

Vibration Controlled Transient Elastography (VCTE)

SHORT DESCRIPTION OF THE TECHNOLOGY

First approved in Europe in 2003, Vibration Controlled Transient Elastography (VCTE) is a noninvasive technology used to measure liver fibrosis. It uses a mechanical vibrator to produce a low-frequency (50 Hz) elastic shear wave propagated through the liver. Ultrasounds track this shear wave and measure its velocity, which is directly related to tissue stiffness or elasticity (E , in kPa), also called the elastic modulus (expressed as $E = 3 \rho v^2$, where v is the shear velocity and ρ is the density of tissue, assumed to be constant). The stiffer the tissue, the faster the shear wave propagates. VCTE is now FDA approved in the USA since 2013.

VCTE is performed on a patient, lying supine, with the right arm elevated to facilitate access to the right liver lobe. The tip of the probe is placed between intercostal spaces (*cf. Figure 1*) at the level where a liver biopsy typically would be performed. The operator locates a liver portion at least 6 cm deep and free of large vascular structures, then presses the probe button to start the measurements (“shots”). The volume of liver measured, approximates a cylindrical portion of liver about 1 cm wide and 4 cm long (3 cm³) below the skin surface. The final result of a VCTE session is the median of successful measurements performed (expressed in kPa). A given investigation can be regarded as reliable if the following criteria are fulfilled:

- 1) A minimum of 10 valid measurements;
- 2) An interquartile range (IQR, reflecting the variability of measurements) $\leq 30\%$ of the median liver stiffness measurements value (IQR/median $\leq 30\%$)

Fibrosis results measurements can range from 1.5 to 75 kPa.



Figure 1: Liver stiffness measurement (LSM) by Vibration Controlled Transient Elastography (VCTE)

Several dedicated probes are available depending on patient morphology: an S probe (for children/babies), M probe (for non-overweight adult) and an XL probe (for overweight adult). These probes automatically adapt measurement readings for patient body type.

MAIN CLINICAL APPLICATIONS

VCTE has clinically meaningful applications that benefit the way in which patients are cared for with suspected or known liver disease. It has increasingly gained acceptance amongst patients and doctors alike, as a point-of-care technology that can be used in an outpatient clinic or office. Consequently, VCTE use translates into a significant decrease in the need for liver biopsy in routine practice and this trend has since been observed in most countries where VCTE has been implemented.

VCTE is now widely used in liver clinics and has been adopted as a first-line tool for liver fibrosis evaluation in treatment-naive patients with viral hepatitis. If VCTE is used with a biomarker test e.g. APRI score, diagnostic accuracy is enhanced even further. This has been recommended by the latest European Association for the Study of the Liver (EASL) clinical practice guidelines (2) and by American Association for the Study of Liver Diseases (AASLD) guidelines for management of viral hepatitis infection, for example (3)

In the era of better therapies being available for both hepatitis B and C, VCTE offers a point of care technology for rapid decision making. It will likely remain an important non-invasive technology for fibrosis evaluation in the strategy to eliminate viral hepatitis.

Use of VCTE has also been evaluated in other chronic liver diseases, and is strongly correlated to hepatic fibrosis in chronic hepatitis B (4, 5), HIV/HCV coinfection (6), NAFLD (7, 8), Alcoholic Liver Disease (9), cholestatic diseases such as PBC or PSC (10, 11) and autoimmune hepatitis (12).

In addition, VCTE has predictive for hepatic decompensation so it is useful to both help stratify cirrhotic patients into different categories of risk as has been recommended by the 2015 BAVENO VI guidelines for management of patients with compensated advanced chronic liver disease (13), and to screen for cirrhosis or detect undiagnosed chronic liver disease in the general population (14).

VCTE is superior to other technologies such as acoustic radiation force impulse imaging and shearwave elastography, given that their place in clinical practice remains to be defined.

The sensible use of VCTE includes selecting appropriate candidates and accepting some confounding factors (15). These include having an idea of the underlying disease state of the liver, excessive obesity very high transaminases (excessive inflammation affects kPa score) and the proximity of the last meal to the measurement performed (16).

CPT code:

There is a CPT code for this procedure: 91200 ("Transient Elastography, e.g. "FibroScan"), for "Liver elastography, mechanically induced shear wave (e.g. vibration), without imaging, with interpretation and report".

SUMMARY

Measurement of VCTE in assessing severity of liver disease is very well supported by a robust literature, with more than 1200 peer reviewed independent publications since 2003. It is now clear that the use of this technique is:

- ✓ Fast, and technically easy to perform by physicians or nurses after short training, with no previous experience in ultrasonography required (2)
- ✓ Highly reproducible (17)
- ✓ Noninvasive, safe and cost efficient (particularly when compared with liver biopsy) (18, 19).
- ✓ Well correlated with the degree of hepatic fibrosis in patients with chronic liver diseases (20).
- ✓ Well correlated with level of portal hypertension, and known to have prognostic value for occurrence of clinical complications such as oesophageal varices (13, 21, 22).

The use of such devices has the potential to improve care of patients with advanced liver disease by providing accurate and non-invasive assessment of liver fibrosis. The use of VCTE reduces the need for liver biopsies, which are expensive, prone to sampling errors and associated with intra and inter observer variability, and with risk of occasional morbidity and mortality.

With the planned elimination strategy by the WHO for viral hepatitis by 2030, the use of such technology will be key in settings such as ours where access to liver biopsy is not readily or widely available.

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