RadioGraphics

EDUCATION EXHIBIT

US Elastography of Breast and Prostate Lesions[1]

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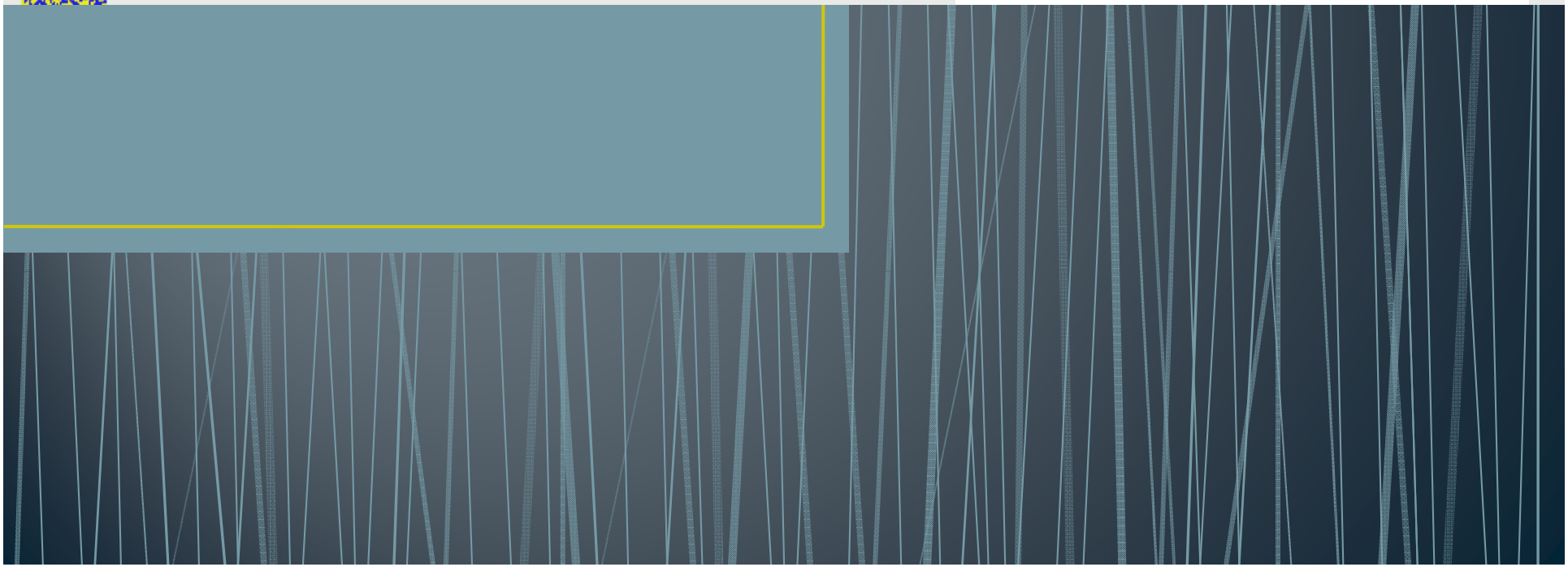


Elastography

Ultrasonographic (US) elastography (sonoelastography) is a noninvasive imaging technique that can be used to depict relative tissue stiffness or displacement (strain) in response to an imparted force. Stiff tissues deform less and exhibit less strain than compliant tissues in response to the same applied force. Thus, the basis of elastography is analogous to manual palpation.

Elastography

Sonoelastography is based on the comparison of signals acquired before and after tissue displacement. Several sonoelastographic techniques have been devised.

Among these techniques, compression sonoelastography and vibration sonoelastography currently have the most prominent role in breast and prostate imaging.

Elastography

Compression elastography involves calculating a strain profile in a direction perpendicular to the tissue surface in response to an externally applied force.

Vibration elastography, on the other hand, generates tissue displacement through the use of an independent external vibration source. Relative displacement is measured by using a variant of Doppler imaging that depicts differential motion of tissue types.

Breast US Elastography

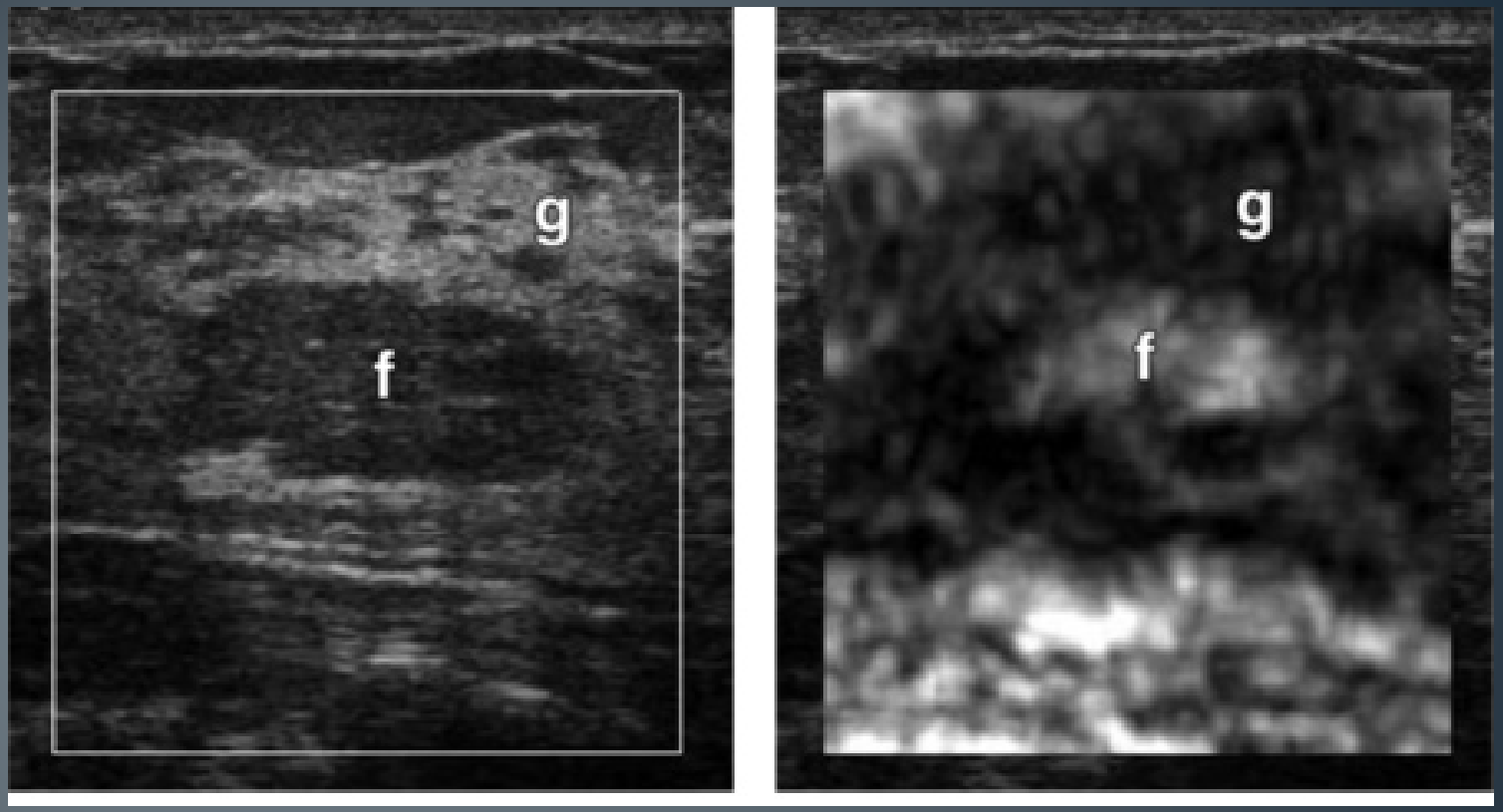
The two most important elastographic characteristics in evaluating breast lesions are size and stiffness criteria.

Structures that are less compressible than surrounding tissues measure larger on the elastogram than they do on the corresponding B-mode image, resulting in a size discordance.

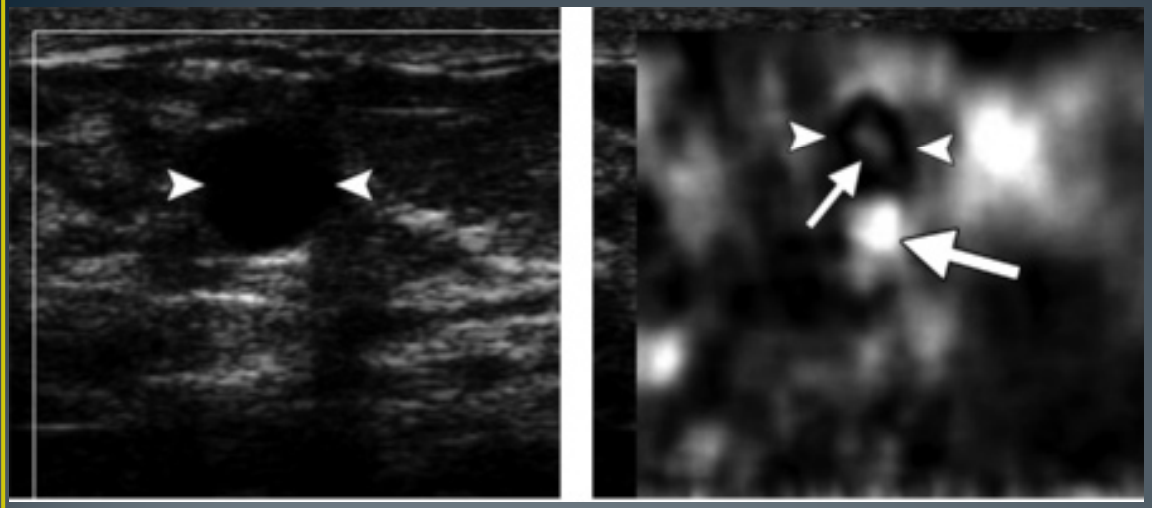
Breast US Elastography

Therefore, cancers will be larger on the elastogram than on the conventional US image.

At elastography, fatty tissue will appear bright with respect to the adjacent glandular tissue, and normal fibrous parenchyma appears darker.

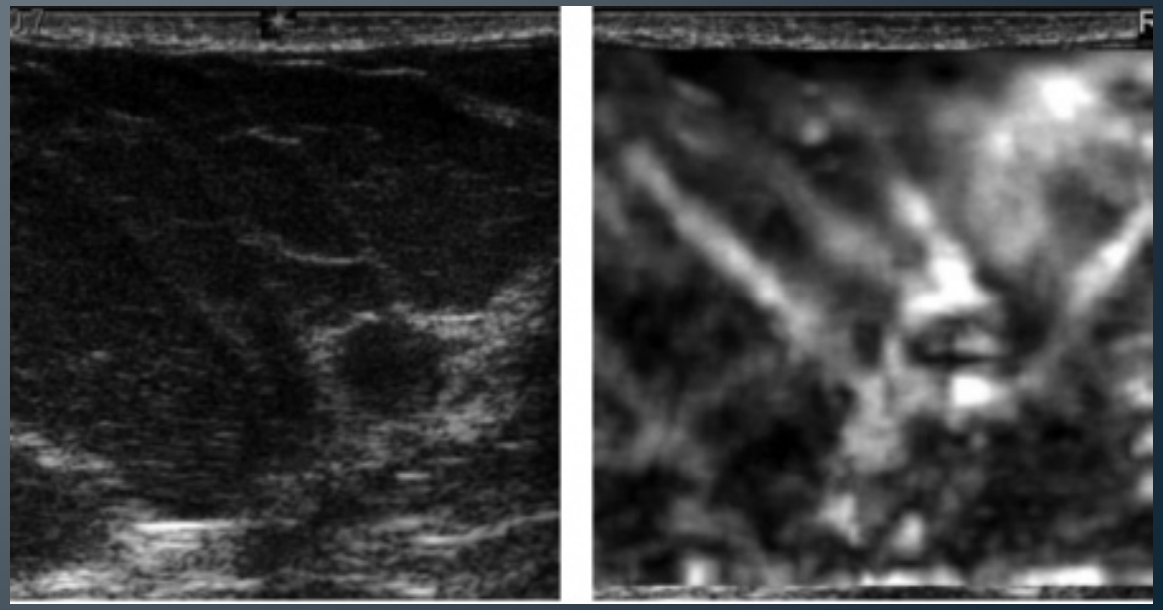


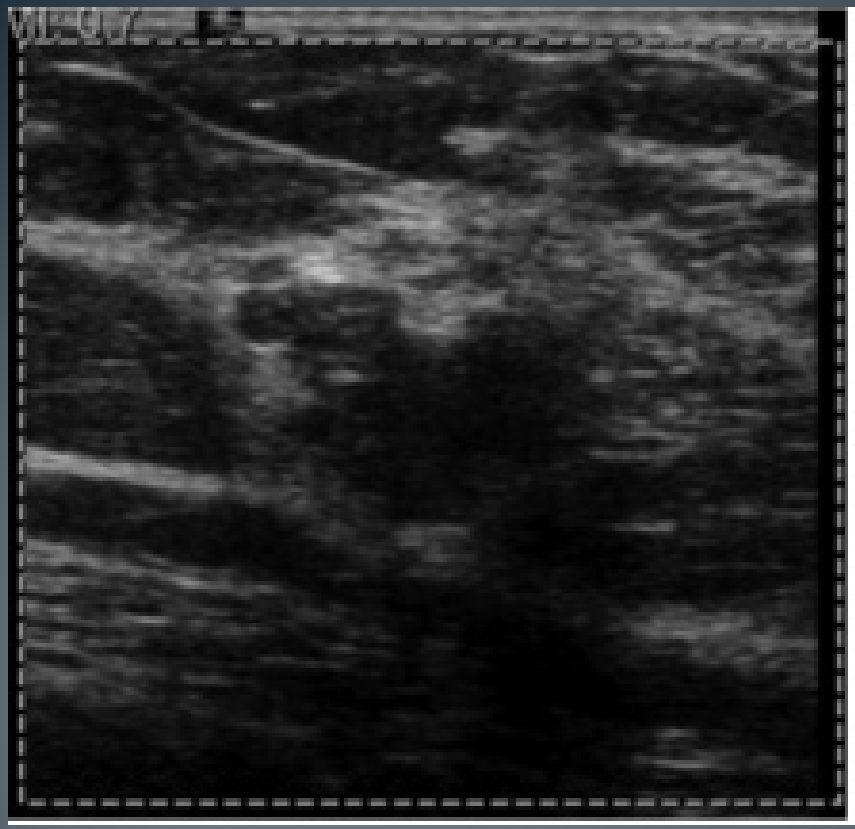
Lobule of fatty tissue appears brighter and smaller than fibrose tissue.

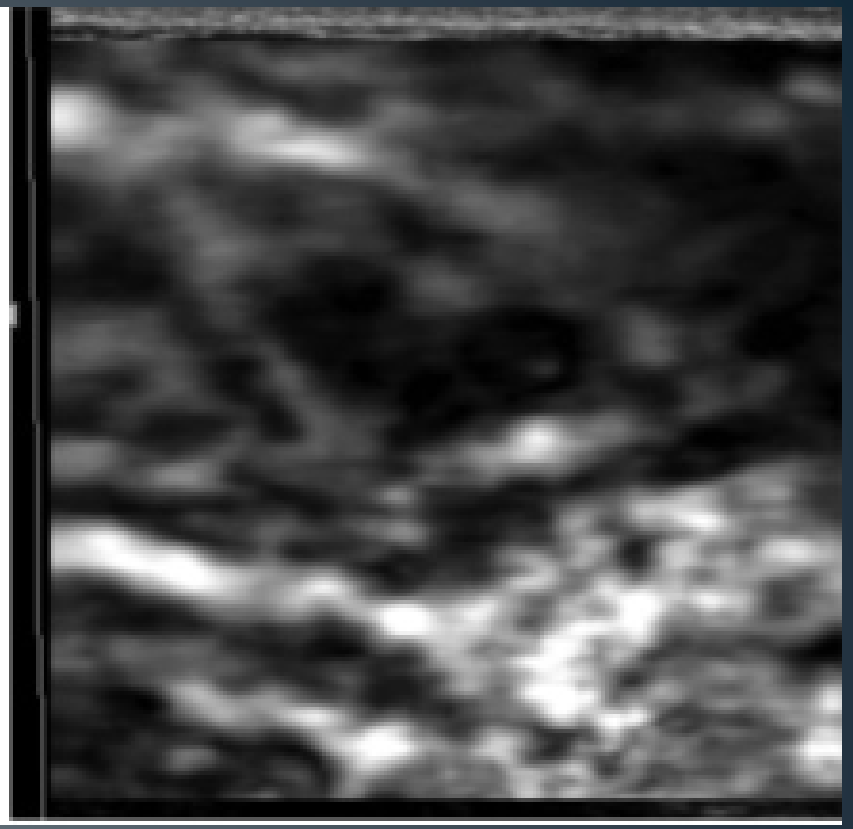


Cyst Round/oval anechoic lesion with enhanced through transmission.

Bull's-eye appearance with posterior bright enhancement.



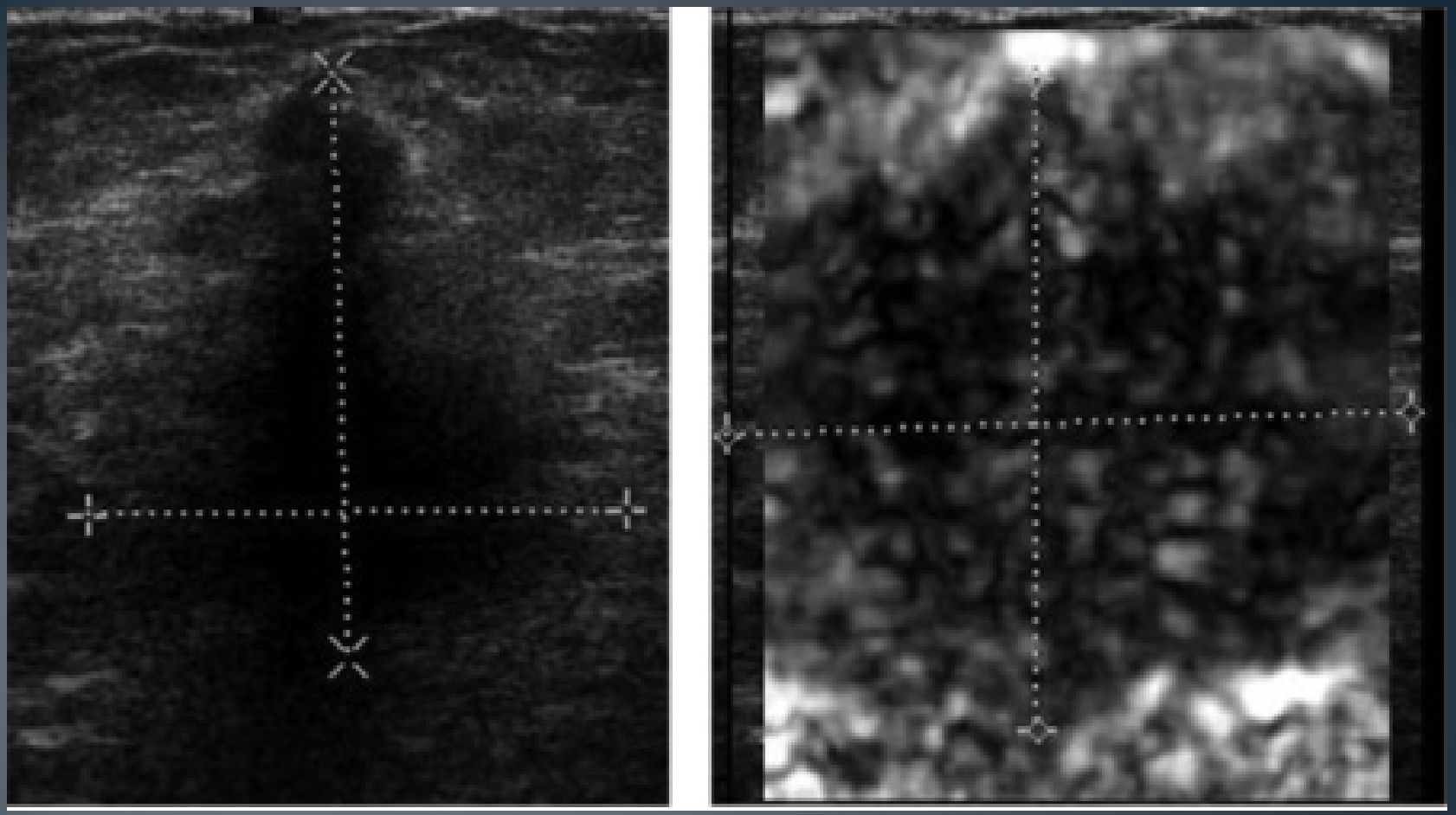




Fibroadenoma

Oval well-circumscribed homogeneous hyperechoic area, wider than tall.

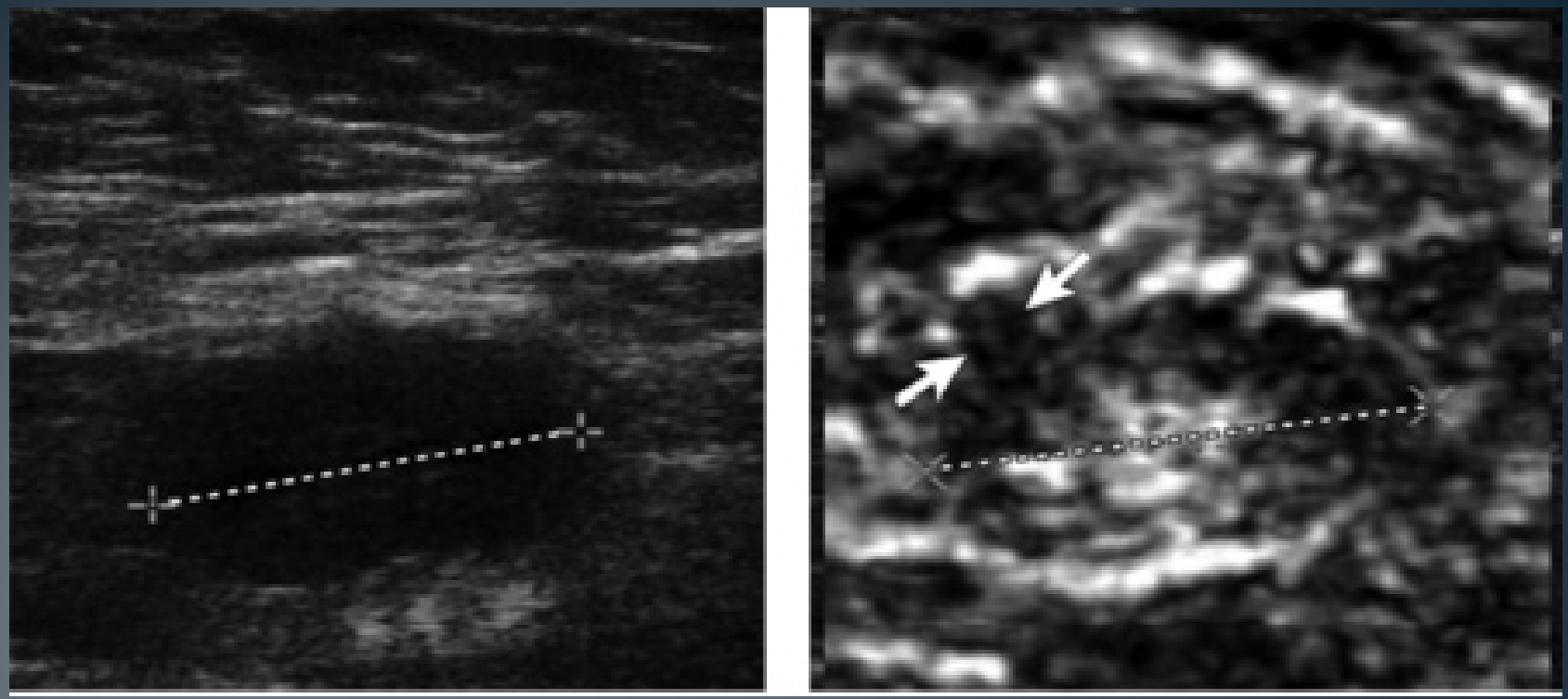
Area of greater stiffness typically smaller than lesion boundaries seen on B-mode.



Invasive ductal carcinoma

Hypoechoic spiculated or microlobular branching mass that is taller than wide.

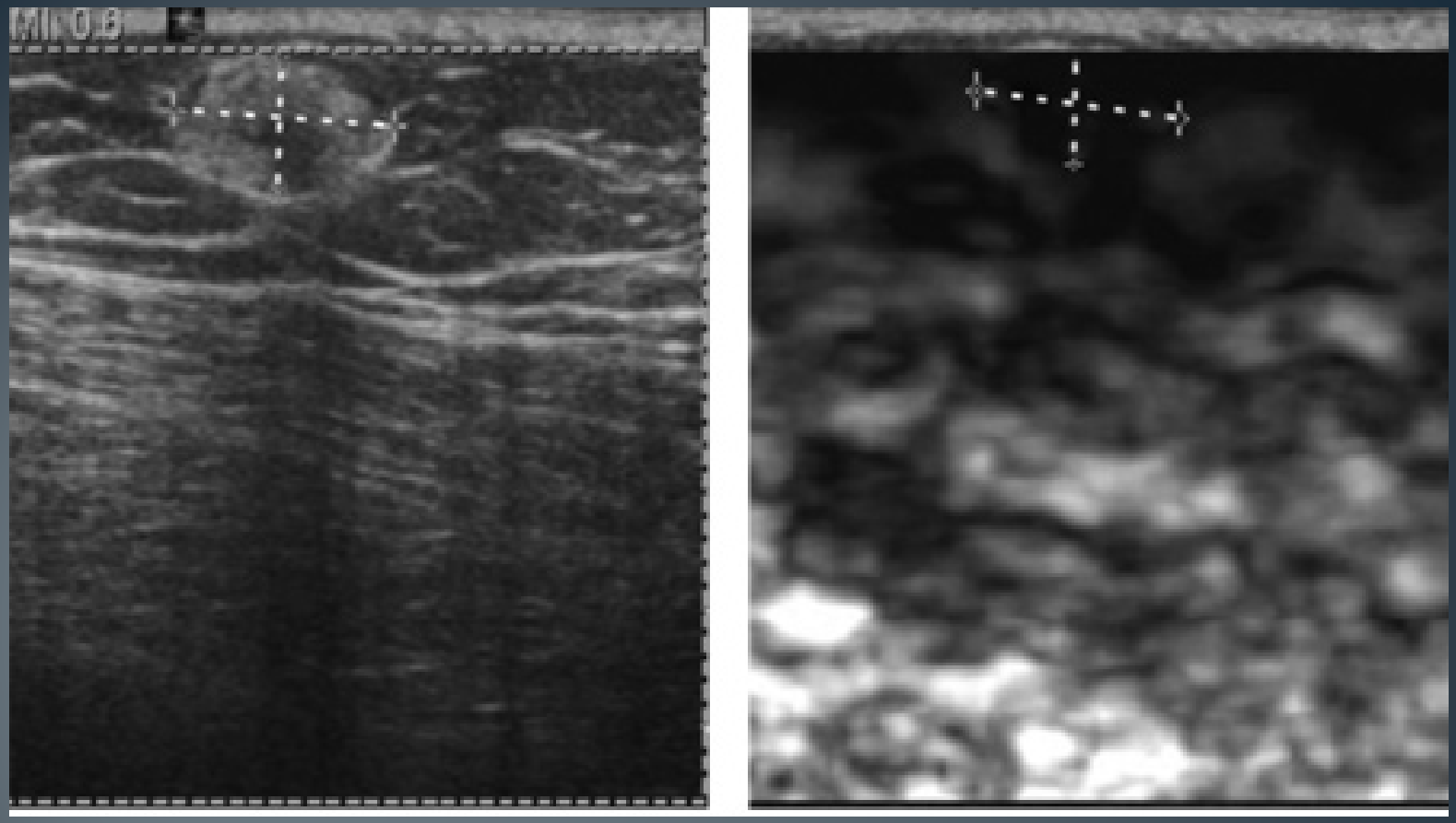
Increased stiffness, lesion larger than on B-mode image.



Malignant lymph node

Rounded and enlarged lesion with loss of fatty hilum.

Low strain and larger than on B-mode Image.



Hematoma

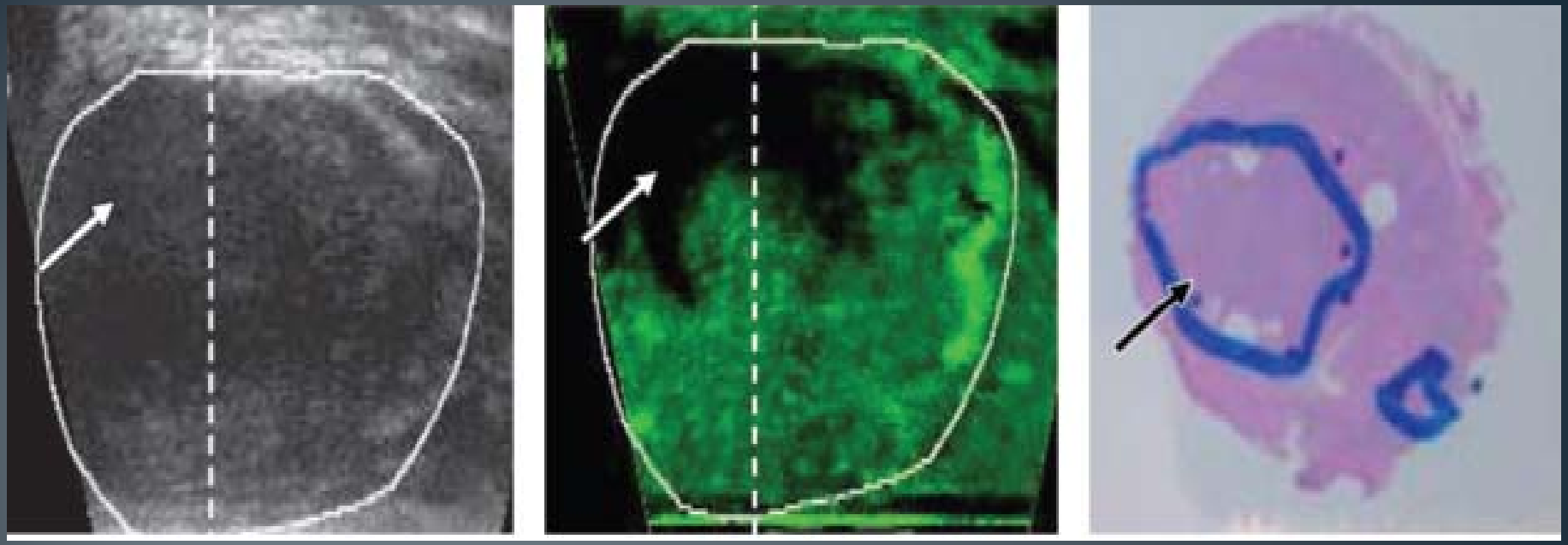
Variable appearance ranging from anechoic
to septate cystic.

Variable: similar appearance to cysts, may be stiff and measure less than on B-mode Image.

Prostate US Elastography

Prostate cancers have a higher elastic modulus (stiffness) than that of surrounding normal prostate tissue.

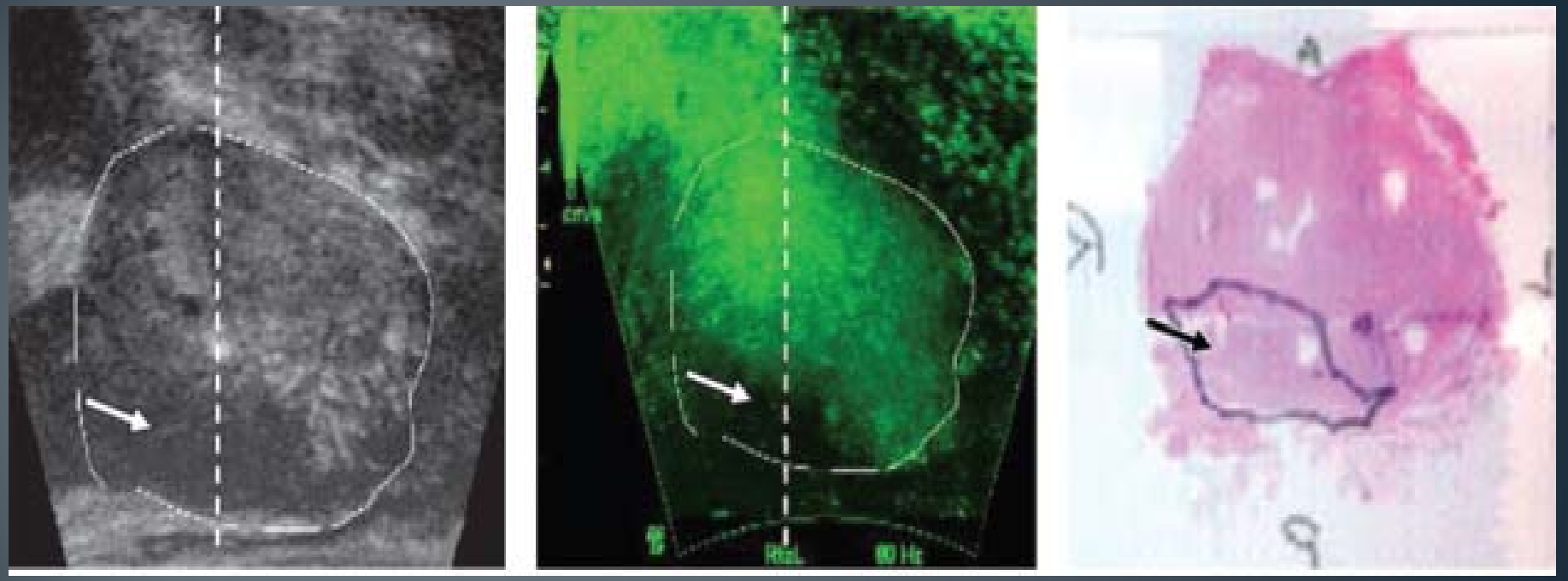
Consequently, prostate cancers will appear dark on elastograms. Often, intermediate-grade and high-grade malignant lesions that are subtle or even unapparent on B-mode US images are prominent on elastograms as dark areas of low strain.



Prostate cancer

Variable echogenicity but most often hypoechoic, typically located in periphery of gland.

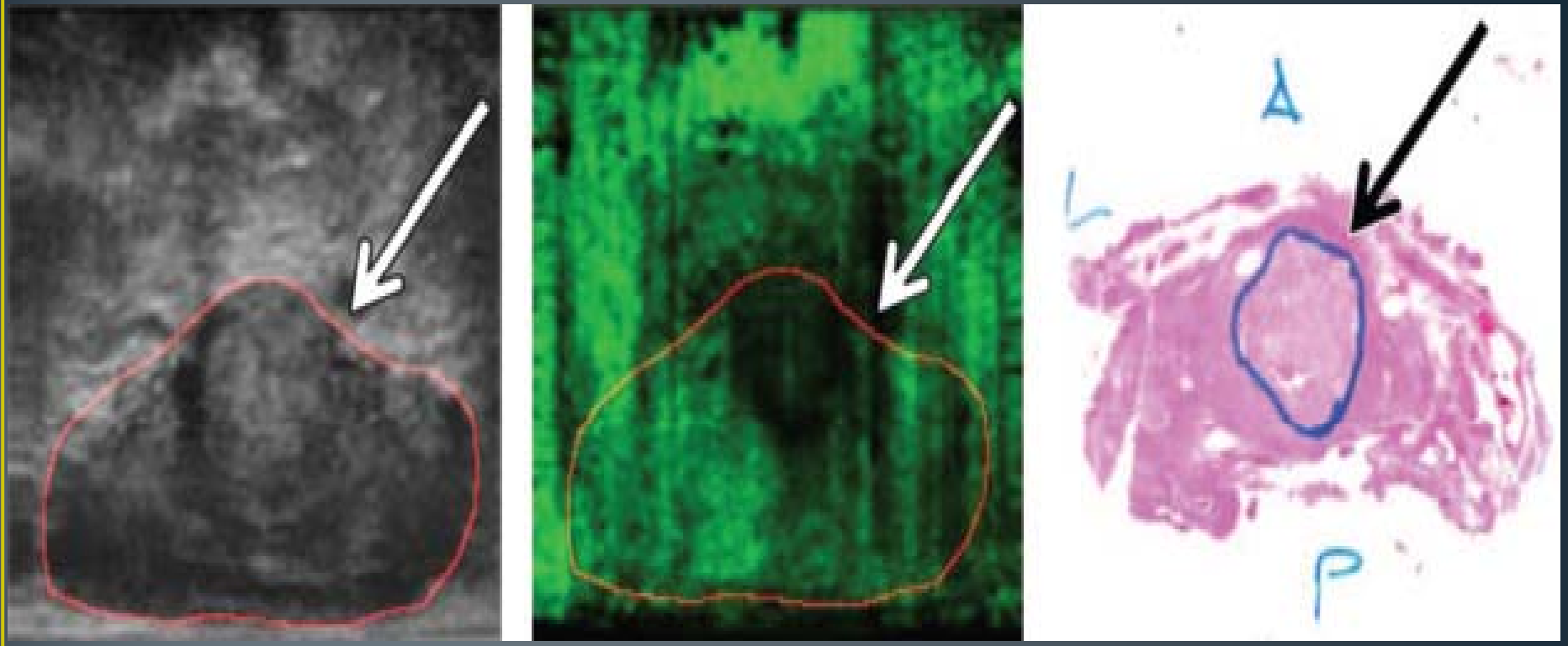
Lower strain than normal prostate tissue and benign prostatic hyperplasia (dark).



Prostate US Elastography

In general, foci of benign prostatic hyperplasia have elastic moduli (stiffness) that are an order of magnitude greater than those of normal prostate tissues but are less than those of prostate carcinomas.

As a result, on elastograms, benign prostatic hyperplasia will appear darker than normal prostate tissue (Fig 16). However, the difference between benign prostatic hyperplasia and prostate carcinoma can be difficult to discern because benign prostatic hyperplasia also appears darker than the background tissues.



Benign prostatic hyperplasia

Variable appearance but most commonly heterogeneous hypoechoic area in transitional zone.

Lower strain than normal prostate tissue (dark) but features can sometimes overlap with those of prostate cancer.

Conclusions

Although not yet established for routine clinical use, US elastography is a promising adjunctive modality for evaluating breast and prostate lesions.

Nevertheless, validation of this modality through prospective trials is warranted. Ultimately, sonoelastography is expected to improve the accuracy of diagnosis for breast and prostate lesions in conjunction with conventional modalities.

As a result, US elastography may be used to reduce biopsy rates for breast lesions and to more appropriatelyguide biopsy of prostate lesions.