Master Course in Heart Failure 25 BAKU

Baku Marriott Hotel Boulevard
30th May - 1st June

Echo assessment of congestion

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Disclosures

- Nothing to disclose

Outline

- Physiology of venous return
- What is VeXUS?
- The role of VeXUS in intensive care.
- The role of VeXUS in acute heart failure.

Right atrial pressure (CVP)

- Often used as a surrogate for RV ability to handle preload
- Not frequently thought of as ‘a downstream afterload’ component of flow across the capillary beds in the organs

$$CO = \frac{80 \times (MAP - CVP)}{SVR}$$

Why systemic venous congestion is

- Excessive intravenous fluid therapy → +ve fluid balance and interstitial oedema → organ dysfunction and adverse outcomes in acute illness.
- Aggressive correction of congestion→ can have negative haemodynamic implications

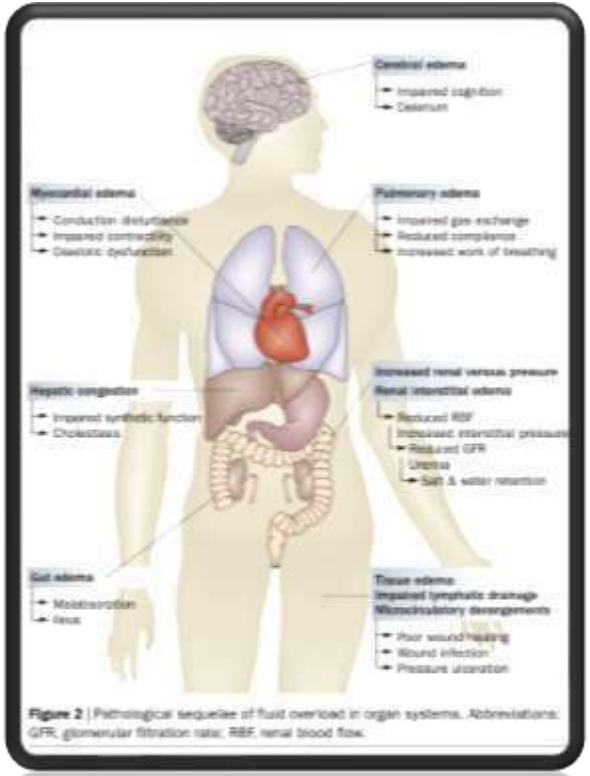


Figure 2 | Pathological sequelae of fluid overload in organ systems. Abbreviations: GFR, glomerular filtration rate; RBF, renal blood flow.

Prowle, J. R. et al. Nat. Rev. Nephrol. 6, 107–115 (2010)

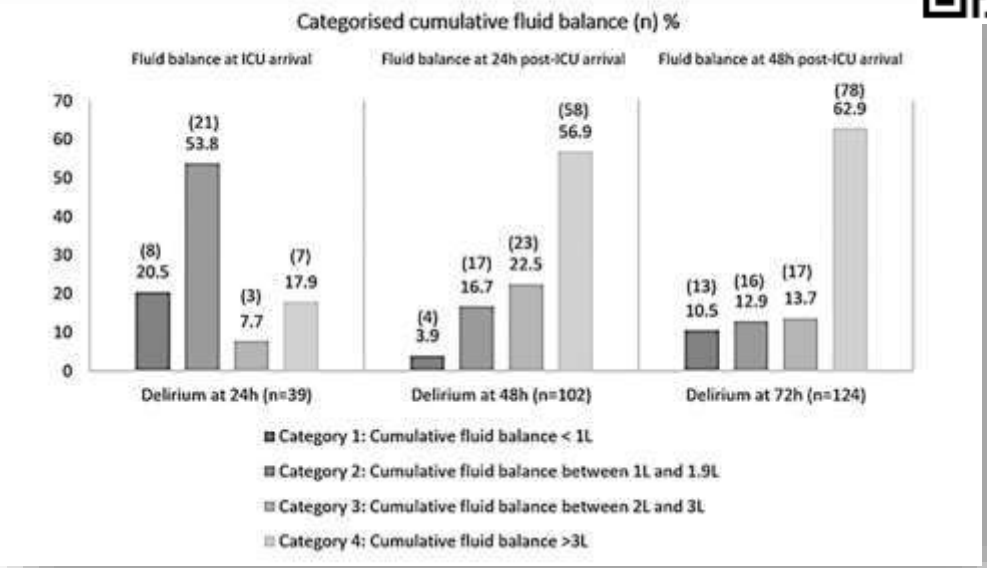
Contents lists available at ScienceDirect

Journal of Cardiothoracic and Vascular Anesthesia

journal homepage: www.jcvaonline.com

Original Article

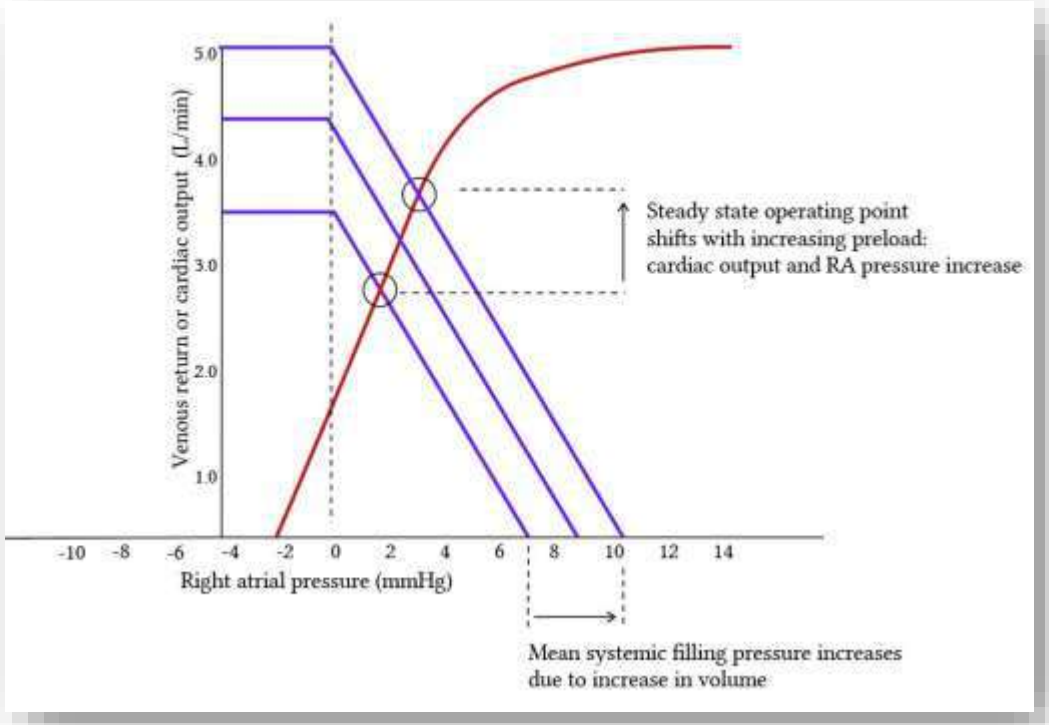
Delirium After Cardiac Surgery and Cumulative Fluid Balance: A Case-Control Cohort Study



Retrospective case control – cohort study (1:1)

Mailhot T et al. JCVA, Volume 33, Issue 1, January 2019, Pages 93-101

Frank-Starling and Guyton's curves



$$VR = \frac{Pmsf - Pra}{\text{Venous rseistance}}$$

VeXUS Score

Beaubien-Souligny et al. Ultrasound J (2020) 12:16
https://doi.org/10.1186/s13089-020-00163-w

The Ultrasound Journal

ORIGINAL ARTICLE Open Access

Quantifying systemic congestion with Point-Of-Care ultrasound: development of the venous excess ultrasound grading system

William Beaubien-Souligny[1,2*], Philippe Rola[3], Korbin Haycock[4], Josée Bouchard[5], Yoan Lamarche[6], Rory Spiegel[7] and André Y. Denault[1,8]

- 145 patients undergoing cardiac surgery
- Repeated daily measurements of IVC, hepatic vein, portal vein and renal vein Doppler during the first 72 hours after surgery
- Five prototypes of venous excess ultrasound grading system combining multiple ultrasound markers were developed.

VeXUS Score

Beaubien-Souligny et al. Ultrasound J (2020) 12:16
https://doi.org/10.1186/s13089-020-00163-w

The Ultrasound Journal

ORIGINAL ARTICLE Open Access

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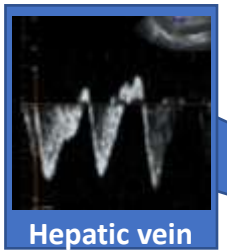
- Results:
- In the post-operative period, the presence of severe congestion (Grade 3) was associated with the development of subsequent AKI. Severe congestion (Grade 3) was the most strongly associated with AKI (HR 3.69, CI 1.65 – 8.24, $p = 0.001$).

ESC European Society of Cardiology
European Heart Journal - Cardiovascular Imaging (2022) 00, 1–4
https://doi.org/10.1093/ehjci/jeac239

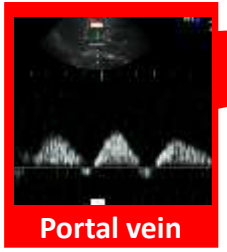
HOW TO

How to assess systemic venous congestion with point of care ultrasound

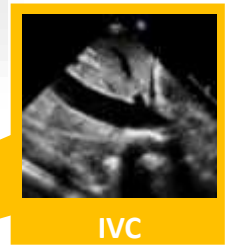
Hatem Soliman-Aboumarie [1,2]* and André Y. Denault [3,4]



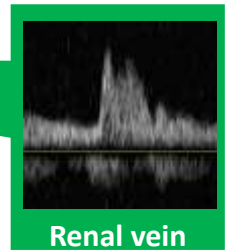
Hepatic vein



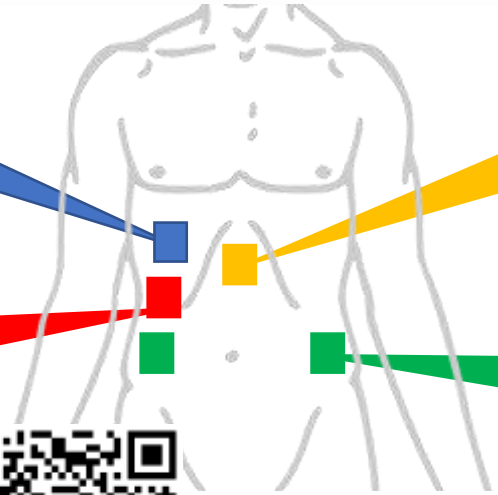
Portal vein



IVC



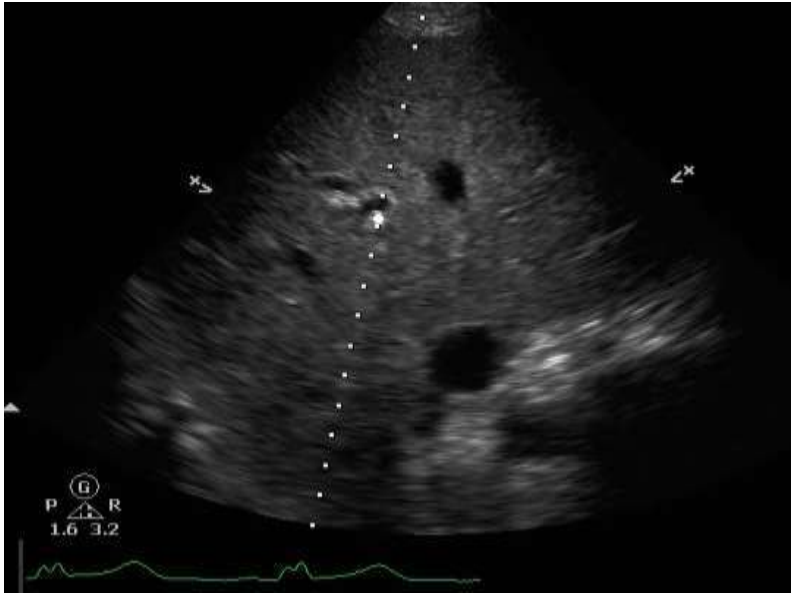
Renal vein



Soliman Aboumarie H, et al. EHJ CVI, December 2022

Inferior vena cava (IVC)

< 2 cm → no significant congestion



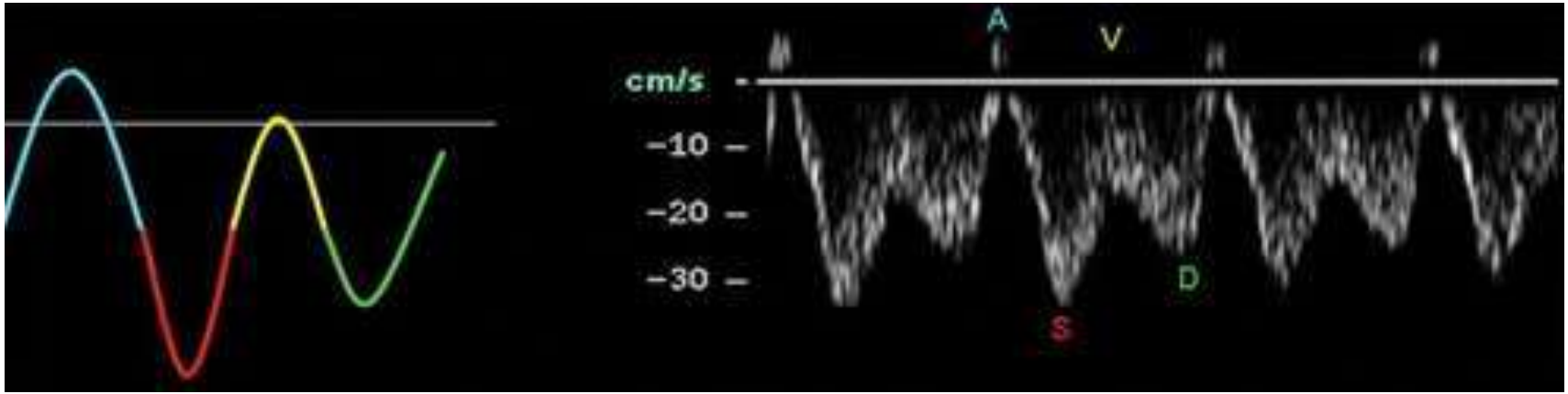
Inferior vena cava (IVC)

> 2 cm → could be congestion

Hepatic veins (2D)

- Sub-xyphoid
- Mid-axillary line (recommended) → tile probe tail up

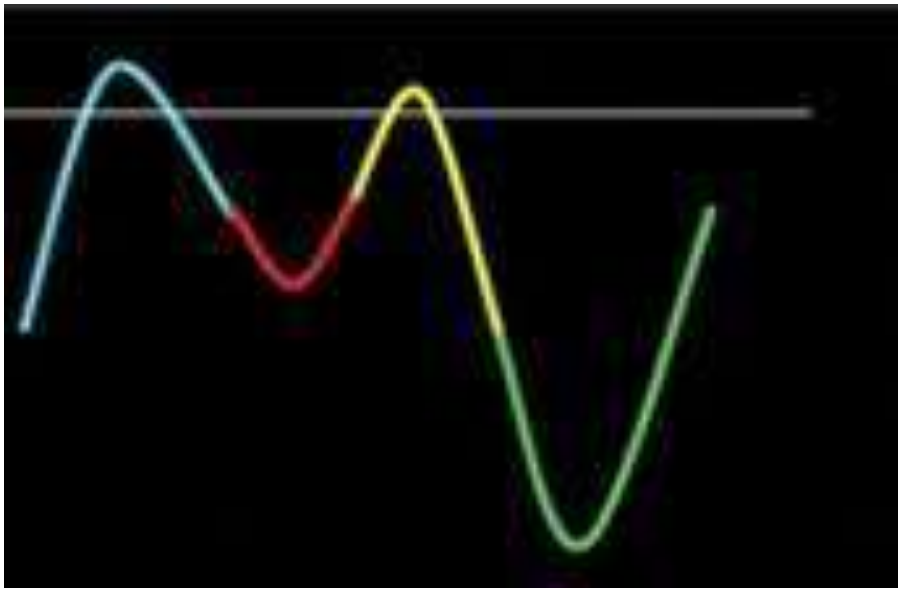
Hepatic veins Doppler



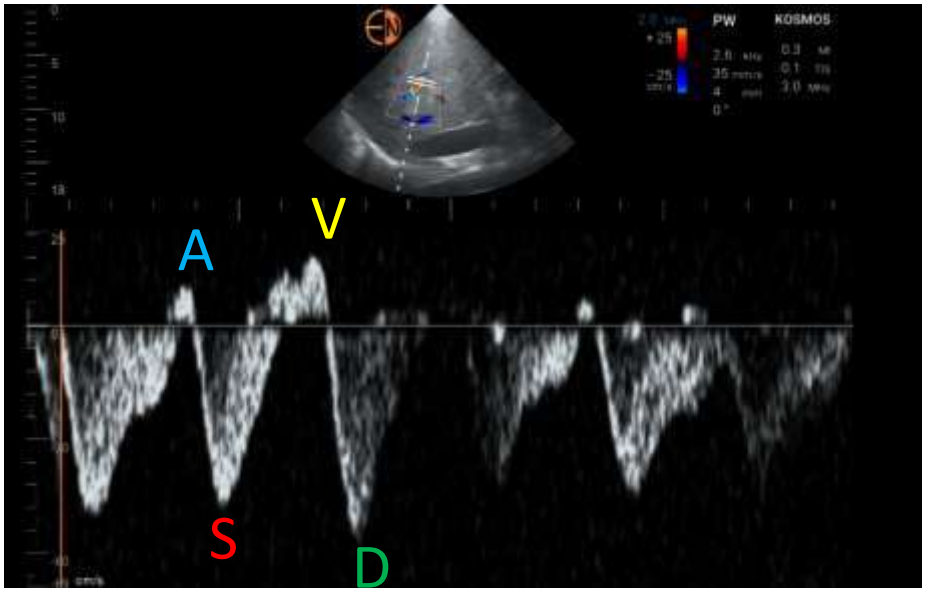
S > D

Normal

Hepatic veins Doppler

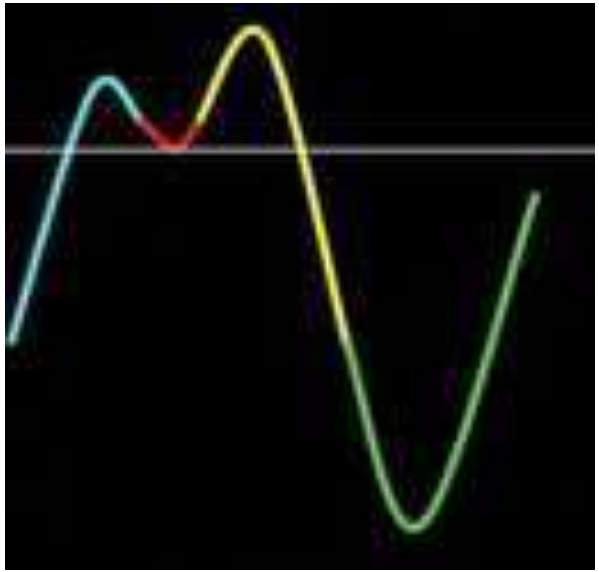


S < D

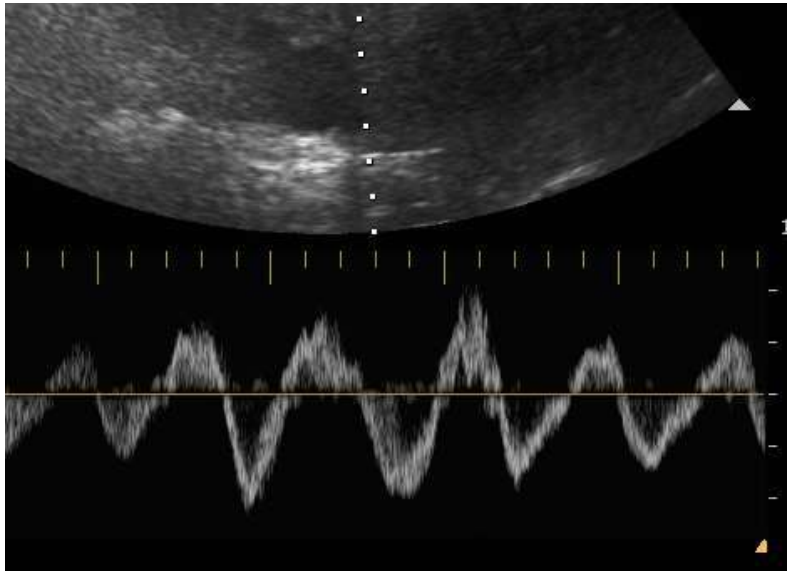


Mildly abnormal

Hepatic veins Doppler

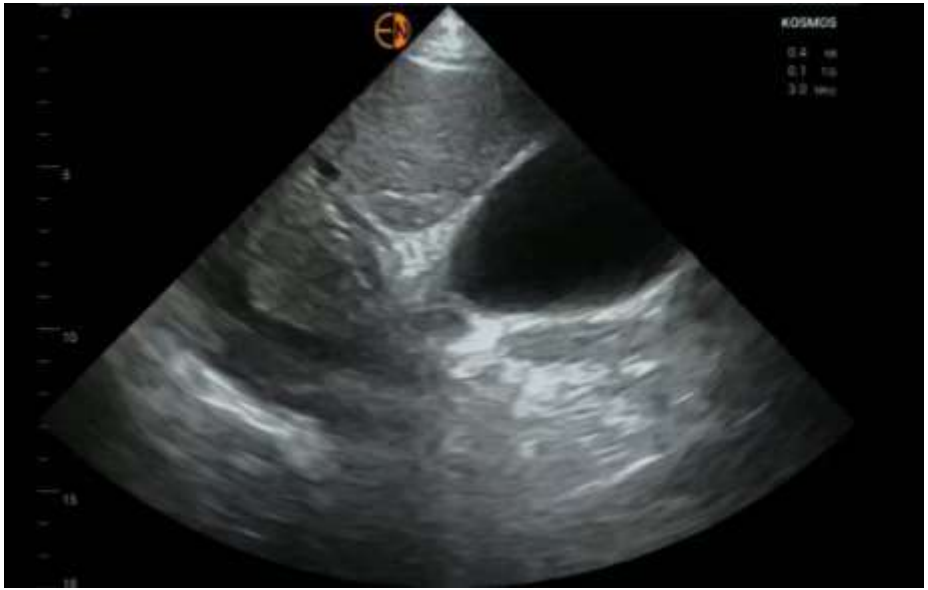


S reversed = retrograde



Severely abnormal

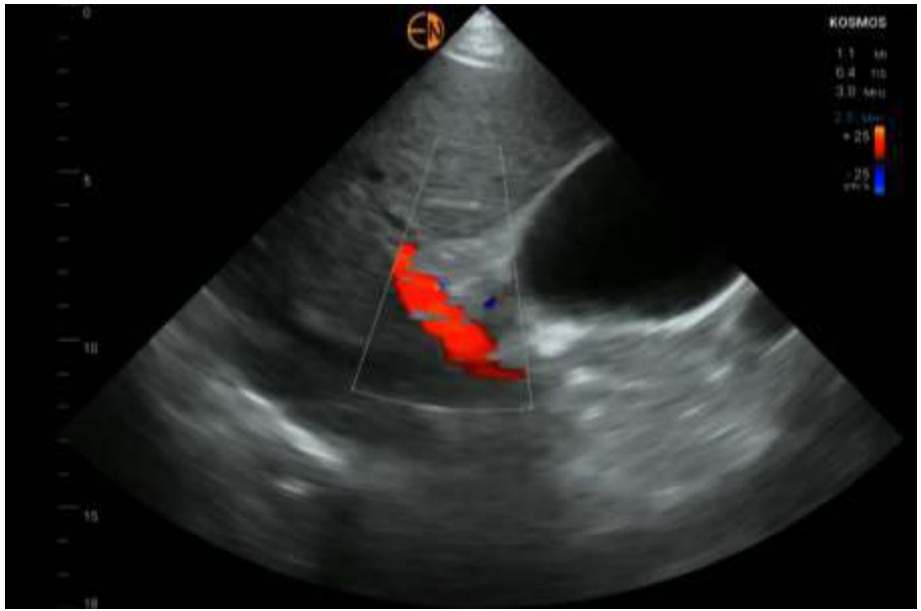
Portal vein (2D)



- Sub-xyphoid
- Mid-axillary line (recommended) → tilt probe tail down

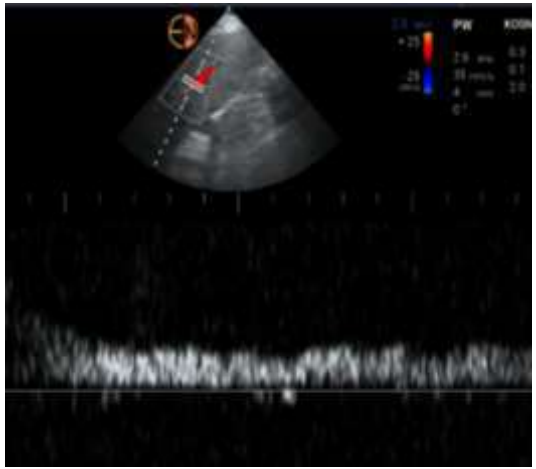
Portal vein Doppler (Colour Doppler)

- *Step 1:* 2D image of the right portal vein
- *Step 2:* Colour Doppler over the portal vein (RED flow = towards probe)
- *Step 3:* PW Doppler sample volume on the right portal vein

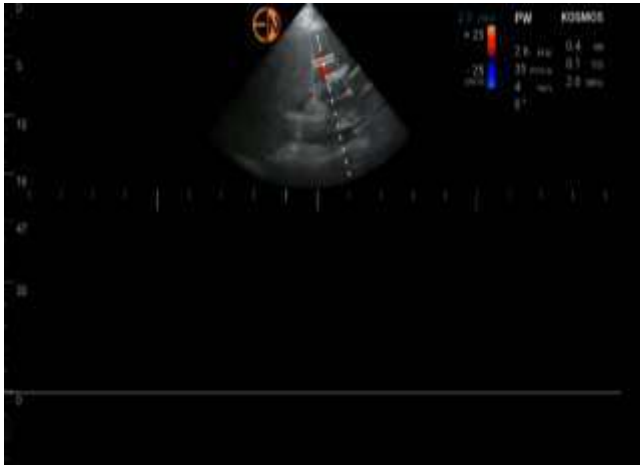


Monophasic flow (non-pulsatile)

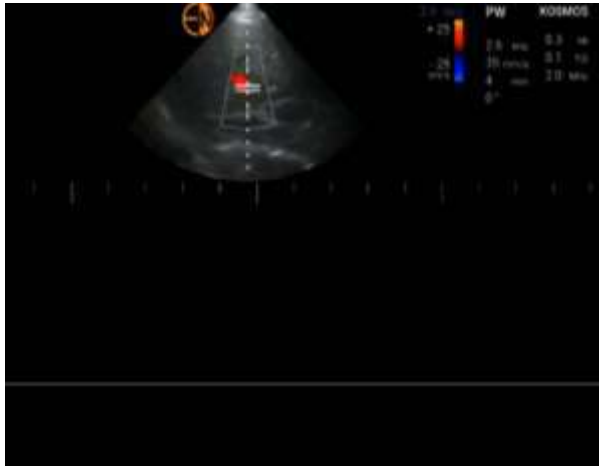
Portal vein (PWD)



Normal
< 30 %



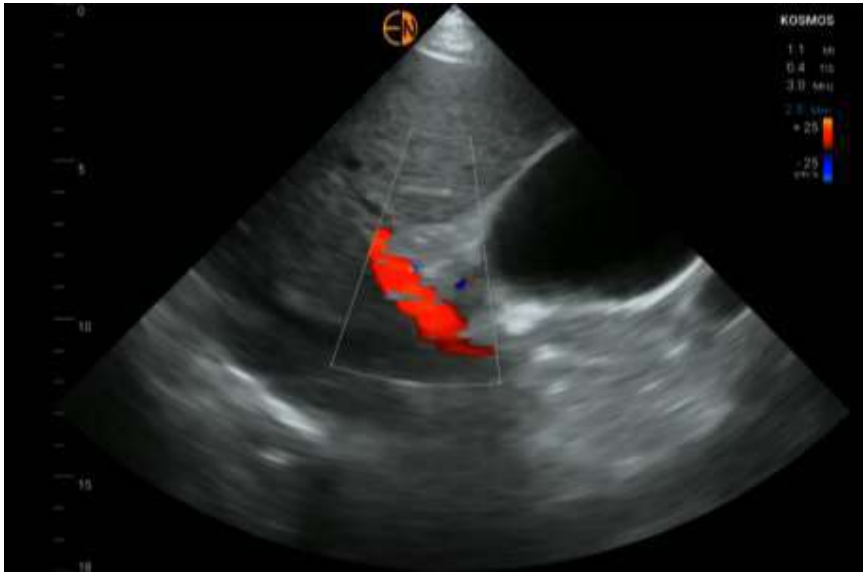
Mildly abnormal
30 - 50 %



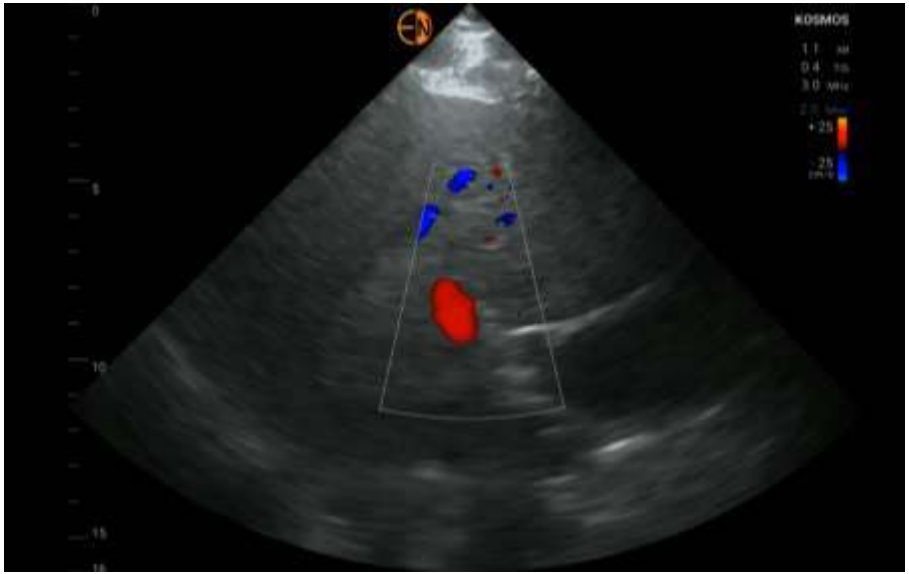
Severely abnormal
> 50%

Pulsatility Index (PI) = Vmax – Vmin / Vmax

Portal vein (Colour Doppler)



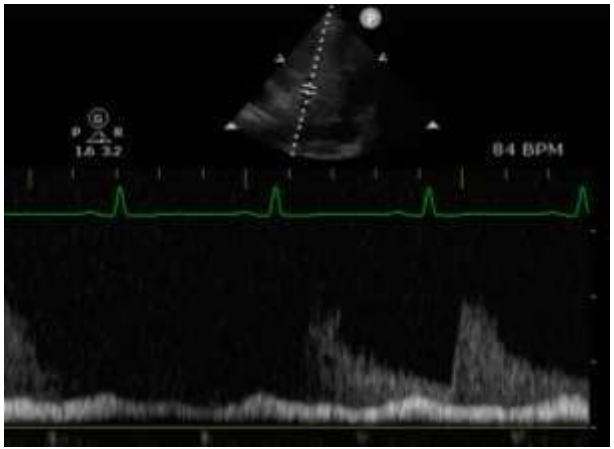
Monophasic = Normal



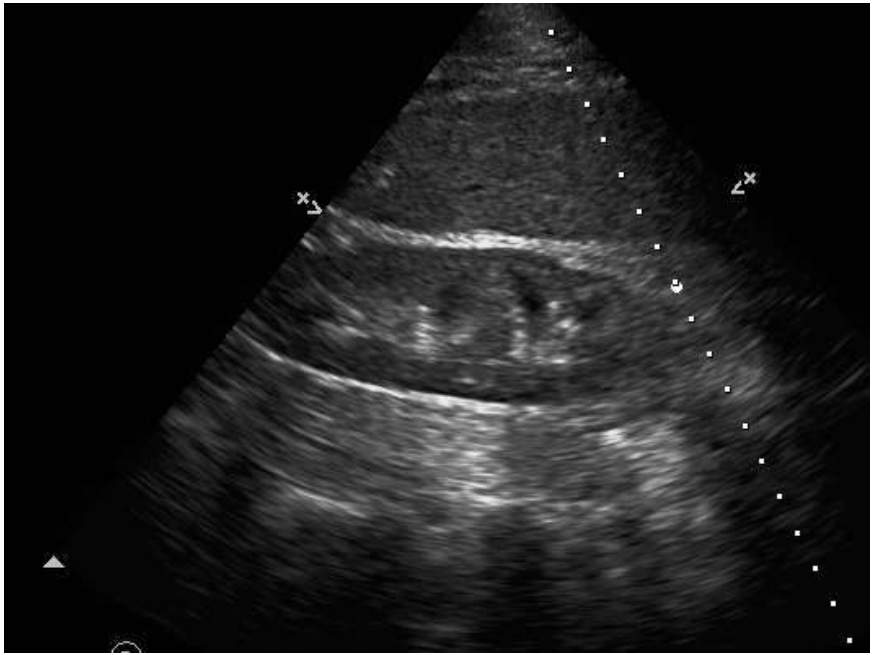
Pulsatile = abnormal

Portal vein Doppler Pitfalls

- Doppler findings of congestion may be absent in cirrhosis or fatty liver.
- Conversely, in young healthy thin individuals, a falsely positive pulsatile hepatic arterial flow can often be seen.
- Hepatic arterial flow can be seen

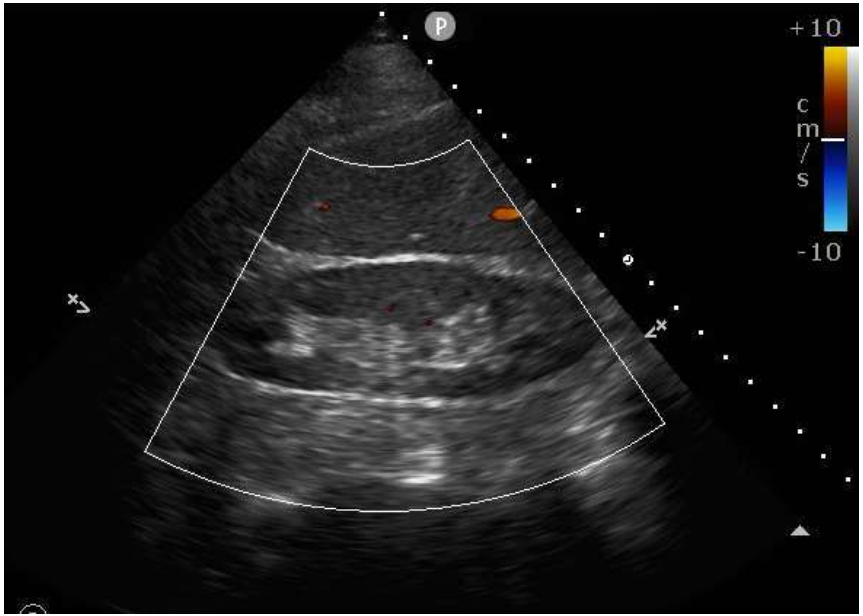


Renal vessels Doppler



- Post-axillary line (either side)
- Interlobar vessels (avoid hilar vessels)

Renal vessels Doppler



- Post-axillary line (either side)
- Interlobar vessels (avoid hilar vessels)

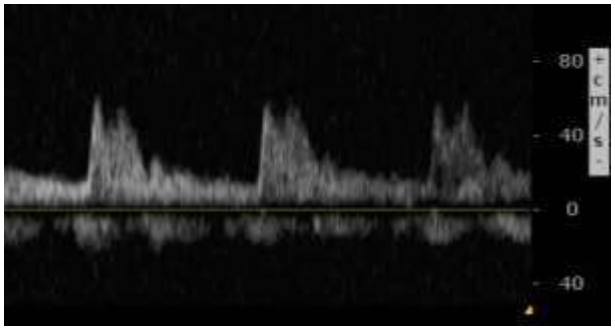
Renal vessels Doppler

- *Step 1:* 2D image of the kidney
- S*tep 2:* Colour Doppler over the kidney, reduce CD gain to 10-25 cm/sec
- *Step 3:* PW Doppler sample volume on the interlobar vessels (vein and artery together)

Renal vessels Doppler

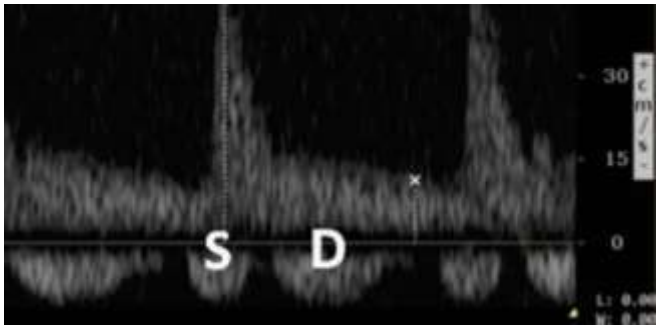
- Most challenging component due to the small size of the vessels.
- More central vessels → flow patterns closer to the hepatic vein profile even without venous congestion
- Interlobar branches are located in between the medullary pyramids and usually offer good Doppler angles for interrogation.

Renal vessels Doppler (PWD)



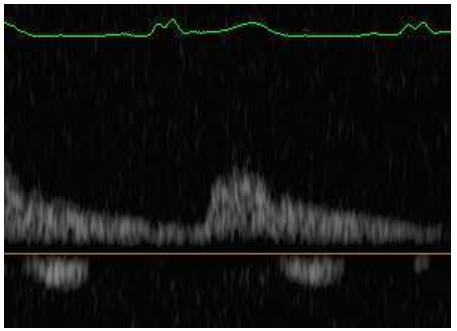
Normal

Monophasic



Mildly abnormal

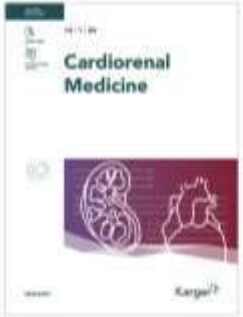
Distinct S and D waves



Severely abnormal

Only D wave

Volume 14, Issue 1
January - December 2024



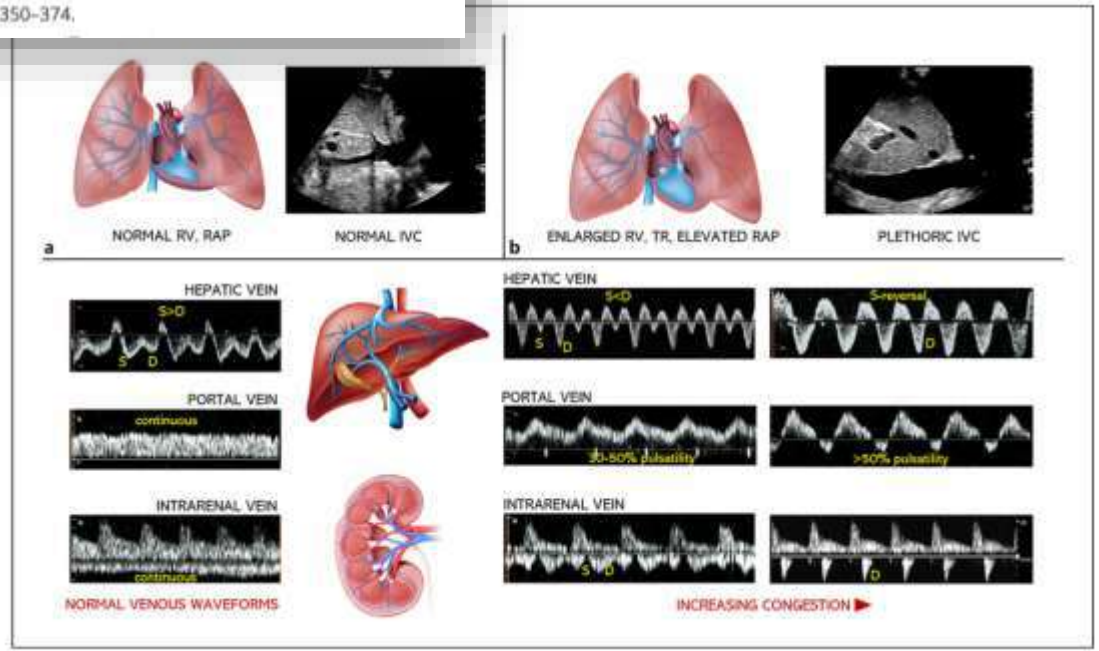
REVIEW ARTICLES | MAY 30 2024

Unlocking the Potential of VExUS in Assessing Venous Congestion: The Art of Doing It Right

Subject Area: Cardiovascular System , Endocrinology , Further Areas , Nephrology

Abhilash Koratala; Gregorio Romero-González; Hatem Soliman-Aboumarie; Amir Kazory

Cardiorenal Med (2024) 14 (1): 350–374.



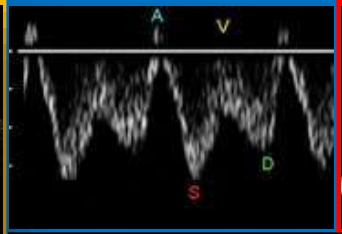
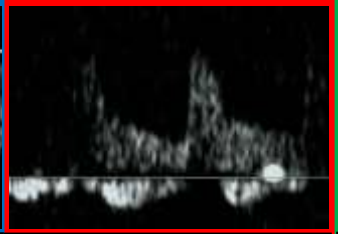
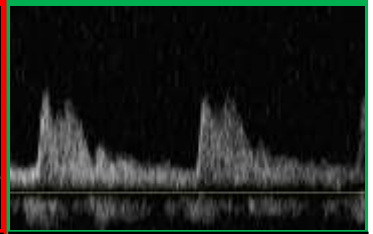
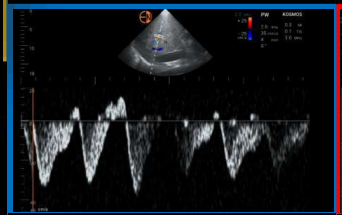
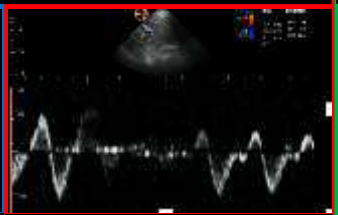
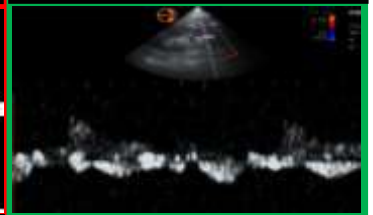
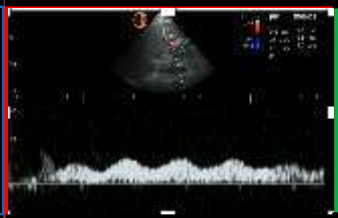
VeXUS Score

Grade 0 (No congestion)
IVC < 2.1 cm

Grade 1 (Mild congestion)
IVC > 2.1 cm + any combination of normal or mildly abnormal pattern

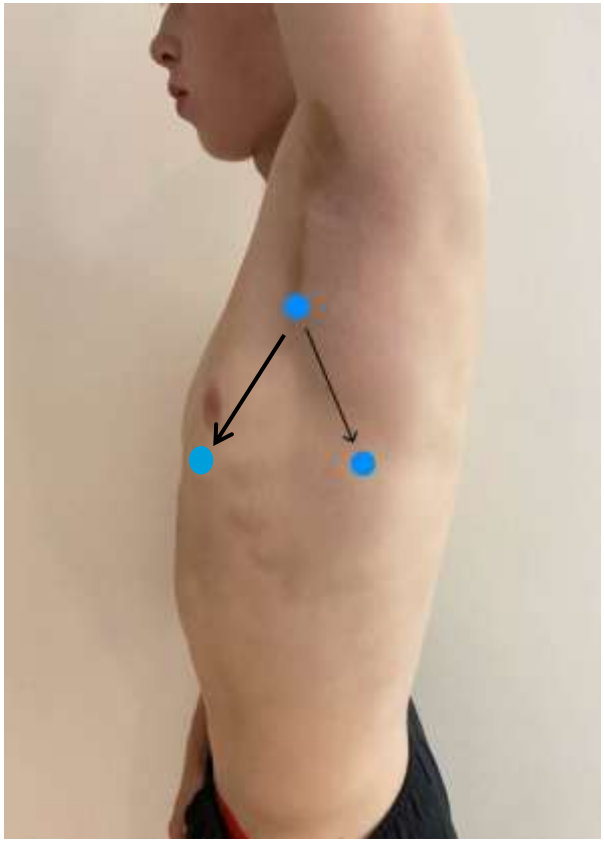
Grade 2 (Moderate congestion)
IVC > 2.1 cm + one severely abnormal pattern

Grade 3 (Severe congestion)
IVC > 2.1 cm + two or more severely abnormal patterns

Inferior vena	Hepatic vein	Portal vein	Renal vein
			
Collapsed IVC < 2.1 cm	Normal: S > D	Normal: PVPI <30%	Normal: continuous
			
Mildly abnormal: S < D	Mildly abnormal: PVPI 30-50	Mildly abnormal:
Dilated IVC > 2.1 cm	 Severely abnormal: S reversal	 Severely abnormal: PVPI >50%	 Severely abnormal: only D wave

Soliman Aboumarie H, et al. EHJ CVI, December 2022

Lung ultrasound Scanning



A-lines

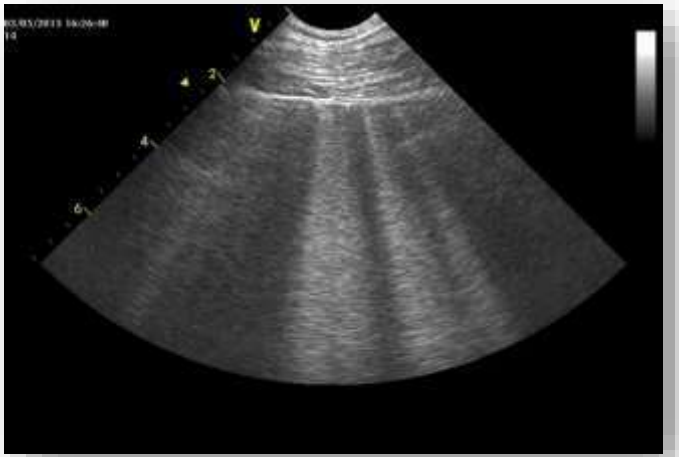
Horizontal reverberation of the pleural line

Can be found in pneumothorax as well!

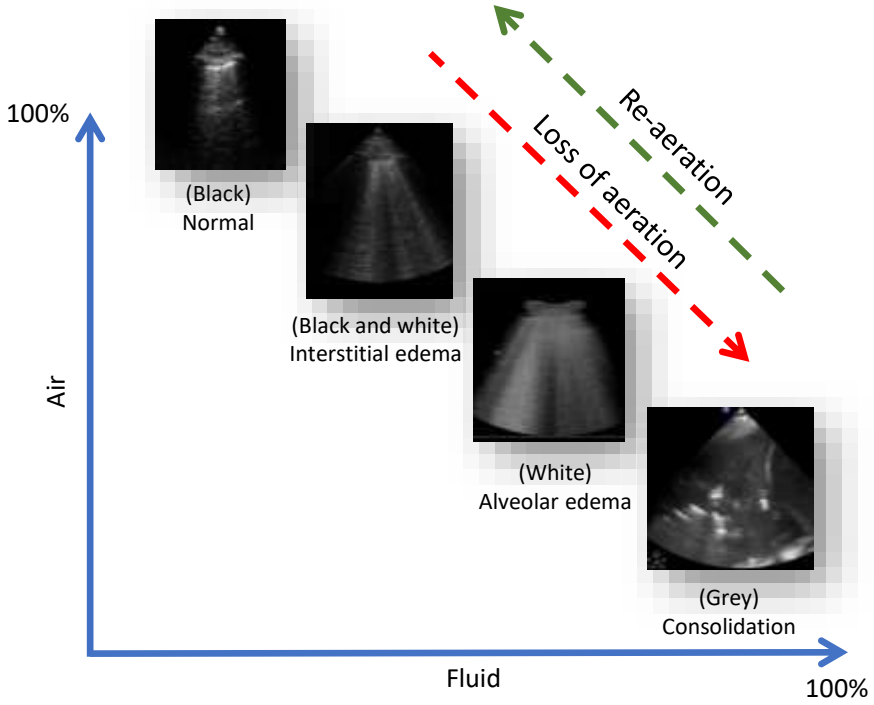
B Lines

The sonographic biomarker of EVLW

- Longitudinal artifacts
- Well defined
- Arising and moving from the pleural line
- Erases A lines.
- Extends to the far field
- Normally < 3 lines in a longitudinal scan



Shades of grey (lung water)



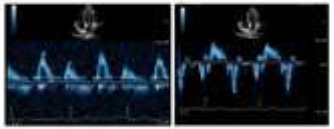
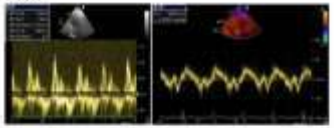
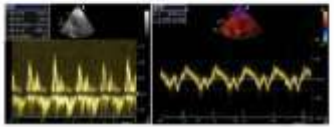
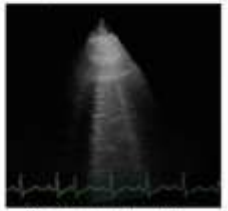
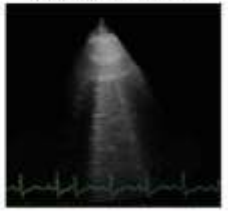
JOURNAL ARTICLE ACCEPTED MANUSCRIPT

Lung ultrasound in acute and chronic heart failure. A Clinical Consensus Statement of the European Association of Cardiovascular Imaging (EACVI)

Luna Gargani, Nicolas Girerd, Elke Platz, Pierpaolo Pellicori, Ivan Stankovic, Alberto Palazzuoli, Emanuele Pivetta, Marcelo Haertel Miglioranza, Hatem Soliman-Aboumarie, Eustachio Agricola, Giovanni Volpicelli, Susanna Price, Erwan Donal, Bernard Cosyns, Aleksandar N Neskovic

European Heart Journal - Cardiovascular Imaging, jead169,
https://doi.org/10.1093/ehjci/jead169
Published: 14 July 2023 **Article history** ▾

Table 4 How to integrate echocardiographic and pulmonary findings to assess congestion status

E/e' and other echocardiographic signs of increased left ventricular filling pressures	B-lines	
Normal 	No B-lines 	No congestion
Increased 	No B-lines 	Haemodynamic congestion
Increased 	Multiple diffuse bilateral B-lines 	Haemodynamic and pulmonary congestion
Normal 	Multiple diffuse bilateral B-lines 	Pulmonary congestion without haemodynamic congestion (check for ALI/ARDS or other causes of B-lines)

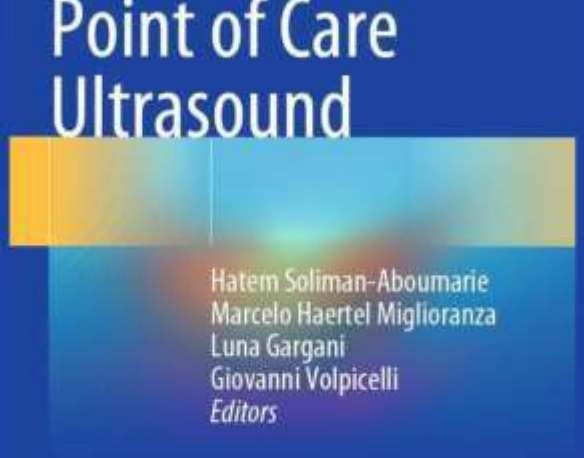
ALI, acute lung injury; ARDS, acute respiratory distress syndrome.

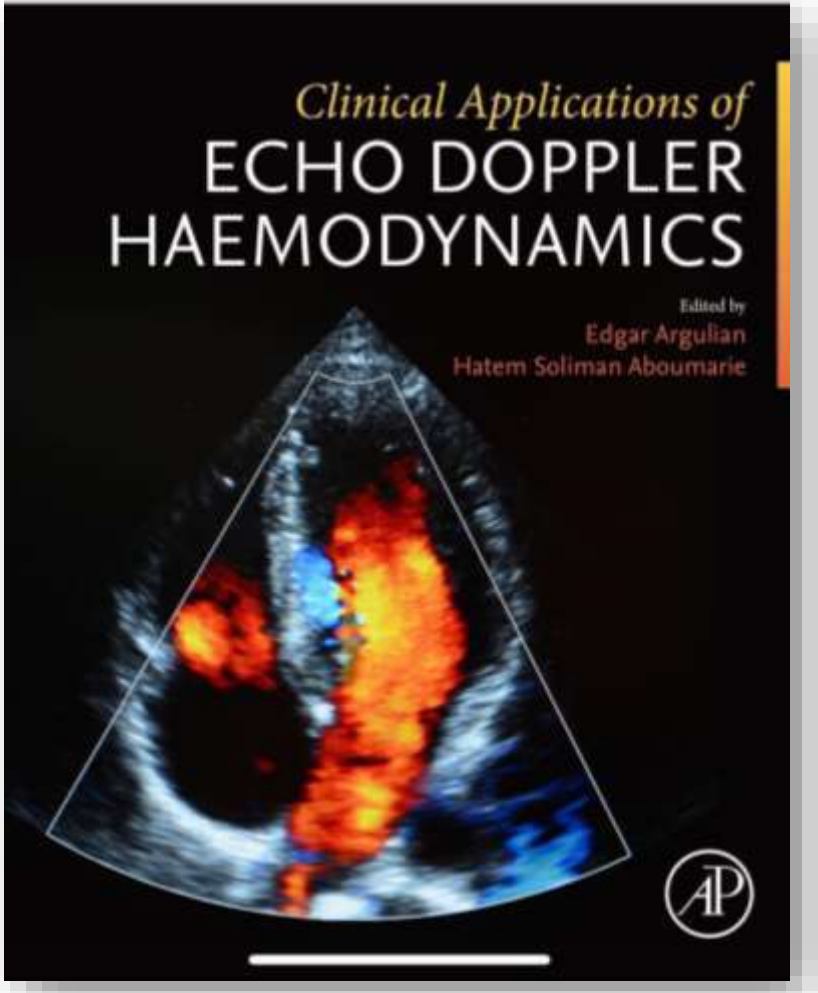
Just published!

"This is the most up-to-date POCUS textbook of the 21st century"

Dr. Andre Denault, Montreal Heart Institute, Canada

SCAN ME




Clinical Applications of
ECHO DOPPLER
HAEMODYNAMICS
Edited by
Edgar Argulian
Hatem Soliman Aboumarie
AP

Take home messages

- VeXUS should part of RV assessment (preload)
- Should be cautious regarding pitfalls of each parameter
- Integrated multimodal echo in cardiac intensive care
- Further future validation and integration into guidelines

Master Course in Heart Failure 25 BAKU

Baku Marriott Hotel Boulevard
30th May - 1st June

Echo assessment of congestion

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