PRIOR COMMUNICATION
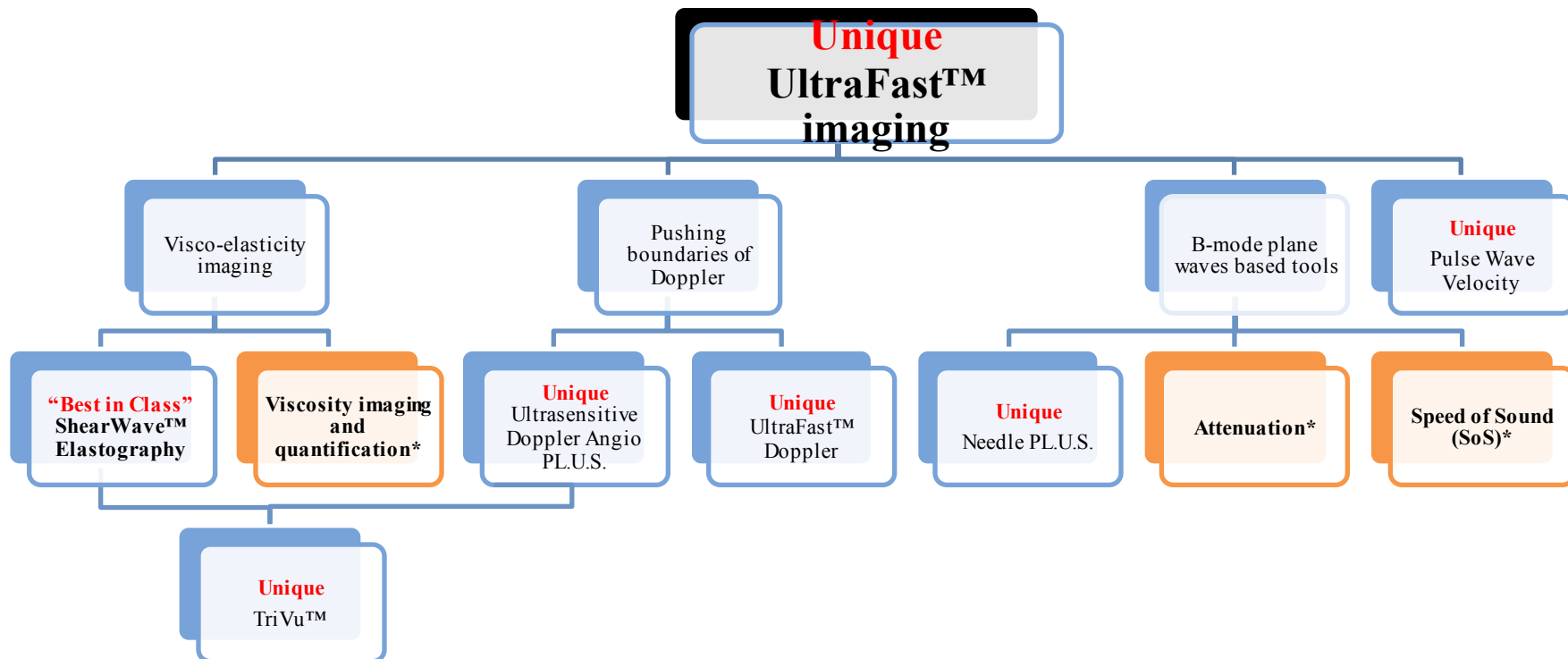
NEW TOOLS FOR LIVER ASSESSMENT

SUPERSONIC IMAGINE – Pioneers in Innovative Imaging Modes

Pioneers in the development of Innovative Imaging Modes in response to clinical challenges, leveraging unique UltraFast™ Imaging performance.

… in 2009, SuperSonic Imagine **introduced ShearWave™ Elastography (SWE)** in the ultrasound market, as a unique solution for **tissue stiffness quantification.**

* Imaging modes / features not yet available on SuperSonic Imagine products.

NEW TOOLS FOR LIVER ASSESSMENT

Coming this Summer 2019 for your Aixplorer MACH 30 systems!

Three new quantitative ultrasound tools, based on SSI-specific UltraFast^{TM} technology, for the evaluation of different indicators of the chronic liver diseases severity (such as NAFLD, NASH, HBV, HCV…):

- **Ultrasound Beam Attenuation**

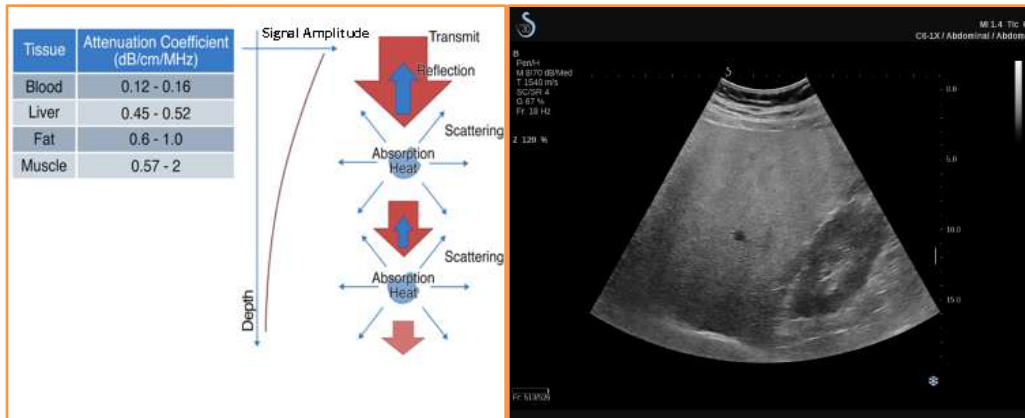- **Speed of Sound**

- **Viscosity Imaging**

NEW TOOLS FOR LIVER ASSESSMENT
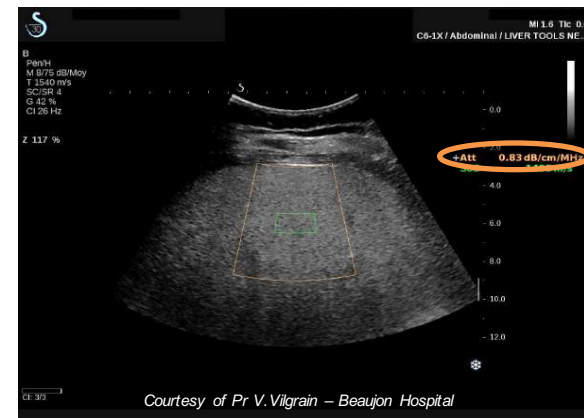
❖ Attenuation

The attenuation measurement tool allows the quantification of the ultrasound beam attenuation in the liver through a B mode region of interest :

- Measurement of the decrease in amplitude of the ultrasound waves as they propagate, as a function of frequency.

- Mesurement performed through a large ROI.

- Instantaneous result displayed on the 2D image (dB/cm/MHz), simultaneously acquired with the Speed of Sound thanks to UltraFast™ technology.

- The higher the attenuation coefficient ; the higher the intrahepatic fat level ; the more severe grade of hepatic steatosis.*

➜ **Attenuation tool seems to be an essential non-invasive biomarker to assess hepatic steatosis severity.**

Hepatic Steatosis – B Mode

Courtesy of Pr V. Vilgrain – Beaujon Hospital
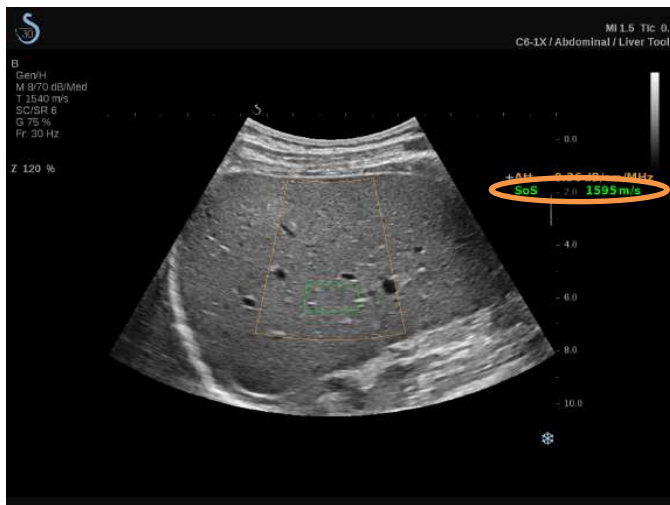
Hepatic Steatosis with Attenuation quantification
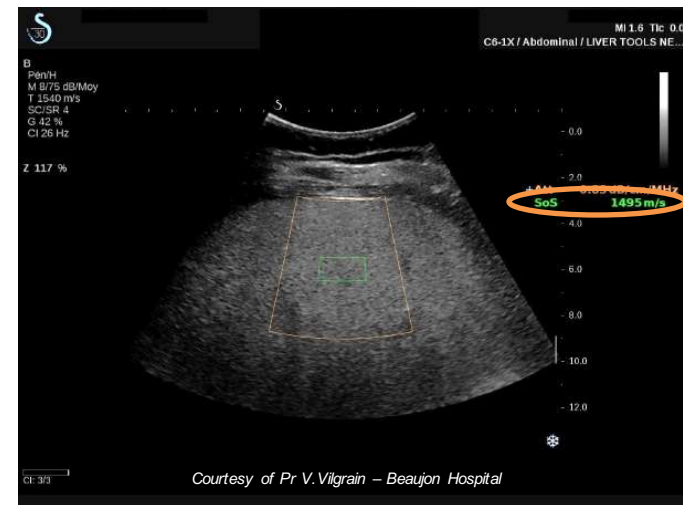
❖ **Speed of Sound (SoS)**

The Speed of Sound measurement tool allows the quantification of the intrahepatic speed of sound from B mode :

- SoS optimization in a targeted region of the liver, performed on a large amount of images (using UltraFast^{TM} technology) to obtain the SoS giving the best image quality in this ROI. This SoS represents the speed of sound in the rest of the liver.
- Instantaneous result displayed on the 2D image (m/s), simultaneously acquired with Attenuation thanks to UltraFast^{TM} technology.
- The lower the speed of sound ; the higher the intrahepatic fat level ; the more severe grade of hepatic steatosis.**

➔ **SoS tool seems to be an essential non-invasive biomarker to assess hepatic steatosis severity.**

Healthy Liver with Speed of Sound quantification

Courtesy of Pr V. Vilgrain – Beaujon Hospital

Hepatic Steatosis with Speed of Sound quantification

** Dioguardi Burgio et al, Ultrasonic Adaptive Sound Speed Estimation for the Diagnosis and Quantification of Hepatic Steatosis: A Pilot Study, Ultraschal Med 2018 Nov 5   ** Imbault et al, Robust sound speed estimation for ultrasound based hepatic steatosis assessment, 2017 Phys. Med Biol,

NEW TOOLS FOR LIVER ASSESSMENT

❖ Viscosity Imaging

This tool allows real-time visualization and quantification of tissue viscosity:

- Shear wave dispersion spectroscopy (analysis of shear wave propagation velocity at several frequencies), giving access to the shear wave dispersion measurement correlated to tissue viscosity (Pa.s).

- Combined in real-time with elasticity imaging (SWE), without compromising on 2D image quality.

- The higher the viscosity value; the higher the inflammation level (necro-inflammatory activity) in the liver.*

- **Viscosity Imaging seems to be an essential non-invasive biomarker to assess chronic liver diseases severity.**

**
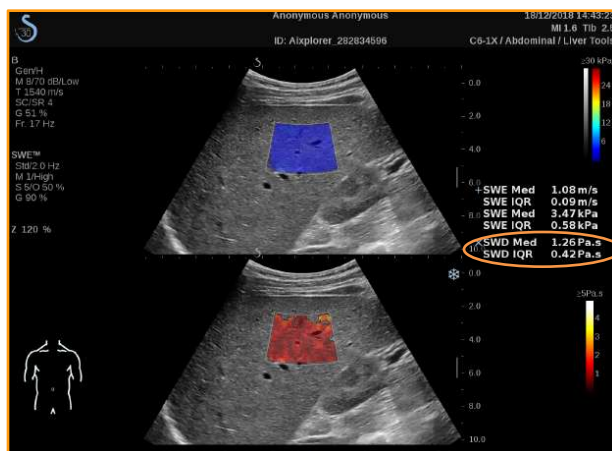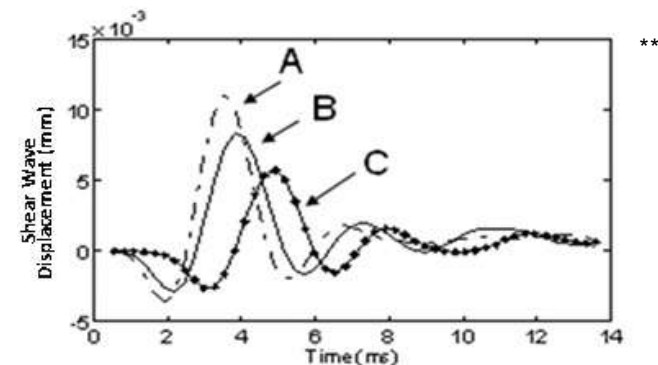
Healthy Liver

*Courtesy of Pr V. Vilgrain – Beaujon Hospital*

Assumed Liver Cirrhosis

* Christopher et al, Shear wave dispersion measures liver steatosis. Ultrasound in Med. &Biol., 2011 * Katsutoshi Sugimoto et al., Viscoelasticity measurement in rat livers using shear-wave elastography, Ultrasound in Med. & Biol., 2018 * Barry et al., Shear Wave Dispersion in Lean Versus Steatotic Rat Livers, J Ultrasound Med 2015
** Deffieux T et al, Shear Wave Spectroscopy for in Vivo Quantification of Human Soft Tissues Visco-Elasticity, IEEE Transactions on Medical Imaging, 2009

A COMPLETE SOLUTION FOR THE DIAGNOSIS OF CHRONIC LIVER DISEASES

❖ The arrival of these new innovative modes reinforces the positioning of SuperSonic Imagine as a major player in multiparametric ultrasound imaging of chronic liver diseases assessment, by obtaining the following information for the same patient:

 – Morphological characteristics through an amazing B-mode image quality.

 – Liver fibrosis staging through stiffness measurement (SWE™).

 – Hepatic Steatosis level through speed of sound measurement (SoS), and ultrasound beam attenuation measurement.*

 – Necro-inflammatory activity level through viscosity measurement.*

 – Perfusion (CEUS) and micro-vascularization (Angio PL.U.S) information allowing focal liver lesions characterization.

 – Information allowing prevention portal hypertension complications through SWE Spleen measurement.
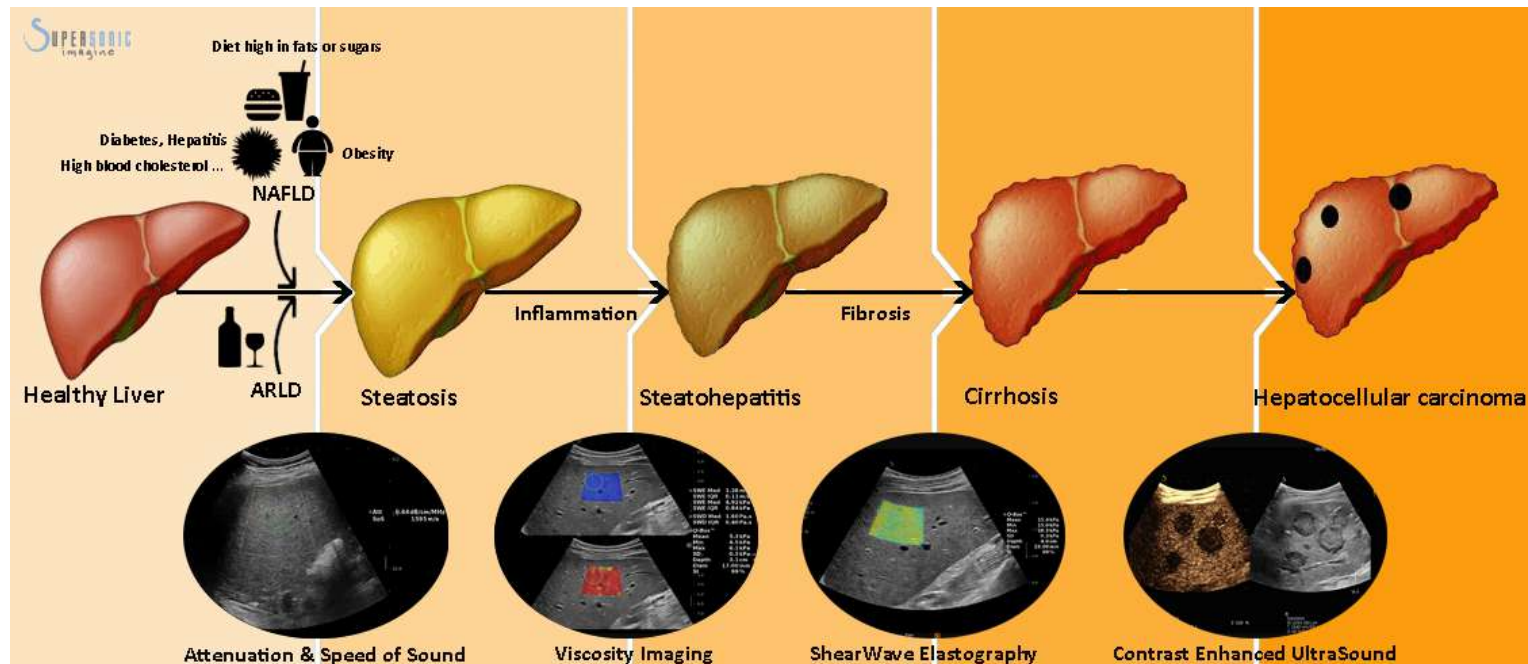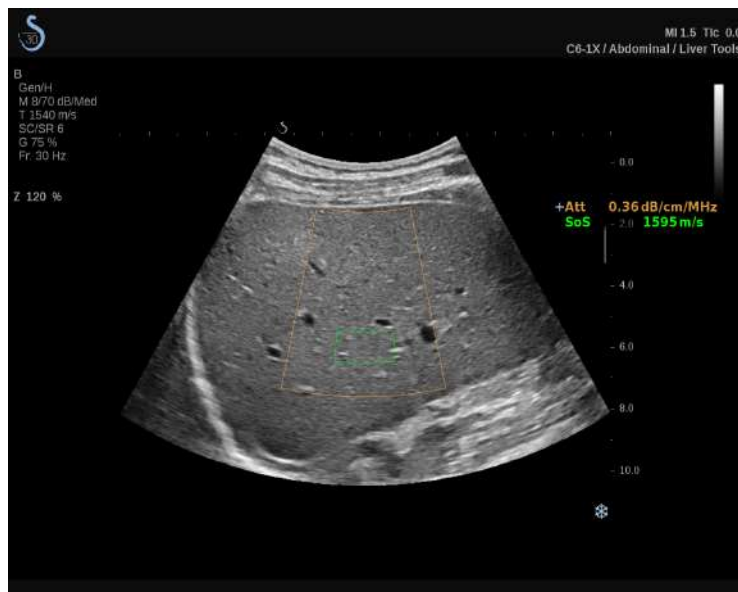

*Must be confirmed by clinical studies

CLINICAL CASES

CLINICAL CASE 1: HEALTHY PATIENT

Parameters	Results	Pathology Scoring
Attenuation	0.36 dB/cm/MHz	Probable S0 *
SoS	1595 m/s	Probable S0 **
Stiffness	3.47 kPa	F0/F1 ***
Viscosity	1.26 Pa.s	Probable A0 / S0 ****

Healthy Liver with Speed of Sound and Attenuation quantification

Healthy Liver with Stiffness and Viscosity visualization and quantification

* Fujiwara et al., The b-mode image-guided ultrasound attenuation parameter accurately detects hepatic steatosis in chronic liver disease, Ultrasound Med. & Biol., Vol. 00, No. 00, pp. 1-10, 2018
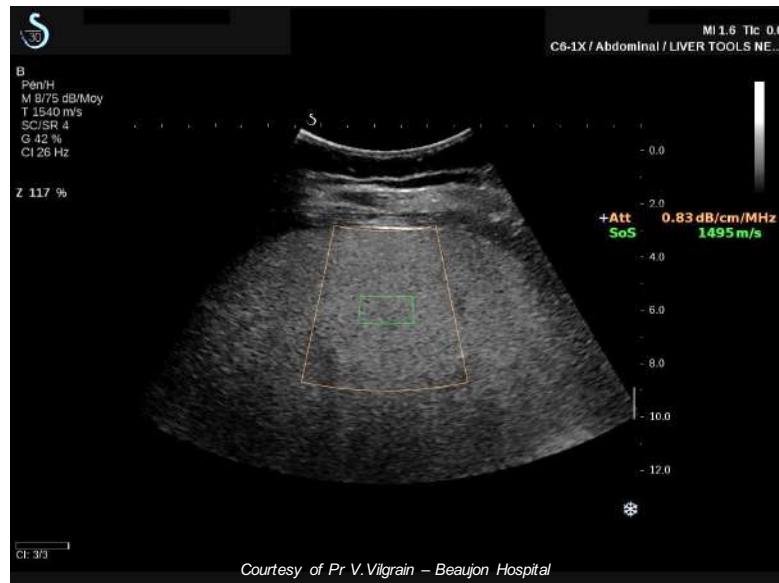** Dioguardi Burgio et al., Ultrasonic Adaptive Sound Speed Estimation for the Diagnosis and Quantification of Hepatic Steatosis: A Pilot Study, Ultraschall Med. 2018 Nov 5.
*** MKG.EC.100 (Rev B) - Aixplorer AixplorerUltimate_Guide assessment fibrosis steatosis - Proposed diagnostic cut-off values and their performance for the evaluation of liver fibrosis severity by SWE™ - NASH - SuperSonic Imagine
**** Preliminary Internal R&D Study " Etude RND SSI hépatopathies chroniques 29072018" - SuperSonic Imagine

CLINICAL CASE 2: OBESE PATIENT WITH KNOWN TYPE II DIABETES

Parameters	Results	Pathology Scoring
Attenuation	0.83 dB/cm/MHz	Probable S3 *
SoS	1495 m/s	Probable S1-S3 **
Stiffness	4.79 kPa	F0/F1***
Viscosity	1.88 Pa.s	Probable A1 to A2 / S2****

Courtesy of Pr V. Vilgrain – Beaujon Hospital

Courtesy of Pr V. Vilgrain – Beaujon Hospital

* Fujiwara et al., The b-mode image-guided ultrasound attenuation parameter accurately detects hepatic steatosis in chronic liver disease, Ultrasound Med. & Biol., Vol. 00, No. 00, pp. 1-10, 2018
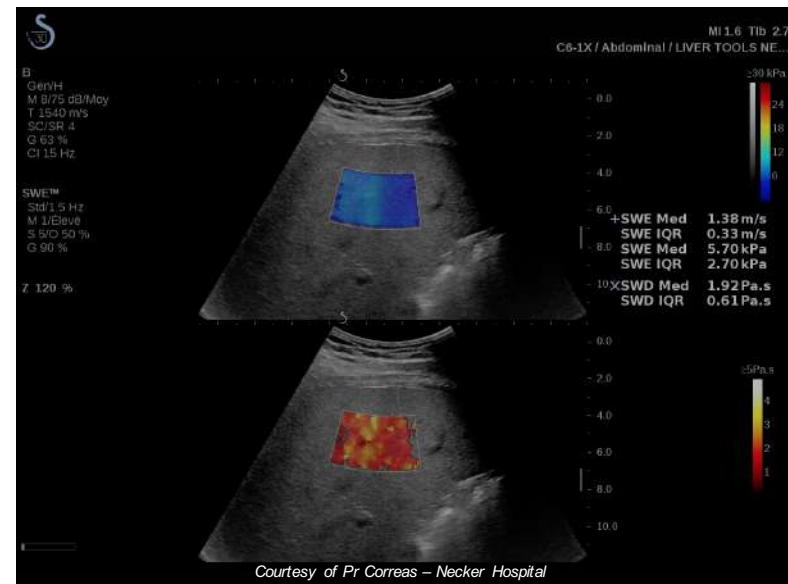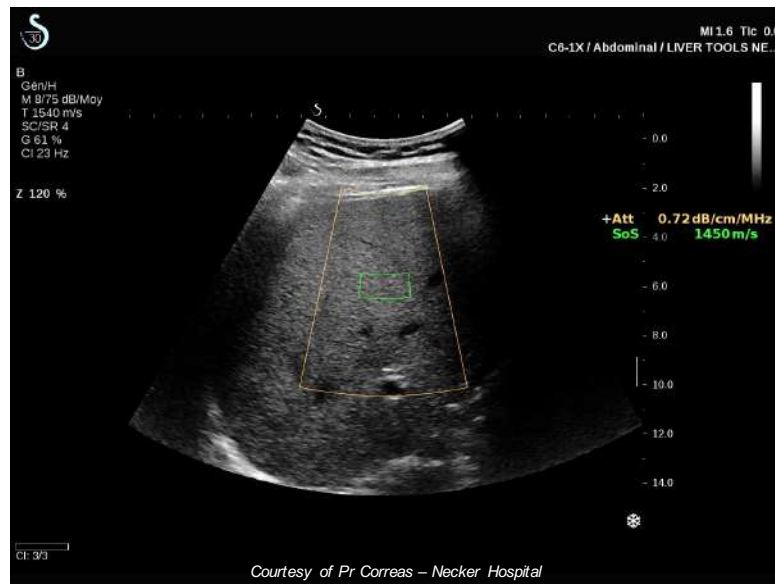** Dioguardi Burgio et al., Ultrasonic Adaptive Sound Speed Estimation for the Diagnosis and Quantification of Hepatic Steatosis: A Pilot Study, Ultraschall Med. 2018 Nov 5.
*** MKG.EC.100 (Rev B) - Aixplorer Aixplorer Ultimate_Guide assessment fibrosis steatosis - Proposed diagnostic cut-off values and their performance for the evaluation of liver fibrosis severity by SWE™ - NASH - SuperSonic Imagine
**** Preliminary Internal R&D Study " Etude RND SSI hépatopathies chroniques 29072018" - SuperSonic Imagine

CLINICAL CASE 3: OBESE CHILDREN WITH KNOWN TYPE II DIABETES

Parameters	Results	Pathology Scoring
Attenuation	0.72 dB/cm/MHz	Probable S3 *
SoS	1450 m/s	Probable S1-S3 **
Stiffness	5.70 kPa	F0/F1 ***
Viscosity	1.92 Pa.s	Probable A1 to A2 / ****

Courtesy of Pr Correas – Necker Hospital

Courtesy of Pr Correas – Necker Hospital

* *Fujiwara et al., The b-mode image-guided ultrasound attenuation parameter accurately detects hepatic steatosis in chronic liver disease, Ultrasound Med. & Biol., Vol. 00, No. 00, pp. 1-10, 2018*
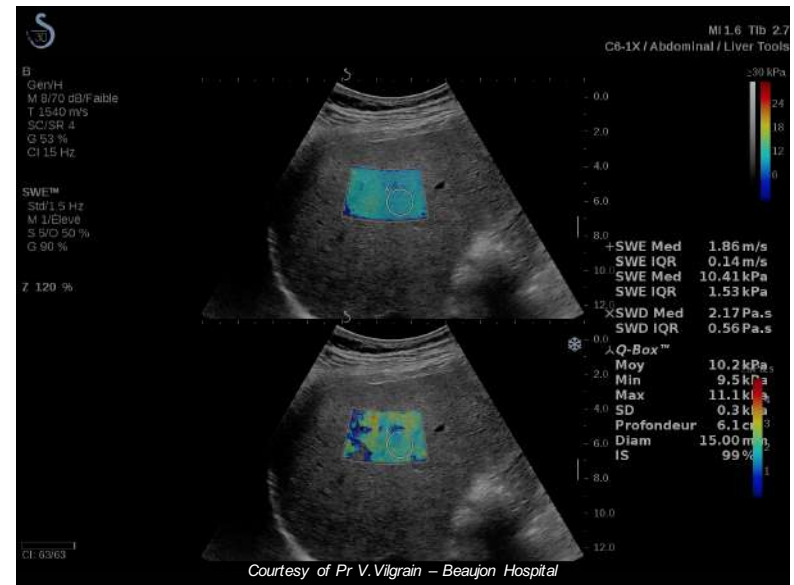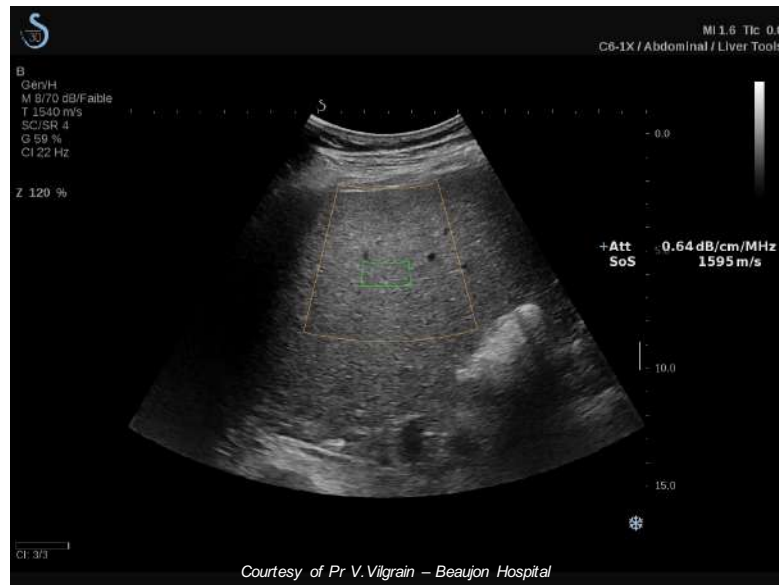** *Dioguardi Burgio et al., Ultrasonic Adaptive Sound Speed Estimation for the Diagnosis and Quantification of Hepatic Steatosis : A Pilot Study, Ultraschall Med. 2018 Nov 5.*
*** *MKG.EC.100 (Rev B) - Aixplorer AixplorerUltimate_Guide assessment fibrosis steatosis - Proposed diagnostic cut-off values and their performance for the evaluation of liver fibrosis severity by SWE™ - NASH - SuperSonic Imagine*
**** *Preliminary Internal R&D Study " Etude RND SSI hépatopathies chroniques 29072018" - SuperSonic Imagine*

Parameters	Results	Pathology Scoring
Attenuation	0.64 dB/cm/MHz	Probable S2 *
SoS	1595 m/s	Probable S0 **
Stiffness	10.41 kPa	F3/F4***
Viscosity	2.17 Pa.s	Probable A3 / S2 ****

Courtesy of Pr V. Vilgrain – Beaujon Hospital

Courtesy of Pr V. Vilgrain – Beaujon Hospital

* Fujiwara et al., The b-mode image-guided ultrasound attenuation parameter accurately detects hepatic steatosis in chronic liver disease, Ultrasound Med. & Biol., Vol. 00, No. 00, pp. 1-10, 2018
** Dioguardi Burgio et al., Ultrasonic Adaptive Sound Speed Estimation for the Diagnosis and Quantification of Hepatic Steatosis : A Pilot Study, Ultraschall Med. 2018 Nov 5.
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