Broken Liver, Broken Heart

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Adult Intensive Care Unit,
Queen Mary Hospital

Patient History

TSE HF; F/43

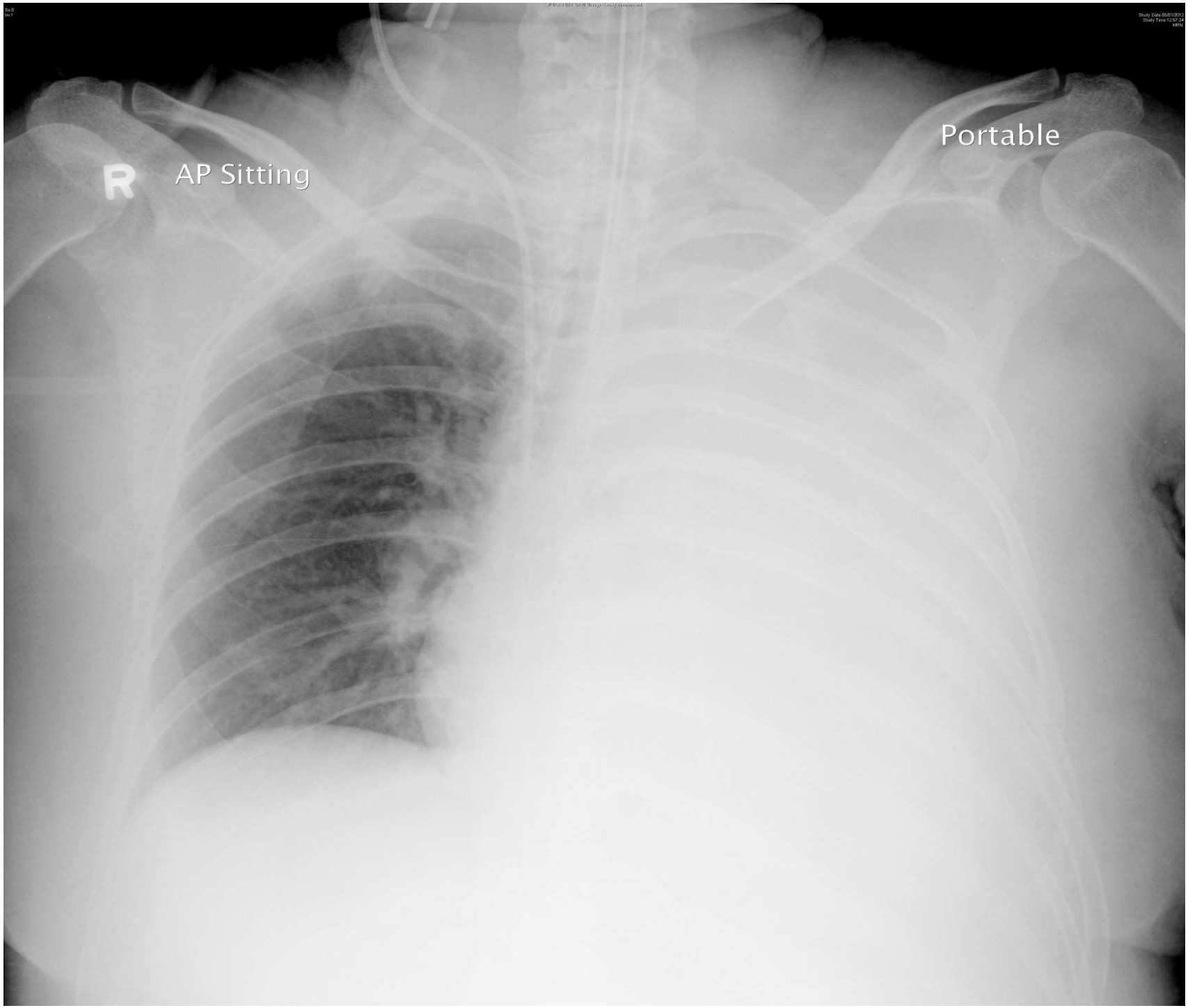
- Wilson's disease with Child's B/C cirrhosis, FU HKSH
- Presented with ascites in 4/2010
- Noted cirrhosis, raised urine copper, decreased serum ceruloplasmin, typical KF rings
- HBsAg –ve
- MRI liver 11/2011: cirrhosis, multiple dysplastic nodules

TSE HF; F/43

- Admitted to regional hospital on 4/1/12
- Fresh PR bleeding and hypovolemic shock
- OGD: mild esophageal varices with no active bleeding
- Hb 6; Plt 72; INR 2.6
- Resuscitated with blood products

TSE HF; F/43

- Sudden unrecordable BP in ward
- CPR with adrenaline and volume replacement
- Intubated
- Admitted to ICU


R
AP Sitting
Portable

Progress (Day 1)

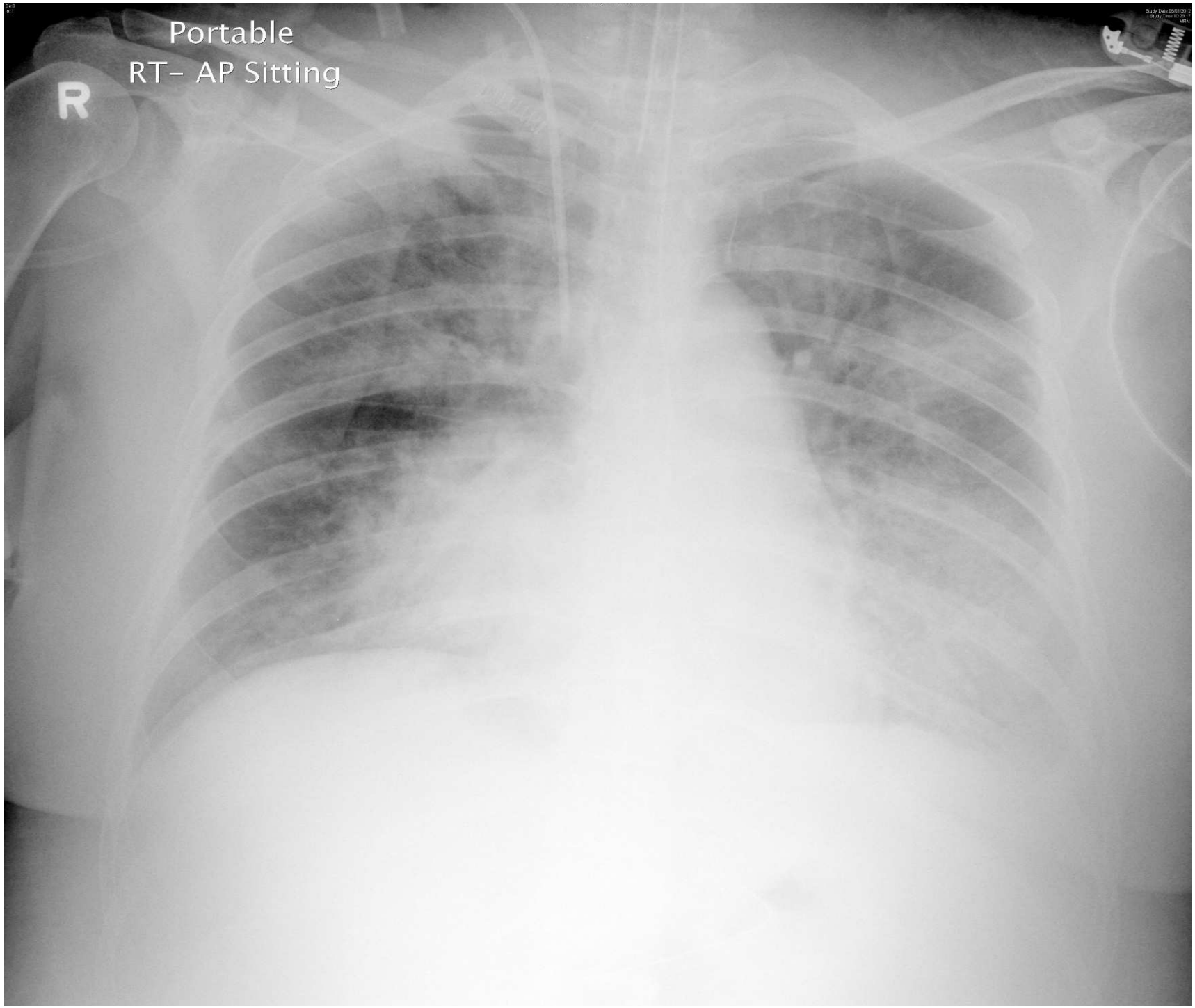
- Large volume blood product transfusion:
  - 6 units PC, 6 units Plt conc, 6 units FFP
- Minimal vasopressors
- Ventilator:
  - PS mode: FiO2 0.6, RR 20

Progress

- No overt ongoing GIB
- Hb 5.7; Plt 53; INR 1.9
- Further transfusion:
  - 2 units PC, 6 units Plt conc, 6 units FFP
- Worsening condition
  - Respiratory distress, FiO2 0.7
  - AKI, Cr ~171 (baseline Cr normal)
  - Hepatic encephalopathy, NH3 130

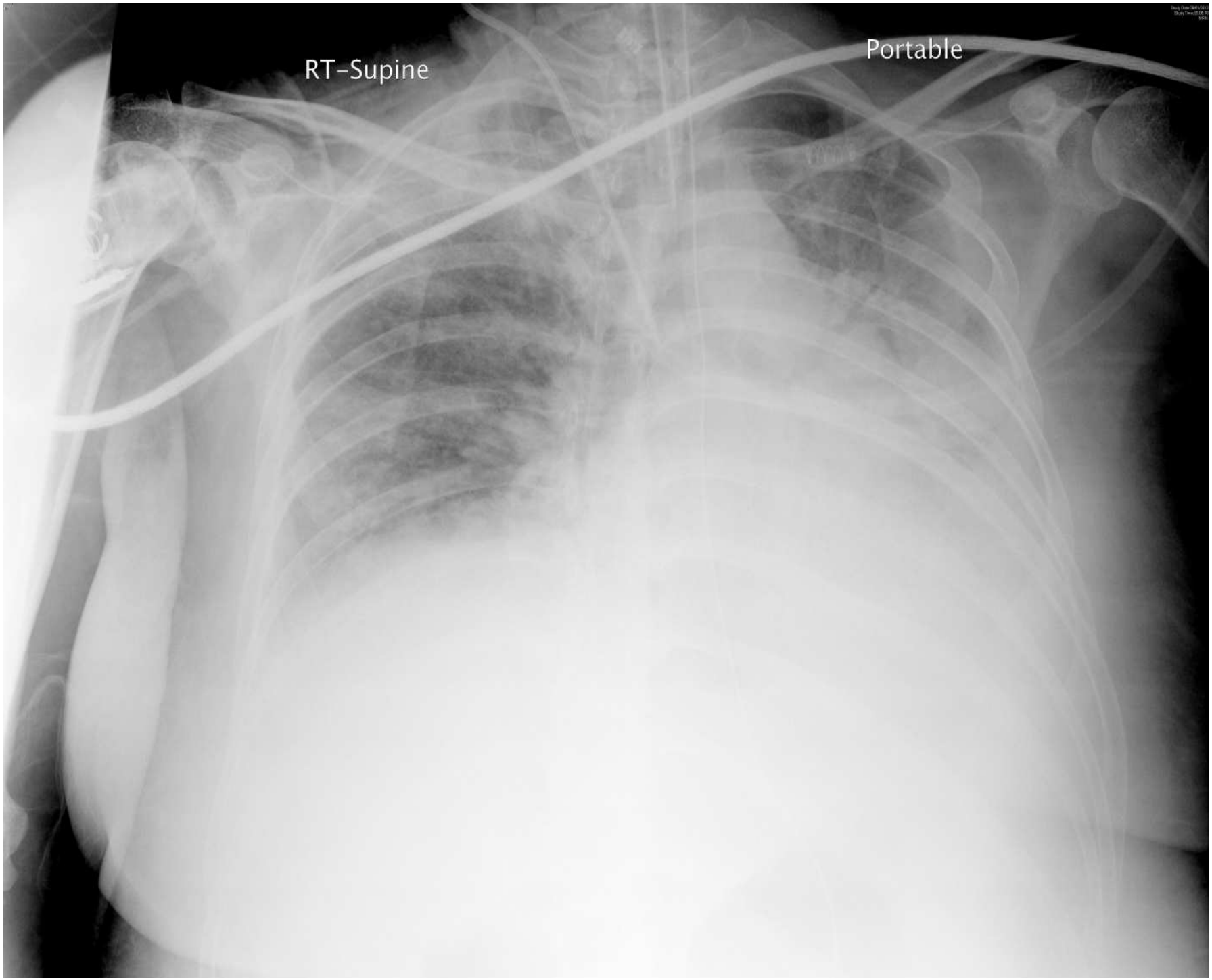
Progress

- Fever
- ETA C/ST -ve
- CXR: massive left pleural effusion
- Lt pleural fluid: transudative, C/ST -ve
- Started Augmentin empirically


Portable
RT- AP Sitting
R

Progress

- Persistent fever
- Repeated thoracocentesis C/ST -ve
- Diagnostic abdominal paracentesis
- Ascitic fluid: C/ST -ve
- Antibiotic regimen: Augmentin (D2) → Levofloxacin (D7) → Sulperazone (D9)


RT-Supine
Portable

Progress (Days 9-12)

- Developed sudden onset GIB and hypovolemic shock 12/1/12 (D9), Sengstaken tube inserted
- OGD 13/1/12: no active bleeding, prominent esophageal varices, banding done
- Hb 4.2; Plt 58; INR 3.4
- Transfused 4 units PC, 10 units Plt conc, 6 units FFP
- Given Sandostatin infusion and PPI

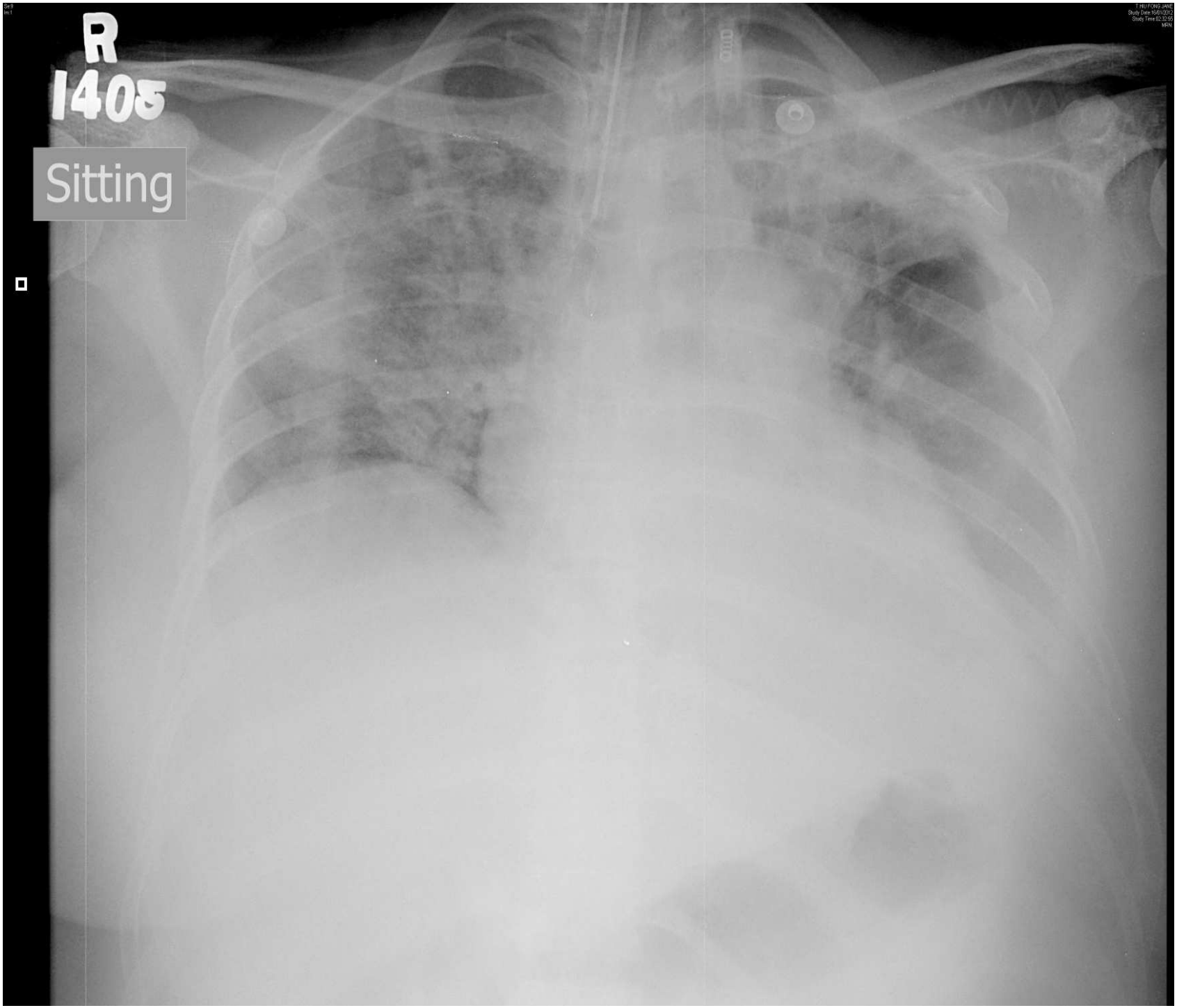
Progress (Days 9-12)

- Deteriorating LFT:
  - Bili 114 → 162
  - INR 3.3
  - NH3 45
- Transferred to QMH AICU for liver transplant workup on 16/1/12 (D13)

Provisional Diagnosis

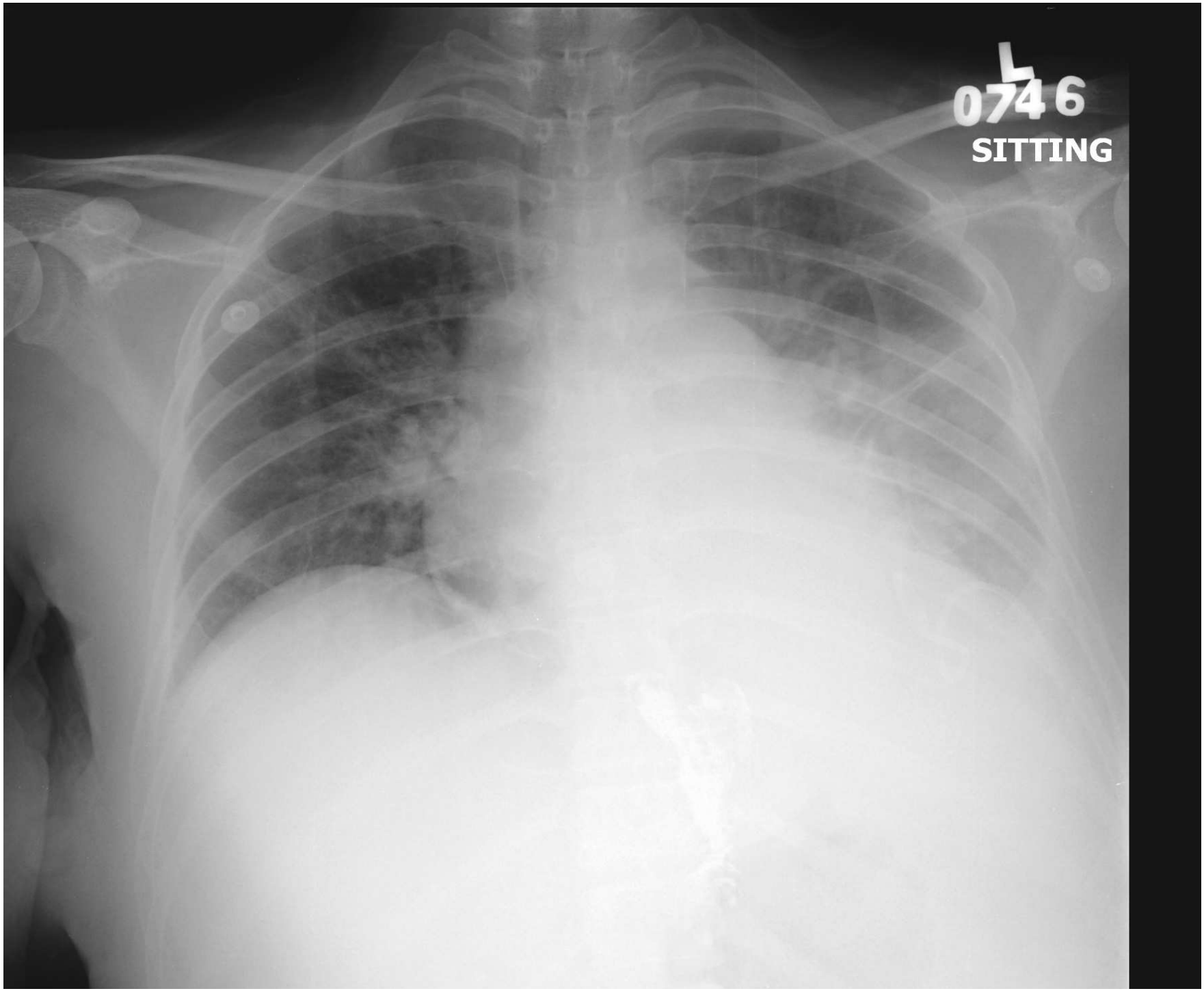
Pneumonia

Decompensated cirrhosis with esophageal variceal bleeding


R
1405
Sitting

Progress (Days 13-14)

- Hemodynamically stable upon arrival
- Bedside Echo: satisfactory LVEF
- Diuresis with frusemide
- Terlipressin 0.5mg Q8H
- Antibiotics switched to Tazocin (D13)


L
0746
SITTING

Progress (Days 15-19)

- Extubated to nasal CPAP on 18/1/12 (D15)
- Pigtail drain inserted on 19/1/12 (D16)
- Off CPAP to 4L/min NC on 19/1/12 pm
- Discharged to ward on 22/1/12 (D19)
- Proceeded to workup for liver transplant

Is it really pneumonia???

TSE HF; F/43

	16/1/12	17/1/12	18/1/12	19/1/12	20/1/12	21/1/12	22/1/12
Input	899	1417	872	2824	2222	2612	763
Output	2125	5414	3874	6908	4147	3561	1608
Balance	-1226	-3997	-3002	-4084	-1925	-949	-845
Mode	PS	PS	PS	CPAP	NC	NC	NC
FiO2	50%	50%	40%	60%	4L	3L	3L
pH	7.46	7.45	7.52	7.49	7.53	7.55	7.50
pO2	9.3	10.2	11.3	10.7	12.3	10.0	7.8
pCO2	5.1	5.8	5.3	6.2	6.1	5.5	6.1
HCO3	27.1	30	32	34	38	35	35.1
BE	3.2	5	8	10	14	12	10.8

TSE HF; F/43

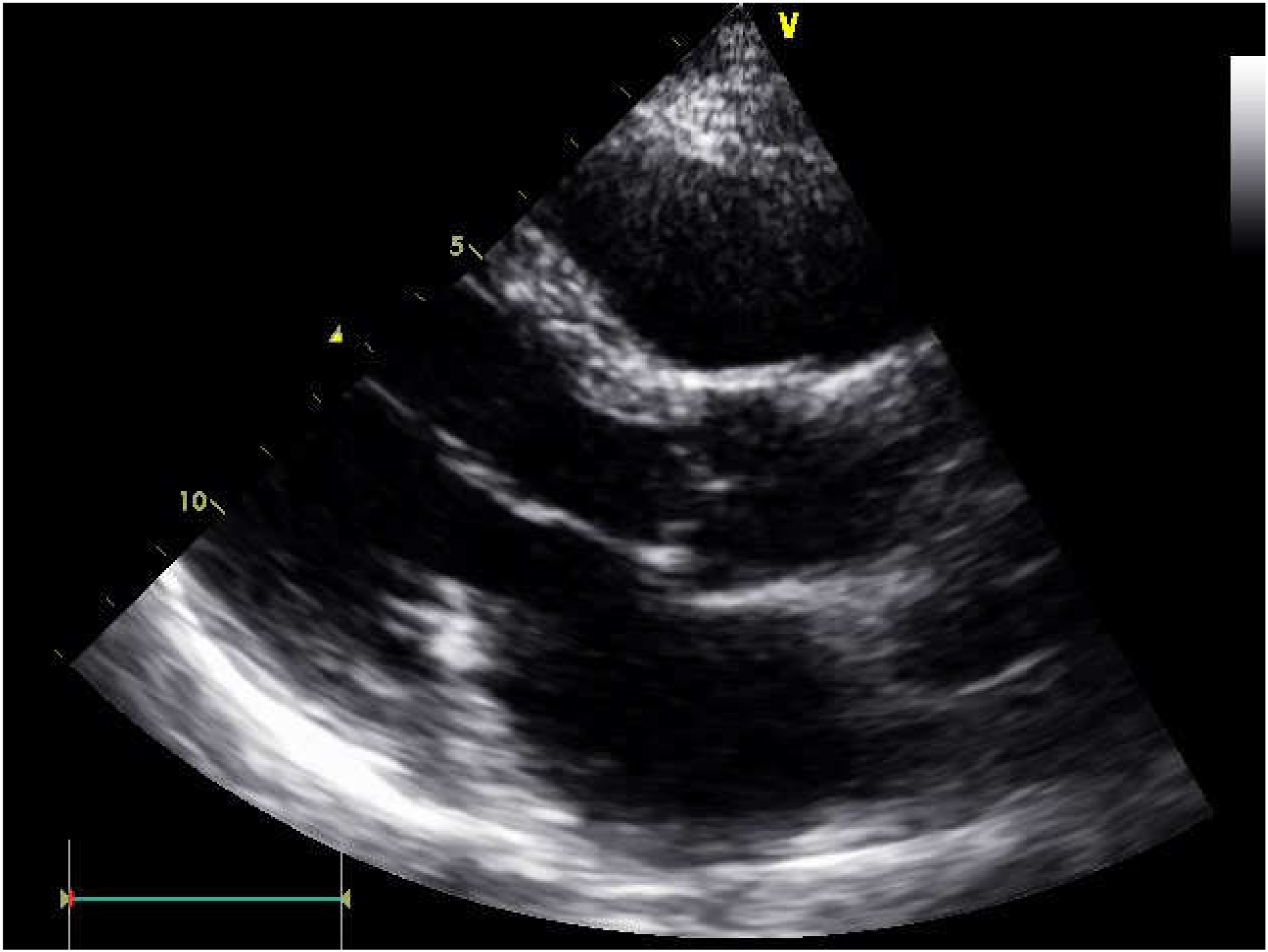
	16/1/12	17/1/12	18/1/12	19/1/12	20/1/12	21/1/12	22/1/12
Na	157	159	157	159	152	144	142
K	3.8	3.4	3.5	2.9	3.5	2.8	3.6
Ur	16.0	15.1	14.2	12.4	10.7	11.0	10.0
Cr	86	82	97	73	71	70	60
Protein	55	55	61	55	57	51	54
Albumin	27	32	36	34	32	30	32
Bilirubin	153	187	280	275	289	289	334
ALP	90	72	80	73	78	81	95
ALT	298	202	156	115	94	70	69
AST	287	156	111	91	87	80	80
GGT	59	51					
NH3	17		<9	<9	<9	<9	<9

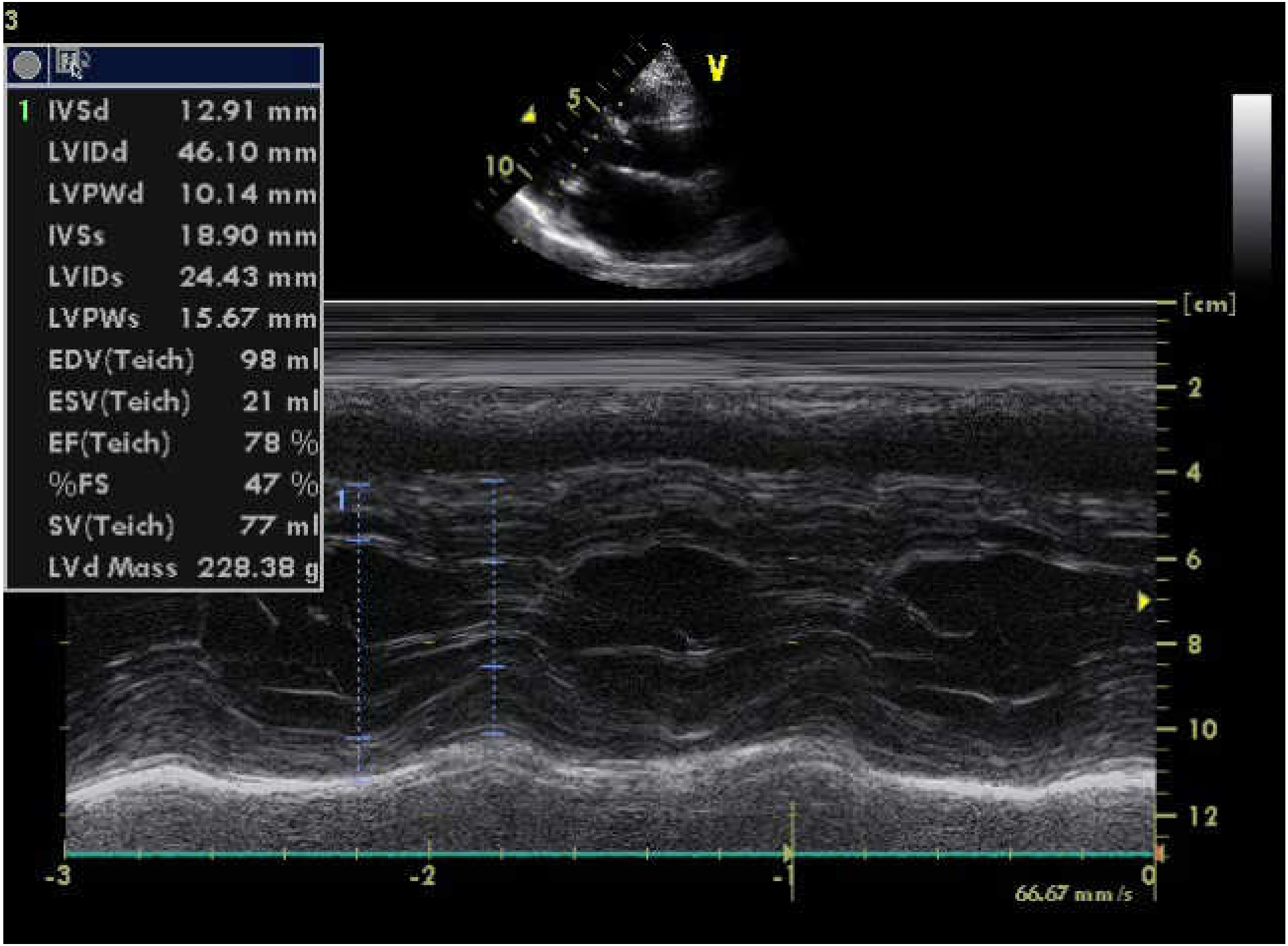
TSE HF; F/43

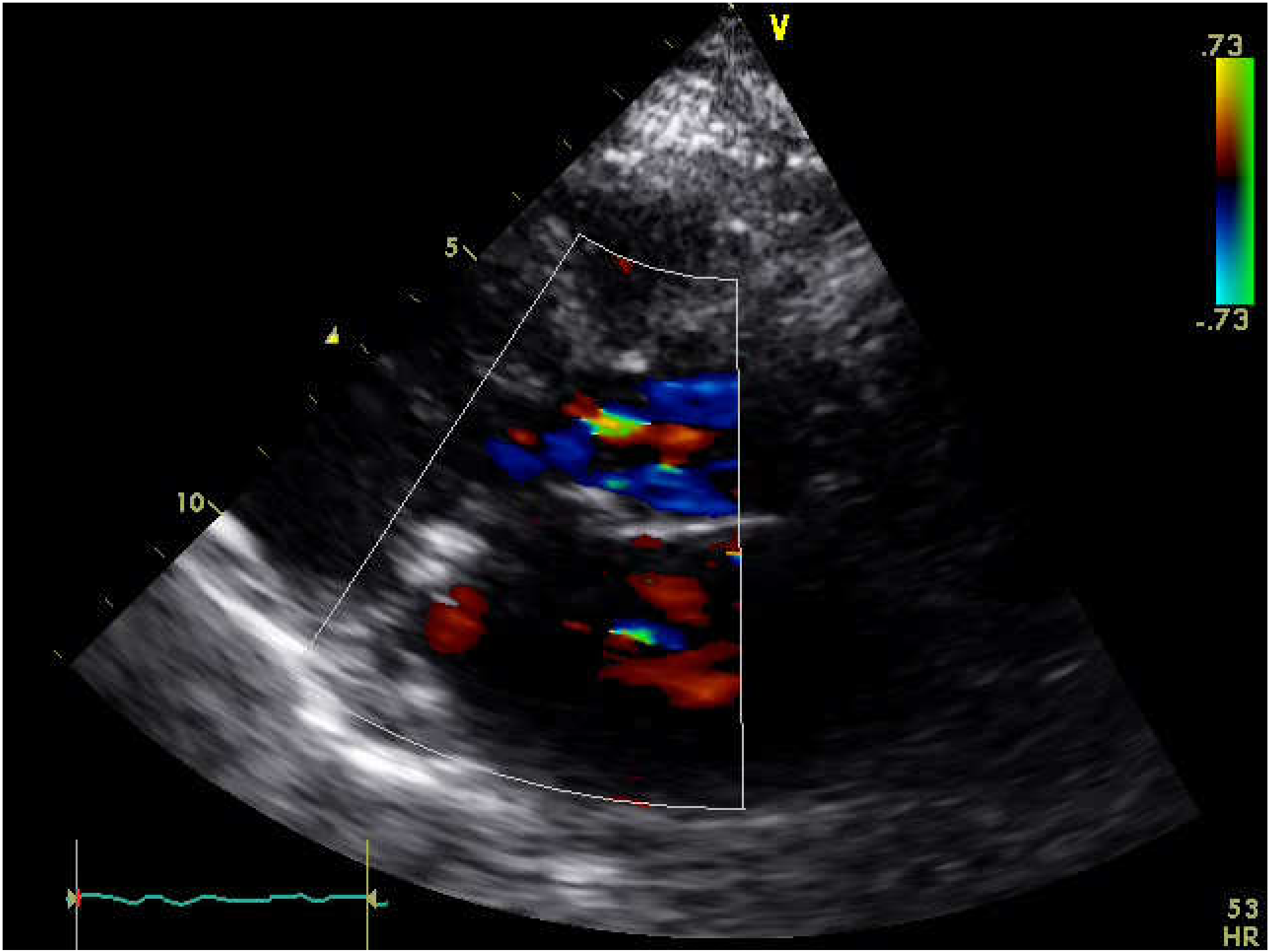
	16/1/12	17/1/12	18/1/12	19/1/12	20/1/12	21/1/12	22/1/12
Hb	9.5	8.5	9.2	8.1	7.7	7.4	7.3
WCC	9.3	8.6	10.7	8.3	7.5	11.5	14.5
Plt	40	39	34	28	43	49	55
PT	24.2	27.0	25.6	27.6	23.0	26.2	23.6
INR	2.3	2.5	2.4	2.6	2.1	2.5	2.2
APTT	33.0	41.8	42.0	47.6	39.4	48.3	44.2

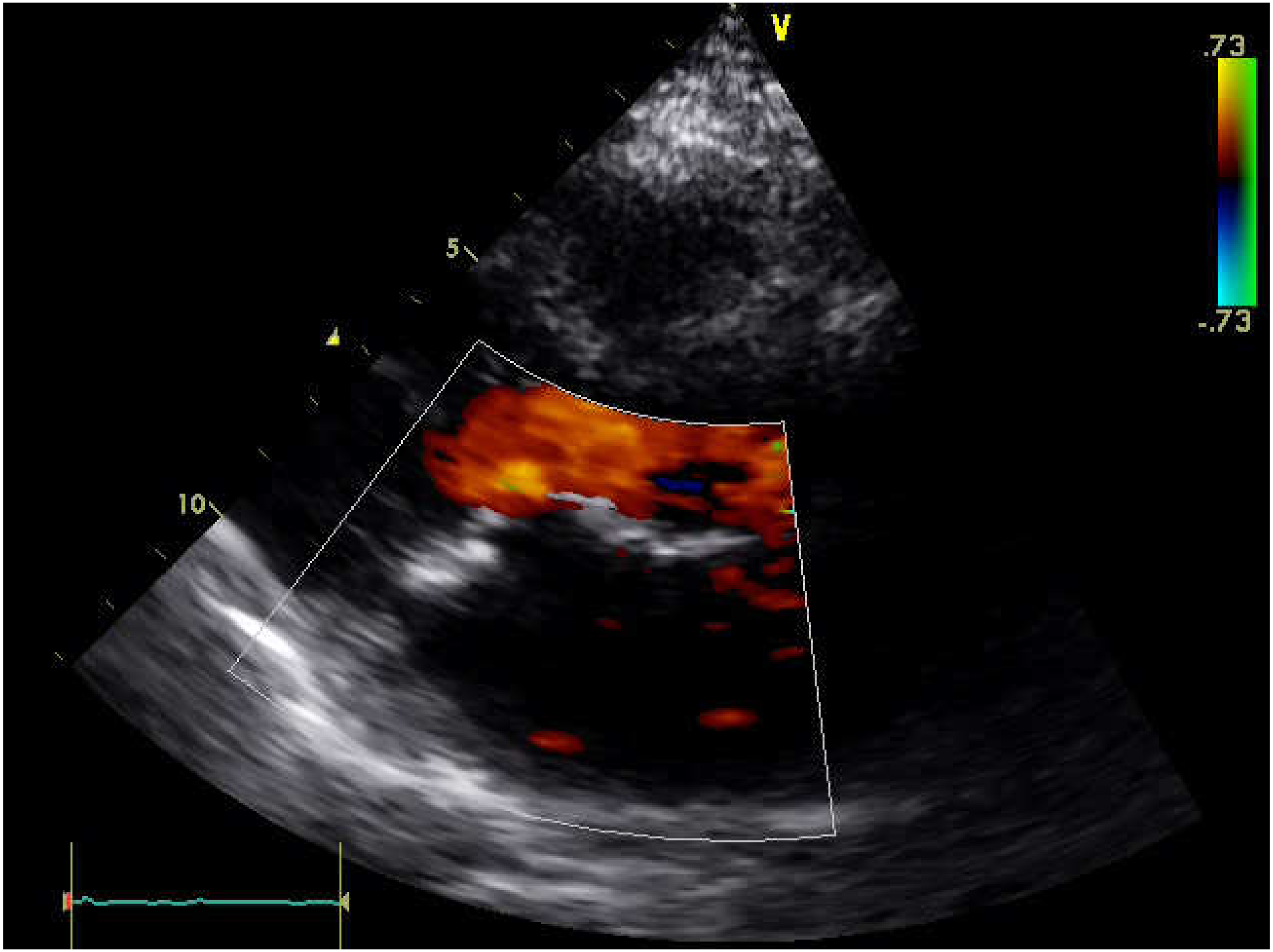
TSE HF; F/43

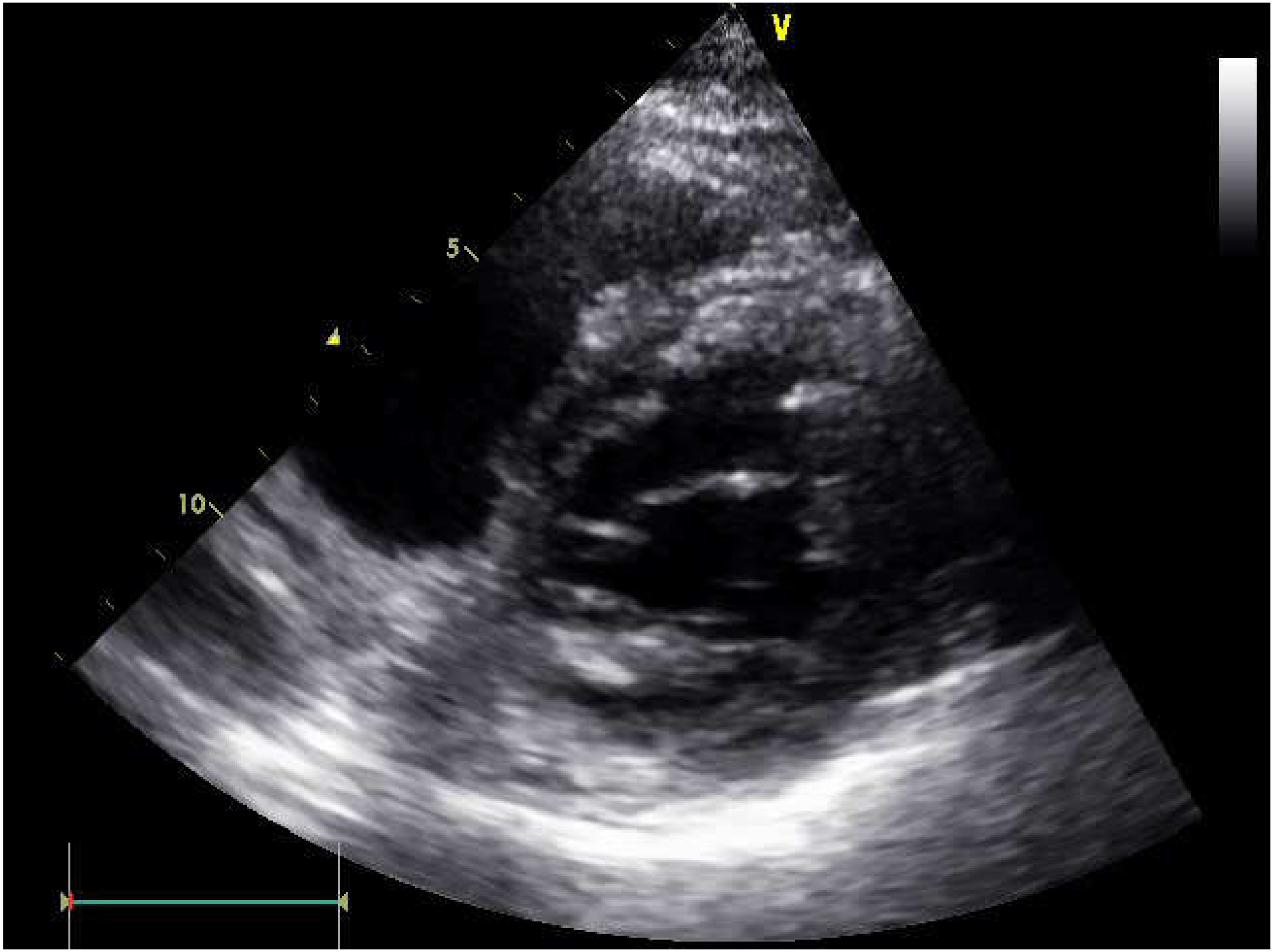
- Detailed echo assessment after off ventilator

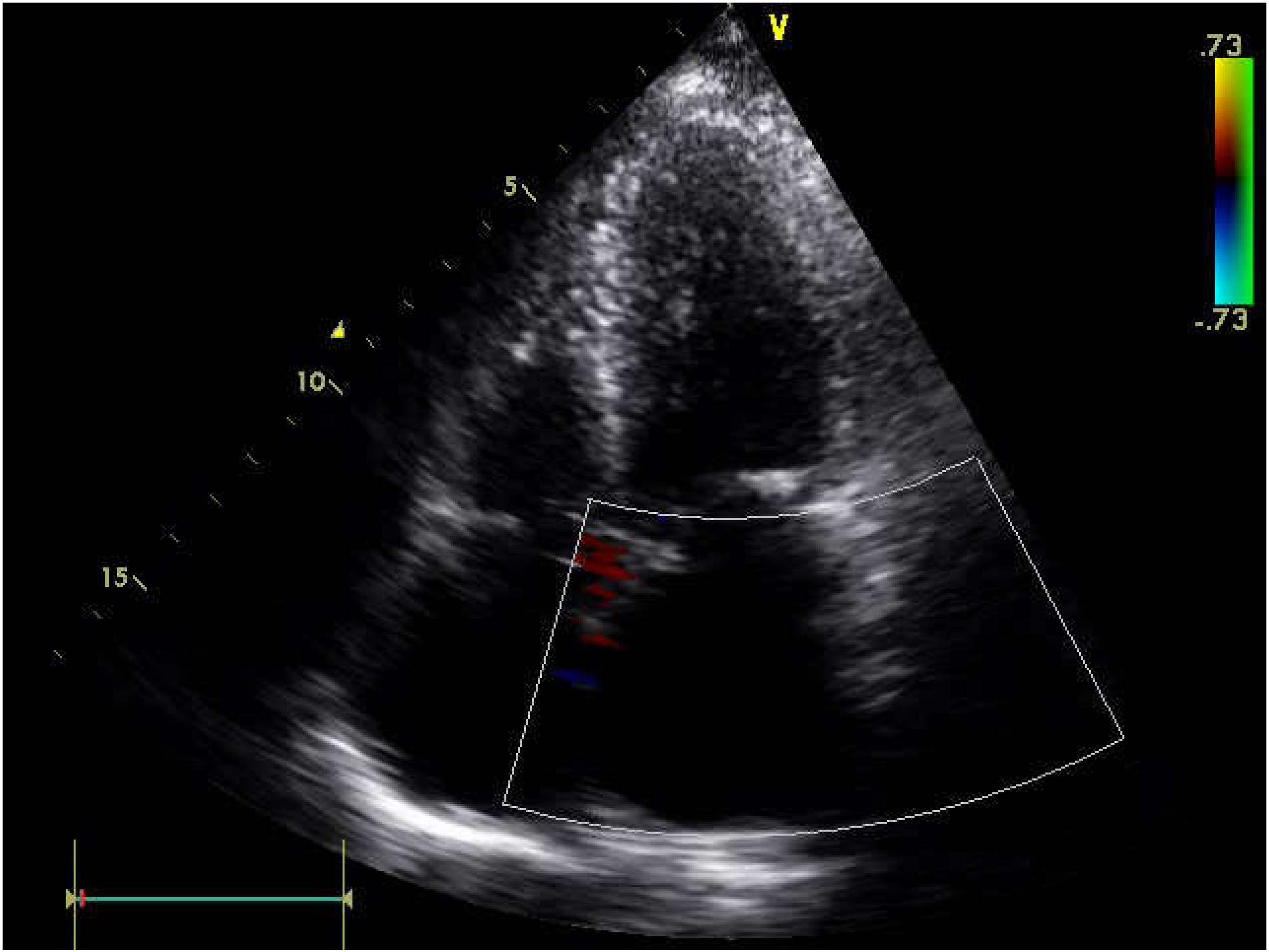

V
5
10

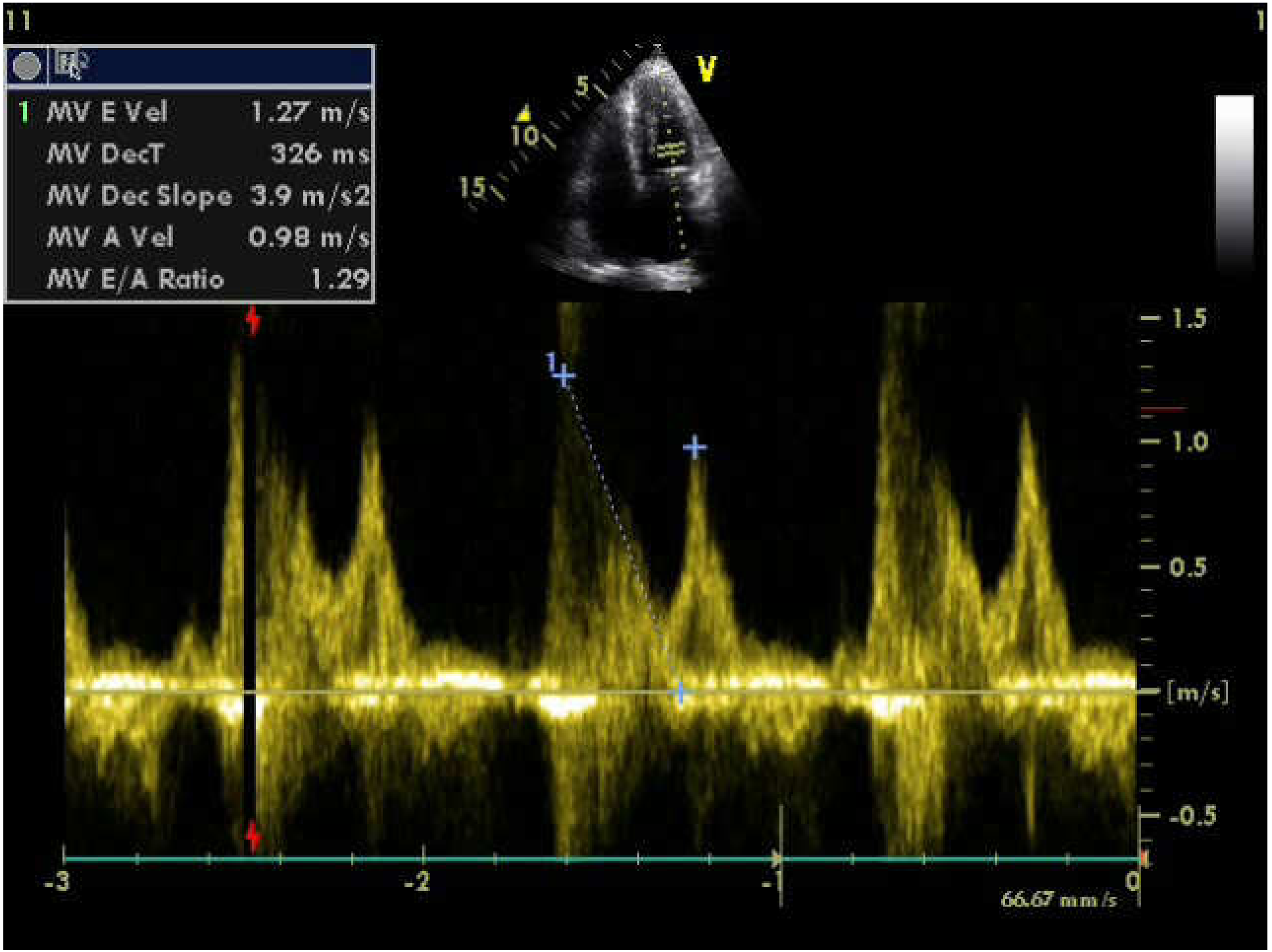

3
1 IVSd 12.91 mm
LVIDd 46.10 mm
LVPWd 10.14 mm
IVSs 18.90 mm
LVIDs 24.43 mm
LVPWs 15.67 mm
EDV(Teich) 98 ml
ESV(Teich) 21 ml
EF(Teich) 78 %
%FS 47 %
SV(Teich) 77 ml
LVd Mass 228.38 g
V
5
10
1
[cm]
2
4
6
8
10
12
-3
-2
-1
0
66.67 mm/s

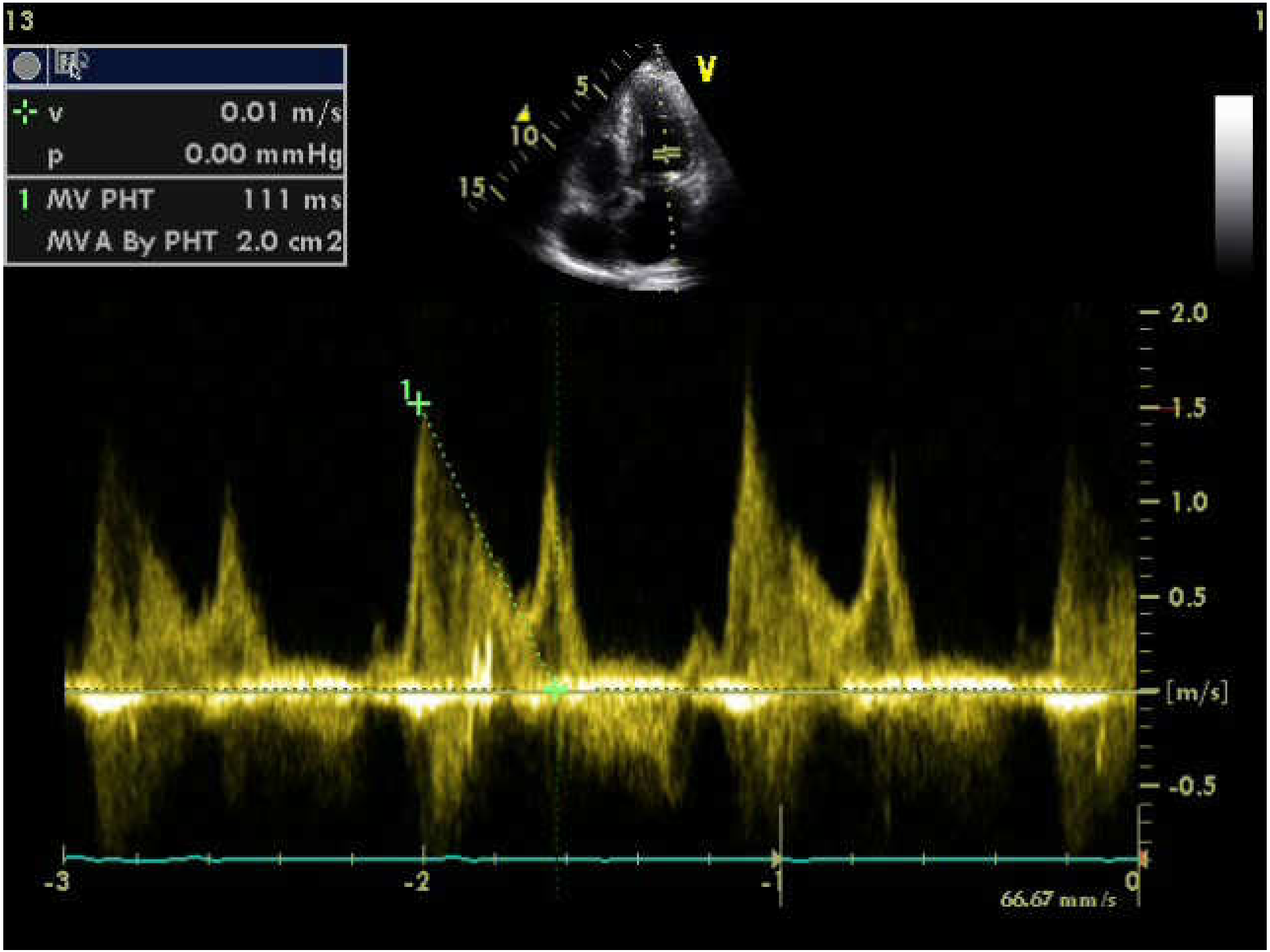

V
.73
-.73
5
10
53
HR

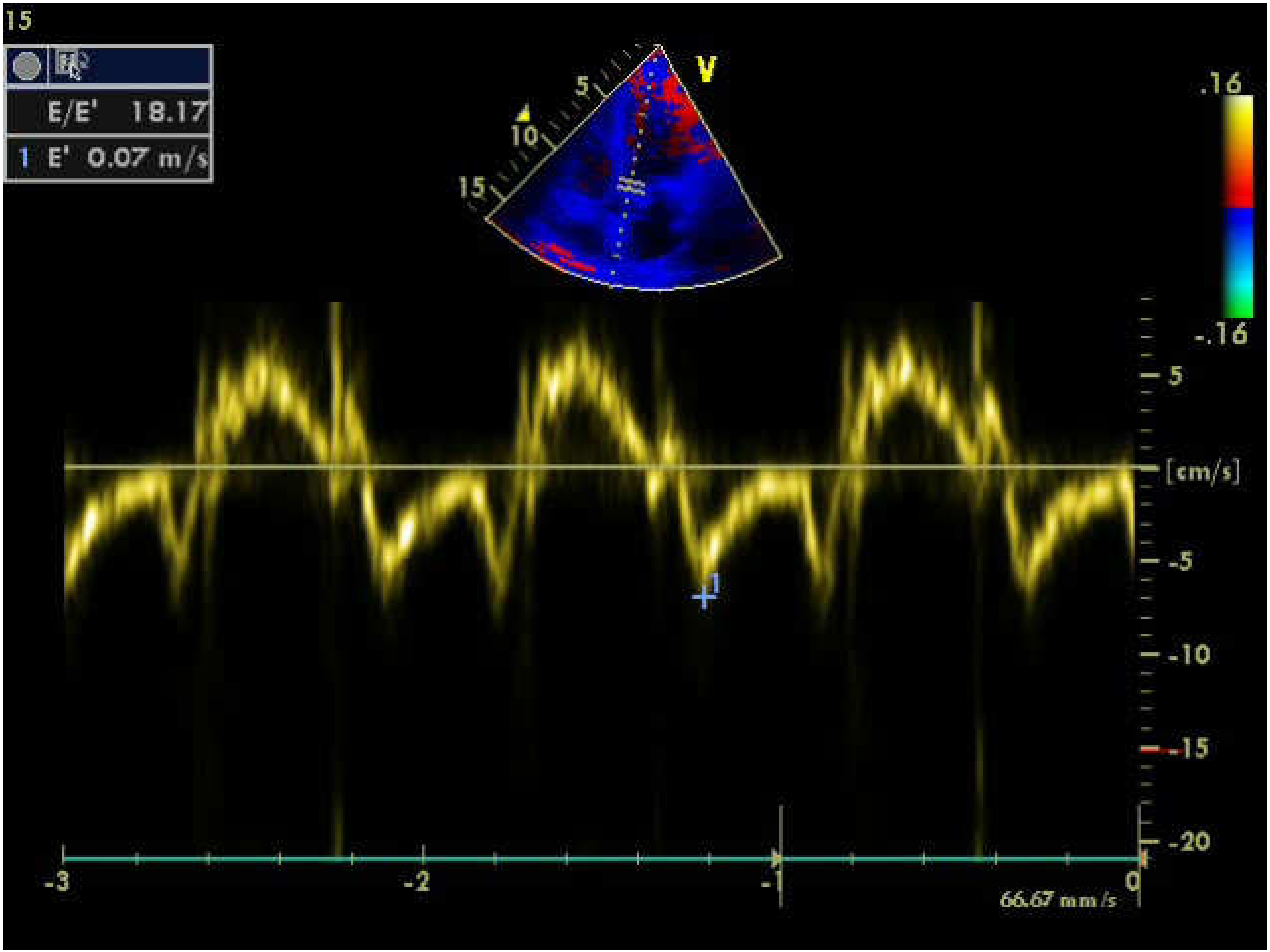

V
.73
-.73
5
10


V
5
10


V
5
10
15
.73
-.73


11
1
1 MV E Vel 1.27 m/s
MV DecT 326 ms
MV Dec Slope 3.9 m/s2
MV A Vel 0.98 m/s
MV E/A Ratio 1.29
5
10
15
V
1
1.5
1.0
0.5
[m/s]
-0.5
-3
-2
-1
0
66.67 mm/s


13
1
v 0.01 m/s
p 0.00 mmHg
1 MV PHT 111 ms
MV A By PHT 2.0 cm2
5
10
15
V
1
2.0
1.5
1.0
0.5
[m/s]
-0.5
-3
-2
-1
0
66.67 mm/s


15
E/E' 18.17
1 E' 0.07 m/s
V
5
10
15
.16
-.16
5
[cm/s]
-5
-10
-15
-20
-3
-2
-1
0
66.67 mm/s

TSE HF; F/43

- Detailed echo assessment after off ventilator
  - Mild LA enlargement
  - Borderline LVH
  - Hyperdynamic LV with EF 75%
  - Diastolic dysfunction (pseudonormal pattern)
    - E/A ratio 1.29
    - Medial E/E’ 18
  - Calcified mitral valve annulus, no mitral stenosis

Final Diagnosis

Diastolic heart failure with fluid overload

Discussion

Background

- Chronic liver disease and cirrhosis is the 11th leading cause of death in Hong Kong
- Chronic hepatitis B is endemic
- Other common causes of cirrhosis
  - Alcoholic cirrhosis
  - Chronic hepatitis C
  - Primary biliary cirrhosis
  - Wilson's disease

Cirrhosis

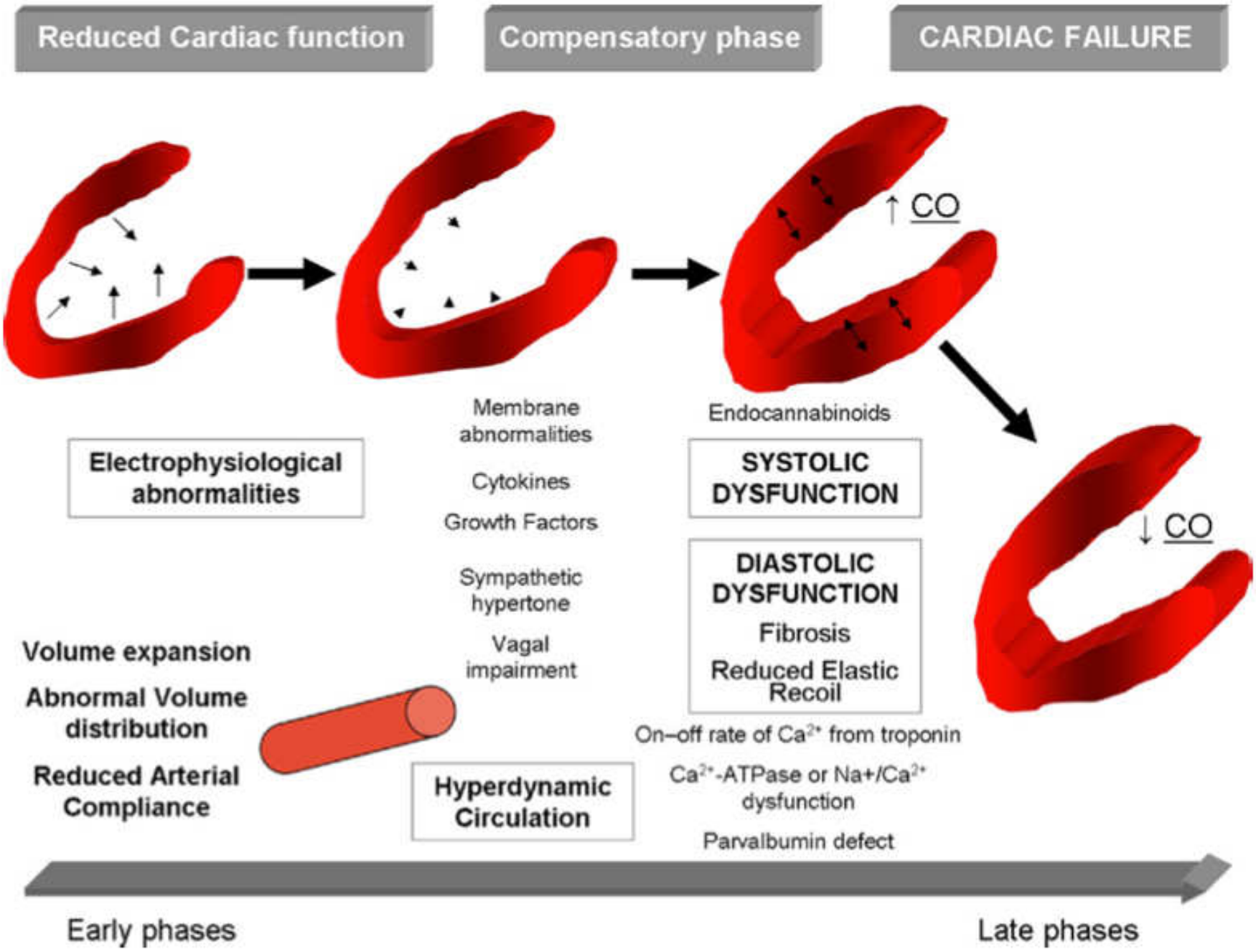
- Complications
  - Spontaneous bacterial peritonitis
  - Variceal bleeding
  - Hepatic encephalopathy
  - Hepatorenal syndrome

What about the heart?

Cirrhotic Cardiomyopathy

Cirrhotic Cardiomyopathy

Defined as the presence of *cardiac dysfunction* in patients with cirrhosis, characterized by *impaired contractile responsiveness* to stress, and / or *altered diastolic relaxation* with electrophysiological abnormalities in the absence of other previously known cardiac disease



J Am Coll Cardio 2010;56:539-49

Current Understanding

Hemodynamic changes

- Resting hyperdynamic state
- Higher resting heart rate
- Lower systemic vascular resistance
- Intravascular volume expansion

Current Understanding

Electrophysiologic changes

- QT interval prolongation
- Electromechanical dyssyncrony
- Inotropic and chronotropic incompetence
- Diastolic dysfunction
- Subtle systolic dysfunction

Diagnostic Difficulties

- Symptoms not easily distinguishable from those of the underlying disease
- Near normal cardiac function at rest
- Blunted cardiac response may be masked by intravascular volume shifts
- Technical difficulties e.g. exercise stress test, dobutamine stress echocardiography

Objectives of Our Study

- To evaluate the cardiac function by echocardiogram, in patients with cirrhosis awaiting liver transplant, focusing on
  - The resting left and right ventricular function
  - The relationship between echocardiographic abnormalities and the complications of cirrhosis

Methods

- 48 patients with cirrhosis referred for liver transplantation evaluated by TTE
- Compared to a historical control group matched for age, sex, and cardiovascular risk factors
- Patients at significant risk for cardiac ischemia underwent coronary evaluation and were excluded if positive

Patients

- 14 (31%) chronic hepatitis B cirrhosis
- 8 (16.5%) alcoholic cirrhosis
- 8 (16.5%) HCC + cirrhosis
- 7 (15%) primary biliary cirrhosis
- 3 (6%) chronic hepatitis C cirrhosis
- Chronic autoimmune hepatitis, polycystic liver disease, congenital hepatic fibrosis, Wilson's disease

Findings

Compared to controls, cirrhotic patients had

- Higher cardiac index
- Lower systemic vascular resistance index
- LV:
  - Similar LV dimensions, LV mass
  - Similar LVEF but lower mitral annular tissue Doppler velocity
  - Higher LV filling pressure
  - More diastolic dysfunction

Findings

- Alcoholic cirrhosis associated with:
  - Lower LV ejection fraction (48±16% vs 62±10%)
  - Larger LV end-systolic dimension
  - Higher LV mass index

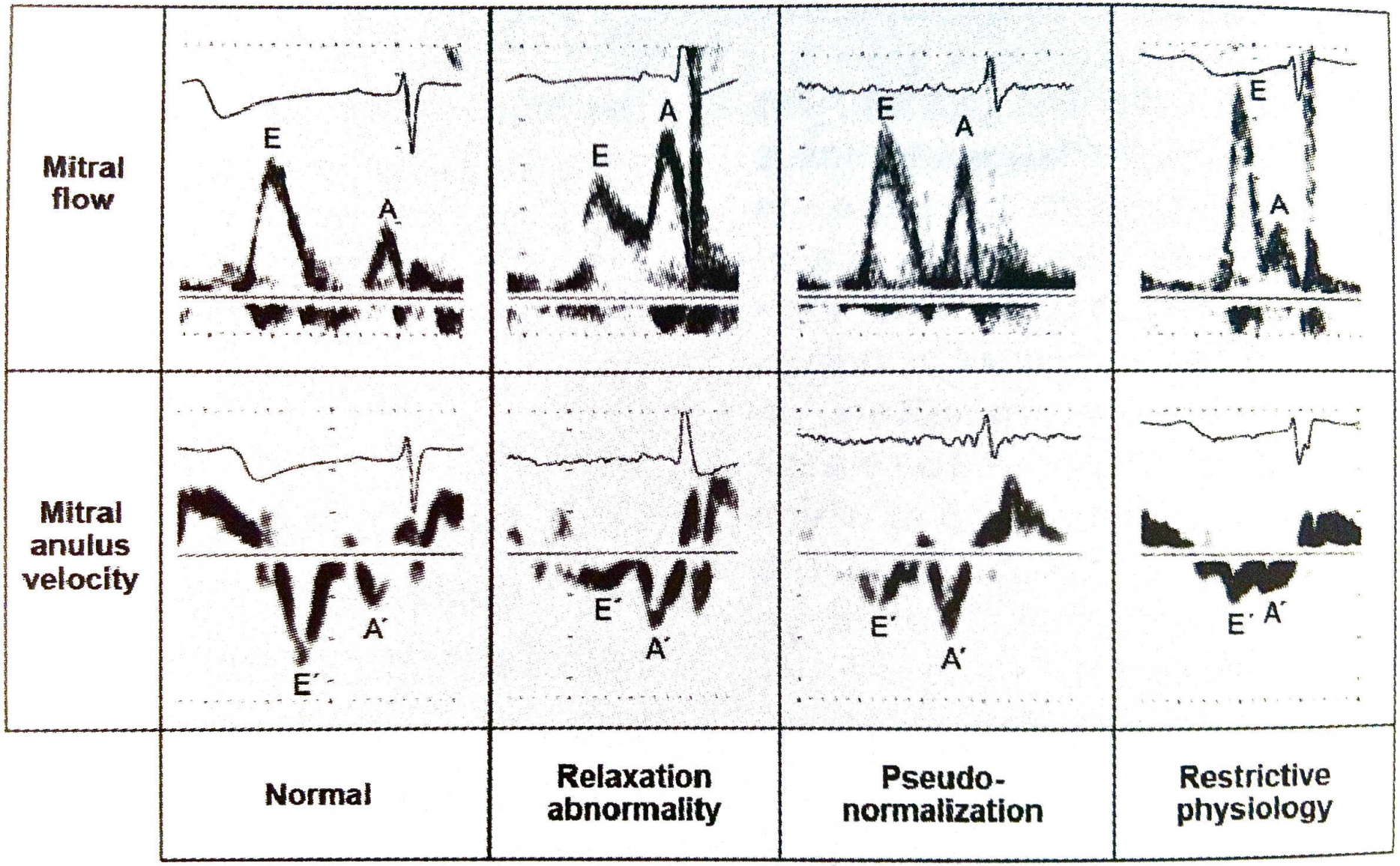
  (all $p<0.01$)

Findings

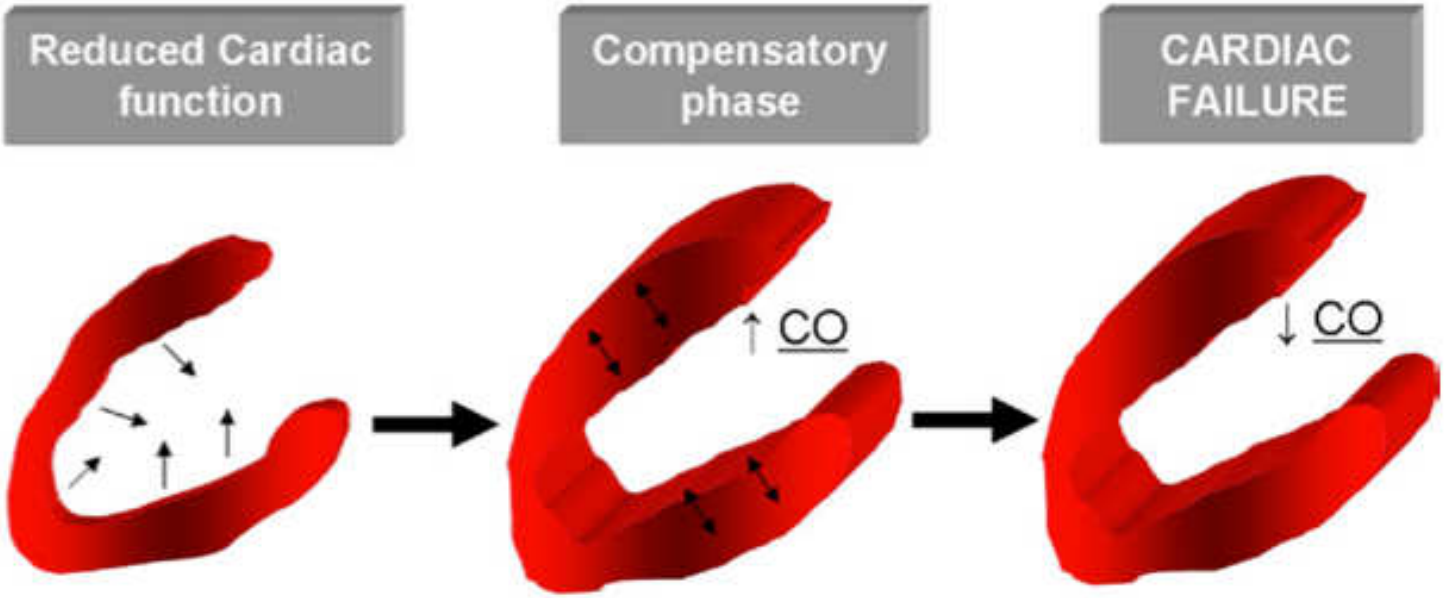
- Ascites associated with:
  - Higher LV S’ velocity
  - More diastolic dysfunction
- No significant differences in echographic parameters in patients with variceal bleeding, spontaneous bacterial peritonitis, and hepatic encephalopathy

Echo Assessment of Diastolic Function

- LV hypertrophy
- Enlarged LA
- Abnormal or pseudonormal E/A ratio
- Decreased mitral annulus E’
- Elevated mitral annulus E/E’



The Echo Manual



CLINICAL Findings	Hyperdynamic State	Hyperdynamic State ↑ ↑ ↑ Palpitations Tachycardia	Hypotension Cardiac Failure sign and symptoms Pulmonary edema
ECG abnormalities	QT prolongation	Multiple Extrasystoles QT prolongation ↑ ↑ ↑	Bundle branch block ST-segment depression Electrical and mechanical dyssynergy
Echocardiographic Findings	prolonged isovolumetric relaxation time	prolonged isovolumetric relaxation time (>80ms) decreased pattern of contractility Diastolic dysfunction	- enlarged left atrium - decreased wall motion - increased wall thickness Systolic Dysfunction

J Am Coll Cardio 2010;56:539-49

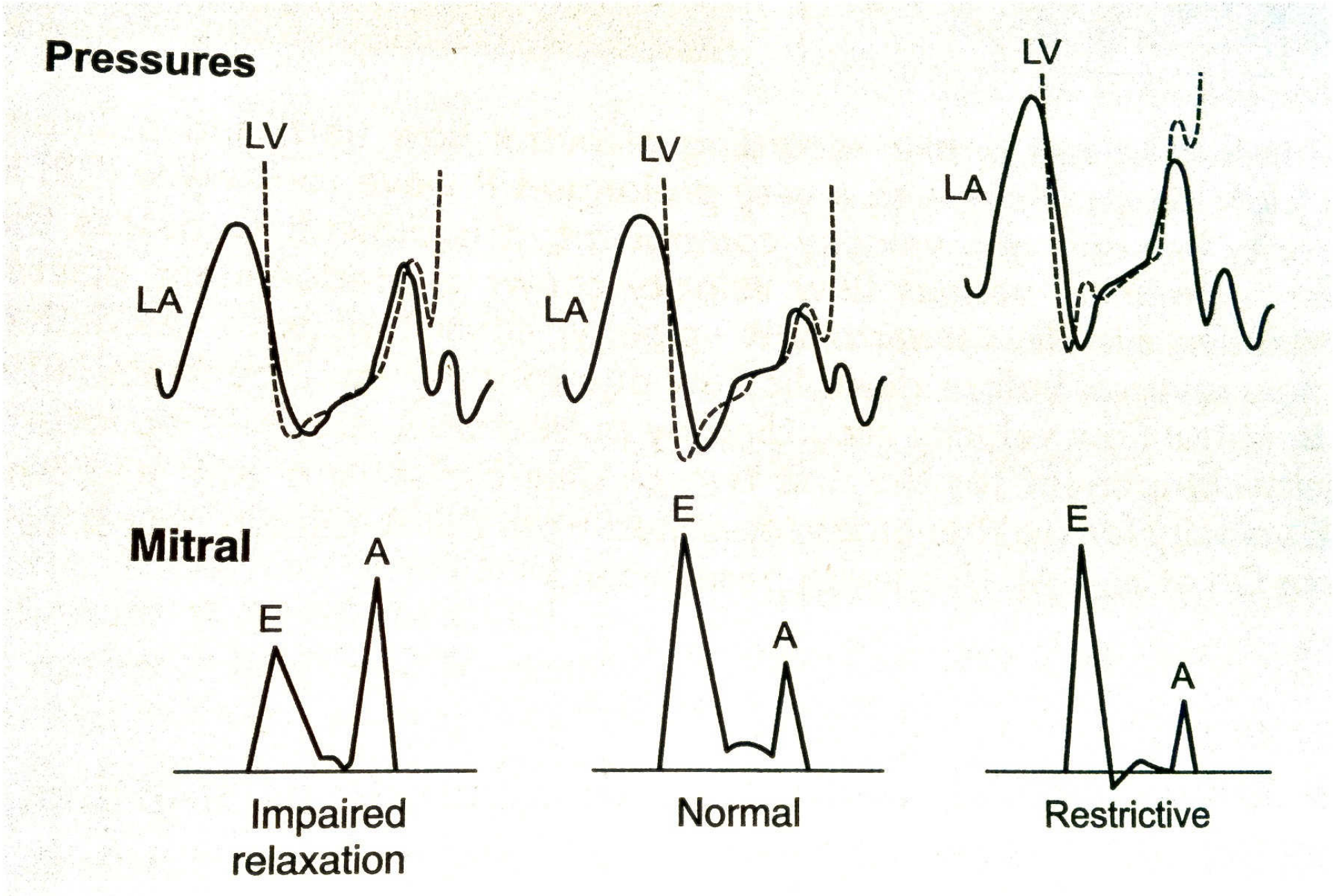
Clinical Relevance

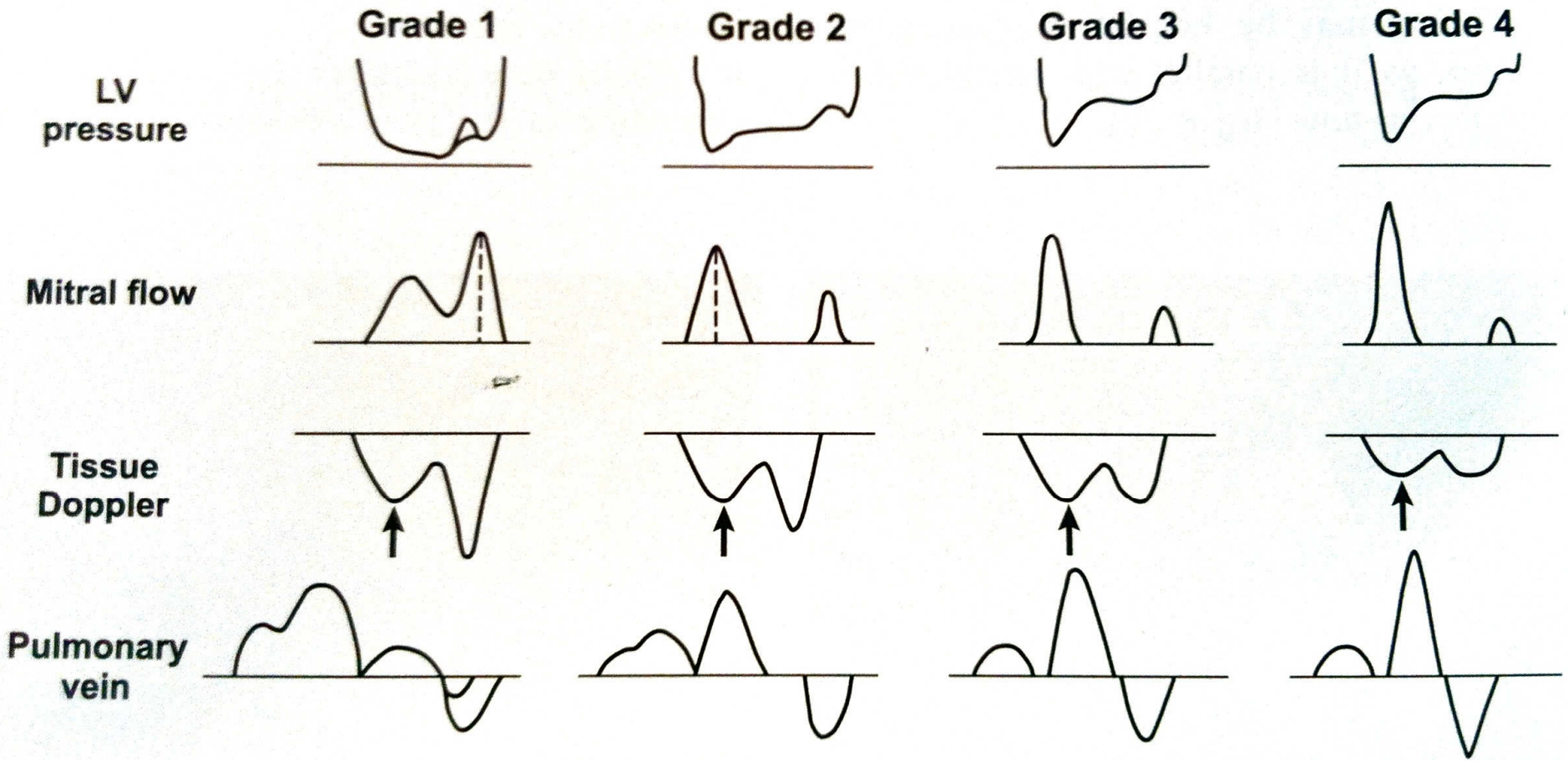
- Geographical differences in the etiology of cirrhosis:
  - More chronic hepatitis B
  - Less alcoholic and chronic hepatitis
- Peri-operative management of patients undergoing hepatectomy and liver transplantation
- Guides fluid resuscitation and optimization of hemodynamics
- Looking only at LVEF probably not enough

Thank you

Findings

- RV:
  - Similar RV dimensions, RVFAC
  - Higher tricuspid annular plane systolic excursion (TAPSE)
  - Higher tricuspid annular tissue Doppler velocity
  - Higher RVSP
  - Higher RV myocardial performance index


Pressures
LV
LA
LV
LA
LV
LA
Mitral
E
A
E
A
E
A
Impaired relaxation
Normal
Restrictive


Grade 1
Grade 2
Grade 3
Grade 4
LV pressure
Mitral flow
Tissue Doppler
Pulmonary vein