Elastography in Clinical Use

Elastography

Elastography is a type of sonographic imaging that measures the stiffness of tissues. It can be used to "palpate" organs without being invasive. Clinicians are able to use elastography to help diagnose abnormalities, especially in the breast and liver.[1]

Different techniques of elastography include Strain Elastography (SE) and Shear Wave Elastography (SWE). SE uses manual compression or internal physiological movement and an ultrasound transducer to measure displacement of tissue. See Image 1.[1] SWE uses vibrations to displace tissue and an ultrasound transducer to measure that displacement. See Image 2.[2] Elasticity is measured in kPa. See Image 3.[3]

Liver Fibrosis

Liver fibrosis is a result of chronic liver disease that can progress to liver cirrhosis. It is caused by an accumulation of collagen fibers and non-collagenous components in the extracellular matrix of the liver. This increases the stiffness of the liver tissue. Elastography is able to determine changes in patients with liver fibrosis due to the increasing stiffness of the tissue. Although biopsies are still the most accurate way to diagnose and stage liver fibrosis, elastography can be helpful in patients with already known fibrosis to note changes in elasticity.[4] See Image 3.[3]

Unfortunately, a standard value for elasticity has yet to be determined for liver fibrosis and biopsy still remains the primary exam for evaluating different liver fibrosis stages.[5]

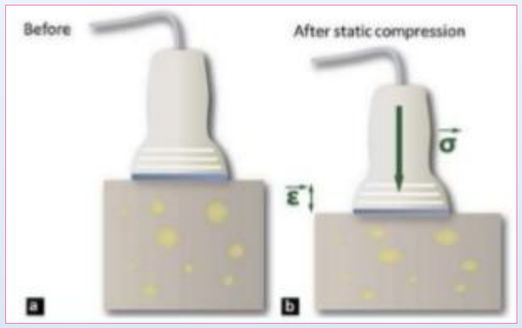

Image 1: Strain elastography uses manual compression to cause tissue displacement that the ultrasound transducer can measure.[1]

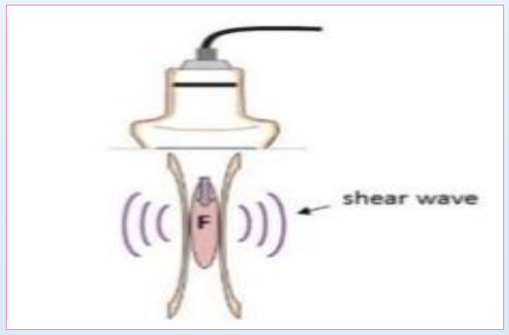

Image 2: Shear wave imaging uses vibrations that displace tissue. The shear waves, or elastic waves are then measured by the ultrasound transducer.[3]

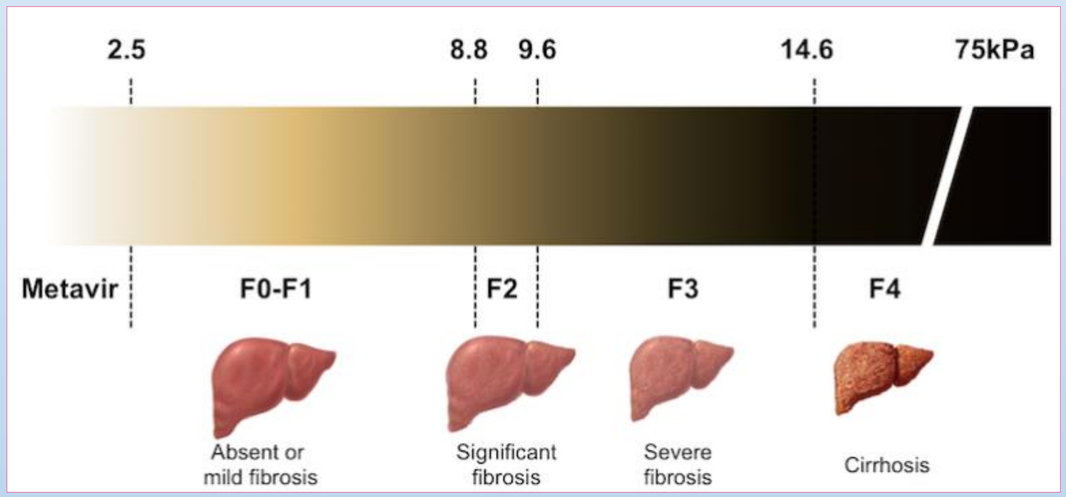

Image 3: A high kPa correlates with stiff tissue. The lower the kPa, the softer the tissue.[3]

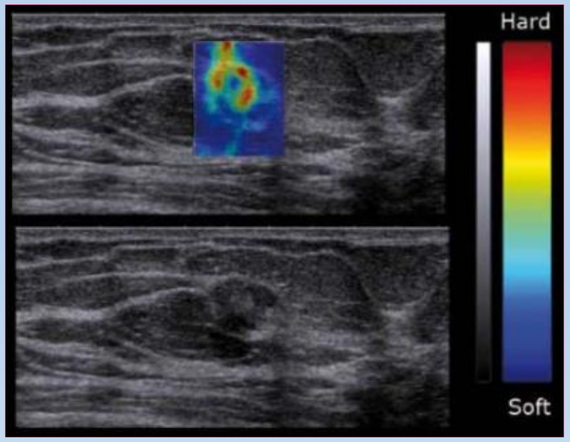

Image 4: The higher the kPa value, the stiffer the tissue (red). This image of a breast malignancy is shown to have both soft and hard areas.[8]

Breast Malignancies

Mammography is the most often exam used for early detection of breast cancer, but is limited by tissue densities hiding possible abnormalities. There is a high number of false negatives in the diagnosis of breast cancer due to both opacities in the breast tissue and radiologist error.[6]

Once an abnormality is detected, however, a breast ultrasound exam is performed. While B-mode ultrasound detects lesions well, it is not as effective at evaluating the lesions. Elastography is able to evaluate the elasticity of the breast tissue, and can aid the B-mode ultrasound technique by improving specificity.[7] See Image 4.[8]

Conclusion

In conclusion, elastography has a promising future in helping clinicians diagnose and track abnormalities in patients' tissues, both deep and superficial. Although more tests need to be done to determine accurate values for elasticity, elastography is likely to become helpful in treating patients. Being able to diagnose diseases and malignancies non-invasively would mean better patient care with less risk.

References

1. Gennisson JL, Deffieux T, Fink M, Tanter M. Ultrasound Elastography: Principles and Techniques. *Diagnostic and Interventional Imaging*. 2013:94(5):487-495. http://www.sciencedirect.com/science/article/pii/S2211568413000302
2. Sound Touch Elastography: A New Solution for Ultrasound Elastography. *HealthManagement.org.* https://healthmanagement.org/c/imaging/whitepaper/sound-touch-elastography-a-new-solution-for-ultrasound-elastography. Published January 19, 2016. Accessed January 15, 2018.
3. Cox-North PP, Shuhart MC. Evaluation and Staging of Liver Fibrosis. *Hepatitis C Online*. https://www.hepatitisc.uw.edu/go/evaluation-staging-monitoring/evaluation-staging/core-concept/all Published October 21, 2015. Accessed January 16, 2018.
4. Soresi M, Giannitrapani L, Cervello M, Licata A, Montalto G. Noninvasive Tools for the Diagnosis of Liver Cirrhosis. *World Journal of Gastroenterology*. 2014:20(48):18131-18150. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4277952/
5. Foucher J, Chanteloup E, Vergniol J, et al. Diagnosis of Cirrhosis by Transient Elastography (FibroScan): a Prospective Study. *Gut*. 2006:55(3):403-408. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1856085/
6. Palazzetti V, Guidi F, Ottaviani L, Valeri G, Baldassarre S, Giuseppetti GM. Analysis of Mammographic Diagnostic Errors in Breast Clinic. *La radiologica medica.* 2016:121(11):828-833. https://link.springer.com/article/10.1007/s11547-016-0655-0
7. Goddi A, Bonardi M, Alessi S. Breast Elastography: A Literature Review. *Journal of Ultrasound.* 2012:15(3):192-198
8. Freiherr G. Shearwave elastography improves breast lesion Dx. *Diagnostic Imaging.* 2010; 32.