ECHOCARDIOGRAPHY IN ICU

Hajar auditorium
Medical City
HMC
Doha, Qatar
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Role of echo in patients with ECMO

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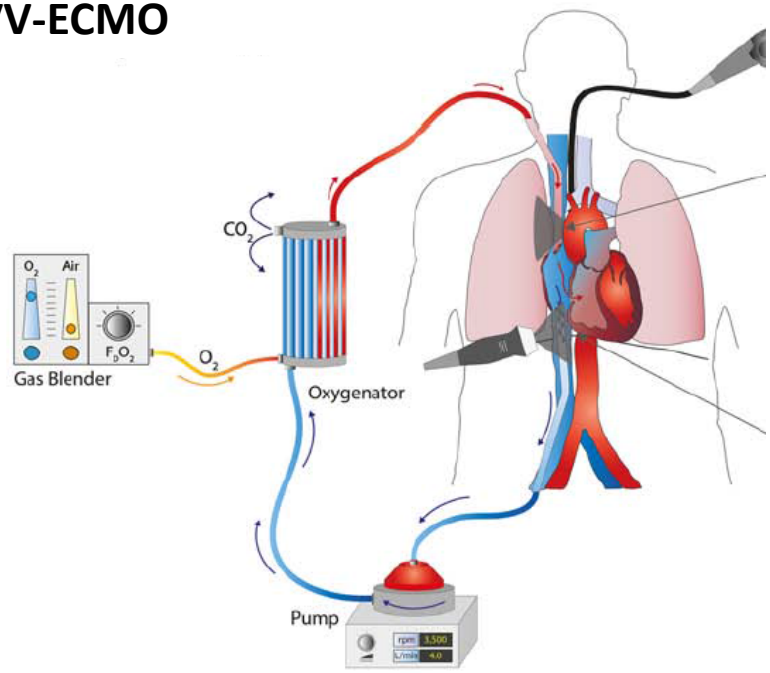
FRANCE

Outline

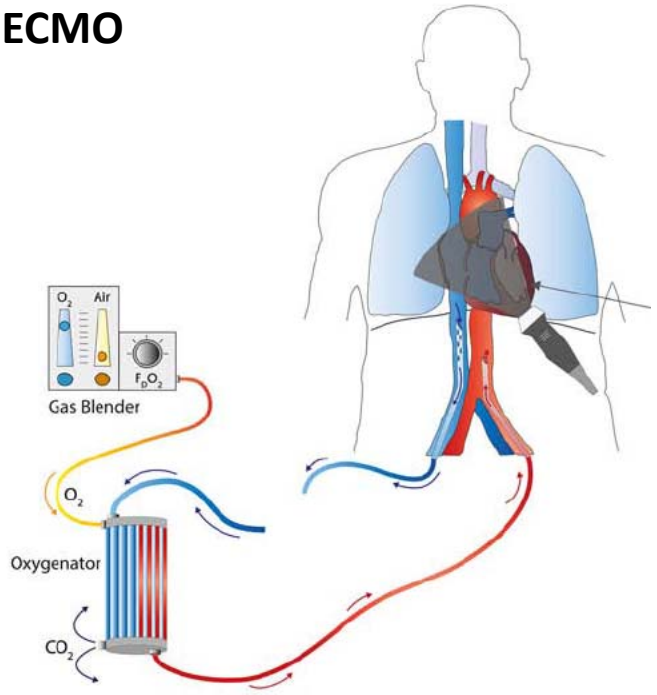
- ECMO description
- Indication, controindications and complications
- Echocardiographic imaging in patients with ECMO

ECMO – definition

VV-ECMO



VA-ECMO



Spectrum of modalities able to provide cardiac and respiratory support, which can be used for extended period (hours to weeks).

VV –ECMO → Provide support in case of isolated respiratory failure

VA –ECMO → Provide support for cardiac and/or respiratory failure

Indications for VV-ECMO

Refractory respiratory failure
(PO2 < 60mmHg and/or acidosis - PH <7.2 or
PO2<100% with FiO2>/=90%)

- Severe bacterial or viral pneumonia
- ARDS
- Aspiration syndromes
- Primary graft failure after lung transplantation
- Massive hemoptysis or pulmonary hemorrhage
- Smoke inalation
- Status asthmaticus
- Airway obstruction
- Alveolar proteinosis
- Pulmonary contusion

Platts et al. JASE 2012

Indications for VA-ECMO

- Cardiac arrest/near-cardiac arrest
- Cardiogenic shock
- Inability to wean from CP bypass after cardiac surgery
- Primary graft failure after heart or heart-lung transplantation
- Sepsis with profound cardiac depression
- Drug overdose/toxycity with cardiac depression
- Myocarditis
- Arrhythmic storm refractory to other measures
- Pulmonary embolism
- Isolated cardiac trauma
- Acute anaphylaxis

- Periprocedural support from high risk PCI
- Chronic cardiomyopathy: bridge to VAD, bridge to transplant, bridge to decision

Platts et al. JASE 2012

Contraindications

ABSOLUTE

- Non recoverable disease
- Irreversible neurologic injury
- Advanced multi-organ failure
- Contraindication to anticoagulation

- Body weight > 125 Kg (difficult vascular cannulation, inadeguate flow?)

RELATIVE

- Age >75 ys
- Inability to anticoagulate
- High dose immunosuppression
- CPR >60 min
- Multiple trauma with multiple bleeding sites

Platts et al. JASE 2012

Complications

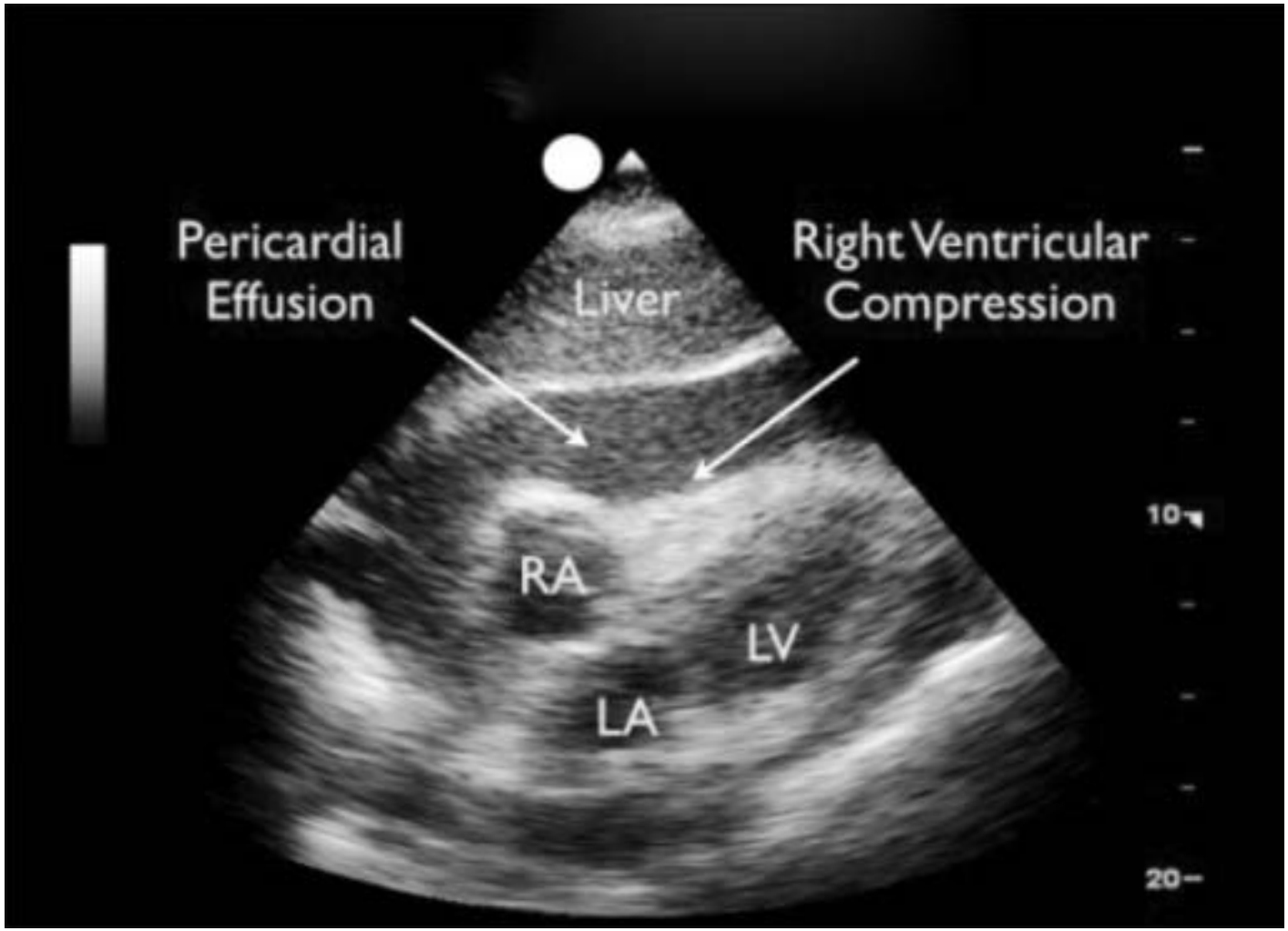
- Bleeding, Thromboembolism, sepsis
- Limb ischaemia, hemolysis, mechanical failure
- Intracerebral bleeding, circuit rupture, accidental decannulation, air embolism

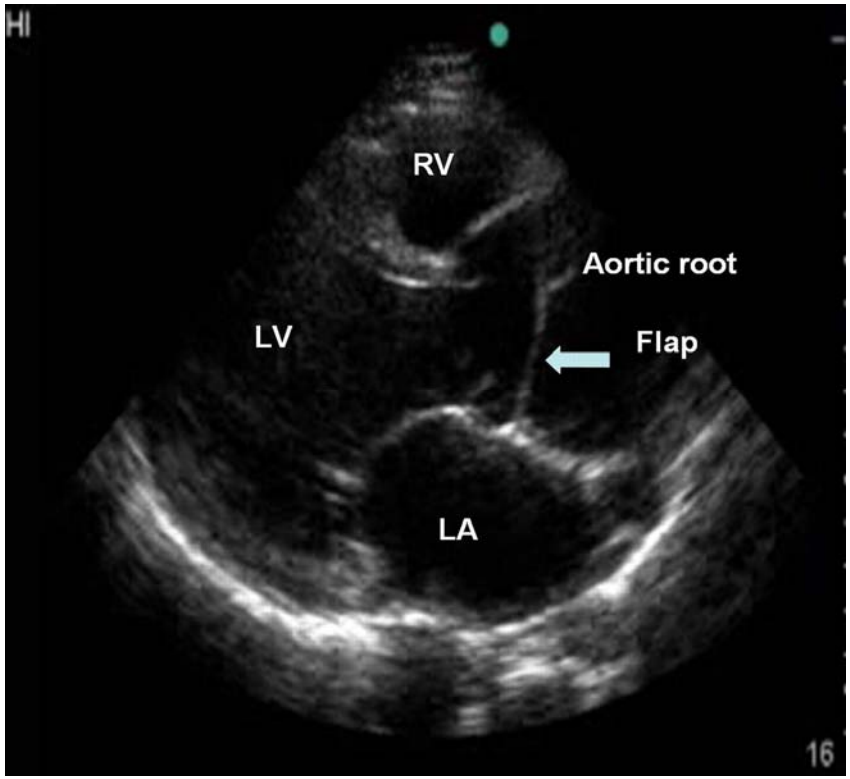
Role of Echo

- PATIENT SELECTION
- INSERTION AND PLACEMENT OF CANNULAS
- MONITOR PROGRESS
- DETECT COMPLICATION
- DETECT CARDIAC RECOVERY / WEANING

Patient’s selection

Look for the cause of of hemodynamic instability

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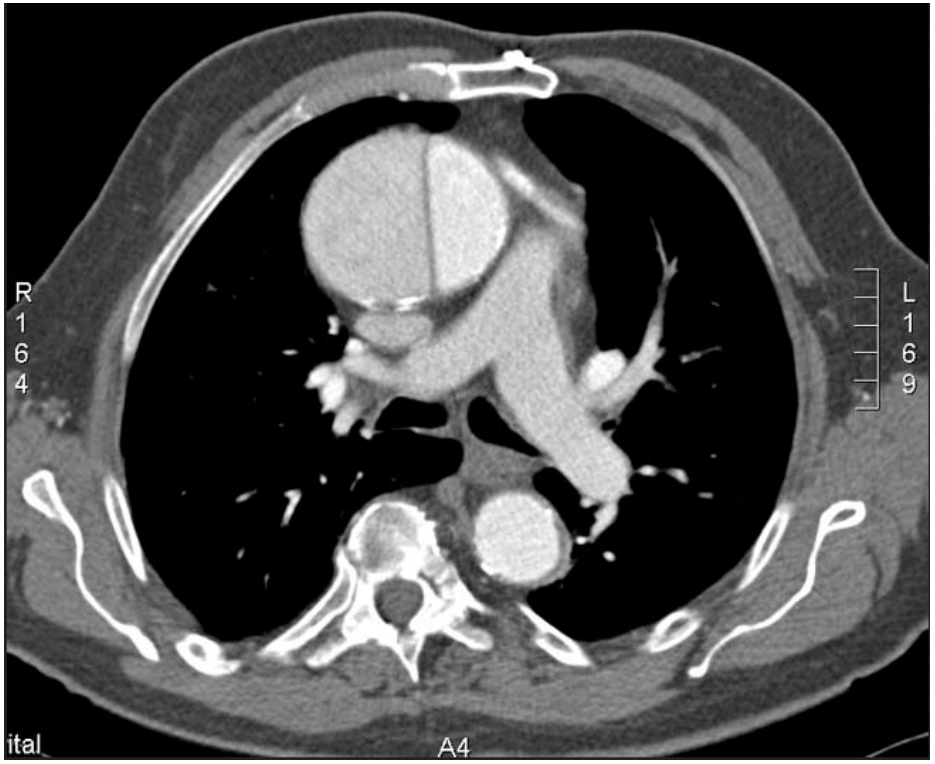
16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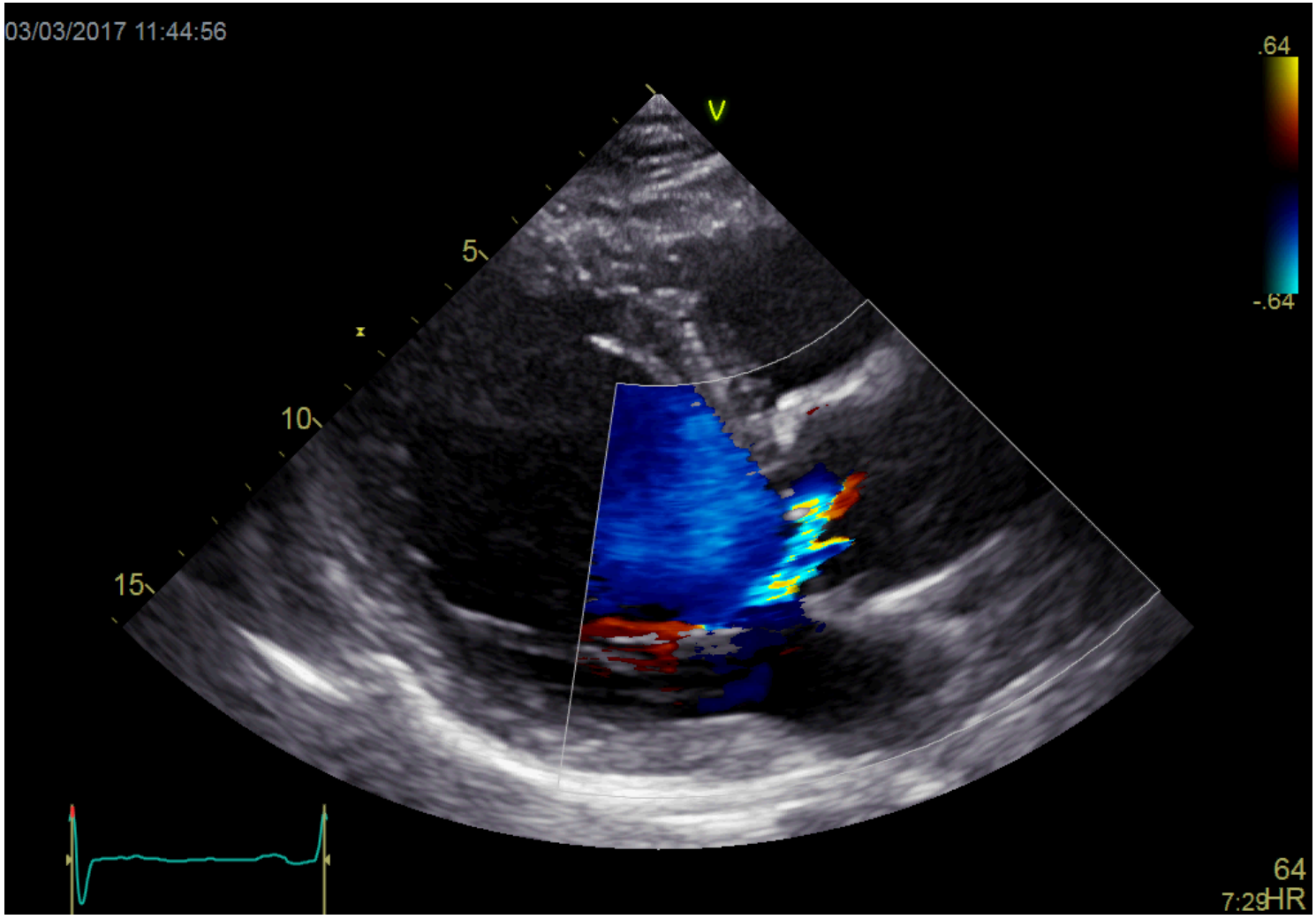
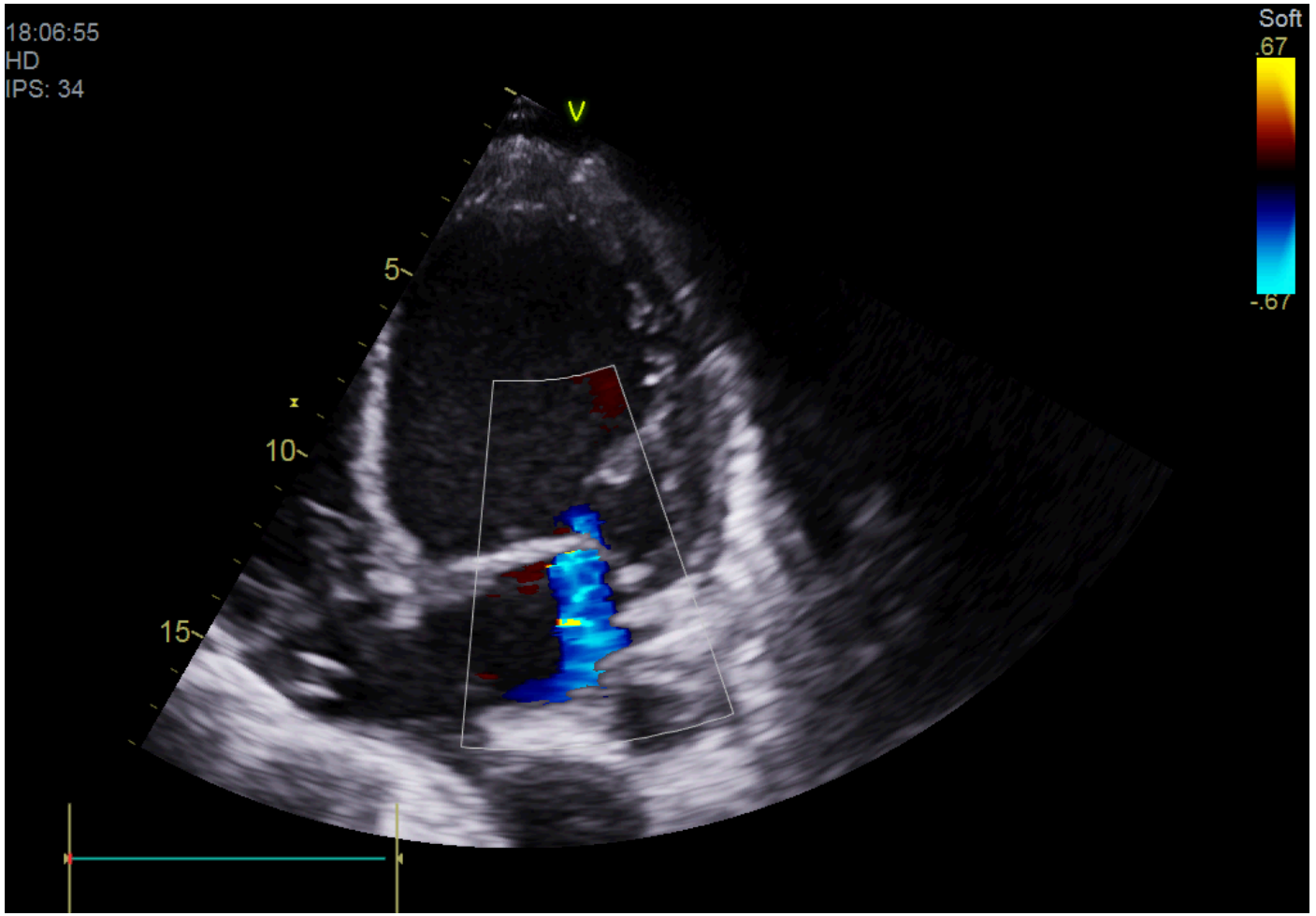
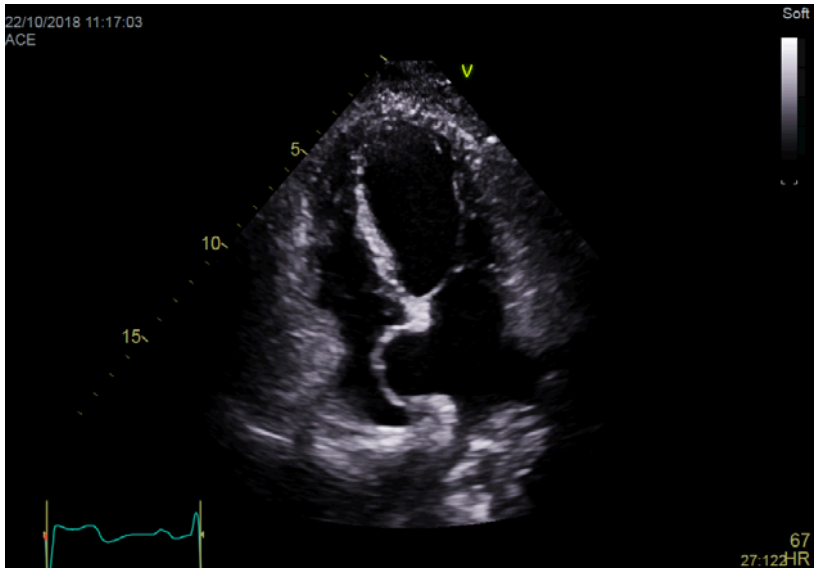
Assessment of valvular function

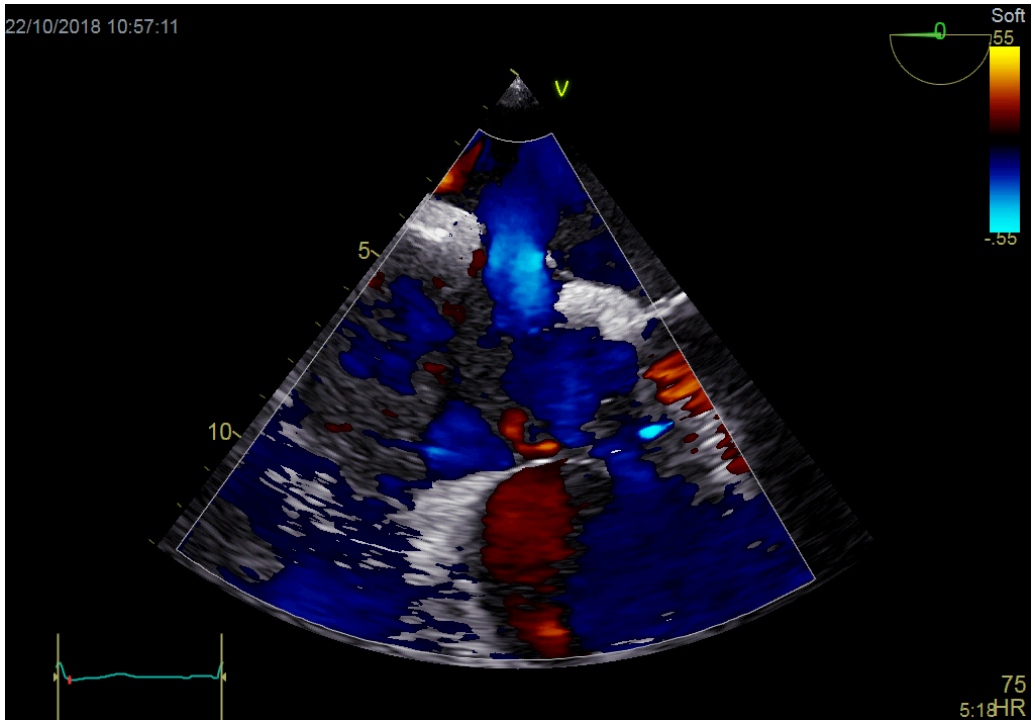


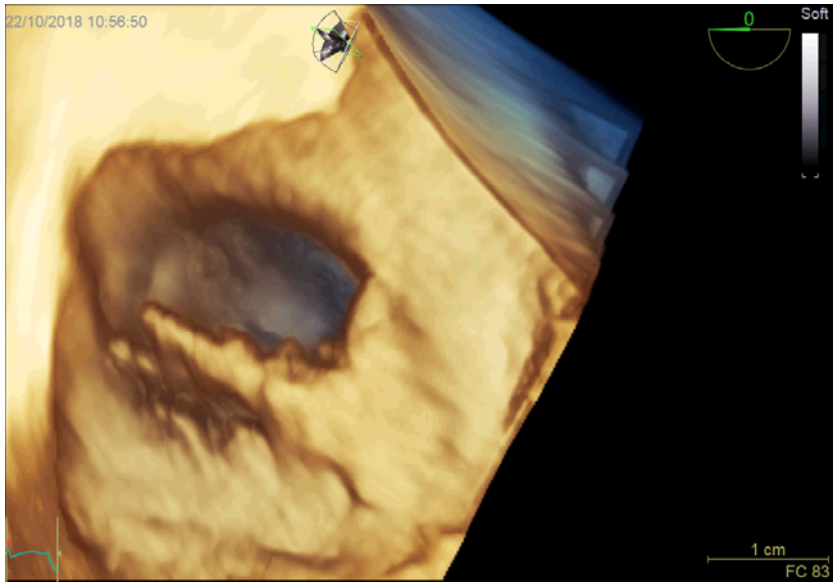
Assessment of valvular function



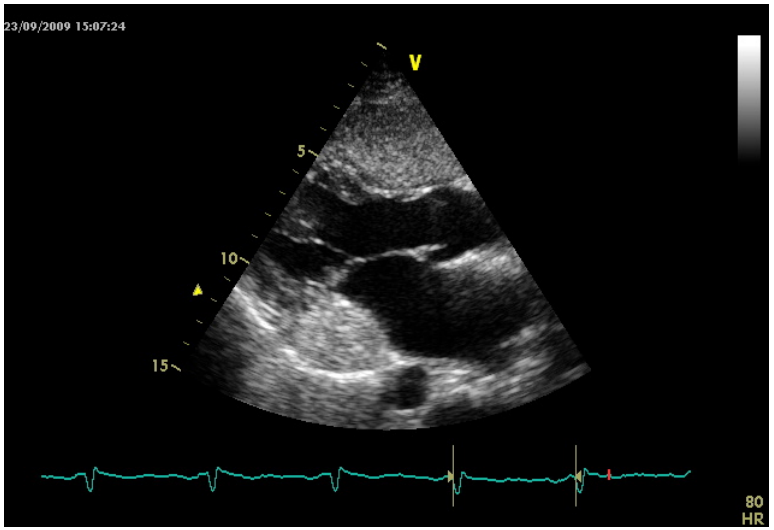
Assessment of the inter-atrial septum

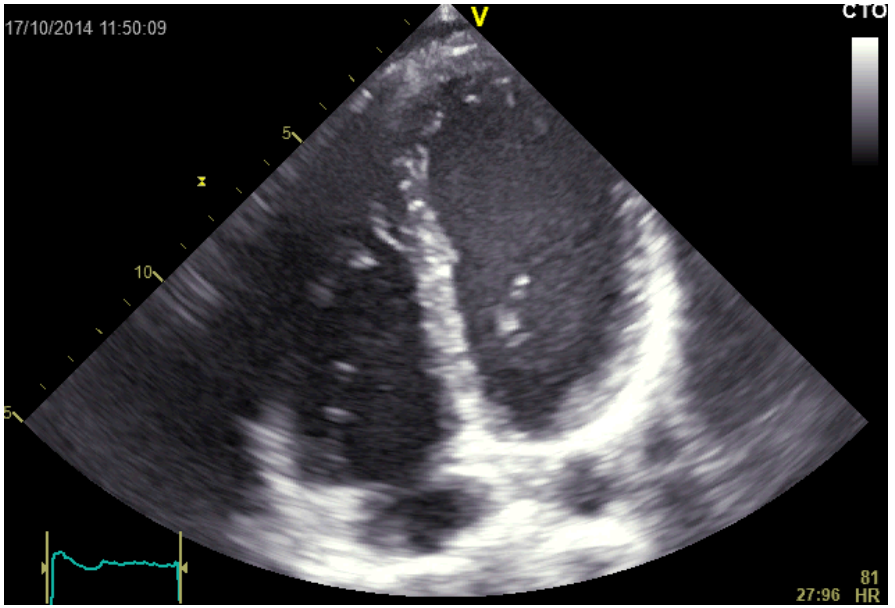






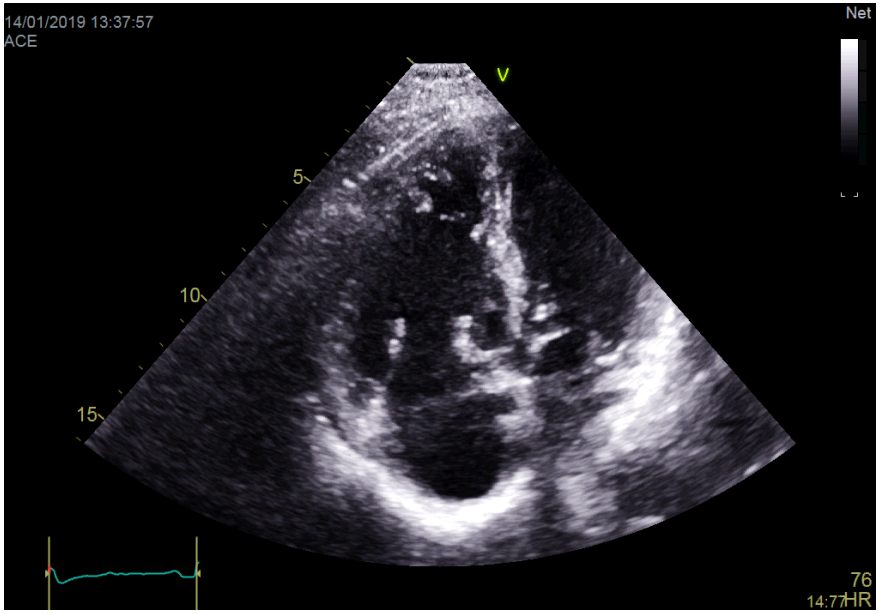
Assessment of the left atrium



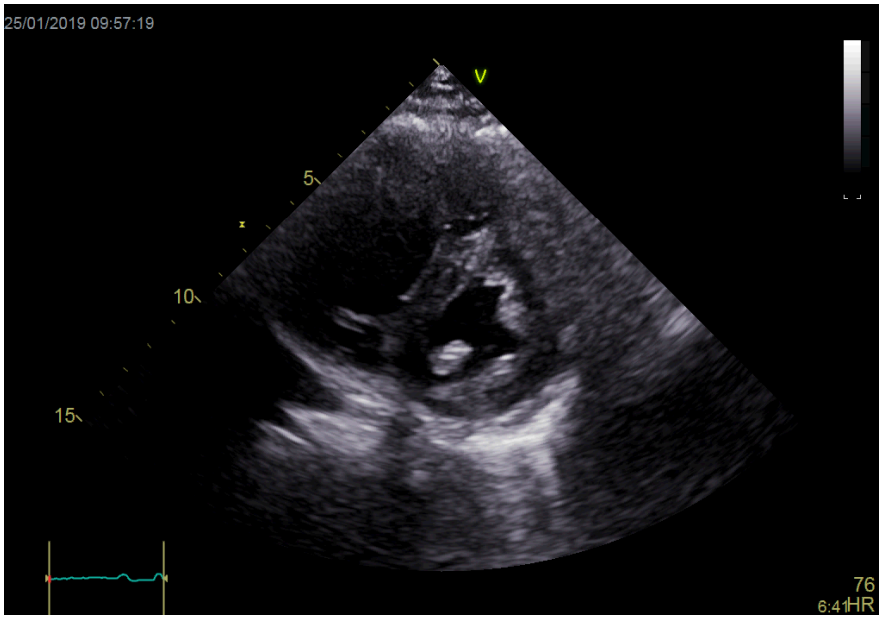


Assessment of the right atrium

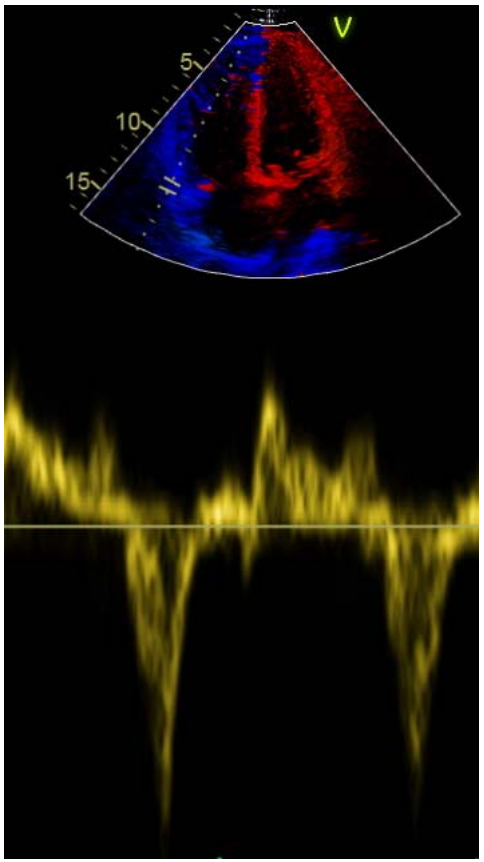
Assessment of the right ventricle

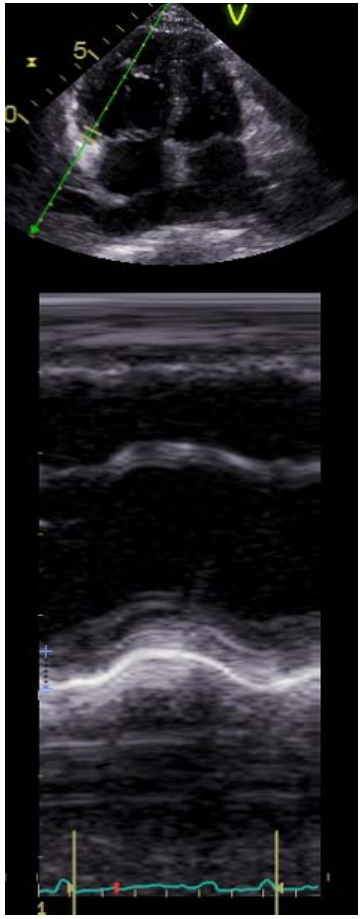


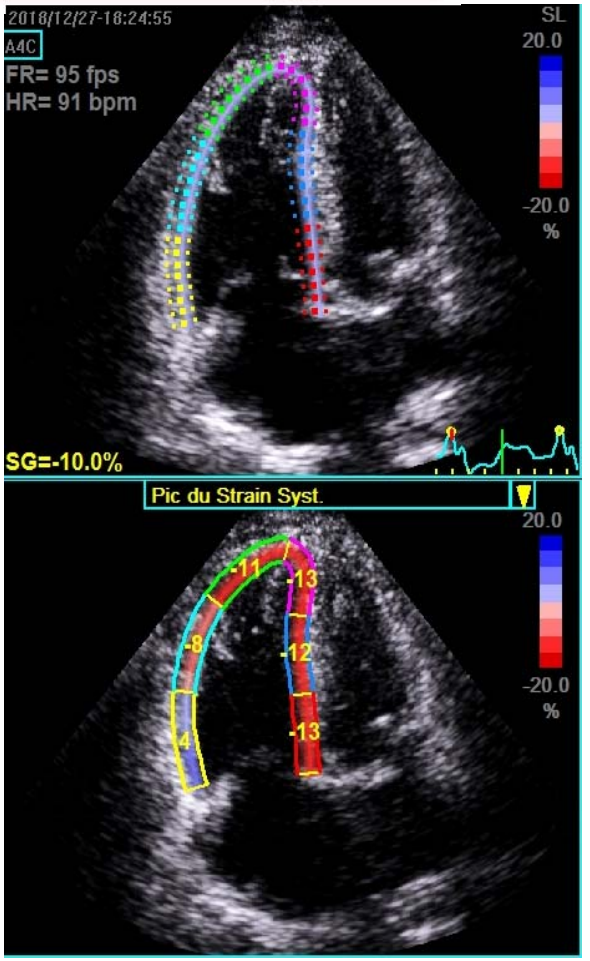
Right ventricle	
Morphology	RV end diastolic area/LV end diastolic area
	Triangular shape versus rounded shape of apex
	RV wall thickness

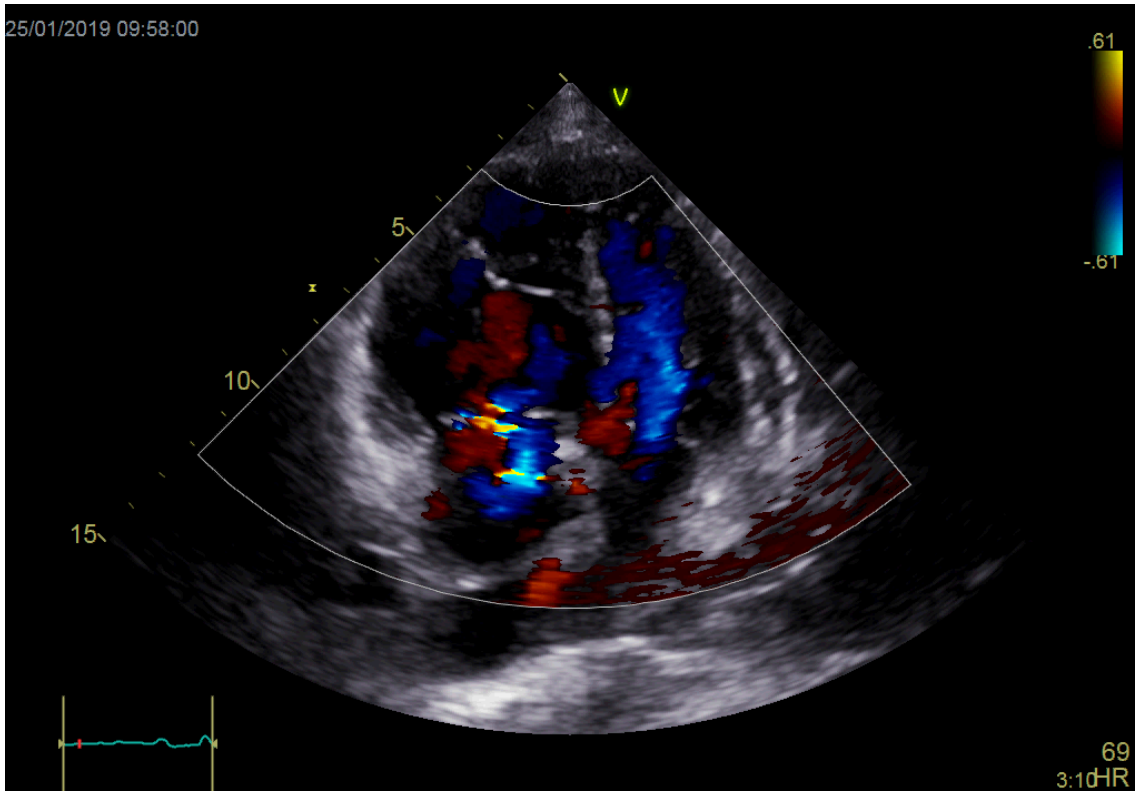


Systolic function	TAPSE, tissue Doppler at tricuspid annulus, S wave Fractional area of change



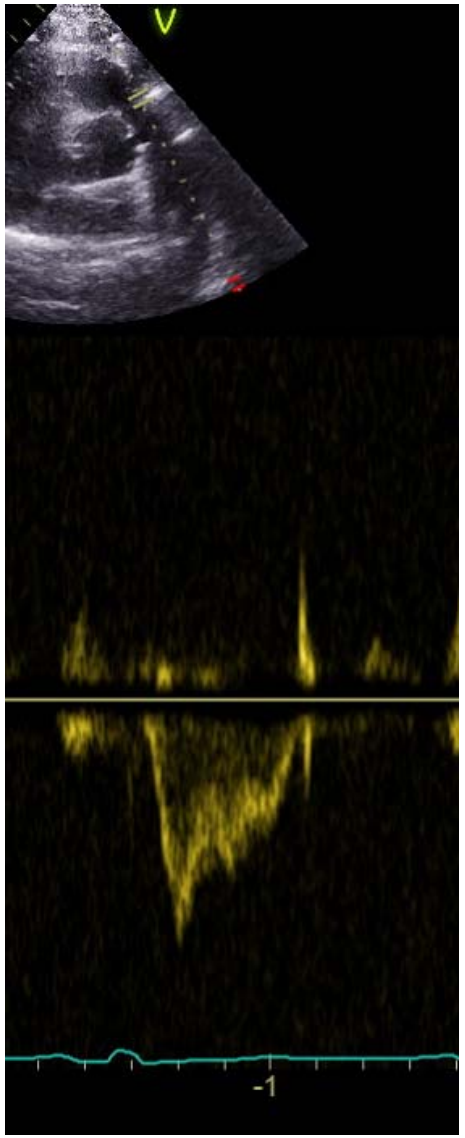






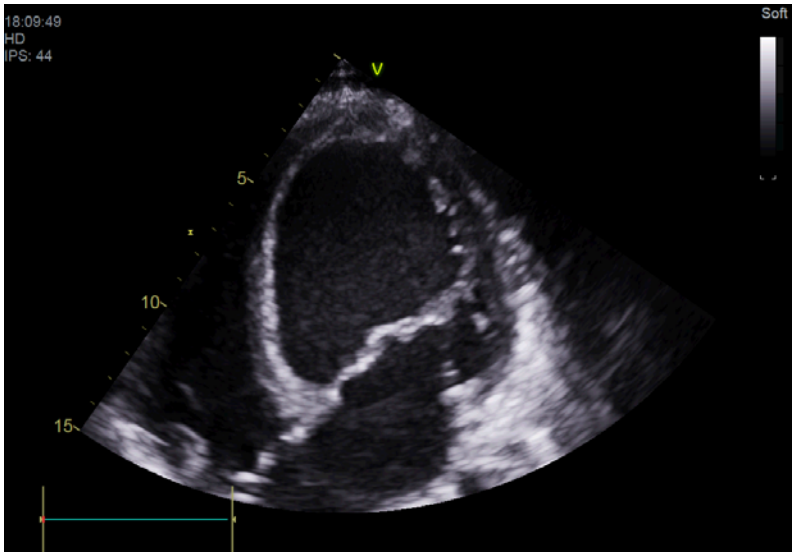
Tricuspid morphology (regurgitation/stenosis)
Presence of a tricuspid prosthesis

Assessment of PW Pulmonary Doppler



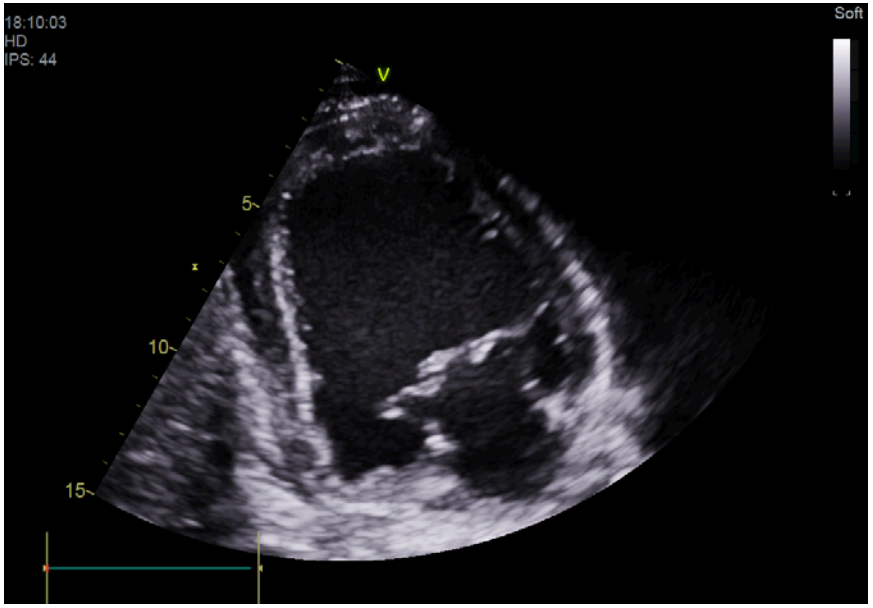
PAT 60 ms

Assessment of the left heart



Morphology	Size, wall thickness
Systolic function	Ejection fraction (Simpson's method) or FAC
	Wall motion abnormalities
	S wave at mitral annulus
	Velocity time integral in LVOT

LVEF <20% should support the indication of VA-ECMO in case of associated respiratory failure



Cannulation

There are currently no recommendations on which imaging modality is superior to guide ECMO cannulation.

VV-ECMO

2 venous cannulas:

1) One in the IVC (drainage)and the other in the SVC (reinjection)

2) Reinjection cannula in the in the RA from the IVC, the drainage cannula in the femoral vein

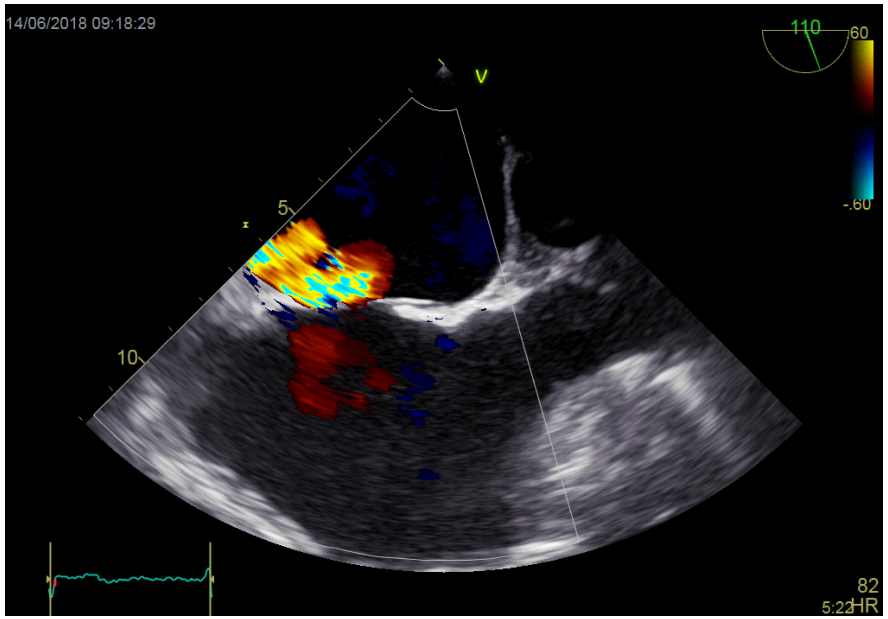
3) A single, dual-lumen cannula inserted into the SVC via the right internal jugular vein.

VA-ECMO

1 venous cannula in the IVC

1 arterial cannular in the femoral/iliac artery

Pavlushkiv et al. Ann Transl Med 2017; 5: 70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110
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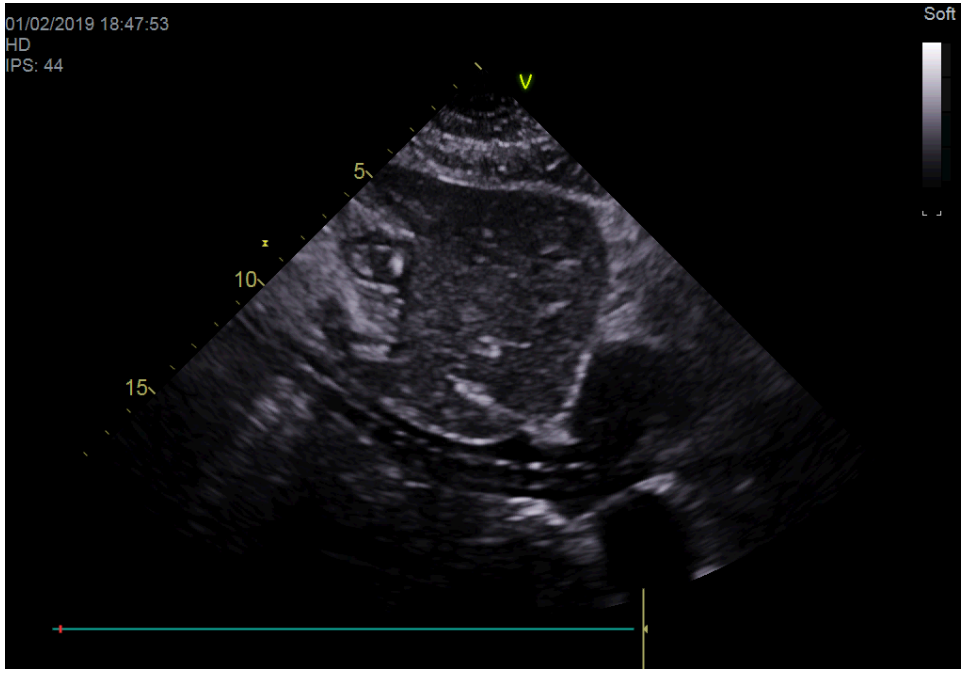
V
5
10
82
HR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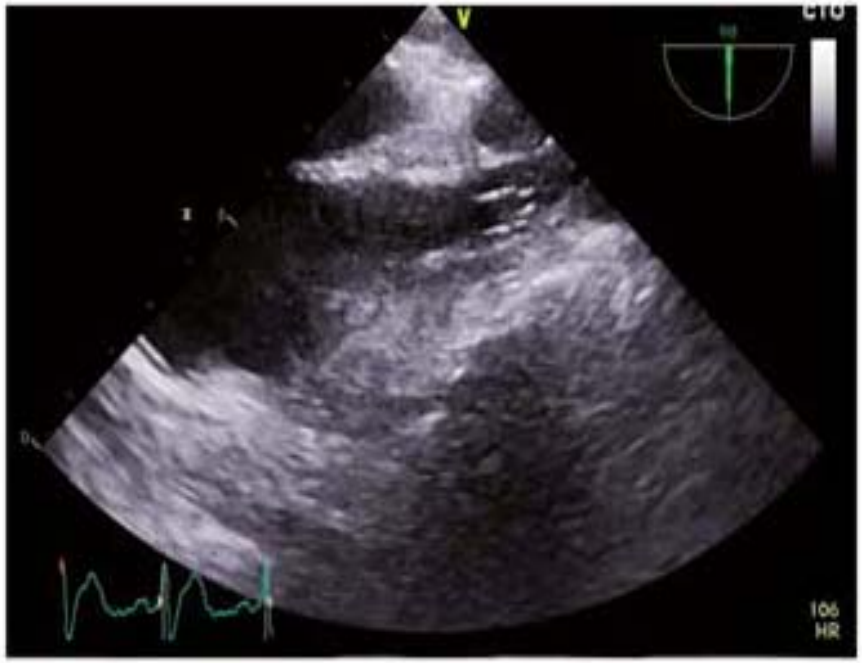
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106
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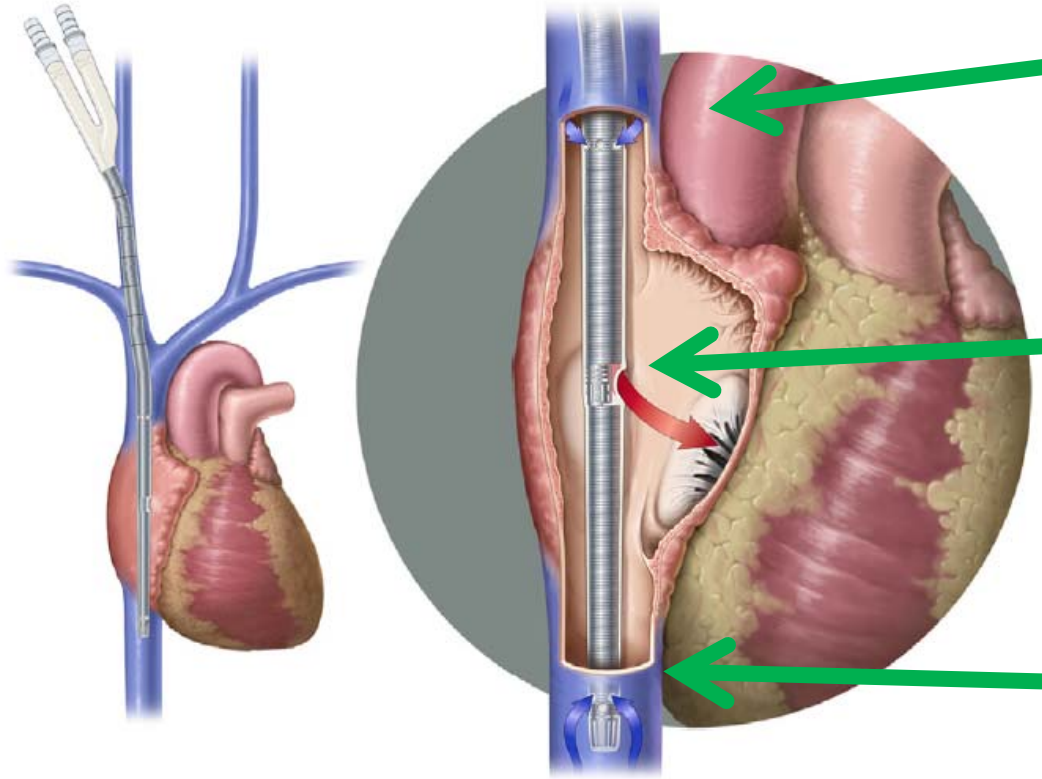
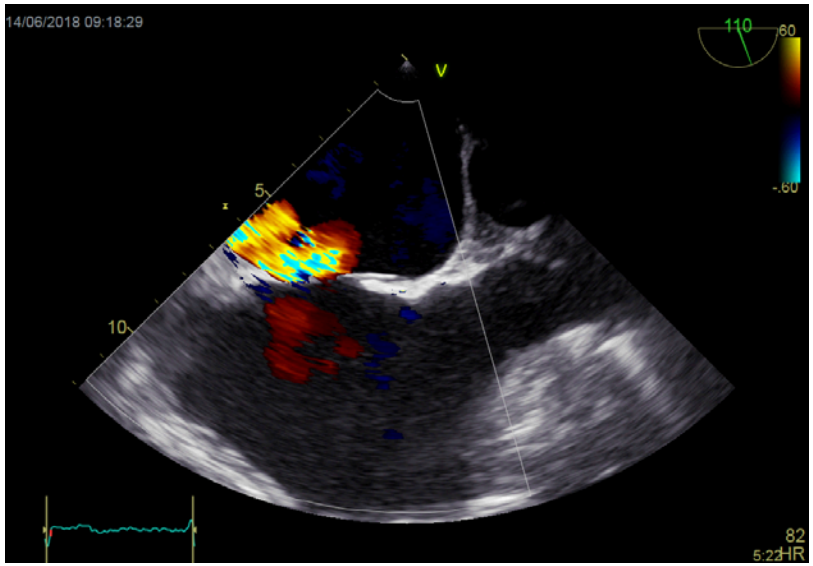


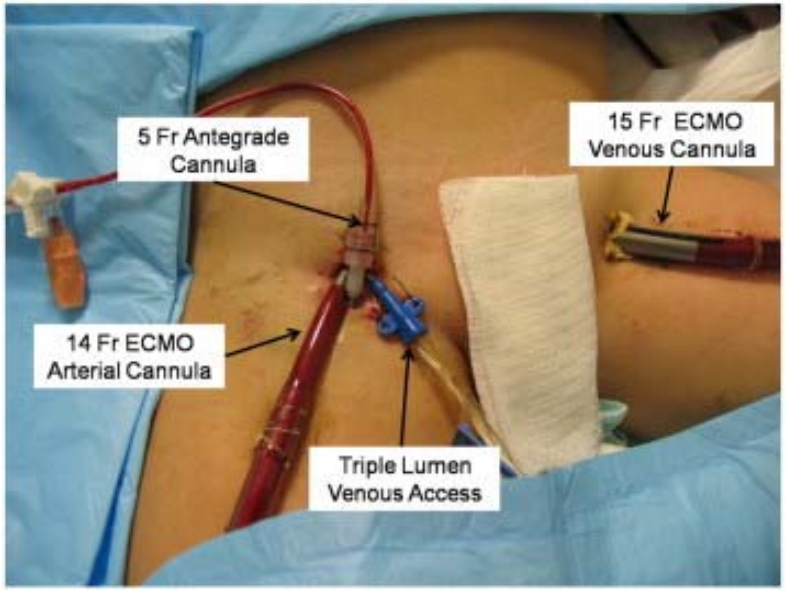


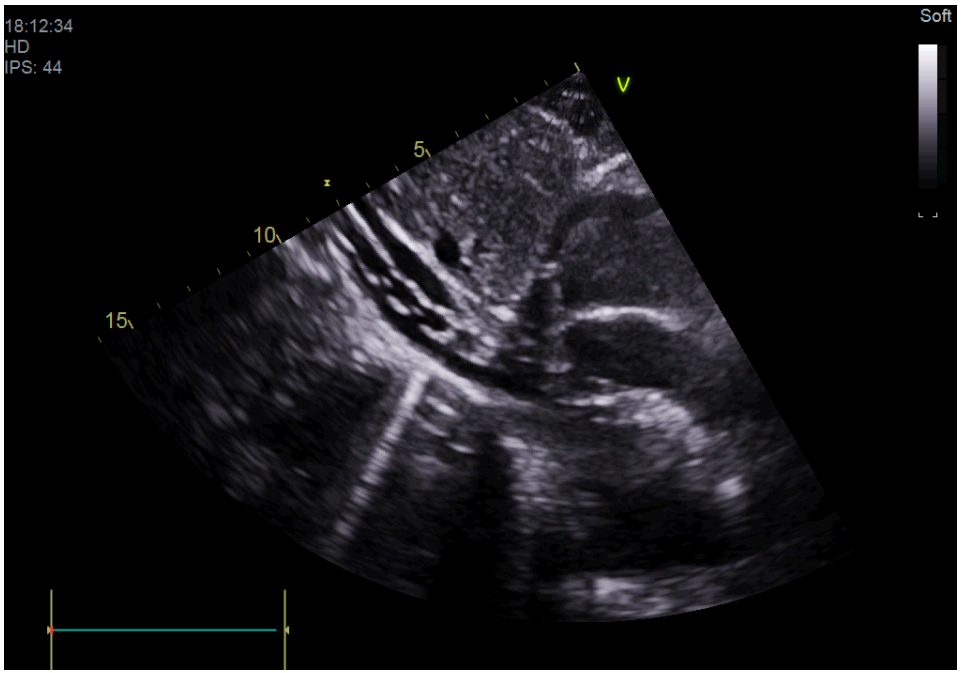
Griffee MG et al. Jour of Cardioth and Vasc Anesth 2018

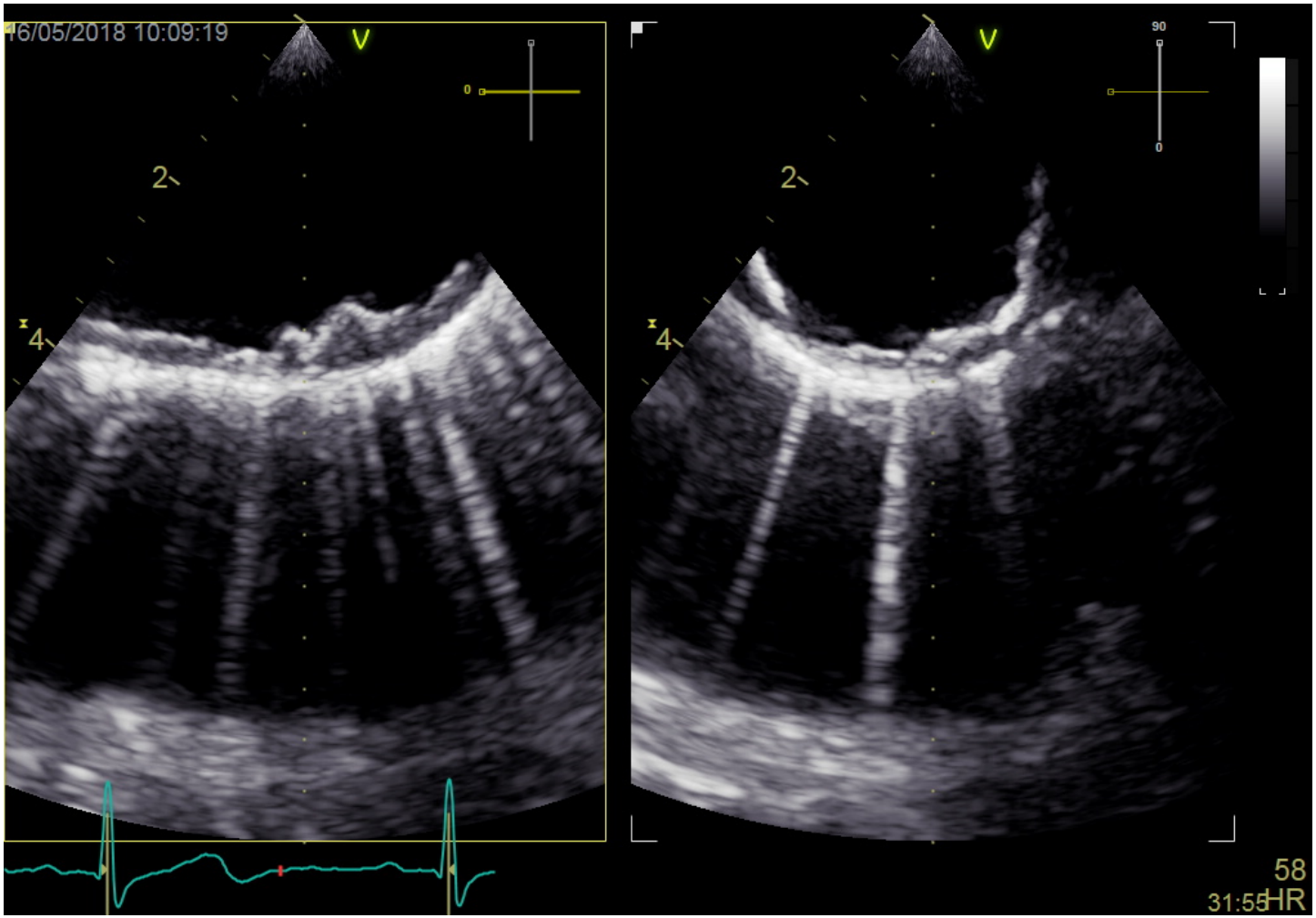
VA-ECMO

Venous cannula in the IVC

Aortic cannula in the iliac artery or distal aorta.






16/05/2018 10:09:19
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V
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31:55 HR

Utility of echo in the assessment of proper cannula positioning

193 pediatric patients supported on ECMO:
101 procedures without Echo guidance → 17.8% repositioning
92 procedures under Echo giodance → 3.3% repositioning

Kuenzler et al. Pediatr Surg 2002

TTE vs XR for cannula positioning in pediatric patients :
33 procedures under TTE guidance → 24% required readjustement
XR didn't reveal incorrect cannula positioning.

Thomas et al. Pediatr Crit Care Med 2009

✓XR is largely available, but lacks sensitivity in detecting cannula positioning

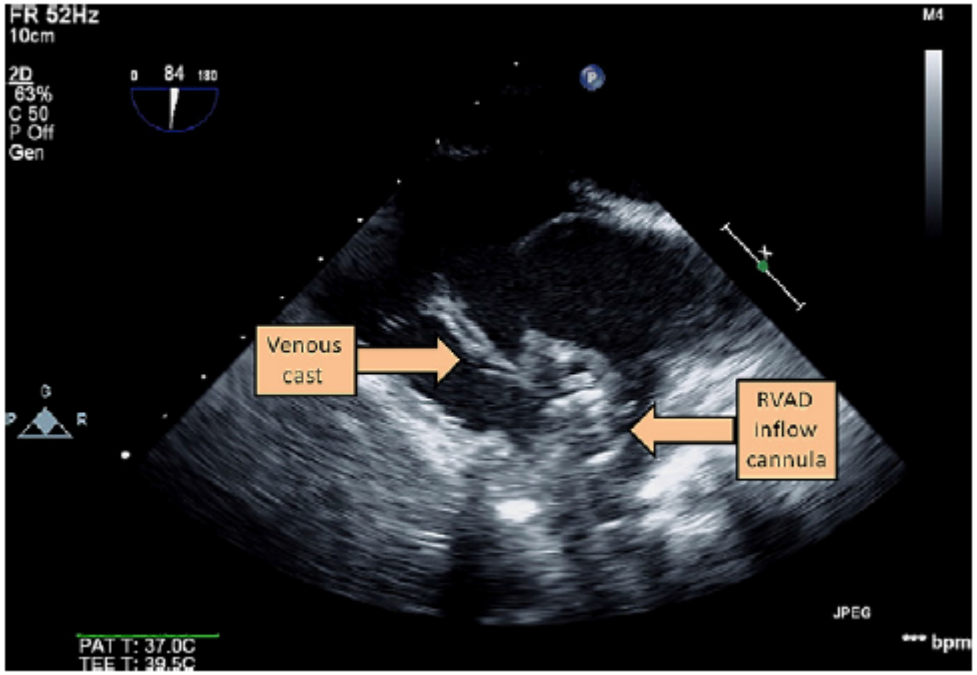
✓Echocardiography provides better spatial orientation of cannulas

Assessment of the patient on ECMO

1) Assessment of pericardial effusion/Tamponade

2) In case of reduced flow, look for thrombosis of the drainage cannula with 2D, PW and Colour Doppler

3) Serial assessment of LV function



60 pediatric patients on ECMO → 7 thrombosis :

3 SVC syndromes

4 incidental thrombosis detected at TTE

→ No specific cause for thrombosis was identified in these patients

Kreik et al. J Pediatr 1995

VA-ECMO weaning

Reduce ECMO flow → 0,5 to 1 L/min
Potential increase in the risk of circuit thrombus formation!

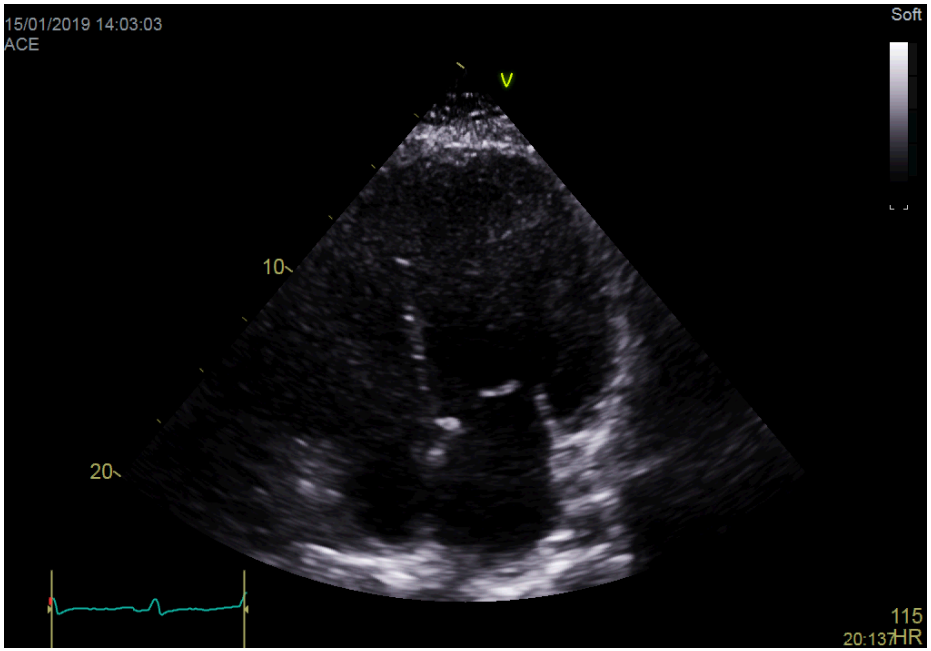
Assess clinical/hemodynamic parameters:
-HR, BP
-Arterial waveform pulsatility
-PaO2 in the radial artery
-Changes in CVP

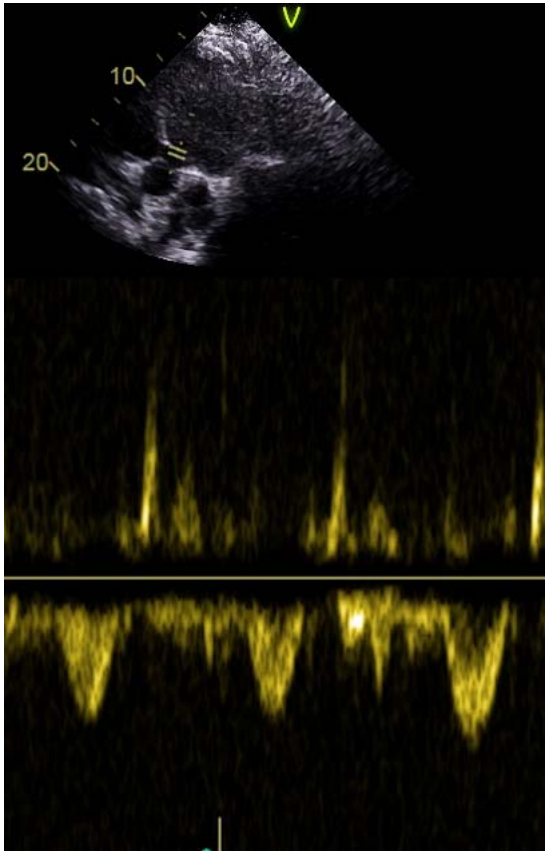
Assess Echo parameters like:
-VTI Ao > 10 cm
-LVEF > 20-25%
- S wave velocity (Sa)> 6 cm/s at the lateral mitral annulus
-Increase in LV GLS of at least 20%

Aissaoui N et al. Crit Care Med 2015
Aissaoui N et al JASE 2012

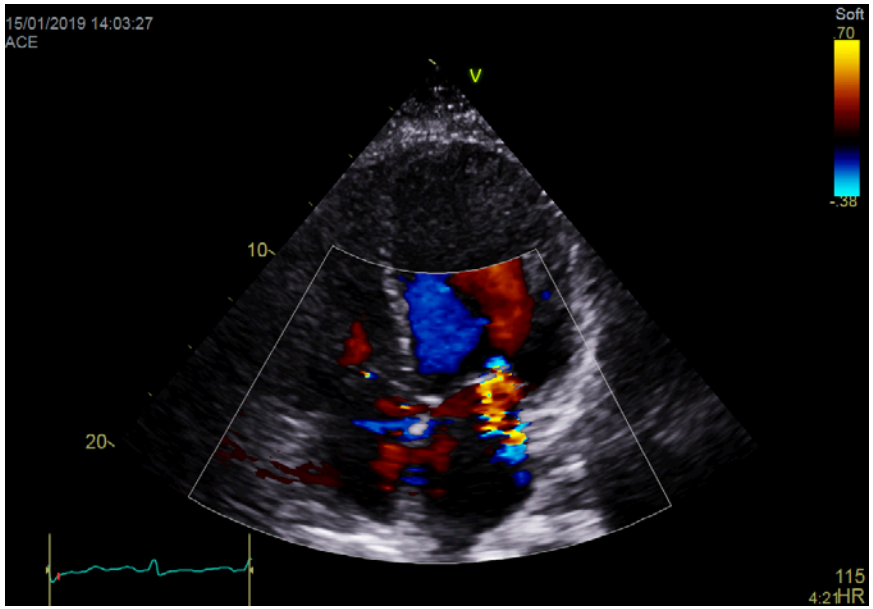
MF, 39 yo

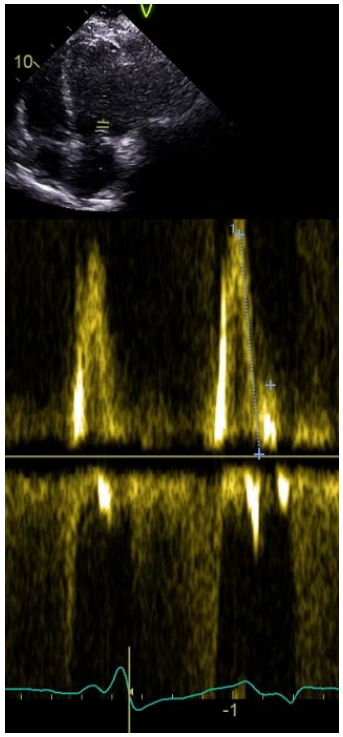
Primary dilated cardiomyopathy
Acute HF





LVEF 10%
VTI-LVOT 6 cm
CO 1.8 L/min





SOR 0.26 cm^2
VR 32 ml

Very elevated LV filling pressure

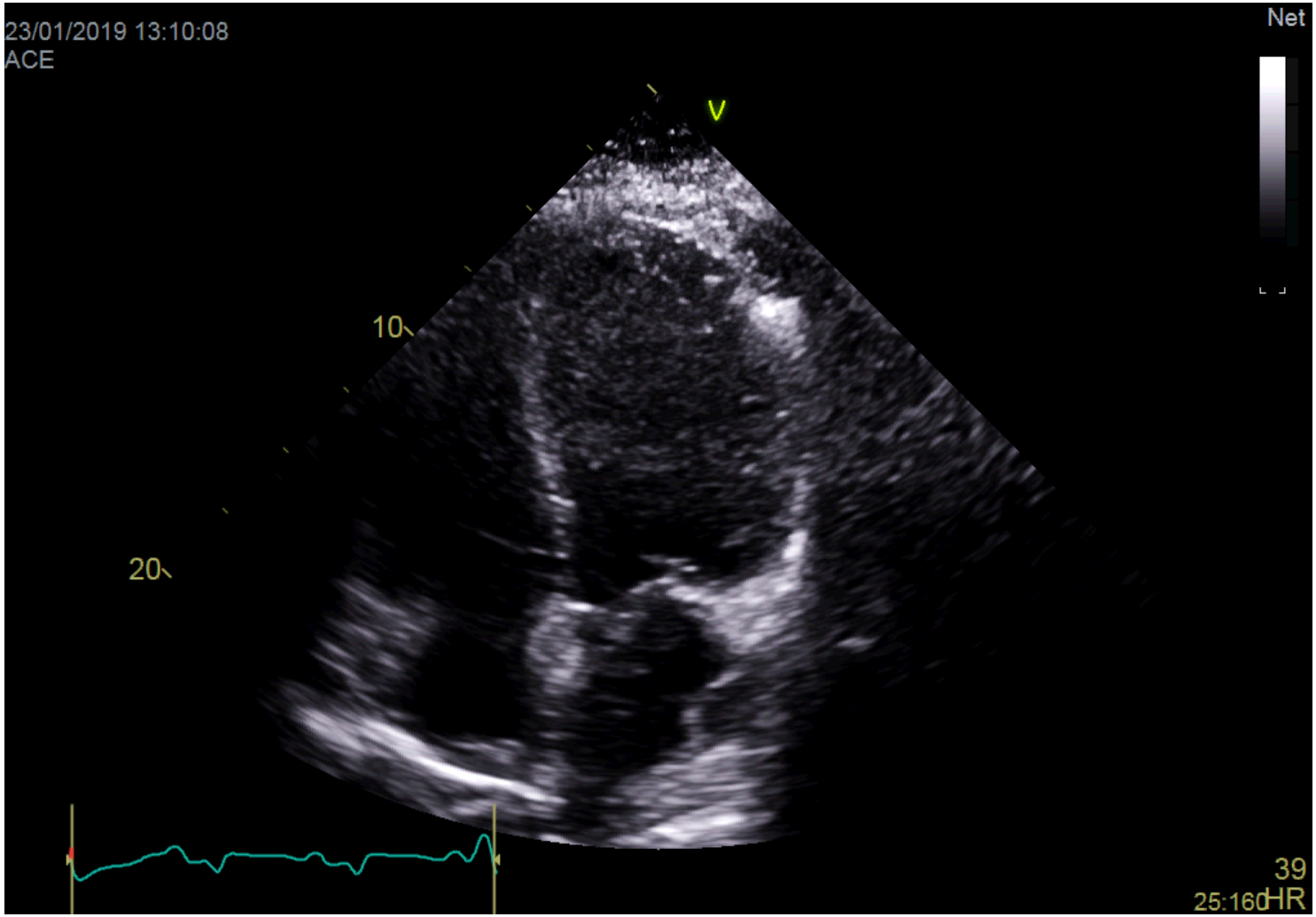
PAPs 37 mmHg, but RV dysfunction

Patients receving dobutamine 10 μg/Kg/min

→ Hypotension, oligo-anuria, progressive kidney and liver failure

→ Noradrenaline 0.5 μg/Kg/min

VA-ECMO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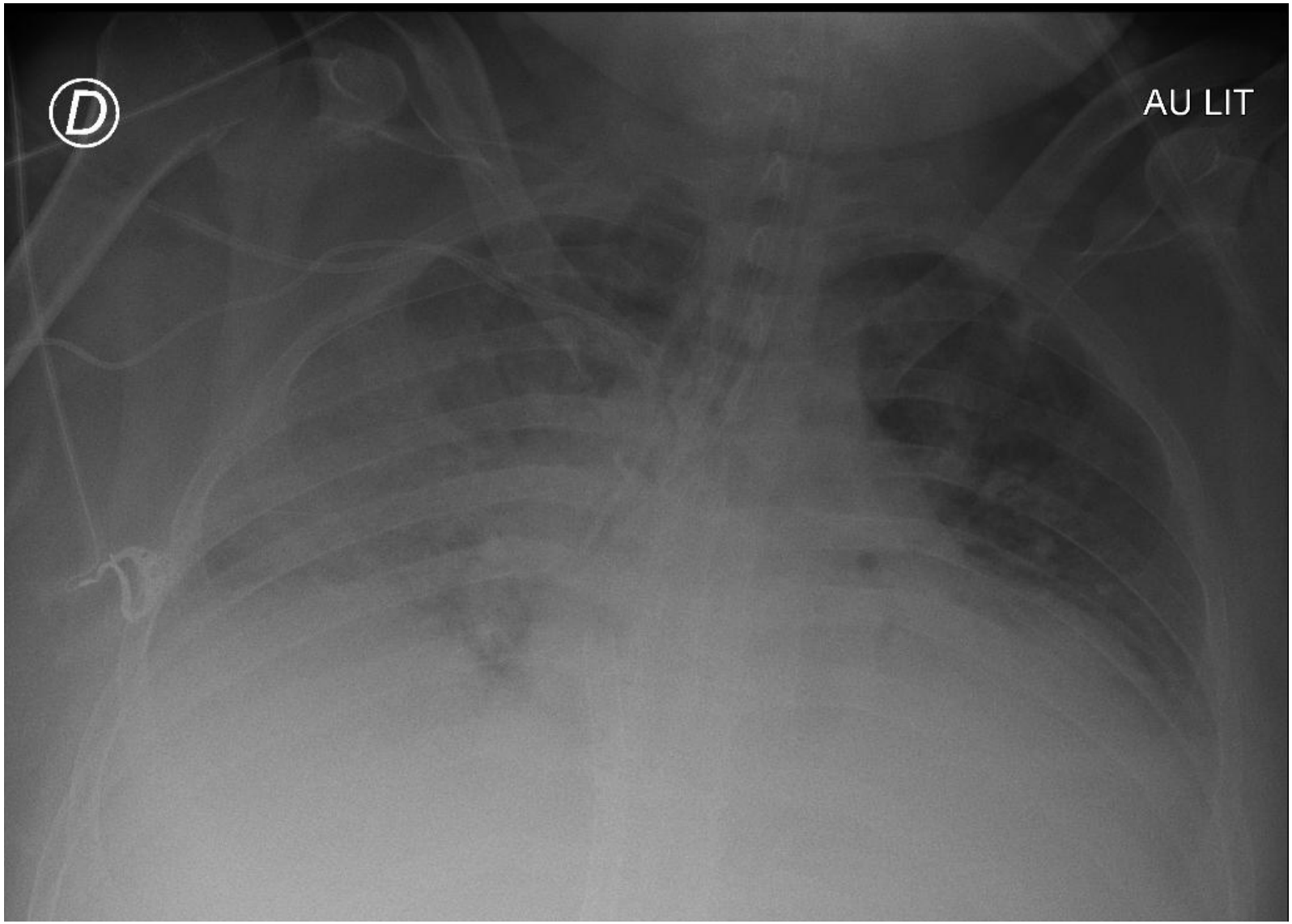
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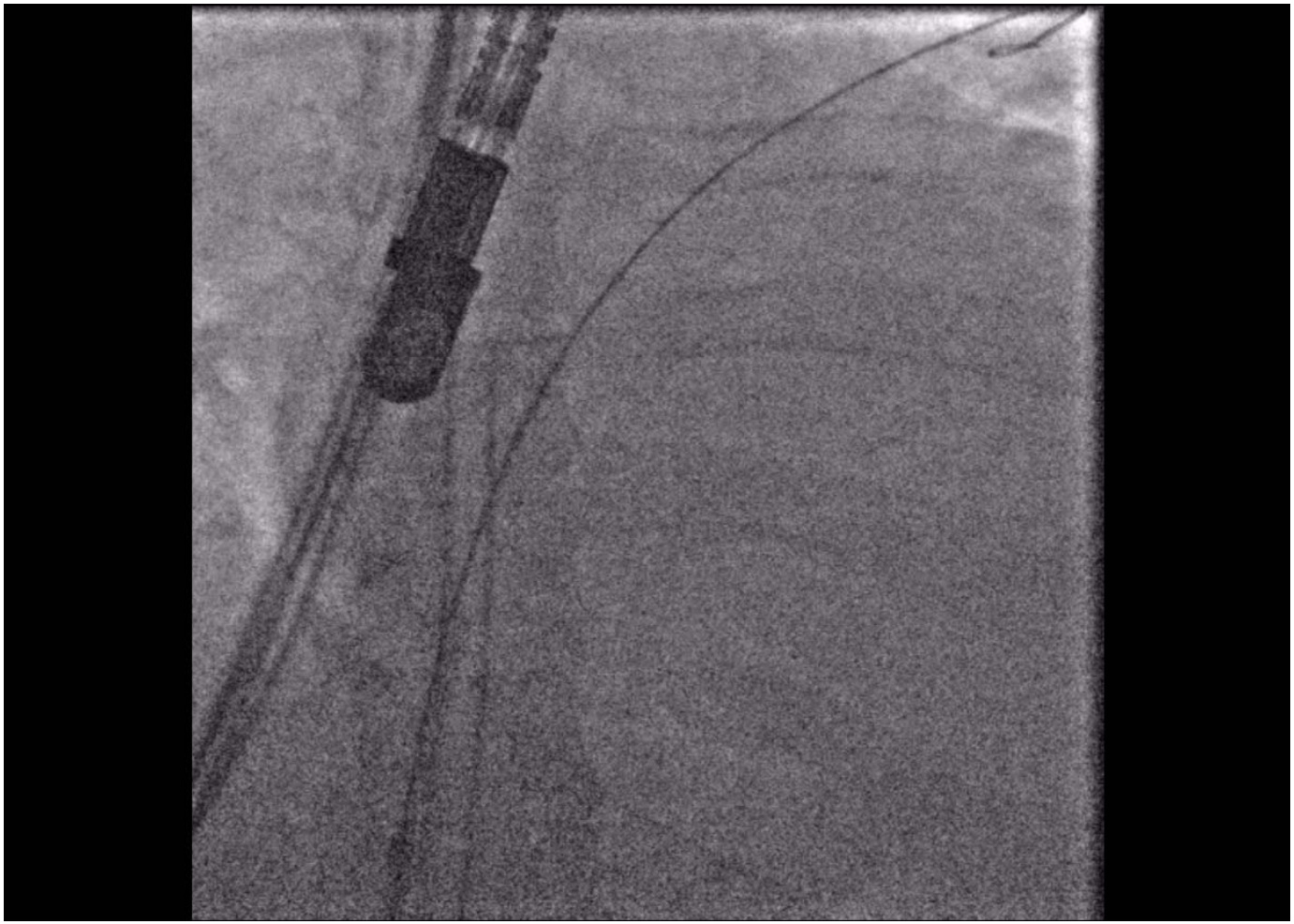

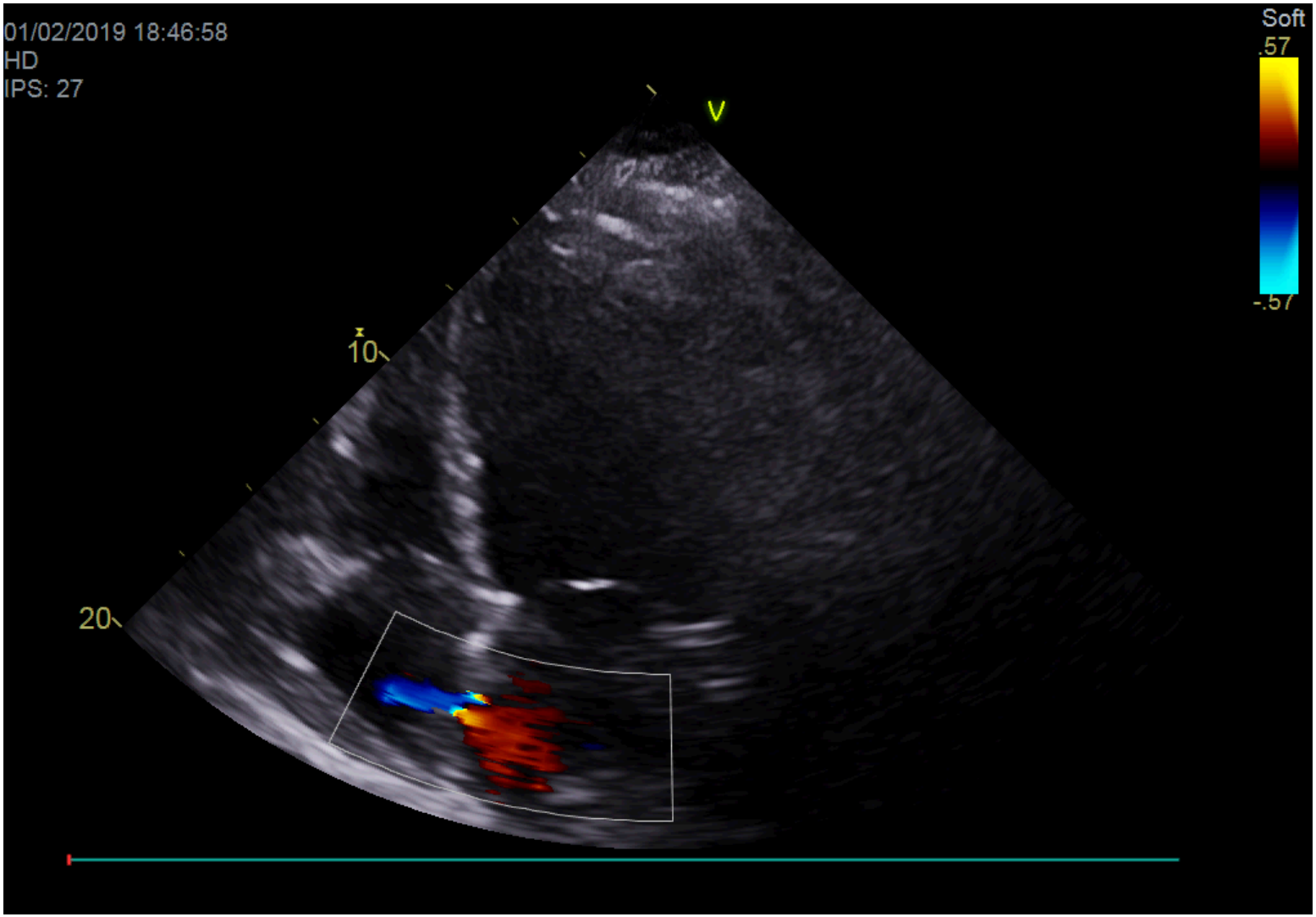
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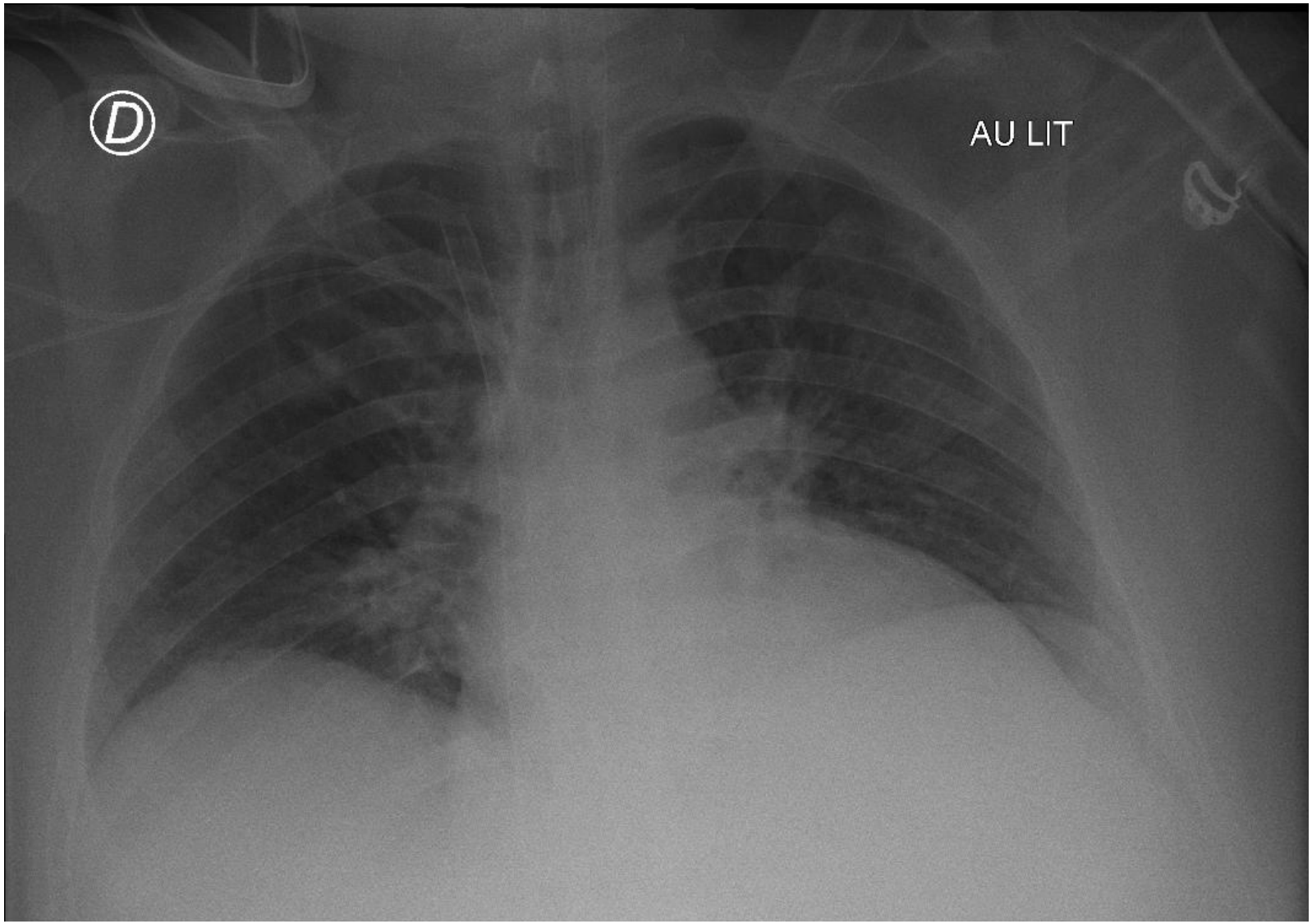
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Thanks for the attention!