

# Flux veineux hépatiques

Roux François 03/12/2024

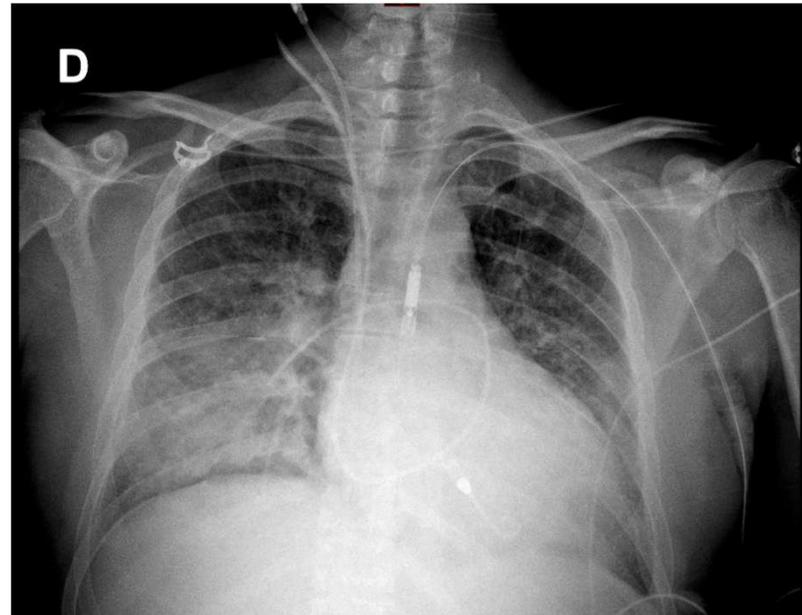
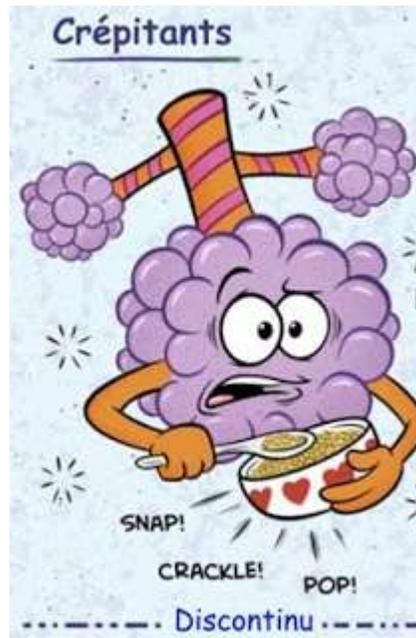
TUSAR Grand ouest

# Plan

- Introduction
- Anatomie
- Fenêtres
- Physiologie
- Anomalies
- Conclusion

# Introduction

- Analogie clinique  
– IVG

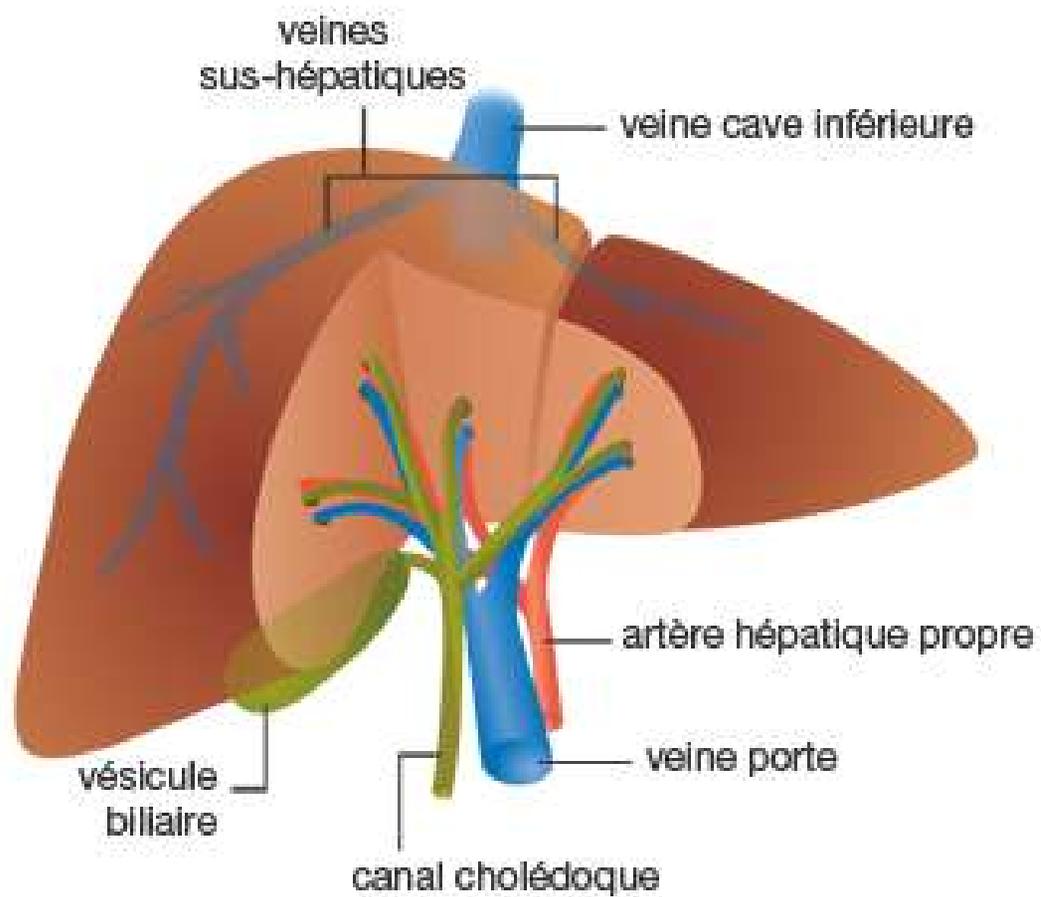


# Introduction

- Analogie clinique
  - IVD

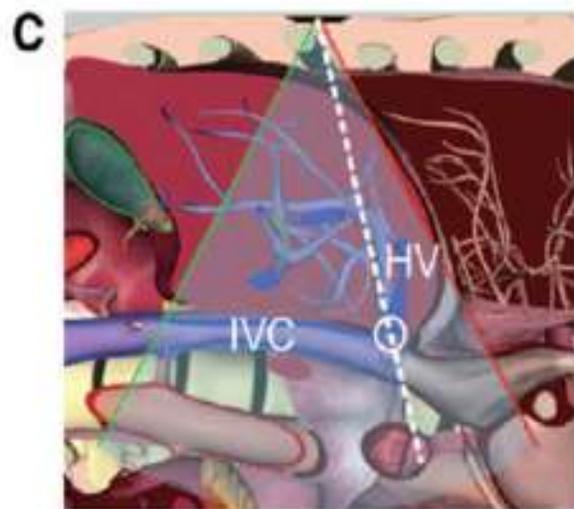
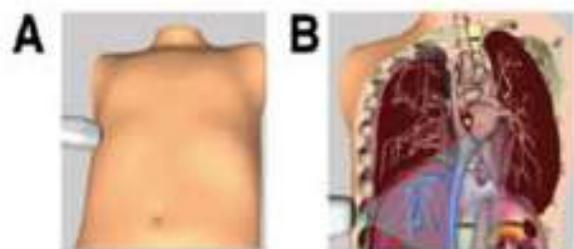


# Anatomie



# ETT

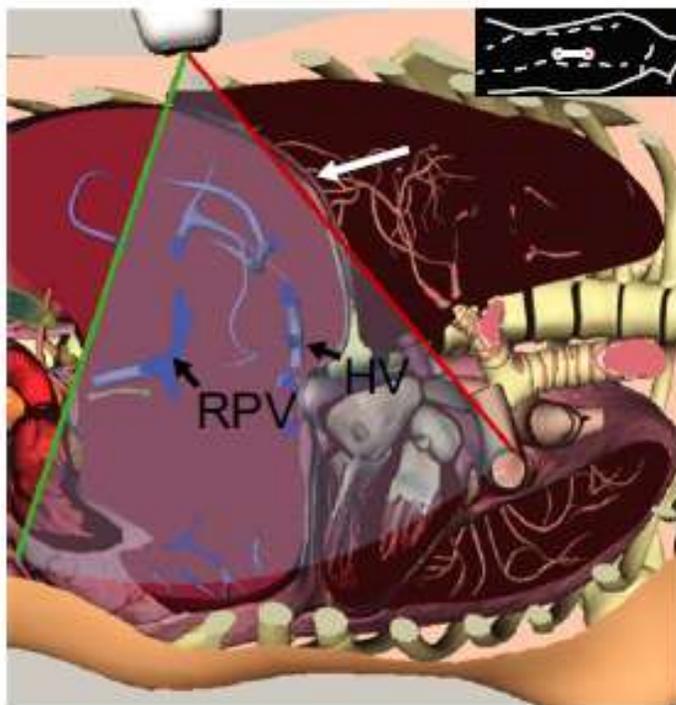
## Transthoracic approach



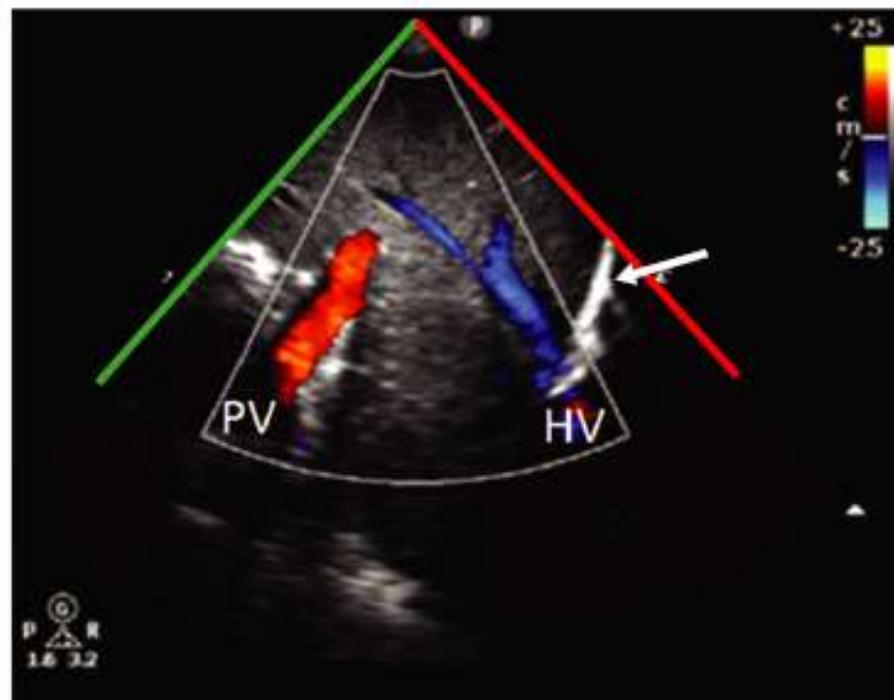
# ETT



# ETT



B



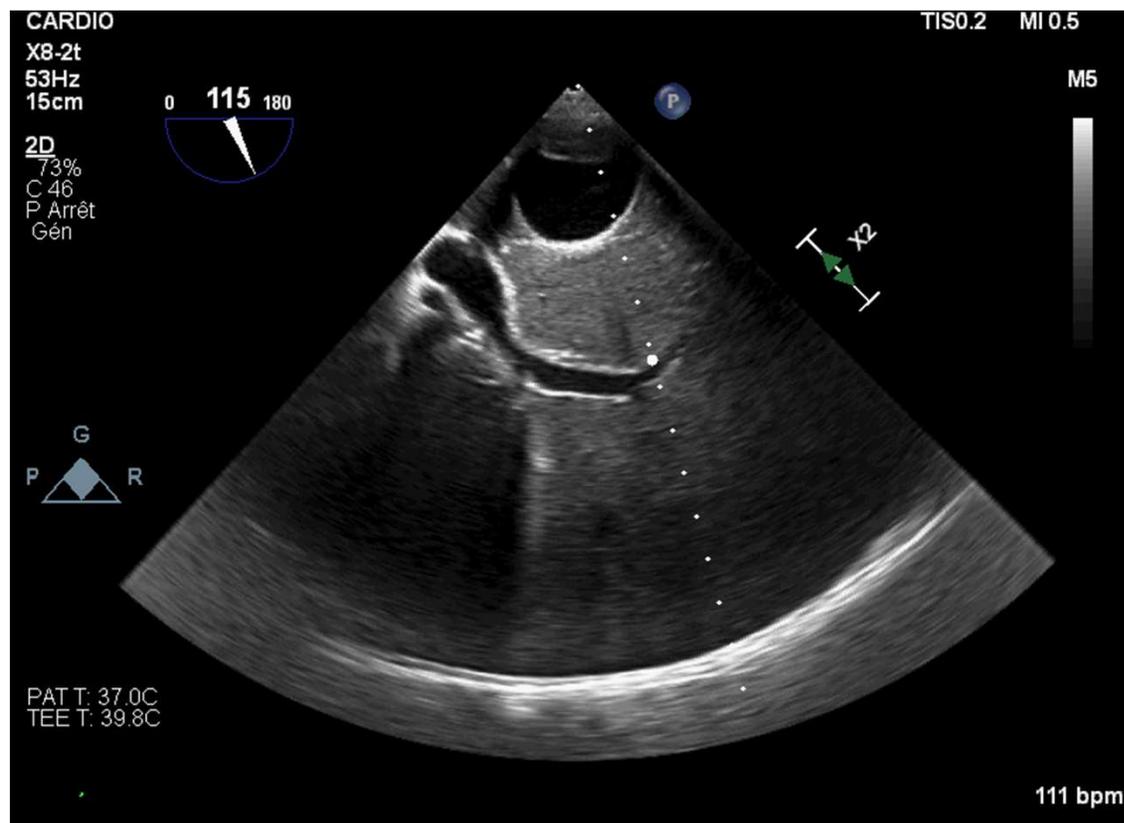
# ETT



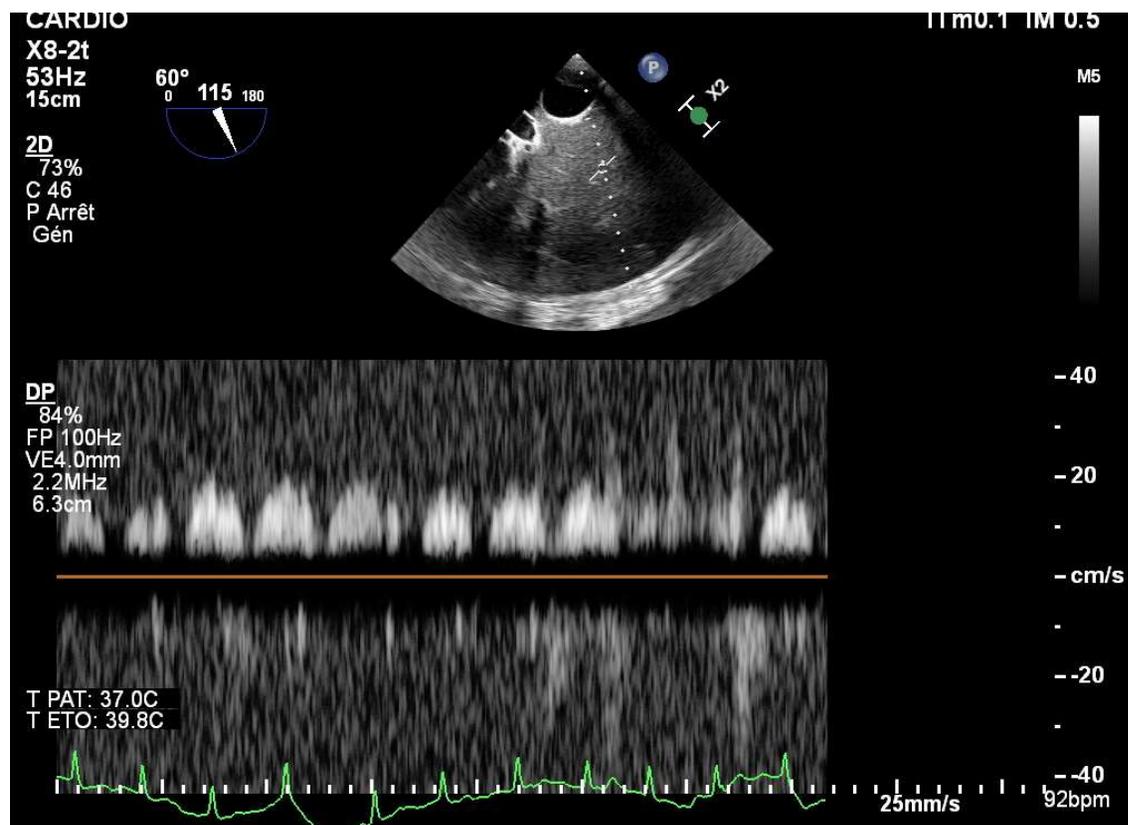
# ETO



# ETO

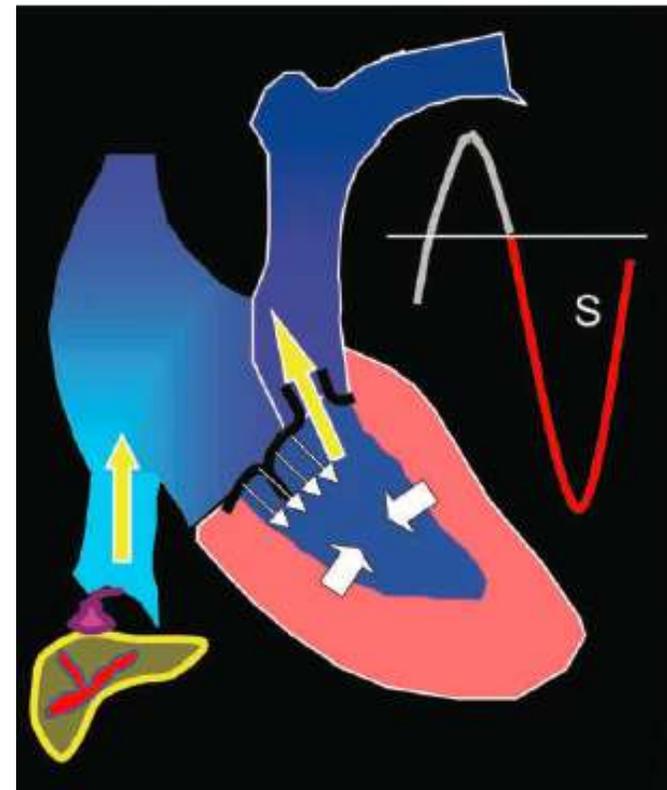
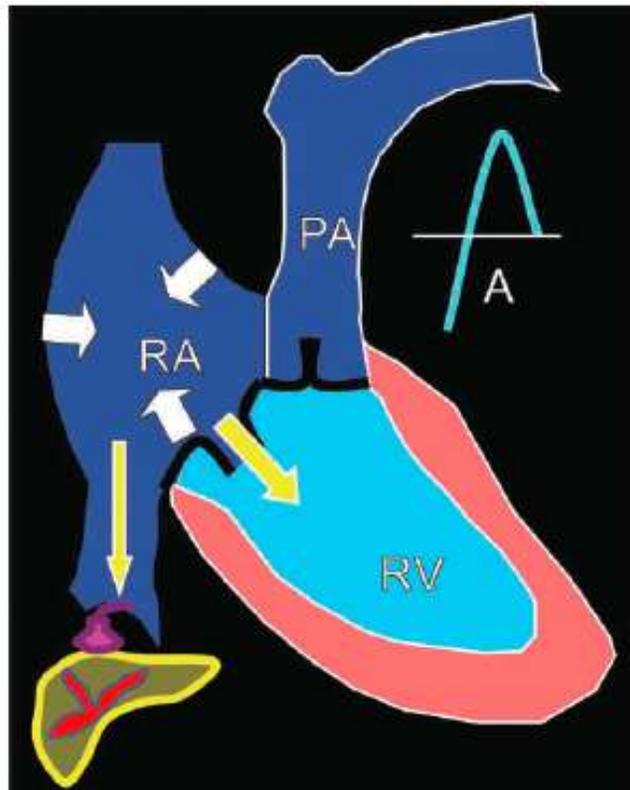


# ETO



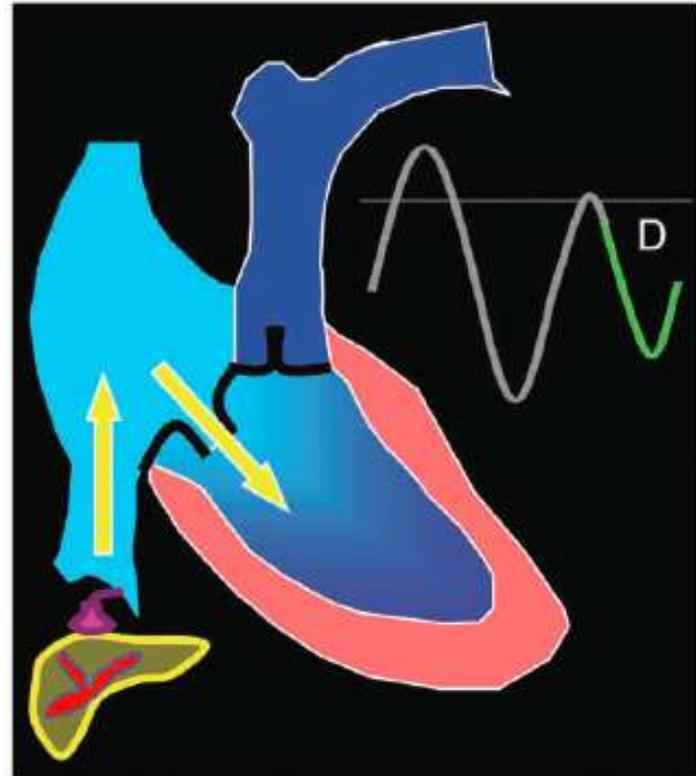
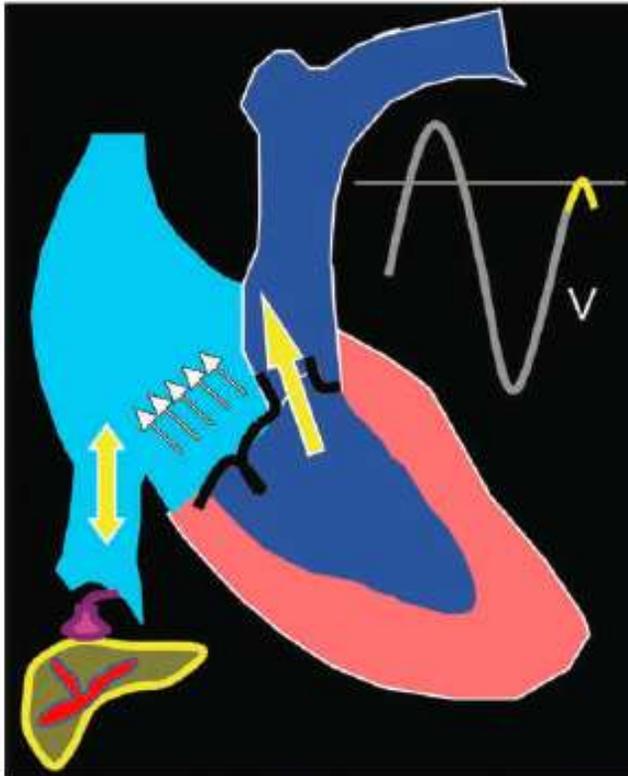
# Physiologie

- Flux veines sus-hépatiques



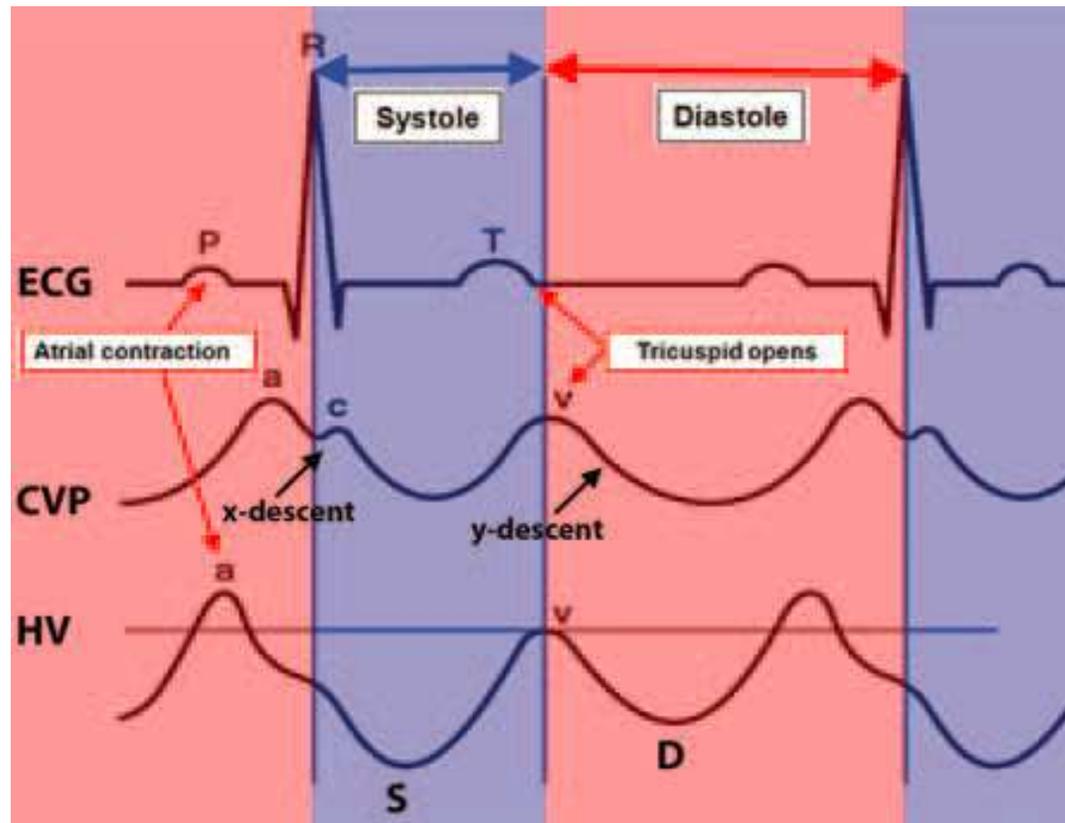
# Physiologie

- Flux veines sus-hépatiques



# Physiologie

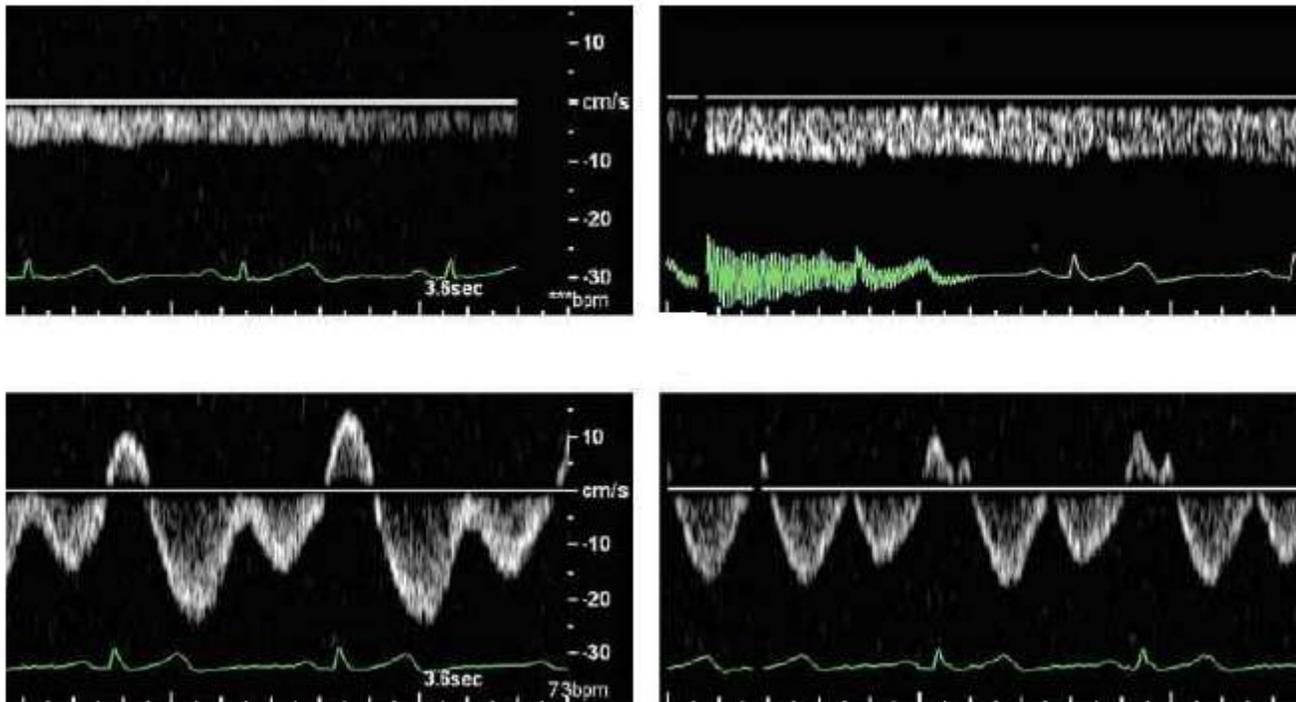
- Flux veines sus-hépatiques



*Dean Alexander McNaughton, MD*

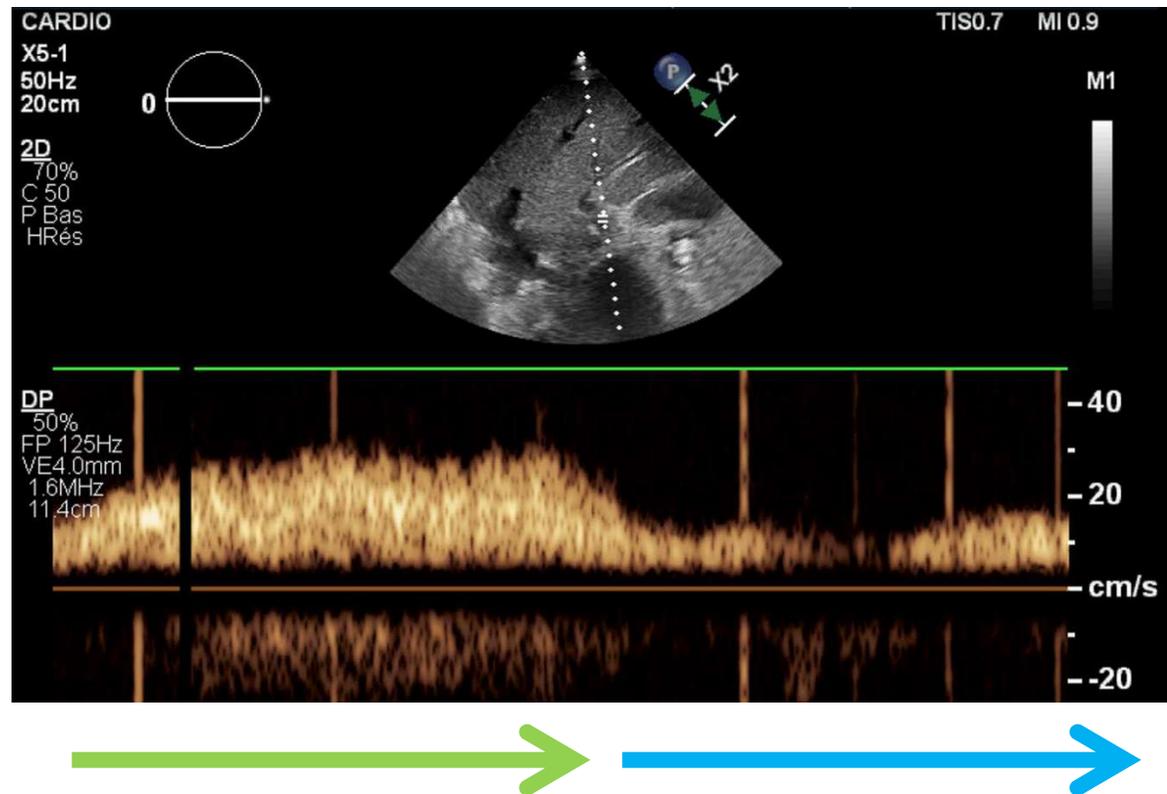
# Physiologie

- Effet de la ventilation
- Mécanique



# Physiologie

- Flux Tronc portal

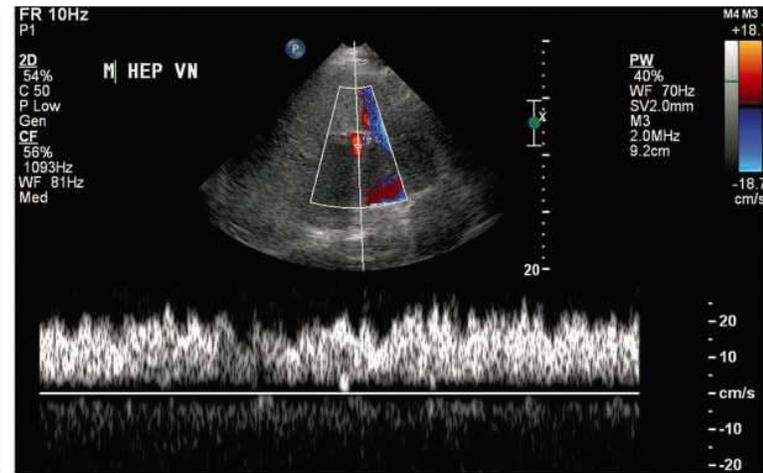
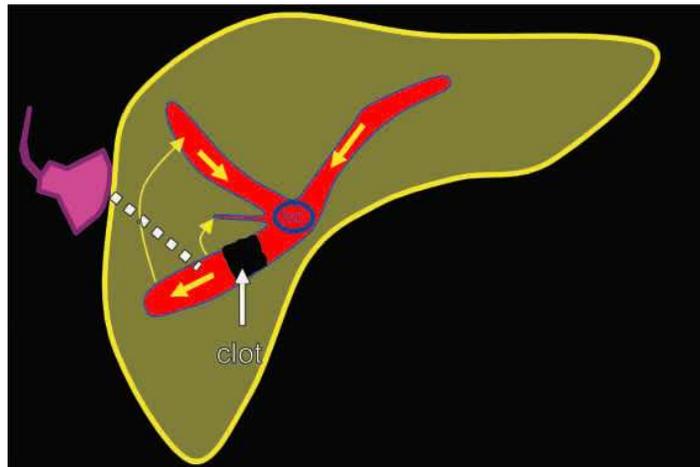


# Anomalies

- Interprétation
  - Direction flux?
  - Rythme régulier ou non?
  - Flux continu, mono-bi ou multiphasique?
  - Relation entre S et D?

# Anomalies

- Flux veines sus-hépatiques
  - Flux rétrograde



# Anomalies

- Flux veines sus-hépatiques
  - Baisse pulsatilitéée

Table 7  
Causes of Decreased Hepatic Venous Phasicity

Cirrhosis

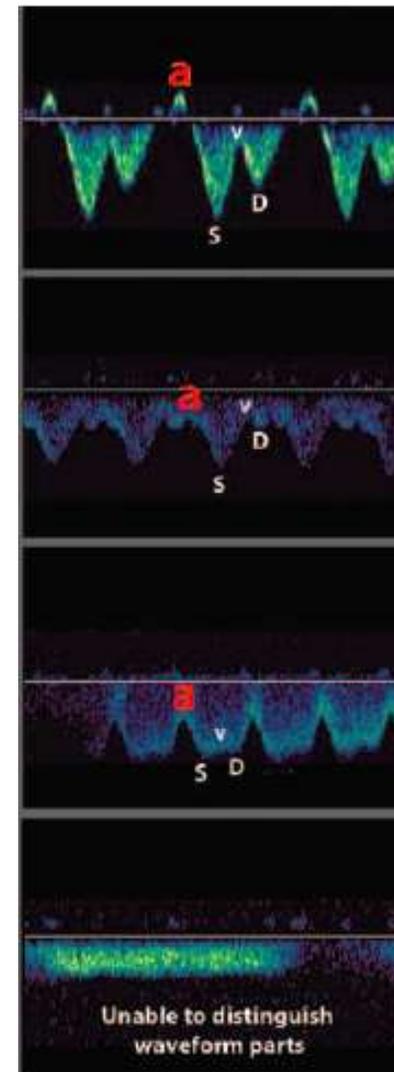
Hepatic vein thrombosis (Budd-Chiari syndrome)

Hepatic veno-occlusive disease

Hepatic venous outflow obstruction from any cause

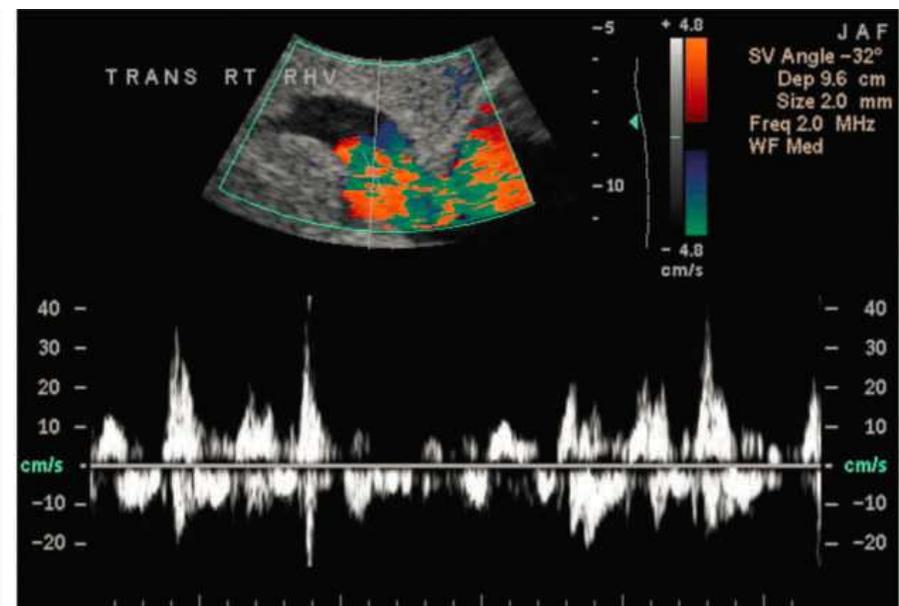
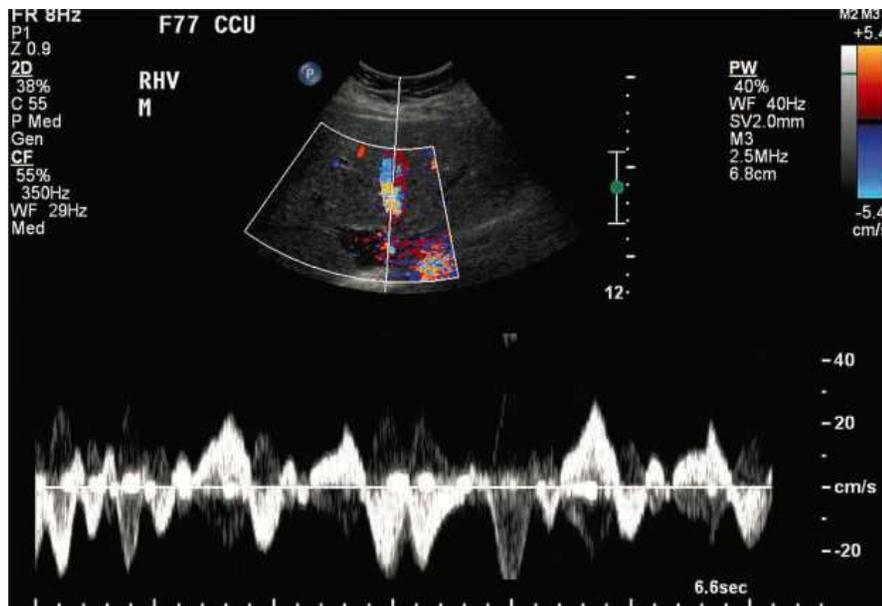
*Dean Alexander McNaughton, MD*

RadioGraphics 2011



# Anomalies

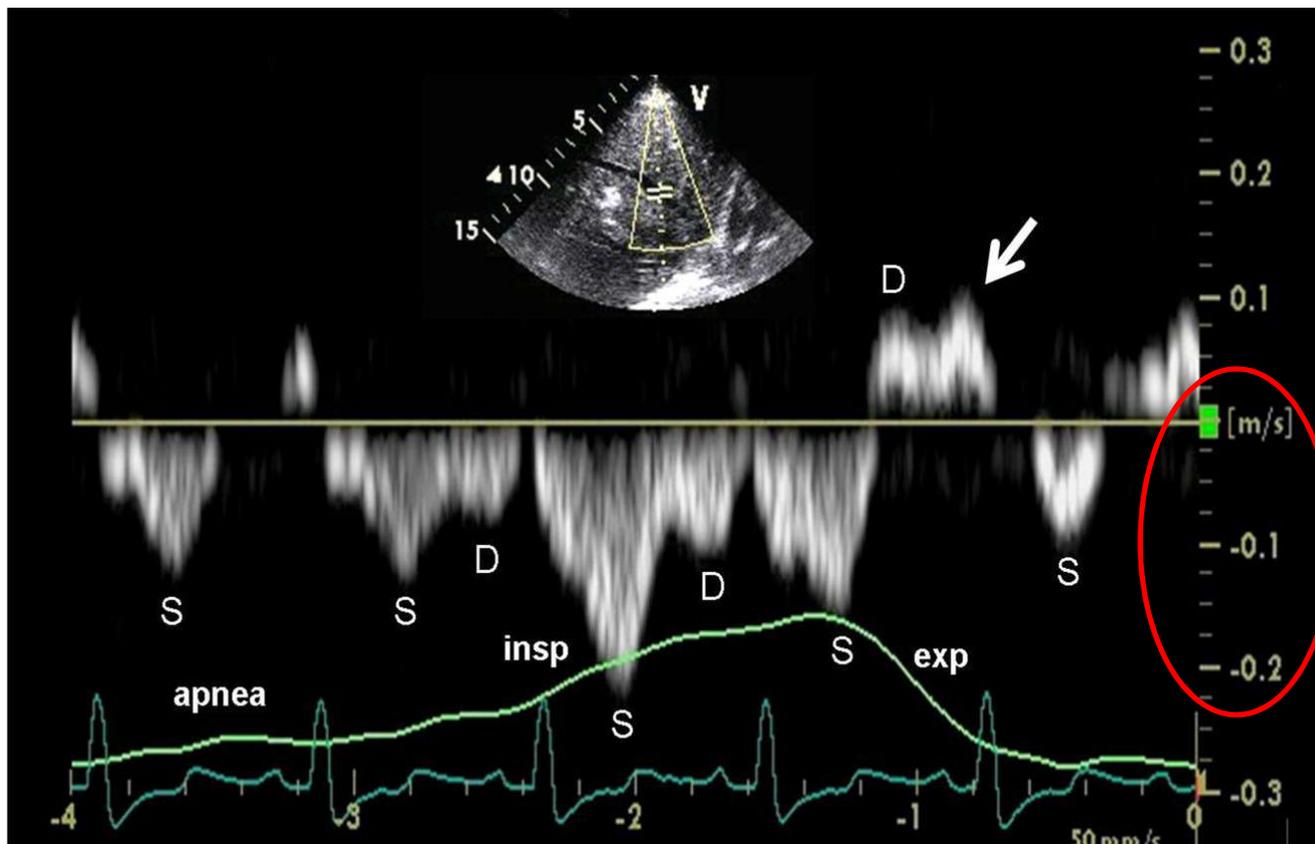
- Flux veines sus-hépatiques
  - Flux irrégulier



# Anomalies

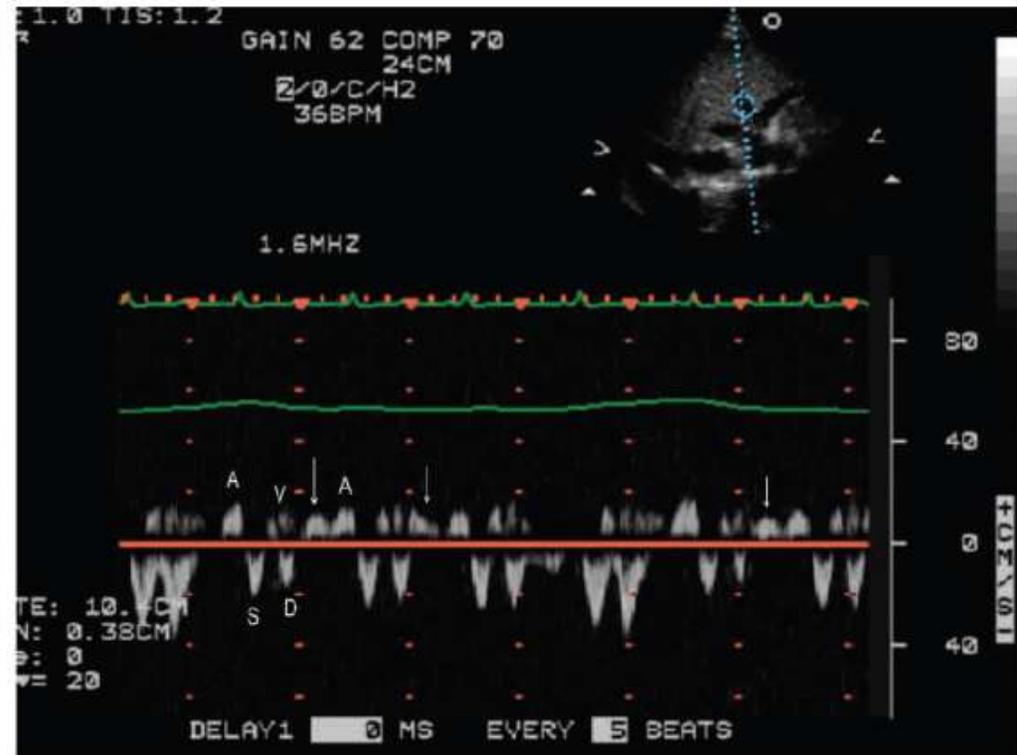
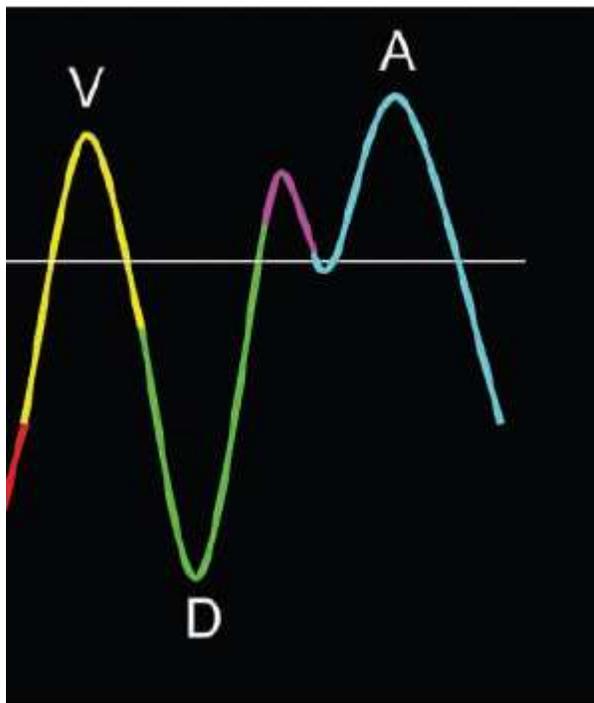
- Flux veines sus-hépatiques

American Society of Echocardiography Clinical Recommendations for Multimodality Cardiovascular Imaging of Patients with Pericardial Disease



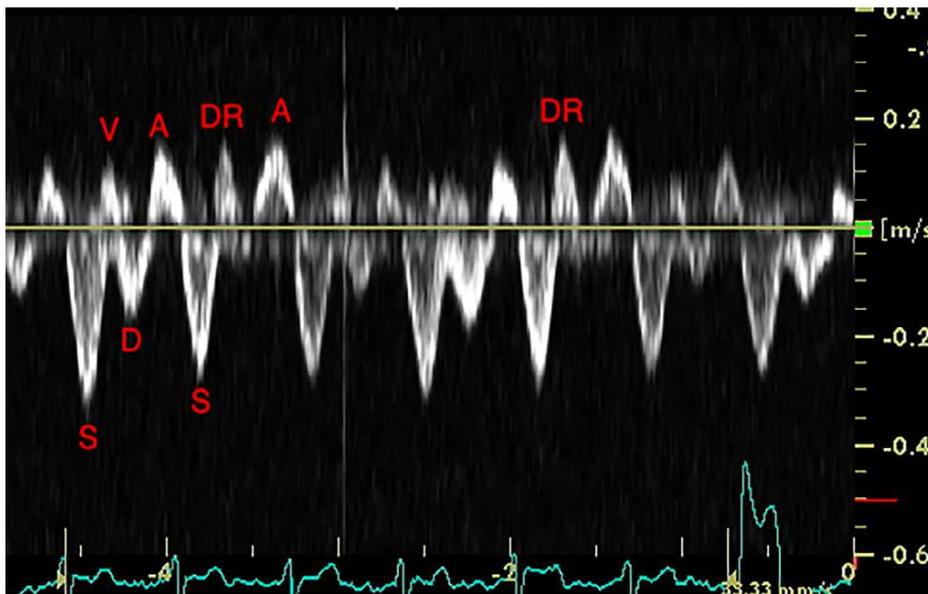
# Anomalies

- Péricardite constrictive

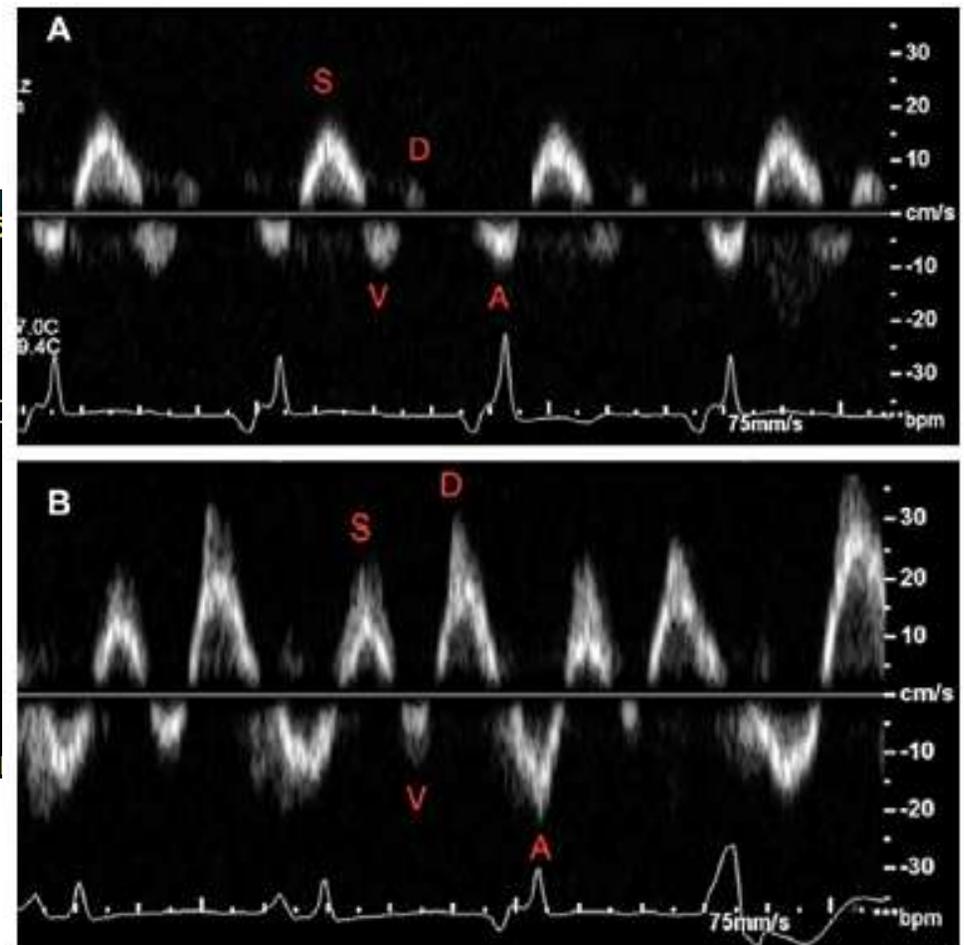


# Anomalies

- Péricardite constrictive

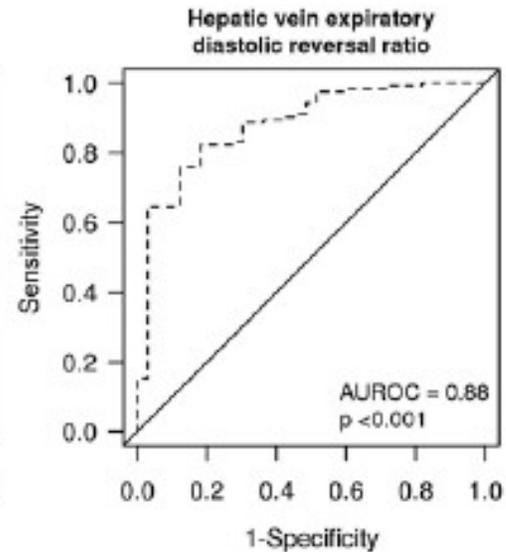
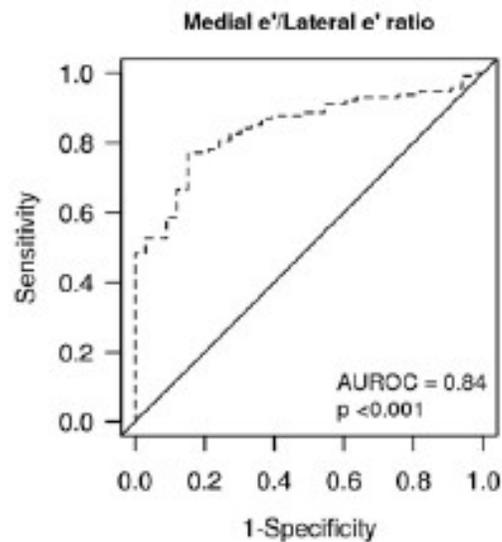
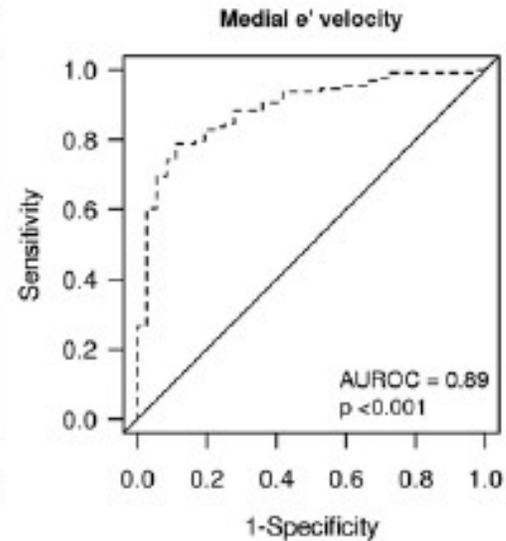
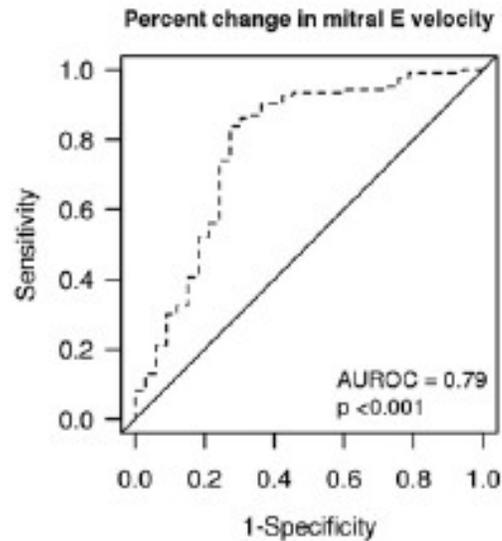


M.A. Helwani et al. / Journal of Cardiothoracic and Vascular Anesthesia 34 (2020)



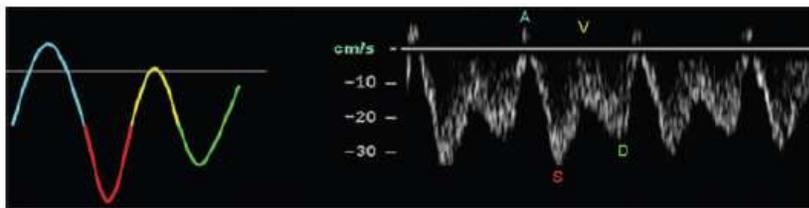
# Anomalies

- Péri

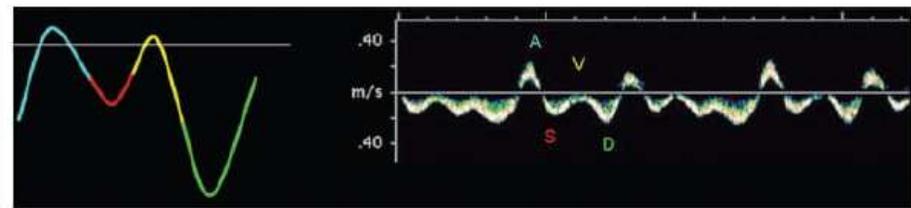


# Anomalies

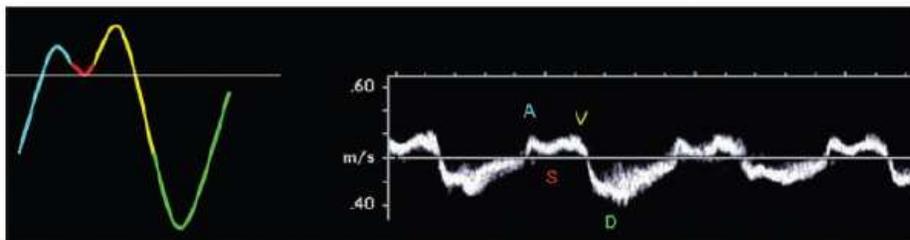
- Flux veines sus-hépatiques
  - Augmentation de la pulsatilité



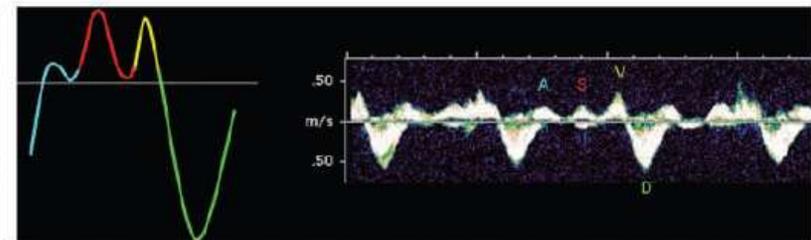
a.



b.



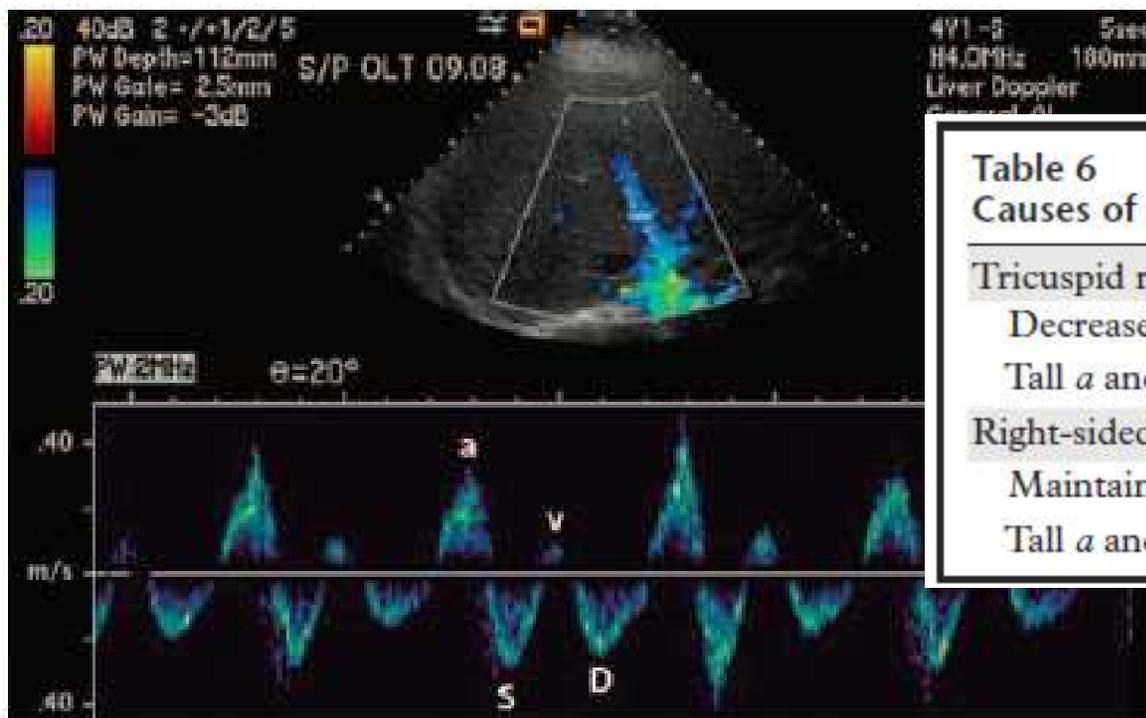
c.



d.

# Anomalies

- Flux veines sus-hépatiques
  - Augmentation de la pulsatilité



**Table 6**  
**Causes of Pulsatile Hepatic Venous Waveform**

**Tricuspid regurgitation**

- Decreased or reversed *S* wave
- Tall *a* and *v* waves

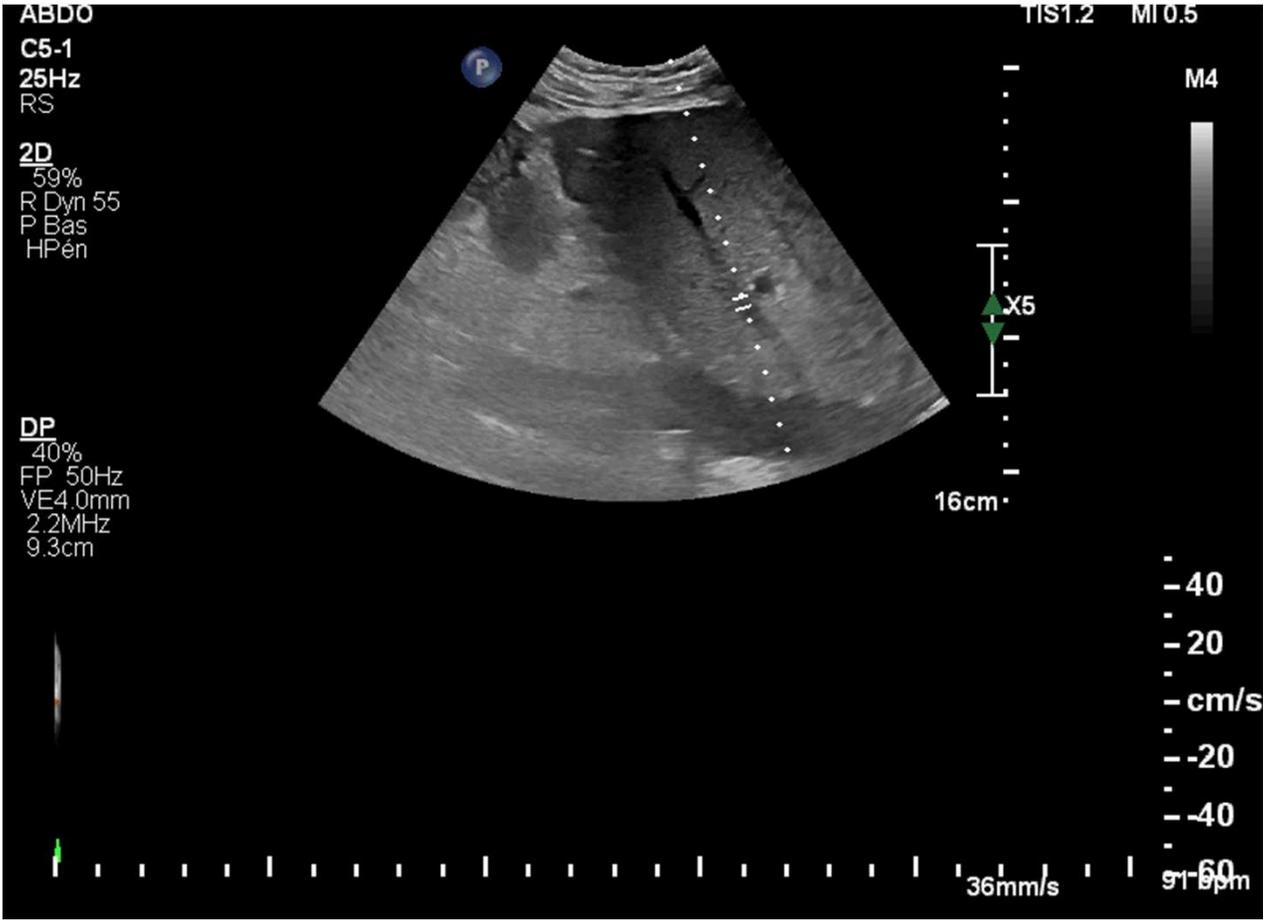
**Right-sided CHF**

- Maintained *S* wave/*D* wave relationship
- Tall *a* and *v* waves

*Dean Alexander McNaughton, MD*

**RadioGraphics 2011;**

# Anomalies



# Anomalies

- Flux veines sus-hépatiques

**Table 3** Estimation of RA pressure on the basis of IVC diameter and collapse

Variable	Normal (0-5 [3] mm Hg)	Intermediate (5-10 [8] mm Hg)		High (15 mm Hg)
IVC diameter	≤2.1 cm	≤2.1 cm	>2.1 cm	>2.1 cm
Collapse with sniff	>50%	<50%	>50%	<50%
Secondary indices of elevated RA pressure				<ul style="list-style-type: none"><li>• Restrictive filling</li><li>• Tricuspid E/E' &gt; 6</li><li>• Diastolic flow predominance in hepatic veins (systolic filling fraction &lt; 55%)</li></ul>

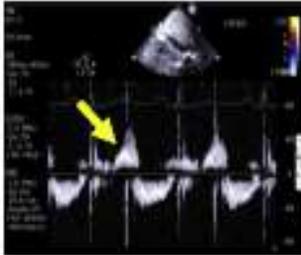
Guidelines for the Echocardiographic Assessment of the Right Heart in Adults: A Report from the American Society of Echocardiography

# Anomalies

- Flux veines sus-hépatiques

## ASE GUIDELINES AND STANDARDS

### Recommendations for Noninvasive Evaluation of Native Valvular Regurgitation

Modality	Optimization	Example	Advantages	Pitfalls
Pulsed wave Doppler: Hepatic vein flow reversal	<ul style="list-style-type: none"> <li>• Align insonation beam with the flow in the hepatic vein</li> </ul>		<ul style="list-style-type: none"> <li>• Simple supportive sign of severe TR</li> <li>• Can be obtained with both TTE and TEE</li> </ul>	<ul style="list-style-type: none"> <li>• Depends on compliance of the right atrium</li> <li>• May not be reliable in patients with atrial fibrillation, paced rhythm with retrograde atrial conduction</li> </ul>

# Anomalies

- Flux veines sus-hépatiques

## 2017 ESC/EACTS Guidelines for the management of valvular heart disease

	Aortic regurgitation	Mitral regurgitation	Tricuspid regurgitation
<b>Qualitative</b>			
Valve morphology	Abnormal/flail/large coaptation defect	Flail leaflet/ruptured papillary muscle/large coaptation defect	Abnormal/flail/large coaptation defect
Colour flow regurgitant jet	Large in central jets, variable in eccentric jets <sup>a</sup>	Very large central jet or eccentric jet adhering, swirling, and reaching the posterior wall of the LA	Very large central jet or eccentric wall impinging jet <sup>a</sup>
CW signal of regurgitant jet	Dense	Dense/triangular	Dense/triangular with early peaking (peak <2 m/s in massive TR)
Other	Holodiastolic flow reversal in descending aorta (EDV >20 cm/s)	Large flow convergence zone <sup>a</sup>	–
<b>Semiquantitative</b>			
Vena contracta width (mm)	>6	≥7 (>8 for biplane) <sup>a</sup>	≥7 <sup>a</sup>
Upstream vein flow <sup>c</sup>	–	Systolic pulmonary vein flow reversal	Systolic hepatic vein flow reversal
Inflow	–	E-wave dominant ≥1.5 m/s <sup>d</sup>	E-wave dominant ≥1 m/s <sup>d</sup>
Other	Pressure half-time <200 ms <sup>f</sup>	TVI mitral/TVI aortic >1.4	PISA radius >9 mm <sup>g</sup>
<b>Quantitative</b>		Primary	Secondary <sup>h</sup>
EROA (mm <sup>2</sup> )	≥30	≥40	≥20
Regurgitant volume (mL/beat)	≥60	≥60	≥30
+ enlargement of cardiac chambers/vessels	LV	LV, LA	RV, RA, inferior vena cava

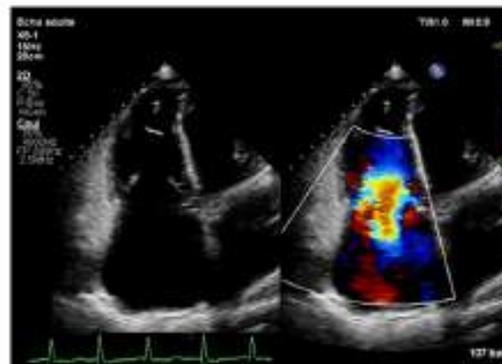
# Anomalies

- Flux veines sus-hépatiques

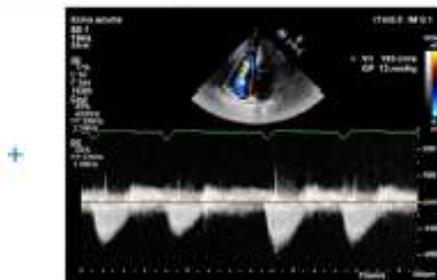
Improvement of the Prognosis Assessment of Severe Tricuspid Regurgitation by the Use of a Five-Grade Classification of Severity

*The American Journal of Cardiology*

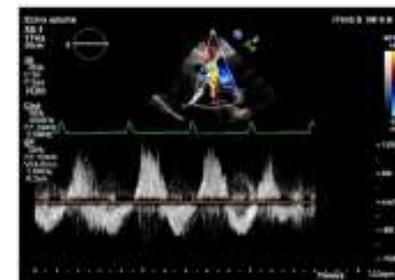
Very severe TR



Coaptation gap  $\geq 10$ mm



Laminar TR flow



Systolic reversal hepatic vein flow

# Anomalies

- Flux veines sus-hépatiques

## Improvement of the Prognosis Assessment of Severe Tricuspid Regurgitation by the Use of a Five-Grade Classification of Severity

*The American Journal of Cardiology*

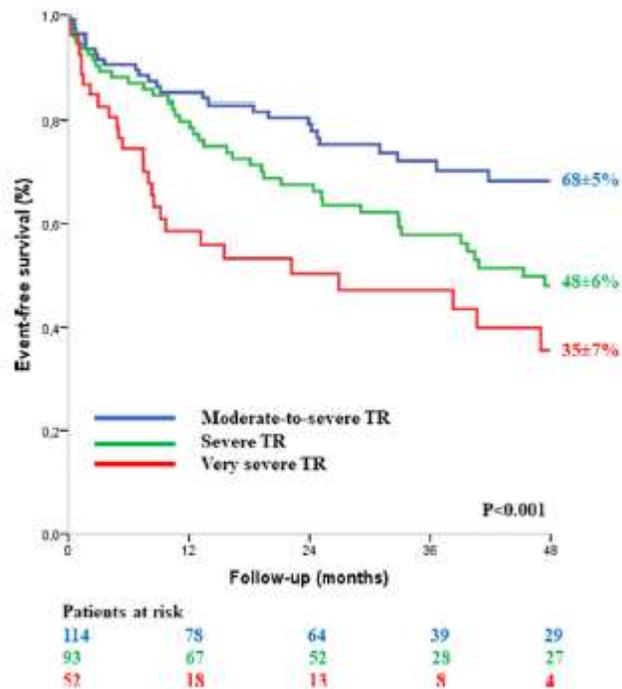


Figure 2. Kaplan Meier event-free survival curves according to tricuspid regurgitation severity. TR = tricuspid regurgitation.

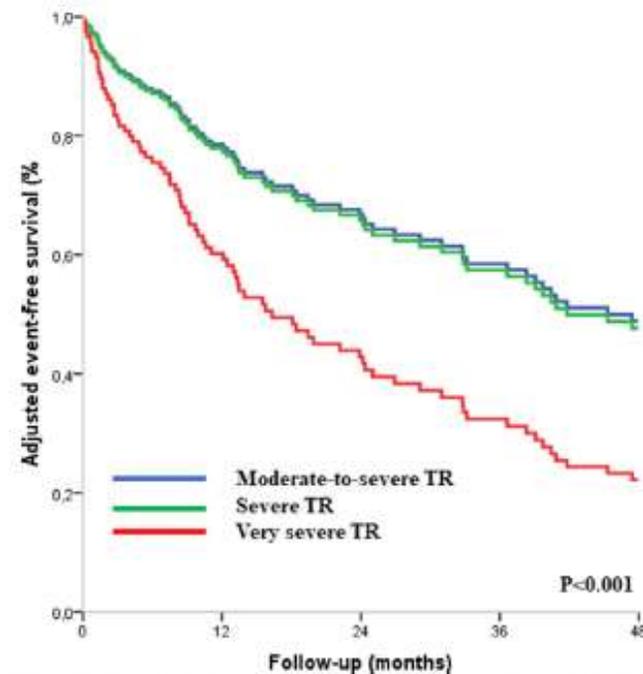


Figure 3. Cox adjusted event-free survival curves according to tricuspid regurgitation severity. TR = tricuspid regurgitation.



a  
S wave  
D wave



b  
S wave  
D wave

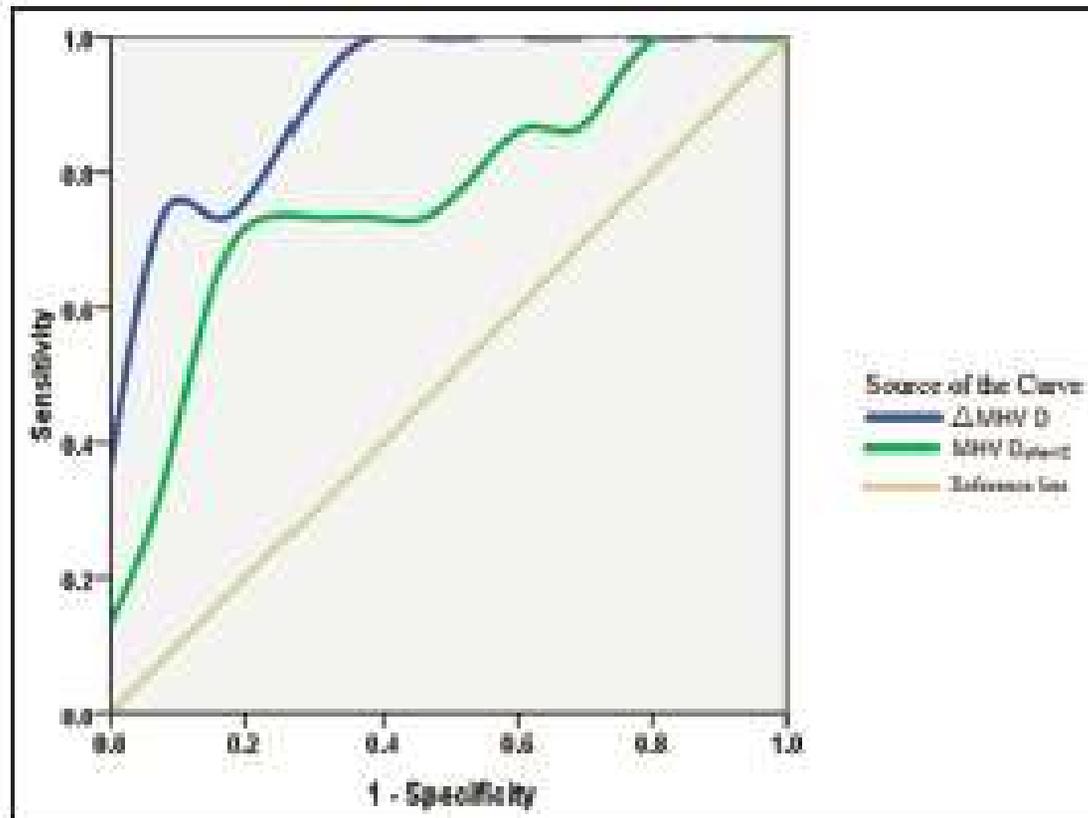
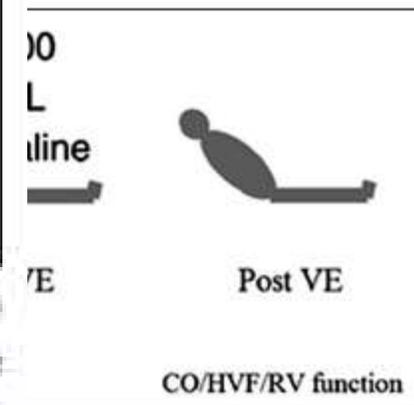


Figure 2: ROC curve analysis showing the relationship between CO and  $\Delta$ MHV D.  $\Delta$ MHV D was able to accurately detect  $<15\%$  increase in CO on ROC curve analysis.  $\Delta$ MHV D  $>21\%$  was associated with no increase in CO during volume expansion, with a sensitivity of 100%, a specificity of 71%, and an AUC of 0.918. MHV D<sub>abw/VE</sub>  $>31.4$  cm/s was associated with no increase in CO during volume expansion, with a sensitivity of 73%, a specificity of 84%, and an AUC of 0.772. CO: Cardiac output; AUC: Area under the curve; ROC: Receiver operating characteristic; MHV: Middle hepatic venous.

Flow after  
ack Fluid



# Anomalies

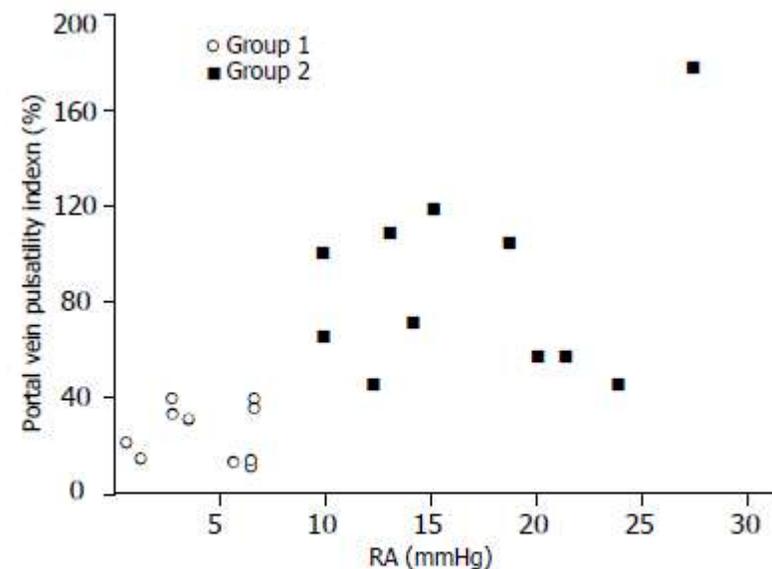


# Anomalies

**Portal vein pulsatility index is a more important indicator than congestion index in the clinical evaluation of right heart function**

**Table 2 Cardiac profiles in patients with congestive heart failure (mean  $\pm$  SD)**

	RA < 10 mmHg	RA $\geq$ 10 mmHg	<i>P</i>
HI (L/min/m <sup>2</sup> )	3.0 $\pm$ 0.9	2.4 $\pm$ 0.4	0.28
AO (mmHg)	89.0 $\pm$ 9.6	87.3 $\pm$ 12.8	0.78
LVED (mmHg)	12.2 $\pm$ 6.7	22.1 $\pm$ 10.9	0.06
PW (mmHg)	14.6 $\pm$ 5.6	29.1 $\pm$ 7.7	0.002
PA (mmHg)	25.0 $\pm$ 6.8	42.4 $\pm$ 12.0	0.004
RA (mmHg)	4.7 $\pm$ 2.1	16.8 $\pm$ 4.9	<0.001
RVED (mmHg)	6.4 $\pm$ 2.1	17.8 $\pm$ 4.4	<0.001

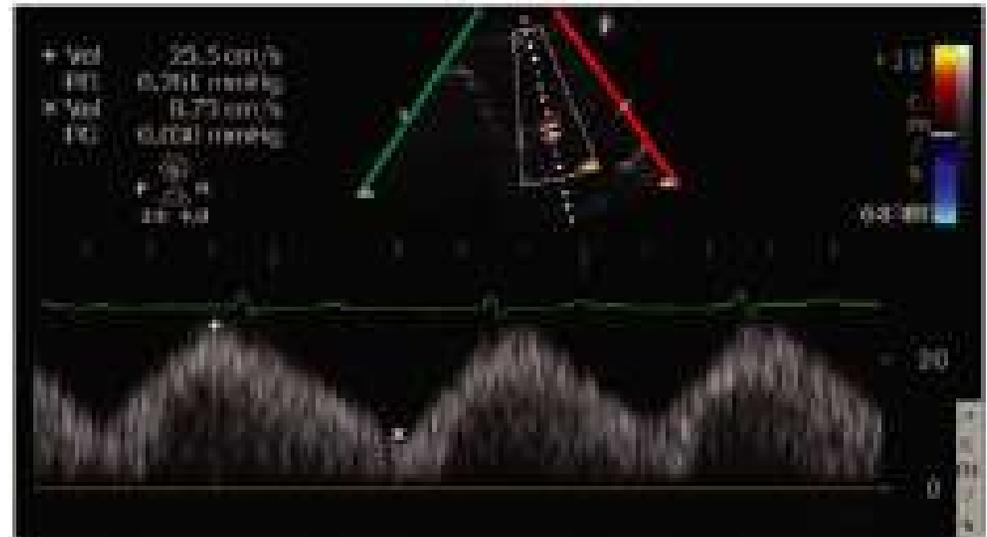


**Figure 1** Portal vein pulsatility index of patients with right atrial pressure < 10 mmHg (Group 1) and  $\geq$  10 mmHg (Group 2).

# Anomalies

- Pulsatilité Flux portal

$$PF(\%) = 100 [(V_{Max} - V_{Min}) / V_{Max}]$$

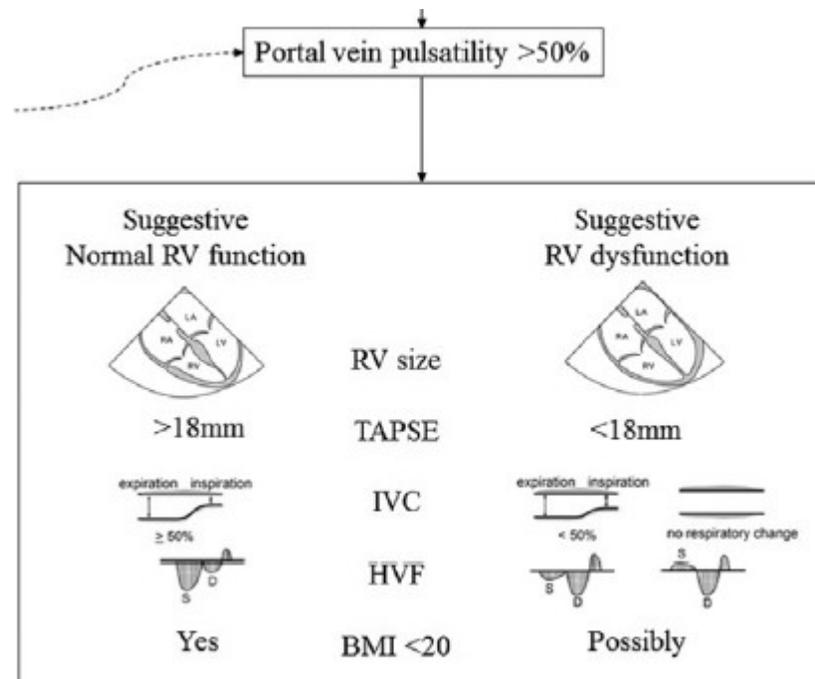


	Any AKI (n=49)			Severe AKI (n=10)		
	HR	CI	P Value	HR	CI	P Value
Pulsatile portal flow (PF ≥50%)	2.09	1.11–3.94	0.02	5.12	1.47–17.9	0.01

# Anomalies

- Pulsatilité Flux portal

Point-of-Care Ultrasonography to Assess Portal Vein Pulsatility and the Effect of Inhaled Milrinone and Epoprostenol in Severe Right Ventricular Failure: A Report of Two Cases



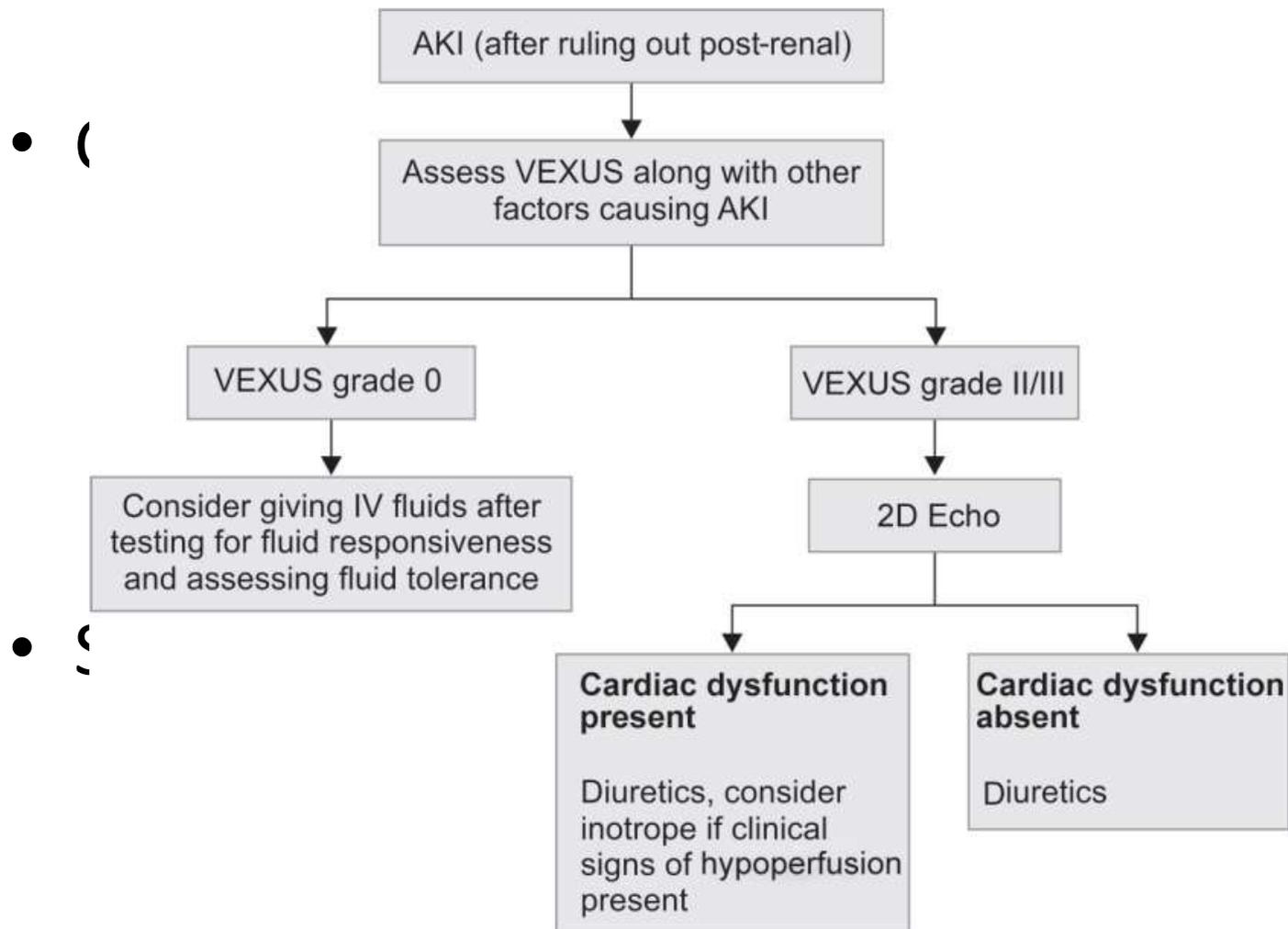
Jan-Alexis Tremblay, MD,

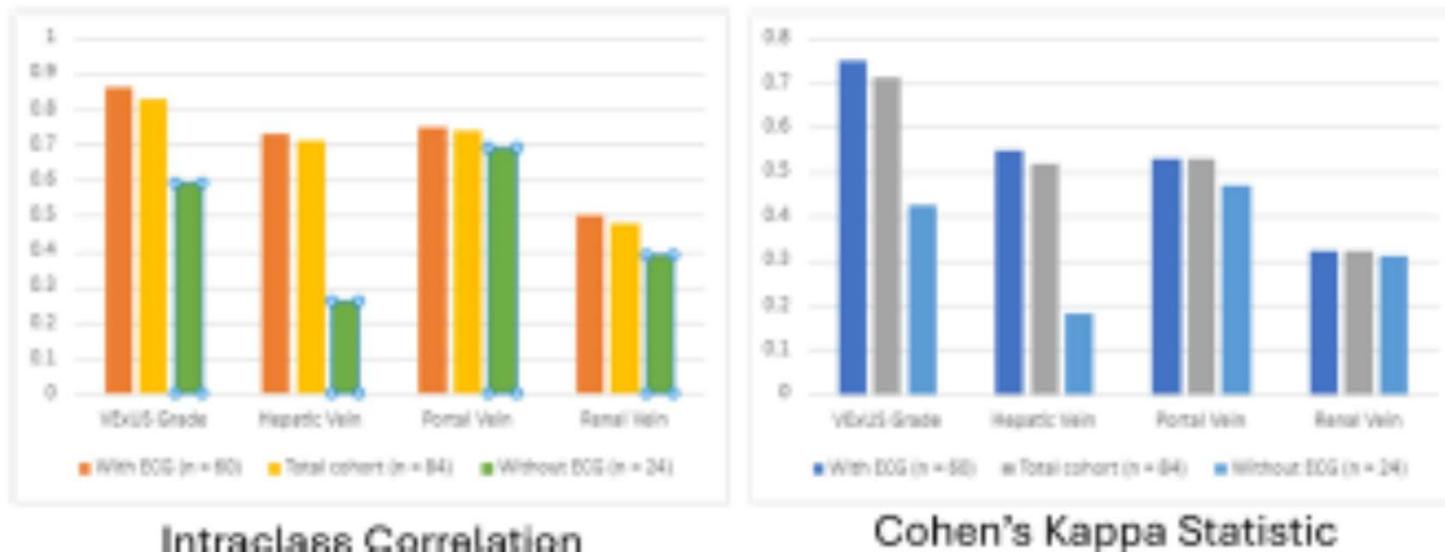
## High postoperative portal venous flow pulsatility indicates right ventricular dysfunction and predicts complications in cardiac surgery patients

Variables	$\beta$	95% CI	P-value
RV systolic dysfunction	15.7	4.7 to 26.6	0.005
RV diastolic dysfunction	20.1	11.9 to 28.3	<0.001
Maximal IVC diameter (cm)	13.4	9.2 to 17.5	<0.001
Variation in IVC diameter during respiration (%)	-0.35	-0.47 to -0.21	<0.001
Hepatic venous flow systolic to diastolic wave ratio	-4.3	-7.2 to -1.4	0.004
TAPSE (cm)	-8.5	-13.5 to -3.4	0.001
LVEF (%)	-0.14	-0.44 to 0.17	0.376

Variables	Univariable			Multivariable		
	OR	95% CI	P-value	OR	95% CI	P-value
Portal flow pulsatility after CPB	5.83	2.04–16.68	0.001	5.13	1.58–16.67	0.007
Systolic RV dysfunction	2.77	1.08–7.09	0.034	1.22	0.37–4.02	0.75
EuroSCORE II	1.41	1.17–1.70	<0.001	1.37	1.10–1.69	0.04

# Combination of Inferior Vena Cava Diameter, Hepatic Venous Flow, and Portal Vein Pulsatility Index: Venous Excess Ultrasound Score (VEXUS Score) in Predicting Acute Kidney Injury in Patients with Cardiorenal Syndrome: A Prospective Cohort Study





**Fig. 1** Inter-rater reliability and concordance of VExUS exam components. Concordance statistics for the cohort. Concordance as measured by intraclass correlation coefficient and Cohen's kappa statistic was greater for the overall VExUS grade than each of its individual components. It was also greater among images with a concurrent electrocardiogram tracing than for images without one

BRIEF REPORT

Open Access

Reliability and reproducibility of the venous excess ultrasound (VExUS) score, a multi-site prospective study: validating a novel ultrasound technique for comprehensive assessment of venous congestion

August A. Longino<sup>1\*</sup>, Katharine C. Martin<sup>1</sup>, Katarina R. Leyba<sup>2</sup>, Luke McCormack<sup>1</sup>, Gabriel Siegel<sup>2</sup>, Vibhu M. Sharma<sup>3</sup>, Matthew Riscini<sup>2</sup>, Carolina O. Lopez<sup>4</sup>, Ivor S. Douglas<sup>1,5</sup> and Edward A. Gill<sup>6</sup>



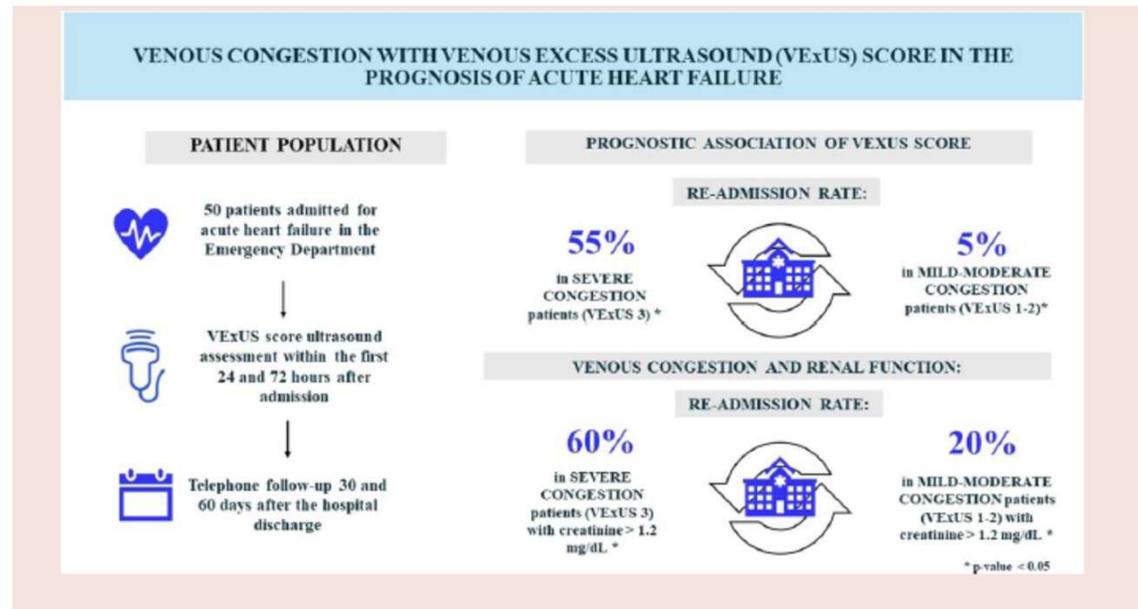
# Assessment of venous congestion with venous excess ultrasound score in the prognosis of acute heart failure in the emergency department: a prospective study

Irene Landi <sup>1</sup>, Ludovica Guerritore<sup>2</sup>, Andrea Iannaccone<sup>3</sup>, Andrea Ricotti<sup>4</sup>, Philippe Rola<sup>5</sup>, and Marco Garrone <sup>2,\*</sup>

<sup>1</sup>Dipartimento di Medicina Traslazionale, Università del Piemonte Orientale, Novara, Italia; <sup>2</sup>Medicina Chirurgia d'accettazione e d'urgenza, Azienda Ospedaliera Ordine Mauriziano, Via Magellano 1, 10128 Torino, Italia; <sup>3</sup>Medicina Interna e Unità di Terapia Semi Intensiva internistica, Azienda Ospedaliera Ordine Mauriziano, Via Magellano 1, 10128 Torino, Italia; <sup>4</sup>Clinical Trial Unit, Azienda Ospedaliera Ordine Mauriziano, Via Magellano 1, 10128 Torino, Italia; and <sup>5</sup>Division of Intensive Care, Santa Cabrini Hospital, Montreal, QC, Canada

Received 28 February 2024; revised 21 April 2024; accepted 14 June 2024; online publish-ahead-of-print 10 July 2024

Handling Editor: Giuseppe Vergaro

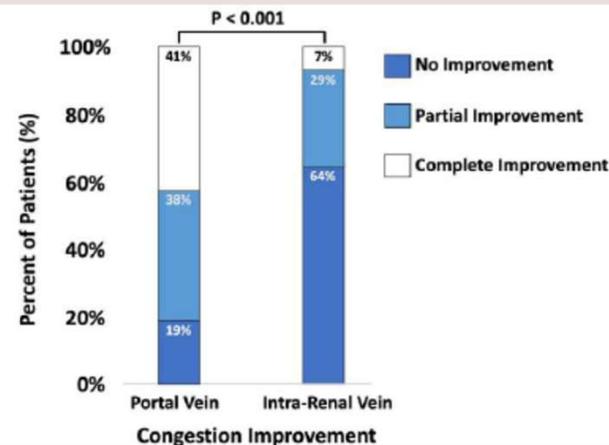
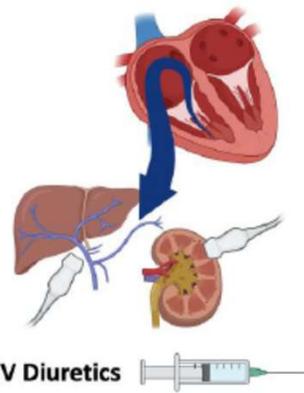


# Portal vein Doppler tracks volume status in patients with severe tricuspid regurgitation: a proof-of-concept study

Sergio M. Alday-Ramírez<sup>1,2</sup>, Mario Andrés de Jesús Leal-Villarreal<sup>2</sup>, César Gómez-Rodríguez<sup>2</sup>, Eslam Abu-Naeima<sup>3</sup>, Fernando Solis-Huerta<sup>4</sup>, Gerardo Gamba<sup>5,6</sup>, Luis A. Baeza-Herrera<sup>1,7</sup>, Diego Araiza-Garaygordobil<sup>2</sup>, and Eduardo R. Argaiz<sup>4,8,\*</sup>

## Graphical Abstract

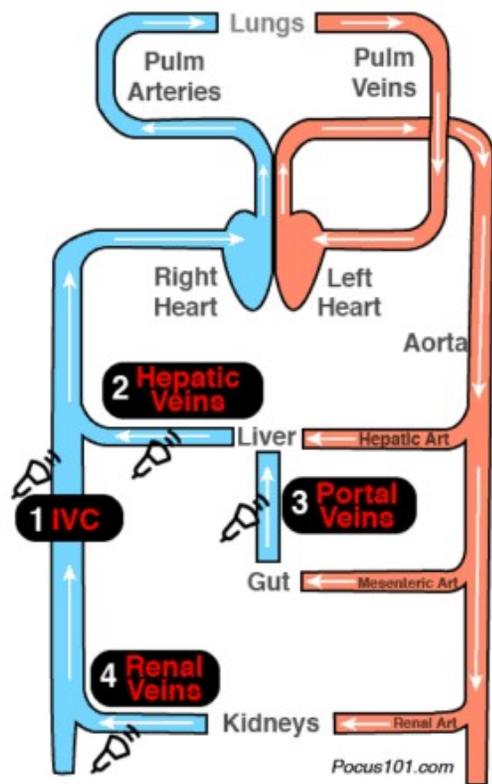
### Severe Tricuspid Regurgitation



## Keywords

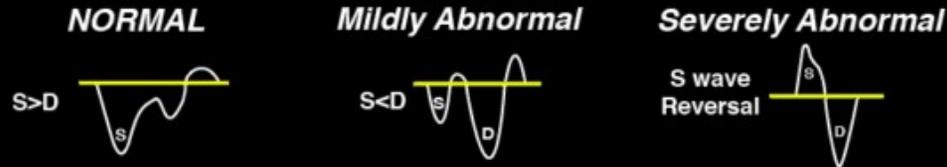
Venous congestion • Portal vein Doppler • Intra-renal venous Doppler • Tricuspid regurgitation • Decongestion • VExUS

# Venous Excess Ultrasound VExUS

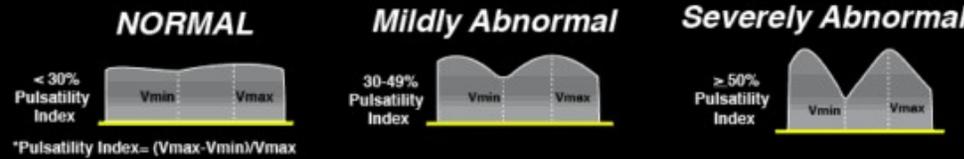


**Step 1: IVC Diameter:** If  $\geq 2\text{cm}$ , proceed to step 2

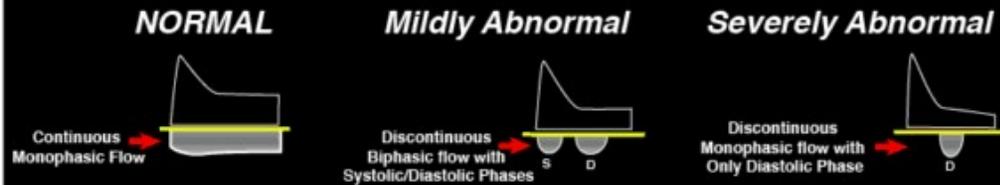
**Step 2: Hepatic Vein Doppler**



**Step 3: Portal Vein Doppler**



**Step 4: Renal Vein Doppler**



## Interpretation

**Grade 0**  
(no congestion)  
IVC < 2cm

**Grade 1**  
(Mild congestion)  
IVC  $\geq 2\text{cm}$   
and any combo  
of Normal or  
Mildly Abnl  
Patterns

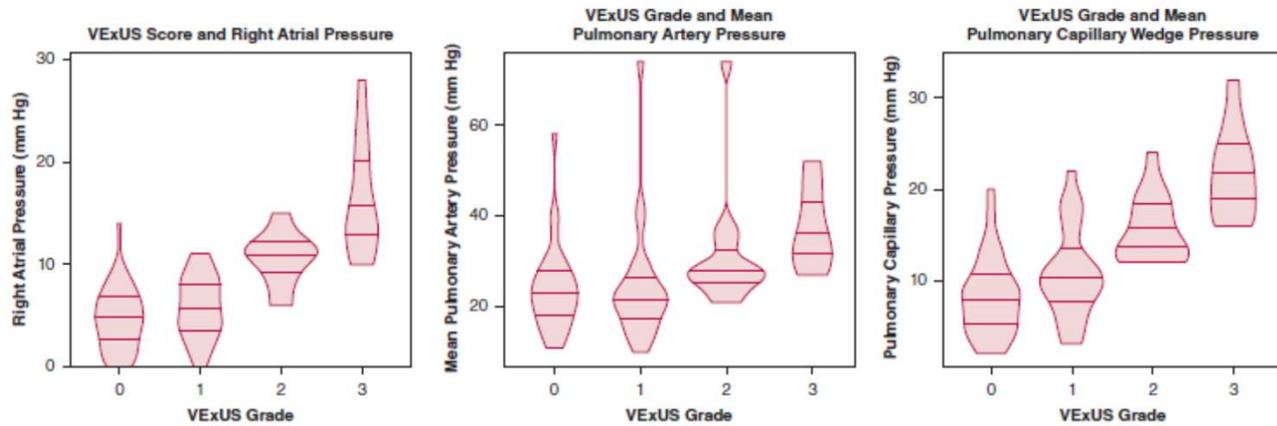
**Grade 2**  
(Moderate congestion)  
IVC  $\geq 2\text{cm}$   
and  
ONE Severely Abnl  
Pattern

**Grade 3**  
(Severe congestion)  
IVC  $\geq 2\text{cm}$   
and  
 $\geq 2$  Severely Abnl  
Patterns

# Prospective Evaluation of Venous Excess Ultrasound for Estimation of Venous Congestion

Check for updates

August Longino, MD, MPH; Katie Martin, BS; Katarina Leyba, MD; Gabriel Siegel, MD; Theresa N. Thai, MD; Matthew Riscinti, MD; Ivor S. Douglas, MD; Edward Gill, MD; and Joseph Burke, MD



**Linear Regression of VExUS and RAP**

Characteristic	Beta	95% CI <sup>†</sup>	P-value
<b>VExUS</b>			
0	–	–	
1	1.4	–0.47, 3.2	.14
2	4.8	2.6, 7.1	< .001
3	11	8.9, 14	< .001
<b>Age</b>	–0.12	–0.19, –0.04	.002
<b>Sex</b>			
Male	–	–	
Female	1.8	0.16, 3.4	.031
<b>Charlson Comorbidity Index</b>	0.43	0.05, 0.80	.028

<sup>†</sup> CI = Confidence Interval

**Linear Regression of VExUS and Mean Pulmonary Artery Pressure**

Characteristic	Beta	95% CI <sup>†</sup>	P-value
<b>VExUS</b>			
0	–	–	
1	0.30	–5.1, 5.7	> .9
2	6.8	0.16, 13	.045
3	15	7.3, 22	< .001
<b>Age</b>	–0.06	–0.27, 0.15	.6
<b>Sex</b>			
Male	–	–	
Female	2.1	–2.7, 6.9	.4
<b>Charlson Comorbidity Index</b>	0.76	–0.35, 1.9	.2

<sup>†</sup> CI = Confidence Interval

**Linear Regression of VExUS and Pulmonary Capillary Wedge Pressure**

Characteristic	Beta	95% CI <sup>†</sup>	P-value
<b>VExUS</b>			
0	–	–	
1	2.5	0.00, 5.0	.050
2	7.0	3.9, 10	< .001
3	13	9.5, 17	< .001
<b>Age</b>	–0.12	–0.21, –0.02	.017
<b>Sex</b>			
Male	–	–	
Female	1.8	–0.45, 4.0	.12
<b>Charlson Comorbidity Index</b>	0.45	–0.06, 1.0	.084

<sup>†</sup> CI = Confidence Interval

# Conclusion

- Information acquise facilement
  - Obésité, post-opératoire
- Corrélation avec gravité
- Mesuré avec ECG/respi

**MERCI POUR VOTRE ATTENTION**