Doppler assessment of normal and complicated fetal heart

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Paediatric Cardiologist

Normal fetal Doppler assessment

- Doppler principles

Arterial Doppler:

- Uterine artery principles
- Umbilical artery Doppler
- Middle cerebral artery Doppler
- Aortic arch Doppler

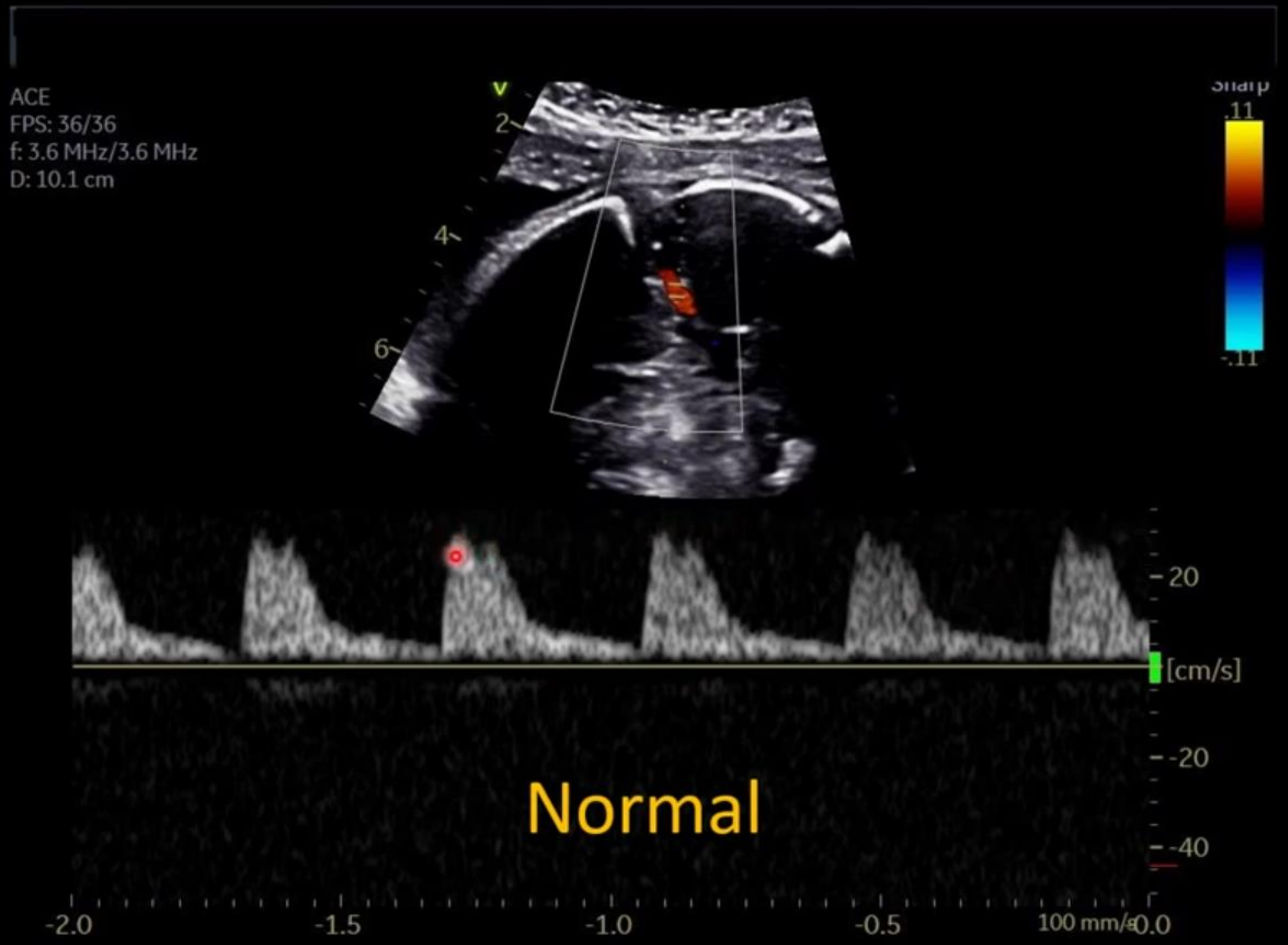
Venous Doppler:

- Ductus venosus Doppler
- Umbilical vein Doppler
- Hepatic vein and IVC Doppler
- Pulmonary vein Doppler

MCA Doppler (why)

- Monitoring of IUGR fetuses, especially those with increased UA impedance:
  - ✓ Measure PI, RI and S/D ratio
- Non-invasive assessment of fetal anemia:
  - ✓ Measure peak systolic velocity (PSV)

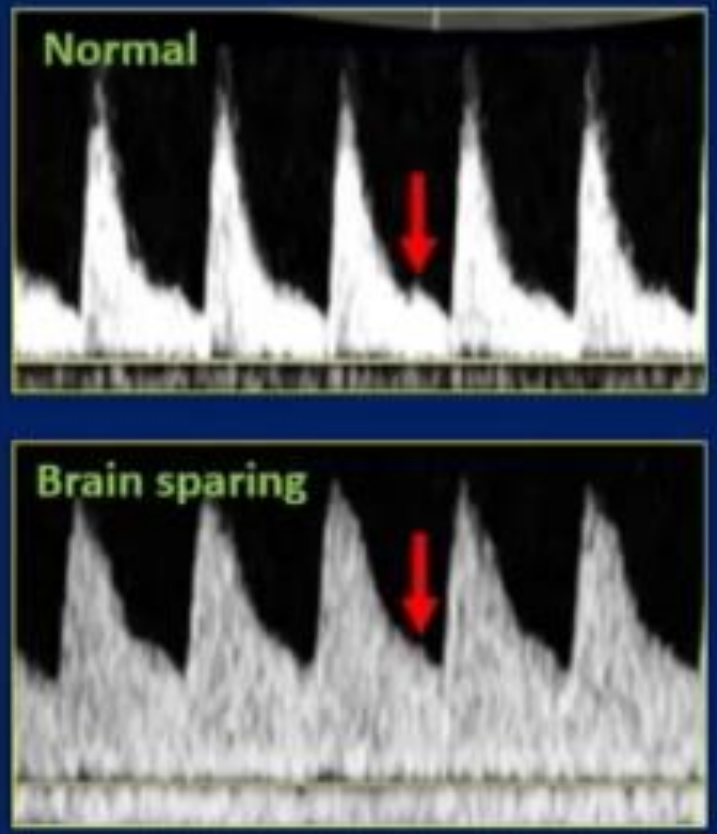
Middle cerebral artery



MCA Doppler (Abnormal)

123 radiology

- Increased diastolic flow (brain sparing)
- PI < 5th percentile is abnormal

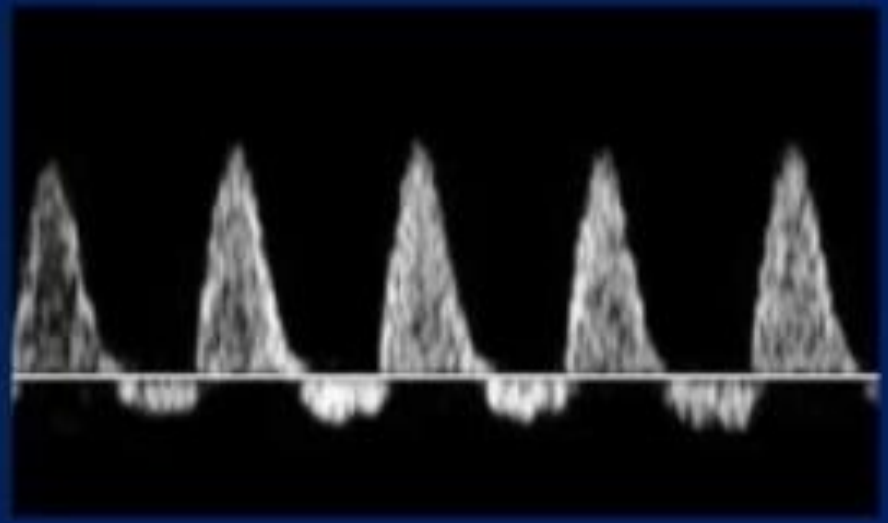


Middle cerebral artery Doppler

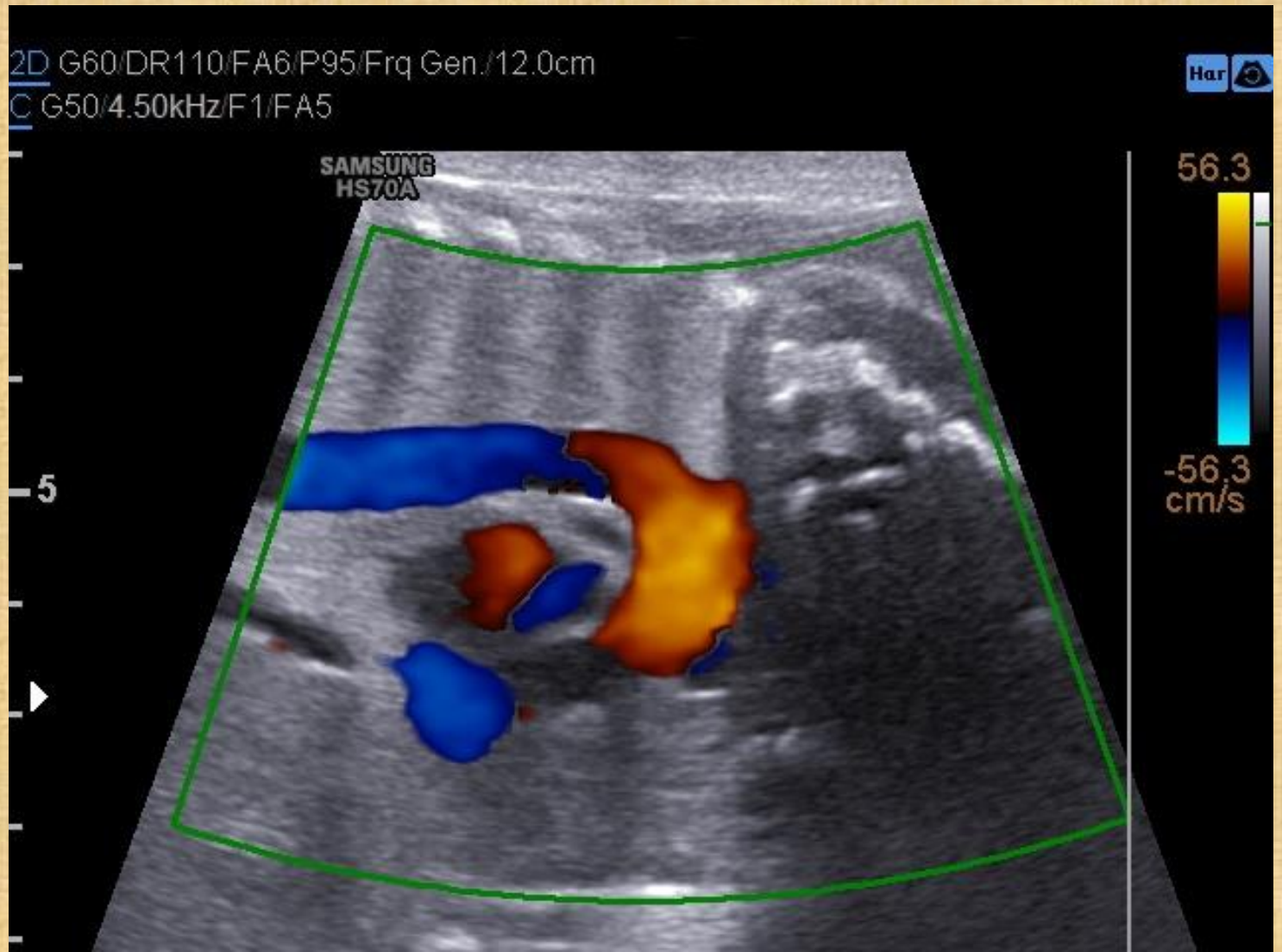
MCA Doppler (Pitfall)

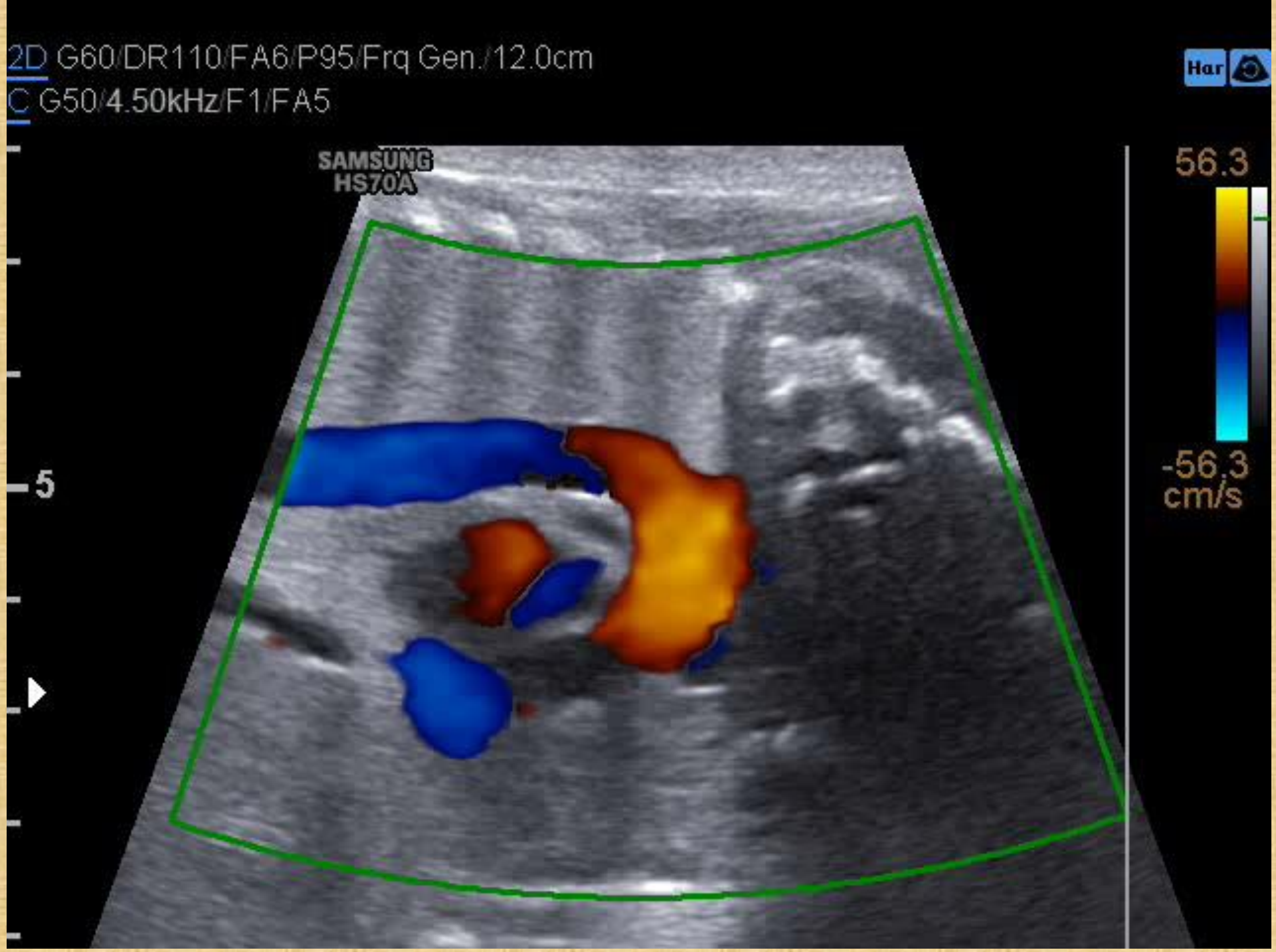
Causes of reversed diastolic flow in MCA:

- Often due to compression on the fetal head by the probe
- Impending fetal death
- Cardiac anomalies.

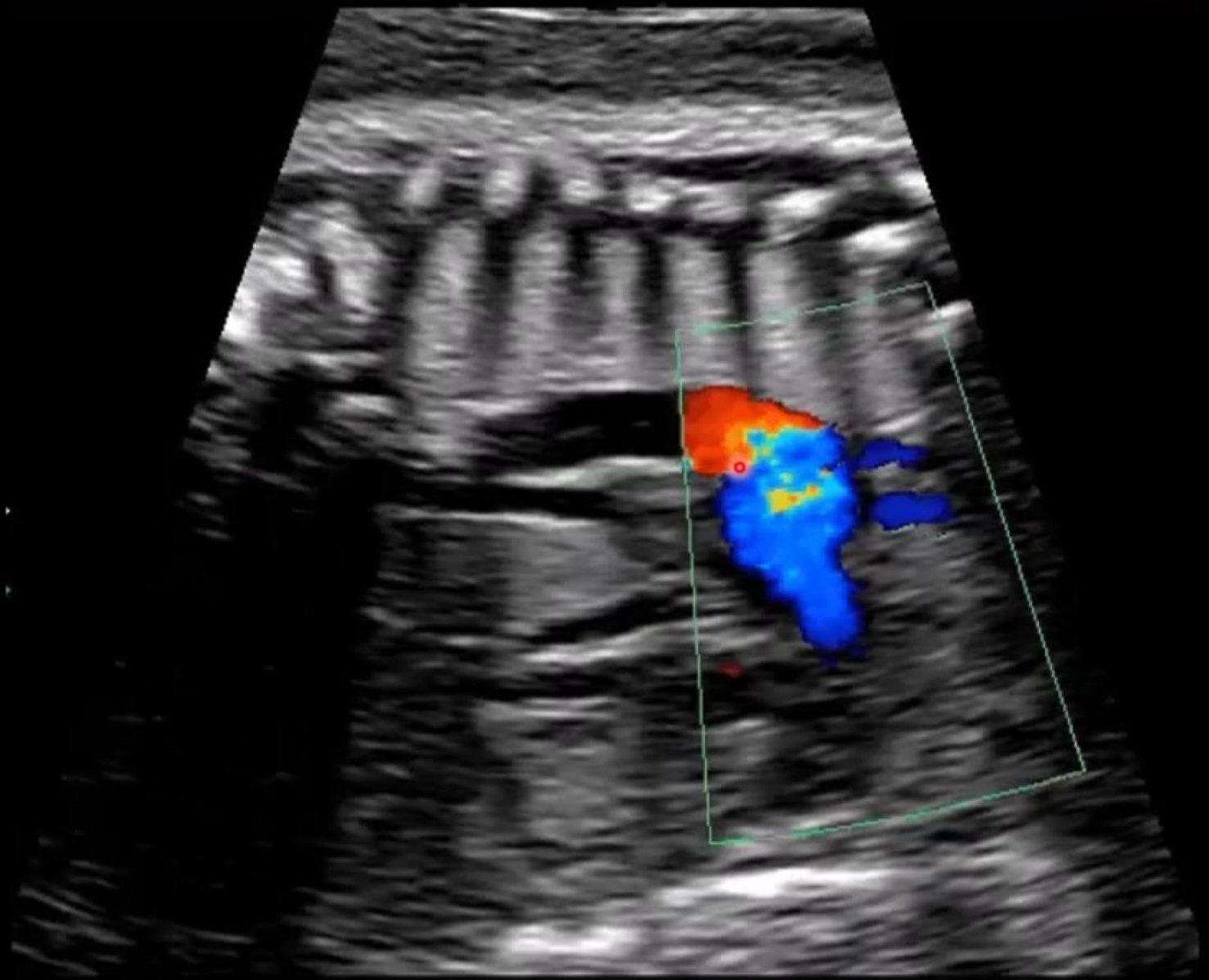


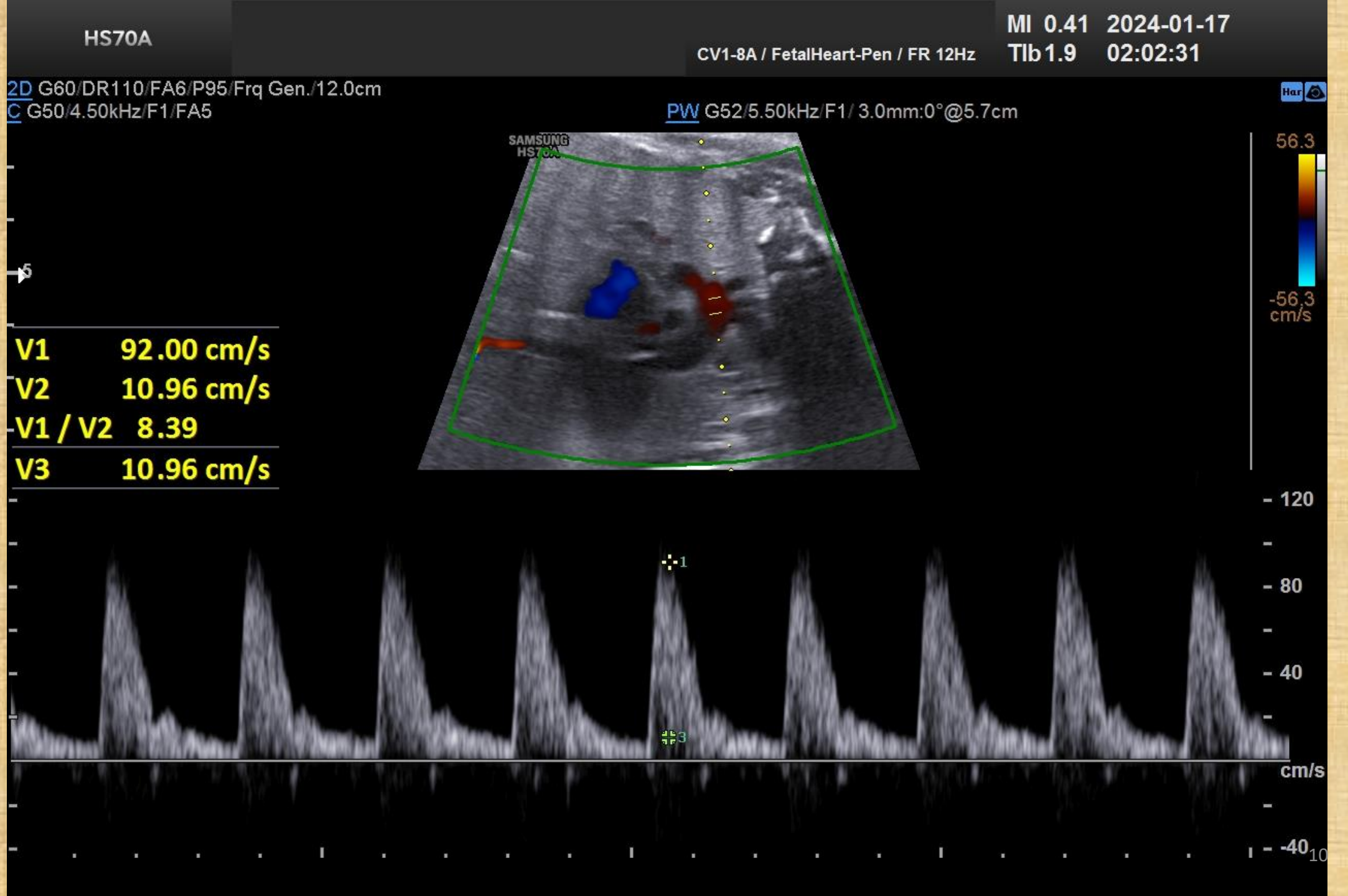
Aortic and Ductal arch Dopplers




2D G60/DR110/FA6/P95/Frq Gen./12.0cm
C G50/4.50kHz/F1/FA5
Har
SAMSUNG
HS70A
56.3
-56.3
cm/s
5

Obstructive lesions: HLHS

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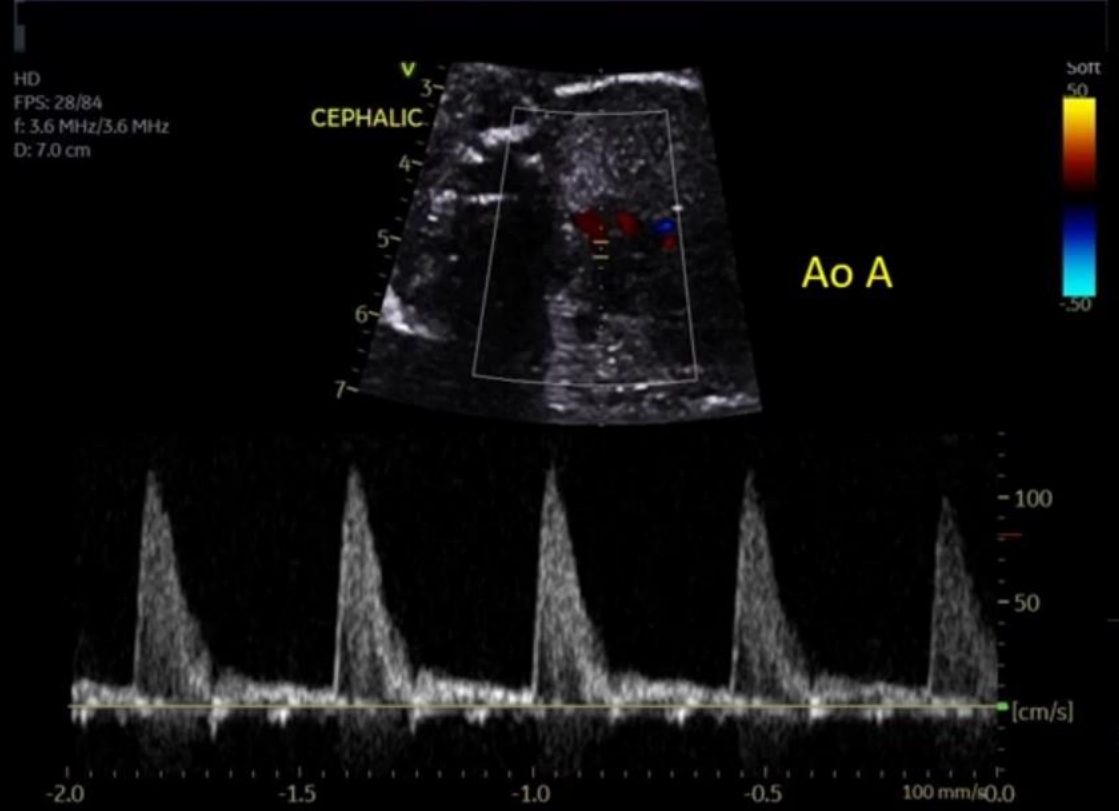
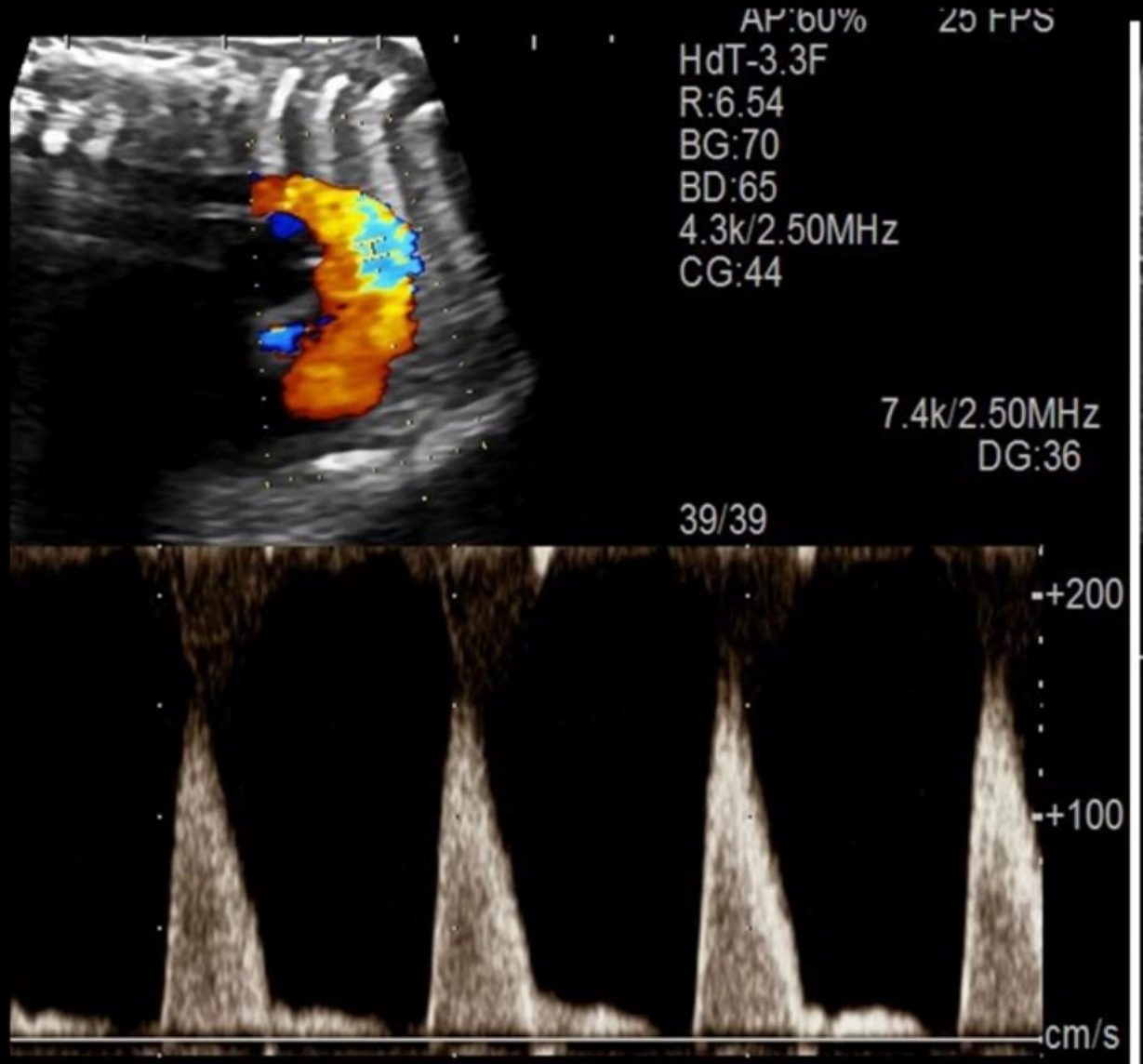
CV1-8A / FetalHeart-Pen / FR 12Hz
MI 0.41 2024-01-17
TIb 1.9 02:02:31
2D G60/DR110/FA6/P95/Frq Gen./12.0cm
C G50/4.50kHz/F1/FA5
PW G52/5.50kHz/F1/ 3.0mm:0°@5.7cm
SAMSUNG
HS70A
56.3
-56.3
cm/s
V1 92.00 cm/s
V2 10.96 cm/s
V1 / V2 8.39
V3 10.96 cm/s
120
80
40
cm/s
-40



Normal AO & DA
Velocities: <1.5m/s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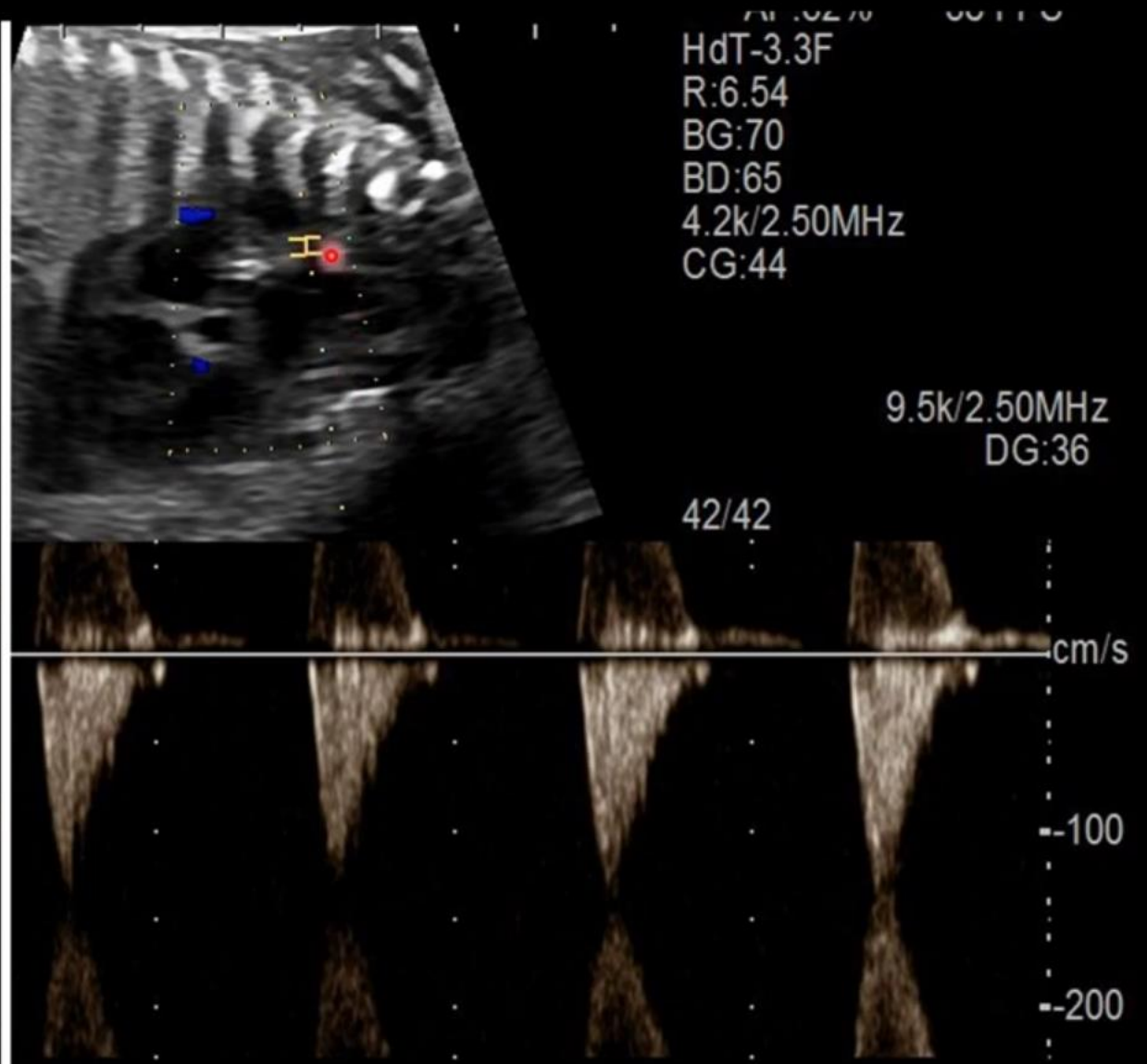
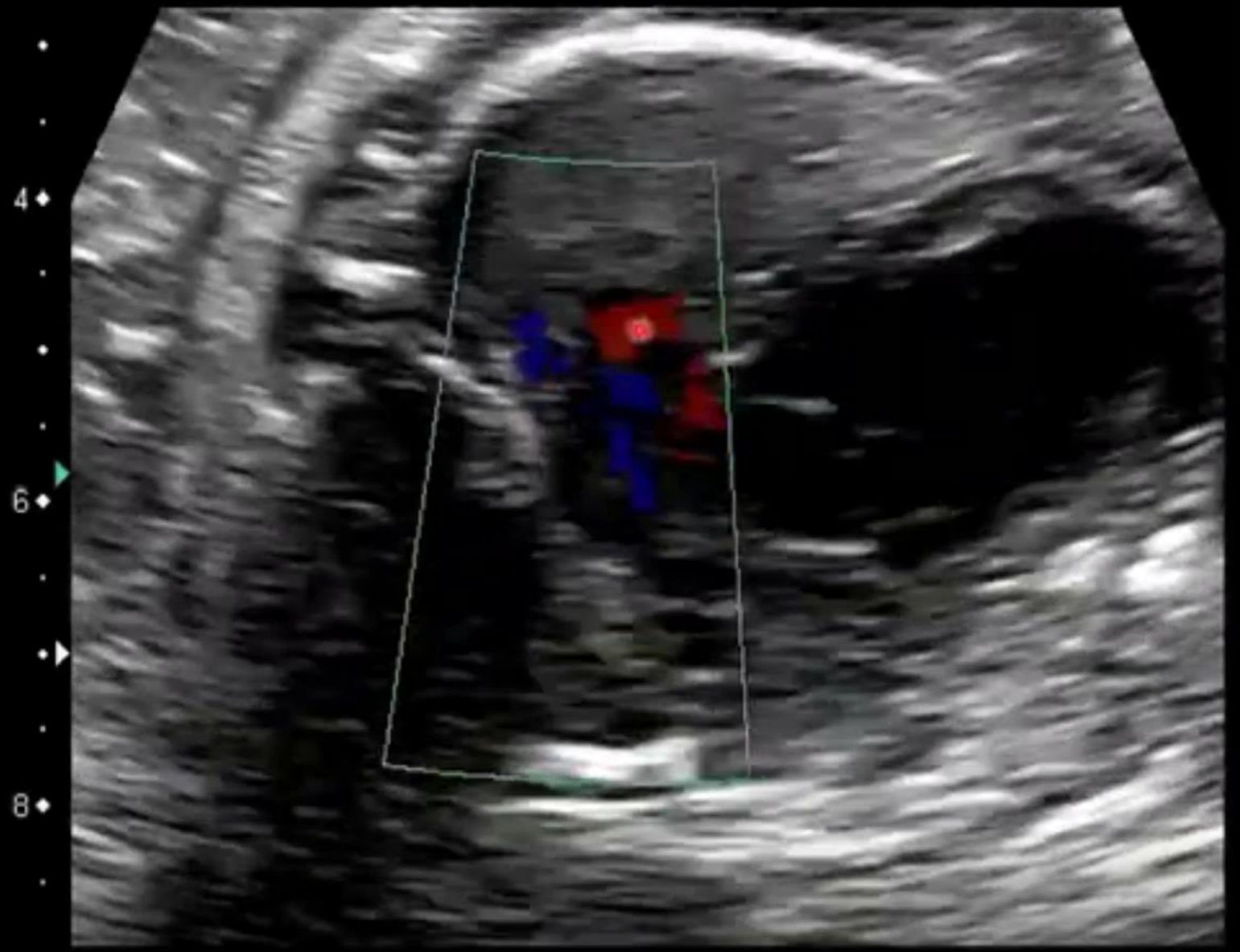
25 FPS
HdT-3.3F
R:6.54
BG:70
BD:65
4.3k/2.50MHz
CG:44
7.4k/2.50MHz
DG:36
39/39
+200
+100
cm/s

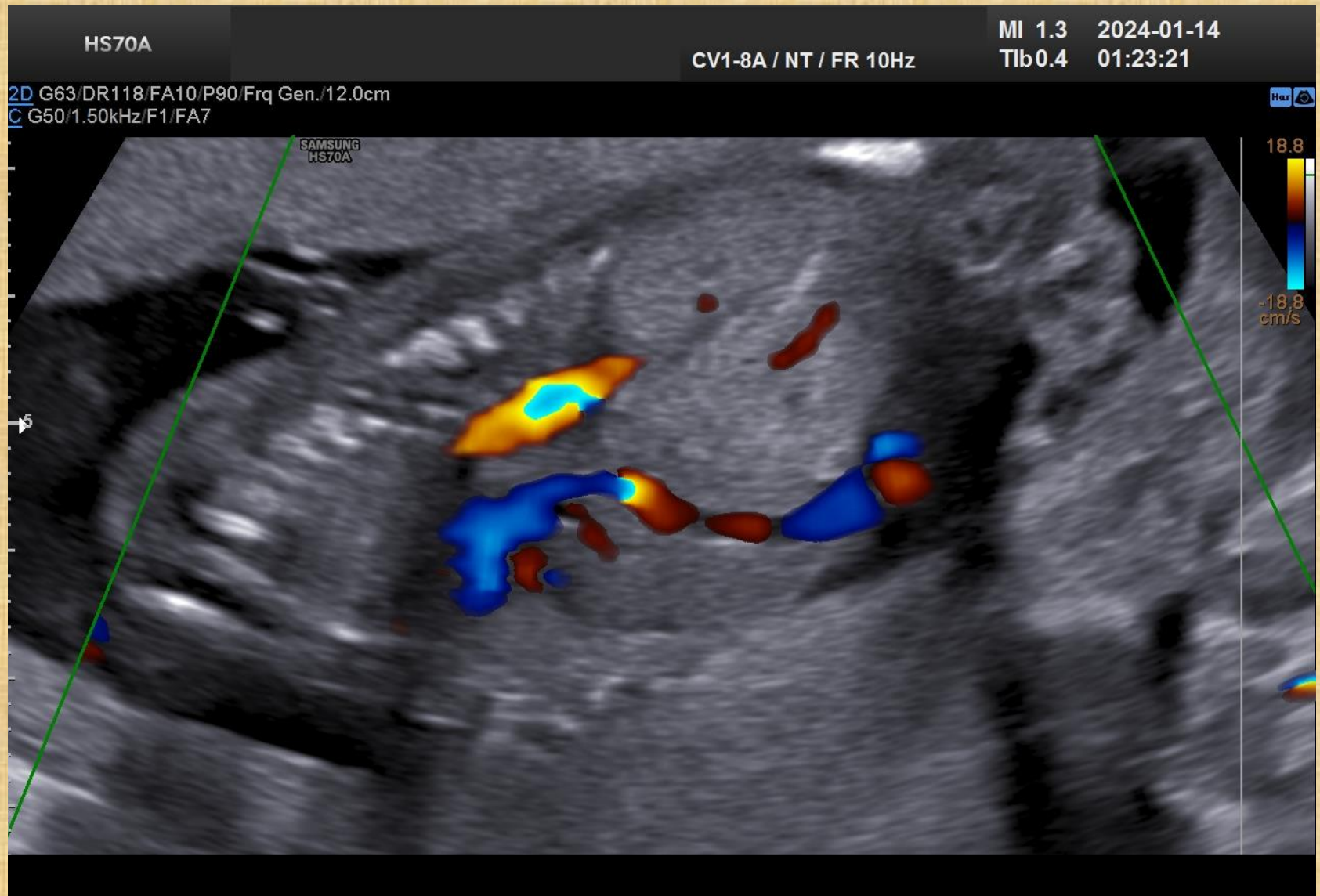

HdT-3.3F
R:6.54
BG:70
BD:65
4.2k/2.50MHz
CG:44
9.5k/2.50MHz
DG:36
42/42
cm/s
-100
-200

Obstructive lesions: HLHS



movavi

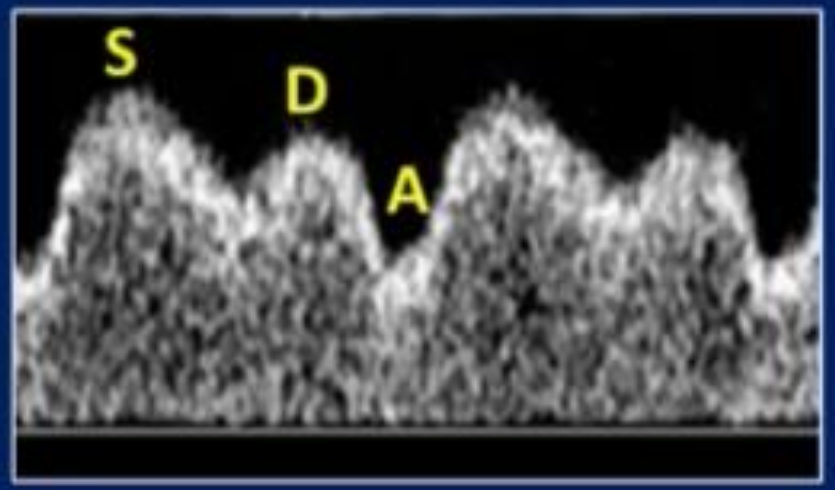
Ductus venosus and hepatic vein Doppler

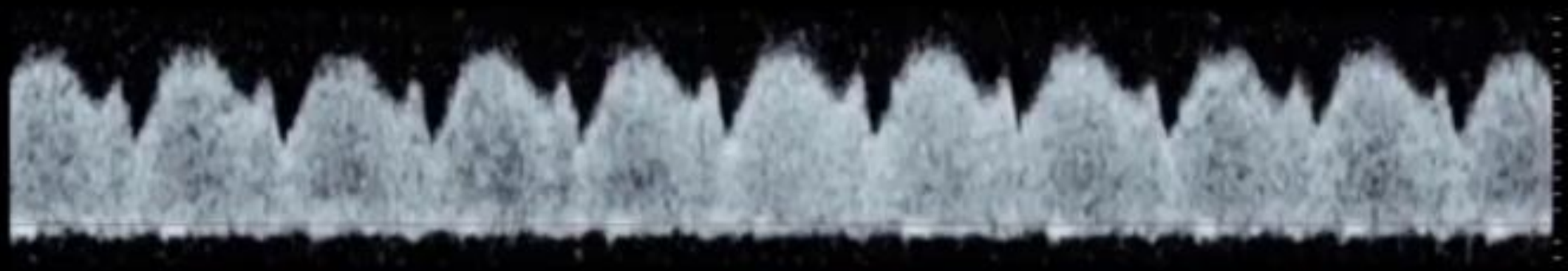


Ductus venosus

Ductus Venosus Doppler (Normal)

- Triphasic waveform:
  - S → ventricular Systole
  - D → ventricular Diastole
  - A → Atrial contraction
- Characteristic sound → like the sound of washing machine



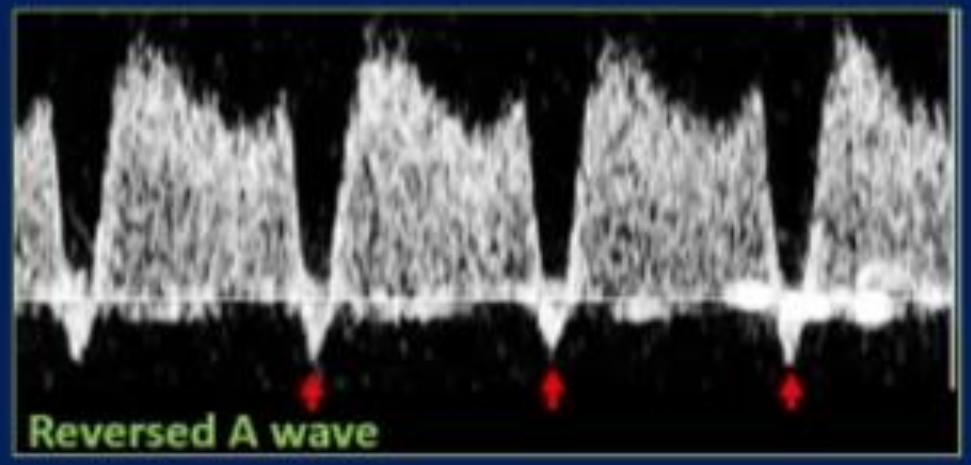


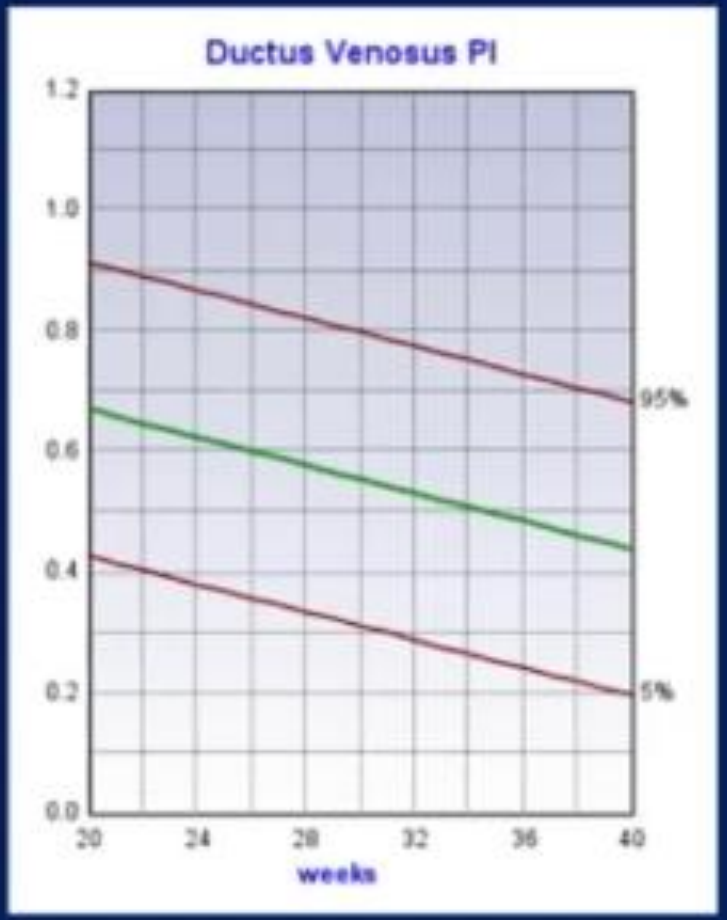
Ductus Venosus Doppler (Abnormal)

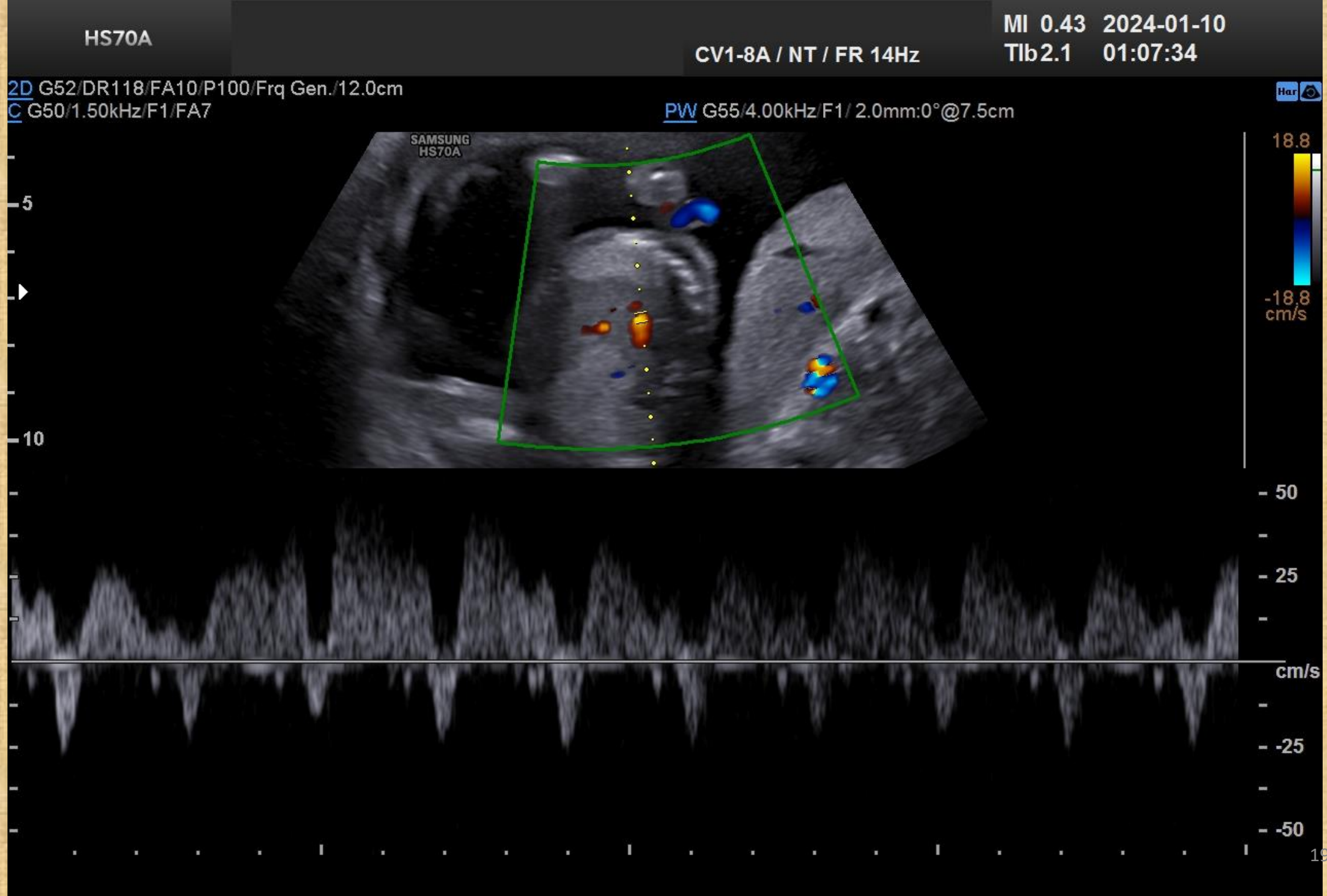
123 radiology

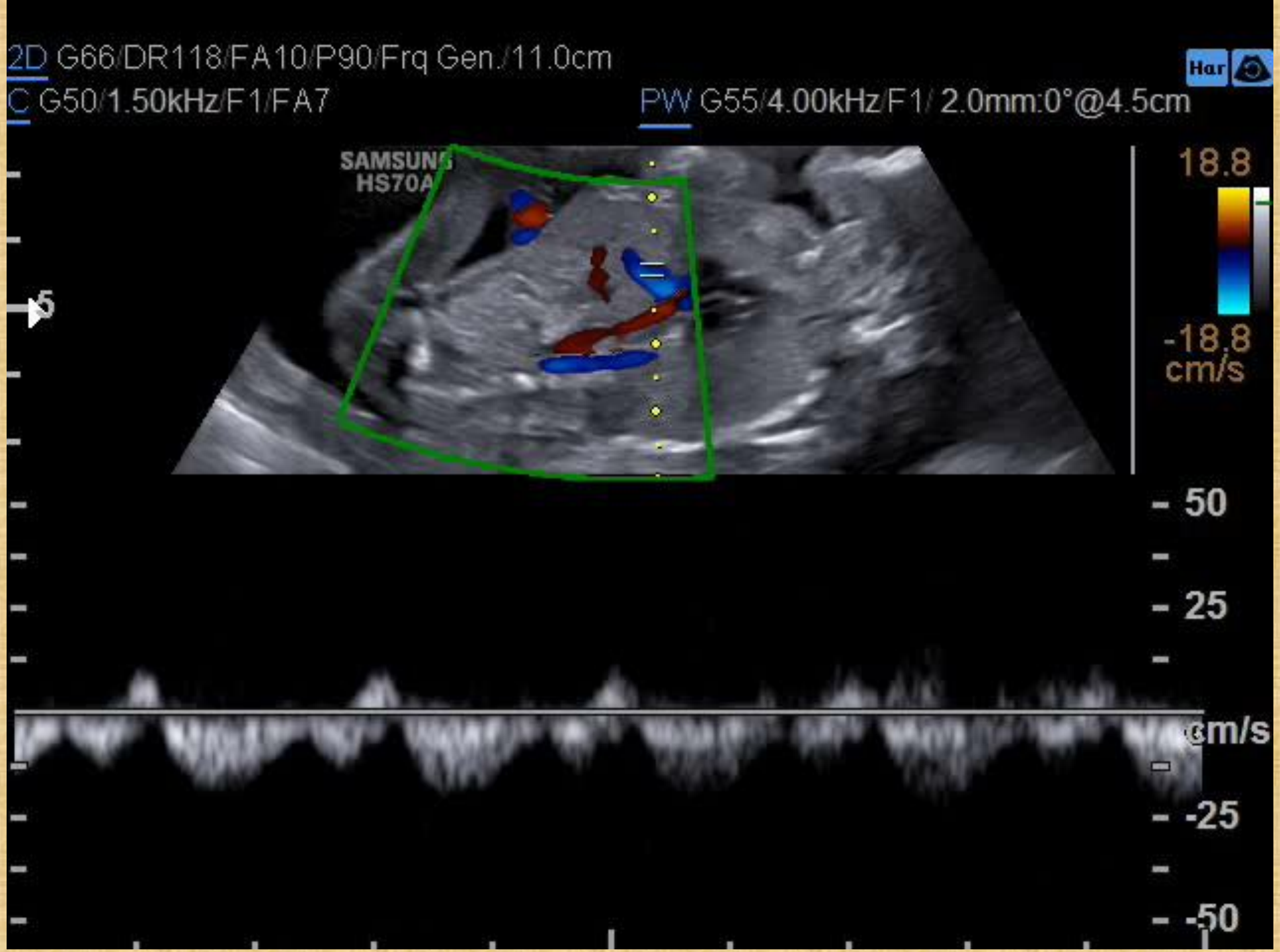
Abnormal:

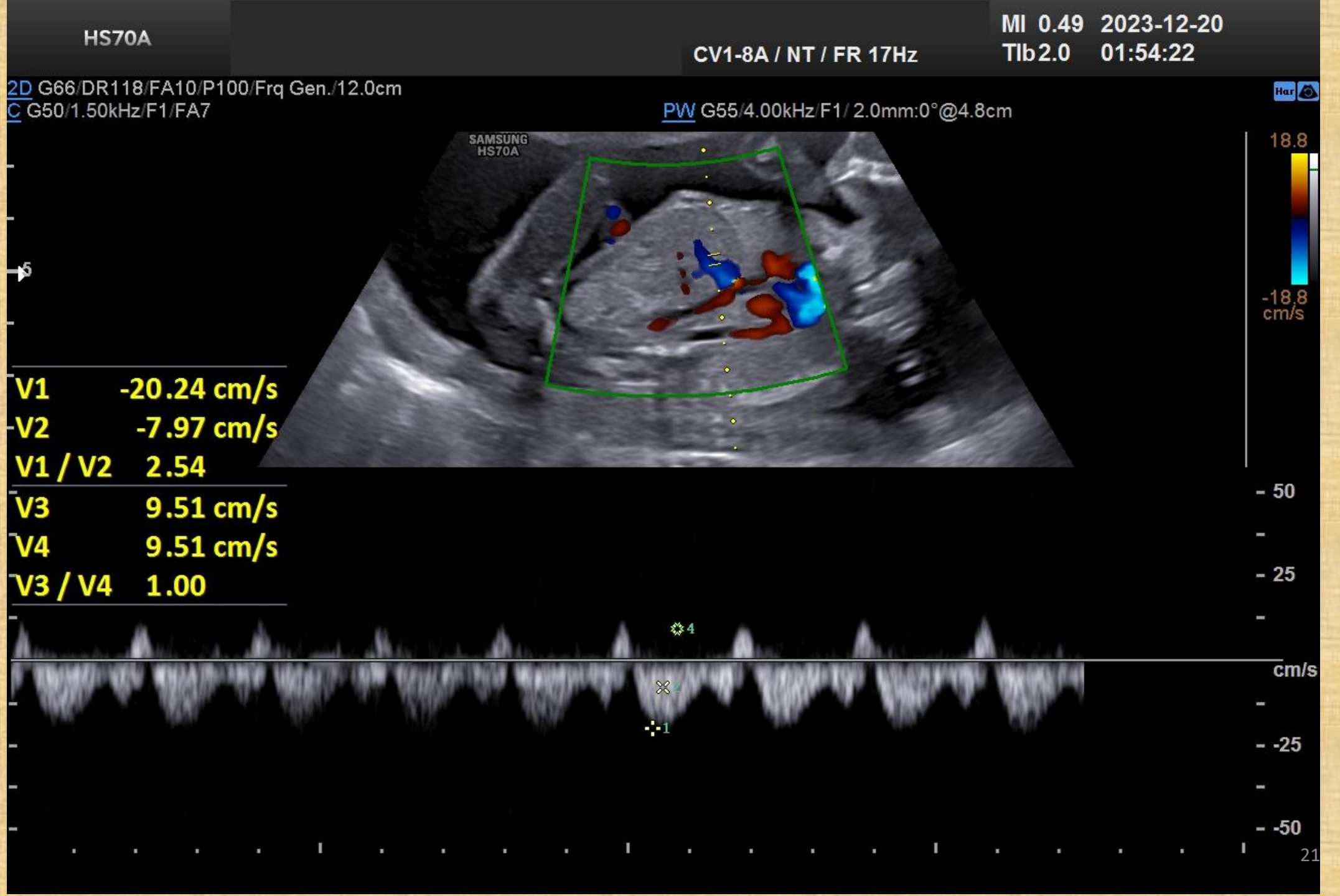
- PI > 95th percentile
- A wave below baseline or reversed



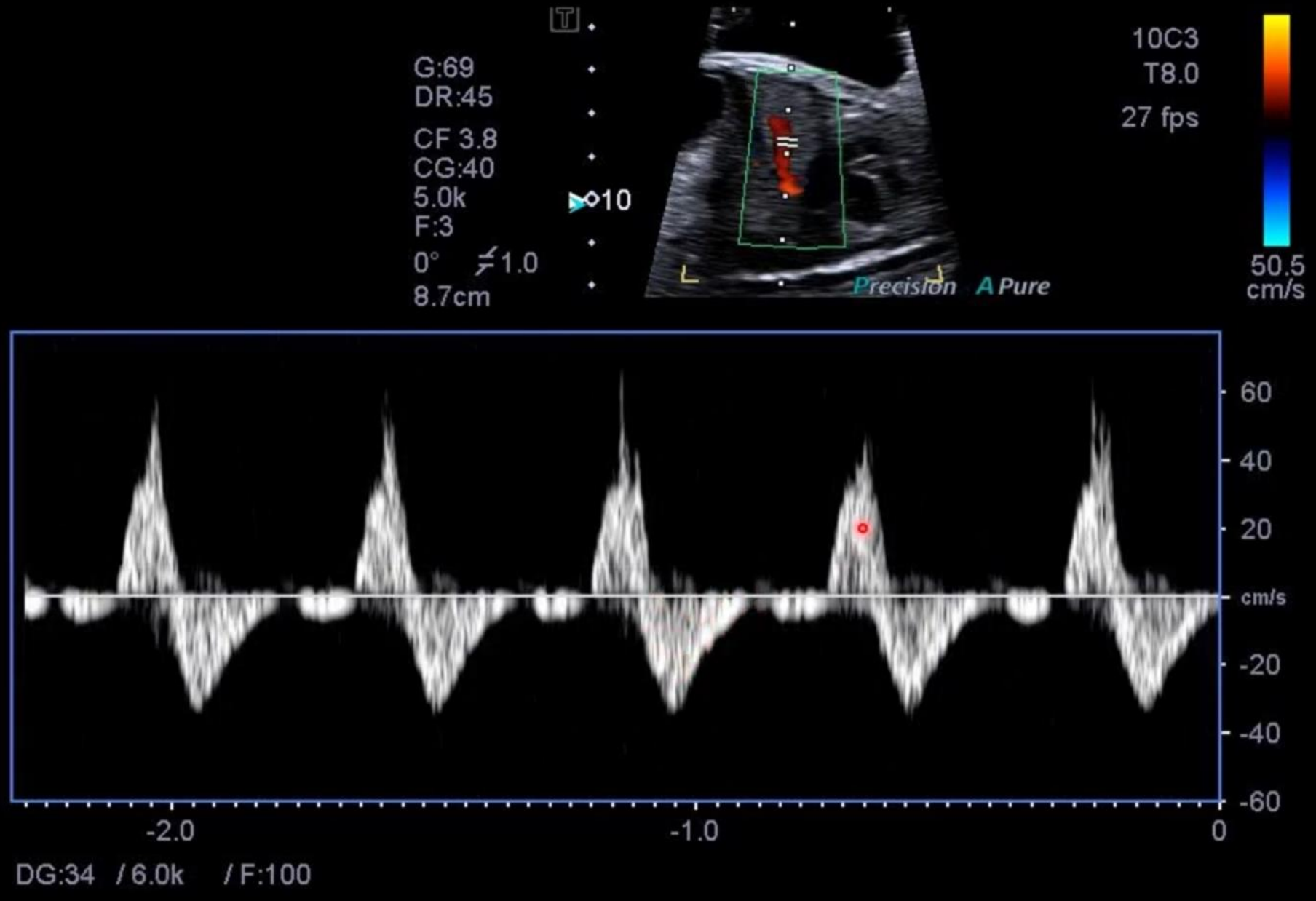


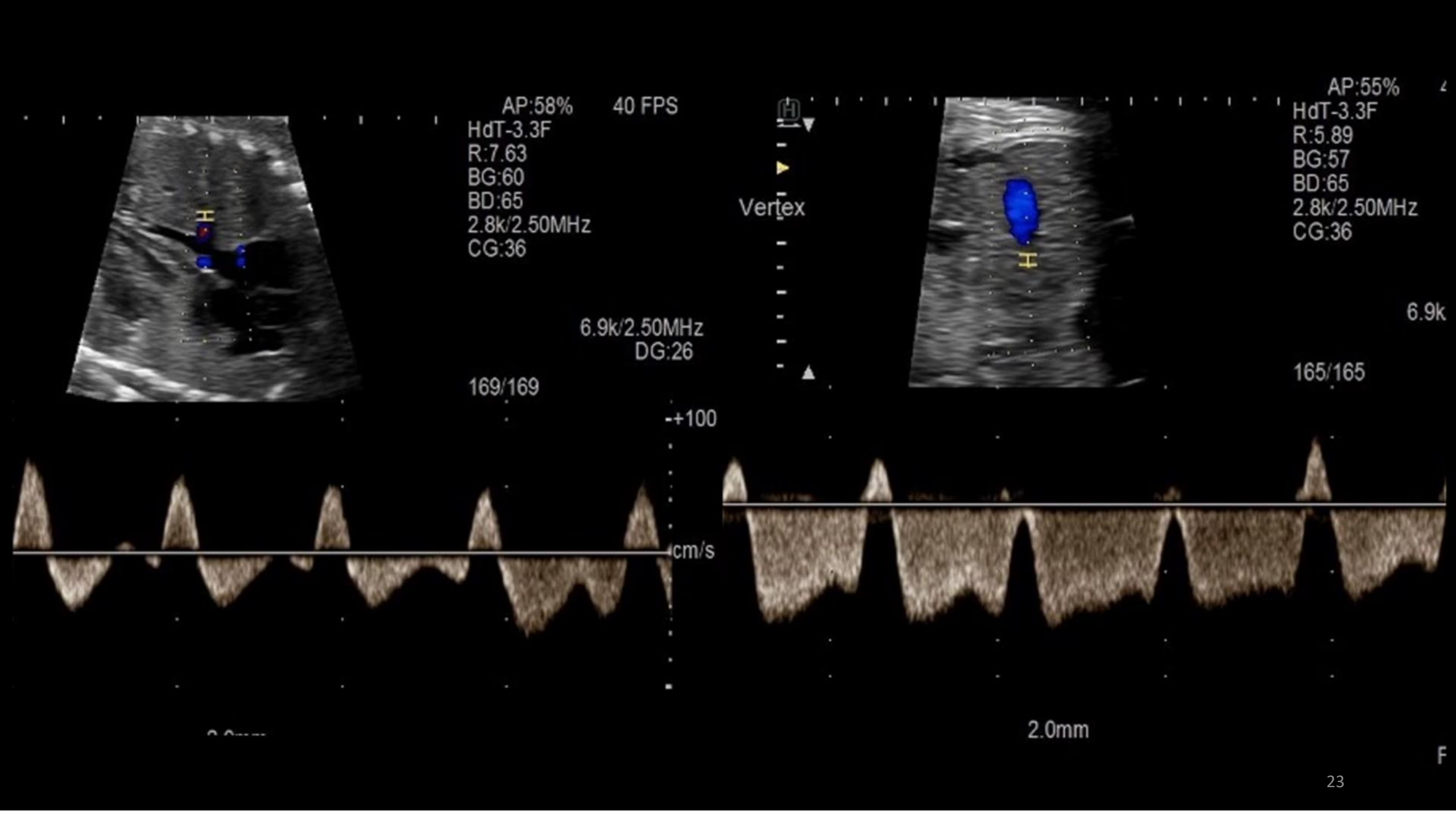

HS70A
CV1-8A / NT / FR 14Hz
MI 0.43 2024-01-10
TIb 2.1 01:07:34
2D G52/DR118/FA10/P100/Frq Gen./12.0cm
C G50/1.50kHz/F1/FA7
PW G55/4.00kHz/F1/ 2.0mm:0°@7.5cm
SAMSUNG
HS70A
18.8
-18.8
cm/s
5
10
50
25
cm/s
-25
-50

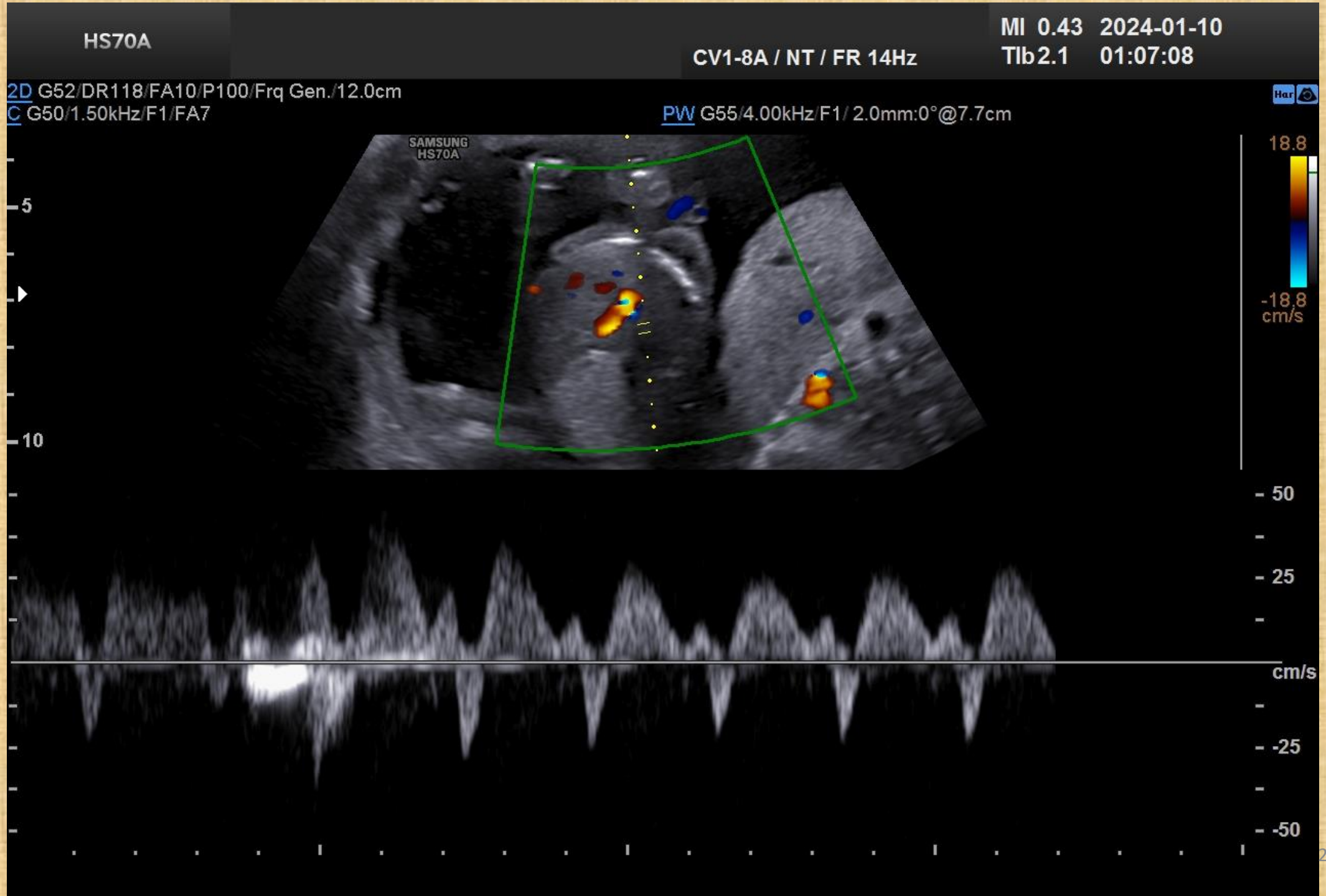

2D G66/DR118/FA10/P90/Frq Gen./11.0cm
C G50/1.50kHz/F1/FA7
PW G55/4.00kHz/F1/ 2.0mm:0°@4.5cm
Har
SAMSUNG
HS70A
18.8
-18.8
cm/s
50
25
cm/s
-25
-50


HS70A
CV1-8A / NT / FR 17Hz
MI 0.49 2023-12-20
TIb 2.0 01:54:22
2D G66/DR118/FA10/P100/Frq Gen./12.0cm
C G50/1.50kHz/F1/FA7
PW G55/4.00kHz/F1/ 2.0mm:0°@4.8cm
SAMSUNG
HS70A
18.8
-18.8
cm/s
V1 -20.24 cm/s
V2 -7.97 cm/s
V1 / V2 2.54
V3 9.51 cm/s
V4 9.51 cm/s
V3 / V4 1.00
50
25
cm/s
-25
-50
21

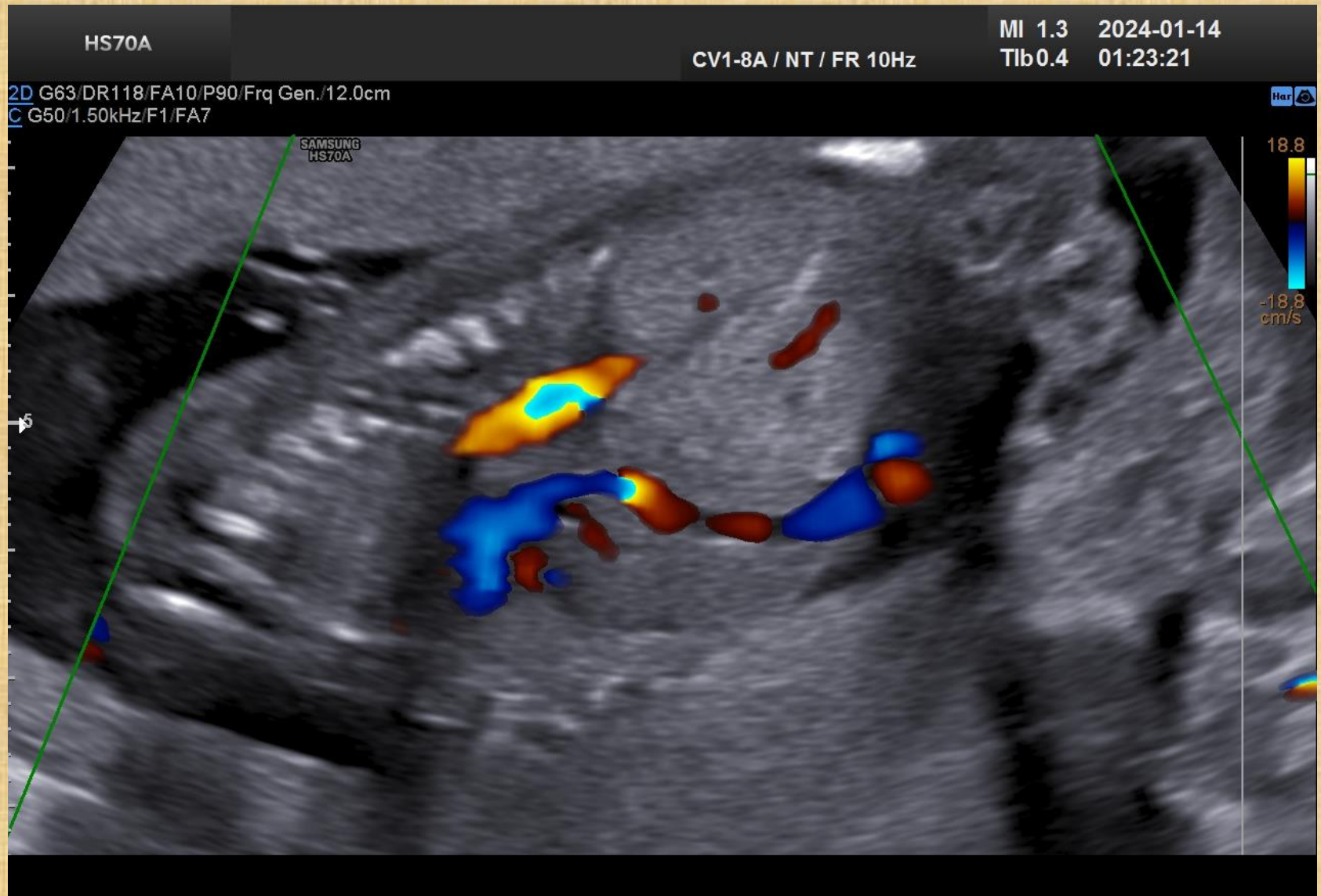
Obstructive lesions: Atrioventricular valve stenosis




AP:58%
40 FPS
HdT-3.3F
R:7.63
BG:60
BD:65
2.8k/2.50MHz
CG:36
6.9k/2.50MHz
DG:26
169/169
+100
cm/s
Vertex
AP:55%
HdT-3.3F
R:5.89
BG:57
BD:65
2.8k/2.50MHz
CG:36
6.9k
165/165
2.0mm
F


HS70A
CV1-8A / NT / FR 14Hz
MI 0.43
TIb 2.1
2024-01-10
01:07:08
2D G52/DR118/FA10/P100/Frq Gen./12.0cm
C G50/1.50kHz/F1/FA7
PW G55/4.00kHz/F1/ 2.0mm:0°@7.7cm
SAMSUNG
HS70A
18.8
-18.8
cm/s
5
10
50
25
cm/s
-25
-50

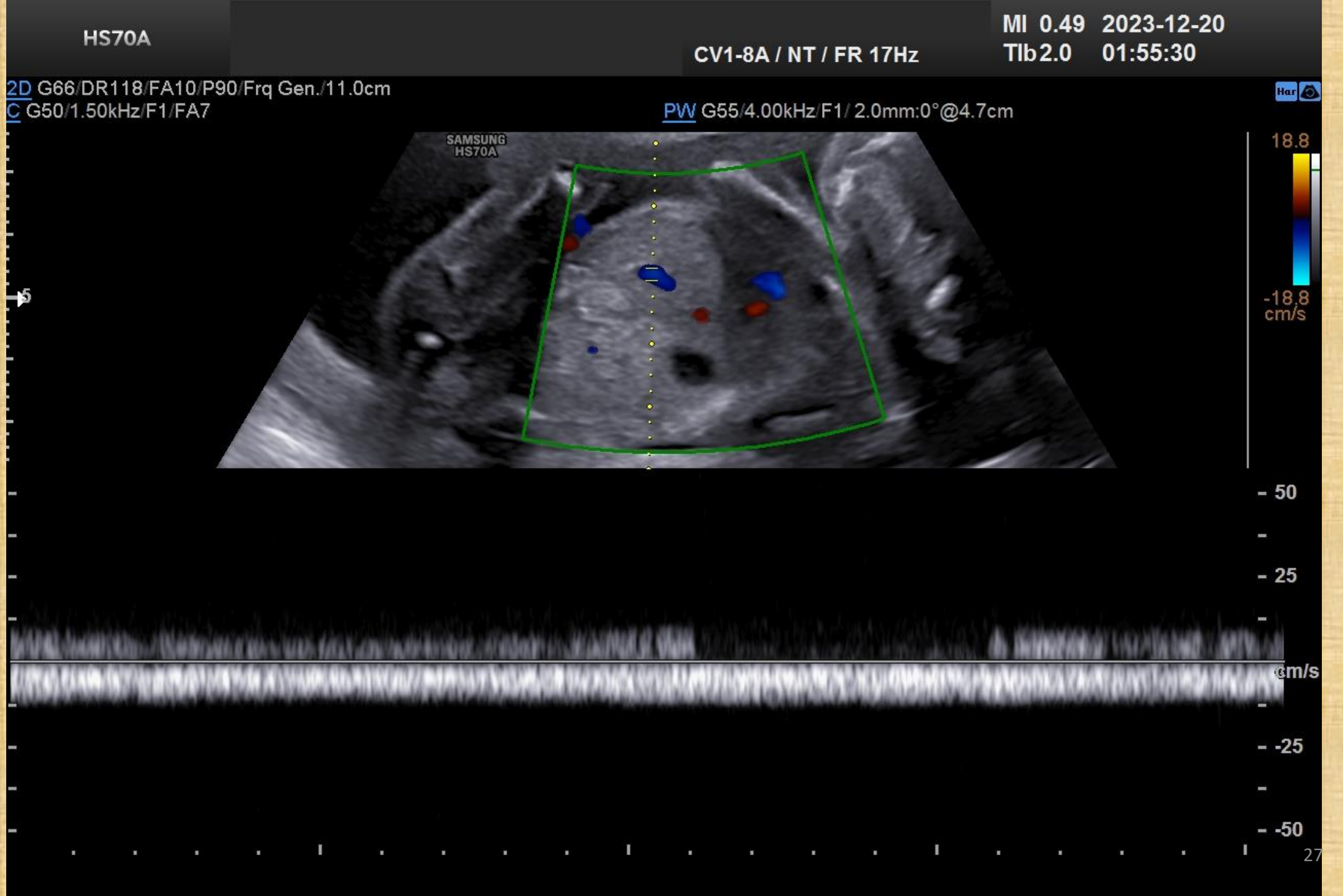
Umblical vein Doppler



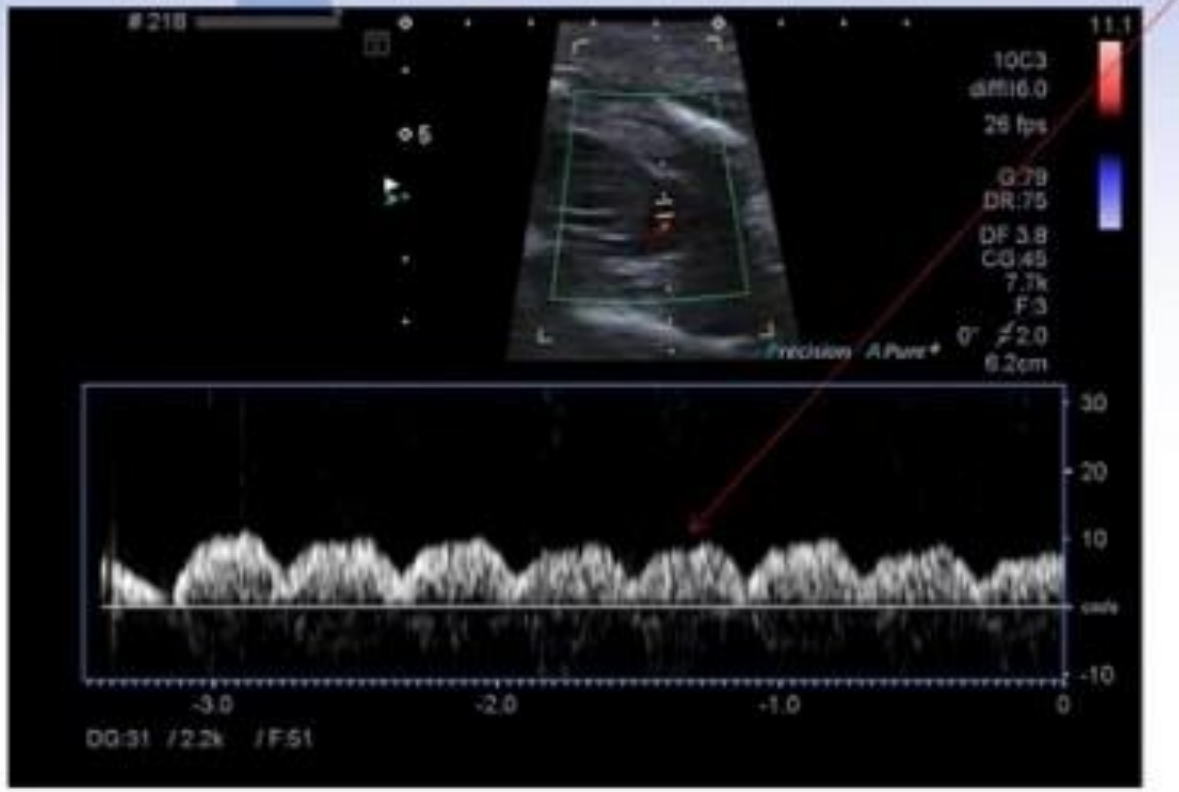
Umbilical Vein Doppler

- Pulsatile flow in early pregnancy
- Becomes non-pulsatile by the beginning of second trimester
- The presence of pulsatility from second trimester onwards can indicate severe pathological state
  - Ominous sign of severely compromised fetus

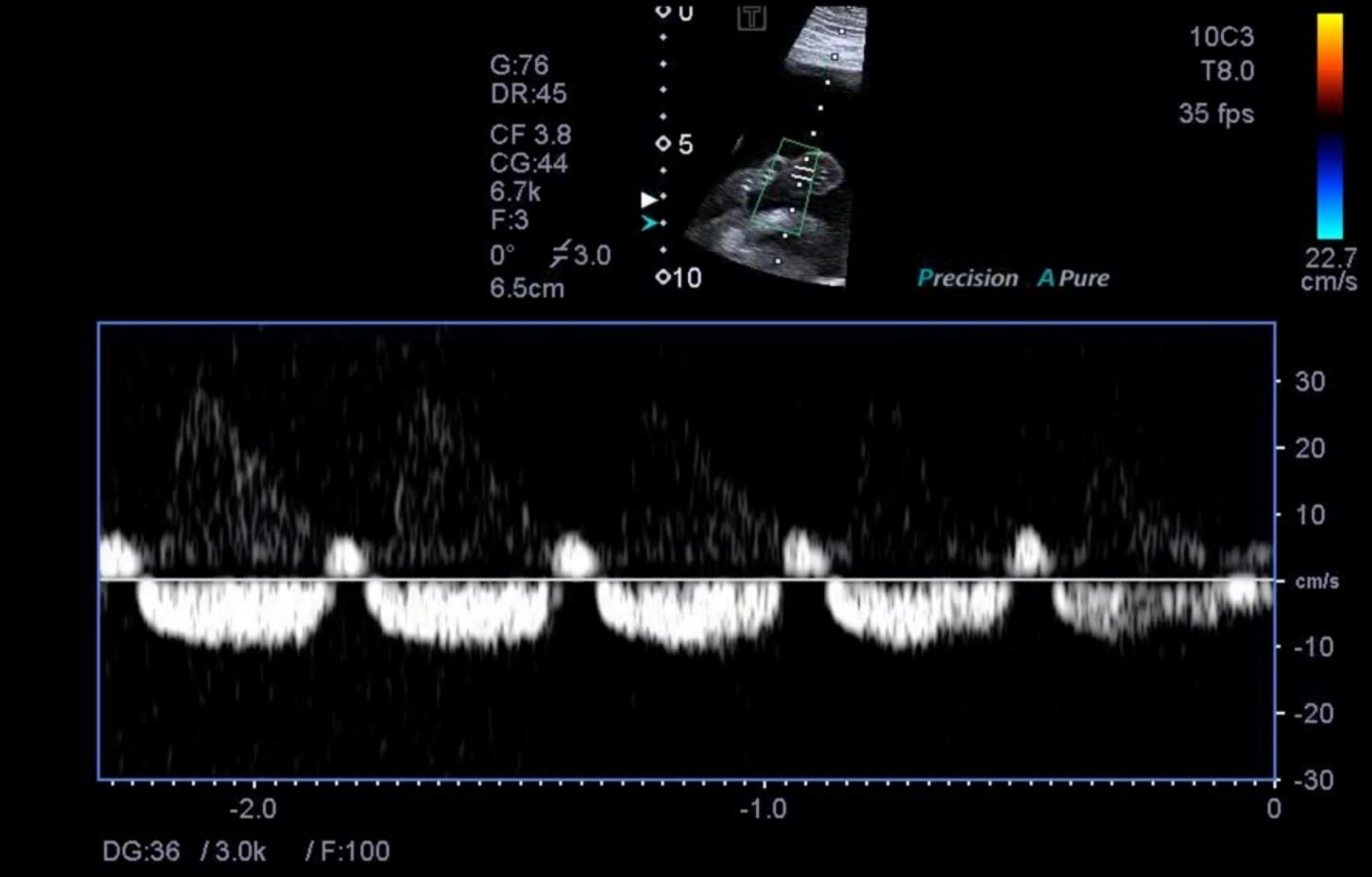
Women's & Children's Hospital ADELAIDE


HS70A
CV1-8A / NT / FR 17Hz
MI 0.49
TIb 2.0
2023-12-20
01:55:30
2D G66/DR118/FA10/P90/Frq Gen./11.0cm
C G50/1.50kHz/F1/FA7
PW G55/4.00kHz/F1/ 2.0mm:0°@4.7cm
SAMSUNG
HS70A
18.8
-18.8
cm/s
50
25
cm/s
-25
-50

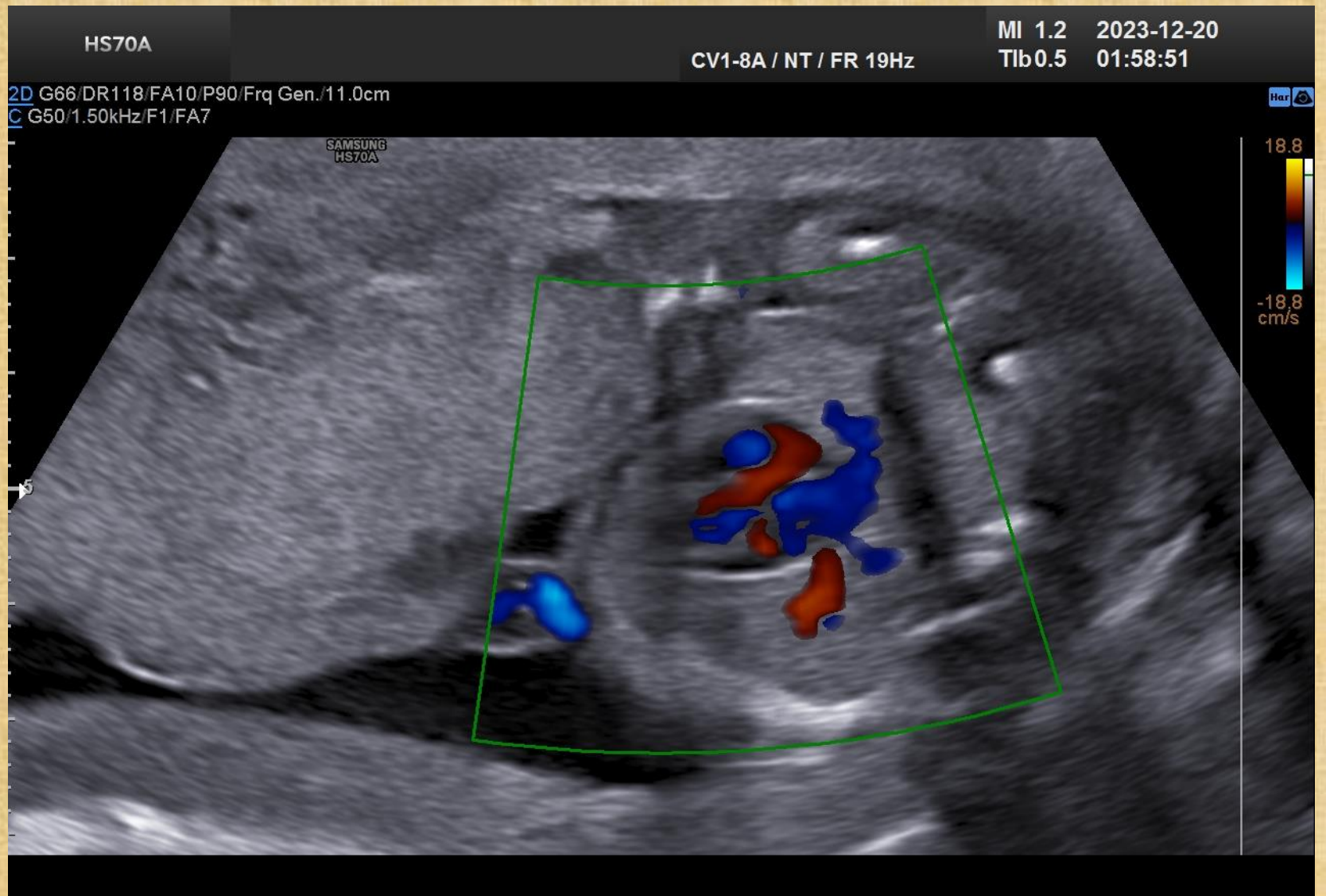
Umbilical Vein Doppler Trace Interpretation



- Abnormal umbilical vein Doppler can be characterised by a triphasic flow pattern
- Fetal mortality imminent

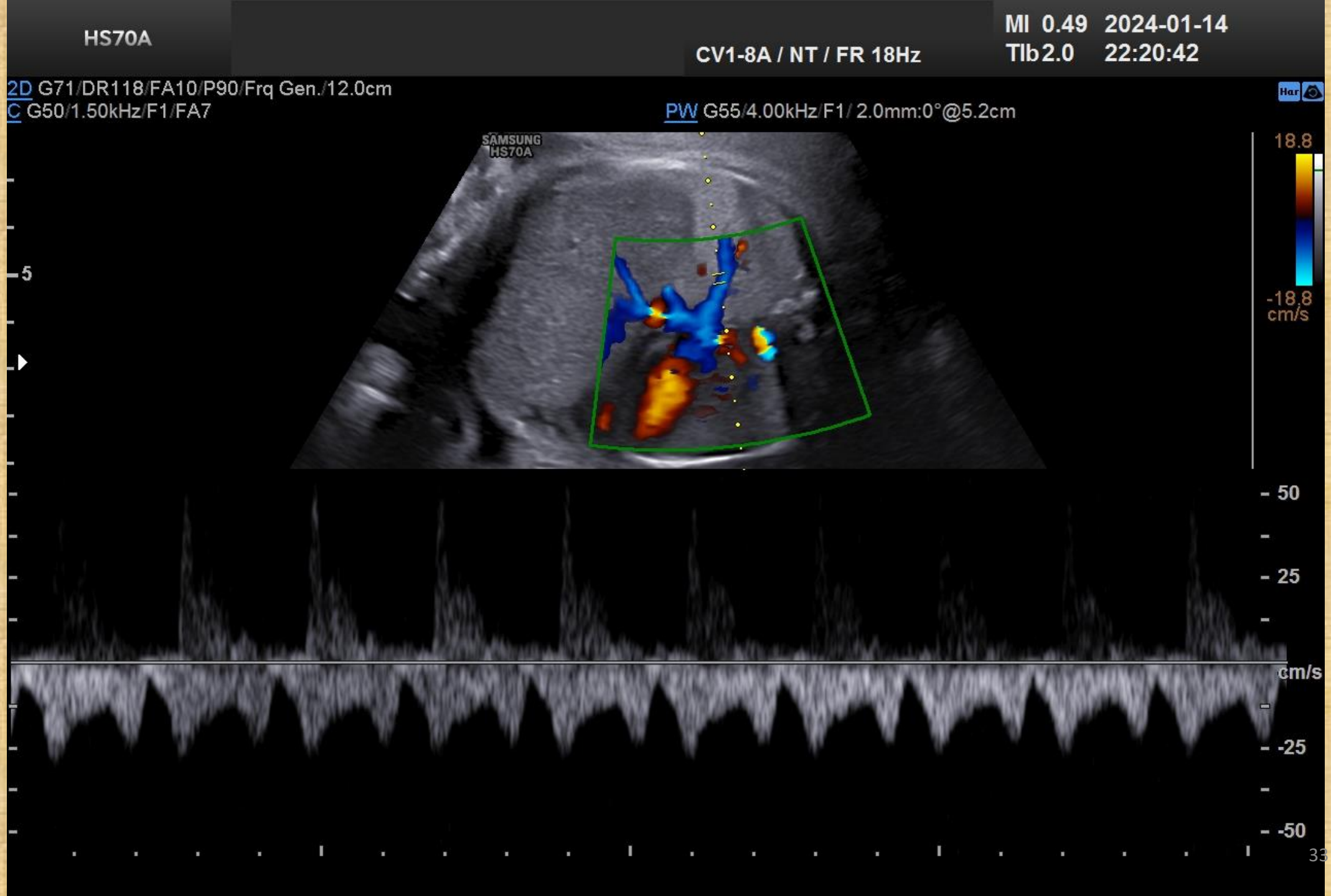

G:76
DR:45
CF 3.8
CG:44
6.7k
F:3
0°
3.0
6.5cm
0
5
10
10C3
T8.0
35 fps
Precision
A Pure
22.7
cm/s
30
20
10
cm/s
-10
-20
-30
-2.0
-1.0
0
DG:36
/ 3.0k
/ F:100

Pulmonary vein Doppler

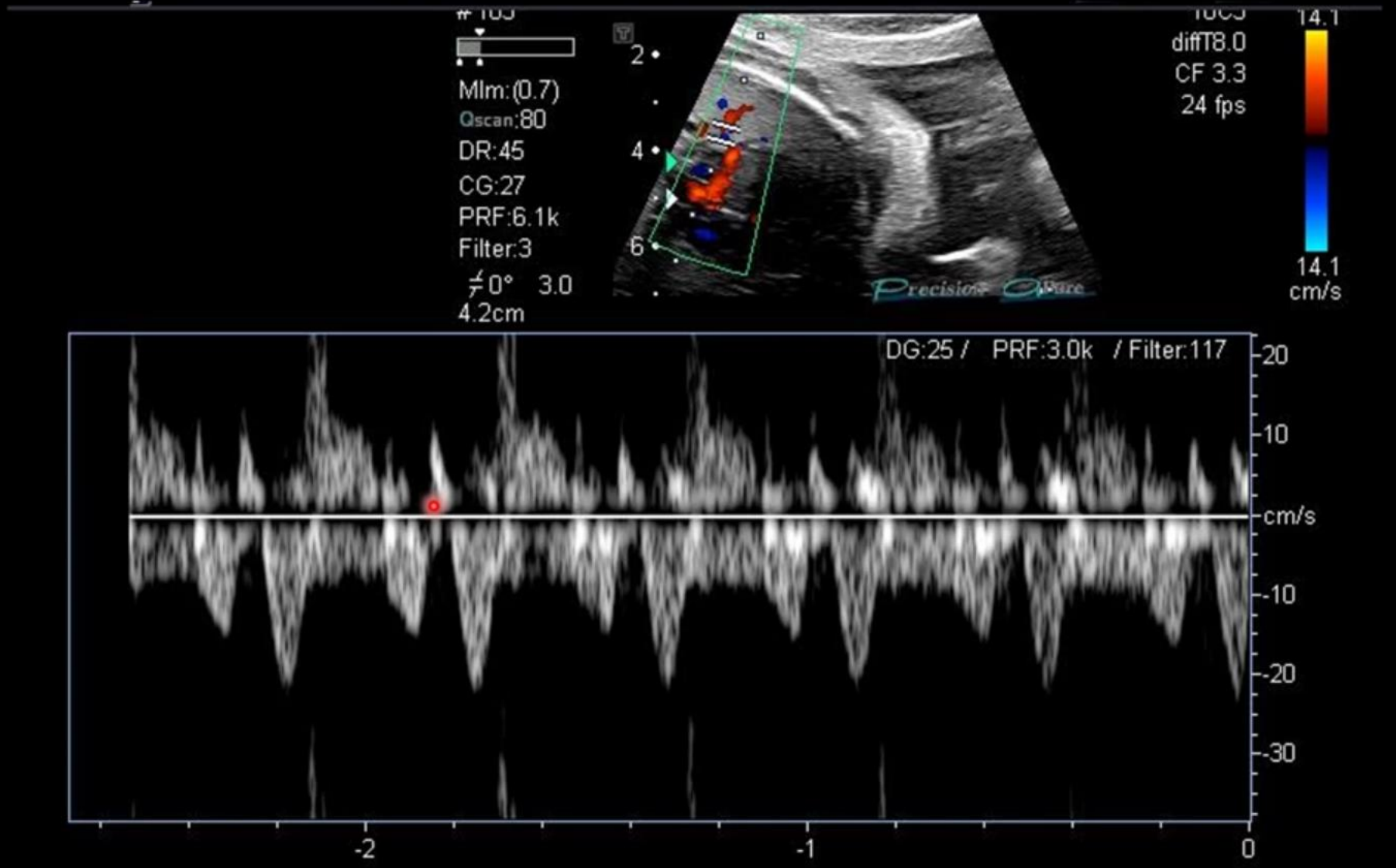


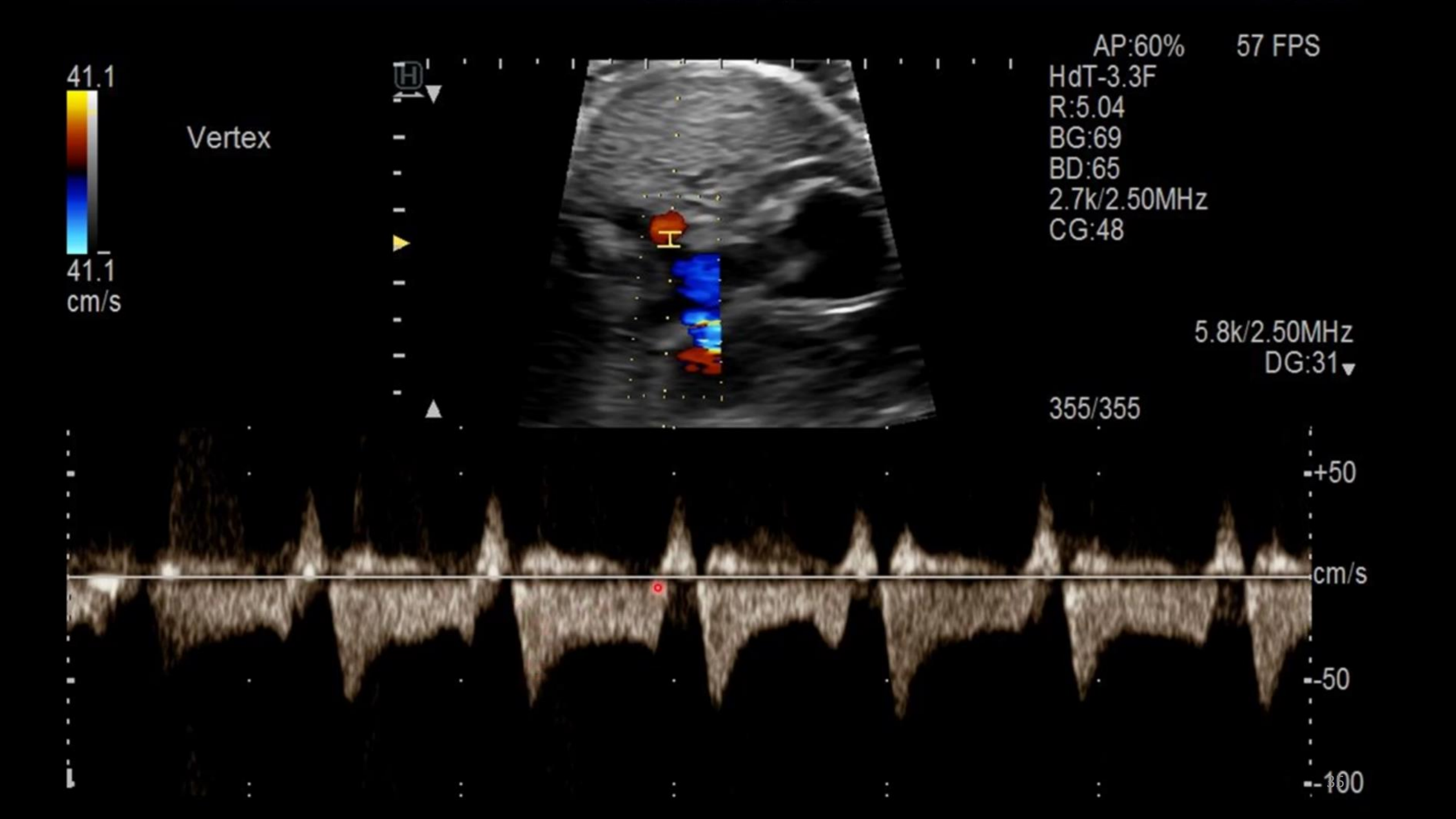

2D G66/DR118/FA10/P90/Frq Gen./11.0cm
C G50/1.50kHz/F1/FA7
Har
SAMSUNG
HS70A
18.8
-18.8
cm/s

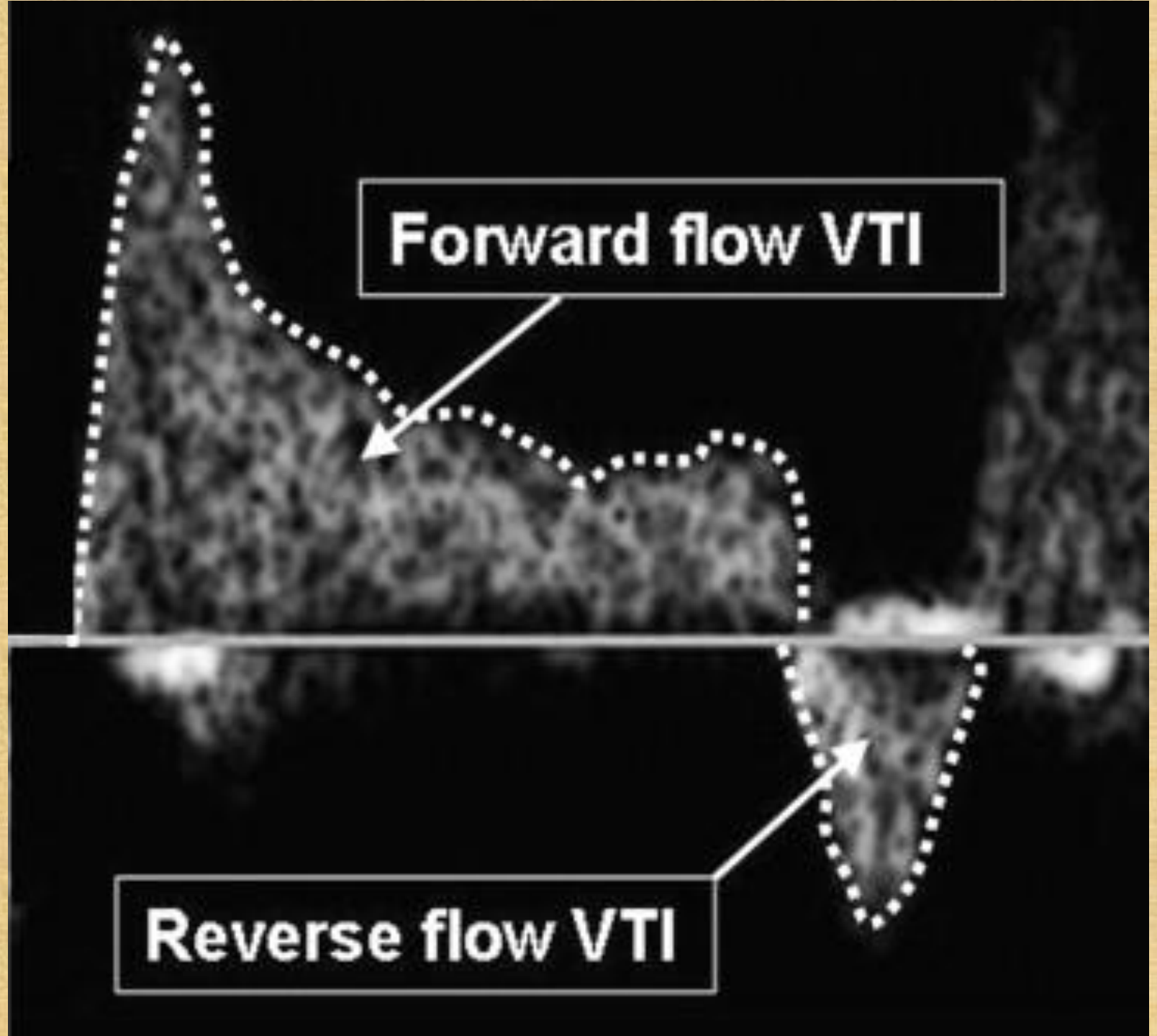

2D G66/DR118/FA10/P90/Frq Gen./11.0cm
C G50/1.50kHz/F1/FA7
PW G55/4.00kHz/F1/ 2.0mm:0°@6.3cm
Har
SAMSUNG
HS70A
18.8
-18.8
cm/s
50
25
cm/s
-25
-50

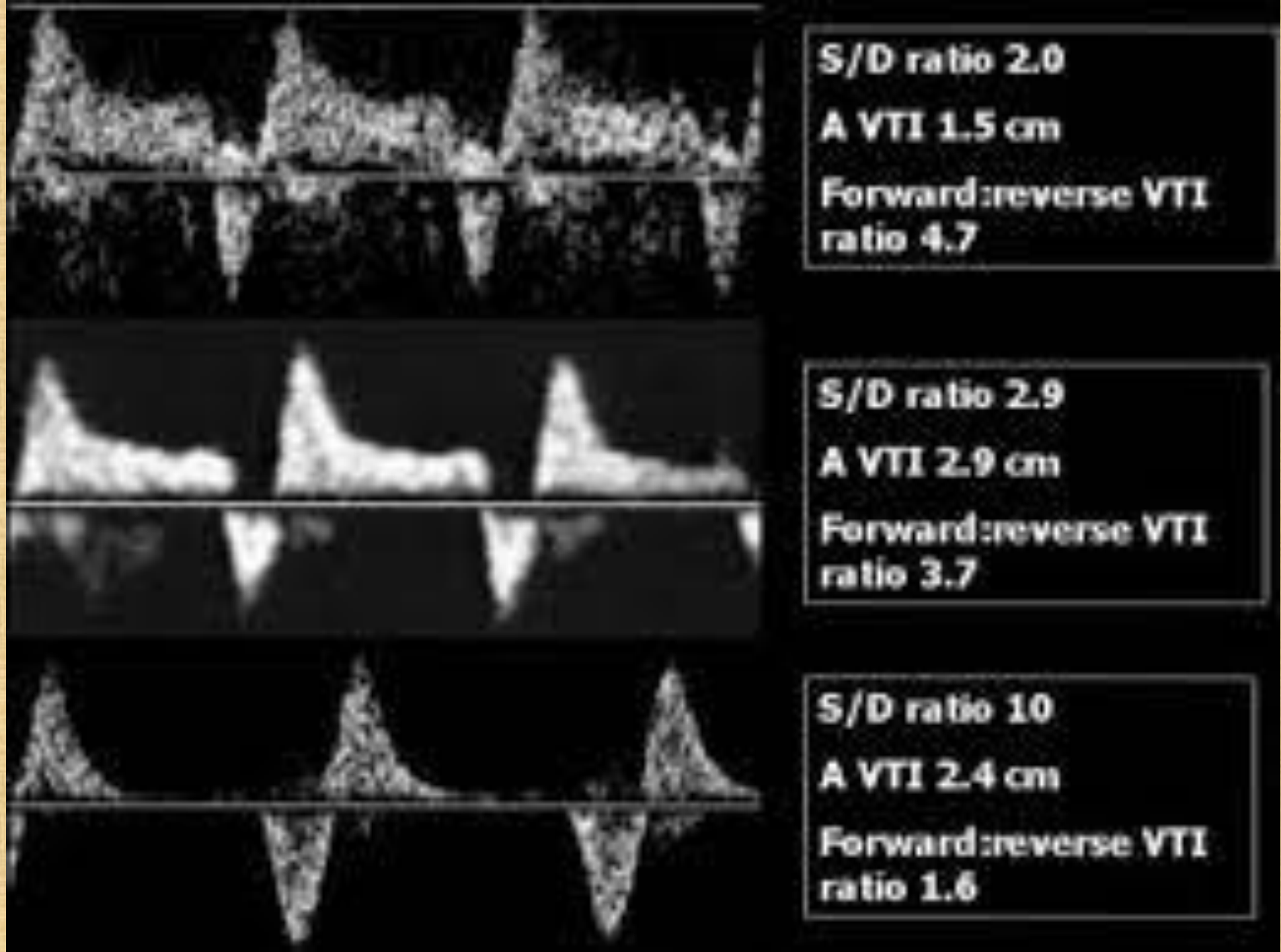

HS70A
CV1-8A / NT / FR 18Hz
MI 0.49
TIb 2.0
2024-01-14
22:20:42
2D G71/DR118/FA10/P90/Frq Gen./12.0cm
C G50/1.50kHz/F1/FA7
PW G55/4.00kHz/F1/ 2.0mm:0°@5.2cm
SAMSUNG
HS70A
Har
18.8
-18.8
cm/s
5
50
25
cm/s
-25
-50

Obstructive lesions: HLHS




41.1
41.1
cm/s
Vertex
AP:60%
57 FPS
HdT-3.3F
R:5.04
BG:69
BD:65
2.7k/2.50MHz
CG:48
5.8k/2.50MHz
DG:31
355/355
+50
cm/s
-50
-100


Forward flow VTI
Reverse flow VTI


S/D ratio 2.0
A VTI 1.5 cm
Forward:reverse VTI ratio 4.7
S/D ratio 2.9
A VTI 2.9 cm
Forward:reverse VTI ratio 3.7
S/D ratio 10
A VTI 2.4 cm
Forward:reverse VTI ratio 1.6

Doppler assessment of Fetal heart disease

Obstructive heart disease:

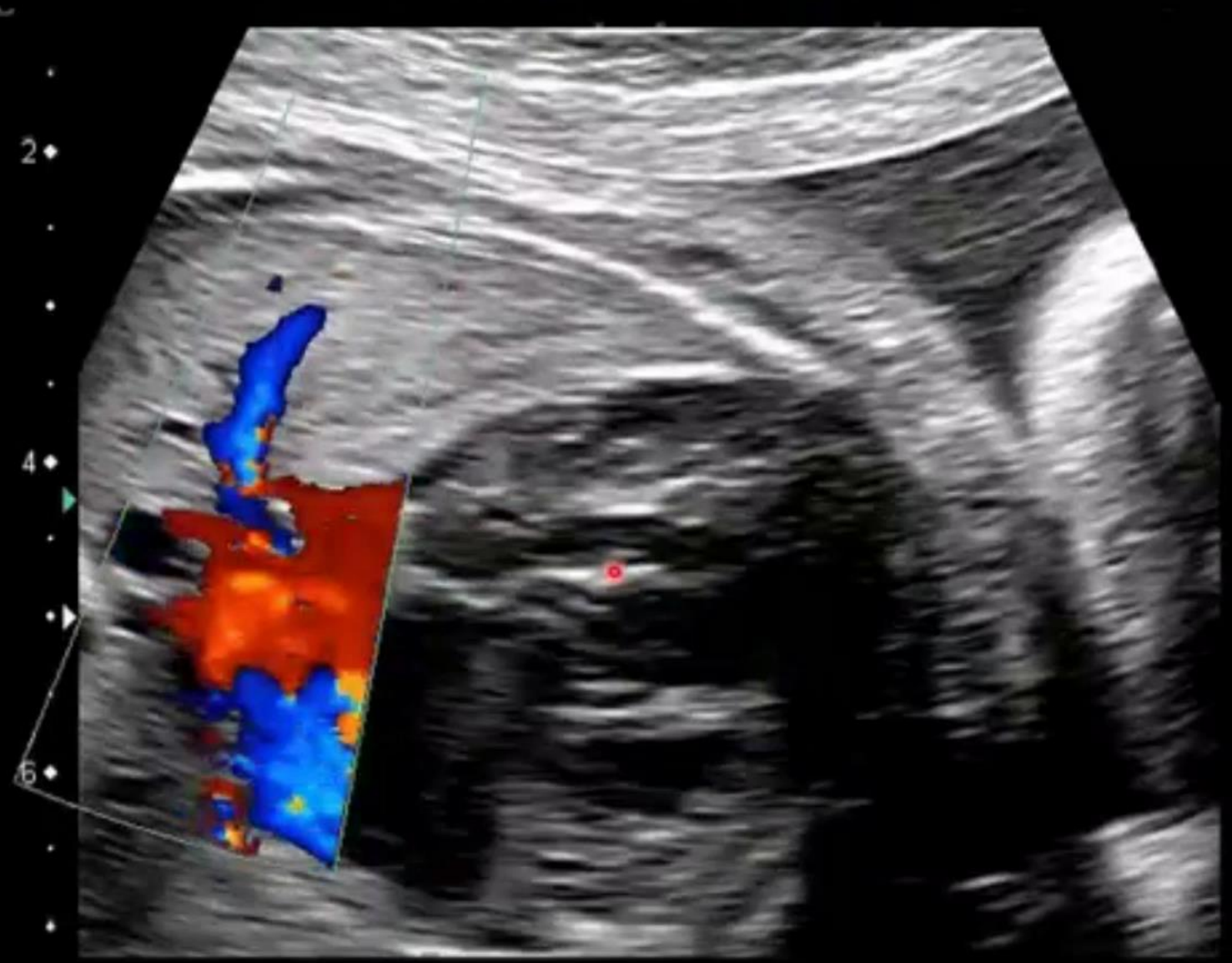
- Left sided obstructive heart
- Right sided obstructive heart

High out flow heart disease:

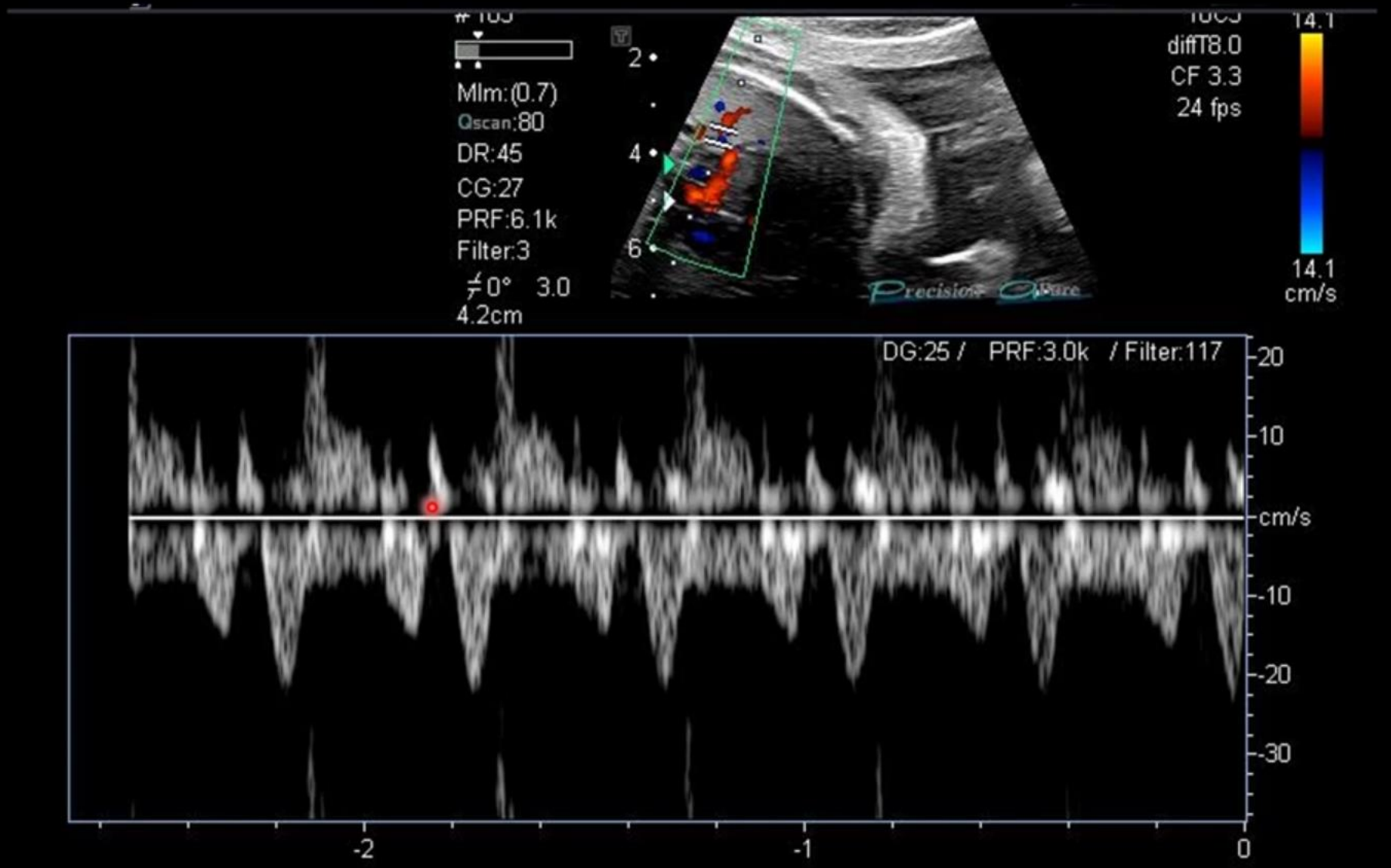
- Ebstein Anomaly
- TTTS
- Absent ductus arteriosus syndrome

Hypoplastic left heart syndrome (HLHS)

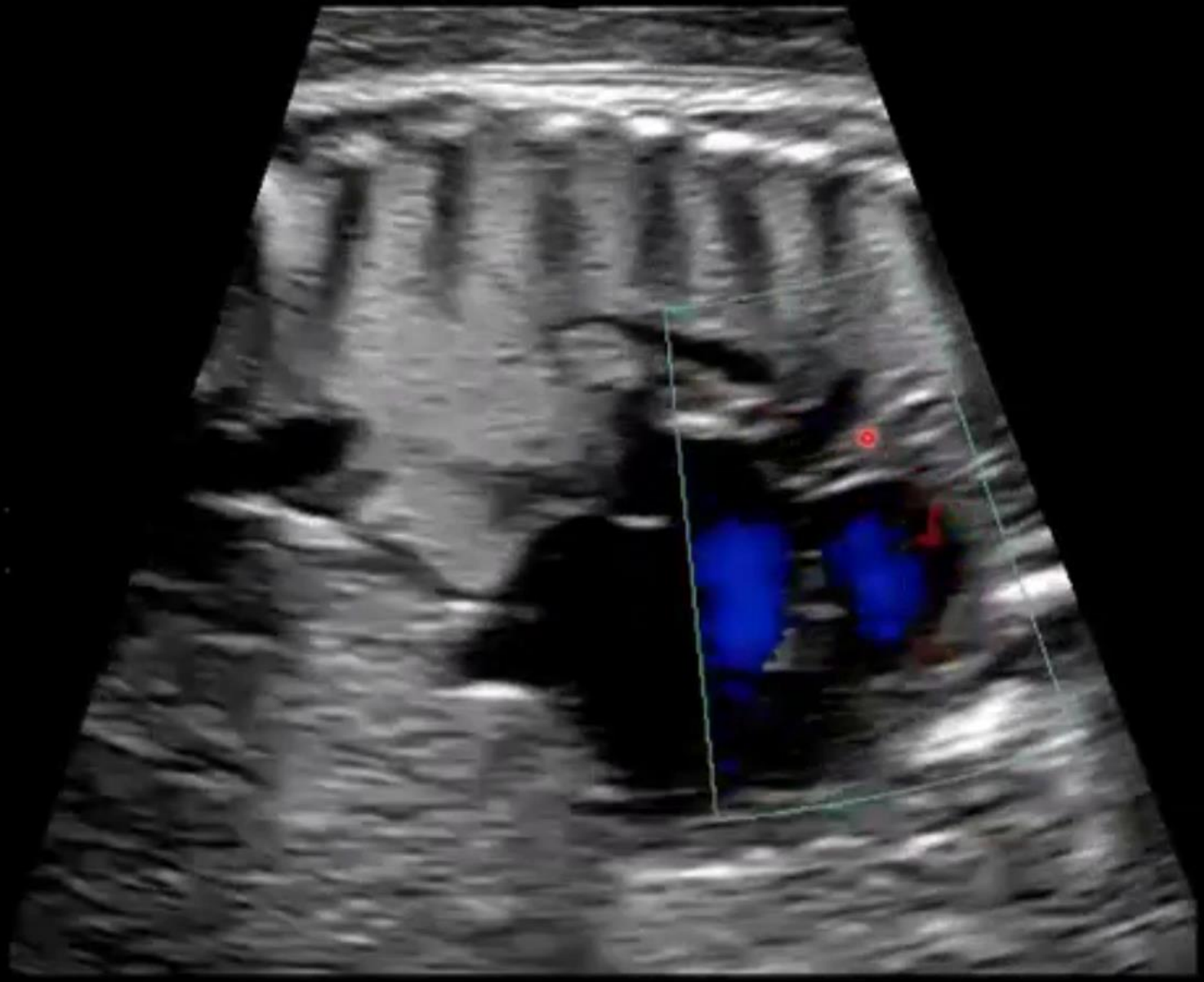
Obstructive lesions: HLHS



Obstructive lesions: HLHS

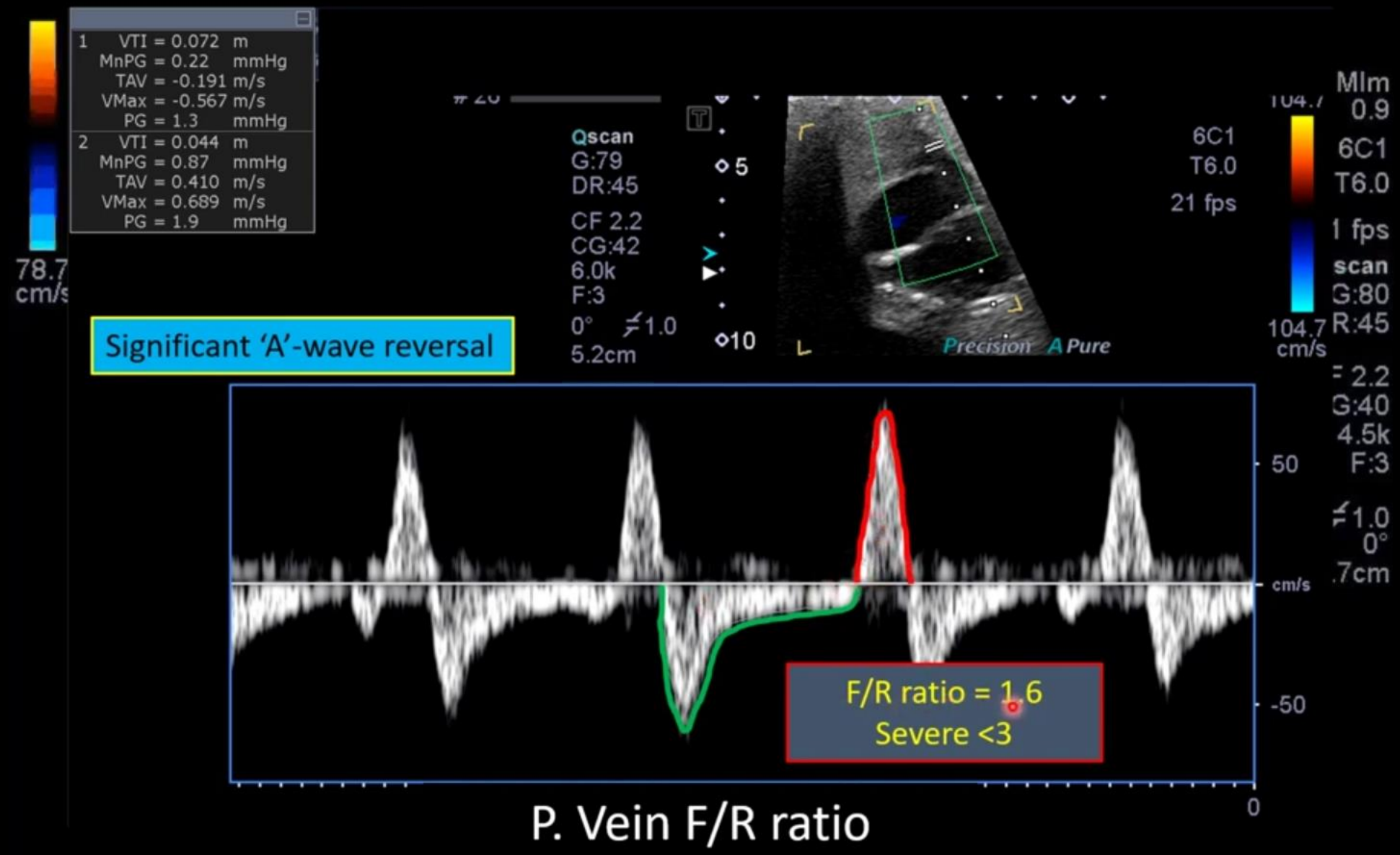


Obstructive lesions: HLHS



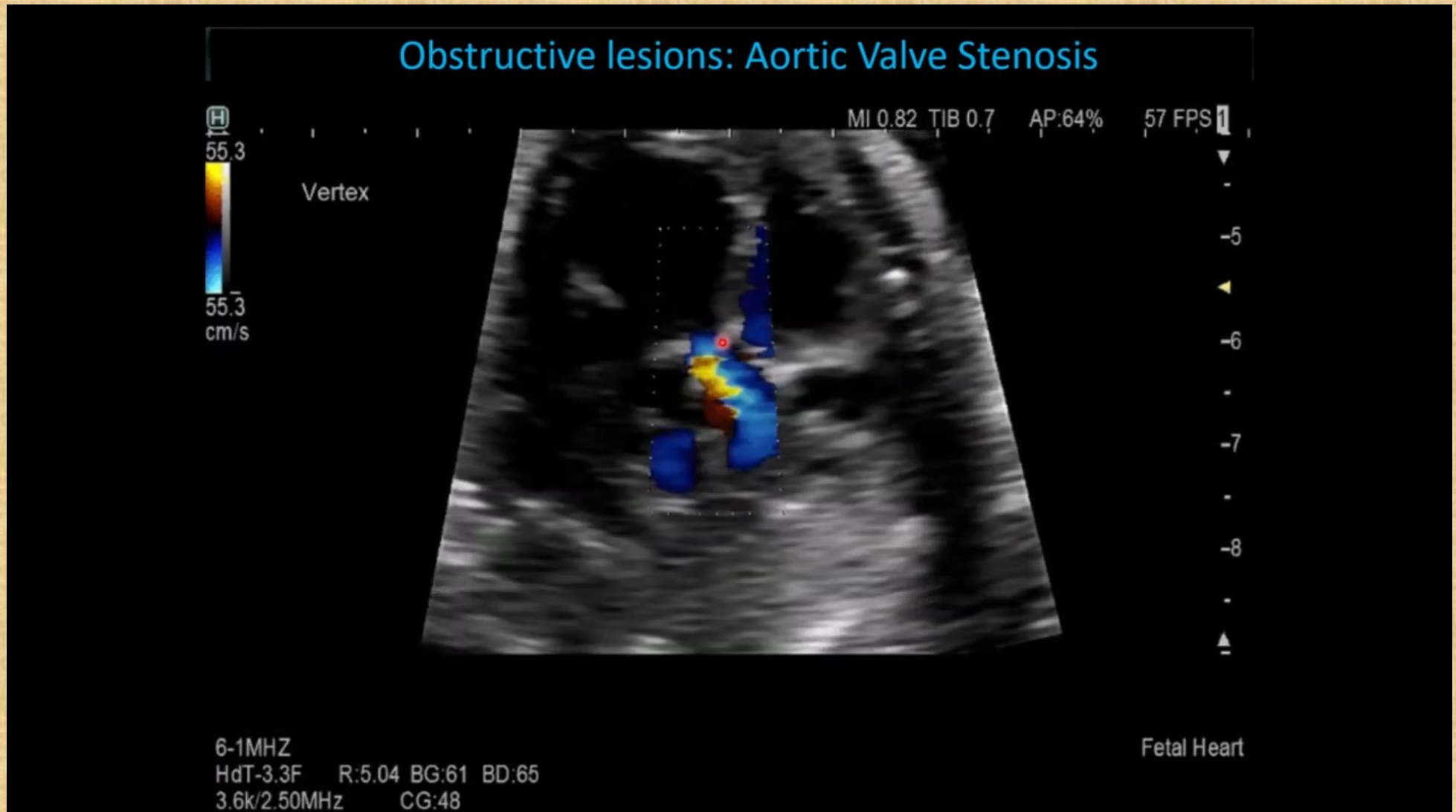
Obstructive lesions: HLHS

Obstructive lesions: HLHS with IAS



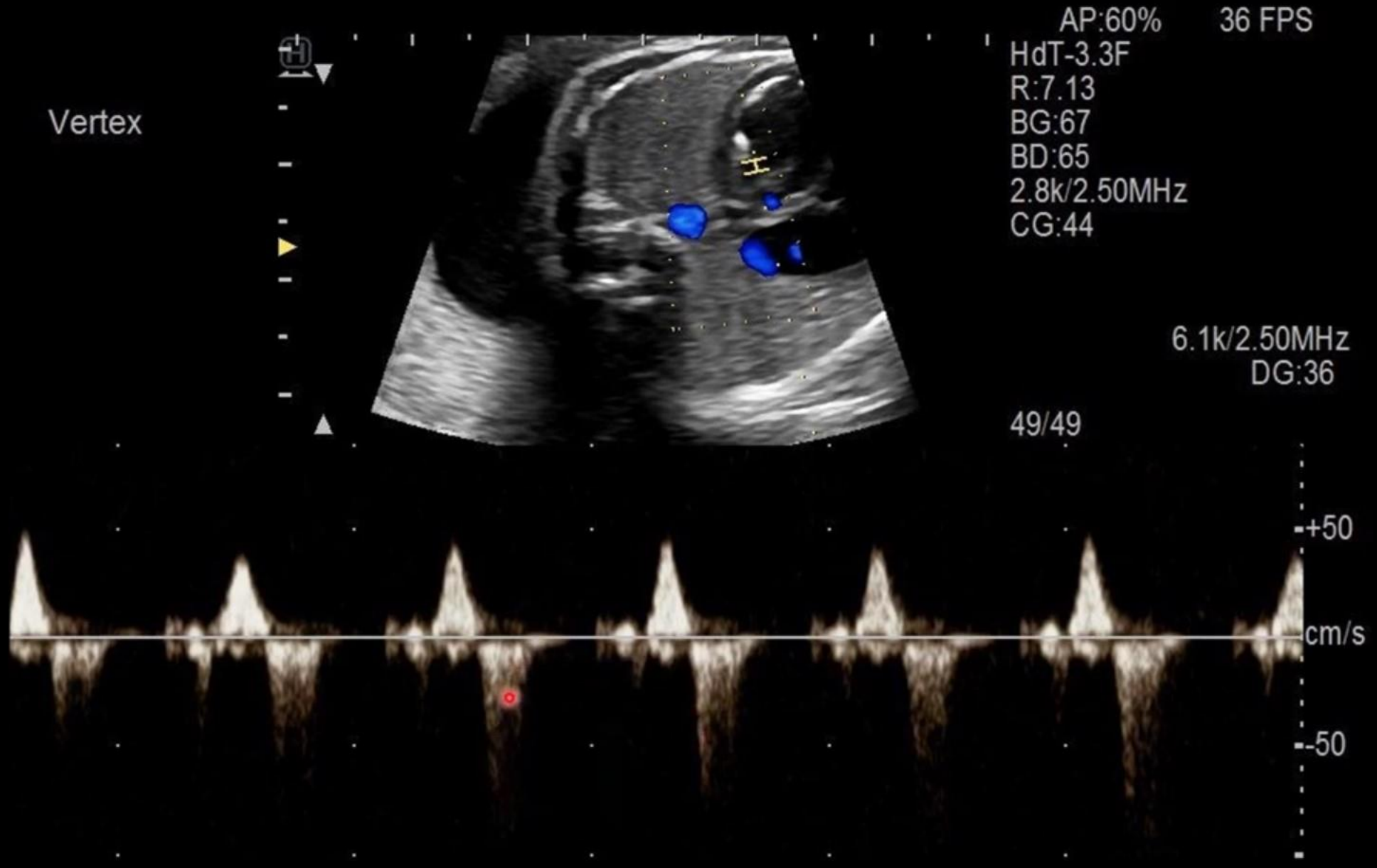
P. Vein F/R ratio

Aortic valve stenosis



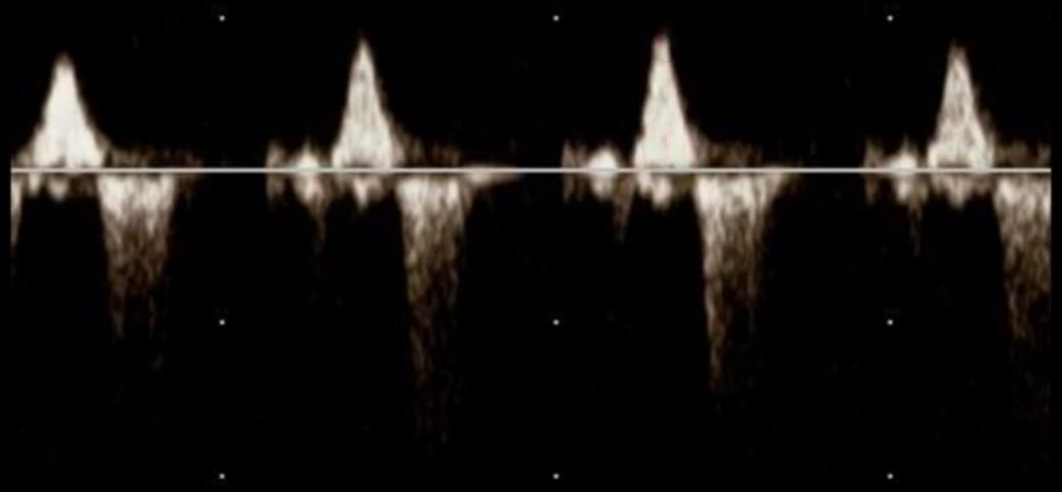
Obstructive lesions: Aortic Valve Stenosis

Obstructive lesions: Aortic Valve Stenosis

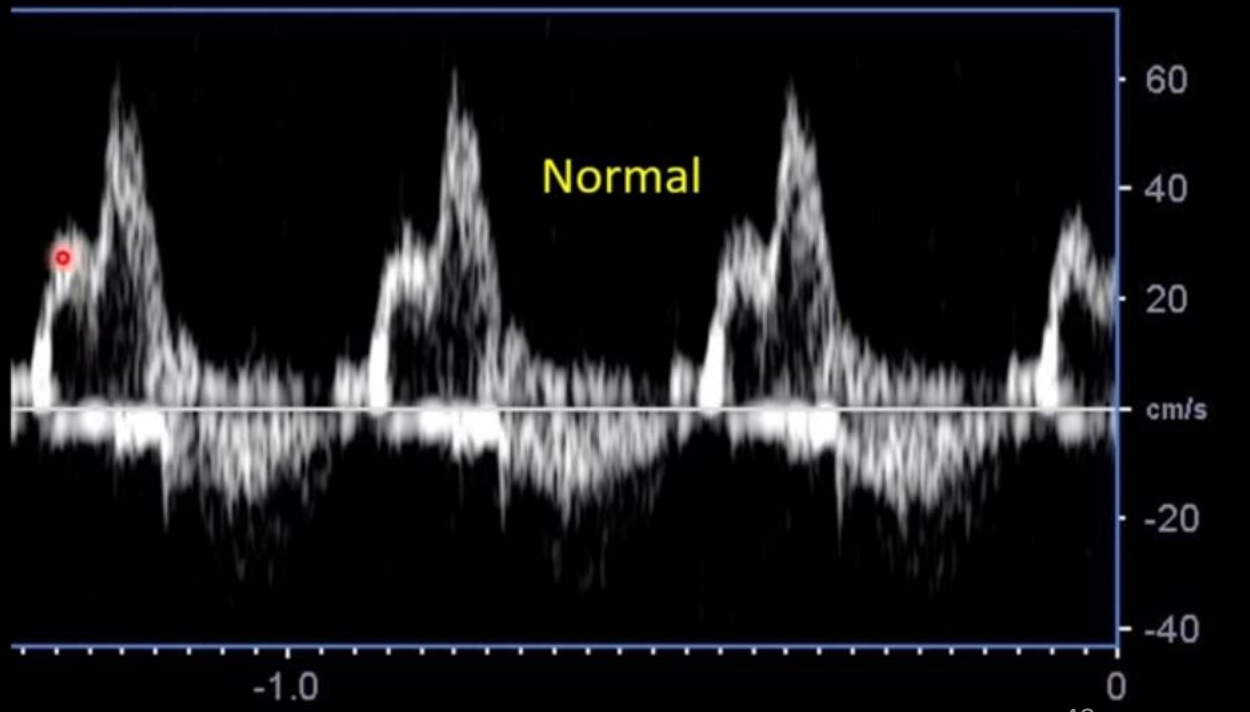


Obstructive lesions: Aortic Valve Stenosis

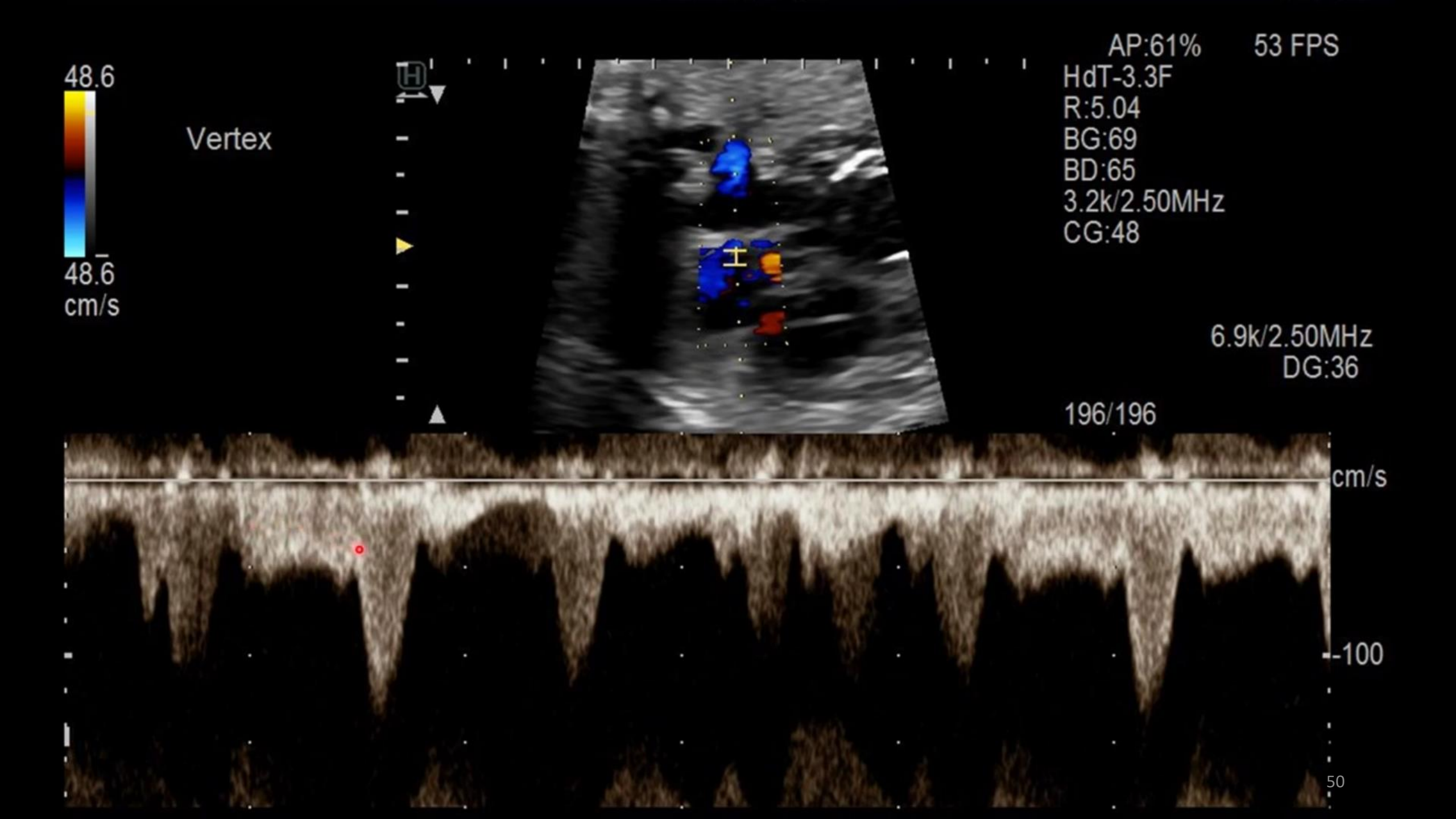
Restrictive

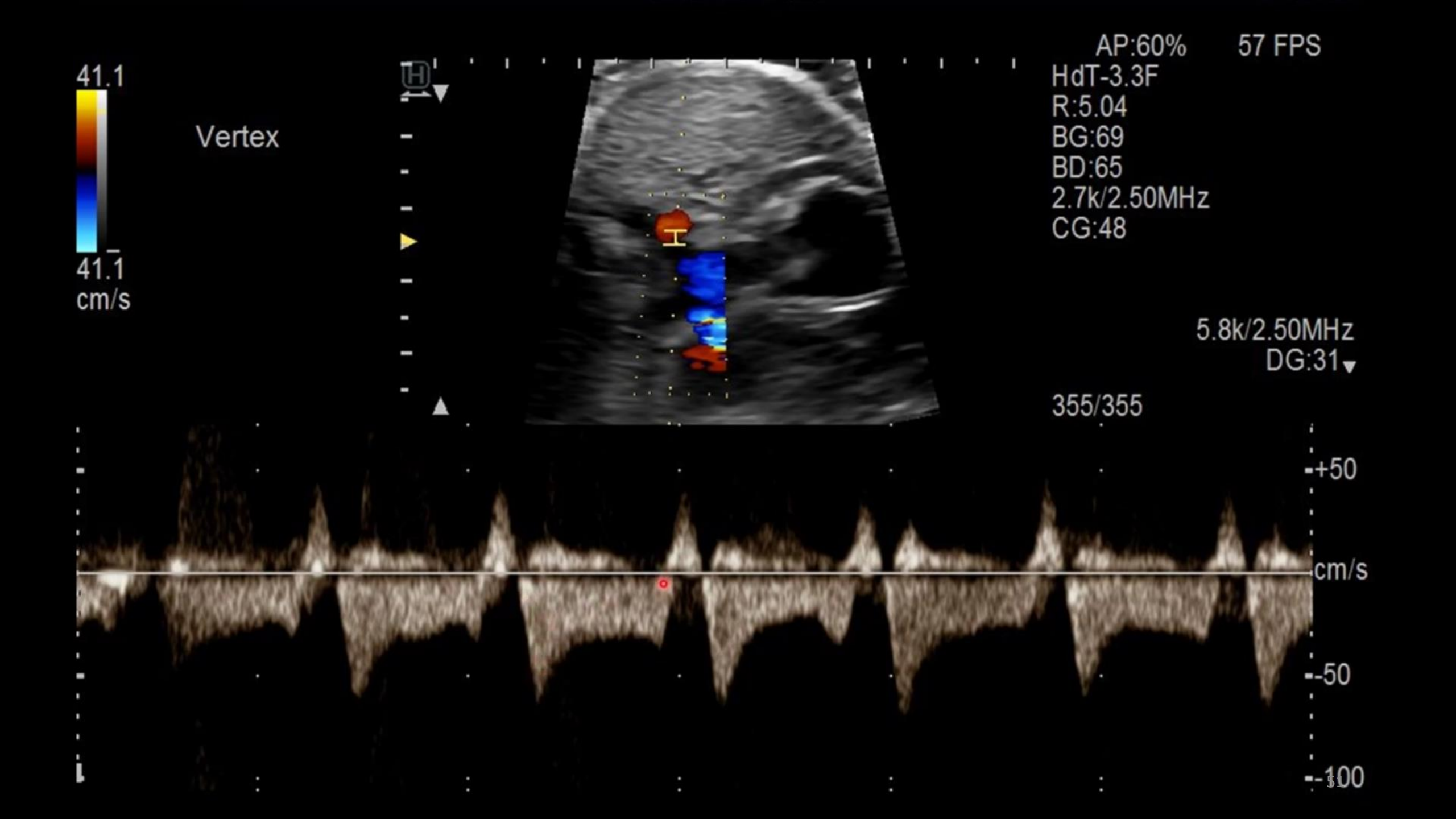


Normal

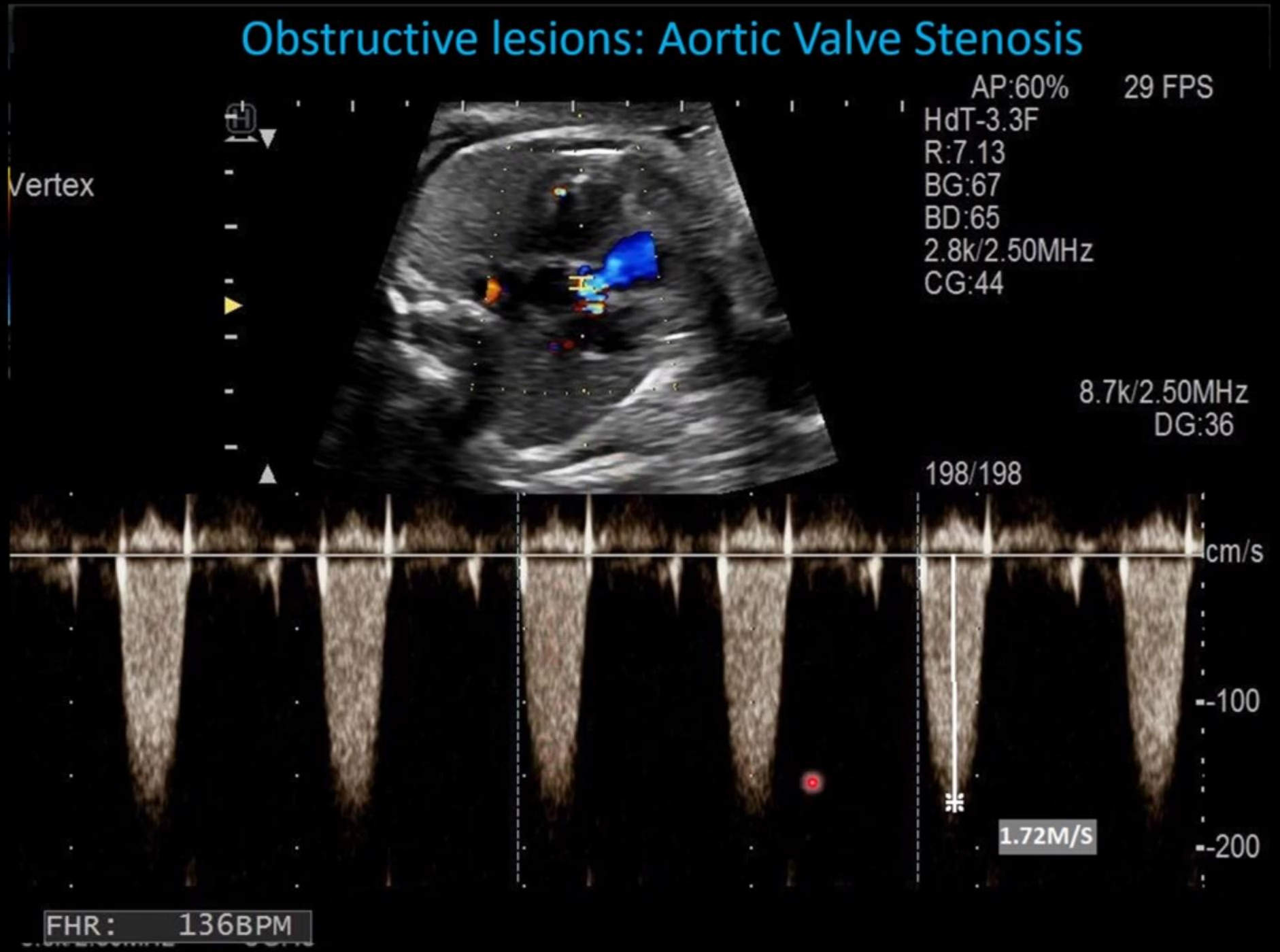



MI 0.82 TIB 0.7 AP:63% 57 FPS
48.6
Vertex
48.6
cm/s
-4
-5
-6
-7
6-1MHZ
R:5.04 BG:69 BD:65
3.2k/2.50MHz CG:46
Fetal Heart

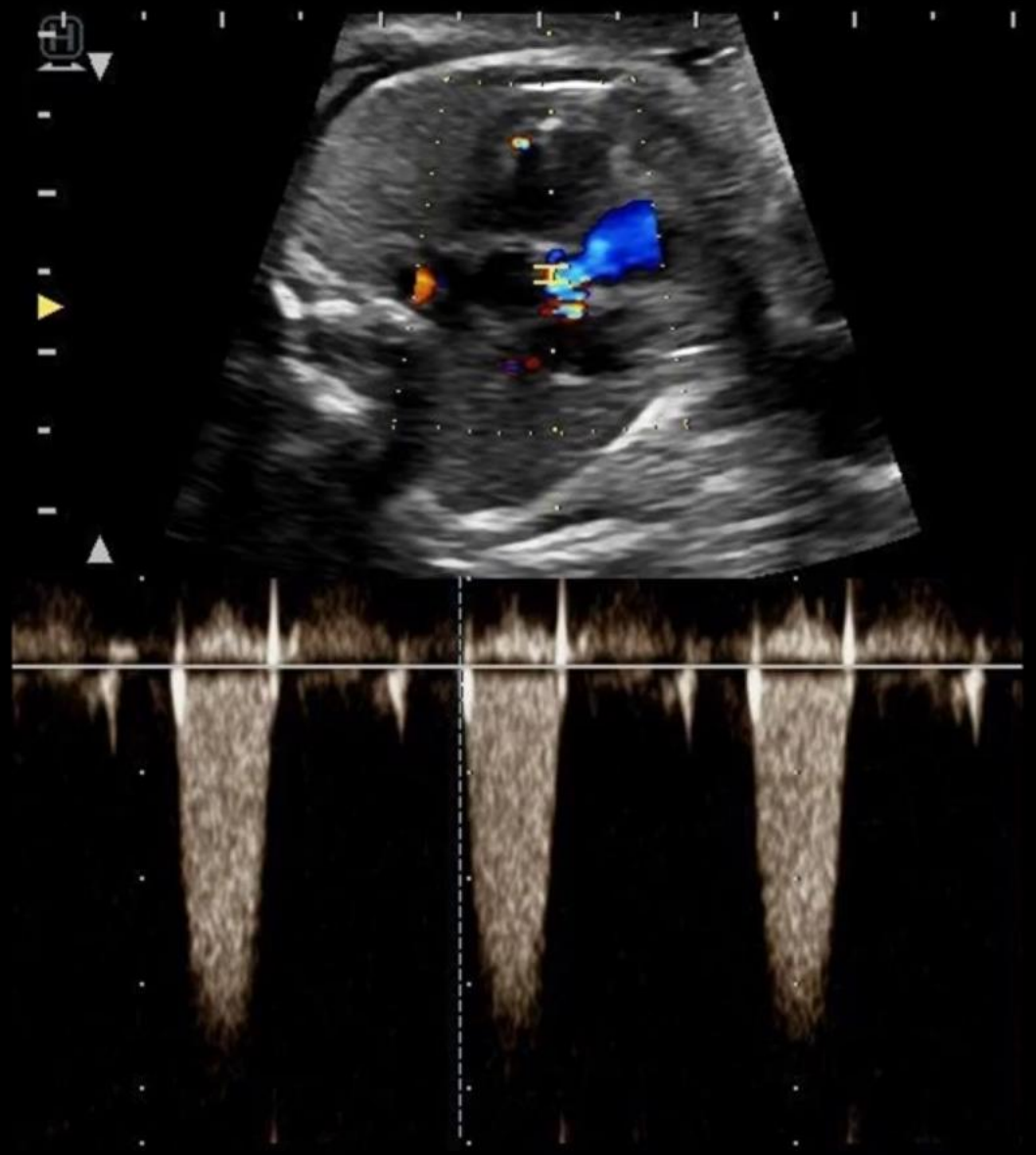

48.6
48.6
cm/s
Vertex
AP:61%
53 FPS
HdT-3.3F
R:5.04
BG:69
BD:65
3.2k/2.50MHz
CG:48
6.9k/2.50MHz
DG:36
196/196
cm/s
-100

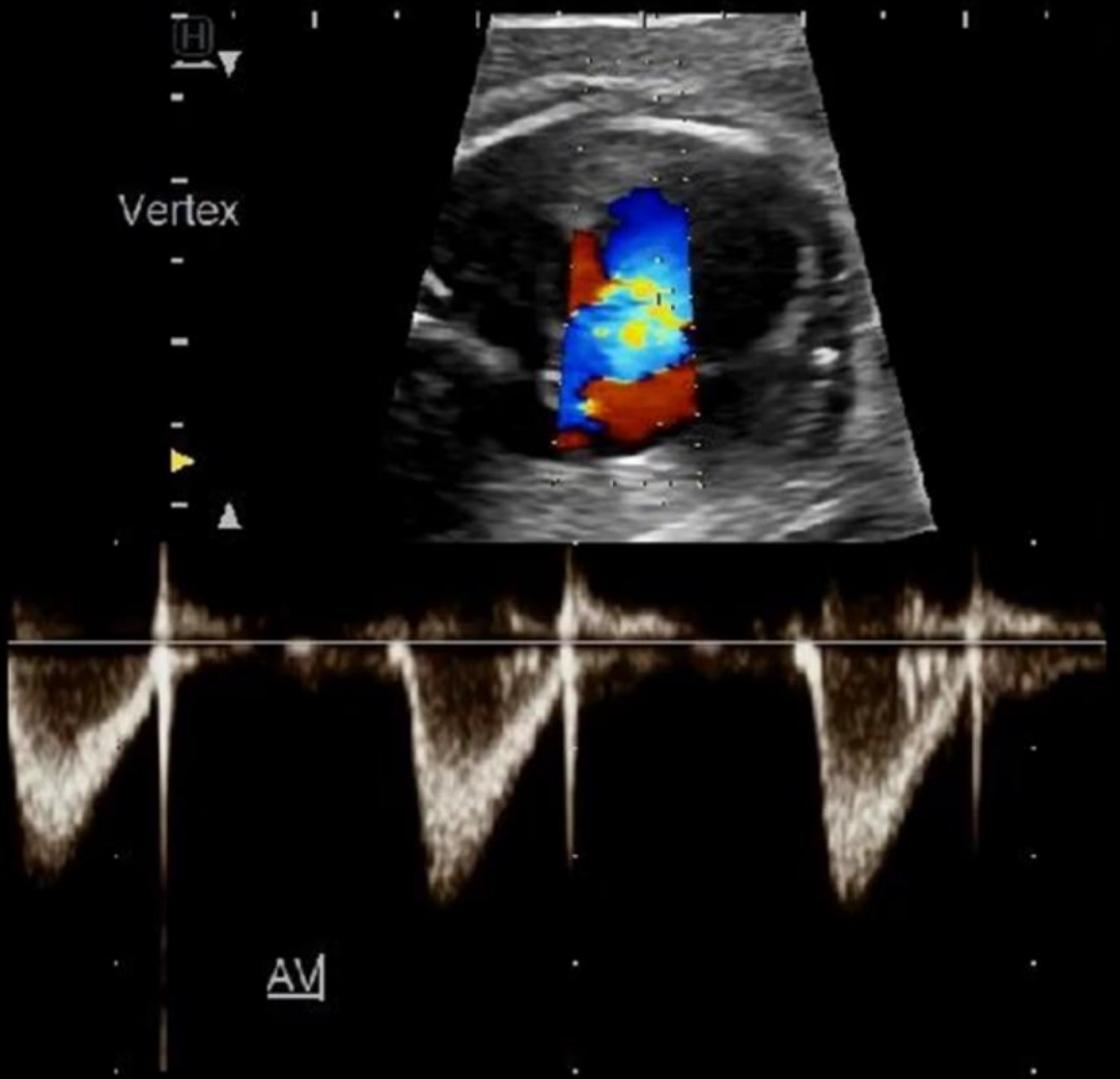

41.1
41.1
cm/s
Vertex
AP:60%
57 FPS
HdT-3.3F
R:5.04
BG:69
BD:65
2.7k/2.50MHz
CG:48
5.8k/2.50MHz
DG:31
355/355
+50
cm/s
-50
-100

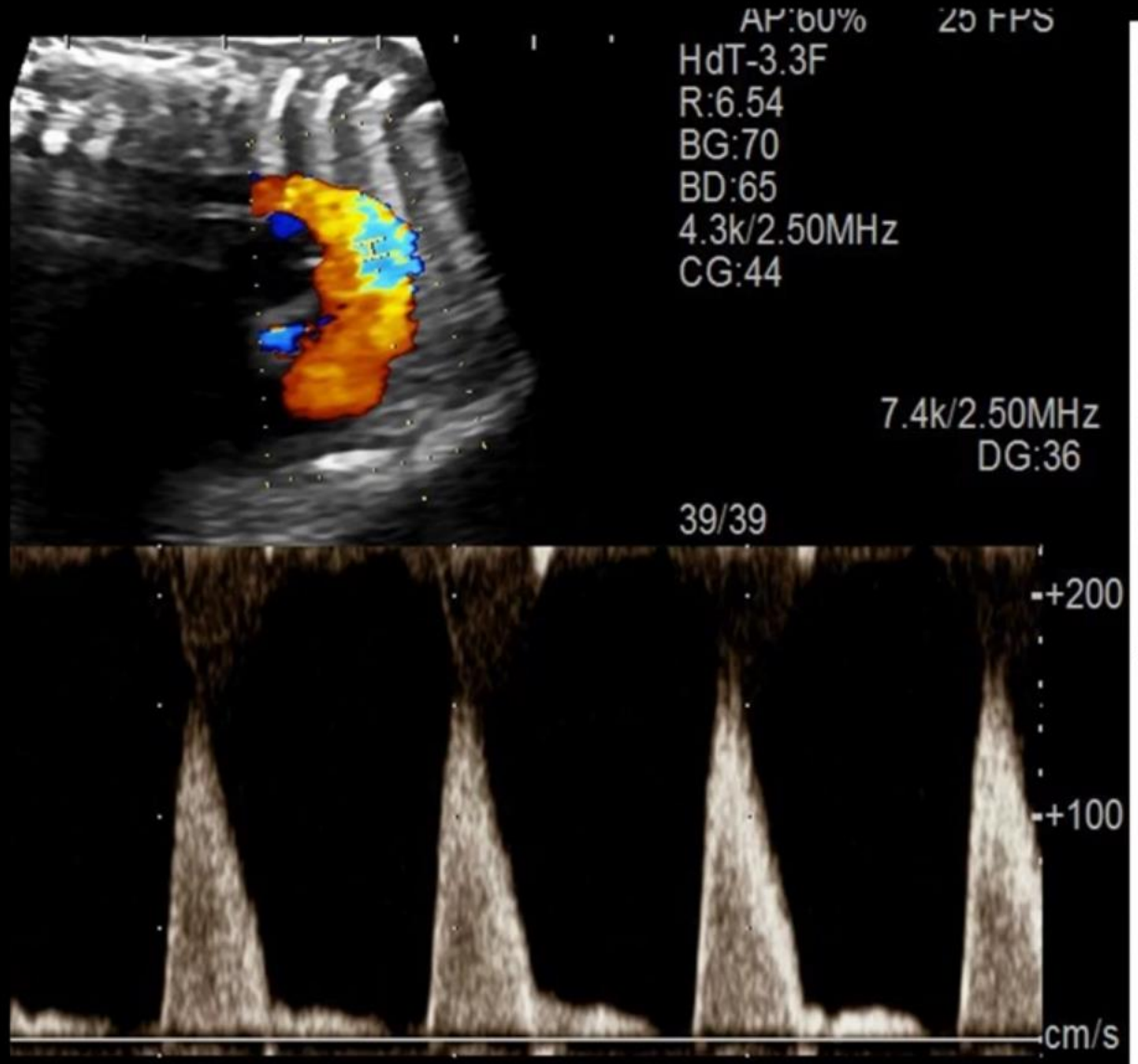
Obstructive lesions: Aortic Valve Stenosis

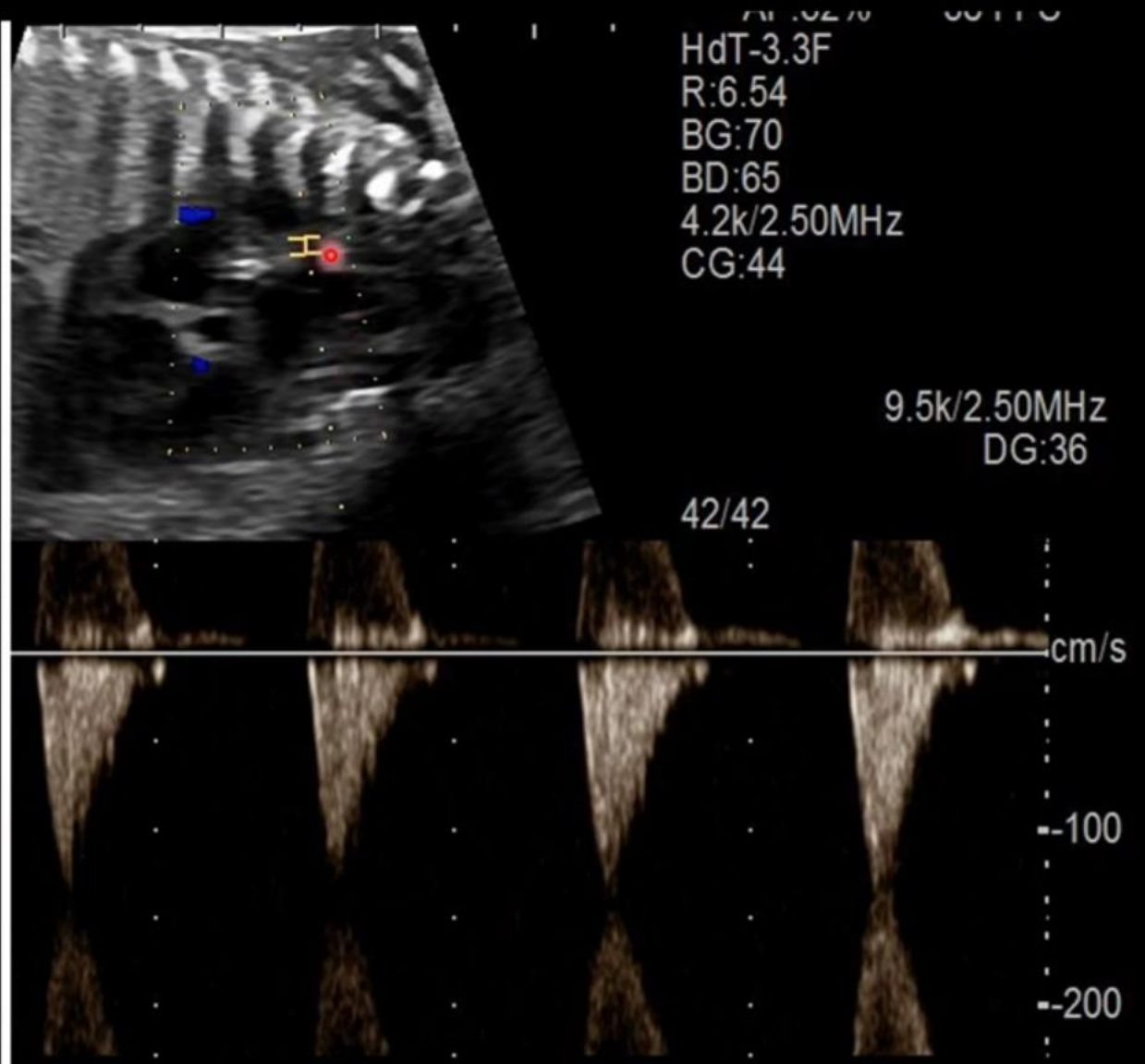


Obstructive lesions: Aortic Valve Stenosis





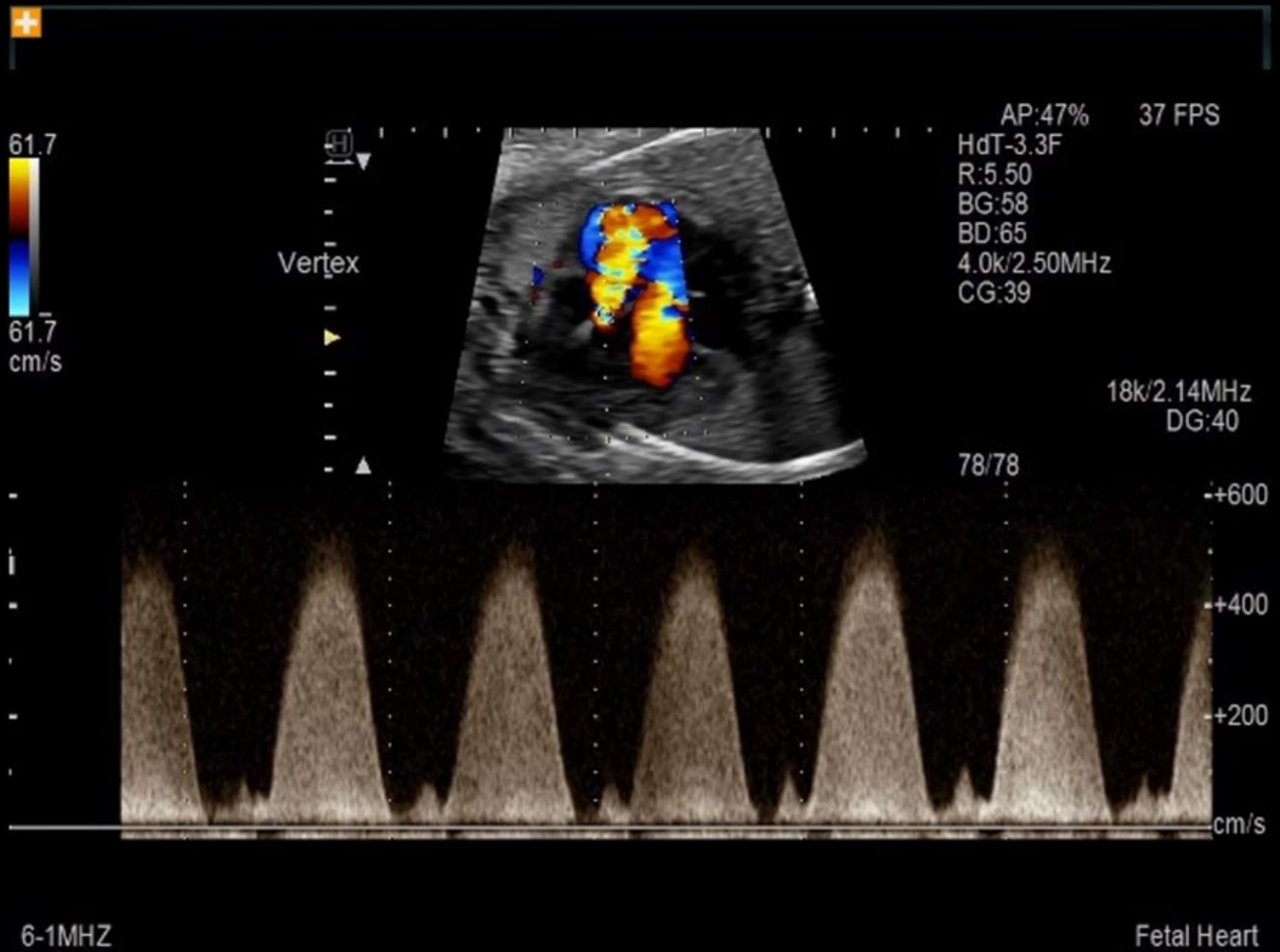

AP:60%
25 FPS
HdT-3.3F
R:6.54
BG:70
BD:65
4.3k/2.50MHz
CG:44
7.4k/2.50MHz
DG:36
39/39
+200
+100
cm/s


HdT-3.3F
R:6.54
BG:70
BD:65
4.2k/2.50MHz
CG:44
9.5k/2.50MHz
DG:36
42/42
cm/s
-100
-200

Pulmonary atresia

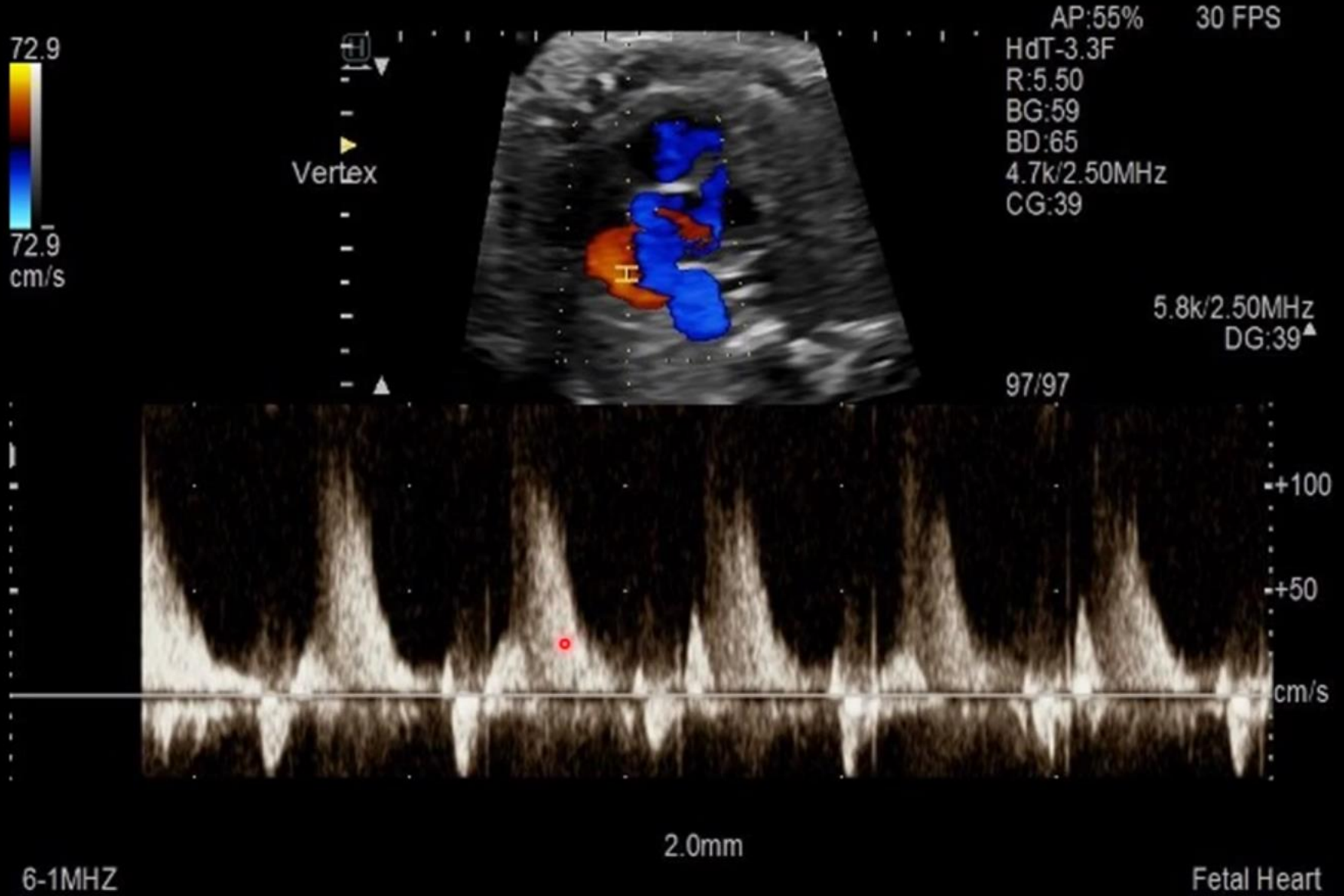
Obstructive lesions: Pulmonary Atresia

Obstructive lesions: Pulmonary Atresia

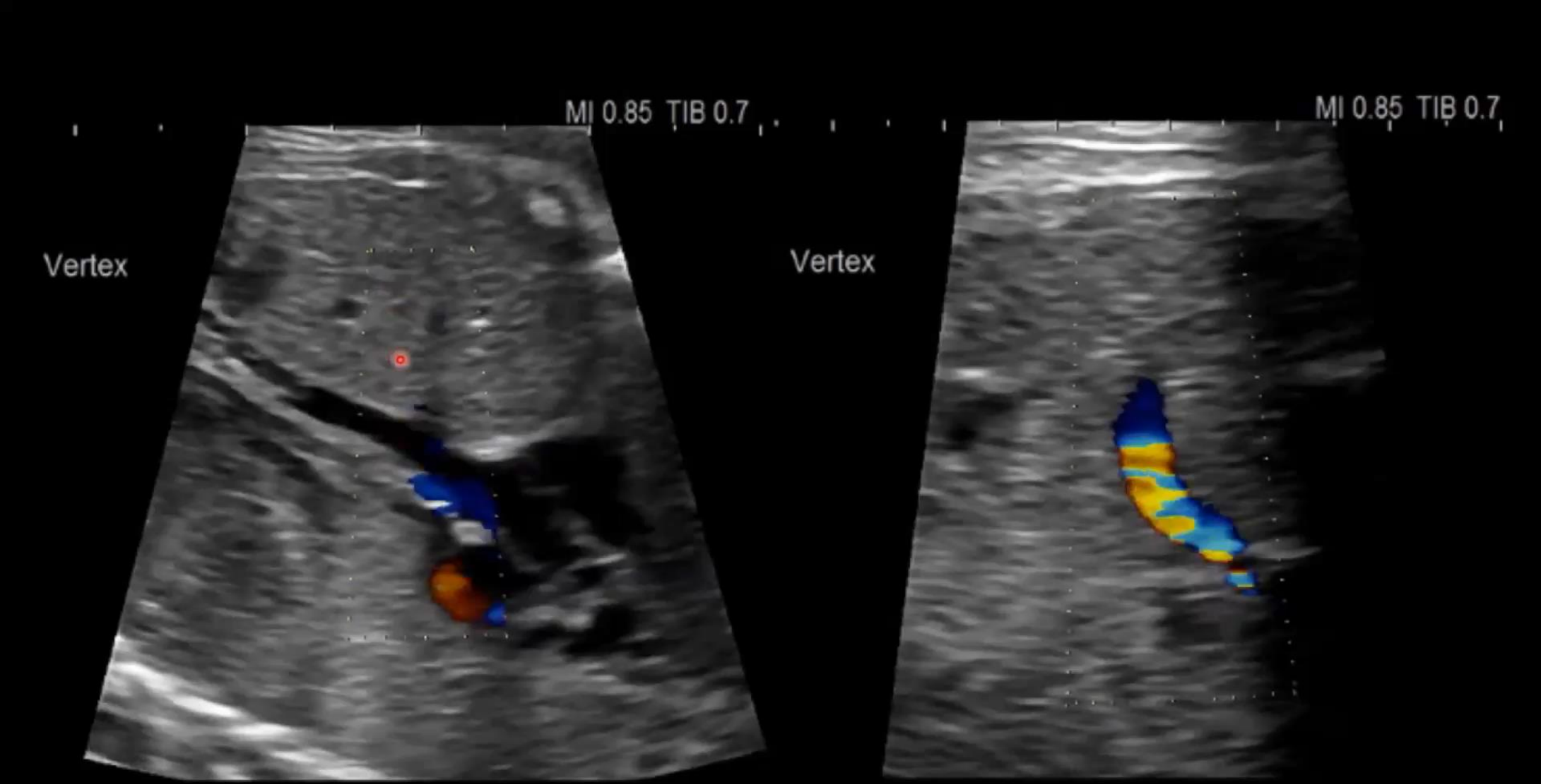


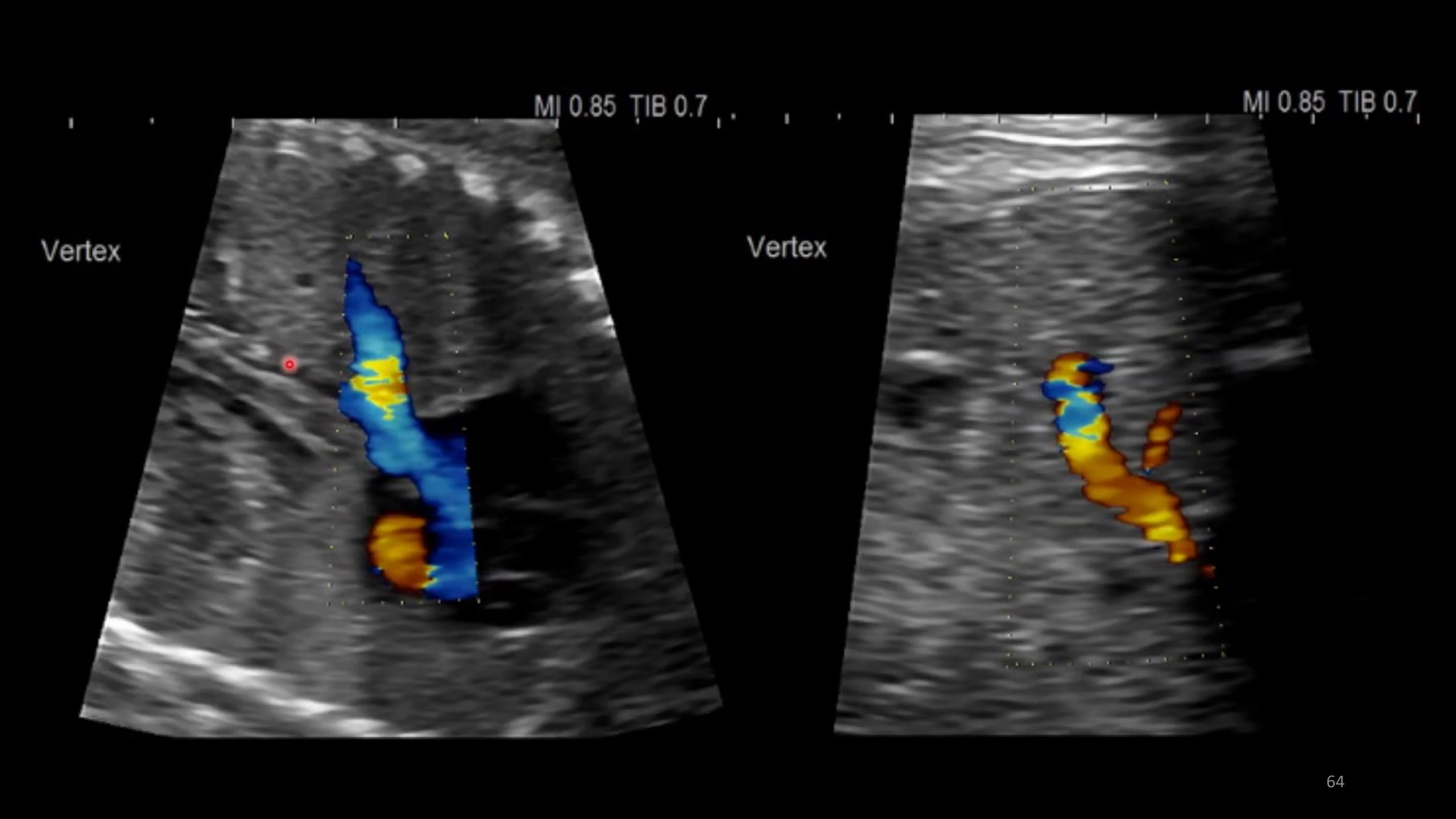
Obstructive lesions: Pulmonary Atresia

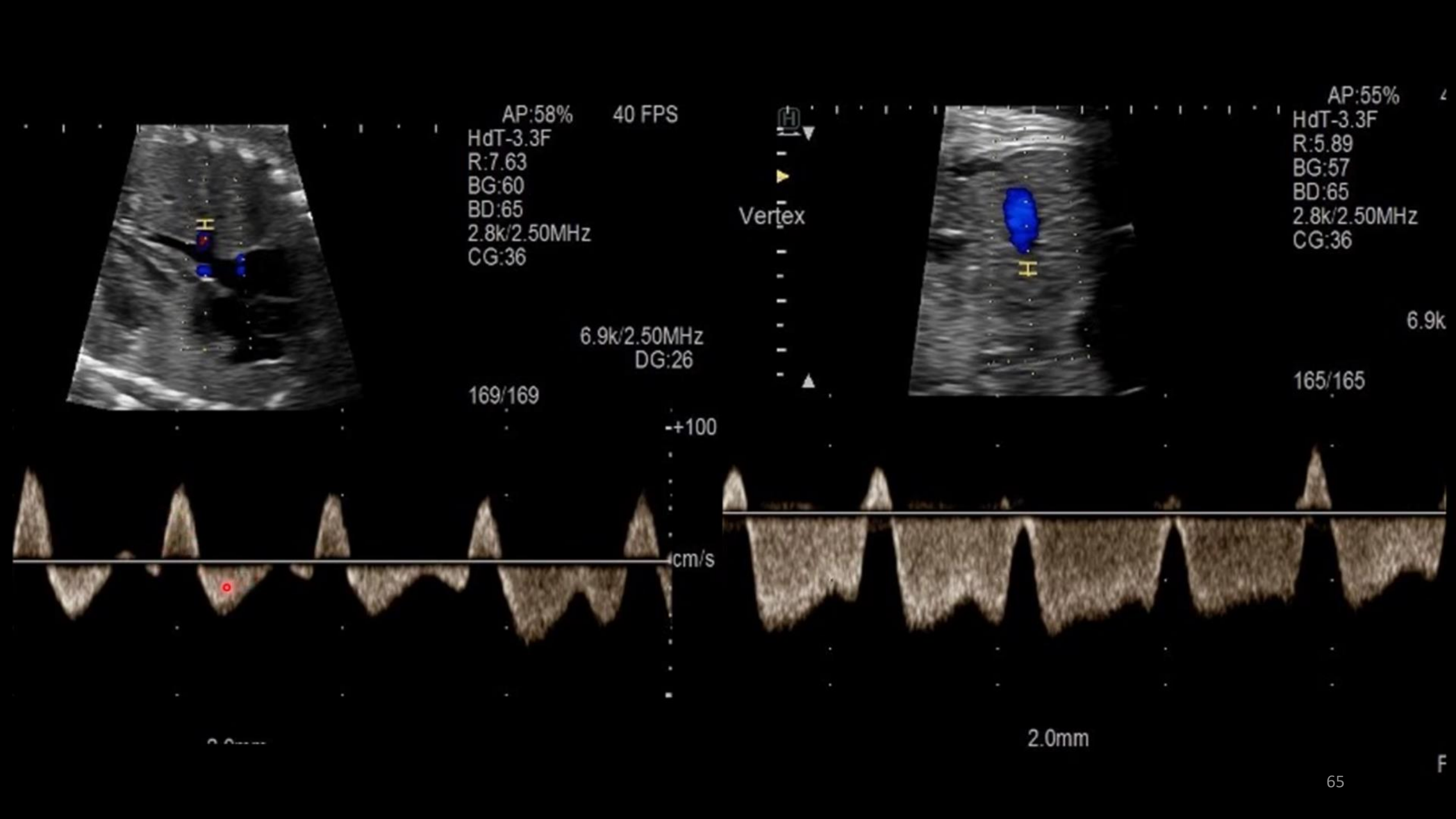
Obstructive lesions: Pulmonary Atresia

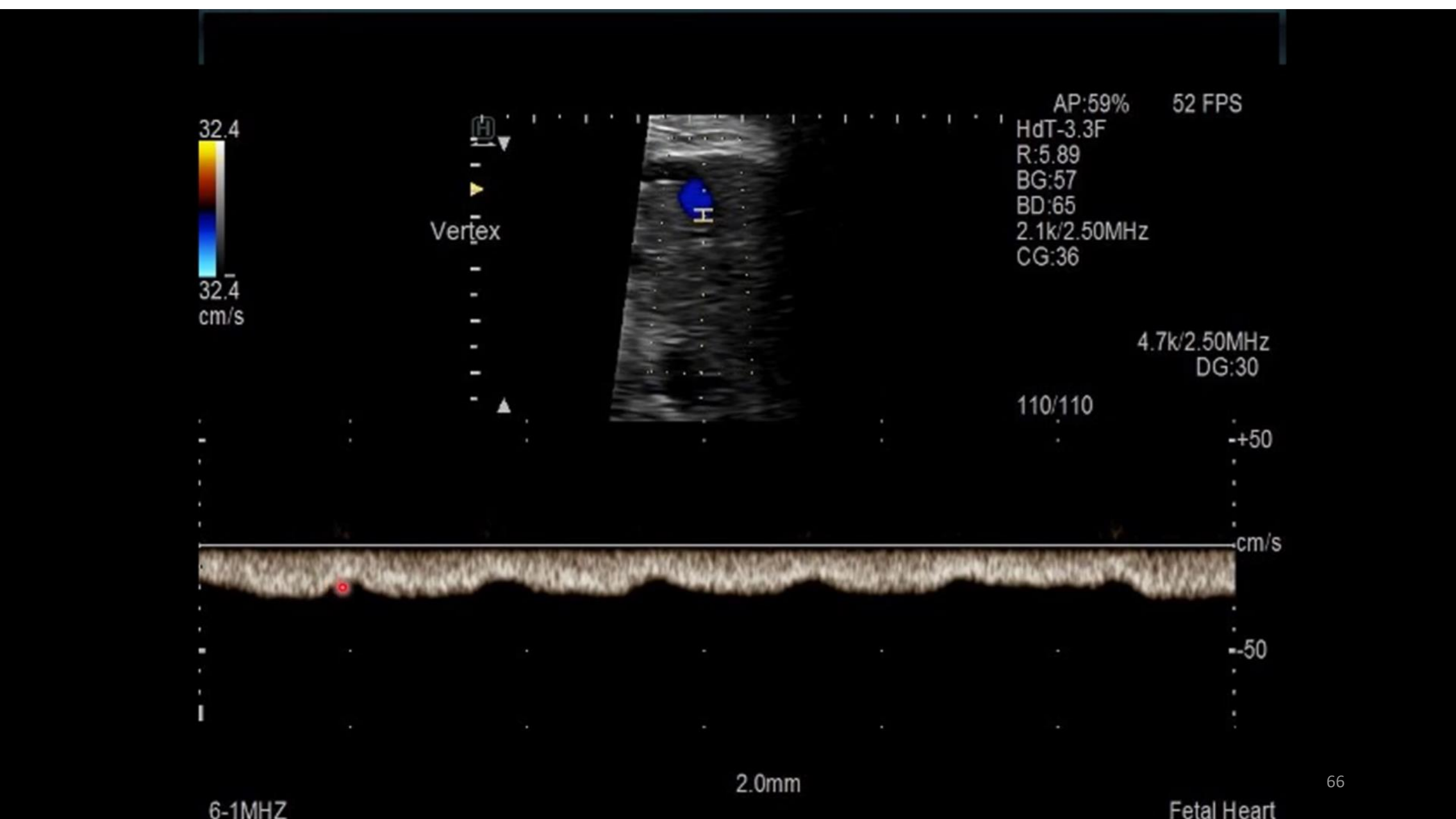



MI 0.85 TIB<0.4
Vertex
MI 0.85 TIB 0.7
Vertex


MI 0.85 TIB 0.7
Vertex
MI 0.85 TIB 0.7
Vertex

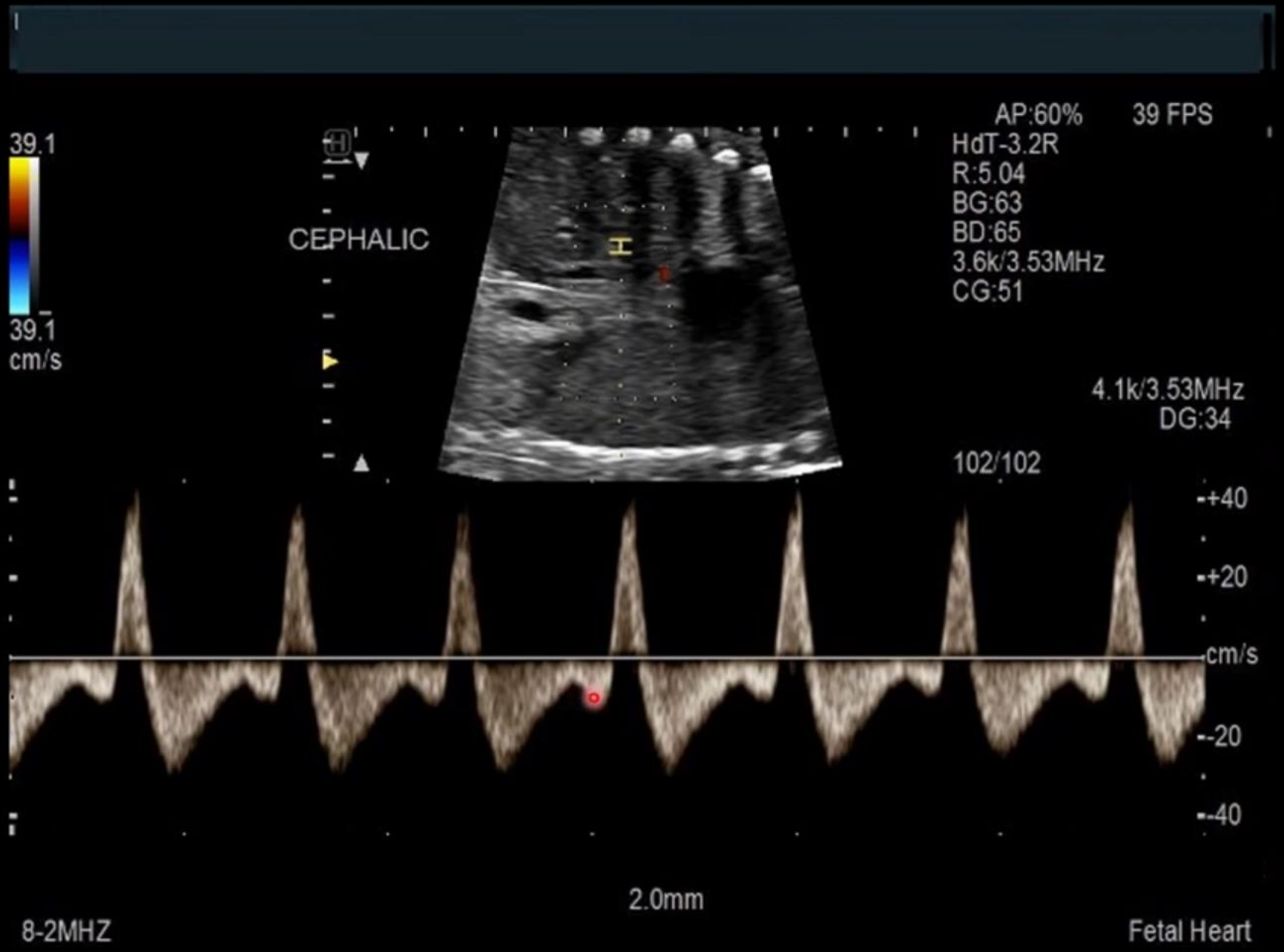

MI 0.85 TIB 0.7
Vertex
MI 0.85 TIB 0.7
Vertex


AP:58%
40 FPS
HdT-3.3F
R:7.63
BG:60
BD:65
2.8k/2.50MHz
CG:36
6.9k/2.50MHz
DG:26
169/169
+100
cm/s
Vertex
AP:55%
HdT-3.3F
R:5.89
BG:57
BD:65
2.8k/2.50MHz
CG:36
6.9k
165/165
2.0mm
F

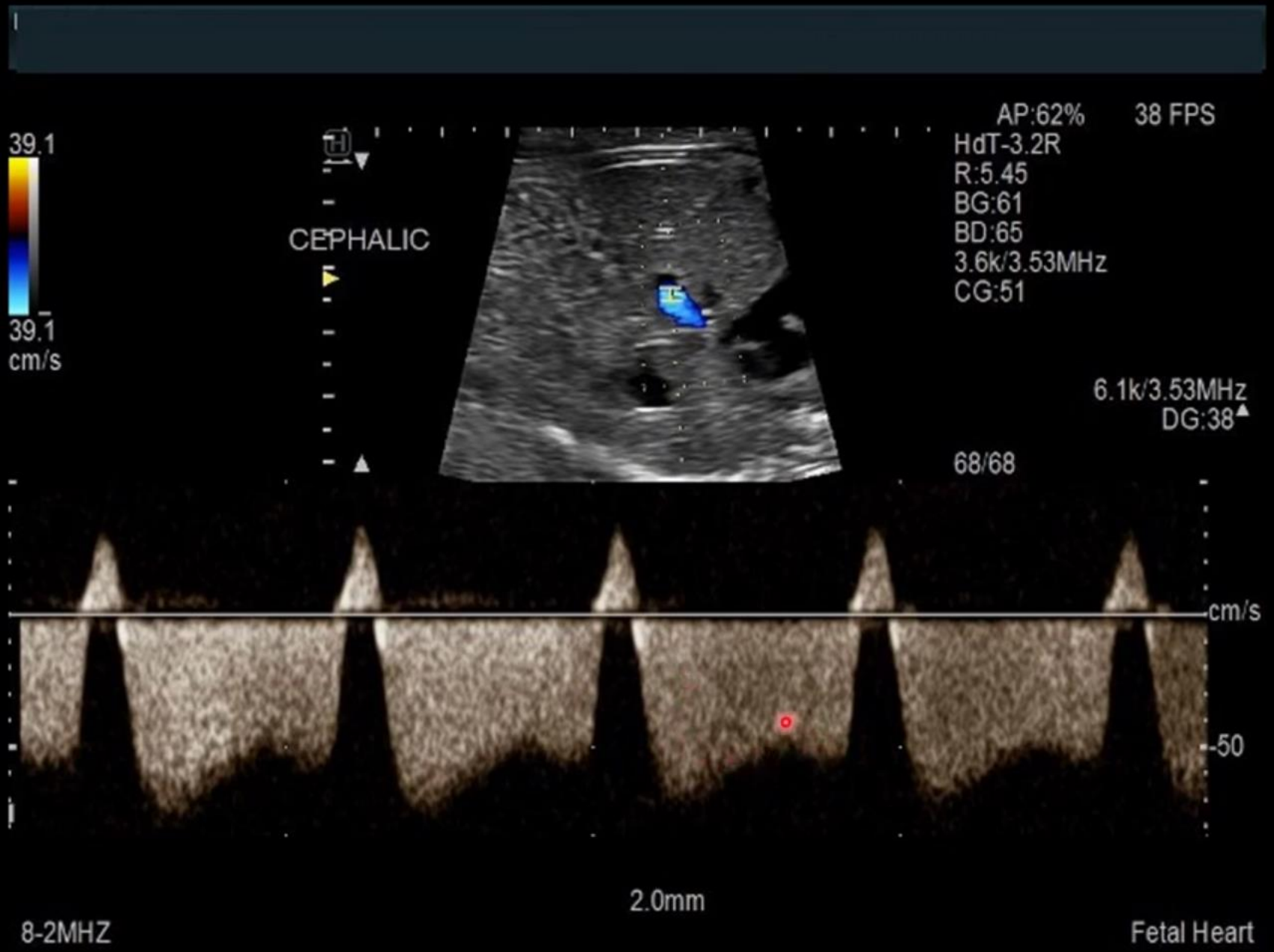

32.4
32.4
cm/s
Vertex
AP:59%
52 FPS
HdT-3.3F
R:5.89
BG:57
BD:65
2.1k/2.50MHz
CG:36
4.7k/2.50MHz
DG:30
110/110
+50
cm/s
-50
2.0mm
6-1MHZ
Fetal Heart

Tricuspid valve atresia

Obstructive lesions: Tricuspid valve atresia



Obstructive lesions: Tricuspid valve atresia

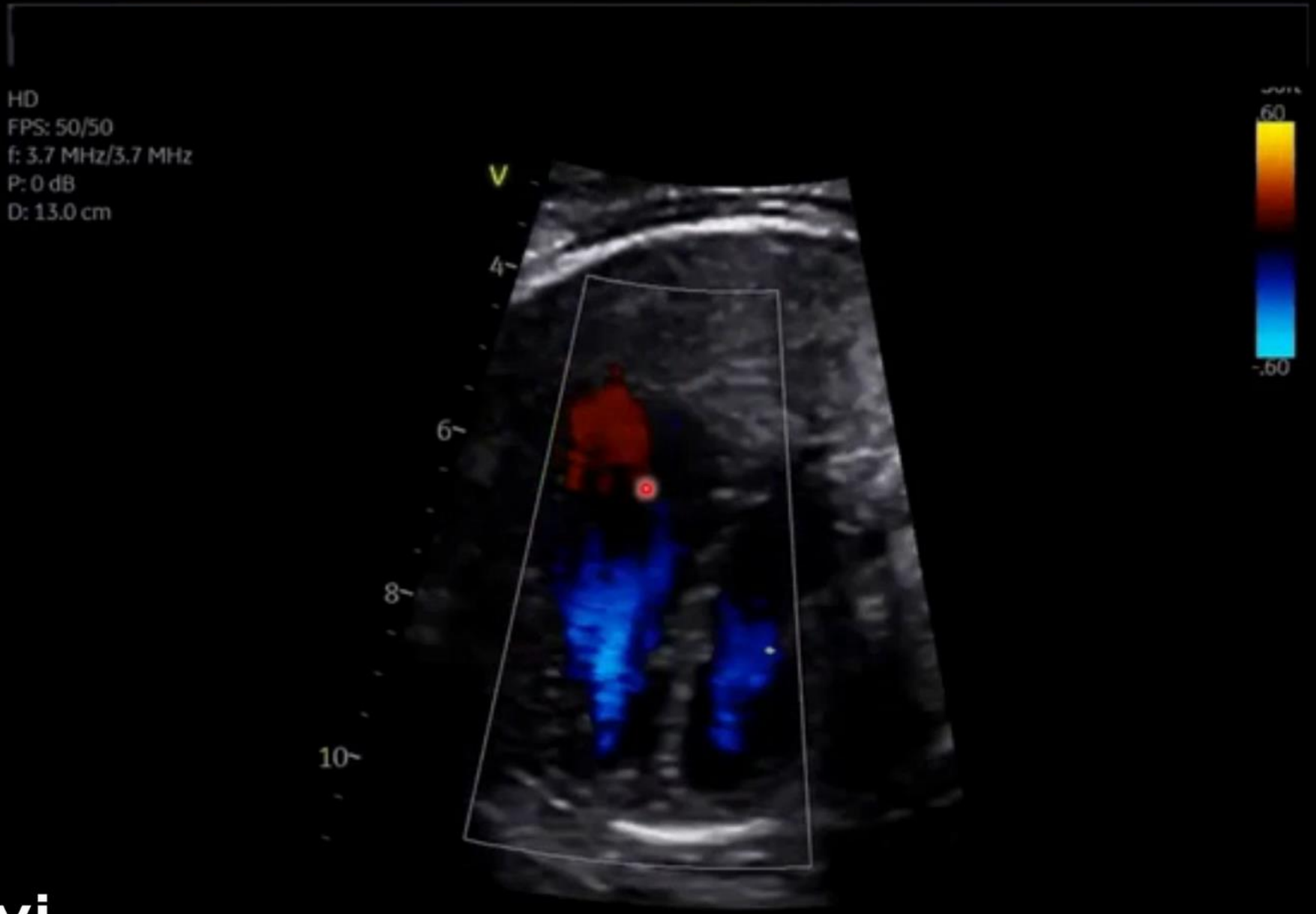


Obstructive lesions: Tricuspid valve atresia

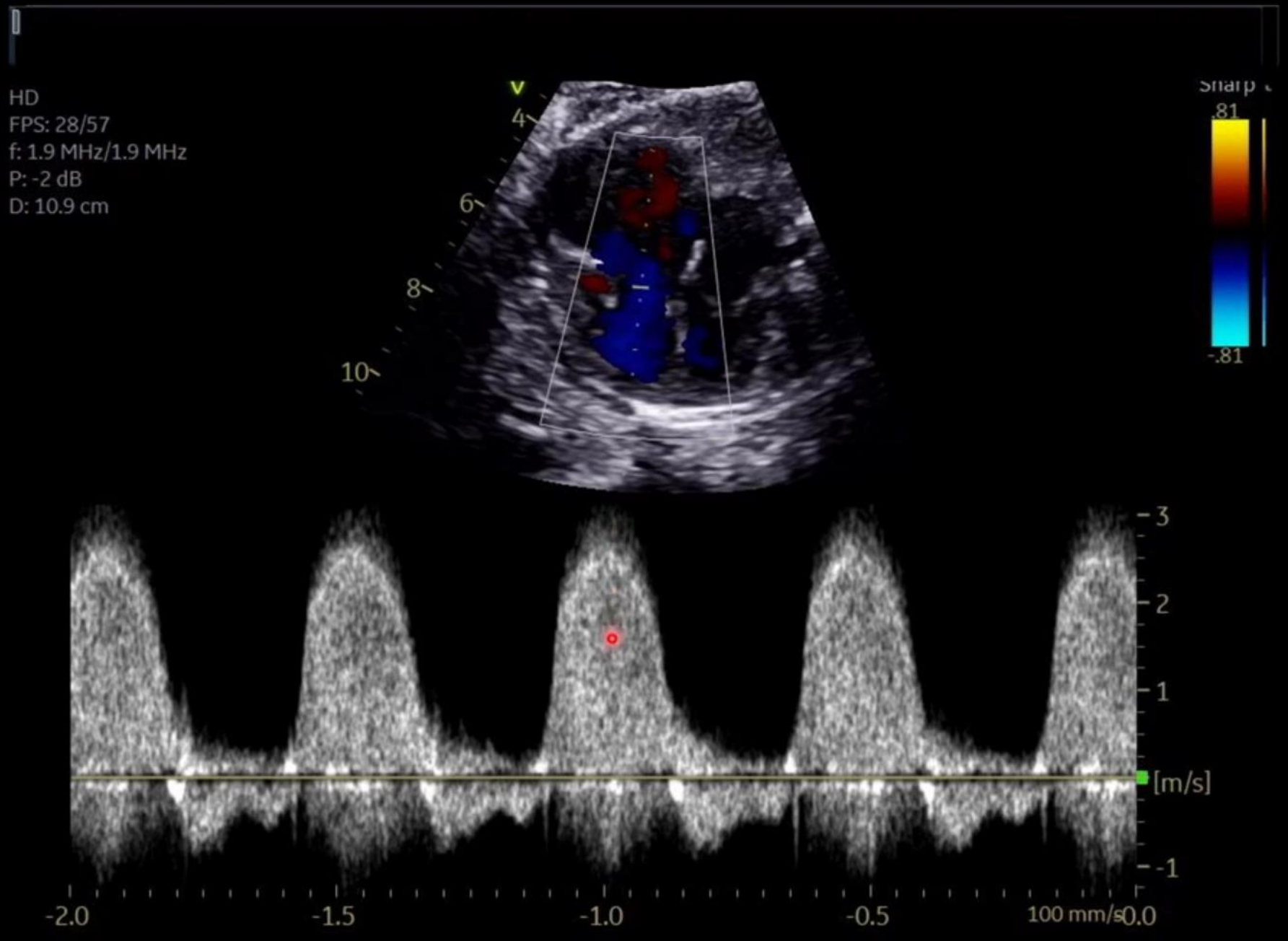
Ebstein’s anomaly

Regurgitant lesions: Ebstein's anomaly

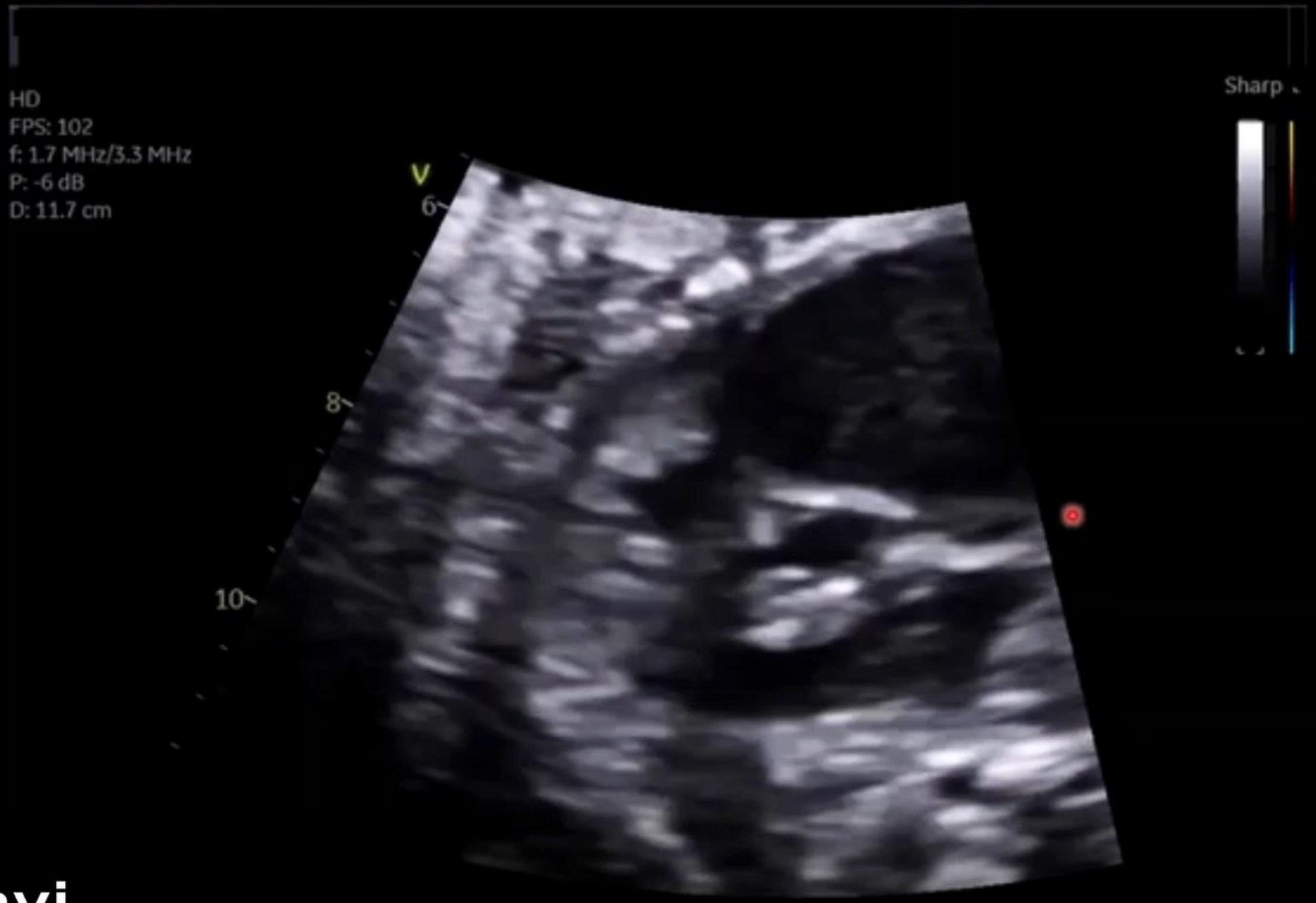
Regurgitant lesions: Ebstein's anomaly/dysplastic TV



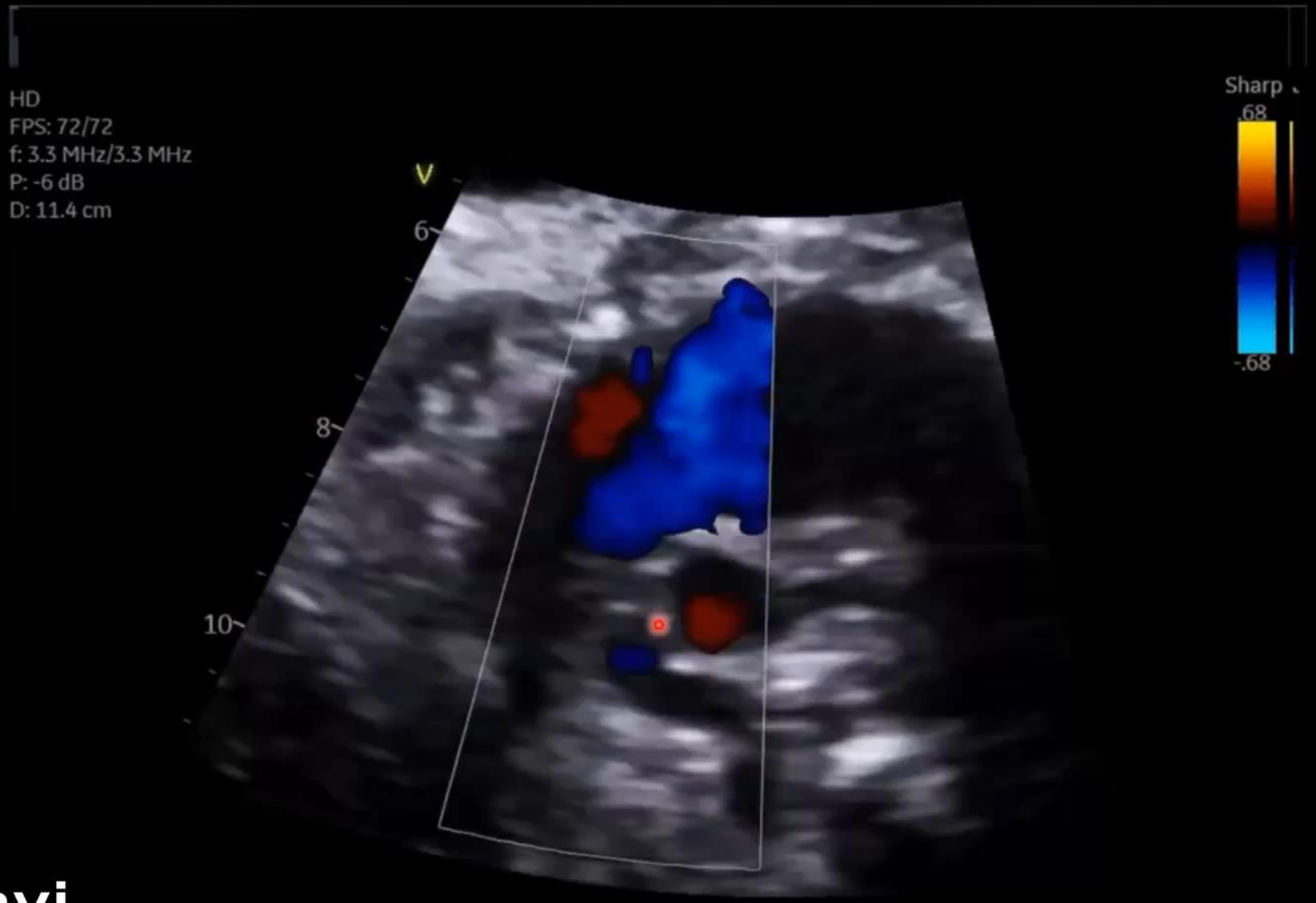
Regurgitant lesions: Ebstein's anomaly/dysplastic TV



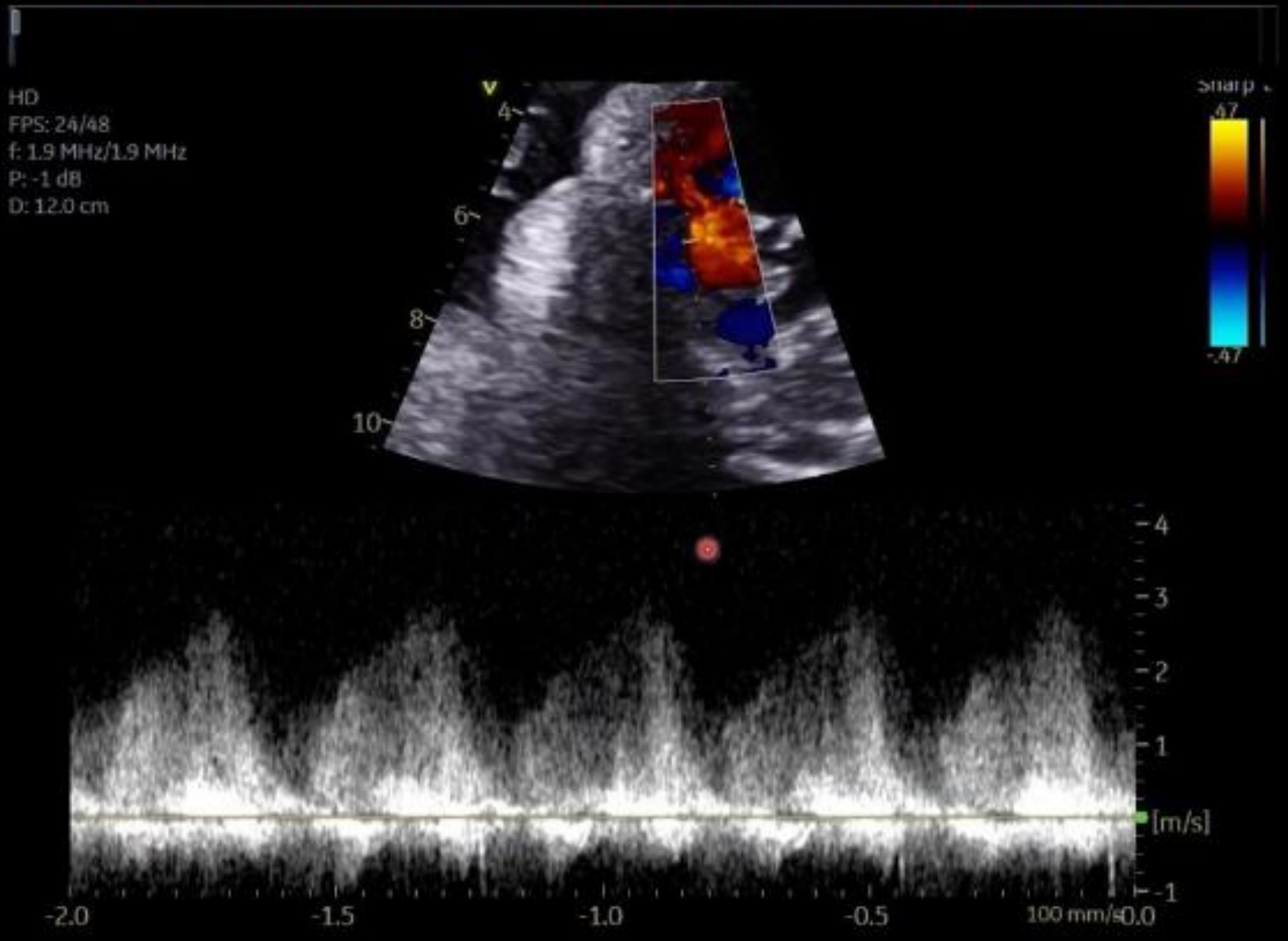
Regurgitant lesions: Ebstein's anomaly/dysplastic TV



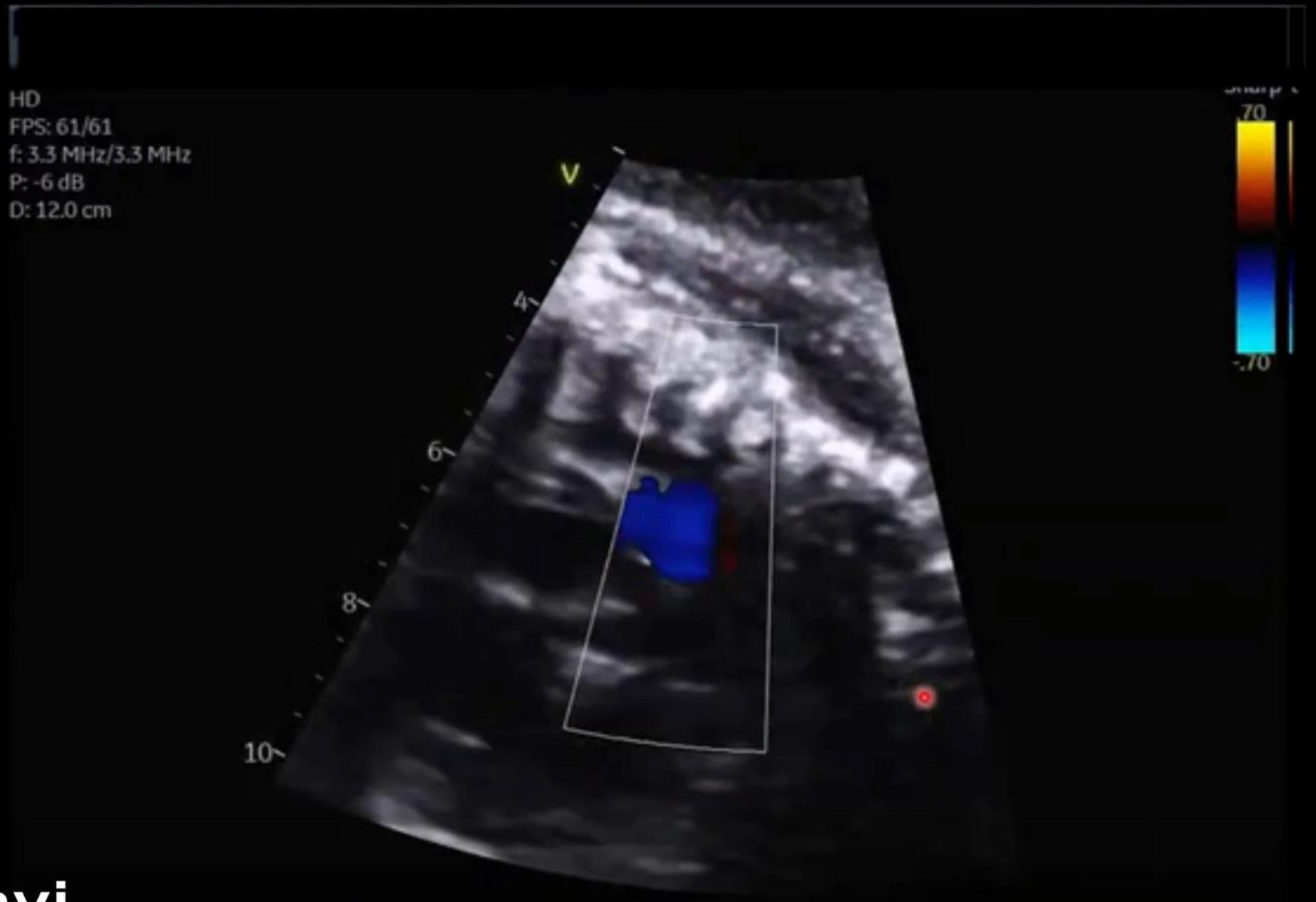
Regurgitant lesions: Ebstein's anomaly/dysplastic TV



Regurgitant lesions: Ebstein's anomaly/dysplastic TV

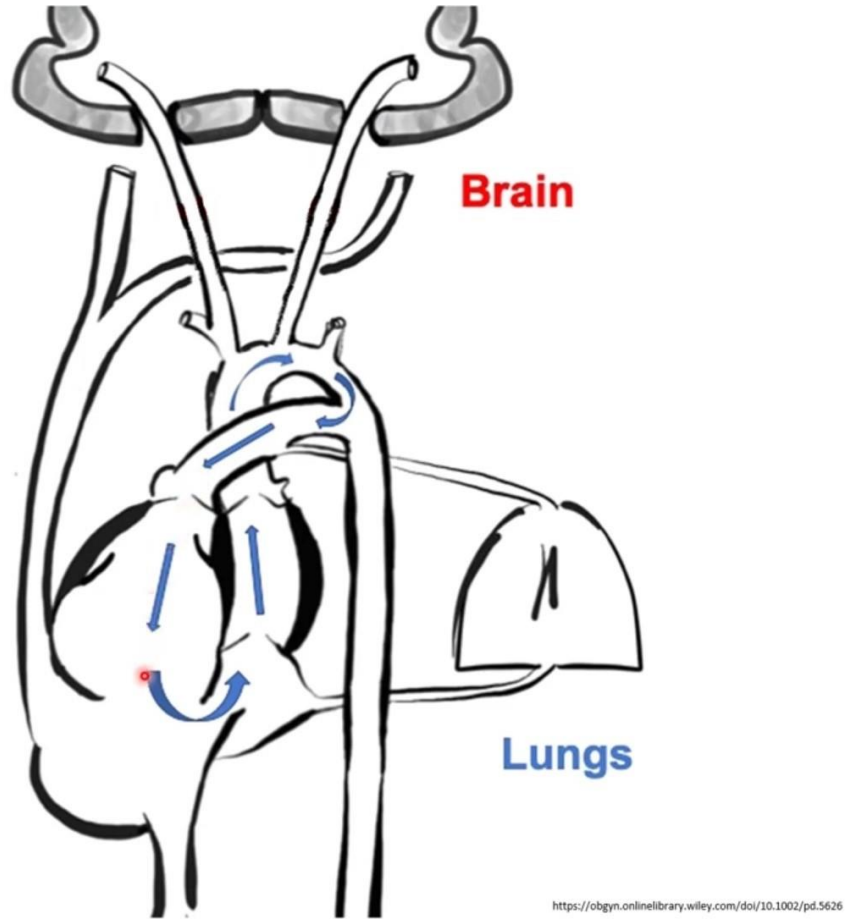


Regurgitant lesions: Ebstein's anomaly/dysplastic TV



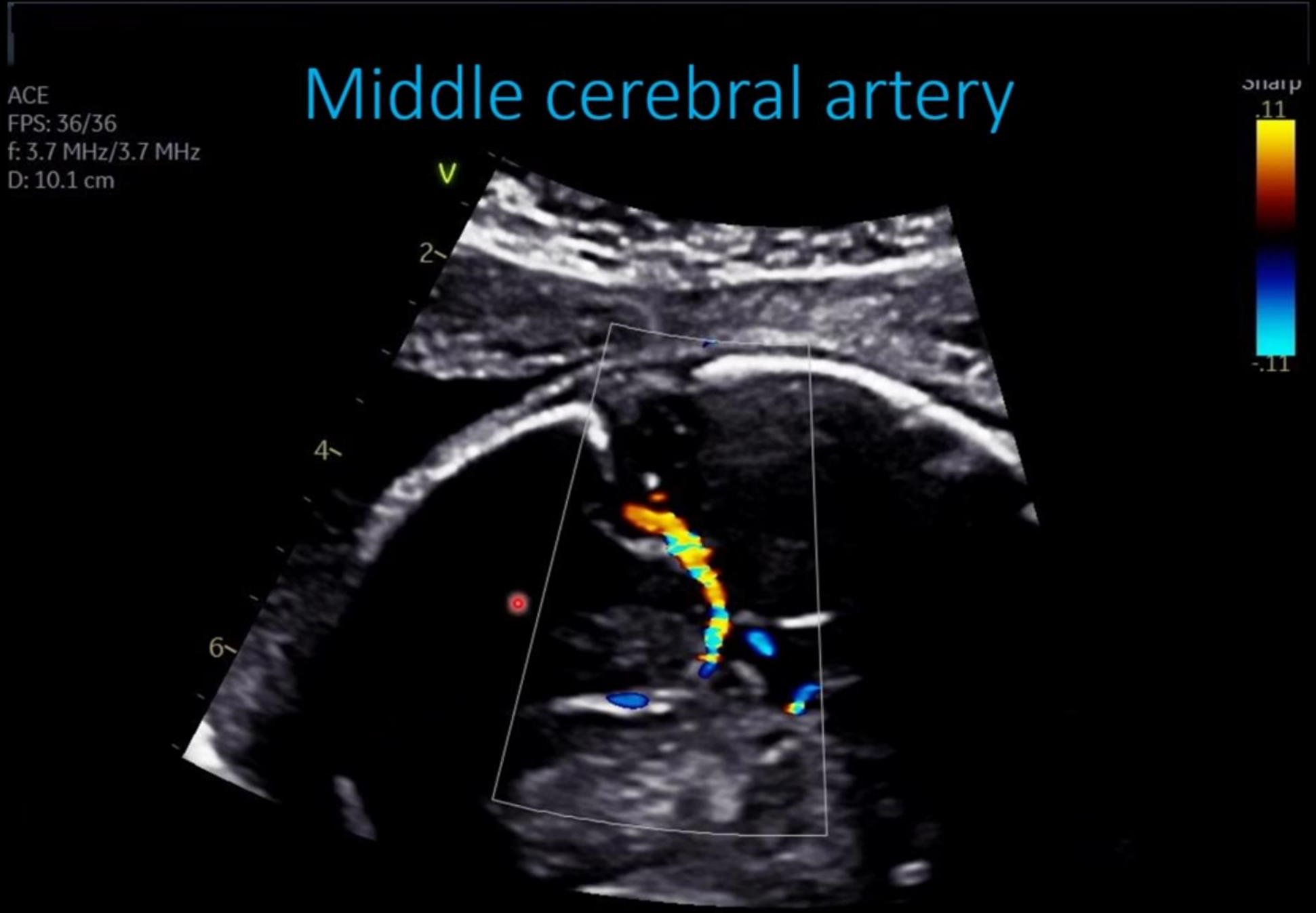
Regurgitant lesions: Ebstein's anomaly/dysplastic TV

“Circular Shunt”

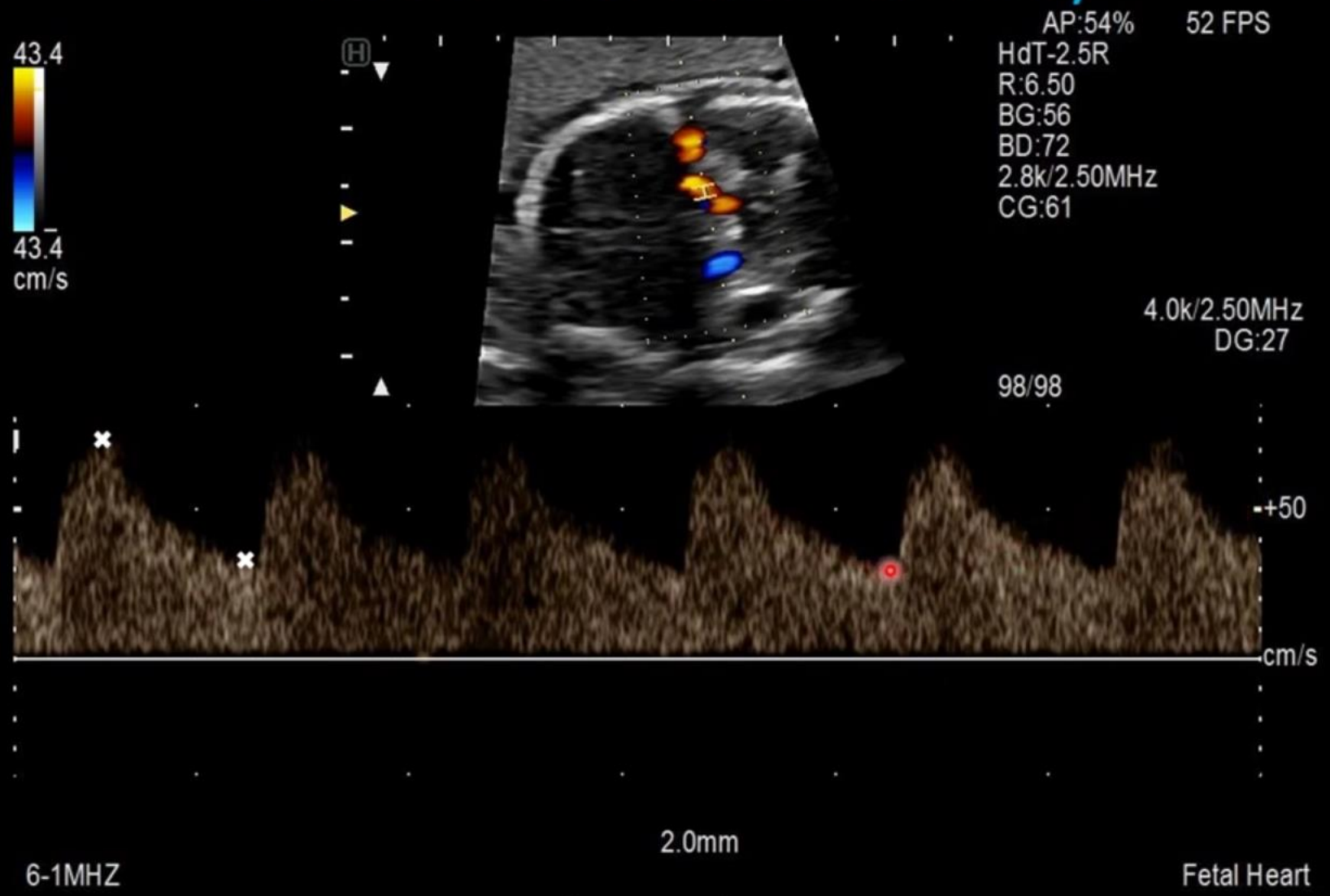


https://obgyn.onlinelibrary.wiley.com/doi/10.1002/pd.5626

Middle cerebral artery



Middle cerebral artery



Anemia