

# Diagnostic Pitfalls of Pulmonary Venous Anomaly

이재영

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# Pulmonary Venous Anomalies

- Abnormal numbers of pulmonary veins
- Stenotic connections
- Normal pulmonary venous connections with anomalous drainage
- Anomalous connections

# Diagnosis

1. Clinical suspicion
2. Stabilization of the patient
3. Imaging
  - Echo
  - CT or MRI

# Case

- 35 wk, 12 hr after birth,
- Cyanosis and Tachypnea
- SaO<sub>2</sub> : 65%

• Dx → RDS? or other ?

• Hx - Surfactant Tx

• RDS with PDA ??

• TAPVR with obstruction !!



# Pulmonary Venous Anomalies

## Diagnosis

- Anatomy – Echo, CT, or MRI
  - Number of pulmonary veins
  - Pulmonary venous connections
  - Pulmonary venous drainage
  - Position and status of the atrial septum
  - Systemic venous connections

# Pulmonary Venous Anomalies

## Diagnosis

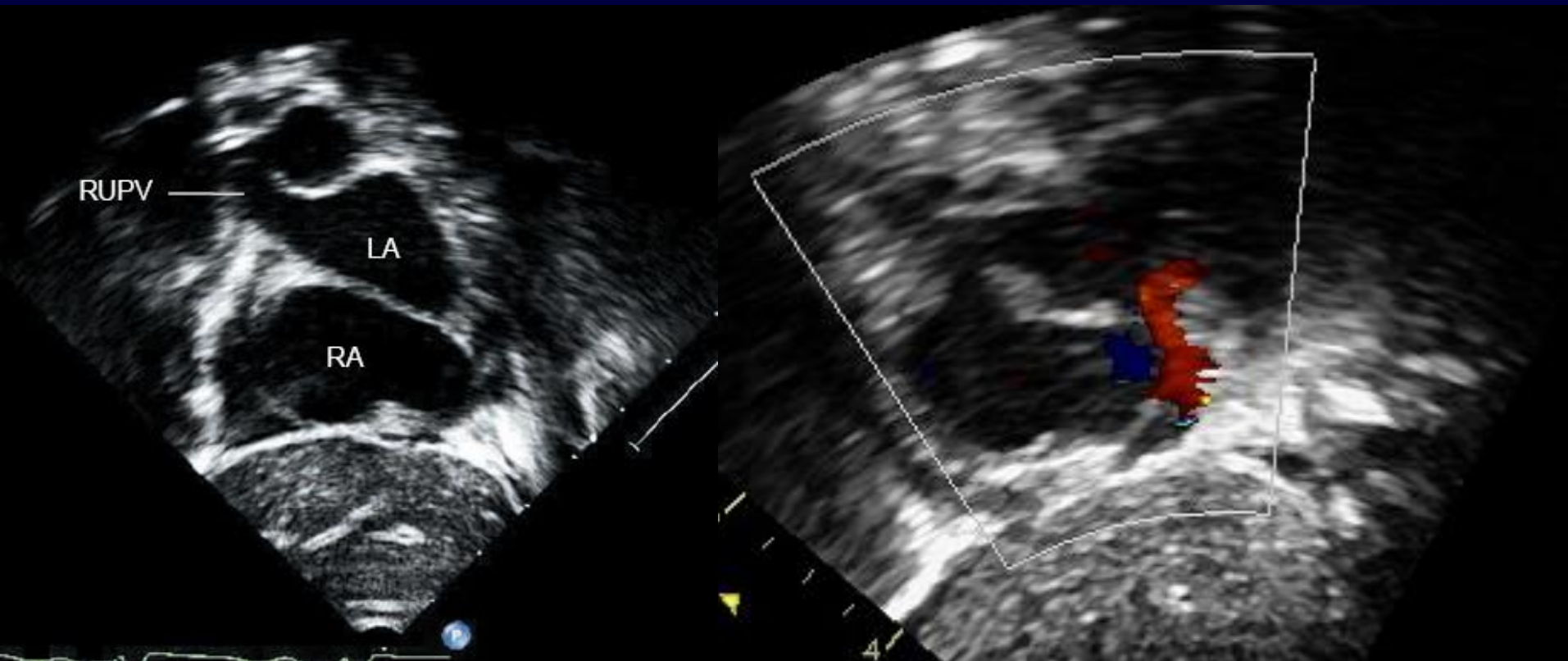
- Hemodynamic assessment – echo
  - Flow direction
  - Pulmonary venous obstruction
  - Atrial septal restriction
  - RV volume load and function
  - RV or pulmonary hypertension
  - LV function and systemic output

# Imaging of pulmonary veins

- Subcostal short axis
- Subcostal long axis
- Apical 4- or 5 chamber
- Parasternal long axis
- High parasternal short axis (“crab view”)

# Pulmonary veins

## Subcostal view

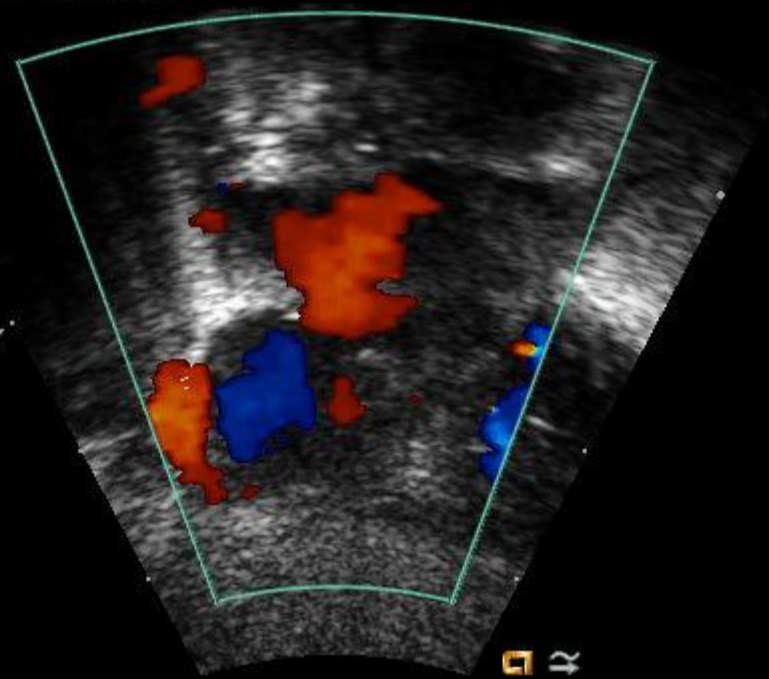




# Pulmonary veins Subcostal view

: 26530745  
ST.MARY'S HOSPITAL

KSKB: 26530745  
SEOUL ST.MARY'S HOSPITAL



Exit

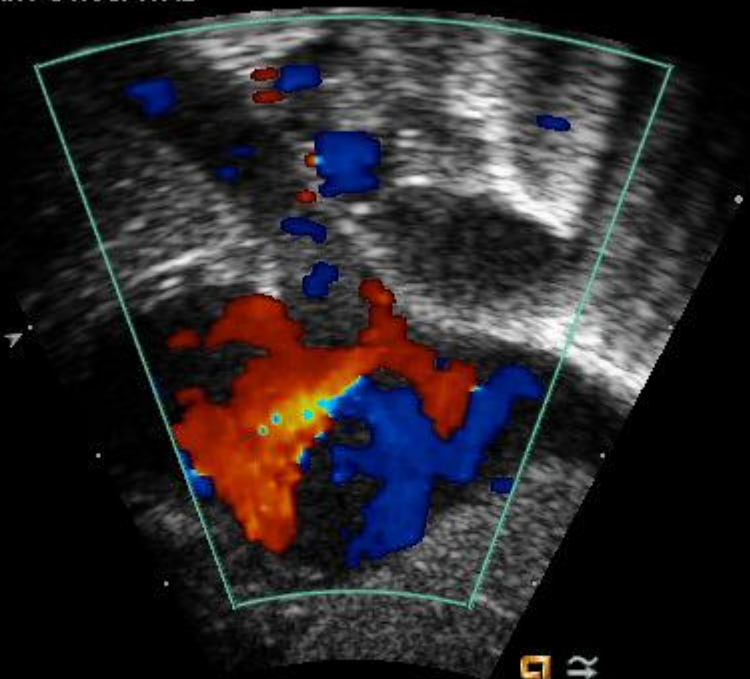
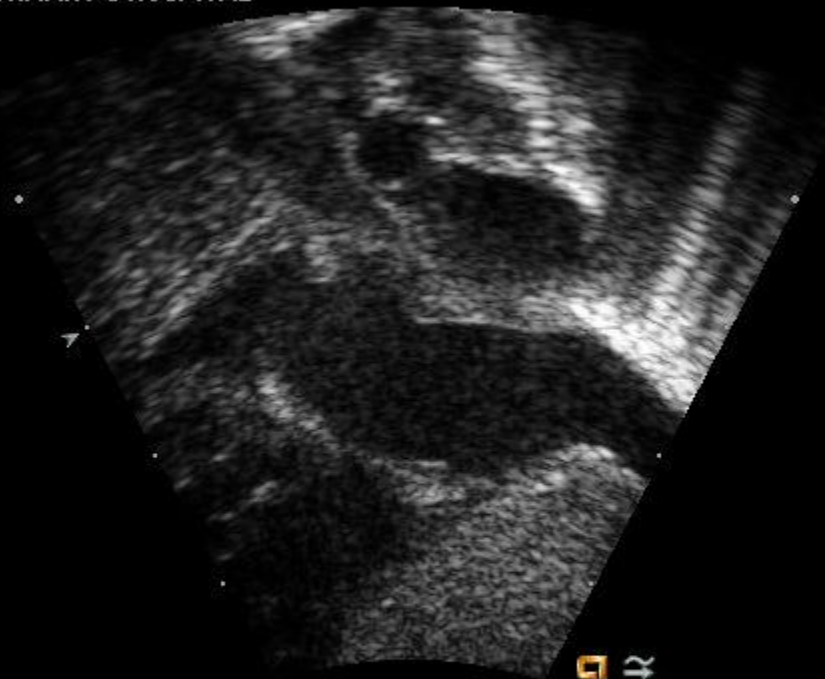
CD Pan

St  
T1  
1/  
CD  
10  
8.  
PE  
Ge  
o

# Pulmonary veins Subcostal view

26530745  
ST.MARY'S HOSPITAL

KSKB: 26530745  
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Store  
T1/-  
1/2  
CD G  
10V  
8.0M  
PED  
Gene  
CD

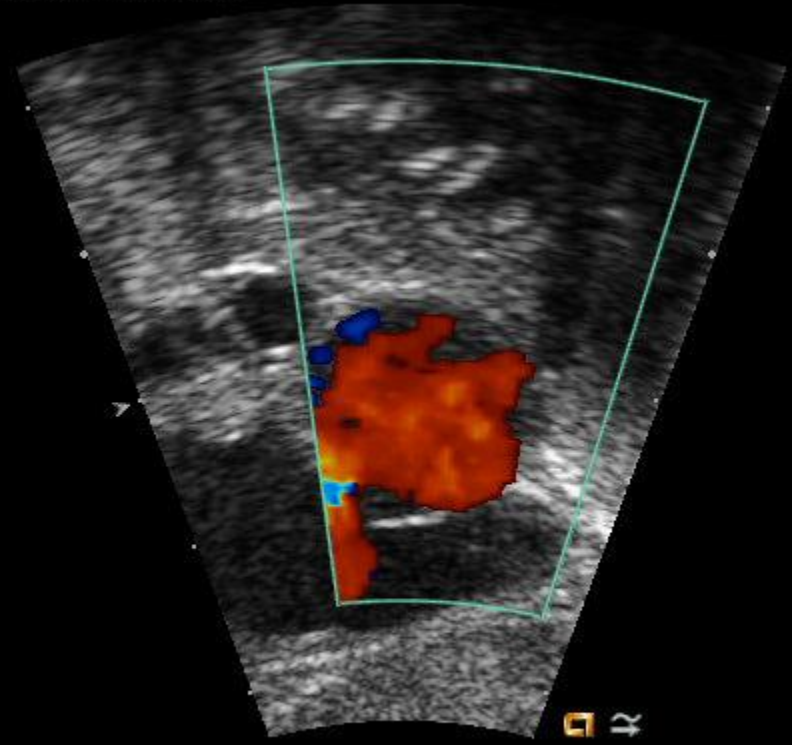
CD Pan

kit

# Pulmonary veins Subcostal view

KKB: 26530745  
UL ST.MARY'S HOSPITAL

KSKB: 26530745  
SEOUL ST.MARY'S HOSPITAL

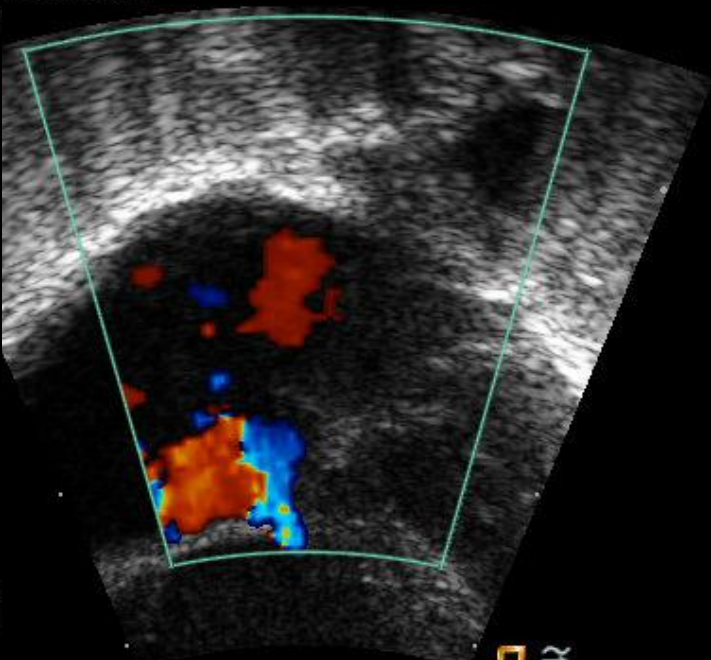


Stor  
T1/  
1/2  
CD  
10V  
8.0  
PED  
Ger

# Pulmonary veins 4-C or 5-C view

KB: 26530745  
ST. MARY'S HOSPITAL

16 May 13 745  
4:41:57 pm  
ST. MARY'S HOSPITAL



Store in progress

64dB S1/ 0/1/ 4  
Gain= 10dB Δ=1

10V4c-S #149  
9.0MHz 318mm  
PED ECHO  
General

Store in

S2/-1/  
1/2  
CD Gain

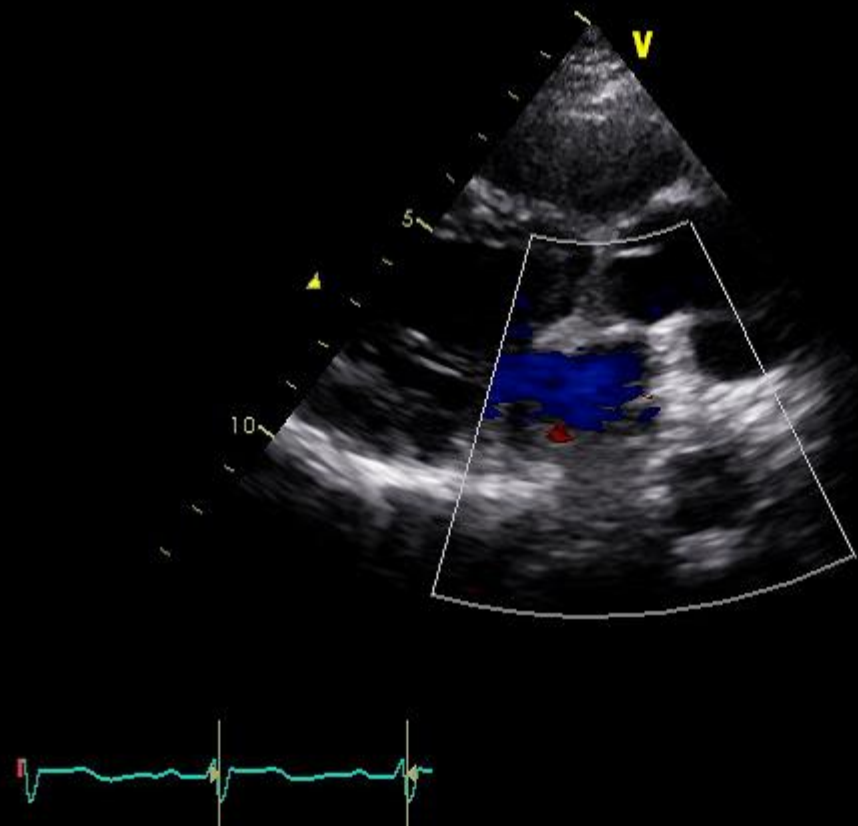
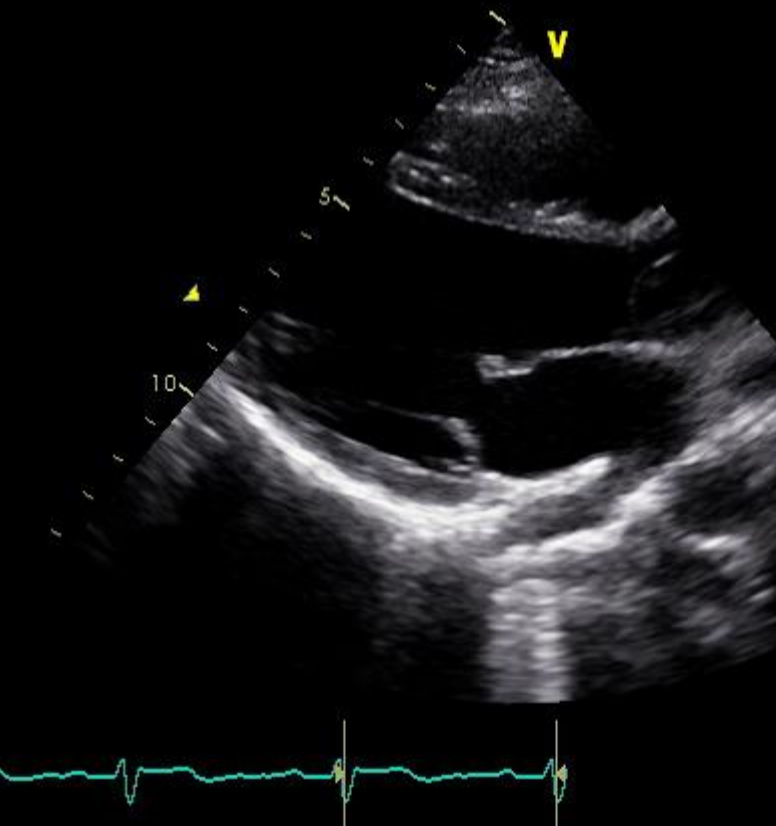
10V4c-  
9.0MHz  
PED ECHO  
General

CD Pan △/□

CD P

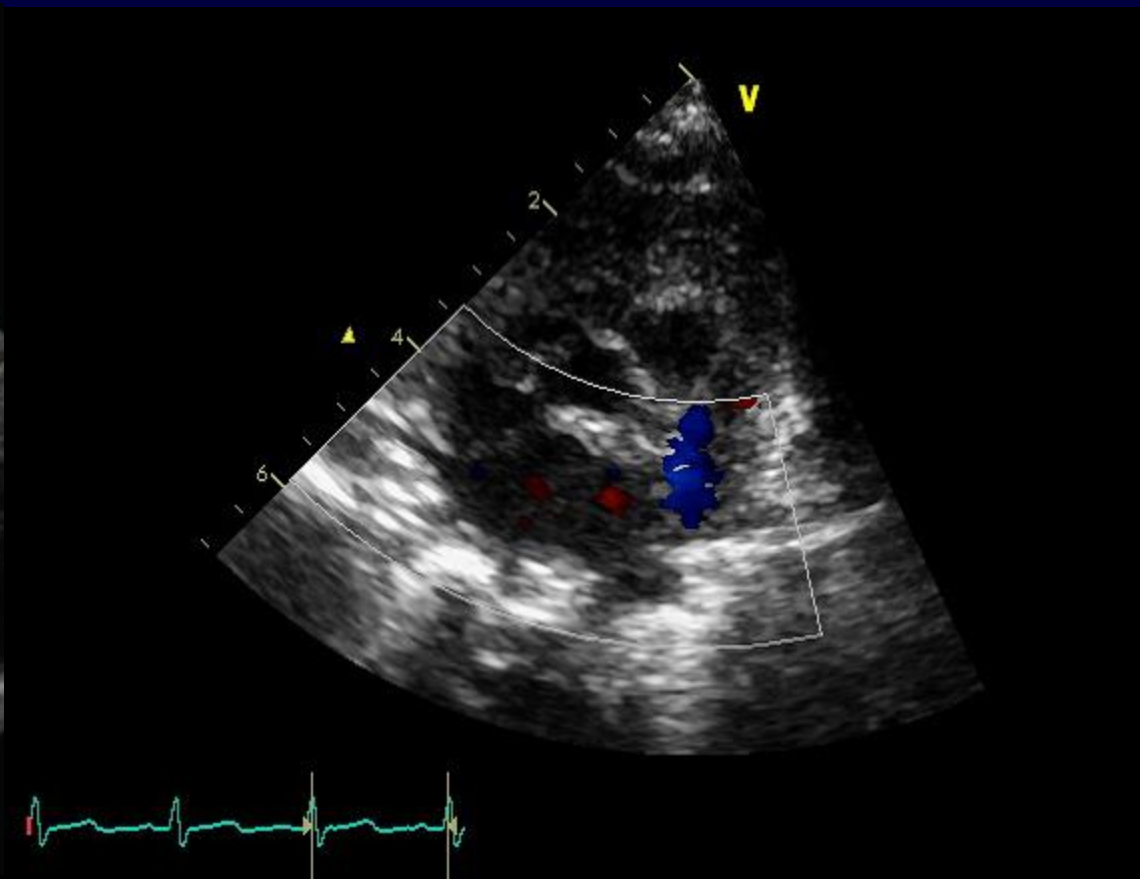
# Pulmonary veins

## Parasternal long axis



# Pulmonary veins

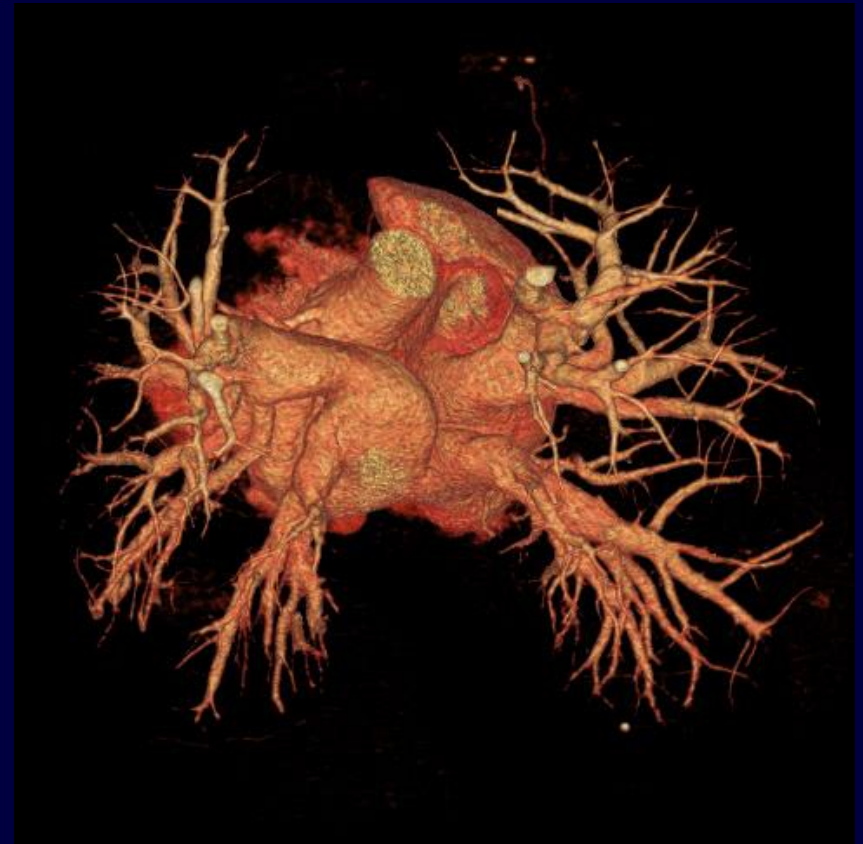
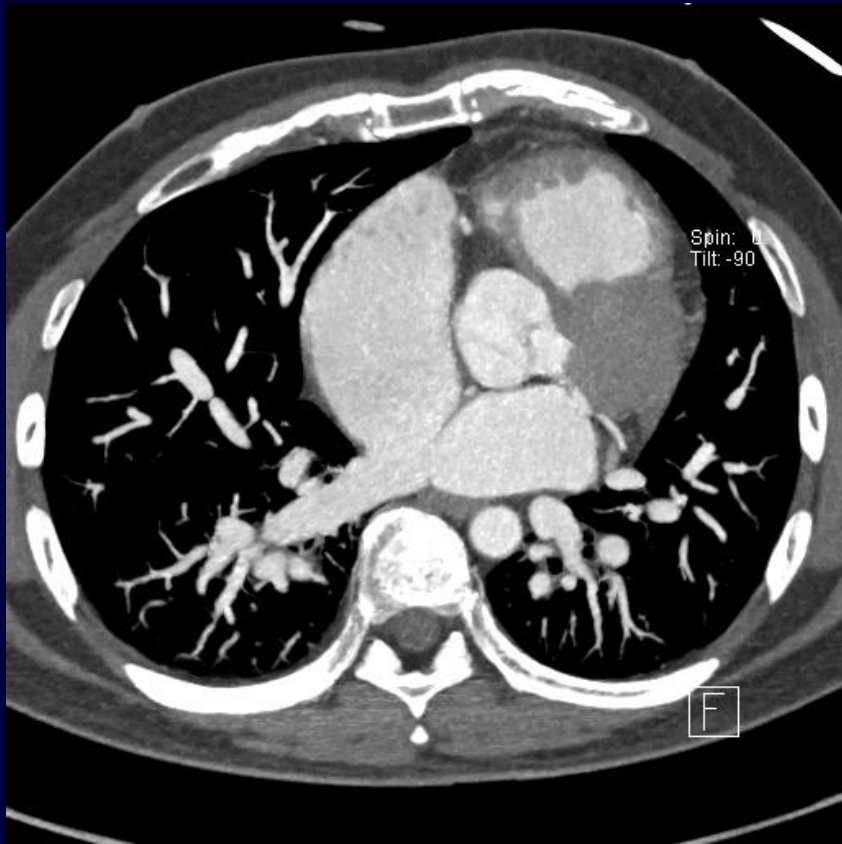
High parasternal short axis (“crab view”)



# Terminology

- Anomalous pulmonary venous ---
  - Connection (TAPVC)
    - Anatomic term
  - Drainage (TAPVD) or Return (TAPVR)
    - Physiologic or hemodynamic term

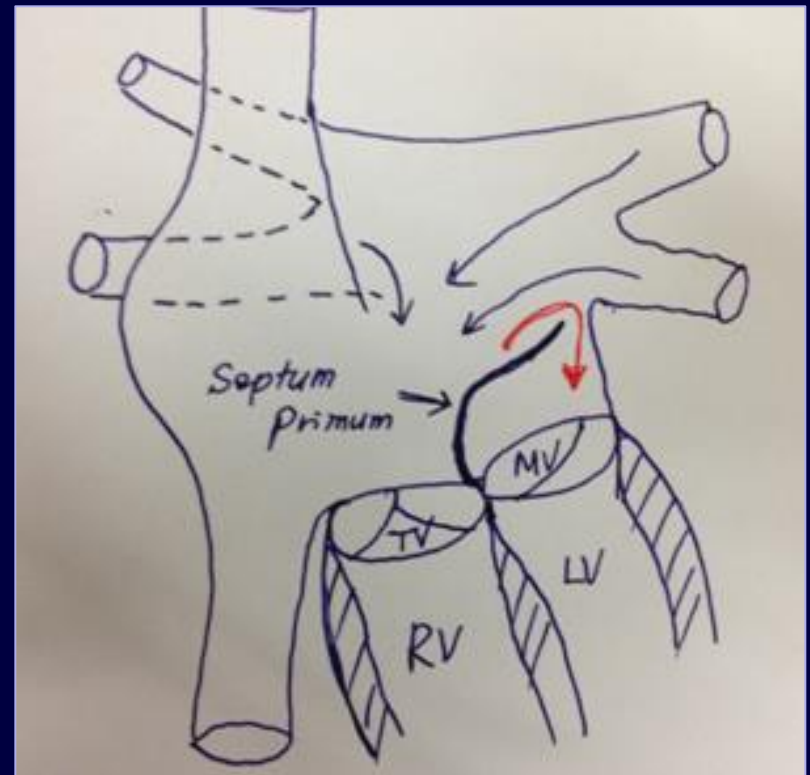
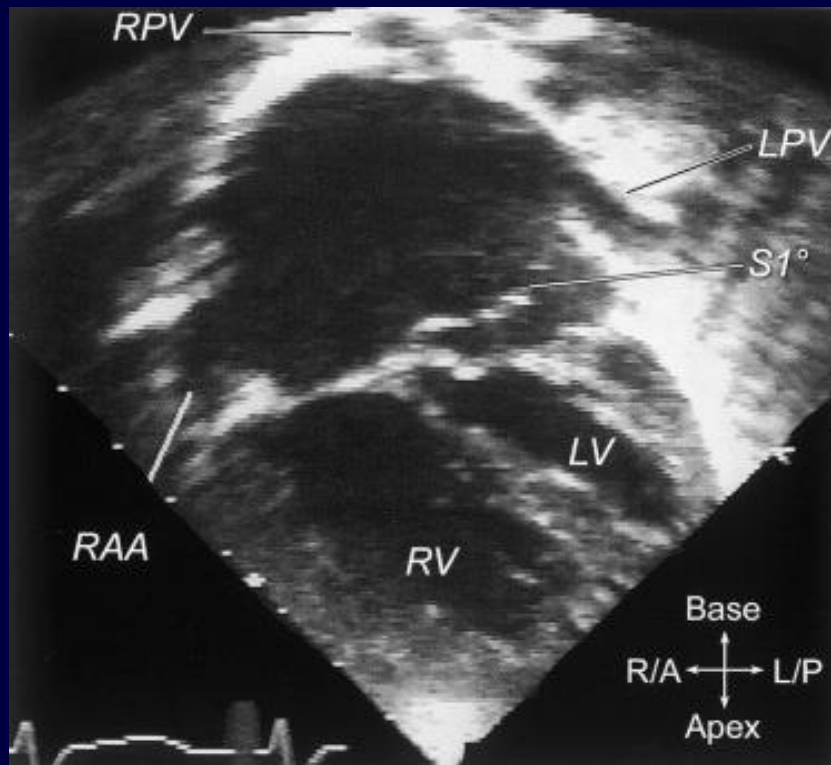
# Normal connection with abnormal drainage



Sinus venosus defect



# Normal connection with abnormal drainage

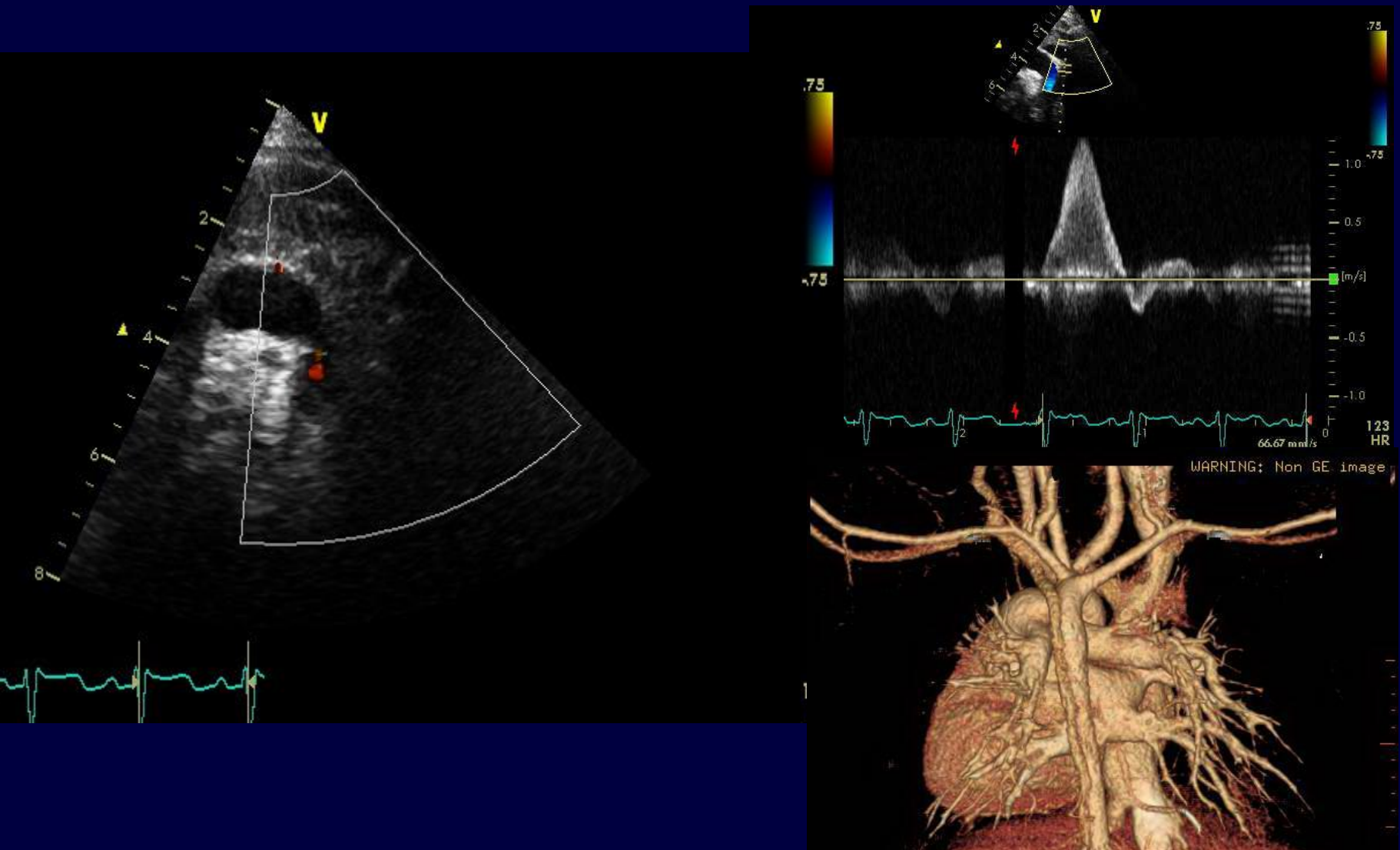


# Abnormal connection

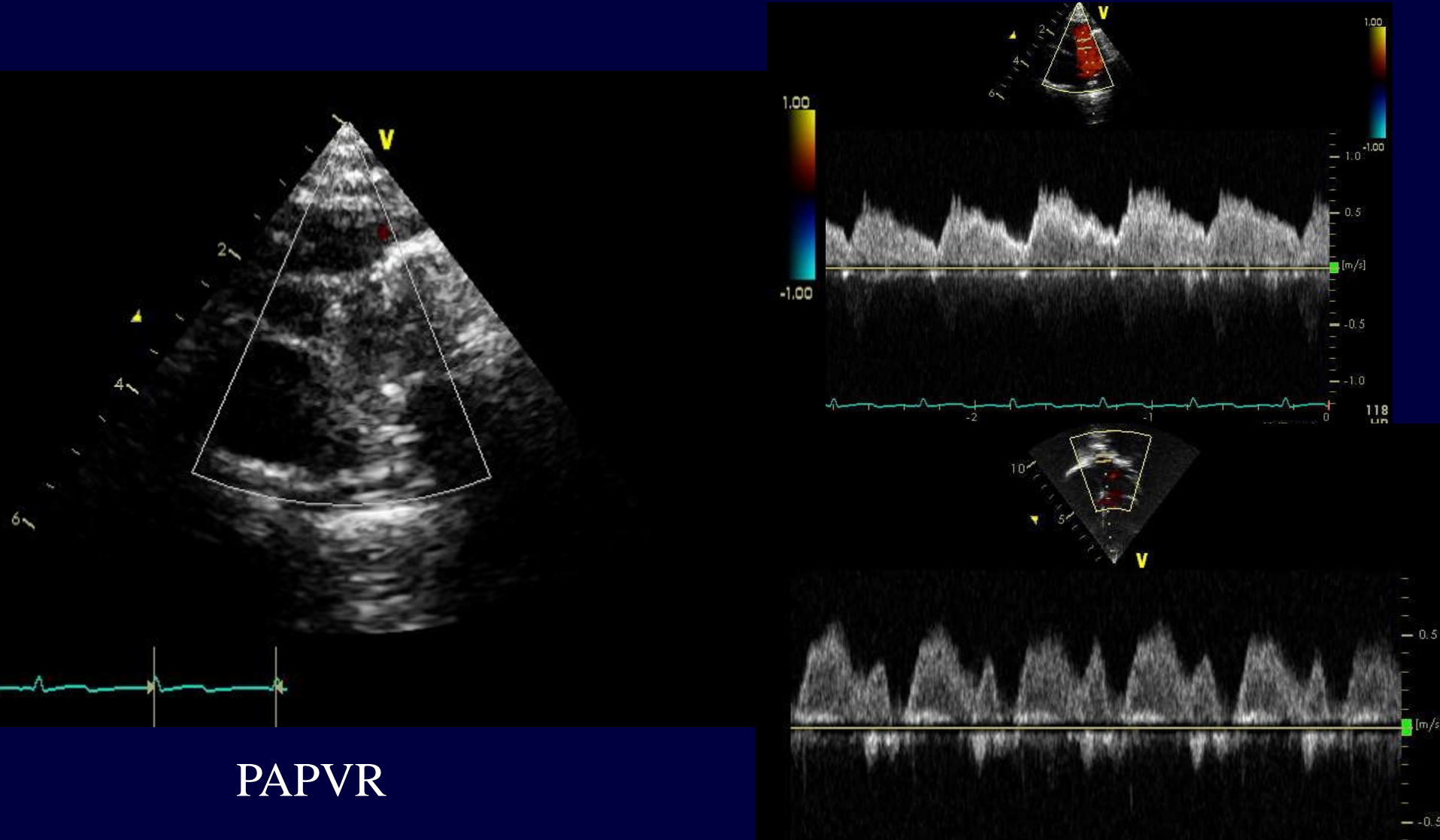


PAPVR

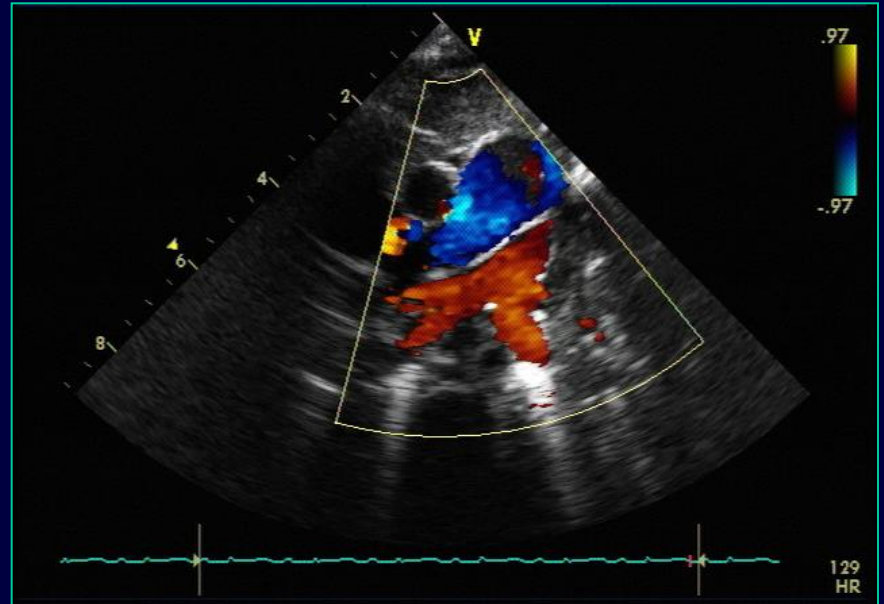
# Flow into innominate vein



# Flow into innominate vein



Female,  
4 months



유정진 선생님 제공

# Flow into innominate vein

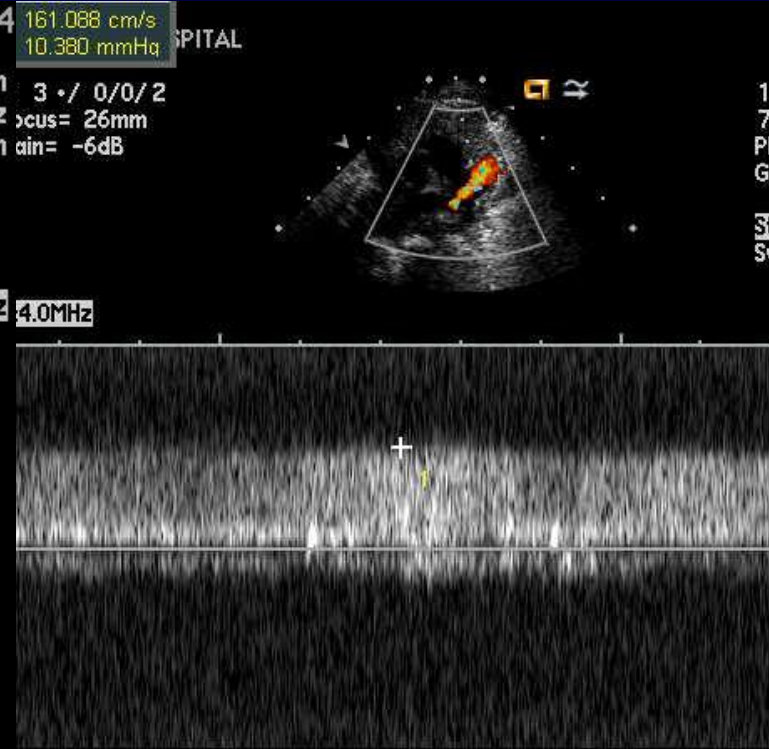
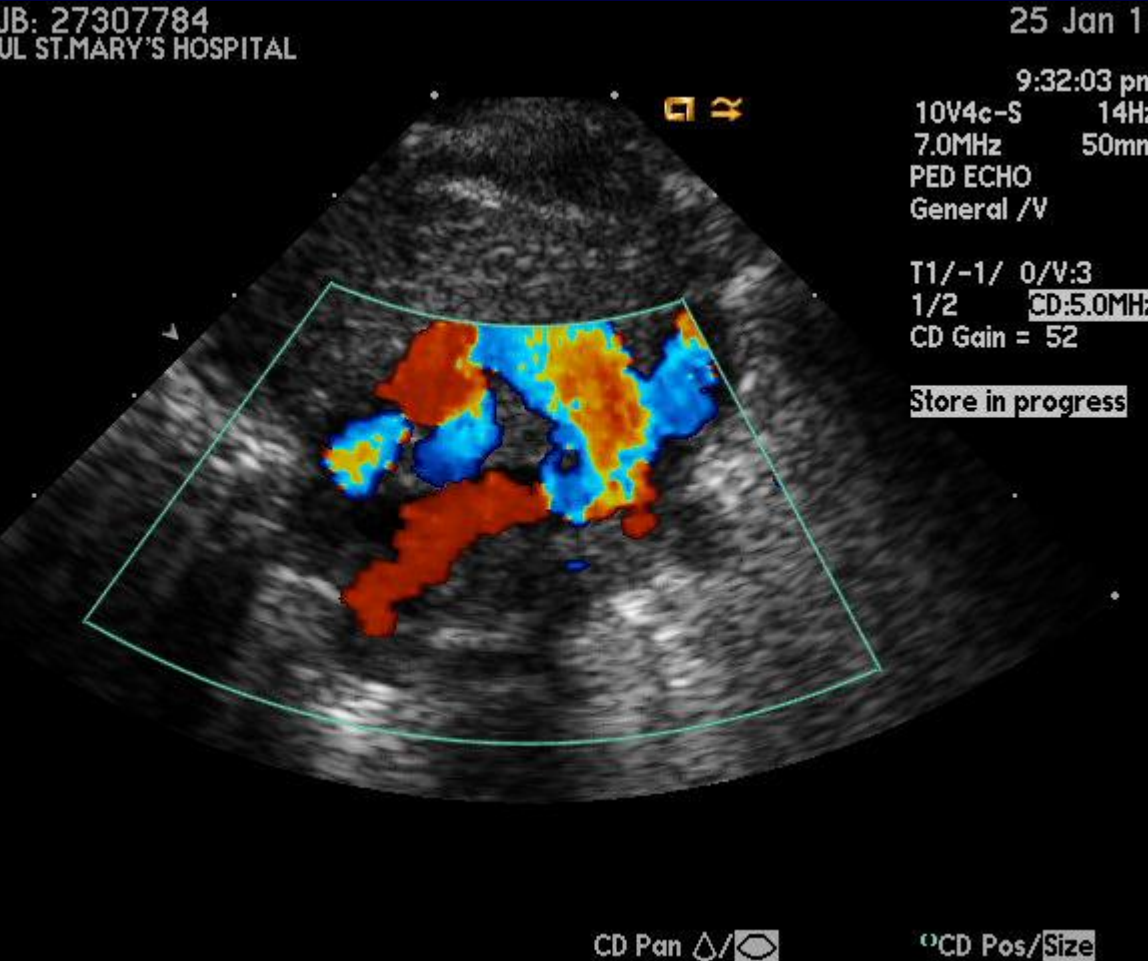
JB: 27307784  
UL ST.MARY'S HOSPITAL

25 Jan 14 161.088 cm/s  
10.380 mmHg SPITAL

9:32:03 pm 3 / 0/0/2  
10V4c-S 14Hz focus= 26mm  
7.0MHz 50mm gain= -6dB  
PED ECHO  
General /V

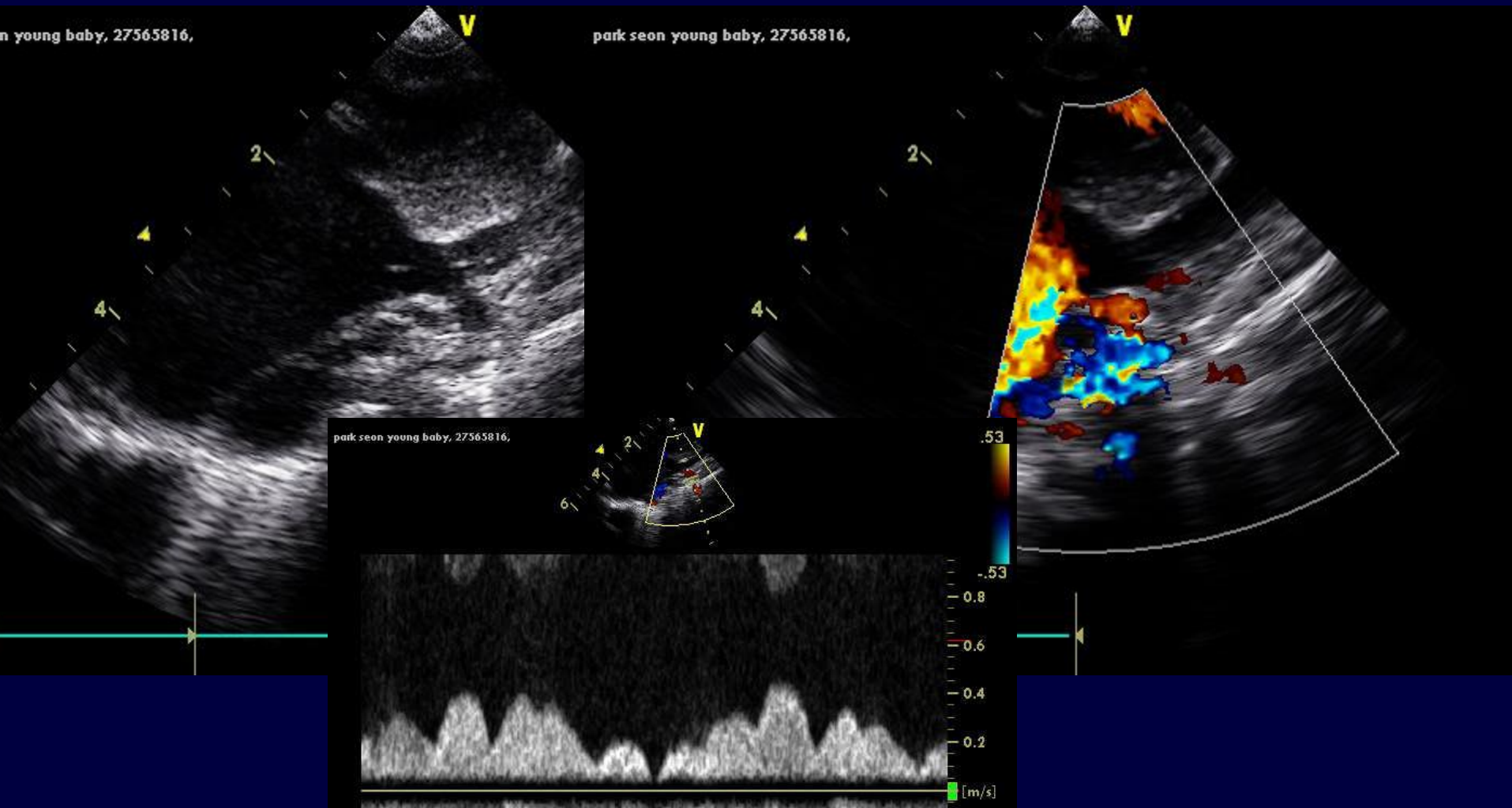
T1/-1/ 0/V:3  
1/2 CD:5.0MHz 4.0MHz  
CD Gain = 52

Store in progress



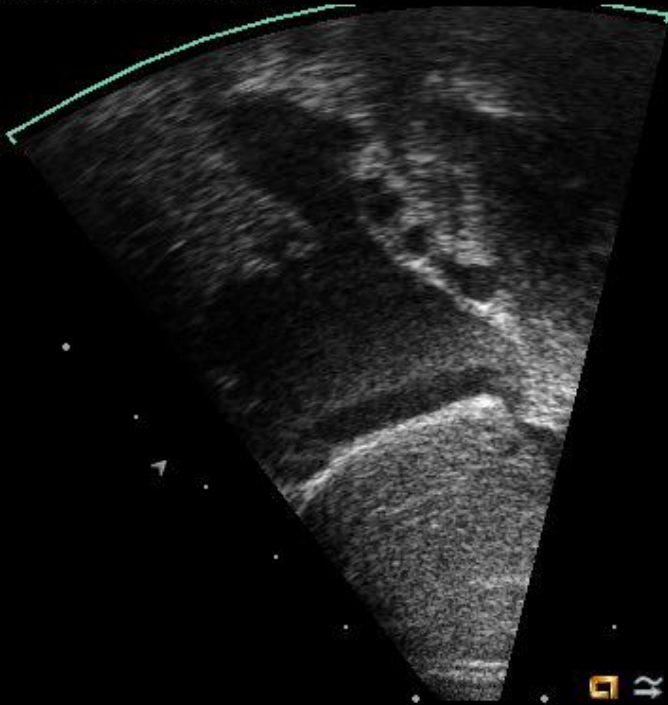
TAPVR with obstruction

# Flow into SVC

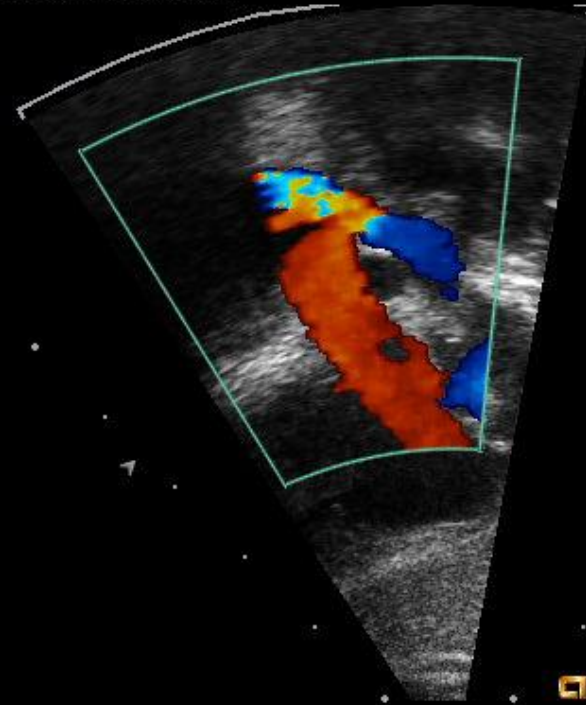


# Flow into SVC

SONG HEE SUN BABY: 24281355  
SEOUL ST.MARY'S HOSPITAL



SONG HEE SUN BABY: 24281355  
SEOUL ST.MARY'S HOSPITAL



D Pos/Width

2D Pos/Width

CD Pan

Store

T1/-1  
1/2  
CD Ge

10V4  
10.0M  
PED E  
Gener

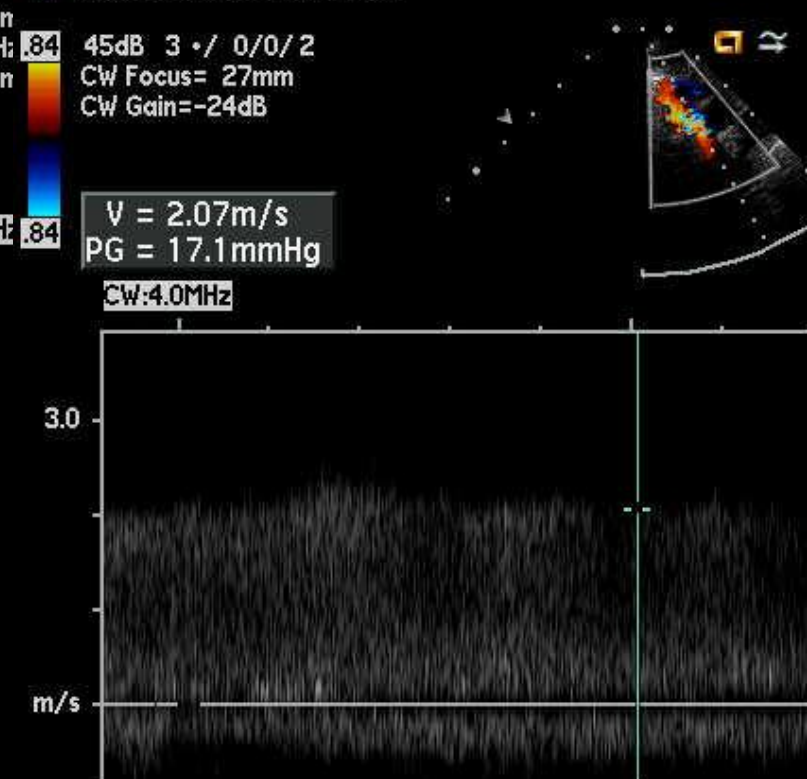
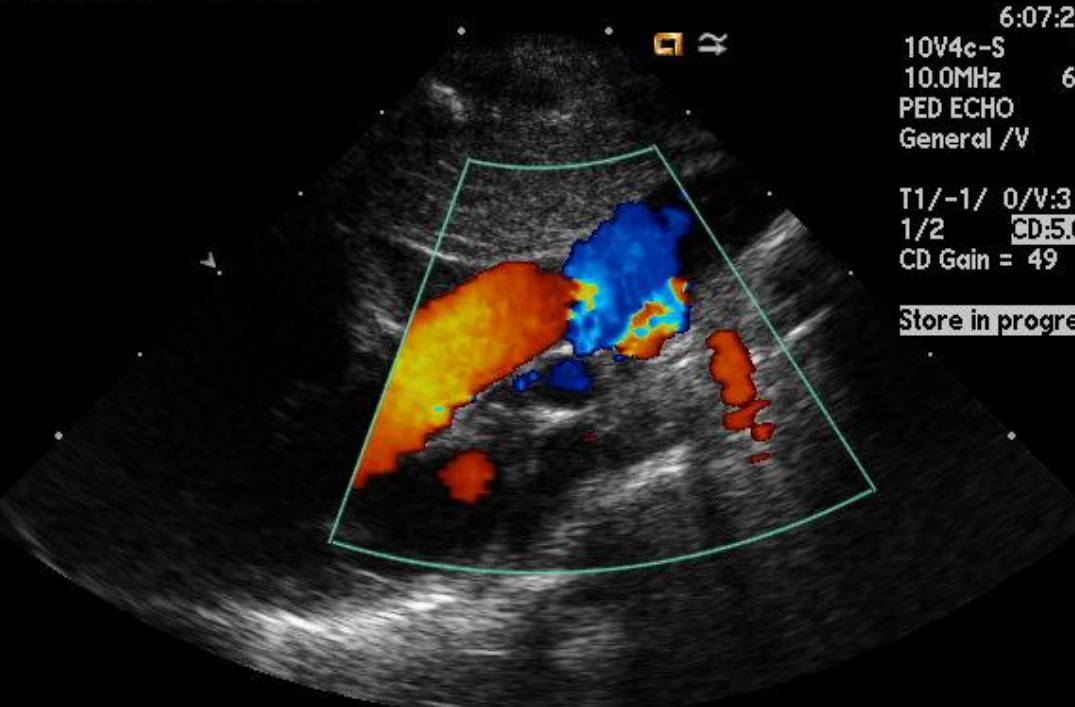
CD



# Supracardiac TAPVR

SONG HEE SUN BABY: 24281355  
SEOUL ST.MARY'S HOSPITAL

22 Jul 1 SONG HEE SUN BABY: 24281355  
SEOUL ST.MARY'S HOSPITAL



CD Pan

CD Pos/Size

2D/CD/Dop

Delete Set

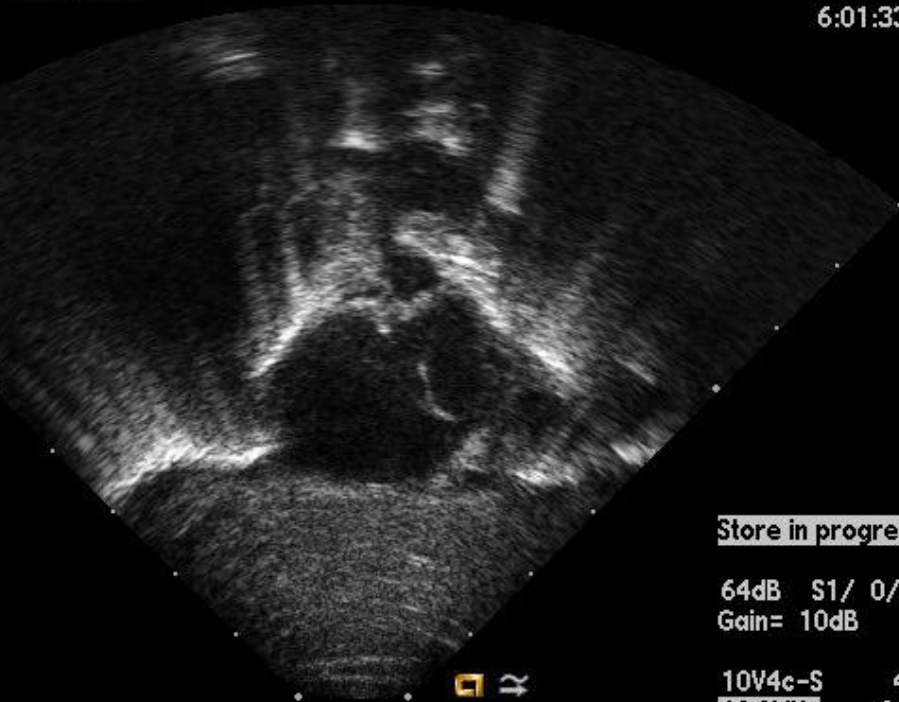
Lock Set

# Supracardiac TAPVR

IN BABY: 24281355  
S HOSPITAL

22 Jul 11

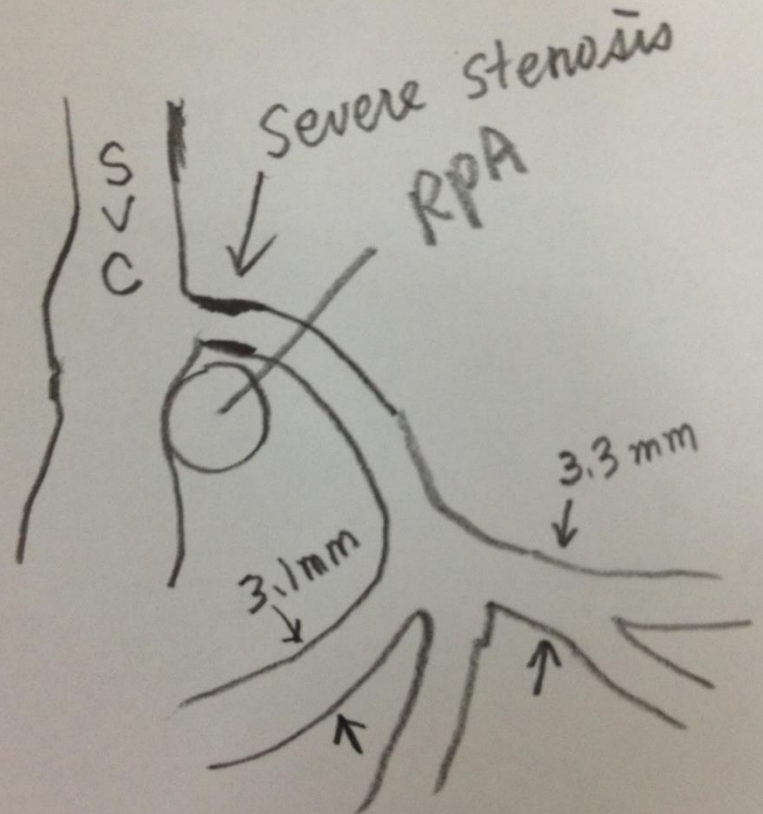
6:01:33 pm



Store in progress

64dB S1/ 0/1/4  
Gain= 10dB Δ=1

10V4c-S 41Hz  
10.0MHz 80mm  
PED ECHO  
General

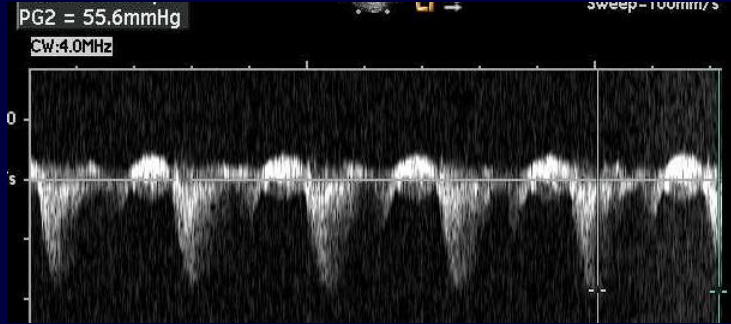
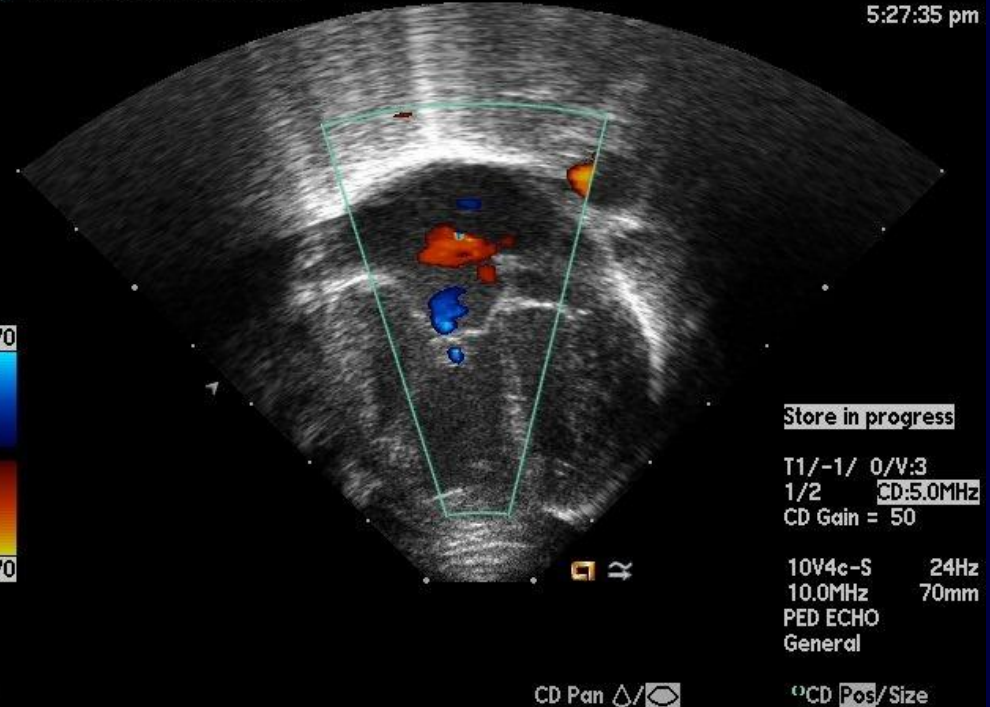
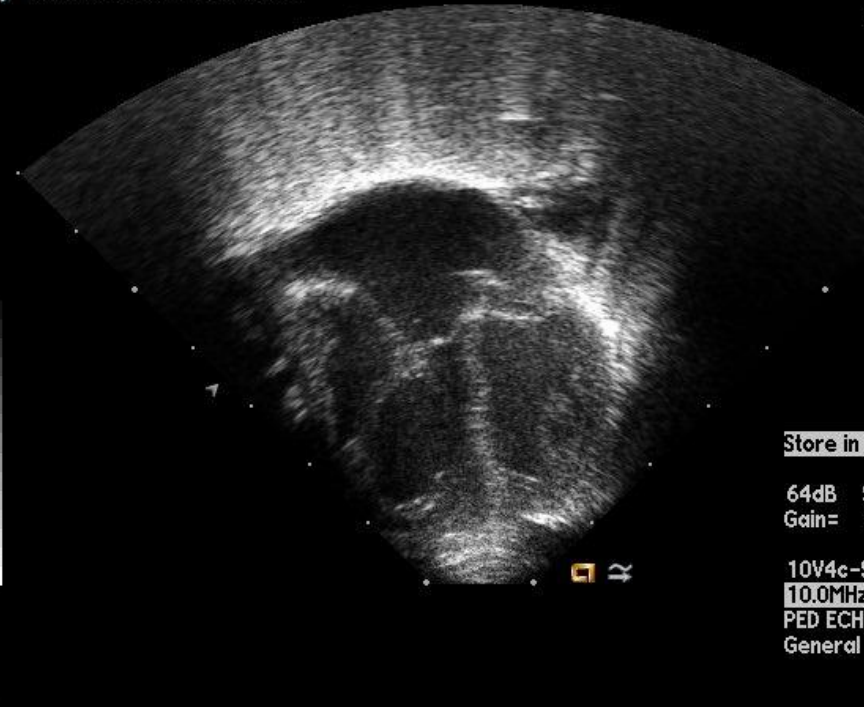


# Supracardiac TAPVR

SONG HEE SUN BABY: 24281355  
SEOUL ST.MARY'S HOSPITAL

SONG HEE SUN BABY: 24281355  
SEOUL ST.MARY'S HOSPITAL

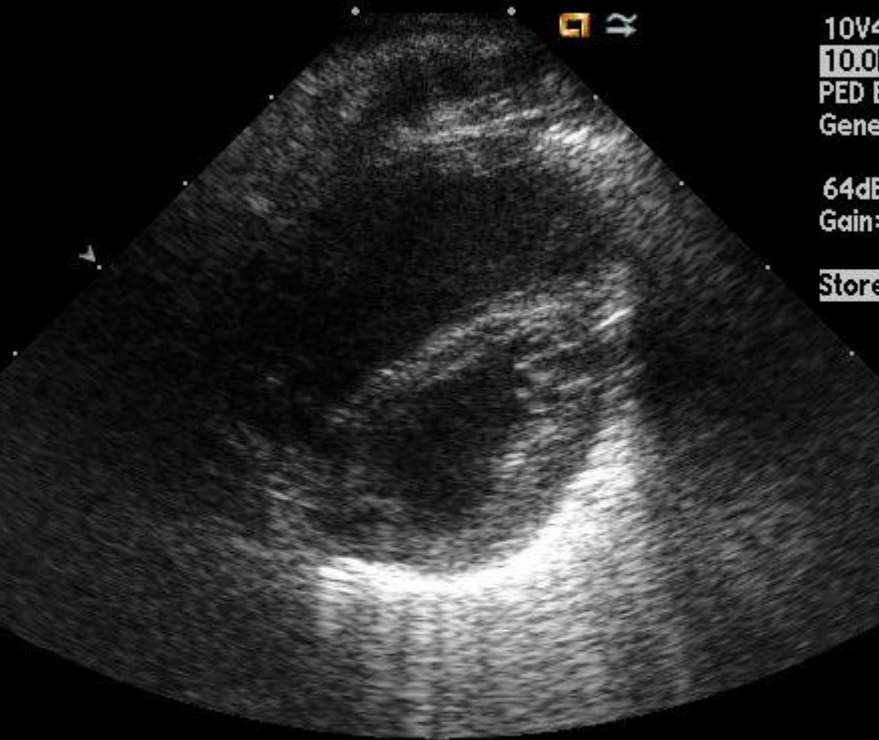
22 Jul 11  
5:27:35 pm



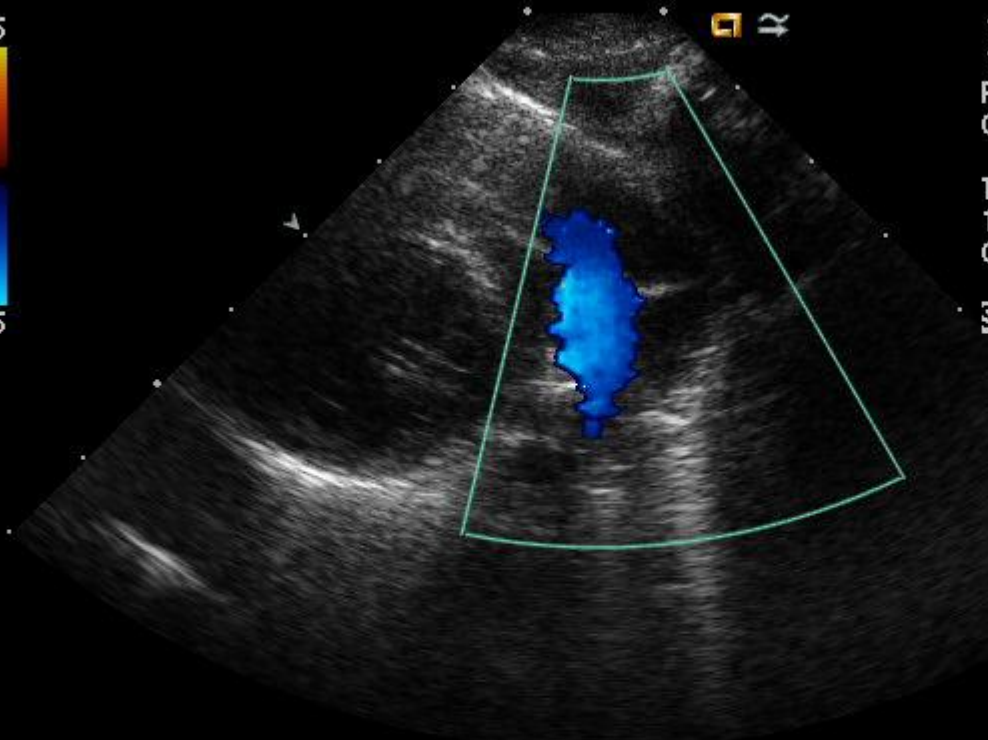
# Supracardiac TAPVR

SONG HE E SUN BABY: 24281355  
SEOUL ST.MARY'S HOSPITAL

SONG HE E SUN BABY: 24281355  
SEOUL ST.MARY'S HOSPITAL



10V4 .55  
10.0  
PED E  
Gene  
64dB  
Gain=  
Store  
.55



# Supracardiac TAPVR

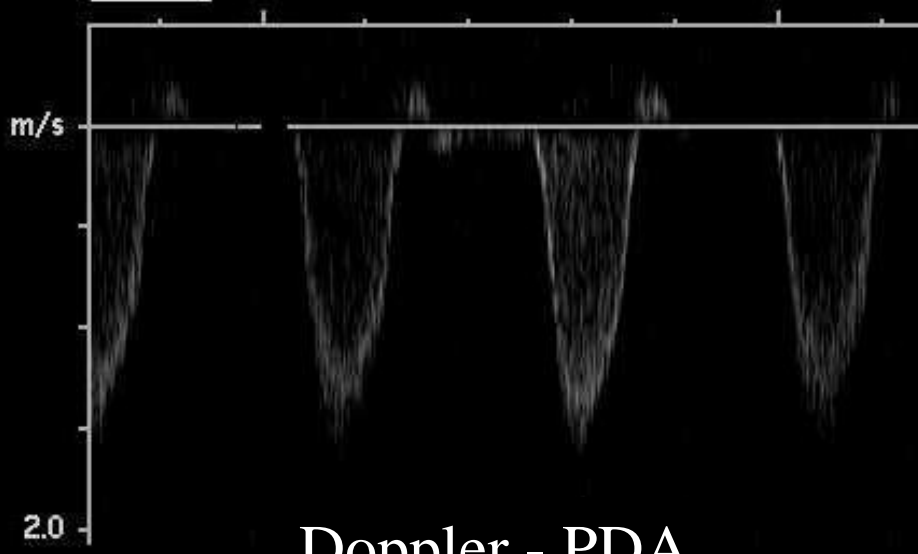
55 45dB 3 · / 0/0/2  
PW Depth= 28mm  
PW Gate= 2.5mm  
PW Gain=-16dB



73 45dB 3 · / 0/0/2  
PW Depth= 35mm  
PW Gate= 2.5mm  
PW Gain=-17dB

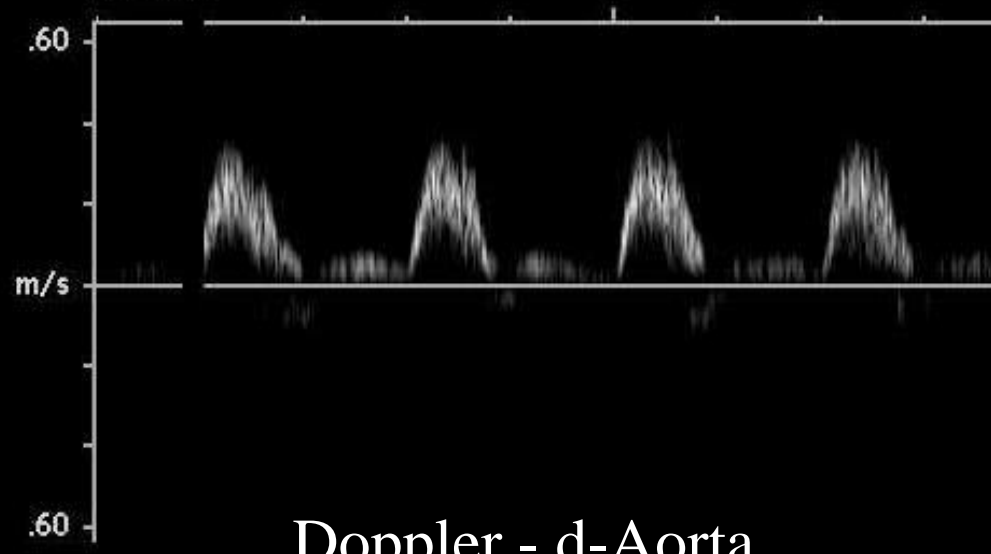


PW:5MHz



Doppler - PDA

PW:5MHz



Doppler - d-Aorta

# Supracardiac TAPVR

shin young hee baby: 24011544  
SEOUL ST.MARY'S HOSPITAL

shin young hee baby: 24011544  
SEOUL ST.MARY'S HOSPITAL

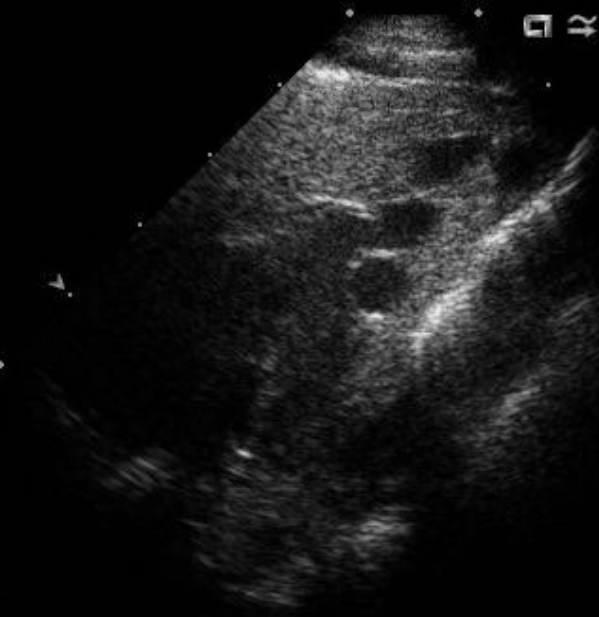
09 M

9:50

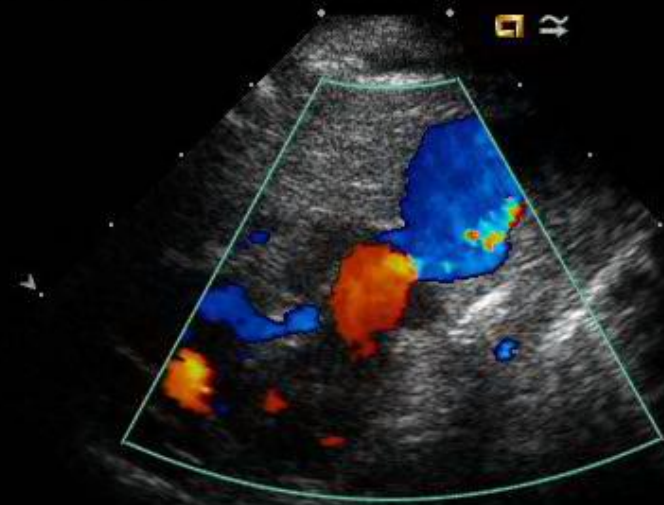
10V4c-S  
9.0MHz  
PED ECHO  
General /V



T1/-1/ 0/V  
1/2 **CD**  
CD Gain = 4

Store in pro...



10.56  
9.0  
PE  
Ge  
64  
Ga  
St  
.72



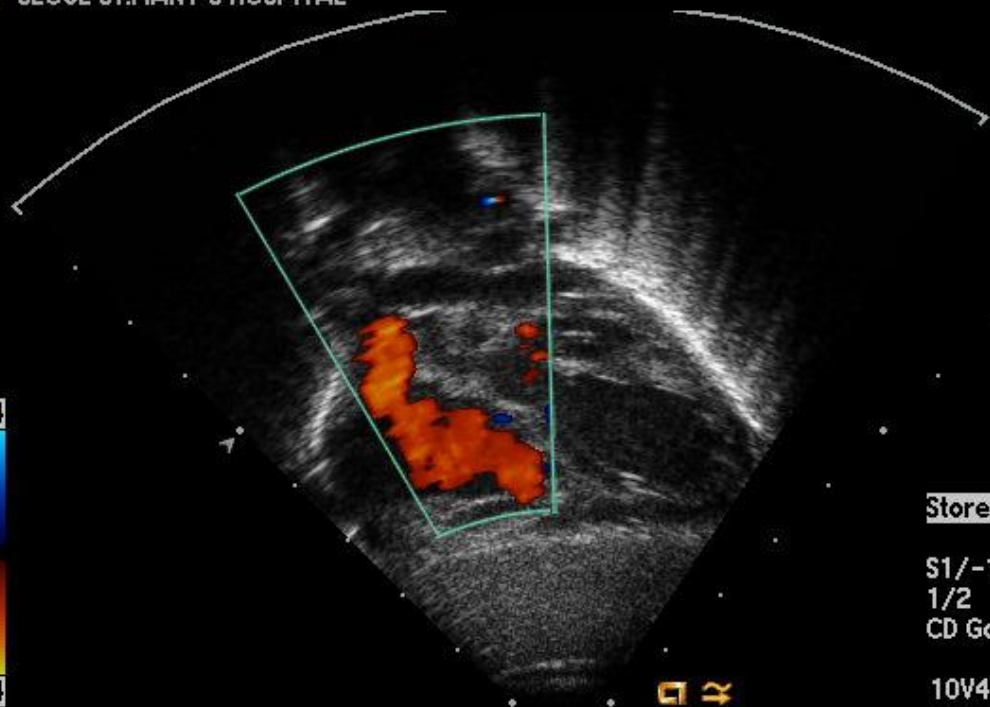
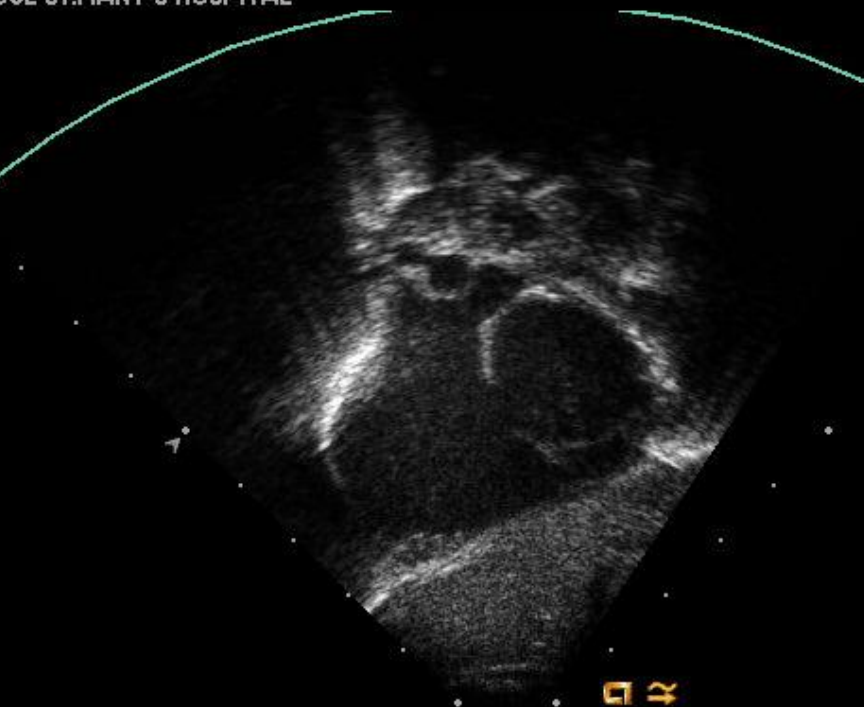
CD Pan  

CD Pos/S

# TAPVR

Y B: 26339211  
DUL ST.MARY'S HOSPITAL

LSY B: 26339211  
SEOUL ST.MARY'S HOSPITAL



Store in  
S1/-1/  
1/2  
CD Gain  
10V4c  
9.0MHz  
PED EC  
Genera

D Pos/Width

2D Pos/Width

CD Pan

CD P

# TAPVR

6339211  
L ST.MARY'S HOSPITAL

18 Mar 13 B: 26339211  
L ST.MARY'S HOSPITAL

10:48:21 am

10V4c-S 20Hz 3 3 0/0/2  
9.0MHz 80mm Depth= 46mm  
PED ECHO Gate= 2.5mm  
General /V Gain= -5dB

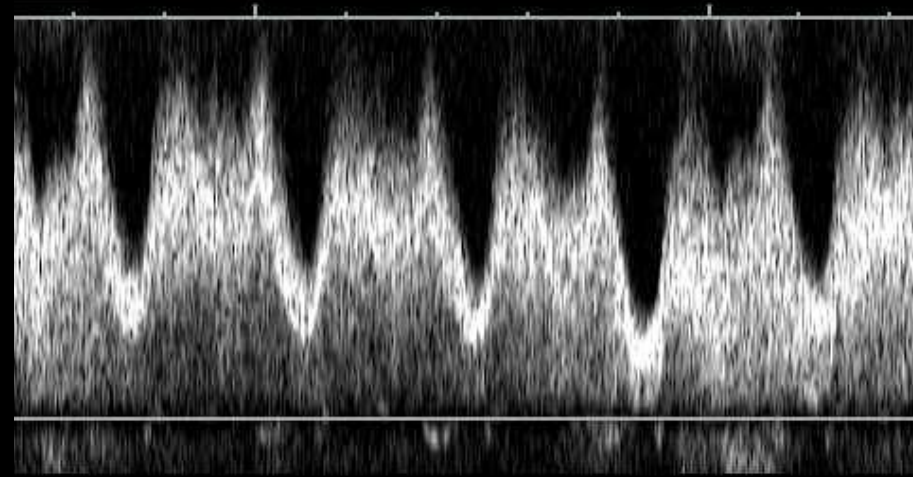
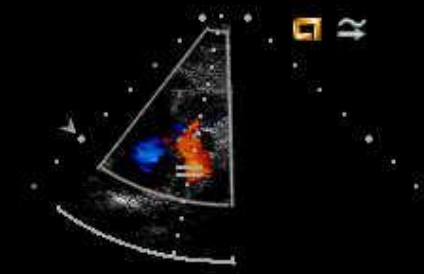
S1/-1/ 0/V:3  
1/2 CD:4.5MHz  
CD Gain = 39



Store in progress

4.5MHz

10V  
9.0M  
PED  
Gene

Stor  
Swe

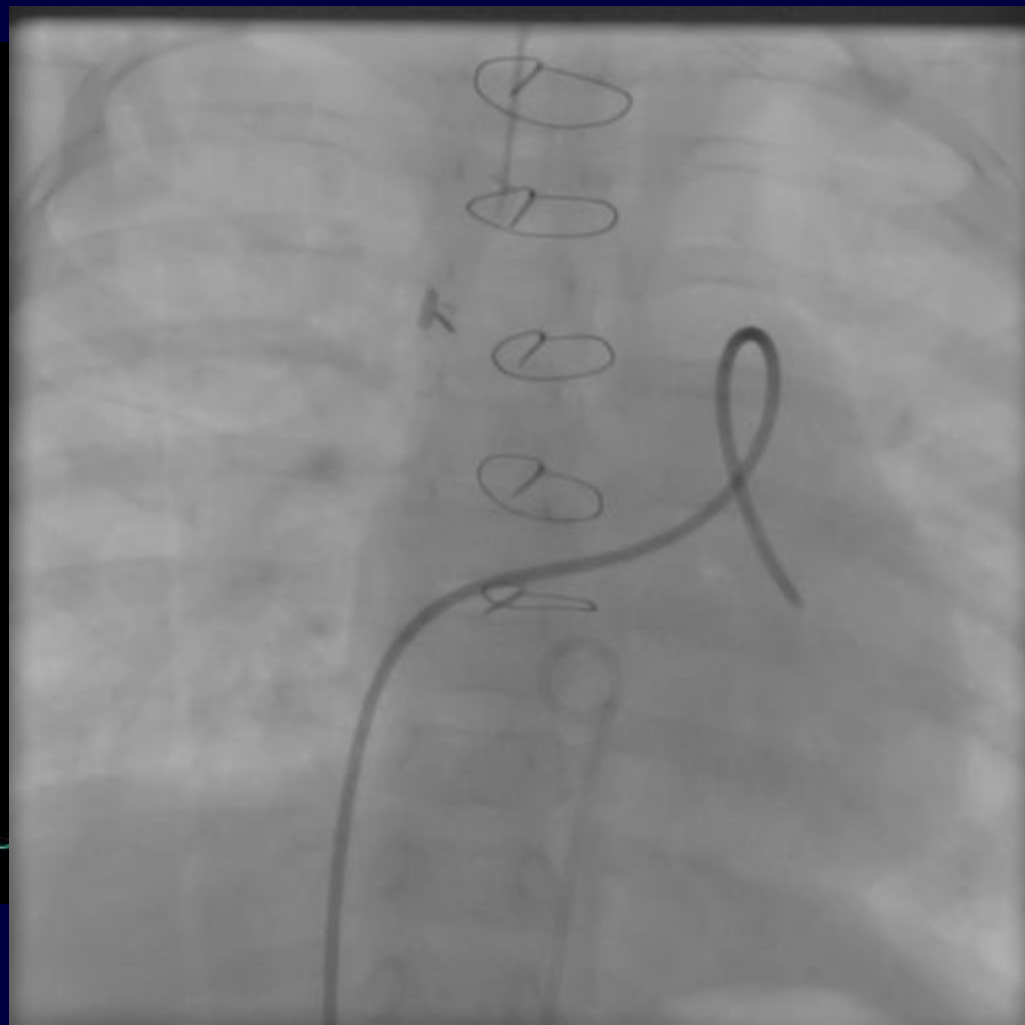
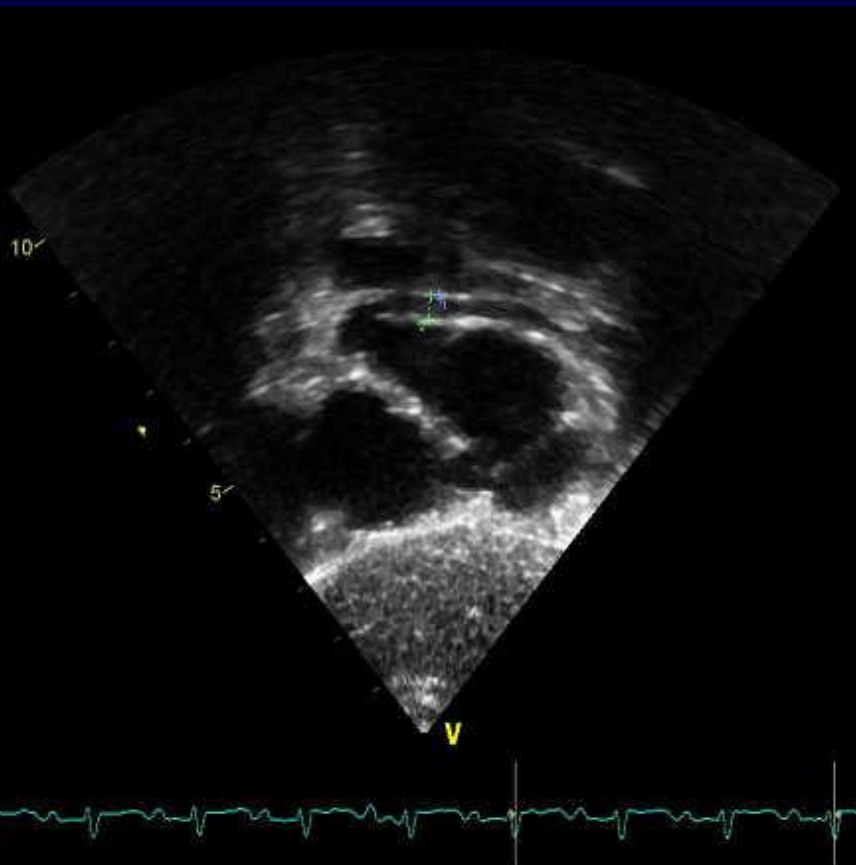


CD Pan  

CD Pos/Size



# TAPVR

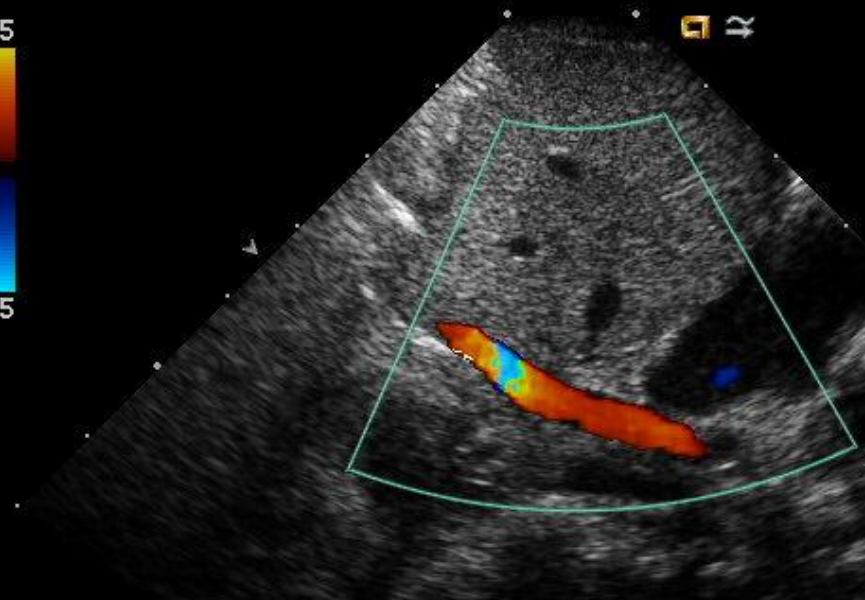


# Abnormal flow penetrating diaphragm

JUNG MI YOO: 23170496  
ST.MARY'S HOSPITAL

JUNG MI YOO: 23170496  
SEOUL ST.MARY'S HOSPITAL

01



5:  
10V4c-S  
8.0MHz  
PED ECHO  
General /  
T1/-1/ 0  
1/2  
CD Gain =

Store in pr

CD Pan

CD Pan

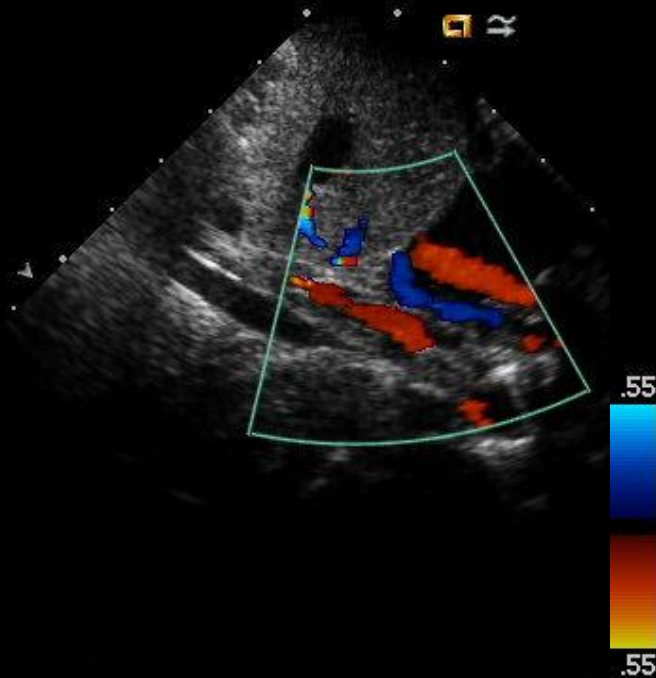
CD Pos

# Intracardiac TAPVR

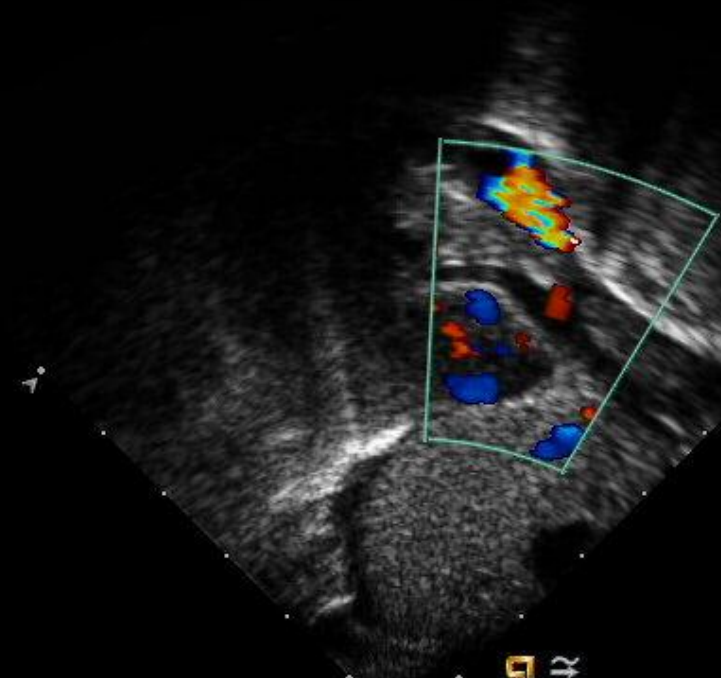
JUNG MI YOO: 23170496  
SEOUL ST.MARY'S HOSPITAL

JUNG MI YOO: 23170496  
SEOUL ST.MARY'S HOSPITAL

01  
5:20



CD Pan



CD Pan

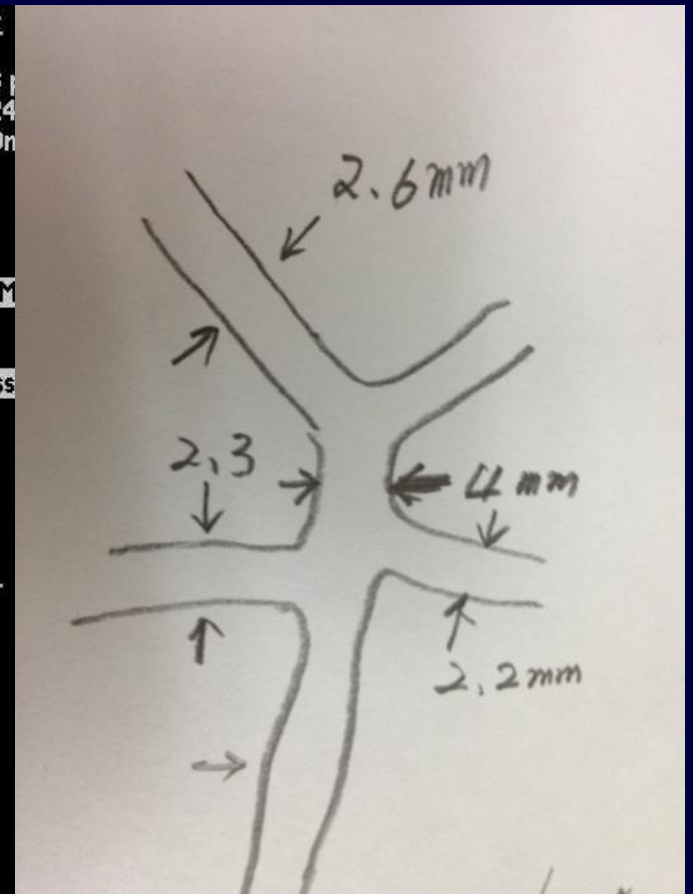
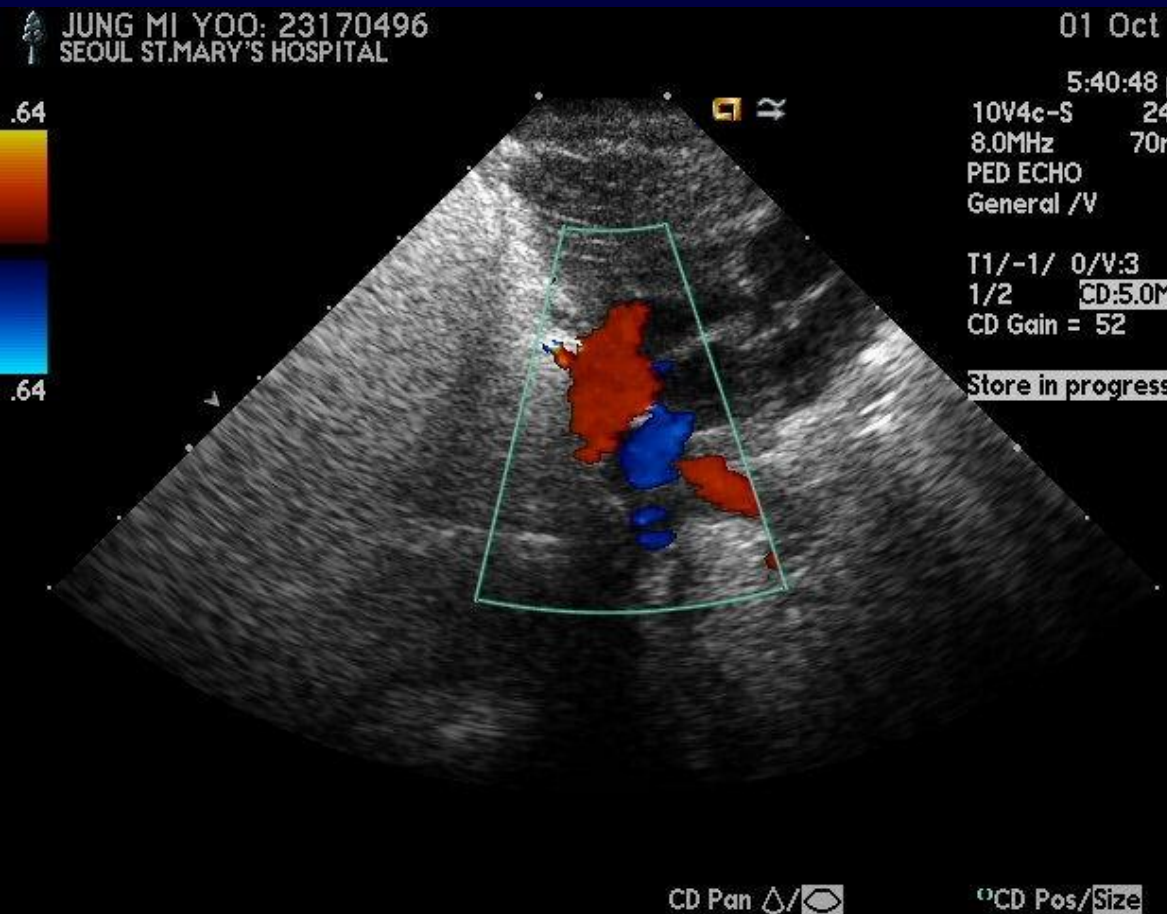
Store in pro

T1/-1/ 0/V  
1/2   
CD Gain = 5

10V4c-S  
7.0MHz  
PED ECHO  
General /V

CD Pos/SI

# Intracardiac TAPVR



# Intracardiac TAPVR

KIMJUNGOCKBABY: 24129544  
SEOUL ST.MARY'S HOSPITAL

KIMJUNGOCKBABY: 24129544  
SEOUL ST.MARY'S HOSPITAL

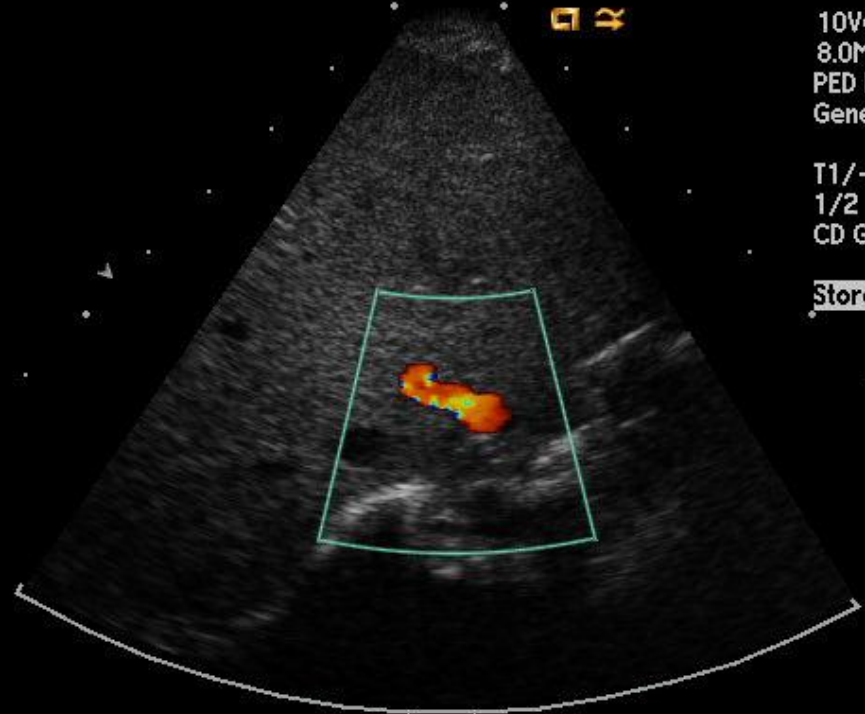
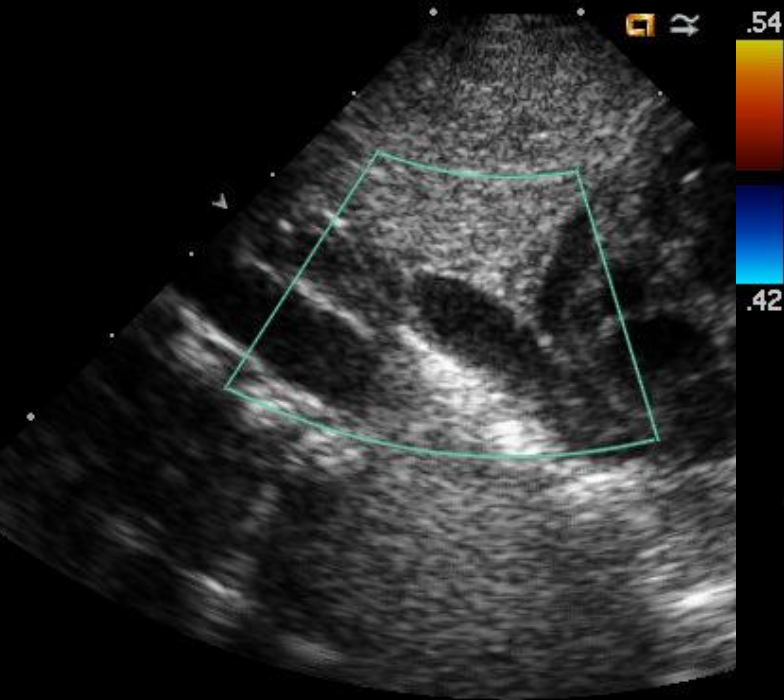
11 Jun 1

6:42:08 pm

10V4c-S 22H  
8.0MHz 80mm  
PED ECHO  
General /V

T1/-1/ 0/V:3  
1/2 CD:5.0MHz  
CD Gain = 47

Store in progress



CD Pan

2D Pos/Width

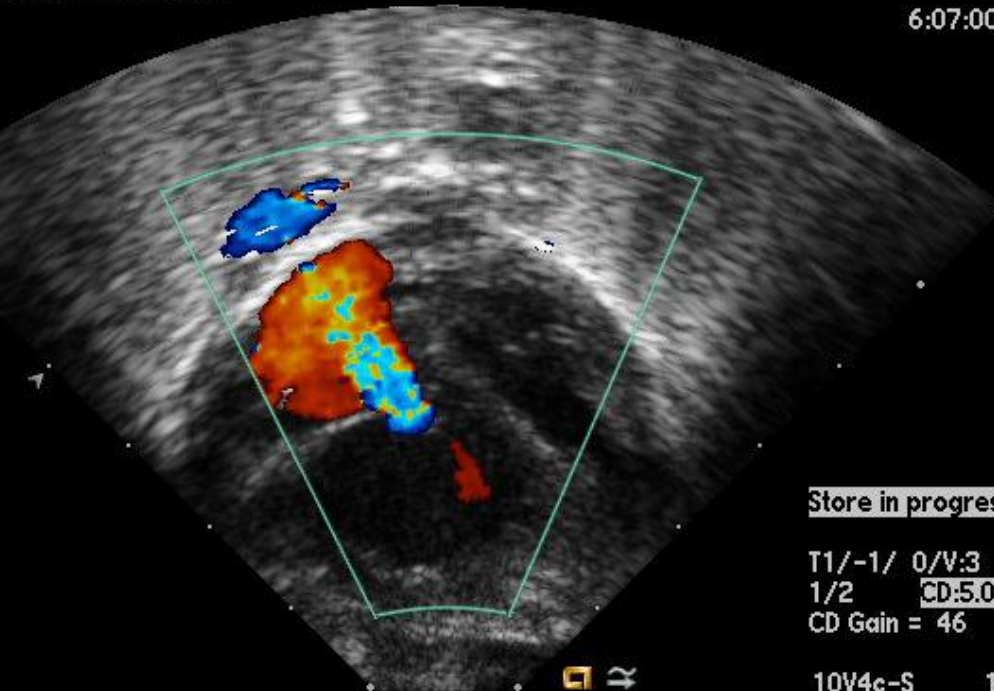
CD Pan

CD Pos/Size

# Intracardiac TAPVR

KIMJUNGOCKBABY: 24129544  
ST. MARY'S HOSPITAL

11 Jun 1 KIMJUNGOCKBABY: 24129544  
6:07:00 pm SEOL ST. MARY'S HOSPITAL



.64 45dB 3 - / 0/0/2  
CW Focus= 32mm  
CW Gain=-16dB

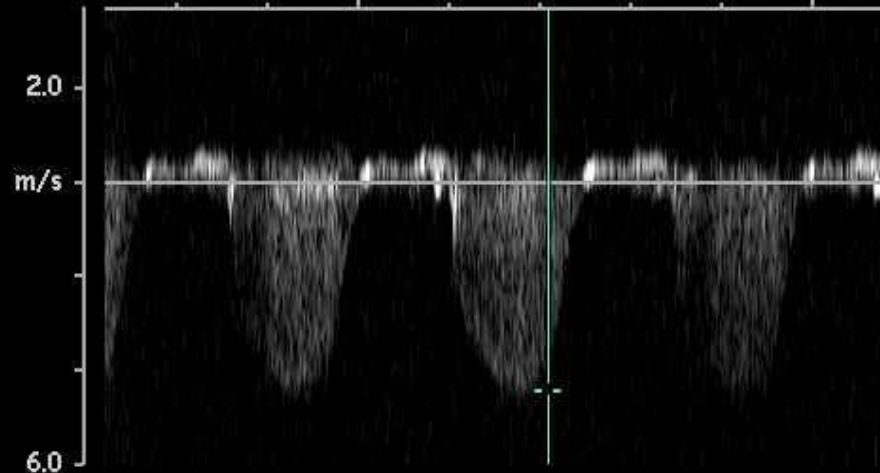
V = -4.41 m/s  
PG = 77.8 mmHg



CW:4.0MHz

Store in progress

T1/-1/ 0/V:3  
1/2 CD:5.0MHz  
CD Gain = 46

10V4c-S 19H:  
6.0MHz 60mm  
PED ECHO  
General /V



CD Pan  

CD Pos/Size

2D/CD/ Dop

Delete Set

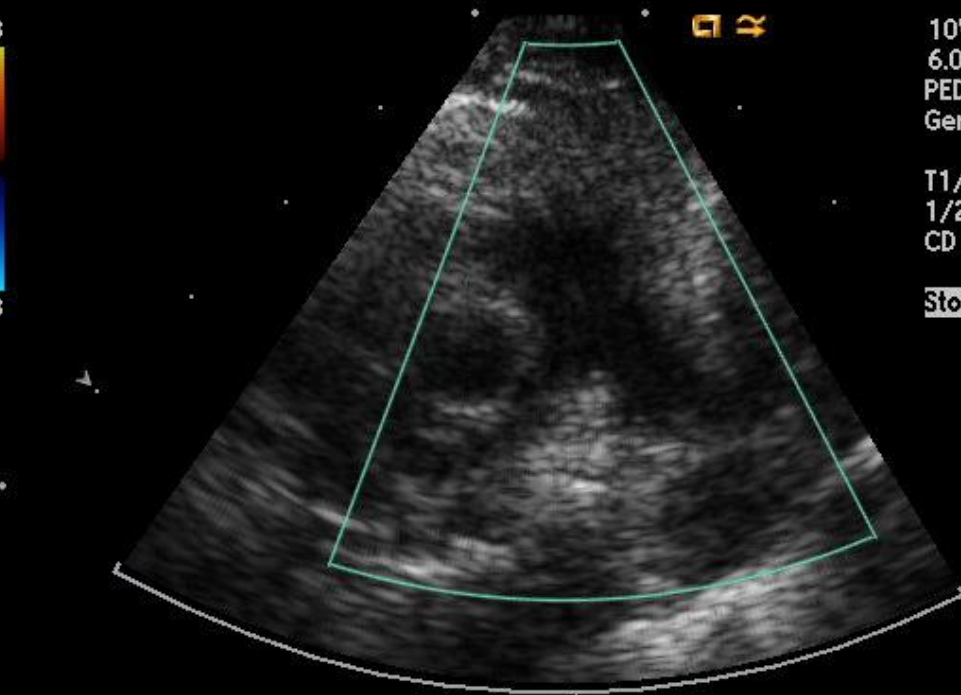
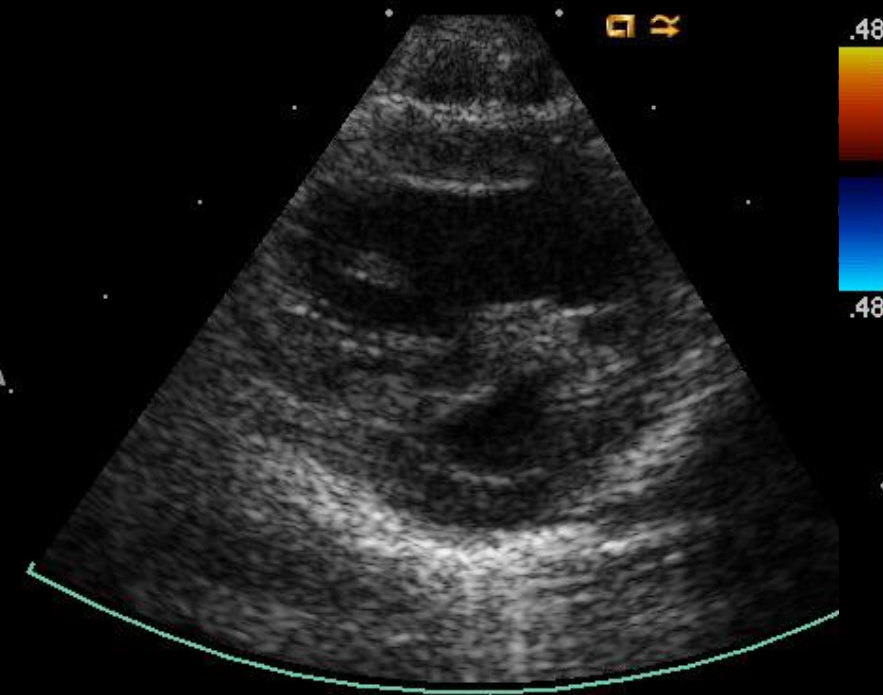
Lock Set

# Intracardiac TAPVR

UNGOCKBABY: 24129544  
ST.MARY'S HOSPITAL

KIMJUNGOCKBABY: 24129544  
SEOUL ST.MARY'S HOSPITAL

1  
6  
10V4c-S  
6.0MHz  
PED ECHO  
General /  
T1/-1/ C  
1/2  
CD Gain =  
Store in p



Pos/Width

2D Pos/Width

CD Pan

CD Pos

# Intracardiac TAPVR

DOB: 24129544  
HOSPITAL

0/0/2  
37mm  
2.5mm  
6dB



11 Jun 11

0/0/2

11:59:07 am h= 31mm

= 2.5mm

10V4c-S

7.0MHz

80mm = -16dB

PED ECHO

General

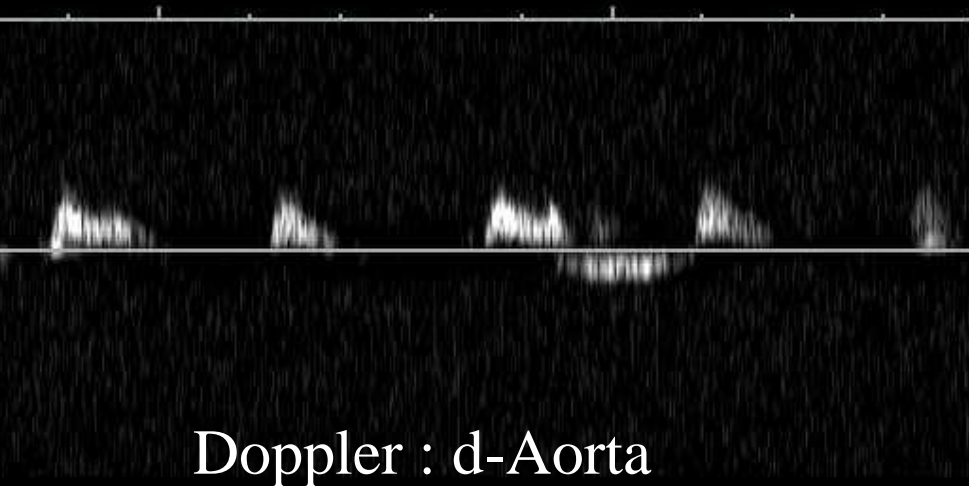
Store in progress  
Sweep=100mm/s

Hz

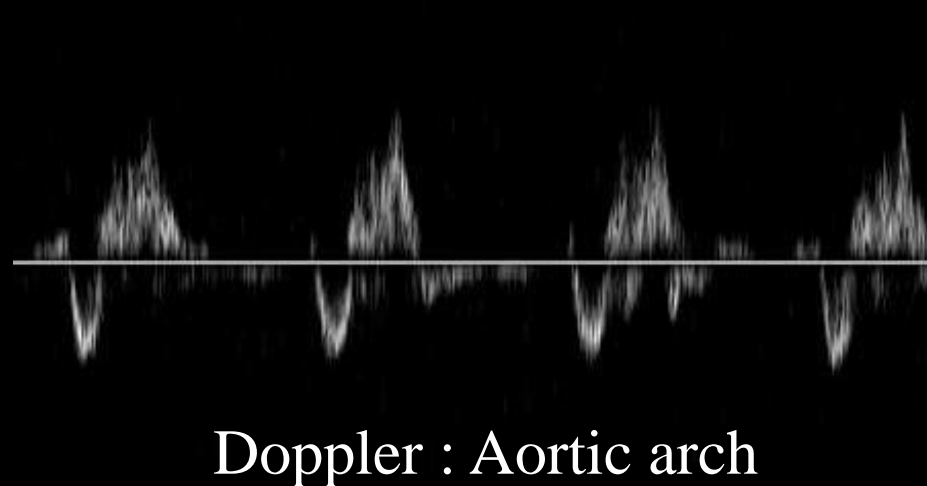


10V  
6.0  
PED  
Gen

Stor  
Swe



Doppler : d-Aorta



Doppler : Aortic arch



# Abnormal flow into IVC



유정진 선생님 제공

# Scimitar syndrome



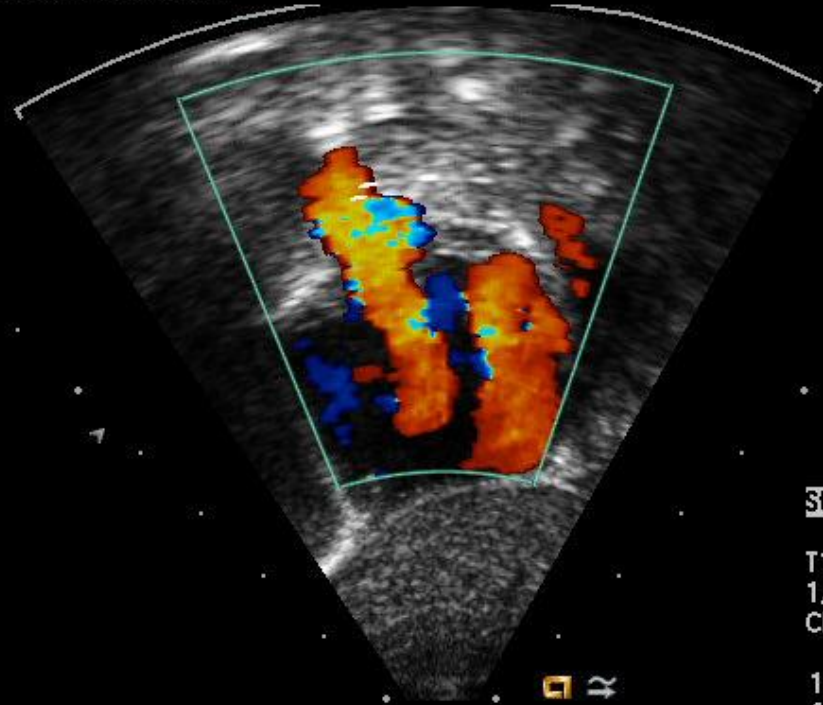
유정진 선생님 제공

# Cardiac TAPVR

amsuckbaby: 24087364  
L ST.MARY'S HOSPITAL

konamsuckbaby: 24087364  
SEOUL ST.MARY'S HOSPITAL

03 Jun 1  
6:58:57 pm




Store in progress

T1/-1/ 0/V:3  
1/2 CD:5.0MHz  
CD Gain = 45

10V4c-S 22H  
6.0MHz 80mm  
PED ECHO  
General /V

Pos/Width

2D Pos/Width

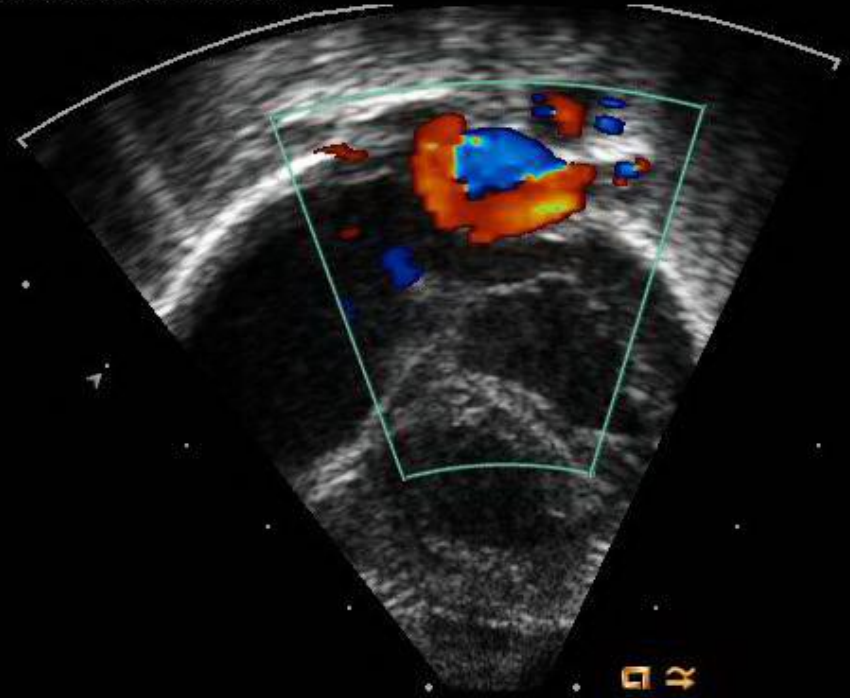
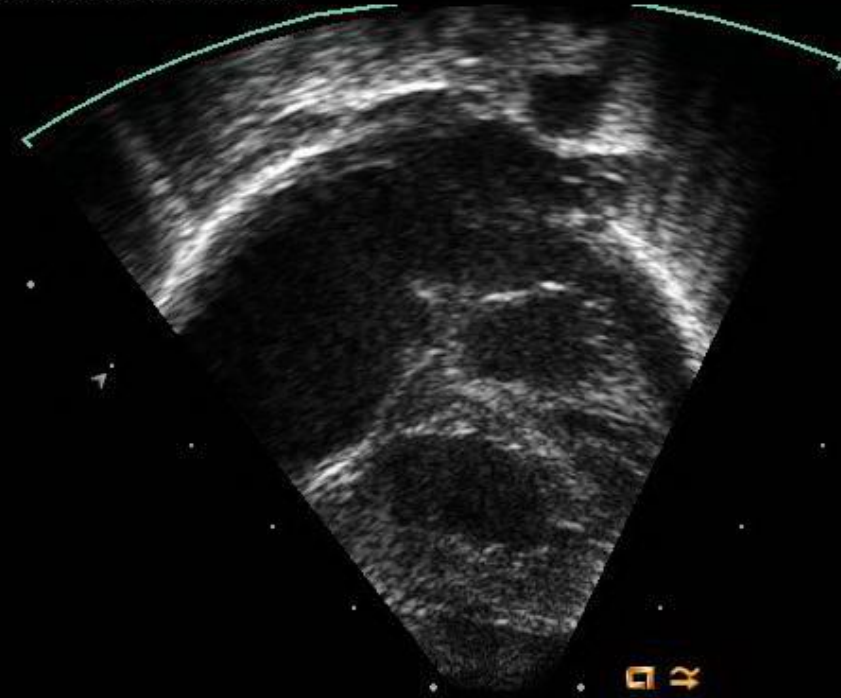
CD Pan  

CD Pos/Size

# Cardiac TAPVR

konamsuckbaby: 24087364  
SEOUL ST.MARY'S HOSPITAL

konamsuckbaby: 24087364  
SEOUL ST.MARY'S HOSPITAL





Store in

T1/-1/  
1/2  
CD Gain

10V4c  
7.0MHz  
PED EC  
Genero

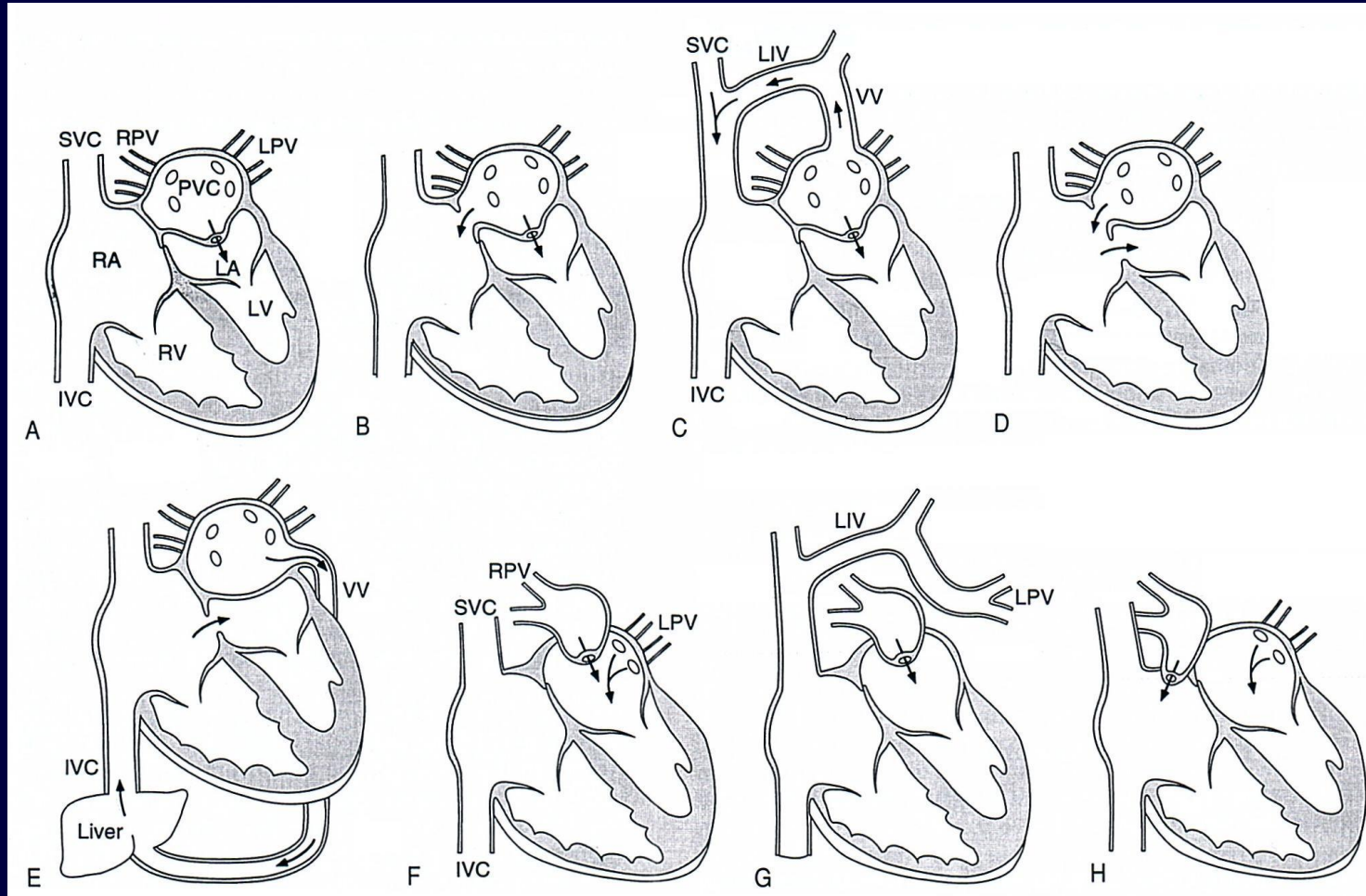
D Pos/Width

2D Pos/Width

CD Pan  

CD P

# Cor triatriatum sinister

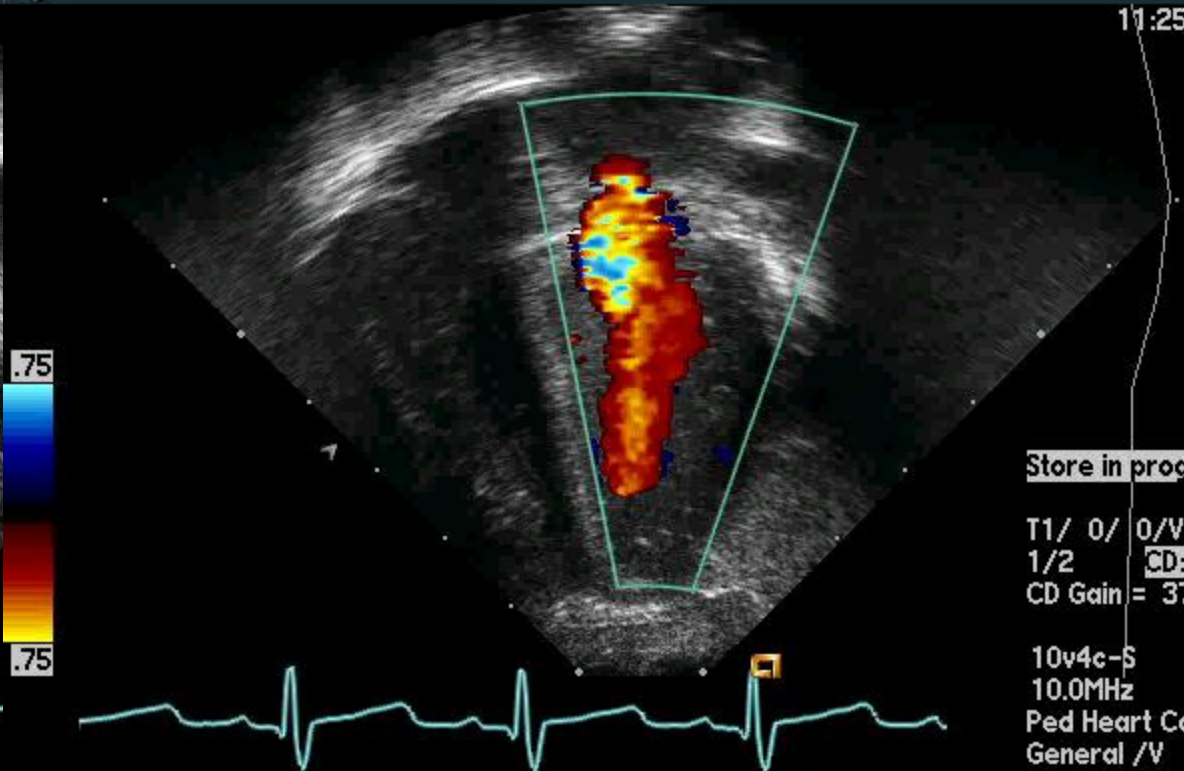


# Cor triatriatum sinister

AM BROWN: 2154481

12 N

11:25



Trigger detected - defaulting to 1 second capture(s)

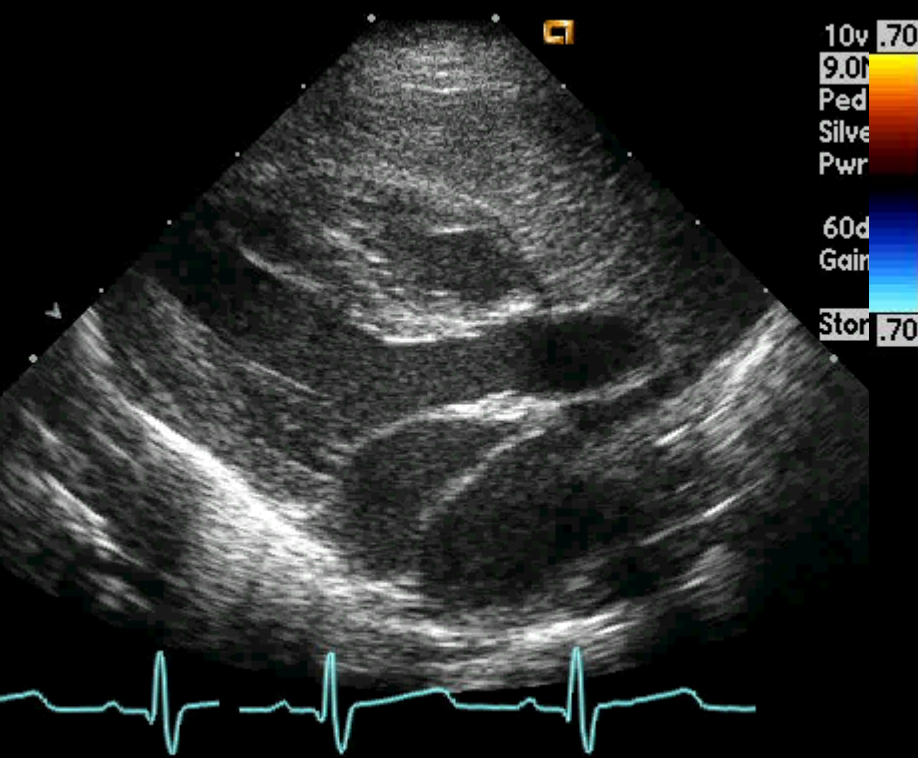
No trigger detected - defaulting to 1 second capture(s)

CD Pan

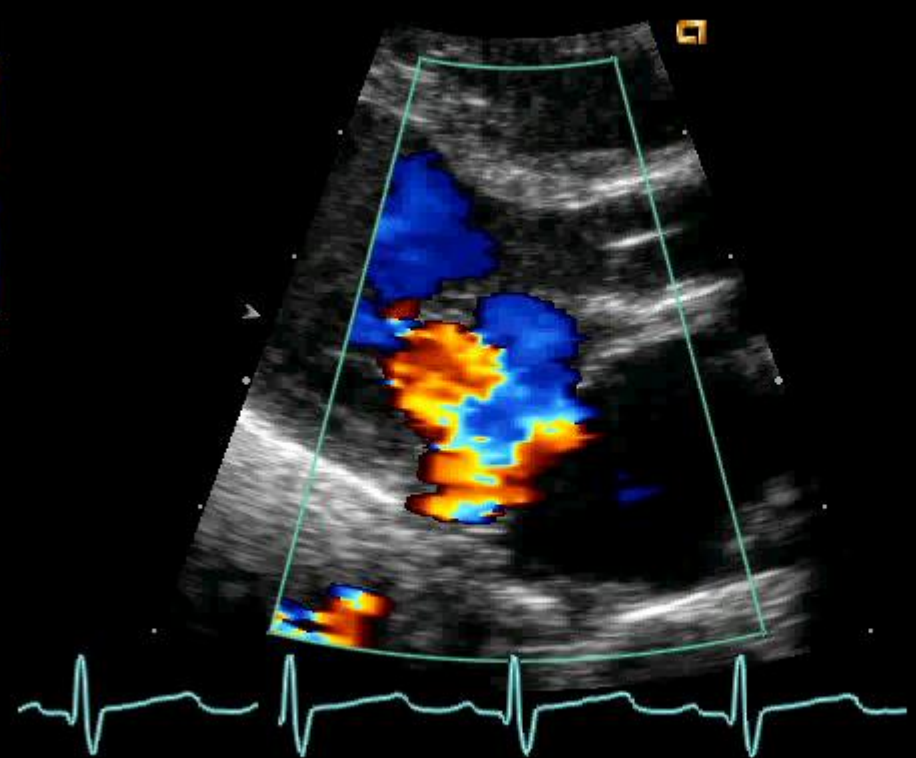
CD Pos/Siz

# Cor triatriatum sinister

LIAM BROWN: 2154481



ted - defaulting to 1 second capture(s)



No trigger detected - defaulting to 1 second capture(s)

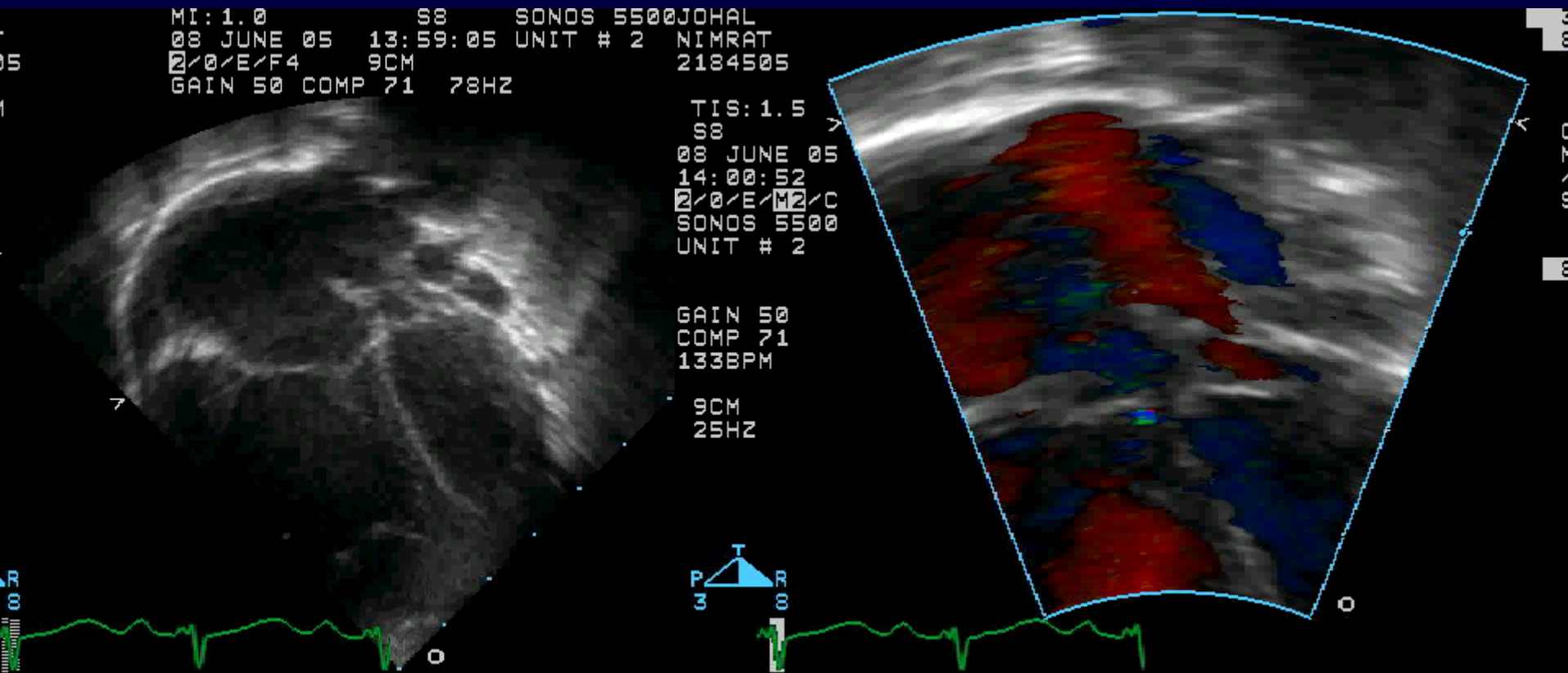
CD Map V1

M/VV

Modify

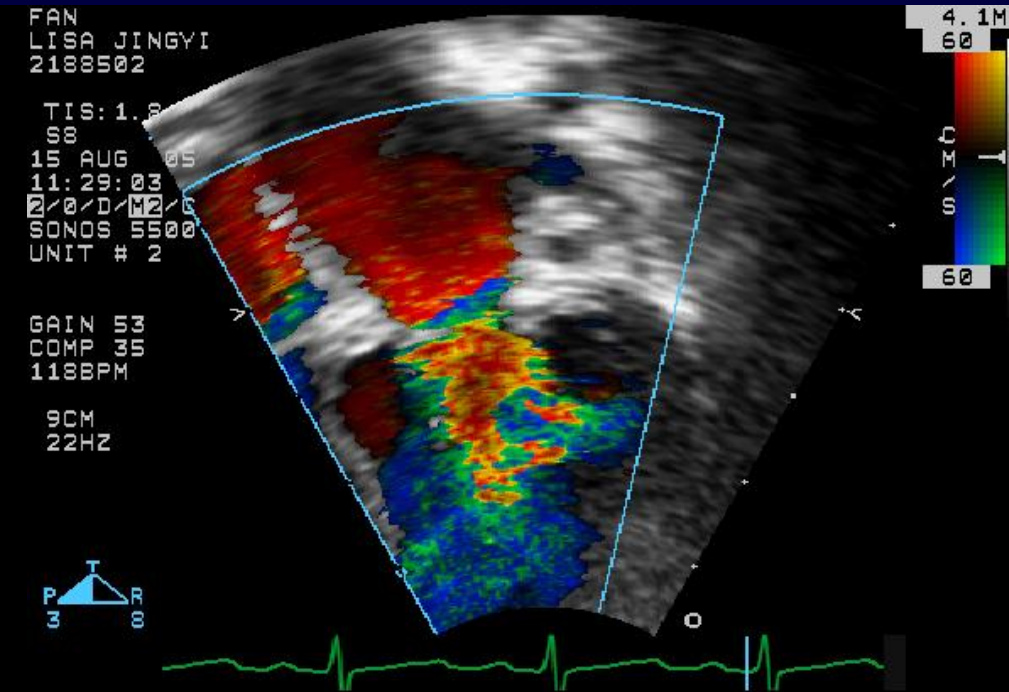
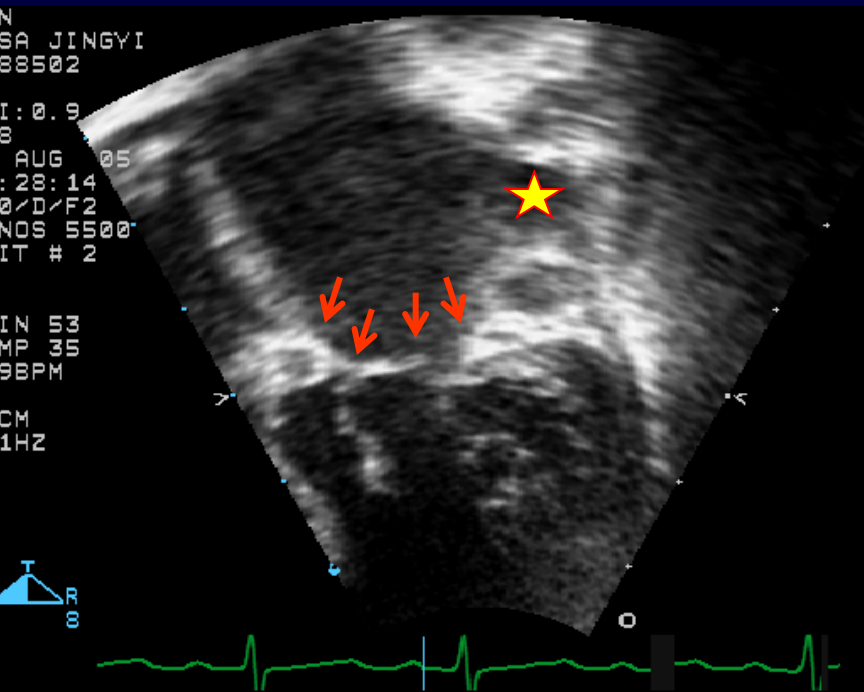
V

# Cor triatriatum sinister

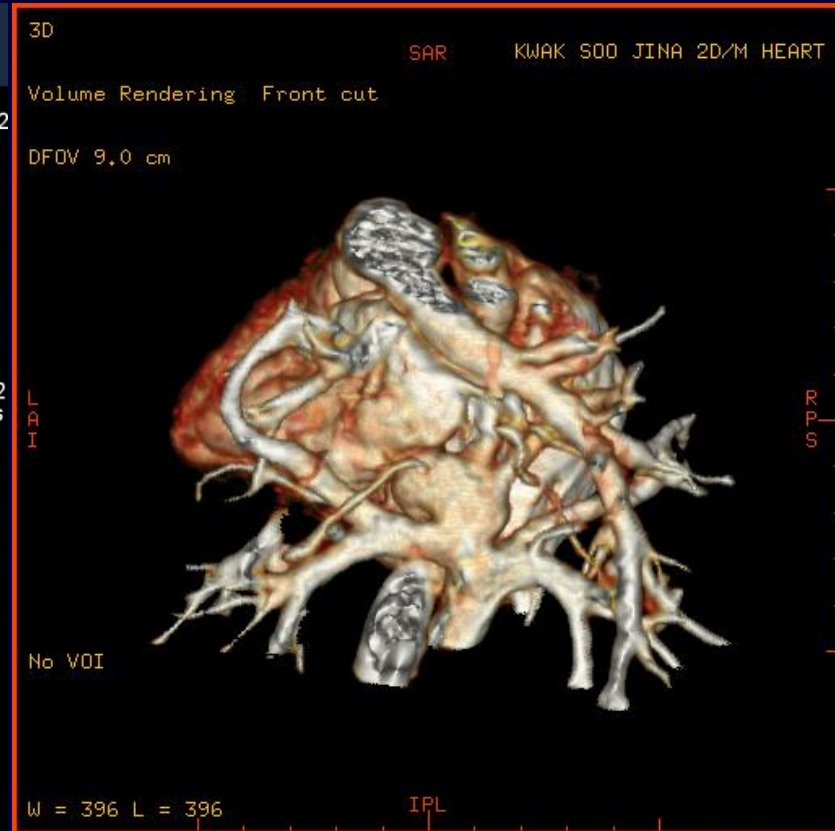
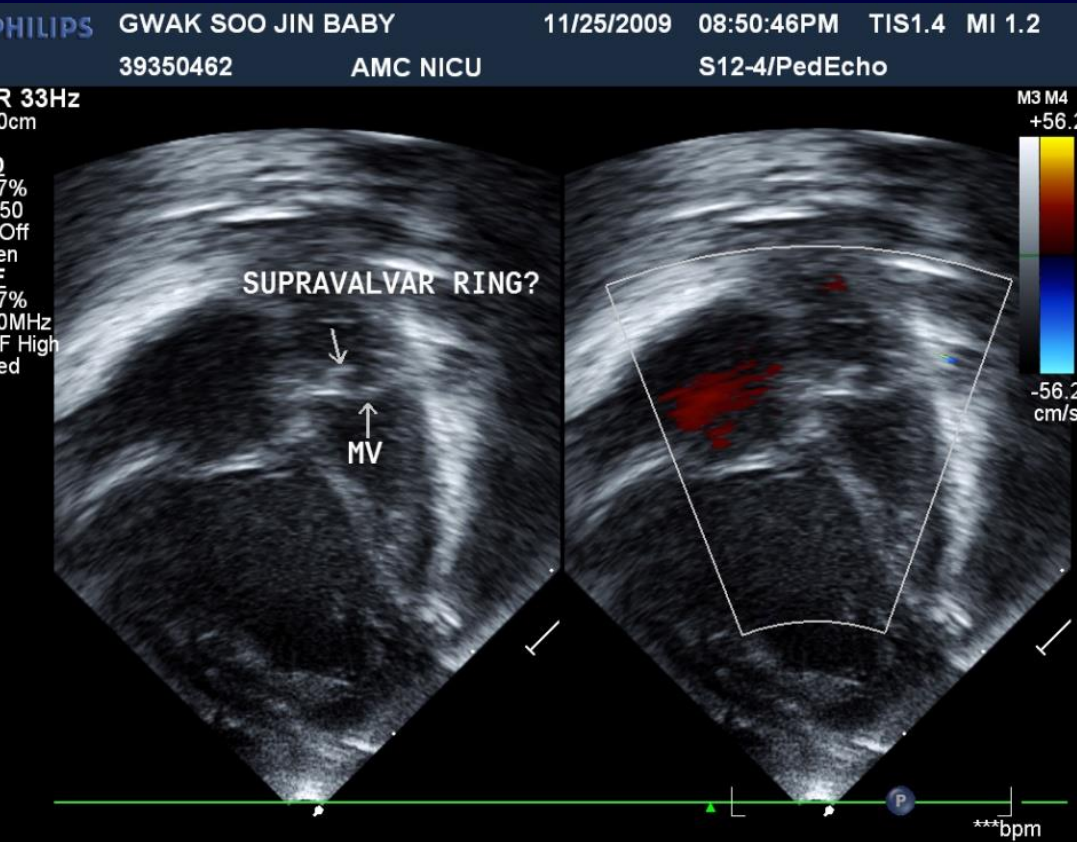




# Supramitral ring

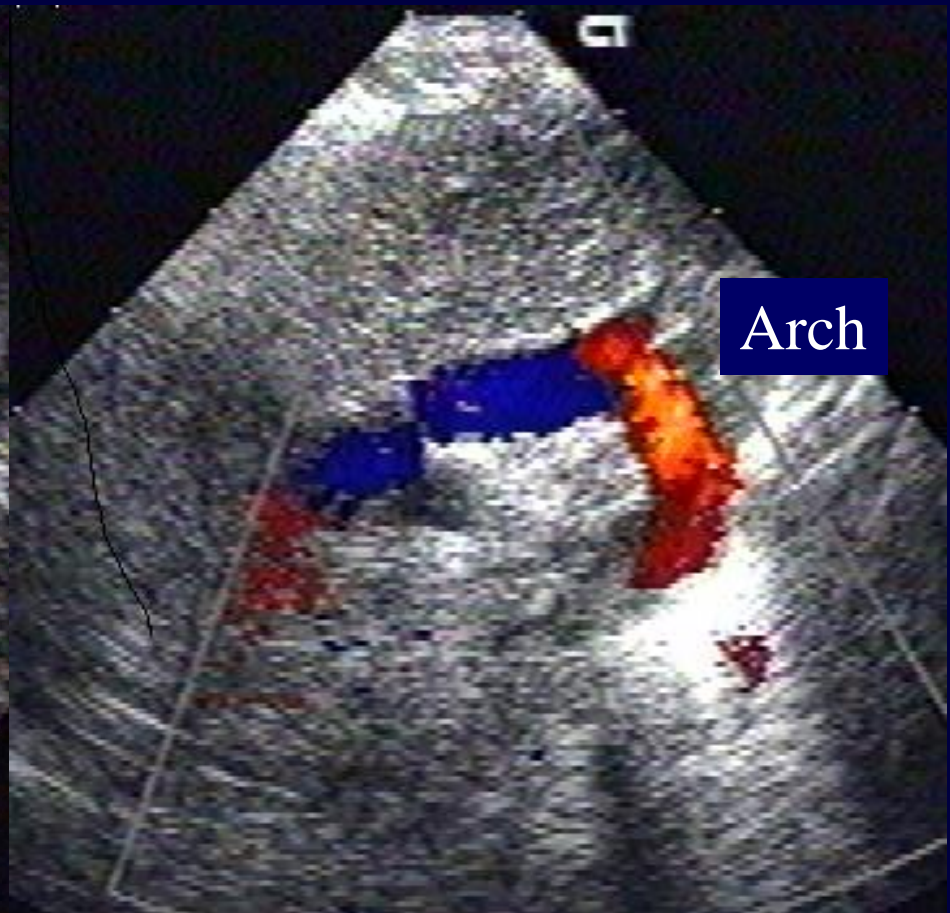
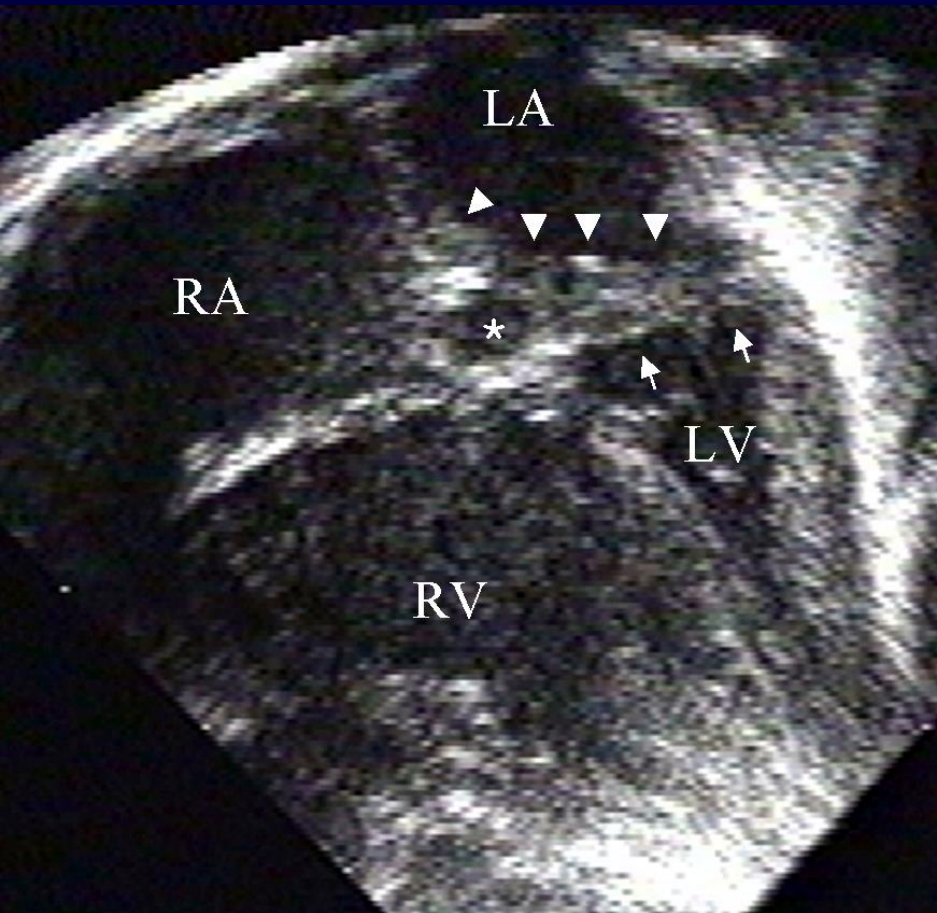


# HLHS? Supramitral ring?



유정진 선생님 제공

# Mitral atresia? HLHS?

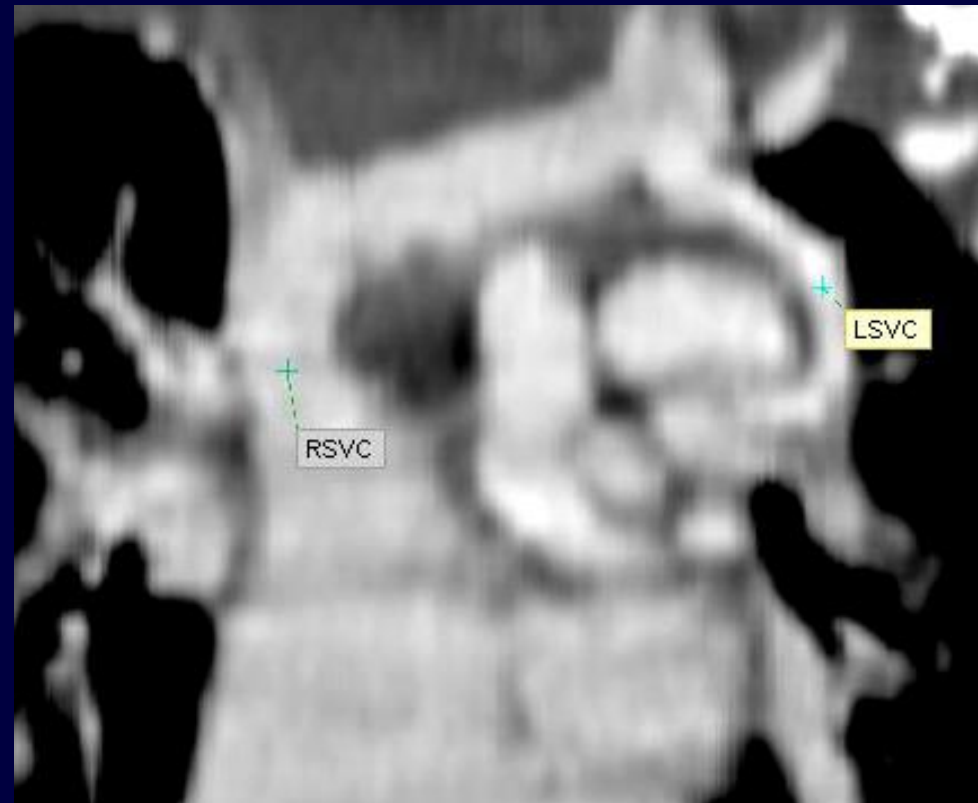
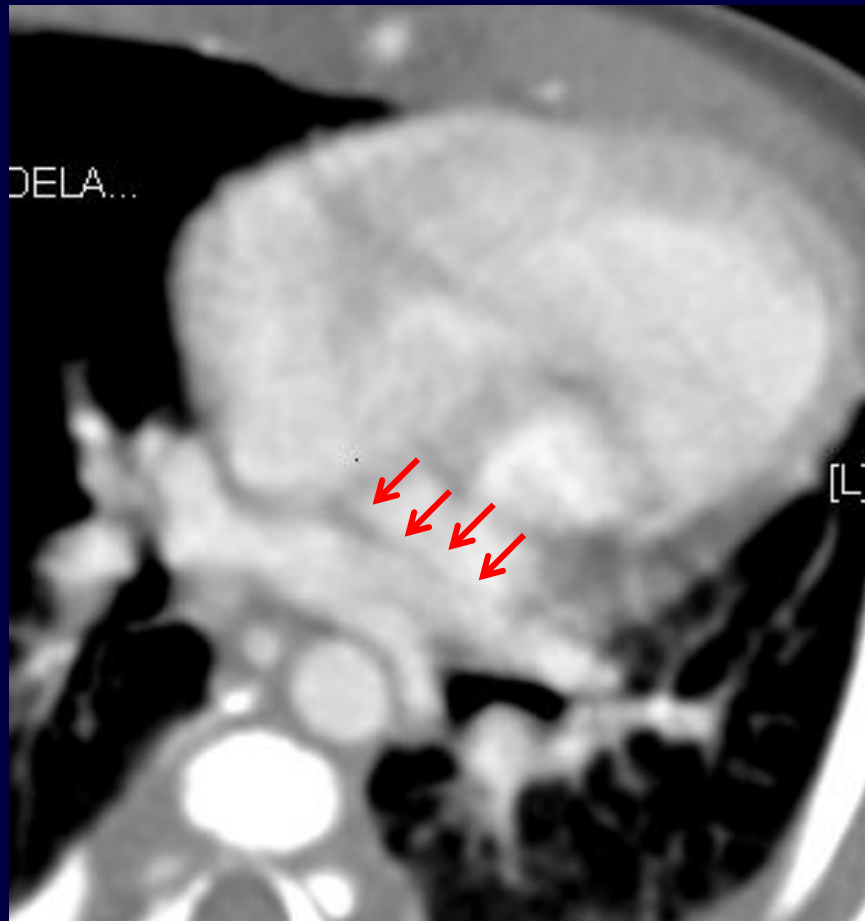


# Cor triatriatum with TAPVR & functional MA

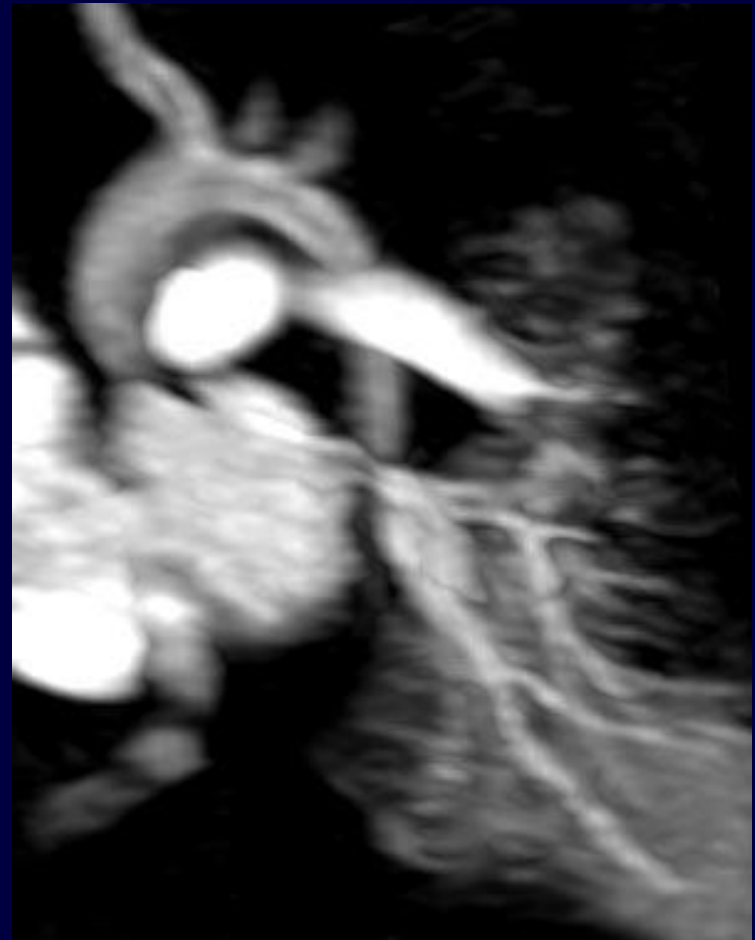
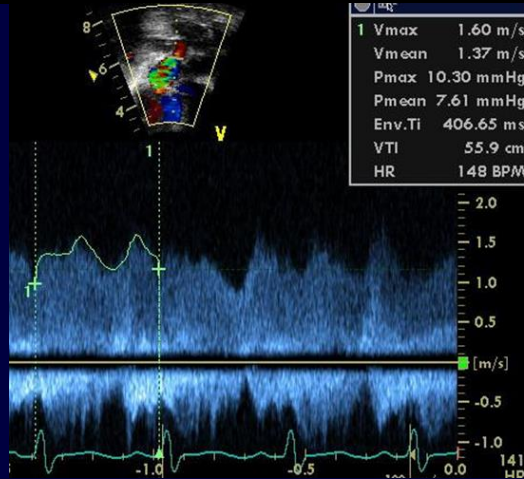
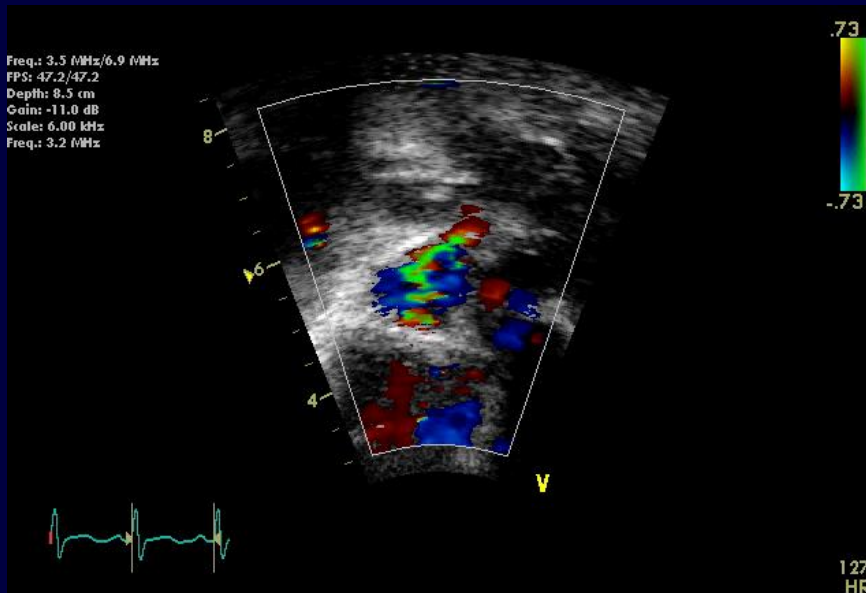


Vertical vein into HV with obstruction

# HLHS, Cor triatriatum with TAPVR



# Individual PV stenosis



# Diagnosis of pulmonary venous anomalies

- Clinical suspicion
  - Early diagnosis is essential
- Step-by-step anatomic approach
- Hemodynamic assessment



***Thank you!***