

## Introduction to VCTE

In this technique, a low-frequency mechanical actuator (50 Hz) generates a shear wave which propagates through tissue and is tracked with ultrasound. Shear wave propagation velocity is proportional to tissue stiffness. Higher stages of fibrosis are associated with increased tissue stiffness, permitting fibrosis staging with VCTE. VCTE is marketed under the trade name Fibroscan. Several VCTE probes are available, including the M probe (3.5 MHz), generally used in adults, the XL probe (2.5MHz), for obese and morbid obese patients, and the S probe (5.0 MHz) for use in children<sup>1</sup>.

## When and how to use VCTE

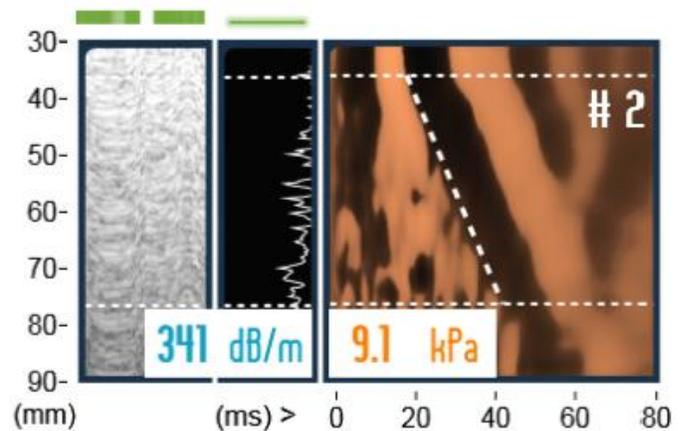
VCTE is widely available and is commonly installed in Hepatology clinics. VCTE is used in many liver diseases including viral hepatitis, alcoholic liver disease, nonalcoholic fatty liver disease and autoimmune liver disease. In general, (1) operators should perform at least 10 valid measurements. The VCTE device assesses measurement quality and automatically rejects measurements that do not meet proprietary quality criteria. (2) Overall study quality can be evaluated using measurement variability criteria, as follows: 'very reliable' ( $IQR/M \leq 0.10$ ), 'reliable' ( $0.10 < IQR/M \leq 0.30$ ), or  $IQR/M > 0.30$  with median stiffness value  $< 7.1$  kPa), and 'poorly reliable' ( $IQR/M > 0.30$  with median stiffness value  $\geq 7.1$  kPa)<sup>2</sup>.

## Accuracy of VCTE

VCTE has been shown to be highly accurate for the diagnosis of cirrhosis (stage F4 fibrosis) and to have intermediate accuracy for the differentiation of liver fibrosis  $\geq$  METAVIR stage F2 from F0 and F1 fibrosis. Meta-analyses have shown that mean AUROC for the diagnosis of  $F \geq 2$ ,  $F \geq 3$  and  $F = 4$  are 0.84 (95% CI, 0.82-0.86), 0.89 (95% CI, 0.88-0.91), and 0.94 (95% CI, 0.93-0.95), respectively<sup>3</sup>.

## Limitations of VCTE

VCTE does not produce images of the underlying liver anatomy. VCTE does not work through perihepatic ascites. Morbid obesity can lead to measurement failure owing to failure of transmission of the mechanical or ultrasound pulse through the thickened body wall. The XL probe improves measurement quality in this situation but does not entirely mitigate the effect of obesity.



Time Motion (TM) and Amplitude (A) mode shear wave propagation images. TM and A modes are used to choose the measurement area. y-axis is distance from skin, x-axis is time. Slope of the dashed line represents shear wave speed ( $V_s$ ). In the left panel, controlled attenuation parameter (CAP) value is presented (blue). CAP is an integrated technology which quantifies steatosis severity, simultaneously to liver fibrosis quantification.

## References:

1. Ozturk, A., Grajo, J. R., Dhyani, M., Anthony, B. W. & Samir, A. E. Principles of ultrasound elastography. *Abdom. Radiol.* **43**, 773–785 (2018).
2. Boursier, J. *et al.* Determination of reliability criteria for liver stiffness evaluation by transient elastography. *Hepatology* **57**, 1182–1191 (2013).
3. Friedrich-Rust, M. *et al.* Performance of Transient Elastography for the Staging of Liver Fibrosis: A Meta-Analysis. *Gastroenterology* **134**, 960–974 (2008).