LAP and diastolic function analysis in the critically ill

A Prof Sam Orde FCICM DDU FASE PhD

ICU specialist, Nepean Hospital, Sydney

Dept Medicine, University of Sydney

YouTube Echo at Nepean

sam.orde@health.nsw.gov.au

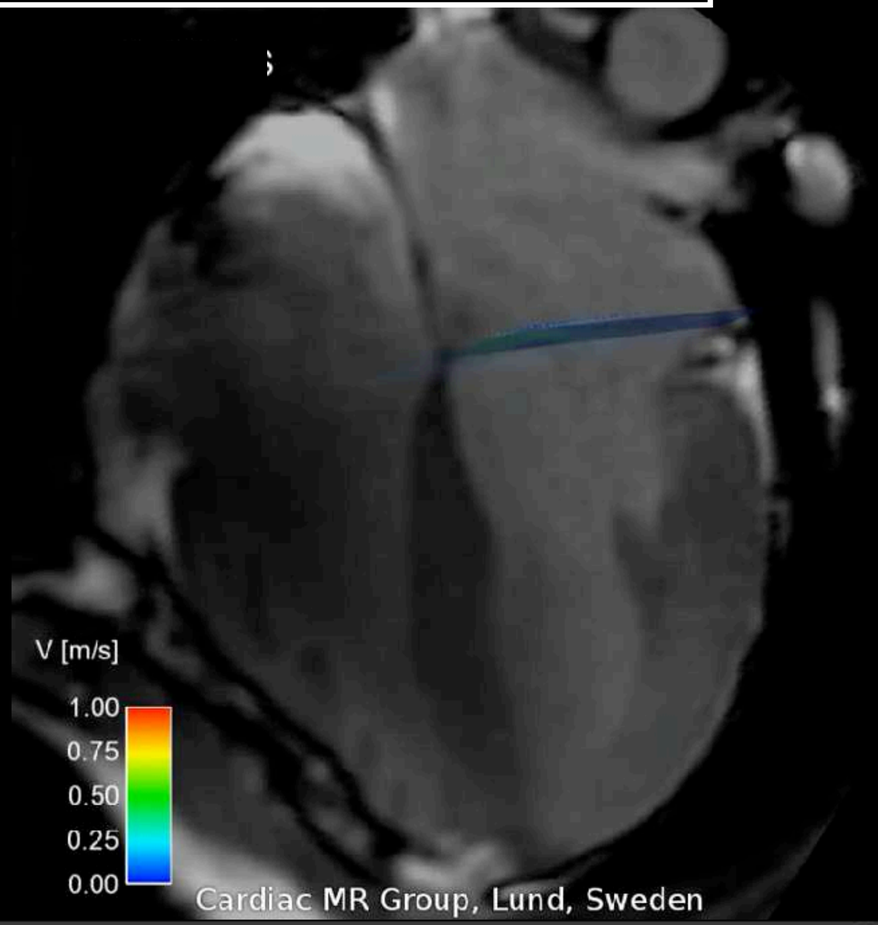
18th March 2025 (20mins 11:45-12:05)

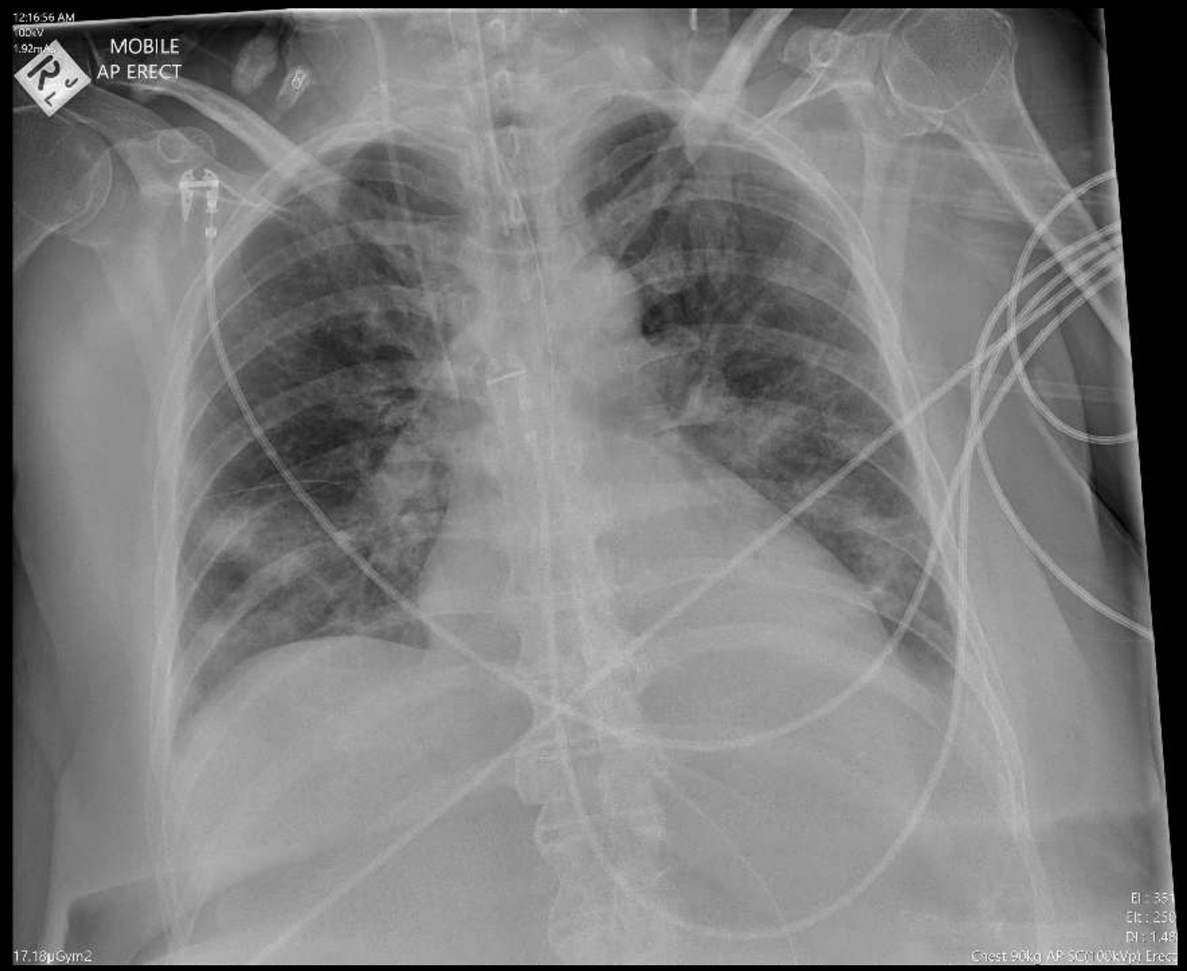
No relevant disclosures

Evaluation of LAP in critically ill

- Which patients to assess
- How to assess
- What influences LV filling pressure

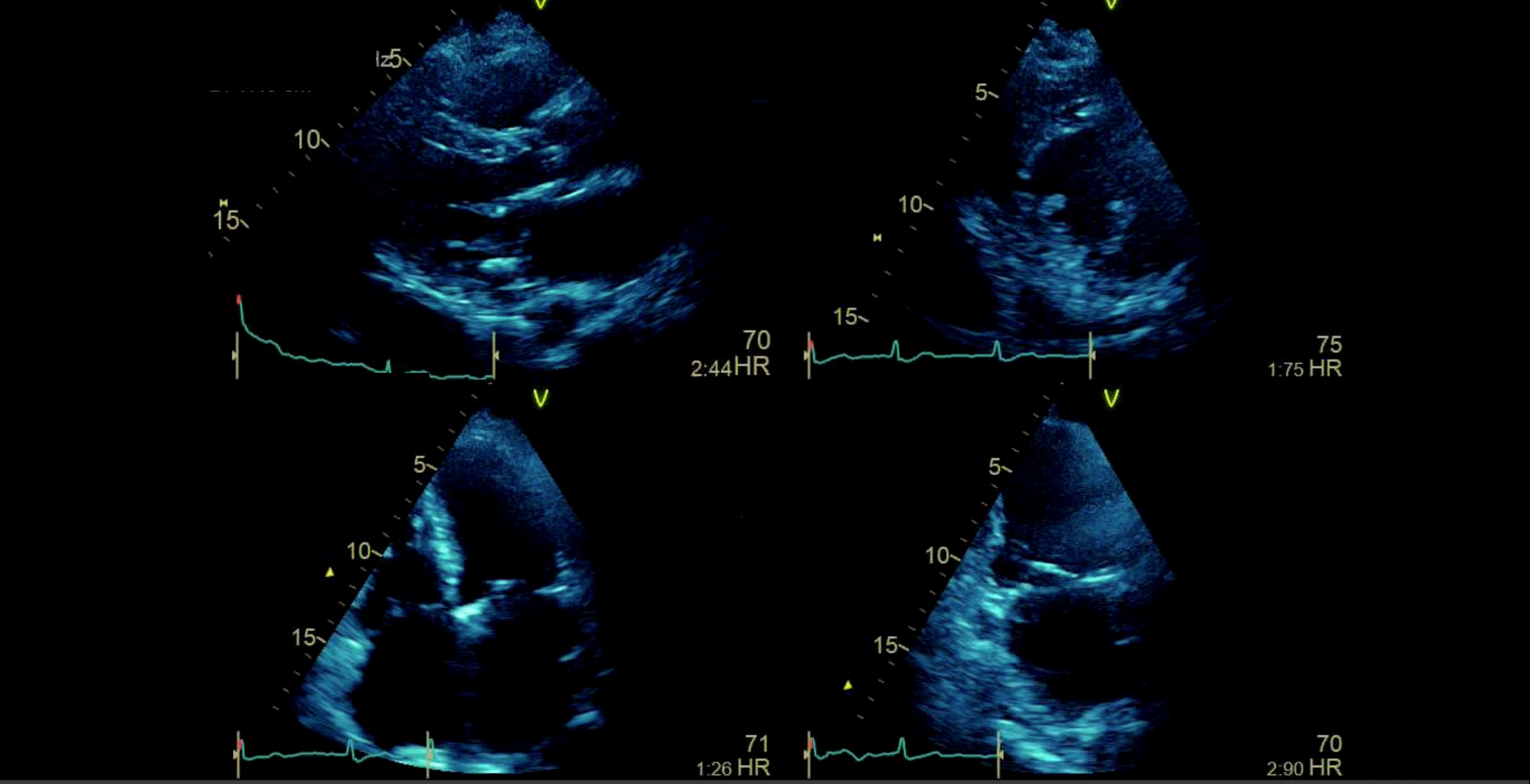
find the 'inflection point'

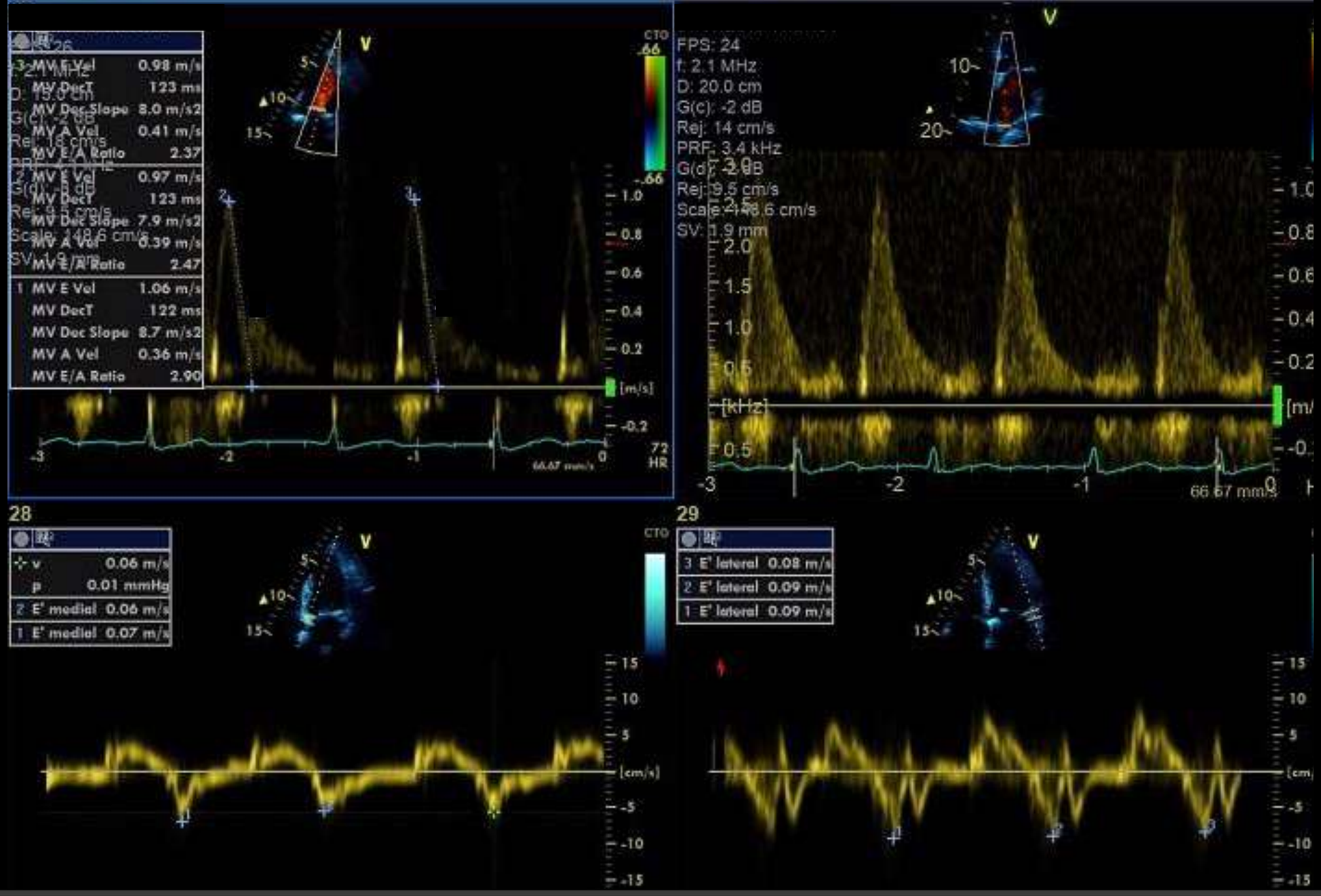


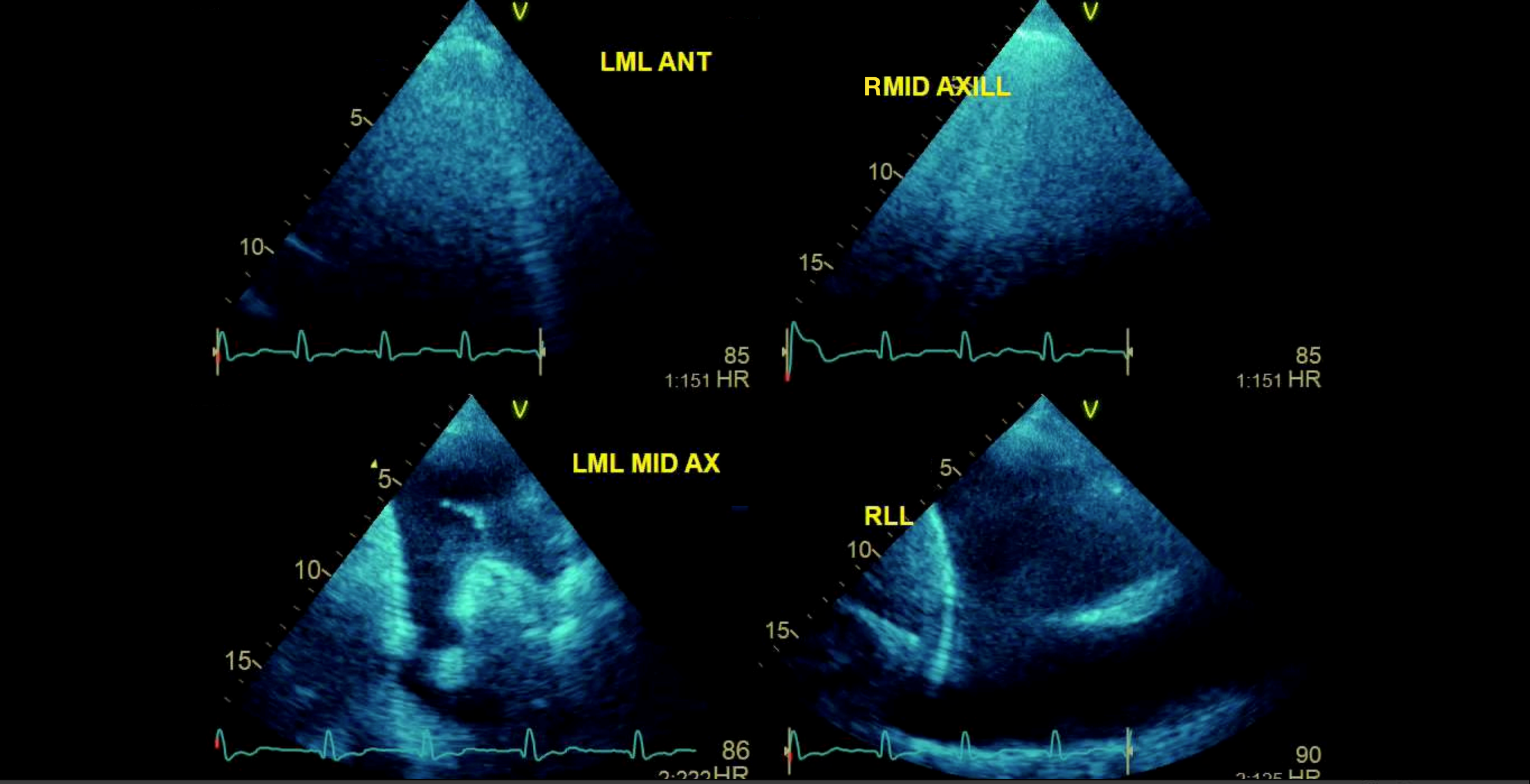


74yo man with pneumonia
MET call on ward vs respiratory distress => ICU => intubation

PMHx: DM, HTN, CRF, HFPEF. Old echo = normal EF on old echo




MV E Vel 0.98 m/s
MV DecT 123 ms
MV Dec Slope 8.0 m/s2
MV A Vel 0.41 m/s
MV E/A Ratio 2.37
MV E Vel 0.97 m/s
MV DecT 123 ms
MV Dec Slope 7.9 m/s2
MV A Vel 0.39 m/s
MV E/A Ratio 2.47
1 MV E Vel 1.06 m/s
MV DecT 122 ms
MV Dec Slope 8.7 m/s2
MV A Vel 0.36 m/s
MV E/A Ratio 2.90
CTO
.66
-.66
[m/s]
72 HR
FPS: 24
f: 2.1 MHz
D: 20.0 cm
G(c): -2 dB
Rej: 14 cm/s
PRF: 3.4 kHz
G(d): -2 dB
Rej: 9.5 cm/s
Scale: 148.6 cm/s
SV: 1.9 mm
[kHz]
66.67 mm/s
28
v 0.06 m/s
p 0.01 mmHg
2 E' medial 0.06 m/s
1 E' medial 0.07 m/s
[cm/s]
29
3 E' lateral 0.08 m/s
2 E' lateral 0.09 m/s
1 E' lateral 0.09 m/s

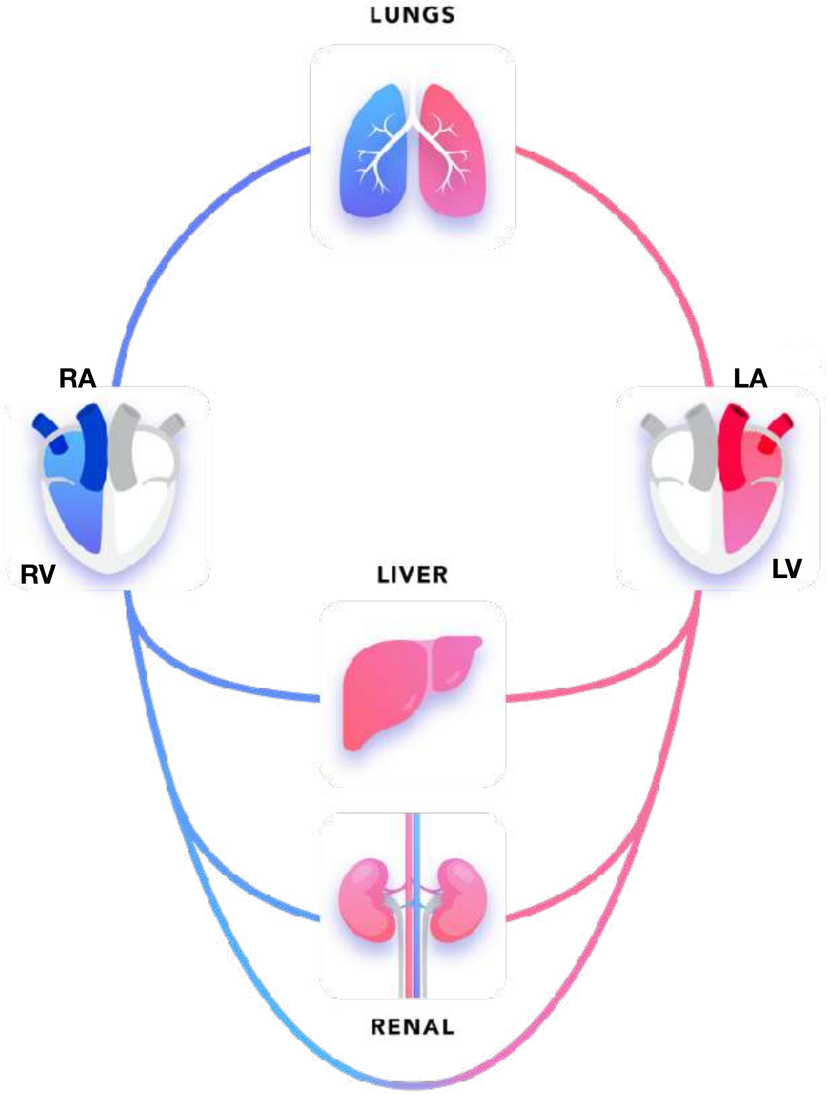

LML ANT
RMID AXILL
LML MID AX
RLL
5
10
15
85
1:151 HR
86
90

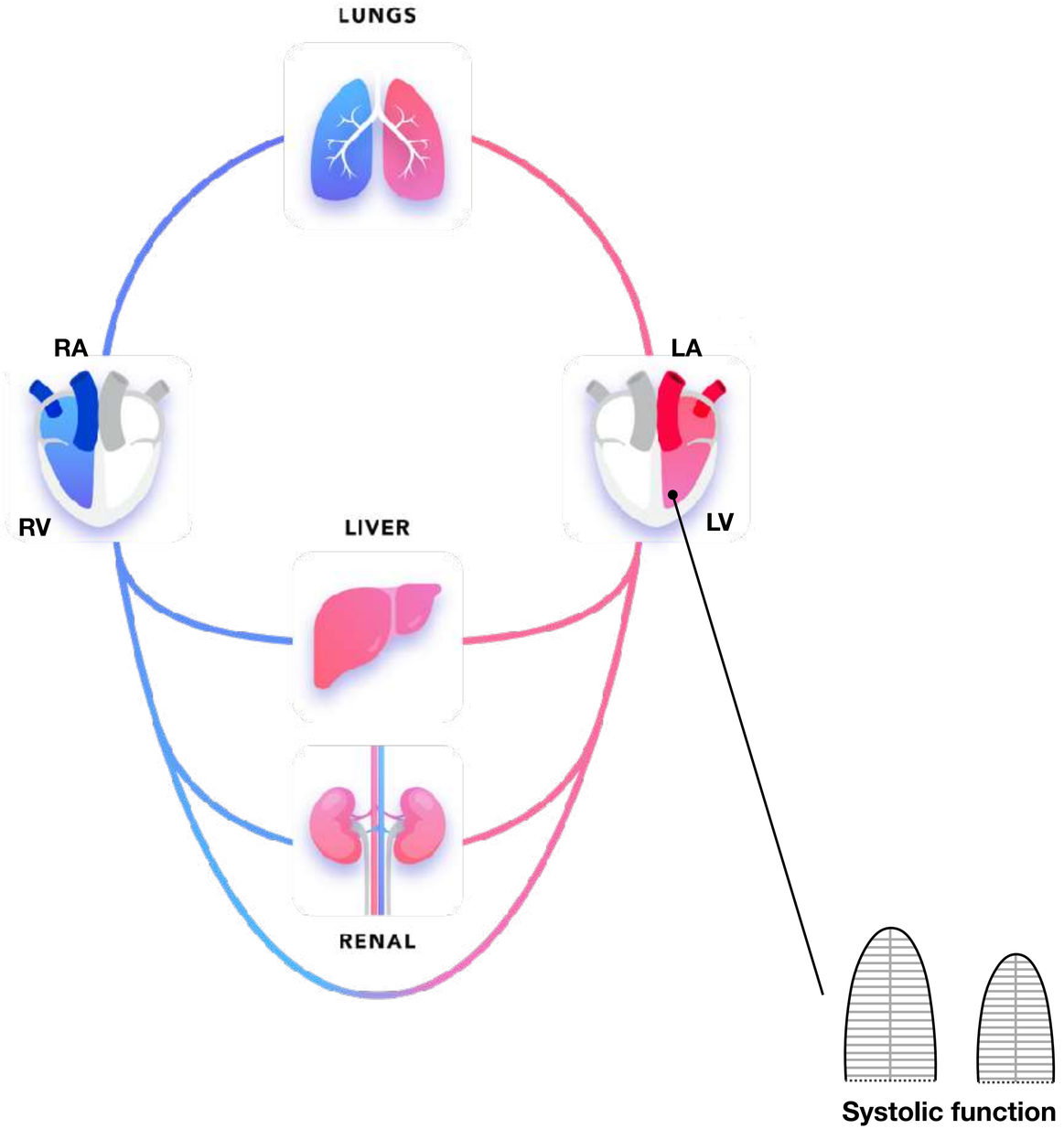
Thoughts …

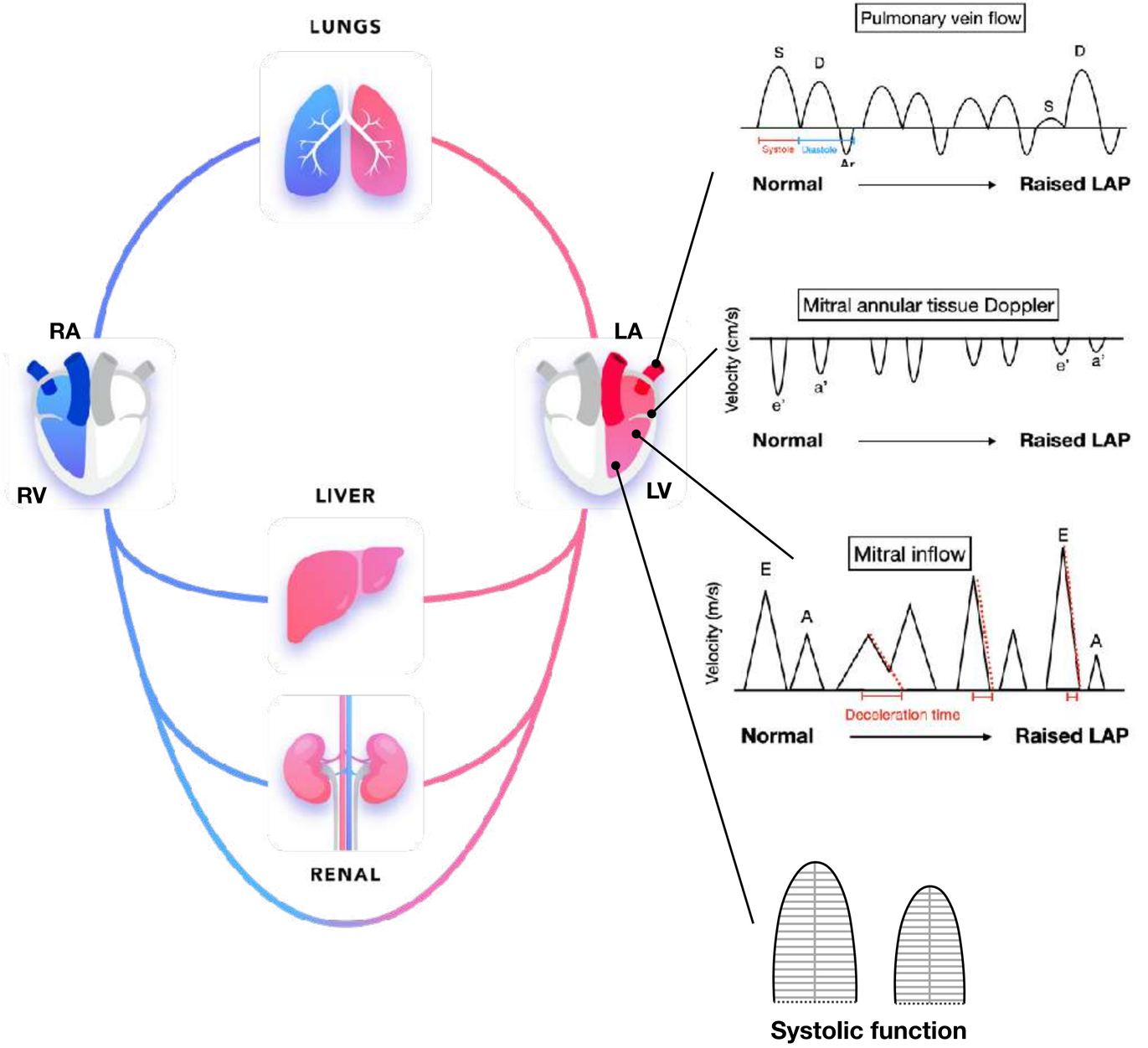
- Severe LV diastolic function + raised LAP + fluid overload
- Management =
  - Diuresis (LV preload reduction)
  - PEEP (LV preload reduction + LV afterload reduction)
  - Keep in SR. Avoid tachycardia
- Don’t miss other pathology (eg: pneumonia etc…)

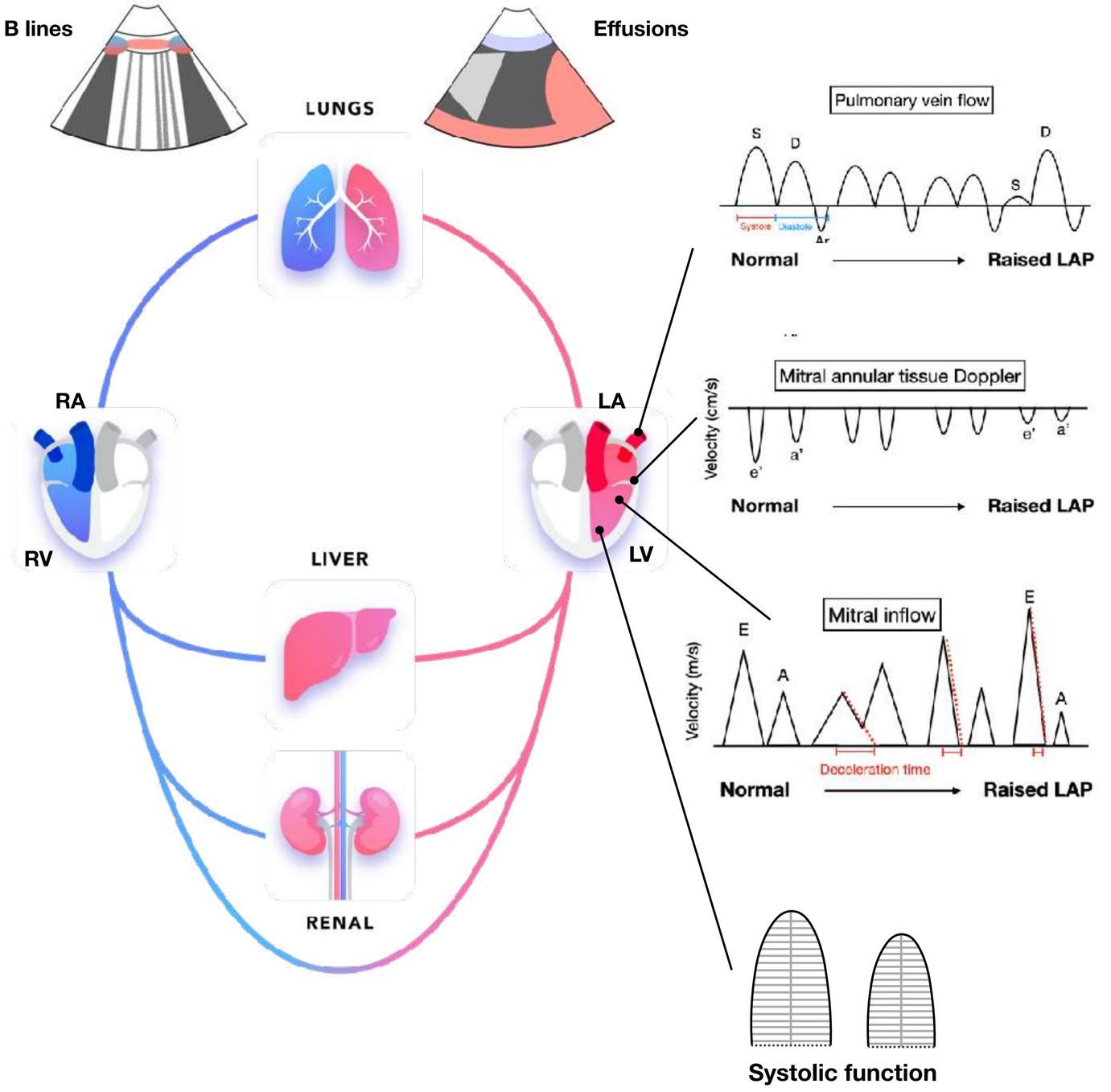
Which critically ill patients to assess LAP?

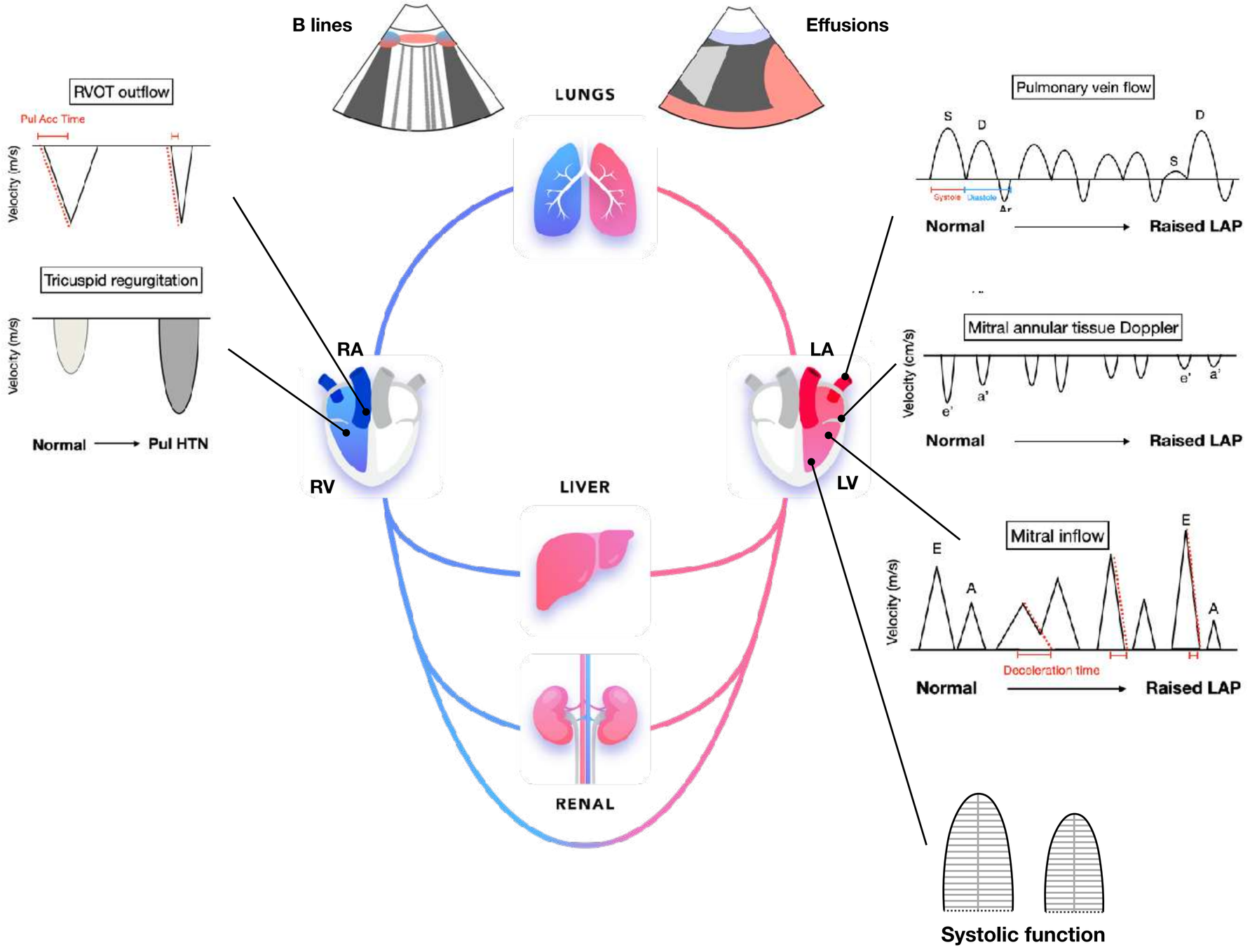
- Patients with heart failure eg: chronic (HFPEF, HFREF) & acute
- Patients ‘at risk’ of +ve fluid balance & pulmonary oedema:
  - Respiratory failure / ARDS
  - RV failure (esp: post capillary pulmonary hypertension)
- Weaning from ventilation

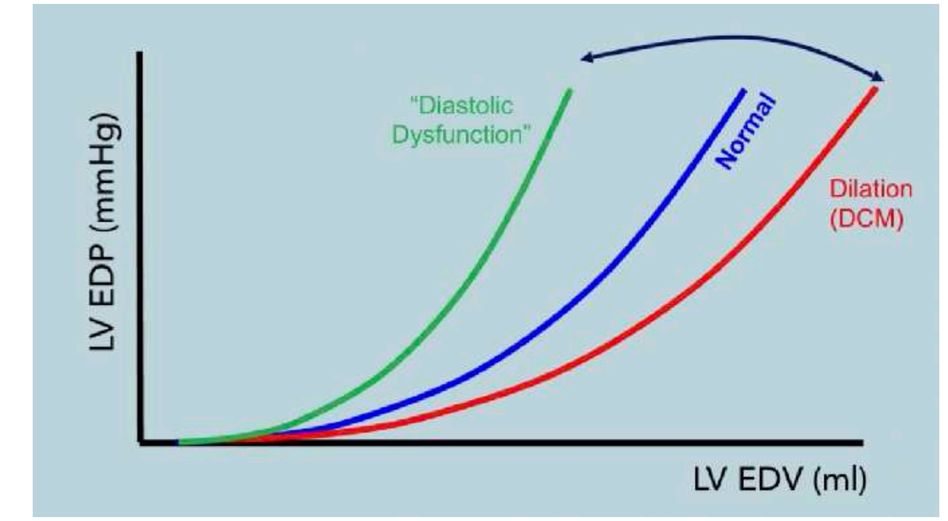

LUNGS
RA
LA
RV
LV
LIVER
RENAL

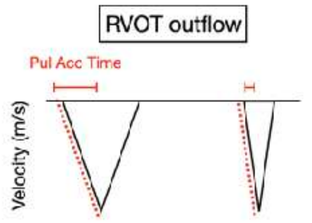

LUNGS
RA
LA
RV
LV
LIVER
RENAL
Systolic function

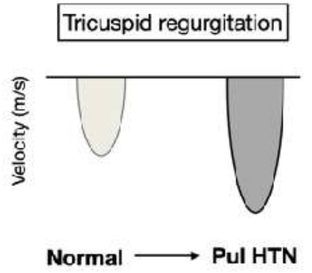

LUNGS
RA
LA
RV
LV
LIVER
RENAL
Pulmonary vein flow
S
D
S
D
Systole
Diastole
Ar
Normal
Raised LAP
Mitral annular tissue Doppler
Velocity (cm/s)
e'
a'
e'
a'
Normal
Raised LAP
Mitral inflow
Velocity (m/s)
E
A
E
A
Deceleration time
Normal
Raised LAP
Systolic function

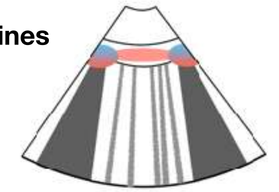

B lines
Effusions
LUNGS
RA
LA
RV
LV
LIVER
RENAL
Pulmonary vein flow
S
D
S
D
Systole
Diastole
Ar
Normal
Raised LAP
Mitral annular tissue Doppler
Velocity (cm/s)
e'
a'
e'
a'
Normal
Raised LAP
Mitral inflow
Velocity (m/s)
E
A
E
A
Deceleration time
Normal
Raised LAP
Systolic function

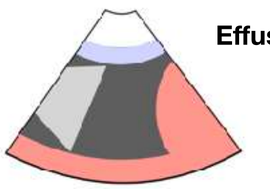

B lines
Effusions
LUNGS
RVOT outflow
Pul Acc Time
Velocity (m/s)
Tricuspid regurgitation
Velocity (m/s)
Normal
Pul HTN
RA
RV
LA
LV
LIVER
RENAL
Pulmonary vein flow
S
D
S
D
Systole
Diastole
Ar
Normal
Raised LAP
Mitral annular tissue Doppler
Velocity (cm/s)
e'
a'
e'
a'
Normal
Raised LAP
Mitral inflow
Velocity (m/s)
E
A
E
A
Deceleration time
Normal
Raised LAP
Systolic function

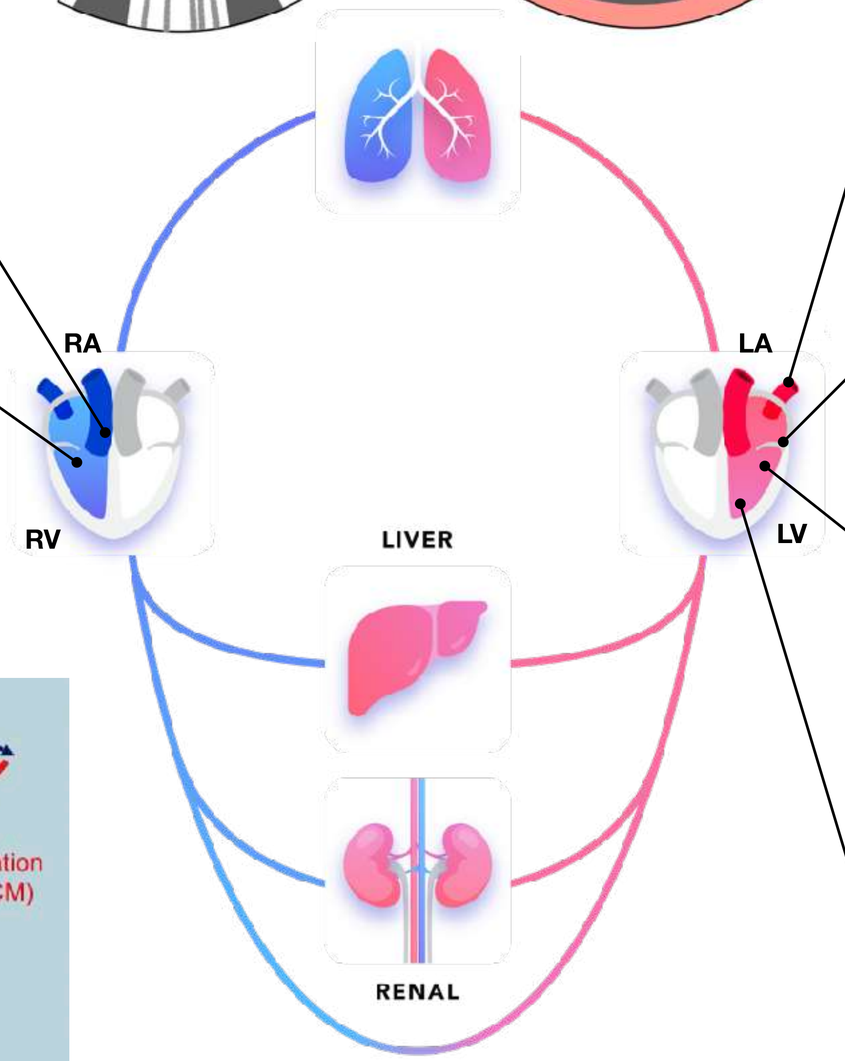

LV EDP (mmHg)
LV EDV (ml)
"Diastolic Dysfunction"
Normal
Dilation (DCM)

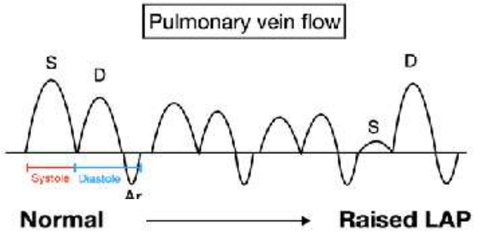

RVOT outflow
Pul Acc Time
Velocity (m/s)

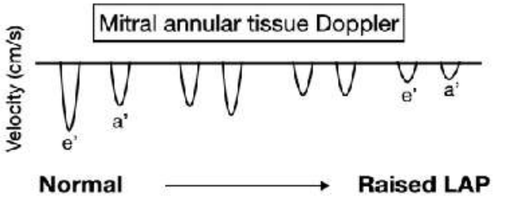

Tricuspid regurgitation
Velocity (m/s)
Normal
Pul HTN

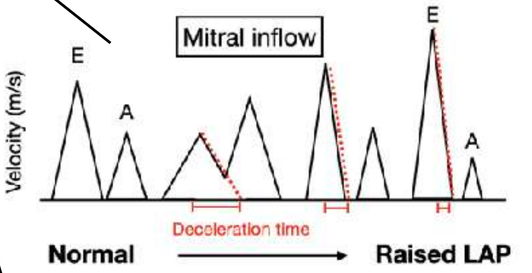

B lines

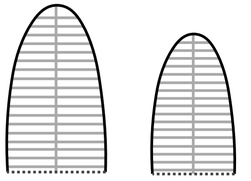

Effusions


LUNGS
RA
RV
LA
LV
LIVER
RENAL

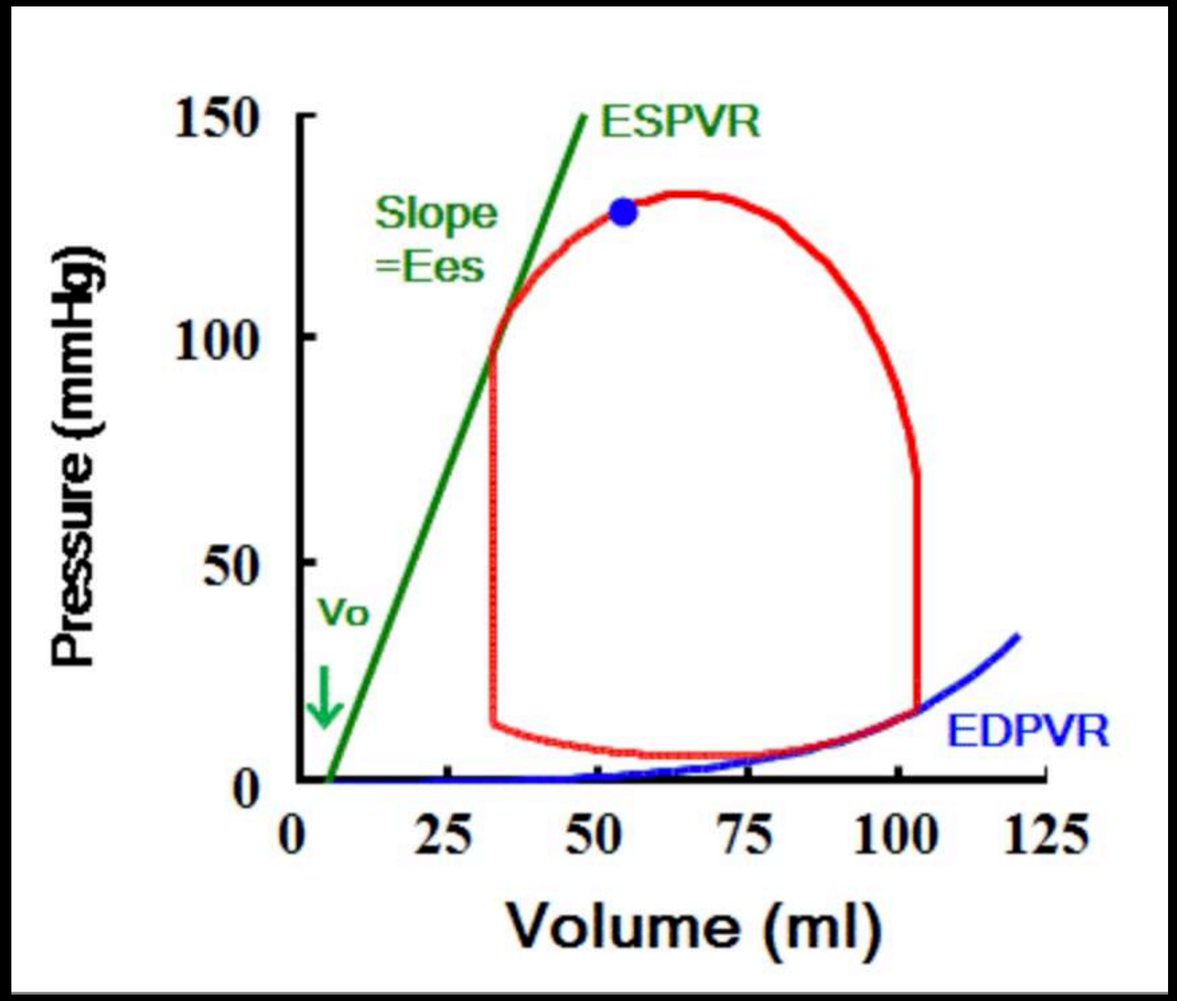

Pulmonary vein flow
S
D
S
D
Systole
Diastole
Ar
Normal
Raised LAP

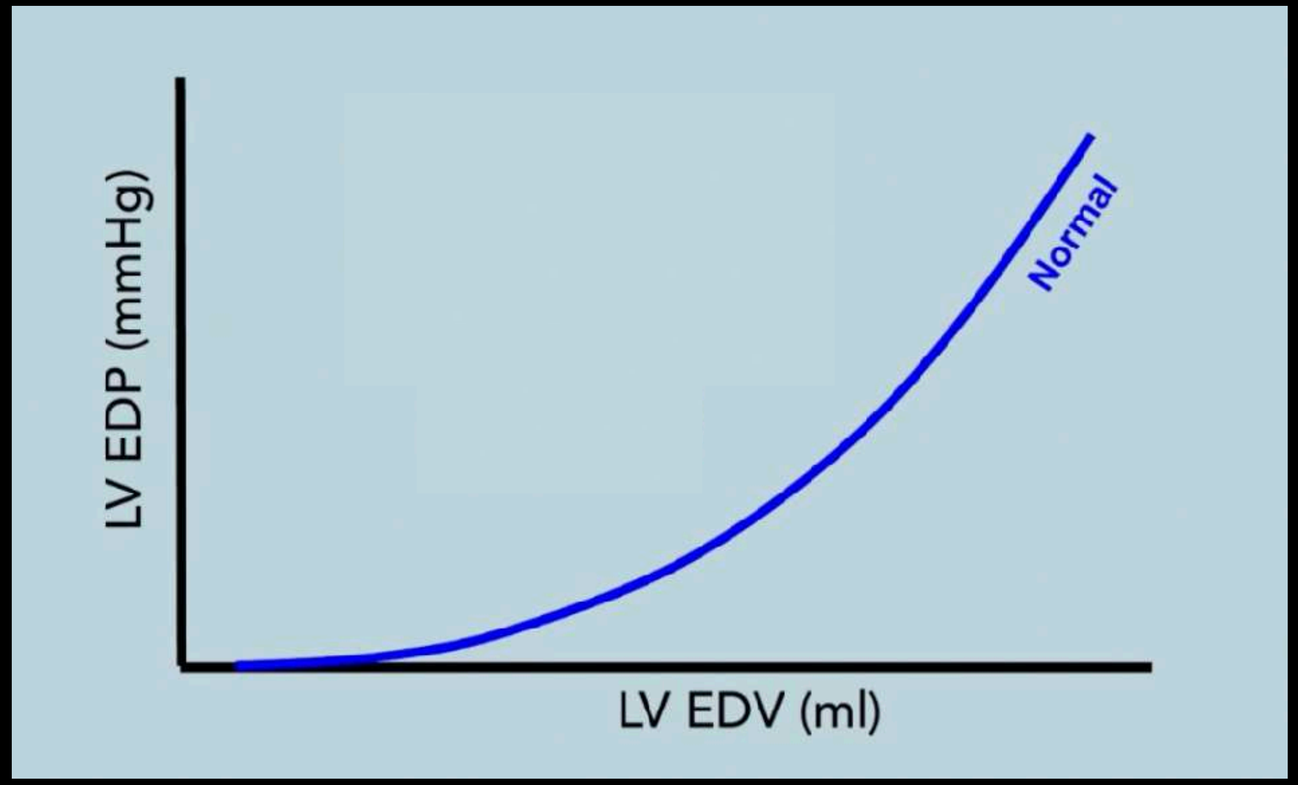

Mitral annular tissue Doppler
Velocity (cm/s)
e'
a'
e'
a'
Normal
Raised LAP


Mitral inflow
Velocity (m/s)
E
A
E
A
Deceleration time
Normal
Raised LAP

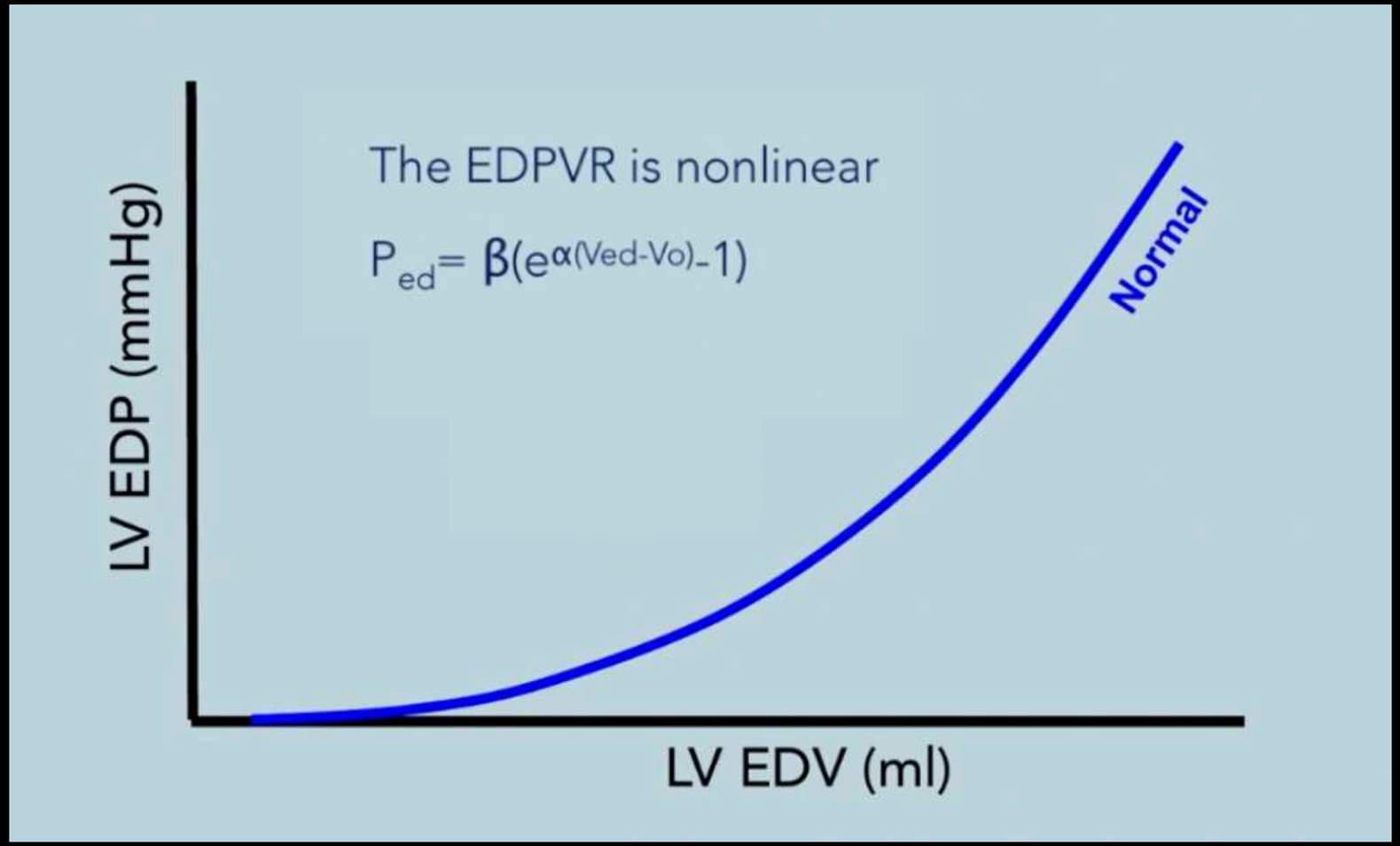

Systolic function

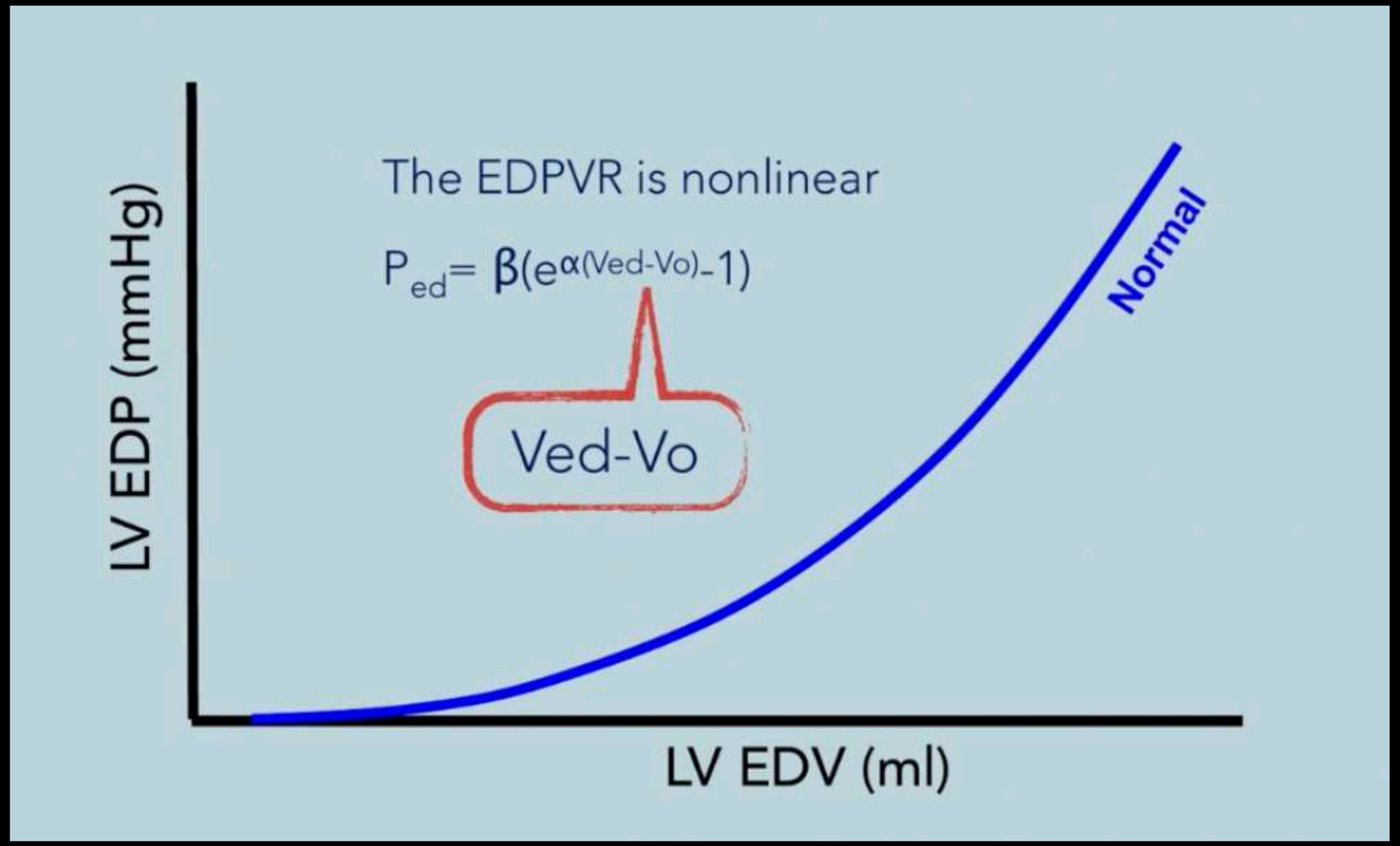
Physiological principles to individualise therapy

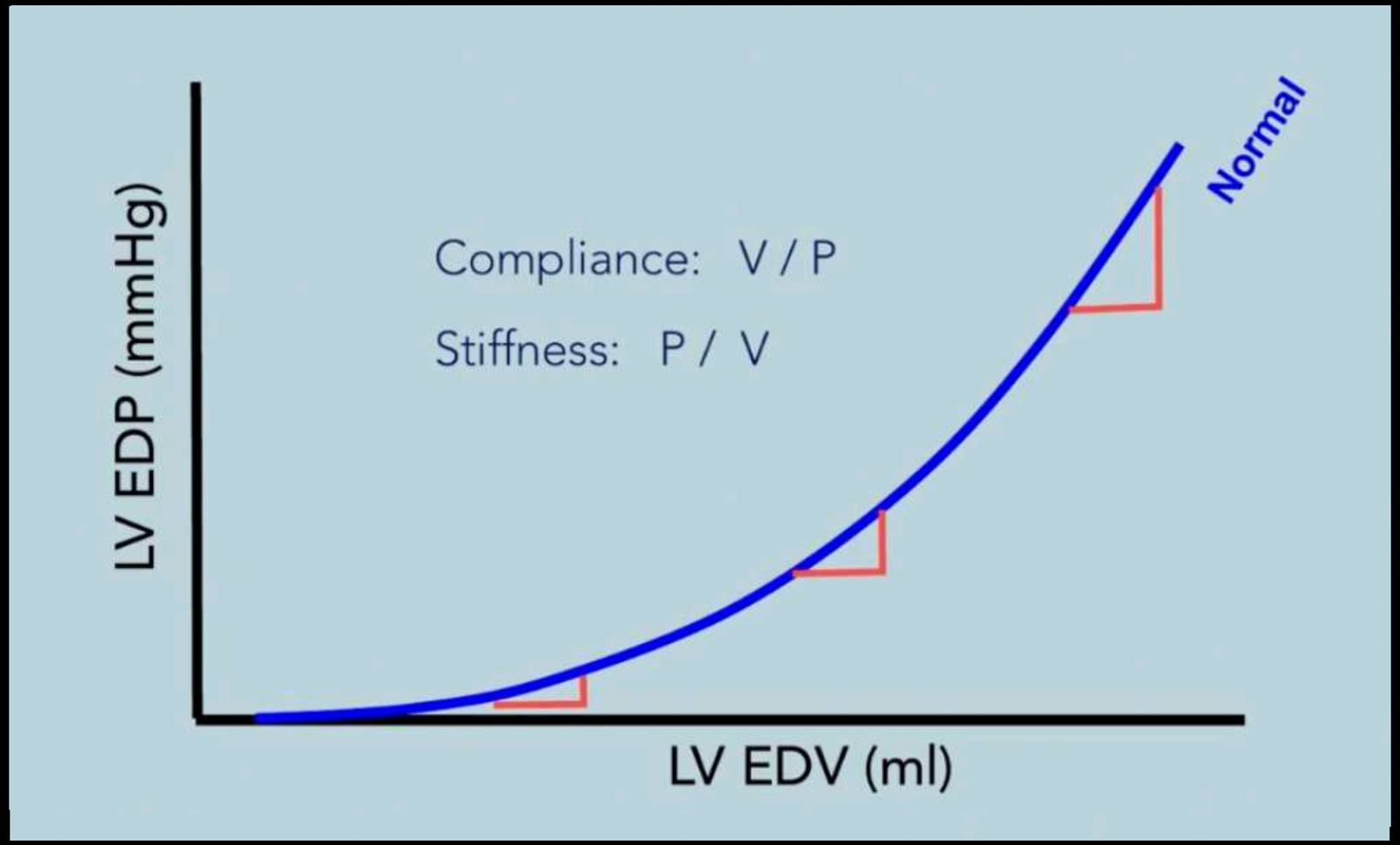


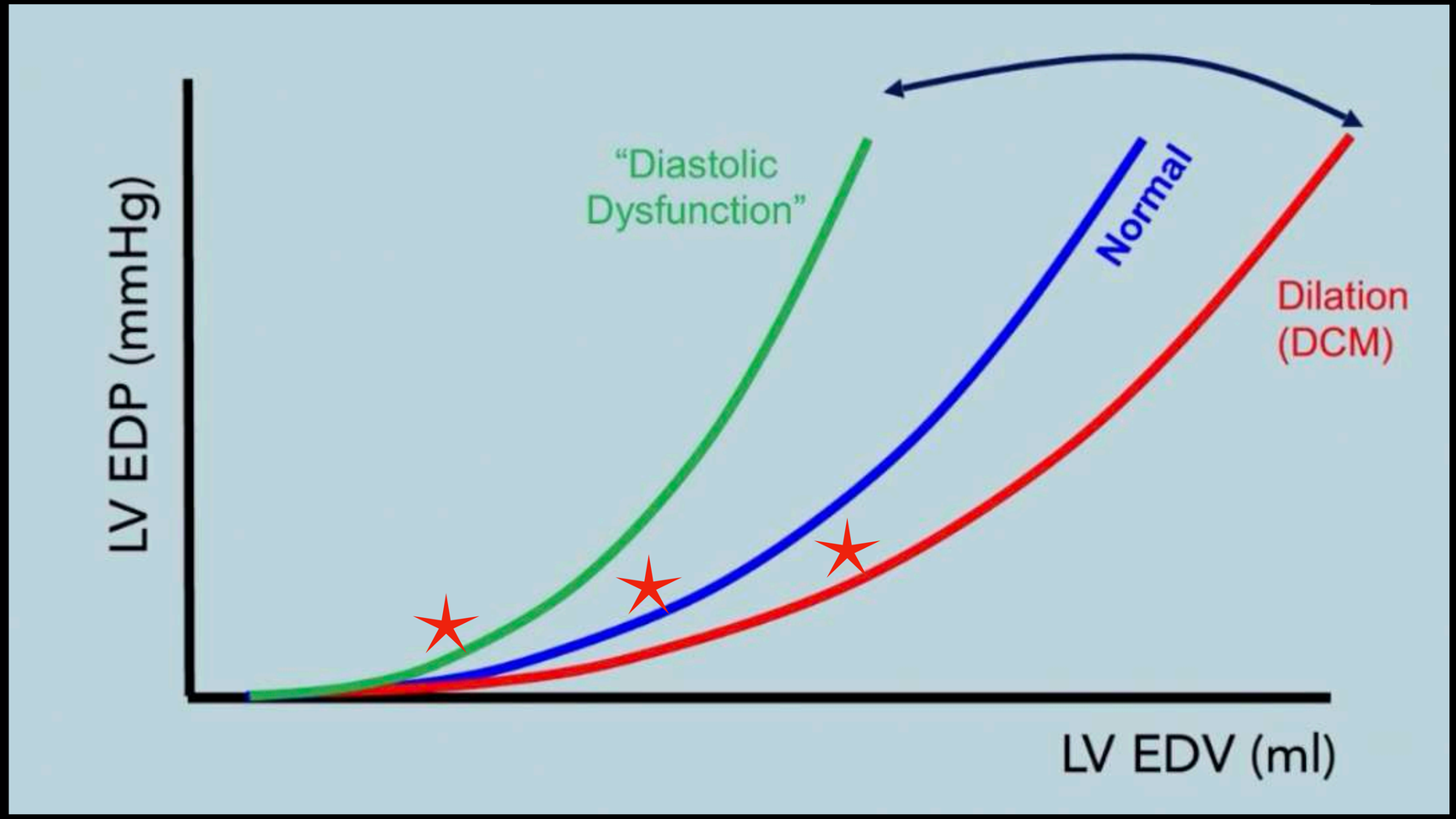


harvi.online






LV EDP (mmHg)
Compliance: V / P
Stiffness: P / V
Normal
LV EDV (ml)


LV EDP (mmHg)
"Diastolic Dysfunction"
Normal
Dilation (DCM)
LV EDV (ml)

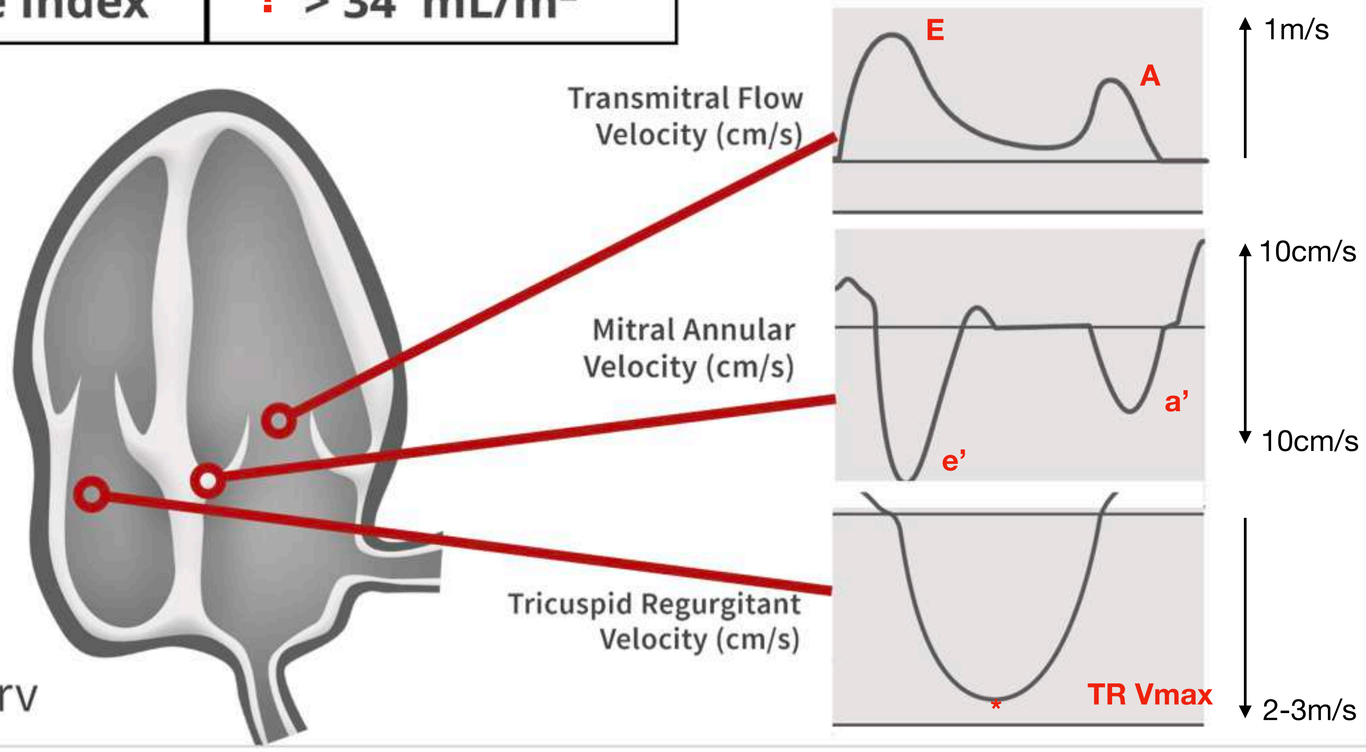
How to assess if there is raised LAP

NB: don’t forget the echo measures we use are **load dependent**

How to assess LAP… conventional measures

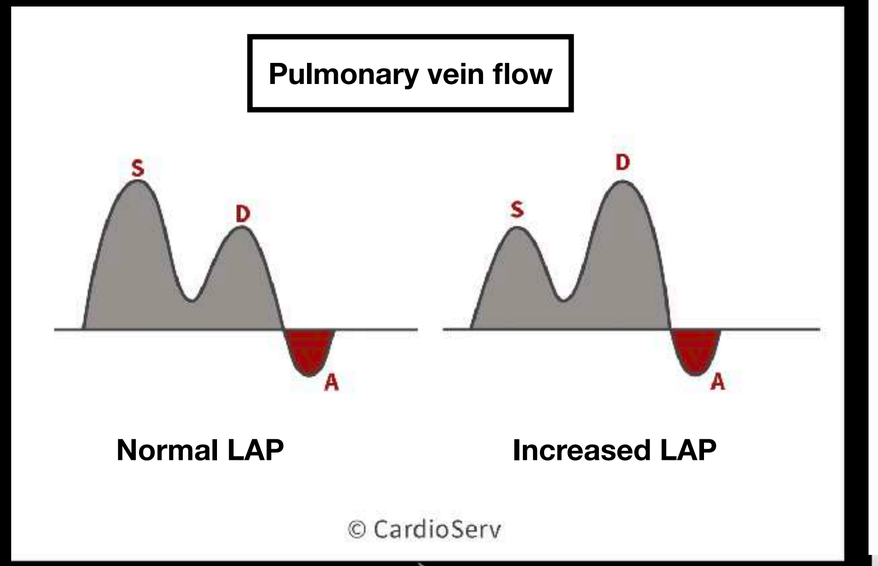
Parameters	Cut-Off Value
Average E/e'	? > 14
TR Velocity	? > 2.8 m/s
LA Volume Index	? > 34 mL/m²

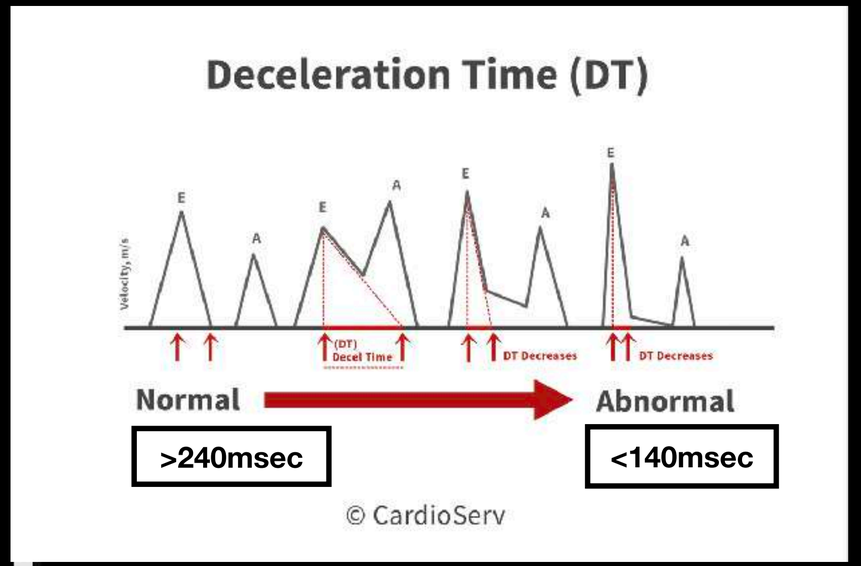
Non-Invasive Assessment LV Filling Pressures

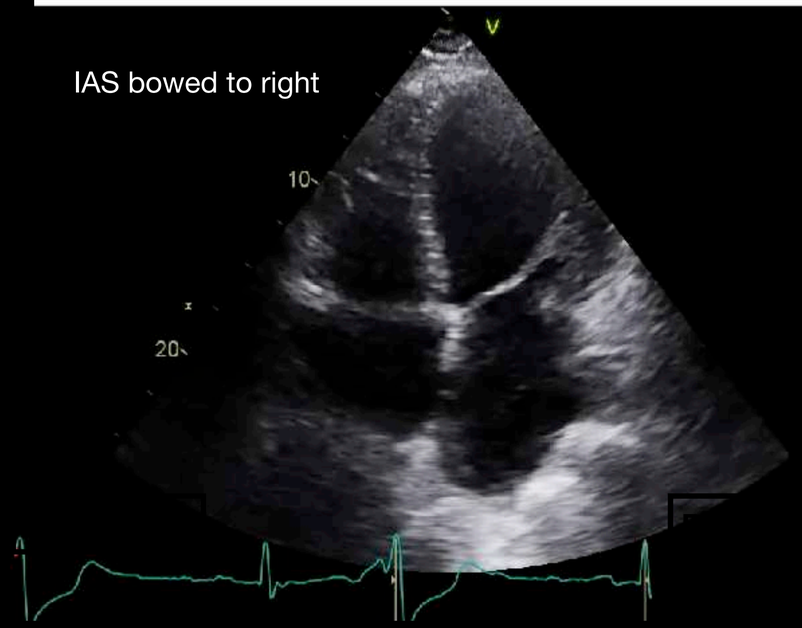


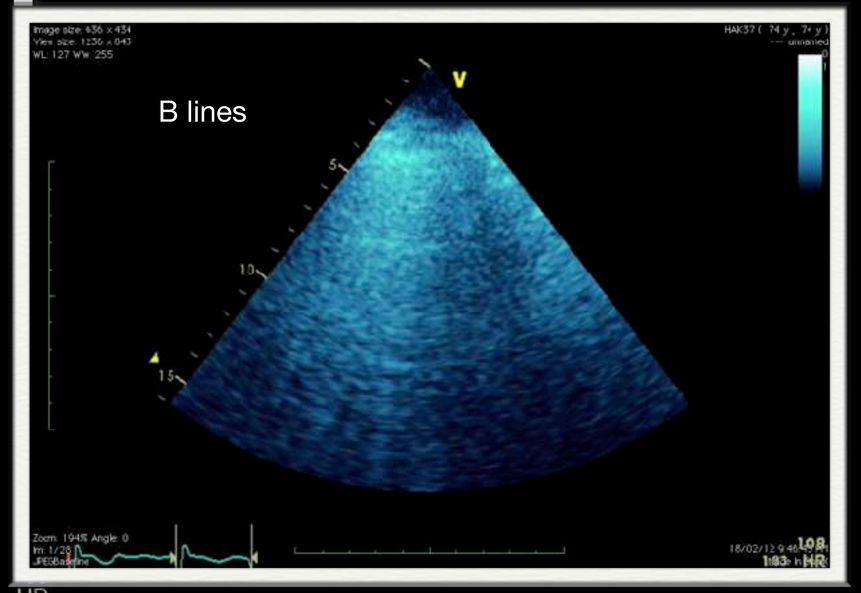
ALL echo measures of LV filling pressures are load dependent

… others

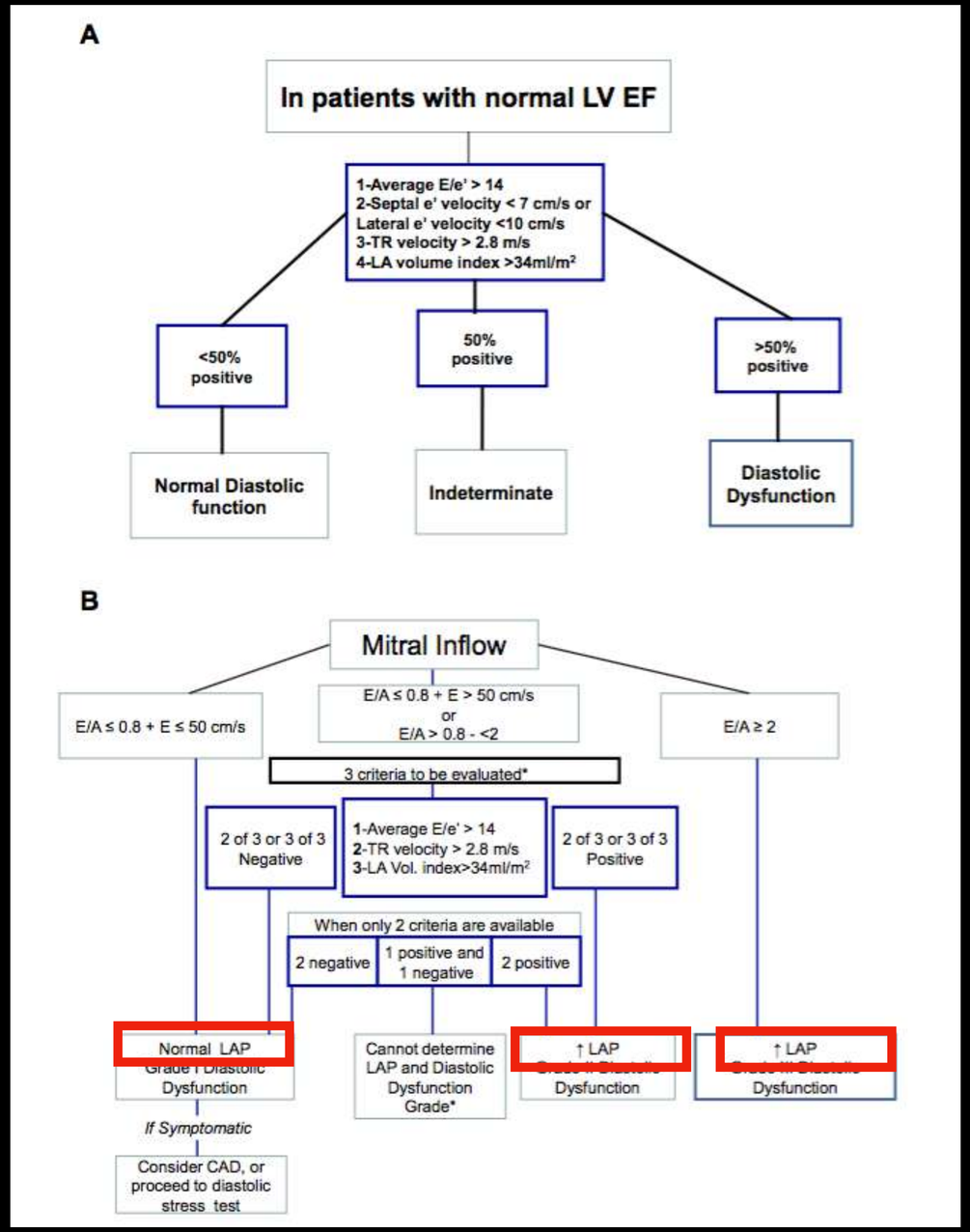

Pulmonary vein flow
S
D
A
S
D
A
Normal LAP
Increased LAP
© CardioServ


Deceleration Time (DT)
Velocity, m/s
E
A
E
A
E
A
E
A
(DT)
Decel Time
DT Decreases
DT Decreases
Normal
Abnormal
>240msec
<140msec
© CardioServ


IAS bowed to right
V
10
20


B lines
V
5
10
15

HR



ASE/EACVI GUIDELINES AND STANDARDS

Recommendations for the Evaluation of Left Ventricular Diastolic Function by Echocardiography: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging

Sherif F. Nagueh, Chair, MD, FASE,[1] Otto A. Smiseth, Co-Chair, MD, PhD,[2] Christopher P. Appleton, MD,[1] Benjamin F. Byrd, III, MD, FASE,[1] Hisham Dokainish, MD, FASE,[1] Thor Edvardsen, MD, PhD,[2] Frank A. Flachskampf, MD, PhD, FESC,[2] Thierry C. Gillebert, MD, PhD, FESC,[2] Allan L. Klein, MD, FASE,[1] Patrizio Lancellotti, MD, PhD, FESC,[3] Paolo Marino, MD, FESC,[3] Jae K. Oh, MD,[1] Bogdan Alexandru Popescu, MD, PhD, FESC, FASE,[2] and Alan D. Waggoner, MHS, RDCS[1], *Houston, Texas; Oslo, Norway; Phoenix, Arizona; Nashville, Tennessee; Hamilton, Ontario, Canada; Uppsala, Sweden; Ghent and Liège, Belgium; Cleveland, Ohio; Novara, Italy; Rochester, Minnesota; Bucharest, Romania; and St. Louis, Missouri*

Not validated in critically ill

2 French ICUs
98 patients
Mechanically ventilated
Echo + PAC

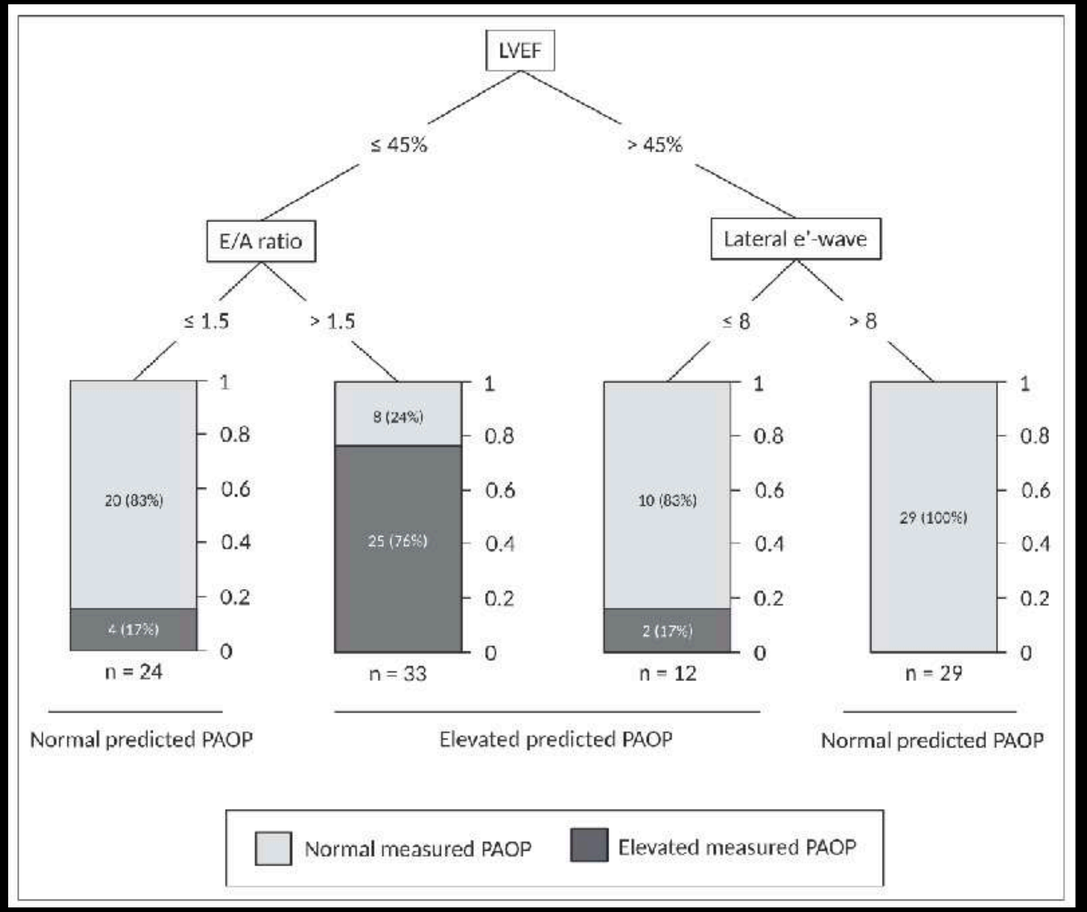
TABLE 2. Categorical Data and the Level of Agreement Between the 2016 American Society of Echocardiography and the European Association of Cardiovascular Imaging Guidelines and Pulmonary Artery Catheterization Measurements for the Assessment of Pulmonary Artery Occlusion Pressure

Variables	Measured PAOP < 18 mm Hg	Measured PAOP ≥ 18 mm Hg	Total
Normal predicted PAOP (grade I echocardiography diastolic dysfunction)	20	6	26
Elevated predicted PAOP (grade II/III echocardiography diastolic dysfunction)	7	17	24
Total	27	23	50
Sensitivity			0.74
Specificity			0.74
Positive predictive value			0.71
Negative predictive value			0.77
Positive likelihood ratio			2.85
Negative likelihood ratio			0.35
Kappa agreement (95% CI)			0.478 (0.235–0.722)

Estimation of Pulmonary Artery Occlusion Pressure Using Doppler Echocardiography in Mechanically Ventilated Patients

Clément Brault, MD[1]; Julien Marc, MD[1]; Pablo Mercado, MD[1]; Momar Diouf, PhD[2]; Christophe Tribouilloy, MD, PhD[3]; Yoann Zerbib, MD[1]; Julien Maizel, MD, PhD[1]; Philippe Vignon, MD, PhD[4–6]; Michel Slama, MD, PhD[1]

Critical Care Medicine (2020)



Estimation of Pulmonary Artery Occlusion Pressure Using Doppler Echocardiography in Mechanically Ventilated Patients

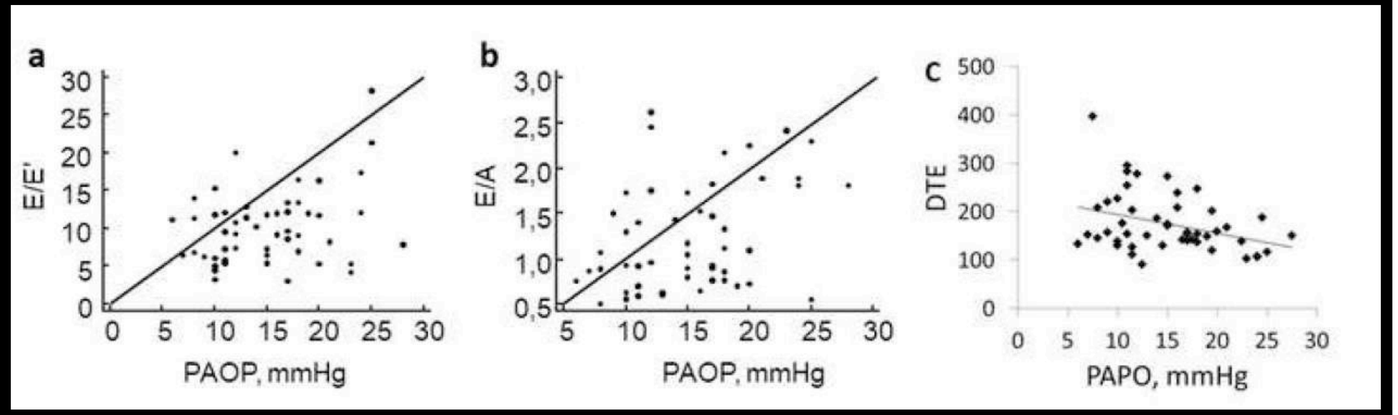
Clément Brault, MD[1]; Julien Marc, MD[1]; Pablo Mercado, MD[1]; Momar Diouf, PhD[2]; Christophe Tribouilloy, MD, PhD[3]; Yoann Zerbib, MD[1]; Julien Maizel, MD, PhD[1]; Philippe Vignon, MD, PhD[4–6]; Michel Slama, MD, PhD[1]

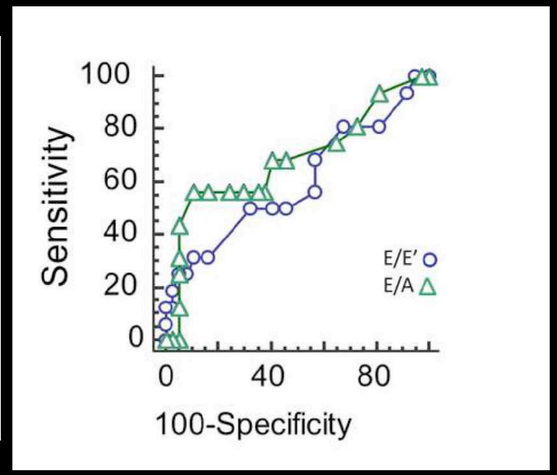
Critical Care Medicine (2020)

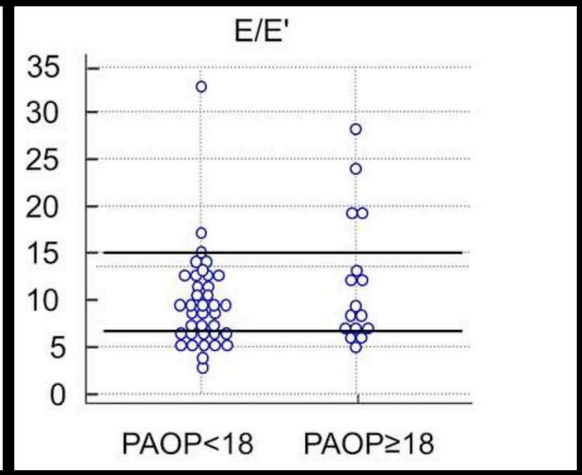
ONLINE CLINICAL INVESTIGATIONS

Doppler Echocardiographic Indices Are Specific But Not Sensitive to Predict Pulmonary Artery Occlusion Pressure in Critically Ill Patients Under Mechanical Ventilation

Mercado … Slama CCM 2020







REVIEW Open Access

Bedside assessment of left atrial pressure in critical care: a multifaceted gem

Emma Maria Bowcock* and Anthony Mclean

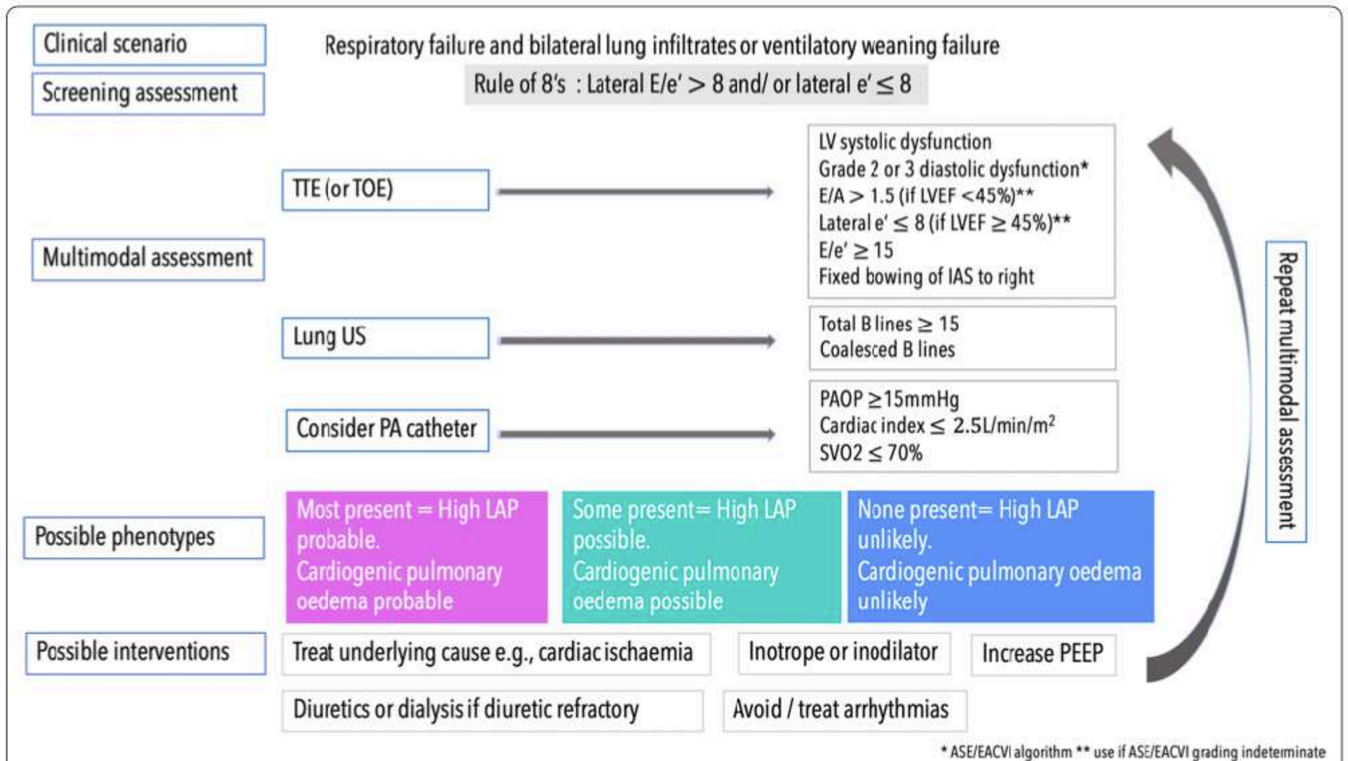
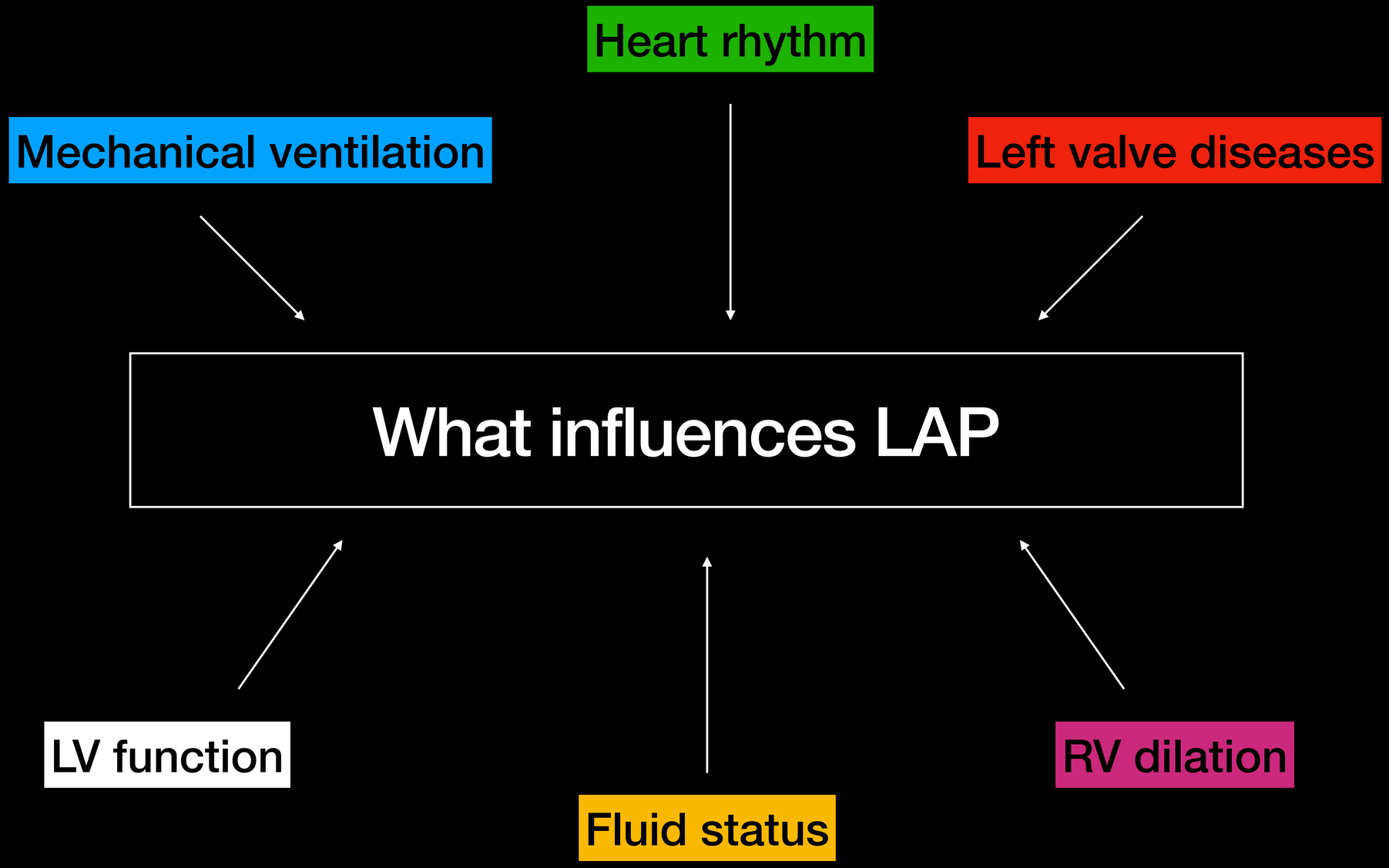


Fig. 6 Proposed multimodal algorithm for a patient presenting with acute hypoxic respiratory failure or failing to wean from mechanical ventilation. Methods for assessment of LAP and its upstream consequence of cardiogenic pulmonary oedema as well as targeted treatment options suggested. * [24], **[29]

What influences LAP


Heart rhythm
Mechanical ventilation
Left valve diseases
What influences LAP
LV function
Fluid status
RV dilation

Fluid status

Case example

Precarious fluid balance

80yo female

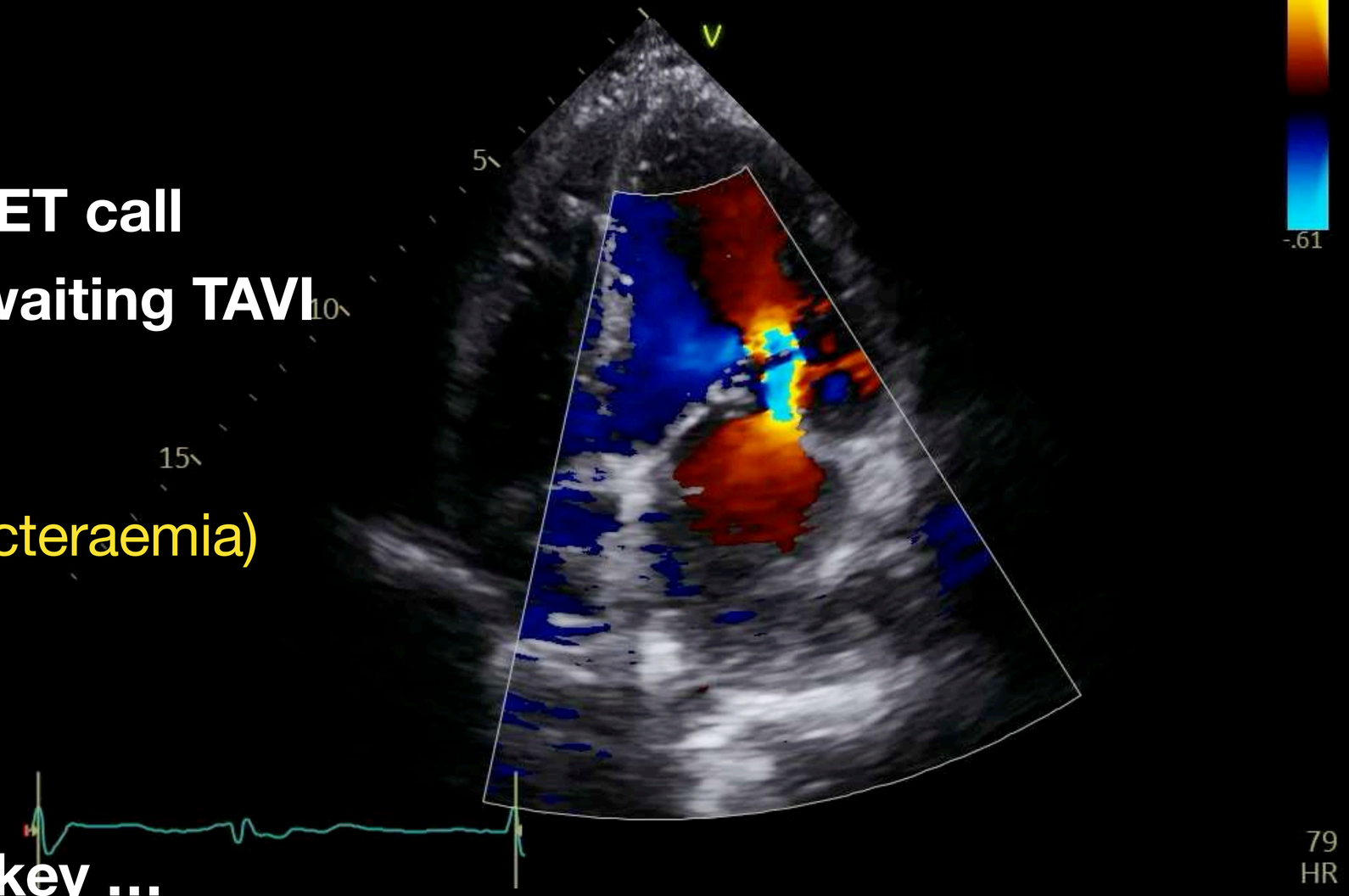
PC: n/v, fever => MET call

PMH: Severe AS awaiting TAVI

Urosepsis

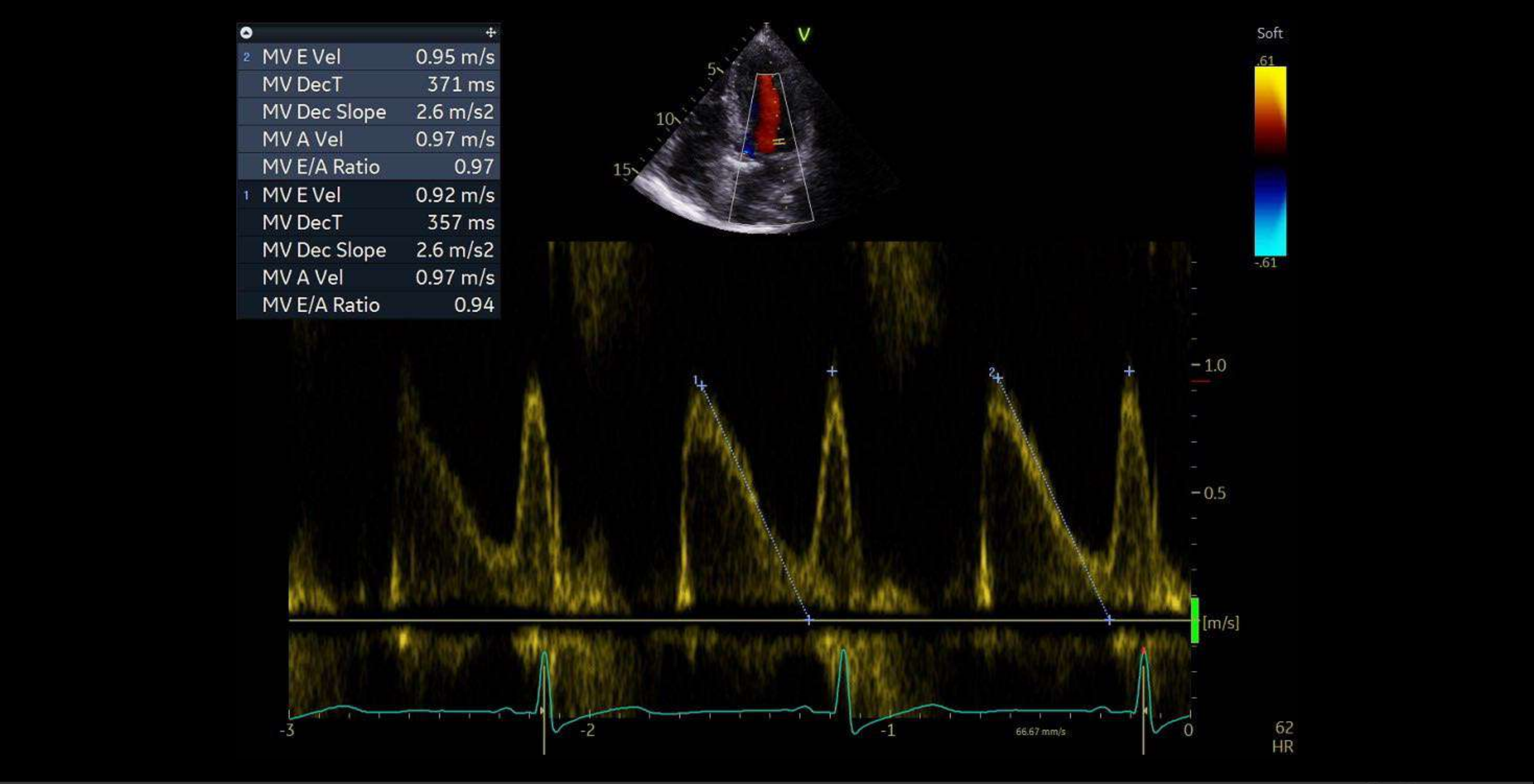
(Proteus mirabilis bacteraemia)

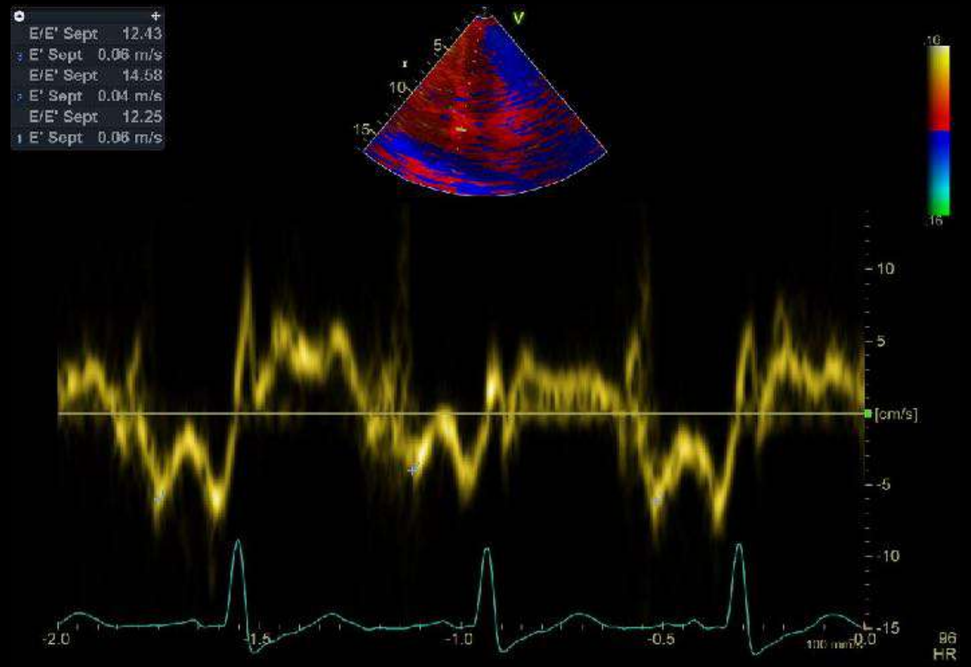
Frail

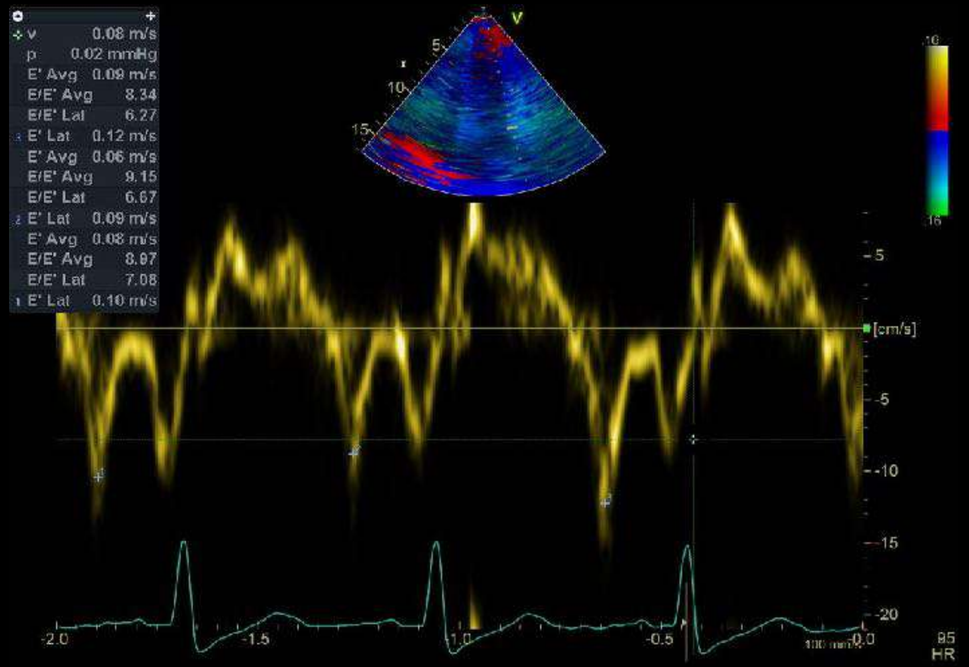


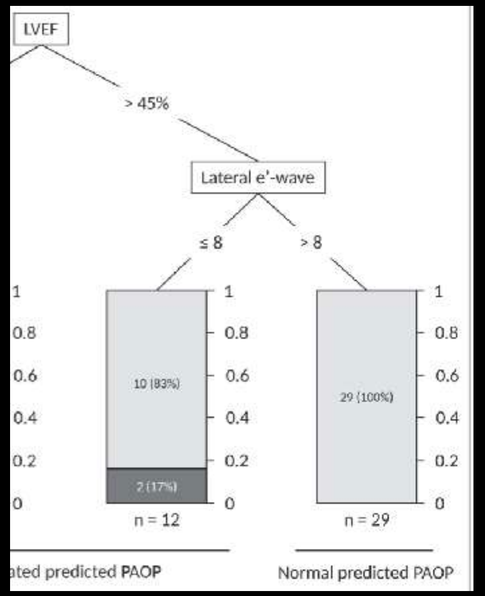
Fluid management key …

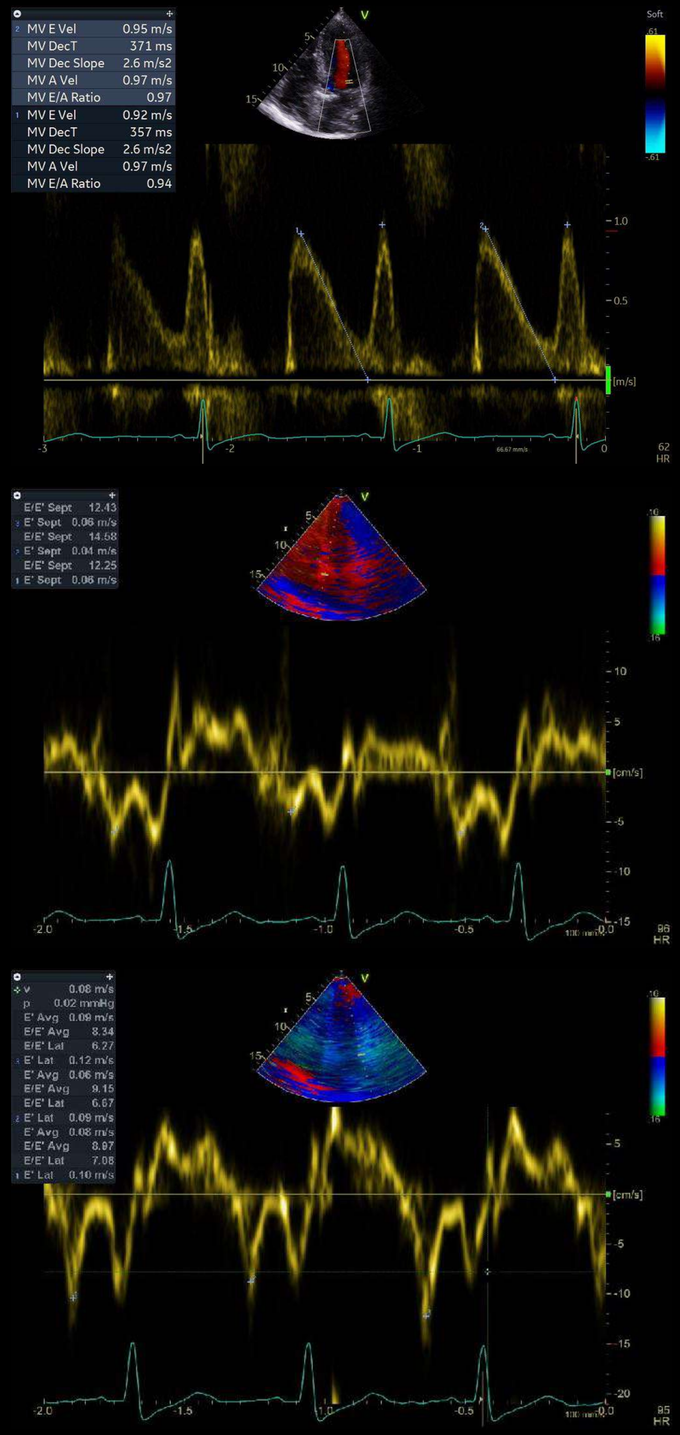
- Avoid hypovolaemia (can => increased AV gradients)
- Avoid fluid overload (can => pulmonary oedema)


MV E Vel 0.95 m/s
MV DecT 371 ms
MV Dec Slope 2.6 m/s2
MV A Vel 0.97 m/s
MV E/A Ratio 0.97
MV E Vel 0.92 m/s
MV DecT 357 ms
MV Dec Slope 2.6 m/s2
MV A Vel 0.97 m/s
MV E/A Ratio 0.94
Soft
.61
-.61
1.0
0.5
[m/s]
-3
-2
-1
0
66.67 mm/s
62
HR

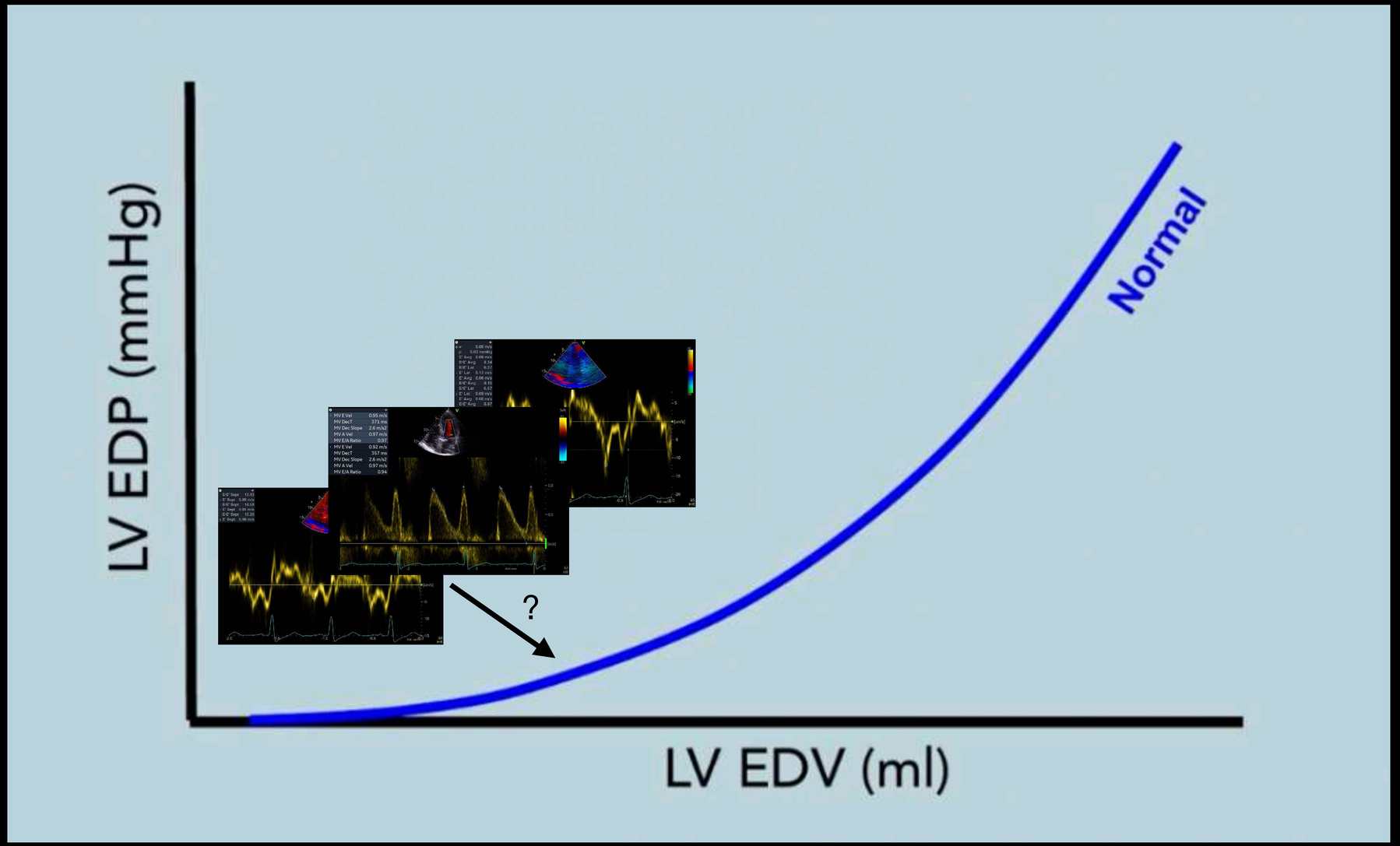

E/E' Sept 12.43
E' Sept 0.06 m/s
E/E' Sept 14.58
E' Sept 0.04 m/s
E/E' Sept 12.25
E' Sept 0.06 m/s
[cm/s]
HR

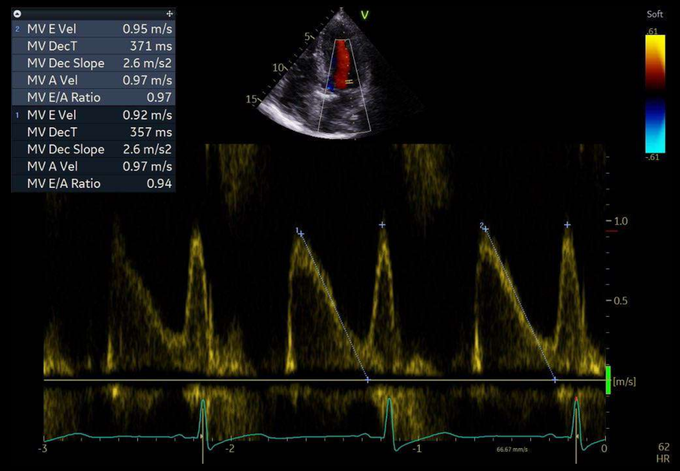

v 0.08 m/s
p 0.02 mmHg
E' Avg 0.09 m/s
E/E' Avg 8.34
E/E' Lat 6.27
E' Lat 0.12 m/s
E' Avg 0.06 m/s
E/E' Avg 9.15
E/E' Lat 6.67
E' Lat 0.09 m/s
E' Avg 0.08 m/s
E/E' Avg 8.97
E/E' Lat 7.08
E' Lat 0.10 m/s
[cm/s]
HR


LVEF
> 45%
Lateral e'-wave
≤ 8
> 8
10 (83%)
2 (17%)
29 (100%)
n = 12
n = 29
ated predicted PAOP
Normal predicted PAOP



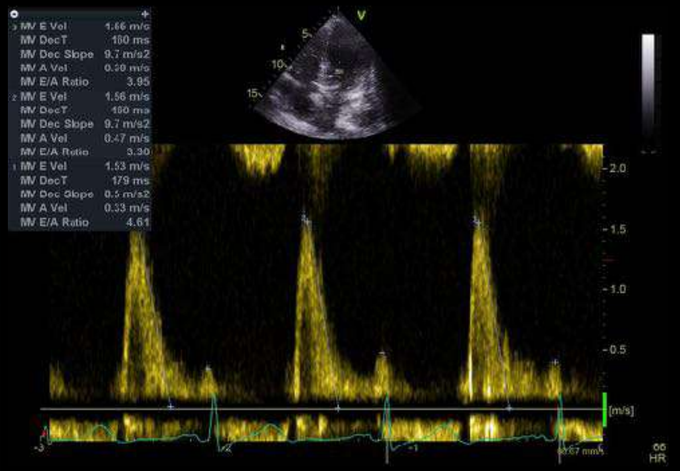
	Admission echo	
E wave Vmax	0.95	
E:A	0.96	
E:e' average	9	
Decel time (msec)	**360**	

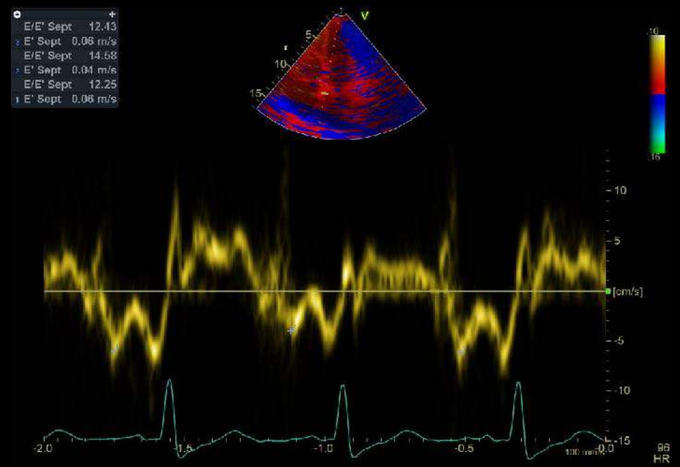

LV EDP (mmHg)
LV EDV (ml)
Normal
?

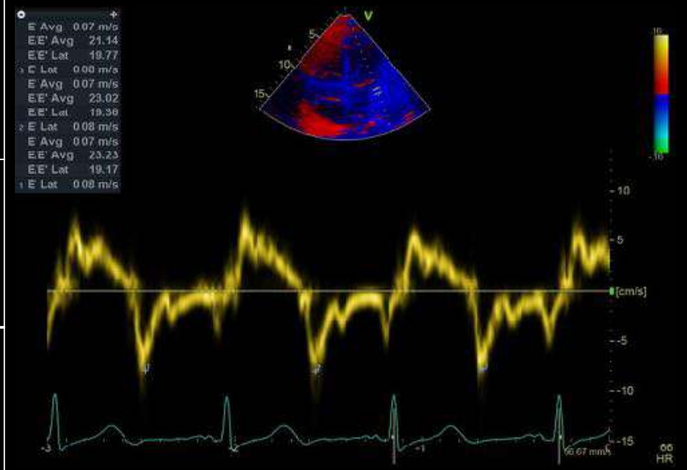


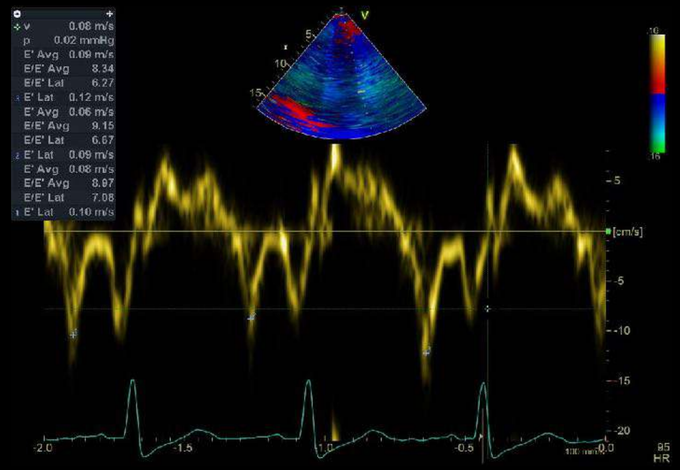
+750ml fluid resuscitation

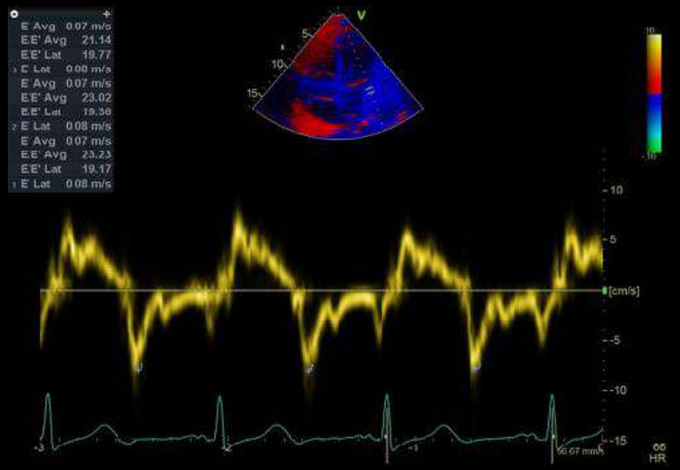
	Admission echo	Post 750ml fluid
E wave Vmax	0.95	1.5
E:A	0.96	4.1
E:e' average	9	21
Decel time (msec)	360	160









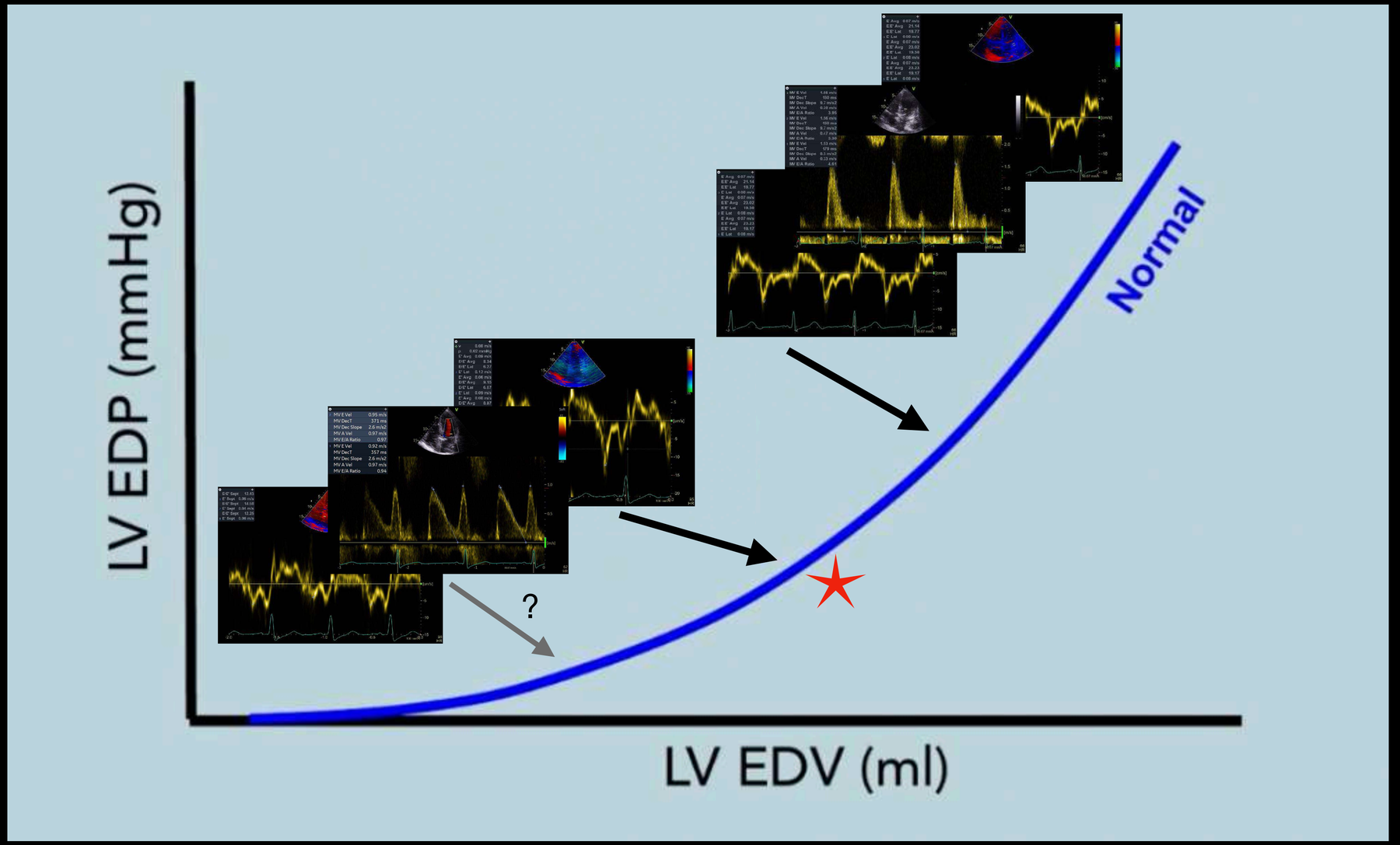


<u>Increased</u>:

- **E:A ratio**
- **E wave Vmax**
- **E:e'**

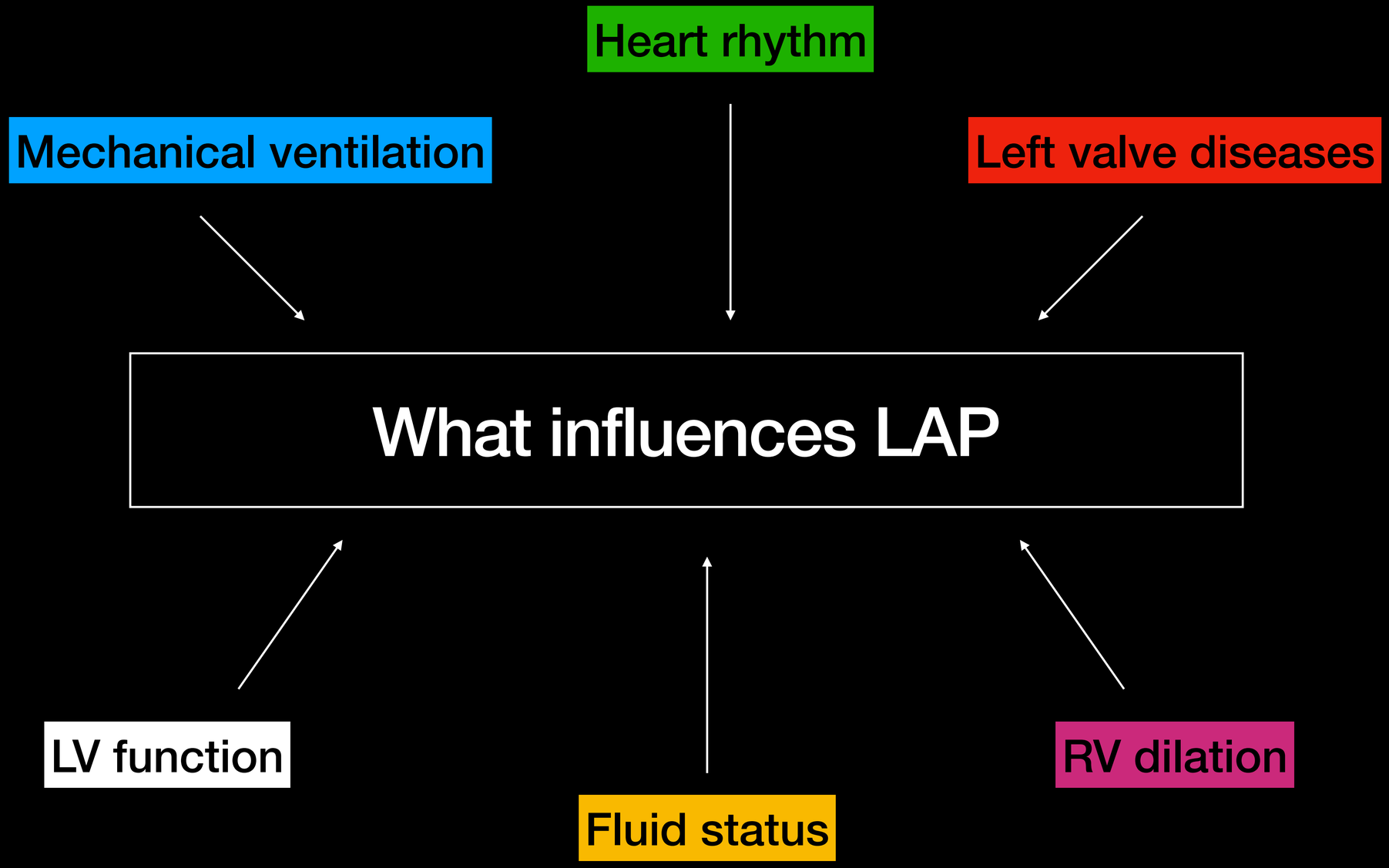
<u>Decreased</u>:

- **Decel time**


LV EDP (mmHg)
LV EDV (ml)
Normal
?

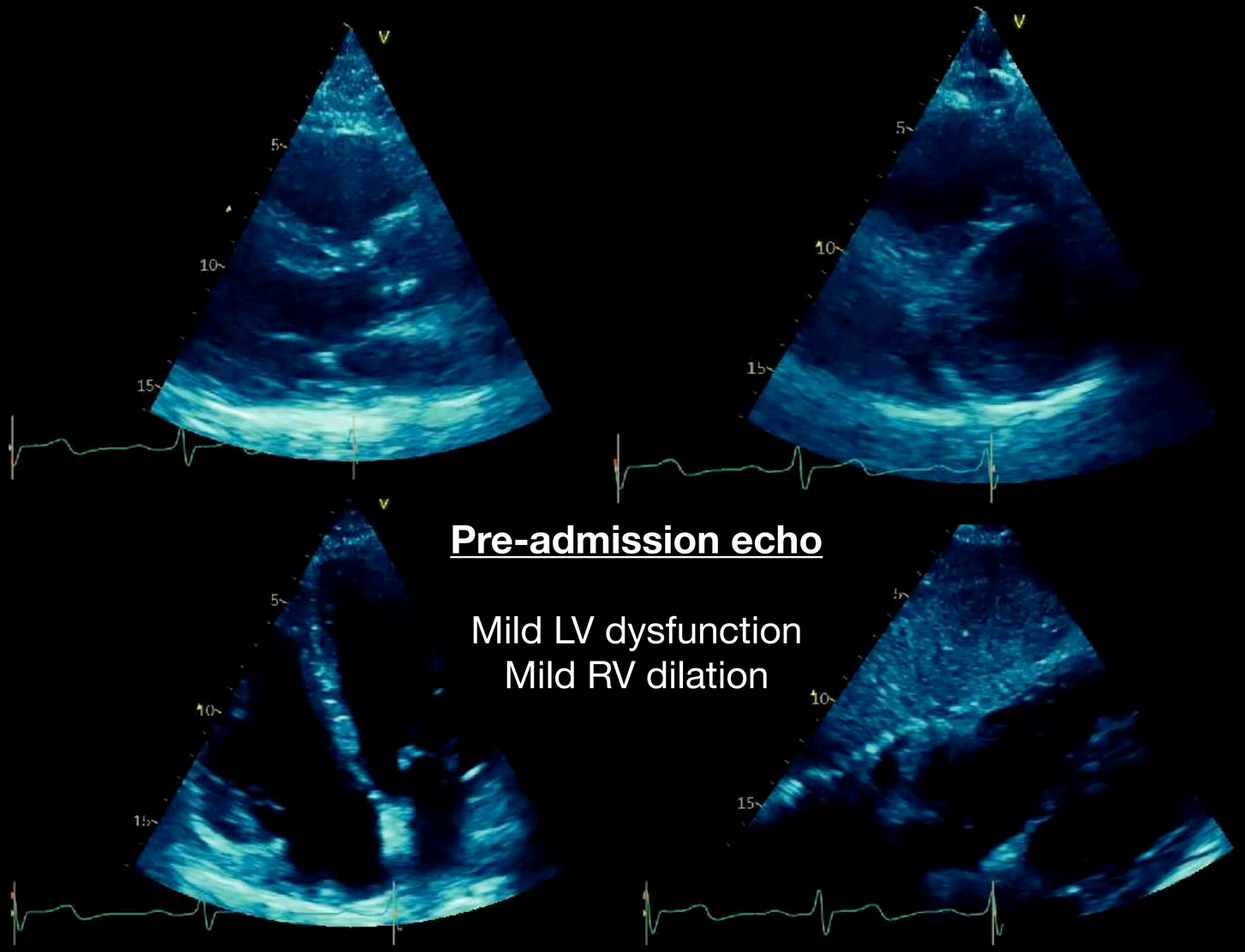
LAP assessment in fluid management

- If ‘significant’ rise in LAP parameters with fluid administration
- … stop giving fluids
- … give catecholamines to increase after load (eg: Noradrenaline)


Heart rhythm
Mechanical ventilation
Left valve diseases
What influences LAP
LV function
Fluid status
RV dilation

LV function

67yo male, immunosuppressed vs ILD, “ex”-smoker, Flu A +ve



Pre-admission echo

Mild LV dysfunction
Mild RV dilation

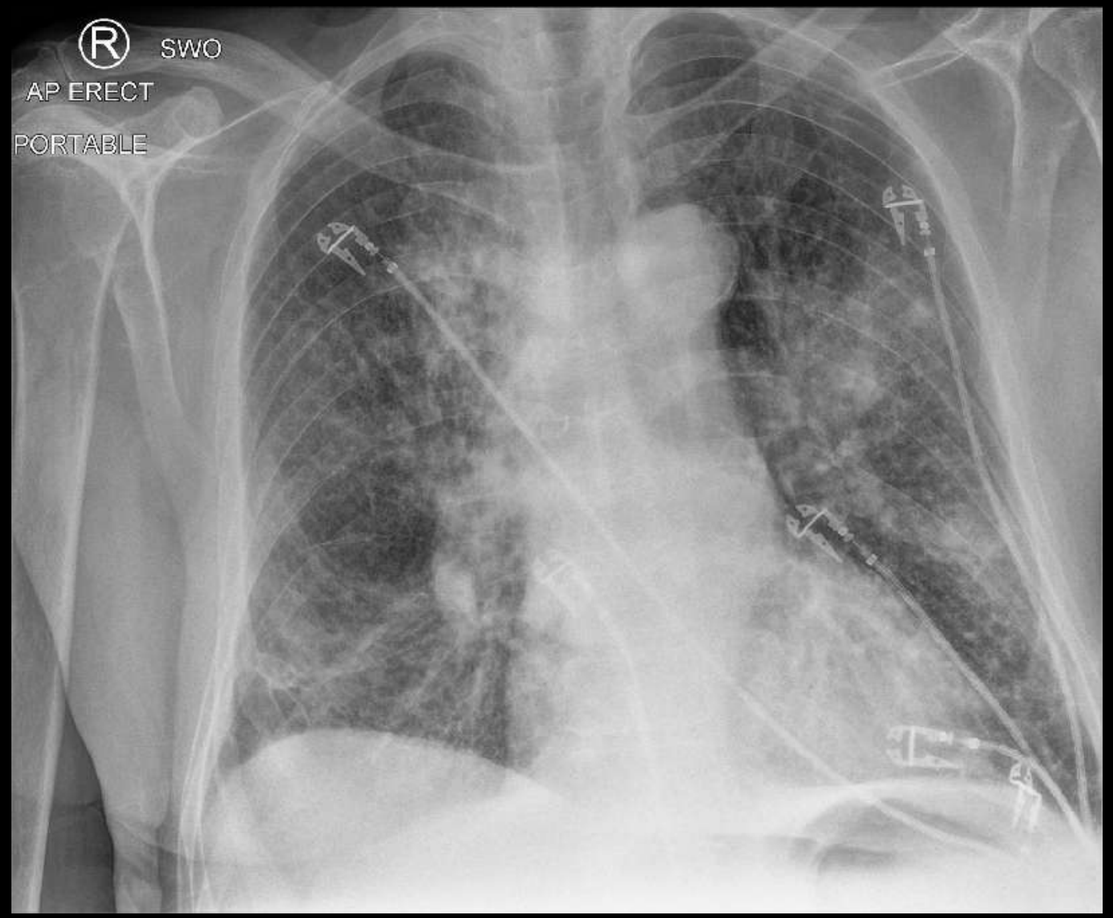
67yo male, immunosuppressed, ILD, “ex”-smoker, Flu A +ve

36hours later … worsening shortness of breath and hypotension

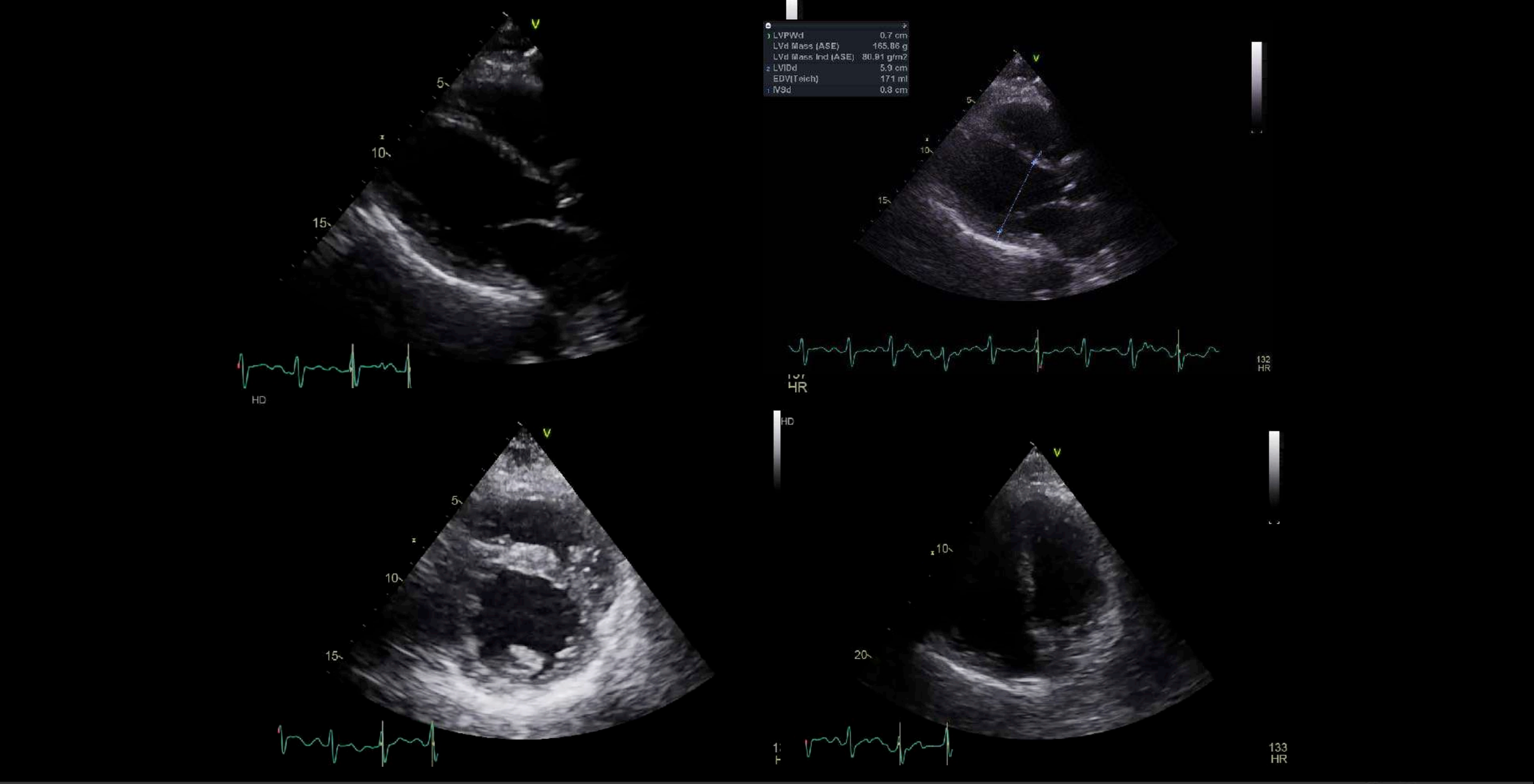
=> ICU & Noradrenaline 6mcg/min

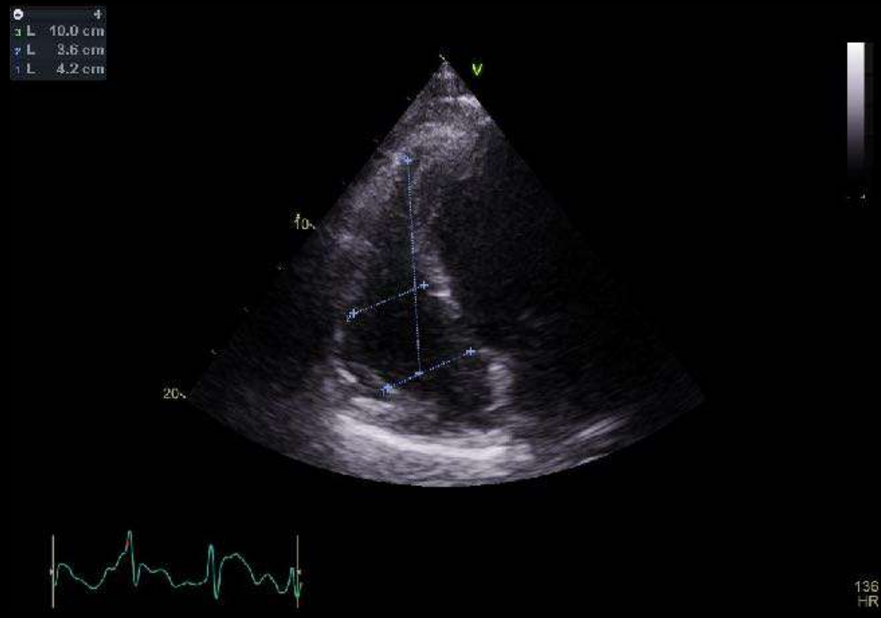
ED admission

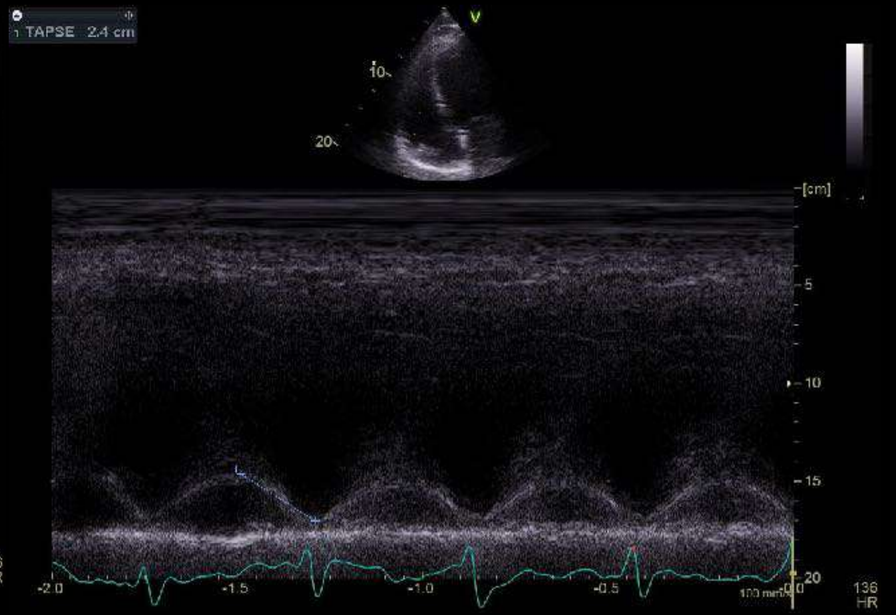
Day 1
in ICU



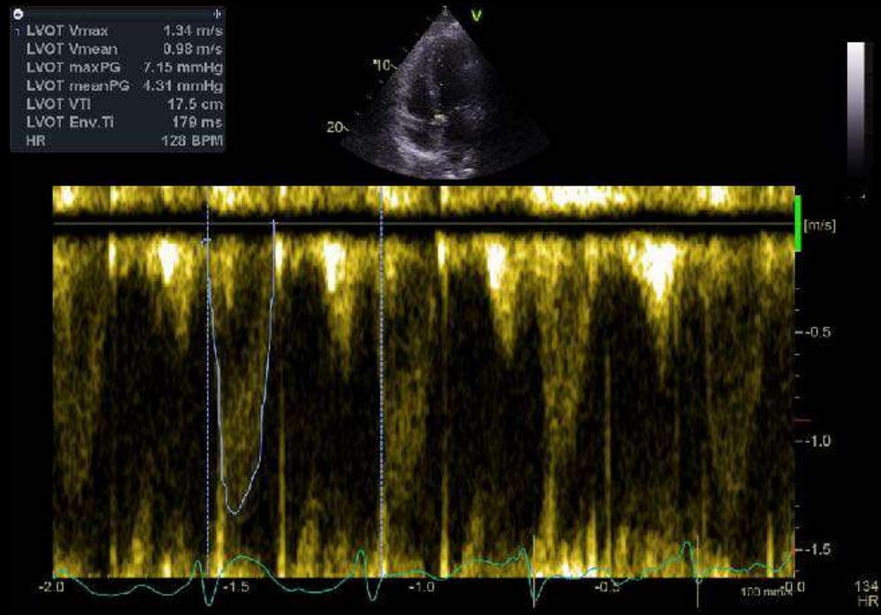
Differential: Fluid overload / worsening pneumonitis / bacterial superinfection / fungal infection / acute ILD flair

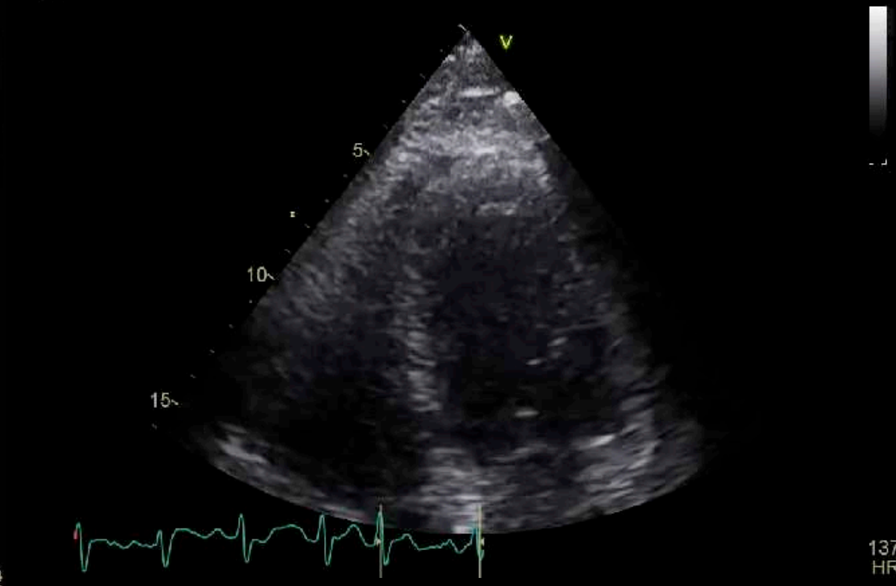

LVPWd 0.7 cm
LVd Mass (ASE) 165.86 g
LVd Mass Ind (ASE) 80.91 g/m2
LVIDd 5.9 cm
EDV(Teich) 171 ml
IVSd 0.8 cm
HD
HR
132
133

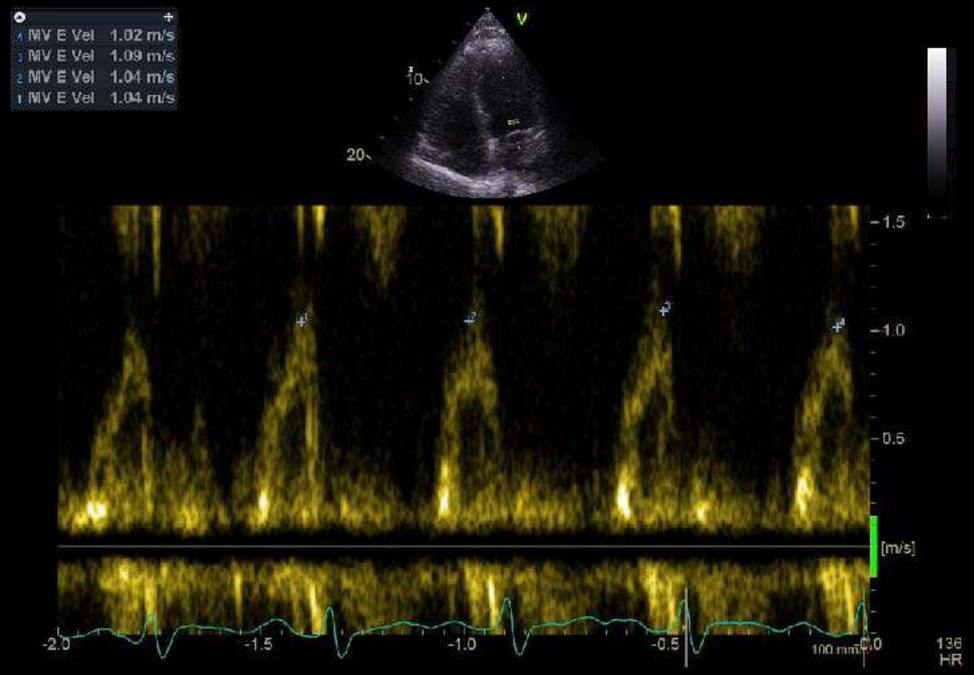


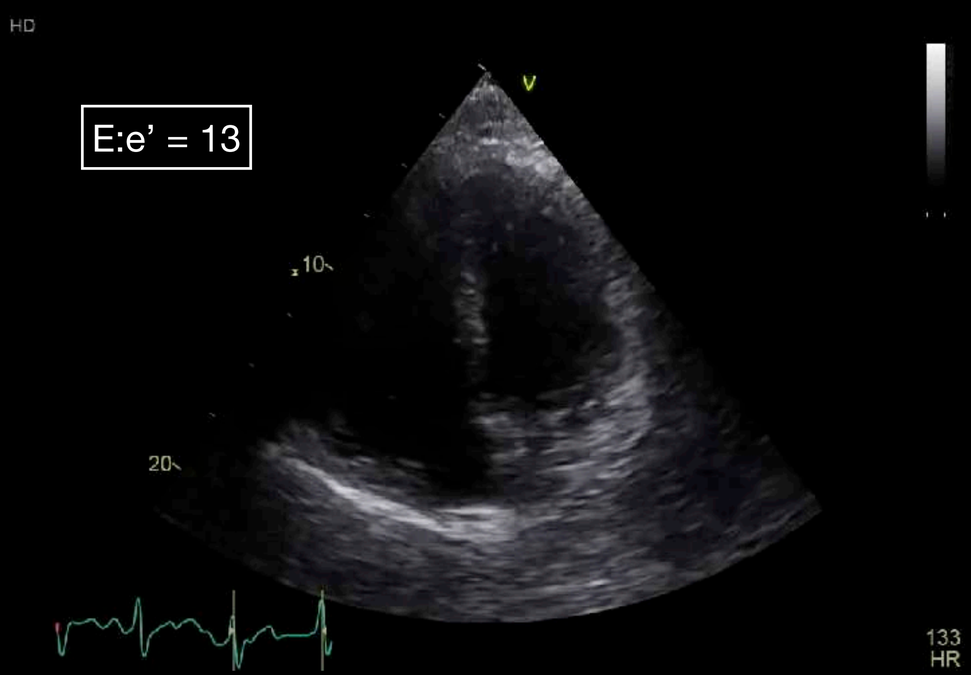


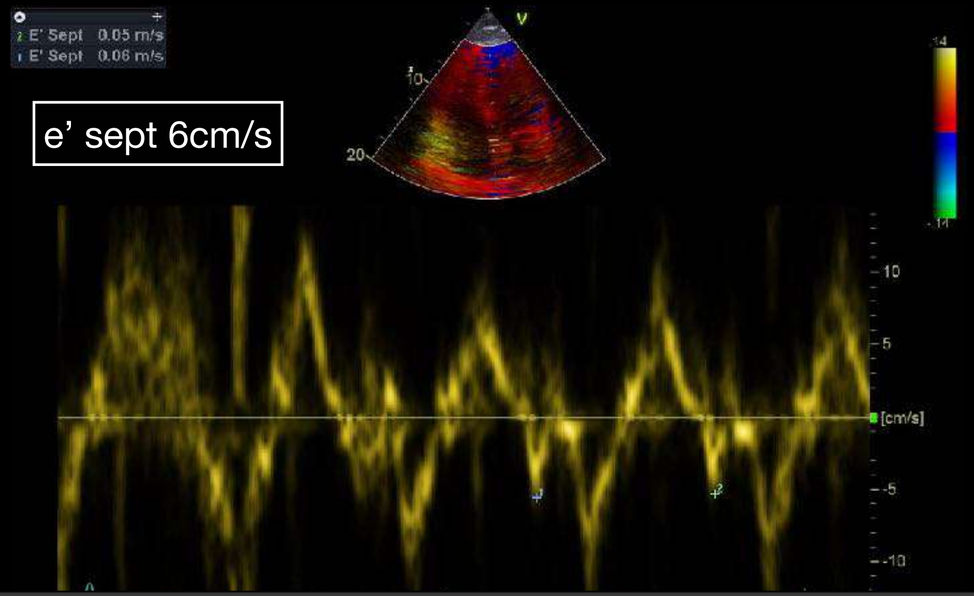
HD

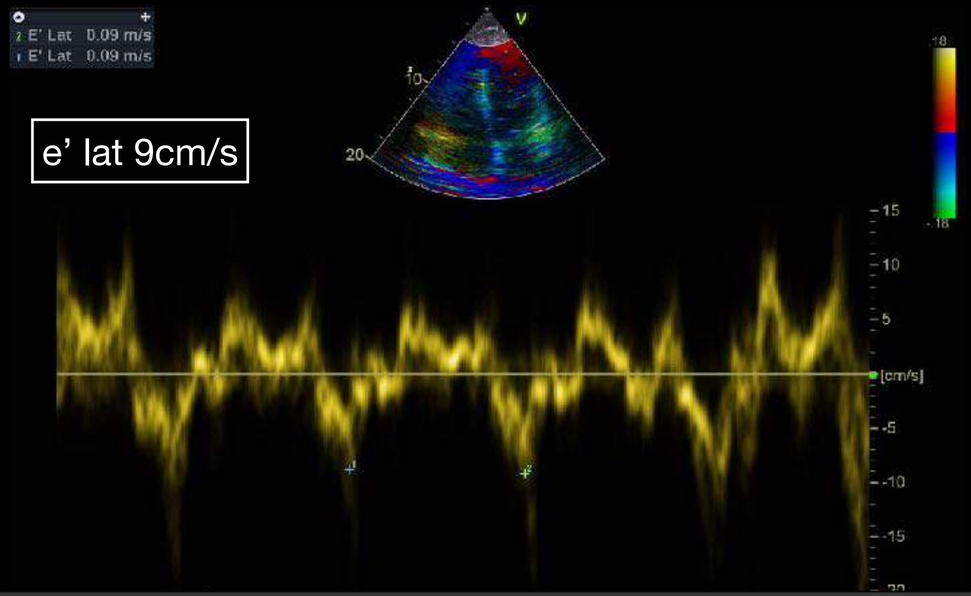


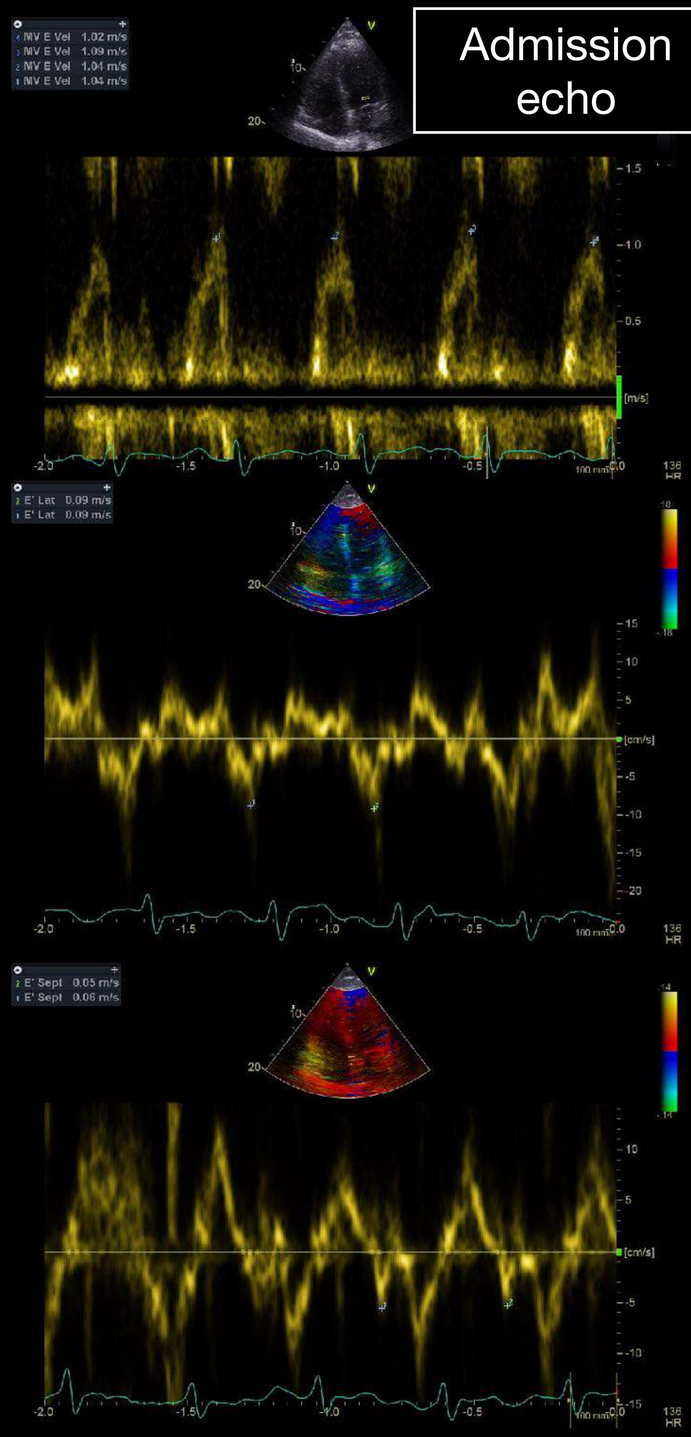




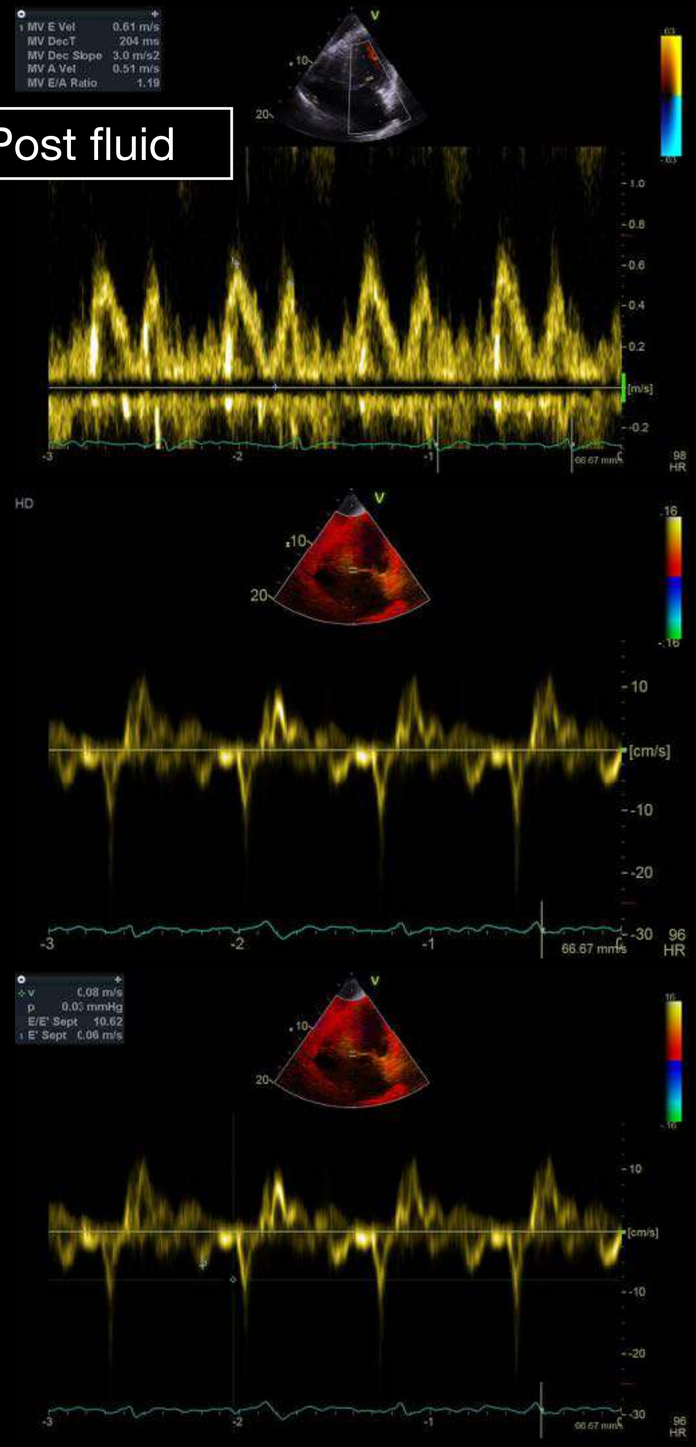








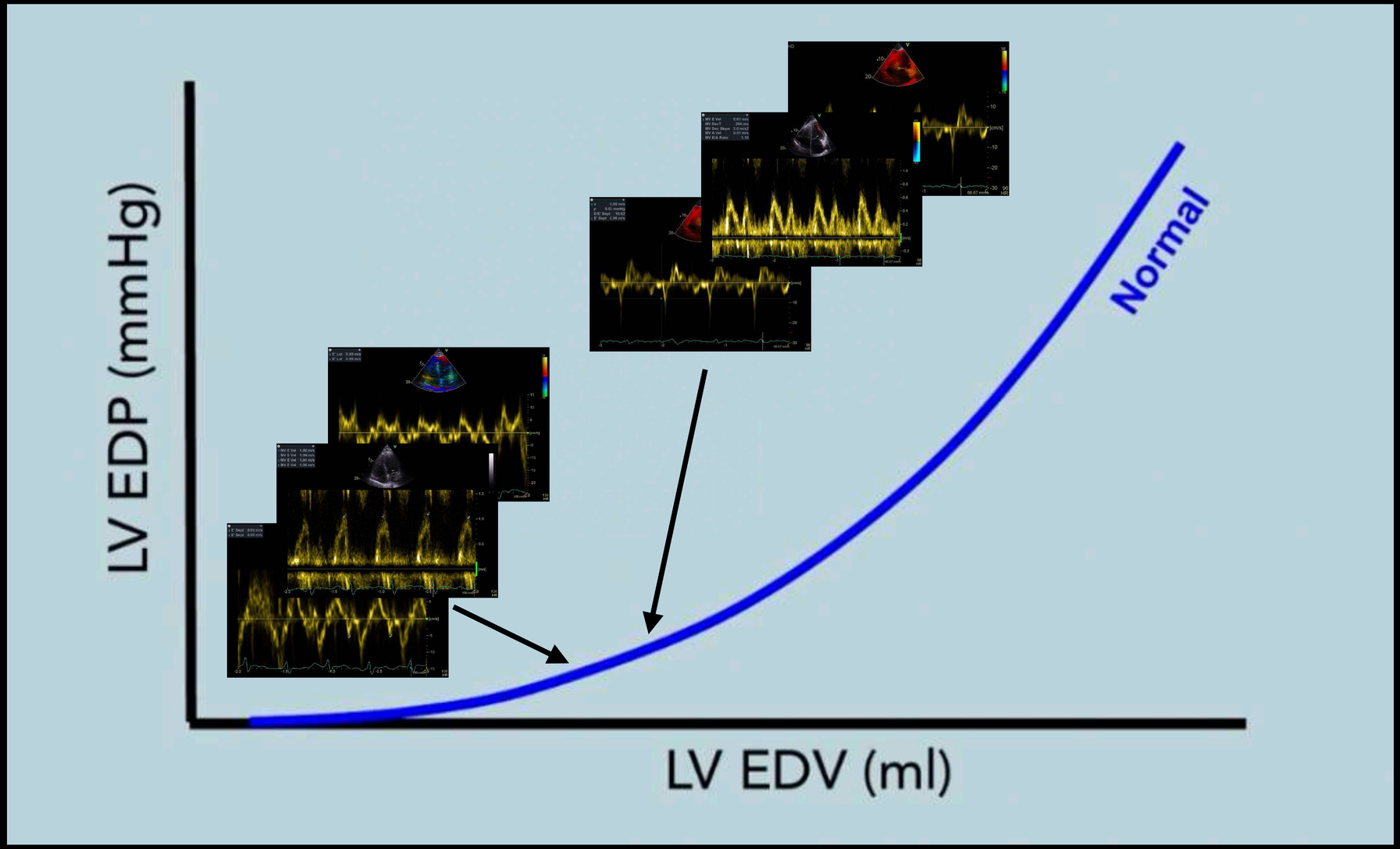
Admission echo



Post fluid

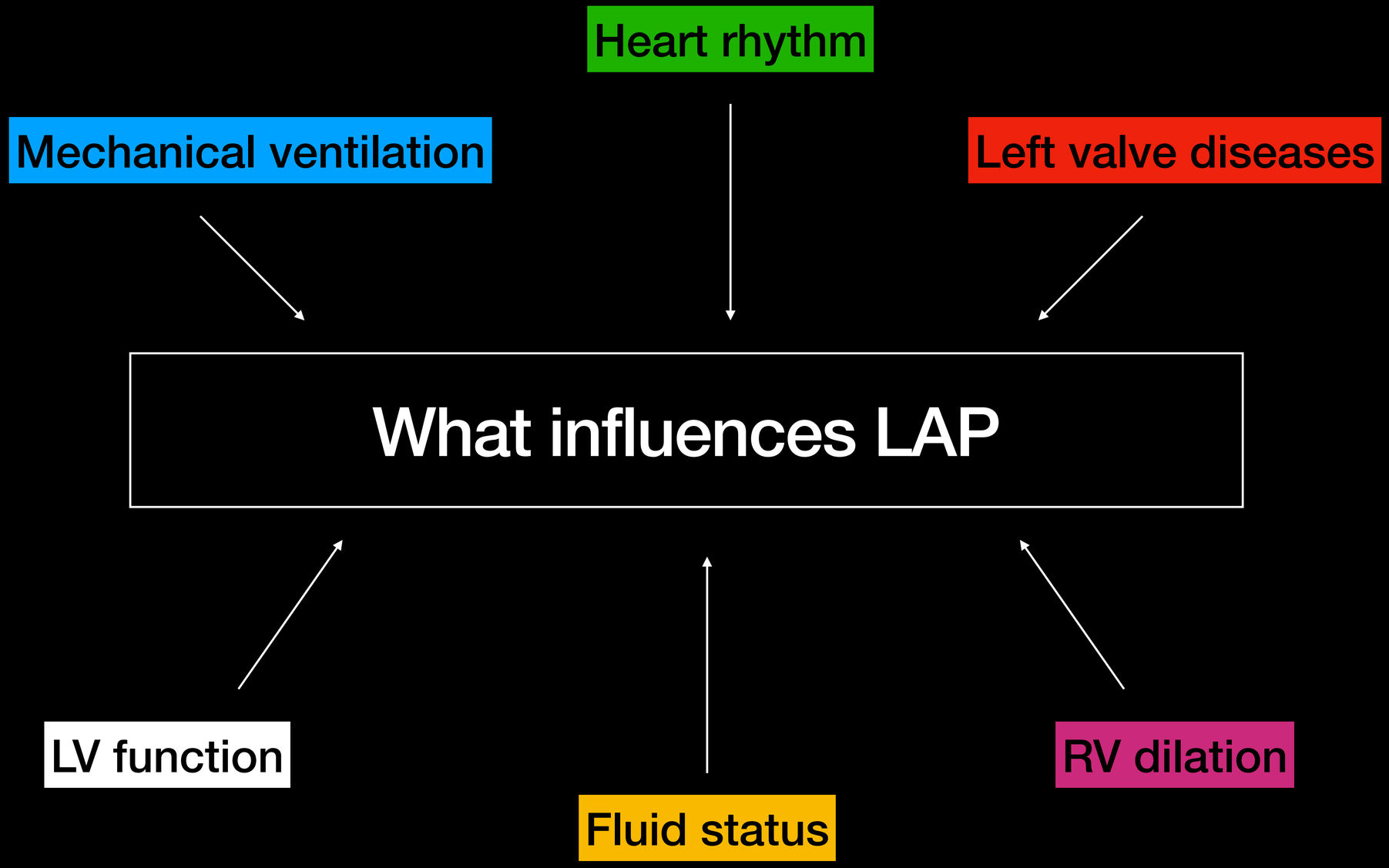
250 ml fluid bolus

	1st echo	Post 250ml fluid
E wave Vmax	?1.02	0.6
E:A	?<1	1
E:e' average	13	10
Decel time (msec)	**?**	**204**

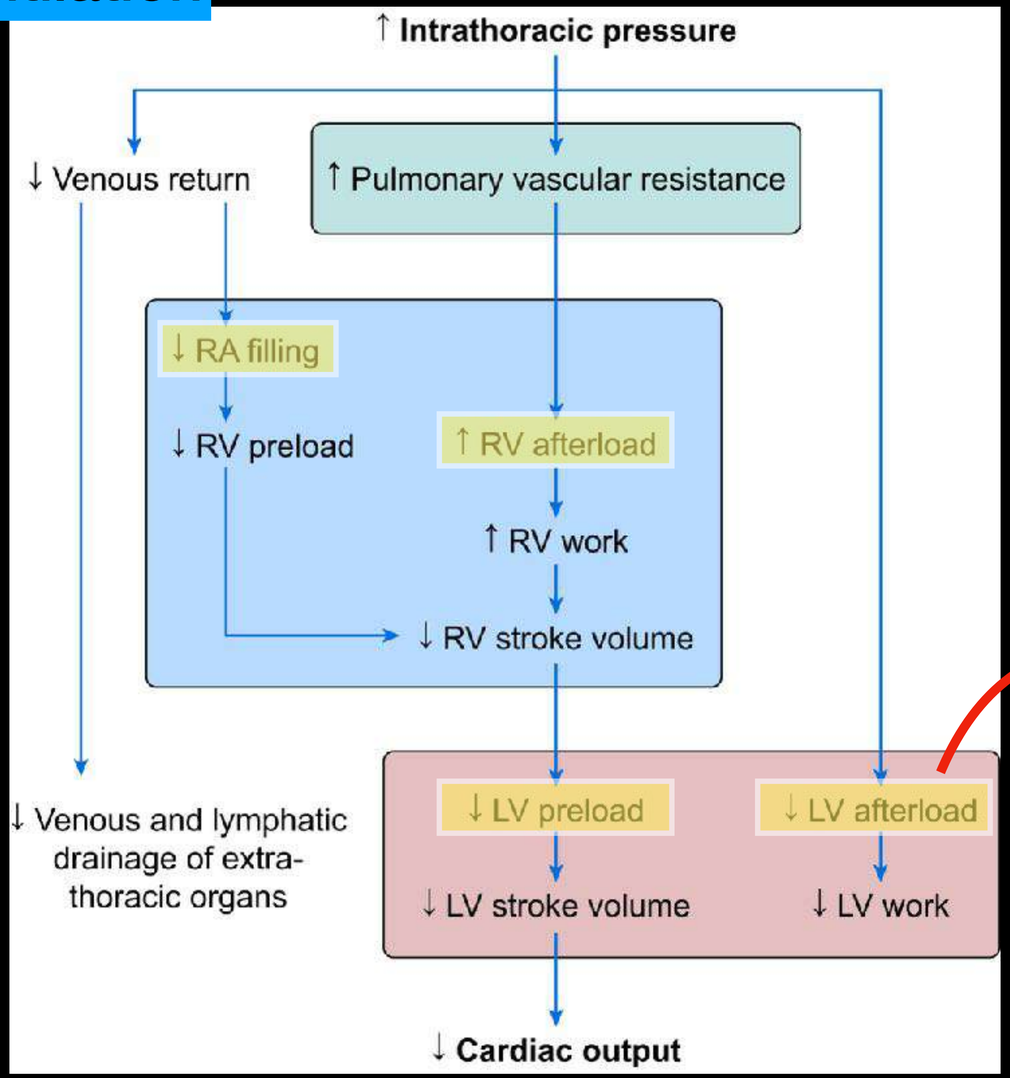

LV EDP (mmHg)
LV EDV (ml)
Normal

LAP assessment in acute LV dysfunction

- Risk high with these patients to get raised LAP / resp failure
- ‘POCUS” using Doppler repeat LAP review
- Judicious fluid bolus and repeat
- Balance fluids vs catecholamines


Heart rhythm
Mechanical ventilation
Left valve diseases
What influences LAP
LV function
Fluid status
RV dilation

Mechanical ventilation



Laplace's law
= P x r / T

The cardiovascular effects of positive pressure ventilation

A. Corp*, C. Thomas and M. Adlam

St James University Hospital, Leeds, UK

BJA Education, 21(6): 202–209 (2021)

doi: 10.1016/j.bjae.2021.01.002

Advance Access Publication Date: 15 March 2021

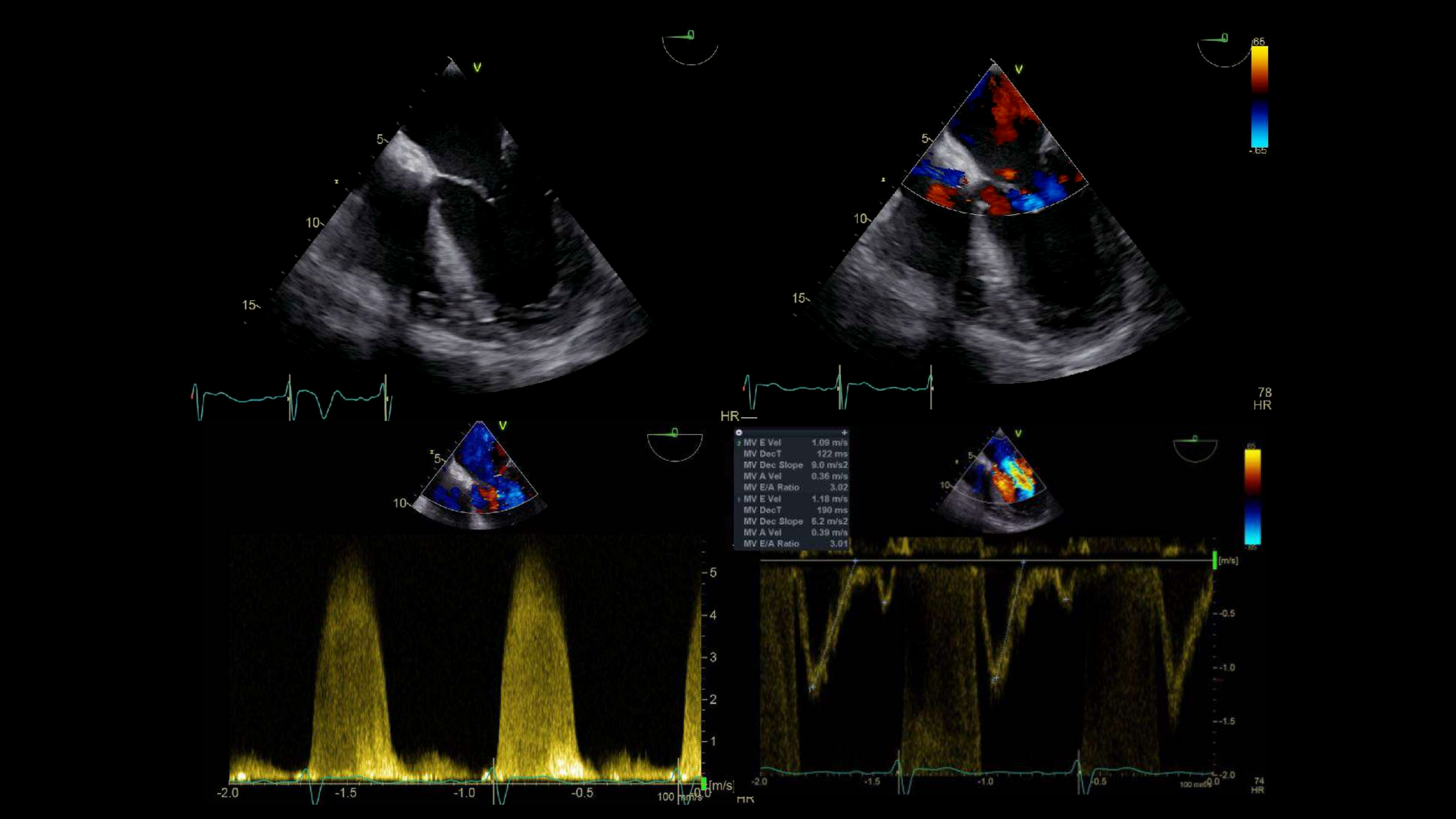
61yo male (truck driver)

PC: Conscious VT, HR 180 and hypotension

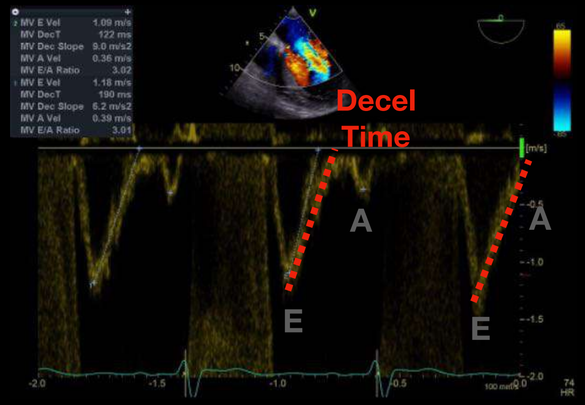
PMH: HTN, DM, BMI 40, smoker

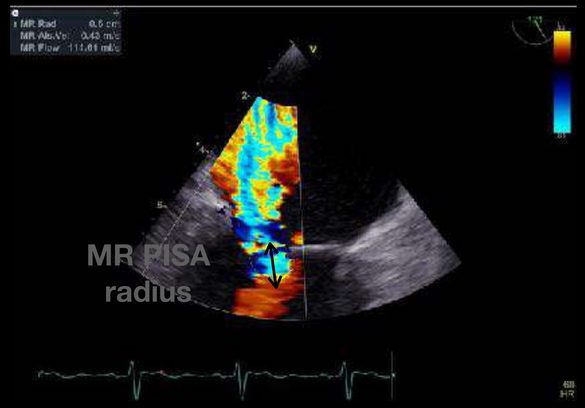
- ED = Mg2+, Amiodarone => SR => CCU
- 24hr later MET call = HTN, desaturation, agitation = APO
- Agitation / intolerance of CPAP => ICU for intubation

- Few days down track CXR better, -ve 4L , mild ARF, ‘difficulty’ weaning


78
HR
MV E Vel 1.09 m/s
MV DecT 122 ms
MV Dec Slope 9.0 m/s2
MV A Vel 0.36 m/s
MV E/A Ratio 3.02
MV E Vel 1.18 m/s
MV DecT 190 ms
MV Dec Slope 6.2 m/s2
MV A Vel 0.39 m/s
MV E/A Ratio 3.01
[m/s]
74
HR

PEEP 10

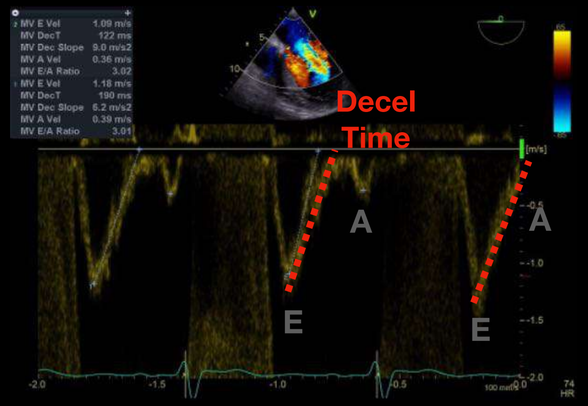


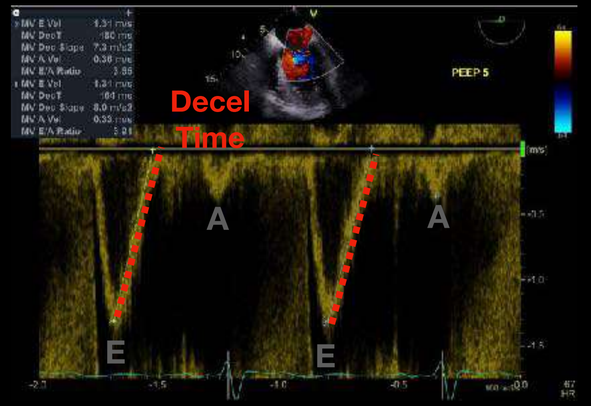


	PEEP 10	
E Vmax	1.15	
Decel Time	190	
E:A	3.0	
E:e'	14	
S:D	0.34	
MR PISA radius (cm)	0.6	

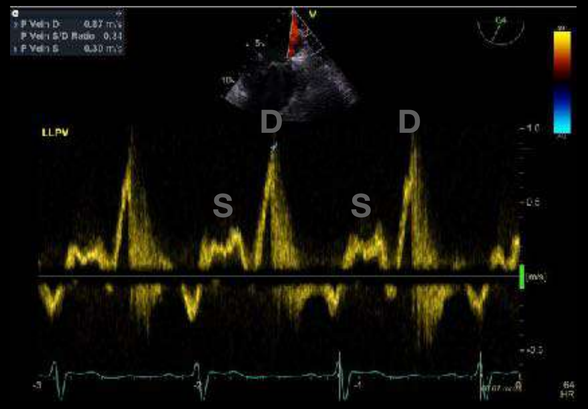
PEEP 10

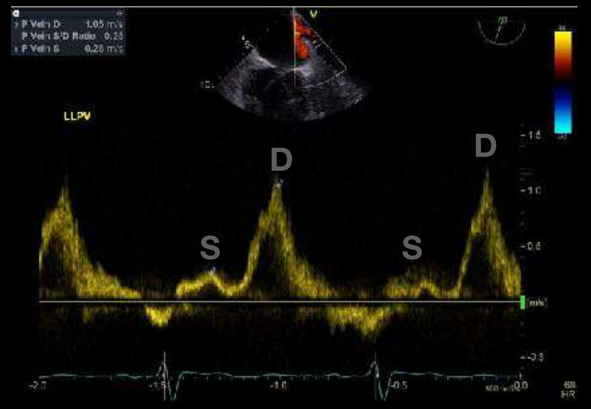
PEEP 5

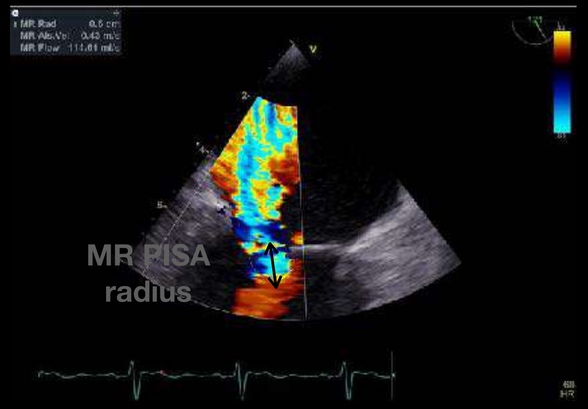




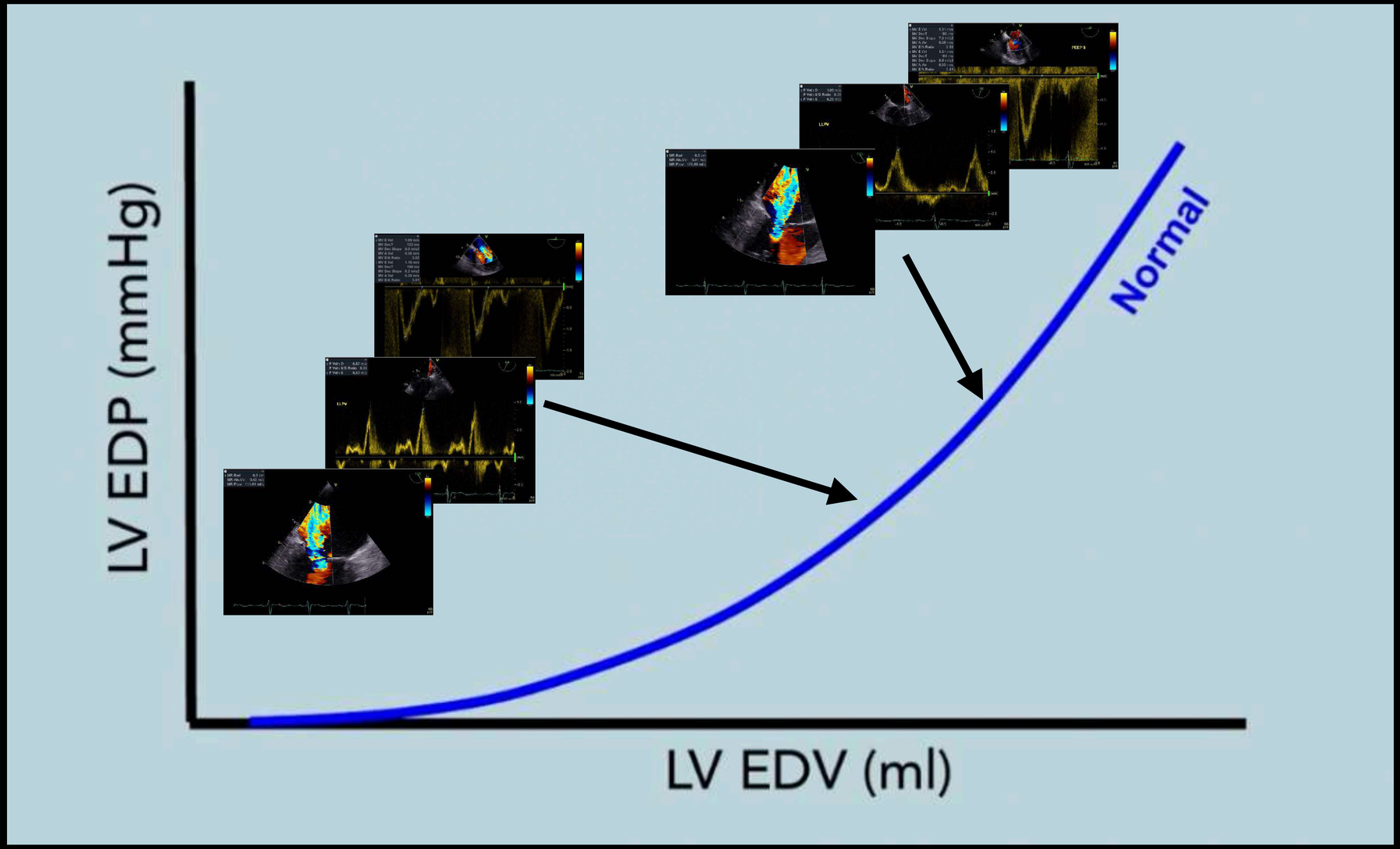
Spontaneous Breathing Trial





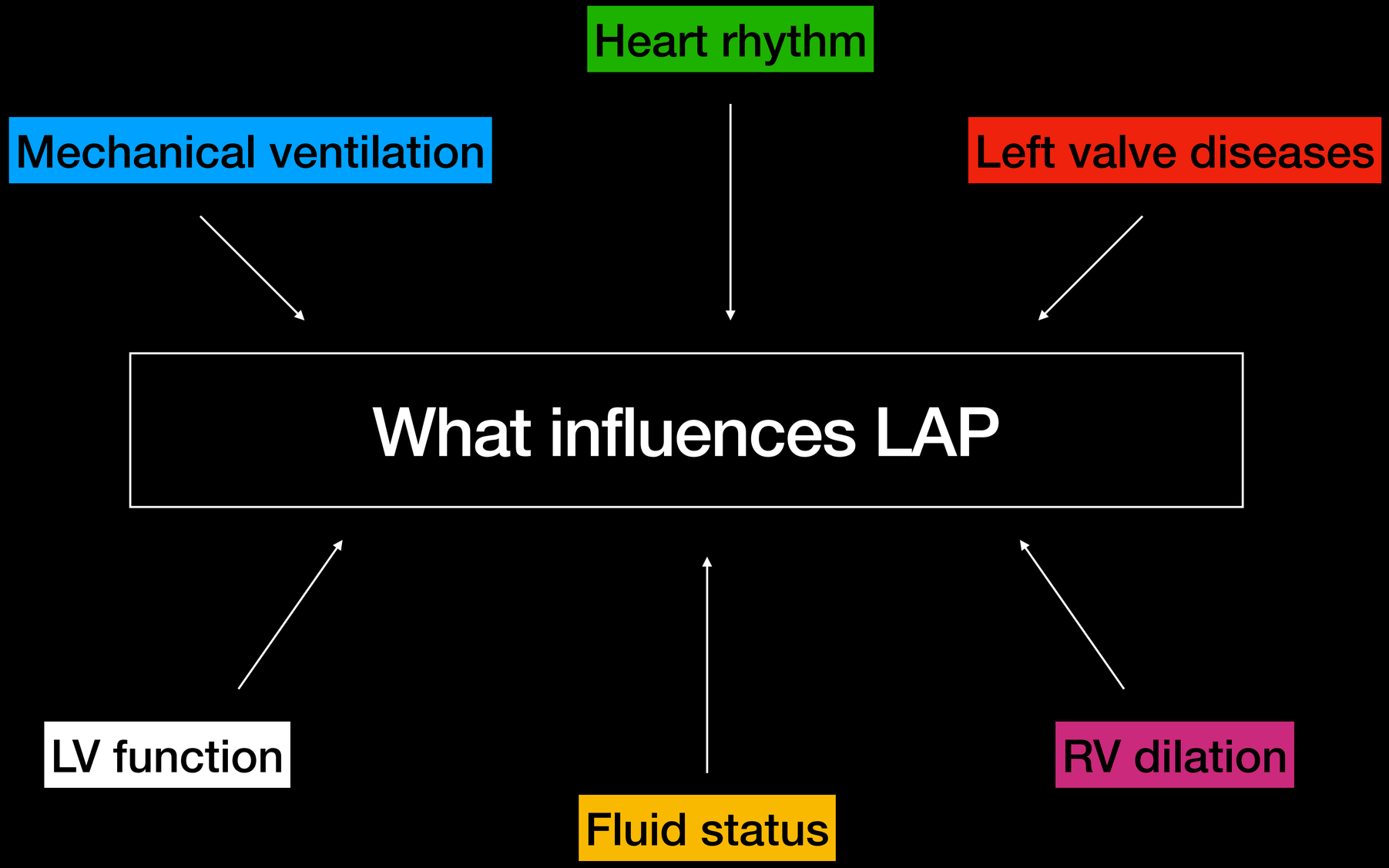


	PEEP 10	PEEP 5
E Vmax	1.15	1.31
Decel Time	190	164
E:A	3.0	3.8
E:e'	14	23
S:D	0.34	0.25
MR PISA radius (cm)	0.6	0.8


LV EDP (mmHg)
LV EDV (ml)
Normal

LAP assessment in weaning from mechanical ventilation

- Significant raised LAP remains despite improved CXR
- Ongoing diuresis *essential*
- Repeat ‘spontaneous breathing trial’ till non-significant change


Heart rhythm
Mechanical ventilation
Left valve diseases
What influences LAP
LV function
Fluid status
RV dilation

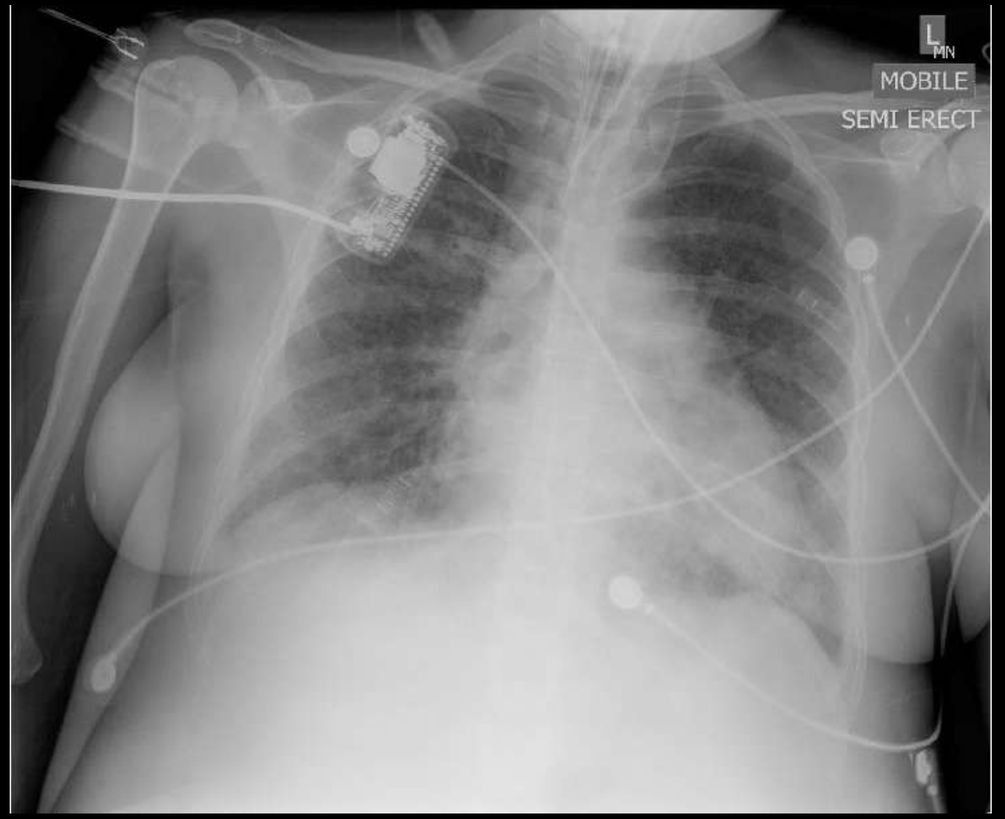
RV dilation

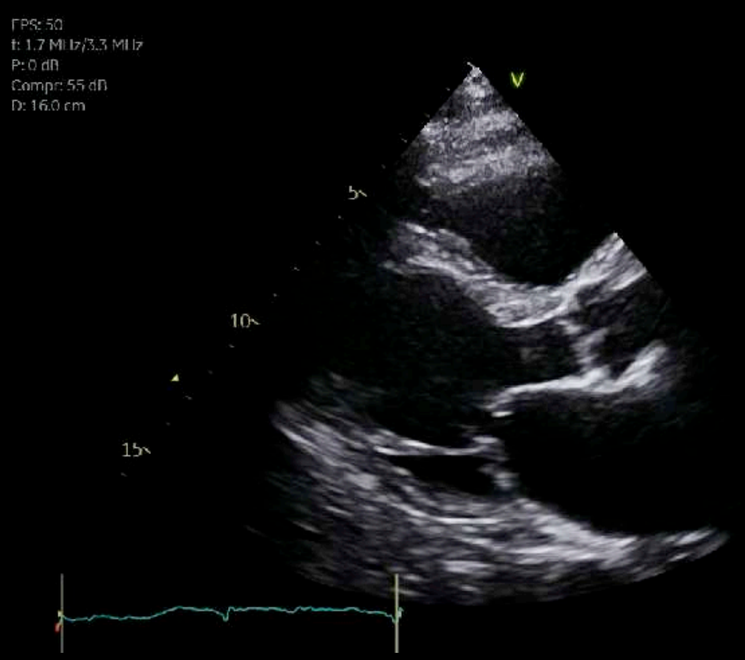
45yo *Pneumocystis jirovecii* pneumonia after renal transplant.

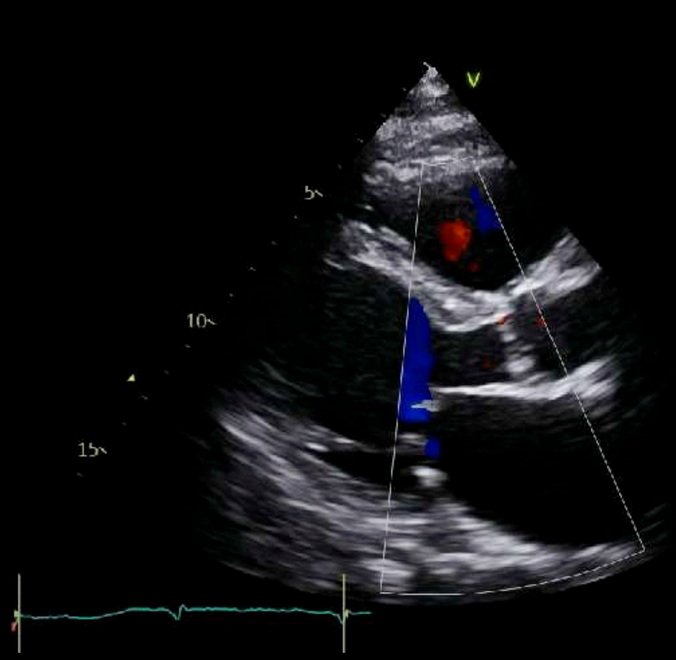
- Failed HFNP => intubation
- Max conventional MV

…. **? start iNO**

Results	13:27	11:28
Point of Care Testing (POCT)		
Specimen Type POCT	Arterial	Arterial
Device Facility	Nepean	Nepean
Device Type	ABL	ABL
Device Ward	ICUA	ICUA
Instrument ID	D210ICUAAB01	D210ICUAAB01
Blood Gas		
Inspired Oxygen	80.0 %	90.0 %
Blood pH	7.23 L	7.22 L
Blood pO2	78 mmHg	63 mmHg L
Blood pCO2	81 mmHg H	81 mmHg H
Blood O2 Saturation	94 % L	88 % L
Blood HCO3	33 mmol/L H	32 mmol/L H
Blood Base Excess	4 mmol/L H	3 mmol/L
Blood Sodium	148 mmol/L H	150 mmol/L H
Blood Potassium	5.4 mmol/L	5.3 mmol/L
Blood Chloride	108 mmol/L H	107 mmol/L
Blood Glucose	13.3 mmol/L	13.7 mmol/L
Blood Lactate	0.9 mmol/L	1.1 mmol/L
Blood Calcium Ionised	1.22 mmol/L	1.25 mmol/L
Blood Total Haemoglobin	103 g/L L	111 g/L L
Blood Oxyhaemoglobin	91.8 % L	85.8 % L
Blood Carboxyhaemoglobin	1.1 %	1.3 %
Blood Deoxyhaemoglobin	6.2 % H	12.2 % H
Blood Methaemoglobin	0.9 %	0.7 %

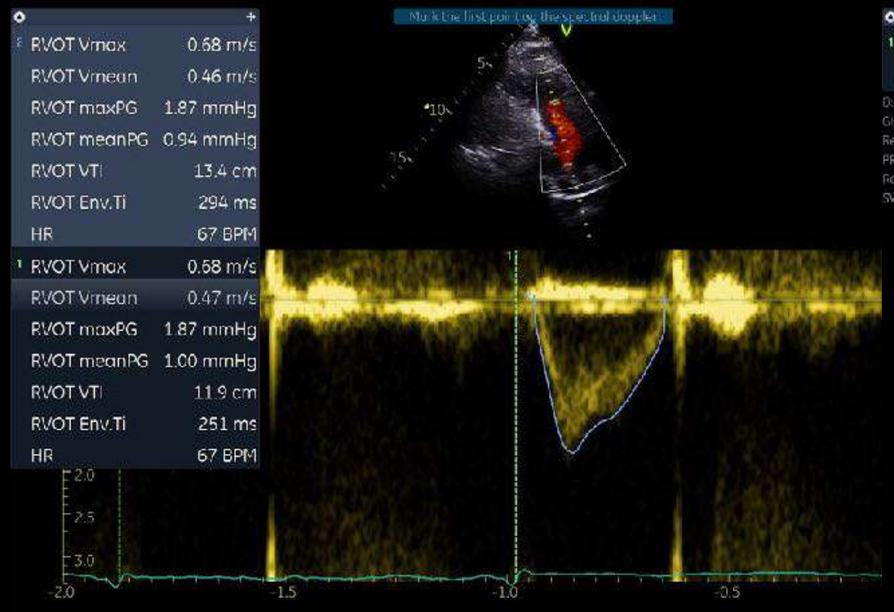


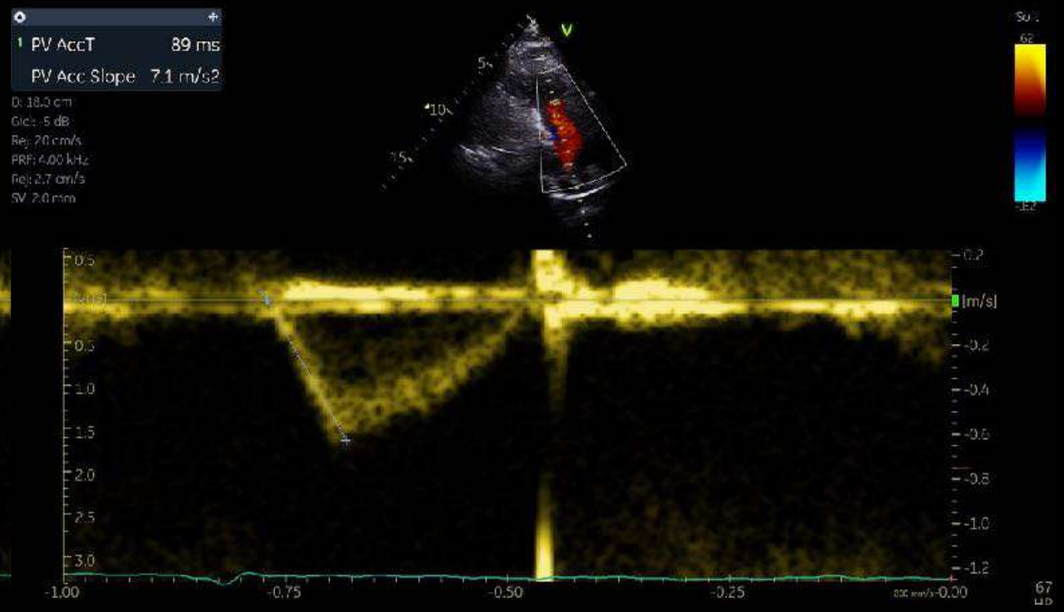

FPS: 50
f: 1.7 MHz/3.3 MHz
P: 0 dB
Compr: 55 dB
D: 16.0 cm
5
10
15
70
THR

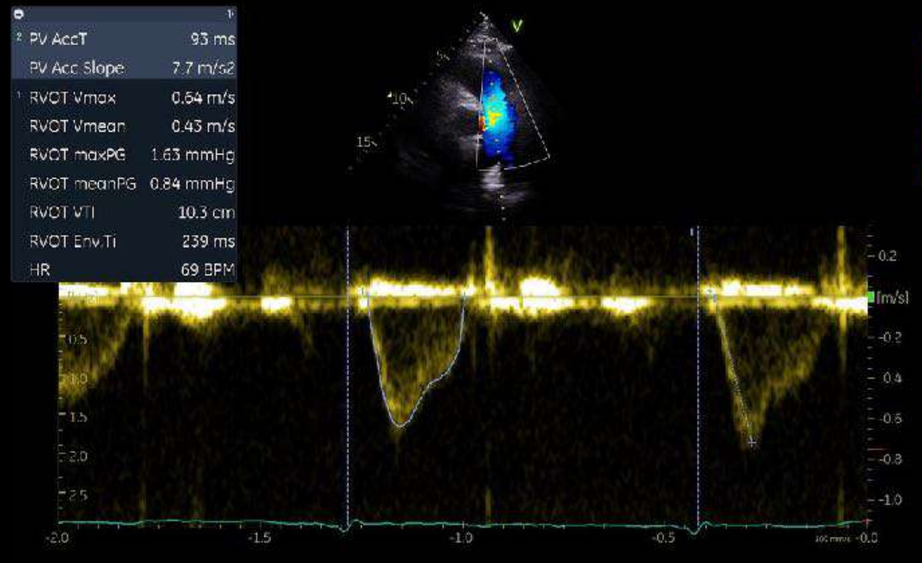

Soft
.62
-.62
5
10
15
71
THR

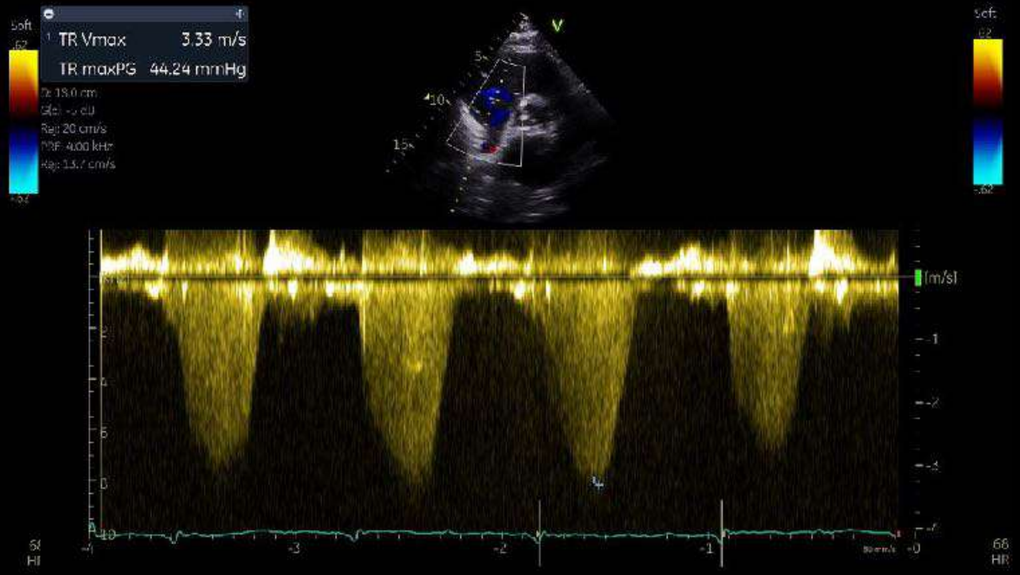

FPS: 19/19
f: 2.5 MHz/2.5 MHz
P: 0 dB
Compr: 55 dB
D: 18.0 cm
G(c): -5 dB
Rej: 20 cm/s
PRF: 4.00 kHz
Soft
.62
-.62
5
10
15
69
THR

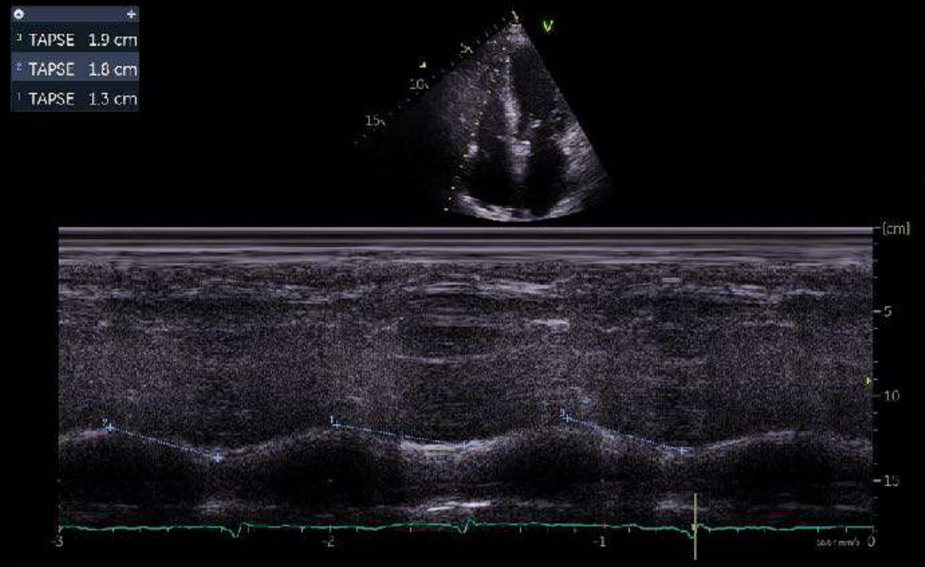

f: 1FPS: 50
P: f: 1.7 MHz/3.3 MHz
CoP: 0 dB
D: Compr: 50 dB
D: 18.0 cm
Soft
Soft
5
10
15
69
THR

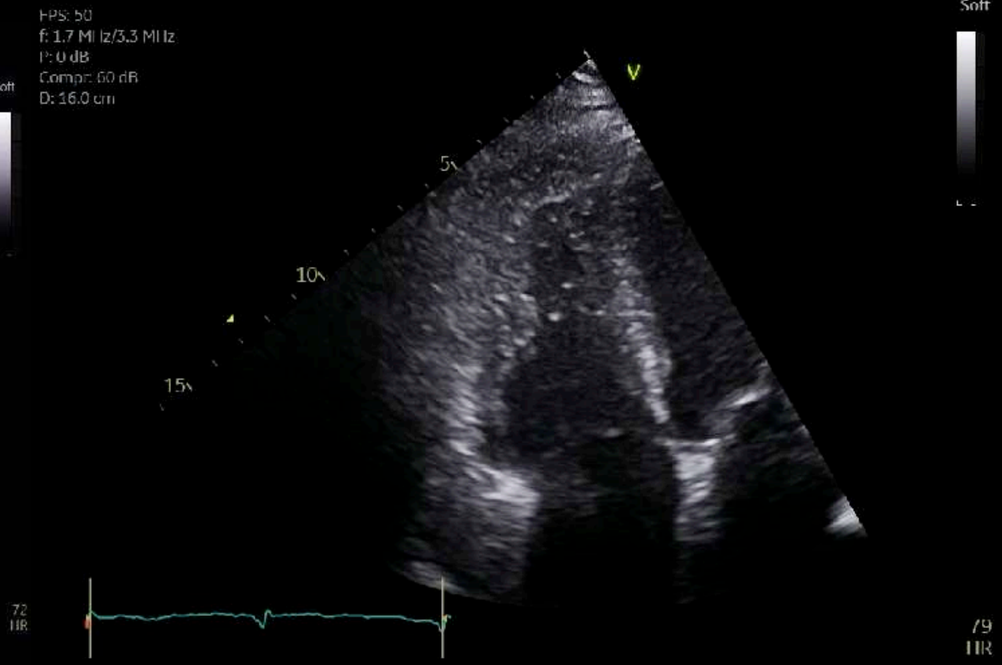

RVOT Vmax 0.68 m/s
RVOT Vmean 0.46 m/s
RVOT maxPG 1.87 mmHg
RVOT meanPG 0.94 mmHg
RVOT VTI 13.4 cm
RVOT Env.Ti 294 ms
HR 67 BPM
RVOT Vmax 0.68 m/s
RVOT Vmean 0.47 m/s
RVOT maxPG 1.87 mmHg
RVOT meanPG 1.00 mmHg
RVOT VTI 11.9 cm
RVOT Env.Ti 251 ms
HR 67 BPM

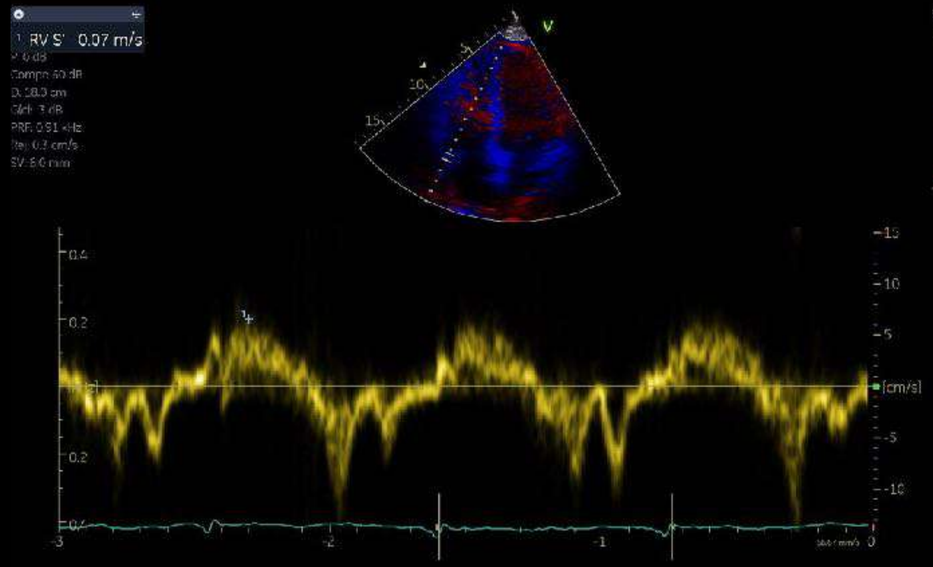

PV AccT 89 ms
PV Acc Slope 7.1 m/s2
[m/s]

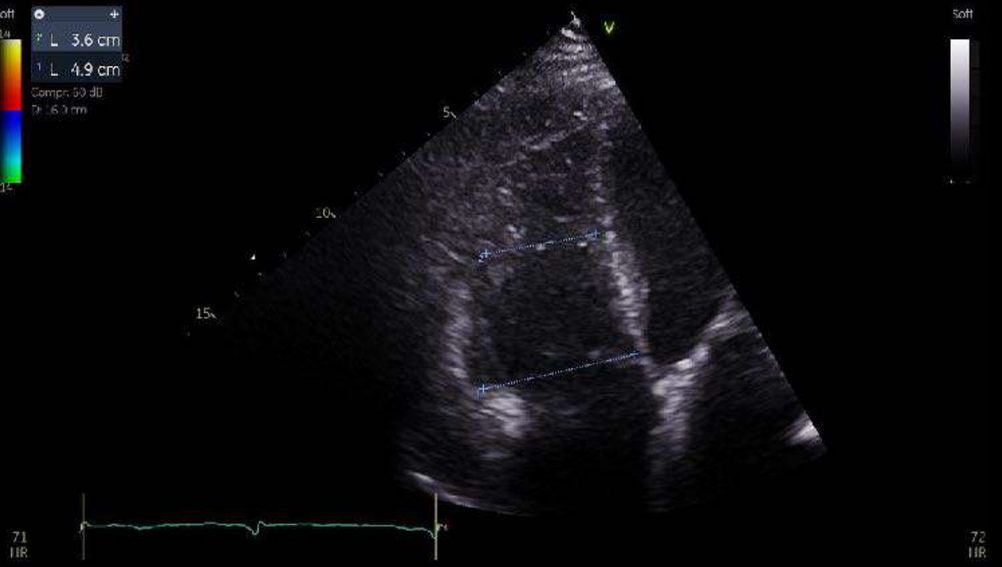

PV AccT 93 ms
PV Acc Slope 7.7 m/s2
RVOT Vmax 0.54 m/s
RVOT Vmean 0.43 m/s
RVOT maxPG 1.63 mmHg
RVOT meanPG 0.84 mmHg
RVOT VTI 10.3 cm
RVOT Env.Ti 239 ms
HR 69 BPM
[m/s]

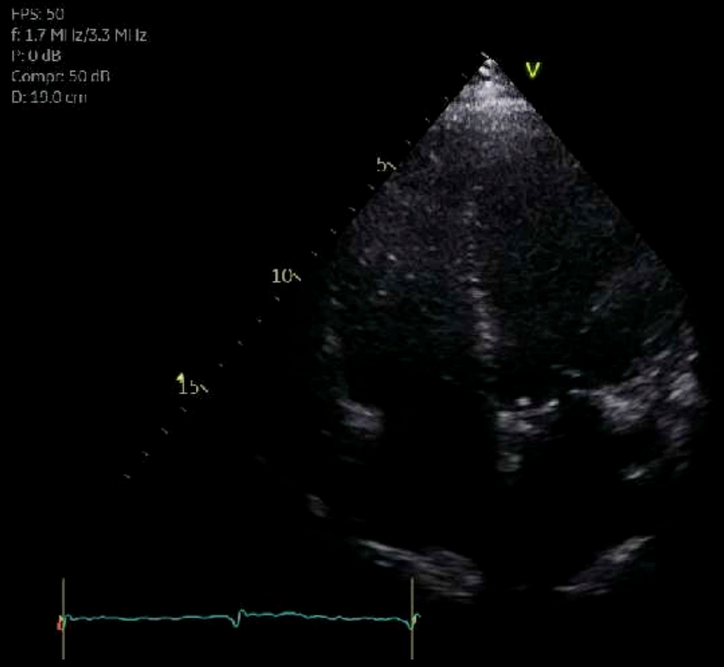

TR Vmax 3.33 m/s
TR maxPG 44.24 mmHg
[m/s]

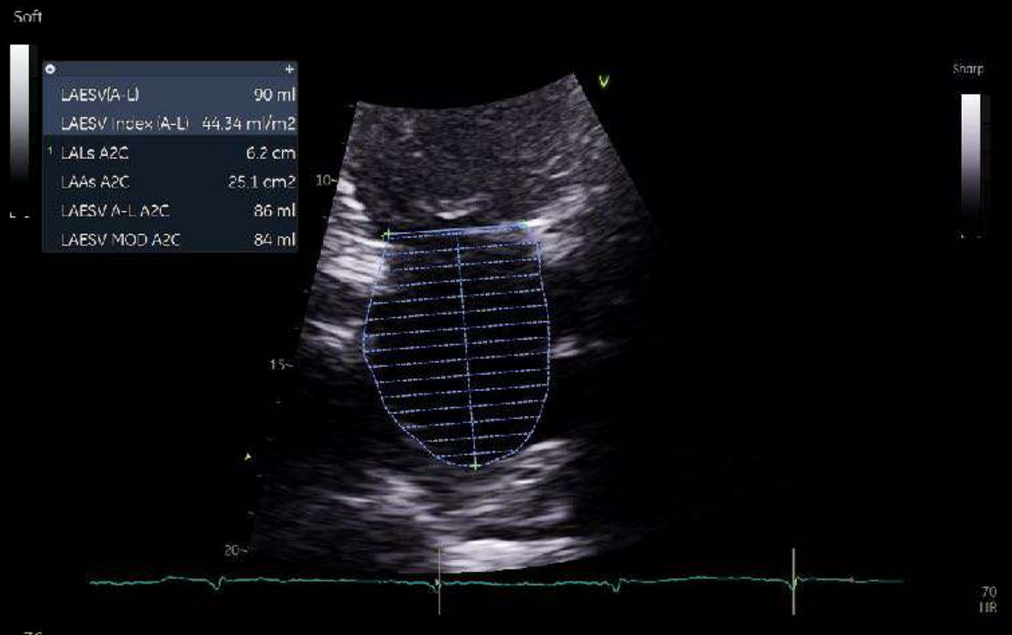

TAPSE 1.9 cm
TAPSE 1.8 cm
TAPSE 1.3 cm
Soft
[cm]

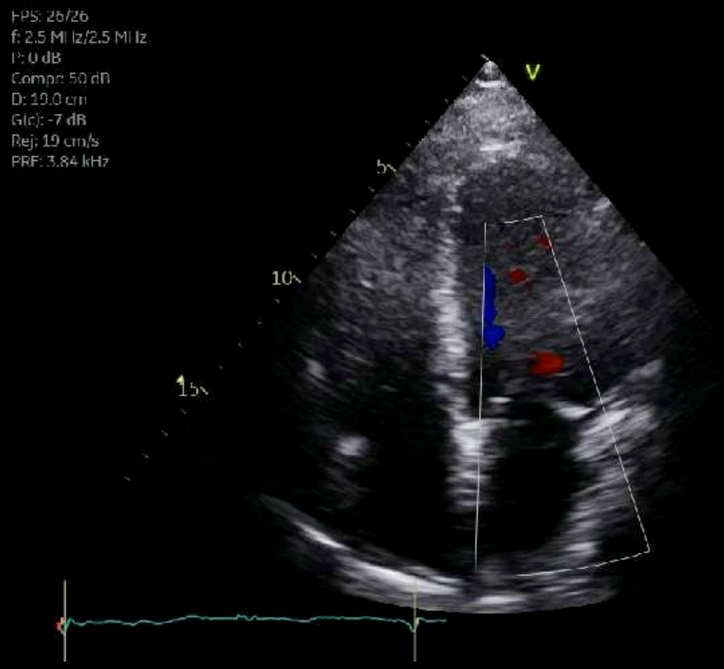

FPS: 50
f: 1.7 MHz/3.3 MHz
P: 0 dB
Compr: 60 dB
D: 16.0 cm
Soft
72
HR
79
HR

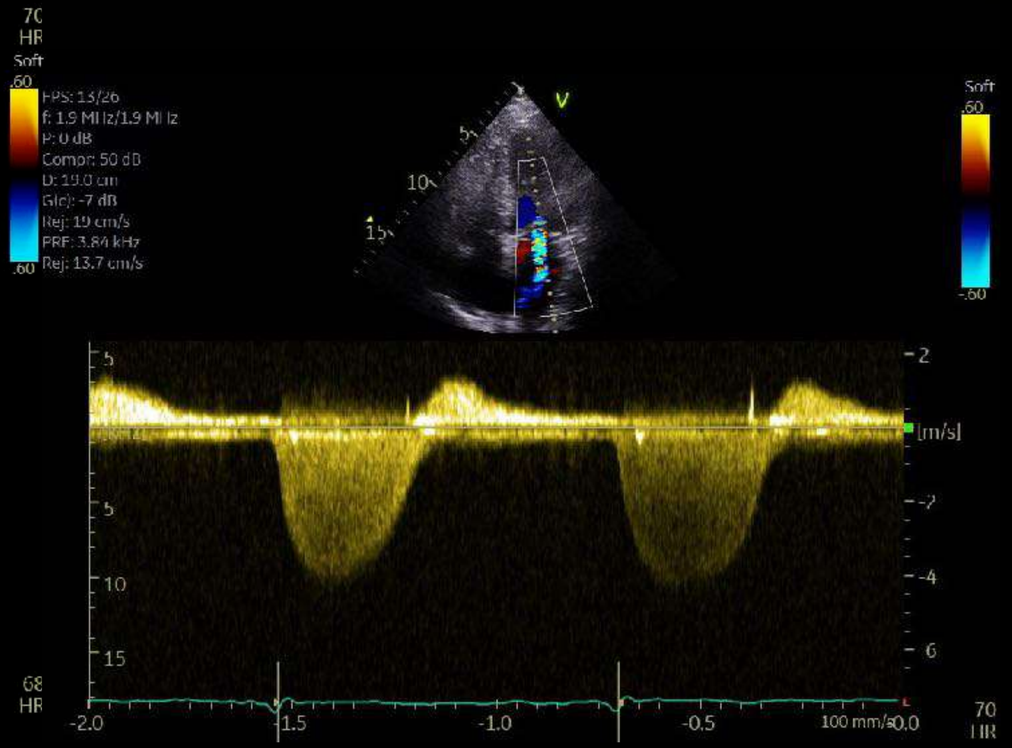

RV S' 0.07 m/s
Soft
[cm/s]

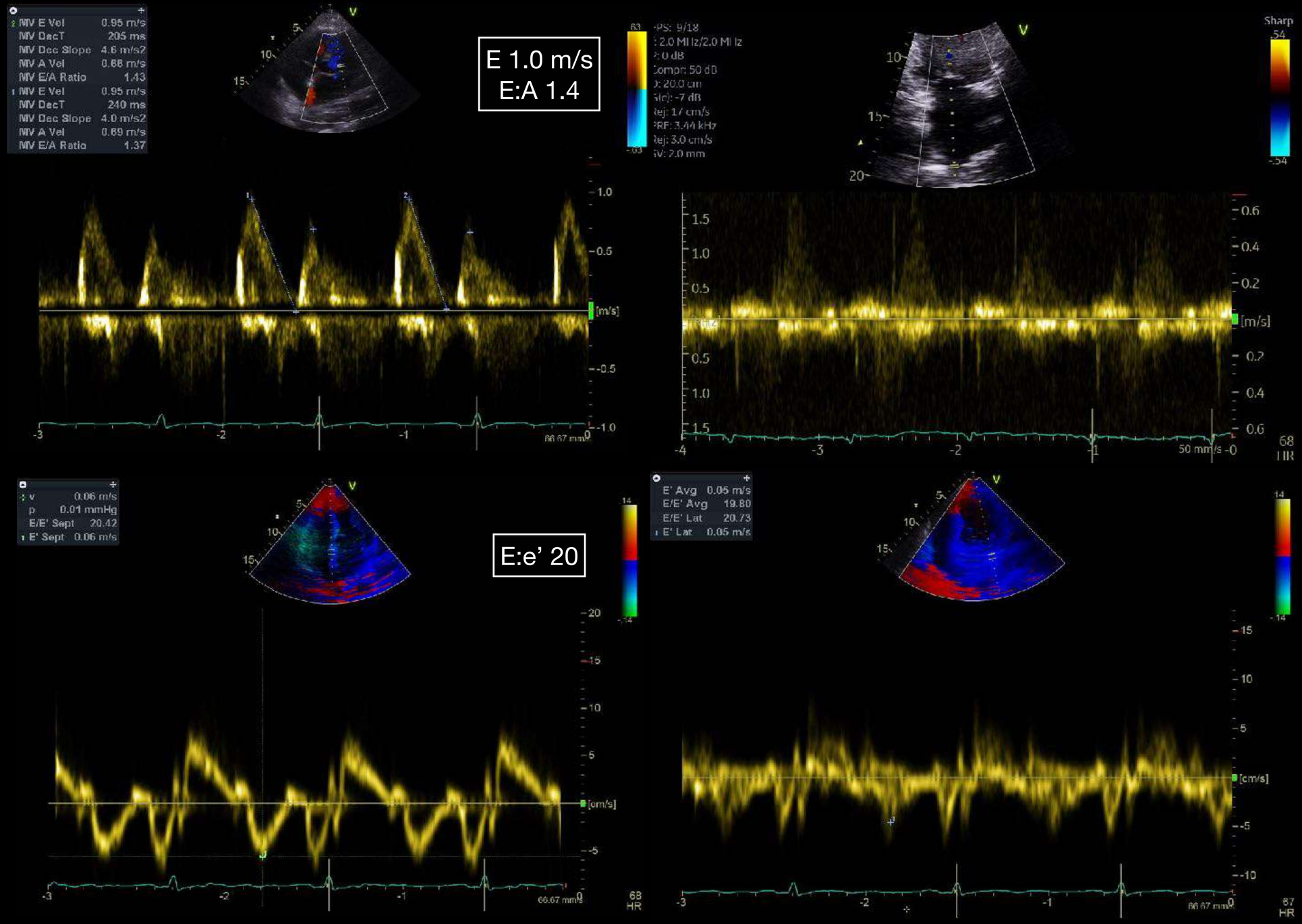

L 3.6 cm
L 4.9 cm
Soft
71
HR
72
HR

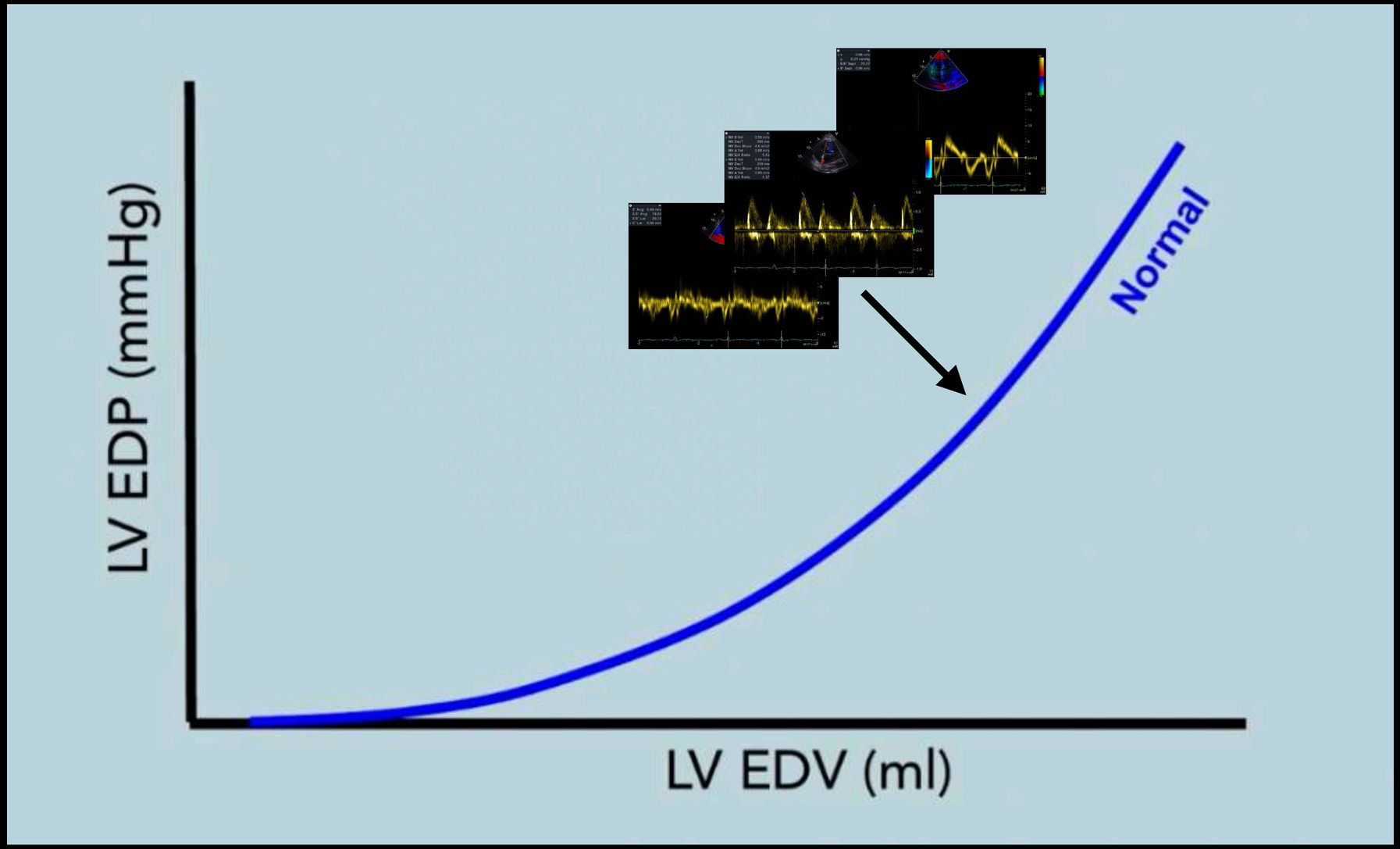

FPS: 50
f: 1.7 MHz/3.3 MHz
P: 0 dB
Compr: 50 dB
D: 19.0 cm

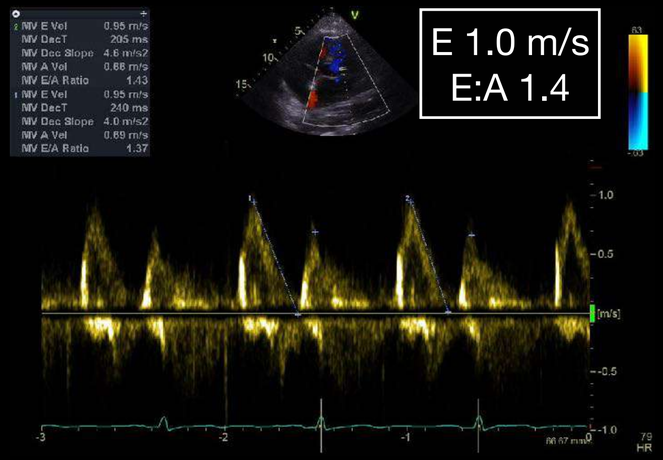

Soft
LAESV(A-L) 90 ml
LAESV Index (A-L) 44.34 ml/m2
LALs A2C 6.2 cm
LAAs A2C 25.1 cm2
LAESV A-L A2C 86 ml
LAESV MOD A2C 84 ml
Sharp
70
HR

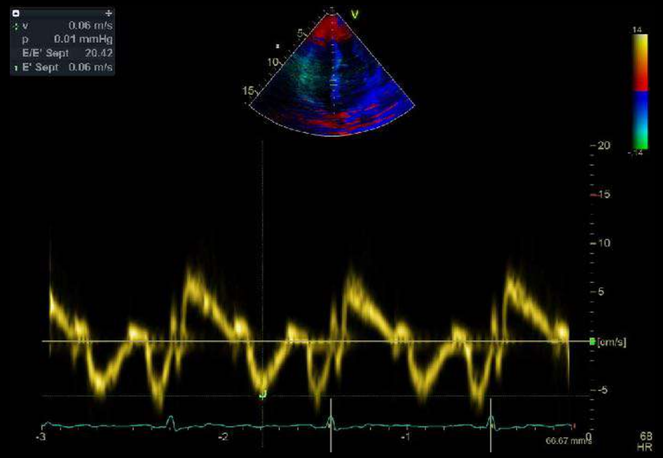

FPS: 26/26
f: 2.5 MHz/2.5 MHz
P: 0 dB
Compr: 50 dB
D: 19.0 cm
G(c): -7 dB
Rej: 19 cm/s
PRF: 3.84 kHz

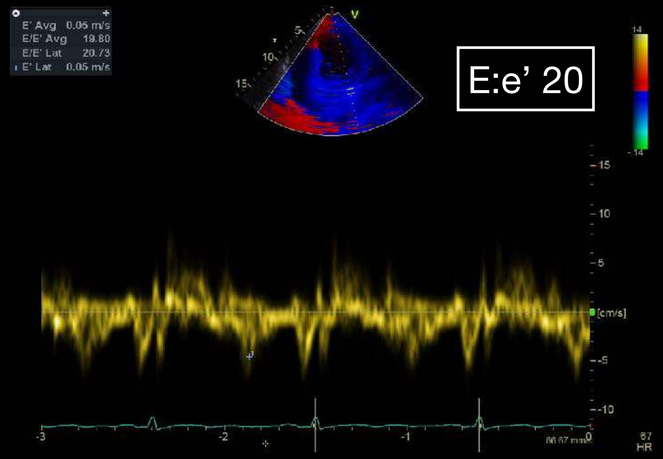

70
HR
Soft
FPS: 13/26
f: 1.9 MHz/1.9 MHz
P: 0 dB
Compr: 50 dB
D: 19.0 cm
G(c): -7 dB
Rej: 19 cm/s
PRF: 3.84 kHz
Rej: 13.7 cm/s
Soft
[m/s]
68
HR
-2.0
-1.5
-1.0
-0.5
100 mm/s
0.0
70
HR


MV E Vel 0.95 m/s
MV DecT 205 ms
MV Dec Slope 4.6 m/s2
MV A Vel 0.66 m/s
MV E/A Ratio 1.43
MV E Vel 0.95 m/s
MV DecT 240 ms
MV Dec Slope 4.0 m/s2
MV A Vel 0.69 m/s
MV E/A Ratio 1.37
E 1.0 m/s
E:A 1.4
Sharp
[m/s]
66.67 mm/s
50 mm/s
68 HR
v 0.06 m/s
p 0.01 mmHg
E/E' Sept 20.42
E' Sept 0.06 m/s
E:e' 20
E' Avg 0.05 m/s
E/E' Avg 19.80
E/E' Lat 20.73
E' Lat 0.05 m/s
[cm/s]
66.67 mm/s
68 HR
86.67 mm/s
87 HR

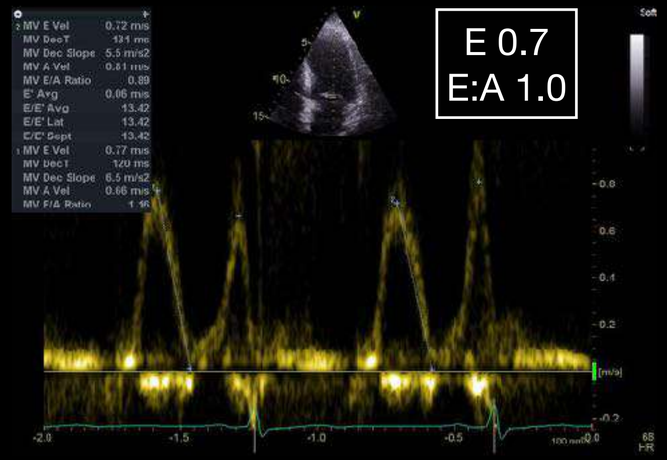

LV EDP (mmHg)
LV EDV (ml)
Normal

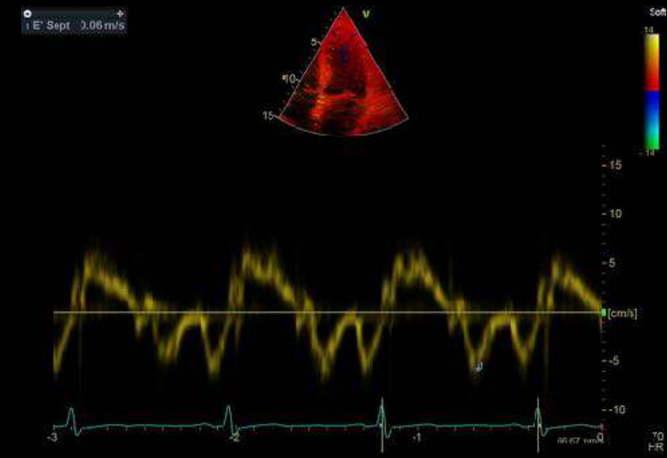

MV E Vel 0.95 m/s
MV DecT 205 ms
MV Dec Slope 4.6 m/s2
MV A Vel 0.68 m/s
MV E/A Ratio 1.43
MV E Vel 0.95 m/s
MV DecT 240 ms
MV Dec Slope 4.0 m/s2
MV A Vel 0.69 m/s
MV E/A Ratio 1.37
E 1.0 m/s
E:A 1.4
[m/s]
HR

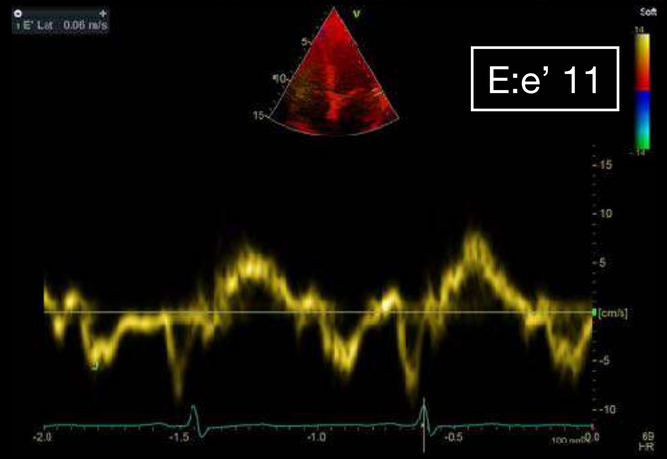

v 0.06 m/s
p 0.01 mmHg
E/E' Sept 20.42
E' Sept 0.06 m/s
[cm/s]
HR


E' Avg 0.05 m/s
E/E' Avg 19.80
E/E' Lat 20.73
E' Lat 0.05 m/s
E:e' 20
[cm/s]
HR

Diuresis


MV E Vel 0.72 m/s
MV DecT 131 ms
MV Dec Slope 5.5 m/s2
MV A Vel 0.81 m/s
MV E/A Ratio 0.89
E' Avg 0.06 m/s
E/E' Avg 13.42
E/E' Lat 13.42
E/E' Sept 13.42
MV E Vel 0.77 m/s
MV DecT 120 ms
MV Dec Slope 6.5 m/s2
MV A Vel 0.66 m/s
E 0.7
E:A 1.0
[m/s]
HR

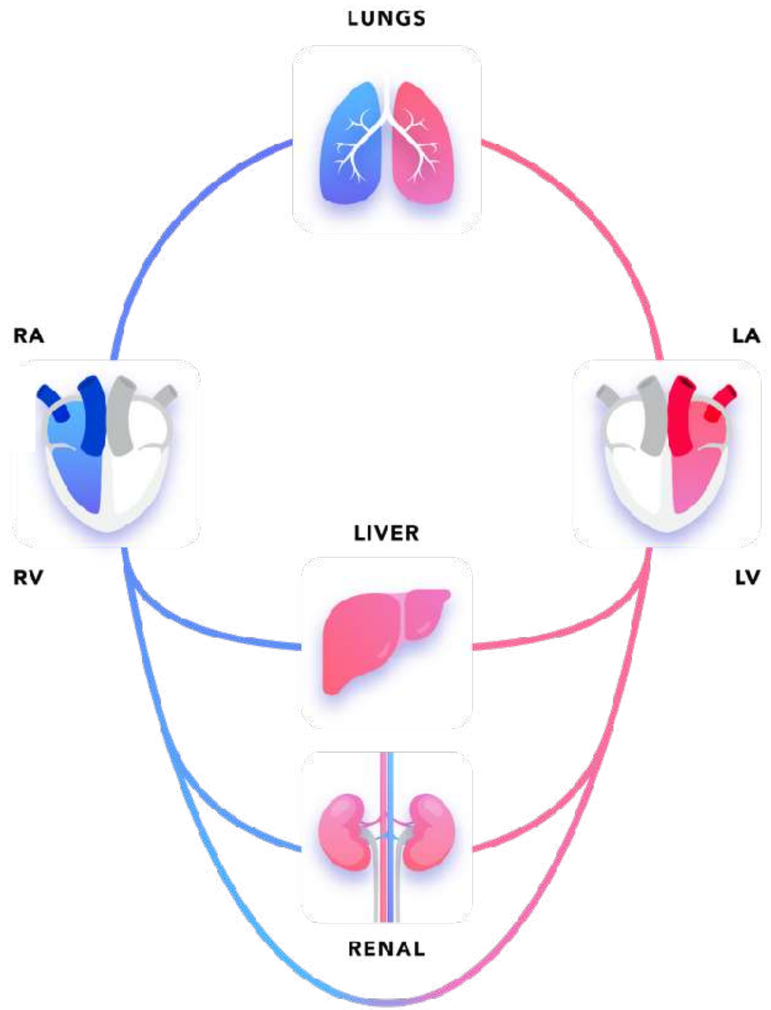

E' Sept 0.06 m/s
[cm/s]
HR

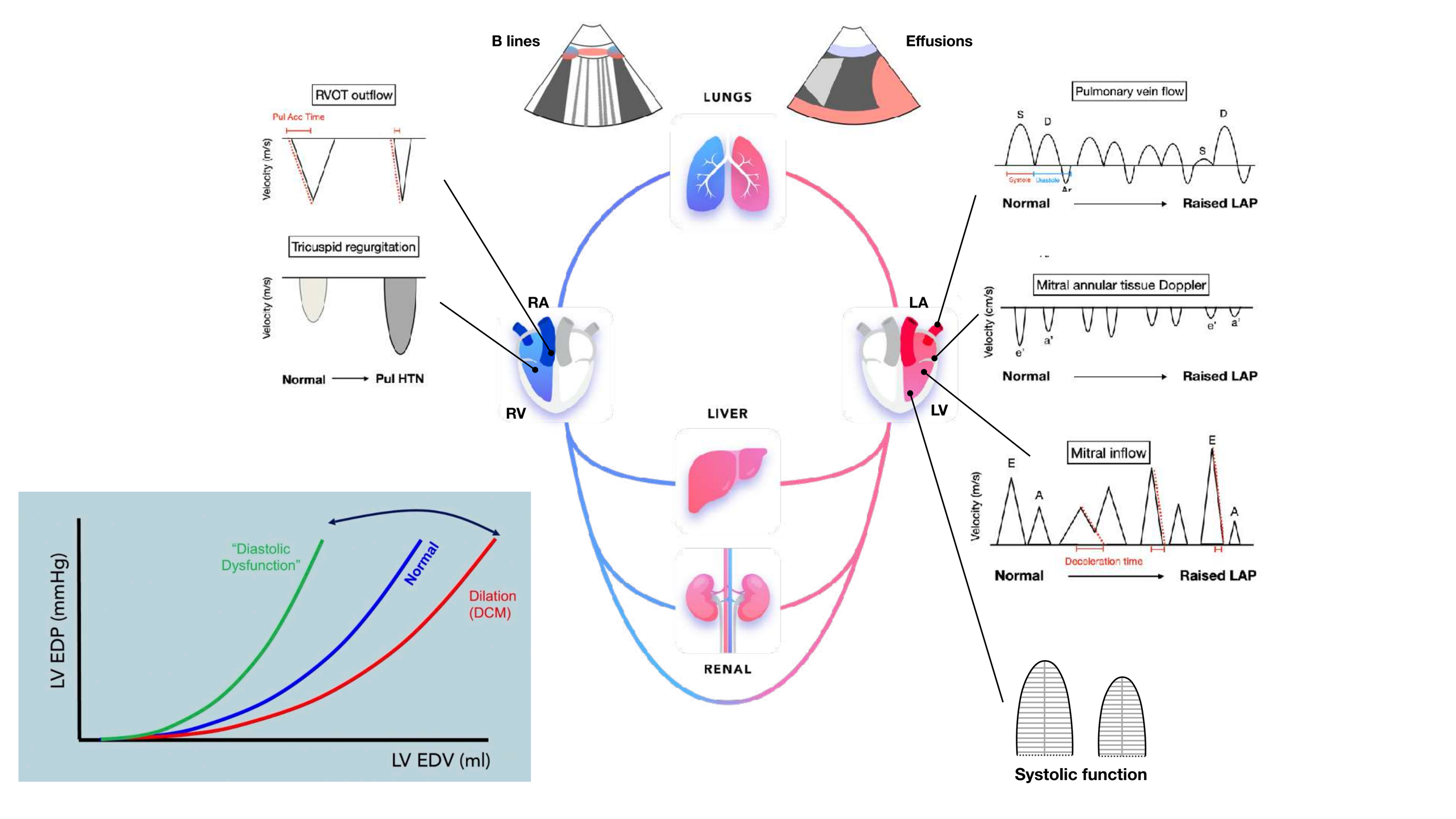

E' Lat 0.06 m/s
E:e' 11
[cm/s]
HR

RV dysfunction in ARDS patient

- Significant “post capillary pulmonary hypertension”
- Diuresis and negative fluid balance before starting iNO
- Keep heart rate low and in sinus
- Inotropes … maybe Levo with lusitropy effect?

Summary : Evaluation of LAP




B lines
Effusions
LUNGS
RVOT outflow
Pul Acc Time
Velocity (m/s)
Tricuspid regurgitation
Velocity (m/s)
Normal
Pul HTN
RA
RV
LA
LV
LIVER
RENAL
Pulmonary vein flow
S
D
S
D
Systole
Diastole
Ar
Normal
Raised LAP
Mitral annular tissue Doppler
Velocity (cm/s)
e'
a'
e'
a'
Normal
Raised LAP
Mitral inflow
Velocity (m/s)
E
A
E
A
Deceleration time
Normal
Raised LAP
Systolic function
LV EDP (mmHg)
LV EDV (ml)
"Diastolic Dysfunction"
Normal
Dilation (DCM)

Initial assessment

1 **Clinical context: respiratory failure, ARDS, 'at risk' fluid overload (eg: heart failure), difficult to wean from mechanical ventilation**

2 **LV systolic dysfunction or hypertrophy**

Normal / **Abnormal**

3 **E:A >1 & e' lateral >10**

No

Yes

	Parameter	Value
Echocardiography assessment	E:A	>1
	e' lateral *	< 10cm/s
	E:e'	>15
	Decelleration time	<160msec
	Interatrial septal bowing	Towards right
	Pulmonary vein flow	S<D
Lung ultrasound	B-lines **	>3 in dependent areas

4 **Probability raised LAP**

Low **Moderate** **High**

Consideration of position of end-diastolic pressure volume relationship

Reassessment after change in preload, contractility or afterload

5 **Risk if further escalation in LAP**

Low **Moderate** **High**

Thank you very much for listening

YouTube = Echo at Nepean

sam.orde@health.nsw.gov.au