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46.1 Introduction

Breast ultrasound is an important diagnostic tool complementary to mammography, especially in women with mammographically dense breasts. Breast ultrasound technology evolves continuously. Currently, with the introduction of the new high resolution probes (11–14 MHz), investigators evaluate a possible role of the breast ultrasound for screening purposes.

46.2 Indications and Findings

Despite of the marked improvements in technology and image quality over the past decade, ultrasound remains primarily a method for differentiating cystic lesions from solid masses and for guiding interventional procedures (aspiration, localization, and core biopsies). It is also used as an adjunct diagnostic tool to further investigate and characterize suspicious findings in mammography. A classification system (BI-RADS for breast ultrasound) similar to that of mammography has been developed for

assessment of mass lesions, based on the following lesion characteristics [1]:

1. *Echogenicity*: Anechoic, hyperechoic, isoechoic, hypoechoic, or mixed echogenicity
2. *Shape*: Oval, round, irregular
3. *Orientation*: Parallel, non parallel
4. *Margin*: Circumscribed, not circumscribed (indistinct, angular, microlobulated, spiculated)
5. *Lesion boundary*: Abrupt interface, thick echogenic rim
6. *Posterior acoustic features*: Posterior acoustic enhancement, posterior acoustic shadowing
7. *Surrounding structures*: Cooper ligaments, ducts, skin.

The suspicious sonographic features can be thought of as “hard”, “soft”, and “mixed”. The “hard” findings suggest the presence of invasive cancer. The “soft” findings tend to represent ductal carcinoma in situ (DCIS) components of the lesion. The “mixed” findings can represent either invasive or DCIS component [2] (Table 46.1), (Fig. 46.1).

A controversial issue is the use of ultrasound for breast cancer screening using either the established technique of handheld whole breast ultrasound or the newer development of volumetric—Automated Breast Ultrasound (ABUS). There is only one randomized control study that addresses the possible role of ABUS as a screening tool for cancer detection [3].

An additional potential use of ultrasound is lymph nodes staging by localizing and aspirate or biopsy axillary lymph nodes with sonographic

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Table 46.1 Hard versus soft suspicious sonographic findings for malignancy

	Finding
Hard	Spiculation/thick hyperechoic halo
	Angular margins
	Acoustic shadowing
Mixed	Taller than wide (not parallel)
	Hypoechoic appearance
Soft	Microlobulation
	Calcifications
	Duct extension
	Branch pattern

features indicative of metastatic disease [4] (Fig. 46.2). Ultrasound is a valuable diagnostic tool in localizing, evaluate and biopsy additional lesions depicted by breast MRI (targeted or second—look ultrasound).

46.3 Results

Breast ultrasound differentiates cystic from solid lesions. According to a landmark study by Stavros et al. [5], it has also a high sensitivity (approximately 93 %) in characterizing a lesion as malignant or not benign and a high negative predictive value (99.5 %). On the other hand,

Fig. 46.1 Ultrasound images in two different sites of the same cancerous nodule and its BI-RADS descriptors

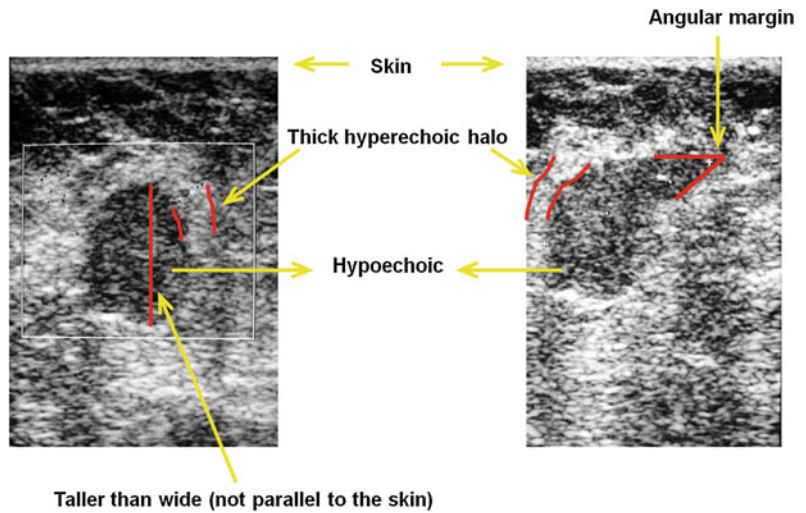
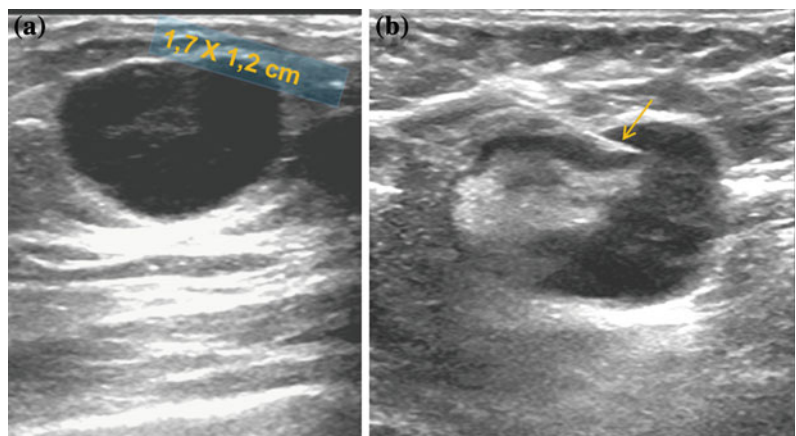


Fig. 46.2 Enlarged intramammary lymph node with cortical thickening and indistinct fatty hilum (a). Enlarged axillary lymph node with cortical thickening. Aspiration needle (arrow)



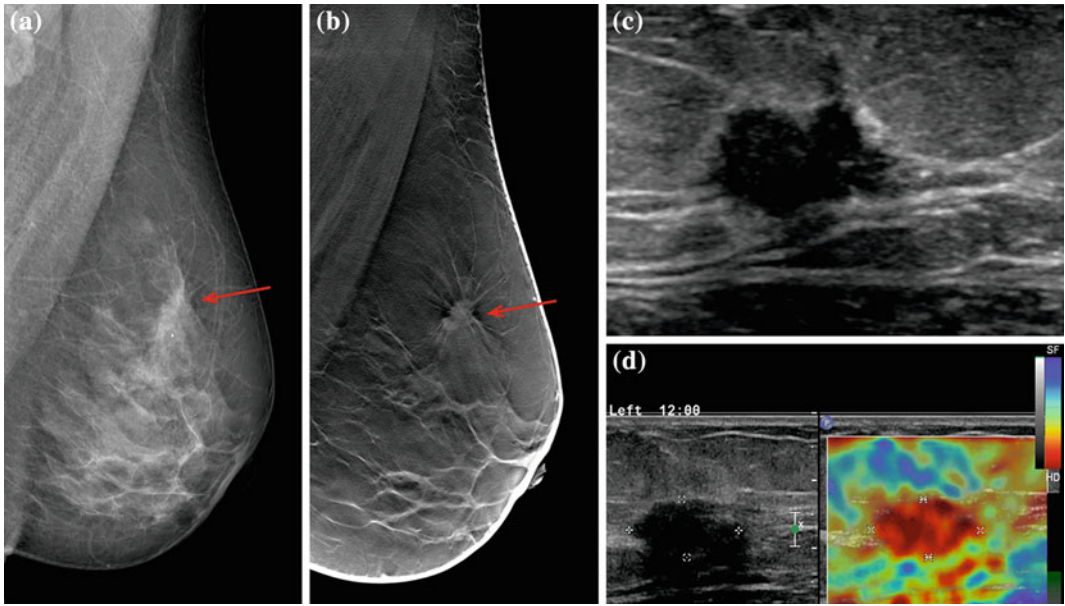


Fig. 46.3 16 mm invasive ductal cancer in a 42-year-old woman. Mammography (a) shows an architectural distortion. Tomosynthesis -1 mm slice (b) reveals a spiculated mass. Ultrasound (c) shows a solid hypochoic

spiculated mass with mild acoustic shadowing. Lesion is hard on elastography (d), a characteristic feature of cancerous lesions (hard depicted as red in color mapping)

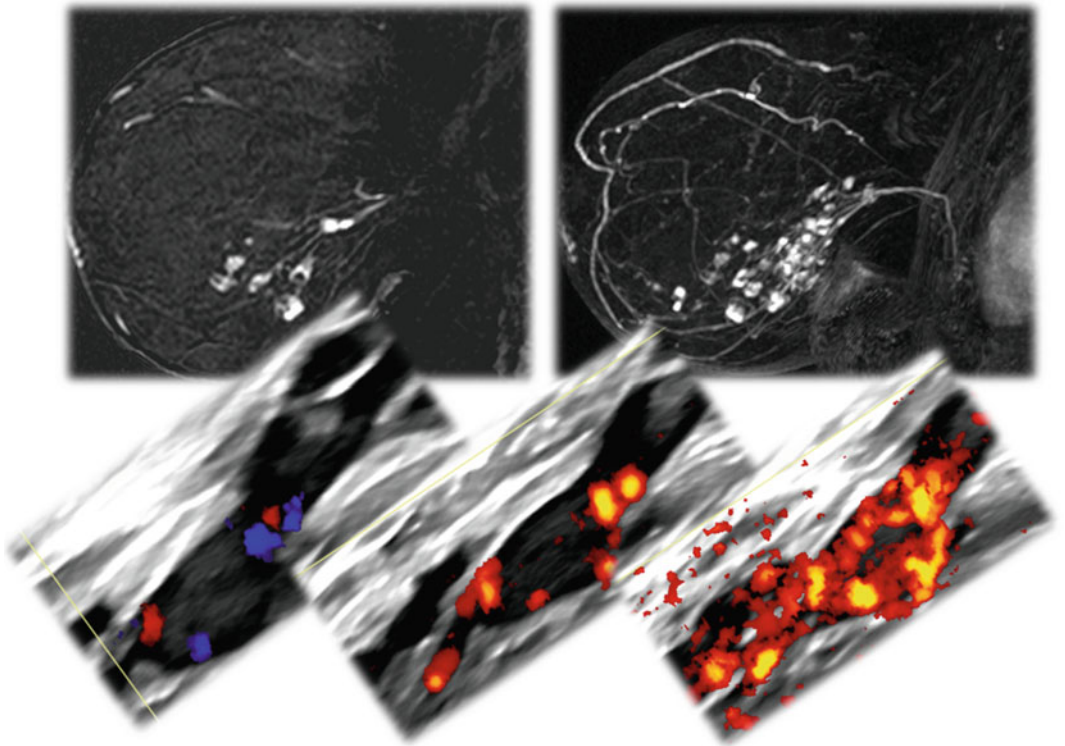


Fig. 46.4 DCIS: MRI shows regional stippled enhancement. Targeted ultrasound reveals intraductal hypervascular tissue

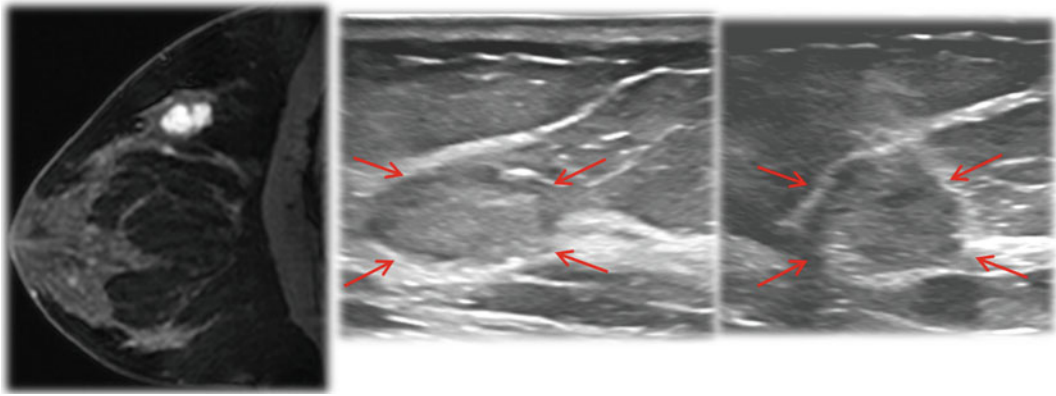


Fig. 46.5 Mixed mucinous carcinoma: MRI shows an enhancing lesion. Targeted ultrasound revealed an isoechoic (easily overlooked) lesion

ultrasound lead in unnecessary biopsies, as its specificity and positive predictive value are low (20.2 and 38.7 %, respectively). Combined conventional ultrasound and elastography was more specific than conventional ultrasound alone. Combining elastography with ultrasound improved specificity and positive predictive value (33.3 and 45.1 %, respectively) [6, 7] (Fig. 46.3). Targeted or second—look ultrasound can identify as many as 89 % of the additional detected lesions on breast MRI and is a reliable method to correlate, further evaluate and biopsy suspicious additional MRI abnormalities [8] (Figs. 46.4, 46.5).

46.4 Conclusions

Breast ultrasound helps in differentiating cystic from solid lesions and in further characterizing solid nodules. Sonographic features of malignancy include speculations, hypoechogenicity, microlobulation, shadowing, vertical orientation of lesion (taller than wide), and angular margins. Ultrasound is a reliable diagnostic tool in evaluation of the axillary lymph node status and in identifying additional abnormalities initially detected on breast MRI. The ability of ultrasound to localize and characterize lesions affects decision making in clinical patient management and contributes to improve patient care.

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