



CONSORCI
HOSPITAL GENERAL
UNIVERSITARI
VALÈNCIA



Servicio de Anestesia,
Reanimación y Tratamiento del Dolor
HOSPITAL GENERAL UNIVERSITARIO VALENCIA

VALORACIÓN DE LA CONGESTIÓN VENOSA CON ECOGRAFÍA: ESCALA VEXUS

Dr^a Ana Broseta Lleó (F.E. Adjunta)
José María González Ibáñez (MIR 3r año)

Servicio de Anestesia Reanimación y Tratamiento del Dolor
Consorcio Hospital General Universitario de Valencia

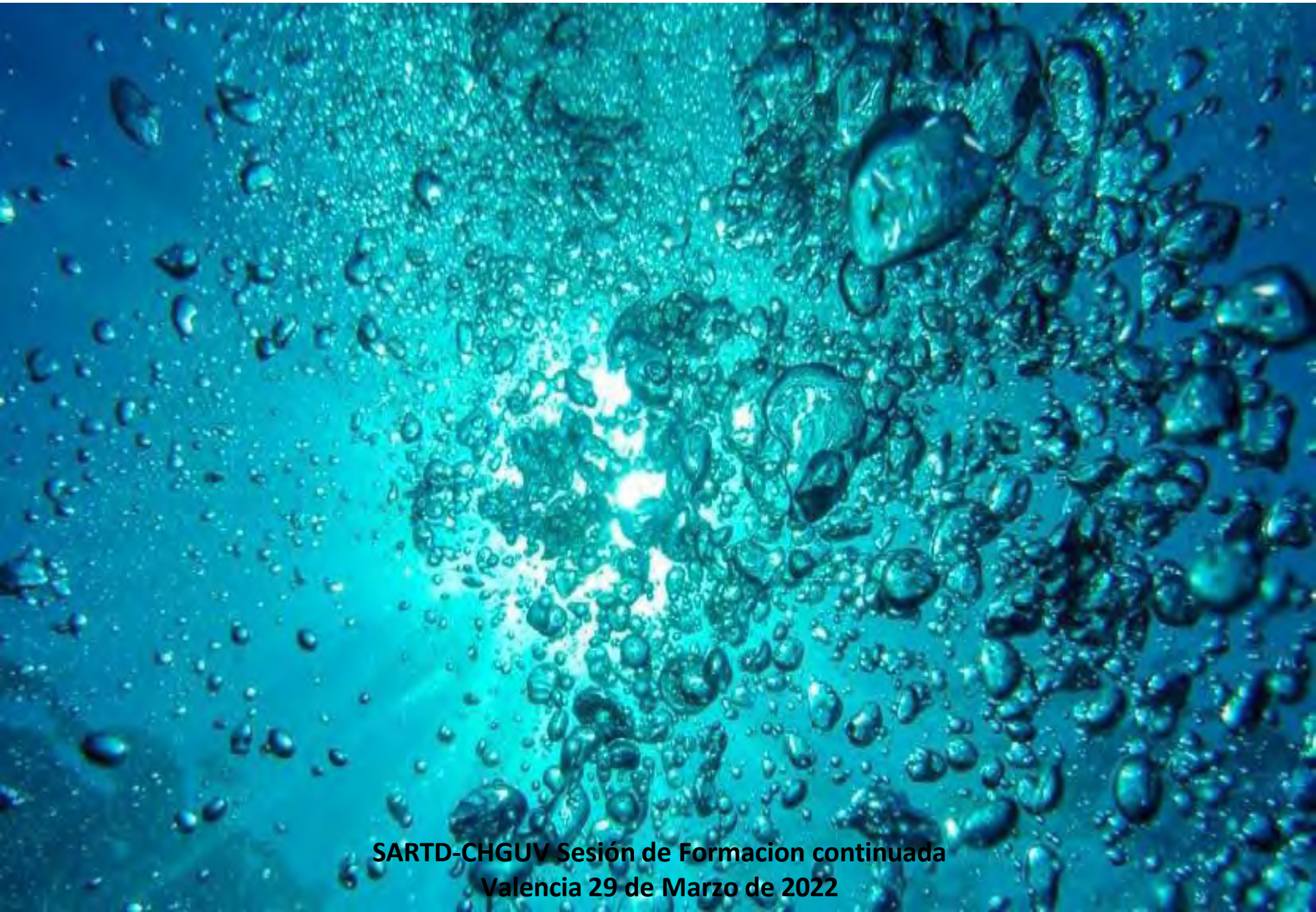


@argaizR
@ThinkingCC
@nephroP
@katiewiskar
@curromir

Índice

- 1) Introducción – Hemodinámica global
- 2) Fisiopatología del sistema venoso
- 3) Sistemática de exploración VExUS
- 4) Preguntas frecuentes
- 5) Conclusiones
- 6) Bibliografía

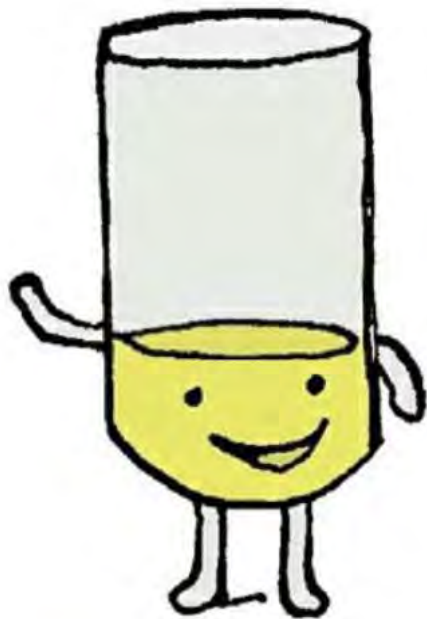
1. Introducción – Hemodinámica global



**SARTD-CHGUV Sesión de Formación continuada
Valencia 29 de Marzo de 2022**

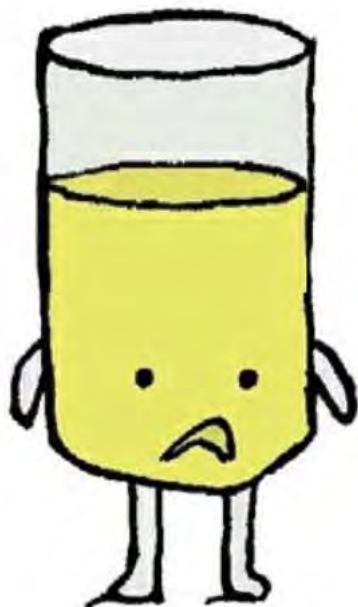
1

When to start fluids



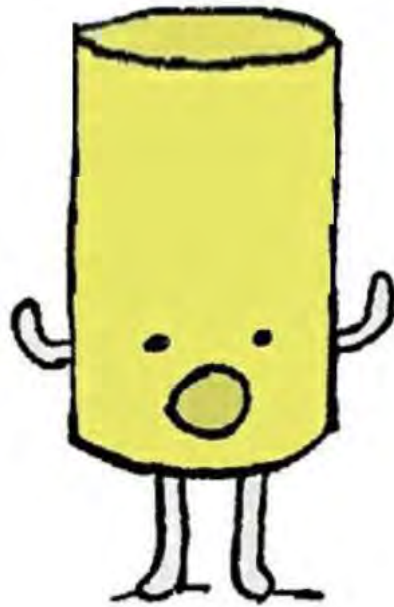
2

When to stop fluids



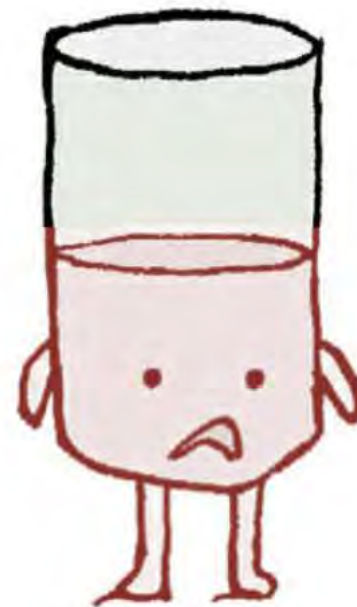
3

When to start fluid removal



4

When to stop removal

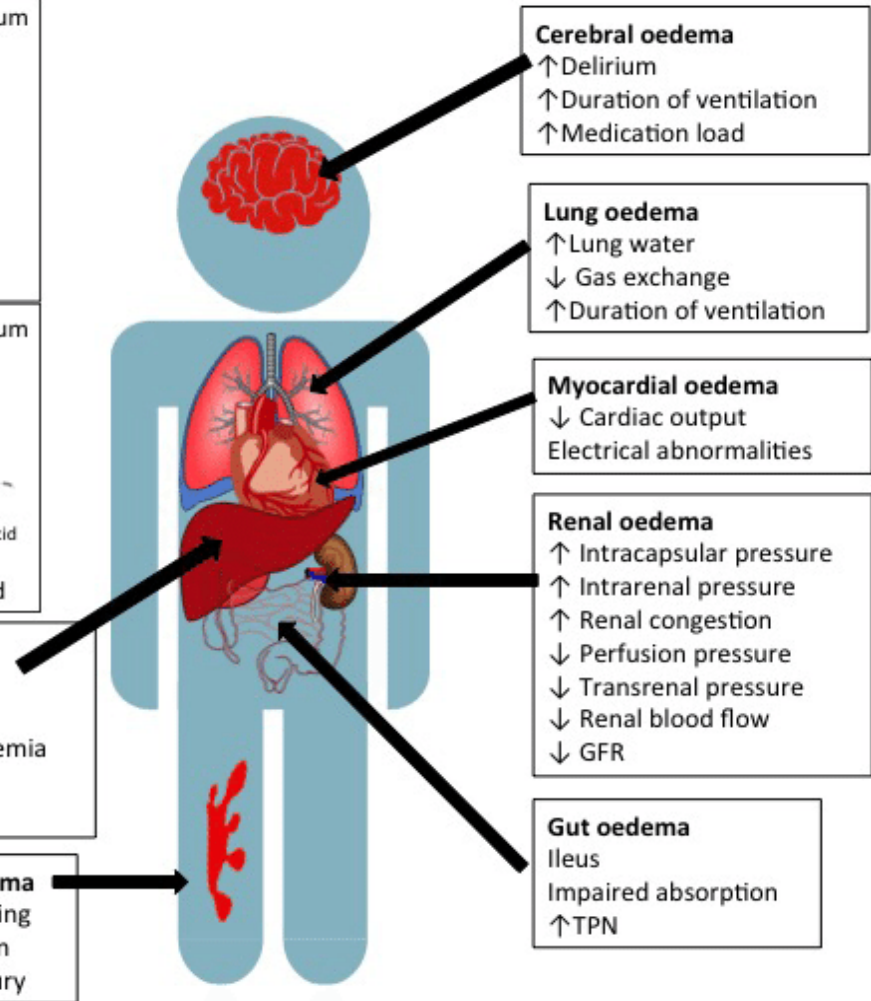
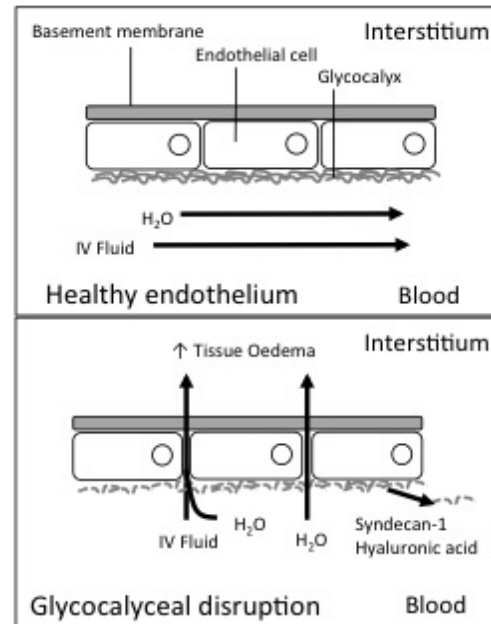






Glassford et al. Korean J Crit Care Med 2016; 31: 4.

Ser
Rea
HOSI



2. Fisiopatología del Sistema Venoso

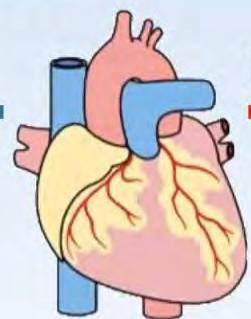


2. Fisiopatología del Sistema Venoso

IN DEPTH

Circulation

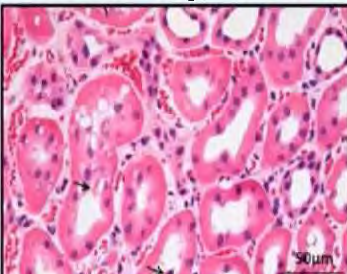
Systemic Consequences of Pulmonary Hypertension and Right-Sided Heart Failure



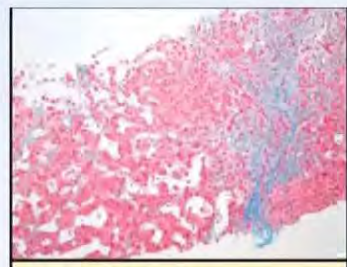
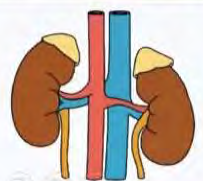
PVC elevada

Bajo Gasto Cardiaco

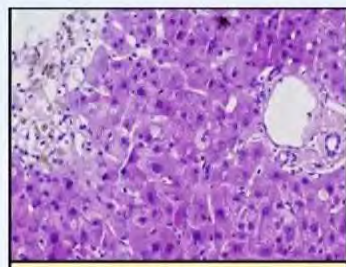
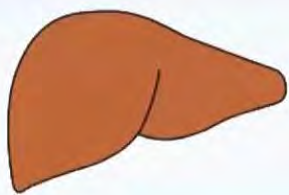
“Tamponade Intra-Capsular”



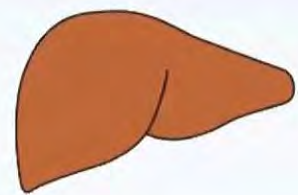
- Backward transmission of CVP
- Activation of venous endothelium
- Inflammatory mediators
- Renal edema
- “intracapsular tamponade”
- Aggravation of back pressure



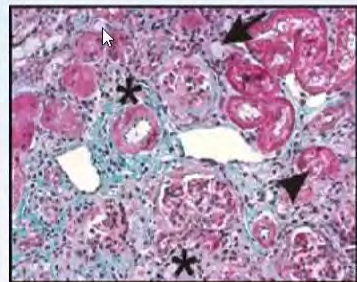
- Jaundice, ascites
- AP, yGT, bilirubin ↑
- Liver fibrosis or cirrhosis



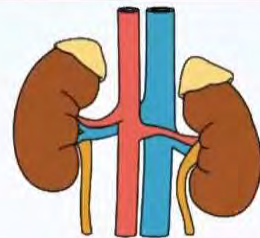
- ASAT, ALAT ↑↑↑
- LDH ↑↑
- Occasional liver failure

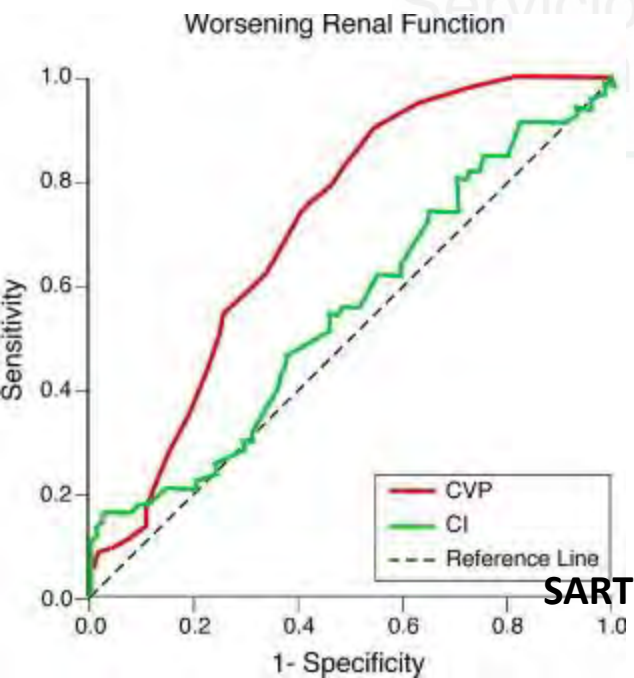
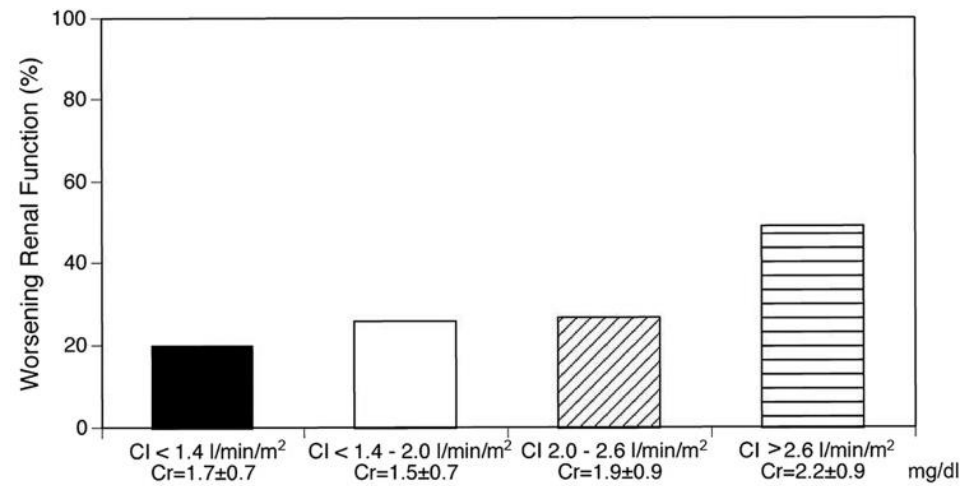
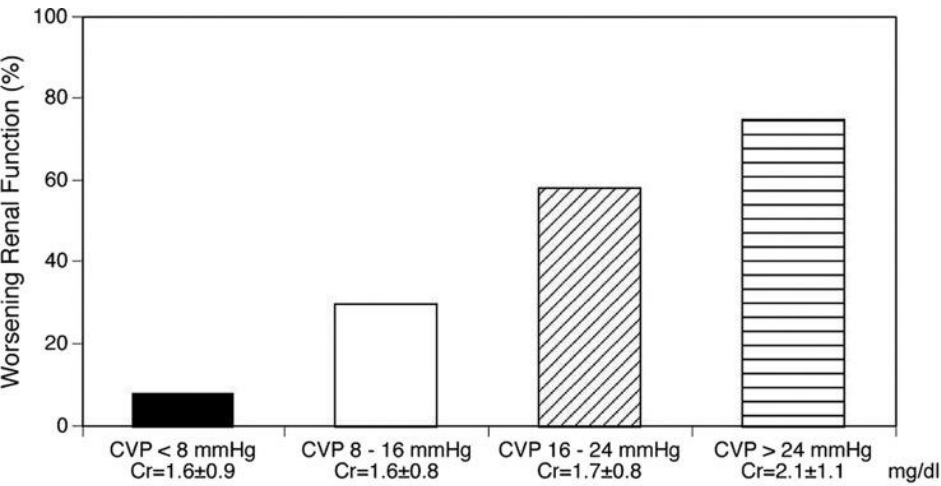


Isquemia



- Low renal perfusion
- Neurohormonal activation
- Oxidative stress
- Impaired cell signaling
- Immune modulation





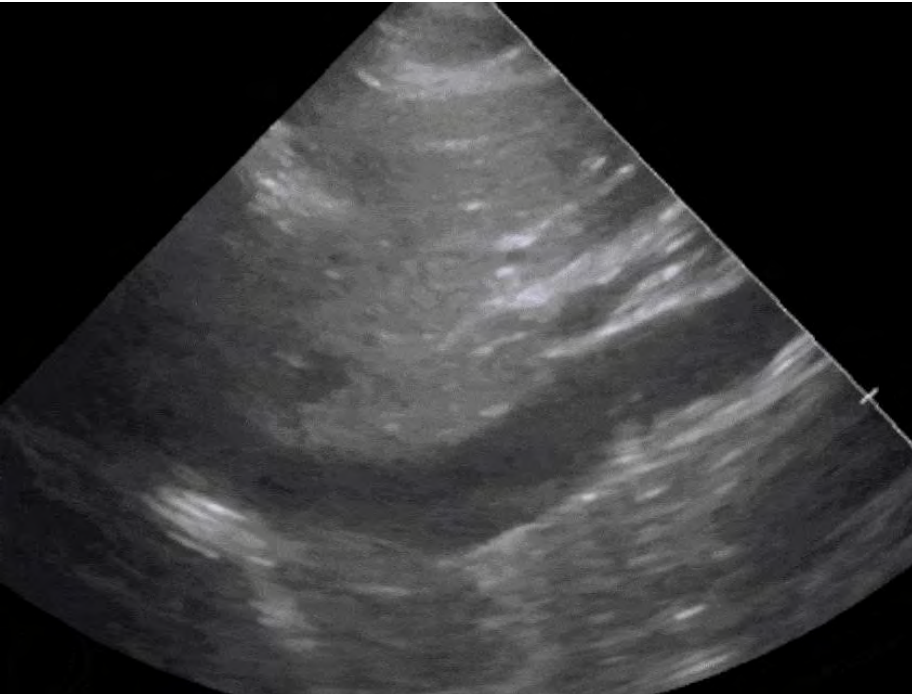
Servicio de Anestesia, Reanimación y Tratamiento del Dolor
HOSPITAL GENERAL UNIVERSITARIO VALENCIA

Importance of Venous Congestion for Worsening of Renal Function in Advanced Decompensated Heart Failure

Wilfried Mullens MD, Zuheir Abrahams MD, PhD, Gary S. Francis MD, FACC, George Sokos DO, David G. Taylor MD, FACC, Randall C. Starling MD, MPH, FACC, James B. Young MD, FACC, W.H. Wilson Tang MD, FACC &

Normal:

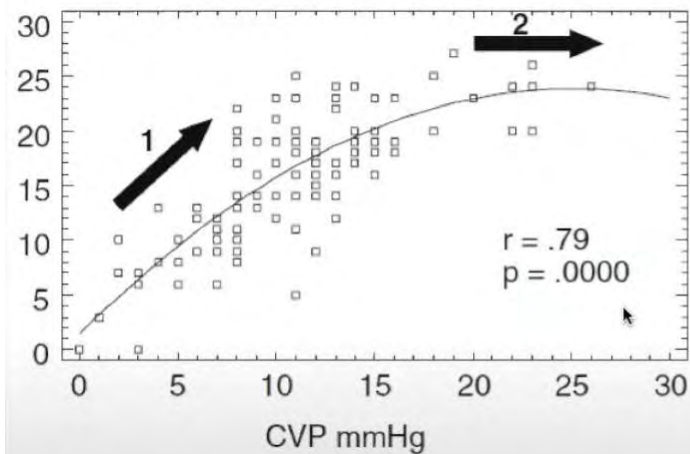
- < 2cm
- Colapsa al inspirar



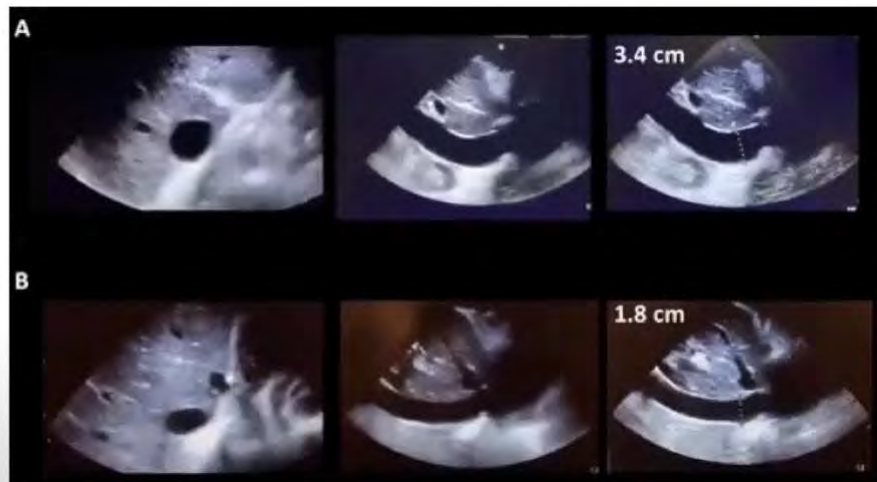
Congestiva:

- > 2cm
- No colapsa



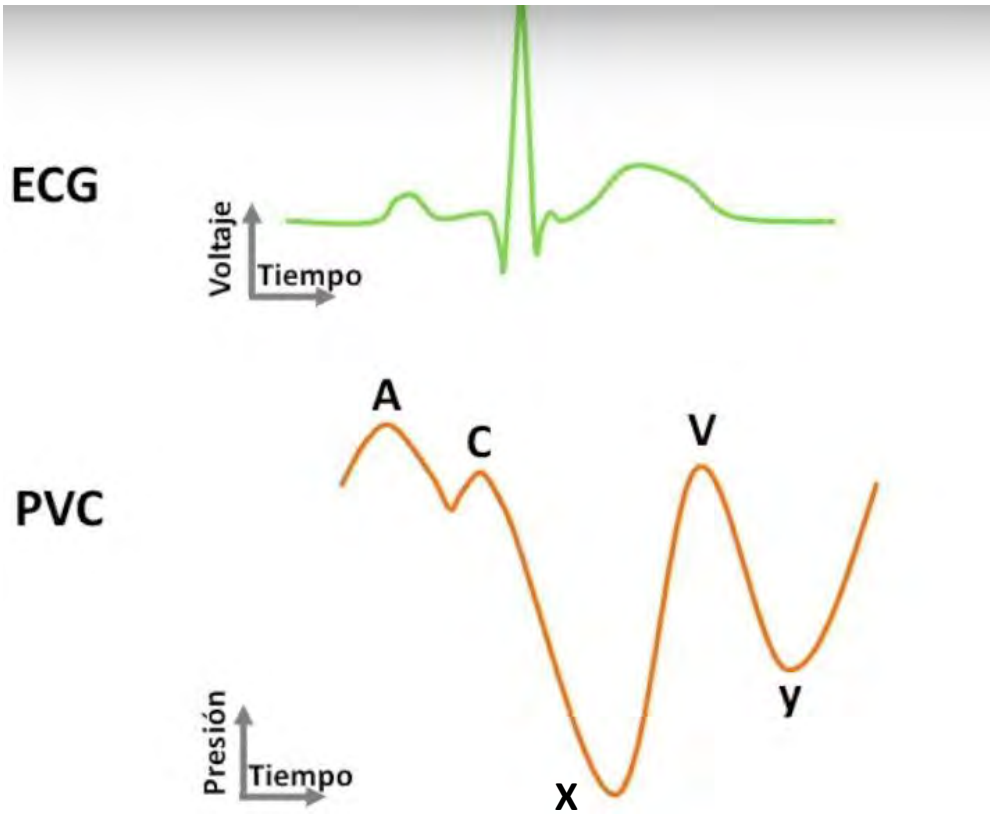


PMID: 16450103



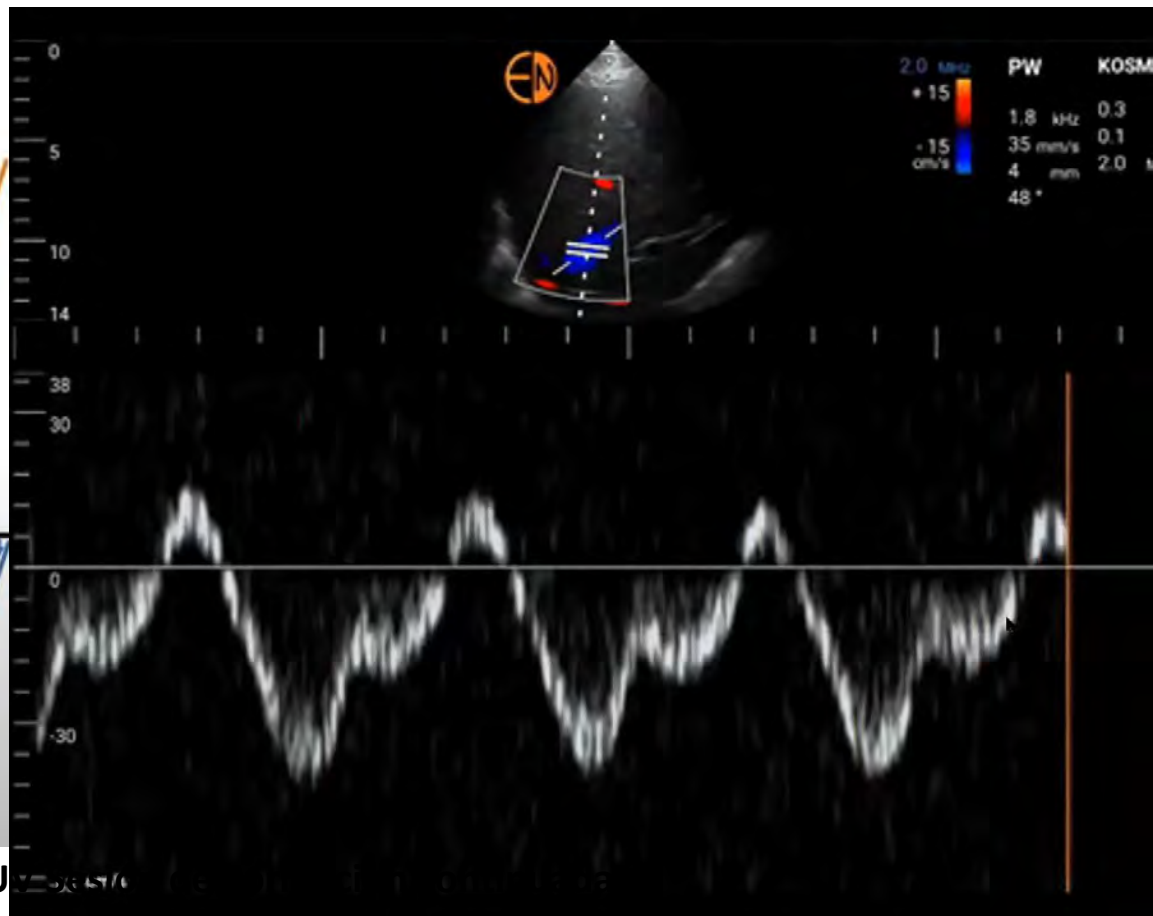
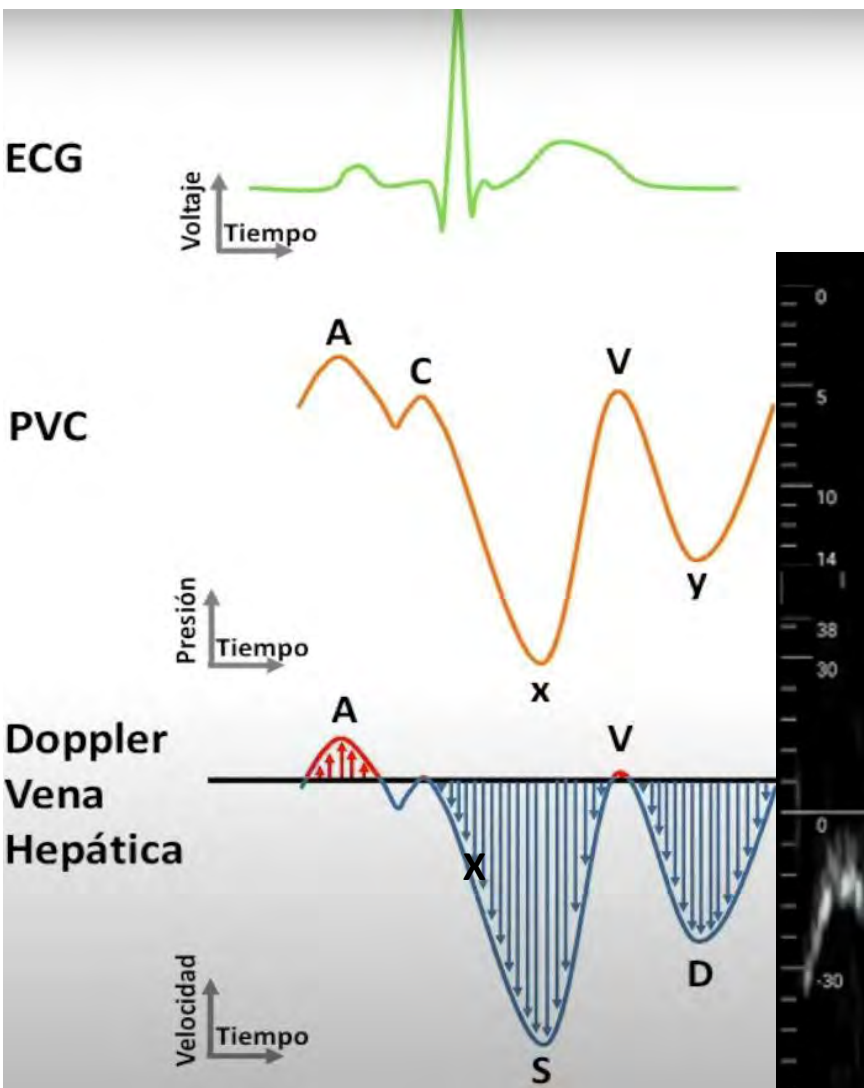
Servicio de Anestesia,
Reanimación y
Tratamiento del Dolor
HOSPITAL GENERAL UNIVERSITARIO VALENCIA

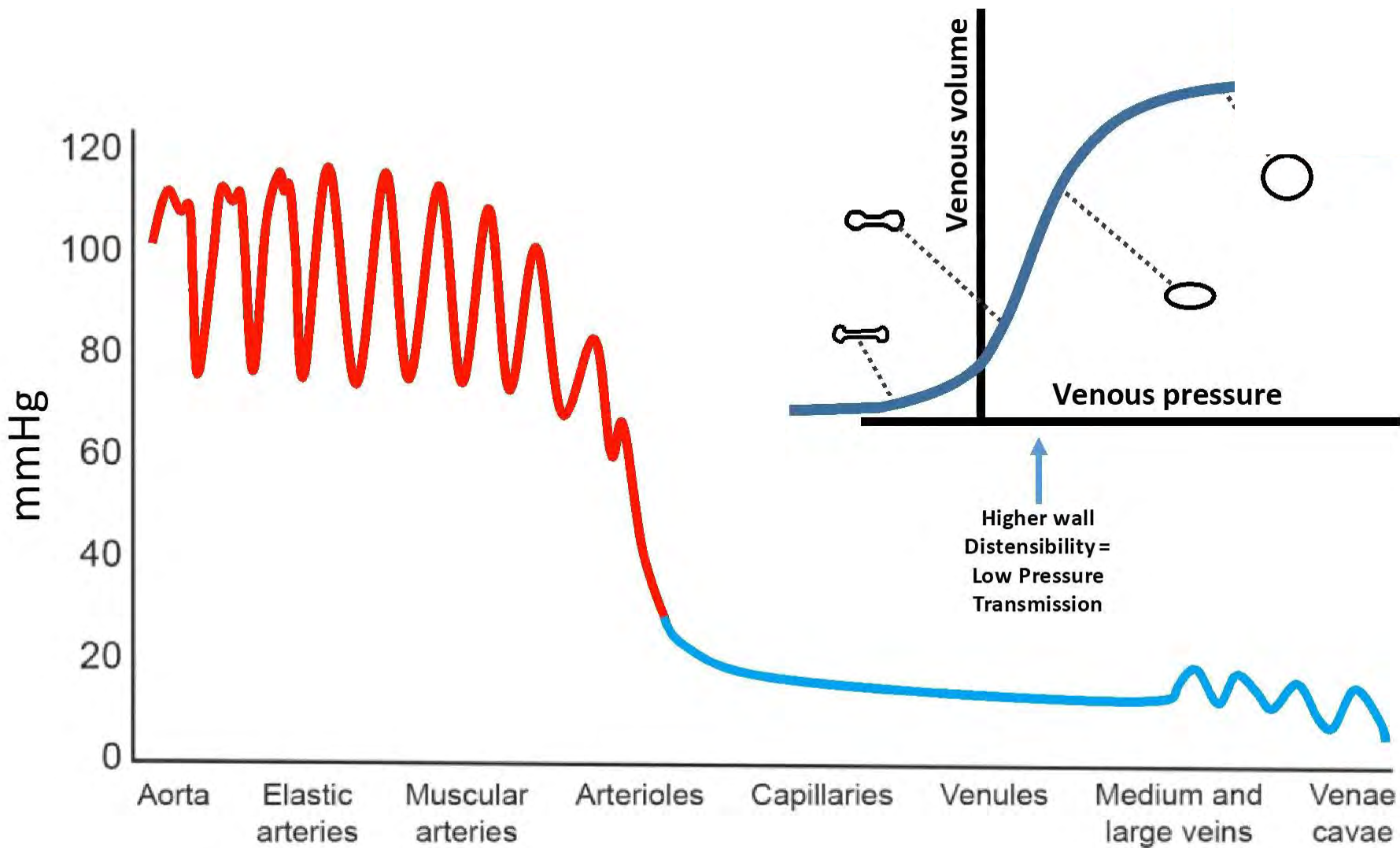
- El diámetro tiene gran variabilidad entre individuos. El diámetro absoluto no nos aporta información.
- El NO COLAPSO inspiratorio sí nos informa que hemos alcanzado un punto de no mayor distensibilidad.

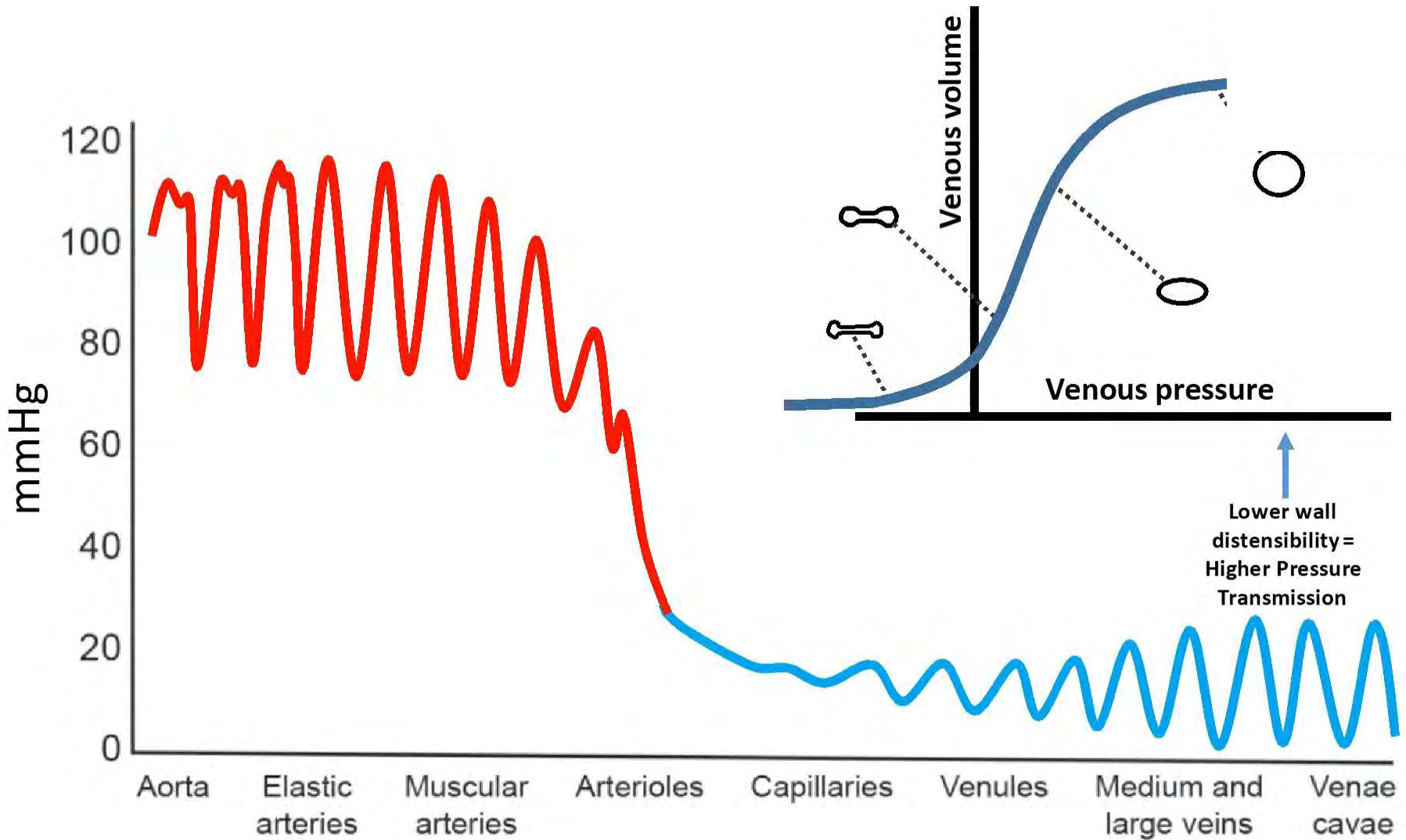


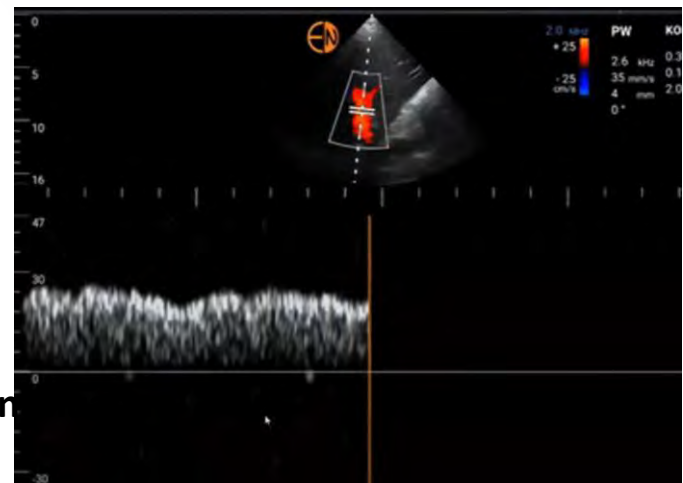
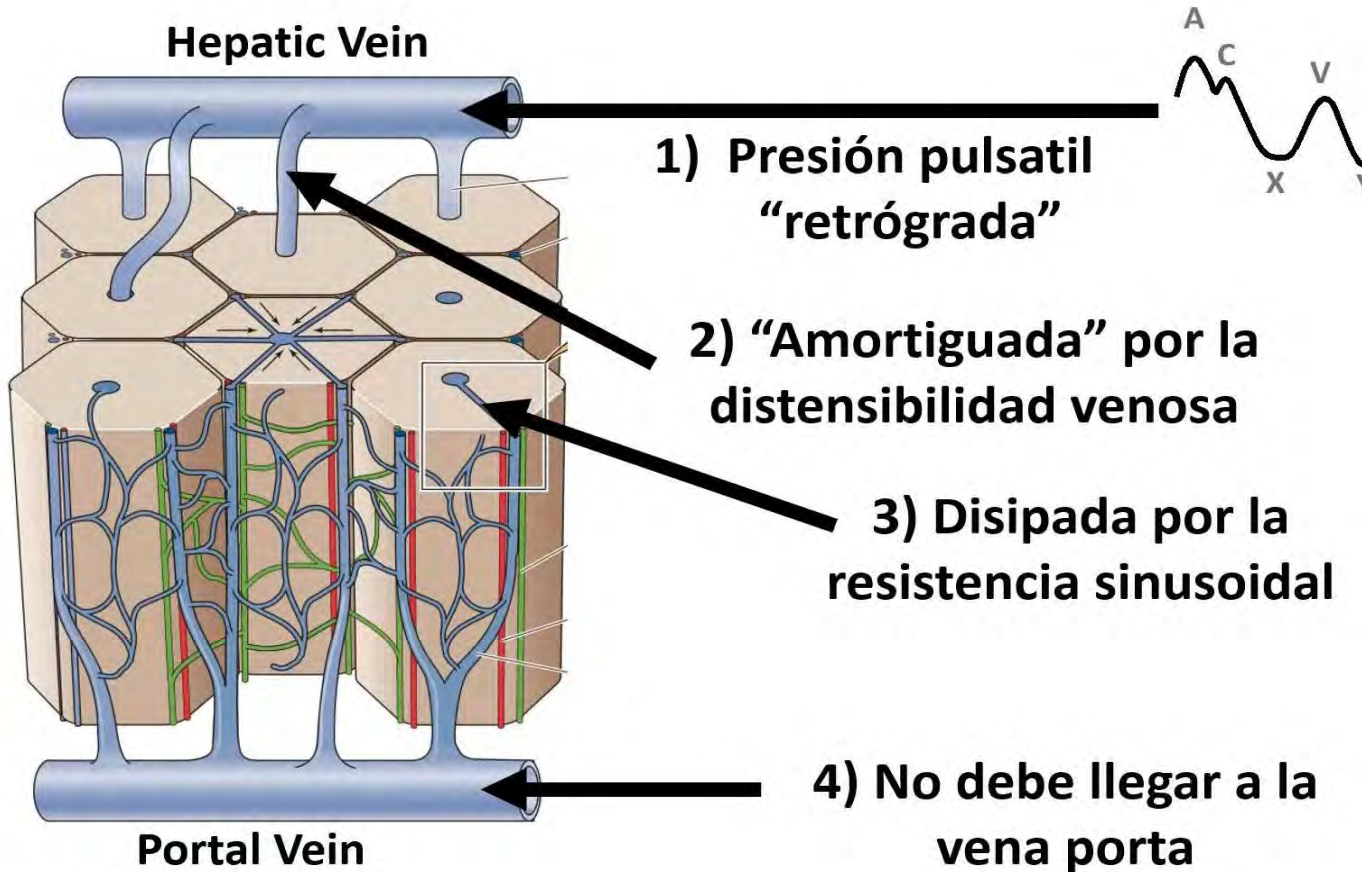
- **A:** patada auricular (sístole auricular).
- **X:** sístole ventricular (relajación aurícula y descenso suelo, efecto succión)
- **V:** aumento de presión por llenado de aurícula derecha
- **Y:** apertura válvula tricúspide

Manejo del Dolor
RSITARIO VALENCIA










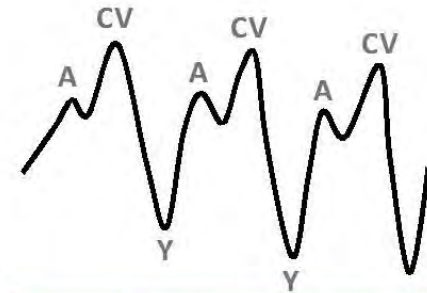
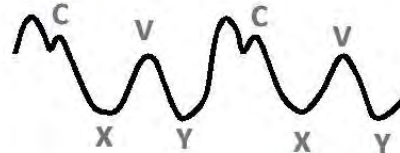


Review Article

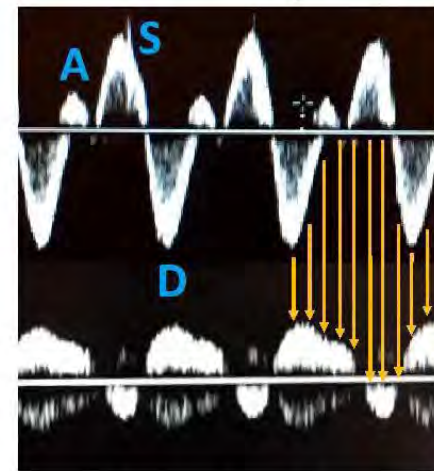
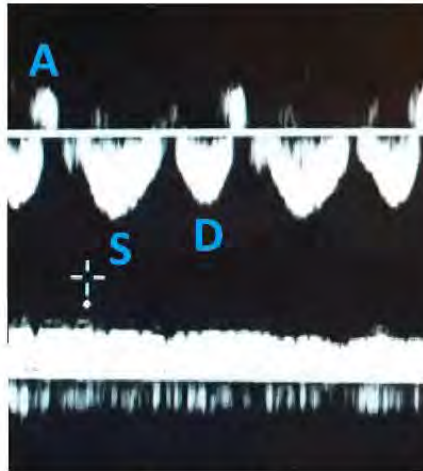
Comprehensive Assessment of Fluid Status by Point-of-Care Ultrasonography

Eduardo R. Argai ¹, Abhilash Koratala ² and Nathaniel Reisinger ³

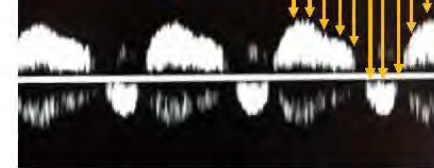
CVP



Hepatic Vein



Portal Vein



Normal

Severe TR

Kidney360

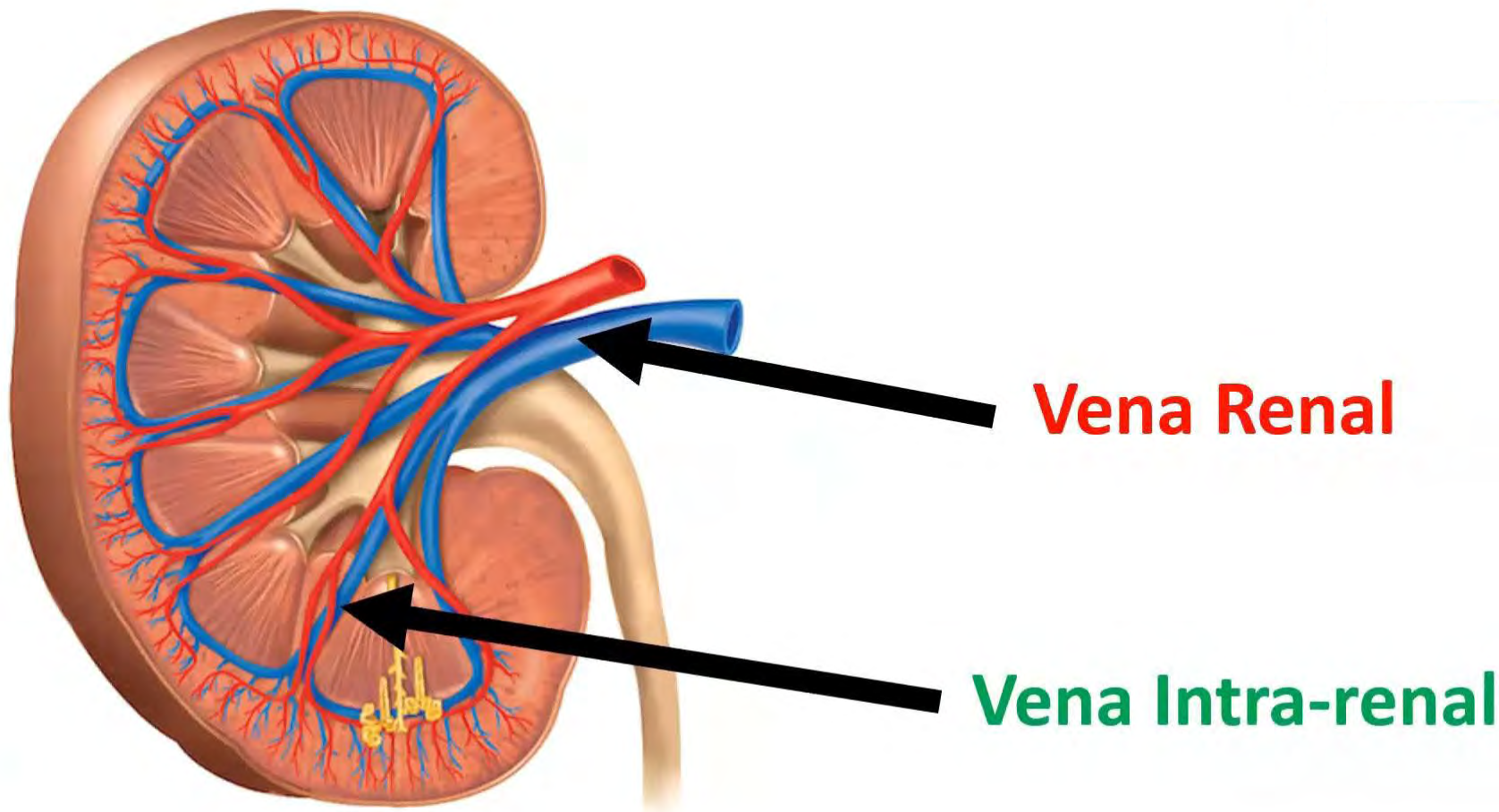
Pulsatile Portal Vein Flow: A Sign of Tricuspid Regurgitation on Duplex Doppler Sonography
1990

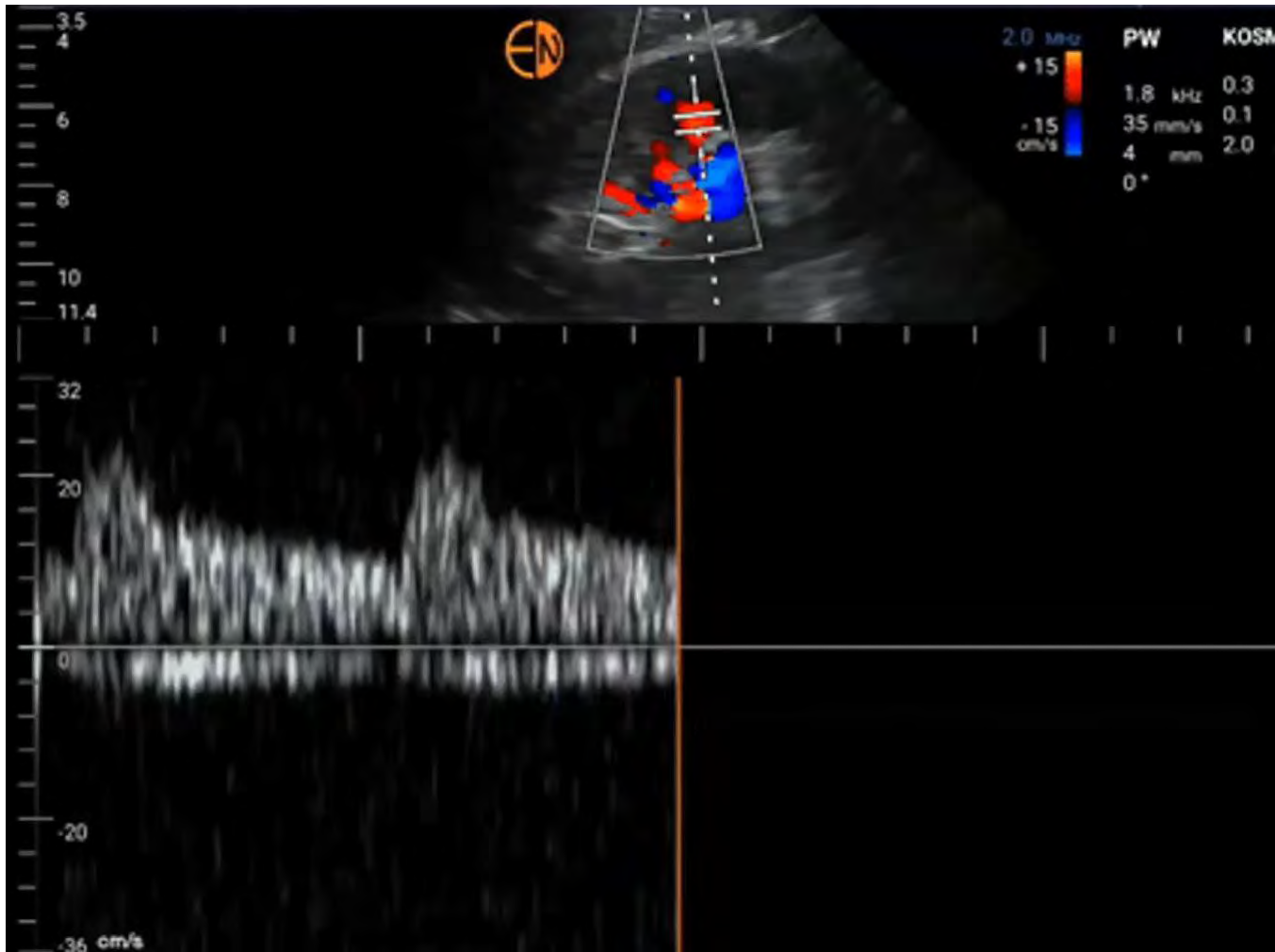
Alterations in Portal Vein Flow and Intrarenal Venous Flow Are Associated With Acute Kidney Injury After Cardiac Surgery: A Prospective Observational Cohort Study

William Beaubien-Souligny, MD; Aymen Benkreira, MD; Pierre Robillard, MD; Nadia Bouabdallaoui, MD; Michaël Chassé, MD, PhD; Georges Desjardins, MD; Yoan Lamarche, MD, MSc; Michel White, MD; Josée Bouchard, MD; André Denault, MD, PhD

Reanimación y Tratamiento del Dolor
VALENCIA

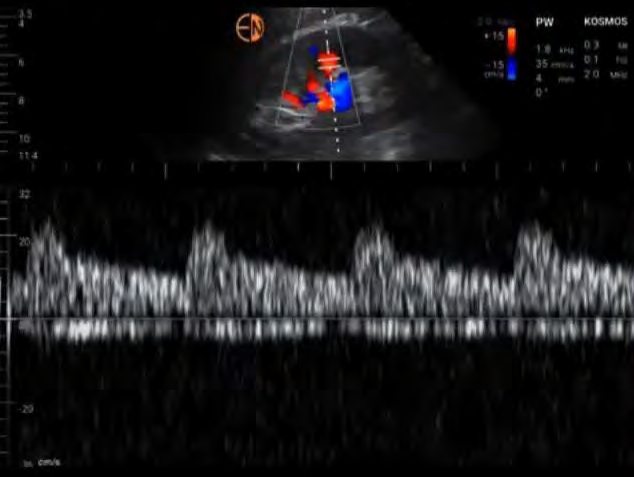
- Mayor posibilidad de AKI si pulsatilidad portal
- No tanto con:
 - PVC, GC, bomba



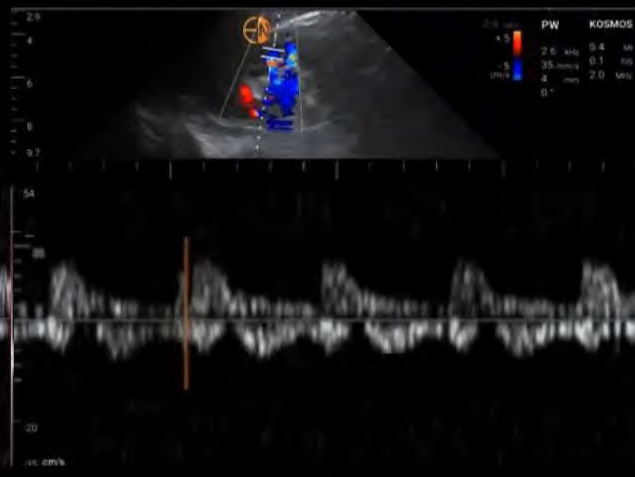


olor
 NCIA

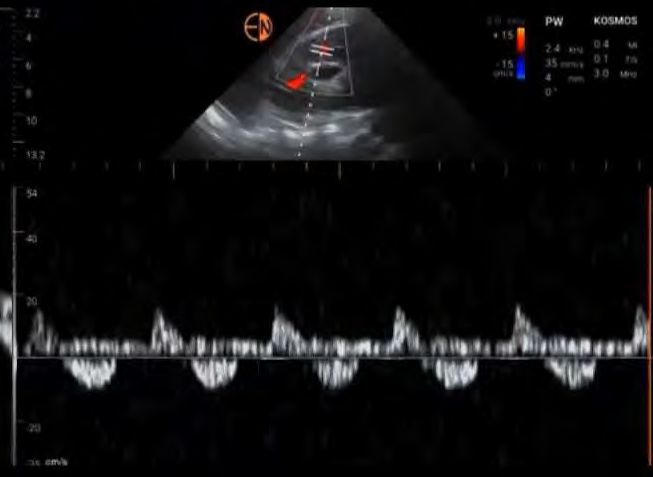
Contínuo



Bifásico



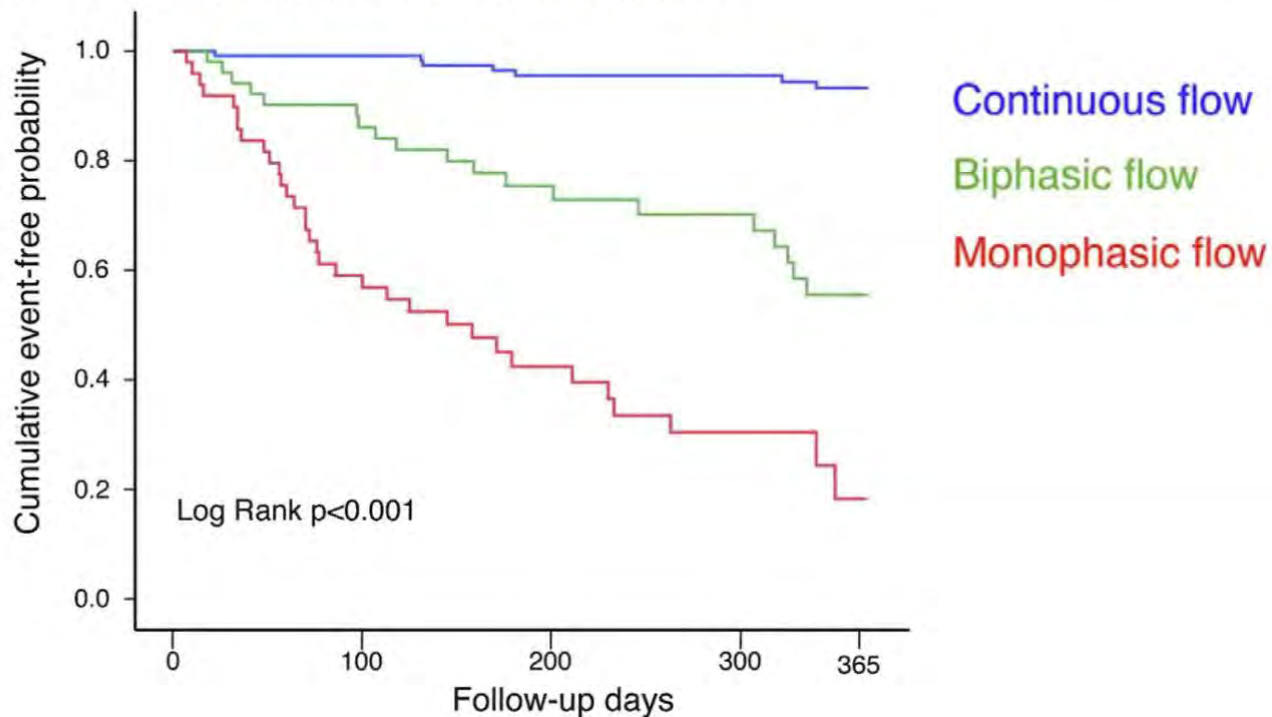
Monofásico



Clinical Implications of Intrarenal Hemodynamic Evaluation by Doppler Ultrasonography in Heart Failure



Noriko Iida, BA,^a Yoshihiro Seo, MD,^b Seika Sai, MD,^b Tomoko Machino-Ohtsuka, MD,^b Masayoshi Yamamoto, MD,^b Tomoko Ishizu, MD,^{b,c} Yasushi Kawakami, MD,^c Kazutaka Aonuma, MD^b



Not Congestive



Severe

VExUS = 0

VExUS = 1

VExUS = 2

VExUS = 3

IVC



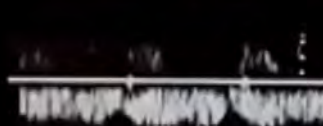
Hepatic Vein



Portal Vein



Intra-Renal Vein





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

William Beaubien-Souligny^{1,2*}, Philippe Rola³, Korbin Haycock⁴, Josée Bouchard⁵, Yoan Lamarche⁶, Rory Spiegel⁷ and André Y. Denault^{1,8}

Table 3 Performance parameters of the different VExUS grading systems assessed at ICU admission to predict acute kidney injury in 145 patients after cardiac surgery

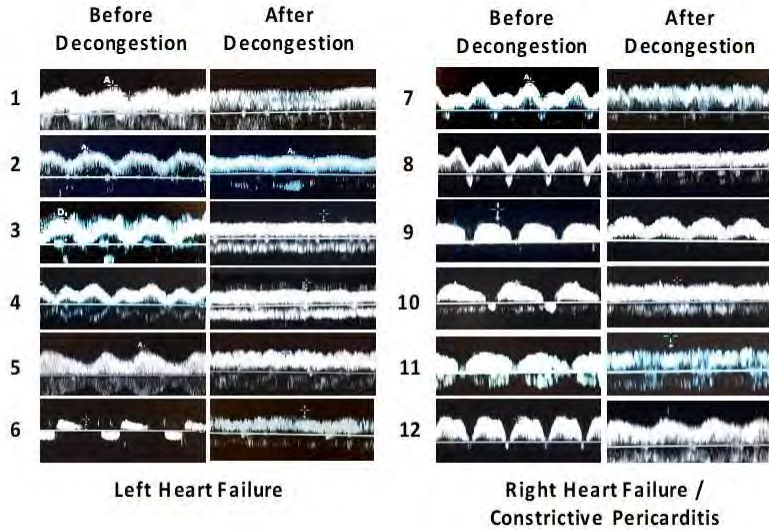
Grading system	Grade	Specificity (CI)	Sensitivity (CI)	+LR (CI)	-LR (CI)
VExUS C	1	41% (31–51%)	73% (59–85%)	1.24 (0.98–1.57)	0.65 (0.40–1.07)
	2	87% (78–92%)	39% (26–54%)	2.86 (1.55–5.30)	0.71 (0.56–0.89)
	3	96% (89–99%)	27% (15–41%)	6.37 (2.19–18.5)	0.77 (0.65–0.91)
Portal Doppler only	Mild	73% (64–82%)	39% (25–52%)	1.46 (0.90–2.37)	0.83 (0.65–1.08)
	Severe	91% (86–97%)	27% (14–39%)	3.12 (1.39–7.01)	0.80 (0.67–0.96)
Hepatic vein Doppler only	Mild	56% (46–66%)	51% (37–65%)	1.16 (0.81–1.66)	0.88 (0.62–1.23)
	Severe	84% (76–91%)	34% (20–48%)	2.11 (1.15–3.89)	0.79 (0.63–0.98)
Renal Doppler only	Mild	80% (72–88%)	45% (31–59%)	2.27 (1.36–3.77)	0.69 (0.52–0.90)
	Severe	94% (89–99%)	25% (12–37%)	3.92 (1.57–9.81)	0.81 (0.68–0.95)
CVP	≥ 8 mmHg	48% (37–59%)	77% (61–88%)	1.47 (1.13–1.90)	0.49 (0.28–0.86)
	≥ 10 mmHg	66% (55–75%)	58% (42–73%)	1.71 (1.16–2.51)	0.64 (0.44–0.91)
	≥ 12 mmHg	83% (73–90%)	33% (20–49%)	1.91 (1.02–3.59)	0.81 (0.66–1.01)

CI confidence intervals, CVP central venous pressure, +LR positive likelihood ratio, -LR negative likelihood ratio

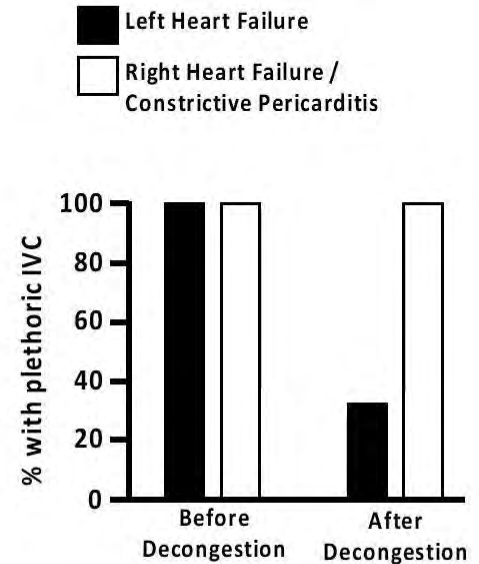
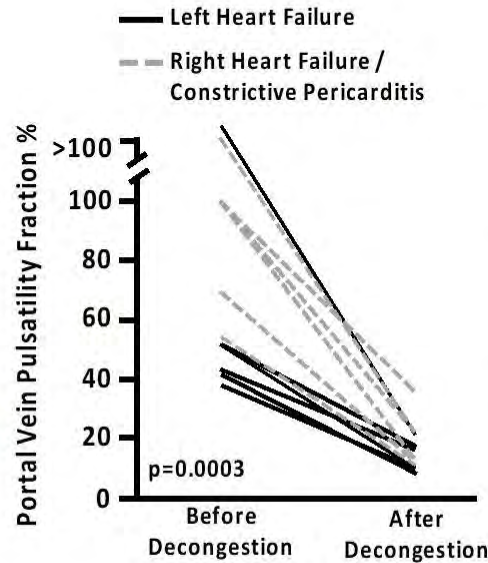
Dynamic Changes in Portal Vein Flow during Decongestion in Patients with Heart Failure and Cardio-Renal Syndrome: A POCUS Case Series

Eduardo R. Argai^a Philippe Rola^b Gerardo Gamba^{a, c}

A

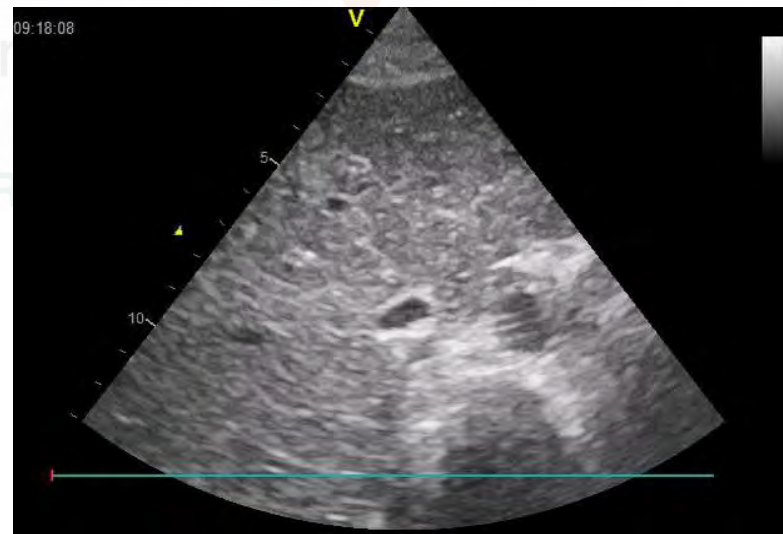
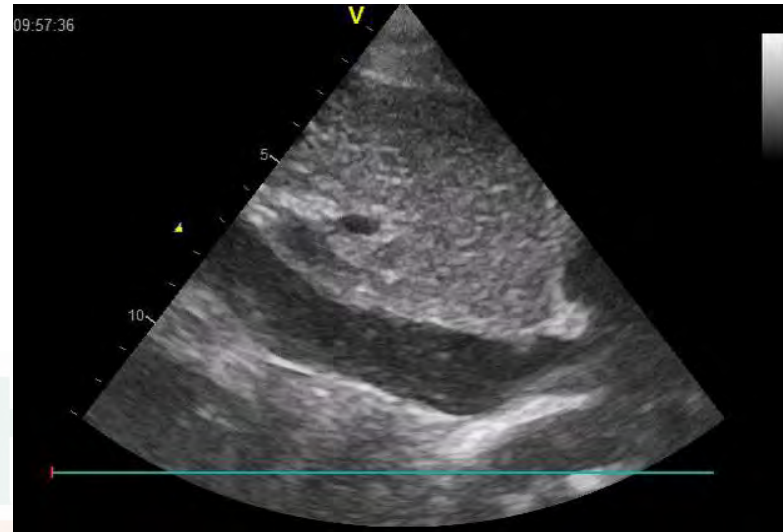


B



Cardiorenal Med. 2021;11(1):59-66.

3. Sistemática de exploración VExUS



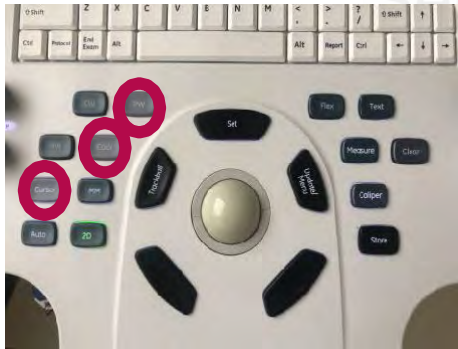
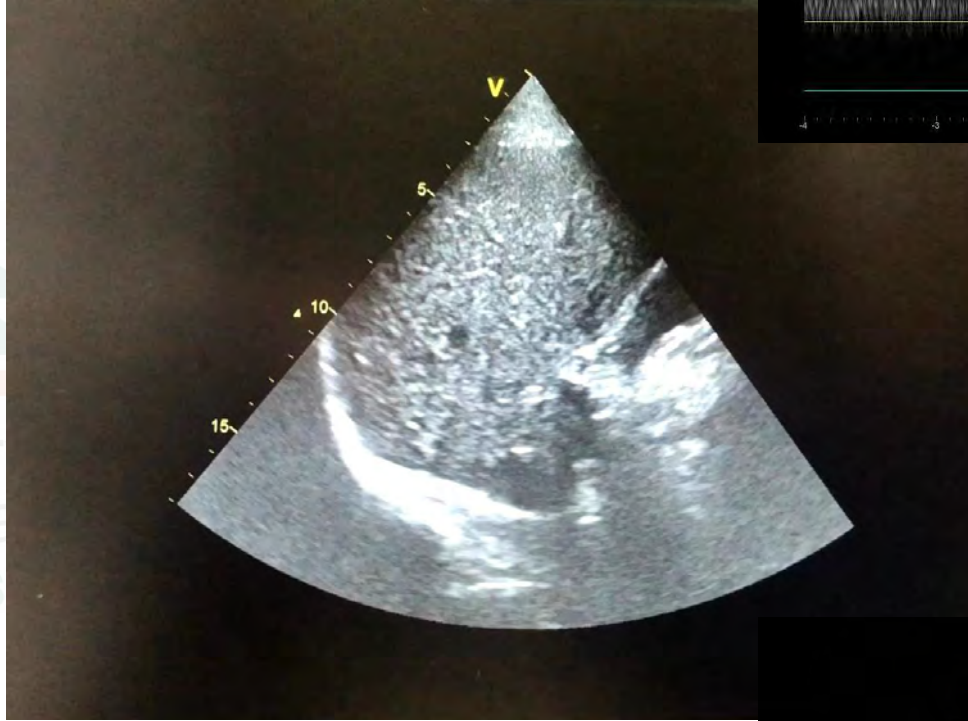
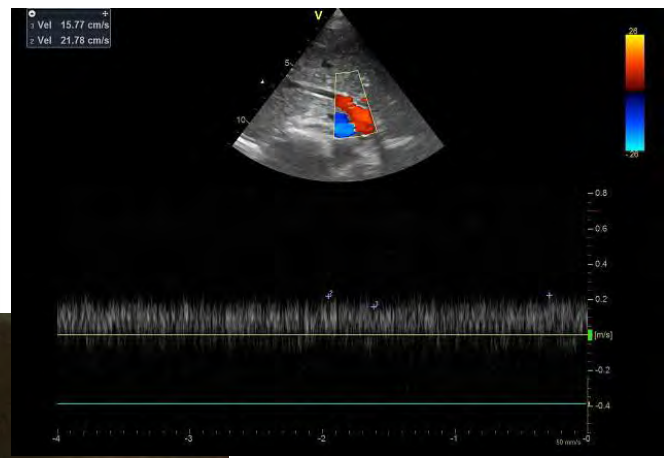
- Error del cilindro
- VM difícil extraer conclusiones



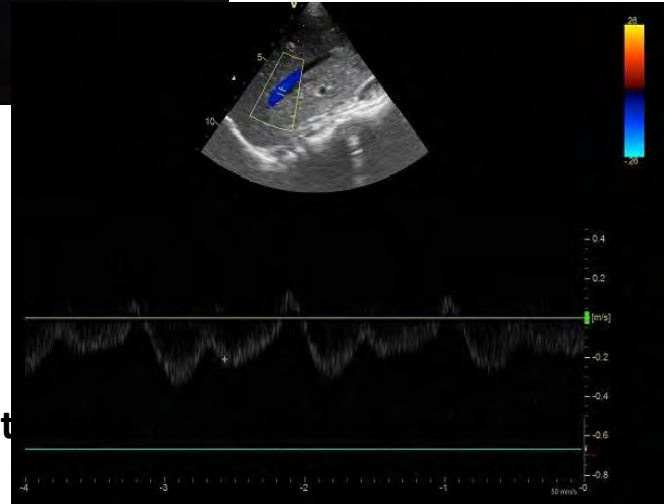
Vena Porta

$$\text{Pulsatility Index} = (V_{\text{max}} - V_{\text{min}}) / V_{\text{max}} \cdot 100$$

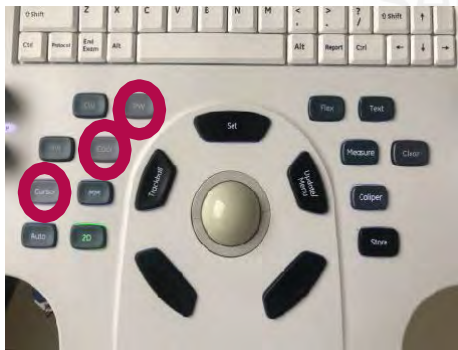
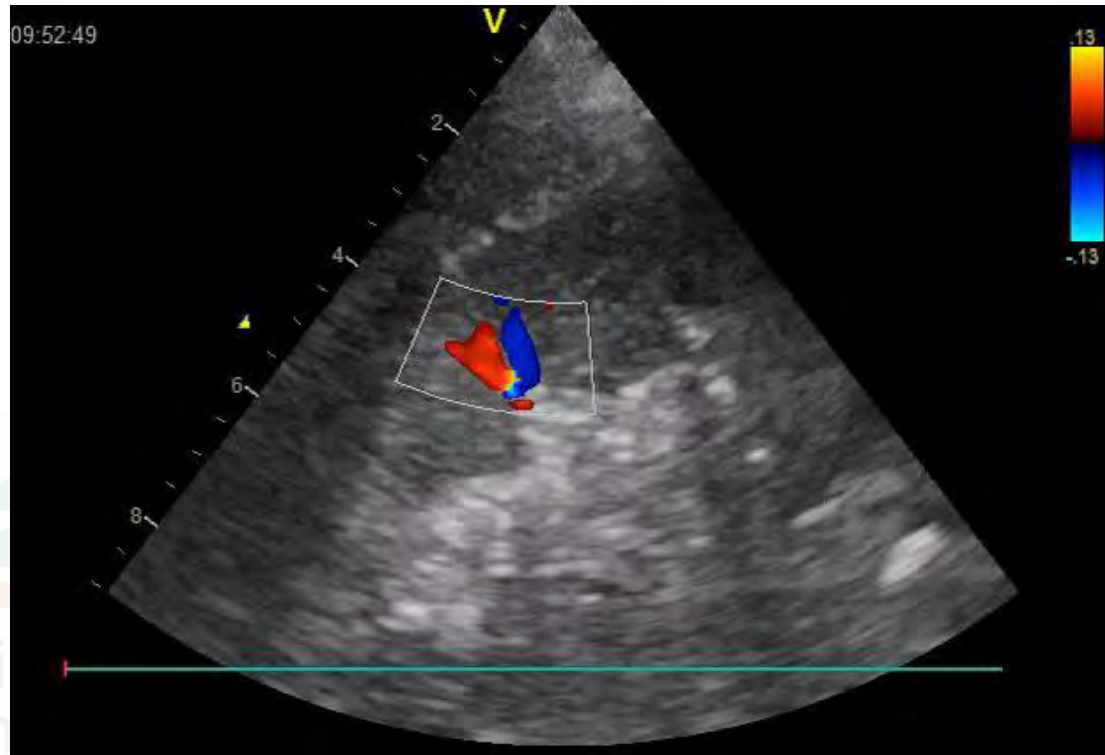
- Normal < 30%
- Leve 30-49%
- Grave > 50%



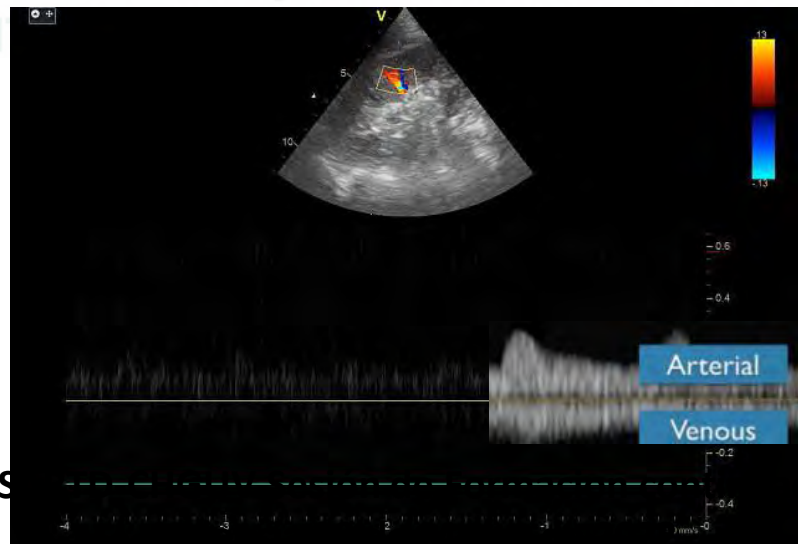
Venas hepáticas



SARTD-CHGUV Servicio de Anestesia, Reanimación y Tratamiento del Dolor
 Valencia 29 de Marzo de 2022



**Venas
Intrarrenales**



4. Preguntas frecuentes



¿Puedo valorar la congestión con las líneas B?

- Indican congestión pulmonar
- Causa cardíaca → izquierda
- VExUS → analiza congestión 2ª a derecha

¿VExUS aporta más que PVC?

- Valora congestión según complianza
- Se transmite retrógrada
- Evalúa el efecto sobre los órganos
- PVC es un dato puntual que nos orienta, pero no evalúa el efecto

¿VExUS 3 = Hipervolemia?

- VExUS 3 = Congestión venosa
- Valorar otras causas de dicha congestión:
 - TEP grave
 - Neumotórax a tensión
 - Taponamiento pericárdico
 - Ventilación con PEEP elevada
- Evaluar causa y valorar tratamiento

¿Está validado en sepsis?

- No, la evidencia está en aumento
- ¿Sepsis + IC?

Grado evidencia

1. Postoperatorio cirugía cardíaca (Paciente de UCI)

→ Marcador de eventos adversos renales

PMID: 29277304, 32270297,
33076961

2. Insuficiencia cardíaca

→ Marcador de eventos adversos
cardíacos y renales

PMID: 25091801, 27179835,
19215833, 33132560

3. Sepsis

→ Marcador de final de resucitación?

No hay evidencia

+

-

¿Para realizar VEXUS el paciente tiene que estar en ritmo sinusal?

- No, en ICV, porta e intrarrenal
- Sí, en venas hepáticas (acoplar ECG)
- El Score permite la valoración sin todas las mediciones (dificultad de medición, no posibilidad de acceso, no condiciones adecuadas)

5. Conclusiones

- Los fallos orgánicos hemodinámicos no se deben exclusivamente a alteraciones del IC o la TA.
- La congestión de los órganos genera un efecto deletéreo en los mismos.
- VExUS valora la congestión y transmisión de las presiones desde la aurícula derecha hasta los órganos abdominales.
- Requiere descartar otras alteraciones corregibles que puedan favorecer la congestión retrógrada:
 - Taponamiento cardíaco
 - Neumotórax a tensión
 - TEP
- Empieza valorando vena cava inferior. Si < 2 cm y colapsa, el paciente no está congestivo. El siguiente punto de exploración más útil es la porta.
- Utilidad para monitorizar el tratamiento descongestivo.
- Siempre interpretar en el contexto clínico y en una valoración integrada POCUS del resto de órganos.

6. Bibliografía

1. Miralles F (H. UP del M. Protocolo VExUS: Valoración de la Congestión Venosa [Internet]. Centro de Educación Hospital H+; 2021.
2. Denault AY, Beaubien-Souligny W, Elmi-Sarabi M, Eljaiek R, El-Hamamsy I, Lamarche Y, et al. Clinical Significance of Portal Hypertension Diagnosed With Bedside Ultrasound After Cardiac Surgery. *Anesth Analg* [Internet]. 2017 Apr;124(4):1109–15
3. Malinowska A, Arslani K, Zellweger N, Gebhard C, Beaubien-Souligny W, Calderone A, et al. Femoral and popliteal venous Doppler during prone and supine position in COVID-19 patients: a potential diagnostic tool to detect abnormal right ventricular function. *Can J Anesth Can d'anesthésie* [Internet]. 2021 May 2;68(5):737–9.
4. Calderone A, Hammoud A, Jarry S, Denault A, Couture EJ. Femoral Vein Pulsatility: What Does It Mean? *J Cardiothorac Vasc Anesth* [Internet]. 2021 Aug;35(8):2521–7.
5. Beaubien-Souligny W, Eljaiek R, Fortier A, Lamarche Y, Liszkowski M, Bouchard J, et al. The Association Between Pulsatile Portal Flow and Acute Kidney Injury after Cardiac Surgery: A Retrospective Cohort Study. *J Cardiothorac Vasc Anesth* [Internet]. 2018 Aug;32(4):1780–7.
6. Beaubien-Souligny W, Benkreira A, Robillard P, Bouabdallaoui N, Chassé M, Desjardins G, et al. Alterations in Portal Vein Flow and Intrarenal Venous Flow Are Associated With Acute Kidney Injury After Cardiac Surgery: A Prospective Observational Cohort Study. *J Am Heart Assoc* [Internet]. 2018 Oct 2;7(19).
7. Boyd JH, Forbes J, Nakada T, Walley KR, Russell JA. Fluid resuscitation in septic shock: A positive fluid balance and elevated central venous pressure are associated with increased mortality*. *Crit Care Med* [Internet]. 2011 Feb;39(2):259–65.
8. Damman K, van Deursen VM, Navis G, Voors AA, van Veldhuisen DJ, Hillege HL. Increased Central Venous Pressure Is Associated With Impaired Renal Function and Mortality in a Broad Spectrum of Patients With Cardiovascular Disease. *J Am Coll Cardiol* [Internet]. 2009 Feb;53(7):582–8.
9. Eljaiek R, Cavayas YA, Rodrigue E, Desjardins G, Lamarche Y, Toupin F, et al. High postoperative portal venous flow pulsatility indicates right ventricular dysfunction and predicts complications in cardiac surgery patients. *Br J Anaesth* [Internet]. 2019 Feb;122(2):206–14.
10. Monzer M A-Y, Steven G M, Robert M F. Pulsatile Portal Vein Flow: A Sign of Tricuspid Regurgitation on Duplex Doppler Sonography. *AJR*. 1990;155:785–8.
11. Denault AY, Aldred MP, Hammoud A, Zeng YH, Beaubien-Souligny W, Couture EJ, et al. Doppler Interrogation of the Femoral Vein in the Critically Ill Patient: The Fastest Potential Acoustic Window to Diagnose Right Ventricular Dysfunction? *Crit Care Explor* [Internet]. 2020 Sep 28;2(10):e0209.

12. Vellinga NA, Ince C, Boerma EC. Elevated central venous pressure is associated with impairment of microcirculatory blood flow in sepsis: a hypothesis generating post hoc analysis. *BMC Anesthesiol* [Internet]. 2013 Dec 7;13(1):17
13. Hanberg JS, Sury K, Wilson FP, Brisco MA, Ahmad T, ter Maaten JM, et al. Reduced Cardiac Index Is Not the Dominant Driver of Renal Dysfunction in Heart Failure. *J Am Coll Cardiol* [Internet]. 2016 May;67(19):2199–208.
14. Beaubien-Souligny W, Rola P, Haycock K, Bouchard J, Lamarche Y, Spiegel R, et al. Quantifying systemic congestion with Point-Of-Care ultrasound: development of the venous excess ultrasound grading system. *Ultrasound J* [Internet]. 2020 Dec 9;12(1):16.
15. Perez Nieto OR, Wong A, Lopez Fermin J, Zamarron Lopez EI, Meade Aguilar JA, Deloya Tomas E, et al. Aiming for zero fluid accumulation: First, do no harm. *Anesthesiol Intensive Ther* [Internet]. 2021;53(2):162–78.
16. Boyd JH, Forbes J, Nakada T, Walley KR, Russell JA. Fluid resuscitation in septic shock: A positive fluid balance and elevated central venous pressure are associated with increased mortality*. *Crit Care Med* [Internet]. 2011 Feb;39(2):259–65
17. Evans L, Rhodes A, Alhazzani W, Antonelli M, Coopersmith CM, French C, et al. Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock 2021. *Crit Care Med* [Internet]. 2021 Nov 14;49(11):e1063–143.
18. Iida N, Seo Y, Sai S, Machino-Ohtsuka T, Yamamoto M, Ishizu T, et al. Clinical Implications of Intrarenal Hemodynamic Evaluation by Doppler Ultrasonography in Heart Failure. *JACC Hear Fail* [Internet]. 2016 Aug;4(8):674–82.
19. Villen T, Tung Y, R. Argai E, Mariz J. Seminario web VExUS: Valoración de Congestión Venosa con POCUS. In: KOSMOS, editor. EchoNous; 022.
20. Rosenkranz, S., Howard, L. S., Gomberg-Maitland, M., & Hoepfer, M. M. (2020). Systemic Consequences of Pulmonary Hypertension and Right-Sided Heart Failure. *Circulation*, 141(8), 678–693.
21. Mullens W, Abrahams Z, Francis GS, Sokos G, Taylor DO, Starling RC, et al. Importance of Venous Congestion for Worsening of Renal Function in Advanced Decompensated Heart Failure. *J Am Coll Cardiol* [Internet]. 2009 Feb;53(7):589–96.

Gracias por vuestra atención

