multi-institutional study of breast core needle biopsy in which the imaging modality used was determined solely by radiologist preference (2), institutional US use ranged from 0%–59% of biopsy procedures. In that study, five of the 20 institutions involved did not use US guidance for any biopsy procedures. However, US guidance offers the advantages of real-time imaging, supine positioning, improved efficiency, avoidance of ionizing radiation, and use of equipment readily available in most radiology departments (1,4,5).

Many techniques for performing US-guided core needle biopsy of the breast have been described (1,3,5–9). In our technique, the curvature of the breast is used to advantage by entering the breast at the periphery. Such entry allows the needle to be parallel to the chest wall, a position that prevents injury and improves needle visualization. This technique can be modified for evaluation of difficult lesions such as those

Abbreviation: BI-RADS = Breast Imaging Reporting and Data System

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that are mobile, deep, small, or in a large breast. The maneuvers can be practiced by using a turkey breast phantom (6). Complications of the technique are uncommon.

In this article, we present indications for US-guided core needle biopsy of the breast, describe our technique for performing such biopsy, and discuss pitfalls of the technique.

Indications for US-guided breast core needle biopsy are similar to those for surgical biopsy; however, use of US guidance is limited to lesions visible at US. If a mammographic abnormality that is suspicious (category 4 in the Breast Imaging Reporting and Data System [BI-RADS] (10)) or highly suggestive of malignancy (BI-RADS category 5) can be visualized with US (or if there is a category 4 or 5 sonographic abnormality), needle biopsy can be performed with US guidance. Demonstration of an invasive tumor before surgery allows one-stage therapeutic surgery (lumpectomy and axillary dissection, or mastectomy) instead of diagnostic excisional surgical biopsy followed by axillary dissection or mastectomy. Needle biopsy is not routinely used for evaluation of probably benign mammographic lesions (BI-RADS category 3) instead of short-term follow-up (11), although the procedure may be an alternative when short-term follow-up will cause undue psychologic stress.

US-guided core needle biopsy is particularly advantageous in cases of suspicious lesions that are detected with US but are mammographically occult. In pregnant women, US guidance is preferable to stereotactic guidance so that ionizing radiation can be avoided. In debilitated patients, the procedure can be performed with the patient on a stretcher if necessary.

Technique

Consent

Mammograms and previous sonograms are reviewed to determine the feasibility of biopsy and to plan the approach. Informed consent is obtained after a discussion of risks and benefits of the procedure and alternatives to the procedure. Risks of the procedure include bleeding, infection, and insufficient material. A history of aspirin or anticoagulant use is sought but is not a contraindication to biopsy. Laboratory tests are not performed unless there is a history of anticoagulant use or a bleeding disorder. For women taking warfarin sodium, discussion with the referring physician is necessary to weigh the risk of hematoma formation due to biopsy versus the risk of discontinuing anticoagulation. In pregnant or lactating women, a milk fistula may form after core biopsy, especially if the lesion is centrally located and deep in the breast (12). Occasionally, surgical biopsy is recommended after a benign needle biopsy result because of discordance between suspicious mammographic findings and the histologic diagnosis. At our institution, such discordance occurs in less than 2% of cases.

The benefit of US-guided core needle biopsy is that a surgical biopsy can be avoided in most cases of benign disease. In cases of malignant disease, diagnostic core needle biopsy can replace diagnostic surgical biopsy and the patient can proceed directly to therapeutic surgery or neoadjuvant chemotherapy (if appropriate). Core needle biopsy is more accurate than fine-needle aspiration unless there is a cytopathologist on-site. In addition, core biopsy allows as-
Preparation

Once consent has been obtained, the patient lies supine on an examination table with the ipsilateral arm resting above the head. If the breast is large, an oblique position facilitates lesion access. The lesion is localized with US guidance. The skin is cleansed with povidone-iodine. A plastic eye-drape (Steri-drape 1020; 3M, St Paul, Minn) is placed with the opening extending from the lesion to the periphery of the breast (Fig 1). The transducer is cleansed with an antiseptic according to the manufacturer's instructions. As an alternative, the transducer may be placed in a sterile sheath (Civco Medical Instruments, Kalona, Iowa) with gel over the crystal, although this process degrades the image (5). Sterile gel is used for conduction.

A 7-MHz or higher-frequency electronically focused linear-array transducer is used. A 14-gauge, long-throw core biopsy needle is used. Use of smaller-gauge needles has been shown to lower sensitivity in stereotactic radiographic breast biopsy (13). Although 16-gm-long needles are usually used for stereotactic biopsy, use of a 10-cm-long needle allows the hand holding the biopsy device to be closer to the breast and thus be more easily stabilized. Several types of automated biopsy devices are available; disposable devices yield less tissue (14).

Biopsy Technique

A freehand technique is used. The transducer is held in one hand, while the biopsy device is held in the other (Fig 1). The dominant hand can be used for either function. It is useful to practice performing both functions with the dominant hand. Resting the flat of the hand and the fourth and fifth fingers on the field stabilizes the transducer without applying undue pressure on the underlying area.

The natural curvature of the breast is used to advantage to optimize needle visualization and decrease the risk of chest wall injury. To apply this technique, the long axis of the transducer is oriented in an approximately radial plane (Fig 2). An entry site at the periphery of the breast, several centimeters from the edge of the transducer, allows the needle to be placed parallel to the chest wall to avoid chest wall injury (Fig 3). Needle angle greatly affects

Assessment of tumor grade and hormonal receptor status with immunohistochemical stains.

Alternatives to the procedure include no further evaluation, short-term mammographic follow-up, and surgical biopsy. The risks and benefits of each alternative should be discussed with the patient in light of the mammographic findings so that an informed decision can be made.
After injecting with bicarbonate, the lesion is injected with a sodium bicarbonate (8.4% vol/vol) may be added to buffer the lidocaine in a 10% vol/vol solution. After the sodium bicarbonate is added, the solution should be used promptly because raising the pH will eventually cause precipitation. US guidance is used while injecting the lidocaine to facilitate planning the angle and depth of the needle approach for the subsequent large-core needle biopsy. Unlike in stereotactic radiographic breast biopsy, lidocaine will not interfere with subsequent ability to image the lesion. Thus, a generous amount may be used, although 3–4 mL is usually adequate.

A skin nick is made 2–3 cm from the edge of the transducer with a number 11 scalpel blade (Figs 2, 3). With an entry site at the periphery of the breast, the needle will subsequently be at the level of most lesions in small or medium-sized breasts (Fig 3). Adjustments can be made for large breasts and deep lesions.

The long axis of the transducer is aligned with the lesion and skin nick (Figs 1, 2). Once the transducer is aligned, the transducer position stays relatively fixed during the biopsy. The 14-gauge needle is placed into the breast through the skin nick and advanced to the edge of the lesion (Fig 5). By keeping the lesion at the far side of the US screen relative to the direction from which the needle will approach, the angle of the needle is better visualized as it is being advanced.

Once the needle is aligned with the lesion, the needle tip is placed at the edge of the lesion. The needle position should be checked to ensure that the distal throw of the needle will not result in chest wall injury. During the biopsy, we warn the patient that she will hear the biopsy device make a loud click rather than that we are going to “fire the gun.” After firing the biopsy device, one should scan the area be-
Figure 6. Disposition of the sample. Photograph shows the specimen being washed from the core notch into formaldehyde solution with sterile water.

For removing the needle to confirm that the needle has traversed the lesion (Fig 5). At least five passes should be made with different areas of the lesion sampled. Samples are placed in a 10% vol/vol formaldehyde solution (Fig 6).

**Postprocedure Care**

After the procedure, direct pressure with the palm of the hand to the entire quadrant to cover both the skin nick and lesion for at least 5 minutes will reduce hematoma formation. Hydrogen peroxide will remove residual povidone-iodine without causing pain at the skin nick. A small amount of antibiotic ointment is applied to the skin nick, which is closed with sterile bandage strips (Steri-strip; 3M). The patient is given a cold pack (Baxter, Deerfield, Ill) to wear inside her brassiere. She is instructed to apply ice packs that day and avoid strenuous activity for the next 2 days. She may take acetaminophen or ibuprofen for discomfort if necessary. She is told to expect some bruising, which will resolve in 5–7 days. We do not routinely contact patients after biopsy to ask about complications unless a complication was noted at the time of the procedure.

Histologic results are correlated with results of mammography and US. If the histologic results are benign and the lesion was probably benign (BI-RADS category 3) or suspicious (BI-RADS category 4) at mammography, 6-month follow-up unilateral mammography is recommended. If the histologic results are benign but
the lesion was highly suggestive of malignancy (BI-RADS category 5) at mammography, surgical excision is recommended. Lesions that demonstrate atypical epithelial proliferation are referred for surgical excision because of the likelihood of finding intraductal or infiltrating carcinoma at excision (15,16). Lesions that demonstrate malignant histologic results proceed to therapeutic surgery, which includes axillary dissection or mastectomy if appropriate. Preoperative diagnosis of malignancy usually results in a single therapeutic surgery rather than a diagnostic surgical biopsy followed by a second therapeutic surgery. An addendum to the core needle biopsy report is dictated when histologic results are available, along with recommendations for subsequent follow-up mammography or excision.

At our institution, when histologic results are benign, the radiologist relays results directly to the patient by telephone and leaves a message for the referring physician. If the histologic results are malignant, the referring physician is contacted initially. Depending on the preference of the referring physician, either the referring physician or the radiologist communicates malignant results to the patient. If the radiologist is requested to call the patient, preferences for surgical consultation are solicited from the referring physician. When the patient is contacted, her results are discussed and an appointment with a breast surgeon is made for her. In this manner, the patient is made aware of the result and also understands the next step in her care.

**PITFALLS**

- **Lesion Visualization**
  Many mammographic abnormalities will not be seen at US, particularly lesions that manifest primarily as calcifications. However, if the calcifications are seen with US, then they can be
Figures 8, 9. Correction of misalignment. (8) Diagram of the breast (overhead view) shows the rotational movement used to realign the lesion and skin nick along the long axis of the transducer. (9) Diagram of the breast (overhead view) shows the sweeping motion used to bring the needle into the plane of the transducer. The transducer position is kept relatively fixed.

evaluated with US-guided core needle biopsy (Fig 7). Air tracking from previous needle passes may mimic calcifications, making biopsy difficult. Stereotactic radiographic breast biopsy is preferable in such cases.

One must be sure that sufficient gel is used and that the focal zone is just below the lesion. Biopsy of deep lesions (below 3.5 cm) may require a 5-MHz transducer. Adjustments in the dynamic range or postprocessing gray scales may improve the contrast so that lesions are more visible.

*Needle Visualization*

Needle visualization is a common difficulty, which may be surprising given the large gauge of the needle. Even large-gauge needles are difficult to visualize if a steep angle is used because such an angle results in fewer reflective echoes (Fig 4). One should place the needle perpendicular to the ultrasound beam to maximize the number of reflected echoes generated from the needle. Such placement is most easily accomplished by entering the breast at the periphery, several centimeters from the edge of the transducer.

If the needle is not visualized, one should ensure that the lesion appears on the screen and that the skin nick is in the plane of the long axis of the transducer. Occasionally, the operator may pull the skin nick above or below the area of interest. The transducer may need to be rotated to correct the alignment (Fig 8). Once the transducer is in position, it should be stabilized by resting the flat of the hand on the breast (Fig 1). The needle is then brought to the lesion by moving the needle in a sweeping motion parallel to the chest wall (Fig 9). Attempting to locate the needle by moving the transducer will result in loss of visualization of the lesion, which will have to be localized again.

*Lesion Mobility*

Traversing lesions with the core needle may be difficult due to lesion mobility. It is essential to confirm that the needle has traversed the lesion after firing the biopsy device but before the needle is removed. If the standard technique is unsuccessful, the adequacy of the needle position should be confirmed sonographically before firing the biopsy device. The transducer is then removed from the field, pressure is applied to the area with the palm of the hand, and the biopsy device is fired. Because continuous imaging has not been used, the needle position after firing should be confirmed sonographically to ensure that the
needle traversed the lesion. Fibroadenomas seem especially prone to being pushed aside by the needle (Fig 10).

If there is extreme difficulty traversing a lesion due to mobility, the breast may be fixed with a mammographic compression plate with a central opening, such as those used for wire localization (17). The transducer can be placed in the opening, whereas the needle is placed from the side of the breast.

- **Deep Lesions**

In a small breast, deep lesions can be approached from the periphery of the breast. However, in a medium-sized or large breast, the distance from the periphery of the breast to the lesion may make this approach impractical.

If the entry point is next to the transducer, the steep needle angle results in difficult visualization and may lead to chest wall injury. Instead, the entry point should be approximately 2 cm from the edge of the transducer and the needle tip should be placed posterior to the lesion. Before the biopsy device is fired, the lesion is lifted away from the chest wall with the needle (Fig 11). With this modified approach, the needle is parallel to the chest wall before firing of the biopsy device and chest wall injury is avoided.

- **Large Breasts**

Central lesions in a large breast are difficult to approach from a peripheral entry site. In these cases, the entry site should be approximately 2 cm from the edge of the transducer, but the

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**Figure 10.** Biopsy of a mobile lesion. (a) US scan obtained before firing the biopsy device shows the lesion (straight arrow) displaced posteriorly by the needle (curved arrow). (b) US scan obtained after stabilizing the area with local pressure shows the needle traversing the lesion (arrow). Histologic analysis demonstrated a fibroadenoma.
Discordant findings. (a) Mammogram shows a palpable, highly suspicious mass in the right breast (BB marker). After attempted surgical excision, histologic analysis demonstrated only benign tissue. Because of the discordant surgical histologic and mammographic findings, early postoperative core biopsy was requested. Sonographic guidance was used because the patient could not tolerate the compression associated with mammography. (b) US scan shows a hypoechoic mass. Histologic analysis demonstrated postoperative hematoma. Once the hematoma improved and compression could be tolerated, wire localization was performed for reexcision under mammographic guidance. Histologic analysis demonstrated infiltrating ductal carcinoma.

Transducer is angled to match the angle of the needle (Fig 12). This approach keeps the needle perpendicular to the ultrasound beam, a position that facilitates visualization.

- **Correlation with Mammography**
  Occasionally, correlation of US findings with mammographic findings is difficult (Fig 13). If the US finding is unclear, a BB may be placed on the skin over the finding and mammography may be performed. An alternative is to compress the breast with a fenestrated grid and obtain a radiograph. With the breast left in compression, the transducer is used in the opening within which the lesion was identified on the mammogram. A postbiopsy mammogram may also demonstrate the biopsy location.

- **Small Lesions**
  Sonographic guidance can facilitate biopsy of lesions less than 1 cm in diameter, if visualized, because adequate sampling of the lesion can be confirmed with real-time imaging (Fig 14).
Figure 14. Metastatic breast carcinoma in the left axillary and right supraclavicular lymph nodes in an elderly woman. The location of the primary tumor was unknown. (a) Spot compression mammo gram of the right retroareolar region shows no abnormalities. (b) US scan obtained after firing the biopsy device shows a small (8-mm-diameter) hypoechoic mass in the right retroareolar region (arrow). The lesion could not be identified on the mammogram. Histologic analysis demonstrated high-grade invasive ductal adenocarcinoma similar to that in the nodes.

To expedite biopsy of a lesion that is difficult to visualize sonographically, the radiologist maintains the transducer position between passes while a technologist removes the tissue from the core needle.

- **Hematoma Formation**
  Hematomas are an uncommon complication but have the potential to be quite large because the breast is not compressed during the procedure (Fig 15). The risk of developing a hematoma that required surgical drainage was 0.2% in a recent multi-institutional study that involved both stereotactic radiographic and US-guided core needle breast biopsy (2).

- **Dense Tissue**
  In some cases, breast tissue may be difficult to traverse due to dense fibrosis. A coaxial system can facilitate biopsy in these cases. A 12-gauge needle with a diamond-tipped inner cannula (Bard, Covington, Ga) is positioned by using the techniques described earlier. The inner cannula is removed, and the 14-gauge core needle is placed through the outer cannula. Different areas of the lesion can be sampled by changing the angle of the outer cannula slightly. An alternative is to fire the core needle along the path leading to the lesion to establish a track for subsequent passes.

Figure 15. Postbiopsy hematoma. Photograph obtained after US-guided core needle biopsy of an infiltrating ductal carcinoma shows a large hematoma in the left breast. The hematoma was drained during lumpectomy.
Conclusions

The term needle biopsy refers to the use of a needle to aspirate or excise tissue samples from a lesion. The needle may be guided by US, fluoroscopy, or CT. Needle biopsy is performed for a variety of reasons, including the evaluation of masses, lesions, and abnormal findings on imaging studies. Needle biopsy can be performed using a variety of needle types, including large-core needles, vacuum-assisted devices, and core biopsy needles. The choice of needle type depends on the lesion characteristics, the operator's preference, and the technical requirements of the procedure. Needle biopsy is a safe and effective method for the evaluation of breast lesions and can be used to determine the presence of cancer or other lesions.

References