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Abstract #8

VELACUR: INITIAL RESULTS IN DISCRIMINATION OF PATIENTS AND HEALTHY VOLUNTEERS BASED ON FIBROSIS AND STEATOSIS

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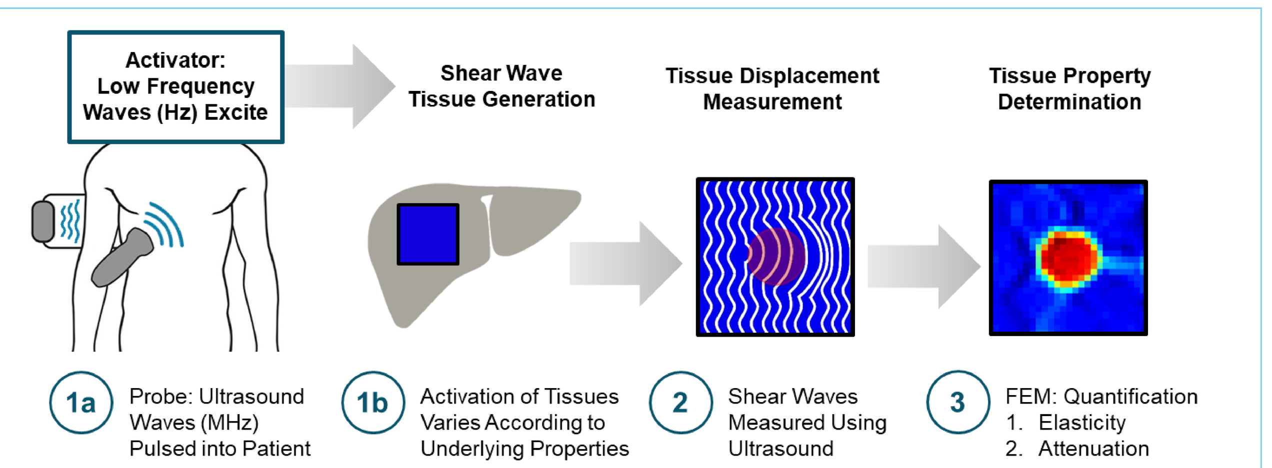
INTRODUCTION

Diagnostic core liver biopsy for assessing liver health has significant drawbacks including sampling bias and patient pain, leading to poor patient compliance[1]. Liver elasticity, or stiffness, is correlated with histological liver fibrosis stage and offers a non-invasive method for assessment and monitoring of liver fibrosis[2]. Ultrasound tissue attenuation is correlated with liver fat content, and is an increasingly important parameter given the rise of non-alcoholic fatty liver disease. Elasticity is most commonly measured by shear wave speed in Transient Elastography (FibroScan®)[3] or shear wavelength in steady-state elastography as in Magnetic Resonance Elastography (MRE)[4]. MRE is the non-invasive imaging method that provides the most accurate assessment of clinical fibrosis stage, when compared to biopsy[5].

AIM

To evaluate the ability of a Velacur™ prototype to discriminate between healthy volunteers and those with clinically diagnosed non-alcoholic fatty liver disease (NALFD) or prior Hepatitis C virus (HCV) infection. Exploratory objectives looked at the concordance and correlation between Velacur and MRE/MRI-PDFF.



Velacur™ technology overview

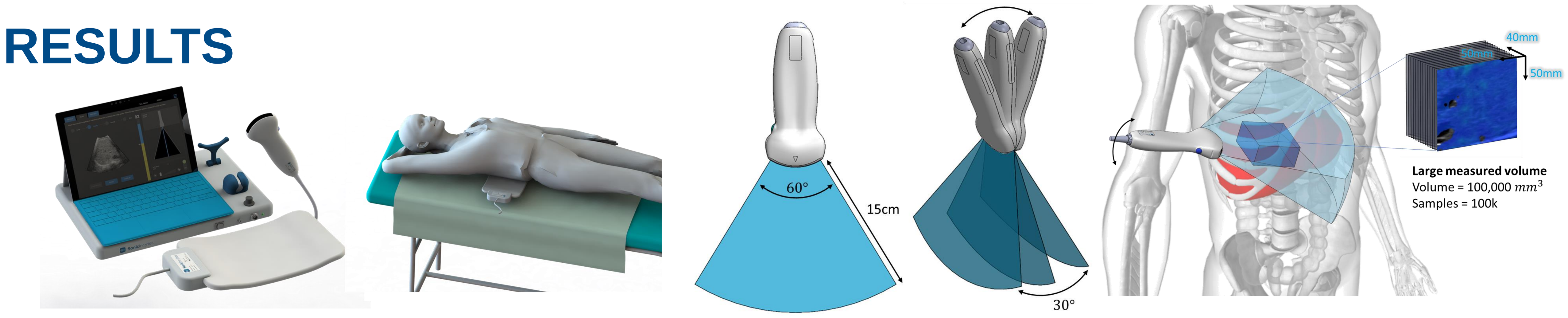
METHODS

We use a prototype elasticity measurement system (Velacur™, previously known as Liver Incytes, Sonic Incytes, BC, Canada) comprising of an ultrasound probe and an activation unit, to excite multi-frequency (40-70 Hz), steady-state shear waves in the patient. As with MRE, the shear wave field is measured over a volume and used to produce the average volumetric spatial elasticity.

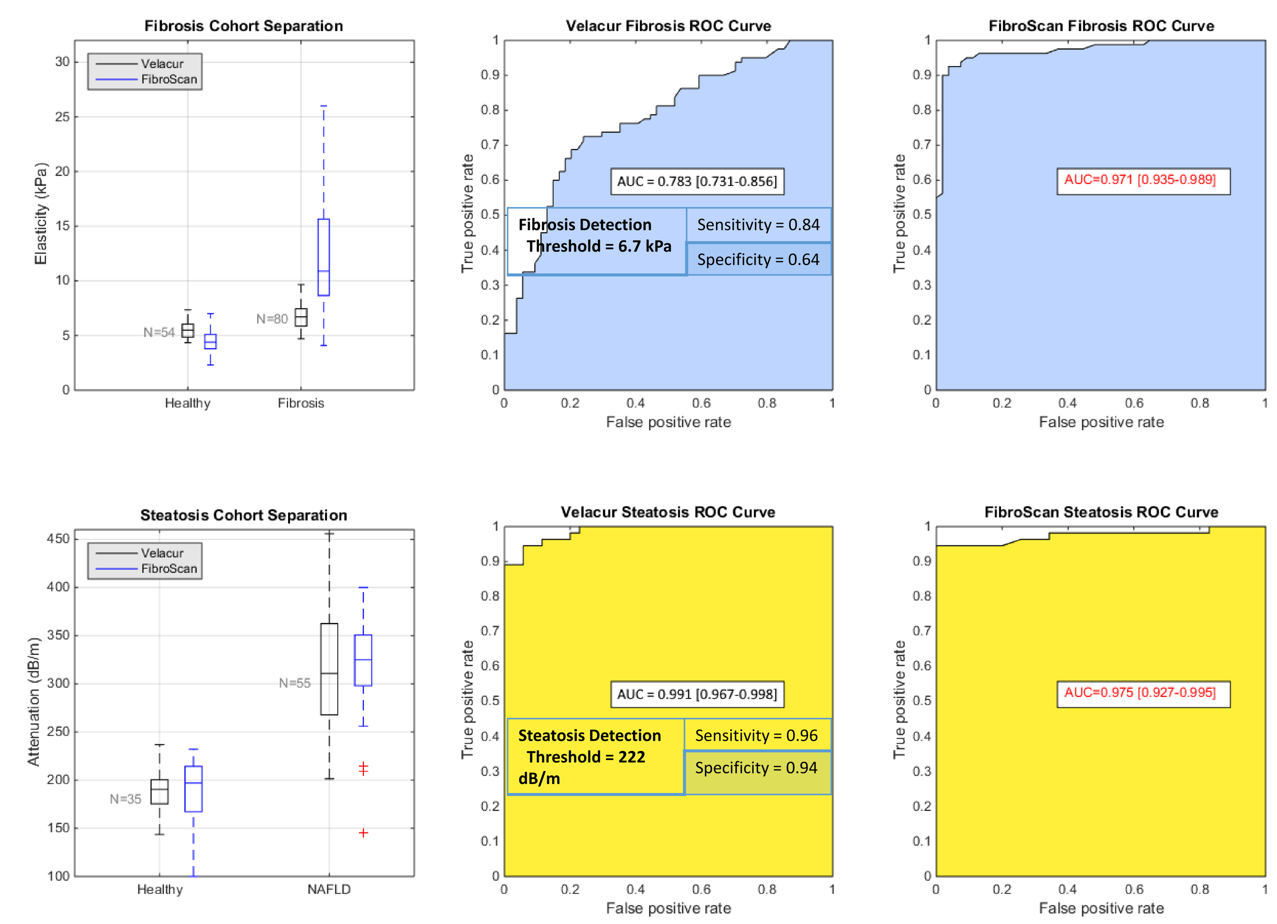
Data processing algorithms are based on previous work[6,7] and data presented here include new algorithms for automatic shear wave data quality assessment and for automatic vessel detection within the liver.

The multi-frequency approach provides an opportunity for averaging to reduce measurement uncertainty. Attenuation measurements are made from the ultrasound data captured simultaneously with elasticity measurements. Both patients (n = 86) and healthy volunteers (n = 54) participated in this study and were scanned with both Velacur, and FibroScan. A sub-set of participants agreed to undergo MRE/MRI-PDFF (n = 31).

RESULTS

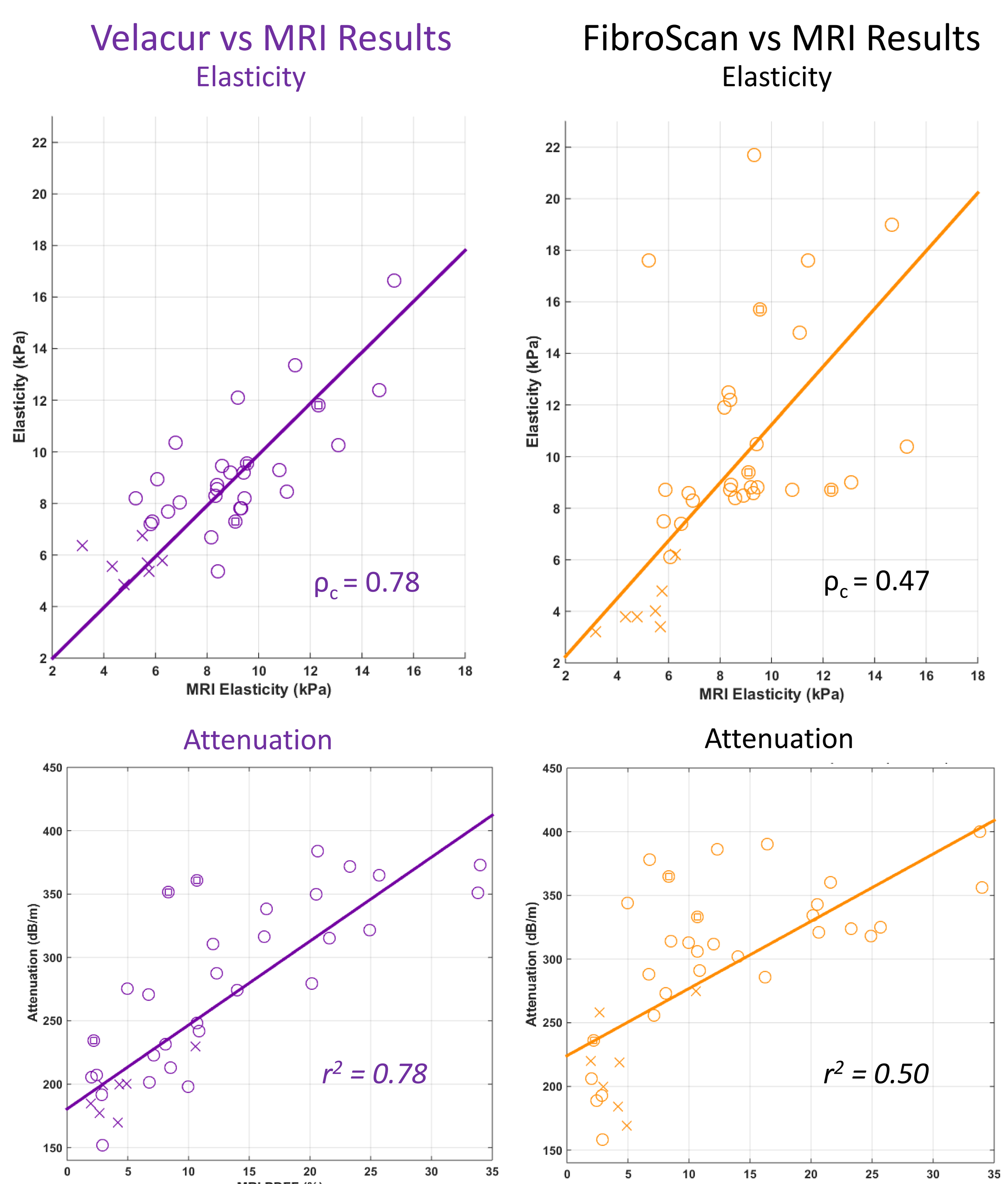


***Above**: The components of the Velacur prototype, including the ultrasound probe, the laptop to run software, the control unit to coordinate the signals and the activation unit which creates shear waves in the patient. A curvilinear abdominal ultrasound probe is used to image the liver volume. Using a sweep motion of the probe, multiple planes of ultrasound data at a depth of 15 cm are acquired over 30 degrees, in the elevational direction. **RIGHT:** A rendering of the general positioning of the probe, liver and measured volume. The blue cone shows how much of the liver can be seen in the ultrasound image. The cube within the liver (right) shows the large region which is used to measure the average elasticity and attenuation.*



***Above**: The cohort separation results for FibroScan and the Velacur prototype. Velacur was able to differentiate the two cohorts in both fibrosis and steatosis. Only healthy volunteers without steatosis and patients with diagnosed with NAFLD were included in the steatosis separation.*

	Healthy	Patients
Number of Enrolments	54	59 NASH, 27 HCV SVR
Number of MRI scans	4 (+3 from prior work)	31
Average Age (range)	28 (19 - 61)	59 (31 - 75)
Average BMI (range)	23.9 (17 - 31.7)	30.9 (18.8 – 41.6)
Median AST (range)		28 (6 – 367)
Median ALT (range)		30 (9 – 217)
Median Platelets (range)		201.5 (63 - 536)
Median Fib-4 (range)		1.475 (0.33 – 7.165)
Elasticity (med ± IQR, kPa)		
Velacur	6.656 ± 1.7	7.67 ± 2.2
FibroScan	4.64 ± 0.6	12.76 ± 1.9
FibroScan Probe	M = 50, XL = 4	M = 41, XL = 44
Attenuation (med ± IQR, dB/m)		
Velacur ACE	215.99 ± 27.7	279.73 ± 30.1
FibroScan CAP	207.31 ± 46.3	293.65 ± 34.9



***Far Above:** Graphs of the concordance coefficient (ρ_c) between Velacur and MRE in purple and FibroScan and MRE in orange. The solid lines are linear fits which cross the origin.*
***Near Above**: Graphs of the correlation coefficient (r^2) between Velacur ACE and MRI-PDFF in purple and FibroScan CAP and MRI-PDFF in orange.*
All graphs include some healthy volunteers from a previous pilot study, and 3 patients were removed as invalid scans due to user or technical error.

CONCLUSIONS

The results from this study demonstrate the promise of this technique for quantitative non-invasive assessment of elasticity and attenuation in volunteers and patients with chronic liver disease. The ability for this Velacur™ prototype, to discriminate between healthy volunteers and patients with liver disease is comparable to FibroScan®, used in current clinical practice.

There is excellent concordance between Velacur elasticity and MRE, at 0.78. The correlation between Velacur attenuation and MRI-PDFF results is also excellent.

The Velacur prototype has proved that it:

- Can recognize advanced disease
- Can scan patients with high BMI, up to 42 kg/m^2
- Has larger measured volume than current clinical care
- Shows higher concordance with MRE
- Correlates well with MRI-PDFF
- Has benefits of portability and accessibility
- Can be used successfully by different user types

These qualities make it suitable for point-of-care diagnosis and regular patient monitoring during and after treatment.

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