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CLINICAL IMAGE

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Venous congestion assessment using point-of-care Doppler ultrasound: Welcome to the future of volume status assessment

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Abstract

With evolution of clinician-performed bedside ultrasonography, noninvasive markers of venous congestion such as hepatic, portal, and intrarenal venous Doppler waveforms are gaining importance as an adjunct to volume status assessment. The intent of this clinical image is to illustrate the classic sonographic stigmata of severe venous congestion, associated with worse prognosis.

KEYWORDS

Doppler, hepatic vein, nephrology, POCUS, point-of-care ultrasound, portal vein, VExUS

1 | WHAT CHANGES OCCUR IN THE DOPPLER ULTRASOUND PATTERNS OF ABDOMINAL VEINS WHEN THERE IS SEVERE ELEVATION IN RIGHT ATRIAL PRESSURE (RAP)?

Normal hepatic vein waveform mainly consists of two anterograde waveforms (below the baseline), S and D, which represent venous return during ventricular systole and diastole, respectively. Normally, S is greater/deeper than D. As the RAP increases, D becomes deeper than S, and eventually, S reverses leaving only D wave below the baseline (monophasic pattern). On the other hand, normal portal vein waveform is relatively continuous with gentle undulation, and with increasing RAP, it becomes more pulsatile and may demonstrate systolic flow reversal. Intrarenal venous flow measured at the interlobar vessels (adjacent to medullary pyramids) is also continuous like that of portal but displayed below the baseline as the flow is away from the transducer. Notably, intrarenal Doppler is often accompanied by arterial tracing, which helps to delineate the phases of cardiac cycle. Venous Doppler assessment can be used in both acute (eg, heart failure exacerbation) and chronic (eg, pulmonary hypertension) scenarios, and unfortunately, the congestive pattern is known to be associated with poor prognosis, particularly in chronic settings.[1,2] **Figure 1** illustrates normal waveforms.

Figure 2 demonstrates the IVC and Doppler waveforms obtained from a 55-year-old woman with chronic pulmonary hypertension requiring home oxygen therapy. The IVC is significantly dilated (~3.4 cm), likely a chronic change and hepatic vein Doppler show S-wave reversal. Similarly, portal and intrarenal veins are pulsatile with systolic flow reversal suggestive of severe organ congestion (consequent to elevated RAP and resistance to venous return).

On a note of caution, the use of Doppler ultrasonography requires a higher operator skill level and it might not be always possible to obtain adequate tracings, particularly in critically ill patients.

ACKNOWLEDGMENTS

Published with written consent of the patient.

CONFLICT OF INTEREST

None declared.

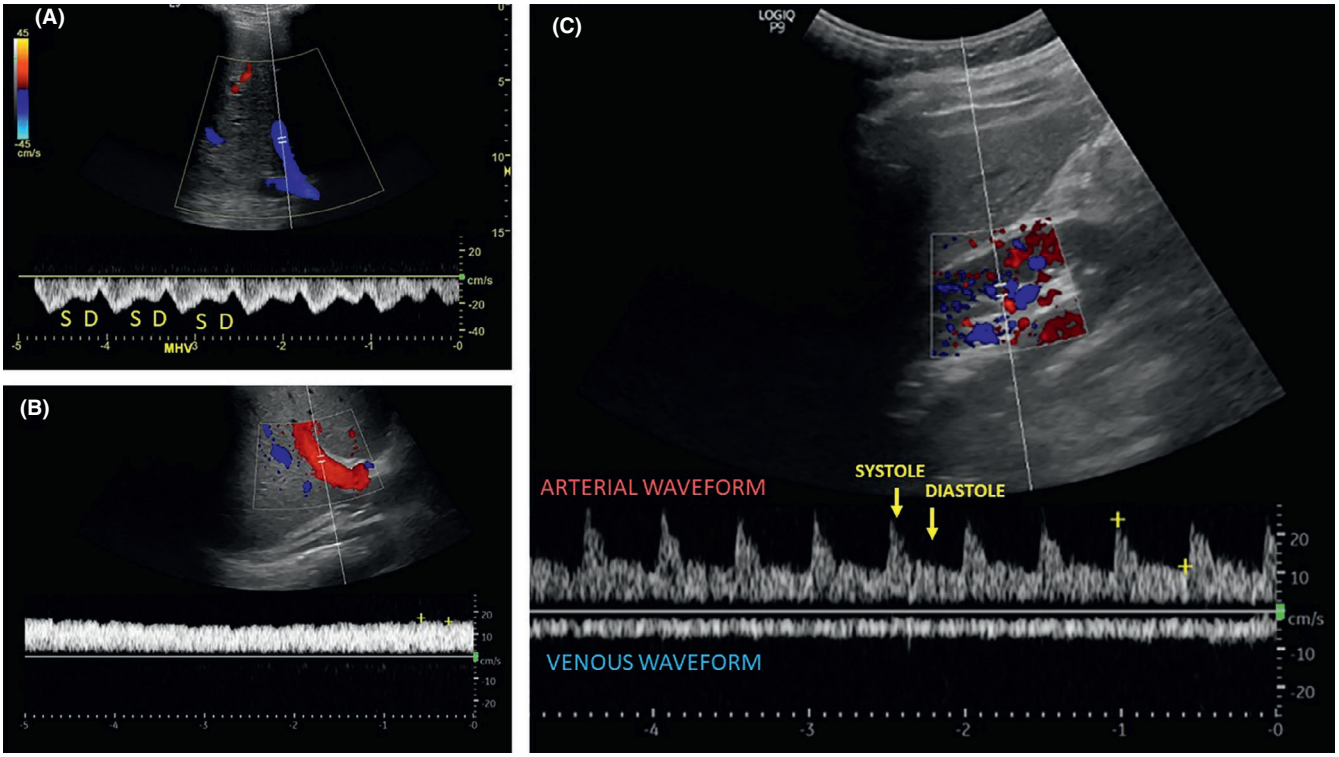

FIGURE 1 Normal hepatic vein (A), portal vein (B), and intrarenal vein (C) Doppler waveforms. S = systolic wave, D = diastolic wave. Note that the normal flow is below the baseline in hepatic and intrarenal veins, while it is above the baseline in portal vein

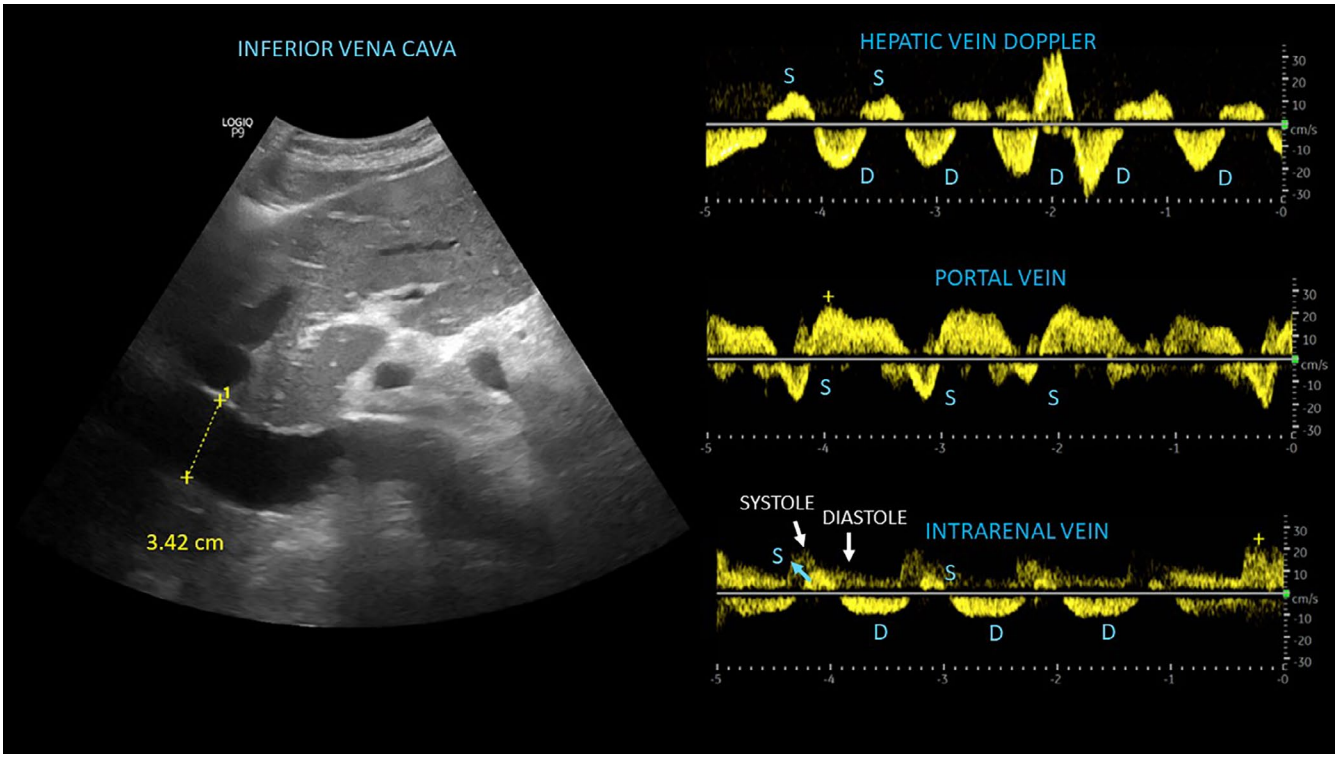

FIGURE 2 Inferior vena cava ultrasound and venous Doppler patterns from the index patient with pulmonary hypertension. S = systolic wave, D = diastolic wave. Note there is systolic flow reversal in all the veins

AUTHOR CONTRIBUTIONS

AK: served as the sole author of the manuscript, attending nephrologist on the case, and acquired the images.

ETHICAL APPROVAL AND INFORMED CONSENT

Institutional review board approval is waived for case studies. Informed consent has been obtained from the patient for the publication of this case report.

DATA AVAILABILITY STATEMENT

The data that support this case study are available from the corresponding author upon reasonable request.

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