Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Visual Journal of Emergency Medicine 27 (2022) 101273

Contents lists available at ScienceDirect

Visual Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/visj

Visual Case Discussion

A man with severe SARS-CoV-2 pneumonia and oliguria

Daniel Manzur-Sandoval [a,*], Ángel Emmanuel Vega-Sánchez [a], Cristóbal Guadarrama-Pérez [a]

[a] Emergency Department. Instituto Nacional de Enfermedades Respiratorias, Mexico City, Mexico

ARTICLE INFO

Keywords:
SARS-CoV-2 pneumonia
Point-of-care ultrasound
Prone position ventilation

1. Visual case discussion

83-year old male with a past history of diabetes and hypertension arrived in the emergency department with a 4-day history of fever, dry cough and desaturation. At his admission he was dyspneic, with respiratory distress and SatO2 of 69%. Severe SARS-CoV-2 pneumonia was diagnosed and invasive mechanical ventilation was started. Due to refractory hypoxemia despite high levels of inspired oxygen fraction and end-expiratory pressure titration, prone position ventilation was started. During his evolution, the patient developed oliguria refractory to crystalloid infusion, so point-of-care ultrasonography was performed to evaluate the degree of venous congestion using a transhepatic view. With a phased array sector probe 2–3 MHz, the operator obtained the images on the right side of the patient. The probe was placed in the 7th-8th intercostal space at the mid axillary line (Fig. 1A) with the marker pointing to the patient's head (Fig. 1B). At this position, the inferior vena cava (IVC) and the hepatic vein were adequately evaluated (Fig. 2A) and a dilated IVC without respirophasic variation was noted (Fig. 2B). Using color Doppler (Fig. 2C, Video 1) and pulse wave Doppler, the venous flow of the hepatic vein was evaluated, showing a normal pattern (Fig. 2D). Tilting the probe to the patient's left side the portal vein was displayed (Fig. 3A) and using color Doppler and pulse wave Doppler an abnormal (pulsatile) flow was noticed suggesting a mild abnormal pattern (Fig. 3B). Finally, displacing the probe posteriorly and one intercostal space below with a counterclockwise rotation, the right kidney was visualized, and using color Doppler the intrarenal venous flow was located (Fig. 3C, Video 2) and pulse wave Doppler was applied showing a mild abnormal pattern (discontinuous) (Fig. 3D). Grade 3 (severe) venous congestion, according to the Venous Excess Ultrasound (VExUS) Score was diagnosed and a dose of furosemide was administered to the patient reaching an adequate urine output and negative fluid balance.

2. Questions

1. In a patient during prone position ventilation, how do the inferior vena cava could be evaluated by ultrasound to assess fluid responsiveness and / or fluid overload?

a) Apical 4 chamber view
b) Subcostal view
c) Paraesternal long axis view
d) Transhepatic view

Correct answer: d

The inferior vena cava (IVC) can be visualized by a transhepatic approach with a significant correlation in the respiratory variation with the subcostal (SC) view. One limitation is when aligning the M-mode cursor with downward deflection of the diaphragm in the TH view the evaluated portion of the IVC might not be in the same position than in the SC view; the diameter should be measured at the same location to avoid error. This technique allows acquisition of images with good quality and in a rapid manner without the need to mobilize the patient during the prone position.

2. Which of the following is not a criteria of fluid overload in the patient, evaluated by VeXUS score?

a) $S > D$ waves in the hepatic venous flow
b) IVC with a maximal diameter of 2.6 cm
c) Portal venous flow with a pulsatility index of 46%
d) Discontinuous intrarenal venous flow

* Corresponding author.
E-mail address: drdanielmanzur@gmail.com (D. Manzur-Sandoval).

https://doi.org/10.1016/j.visj.2022.101273
Received 24 November 2021; Received in revised form 26 December 2021; Accepted 2 February 2022
Available online 4 February 2022

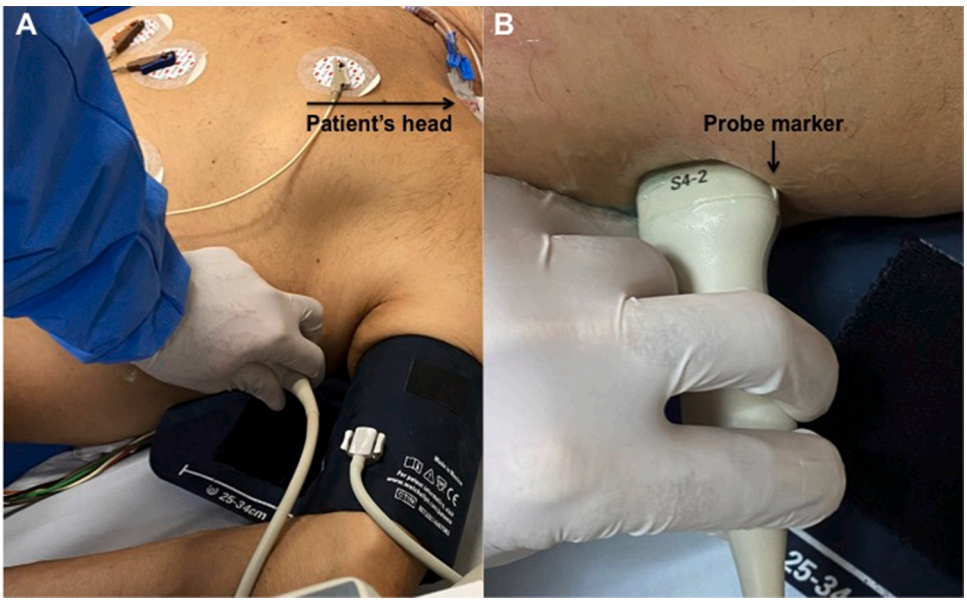

Fig. 1. A. Position of the explorer at the right side of the patient. B. Probe marker pointing to the patient's head.

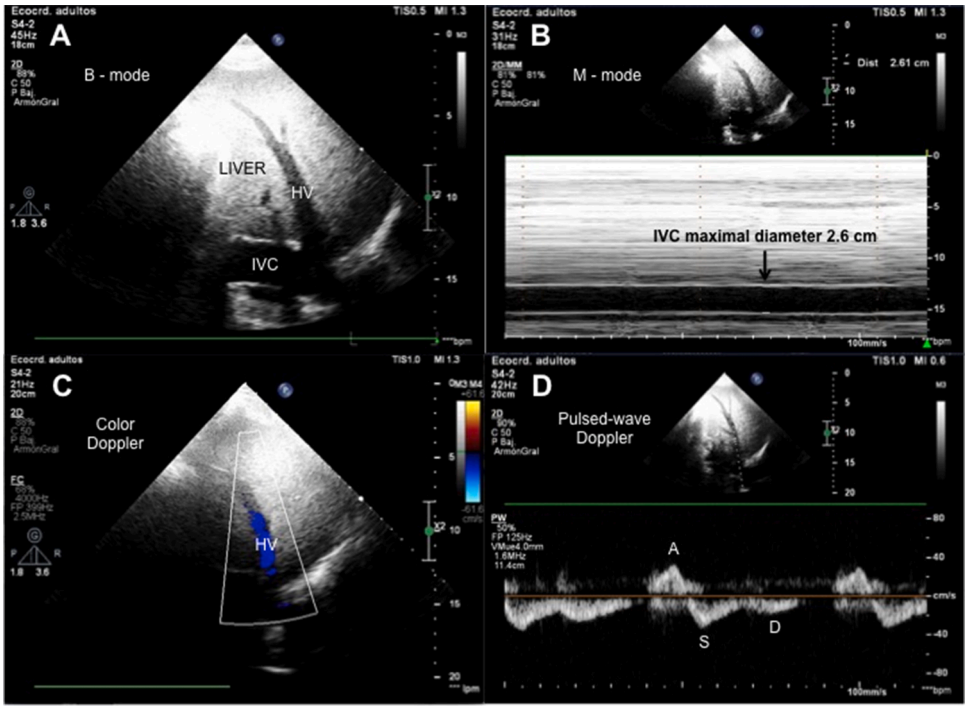

Fig. 2. A. Bidimensional view of the inferior vena cava (IVC) and the hepatic vein (HV). B. Alining the M-mode cursor perpendicular to the IVC, a maximal diameter of 2.6 cm is measured, without respirophasic variation. C. Applying color Doppler to the hepatic vein (HV) the venous flow is located. D. Pulse wave Doppler at the hepatic vein, a normal venous flow pattern is visualized, with a systolic (S) wave > diastolic (D) wave.

Correct answer: a

With the VExUS Score, the following patterns are considered abnormal: an IVC > 2 cm, a D > S waves or an S wave reversal in the hepatic venous flow, a portal venous flow with a pulsatility index > 30% and a discontinuous (biphasic or monophasic) intrarenal venous flow.

3. Video 1

In color Doppler flow mapping, a blue hepatic vein waveform indicates flow away from the ultrasound probe.

4. Video 2

Applying color Doppler to the right kidney, the intrarenal venous flow is located (blue color).

5. Discussion

Point-of-care ultrasonography is the standard for the hemodynamic monitoring in severe COVID-19 [1]. Given the high needs of prone position ventilation during the COVID-19 pandemic, the ultrasonographic technique during this maneuver has been proposed [2]. Fluid overload is

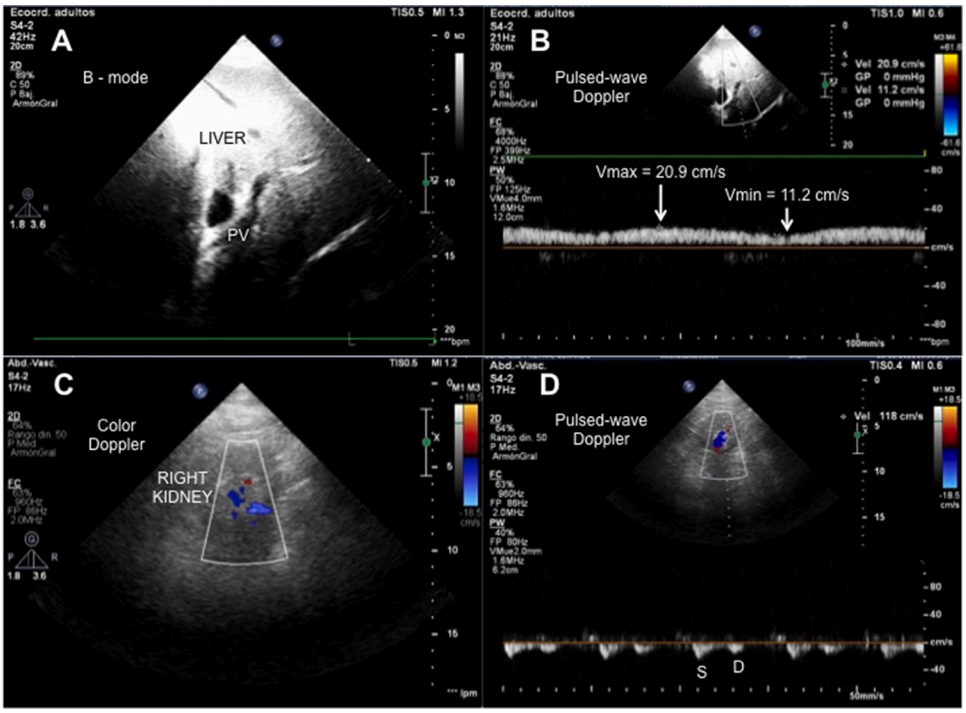

Fig. 3. A. Bidimensional view of the portal vein. B. Pulse wave Doppler at the portal vein (PV), an abnormal (pulsatile) venous flow is visualized, with a pulsatility index of 46% [(Vmax − Vmin) / (Vmax)] × 100 (normal flow = continuously), indicating a mild abnormality. C. Applying color Doppler to the right kidney, the intrarenal venous flow is located. D. Pulse wave Doppler at the intrarenal venous flow, an abnormal (discontinuous) pattern is visualized, with the appearance of systolic (S) and diastolic (D) waves (normal flow = continuously), indicating a mild abnormality.

frequent following the initial aggressive fluid resuscitation, and the VExUS Score evaluates and scores the severity of venous congestion and correlate with and increased risk of acute kidney injury and guide the management of volume overload [3]. In this article, we describe for the first time this technique during prone position ventilation, since this maneuver should not be a limitation for the correct hemodynamic evaluation of this critically ill patients.

6. Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author contributions

DMS: conceptualization, image acquisition, writing the original draft, review and editing, AEVS: review and editing, CGP: supervision, review.

Declaration of Competing Interest

None

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.visj.2022.101273.

References

1 García-Cruz E, Manzur-Sandoval D, Rascón-Sabido R, et al. Critical care ultrasonography during COVID-19 pandemic: the ORACLE protocol. *Echocardiography*. 2020;37(9):1353–1361. https://doi.org/10.1111/echo.14837.
2 García-Cruz E, Manzur-Sandoval D, Gopar-Nieto R, et al. Transthoracic echocardiography during prone position ventilation: lessons from the COVID-19 pandemic [published online ahead of print, 2020 Aug 28] *J Am Coll Emerg Physicians Open*. 2020;1(5):730–736. https://doi.org/10.1002/emp2.12239.
3 Rola P, Miralles-Aguiar F, Argaiz E, et al. Clinical applications of the venous excess ultrasound (VExUS) score: conceptual review and case series. *Ultrasound J*. 2021;13 (1):32. https://doi.org/10.1186/s13089-021-00232-8. Published 2021 Jun 19.