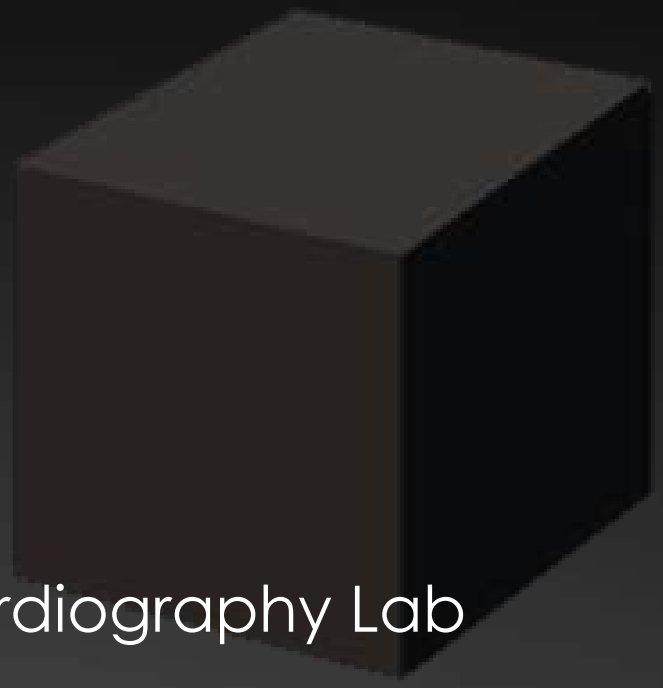
Imaging Evaluation of a (Possible?)Thrombus: This is How I Do It



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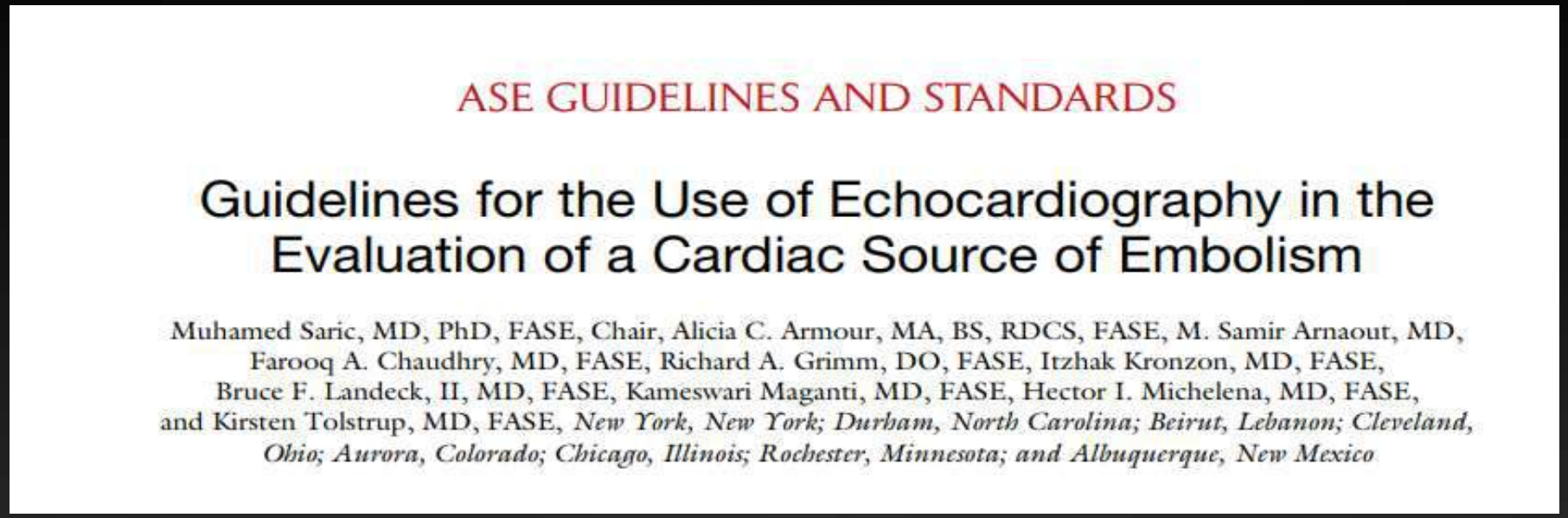
NO CONFLICT OF INTEREST OR FINANCIAL DISCLOSURES

Outline: Non-invasive Thrombus Evaluation

- Imaging technology & Techniques:
  - Echo characteristics of thrombus
- *Normal variants*
  - *How to tell if real or not/ false positives*
- *Review of Cases*
- *Additional imaging*
  - *Contrast Echo, MRI/CT*



- Guidelines exist for use of echo for thrombus eval
  - Limited guidance for pediatric patients

Echo Characteristics of Thrombus

- Highly echogenic mass w/in a chamber or contiguous w/endocardium or valves
- Typically have bright and smooth borders, homogeneous appearance
- Tend to reside in certain areas:
  - Cardiac apex (DCM), appendages (arrhythmia)
  - Tip of catheter (atria)
  - Adjacent to foreign material/patches
  - Low flow areas (BDG or Fontan pathway)

Basic Principles: Thrombus in the heart

- Must see in at least two views
- Distinct from the myocardium
- Mobility of structure
- Clinical context
  - Rare in healthy children with NL hearts
  - Pretest probability
- Two echocardiographers should agree

Echo Techniques for Visualizing Thrombus: *increasing the yield*

- High frequency probes
- Multiplane imaging with orthogonal views
  - Additional off axis/non-std views
- Complete sweeps from post-anterior
- Assess for color flow disturbances
- Transpulmonary contrast

Normal Variants

- The heart has several structures that mimic thrombus and complicate imaging
  - Can be difficult to differentiate from thrombus
- Understanding these normal variants is important to minimize false positives

Coumadin Ridge (aka Q-tip)- *often mistaken for thrombus*

13y/o with stroke

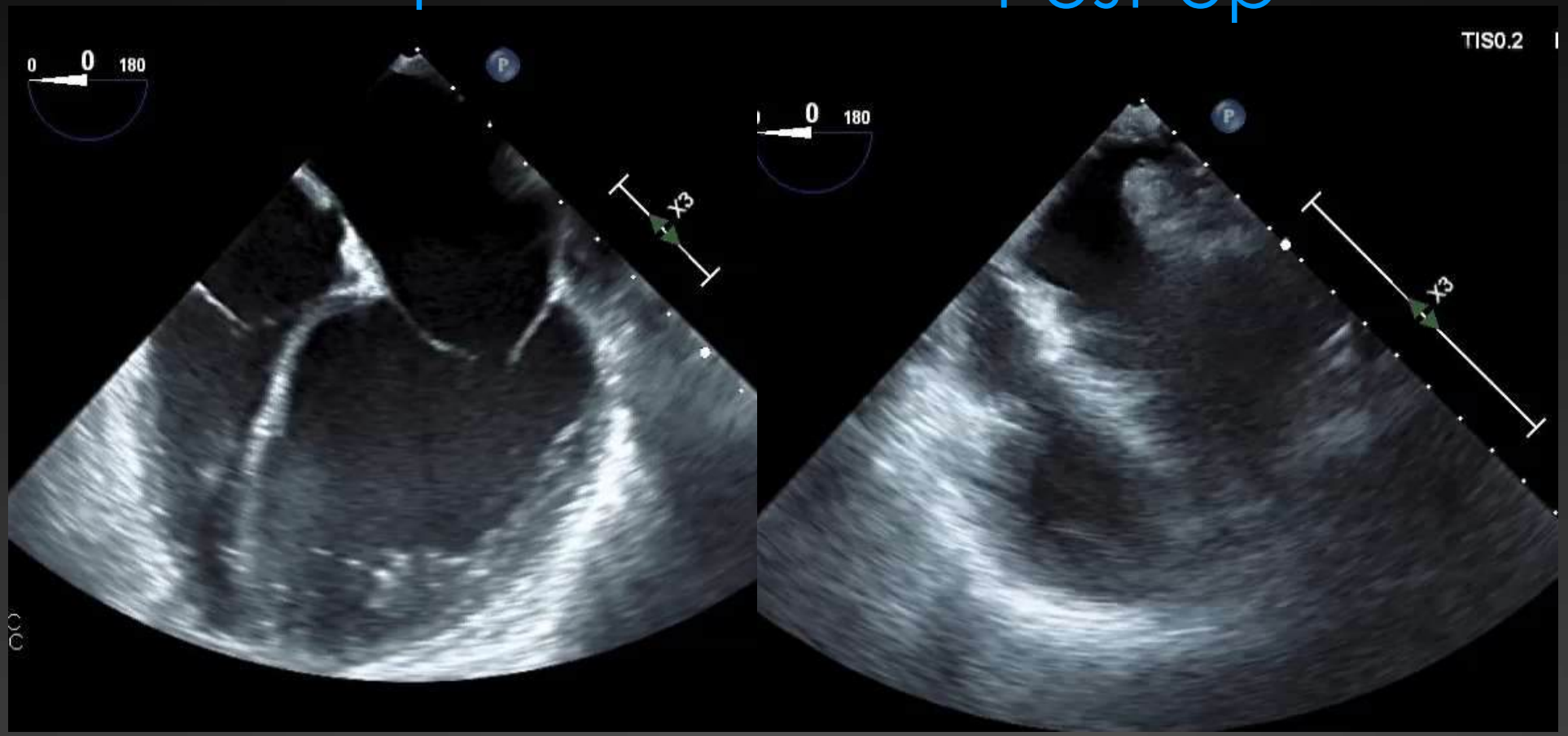
Chiari network-

- Incomplete resorption of the right valve of sinus venosus leading to mobile, reticular network in the RA near opening of IVC and coronary sinus

Inverted Atrial Appendage

Pre-op

Post-op

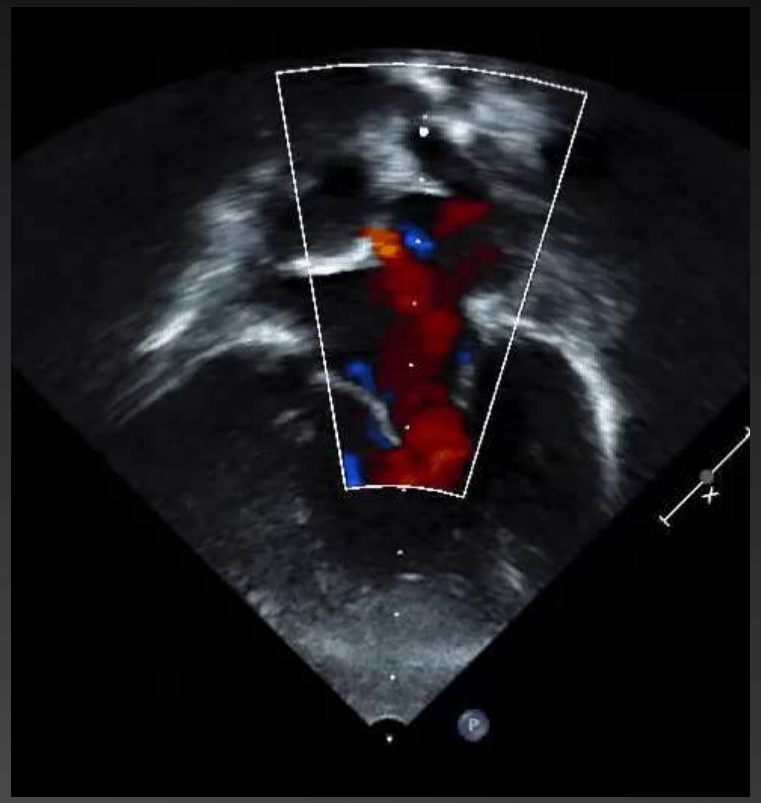


Real versus Artifact ?

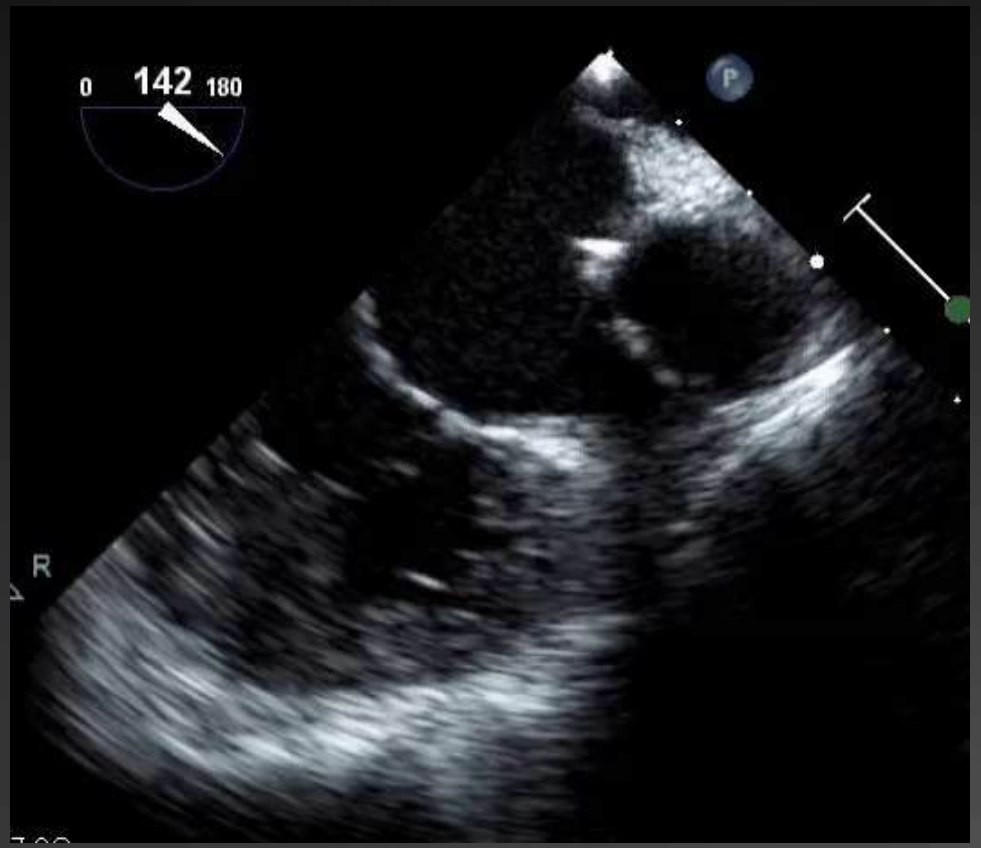
- Artifacts are common and can mimic thrombus
  - Reverberation and shadowing artifacts are most common
- Stick to basic rules
  - Ability to visualize presence in orthogonal and off axis views
  - Alterations in color flow patterns

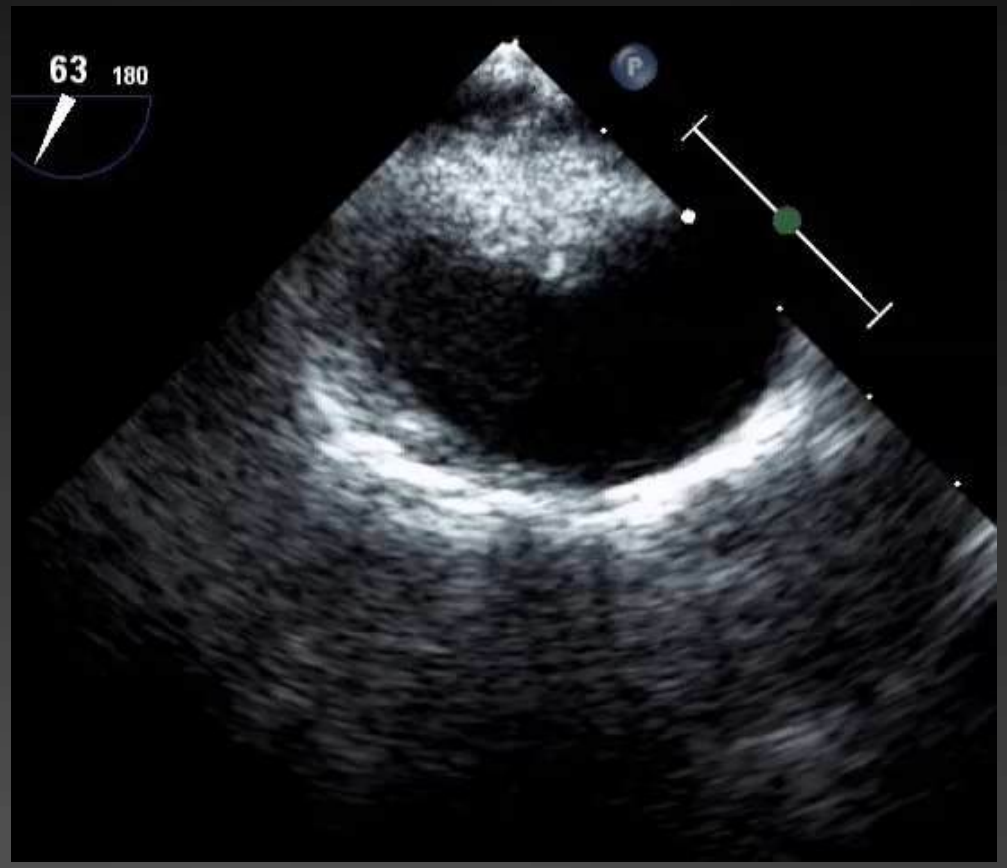
Reverberation artifact

Fontan pt with Thrombus ?



TEE is normal





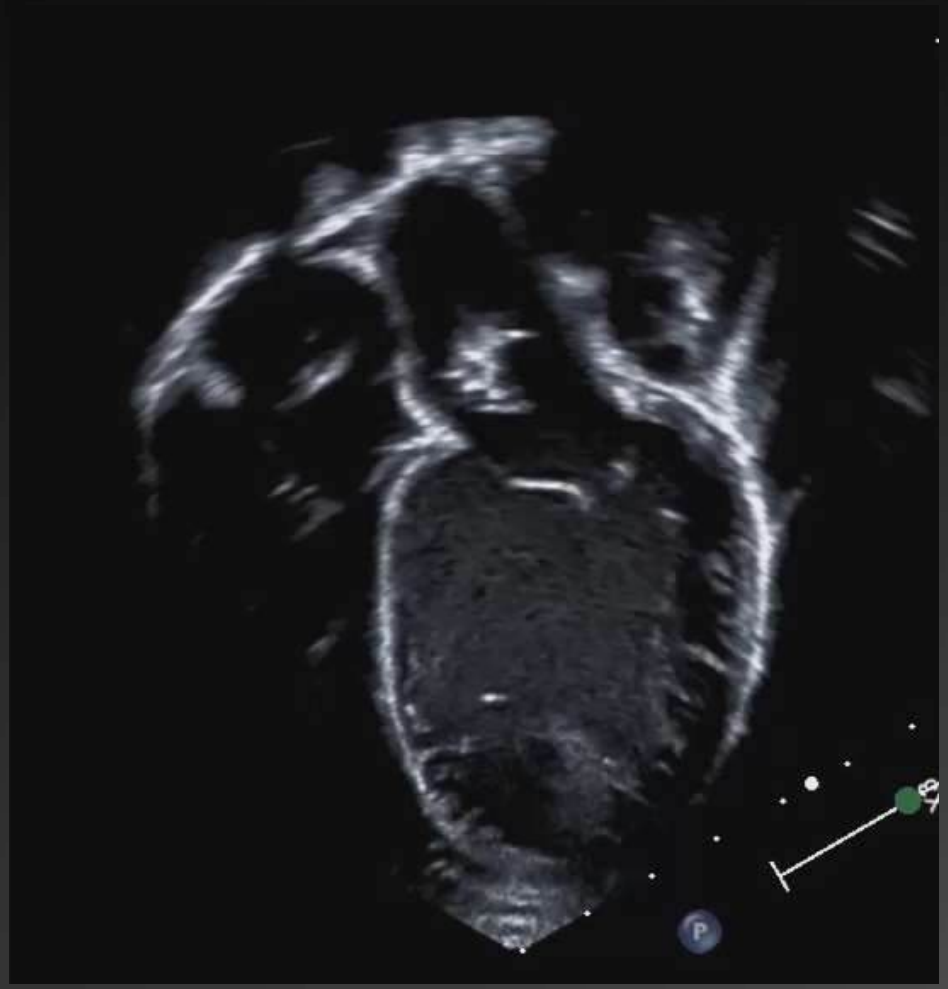
Lambl's Excrescence

-Thin (< 2mm), filamentous, mobile strand attached to left sided valves on point of valve closure.
-AV: on LV side and MV: on atrial side.
-Have been liked to thromboembolism, typically monitored in peds pts that are asymptomatic.

Spontaneous Echo Contrast (SEC)

- Thrombogenesis occurs along a continuum that starts with SEC or “smoke” secondary to stasis
- SEC has been associated with later thrombosis formation and embolism

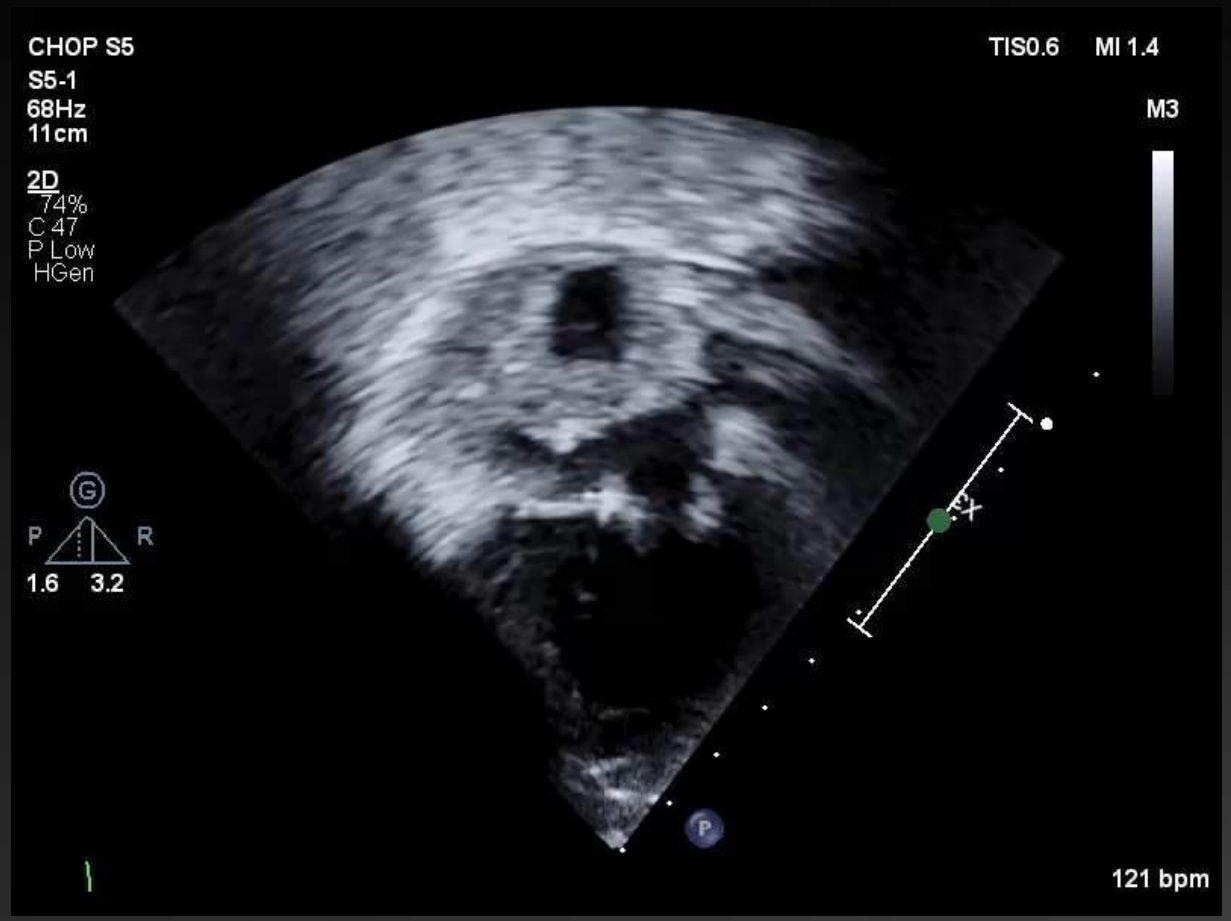
SEC- ominous sign



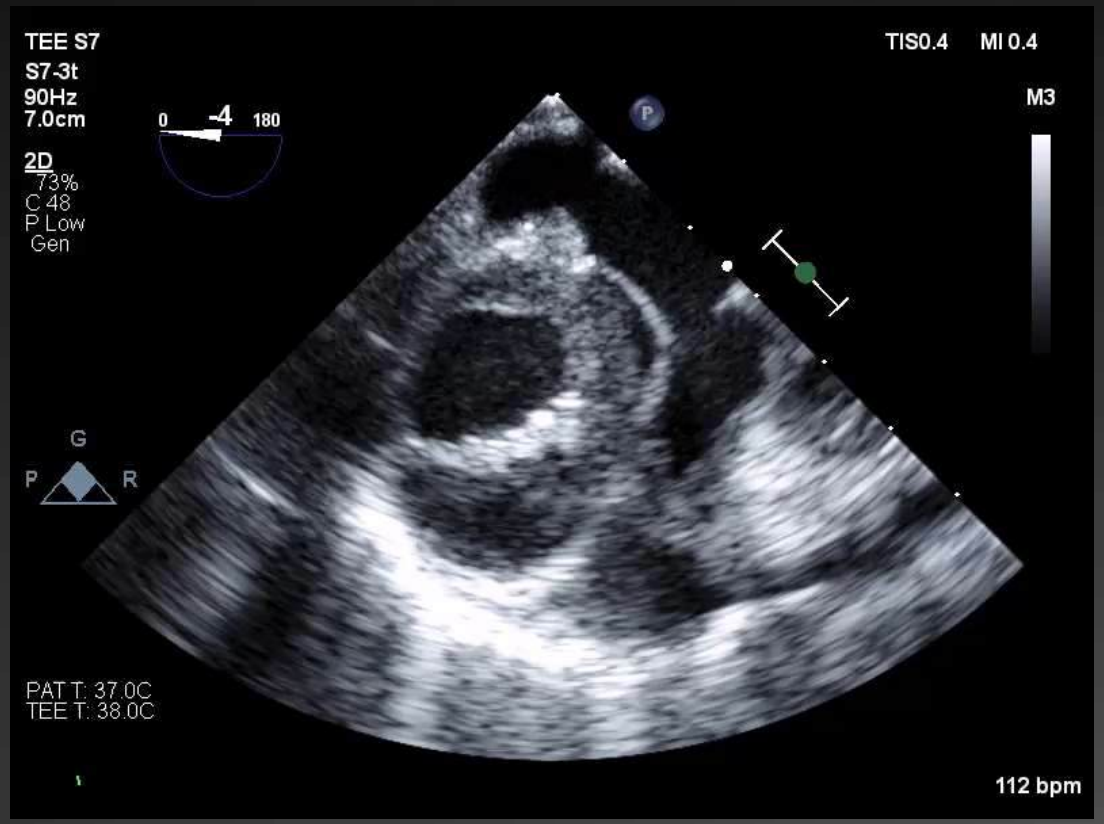
Thrombus with CHD

- Low flow states, cardiac dysfunction
- Foreign material
- Central lines
- High suspicion
  - Particularly in single ventricle with lines

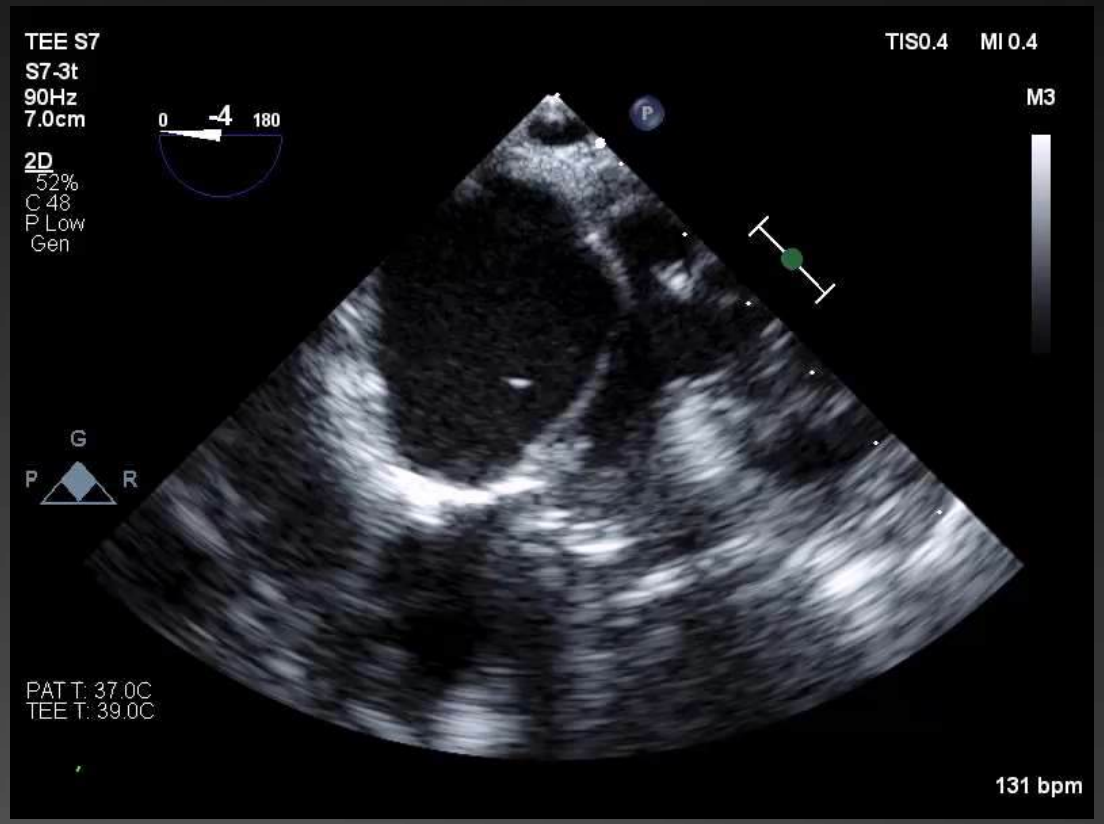
Post-op Fontan



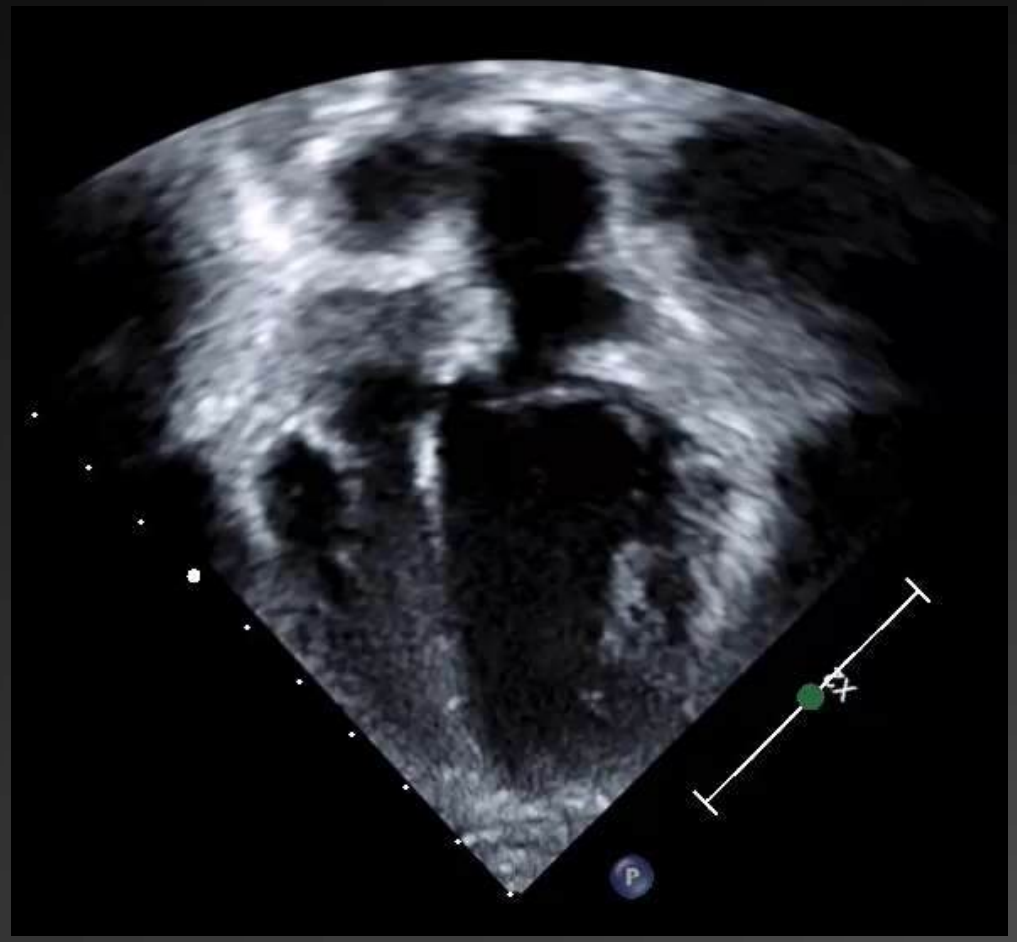
Pre-op



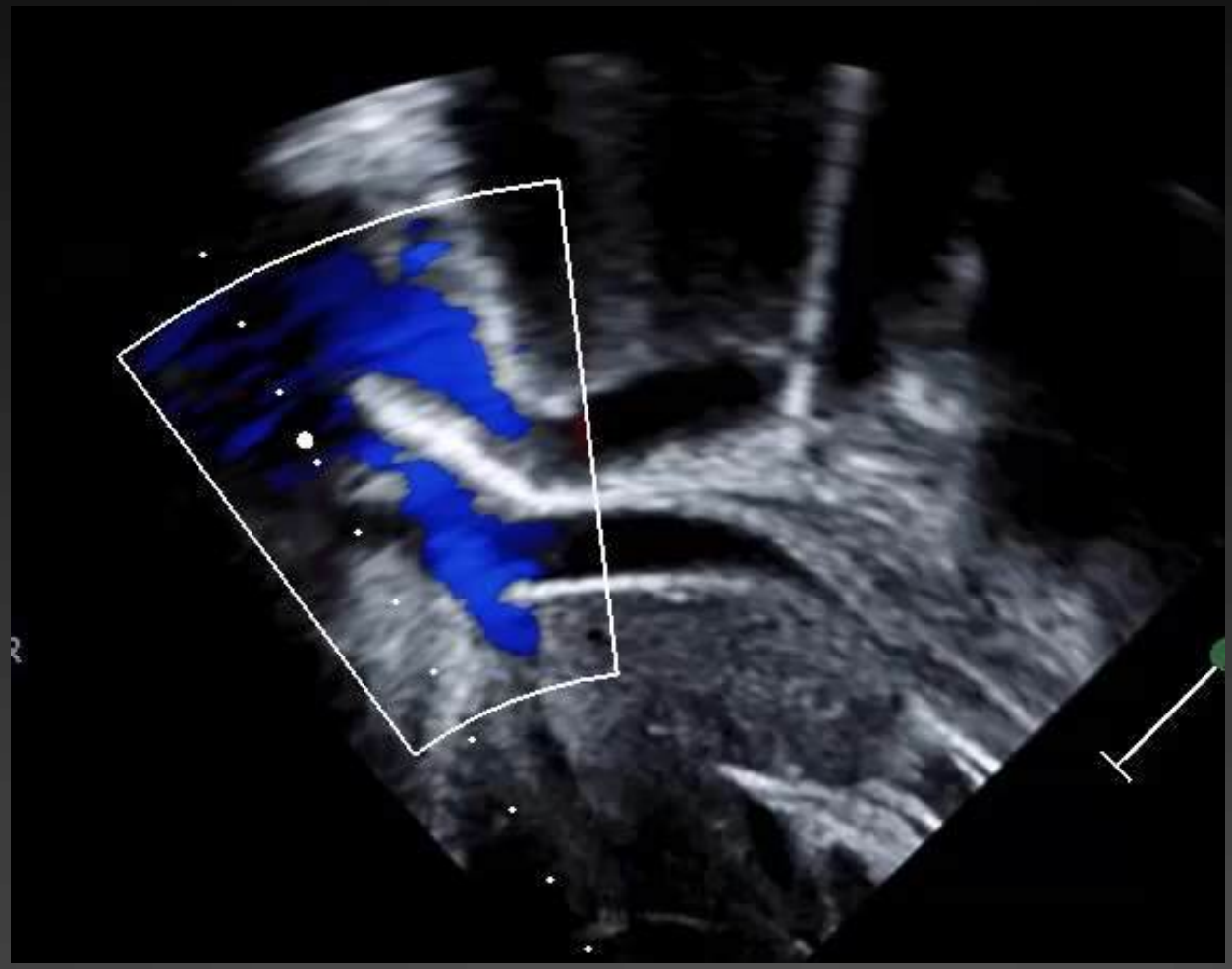
Post-op



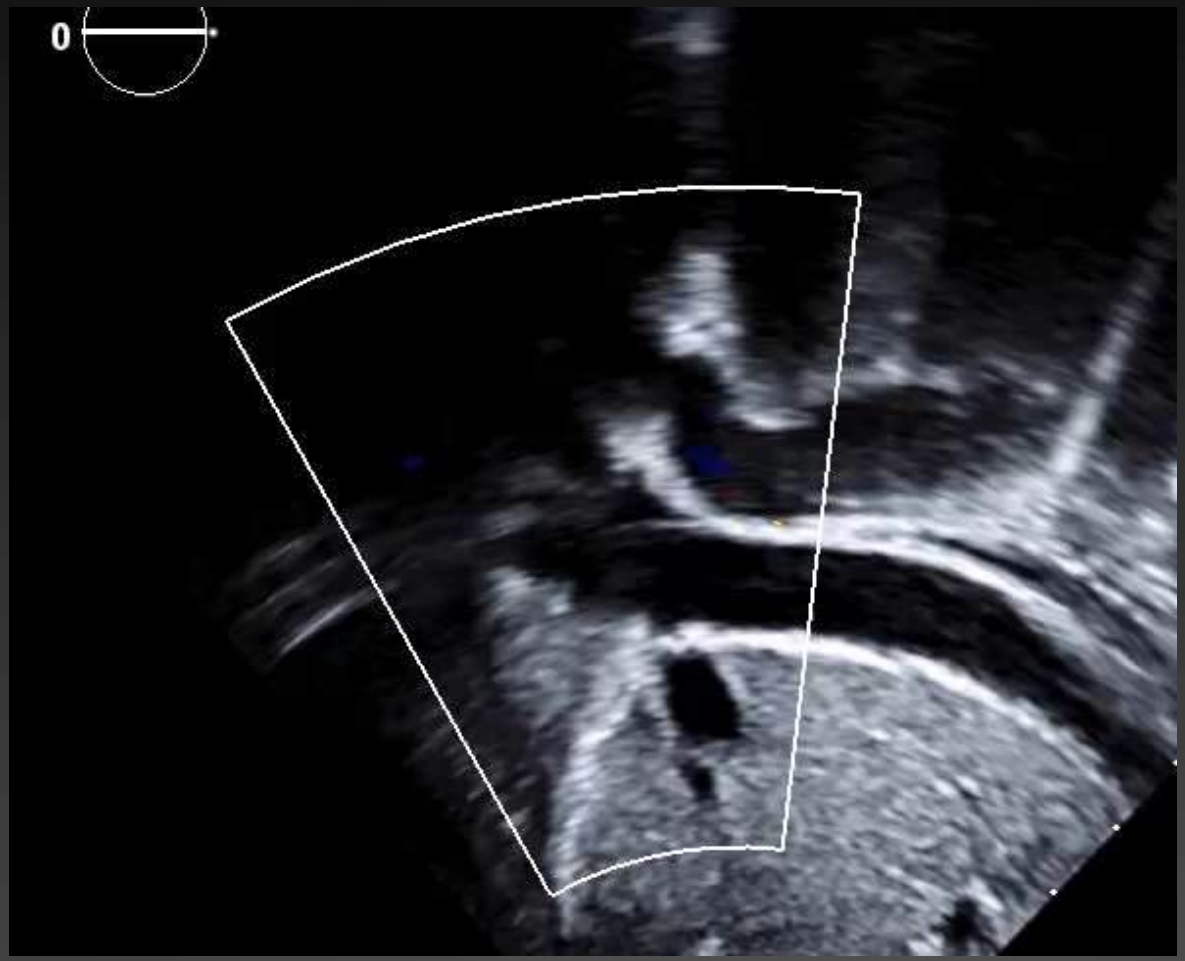
Typical EC Fontan



Color flow disturbance



S/p Lovenox



The Role of TEE

- Sometimes you must obtain a TEE

Table 3 Relative benefit of TTE and TEE in evaluation of cardiac sources of embolism

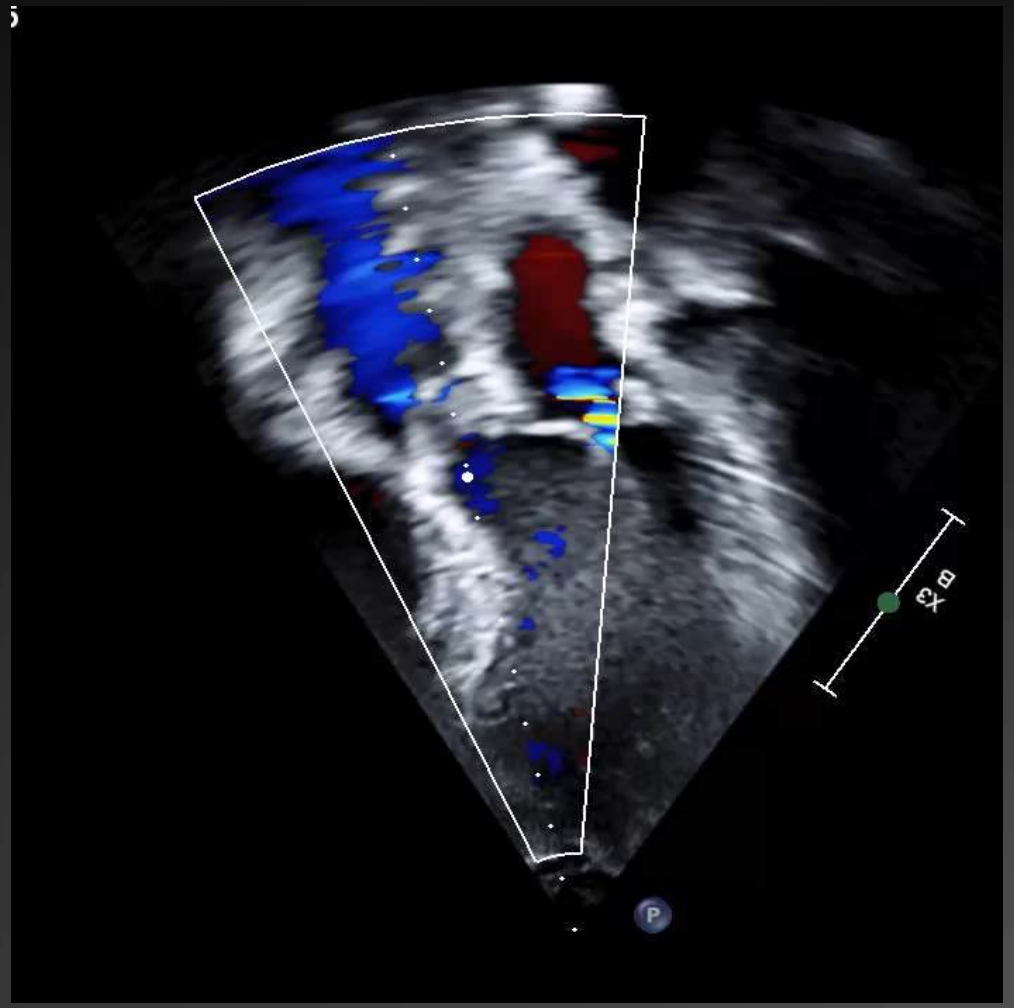
	Potential source of embolism	TTE	TEE
Favors TEE	LA/LAA thrombus or SEC	−/+	++++
	Aortic atheroma	−/+	++++
	Prosthetic valve abnormalities	+	++++
	Native valve vegetation	++	++++
	Atrial septal anomalies	++	++++
	Cardiac tumors	+++	++++
Favors TTE	LV thrombus	++++	++

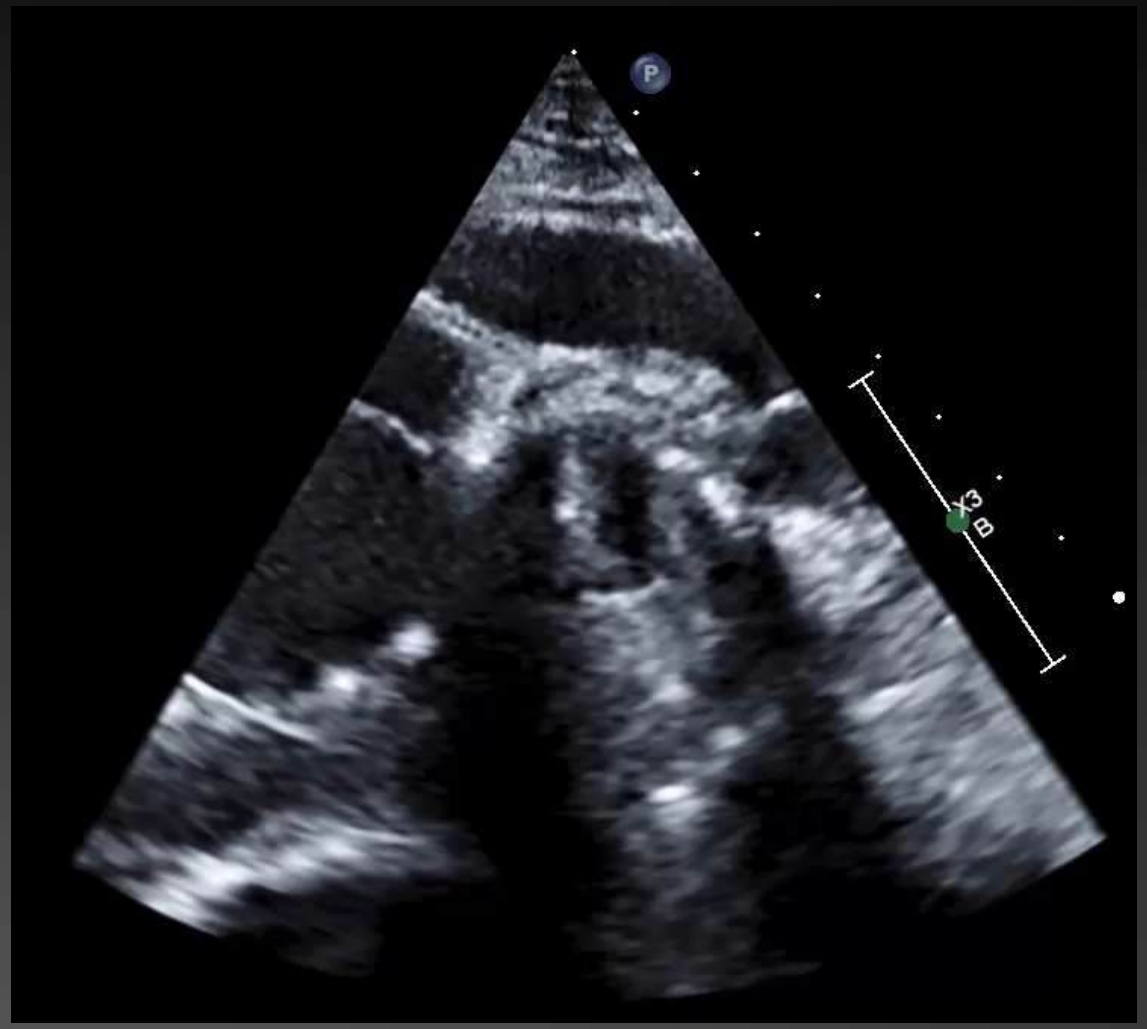
Based on data from Spencer KT. Cardiac source of emboli. In Lang R, Goldstein S, Kronzon I, Khandheria BK, eds. Dynamic Echocardiography. St. Louis, MO: Sanders/Elsevier; 2010:164–168.

SEC- spontaneous echo contrast

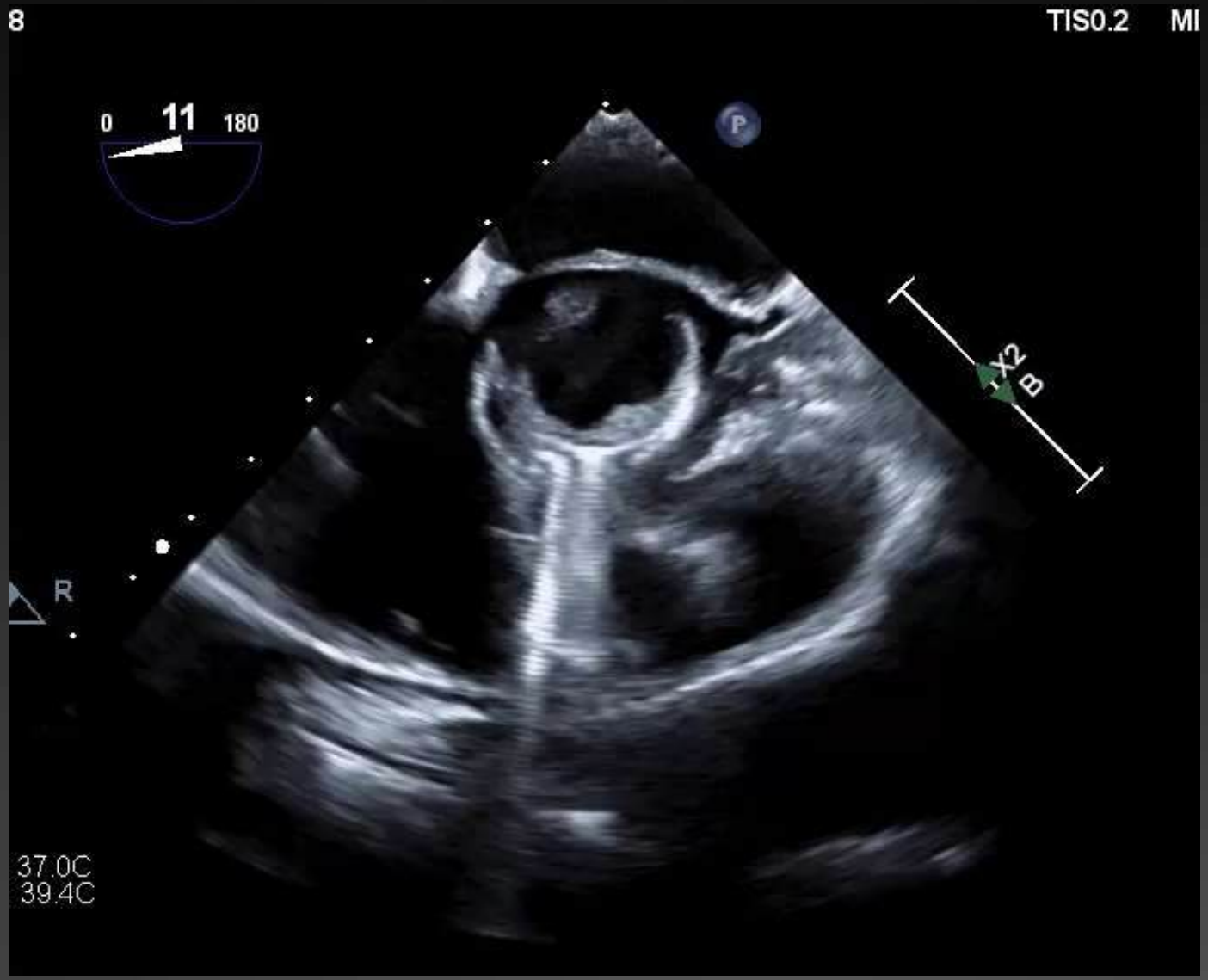
Teenager with Prosthetic (On-X) aortic valve

New gradient





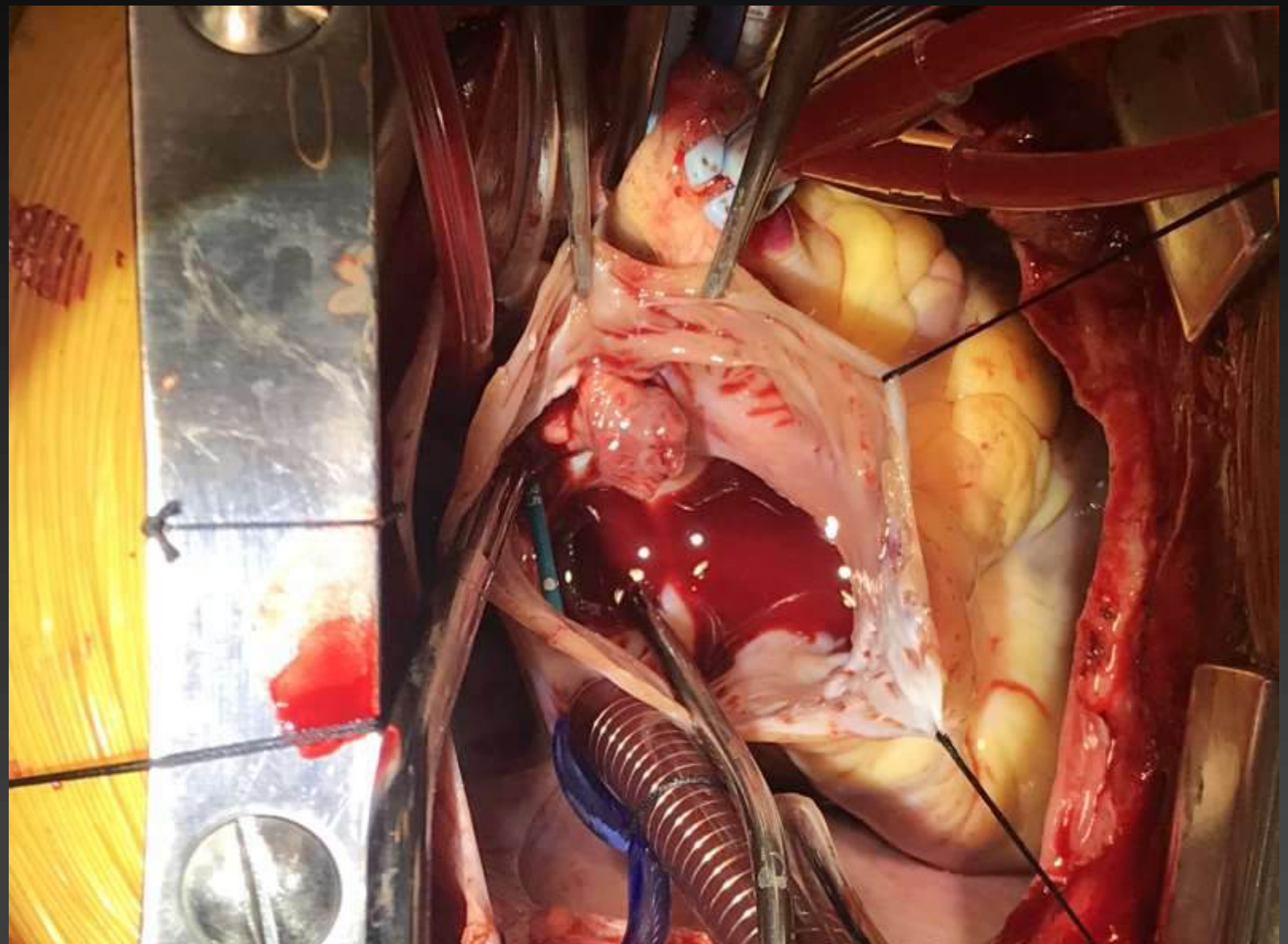
Prosthetic Valve Thrombus



12 y/o with hemophilia and central line

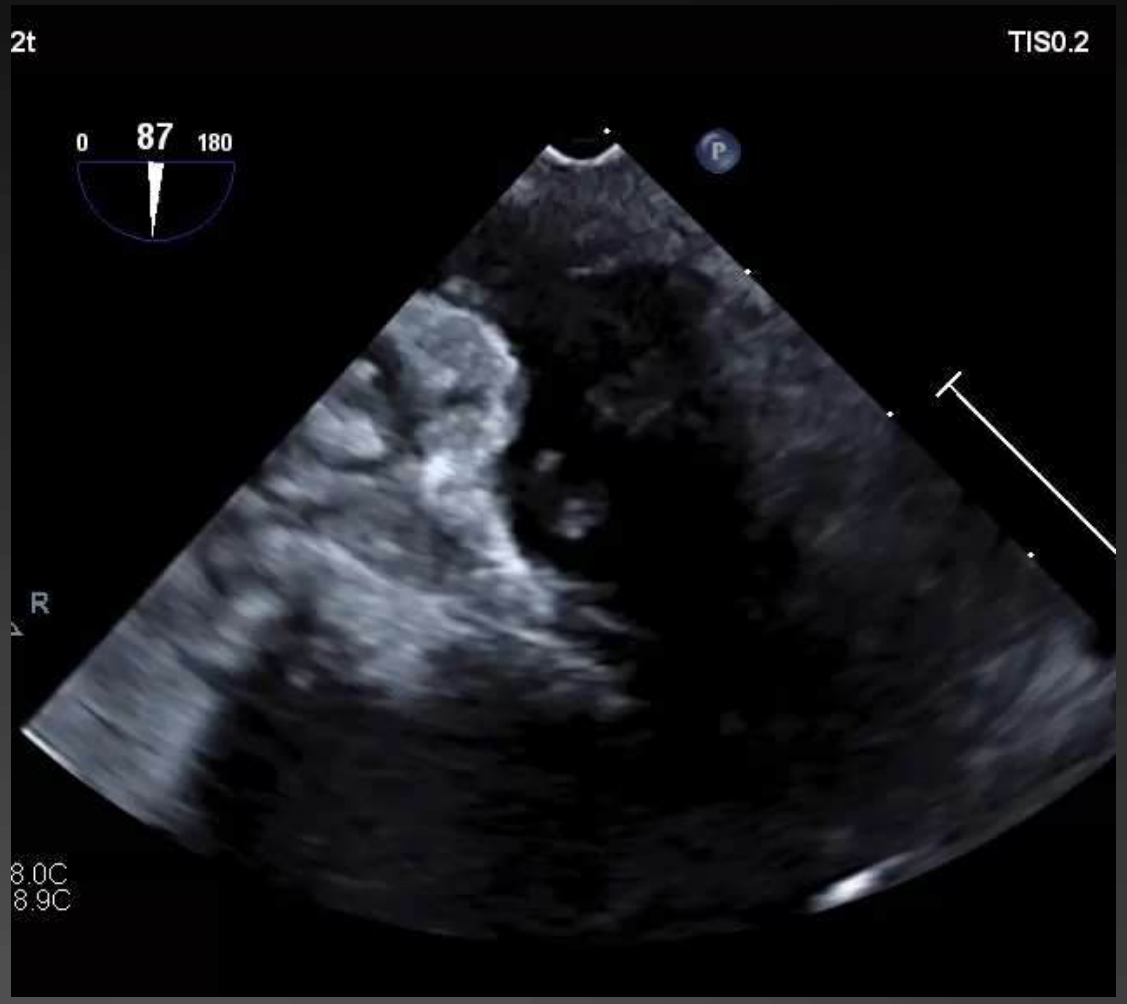
TEE performed the following day

OR the following day



Not all is thrombus- 13 y/o splenic infarct

Not Thrombus!

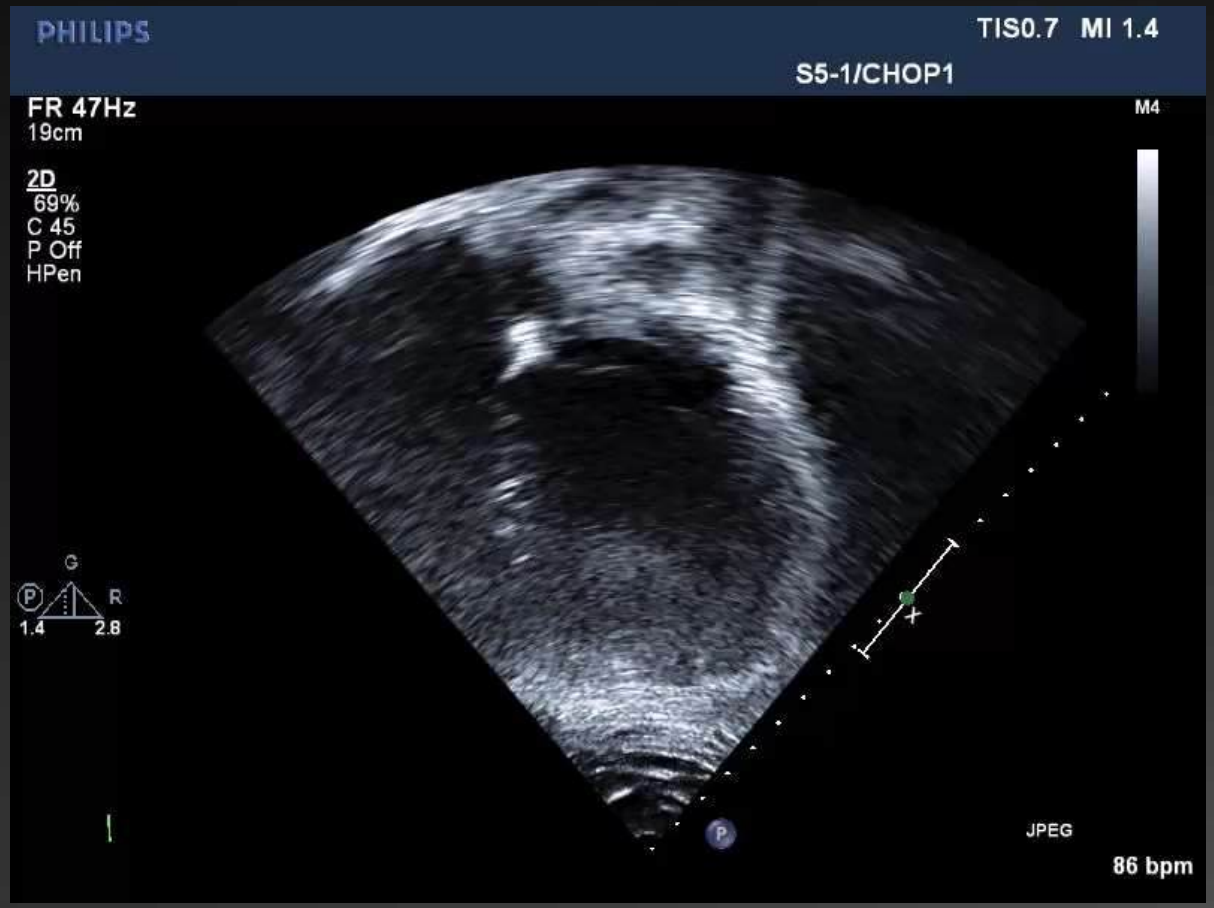


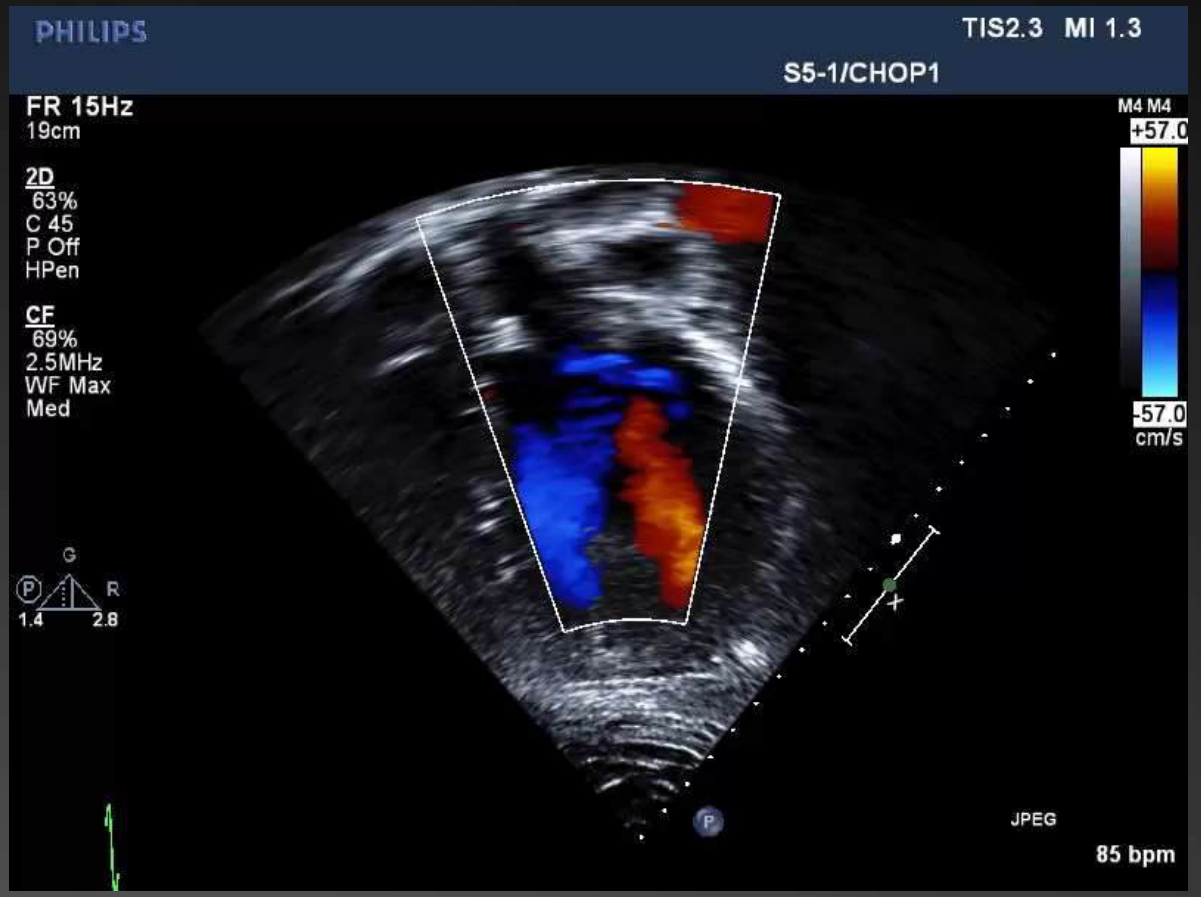
HLHS with mitral stenosis &aortic atresia

MRI- Delayed Enhancement

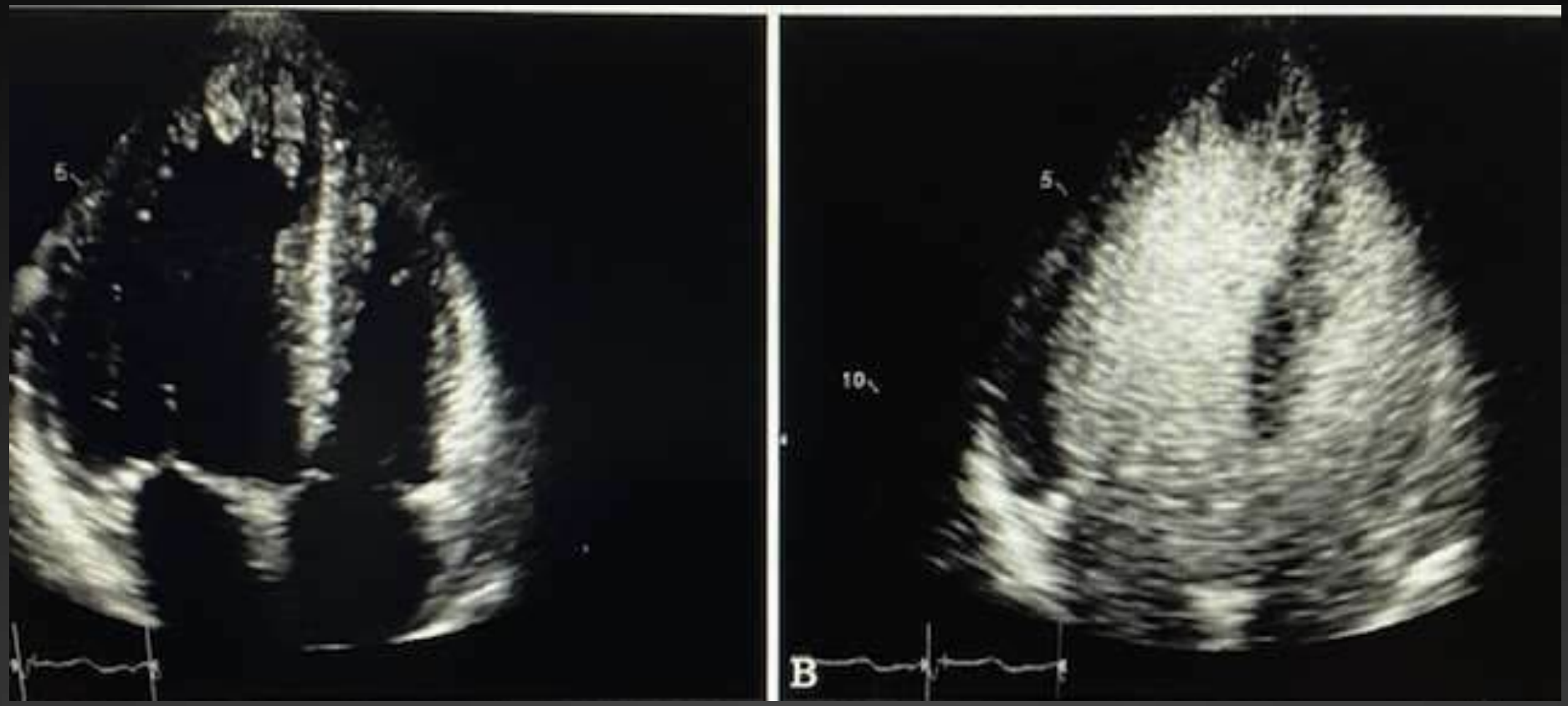
- LV thrombus

Add contrast for thrombus



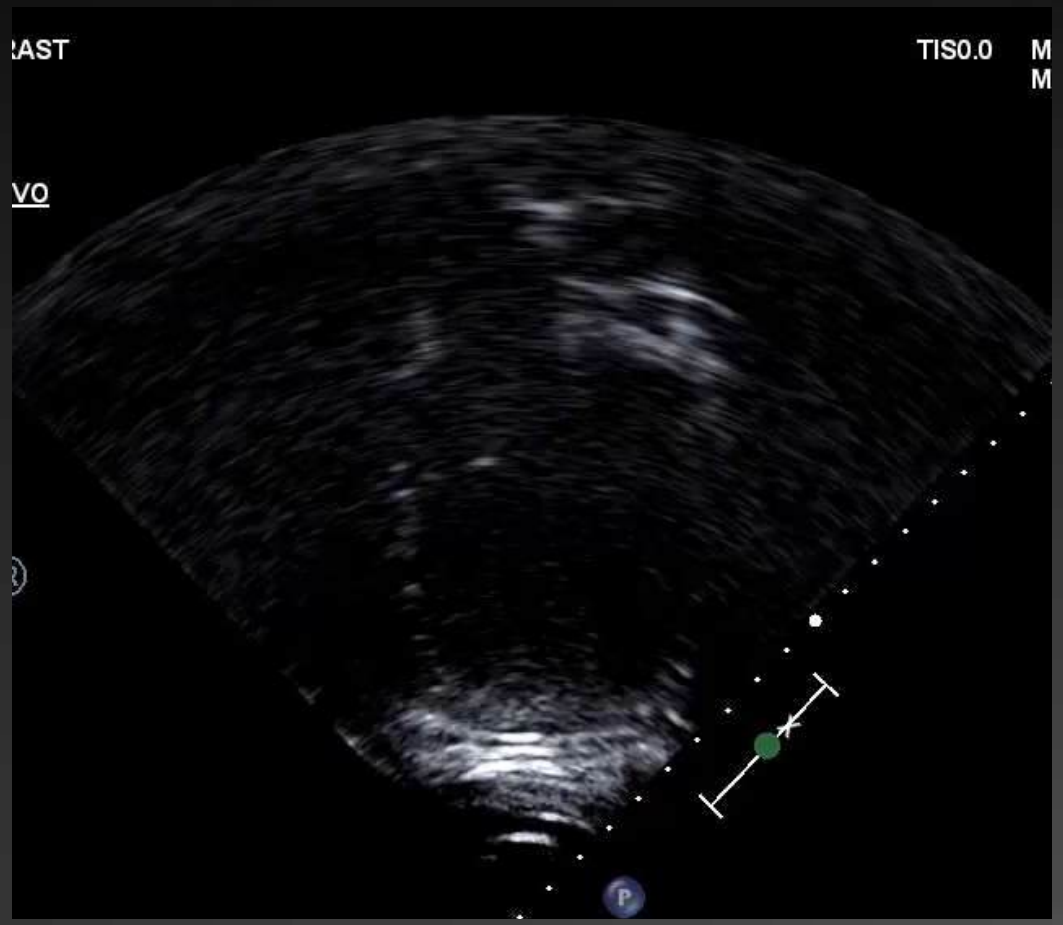


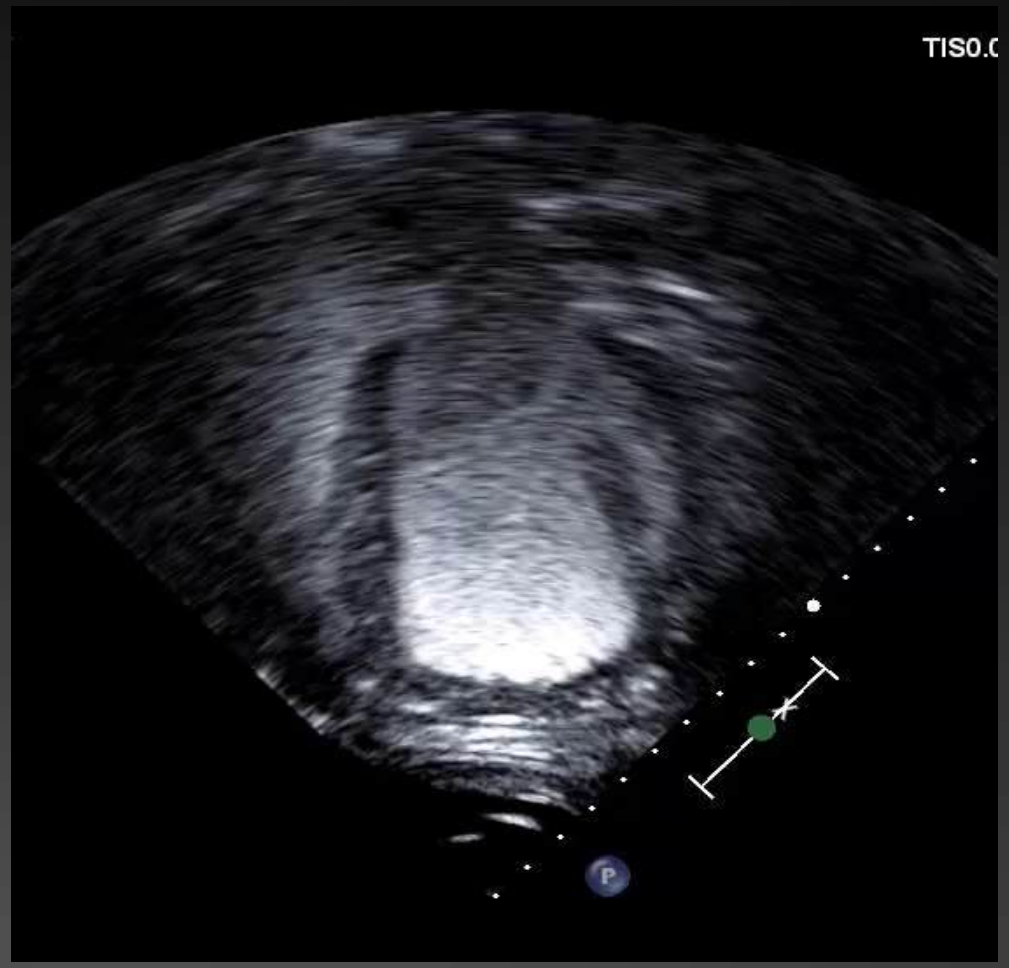
Transpulmonary contrast



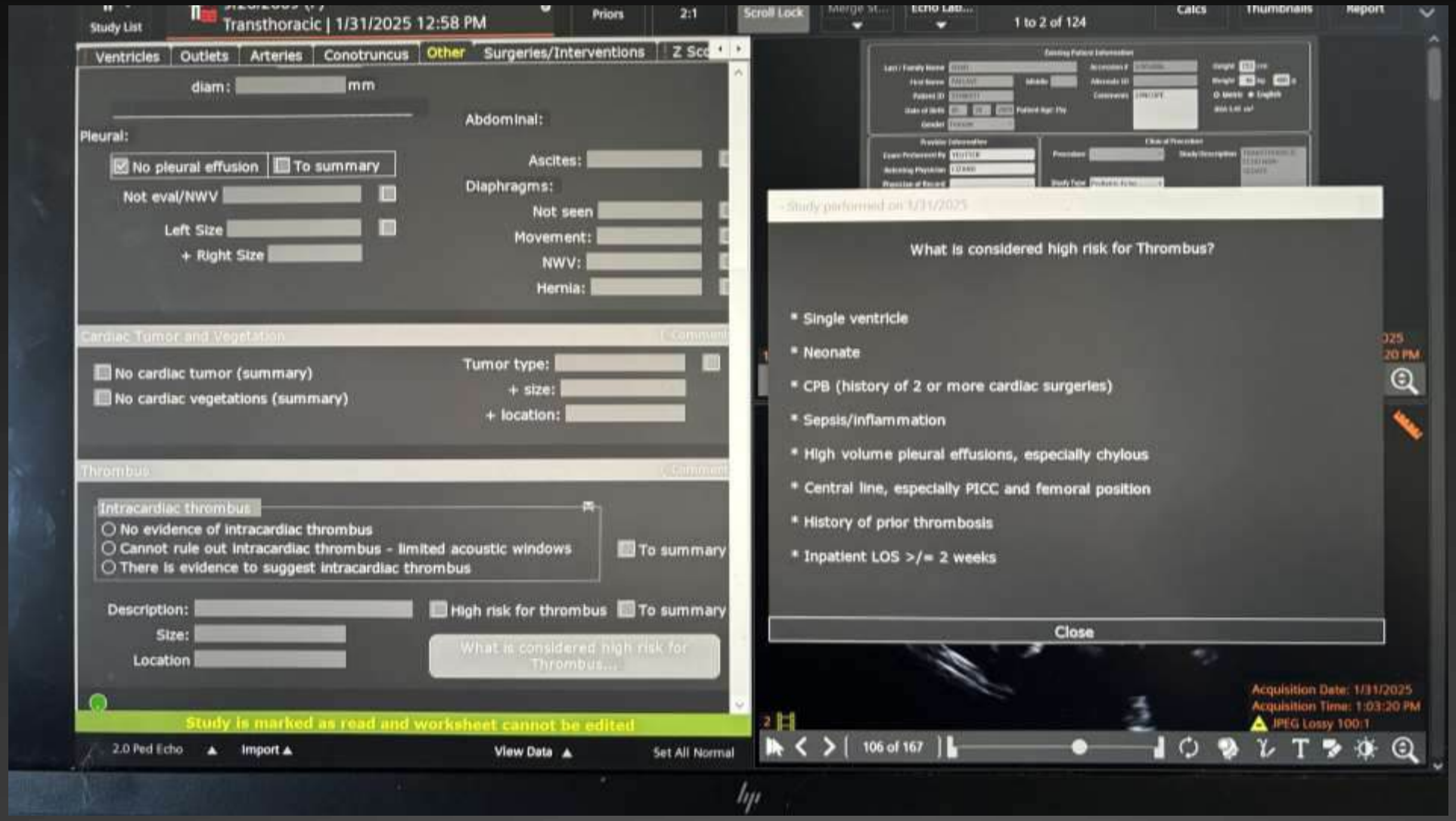
- Excellent for border definition
- Identify if a structure is vascularized
  - Thrombus is black/non-vascularized

Lumason injection in DMD





Reporting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Scroll Lock
1 to 2 of 124
Calcs
Thumbnails
Report
Ventricles
Outlets
Arteries
Conotruncus
Other
Surgeries/Interventions
diam: mm
Pleural:
No pleural effusion
To summary
Not eval/NWV
Left Size
+ Right Size
Abdominal:
Ascites:
Diaphragms:
Not seen
Movement:
NWV:
Hernia:
Cardiac Tumor and Vegetation
No cardiac tumor (summary)
No cardiac vegetations (summary)
Tumor type:
+ size:
+ location:
Thrombus
Intracardiac thrombus
No evidence of intracardiac thrombus
Cannot rule out intracardiac thrombus - limited acoustic windows
There is evidence to suggest intracardiac thrombus
To summary
Description:
High risk for thrombus
To summary
Size:
Location
What is considered high risk for Thrombus...
Study is marked as read and worksheet cannot be edited
2.0 Ped Echo
Import
View Data
Set All Normal
What is considered high risk for Thrombus?
* Single ventricle
* Neonate
* CPB (history of 2 or more cardiac surgeries)
* Sepsis/inflammation
* High volume pleural effusions, especially chylous
* Central line, especially PICC and femoral position
* History of prior thrombosis
* Inpatient LOS >/= 2 weeks
Close
Acquisition Date: 1/31/2025
Acquisition Time: 1:03:20 PM
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106 of 167

Conclusion: Imaging Algorithm

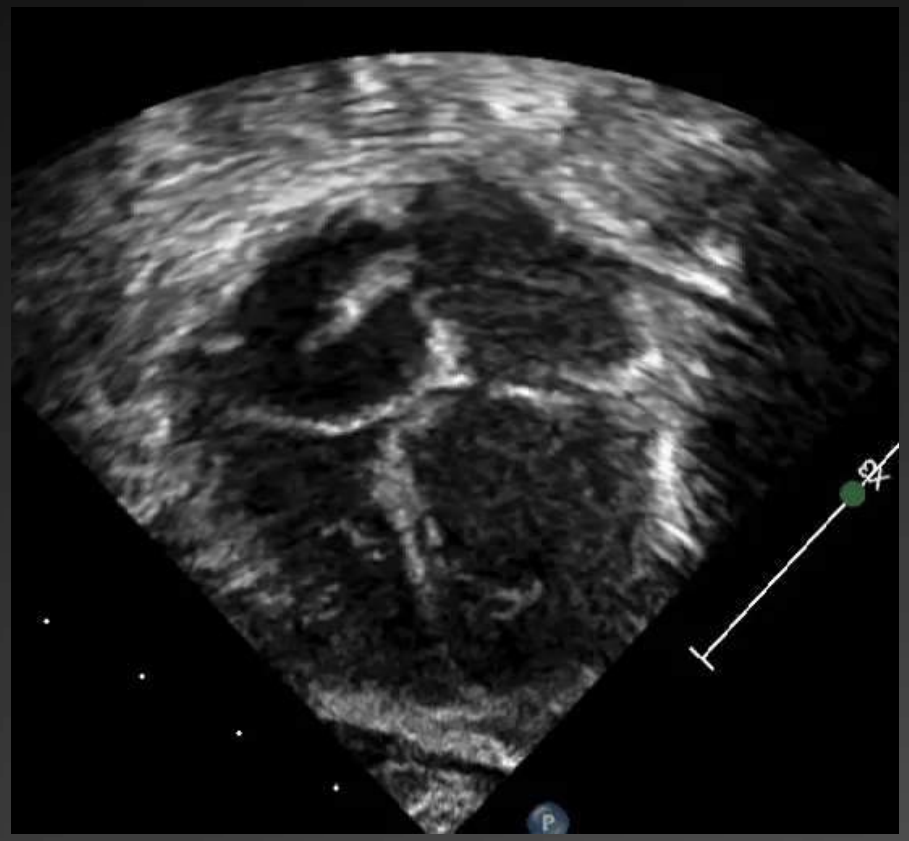
- What is the history or clinical context
  - Is there increased risk ?
- Be familiar with normal variants in the heart
- Rule out artifact with optimization of settings/transducers
  - Perform TEE for alternative imaging plane
- Consider additional imaging (MRI) for tissue characterization/extension
  - Contrast imaging

THANK YOU

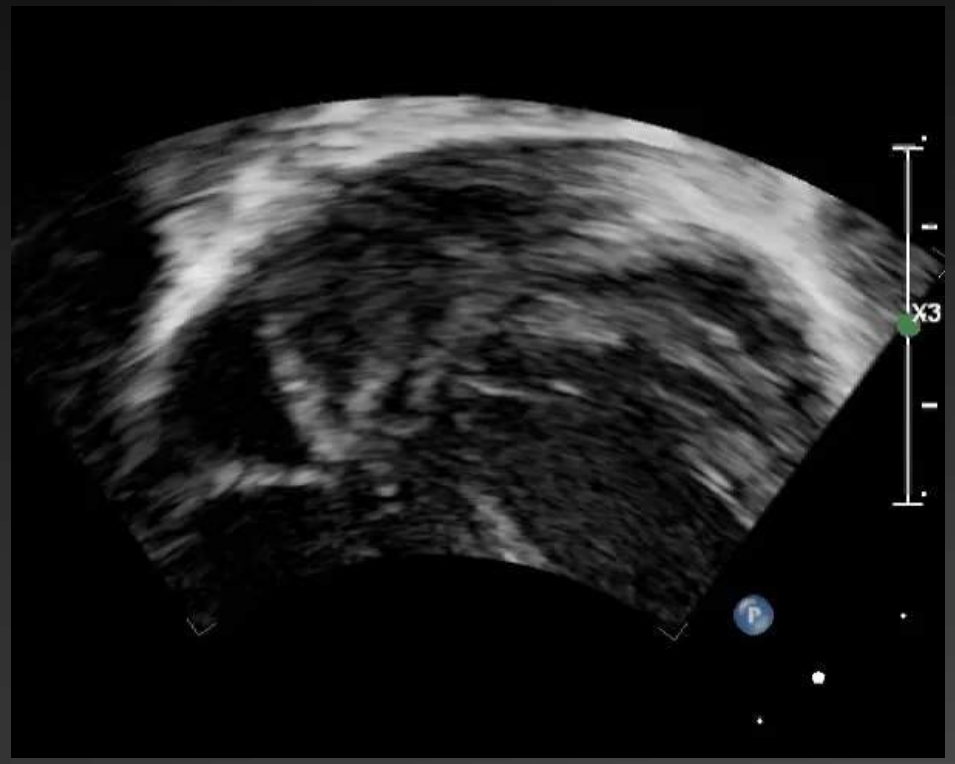
PA-IVS

Lambl's Excrescence

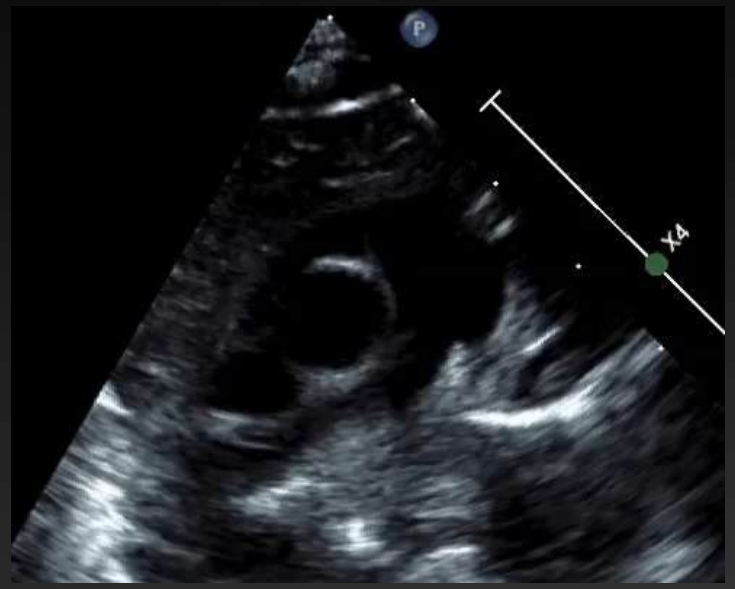
Neonate s/p Arch repair

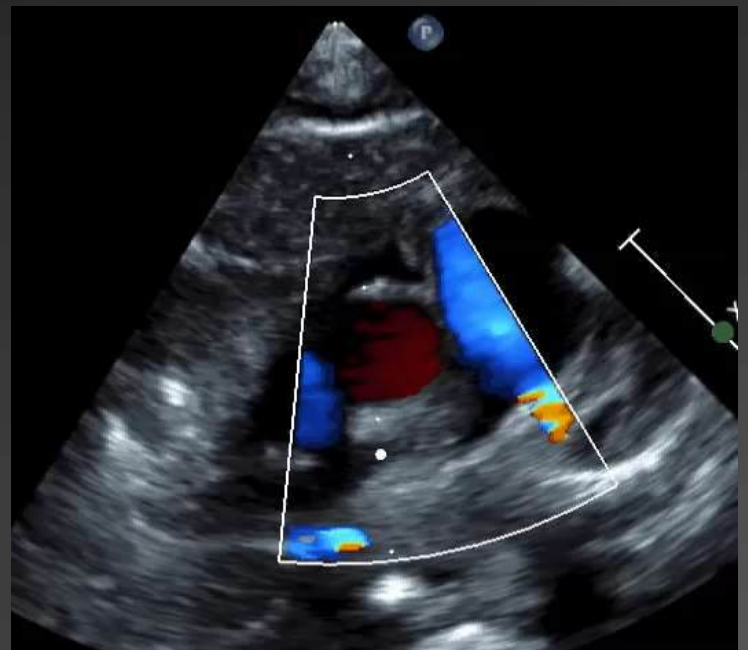


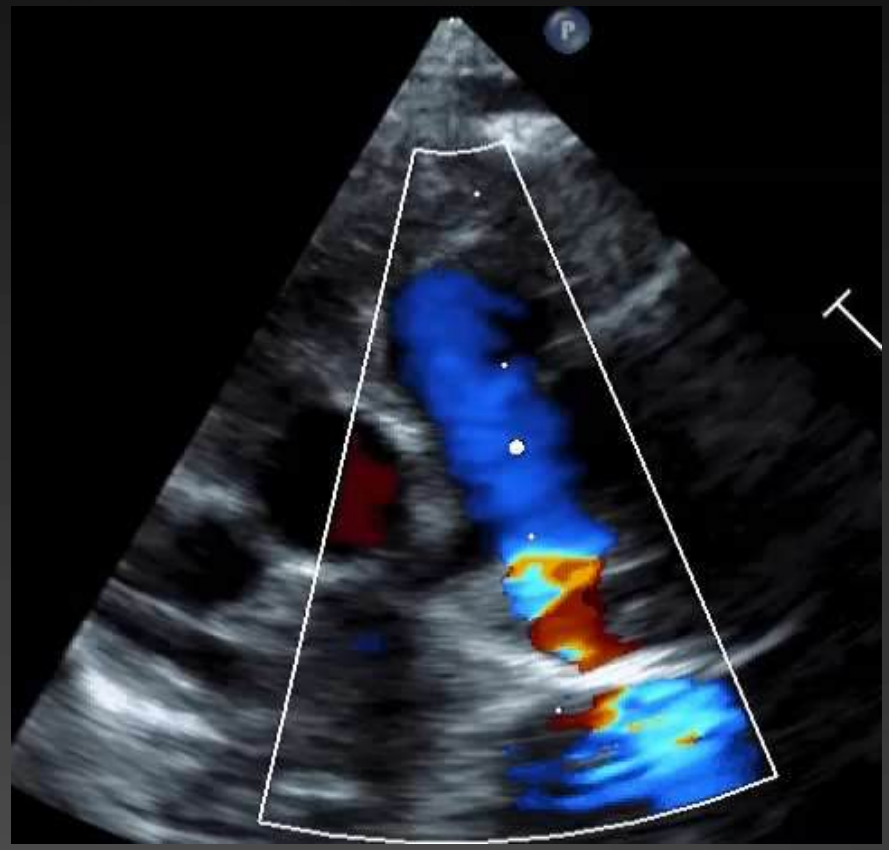
Pulmonary Embolus



Pulmonary Embolus







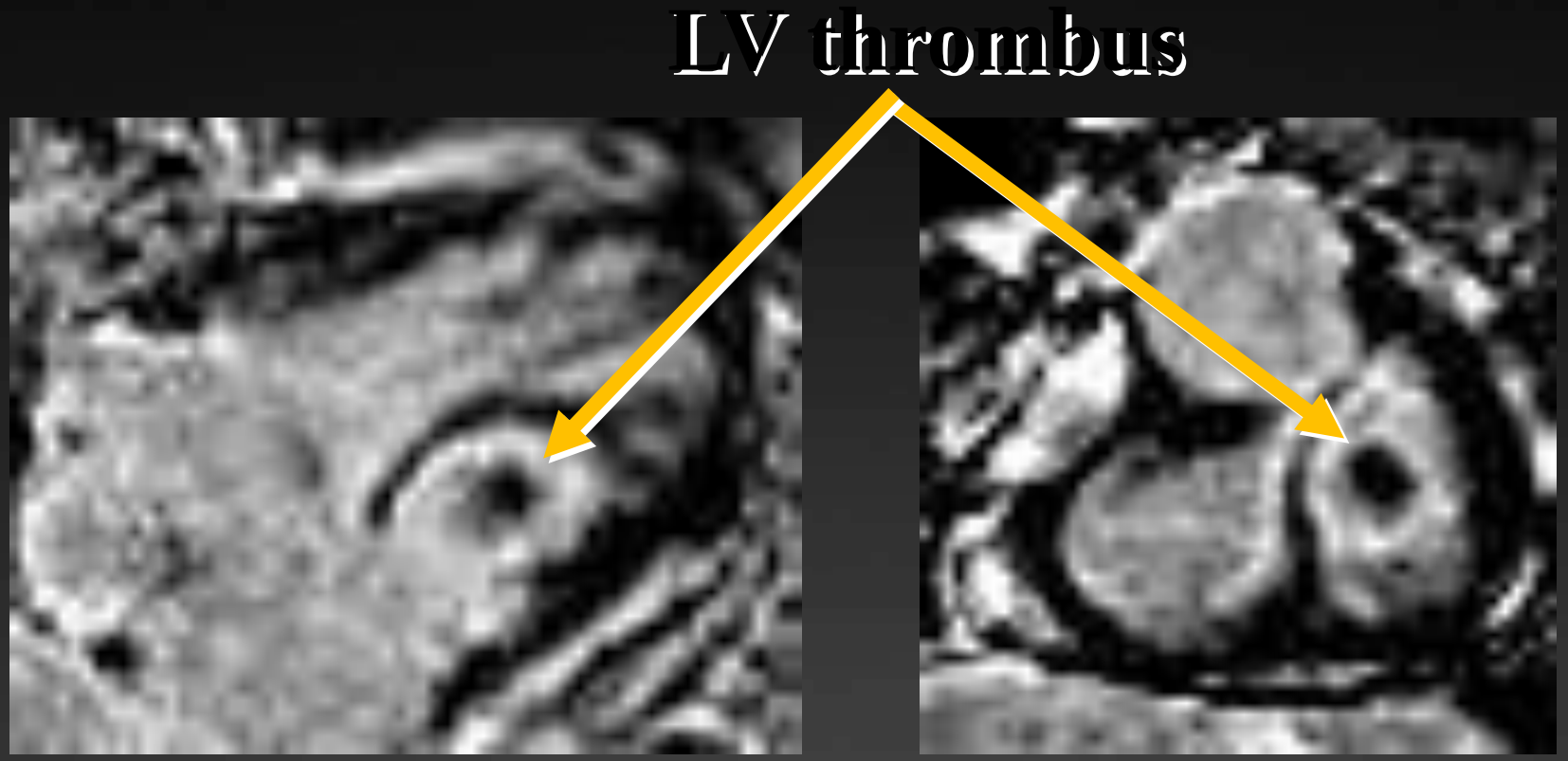
Alternatives to Echo for Imaging of Thrombus: *Role of MRI*

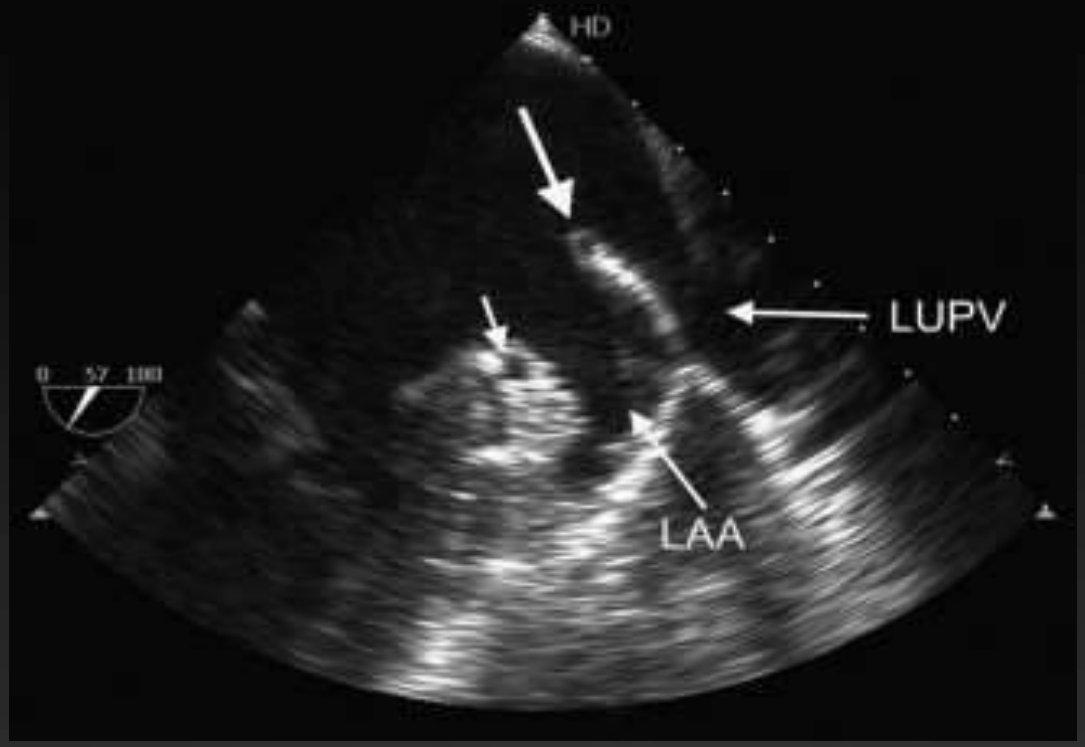
- Improved information on localization and extension of thrombus
- Tissue characterization to help determine tumor from thrombus


JPE

HLHS with mitral stenosis &aortic atresia

HLHS – Delayed Enhancement





- Normal cardiac structure that mimics thrombus, not echogenic, moves with cardiac motion
  - it is the confluence of the LPV with the roof of the LAA.
- For years it was mistaken for thrombus and led to unnecessary treatments

Cast/Fibrin Sheath

Pt with hx of a previous line

By echo see parallel lines that are smooth

Fibrin and SMCs adhere to external catheter surface