11th ANNUAL HEART FAILURE UPDATE 2024

Friday May 24 - Saturday May 25

Marriott Chateau Champlain, Montreal, Quebec

CHFS SCIC

Canadian Heart Failure Society
Société canadienne d'insuffisance cardiaque

𝕏 @CanHFSociety #HFupdate

POCUS Workshop

“Don’t touch the patient—state first what you see.” Sir William Osler

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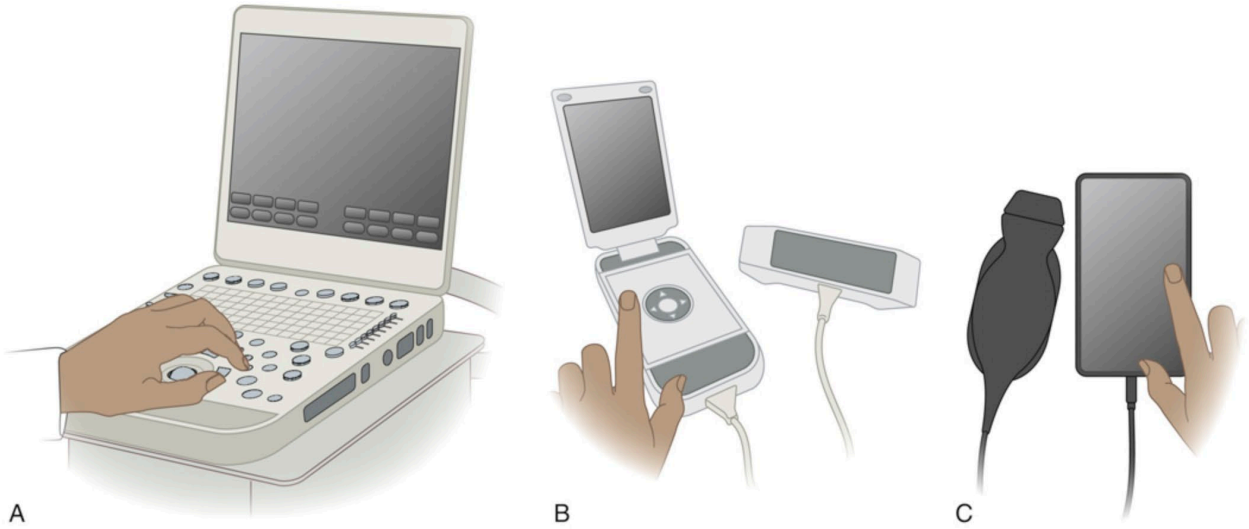
Conflict of Interest – Disclosure

- No relevant relationships with any commercial or non-profit organizations

Learning Objectives

- Appreciate how and when POCUS is useful for outpatient clinics
- Use POCUS to guide diagnosis and treatment of patients in acute cardiac care and acute non-cardiac care

What is POCUS?



- Acquisition
- Interpretation
- Immediate clinical integration of ultrasonographic imaging
- Performed by a treating clinician rather than by a radiologist or cardiologist
- Performed at the patient's bedside

Diaz-Gomez et al. *NEJM* 2021

Application Examples

- Performing ultrasound-guided procedure
  - Venous and arterial access, pericardiocentesis, thoracentesis, joint aspiration...
- CPR monitoring of cardiac contraction
- Evaluating congestion and perfusion in acute care
- Characterizing nonspecific clinical conditions

Warning!

- POCUS should be a **qualitative** or **semi-quantitative** examination aimed at addressing a specific question
- POCUS does not replace consultative ultrasonography performed by a cardiologist or radiologist
- POCUS exams should be stored in DICOM format
- Be mindful of the examination's limitations, as well as your own

POCUS Workshop

Case 1

Heart Failure Clinic

Case

- 75-year-old man, BMI 40
- HFrEF (dilated CMP)
  - EF 29%, RV good
  - Mild functional MR
- Max dose of GDMT and CRT-D
- NYHA 3/4 since 1 month ago
  - previously 2/4

Case

- BP 92/70, HR 62
- JVP ~~~10 mmHg~~ 9 mmHg
- Soft mitral systolic murmur
- Normal pulmonary auscultation
- No edema

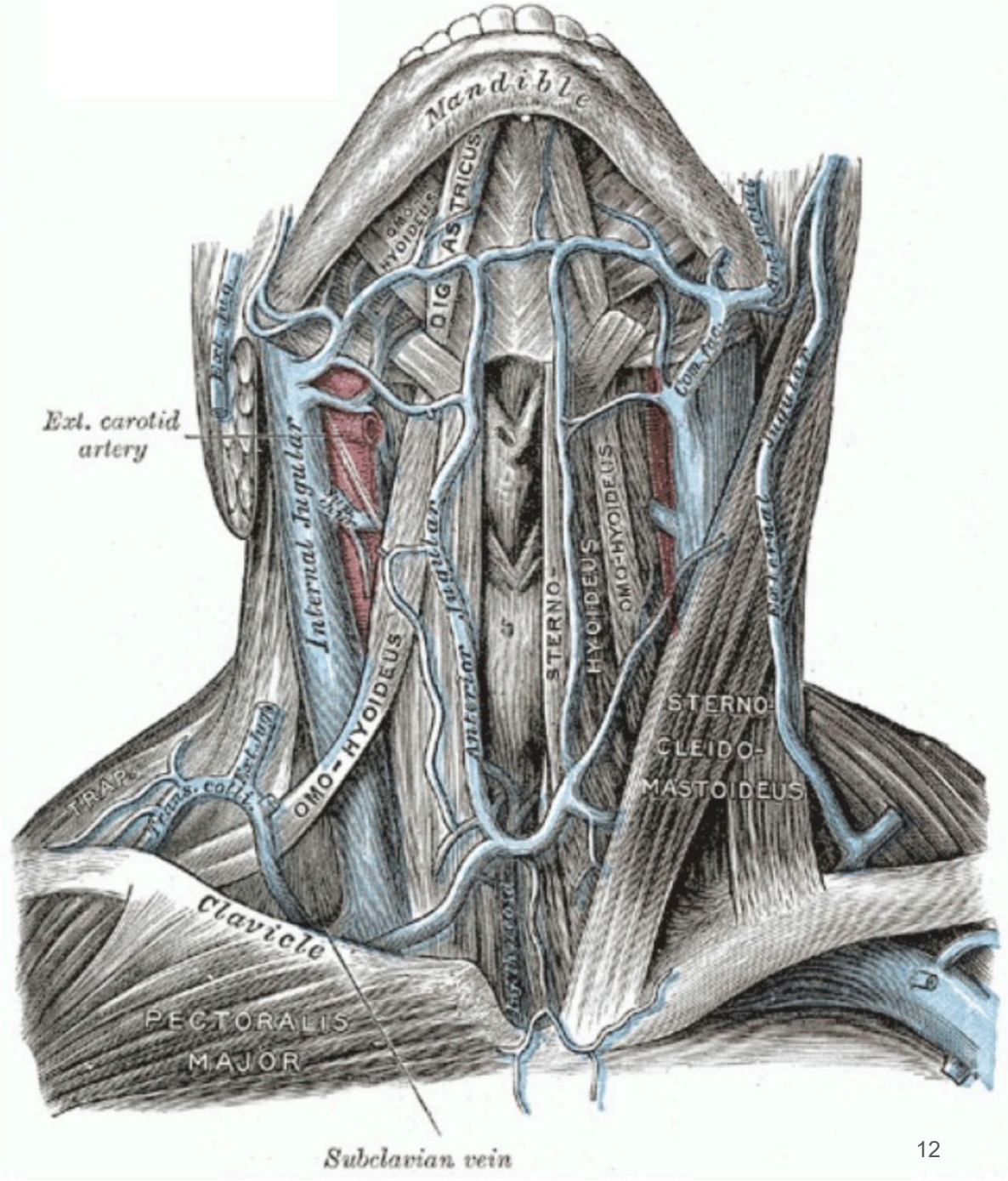
Case

- Blood work
  - CBC normal
  - Creatinine 120 mmol/L (baseline 90)
  - Normal liver enzymes
  - NT-proBNP 900 (no significant change)

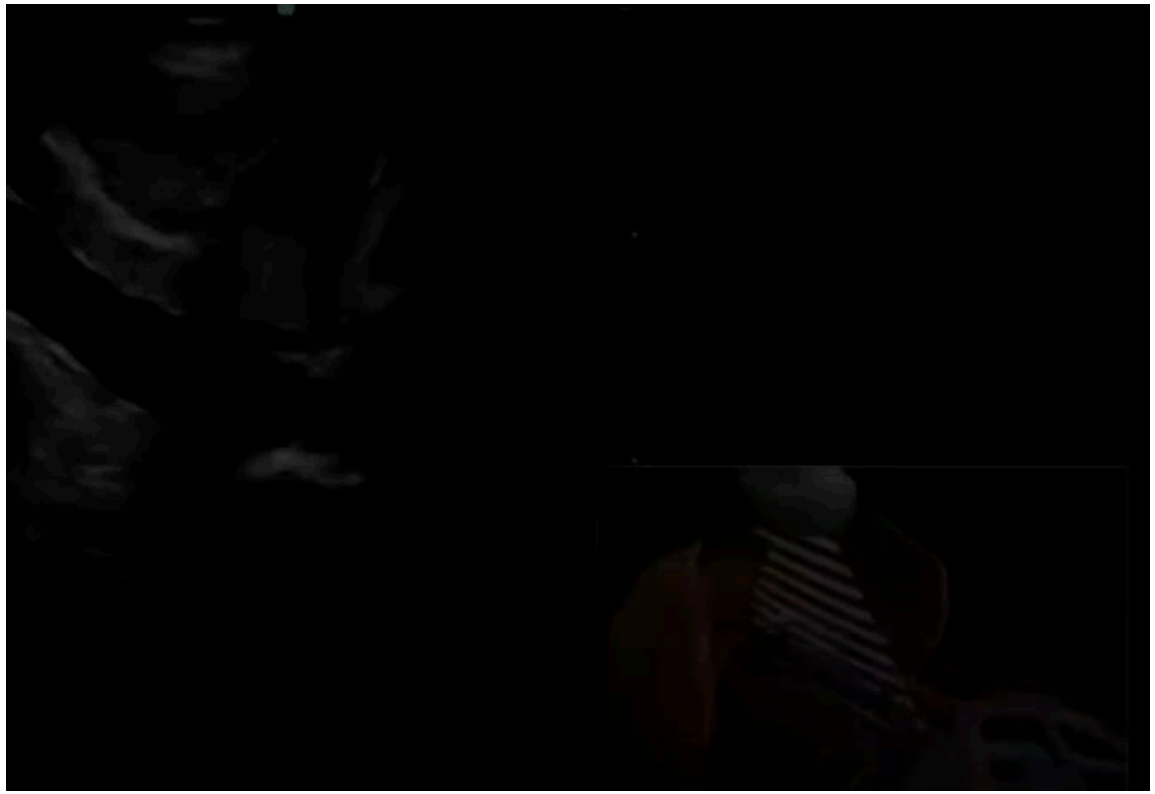
JVP

- The overall accuracy in predicting volume status is approximately 55%

- Correlation coefficient
  - Med student: 0.74
  - Resident: 0.71
  - Attending: 0.65



IVC Assessment



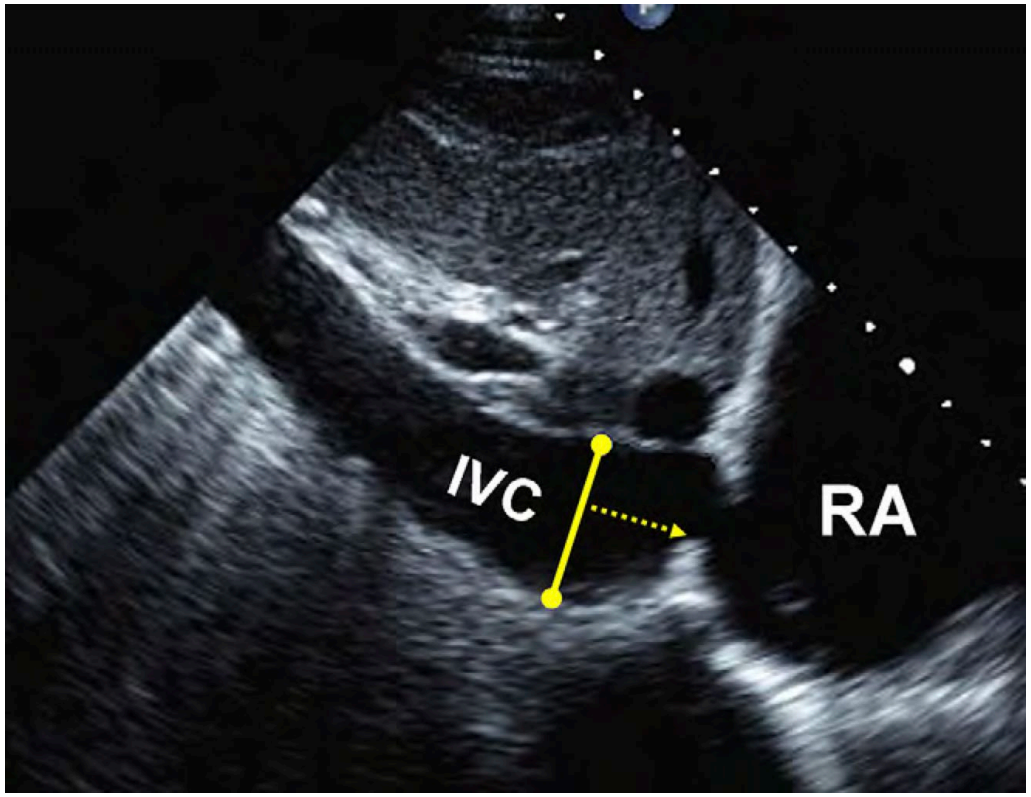


Table 3 Estimation of RA pressure on the basis of IVC diameter and collapse

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%

Rudski et al. *JASE* 2010

Inaccuracy of Right Atrial Pressure Estimates Through Inferior Vena Cava Indices

Corrado Magnino, MD[a,*], Pierluigi Omedè, MD[b], Eleonora Avenatti, MD[a], Davide Presutti, MD[b], Andrea Iannaccone, MD[a], Michela Chiarlo, MD[a], Claudio Moretti, MD[b], Fiorenzo Gaita, MD[b], Franco Veglio, MD[a], Alberto Milan, MD, PhD[a], and RIGHT1 Investigators

Table 4
Correlation, r squared, mean bias and accuracy of comparison between invasive right atrial pressure and echocardiographic estimates derived from different estimation models

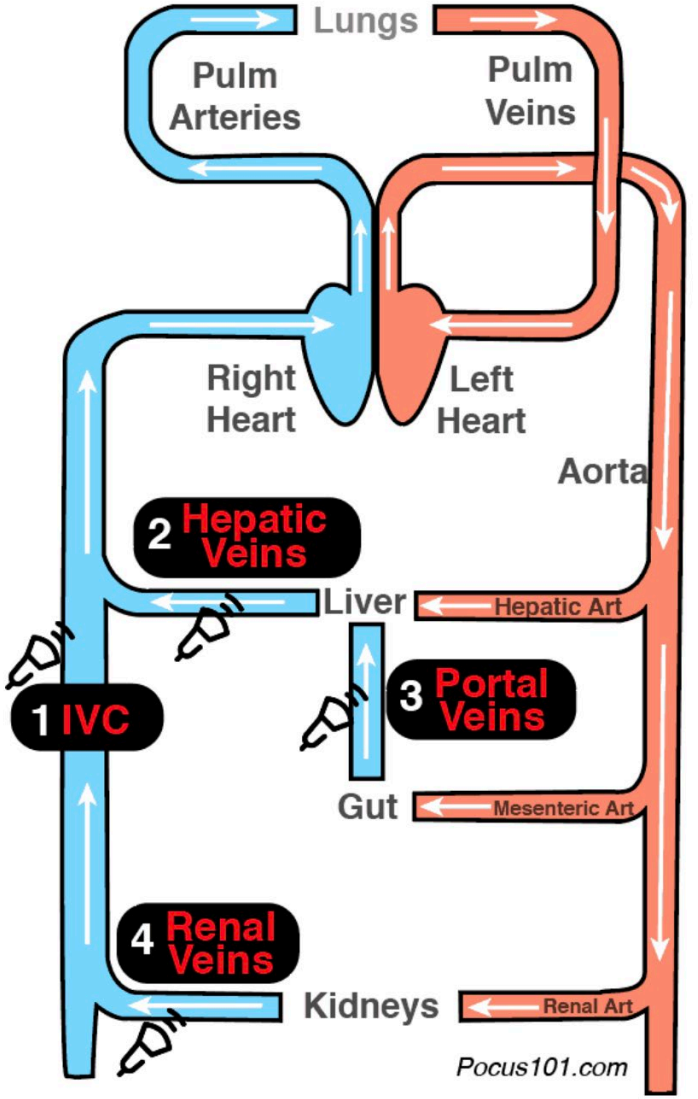
Model	c Pearson	p	R^2	mean bias (mmHg) [confidence limits]	2.5 mmHg accuracy	relative accuracy
Kircher[2,*]	0.16	0.05	0.02	–2.2 [–12.0; 7.5]	54 (35%)	48 (31%)
Pepi[3,*]	0.34	<0.001	0.12	–0.7 [–11.0; 9.6]	53 (37%)	61 (40%)
Lang[7]	0.39	<0.001	0.15	0.4 [–10.2; 11.0]	48 (37%)	55 (42%)
Brennan[4]	0.42	<0.001	0.18	0.0 [–11.1; 11.1]	46 (35%)	43 (33%)
Rudski 1[5]	0.34	<0.001	0.11	–2.3 [–13.0; 8.5]	50 (33%)	47 (31%)
Rudski 2[5,†]	0.34	<0.001	0.12	–2.7 [–14.5; 9.0]	38 (25%)	42 (27%)

* In this scheme the estimates are based only on inferior vena cava measurements.

† In this scheme the estimates obtained from the Rudski 1 method are modified according to other parameters derived from the right ventricular diastolic function. See text for details.

VExUS Score Protocol

- Venous excess ultrasound grading system
- Originally created to predict AKI after cardiac surgery
- Incorporating assessment of:
  - IVC
  - Hepatic veins
  - Portal veins
  - Renal veins



Brief Report | Open access | Published: 26 May 2023

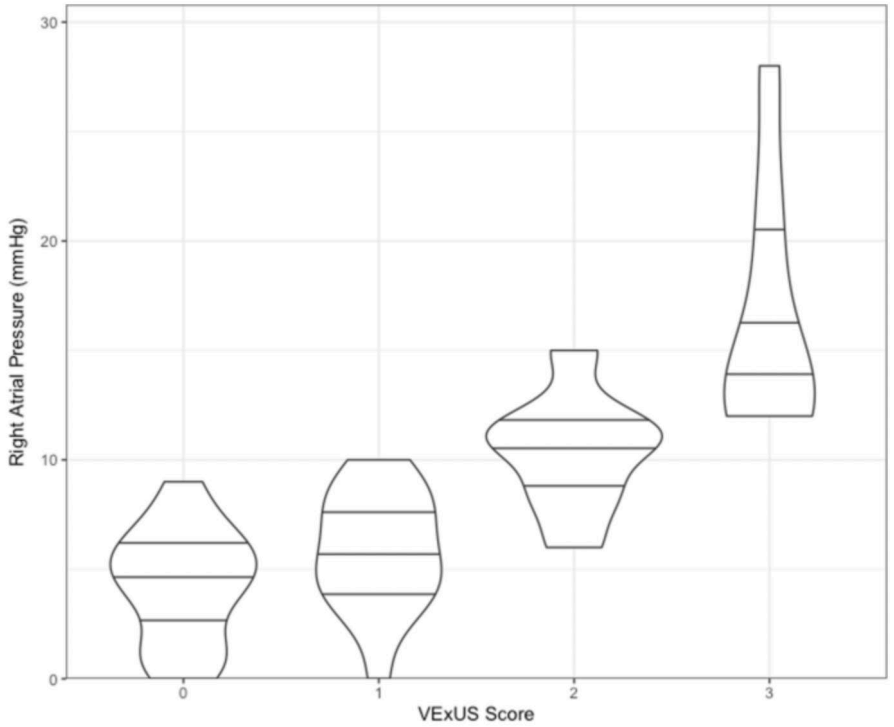
Correlation between the VExUS score and right atrial pressure: a pilot prospective observational study

August Longino, Katharine Martin, Katarina Leyba, Gabriel Siegel, Edward Gill, Ivor S. Douglas & Joseph Burke

Critical Care **27**, Article number: 205 (2023) | Cite this article

- Predicting CVP > 12 mmHg
  - VExUS: AUC 0.99
  - TVC diameter: AUC 0.79

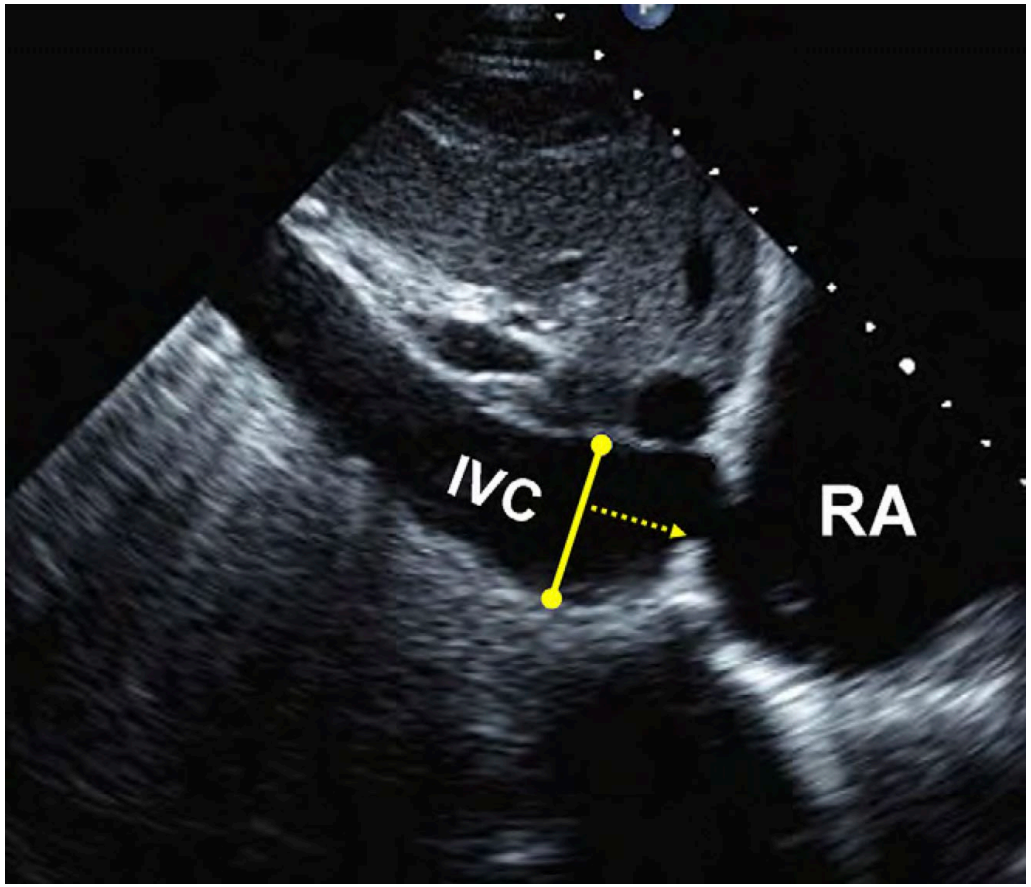
Fig. 1



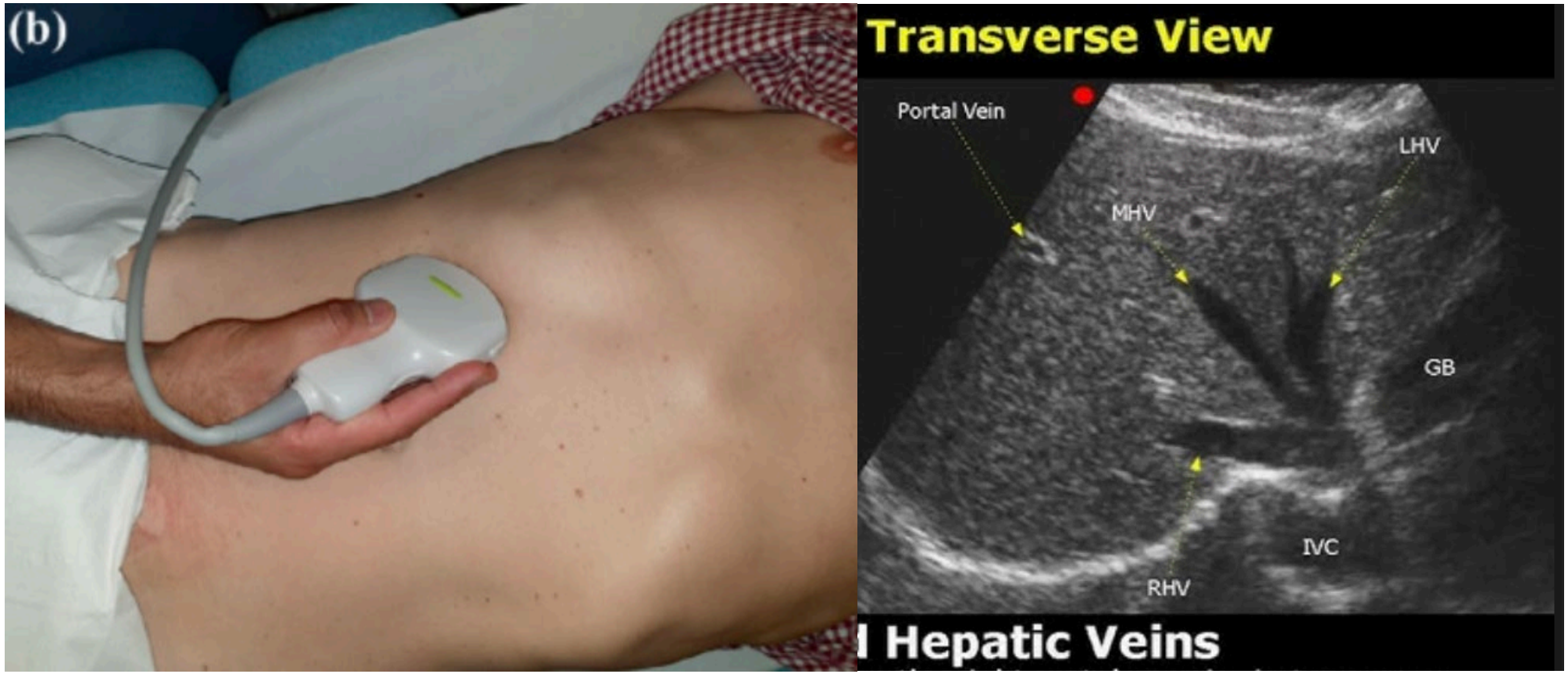
Violin plot of VExUS score and right atrial pressure (RAP). The width of the columns represents the proportion of data located there. Horizontal lines within columns demarcate data quartiles. Elevated VExUS grade appears to be associated with greater RAP

Step 1 – IVC

- Subcostal IVC measurement
  - < 2 cm
    - STOP protocol
    - No congestion
  - ≥ 2cm
    - Go to step 2

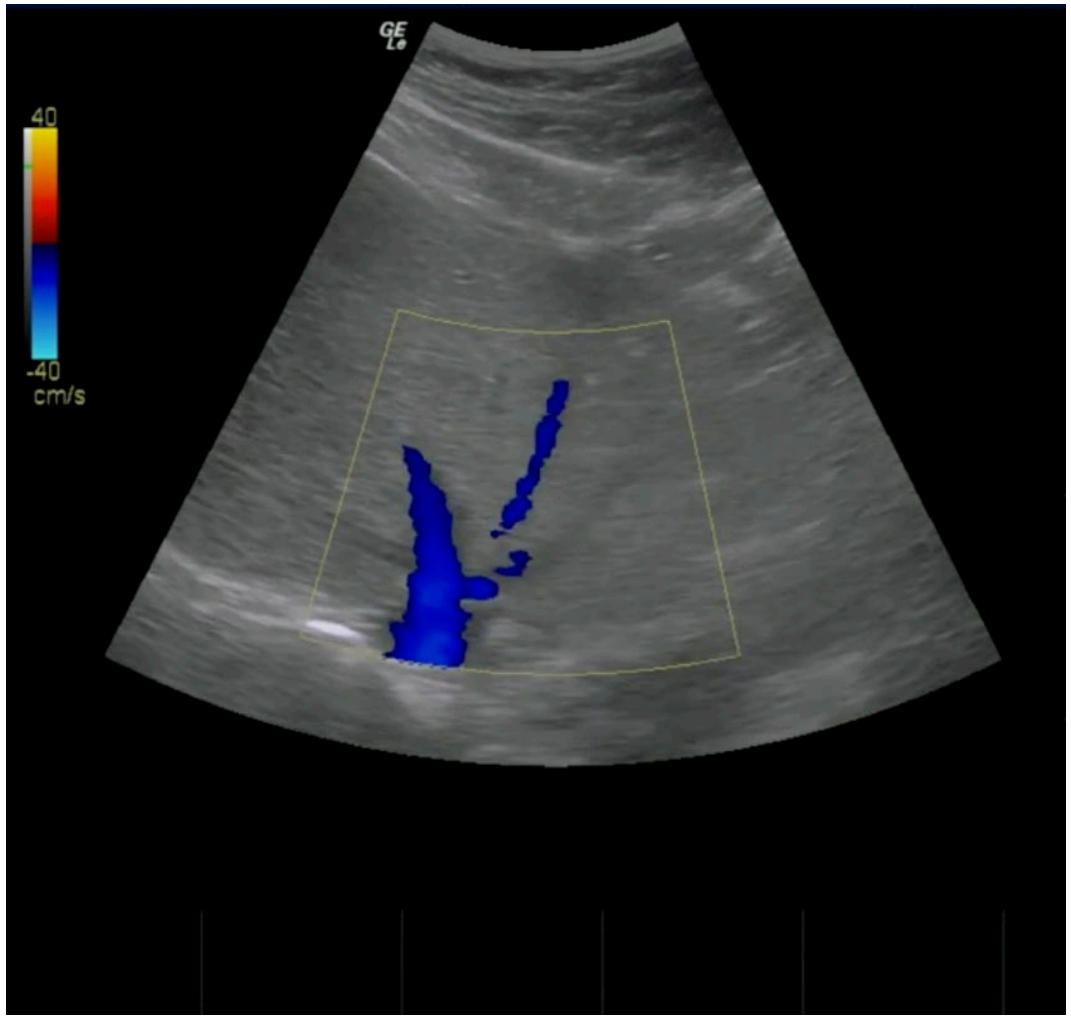


Step 2 – Hepatic Veins



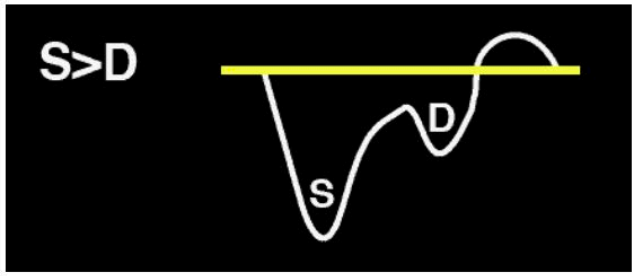
Pilcher, J.M. et Al *Ultrasound in the Critically Ill.*

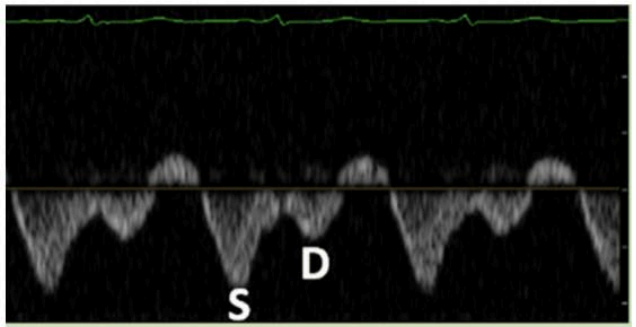
Step 2 – Hepatic Veins



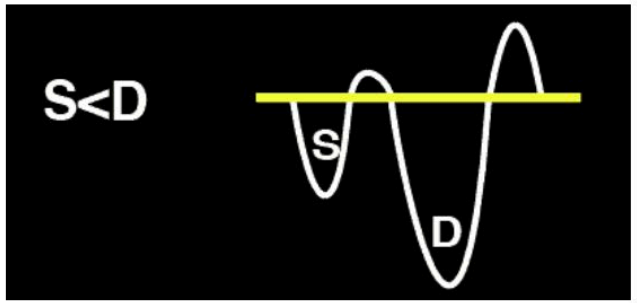
Step 2 – Hepatic Veins

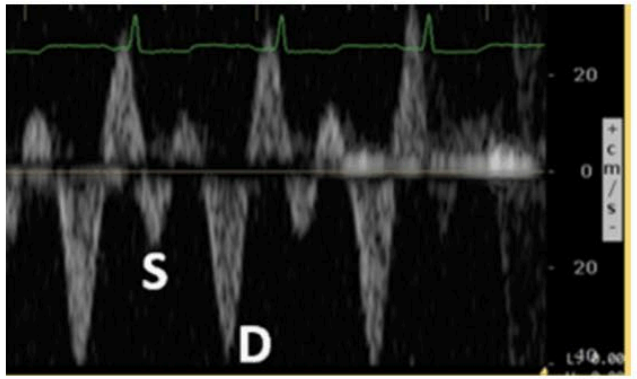
Normal Hepatic Vein Doppler: S>D



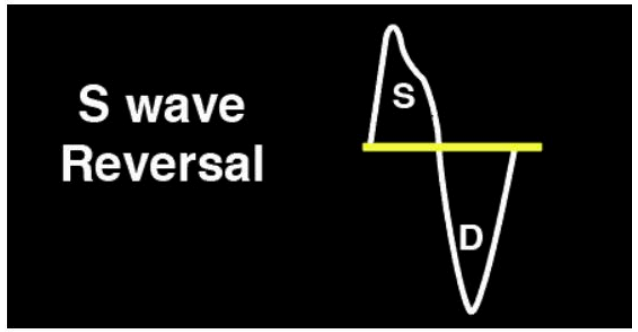


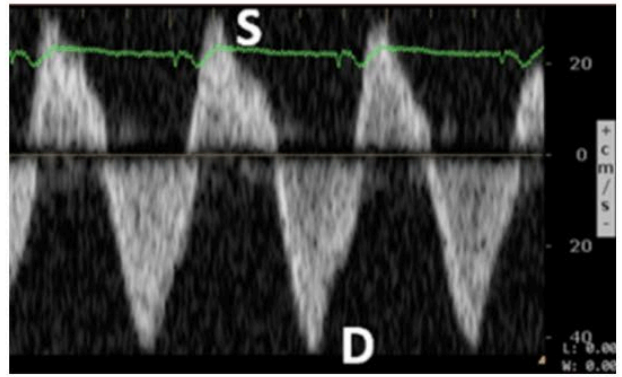
Mild Hepatic Vein Abnormality: S<D



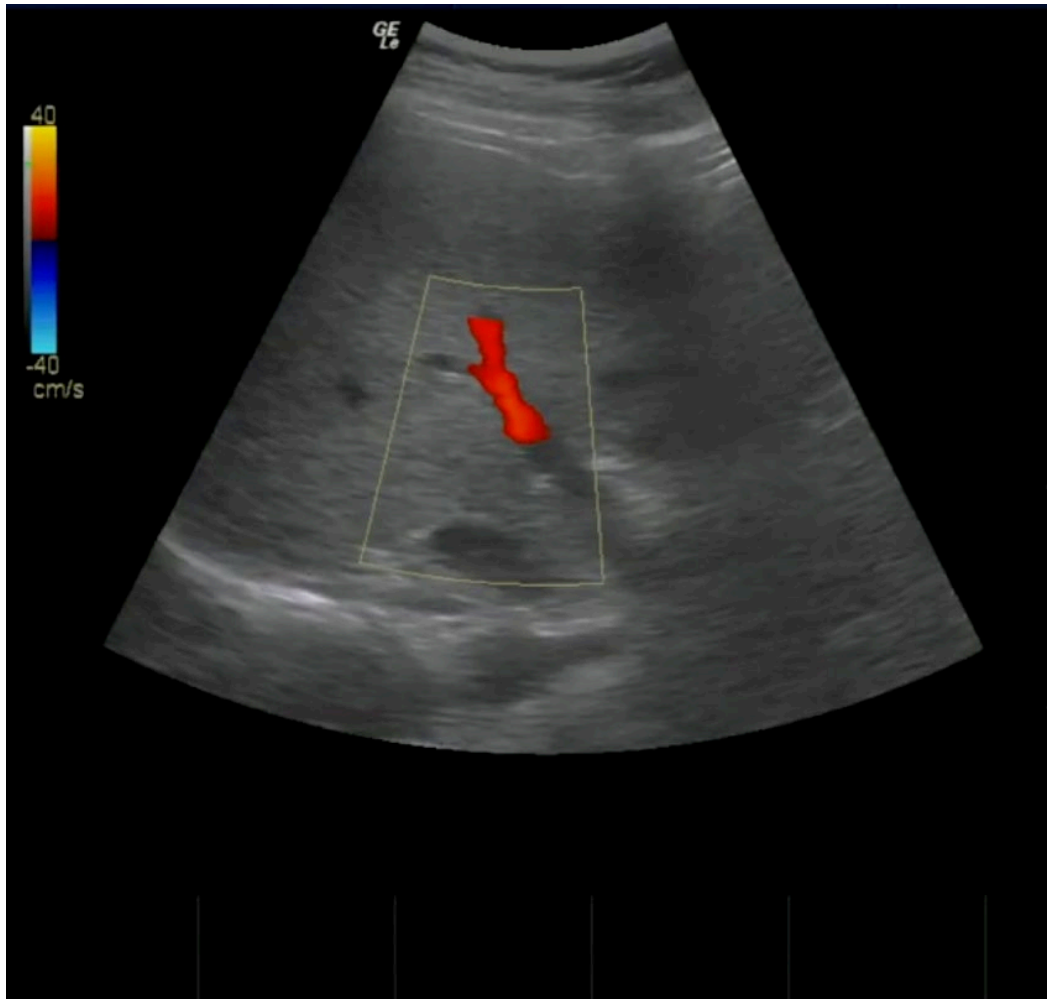


Severe Hepatic Vein Abnormality: S Reversal





Step 3 – Portal Veins

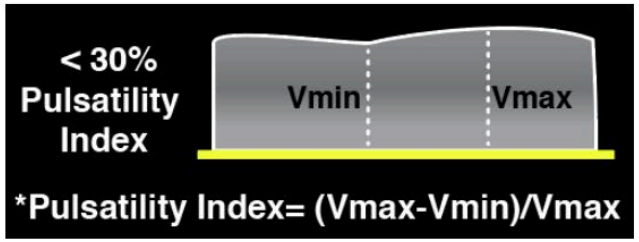


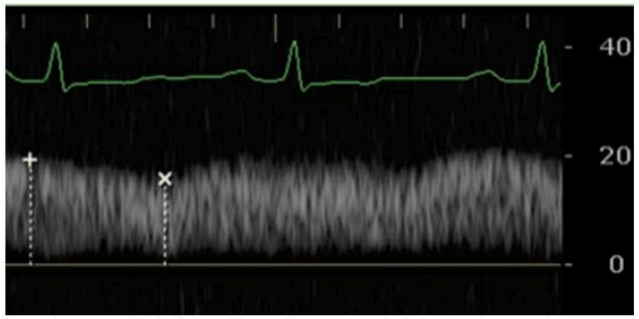
POCUS 101
Pilcher, J.M. et Al *Ultrasound in the Critically Ill.*

Step 3 – Portal Veins

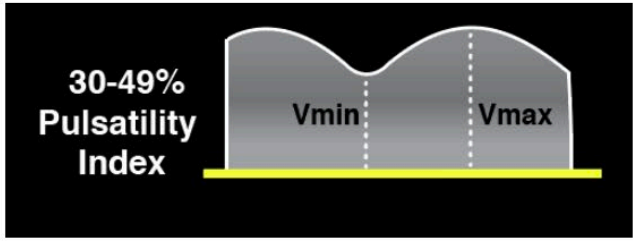
Normal

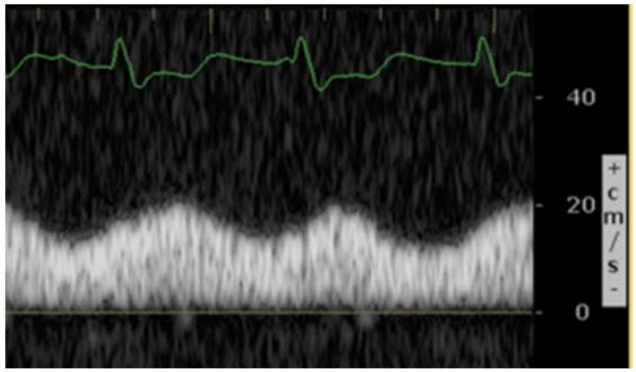
Portal Vein Doppler



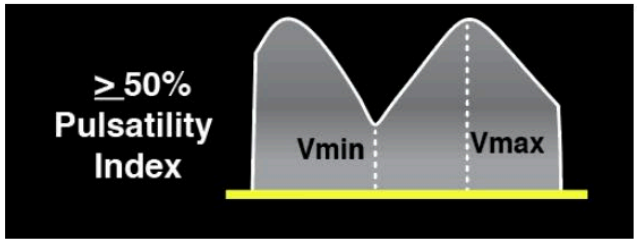


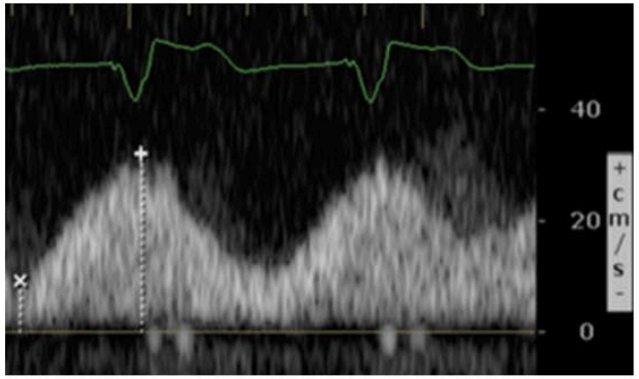
Mild Portal Vein Abnormality





Severe Portal Vein Abnormality





Step 4 – Renal Veins

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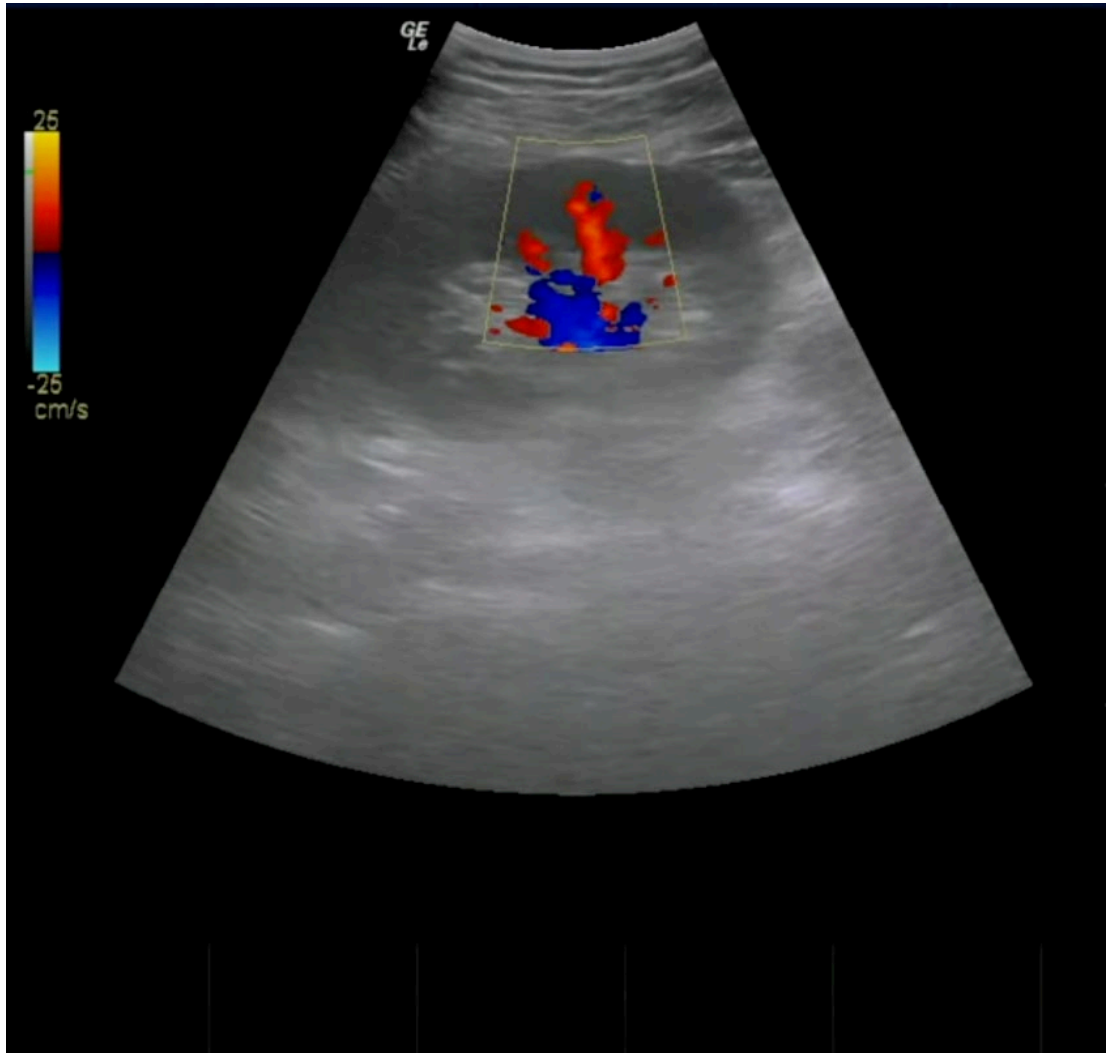
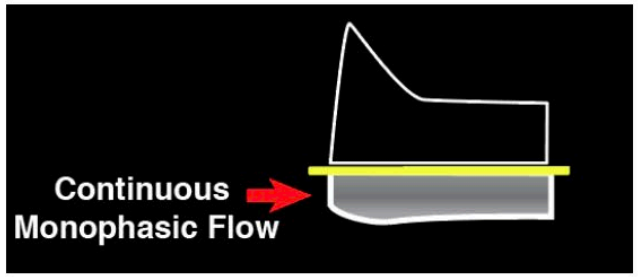
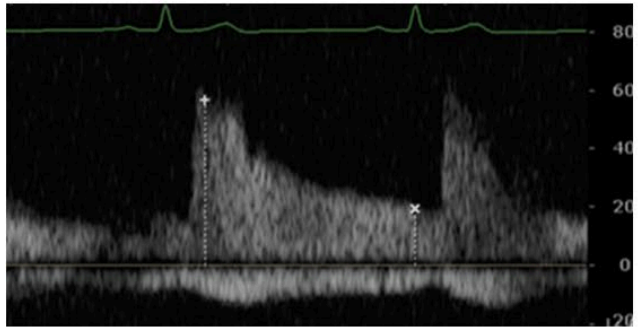


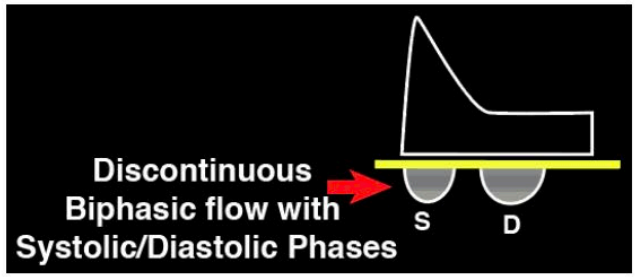
Step 4 – Renal Veins

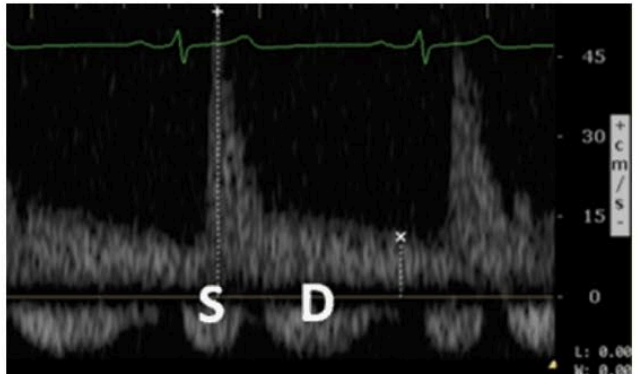
Normal Intrarenal Vein Doppler



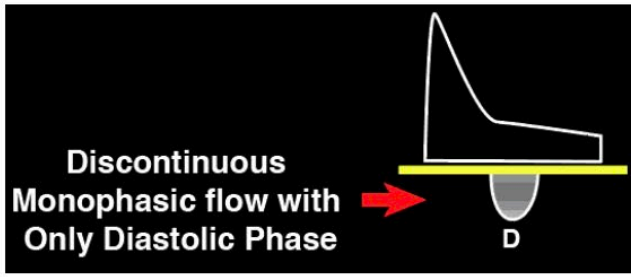


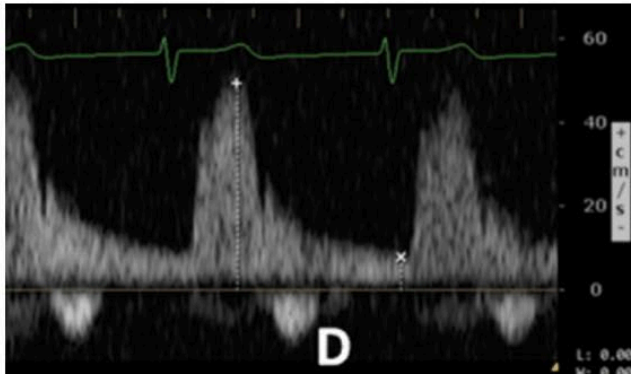
Mild Intrarenal Vein Abnormality





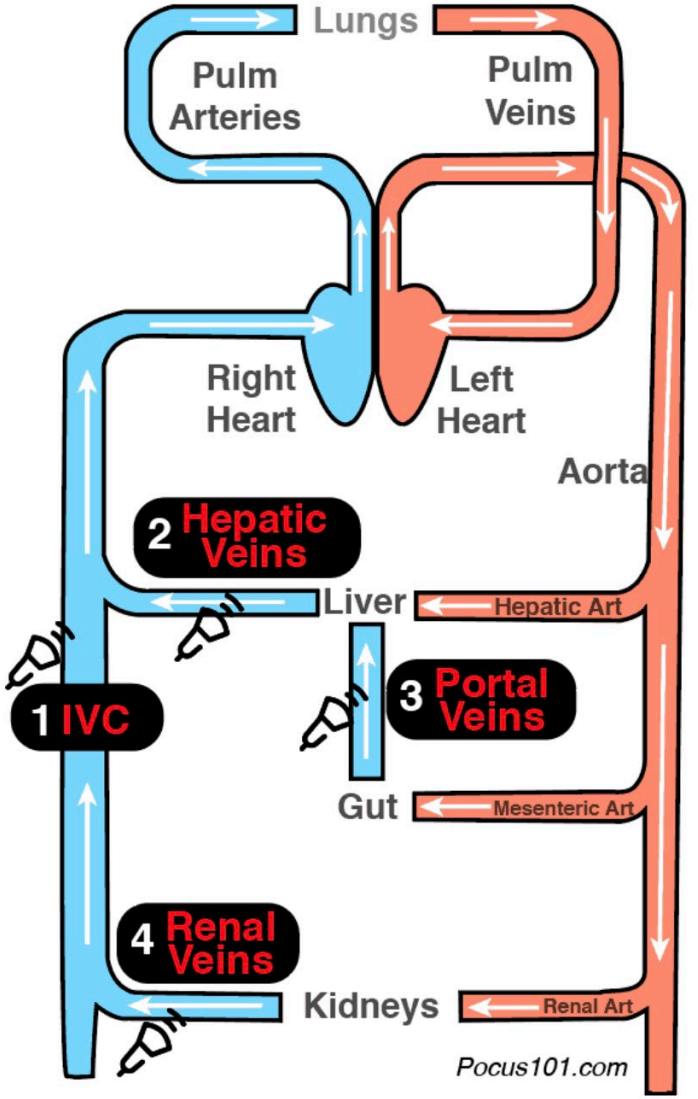
Severe Intrarenal Vein Abnormality



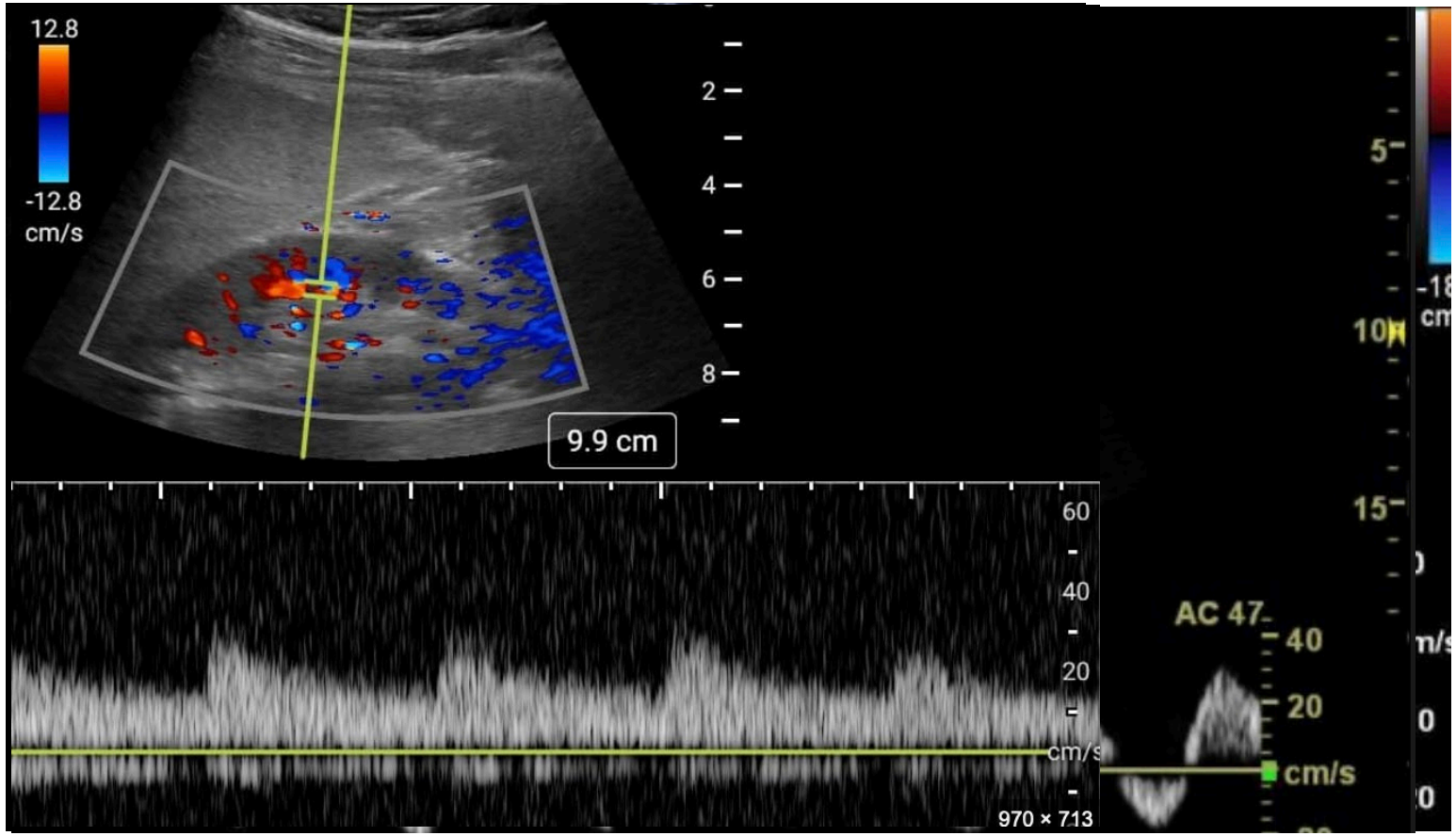


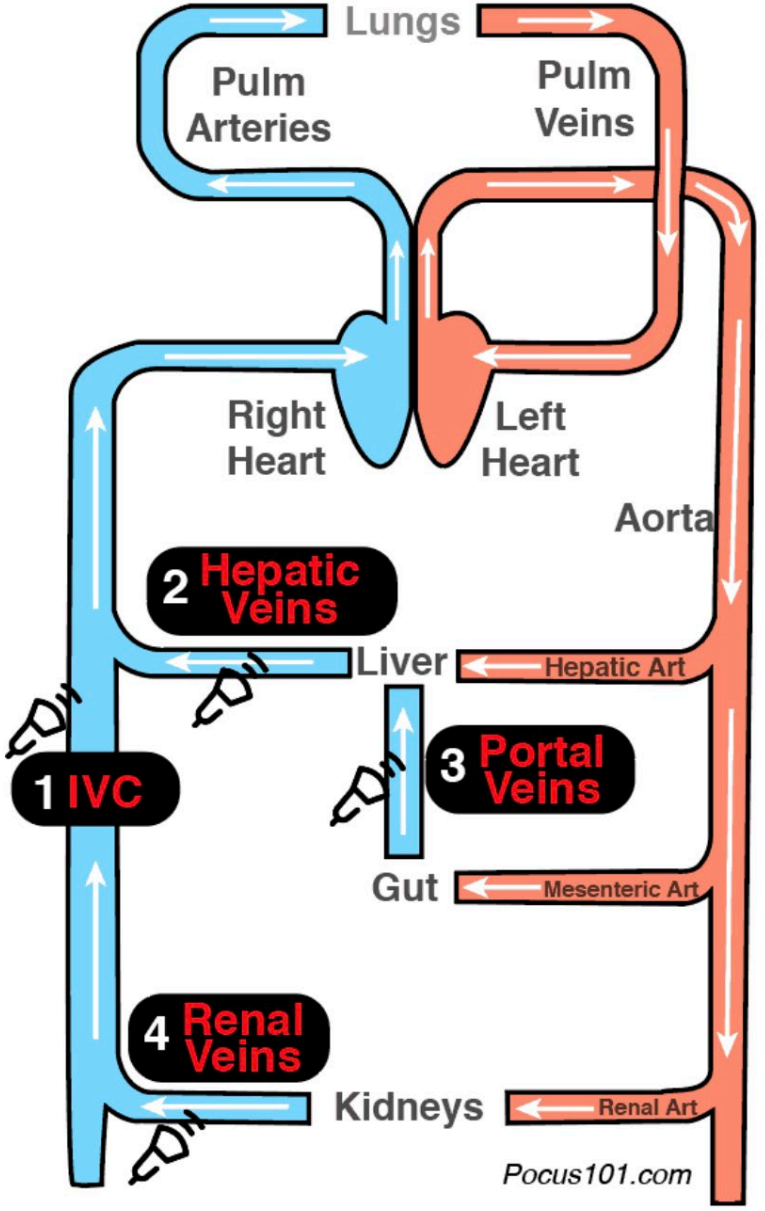
Step 5 – Integrate

- Grade 0: No congestion
  - IVC < 2 cm
- Grade 1: Mild congestion
  - IVC ≥ 2 cm with normal or mildly abnormal veins profile
- Grade 2: Moderate congestion
  - IVC ≥ 2 cm with 1 severely abnormal veins pattern
- Grade 3: Severe congestion
  - IVC ≥ 2 cm with 2 or more severely abnormal veins pattern



Case


12.8
-12.8
cm/s
9.9 cm
60
40
20
cm/s
970 × 713
AC 47
40
20
cm/s


Lungs
Pulm Arteries
Pulm Veins
Right Heart
Left Heart
Aorta
2 Hepatic Veins
Liver
Hepatic Art
1 IVC
3 Portal Veins
Gut
Mesenteric Art
4 Renal Veins
Kidneys
Renal Art
Pocus101.com

POCUS Workshop

Case 2

Acute Care

Case in CCU

- 45-year-old man
- Admitted today for OHCA 2nd anterior STEMI
- Resuscitate during 10 minutes in emergency and underwent LAD PCI with good result
- TTE is scheduled for tommorow

Case in CCU

- Neuro : RASS -5 on sedation
- HD : 75/32 HR 105 cold extremities
  - On high dose of vasopressors
- Respiration: Ventilator Auto-mode FiO2 100%
- Was under a normothermia protocol, but it was discontinued due to the onset of low BP

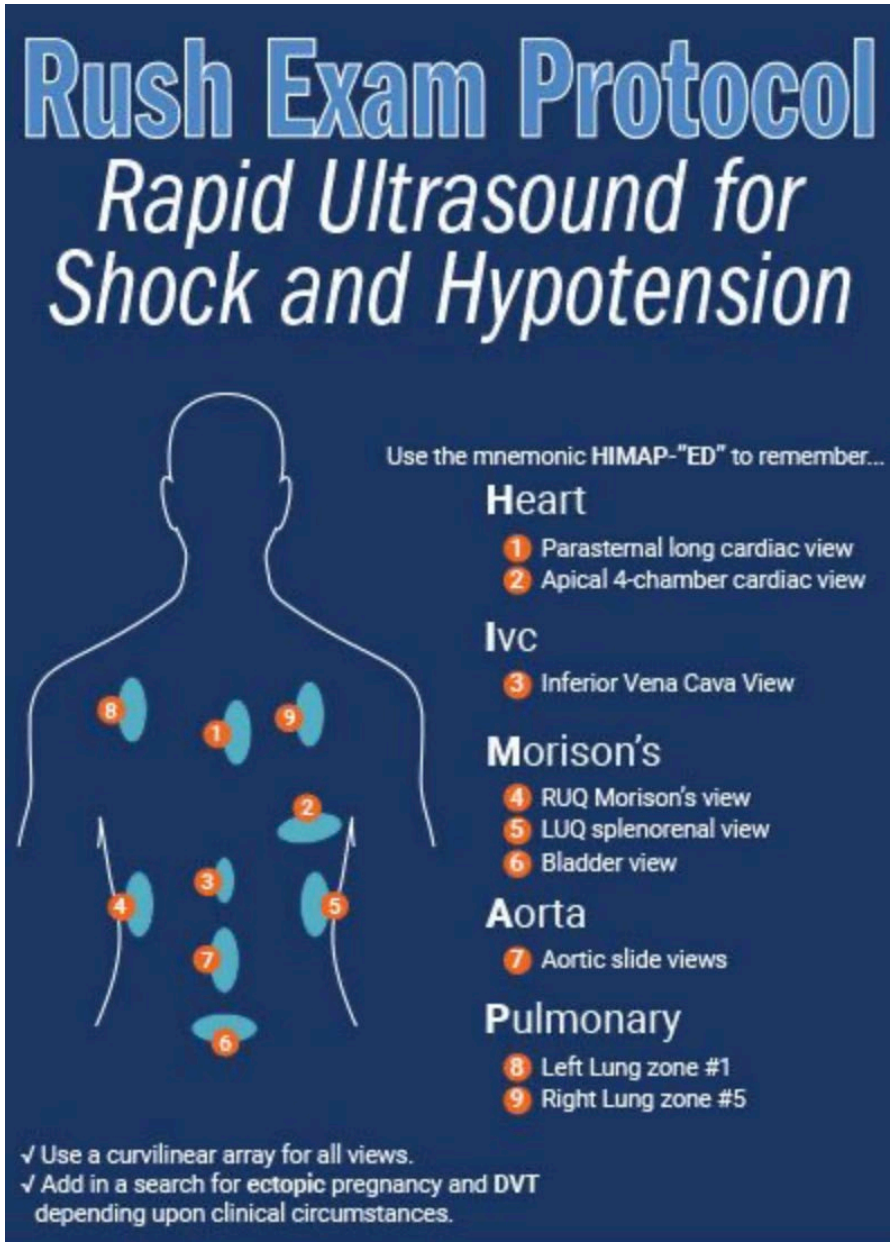
Where Do We Start?

- **Hypotension**
  - Cardiogenic shock?
  - Sepsis?
  - Hemorrhagic complications of resuscitation?

- **Hypoxemia**
  - Acute pulmonary edema?
  - Pneumothorax/hemothorax caused by resuscitation?
  - Pneumonia?

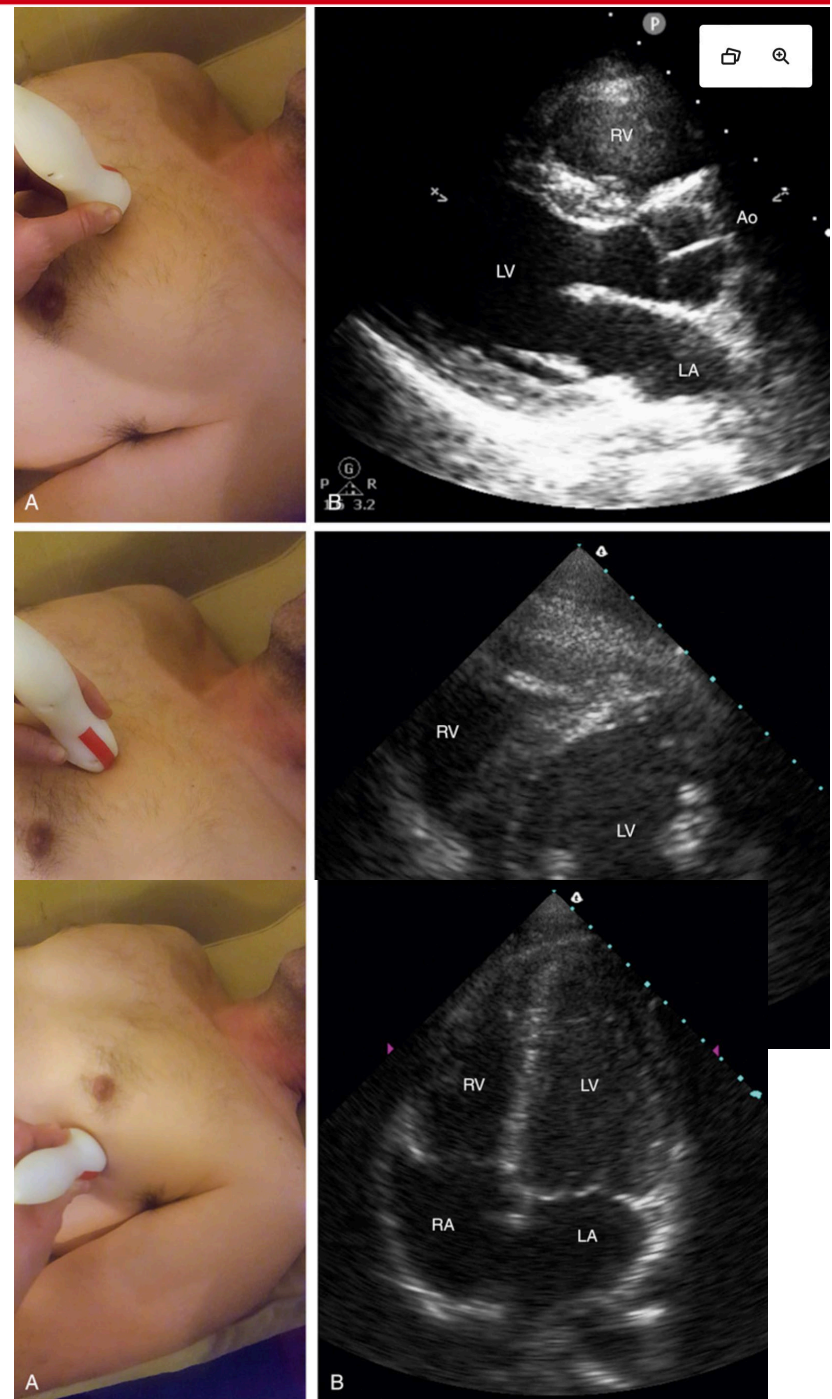
RUSH Protocol

- **H**eart
- **I**nferior vena cava
- **M**orison's pouch
- **A**orta
- **P**ulmonary



HEART

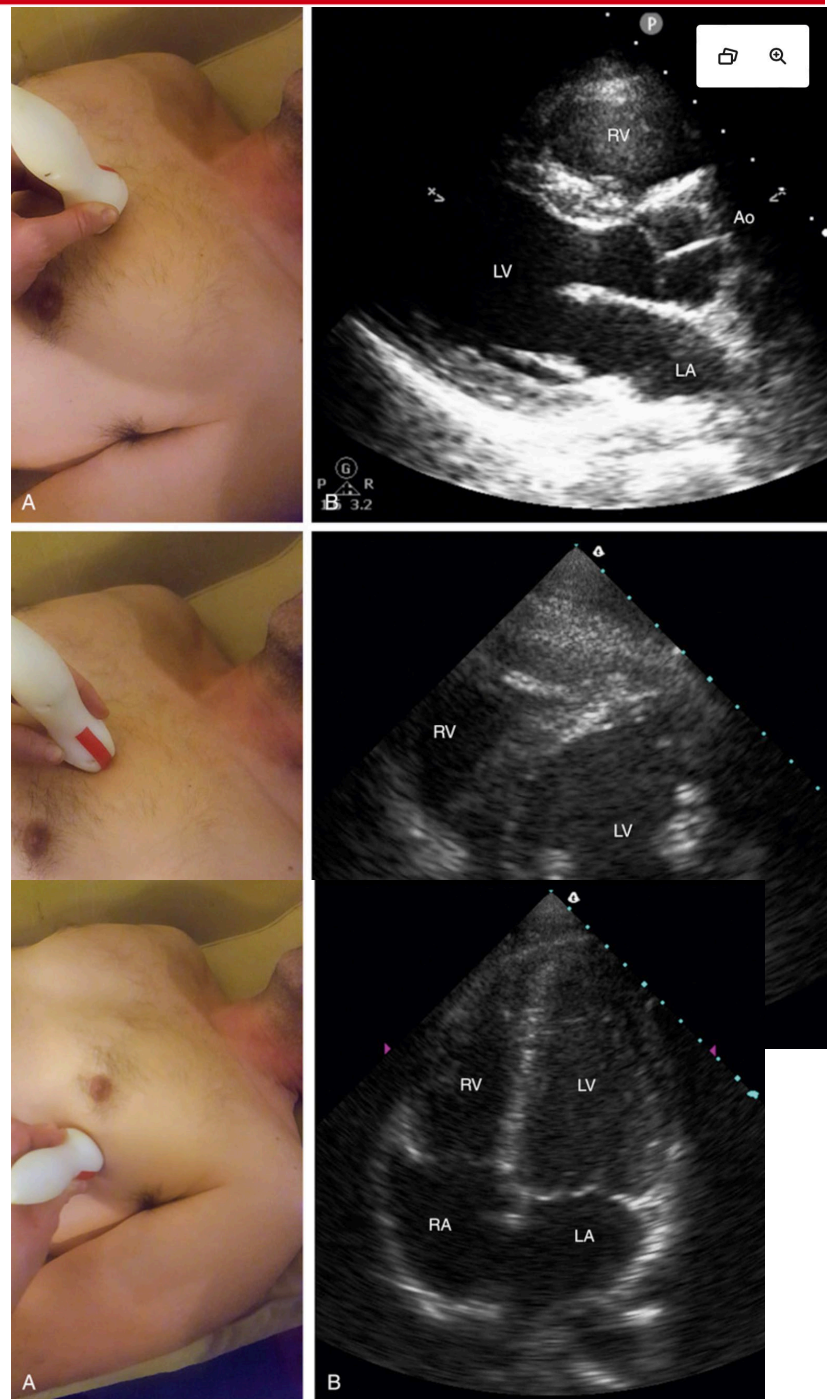
- **Parasternal view and apical view**
  - Semi-quantitative assessment of ejection fraction
  - Regional wall abnormality
  - Right ventricle
  - Pericardial effusion



Otto

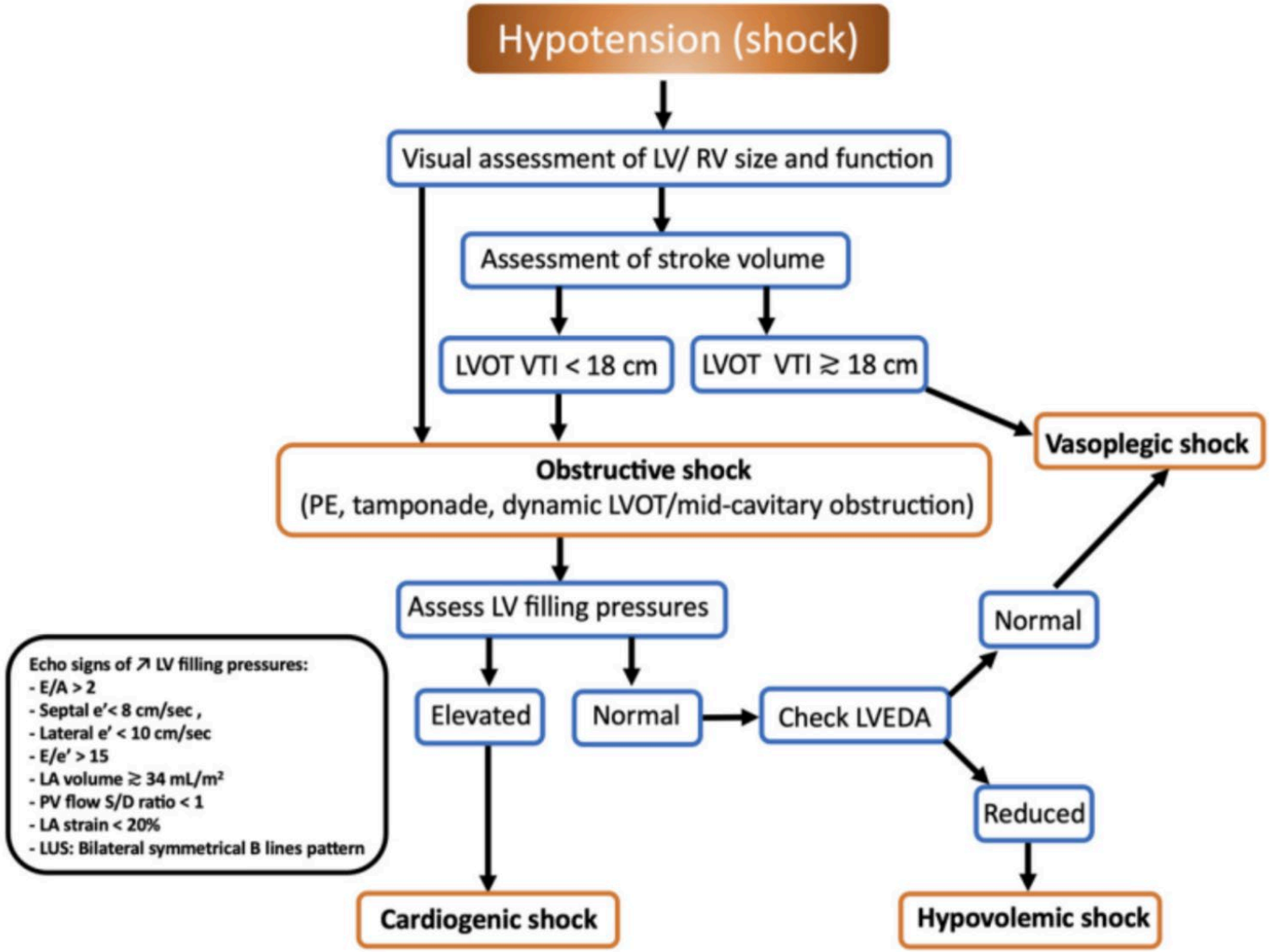
HEART

- **Hemodynamic assessment:**
  - LVOT VTI
  - LV filling pressure
    - E/A
    - E/e’
    - LA volume



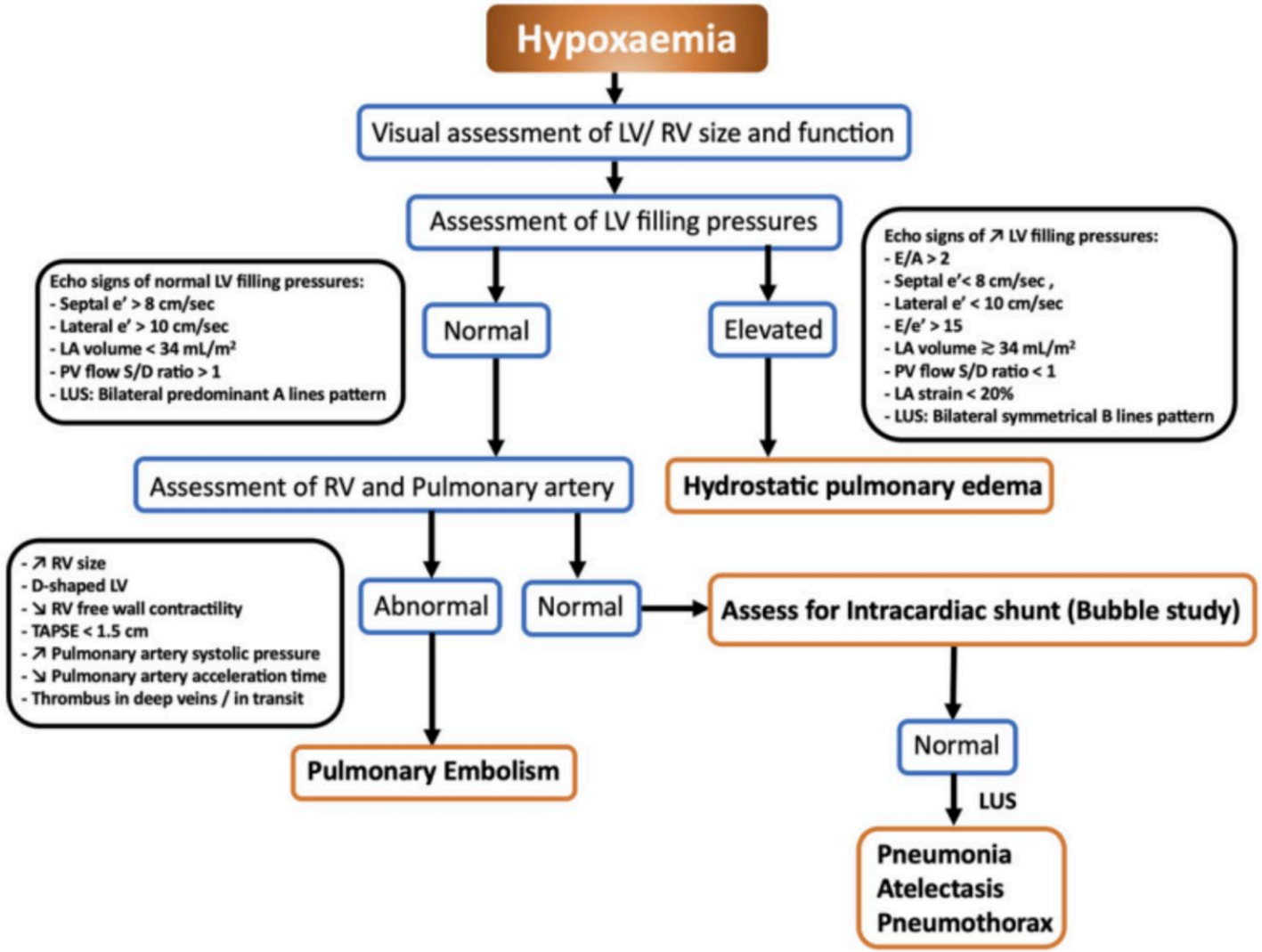
Otto

HEART



Soliman-Aboumarie et al. *Imaging* 2022

HEART



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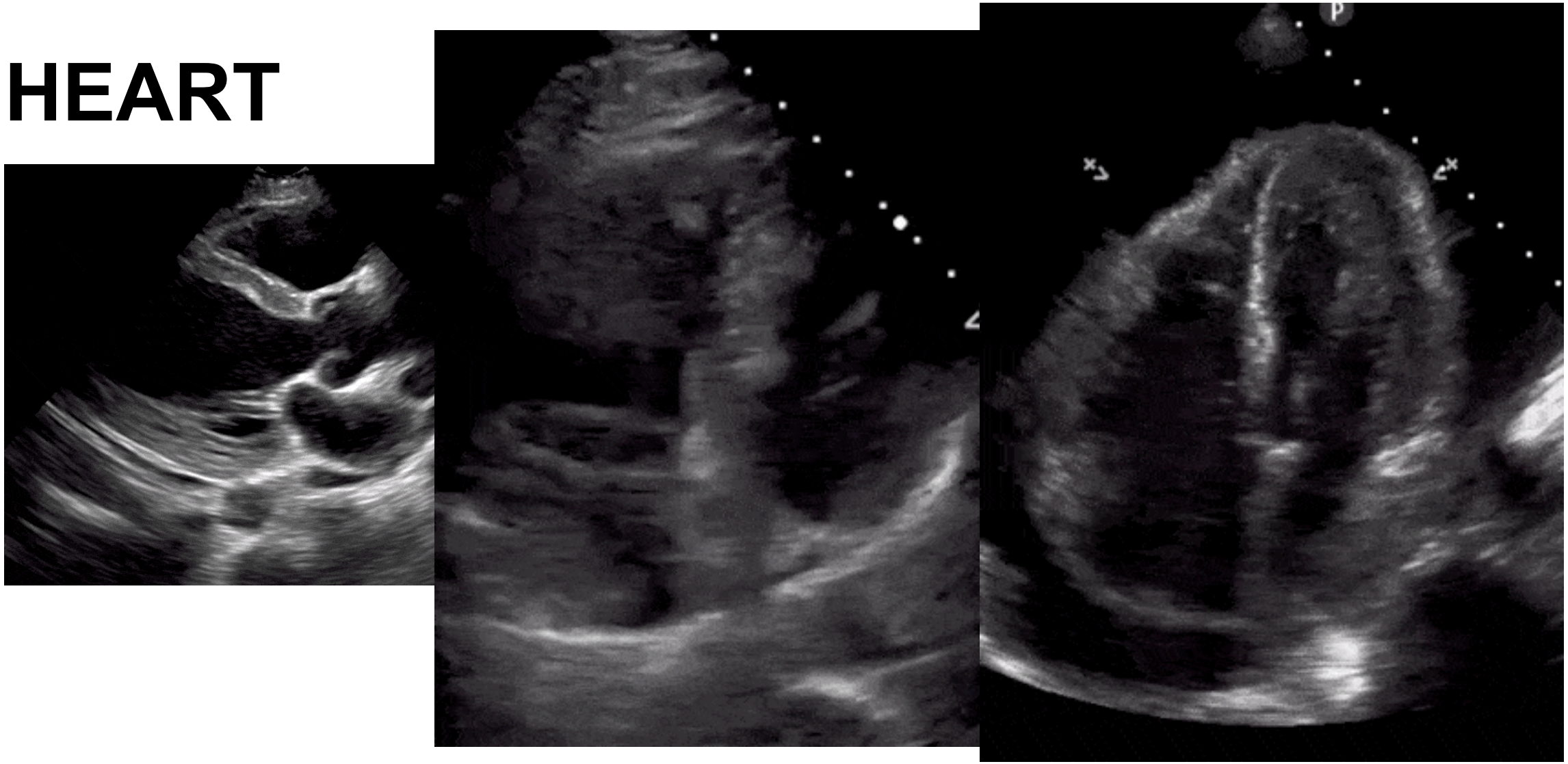
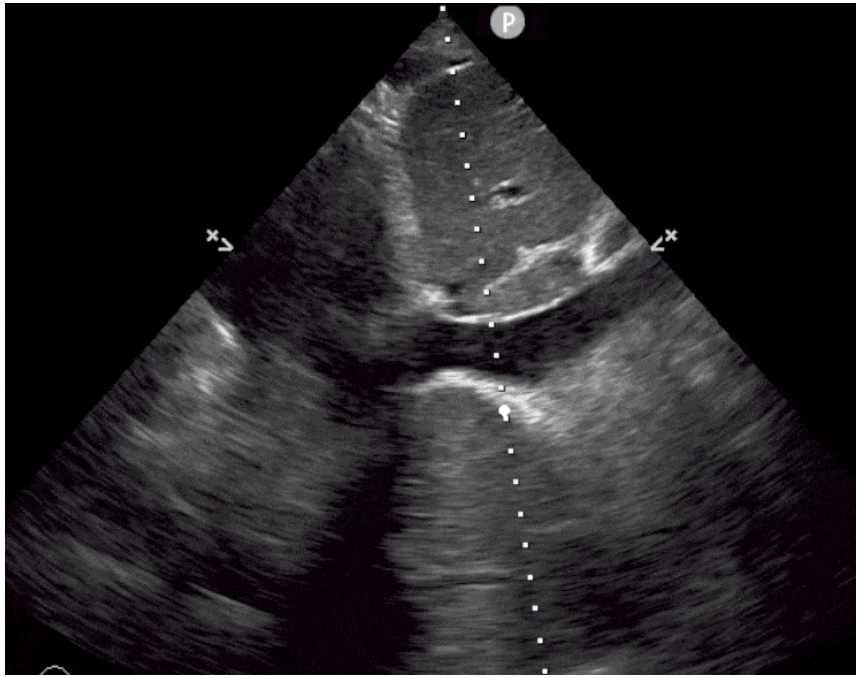
HEART



Integration of HEART and IVC

Type of Shock	LV Ejection Fraction	Cardiac Output	IVC
Distributive	High	High	Collapsible
Obstructive	Normal/High	Low	Noncollapsible
Cardiogenic	Low	Low	Noncollapsible
Hypovolemic	High	Low	Collapsible

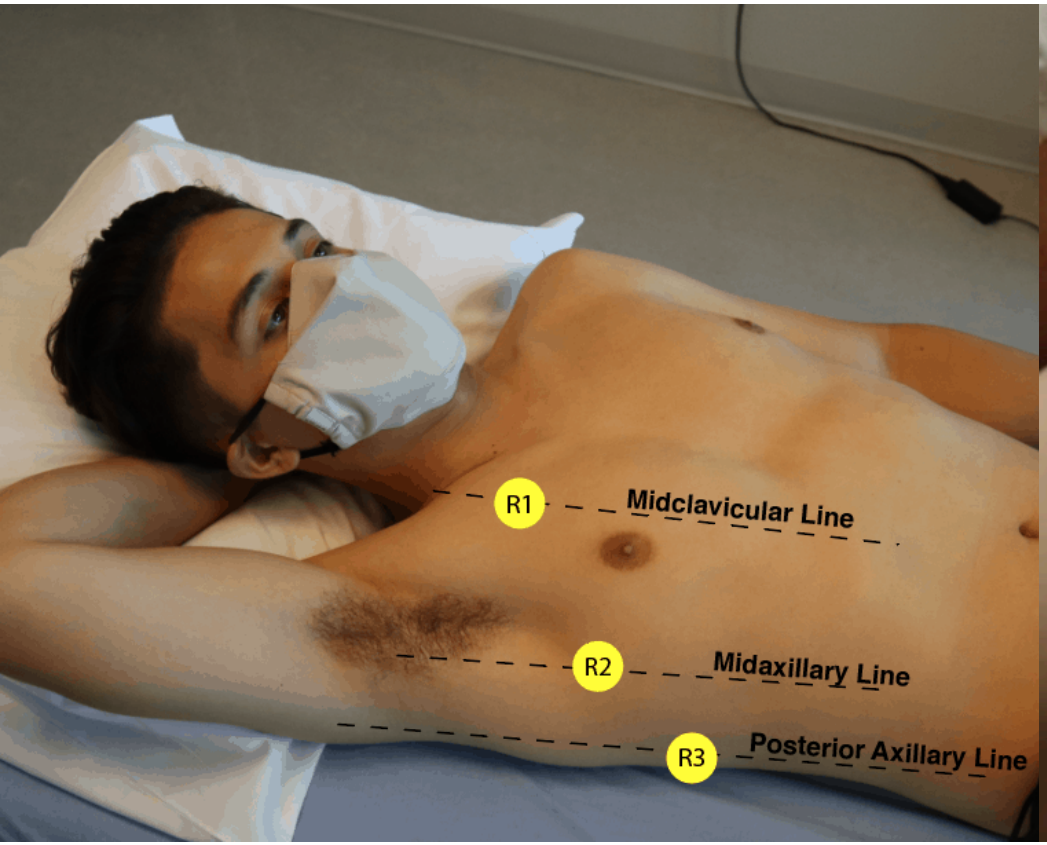


Morison's Pouch and Friends

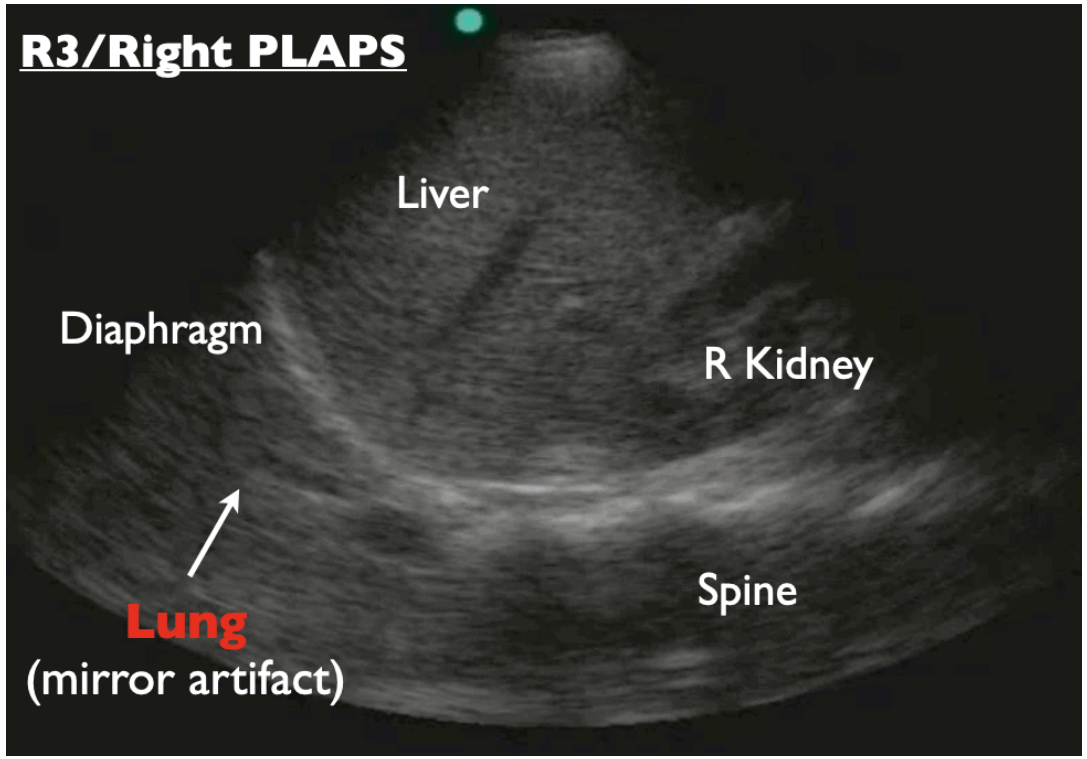
- Hypotension may be caused by hemorrhagic complications of resuscitation, fibrinolysis, trauma, or heparin

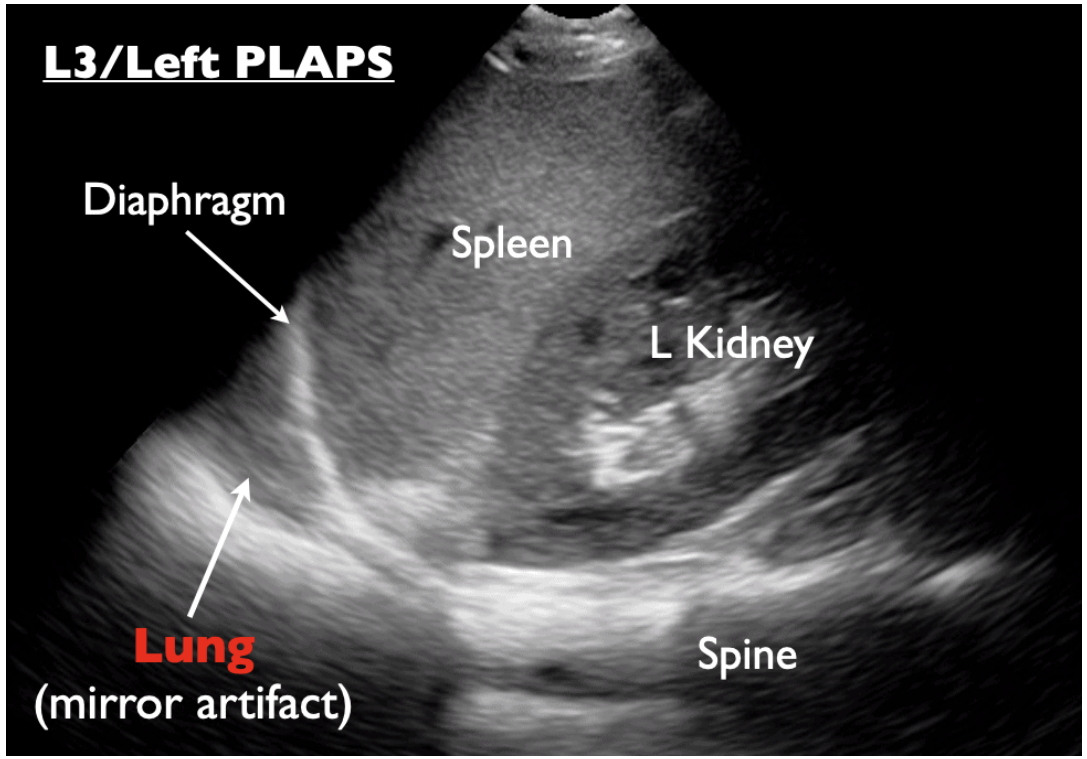
- There are 5 possible areas to assess free fluid:
  - Right thorax
  - Right upper quadrant
  - Left thorax
  - Left upper quadrant
  - Rectovesical pouch (will not be covered)

Right and Left Thorax

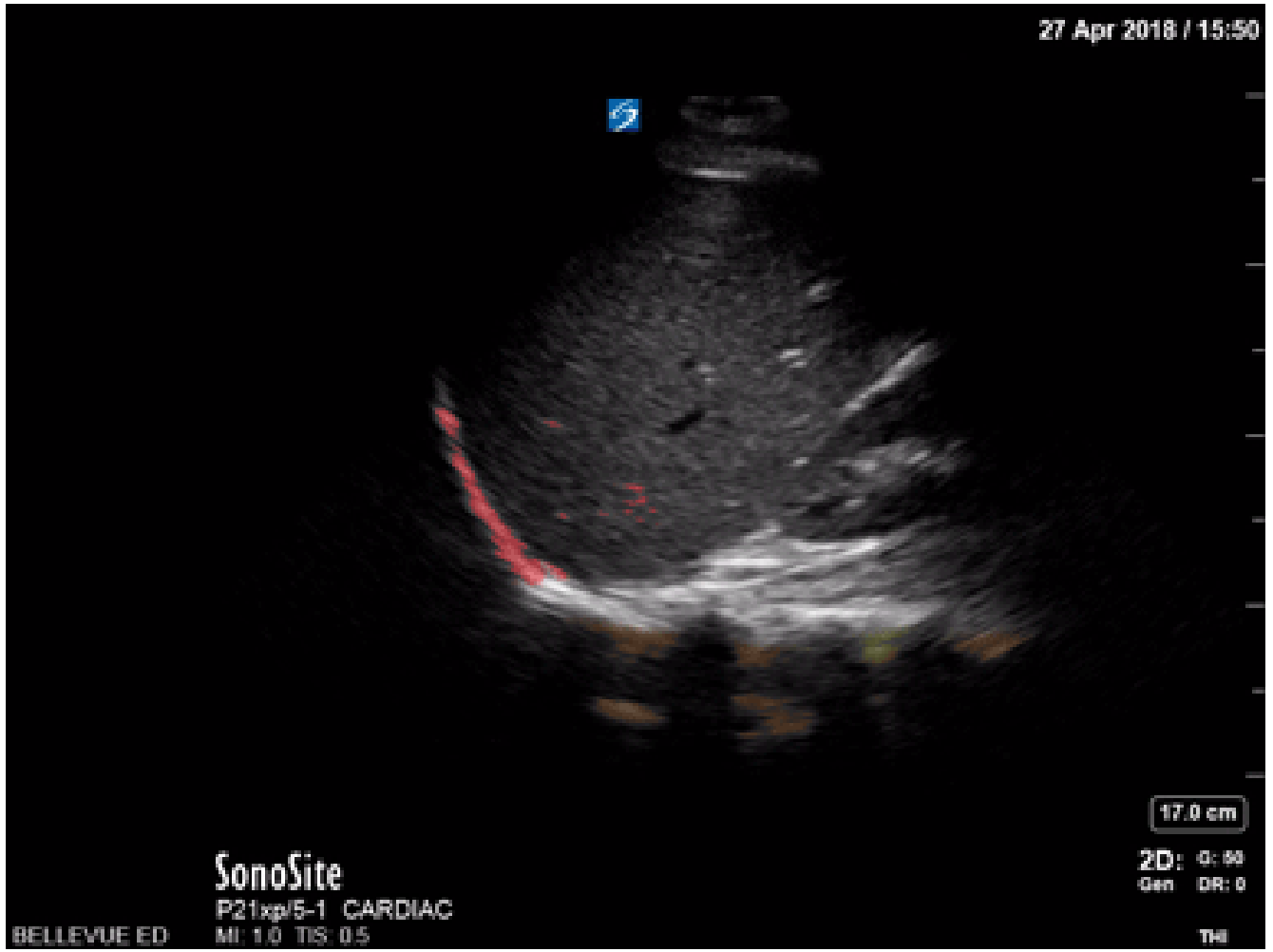


Right and Left Thorax

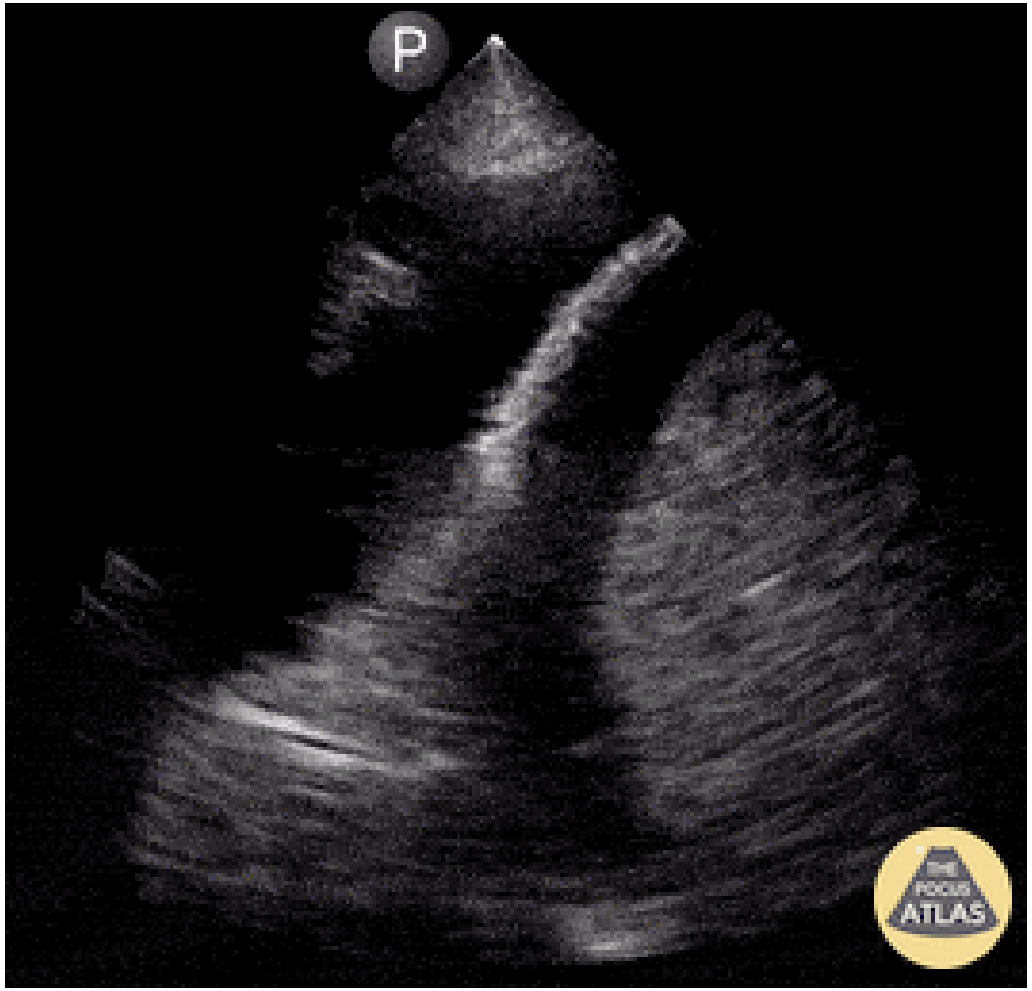


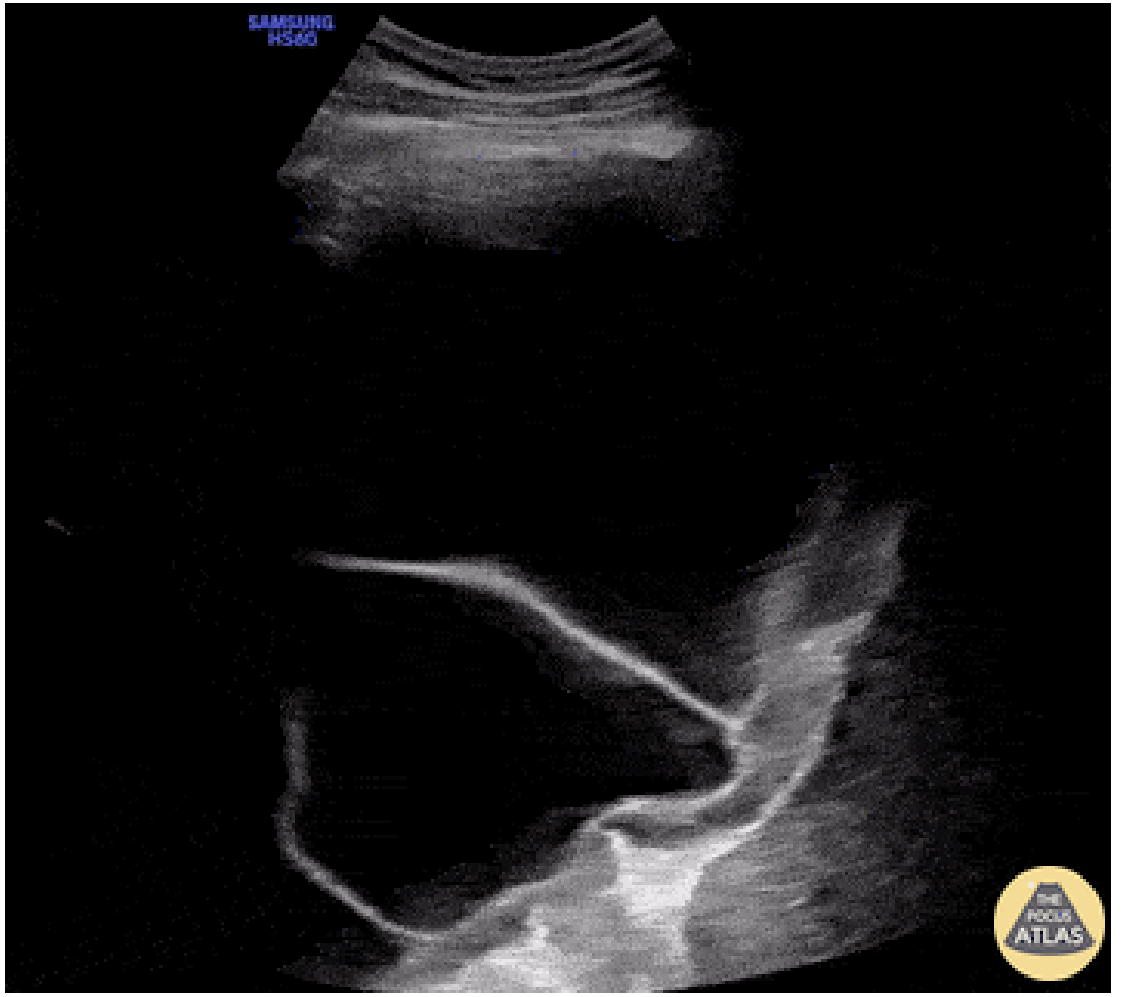


Right and Left Thorax

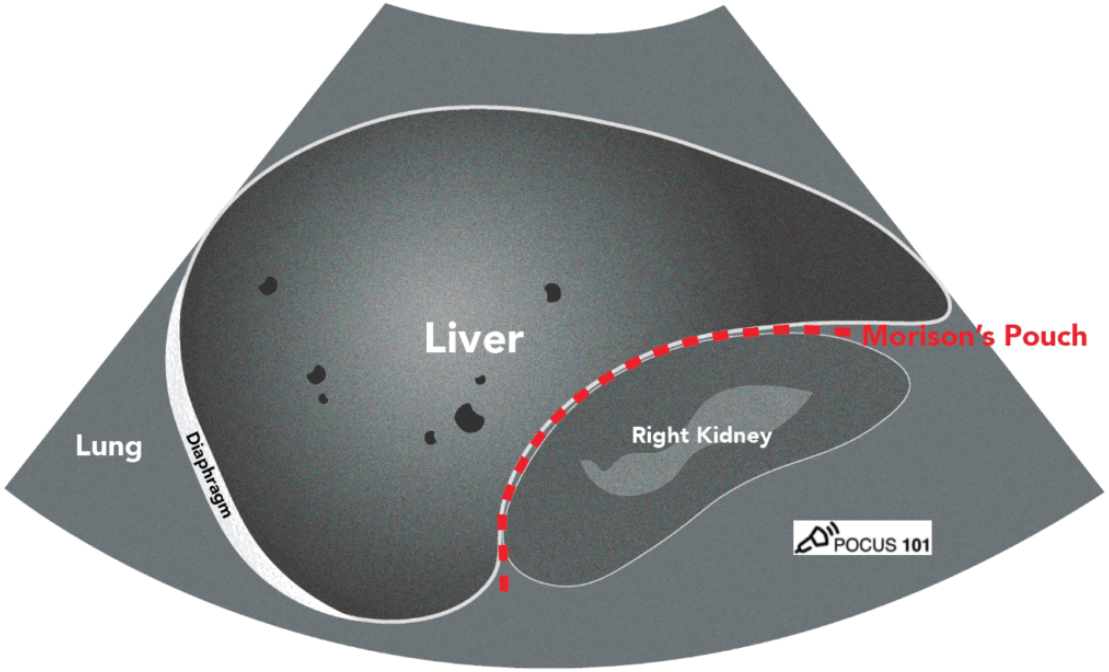


Right and Left Thorax

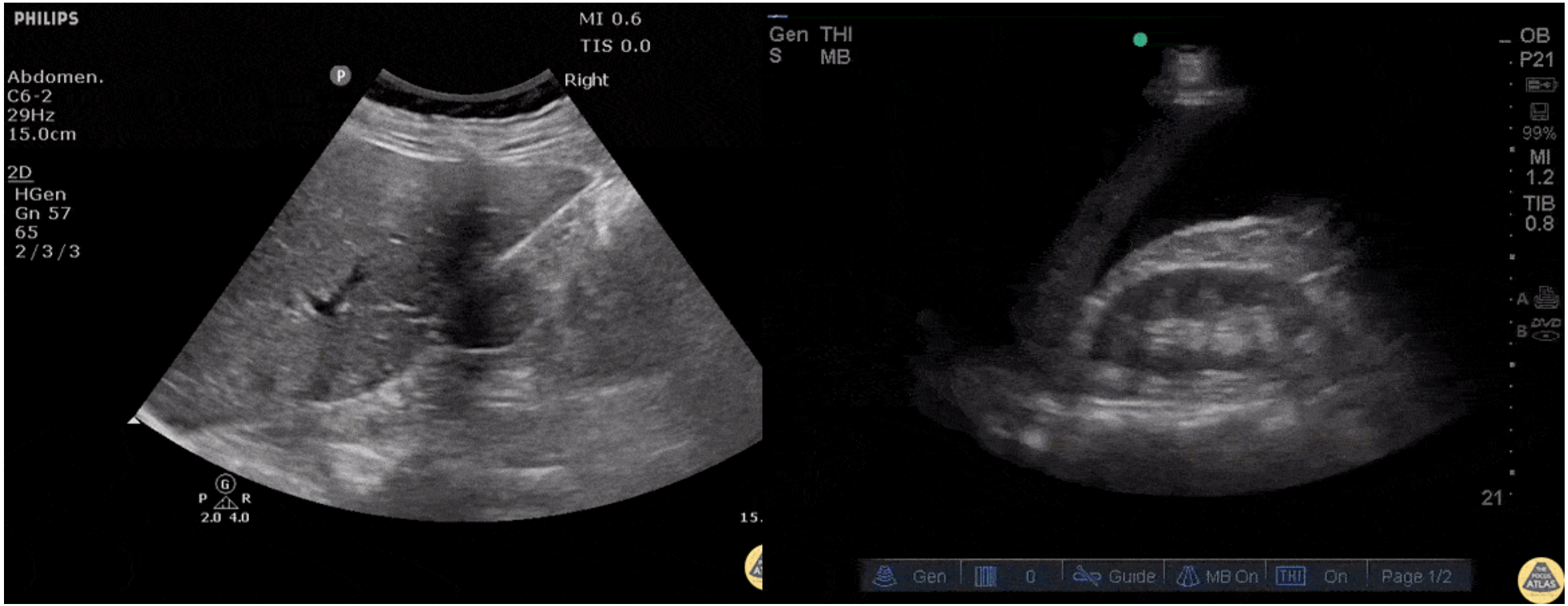




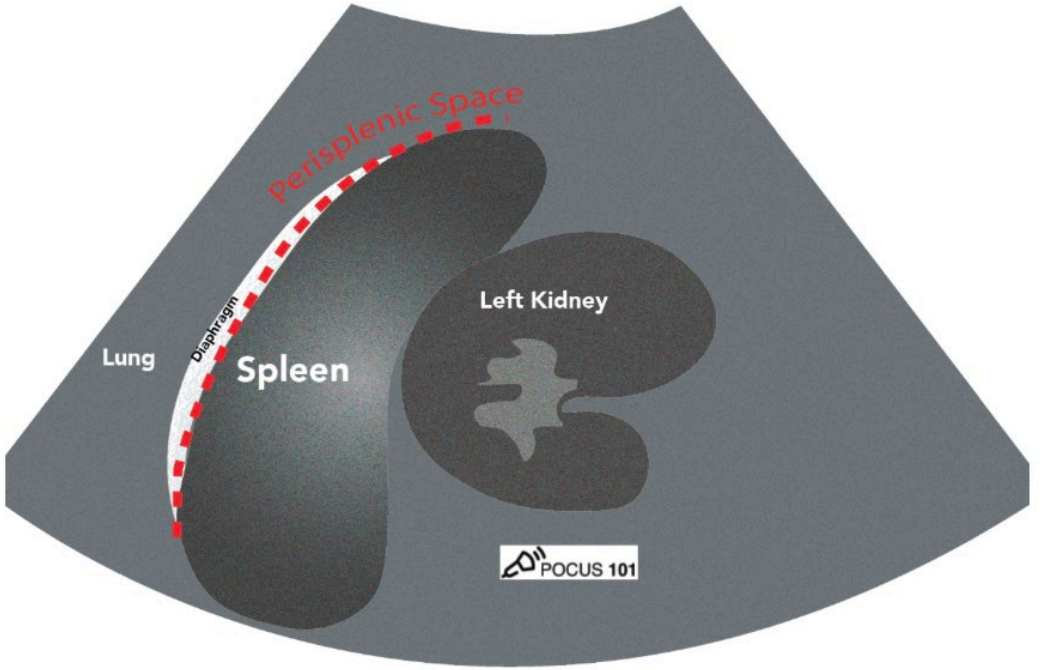
Right Upper Quadrant



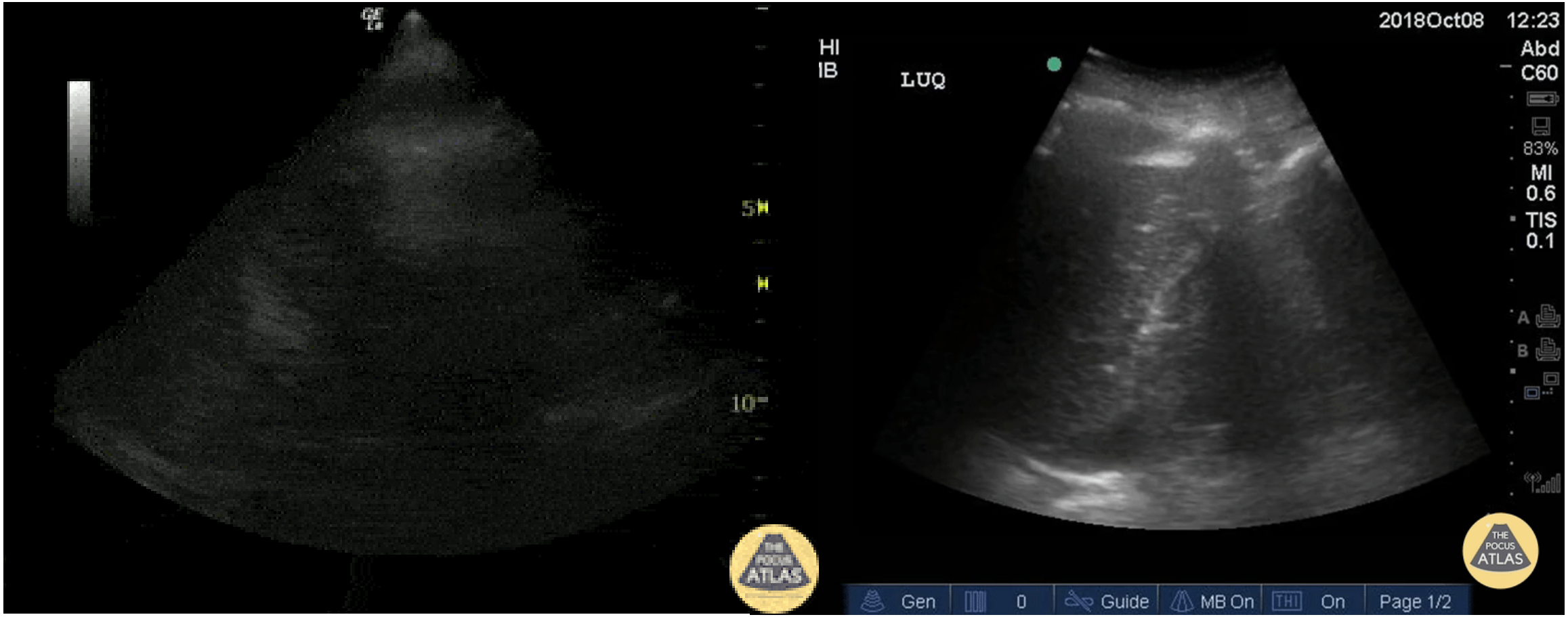
Right Upper Quadrant



Left Upper Quadrant

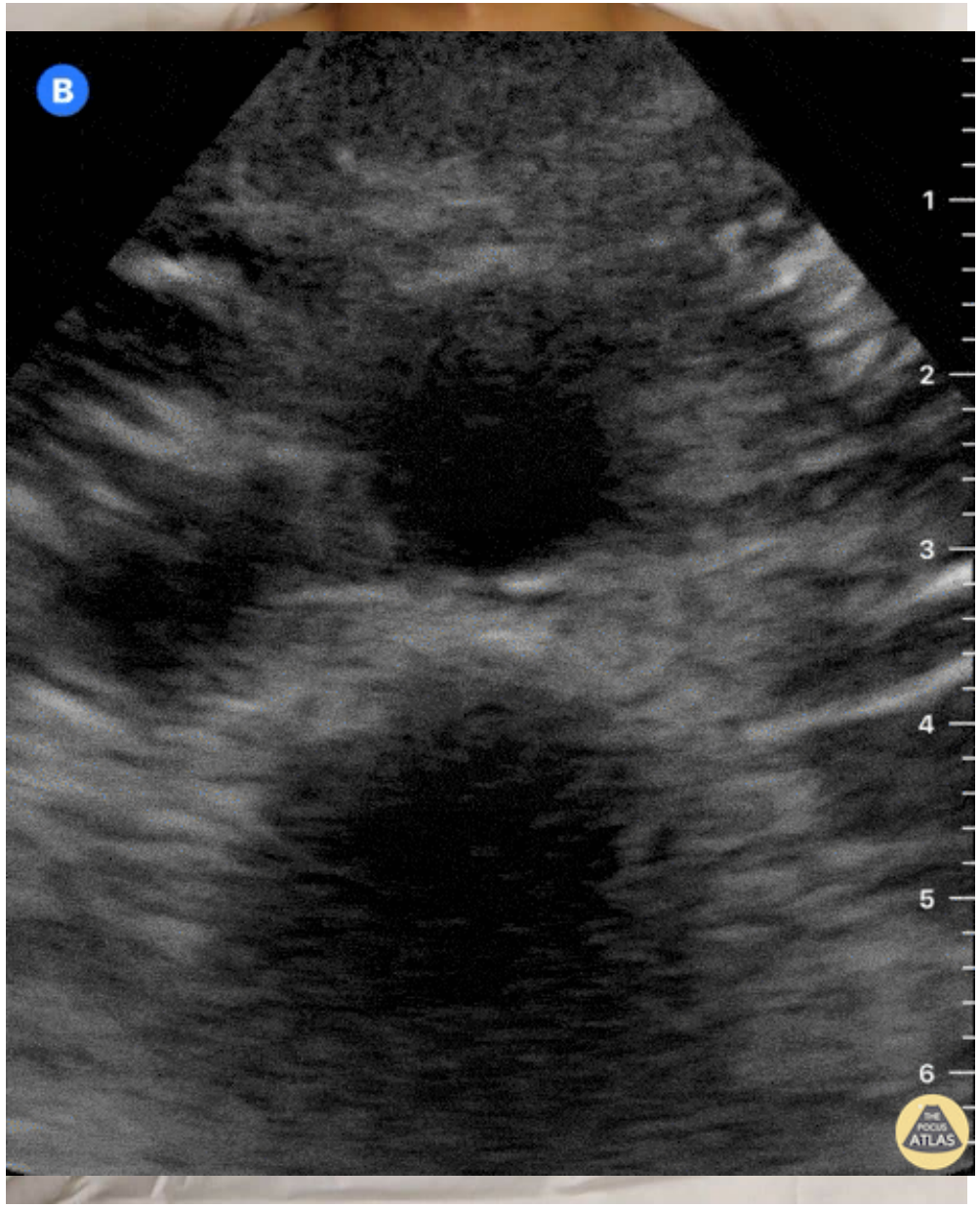


Left Upper Quadrant

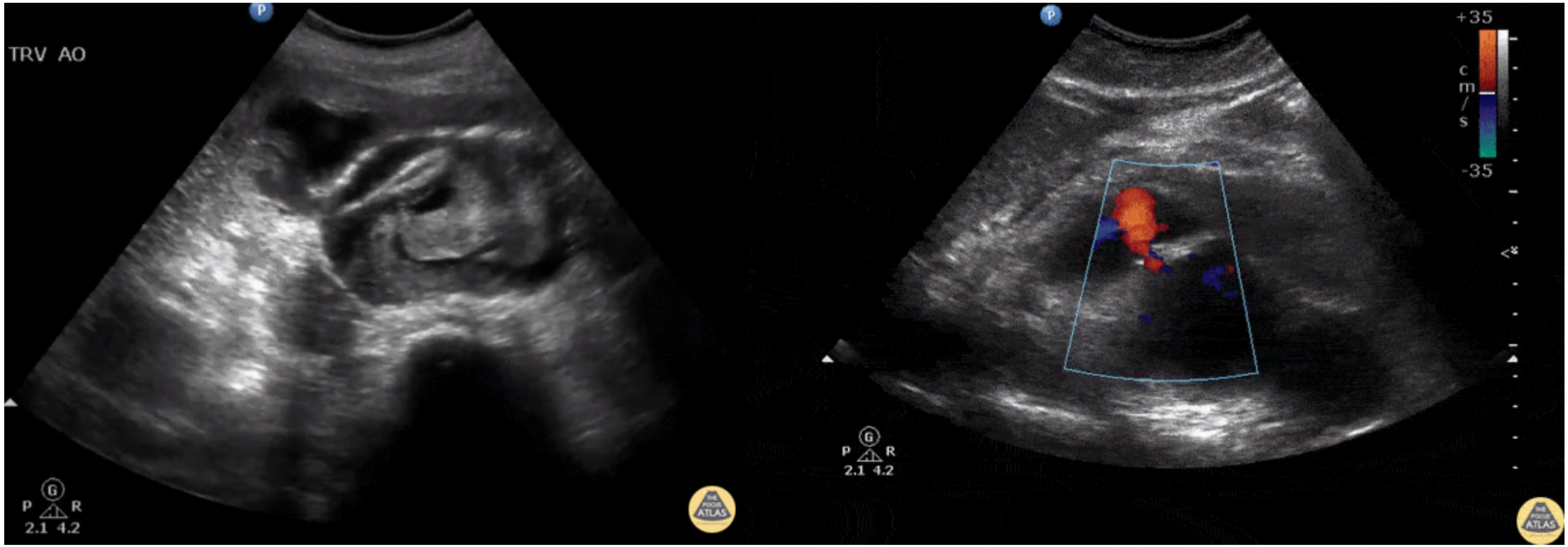


Aorta

- Abdominal aorta measures < 3 cm
- Transverse view is widely regarded as the primary method in POCUS; multiple perspectives can be acquired
- Evaluation of both the ascending and transverse aorta is important

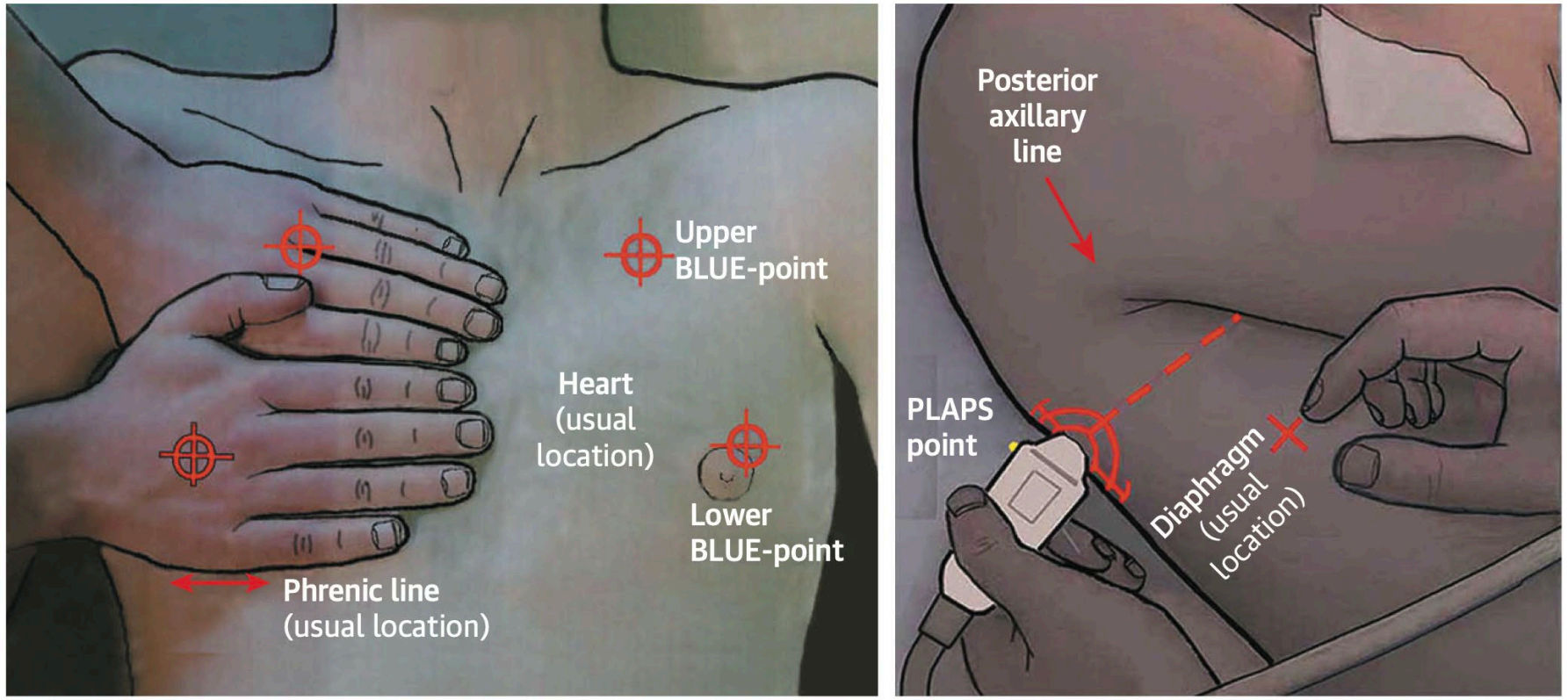


Aorta



Lung Ultrasound – ABC

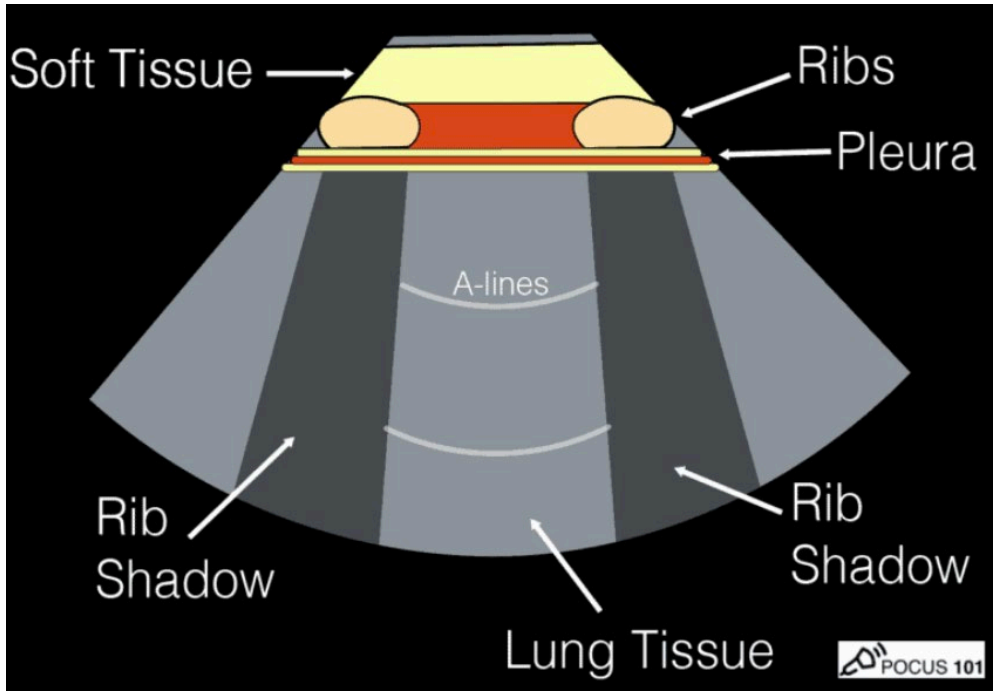
FIGURE 1 The BLUE Points



Picano et al. *JACC CV Imaging*, 2018

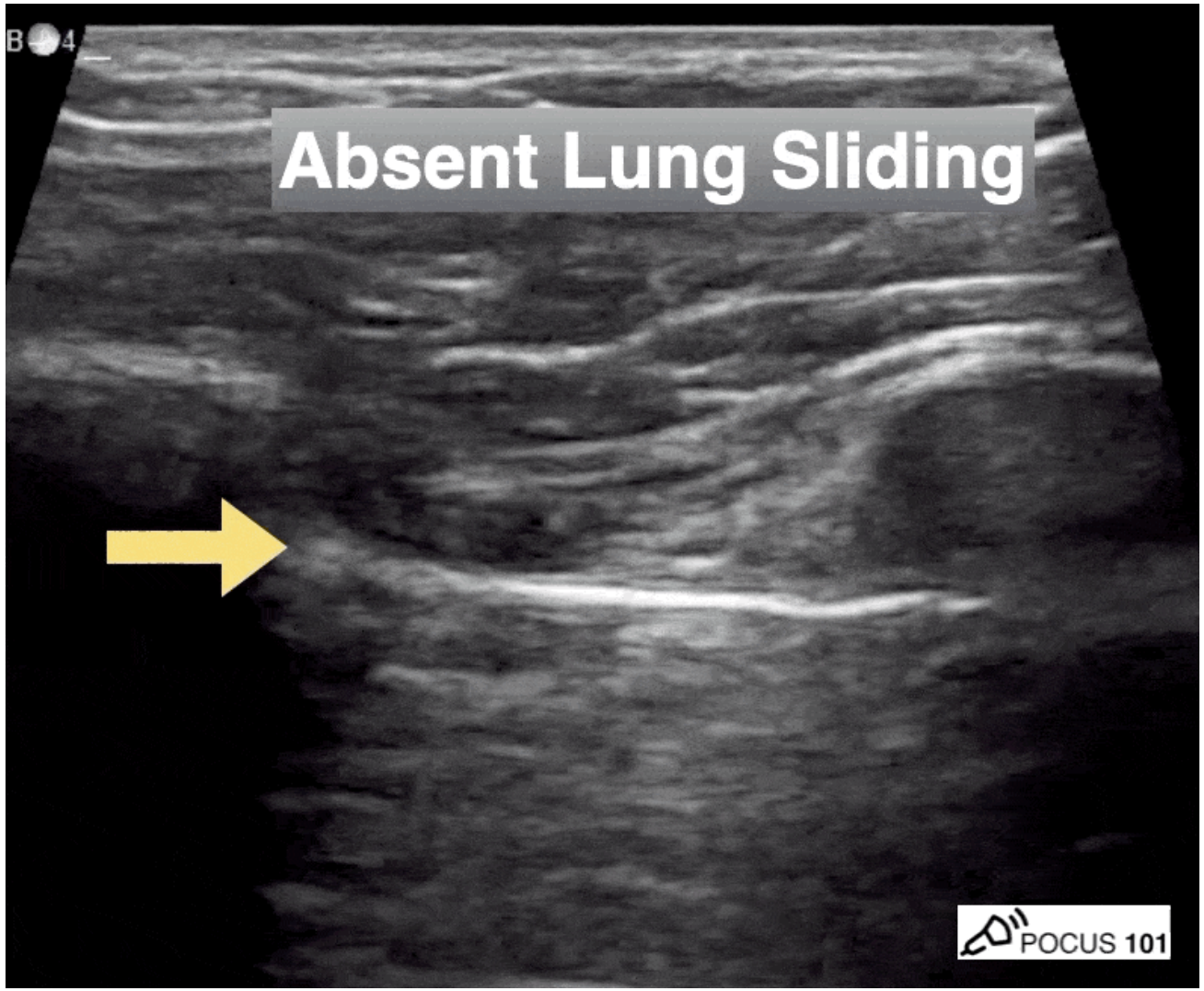
Pleural Line

- Pleural movement
  - PTX = 100% VPN



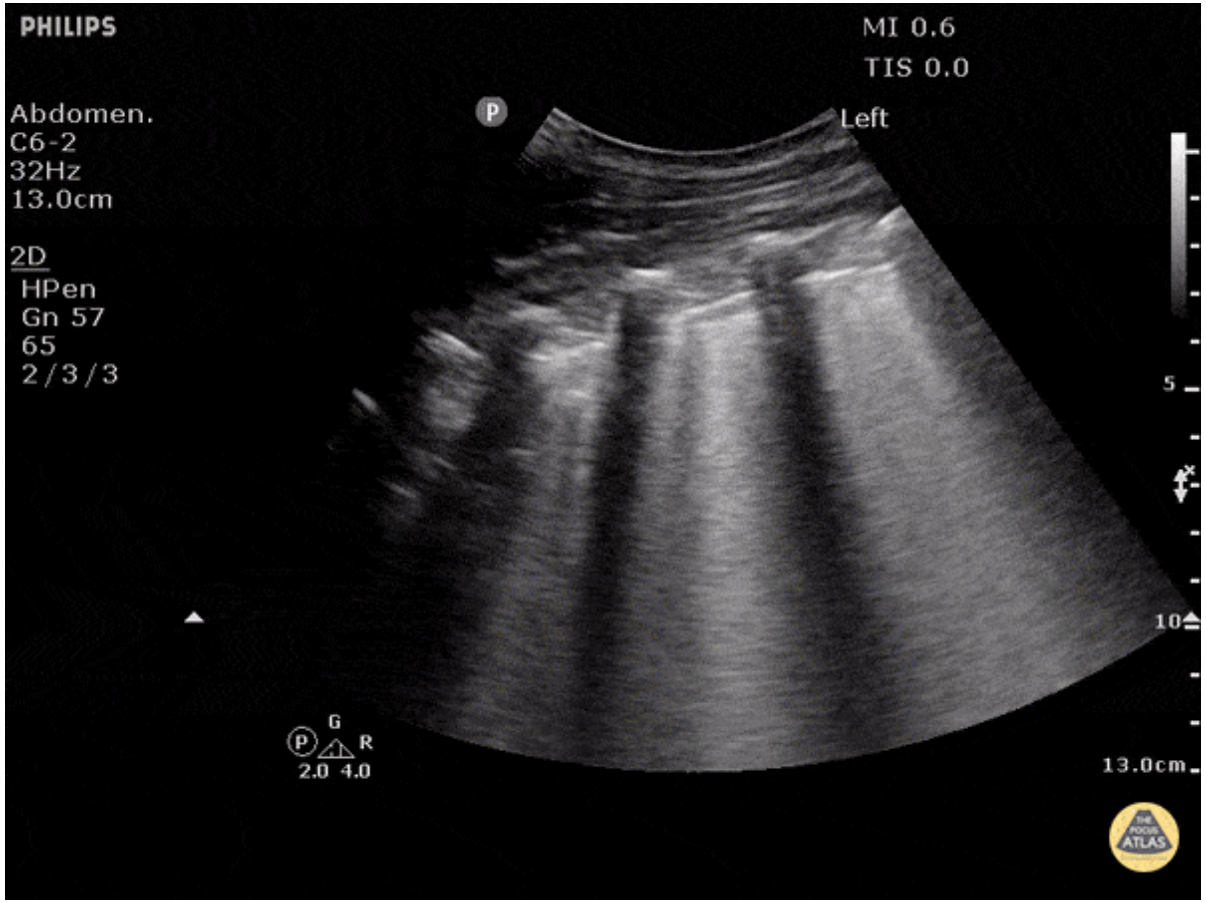
Pleural Line

- Absent lung sliding?
  - Pneumothorax
  - Pneumonia
  - ARDS

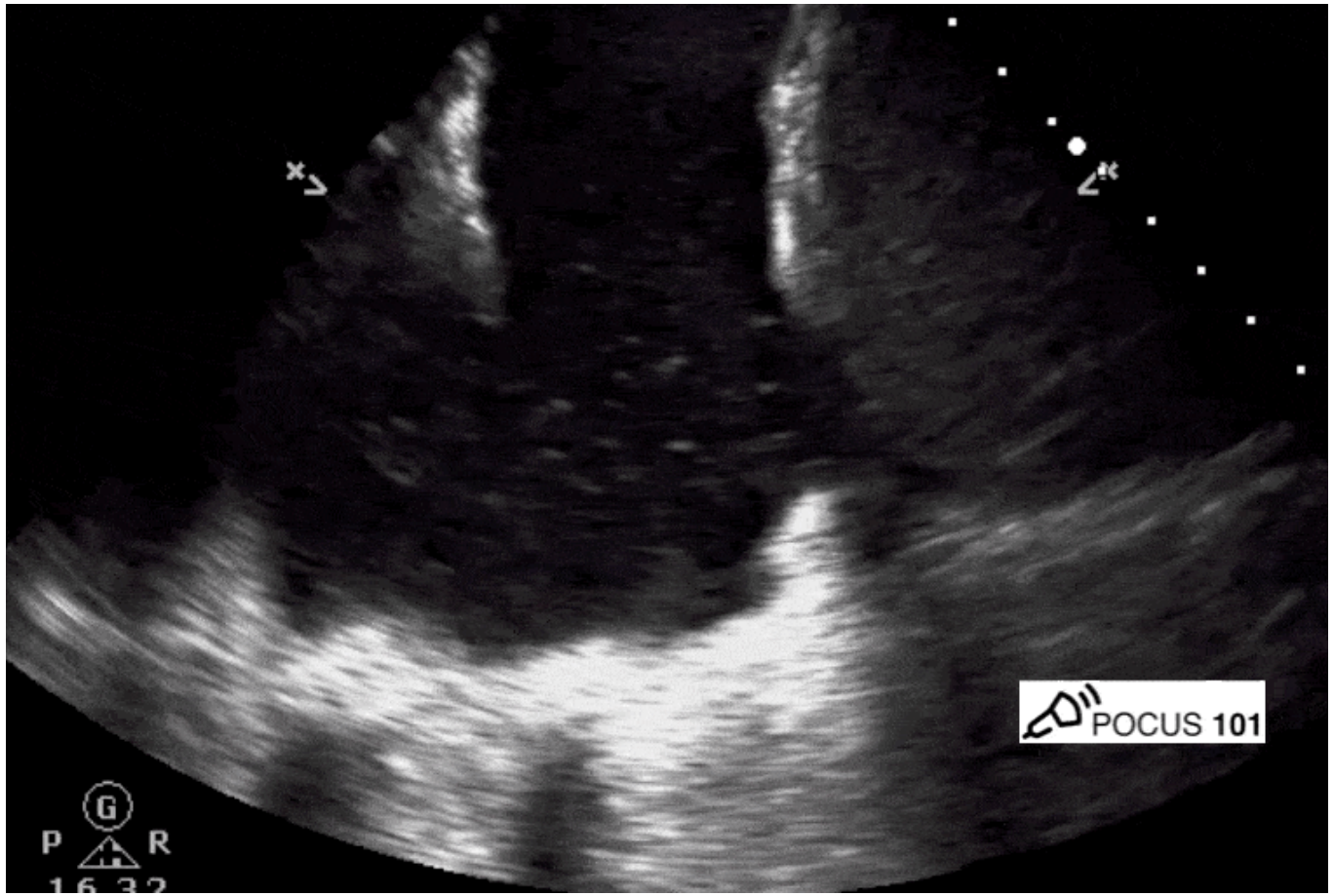


Lung Parenchyma

- B-Lines
  - Vertical artifacts resembling comet tails
  - Move with pleural movement
  - Appear hyperechoic
  - 1–2 B-lines may be physiological
  - More indicates pathology
- Causes include conditions like ARDS, pneumonia, and lung edema



Case



Take-home messages

- Evaluating central venous pressure alone is insufficient for predicting volume status
- POCUS serves as a complementary modality to enhance physical examination in heart failure clinics
- POCUS enables rapid management of a critically ill patient with an undifferentiated clinical condition

References

- Beaubien-Souligny, William et al. “Quantifying systemic congestion with Point-Of-Care ultrasound: development of the venous excess ultrasound grading system.” *The ultrasound journal* vol. 12,1 16. 9 Apr. 2020, doi:10.1186/s13089-020-00163-w
- Díaz-Gómez, José L et al. “Point-of-Care Ultrasonography.” *The New England journal of medicine* vol. 385,17 (2021): 1593-1602. doi:10.1056/NEJMra1916062
- Giannotti, Giovanna et al. “Hand-held echocardiography: added value in clinical cardiological assessment.” *Cardiovascular ultrasound*vol. 3 7. 24 Mar. 2005, doi:10.1186/1476-7120-3-7
- Longino, August et al. “Correlation between the VExUS score and right atrial pressure: a pilot prospective observational study.” *Critical care (London, England)* vol. 27,1 205. 26 May. 2023, doi:10.1186/s13054-023-04471-0
- Magnino, Corrado et al. “Inaccuracy of Right Atrial Pressure Estimates Through Inferior Vena Cava Indices.” *The American journal of cardiology* vol. 120,9 (2017): 1667-1673. doi:10.1016/j.amjcard.2017.07.069
- Mehta, Manish et al. “Handheld ultrasound versus physical examination in patients referred for transthoracic echocardiography for a suspected cardiac condition.” *JACC. Cardiovascular imaging* vol. 7,10 (2014): 983-90. doi:10.1016/j.jcmg.2014.05.011
- Picano, Eugenio et al. “Lung Ultrasound for the Cardiologist.” *JACC. Cardiovascular imaging* vol. 11,11 (2018): 1692-1705. doi:10.1016/j.jcmg.2018.06.023
- Pilcher, J.M., Patel, P. (2022). Abdominal Ultrasound—Liver, Spleen and Biliary Tree. In: Walden, A., Campbell, A., Miller, A., Wise, M. (eds) Ultrasound in the Critically Ill. Springer, Cham. https://doi.org/10.1007/978-3-030-71742-1_12
- POCUS 101
- POCUS atlas
- Rudski, Lawrence G et al. “Guidelines for the echocardiographic assessment of the right heart in adults: a report from the American Society of Echocardiography endorsed by the European Association of Echocardiography, a registered branch of the European Society of Cardiology, and the Canadian Society of Echocardiography.” *Journal of the American Society of Echocardiography : official publication of the American Society of Echocardiography* vol. 23,7 (2010): 685-713; quiz 786-8. doi:10.1016/j.echo.2010.05.010
- Soliman-Aboumarie, Hatem et al. “Echocardiography in the intensive care unit: An essential tool for diagnosis, monitoring and guiding clinical decision-making.” *Physiology international*, 10.1556/1647.2021.00055. 25 Nov. 2021, doi:10.1556/1647.2021.00055

Q&A Period

THANK YOU!

Please remember to complete the session evaluation

Next Up! Please make your way down to the *Exhibit Hall (Samuel ABC) for a Health Break* and then proceed to the *Champlain Ballroom for Plenary 4 Hit Me With Your Best Shock* beginning at 2:20 pm.