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THE ROLE OF ULTRASOUND ELASTOGRAPHY IN THE DIFFERENTIAL DIAGNOSIS OF BENIGN AND MALIGNANT BREAST LESIONS

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Introduction. Breast diseases represent an important diagnostic problem in modern medicine. Conventional B-mode ultrasonography is widely used for the detection and characterization of breast lesions; however, some benign and malignant lesions may demonstrate similar morphological features. Ultrasound elastography is an advanced non-invasive imaging technique that provides additional information about tissue stiffness and can improve the differentiation of breast lesions.

Aim. To evaluate the diagnostic capabilities of ultrasound elastography in differentiating benign from malignant breast lesions and to assess its potential role as an additional method to conventional ultrasound examination.

Materials and Methods. A review of published clinical studies and systematic reviews evaluating strain elastography (SE) and shear-wave elastography (SWE) in the diagnosis of breast lesions was performed. The main diagnostic parameters considered were tissue stiffness, strain ratio, shear-wave velocity, sensitivity, specificity, and area under the receiver operating characteristic curve (AUC). Histopathological examination was considered the reference standard in most studies.

Results. Ultrasound elastography demonstrates significant potential for differentiating benign and malignant breast lesions. Malignant tumors generally exhibit increased tissue stiffness compared with benign lesions, which can be assessed qualitatively by strain elastography or quantitatively using shear-wave elastography. A meta-analysis of 87 studies including 19,043 breast lesions demonstrated that SWE had good diagnostic performance, with pooled sensitivity of approximately 86% and specificity of approximately 87% when mean shear-wave speed was used. The corresponding AUC was 0.93, indicating high discriminative ability.

Strain elastography also provides valuable diagnostic information through qualitative elasticity scores and semi-quantitative strain ratios. A systematic review and meta-analysis evaluating strain-ratio thresholds confirmed the diagnostic usefulness of this parameter, although considerable variation in cut-off values between studies was observed.

The combination of conventional B-mode ultrasonography with elastography may provide better diagnostic performance than B-mode ultrasound alone. In a comparative study, the addition of either strain or shear-wave elastography significantly improved the diagnostic accuracy of breast lesion characterization. More recent evidence suggests that sonoelastography overall has pooled sensitivity of approximately 88% and specificity of 84%, while SWE demonstrated sensitivity of 90%, specificity of 86%, and an AUC of 0.92.



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Discussion. The main advantage of ultrasound elastography is its ability to provide functional information about tissue mechanical properties in addition to the morphological information obtained by conventional ultrasound. This may be particularly useful for lesions with indeterminate BI-RADS characteristics. Elastography can potentially help increase specificity and reduce unnecessary biopsies, especially when used as an adjunct to conventional ultrasound rather than as a replacement for histopathological verification.

However, diagnostic performance may be influenced by lesion size, depth, histological subtype, examination technique, operator experience, equipment, and the selected stiffness threshold. Therefore, standardized acquisition protocols and interpretation criteria are important for achieving reproducible results. Current evidence supports the use of elastography as a complementary diagnostic technique rather than an independent substitute for conventional imaging and biopsy when malignancy is suspected.

Conclusion. Ultrasound elastography is a promising, non-invasive and informative method for the differential diagnosis of benign and malignant breast lesions. Both strain elastography and shear-wave elastography can provide additional diagnostic information and improve lesion characterization when combined with conventional B-mode ultrasonography. The method has considerable potential for improving diagnostic confidence and optimizing the management of patients with indeterminate breast lesions. Further prospective studies and standardization of elastographic parameters are required to establish universally applicable diagnostic thresholds.

Keywords: breast lesions, breast cancer, ultrasound, elastography, strain elastography, shear-wave elastography, differential diagnosis, BI-RADS, tissue stiffness.

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