Aixplorer® Tips

Evaluation of Liver Fibrosis using ShearWave™ Elastography on Aixplorer®

SSID02892-01
November 2012

Introduction

From a clinical standpoint, staging liver fibrosis is of major importance[1, 2]:

- to make a prognosis
- to follow up the evolution of chronic liver diseases (cirrhosis or hepatitis)
- to monitor antifibrotic treatments

The stage of the fibrosis is correlated to the stiffness of the tissue, which is also correlated to the velocity of the shear wave

ShearWave™ Elastography (SWE™) performed with Aixplorer® is a 2D imaging mode[1,3] that provides a view of the organ and a map of the shear wave velocity over the region of interest. With the Adjustable Numerical Scale, the map can be fine-tuned to highlight the stiffer or the softer parts of the ROI.

Apart from fibrosis, many studies demonstrated the influence of several clinical factors on liver stiffness:

1. Respiration[4], deep breath
2. Central venous pressure[5]
3. Intrahepatic cholestasis[6-7]
4. Hepatic necro-inflammatory activity (steatosis[8] for example)
5. Peliosis hepatitis (affection of the liver parenchyma vasculature)
6. Thrombosis of hepatic vein (clot)
7. Congestive hepatopathy[9]…

These should be considered when assessing liver stiffness.

The known limitations of conventional ultrasound examination also apply to the SWE™ mode: narrow intercostal spaces, thick layer of fat…
Noteworthy: the presence of ascites is not a limitation for the evaluation of liver fibrosis with SWE™.

Reference

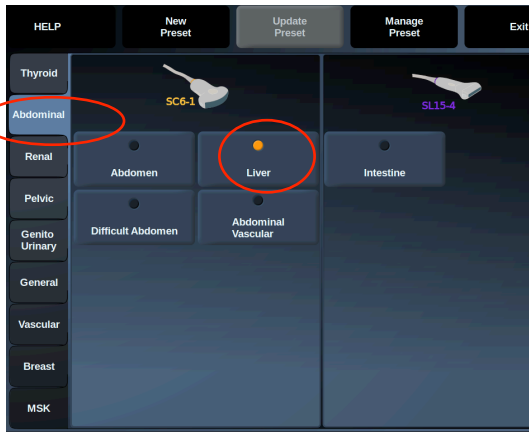
1. Quantitative viscoelasticity mapping of human liver using supersonic shear imaging: preliminary in vivo feasibility study. *Muller M, Gennisson JL, Deffieux T, Tanter M, Fink M.* Ultrasound Med Biol. 2009 Feb;35(2):219-29.
2. Management of Hepatitis C: June 2002. *National Institute of Health Consensus Development Conference Statement.* Hepatology 2002; 36[5 suppl 1]:S3–S20
3. Supersonic shear imaging: A new technique for soft tissues elasticity mapping. *Bercoff J, Tanter M, Fink M.* IEEE Trans Ultrason Ferroelectr Freq Control 2004c;51(4):396–409.
4. The effect of the respiratory cycle on liver stiffness values as measured by transient elastography. *Yun MH, Seo YS, Kang HS, Lee KG, Kim JH, An H, Yim HJ, Keum B, Jeen YT, Lee HS, Chun HJ, Um SH, Kim CD, Ryu HS.* J Viral Hepat. 2010 Oct 4.
5. Liver stiffness is directly influenced by central venous pressure. *Millonig G, Friedrich S, Adolf S, Fonouni H, Golriz M, Mehrabi A, Stiefel P, Pöschl G, Büchler MW, Seitz HK, Mueller S*. J Hepatol. 2010 Feb;52(2):206-10.
6. Transient elastography. *Della Valle S, Branchi F, Rigamonti C, Fraquelli M.* Recenti Prog Med. 2009 Apr;100(4):195-201.
7. Transient elastography (FibroScan): a new tool in hepatology. *Vergniol J, de Lédinghen V.* Presse Med. 2009 Oct;38(10):1516-25.
8. Ultrasound-based Hepatic Elastography Origins, Limitations, and Applications, Eric B. Cohen, MD* and Nezam H. Afdhal, MDw (J Clin Gastroenterol 2010;44:637–645).
9. Hepatic congestion plays a role in liver stiffness. *Frulio N, Laumonier H, Balabaud C, Trillaud H, Bioulac-Sage P.* Hepatology. 2009 Nov;50(5):1674-5.

Imaging & Quantification Protocol

1. The patient

- He/she lies in the supine position, with the right arm in maximum abduction to make the right hypochondrium accessible.
- Fasting is mandatory.
- Normal breathing is recommended.

2. The probe



- Choose the SC6-1 curved probe, with the preset "**Liver**" in the "Abdominal" application.
- Scan intercostally (probe parallel to the intercostal space within the space) with sufficient gel and minimize rib shadowing. If SWE signal is weak, unstable, and/or not visible, apply a pressure on the probe to open the rib space (improve the acoustic window) and decrease tissue thickness between the probe and the ribs. Contrary to what has been recommended as a rule for most of the organs, a **pressure must be applied to the probe** when scanning the liver. The ribs will absorb the pressure and the elasticity of the liver will not be impacted.
- The patient can be scanned subcostally, although it is not recommended. If scanned subscostally, apply the slightest pressure required for visualization in B-Mode.
- Slow or even no movement of the probe is recommended to avoid motion artifact and to stabilize the map.

The SWE™ acquisition of the right lobe is recommended in priority. However, if it has to be performed on the left lobe, apply the slightest pressure required for visualization in B-Mode. Be aware that the SWE™ acquisition on the left lobe is more subtle and requires no pressure.

3. SWE™ and the B-Mode image

The brightness of the B-Mode image is related to the best acoustic window for the SWE velocity map. **Ensure the optimal B-Mode image before engaging the SWE™ Mode and placing the SWE™ box:**

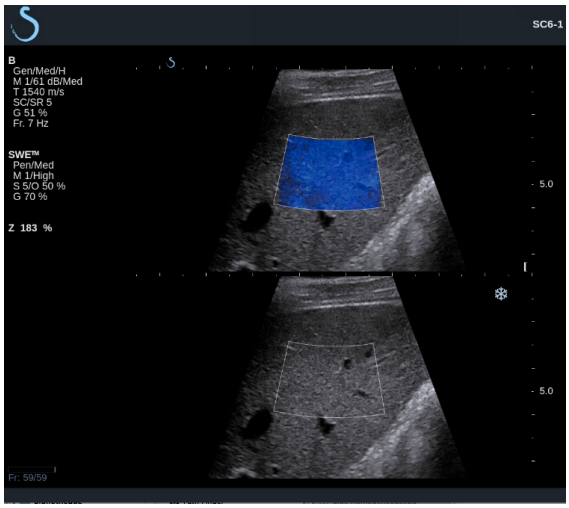
- Enlarge the intercostal space and decrease the thickness of the subcutaneous fatty layer, by using correct patient positioning and pressure on the probe.
- Ensure the optimum contact between the probe and the skin.
- Place the probe parallel to the intercostal window to avoid shadowing from the ribs.

4. The SWE™ Velocity map

Maintain pressure on the probe.
The SWE™ default settings have been optimized for the assessment of liver fibrosis. Run the first exam with the default settings.
Adjust them only if necessary.

a. *The SWE™ box*

- Move it onto a vessel-free parenchyma.
- Place it within a zone of uniform parenchyma as defined by the B-Mode image.
- Avoid placing the SWE™ box close to the liver capsule.
- The most robust acquisition is performed between 3 and 7 cm in depth.



b. *SWE™Optimization (Res/Std/Pen)*

If a lack of SWE™ signal is observed, turn to "Penetration"

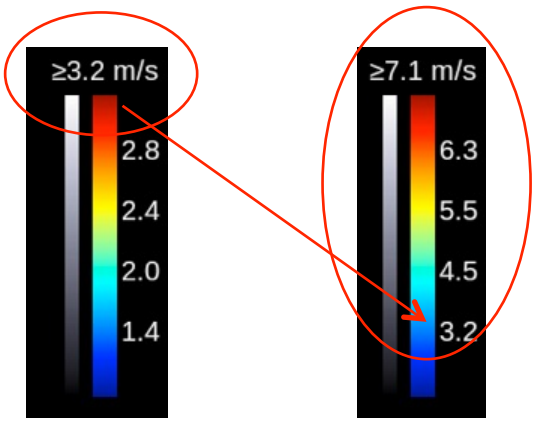
c. *Freezing the image*

- The patient should hold his/her breath for at least 4 seconds during the expiration phase.
- This delay allows sufficient filling of the SWE box and stabilization of the image in a no-movement context.
- Freeze

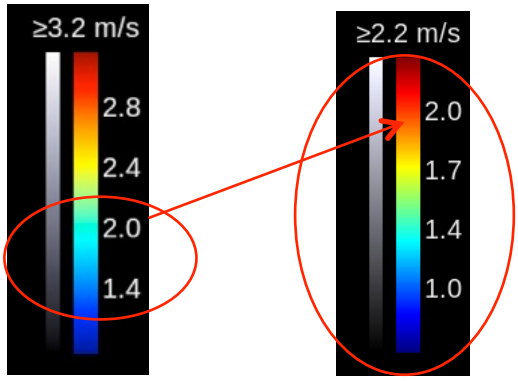
d. SWE™ Adjustable Numerical Scale (Live or frozen)

Default value: 0-3.2 m/s

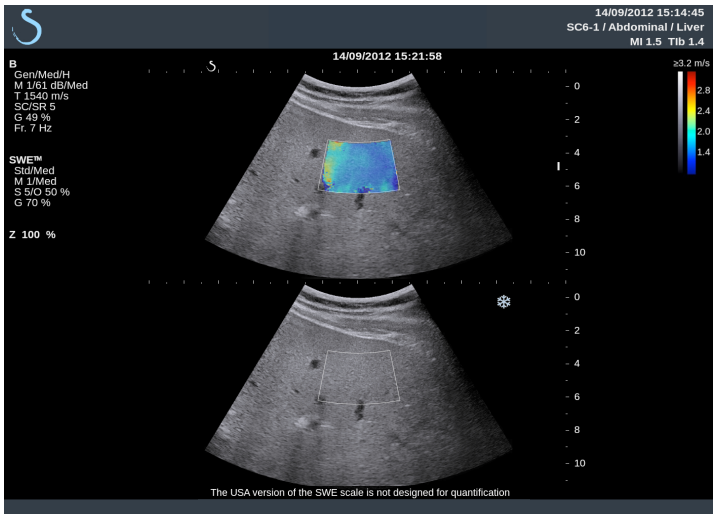
- Increasing the scale enables the velocities higher than 3.2 m/s to be spread over a wider range, hence to better discriminate the areas with different velocities higher than the default value.



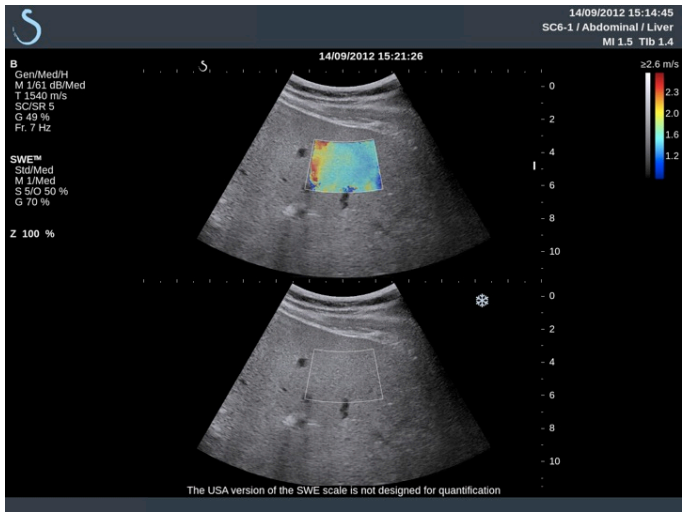
- Decreasing the scale enables the velocities lower than 3.2 m/s to be spread over a wider range, hence to better discriminate the areas with different velocities lower than the default value.



Default ANS: 3.2 m/s



Decreasing the ANS will show more details in softer tissue: 2.6 m/s

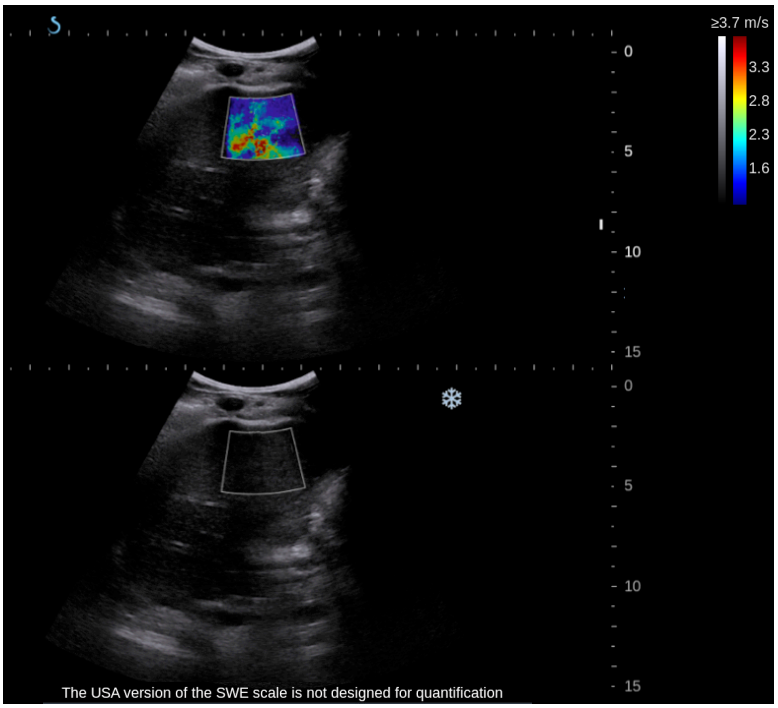


c. Assessing the reliability of the SWE™ acquisition

- Repeat this procedure 3 times to acquire 3 valid, independent SWE™ images of the same scanning view.

- If the 3 acquisitions are not similar, it is recommended to consider the test a failure.

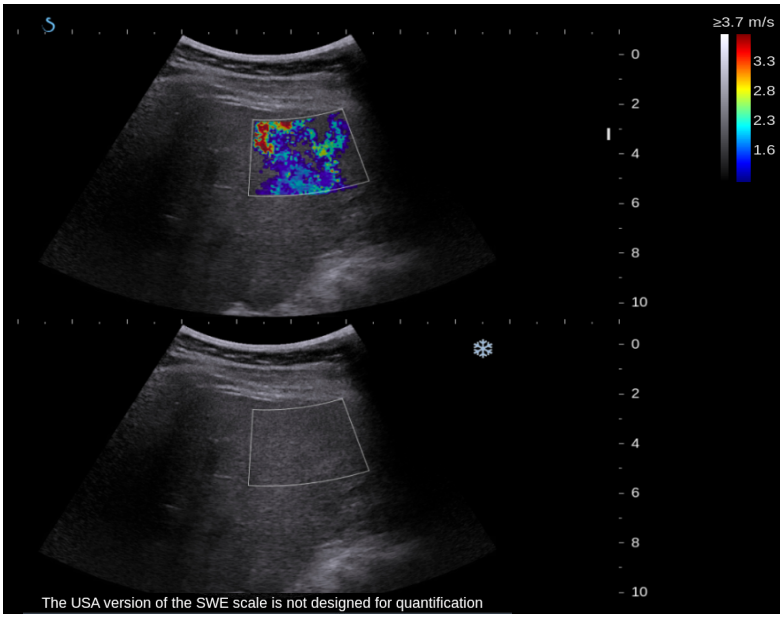
Examples of acquisitions that should be considered unsuccessful



B-mode image

Shadowing, poor image quality, rushed acquisition.

Non valid for the SWE™ Velocity map



SWE™ Velocity map

SWE box underneath the capsule, liver motion due to the patient's respiration, lack of SWE signal, rushed acquisition.

Non valid SWE™ acquisition

SuperSonic Imagine France
Les Jardins de la Duranne Bat E & F
510, rue René Descartes
13857 Aix-en-Provence Cedex
France
✆ +33 (0)4 42 99 24 32
🖷 +33 (0)4 42 52 59 21
✉ contactsFR@supersonicimagine.fr
Hotline (du lundi au vendredi
8h30-17h30) : 04 26 70 02 70

SuperSonic Imagine, Inc USA
11714 North Creek Parkway N, Suite 150
Bothell, WA 98011
USA
✆ +1 (425) 686 6380
🖷 +1 (425) 686 6387
✉ contactsUSA@supersonicimagine.com

SuperSonic Imagine Asian Distribution Network
Les Jardins de la Duranne Bat F
510, rue René Descartes
13857 Aix-en-Provence, France
✆ +33 (0)4 42 99 24 32
🖷 +33 (0)4 42 52 59 21
✉ contactsASIA@supersonicimagine.com

SuperSonic Imagine Ltd. UK
18, Upper Walk
Virginia Water
Surrey GU25 4SN
UK
✆ +44 (0)845 643 4516
✉ contactsUK@supersonicimagine.com

SuperSonic Imagine GmbH Deutschland
Dietlindenstr. 15
80802 München
Deutschland
✆ +49 89 36036 844
🖷 +49 89 36036 700
✉ contactsDE@supersonicimagine.com

www.supersonicimagine.com

SUPERSONIC imagine
The Theragnostic Company™