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Cardiology 2018

Atrioventricular Septal Defects: Imaging Techniques after Surgery

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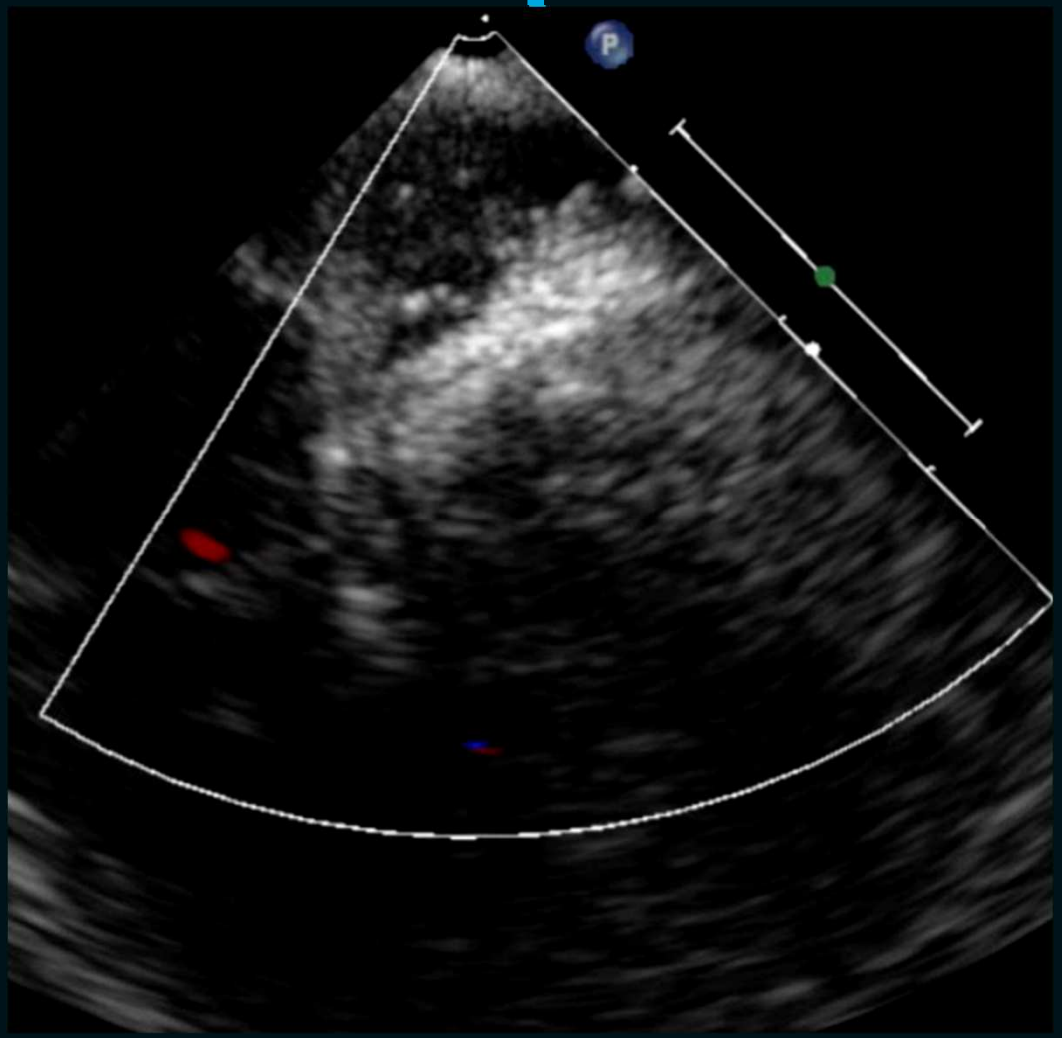
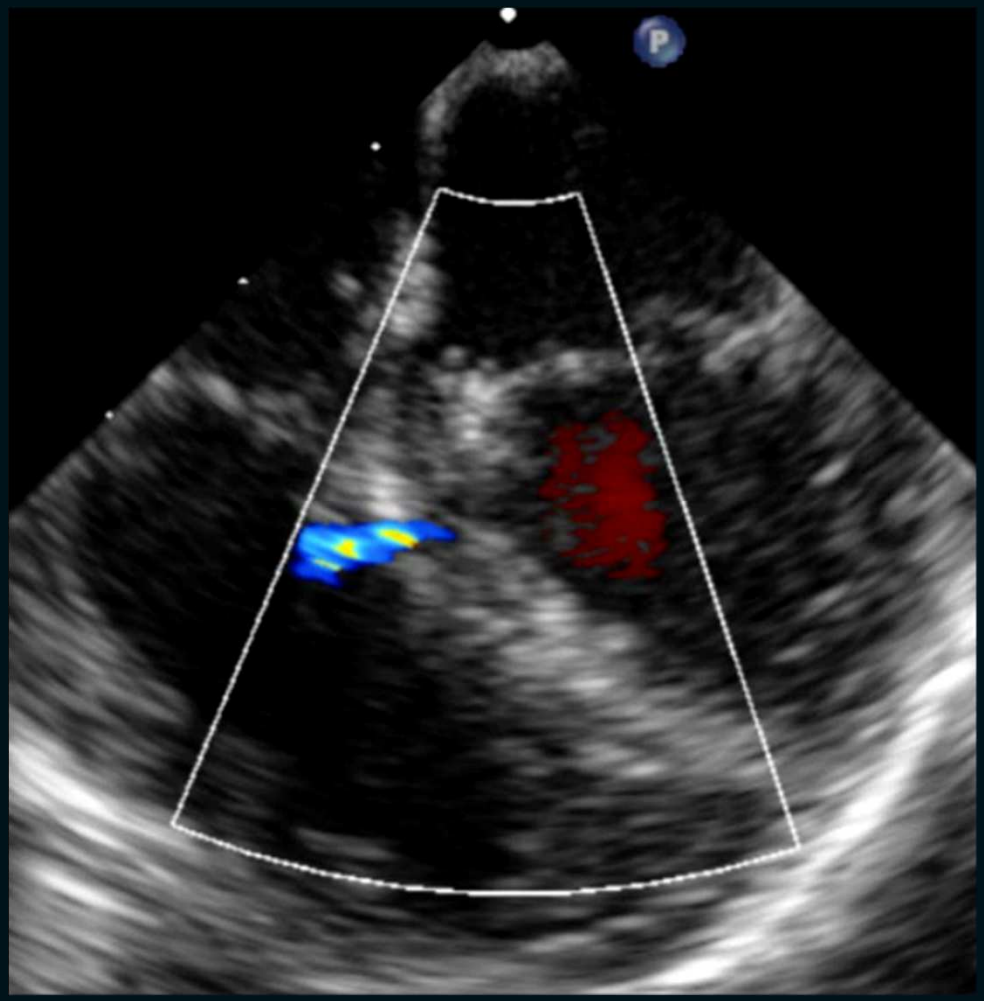
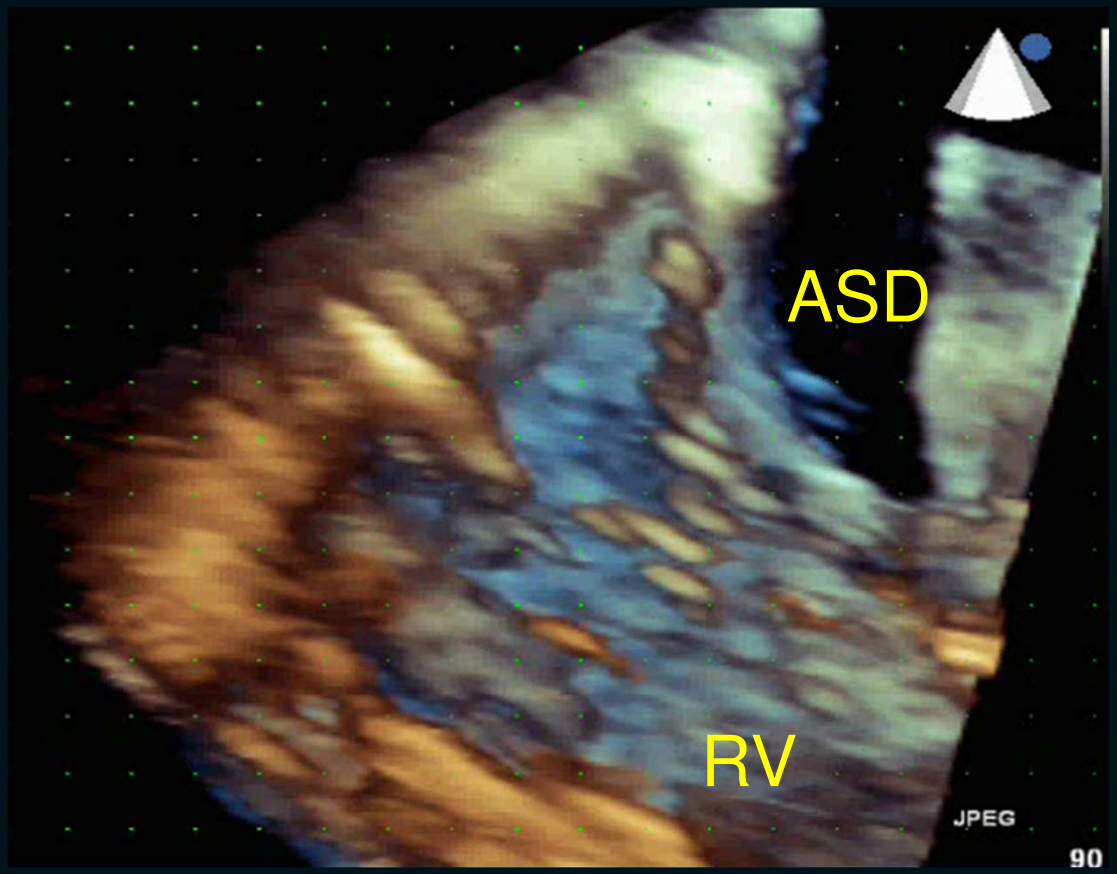
Intraop TEE-Residual Defects



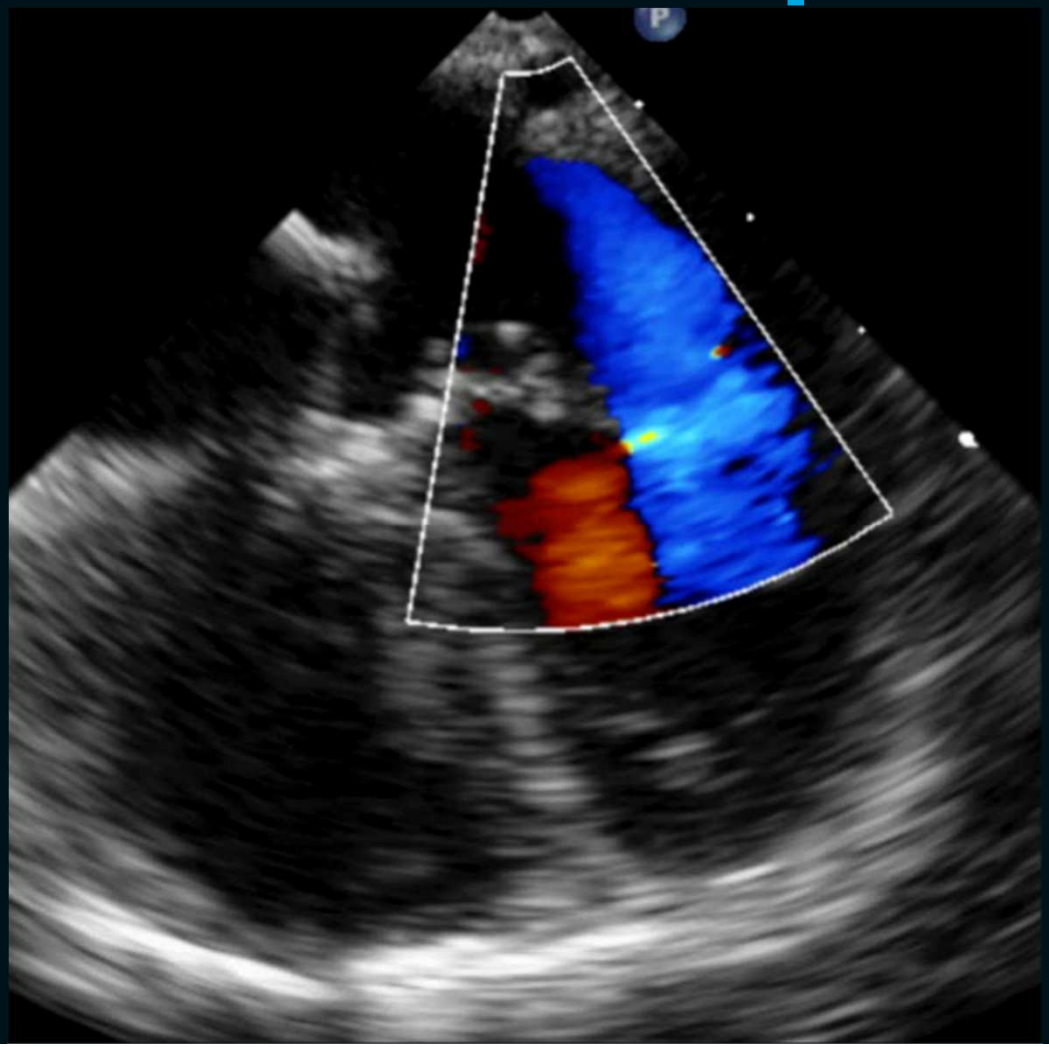


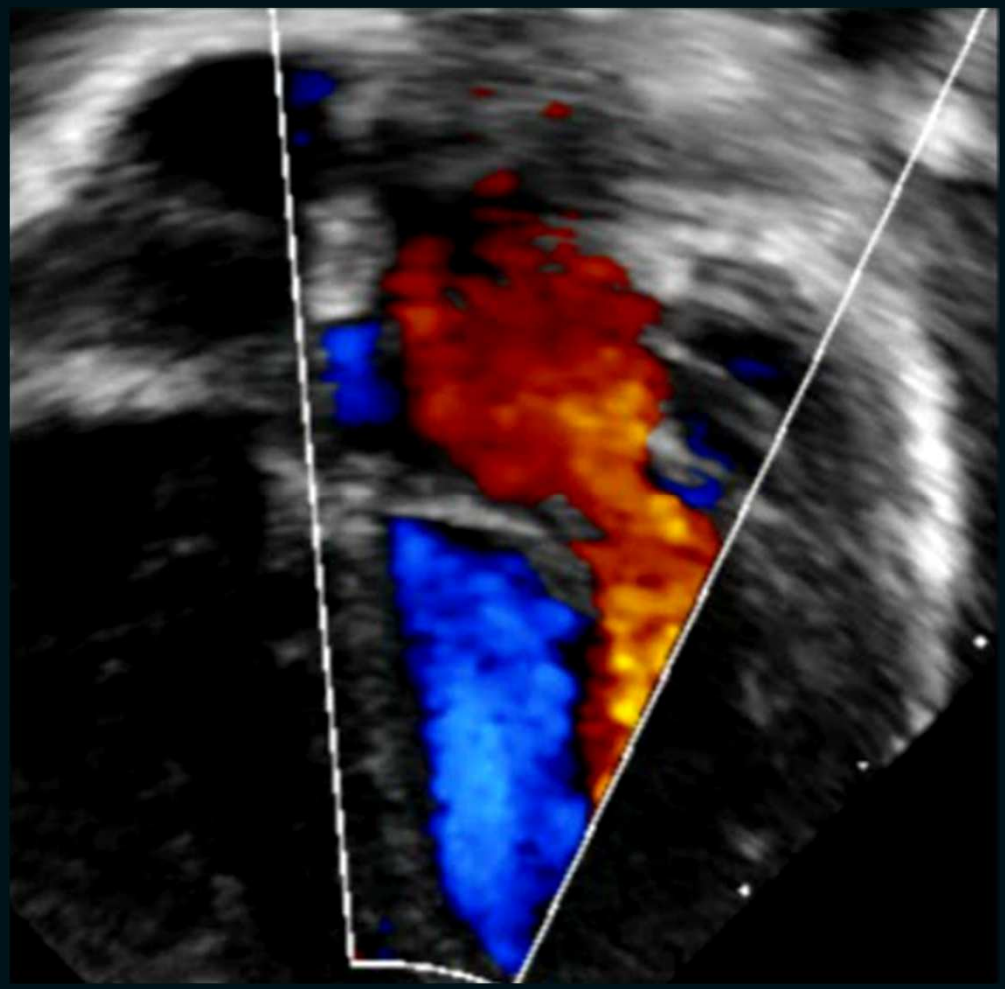
TEE—larger residual ASD



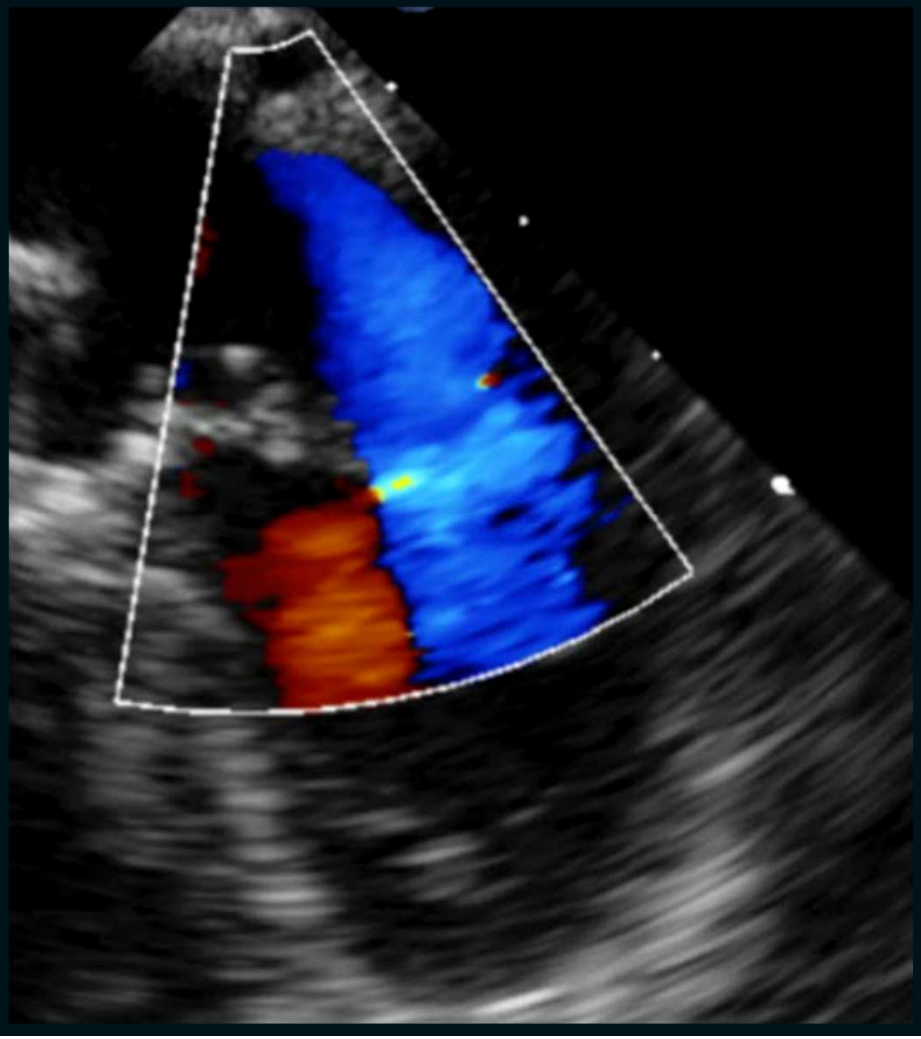
Courtesy of Girish Shirali

Intraop TEE--LAVVR

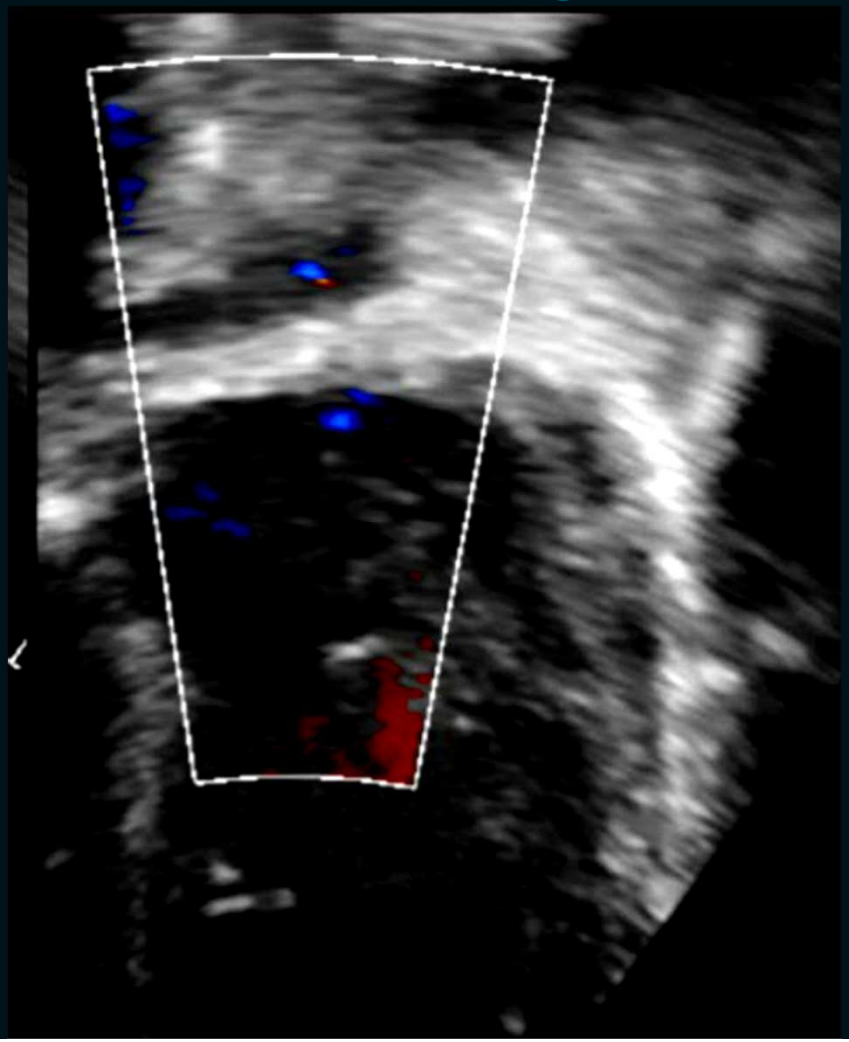


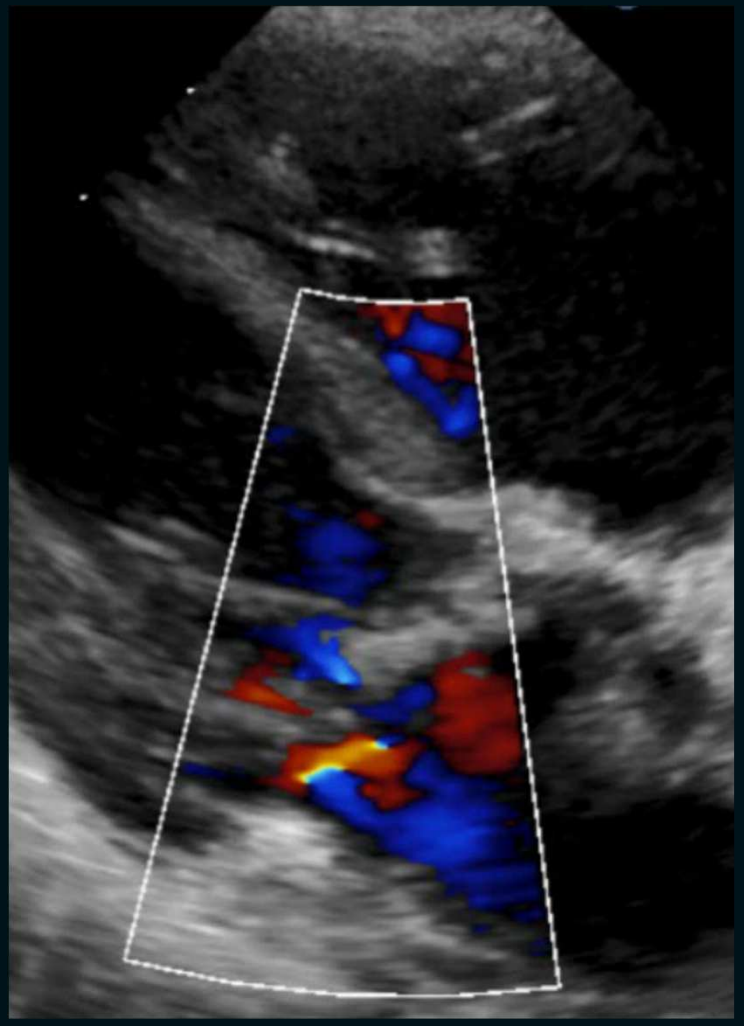


Intraop TEE—Trivial LAVVR



Discharge TTE—Same Patient





Kim et al. Ann Thorac Surg, 2005. 80(1)

- *"Predictive value of intraoperative transesophageal echocardiography in complete atrioventricular septal defect"*
- Single center, 35 patients, 1997-2004
- Compared intraop TEE to subsequent TTE
- 29% (10/35) LAVVR progressed from grade I to II

Do Residual Lesions Persist?

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The Heart Center
Changing What's Possible

Atz et al. JTCVS, 2011. 141(6)

- PHN ACE MR study (Complete AVSD)
- 1 Month Echo
  - 16% had a residual ASD (1% >3mm)
  - 48% with a residual ventricular shunt (8% >3mm)
- 6 Month Echo
  - No patients with ASD >3mm
  - 1 patient (out of 117) had VSD >3mm

Atz et al. JTCVS, 2011. 141(6)

- LV dysfunction
  - 35% at 1 month
  - 10% at 6 months
- No change in # ≥ moderate LAVVR (24% vs 22%)
- No patients had significant LAVV stenosis or LVOTO at either time point

Left AV Valve Regurgitation

- 15-40% have moderate-severe LAVVR
- Generally stable after the 1st month
- 5-12% reoperation for LAVVR (contemporary series)
- Reoperation generally required within a few years
  - 3.5mo-2yr after 1st surgery

How do we quantify Left AV Valve Regurgitation?

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The Heart Center
Changing What's Possible

Prakash et al. Pediatr Cardiol, 2012. 33(2)

- "*Challenges in echocardiographic assessment of mitral regurgitation in children after repair of atrioventricular septal defect*"
- PHN ACE MR study
- 149 patients after repair of AVSD (61% complete, 39% partial/transitional)
- 6 month post-op echo
- Compared various methods to quantify LAVVR with LV volume z-score

Comparison of Methods for LAVVR

- Subjective grade of LAVVR vs.
- Quantitative assessment
  - Vena contracta width
  - Vena contracta cross-sectional area
  - Regurgitant volume/fraction

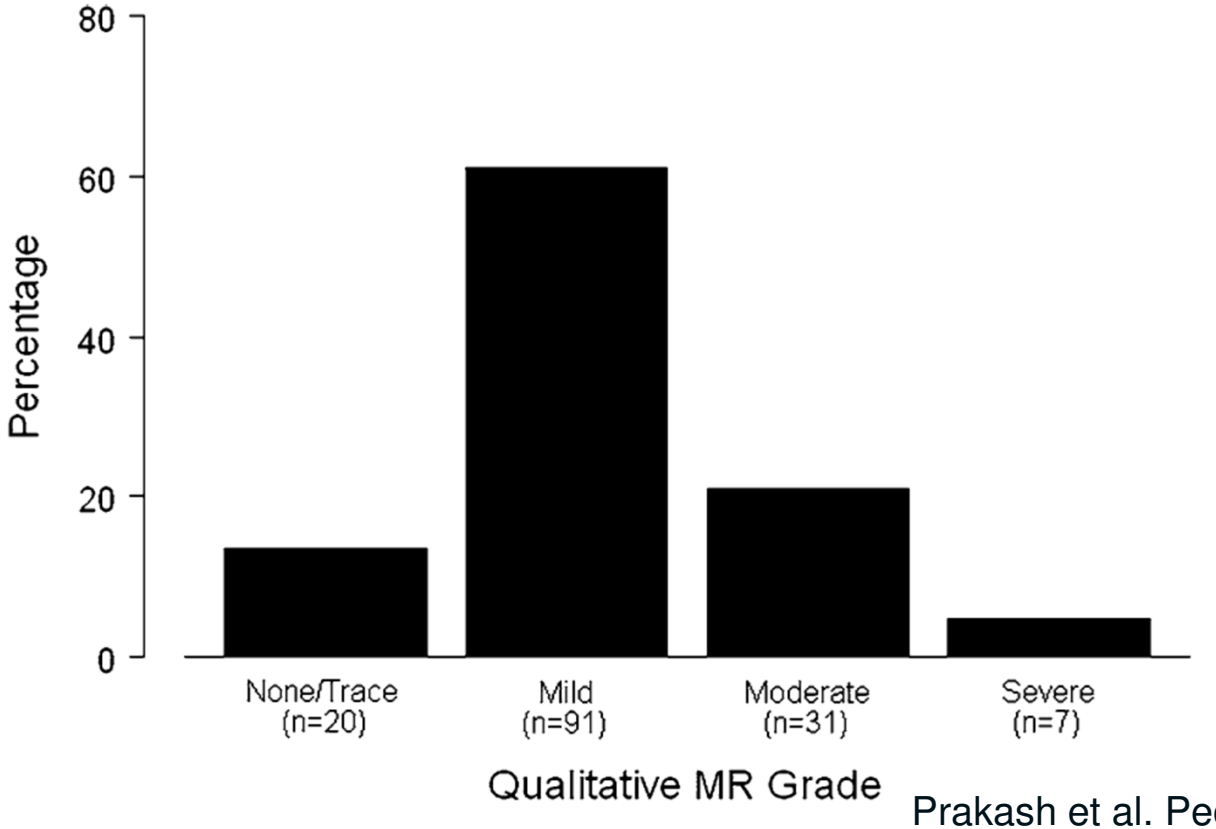
Prakash et al. Pediatr Cardiol, 2012. 33(2)

Regurgitant Volume/Fraction

- LV stroke volume from 2D tracing - Aortic stroke volume by Doppler
- Correlated with LVEDVz (both R^2 0.45), but…
- Negative value in 75% of subjects
- Poor intra-observer agreement (ICC 0.281, 0.167)

Prakash et al. Pediatr Cardiol, 2012. 33(2)

Subjective grade of LAVVR



Prakash et al. Pediatr Cardiol, 2012. 33(2)

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Subjective grade of LAVVR

- Correlated with quantitative measurements of regurgitation
- Significantly associated with LVEDVz (R^2=0.53)
- Modest intraobserver agreement (kappa 0.56)

Prakash et al. Pediatr Cardiol, 2012. 33(2)

Vena Contracta Width/Area

- Lateral and anterior-posterior
- Subjects with >1 jet were excluded
- Significantly associated with LVEDVz(R^2 0.24-0.54)
- Best interobserver agreement (ICC 0.62-0.73)
- Not significantly better than subjective grading

Prakash et al. Pediatr Cardiol, 2012. 33(2)

Cardiac MRI for LAVVR

- Very limited data in literature for CHD
- Valve anatomy generally seen better by echo (TTE ± TEE)
- Accurate measurement of LV volume and function
- Regurgitant fraction/volume
- Adult data (non CHD) suggests poorer outcomes with RF >40% or RVol >29ml/m^2
  - Better predictive value than LV volume

Myerson SG, et al. Circulation. 2016;133:2287-2296

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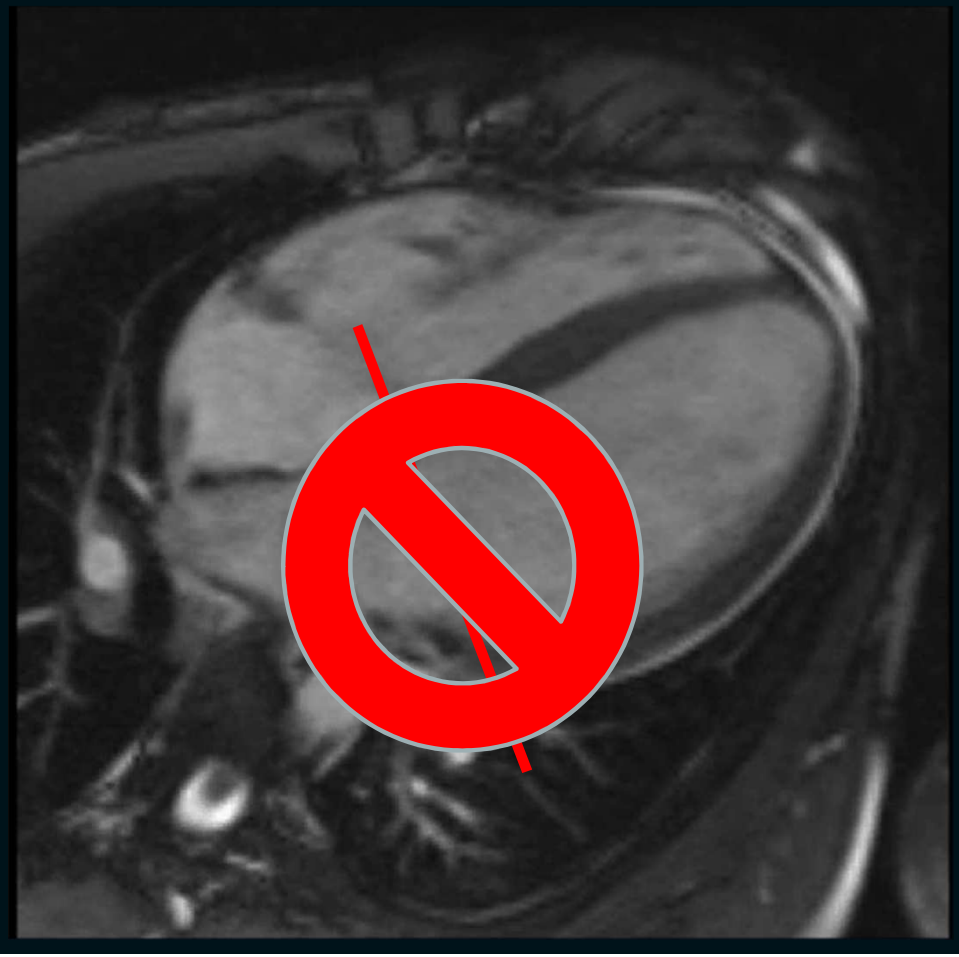
CMR Quantification of LAVVR



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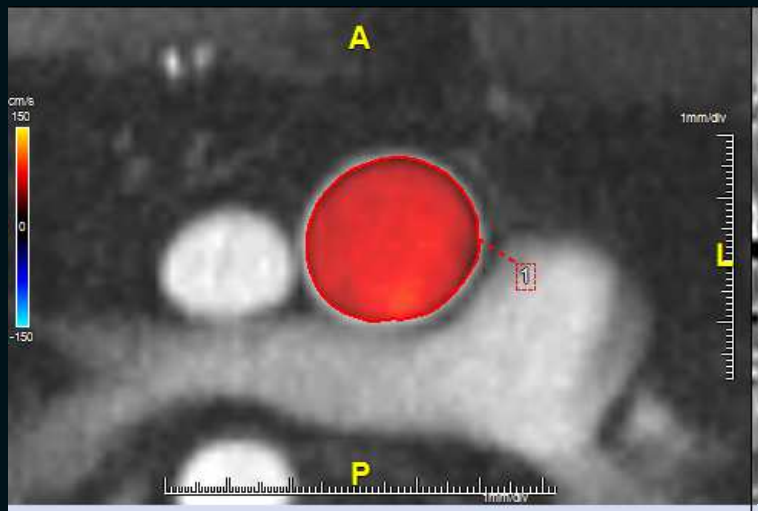
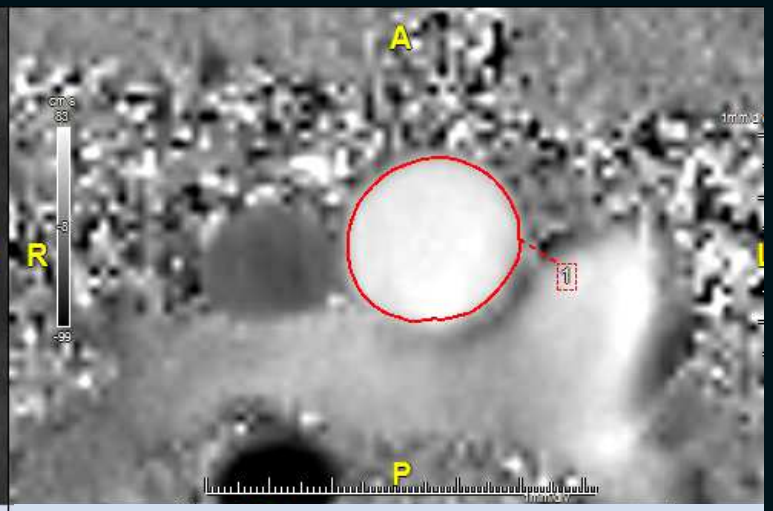
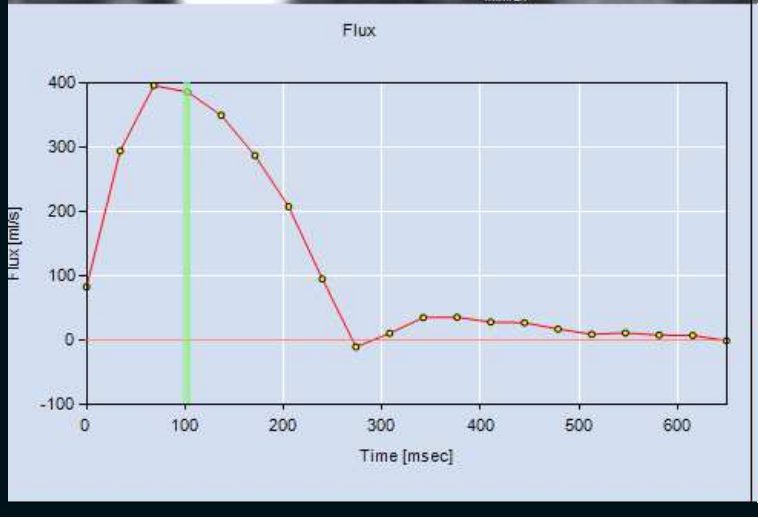


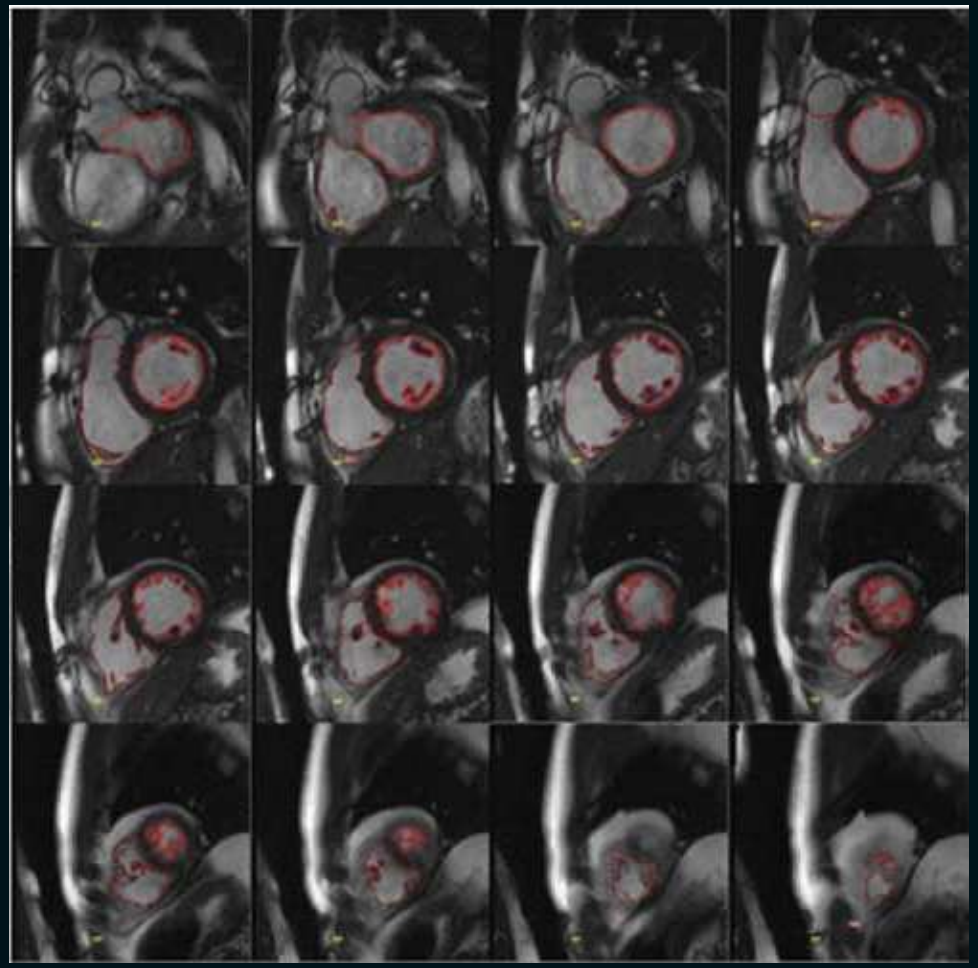





```
ROI No: 1
Stroke Volume: 76.79 ml
Forward Flow Volume: 76.89 ml
Backward Flow Volume: 0.1 ml
Regurgitant Fraction: 0.13 %
Absolute Stroke Volume: 76.99 ml
Mean Flux: 114.34 ml/s
Mean Velocity: 20.61 cm/s
Stroke Distance(time velocity integral): 13.8 cm
```

No	Time [msec]	Flux [ml/s]	Area [cm^2]	Velocity [cm/s]	Max Vel [cm/s]	M
01	0.00	83.25	4.79	17.37	52.00	
02	34.20	294.85	5.30	55.59	82.00	
03	68.40	396.48	5.66	70.07	90.00	
04	102.60	386.46	5.62	68.74	94.00	
05	136.80	350.15	5.89	59.42	89.00	
06	171.00	287.70	5.79	49.73	77.00	
07	205.20	208.00	5.60	37.12	62.00	

CMR Quantification of LAVVR



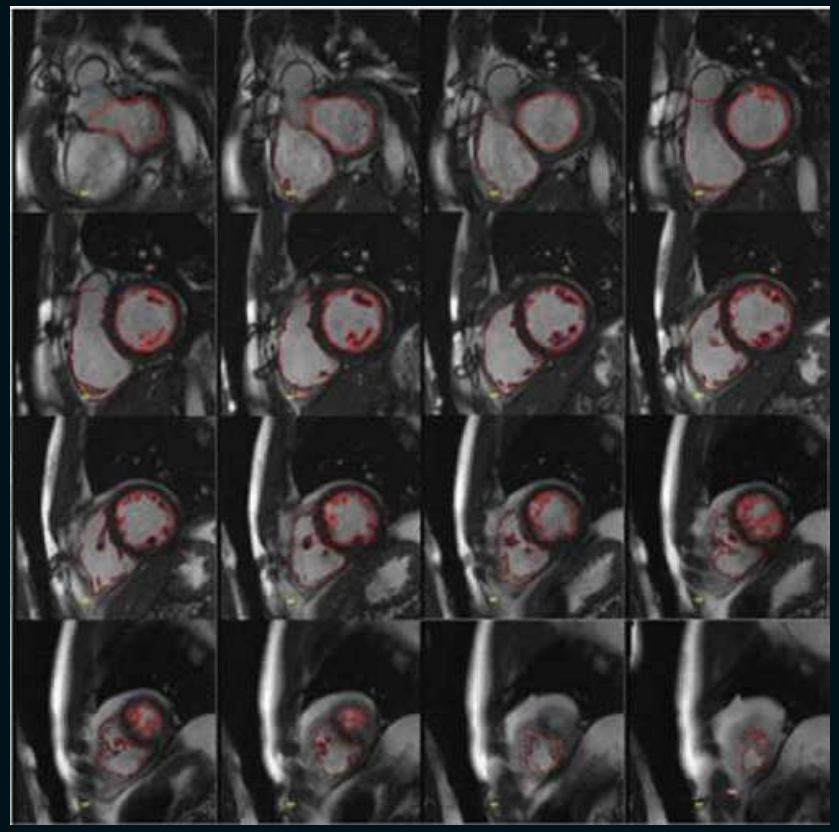
LV Volumes

- Diastolic
- Systolic

Fratz S, et al. Am J Cardiol 2009;103:1764 –1769

CMR Quantification of LAVVR

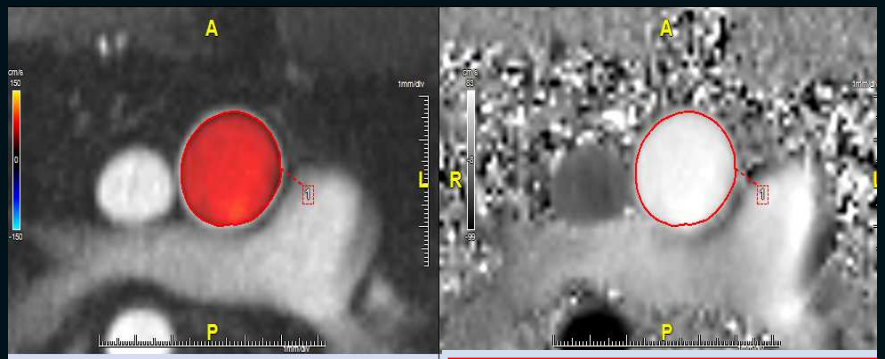
LV Stroke Volume

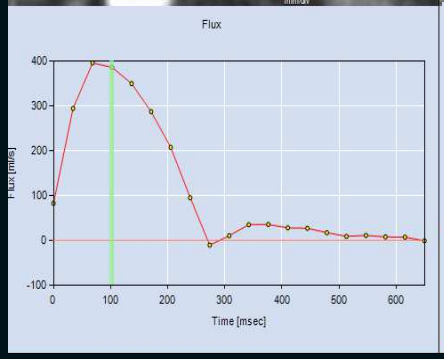


Fratz S, et al. Am J Cardiol 2009;103:1764 –1769

-

Ao Stroke Volume





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= Mitral Regurgitation*

* Assuming no VSD

Mechanisms of Left AV Valve Regurgitation

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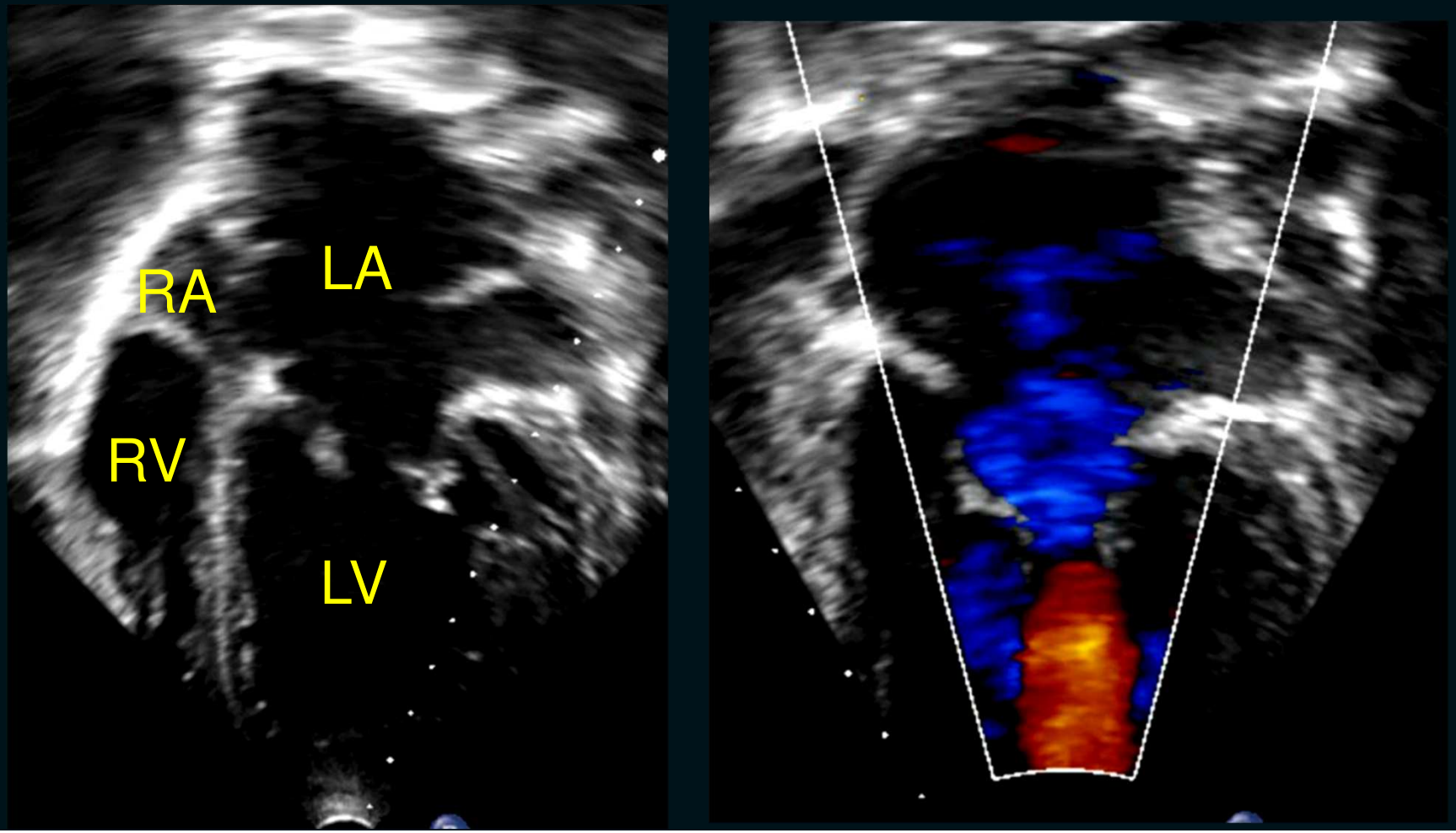
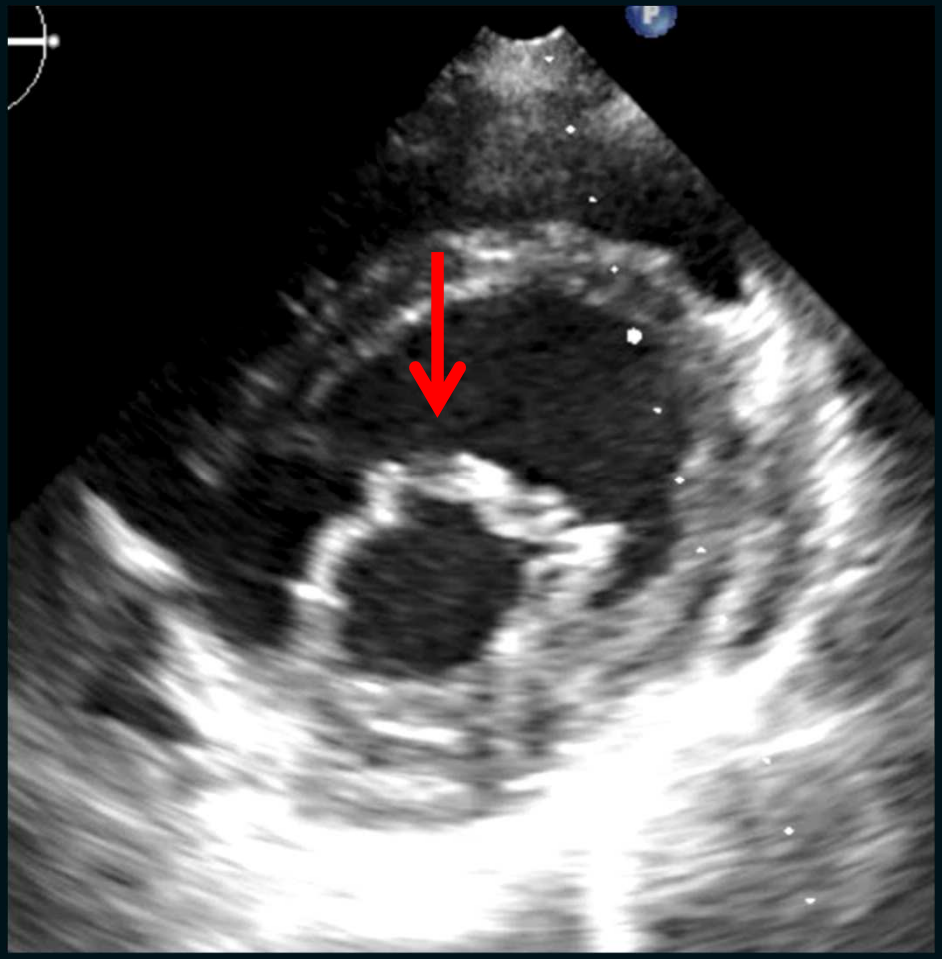
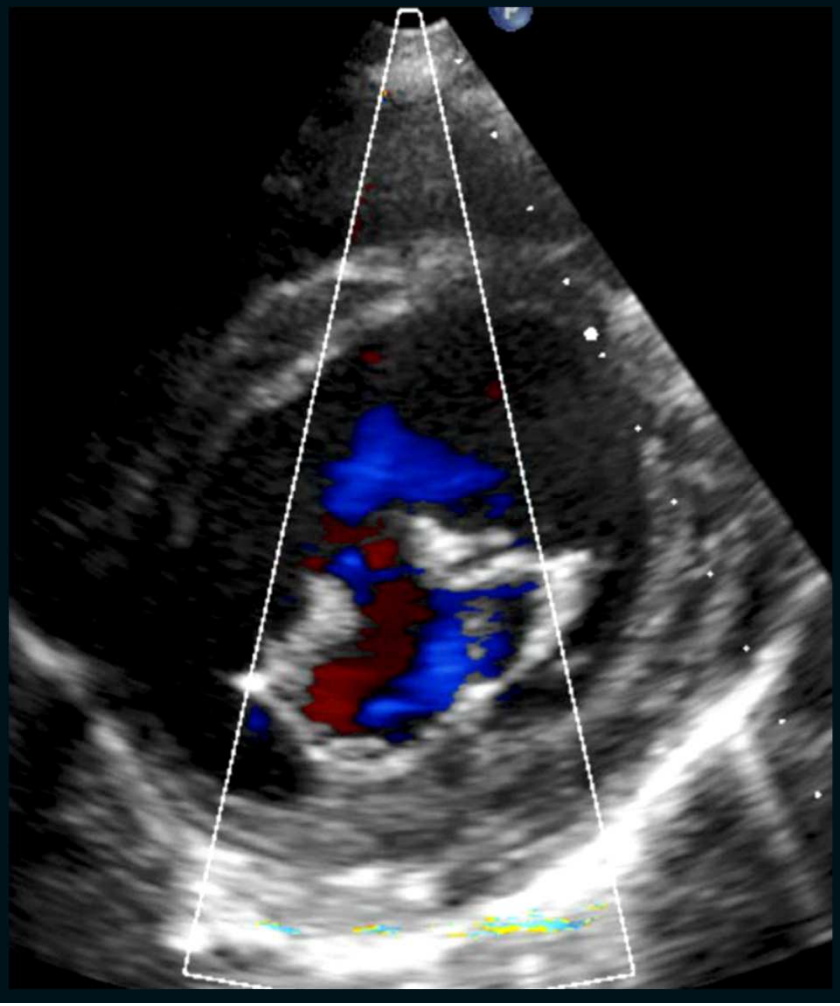
Changing What's Possible

LAVVR—Residual “Cleft”



LAVVR—Residual “Cleft”





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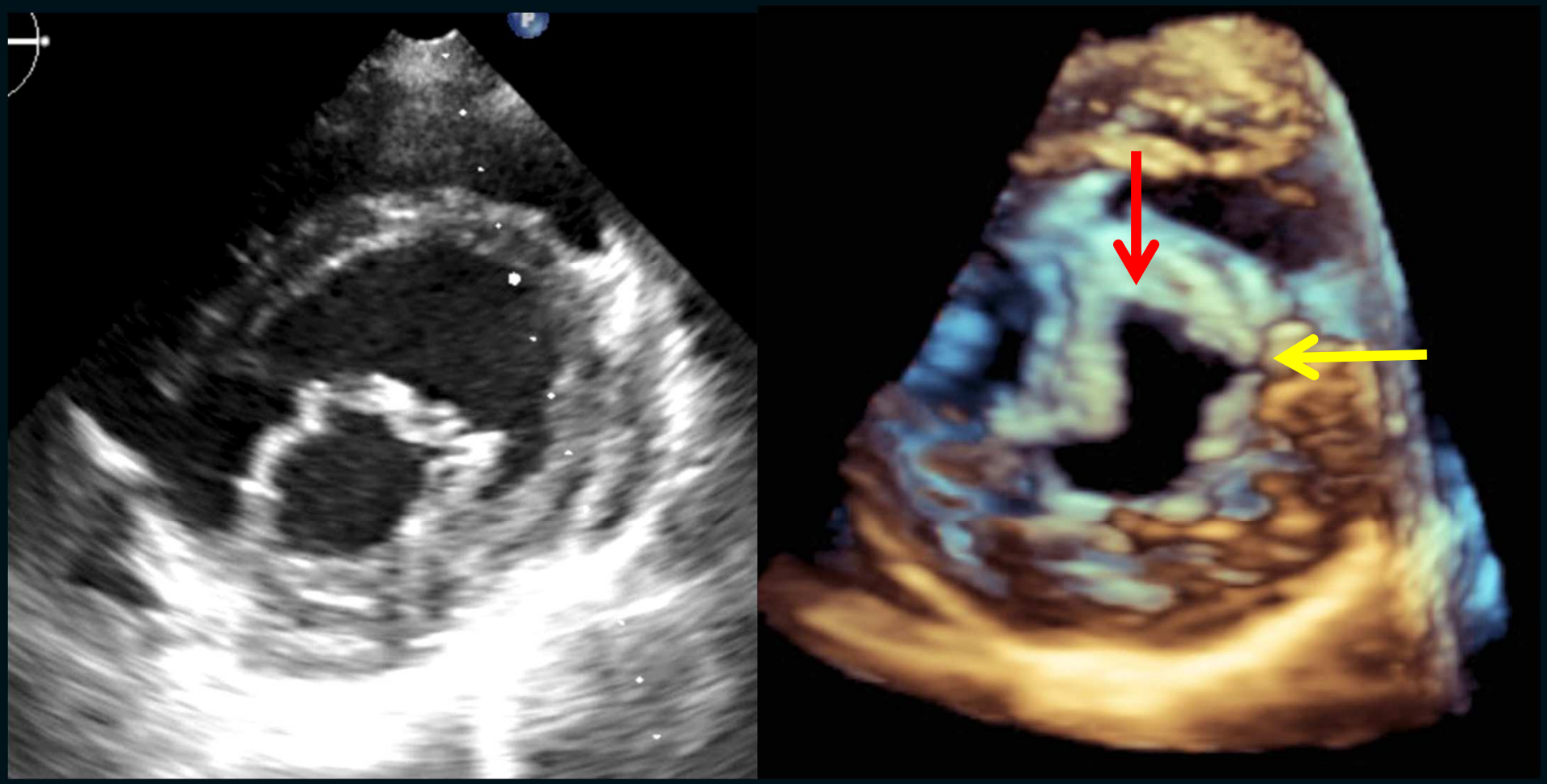
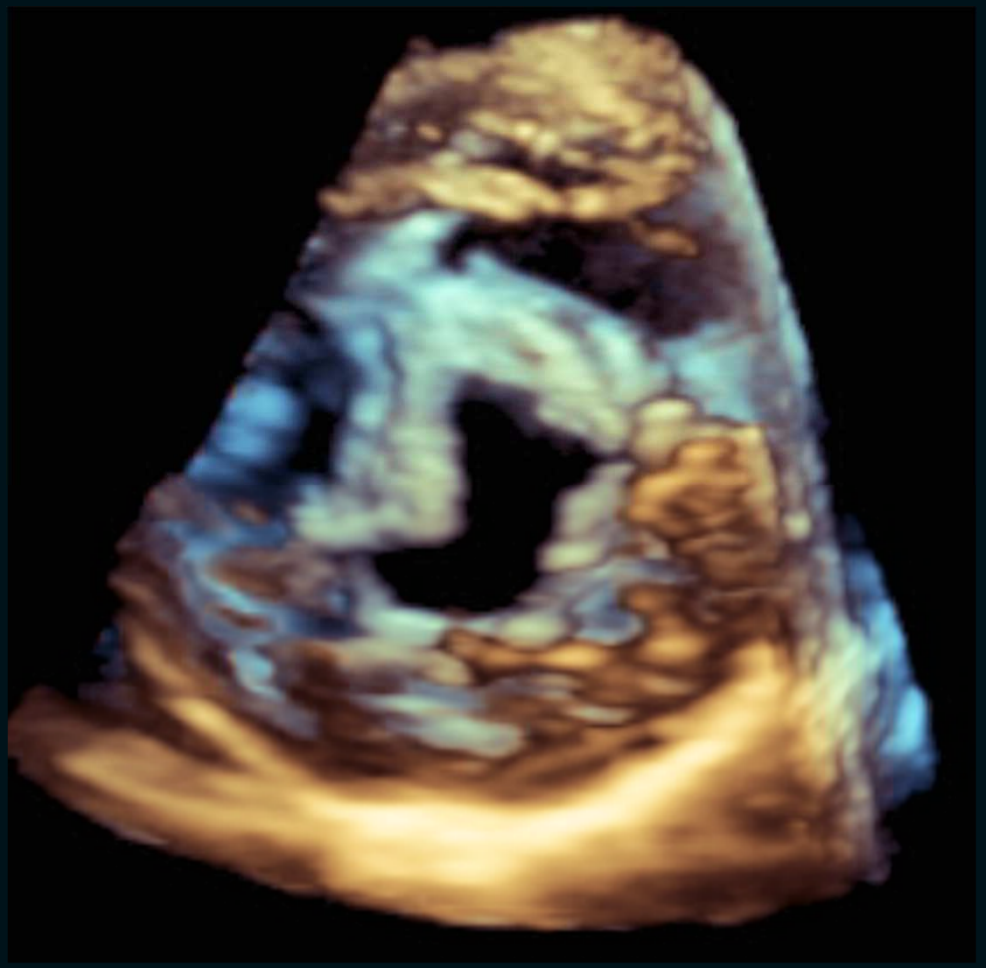
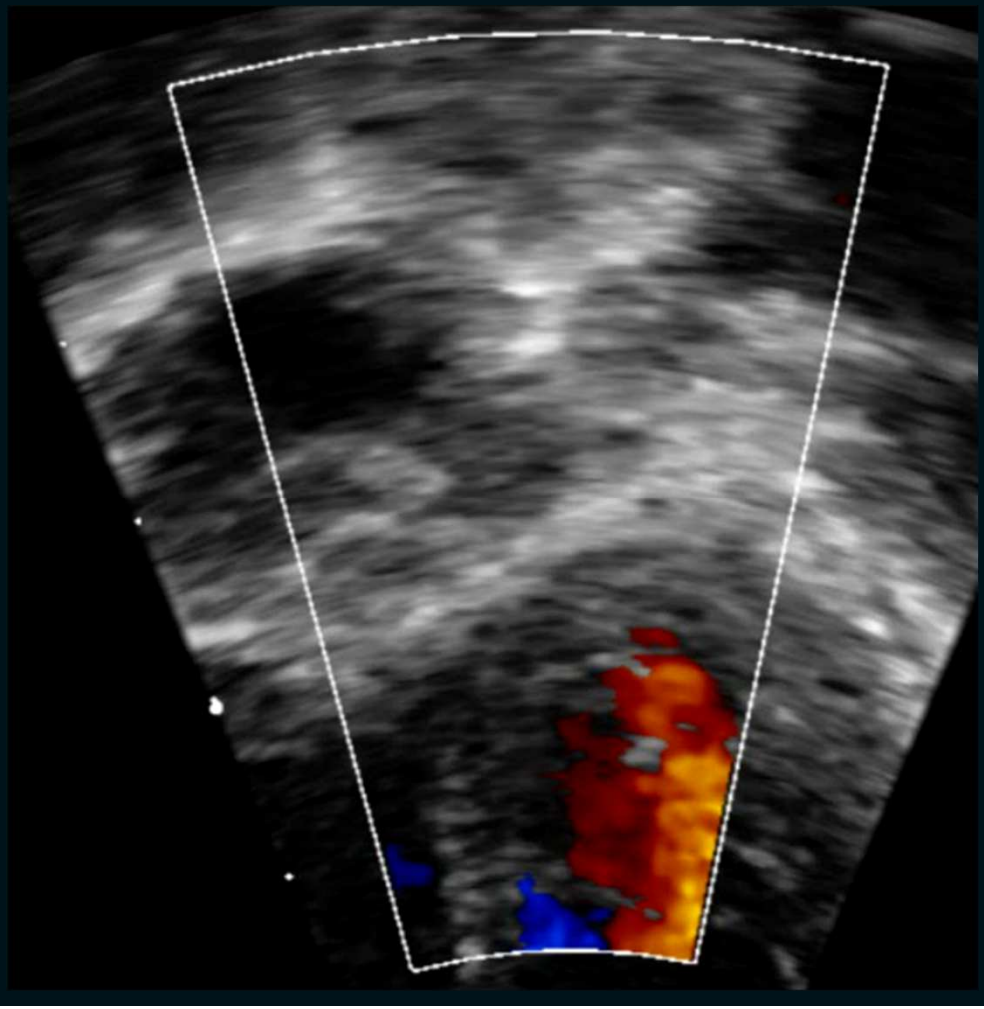


LAVVR—Residual “Cleft”



LAVVR—”Cleft” Closed



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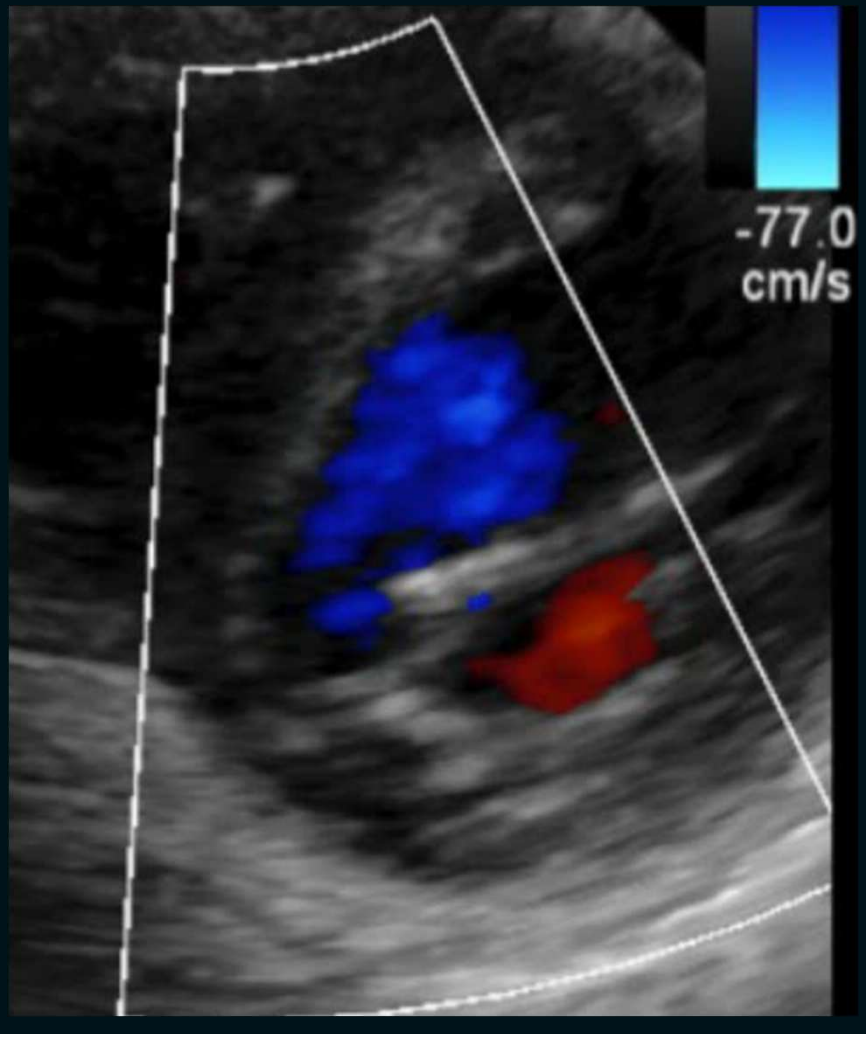

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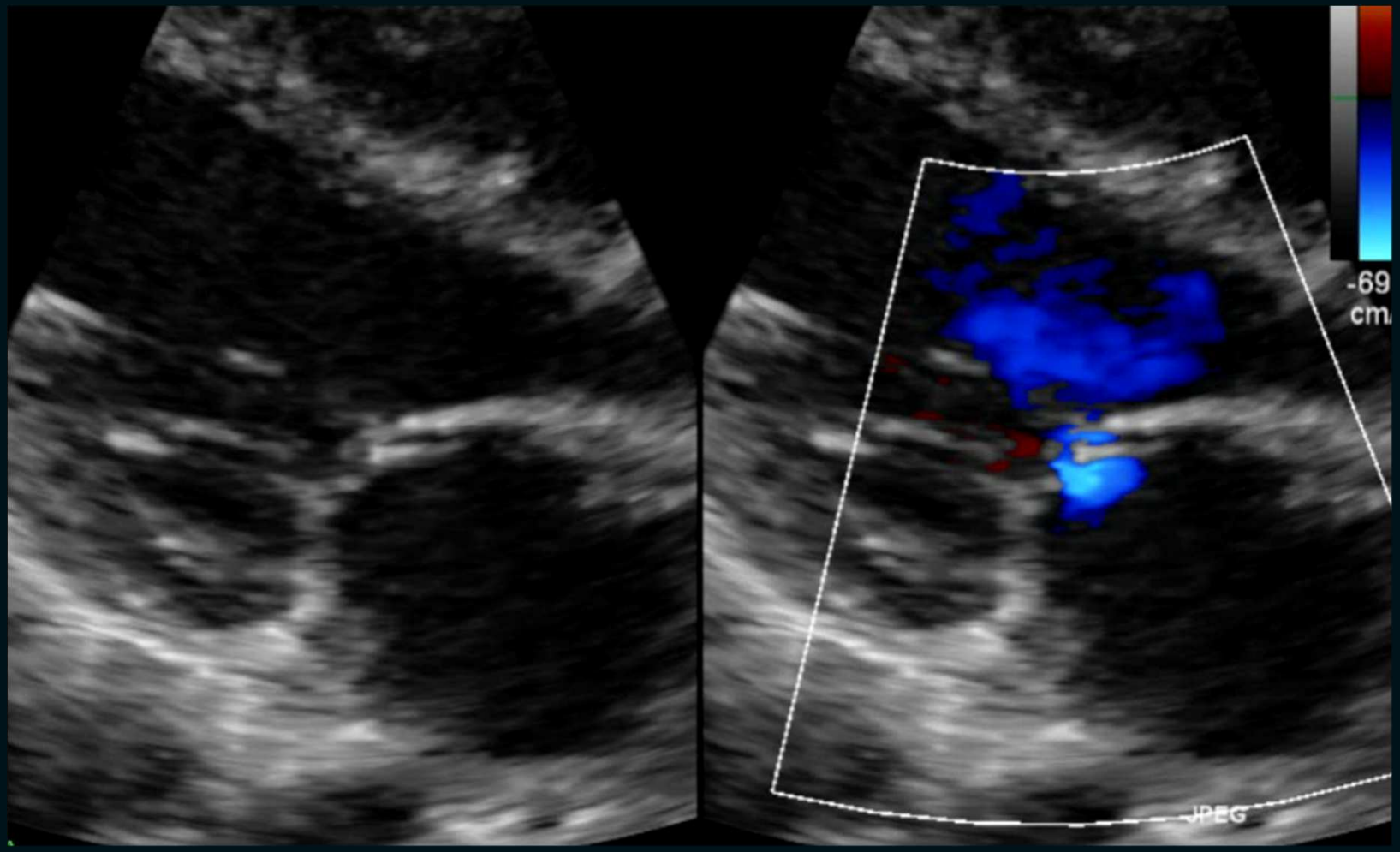

Left Ventricular Outflow Tract Obstruction

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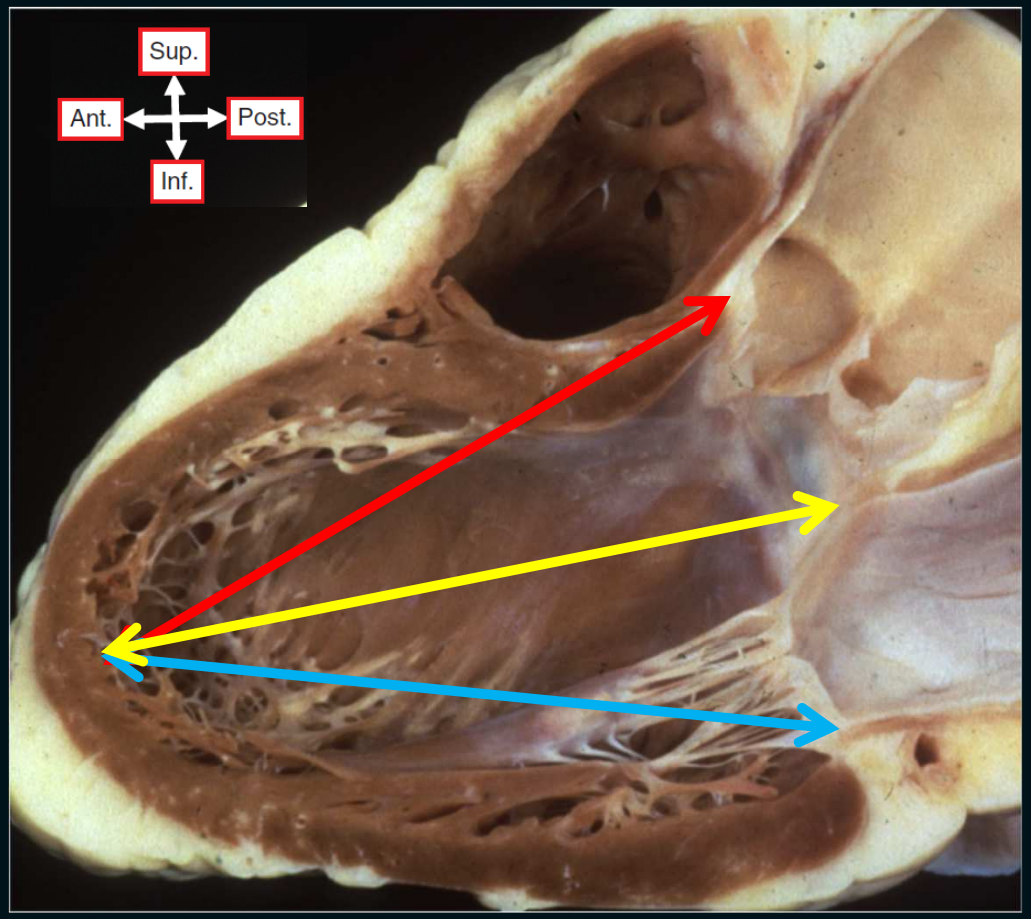
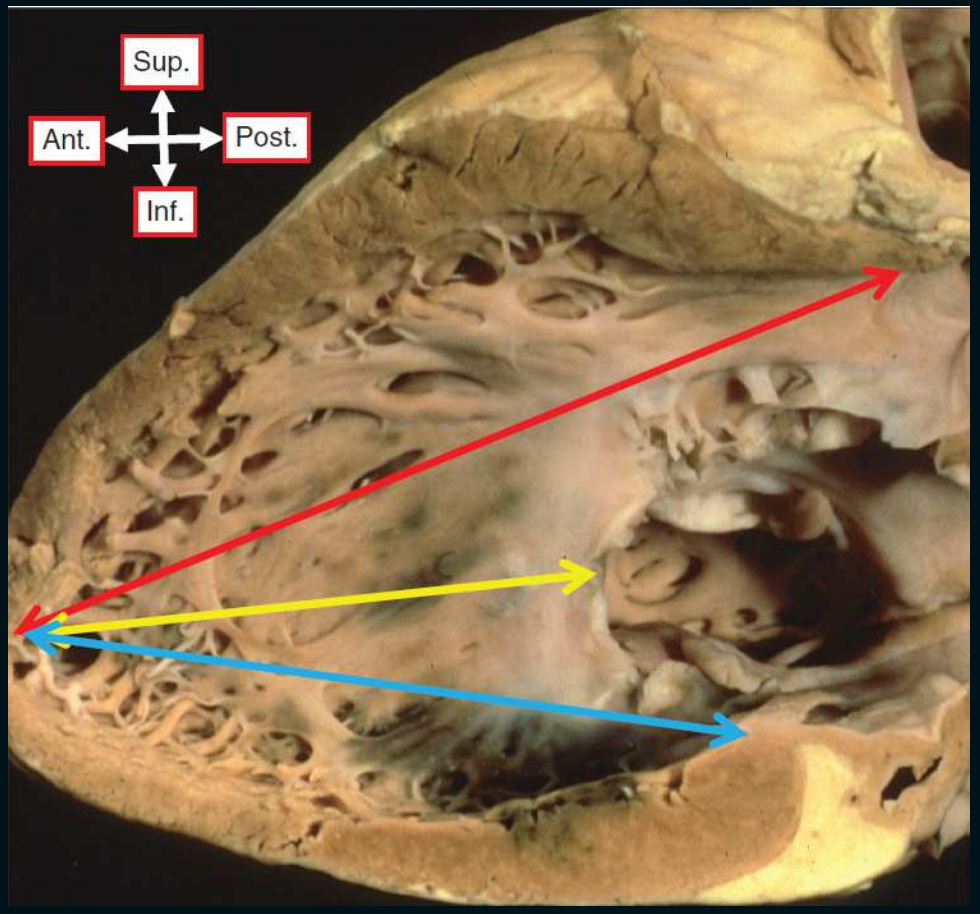
Changing What's Possible

LV Outflow Tract Obstruction

- Between 1-6% require surgery for LVOTO after primary repair
  - 5-12 yr after AVSD repair
- Often progressive
- Substrate:
  - “Unwedging” of the aortic root
  - “Scooped out” muscular septum
  - Chordal attachments in LVOT

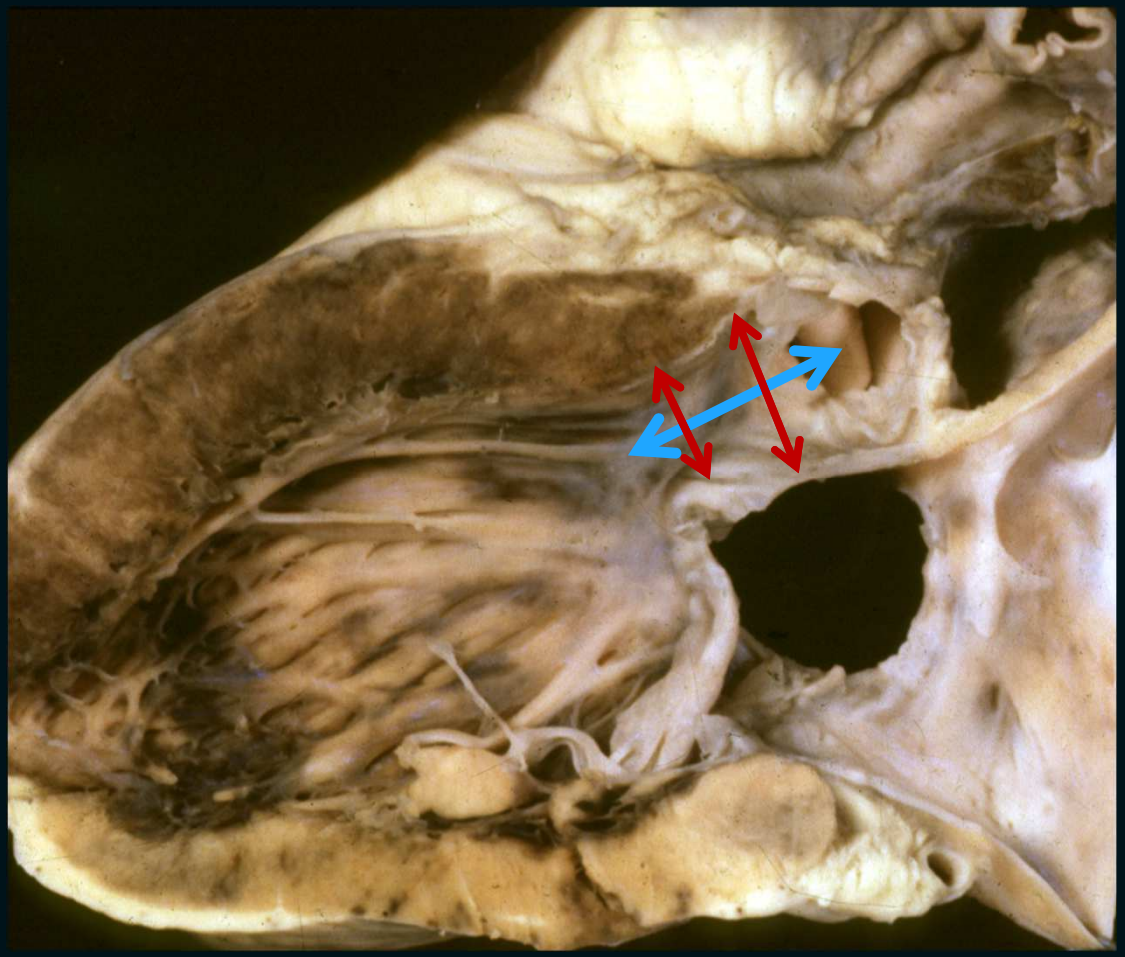
LVOT Obstruction Substrate





From Anderson, Spicer, Hlavacek, et al. “Wilcox Surgical Anatomy of the Heart”, 4th Ed. 2013

LVOT Obstruction Substrate



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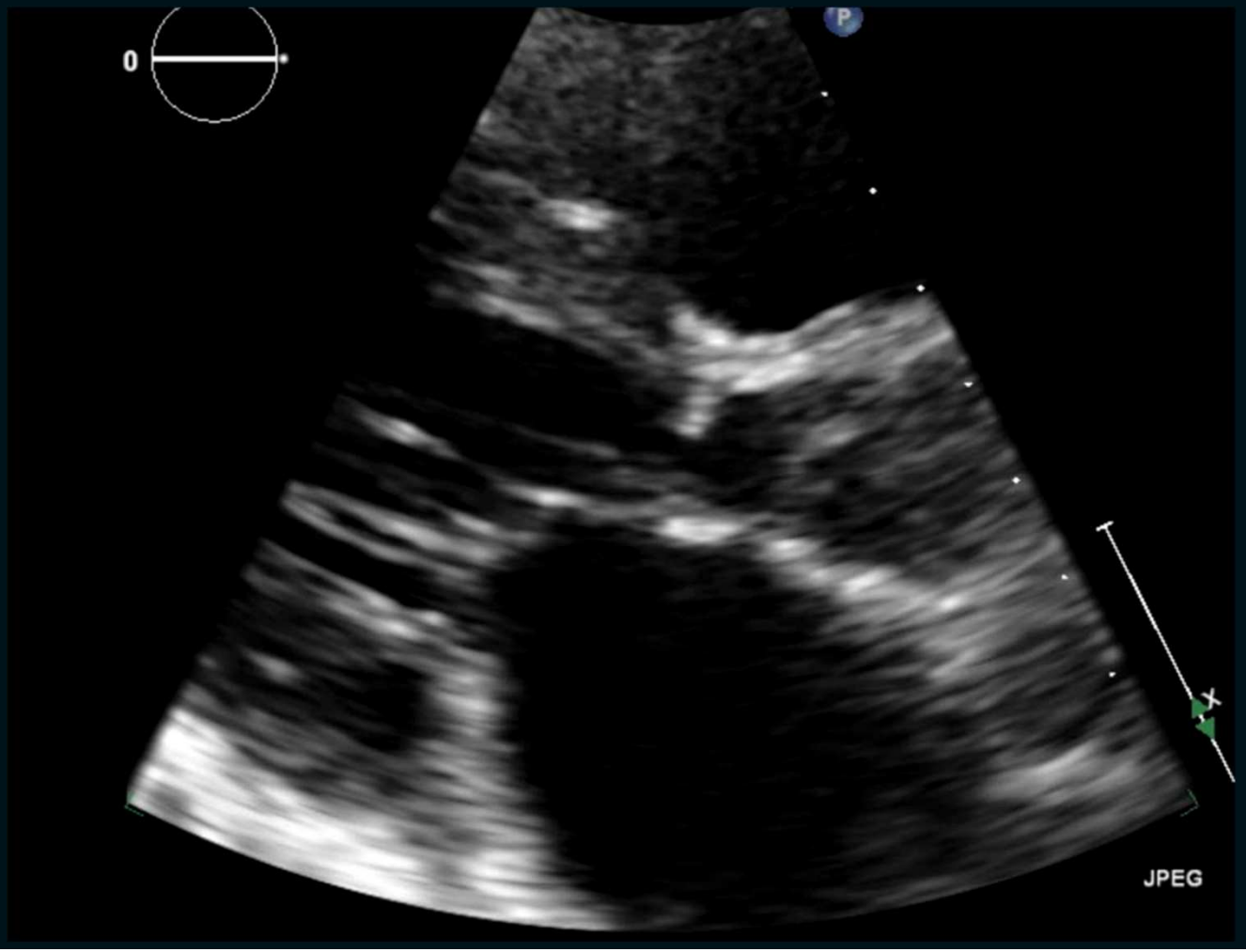
LVOTO-Discrete Membrane



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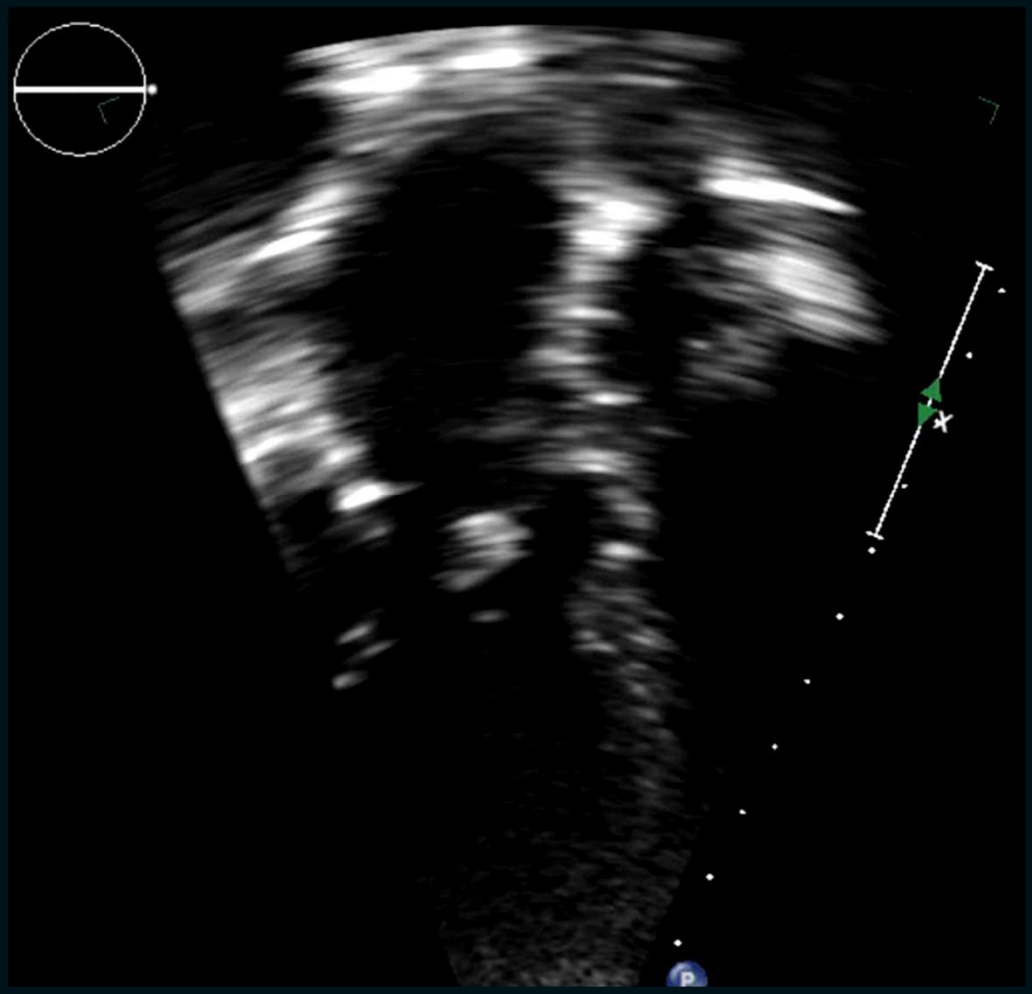
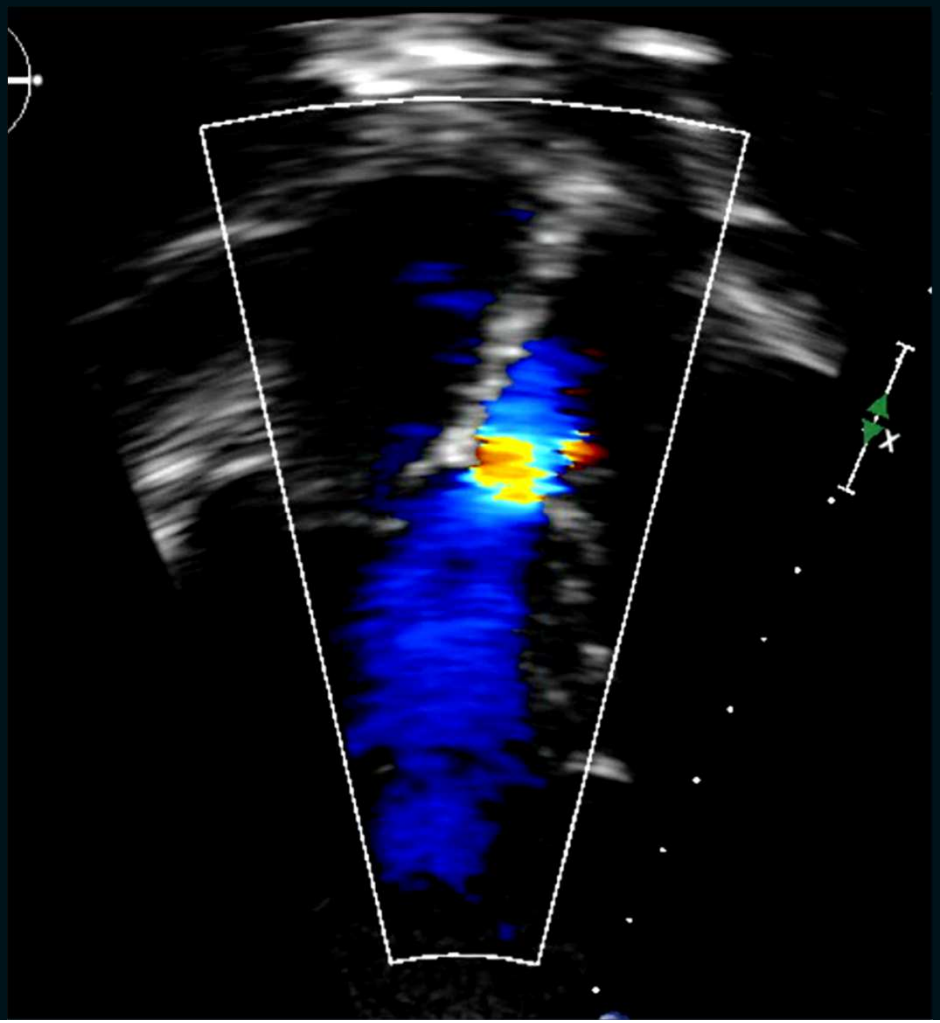
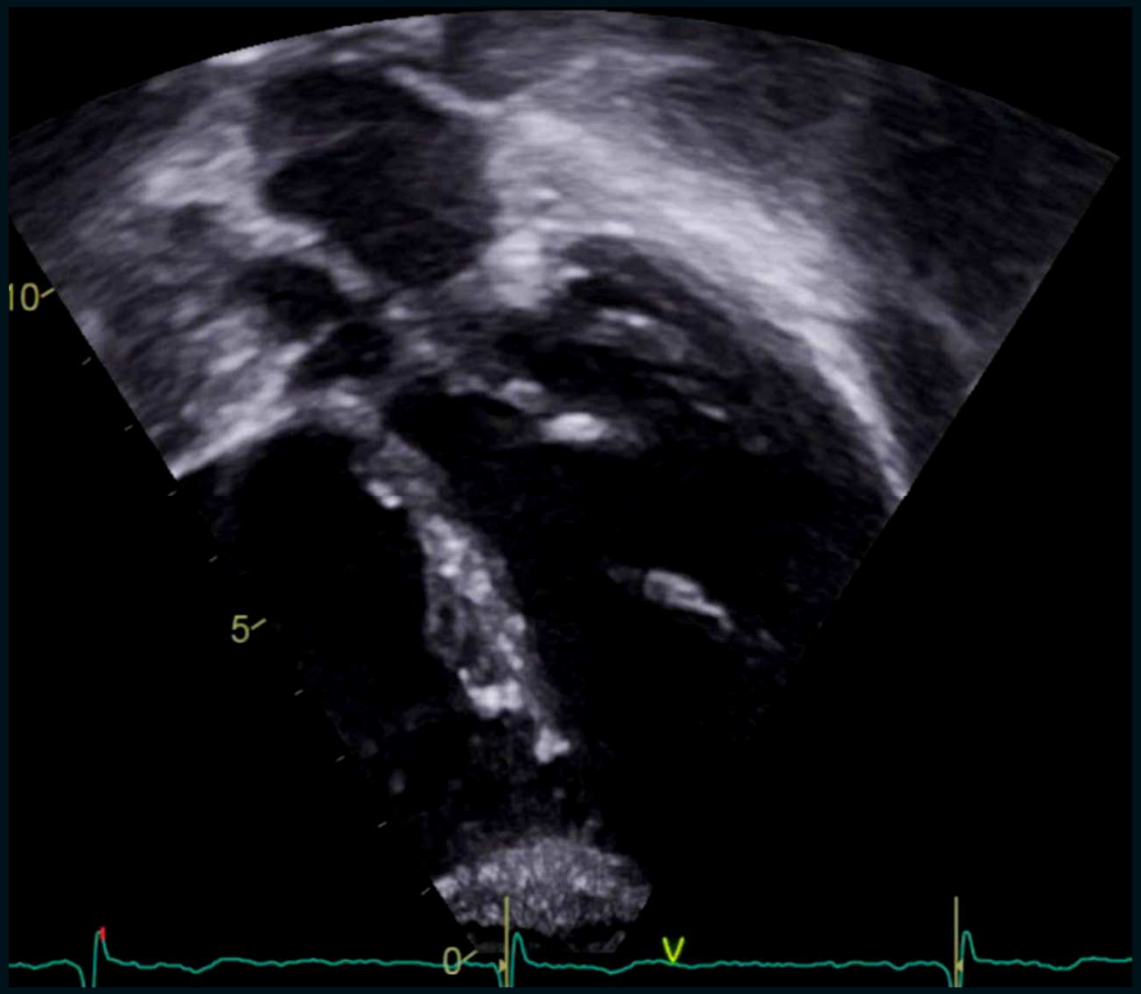




LVOTO-Chordae



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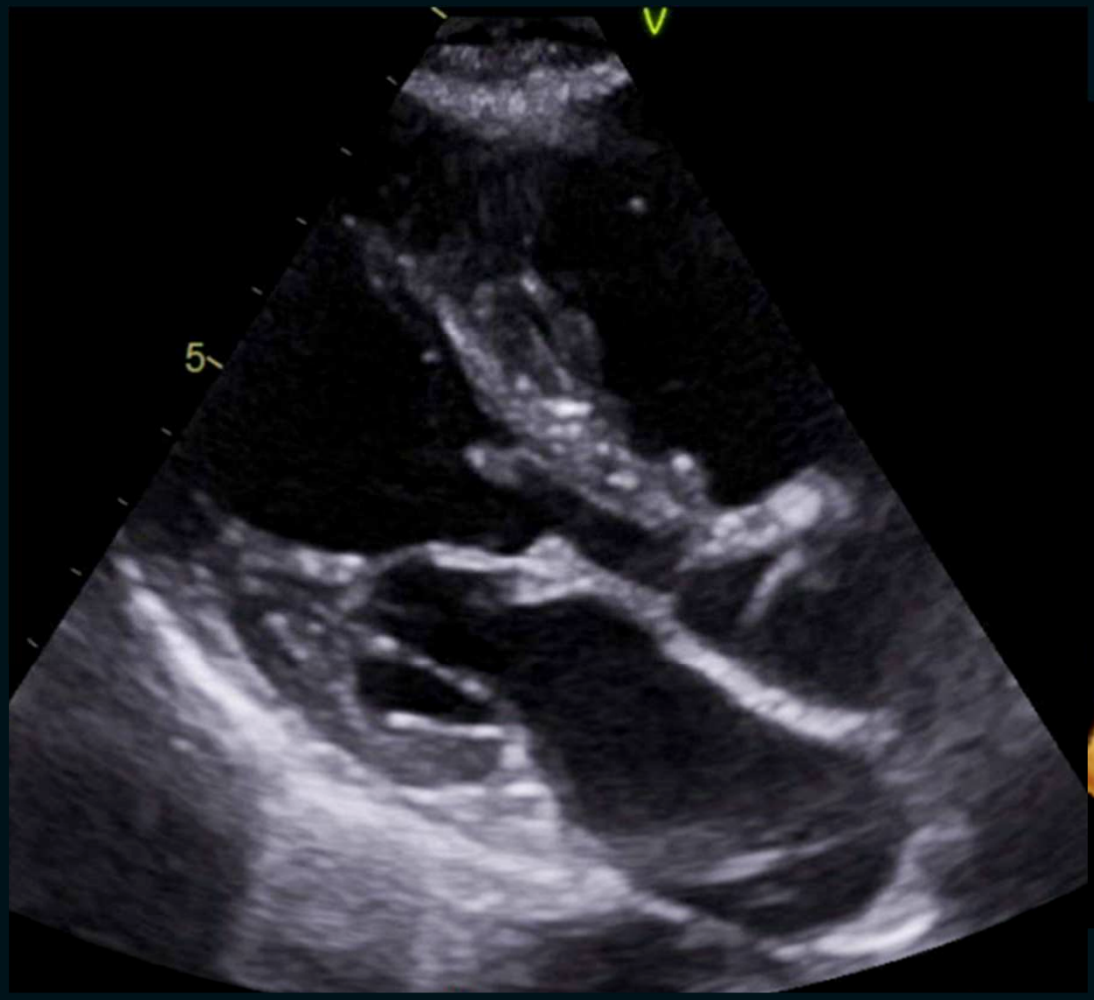

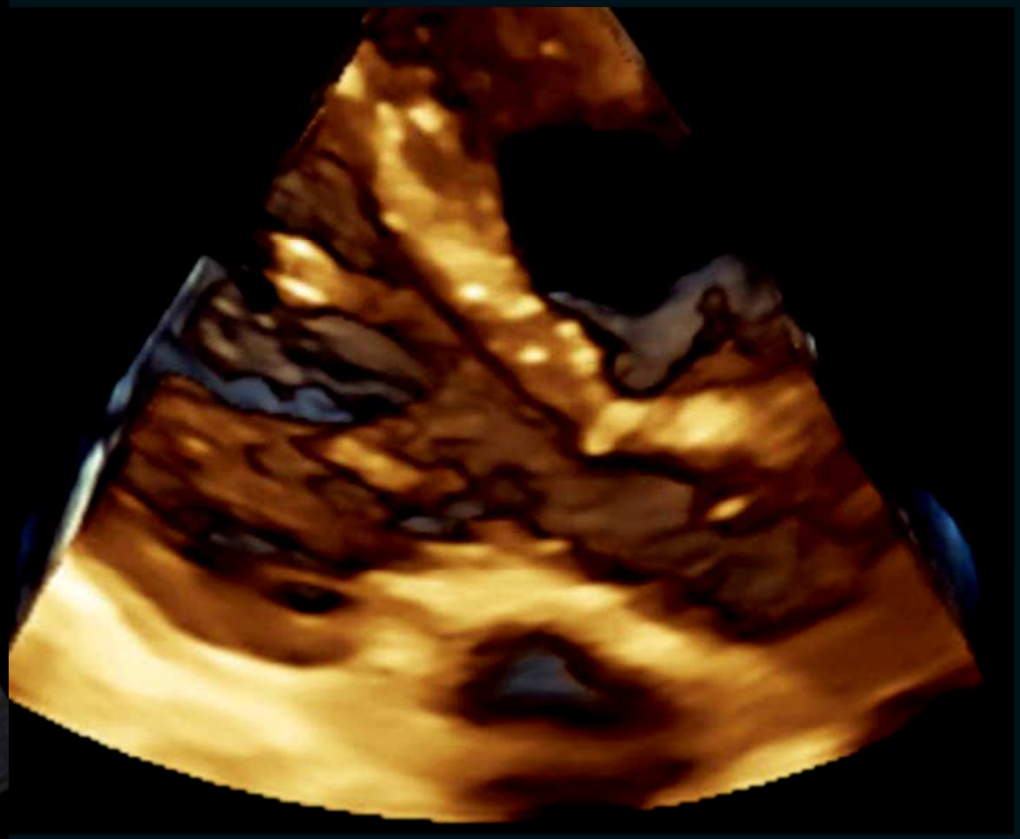

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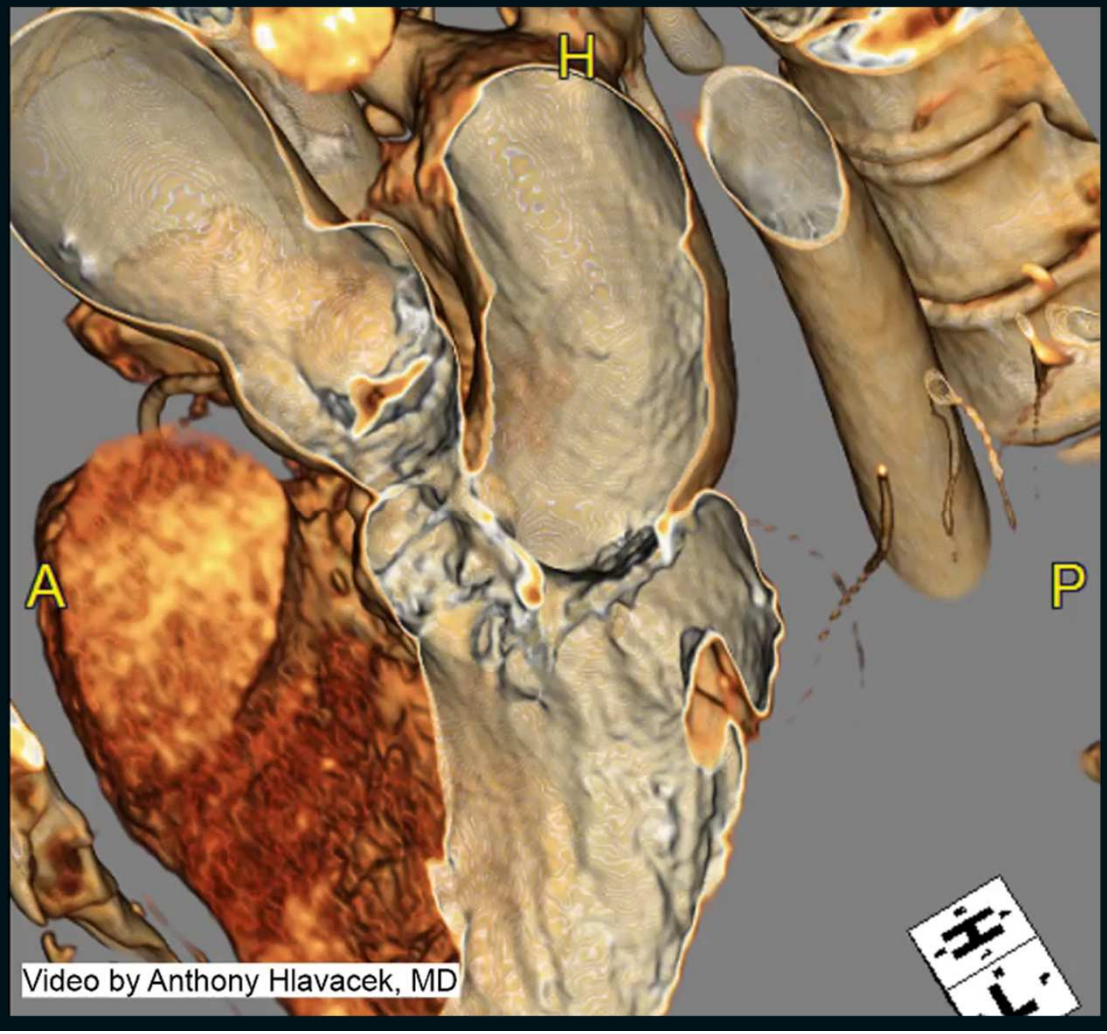
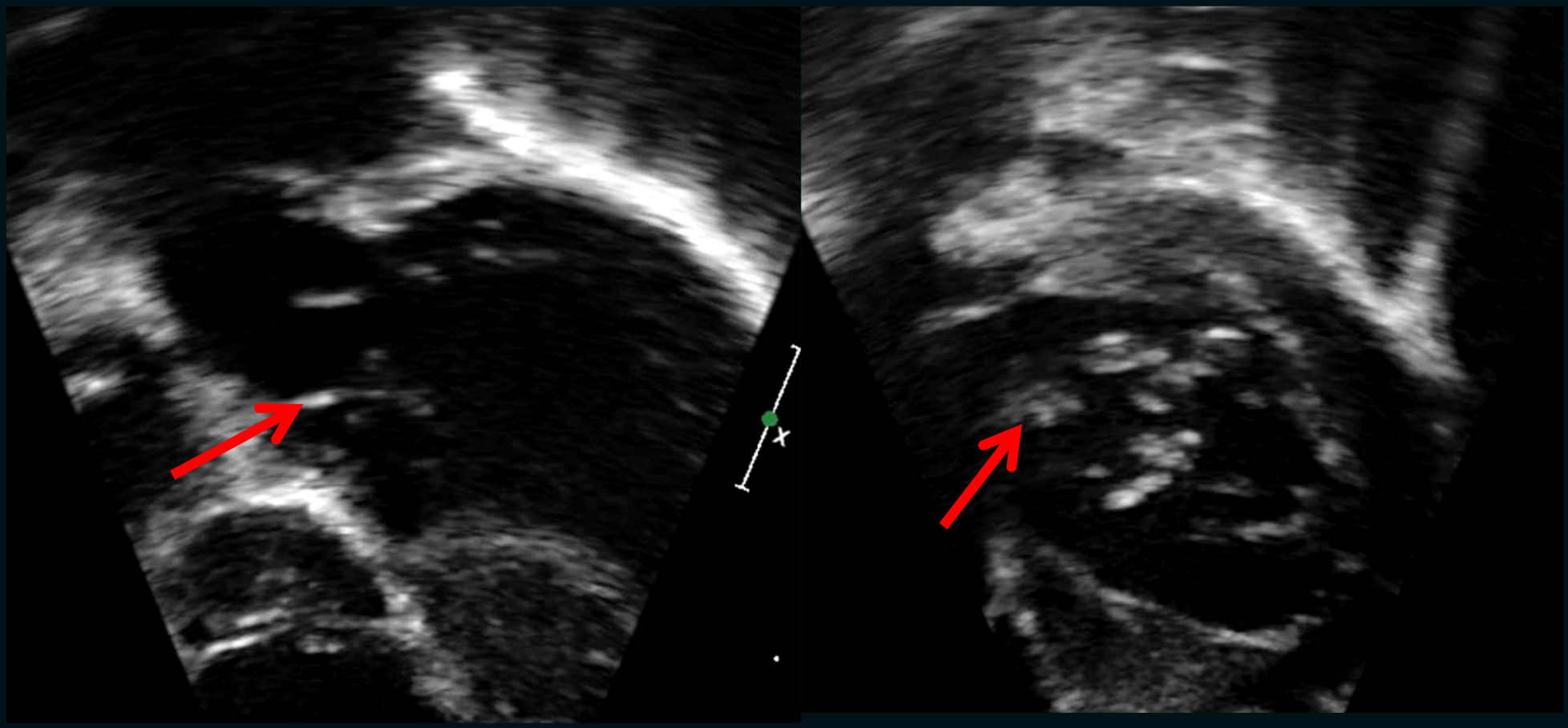


LVOTO-Chordae and Muscular



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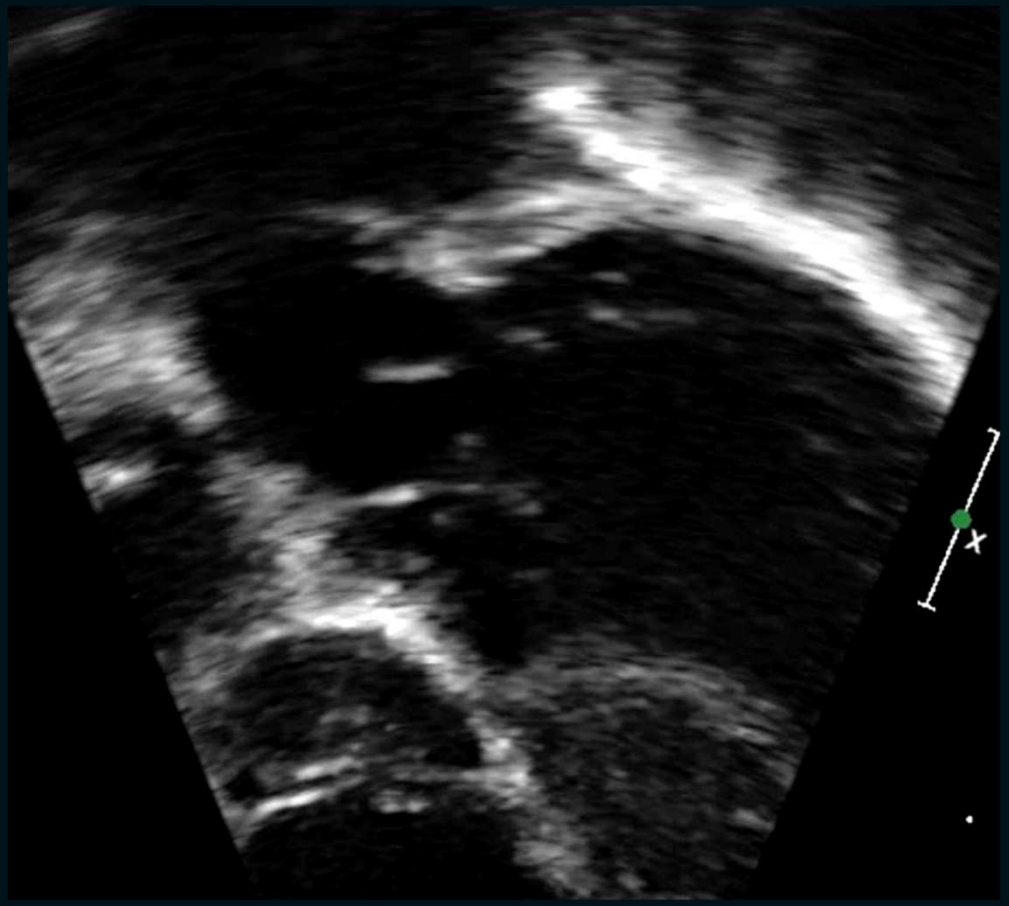

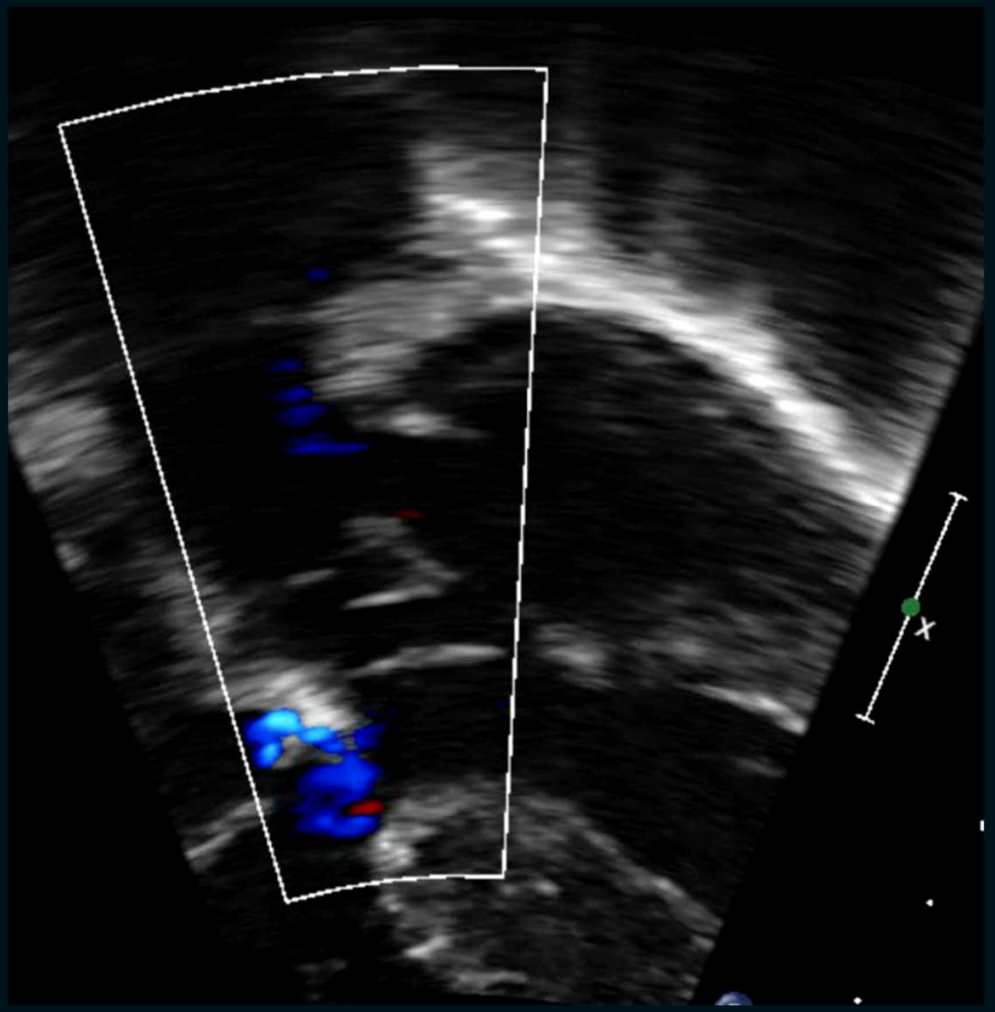

Conclusion

- Residual lesions common after AVSD repair
- Residual ASD/VSD often improve/resolve
- LAVVR and LVOTO most common issues requiring intervention
  - LAVVR early, LVOTO later
- 3D echo can be helpful
- CMR potentially useful with LAVVR