

Figure 9.14 86-year-old female could not access the stereotactic biopsy table, and the breast compressed thickness measured less than 2 cm. (a) Craniocaudal left mammogram shows clustered calcifications in the medial left breast associated with a palpable triangular marker. (b) Grayscale high-resolution ultrasound shows the clustered microcalcifications (arrow). (c) Ultrasound-guided vacuum-assisted core needle biopsy using a Suros Celero 12-gauge biopsy device shows the grouped calcifications within the needle trough. (d) Specimen radiography demonstrates targeted calcifications in at least two cores. (e) Postbiopsy left mammogram shows clip marker placement at site of targeted calcifications, which have been largely removed during biopsy.

9.9 Breast Cancer Imaging

Breast ultrasound is an important, cost-effective, and quick imaging tool for staging patients with breast cancer in our institution at the M.D. Anderson Cancer Center. Disease is assessed for unifocality versus multifocality versus multicentricity (Fig. 9.15); and histological confirmation of additional sites of disease via ultrasound-guided biopsy at the time of ultrasound evaluation is possible.^{49–52} Regional lymph nodes are assessed to include the ipsilateral axillary, infraclavicular, internal mammary, and supraclavicular nodal basins (Fig. 9.16). Sonographic features that suggest lymph node abnormality include the absence of a central echogenic “fatty hilus,” and subtle eccentric cortical hypertrophy that can be hypoechoic relative to the rest of the nodal cortex⁵³ (Fig. 9.16). Because afferent lymphatic channels enter a node through the periphery of the cortex, abnormalities of the cortex can indicate early metastatic involvement. It is therefore critical to direct the needle tip to the hypoechoic abnormal cortex (Fig. 9.16) and not the central hilus or the

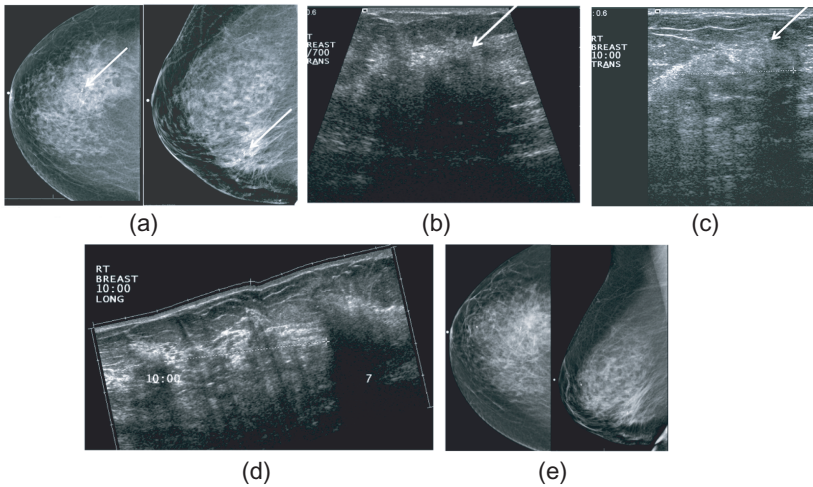


Figure 9.15 56-year-old female presents for staging mammogram and ultrasound status after outside diagnosis of unifocal invasive lobular carcinoma in inferior right breast. (a) Craniocaudal and lateromedial right mammograms show postbiopsy clip (arrow) and associated architectural distortion in right 6-o'clock position, marking site of known invasive lobular cancer. No further mammographic abnormality is seen. (b) Grayscale ultrasound shows known invasive lobular cancer in right 7-o'clock position, presenting as an area of heterogeneous breast tissue (arrow) with marked posterior acoustic shadowing. (c) Grayscale ultrasound shows second area of irregular heterogeneous breast tissue in right upper, outer quadrant 10-o'clock position (arrow). Core needle biopsy showed invasive lobular cancer at histopathology, consistent with multicentric disease. (d) Extended-field-of-view grayscale ultrasound shows two separate masses in right 7- and 10-o'clock positions, 5 cm apart. (e) Postprocedural mammograms after placement of second marker clip in 10-o'clock position confirms multicentric disease.

normal cortical regions during biopsy to ensure the highest possible yield of metastases.^{54–57} Any suspicious lymph nodes identified at the time of staging ultrasound are subjected to ultrasound-guided needle biopsy with immediate on-site evaluation by a dedicated breast cytopathologist, allowing for accurate nodal staging [American Joint Committee on Cancer (AJCC) criteria] and comprehensive care for the breast cancer patient.^{54–57} The highest-order suspicious node detected is subjected to biopsy, as the N stage impacts overall staging, determines eligibility for various chemotherapy protocols, and also contributes to adjuvant radiation therapy planning.⁵⁸ Additionally, these sites of disease can also be used to assess response in patients undergoing neoadjuvant chemotherapy.

9.10 Tumor Response

Ultrasound is effective in the assessment of tumor response to neoadjuvant chemotherapy.⁵⁹ Volume measurements of a mass by ultrasound are

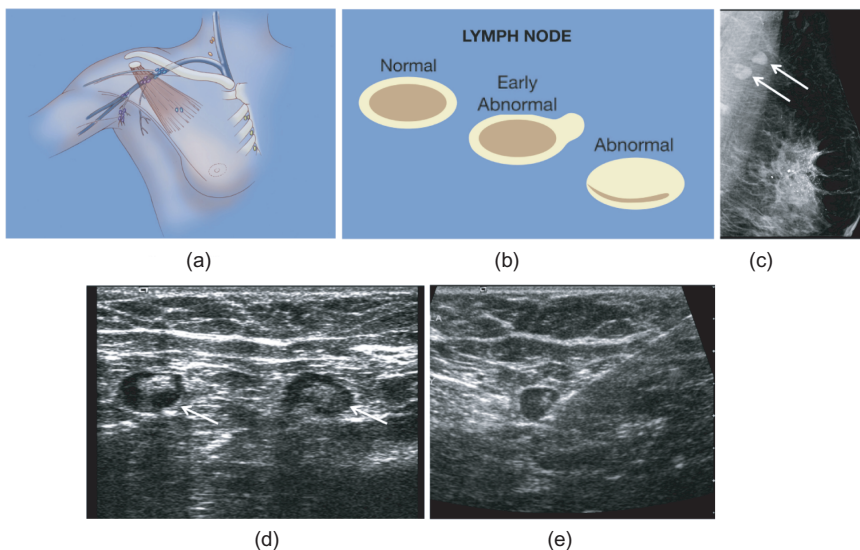


Figure 9.16 (a) Schematic of regional nodal basins routinely assessed during staging ultrasound for breast cancer patients at M.D. Anderson Cancer Center. These include the axillary (purple), infraclavicular (blue), internal mammary (yellow), and supraclavicular (orange) nodal regions. (b) Schematic of superficial lymph-node configurations. An elliptical node with a thin C-shaped rim suggests benign findings; eccentric cortical hypertrophy is suspicious and should be sampled with fine-needle aspiration biopsy; effacement (partial or complete) is an abnormal finding and requires sampling to confirm metastases. (c) Left mediolateral oblique mammogram in a 47-year-old female with known invasive and *in situ* ductal carcinoma shows prominent left axillary nodes with dense cortical thickening (arrows). (d) Grayscale ultrasound shows two nodes with eccentric cortical thickening (arrows). (e) Ultrasound-guided fine-needle aspiration biopsy confirmed metastases at cytopathological evaluation.

obtained by measurements in three orthogonal planes and by applying a volumetric formula for an ellipsoid.

9.11 Second-Look Ultrasound After a Positive Breast Magnetic-Resonance or PET Scan Study

Directed or targeted breast ultrasounds have been very effective in investigating abnormalities detected on breast MRI or PET/CT scans.^{60–65} This ultrasound method can be the first study for patients who have undergone breast MRI without prior ultrasound studies, or can be a second-look procedure for patients who have had a previous breast ultrasound. In any case, the study allows one to focus attention on targeted areas of abnormalities documented on the MR or PET/CT roadmap. Correlative lesions successfully documented by ultrasound can be quickly and accurately biopsied with clip marker placement^{60–62}

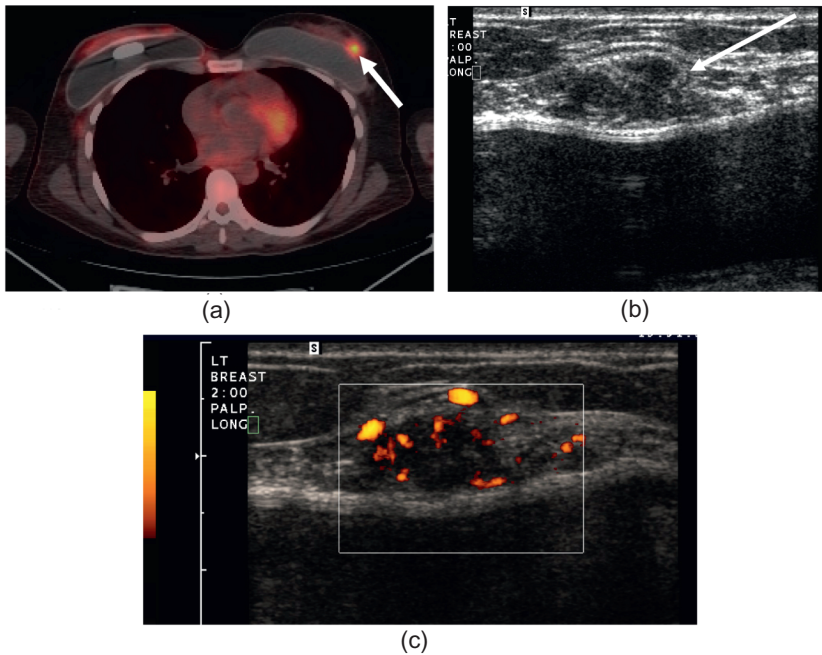


Figure 9.17 39-year-old female with contralateral right-breast cancer had negative left-breast screening ultrasound. (a) Staging PET-CT shows hypermetabolism in left breast (arrow). (b) Second-look ultrasound shows irregular solid hypoechoic mass (arrow) abutting the underlying implant. (c) Power Doppler ultrasound shows marked associated internal hypervascularity. Core needle biopsy confirmed invasive ductal breast cancer at histopathology.

(Fig. 9.17). Otherwise, a separate MR-guided procedure, which is much more expensive and technically more complicated, must be scheduled.

9.12 Limitations

9.12.1 Operator dependence and reproducibility

Real-time imaging of a breast using handheld transducers remains the standard of care, underscoring the importance of operator dependence, technical expertise, and clinical experience.⁶⁶ Automation of the image acquisition process of grayscale ultrasound in lieu of real-time scanning has not transitioned successfully into the clinic, largely due to the need for a physician or trained operator to override the FP and FN findings, and to distinguish true morphological abnormalities from pitfalls related to normal anatomy and ultrasound artifacts.⁶⁷ Technological advancement of this technique is finding its way into the clinic by permitting limited automated scanning as a coregistration technique for correlation with breast MRI or CT findings. Some companies are seeking to minimize operator dependency by automating this process using a