



Discordant 2D shear wave elastography values in post-Fontan patients with ascites: a potential interpretive pitfall

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Abstract

Fontan-associated liver disease (FALD) may progress to portal hypertension, ascites, and nodular liver remodelling. Two-dimensional shear wave elastography (2D-SWE) can be performed in patients with ascites, but its reliability in this setting remains uncertain. We report two post-Fontan patients with ascites and nodular liver morphology on B-mode ultrasound who showed markedly discordant liver stiffness values. The pediatric patient had high stiffness (median 24.25 kPa; IQR/median 3.4%), whereas the adult patient with clinical decompensation, large-volume ascites, and pleural effusion had unexpectedly low stiffness (median 9.55 kPa; IQR/median 23.6%). These cases suggest that substantial ascites may contribute to misleading 2D-SWE measurements. In post-Fontan patients, elastography should be interpreted alongside acquisition quality metrics, morphology, and clinical findings.

Keywords Fontan-associated liver disease · Two-dimensional shear wave elastography · Ultrasound · Ascites · Liver stiffness

Introduction

Fontan-associated liver disease (FALD) is a chronic complication of Fontan circulation characterized by hepatic congestion, progressive fibrosis, portal hypertension, and nodular remodelling. Because no uniform definition exists, several non-invasive modalities, including transient elastography (TE), two-dimensional shear wave elastography (2D-SWE), and magnetic resonance elastography (MRE), have been used to assess the Fontan liver.

2D-SWE is increasingly used in chronic liver disease because it provides real-time imaging, high spatial resolution, and assessment of a larger field of view than TE. However, in post-Fontan patients, liver stiffness may reflect hemodynamic congestion as well as fibrosis, which limits its specificity for parenchymal disease [1, 2].

Identifying clinically significant FALD remains challenging, yet features of portal hypertension are associated with poorer outcomes in the Fontan population [3]. Ascites is a recognized limitation of TE because elastic waves do not propagate through fluid. In contrast, 2D-SWE generates shear waves within the liver parenchyma and can therefore be performed in patients with ascites. However, evidence for its reliability in moderate-to-large ascites remains limited and inconsistent [4, 5].

We report two post-Fontan patients with ascites and nodular liver morphology on B-mode ultrasound who demonstrated markedly discordant 2D-SWE values, highlighting a potential interpretive pitfall in this setting.

2D-SWE acquisition protocol

2D-SWE examinations were performed using a GE LOGIQ E10 system with a C1-6 convex array transducer (central frequency 4 MHz). Measurements were obtained through a right intercostal approach, with the region of interest placed 15–20 mm below the liver capsule while avoiding major vessels, in accordance with general SWE acquisition recommendations. Patients fasted for at least 4 h before scanning.

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Case 1

An 8-year-old boy with prior Fontan palliation for double inlet left ventricle and a BMI of 15.0 kg/m² underwent 2D-SWE liver assessment as part of a research project. The interval between the Fontan operation and the 2D-SWE examination was 2 years.

Ultrasound showed hepatomegaly and mild-to-moderate ascites. B-mode imaging (Fig. 1) demonstrated hepatic nodules consistent with nodular remodelling in FALD. Median liver stiffness across 12 acquisitions was 24.25 kPa (IQR/median 3.4%).

Case 2

A 34-year-old man with prior Fontan palliation for double inlet left ventricle and double outlet right ventricle, with a BMI of 27.4 kg/m², presented with marked abdominal distension and dyspnea. The interval between the Fontan operation and the 2D-SWE examination was 23 years.

Ultrasound showed large-volume ascites and a left pleural effusion. B-mode imaging (Fig. 2) demonstrated a nodular liver with multiple nodules. Median liver stiffness across 12 acquisitions was 9.55 kPa (IQR/median 23.6%), an unexpectedly low value in the context of nodular morphology and clinical decompensation.

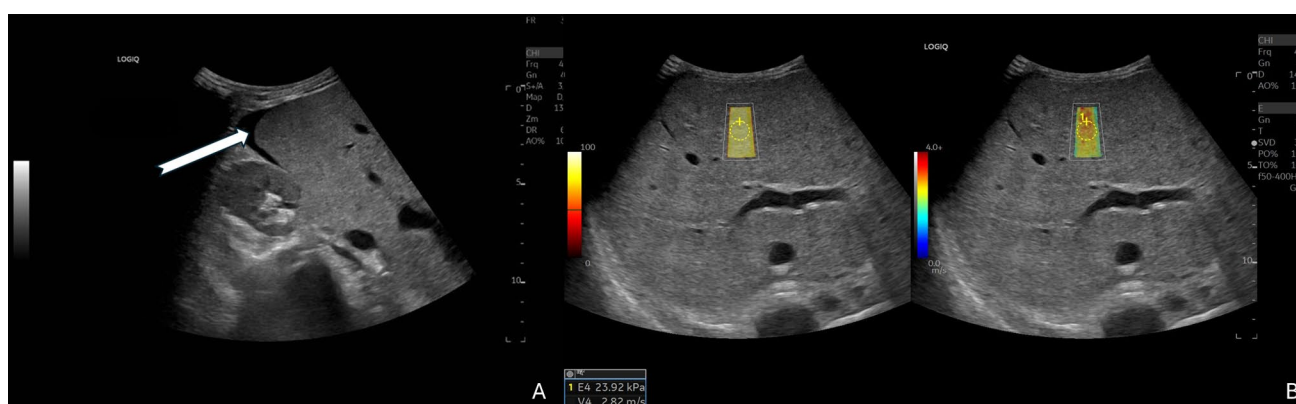


Fig. 1 8-year-old boy with prior Fontan palliation undergoing liver ultrasound and two-dimensional shear wave elastography (2D-SWE). **A** B-mode ultrasound demonstrates perihepatic ascites (arrow). **B** 2D-SWE. Right subpanel: quantitative stiffness map displayed within the rectangular elastography sampling box; the reported stiff-

ness value (example acquisition: liver stiffness 23.92 kPa; shear-wave speed 2.82 m/s) is measured within the circular measurement ROI (Q-Box). Left subpanel: corresponding quality map for the same sampling box and circular measurement ROI



Fig. 2 34-year-old man with prior Fontan palliation undergoing liver ultrasound and two-dimensional shear wave elastography (2D-SWE). **A** B-mode ultrasound demonstrates coarse heterogeneous parenchyma and an irregular liver contour (short arrow), with associated ascites (long arrow). **B** 2D-SWE. Right subpanel: quantitative stiff-

ness map displayed within the rectangular elastography sampling box; the reported stiffness value (example acquisition: liver stiffness 7.02 kPa; shear-wave speed 1.53 m/s) is measured within the circular measurement ROI (Q-Box). Left subpanel: corresponding quality map for the same sampling box and circular measurement ROI

Discussion

Although 2D-SWE can be performed in patients with ascites, these cases show that liver stiffness values may be difficult to interpret when they are discordant with B-mode morphology and clinical findings. In Fontan physiology, hepatic congestion may elevate stiffness independently of fibrosis, which complicates interpretation even in the absence of ascites [1]. Ascites adds further technical challenges, including increased depth, limited breath-holding, and motion or pulsatility artefact.

A recent study focused on patients with ascites reported an approximately 84% reliable measurement success rate for 2D-SWE and described common causes of failure or poor reliability, including depth, breath-hold limitations, and motion or pulsatility [5]. The literature remains mixed on whether ascites materially affects elastography quality [5]. In our adult case, large-volume ascites, pleural effusion, dyspnea, and the less favourable IQR/median may all have contributed to a misleadingly low or less reliable stiffness value despite nodular morphology.

Accordingly, 2D-SWE in post-Fontan patients with ascites should be interpreted as one component of a multiparametric assessment rather than as a stand-alone marker. Reports should include technique details and acquisition quality metrics, particularly the median and IQR/median, in line with current guidance [6]. When elastography values are discordant with B-mode findings or clinical features of portal hypertension, complementary assessment with Doppler hemodynamics, serum fibrosis indices, cross-sectional imaging, or MR elastography, when available, may provide more reliable characterization [1, 6].

Conclusion

In two post-Fontan patients with ascites and nodular liver morphology, 2D-SWE produced markedly discordant stiffness values. These cases suggest that substantial ascites may impair reliability and yield misleading measurements. Quality metrics and cautious multiparametric interpretation are therefore essential in FALD.

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Declarations

Conflict of interest None.

Ethical approval Institutional approval was obtained from the relevant hospital IRB (approval ID: 2025-964) and the university REC (Fast-Track/2025/85/Staff).

Consent to participate and for publication Written informed consent for publication of anonymized clinical information and images was obtained from the patient and/or the patient's parent or legal guardian, as appropriate, in accordance with the principles of the Declaration of Helsinki.

References

1. Inmutto N, Jantarangkoon A, Nimitrungtaewee N et al (2025) Doppler ultrasound and 2D shear wave ultrasound elastography for liver fibrosis evaluation in Fontan-associated liver disease. *BMC Gastroenterol* 25:553
2. Gill M, Mudaliar S, Prince D, Than NN, Cordina R, Majumdar A (2023) Poor correlation of 2D shear wave elastography and transient elastography in Fontan-associated liver disease: a head-to-head comparison. *JGH Open* 7:690–697
3. Elder RW, McCabe NM, Hebson C et al (2013) Features of portal hypertension are associated with major adverse events in Fontan patients: the VAST study. *Int J Cardiol* 168:3764–3769
4. Hirooka M, Koizumi Y, Hiasa Y et al (2011) Hepatic elasticity in patients with ascites: evaluation with real-time tissue elastography. *AJR Am J Roentgenol* 196:W766–W771
5. Hari A, Štabuc B (2024) Possible use of 2D shear wave liver elastography in new-onset ascites evaluation. *BMC Gastroenterol* 24:68
6. Ferraioli G, Barr RG, Berzigotti A et al (2018) WFUMB guideline/guidance on liver multiparametric ultrasound: part 1. Update to 2018 guidelines on liver ultrasound elastography. *Ultrasound Med Biol* 50:1071–1087

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