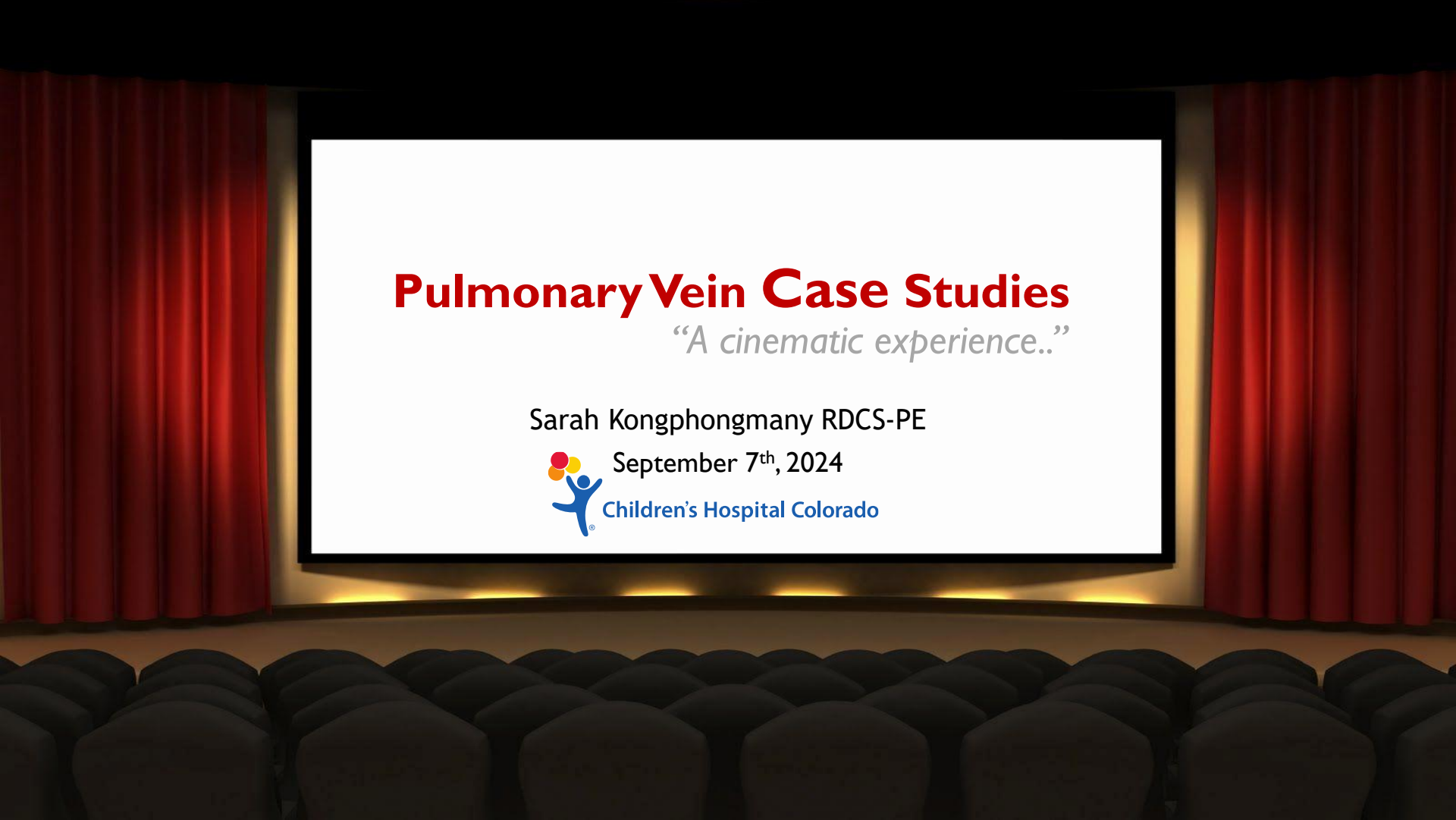
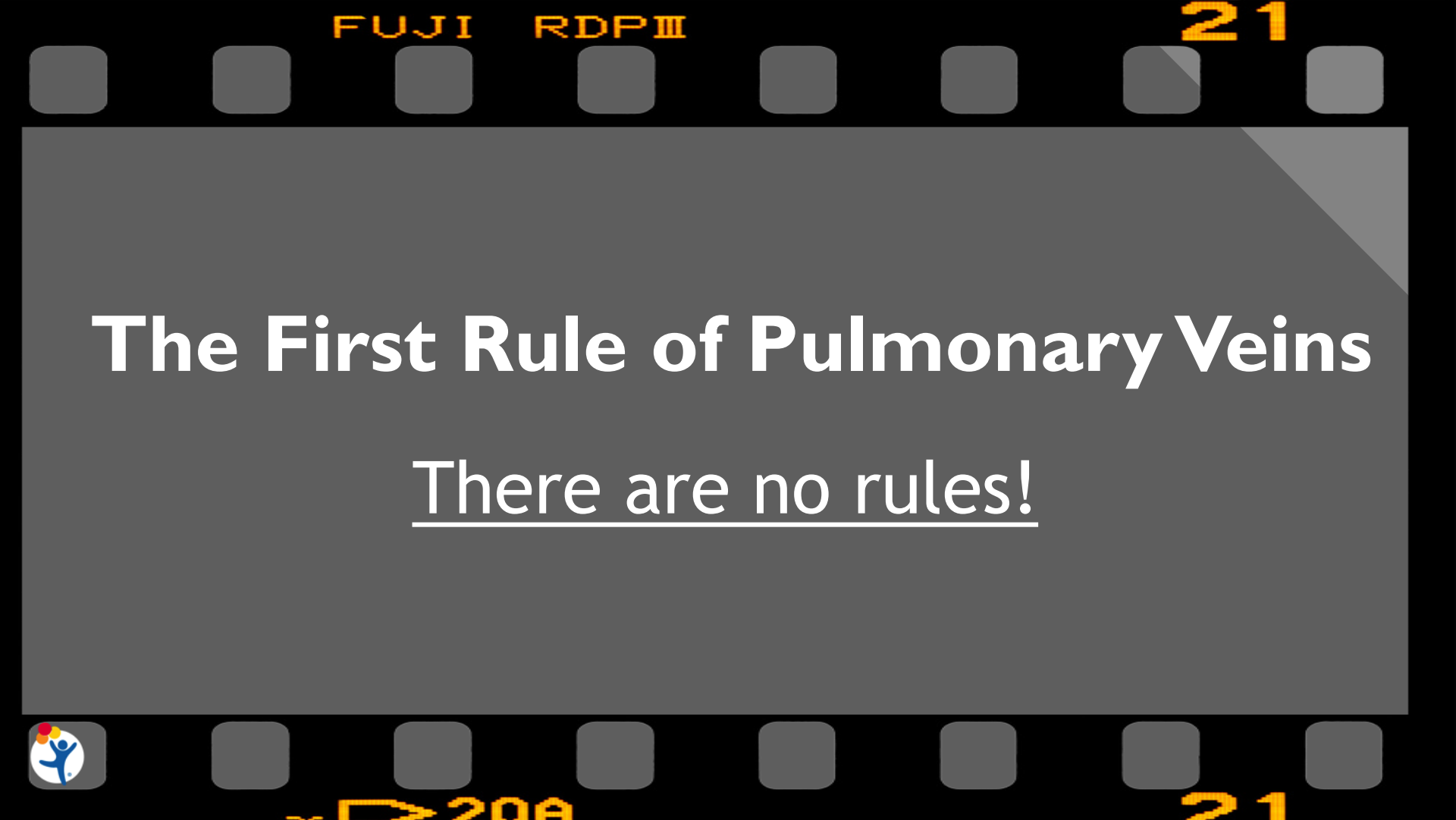

Pulmonary Vein Case Studies
"A cinematic experience.."
Sarah Kongphongmany RDCS-PE
September 7th, 2024
Children's Hospital Colorado

I have no disclosures.

Coming Soon…

- Rules of Pulmonary Veins
- The Usual Suspects
- Three Case Studies
- The Imposter


FUJI RDPⅢ
21
The First Rule of Pulmonary Veins
There are no rules!
20a
21

Line-up the Four Usual Suspects

1. Innominate vein
2. Right superior vena cava
3. Inferior vena cava
4. Coronary sinus

Interrogate them!

Case #1

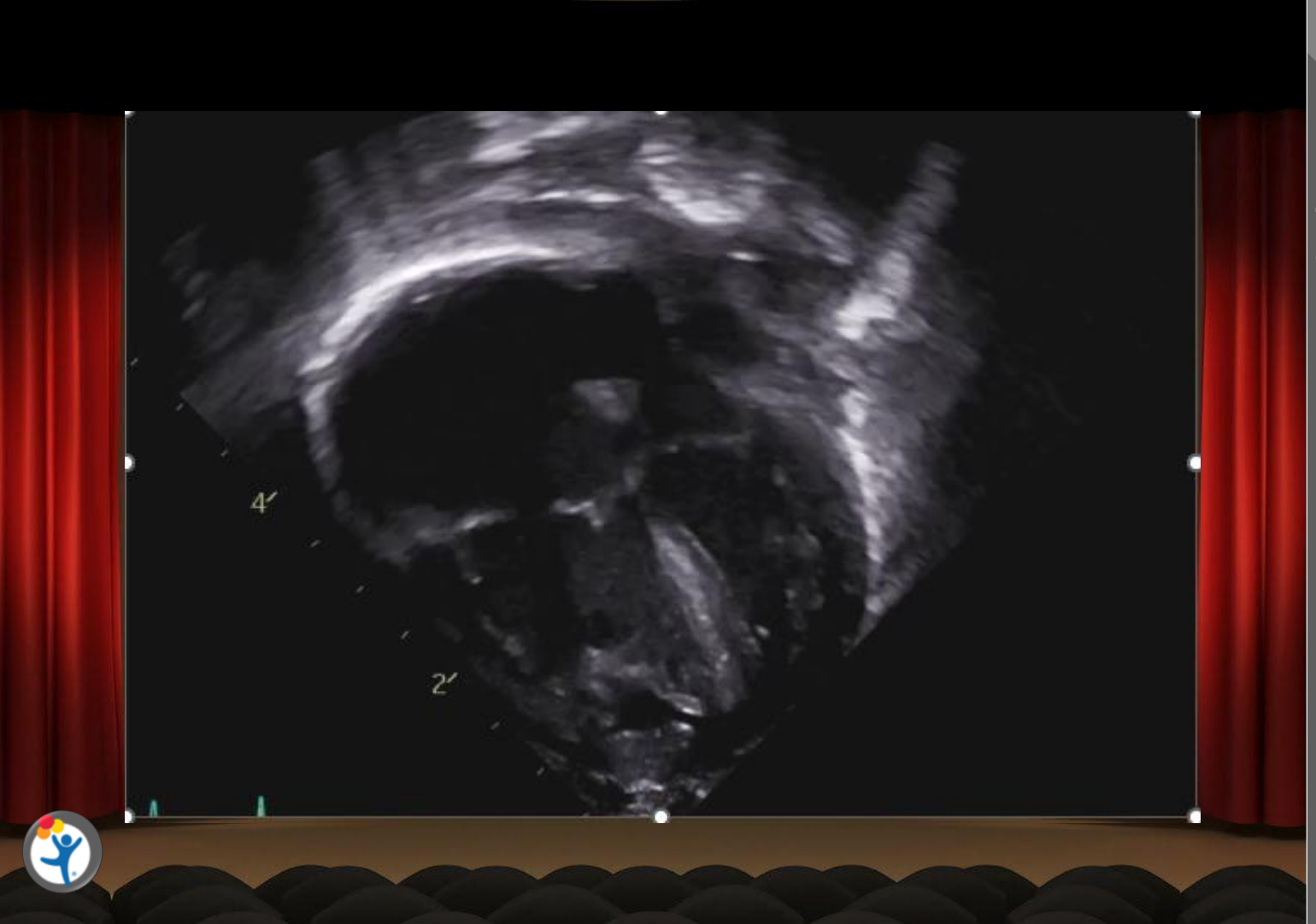
- Patient born via C-Section at 37 weeks gestation at outside hospital
- Respiratory distress, significant hypoxia, no murmur

Parasternal Long Axis

- Right ventricle looks dilated

- Tissue ridge in the left atrium

Apical Four Chamber



- Right heart is dilated

- What causes volume overload of the right heart?

Coronal Sweep

- Two possible shunts around the atrial septum

- If both were ASDs, they would shunt in the same direction

Posterior Coronal

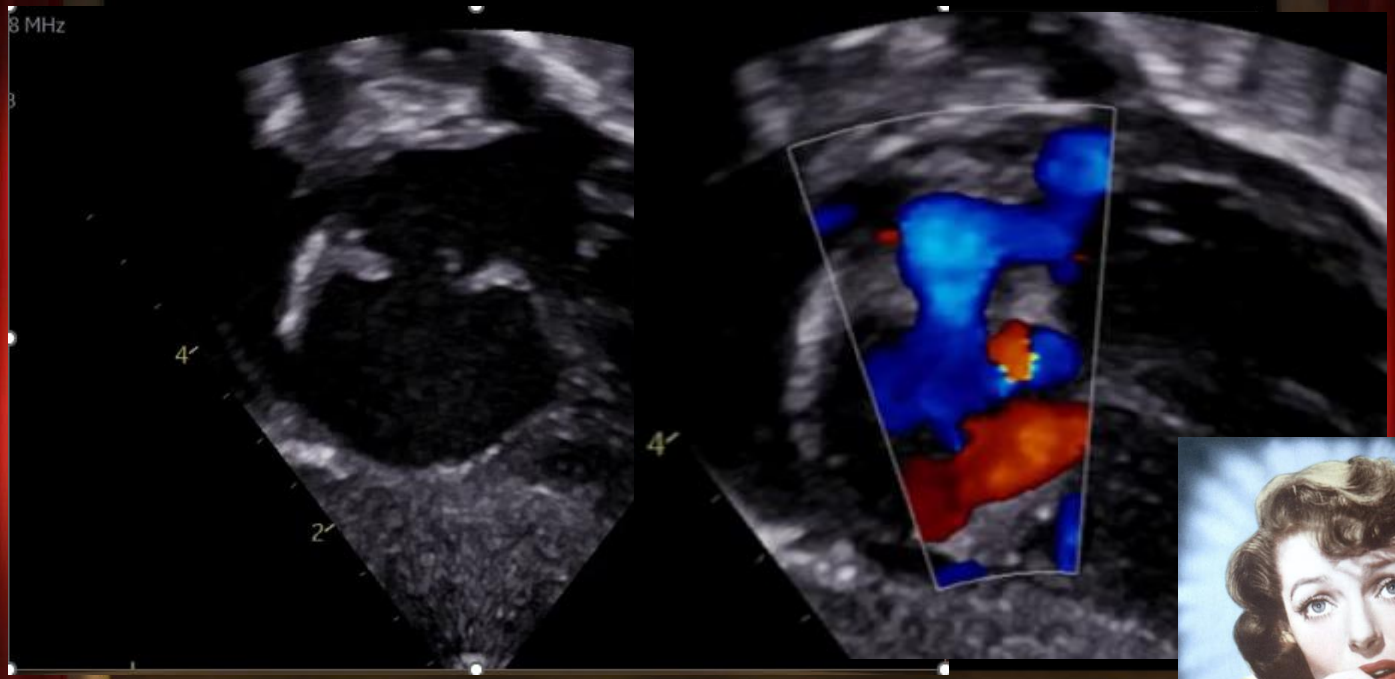
- This structure is very posterior

- Color Doppler shows left to right flow

Anterior Coronal

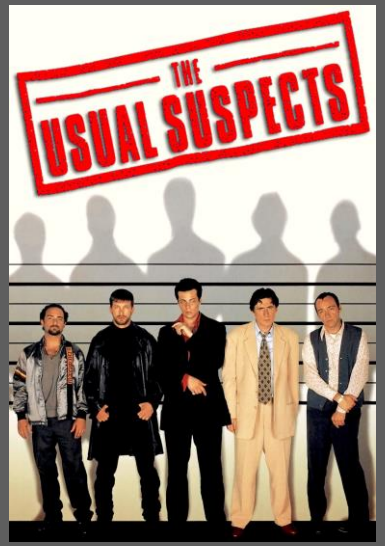
- Suspicious for an ASD because we can see both atria & AV valves

- Right to left flow in an ASD/PFO: Cause for Alarm!



Double Feature!

Right-to-left shunting in an ASD/PFO



Suprasternal Short Axis

- Looks like all four veins are headed the same direction

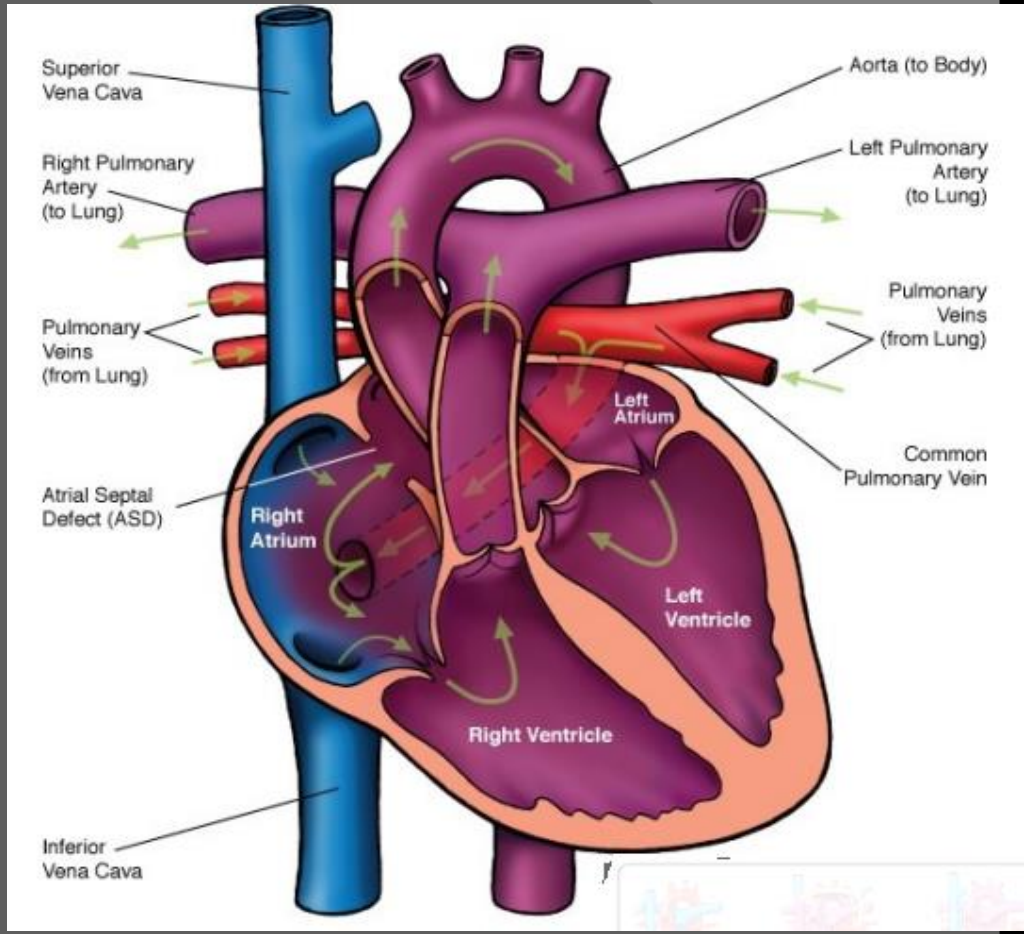
What's the diagnosis?

Total anomalous pulmonary venous return to the coronary sinus

Is it critical?

Yes, if the atrial shunt is restrictive

Don't be fooled by left to right shunting from the coronary sinus!



Whale's Tail

Case #2

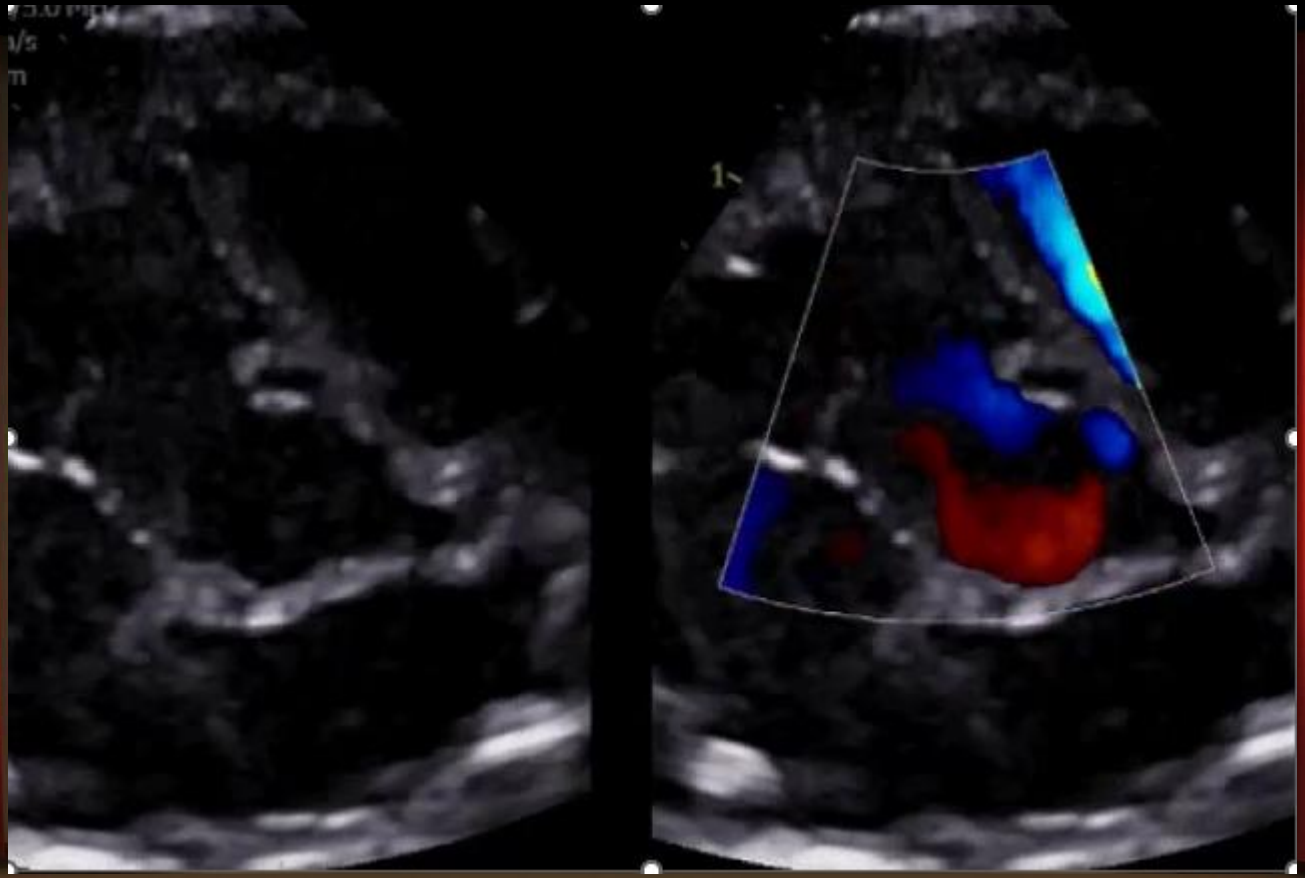
- Patient born via C-Section at 33 weeks gestation
- Cyanotic with severely increased work of breathing
- Prenatal dx of large VSD and possible BAV

Parasternal Long Axis

- Looks like there could be a VSD

- Right ventricle looks big

- Left ventricle looks underfilled



Targeted for VSD

- Prenatal diagnosis was right so far!

- VSD shunting is bidirectional

En Face Aortic Valve

- Not a bicuspid valve

- Case closed?

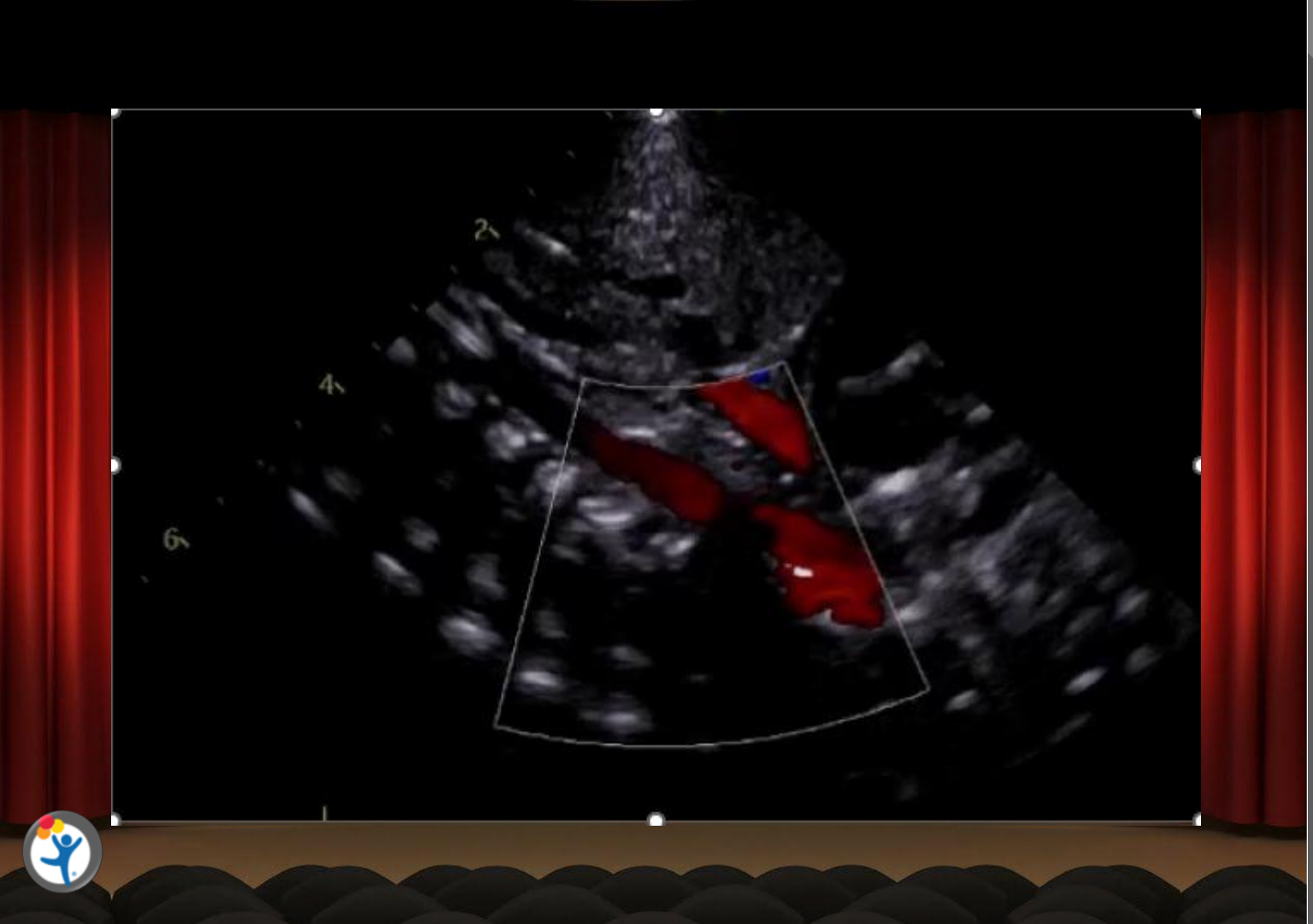
Apical Four Chamber

- The right atrium looks abnormal, it is bowing into the left atrium

Subcostal Coronal

- The atrial septum is bowing right to left

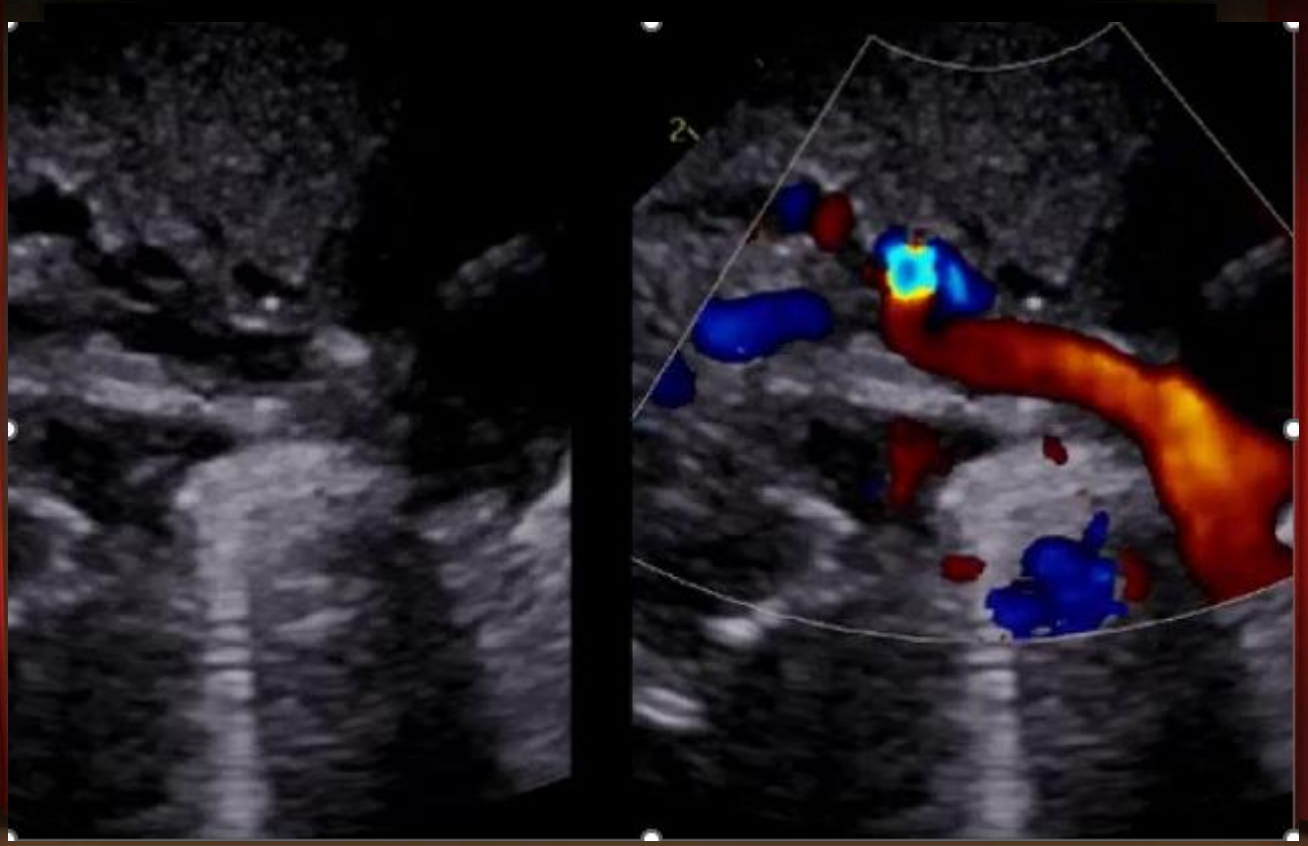
- The shunting is right to left: Cause for Alarm!



Subcostal Aorta & IVC

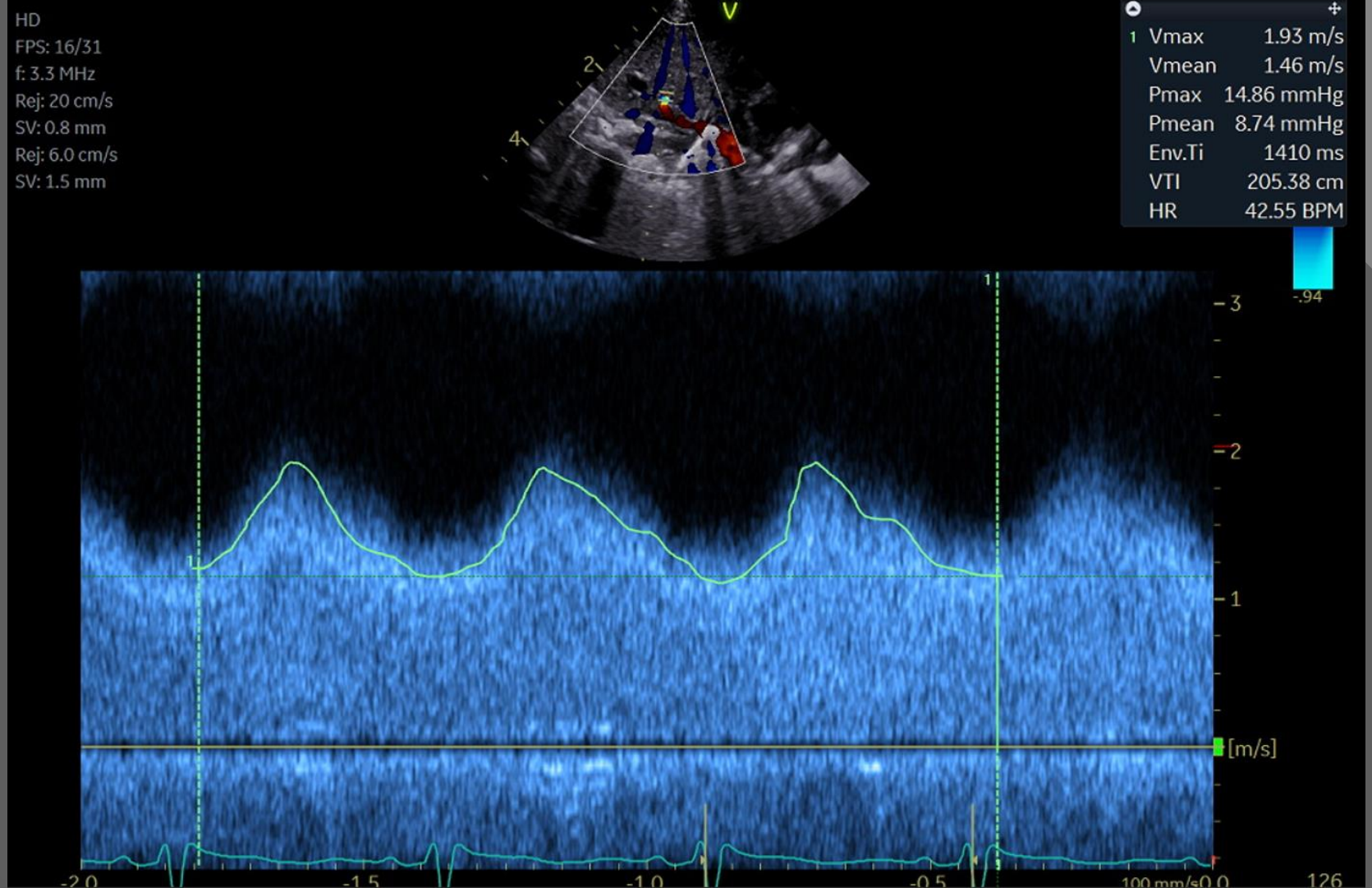
- Strange red flow near the abdominal aorta
- Even if I don't know what it is, I should investigate it

Subcostal IVC Sweep



- There is a continuous phasic structure running between the aorta and IVC

- It is connecting to something in the liver with turbulent flow


HD
FPS: 16/31
f: 3.3 MHz
Rej: 20 cm/s
SV: 0.8 mm
Rej: 6.0 cm/s
SV: 1.5 mm
V
2
4
1 Vmax 1.93 m/s
Vmean 1.46 m/s
Pmax 14.86 mmHg
Pmean 8.74 mmHg
Env.Ti 1410 ms
VTI 205.38 cm
HR 42.55 BPM
-.94
3
2
1
[m/s]
-2.0
-1.5
-1.0
-0.5
100 mm/s
0.0
126

Suprasternal Short Axis

- Multiple veins are coming together and diving downwards

- That right upper vein is not convincing

- Sweep the Crab!

Interrogate the Suspects

- There is a red flow seen connecting to the right SVC

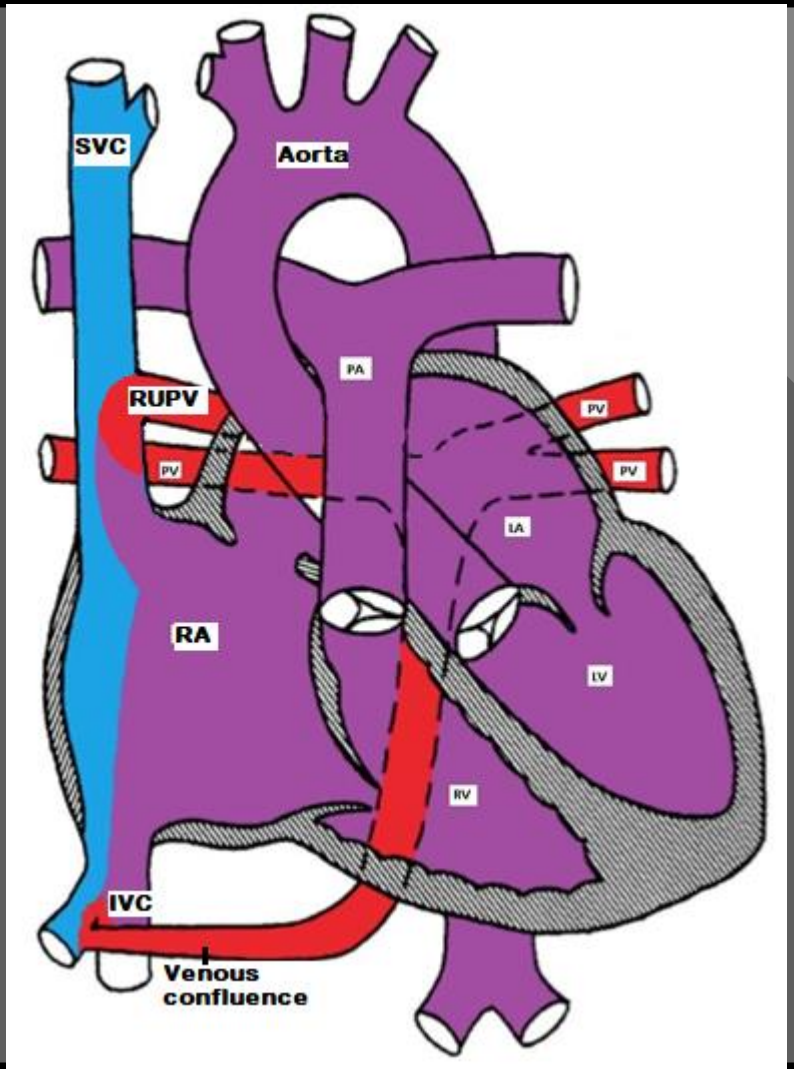
What's the diagnosis?

Mixed total anomalous pulmonary venous return

Is it critical?

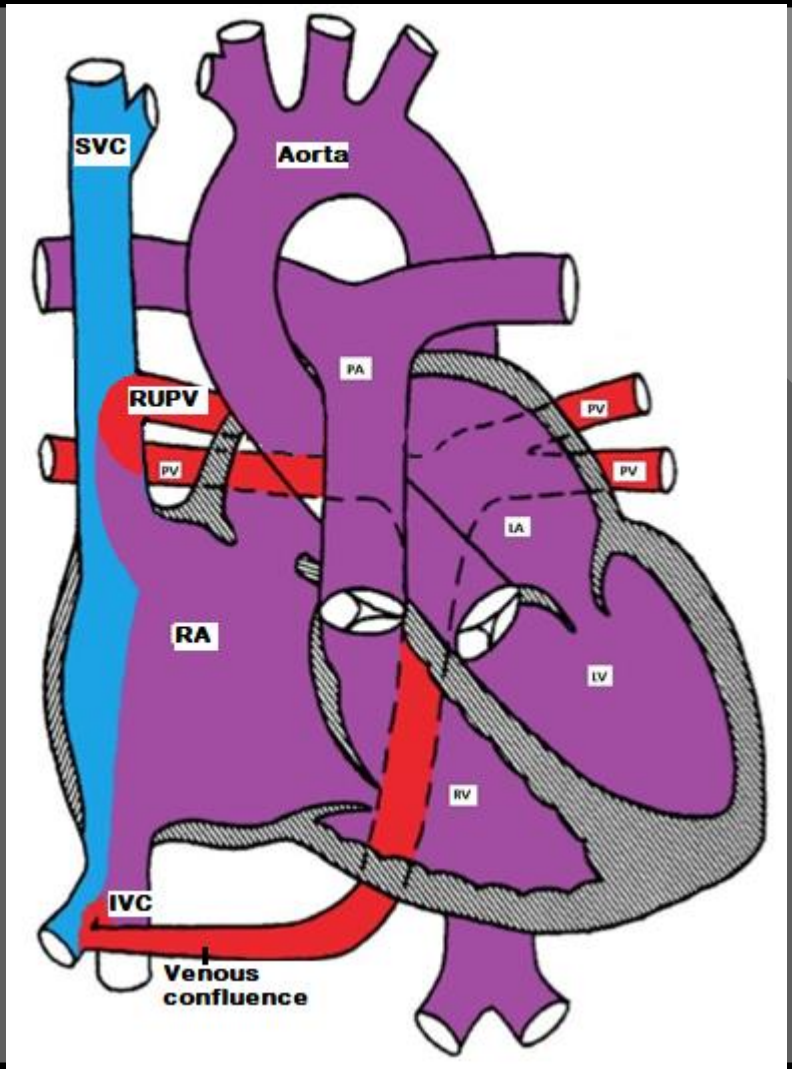
Yes! Infracardiac anomalous veins are the most common to be obstructed. Medicine won't save them!

When in doubt sweep the crab!

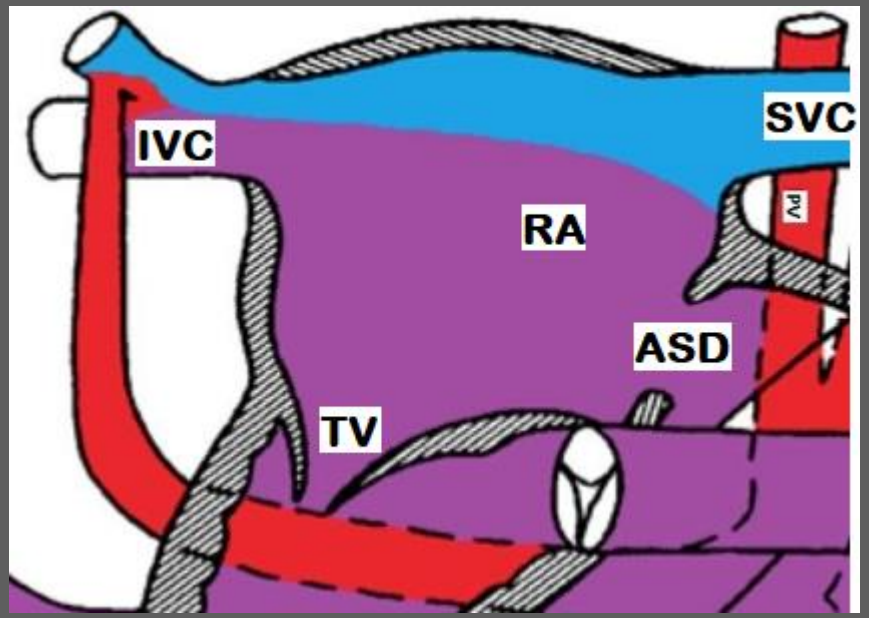


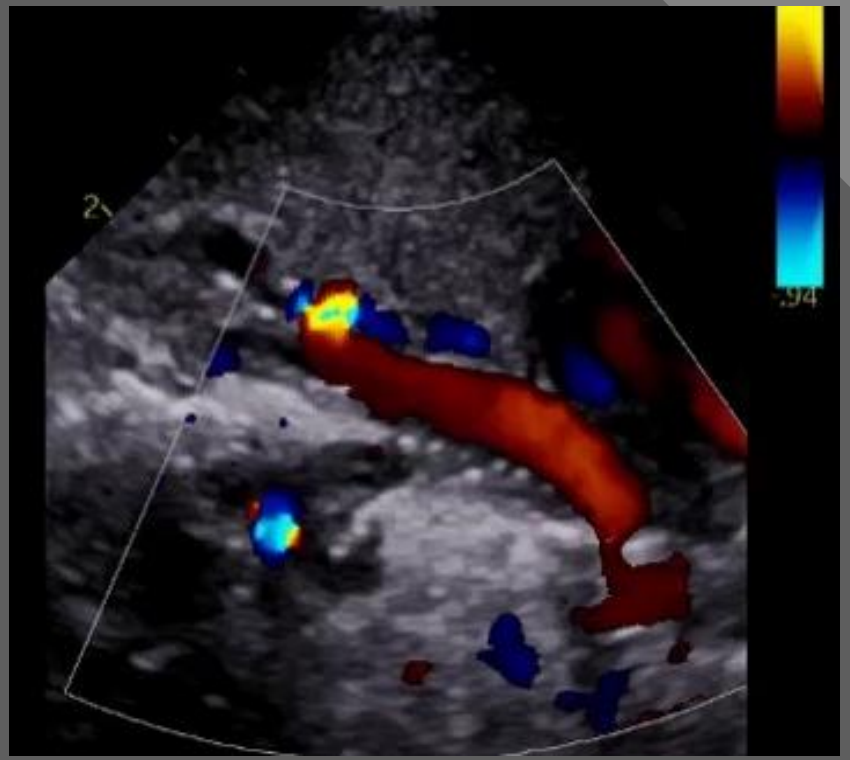
What are the connections?

- The left upper, left lower, right middle, and right lower pulmonary veins form a confluence and join the ductus venosus
- The right upper vein drains in the right superior vena cava

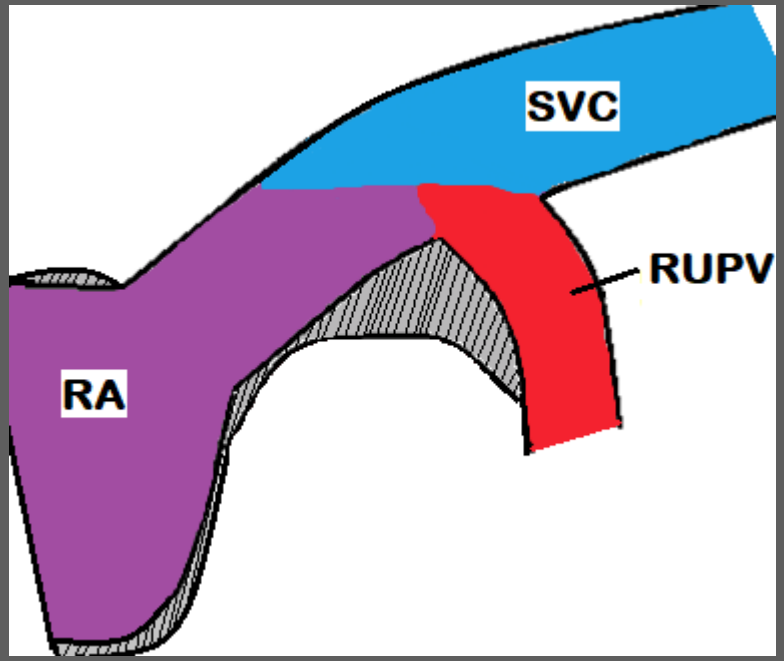


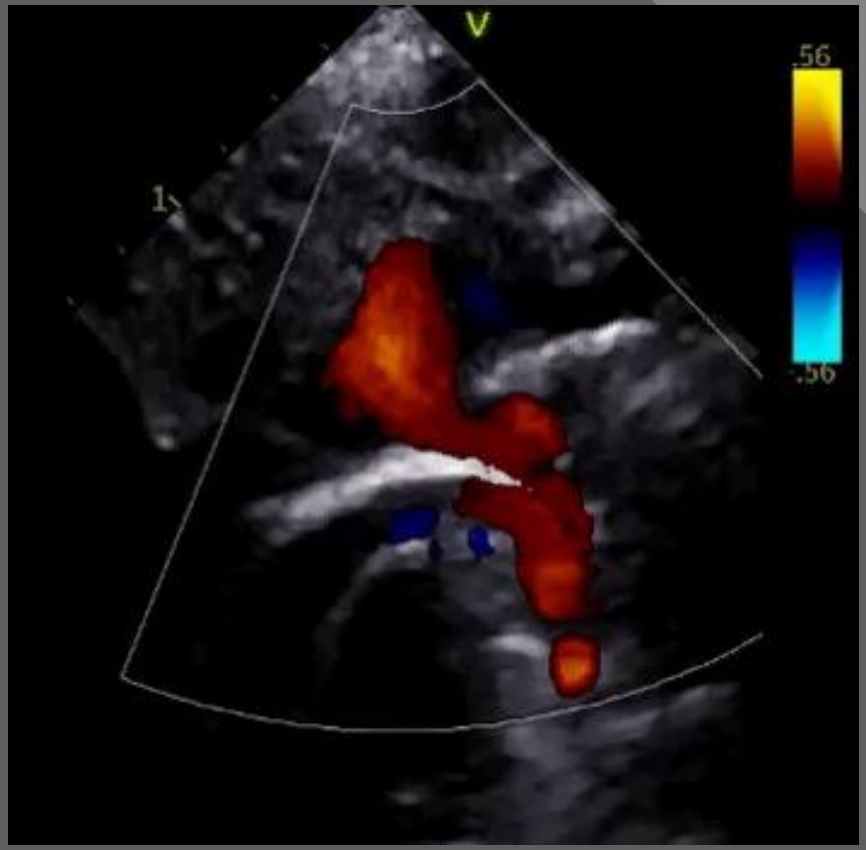
Ductus Venosus Vertical Vein





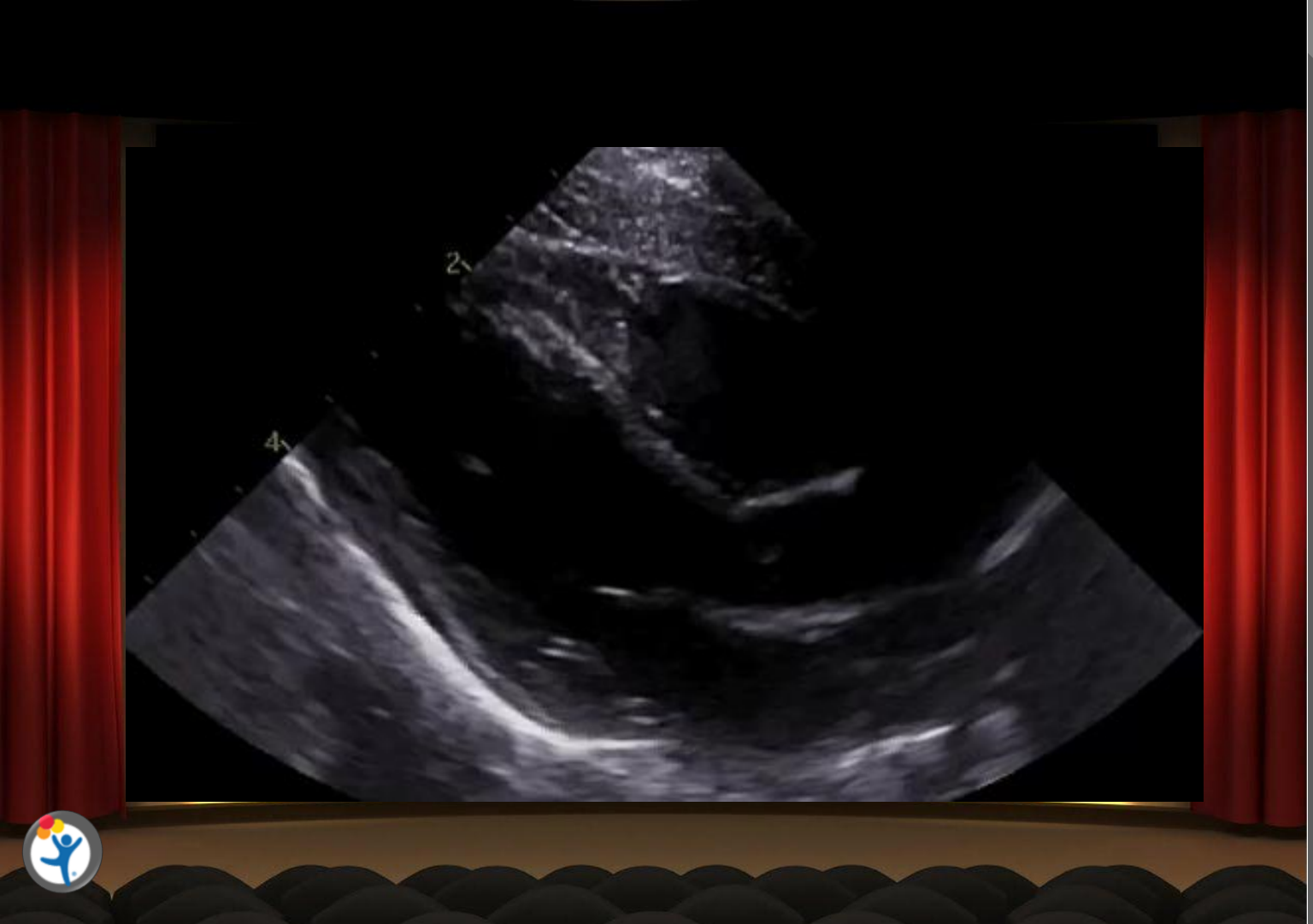
Right Upper Pulmonary Vein to SVC





Case #3

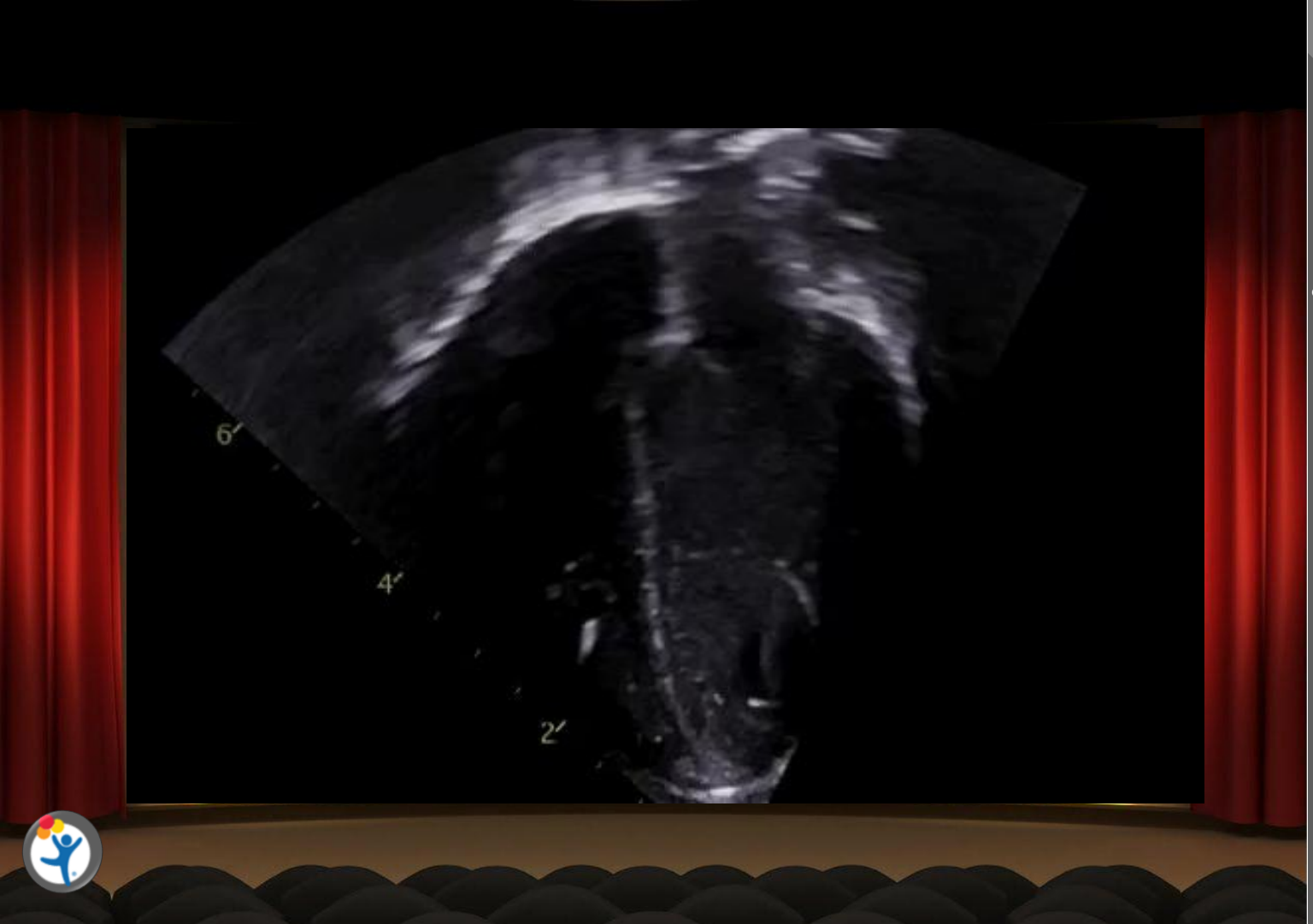
- Patient presents to outpatient clinic at 26 days of life.
- New murmur



Parasternal Long Axis

- Chambers look normal in size

Apical Four Chamber



- Function looks great
- Chambers still appear normal in size

Coronal Sweep

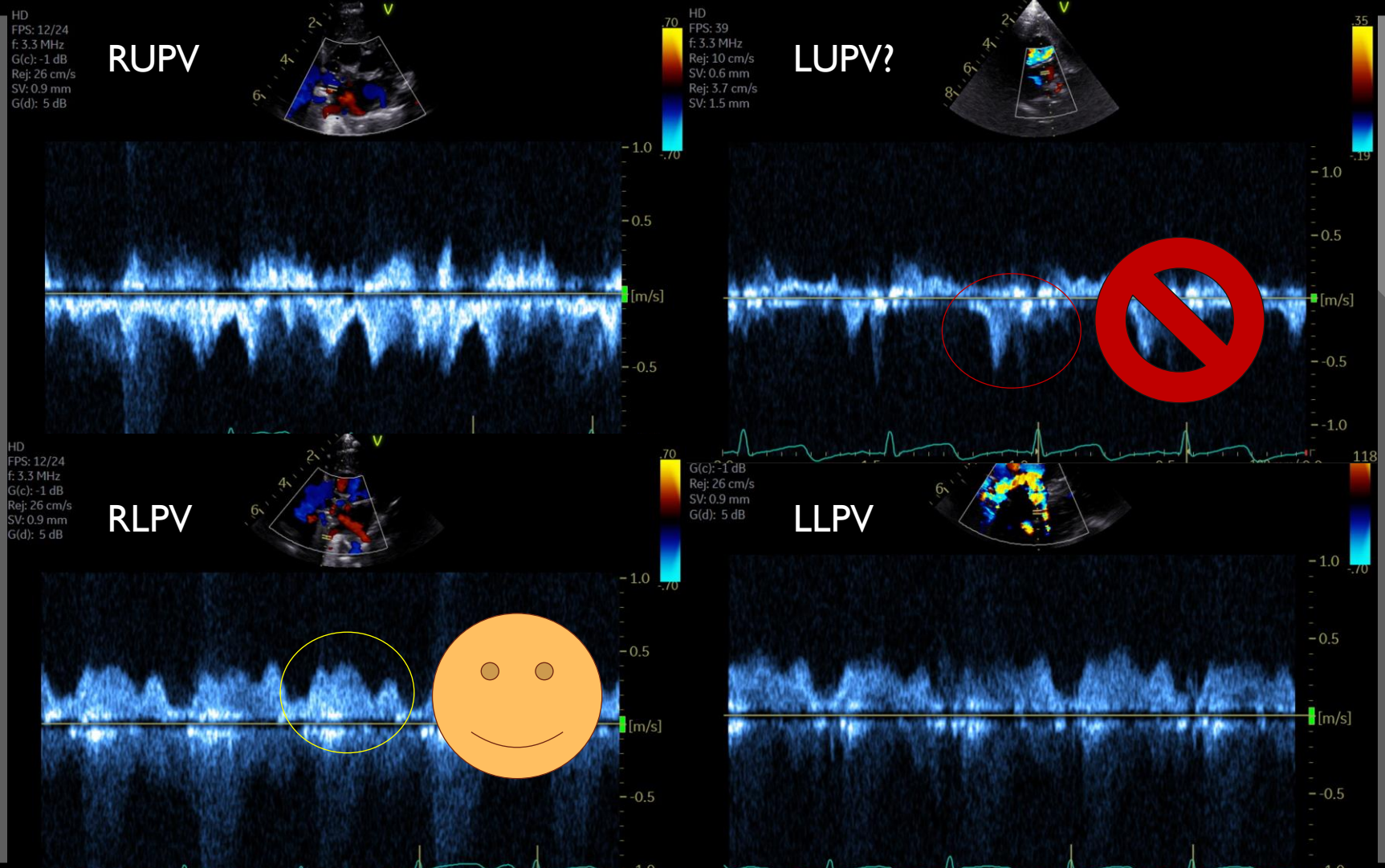
- A PFO with predominately left to right flow

- So far nothing concerning!

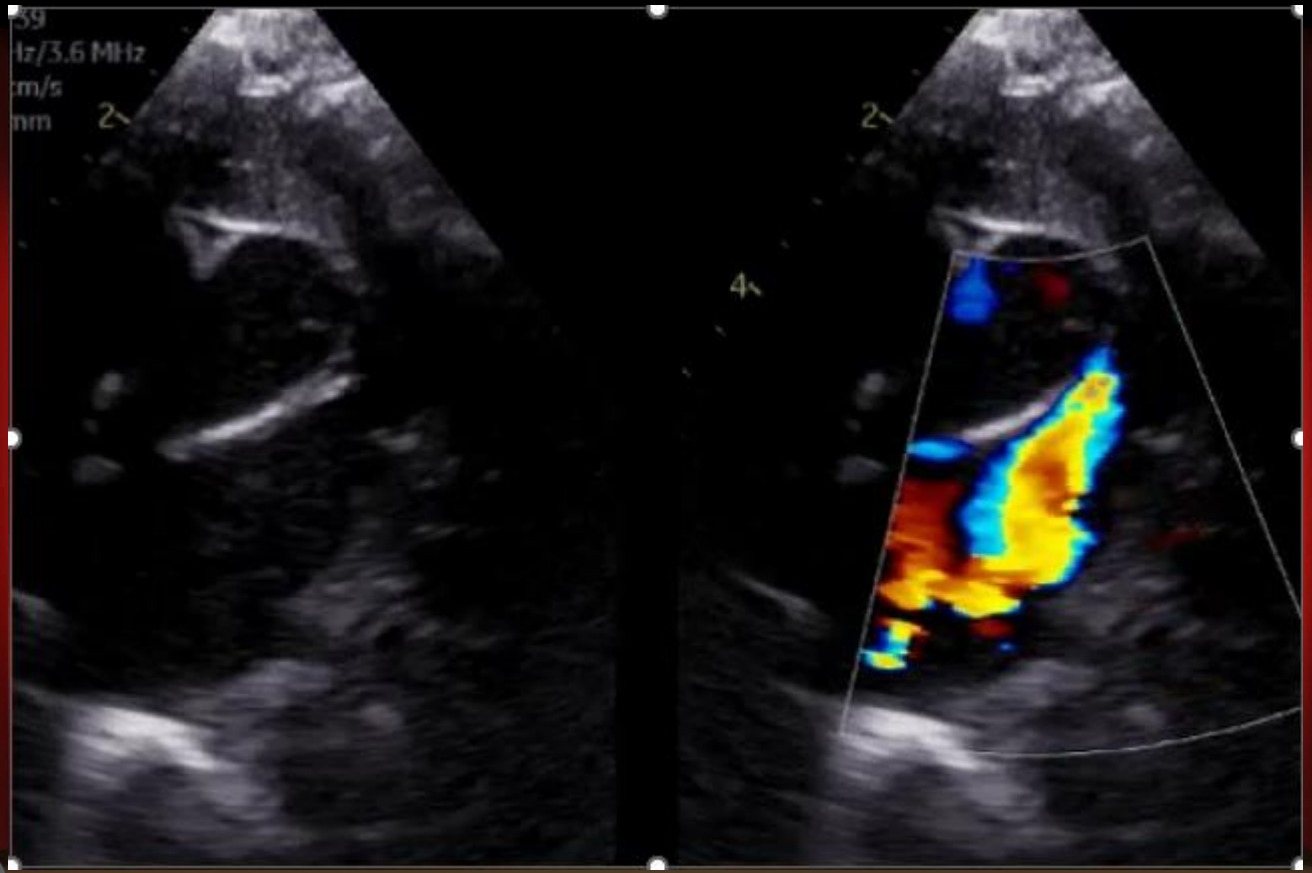
Suprasternal Short Axis

- Three veins show phasic flow

- In the region of the left upper vein there is pulsatile flow


RUPV
LUPV?
RLPV
LLPV
HD
FPS: 12/24
f: 3.3 MHz
G(c): -1 dB
Rej: 26 cm/s
SV: 0.9 mm
G(d): 5 dB
HD
FPS: 39
f: 3.3 MHz
Rej: 10 cm/s
SV: 0.6 mm
Rej: 3.7 cm/s
SV: 1.5 mm
G(c): -1 dB
Rej: 26 cm/s
SV: 0.9 mm
G(d): 5 dB
[m/s]
1.0
0.5
-0.5
-1.0
118

Short Axis



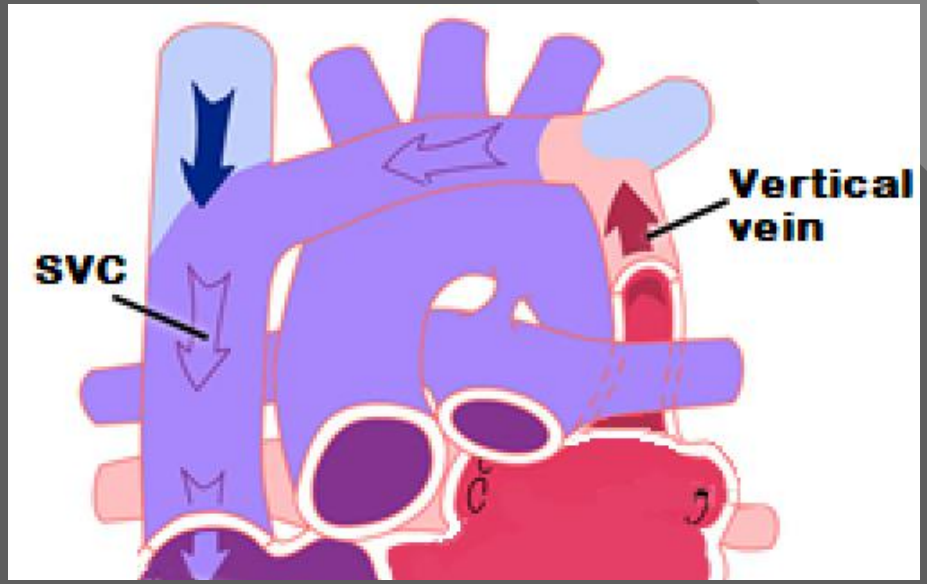
- This structure is trabeculated with to-fro flow
- Finger-like in appearance
- It's the left atrial appendage

Suprasternal SAX Sweep

- There is a generous red flow entering the innominate vein from the patient's left

What's the diagnosis?

Partial anomalous pulmonary venous return: left upper pulmonary vein to innominate vein



Is it critical?

Not typically! This patient will be followed for signs of right heart dilation. It may never be intervened on.

Don't mistake the left atrial appendage for the left upper pulmonary vein!

Epilogue: The Imposters

Normal Variants & Artifact

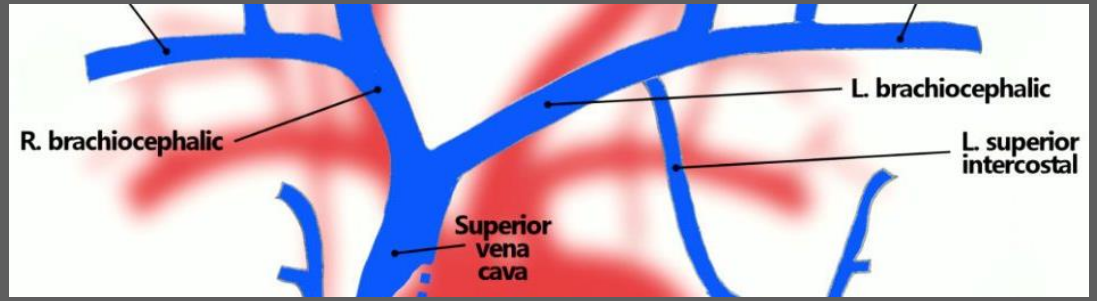
The Four Usual Suspects have an "imposter"

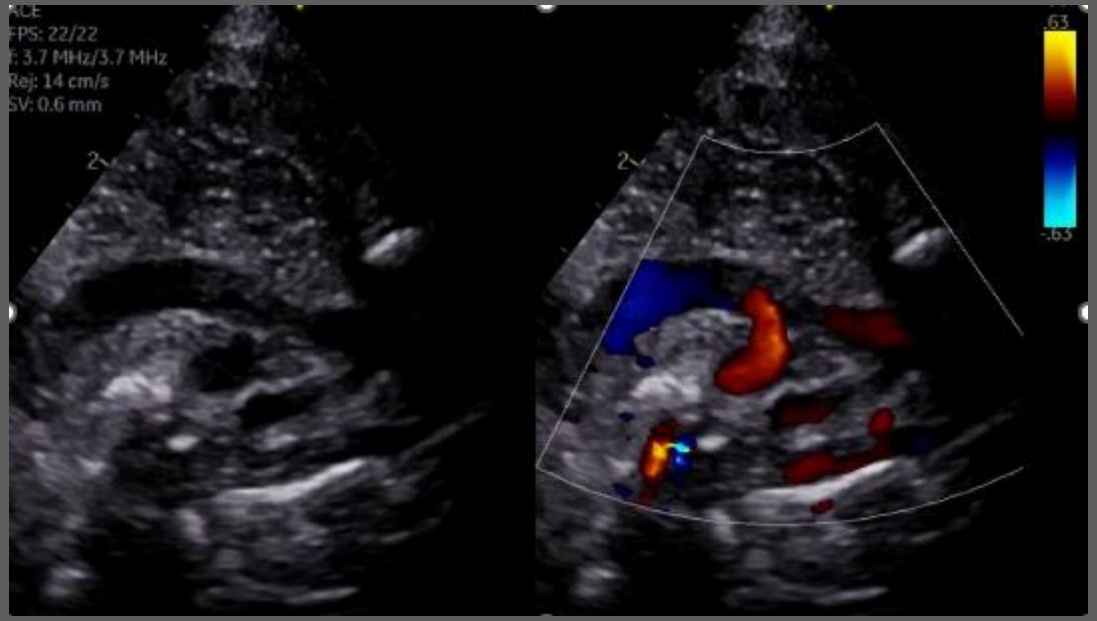
Your suspects could be innocent!

Avoid misinterpretation by correlating your findings:

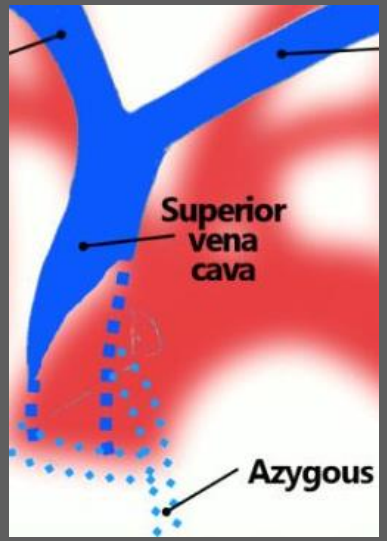
- Do they have right heart enlargement?
- Do they have an atrial shunt with right-to-left flow?
- Is the structure's appearance & Doppler consistent with anomalous pulmonary venous flow?

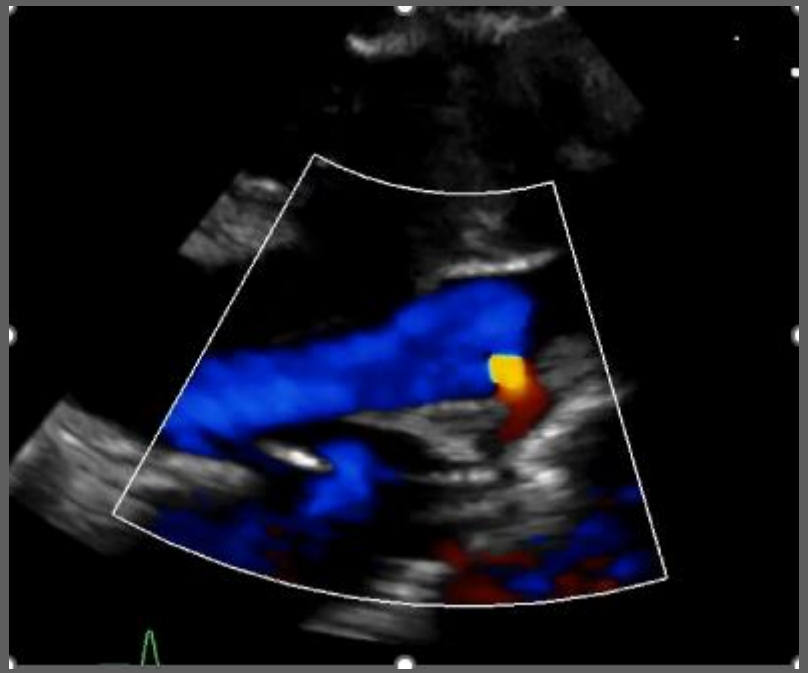
Innominate vein & Left superior intercostal



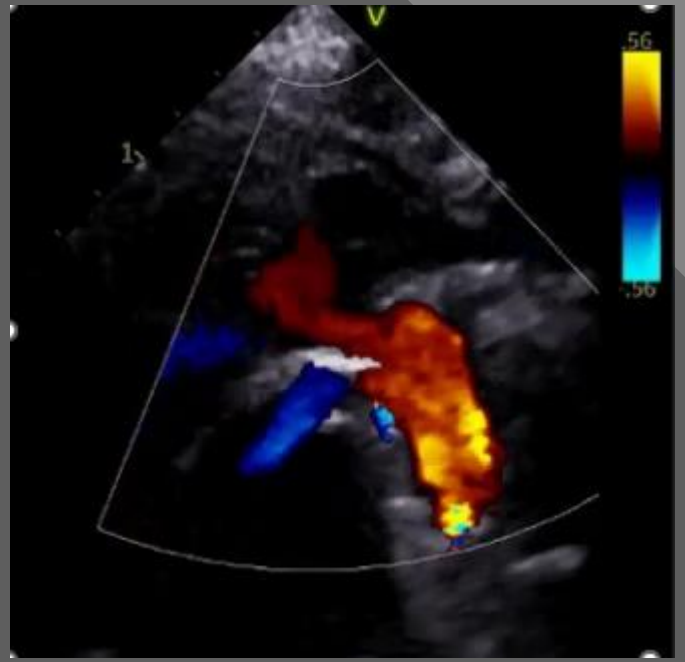


Superior Vena Cava & Left superior intercostal



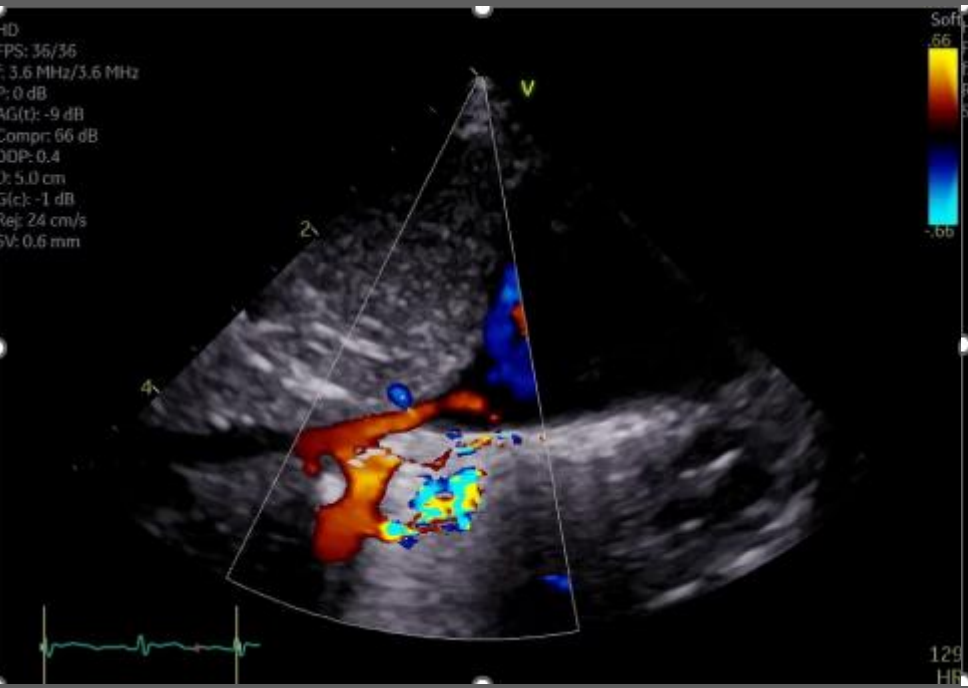


Azygous Vein
Red flow correlates with the SVC flow



Anomalous Pulmonary Vein
Red flow has a different pattern than SVC flow

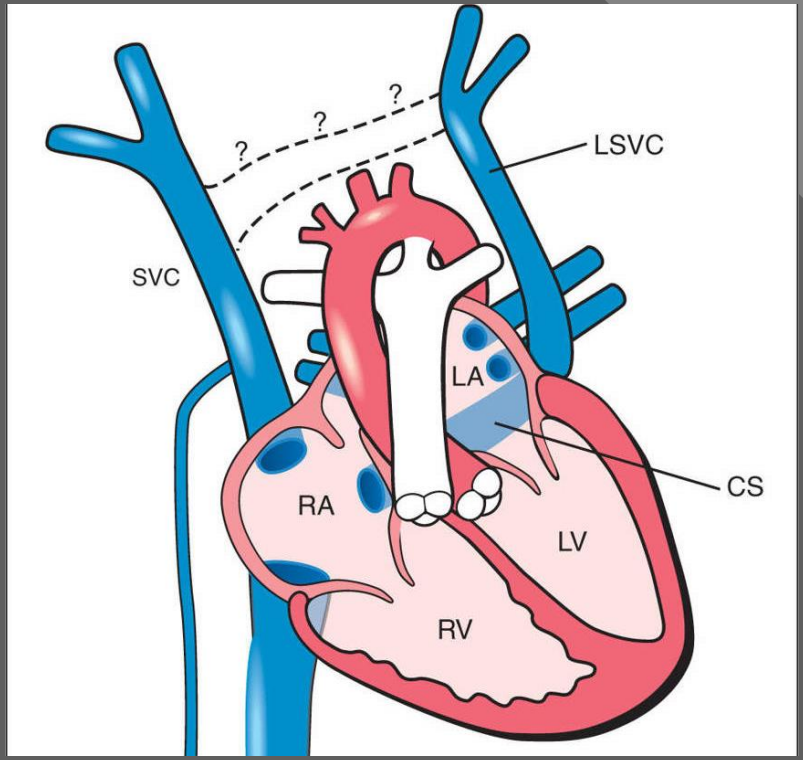
Inferior vena cava & mirror image artifact



Mirror Image Artifact
Red flow mirrors the IVC flow
& doesn't connect

Anomalous Venous Drainage
Red flow independently originates
& connects to the IVC

Coronary sinus & Persistent left superior vena cava



Credits

1. Interrogate the four usual suspects

2. Sweep the crab

3. Cause for Alarm: right to left ASD/PFO

The End

"**GLORIOUSLY** DARING"
★★★★★

"NOT ENOUGH **MOVIE PUNS**"
★★★☆☆

"THE BEST **THEATRE THEMED** PRESENTATION OF THE YEAR"
★★★★☆

References

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- Intracardiac TAPVC R.6af2ca079466924db53c1f8f1bdea997 (540×573) (bing.com)
- PAPVC R.695e3984f9a4b1943edcc1ac6a2c25e2 (1920×1440) (bing.com)
- Left superior intercostal www.pinterest.co.uk/pin/784259722582468166/
- Persistent LSVC What Does The Coronary Sinus Drain Into - Best Drain Photos Primagem.Org