CARDIOLOGY 2023

Advanced Cardiac CT Imaging: Utility in Critical Decision Making

David M Biko, MD

Interim Chief, Body Division

Director, Section of Cardiovascular and Lymphatic Imaging
Children's Hospital of Philadelphia

Assistant Professor of Radiology

University of Pennsylvania Perelman School of Medicine

Disclosures

Receive book royalties from Wolters-Kluwer

Why CTA for Evaluation of Congenital Heart Disease?

Fast

- Critically ill
- Claustrophobic
- Children

High Spatial Resolution

- Coronary artery
- Calcifications within vessels and conduits
- 3D Modeling

Compatibility

- Metallic artifact
- VAD/ECMO catheter

Extracardiac Structures

- Lung
- Airway
- Bones

Disadvantages- ionizing radiation, no flow data, tissue characterization

Why CT for Evaluation of Congenital Heart Disease?

Fast

- Critically ill
- Claustrophobic
- Children

High Spatial Resolution

- Coronary artery
- Calcifications within vessels and conduits
- 3D Modeling

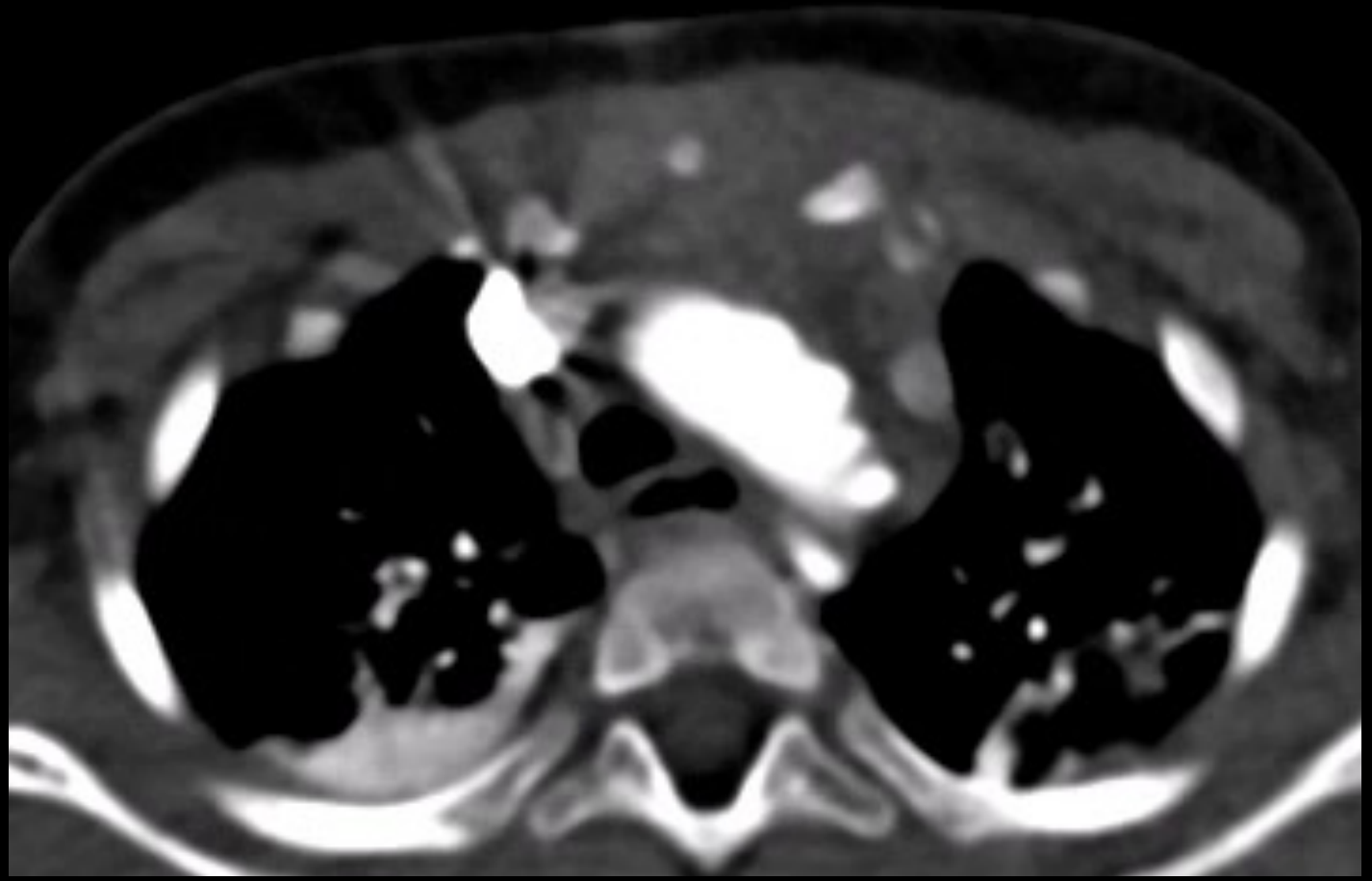
Compatibility

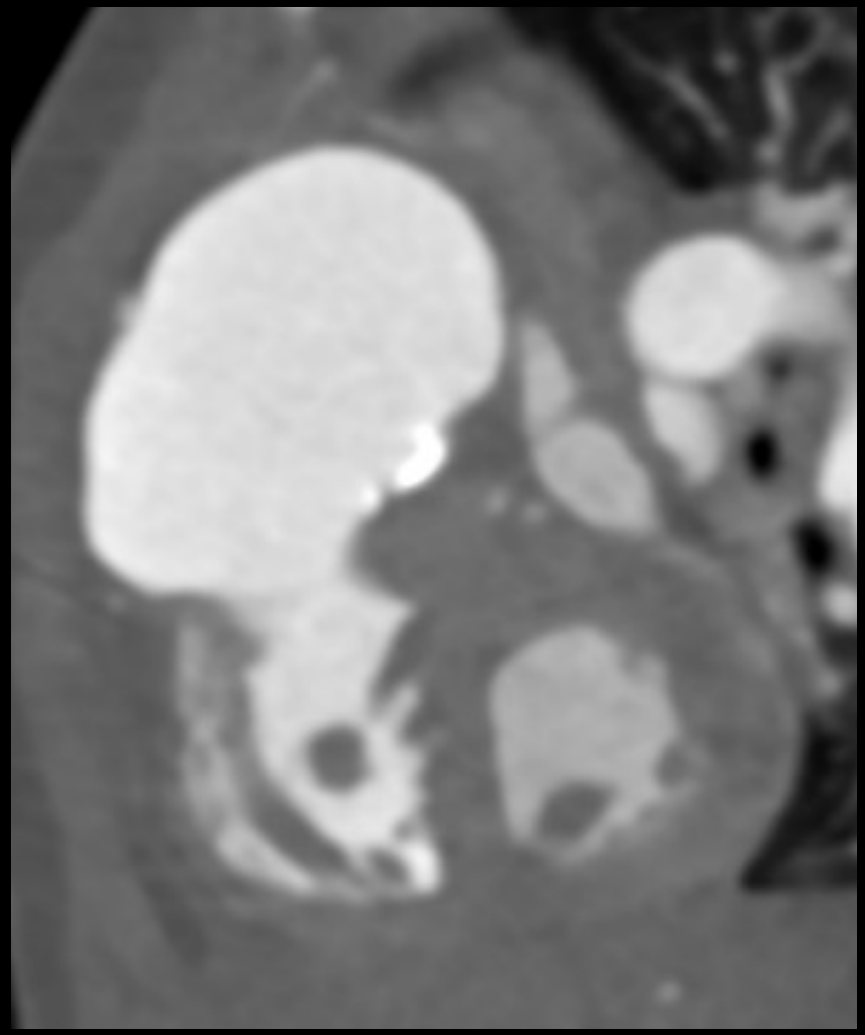
- Metallic artifact
- VAD/ECMO catheter

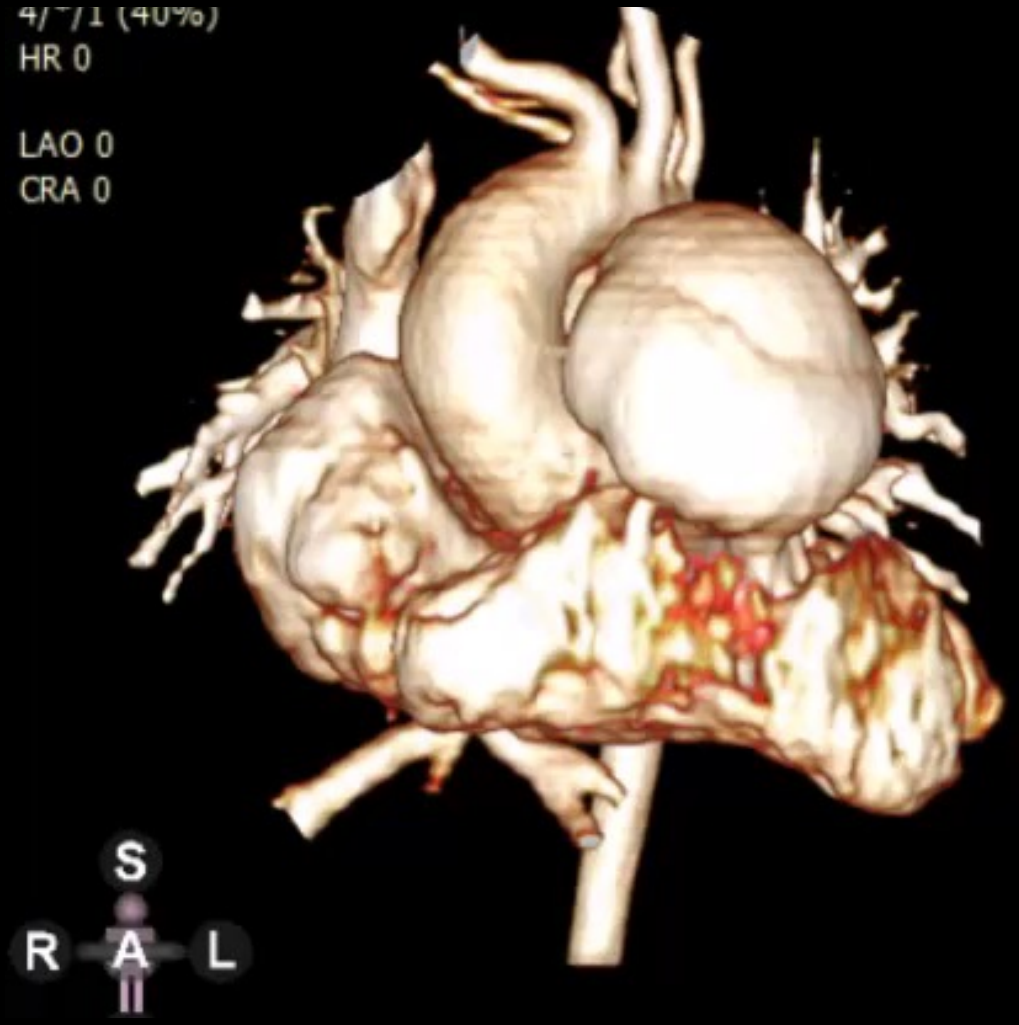
Extracardiac Structures

- Lung
- Airway
- Bones

15 month old with TOF

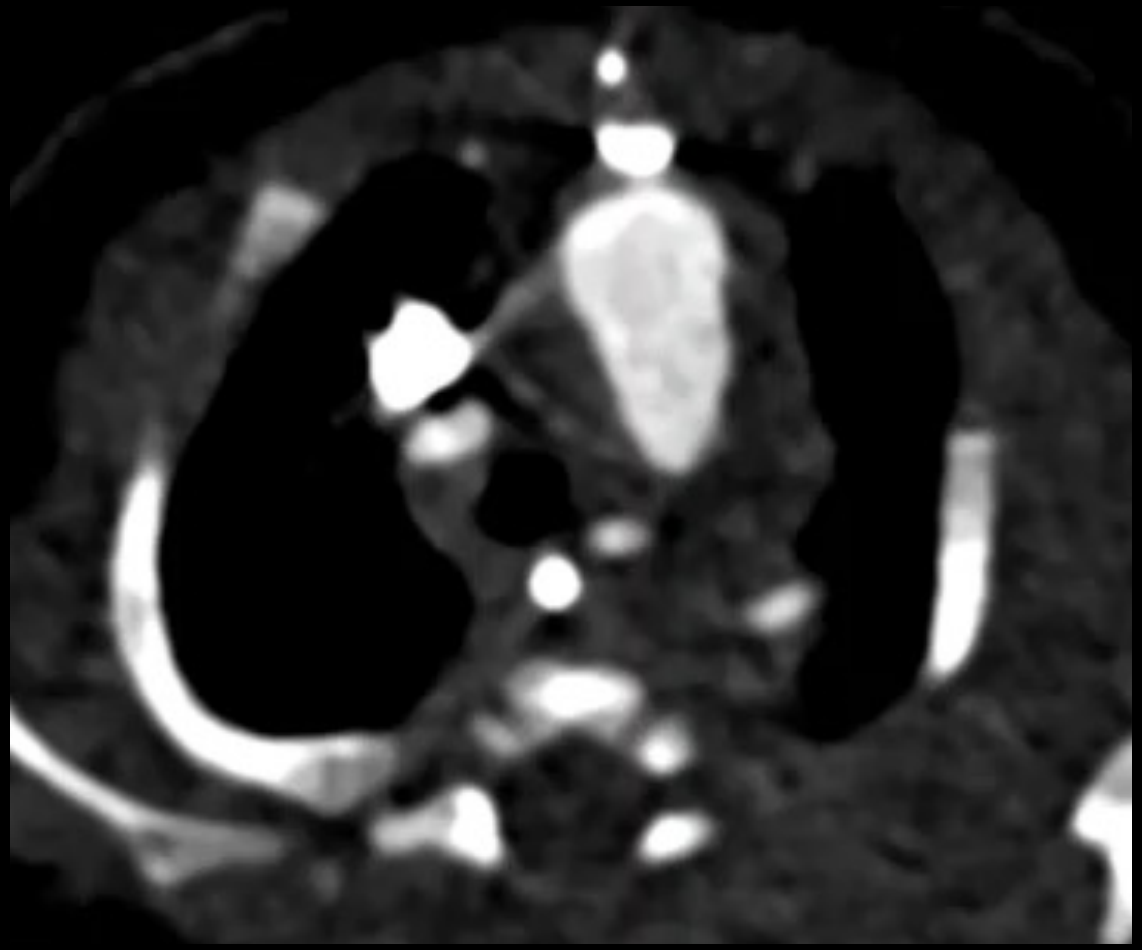




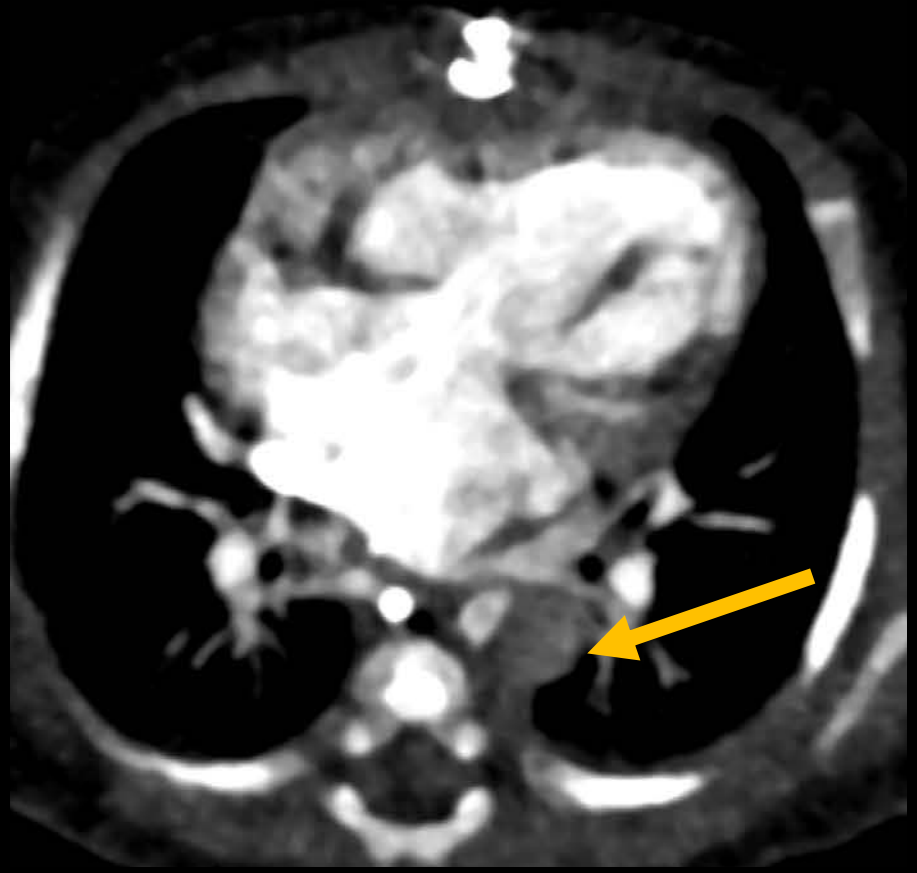


Free breathing with no sedation

6 week old HLHS s/p Sano with desaturations



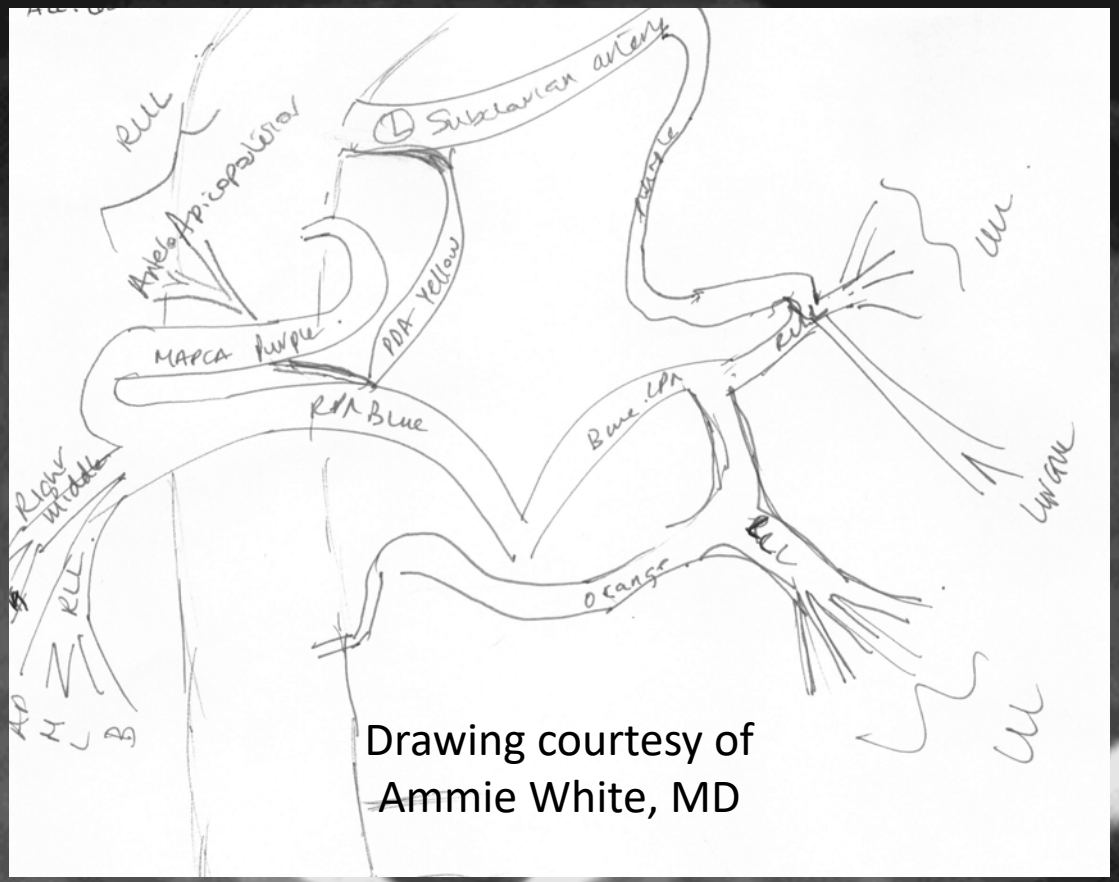
Courtesy of Lorna Browne, MD
Children's Hospital Colorado



Type B Aortic Dissection post Sano

No sedation for CT

4 day old w/ TOF/PA with MAPCAs



Drawing courtesy of
Ammie White, MD

4 day old; 3.0 kg
HR 179 bpm
1.5 mL/s via foot

8 day old w/ TAPVR to coronary sinus, pulmonary stenosis & TA

8 day old; 2.7 kg
HR 162 bpm
0.8 mL/s via right hand

Why CT for Evaluation of Congenital Heart Disease?

Fast

- Critically ill
- Claustrophobic
- Children

High Spatial Resolution

- Coronary artery
- Calcifications within vessels and conduits
- 3D modeling

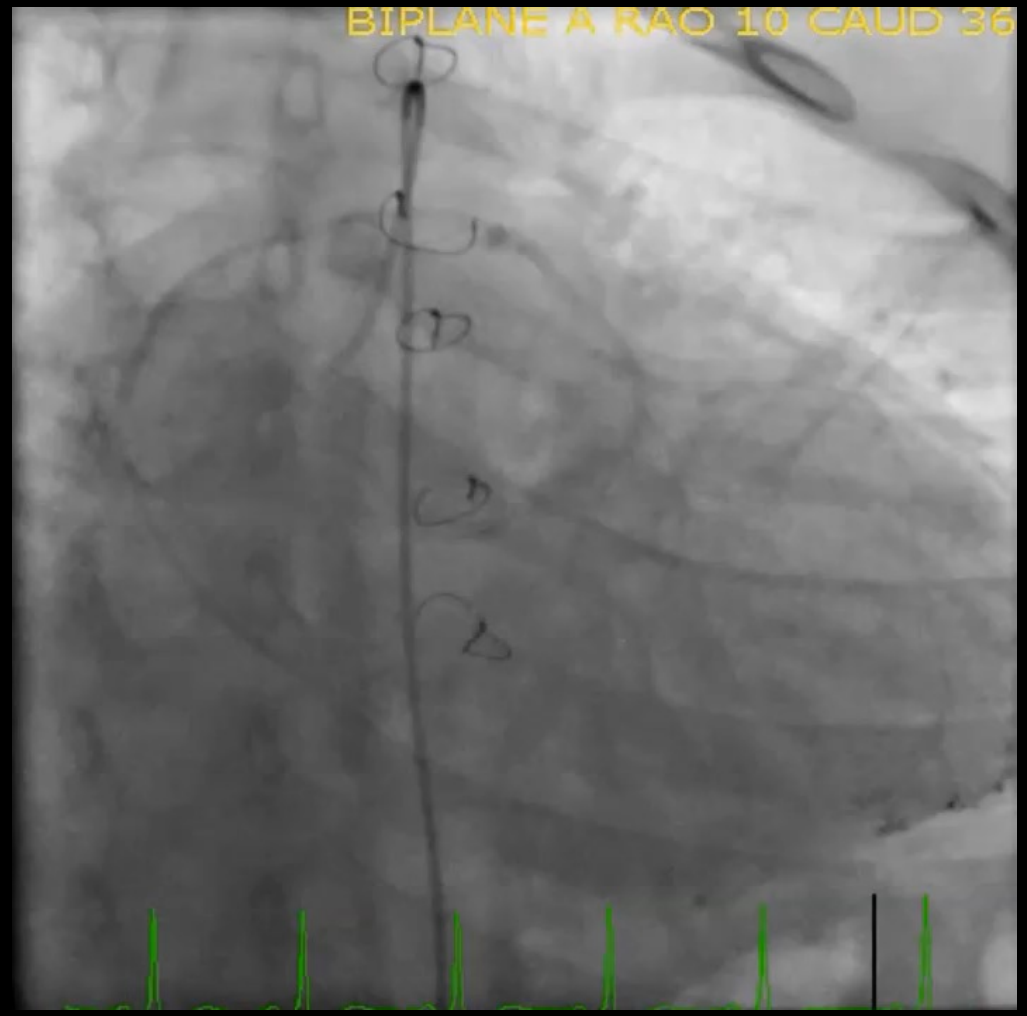
Compatibility

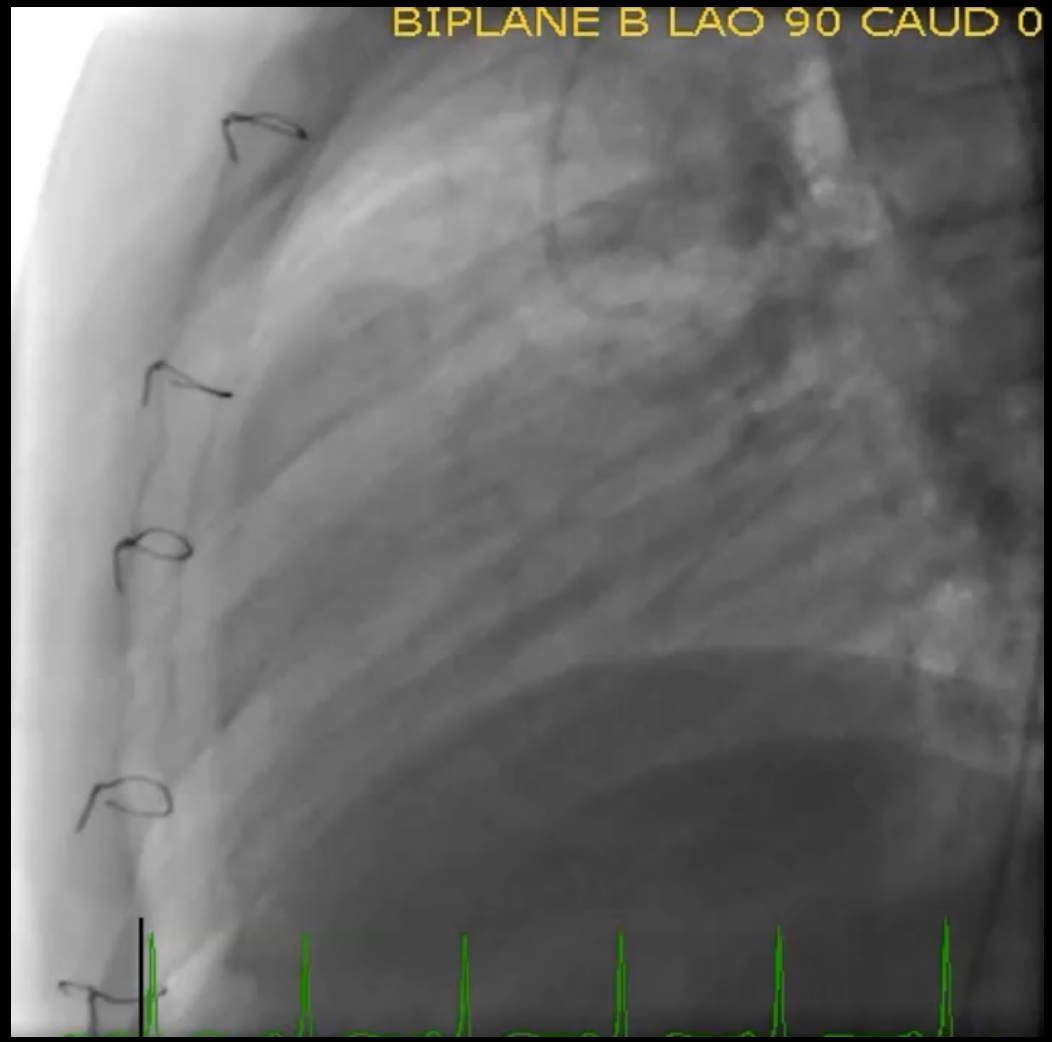
- Metallic artifact
- VAD/ECMO catheter

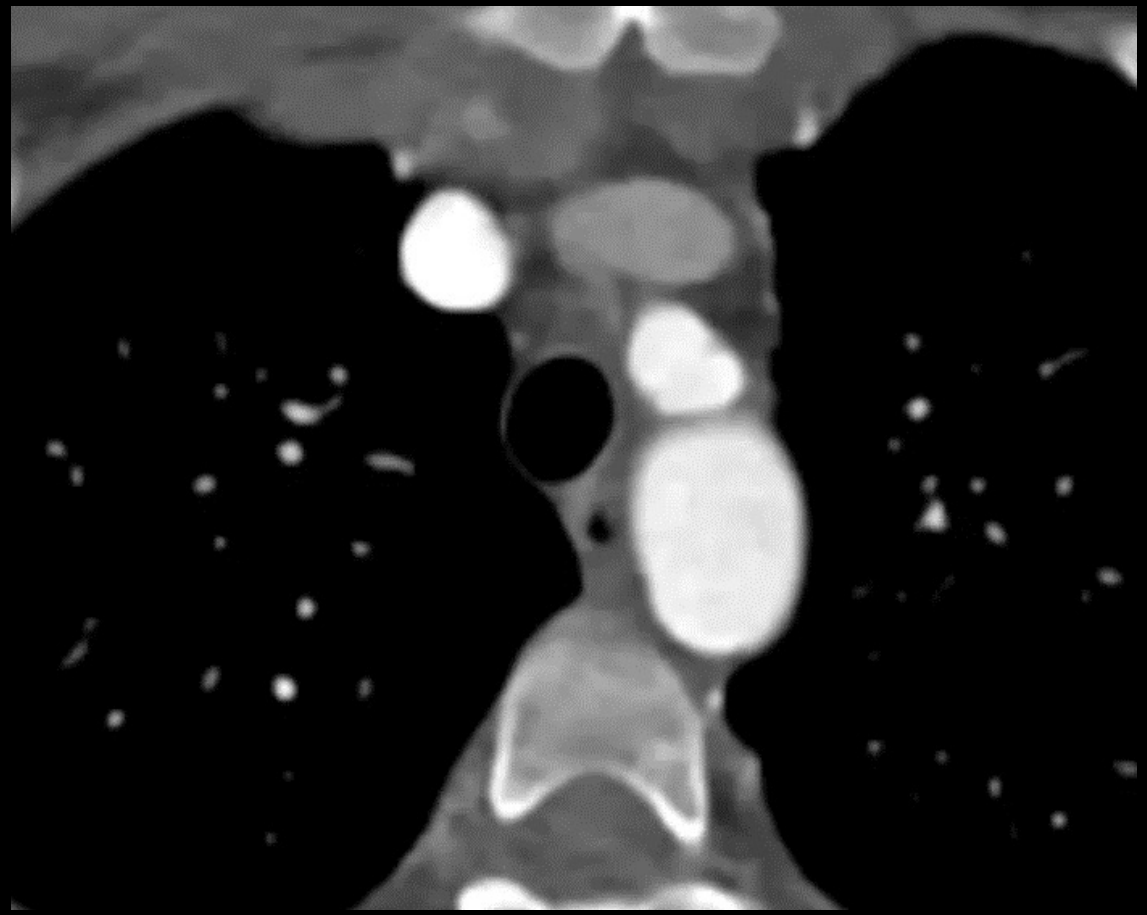
Extracardiac Structures

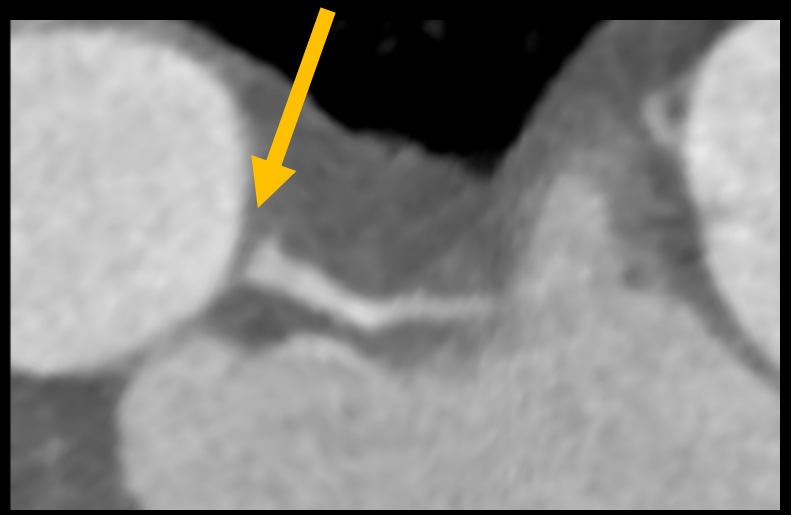
- Lung
- Airway
- Bones

13 yo h/o ASO now with perfusion defect



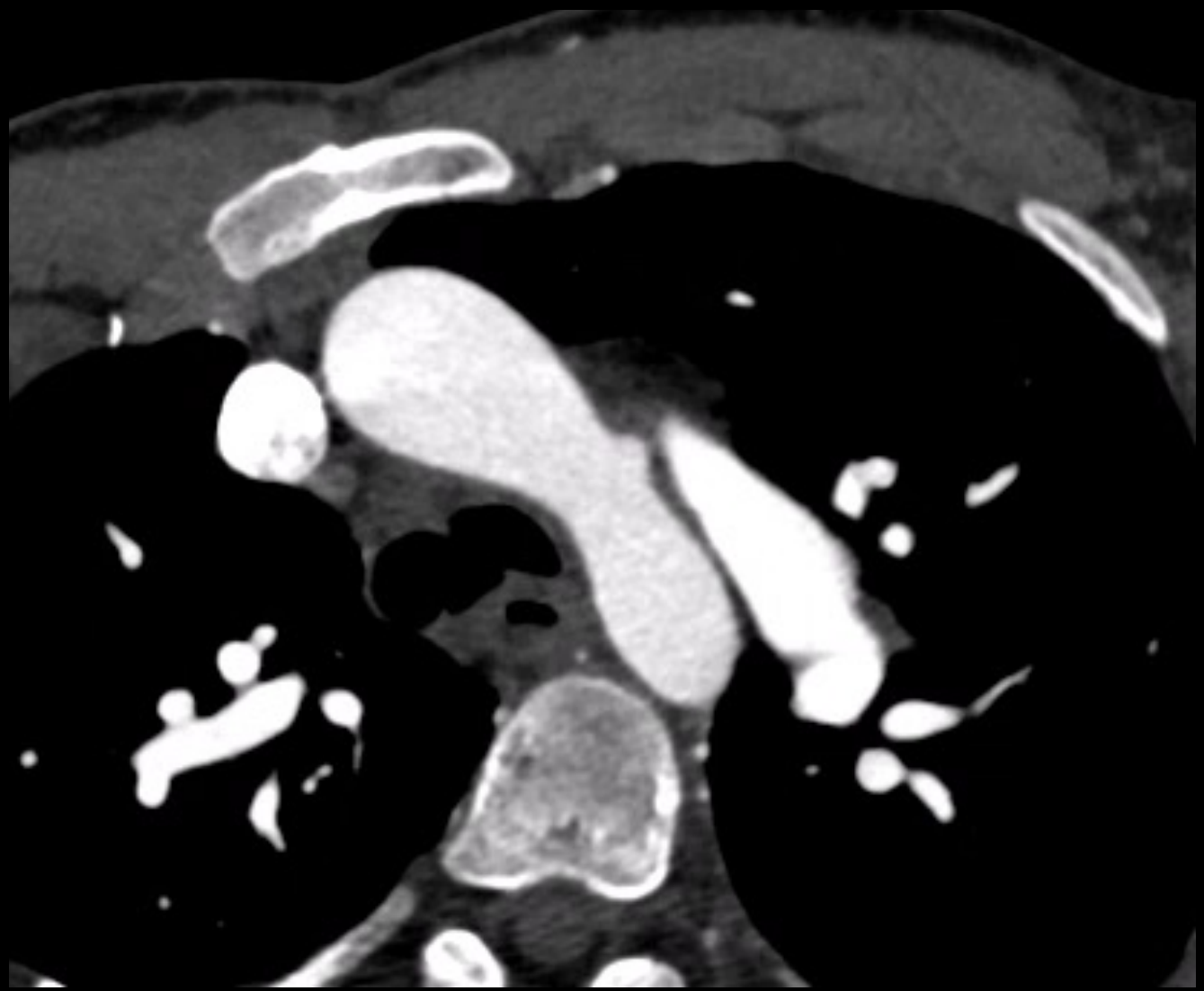






Coronary Imaging with High Spatial Resolution

16 year old TOF post repair, pre-evaluation valve



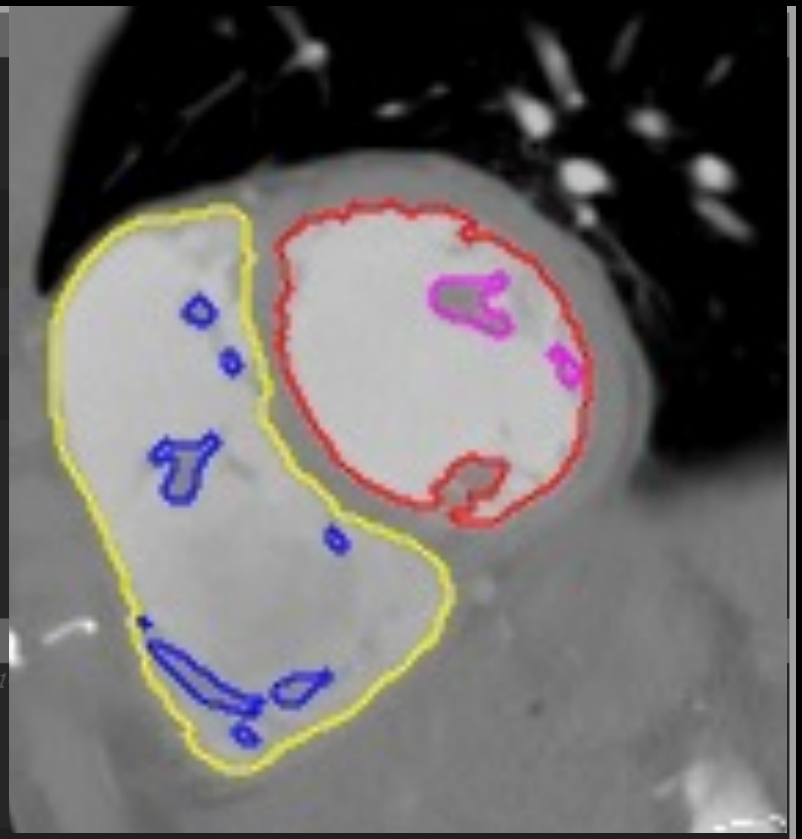
SAX3D Stack LV Function

EDV:	100.50 ml
ESV:	38.50 ml
SV:	62.00 ml
EF:	61.69 %
CO:	4.46 l/min
CI:	3.23 l/min/m²
HR:	72.0/min
Pap Mass (Diast):	3.08 g
Pap Mass (Syst):	0.79 g
Phase Diastole:	20
Phase Systole:	8
EDV/H:	62.39 ml/m
EDV/BSA:	72.79 ml/m²
ESV/H:	23.90 ml/m
ESV/BSA:	27.89 ml/m²
SV/H:	38.49 ml/m
SV/BSA:	44.91 ml/m²

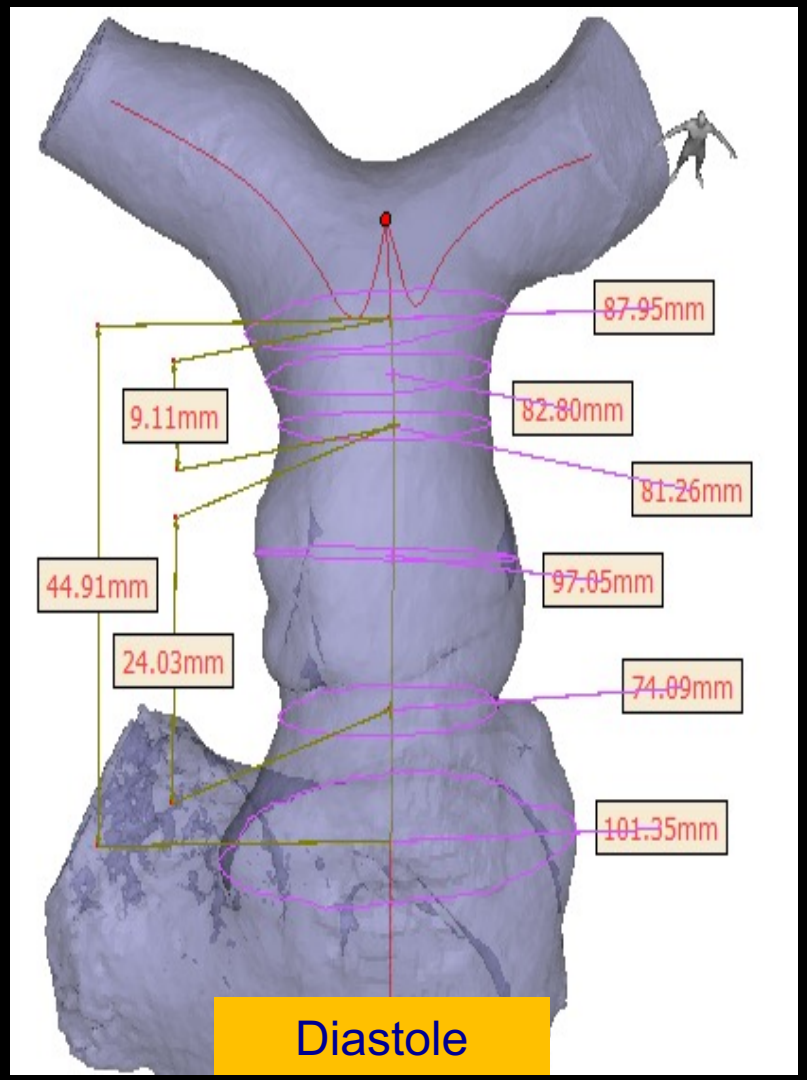
SAX3D Stack RV Function

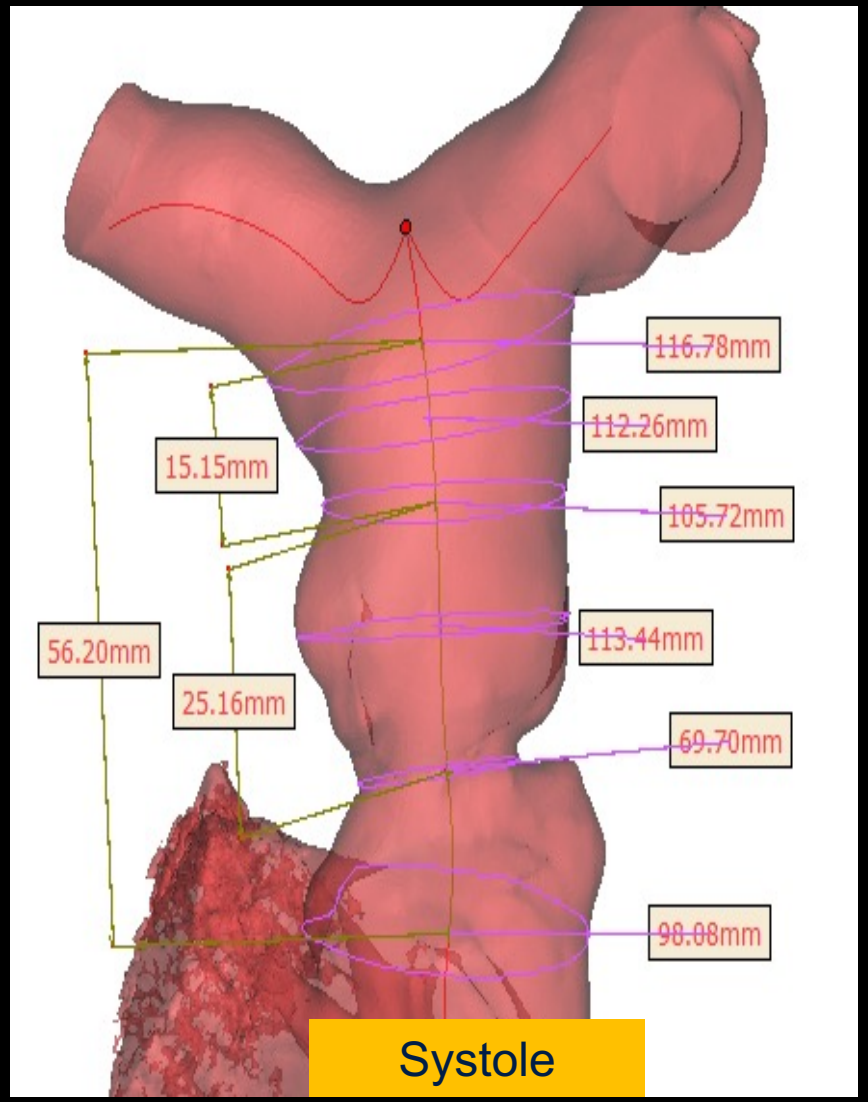
number of slices used to calculate syst. (phase 8: 1

RVEDV:	241.84 ml
RVESV:	115.35 ml
RVSV:	126.49 ml
RVEF:	52.30 %
RVCO:	9.11 l/min
RVCI:	6.60 l/min/m²
HR:	72.0/min
RV Pap Mass (Diast):	11.02 g
RV Pap Mass (Syst):	4.90 g
Phase Diastole:	20
Phase Systole:	8
RVEDV/H:	150.12 ml/m
RVEDV/BSA:	175.16 ml/m²
RVESV/H:	71.60 ml/m
RVESV/BSA:	83.55 ml/m²
RVSV/H:	78.51 ml/m
RVSV/BSA:	91.61 ml/m²



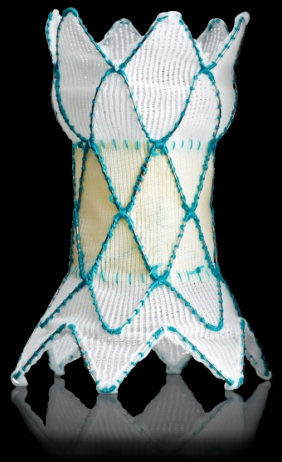
Virtual Models Based on CT scans

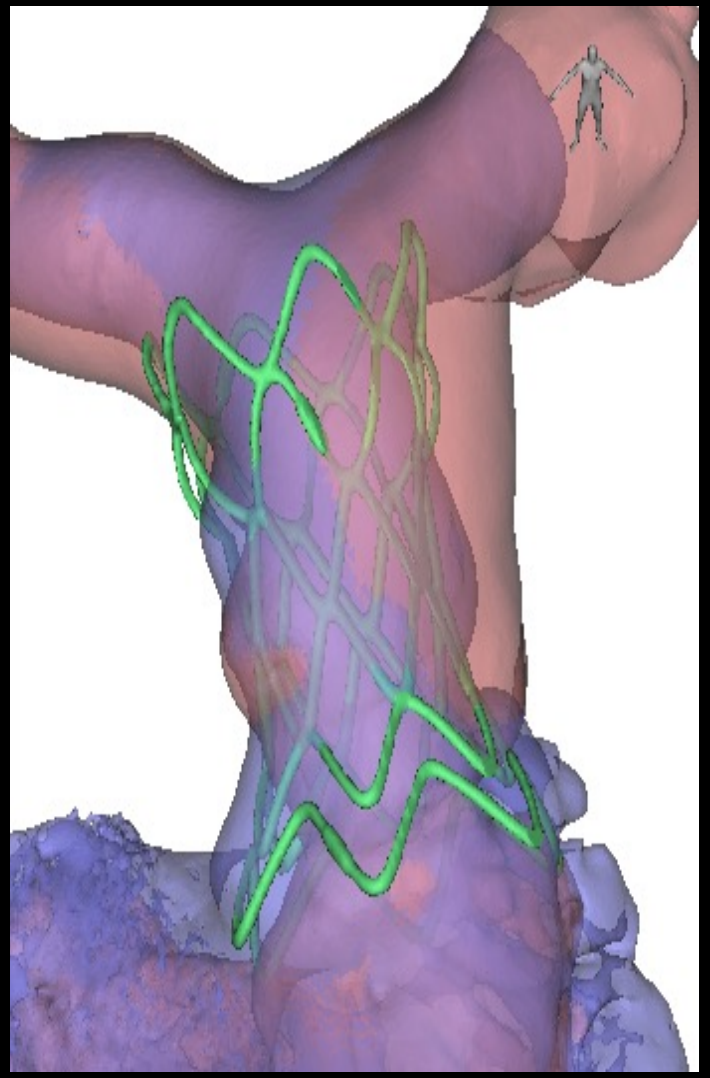


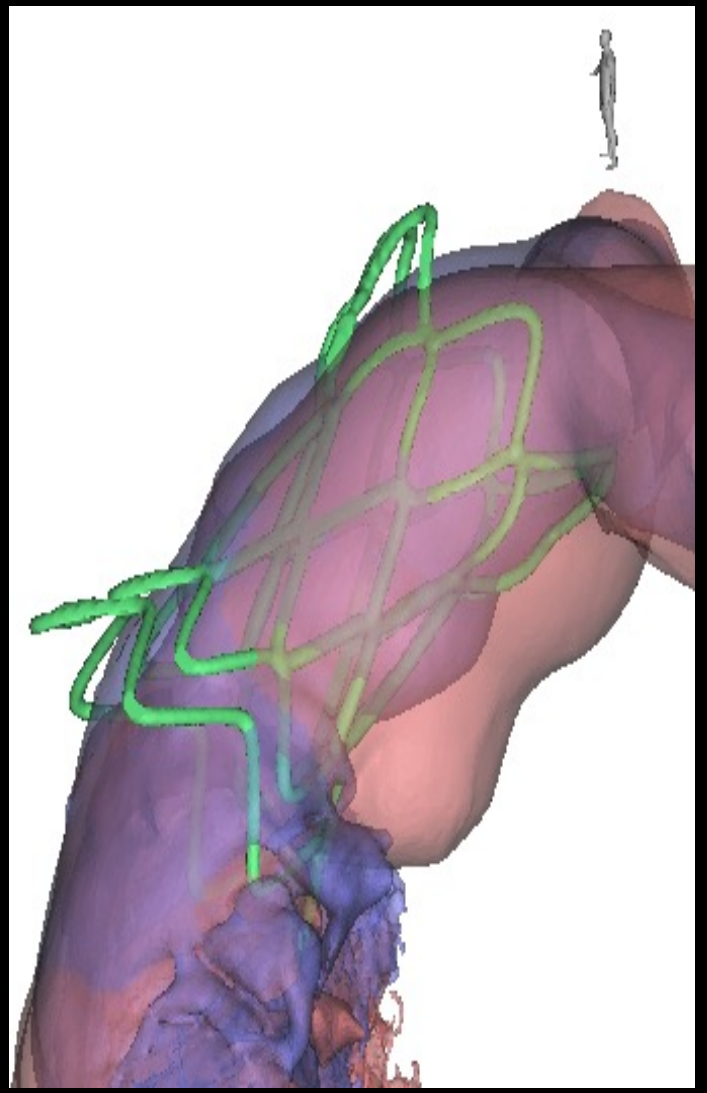


Courtesy of Matthew Gillespie, MD; Children's Hospital of Philadelphia

Anatomy with device overlay

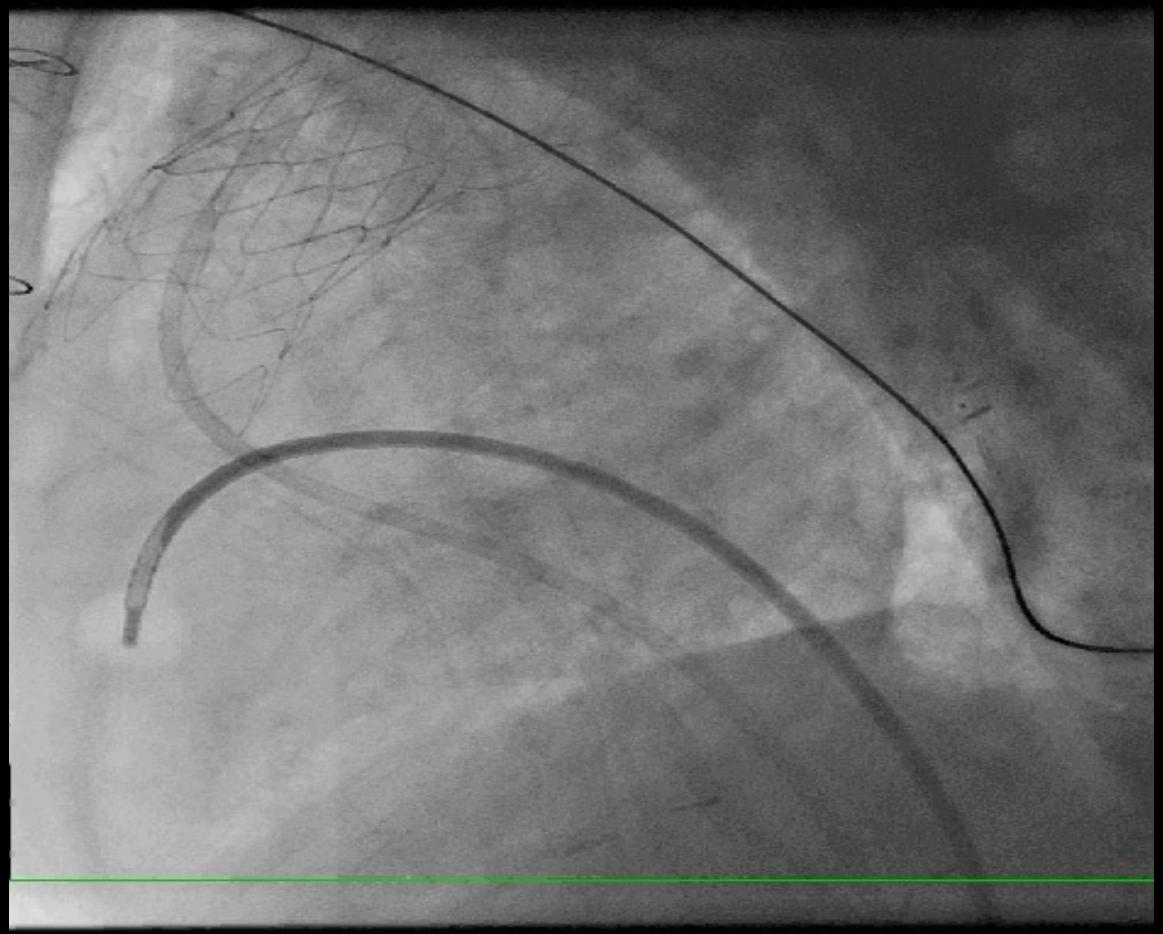






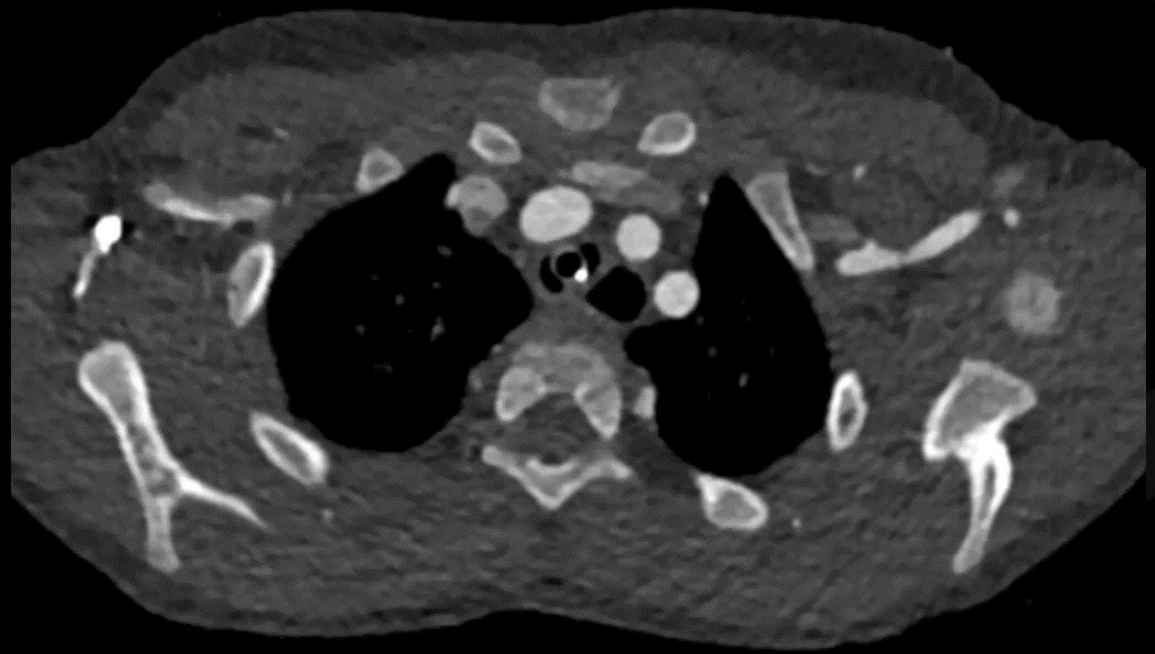
Courtesy of Matthew Gillespie, MD; Children's Hospital of Philadelphia

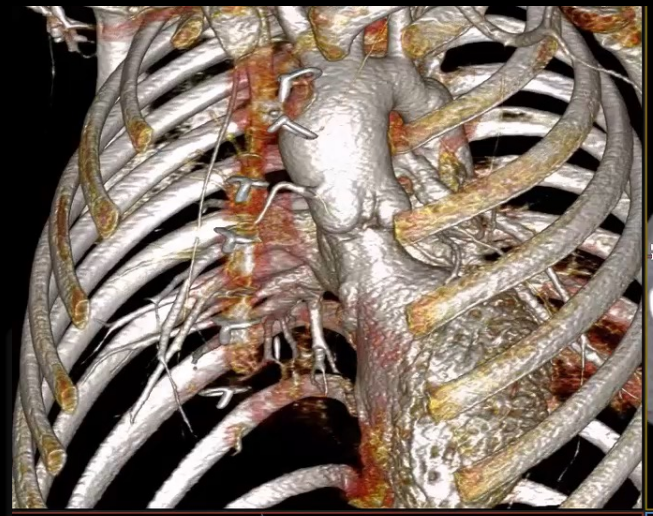
RV gram post device placement

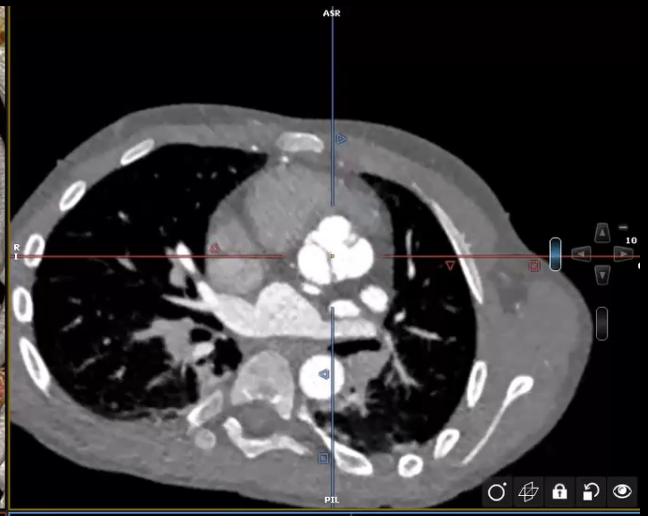


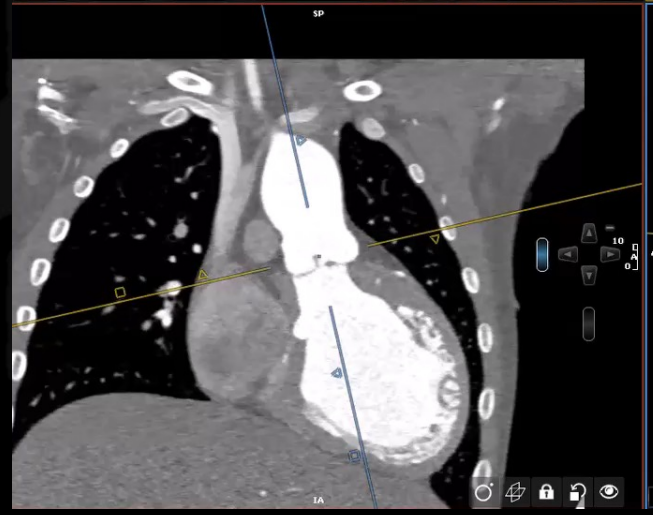
Courtesy of Matthew Gillespie, MD
Children's Hospital of Philadelphia

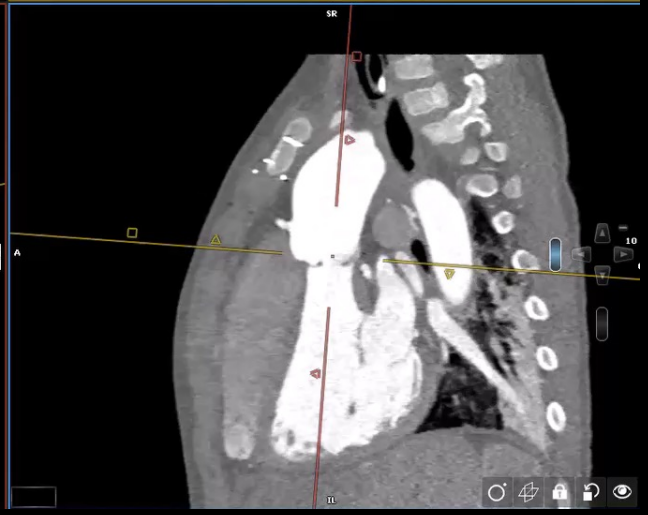
6 yo with a h/o DORV s/p ASO w/ neo-aortic regurgitation





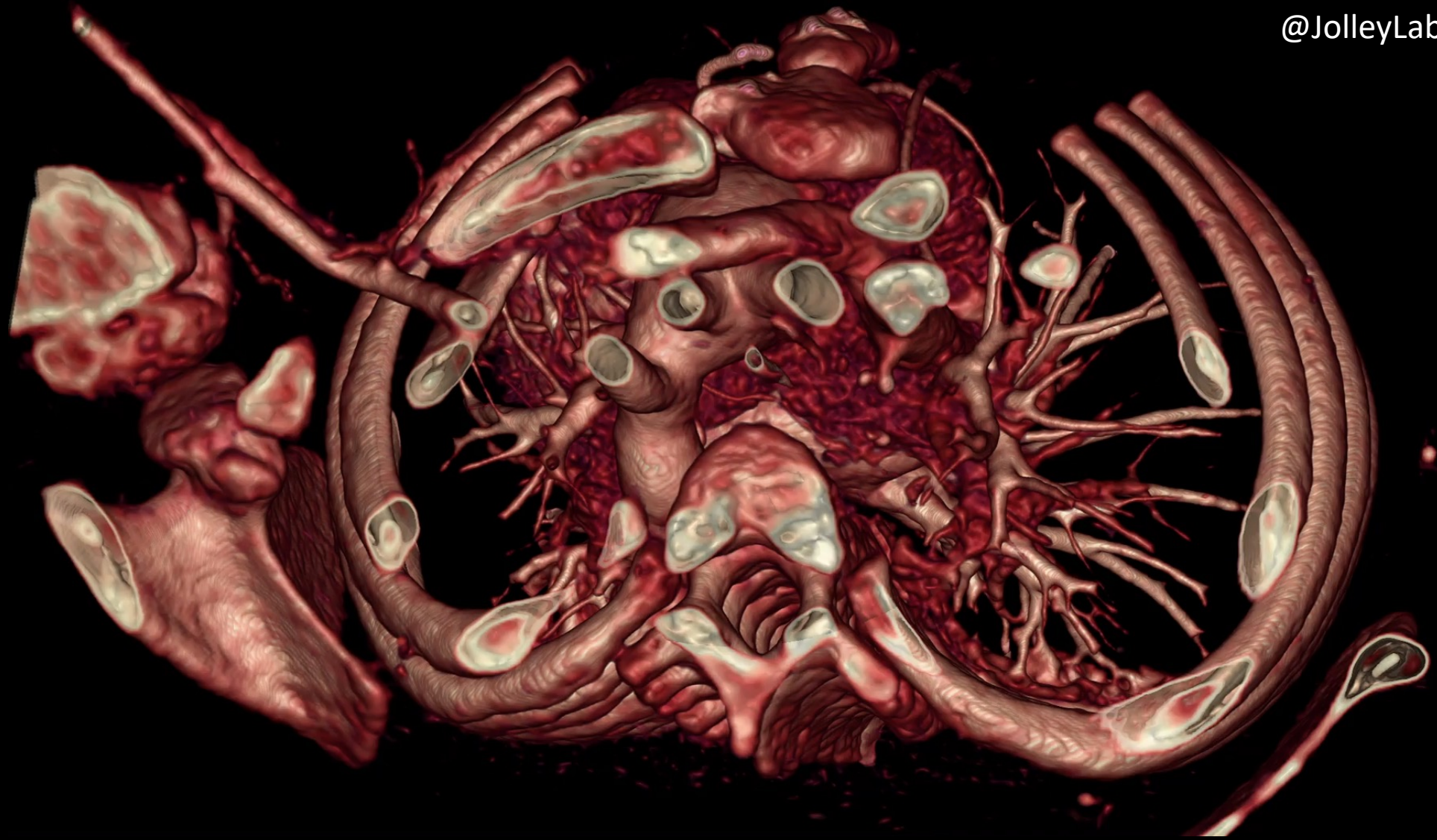




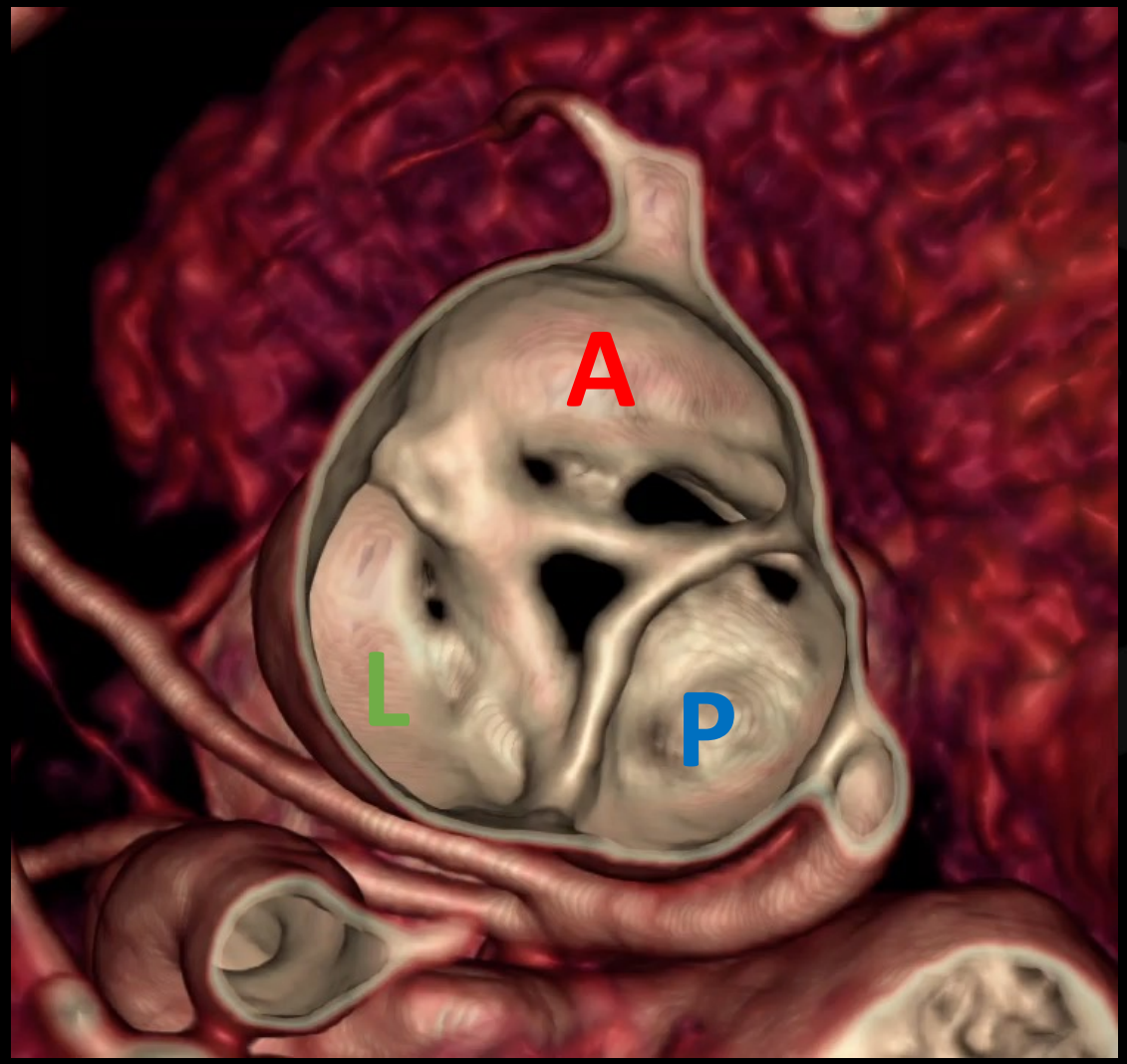


CTA Volume Rendering

Volume rendering courtesy of
Matt Jolley, MD
Children's Hospital of Philadelphia
@JolleyLab



Leaflet Morphology



Anterior-Facing

Leftmost (Noncoronary)

Posterior-Facing

Volume rendering courtesy of
Matt Jolley, MD
Children's Hospital of Philadelphia
@JolleyLab

Why CT for Evaluation of Congenital Heart Disease?

Fast

- Critically ill
- Claustrophobic
- Children

High Spatial Resolution

- Coronary artery
- Calcifications within vessels and conduits
- 3D Modeling

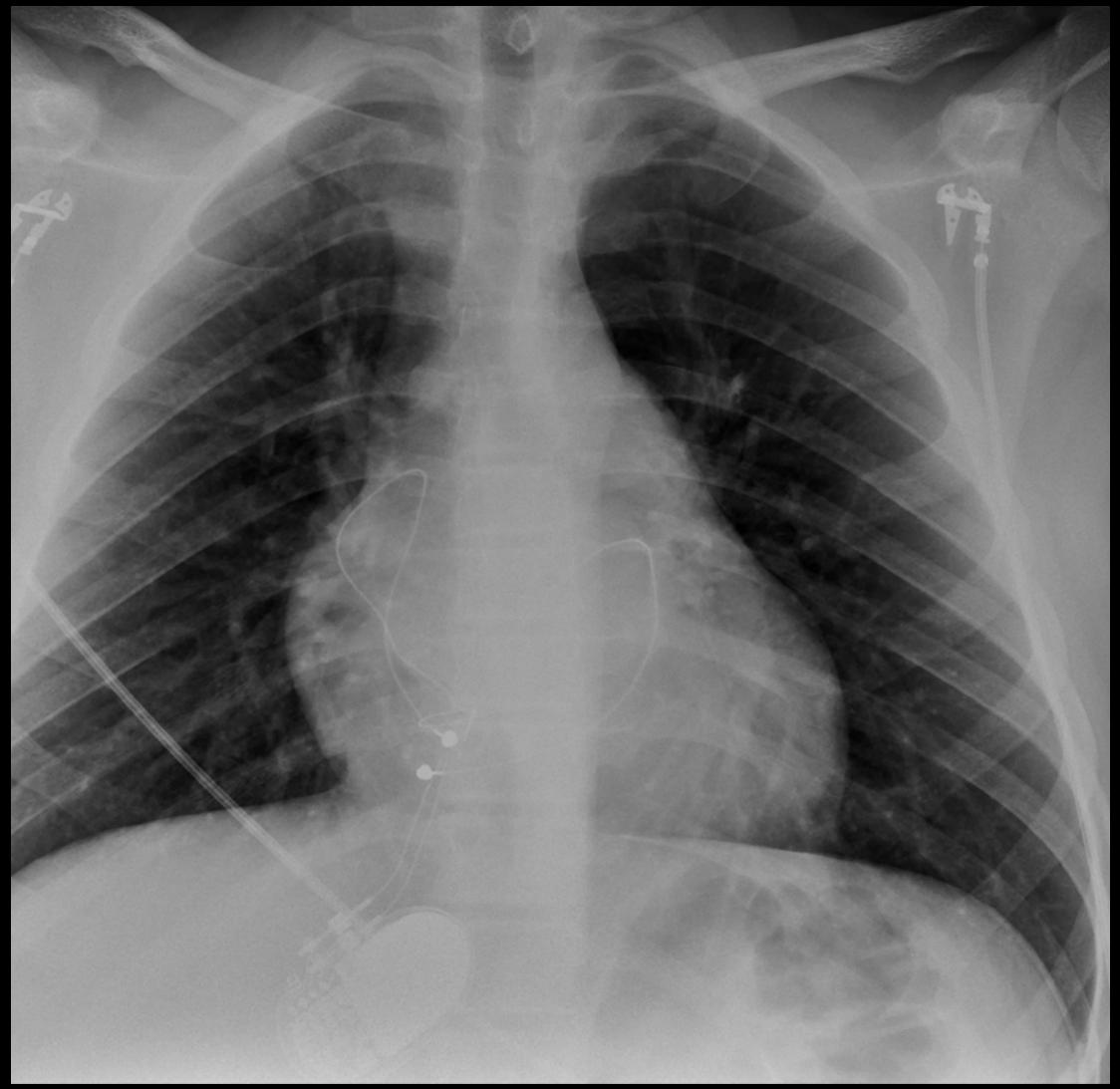
Compatibility

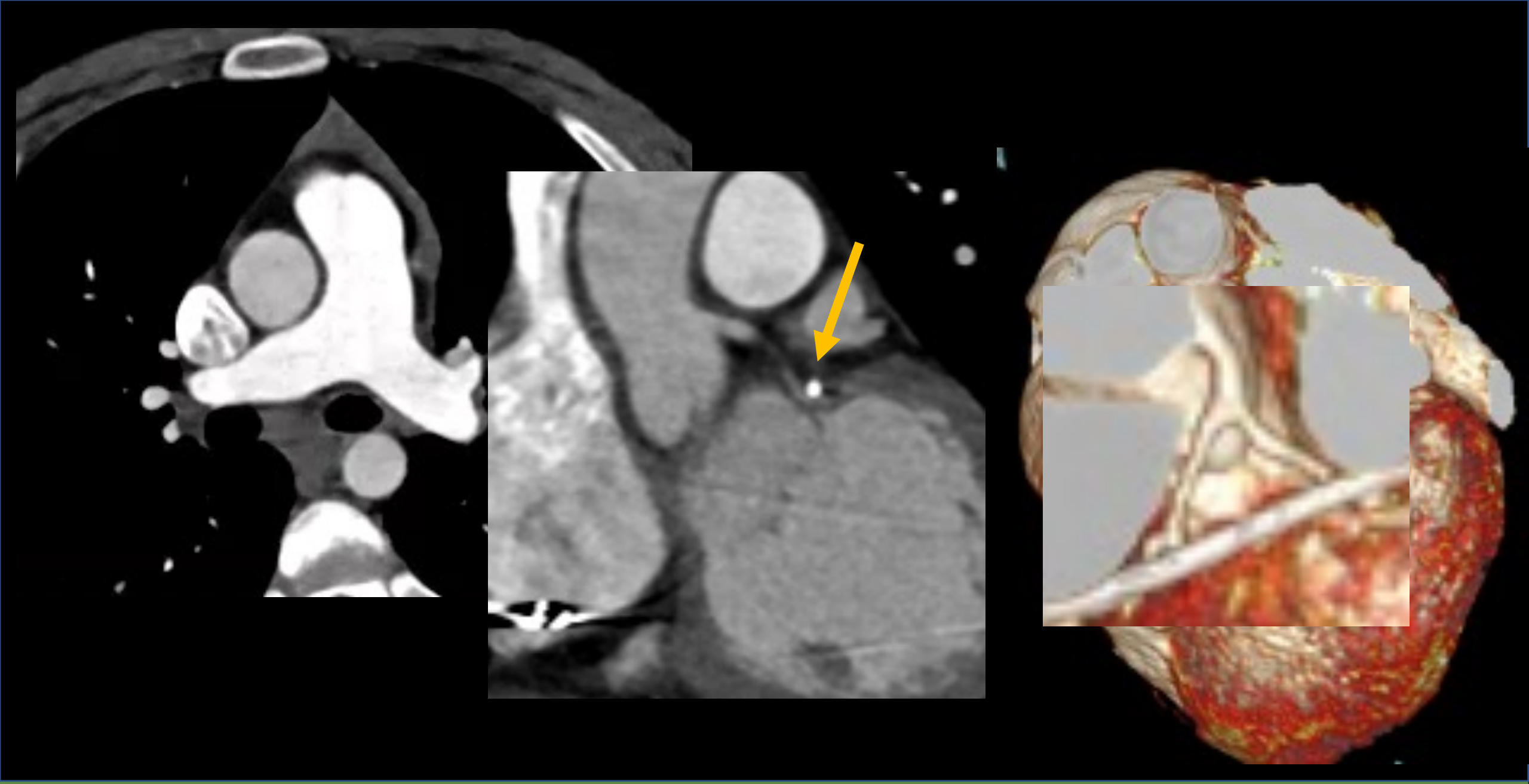
- Metallic artifact
- VAD/ECMO catheter

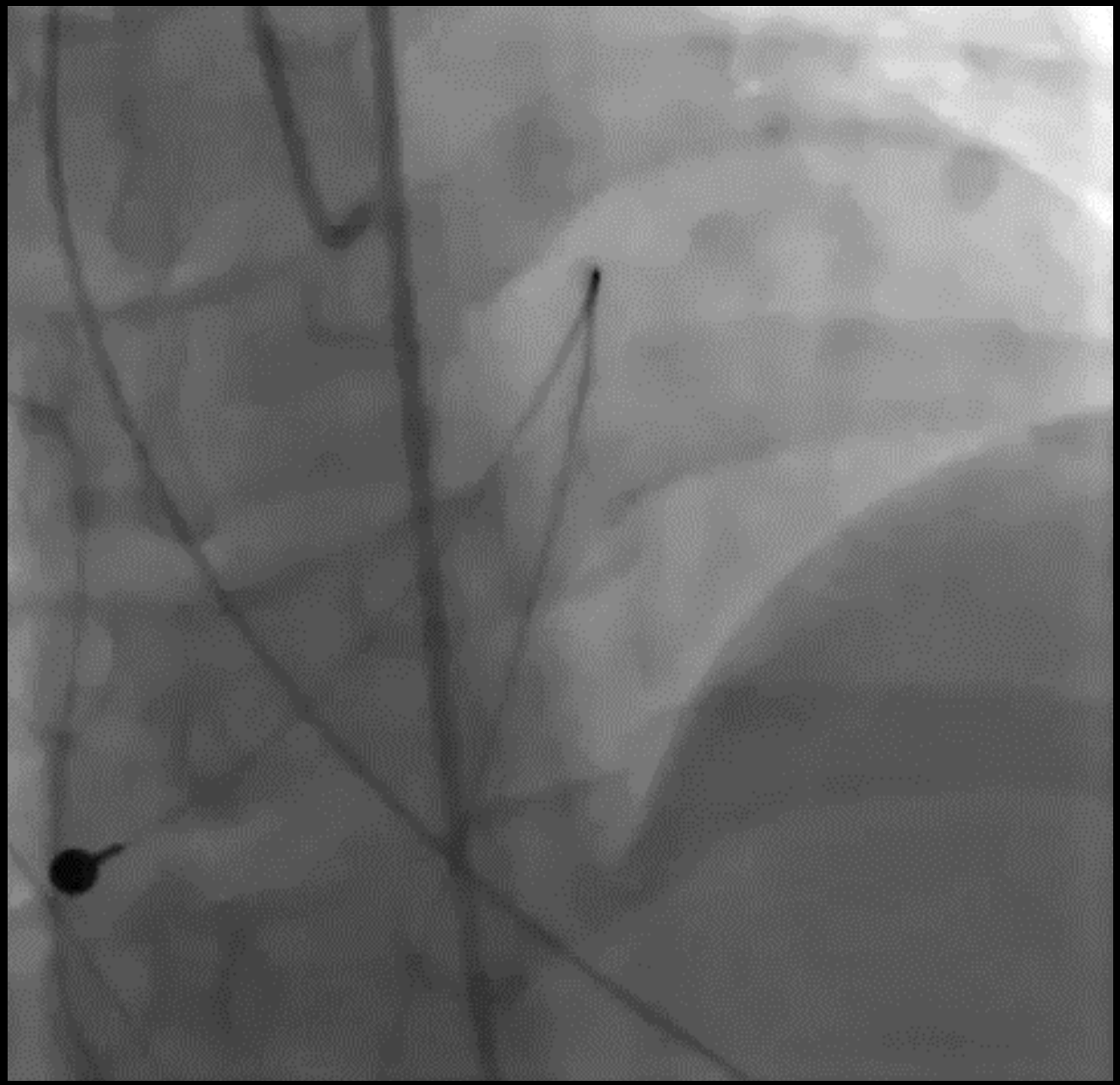
Extracardiac Structures

- Lung
- Airway
- Bones

13 year old with epicardial pacer for heart block



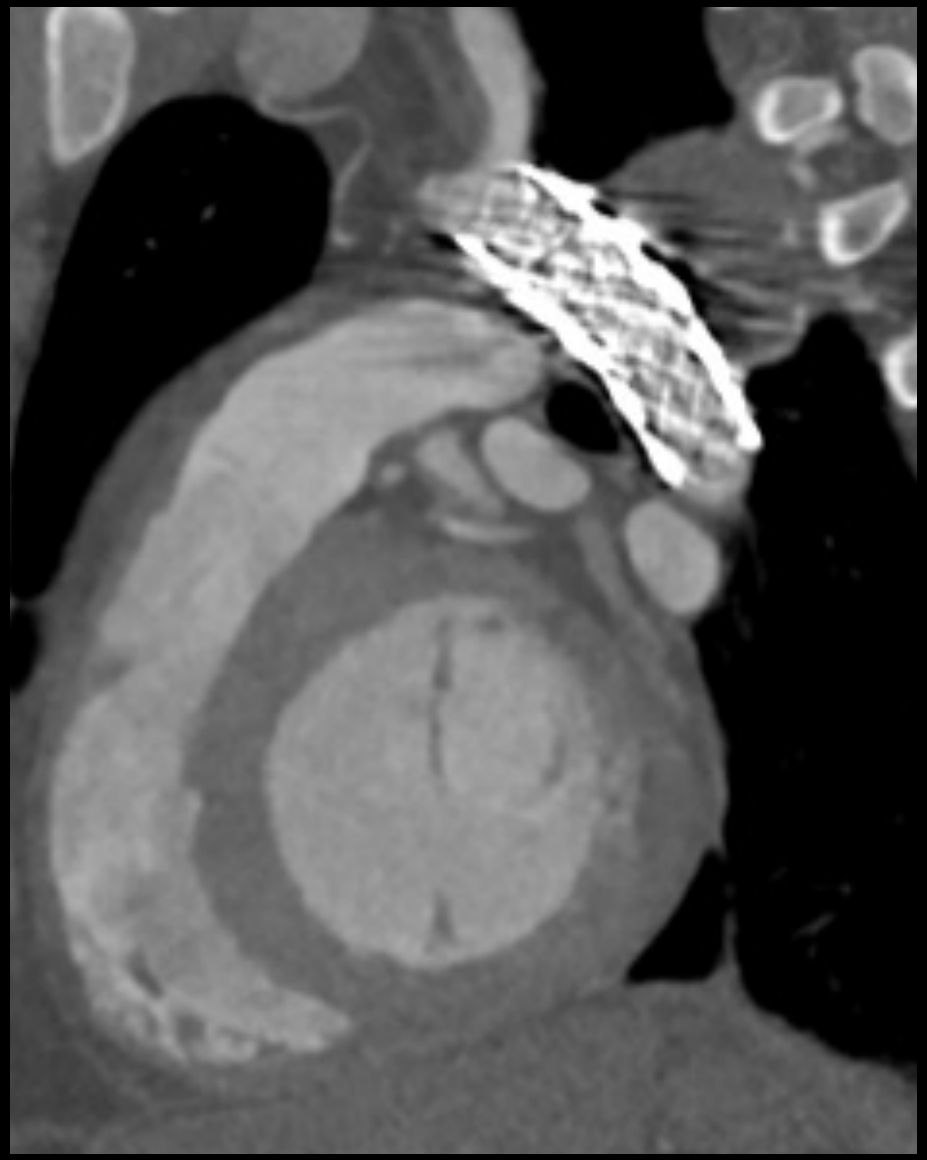


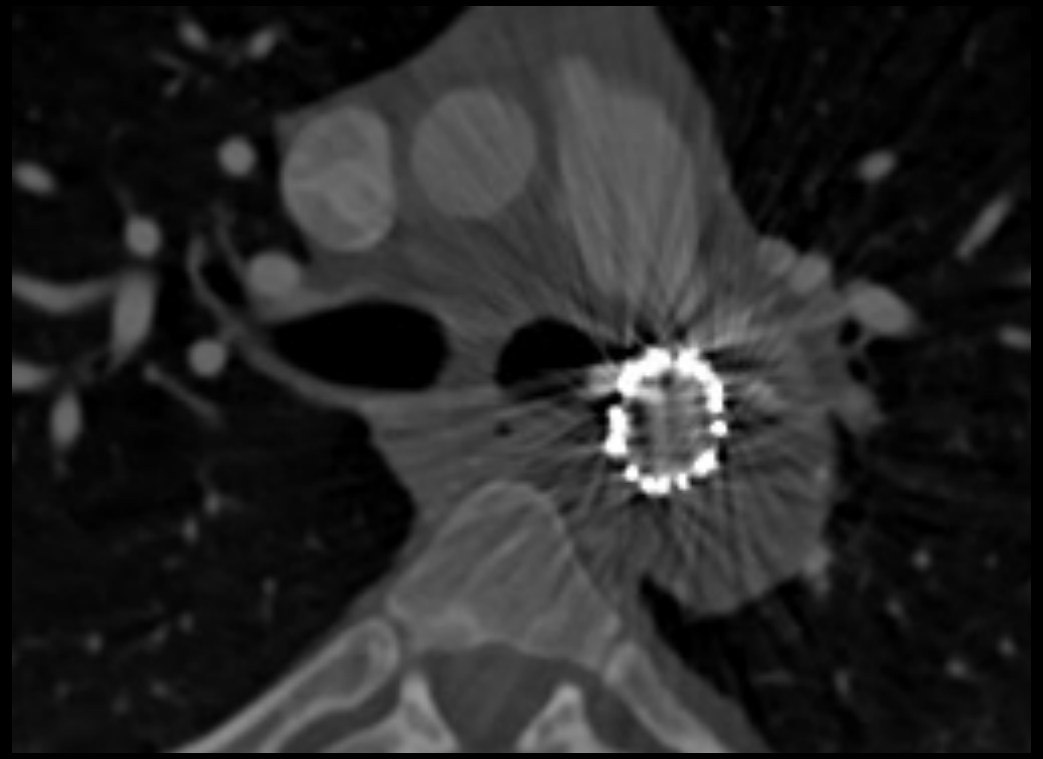


Coronary assessment in presence of lead

Surgical removal of pacemaker lead

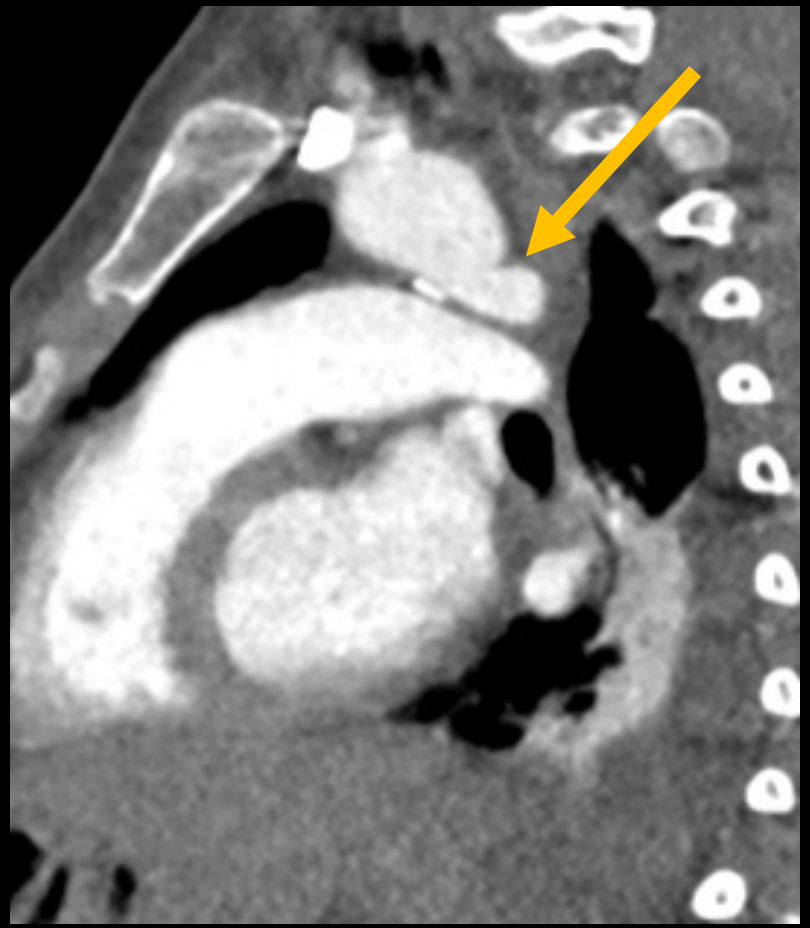
20 year old with Williams syndrome h/o coarctation repair

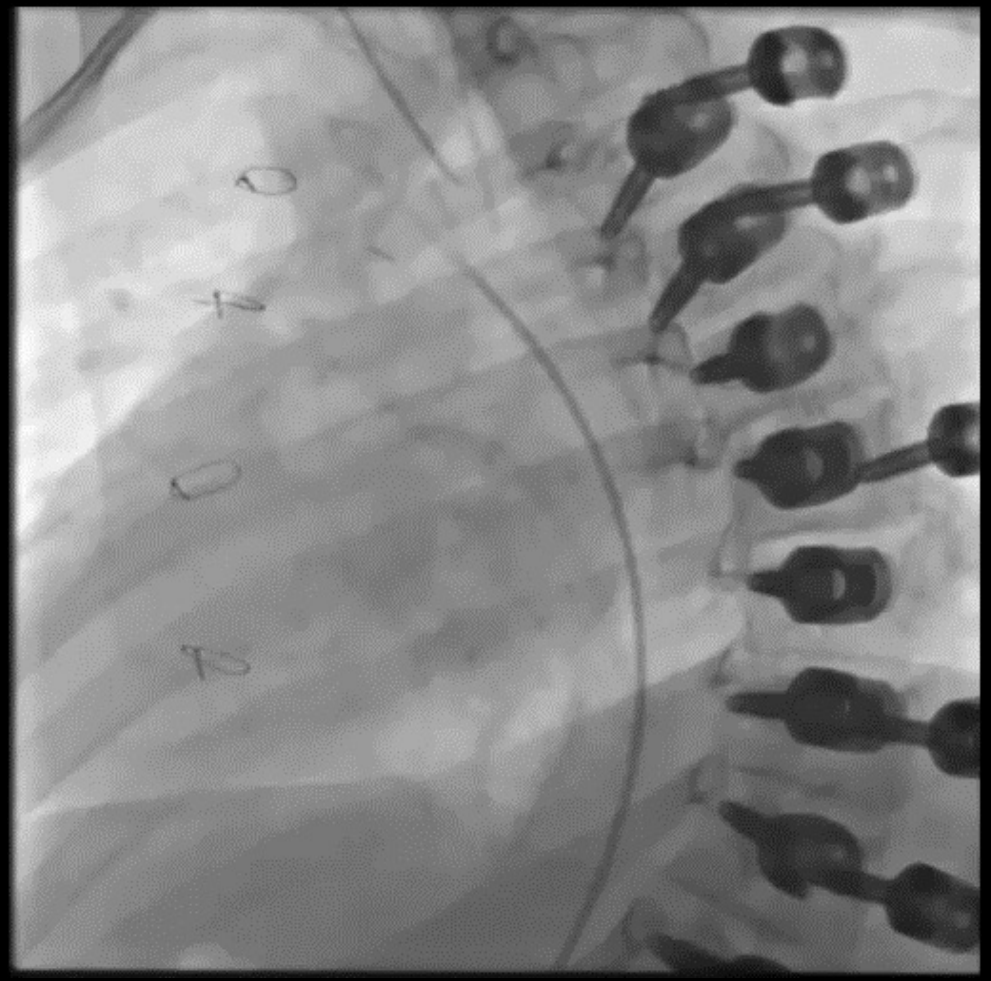


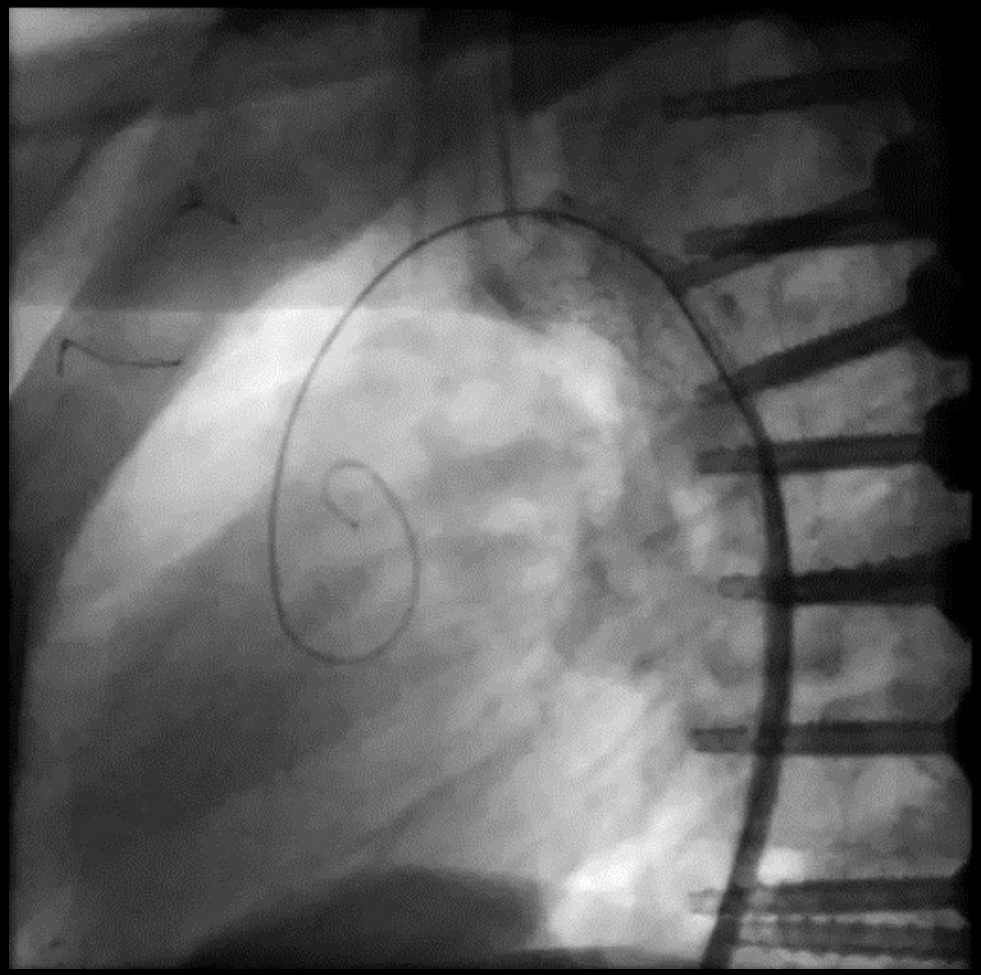


Evaluation of aneurysm post stent

14 year old h/o coarctation and spinal rods







CT evaluation in presence of spinal hardware

Why CT for Evaluation of Congenital Heart Disease?

Fast

- Critically ill
- Claustrophobic
- Children

High Spatial Resolution

- Coronary artery
- Calcifications within vessels and conduits
- 3D Modeling

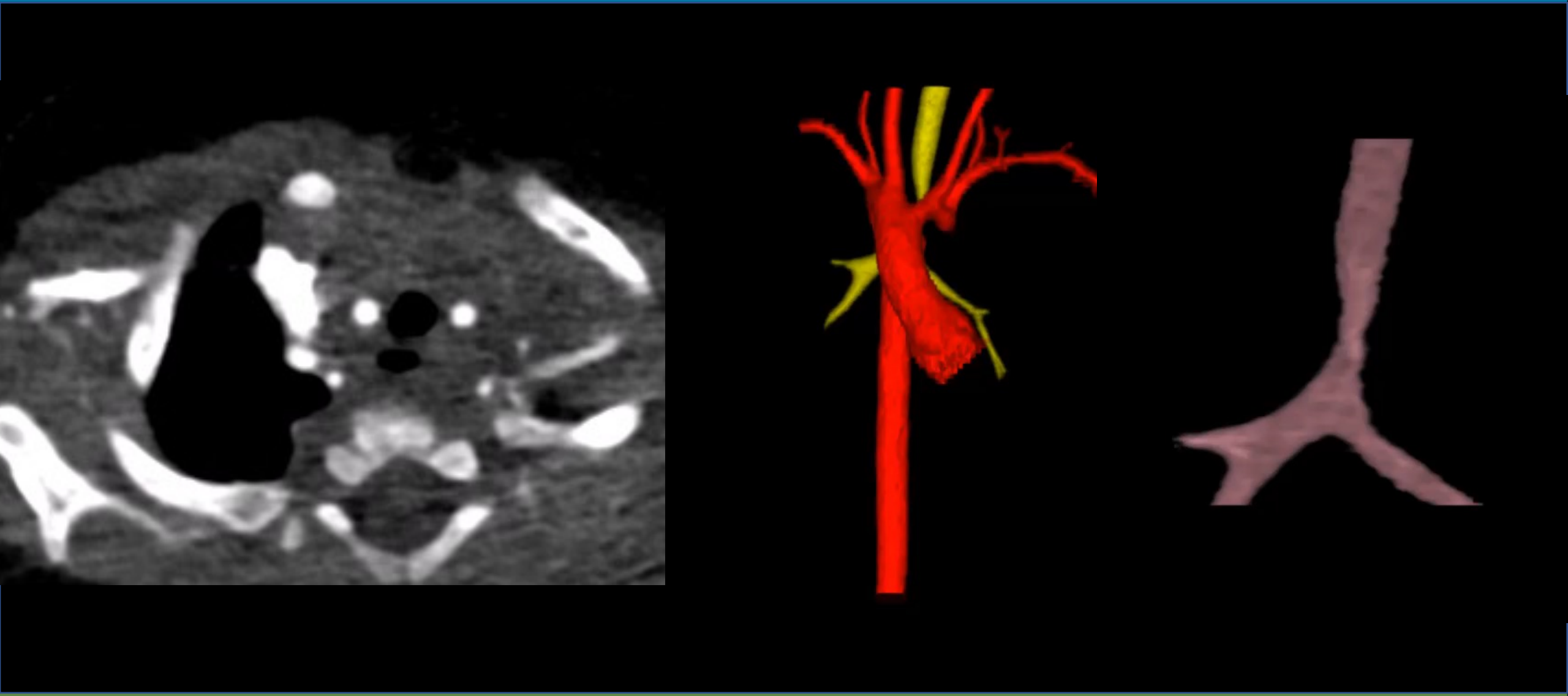
Compatibility

- Metallic artifact
- VAD/ECMO catheter

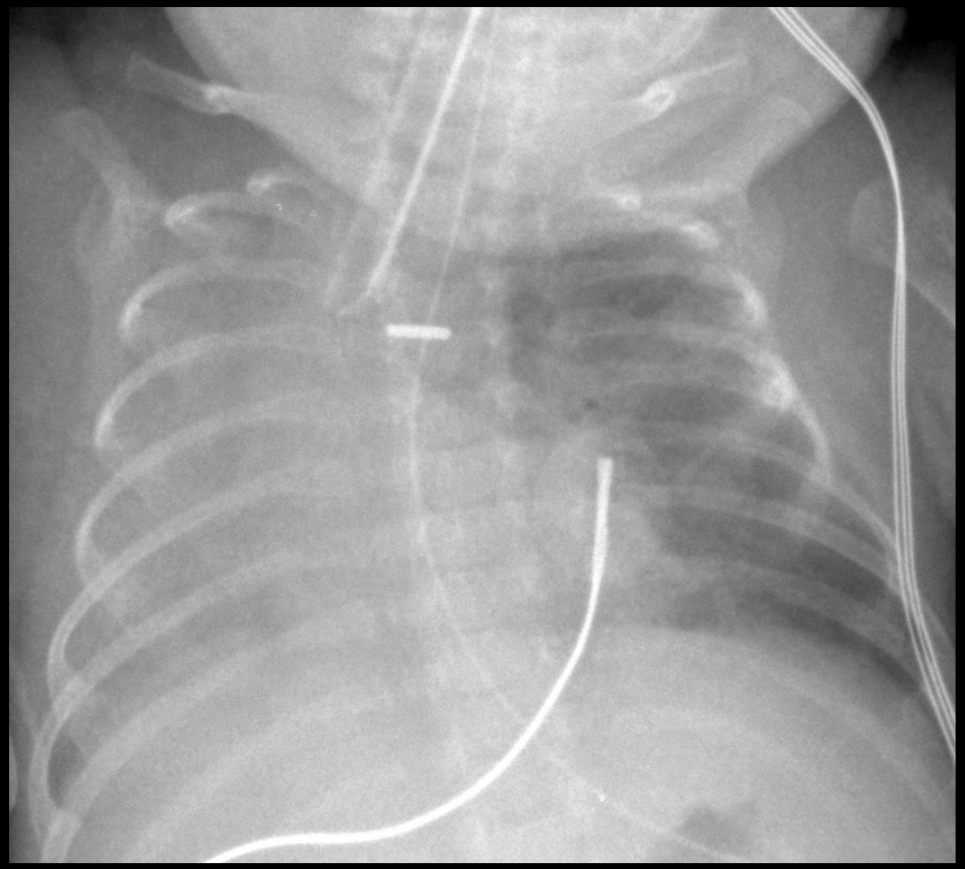
Extracardiac Structures

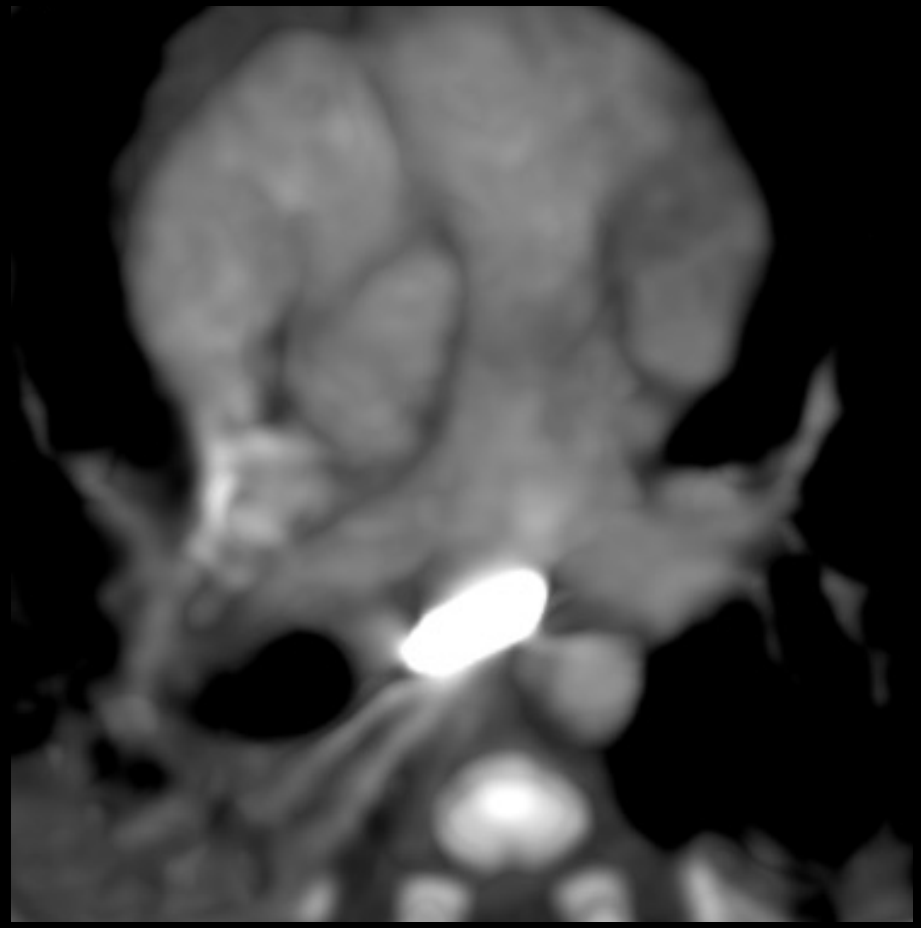
- Lung
- Airway
- Bones

2 mo old with double aortic arch and stridor

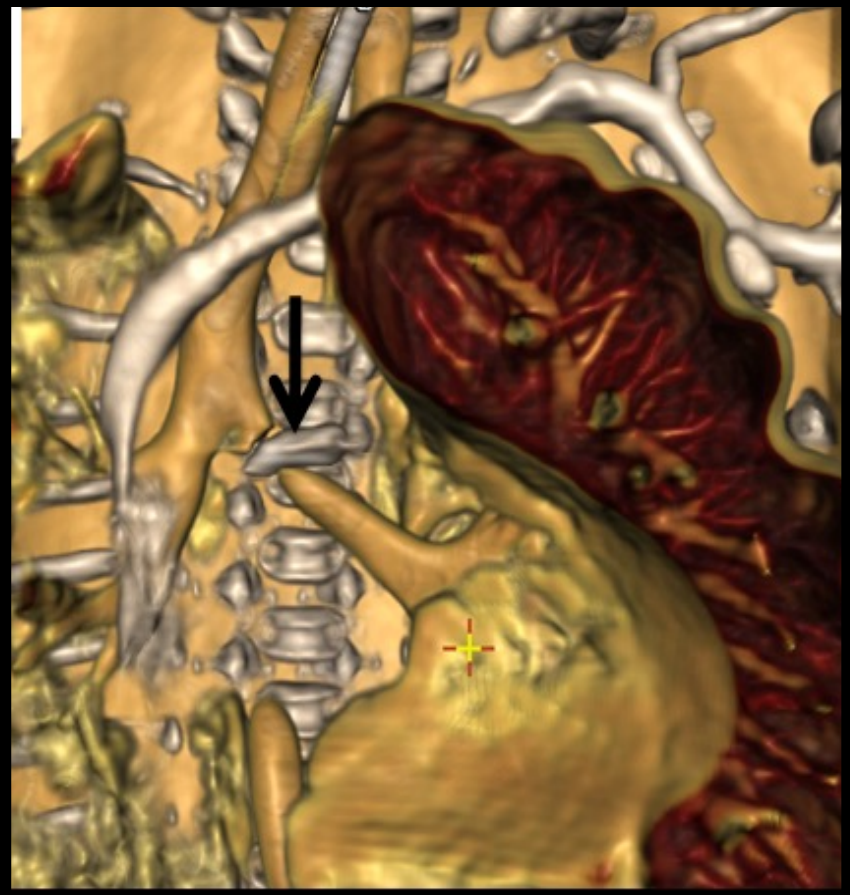


27 week old with respiratory distress





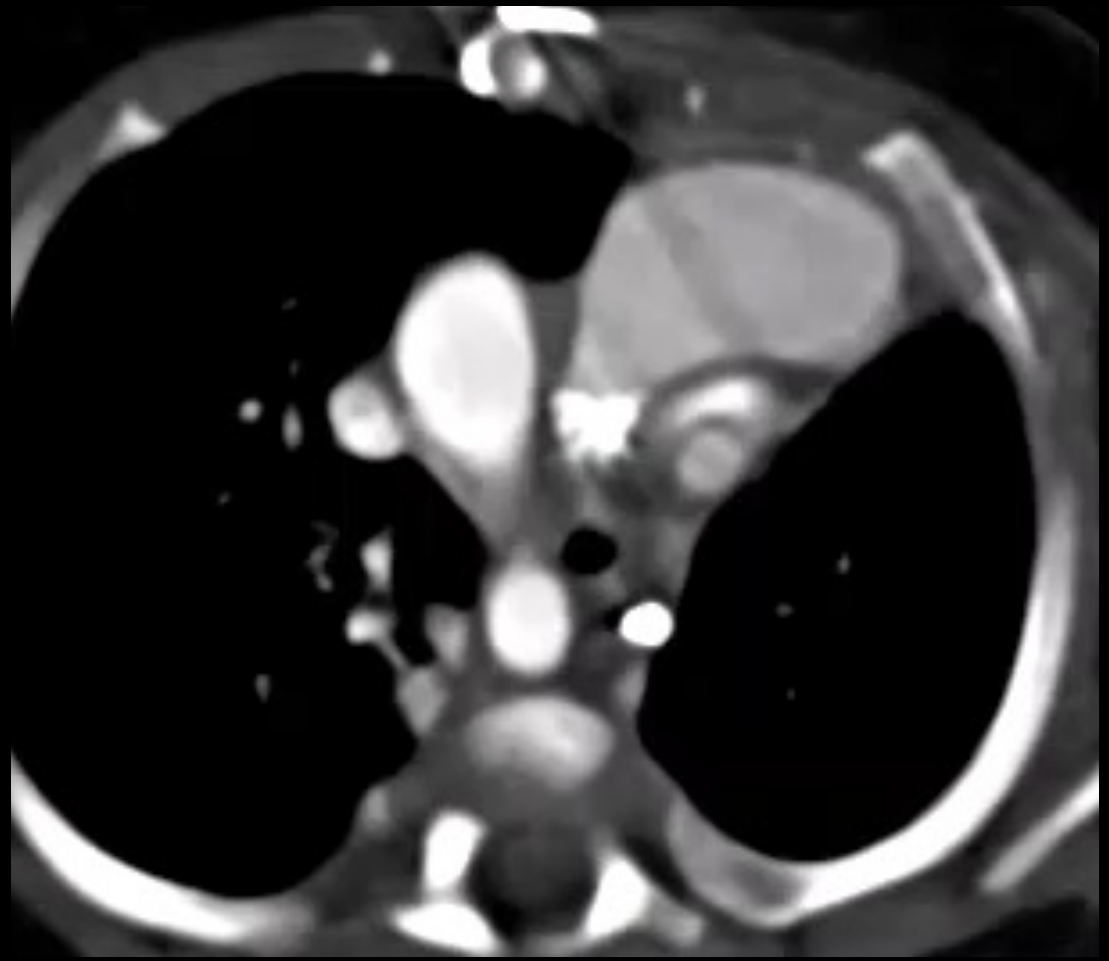
Courtesy of Lorna Browne, MD
Children's Hospital Colorado

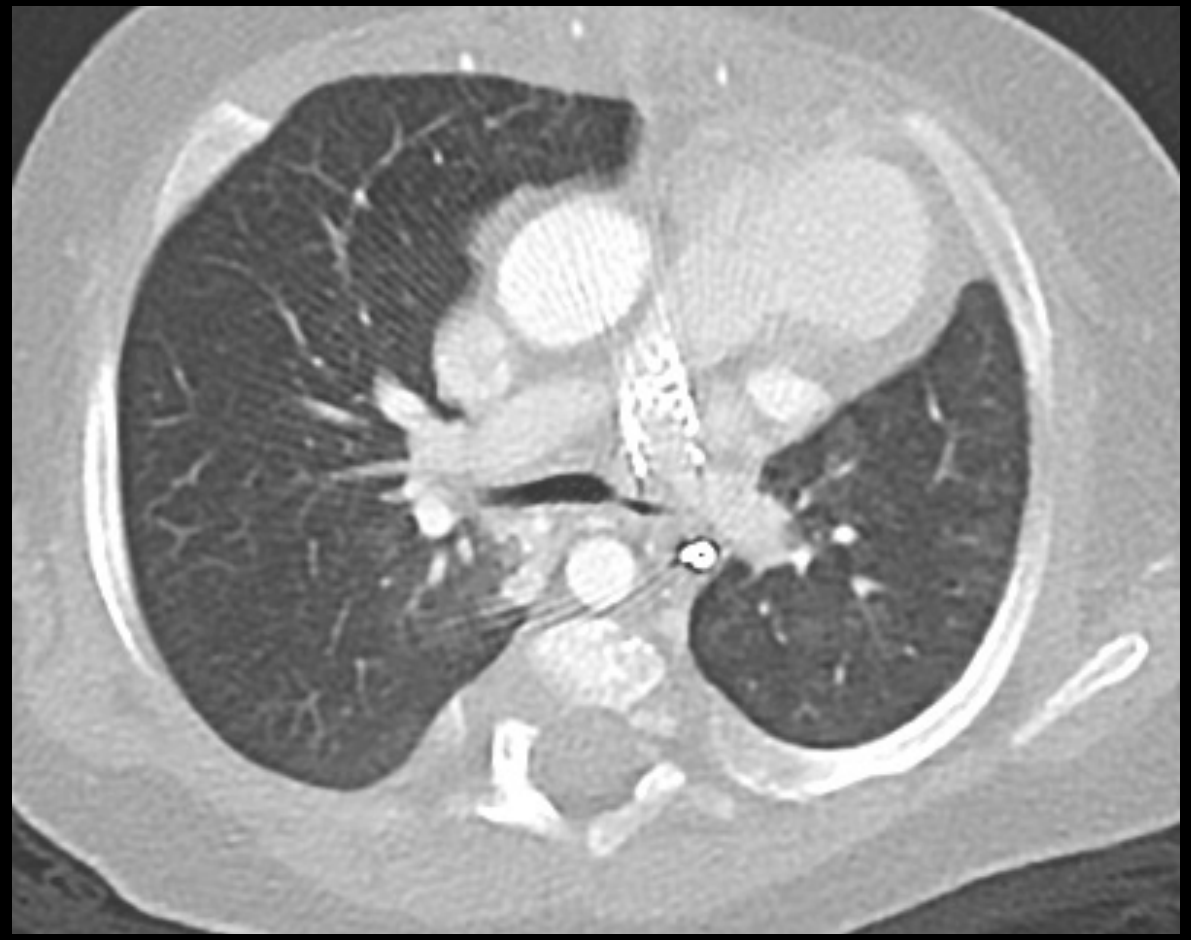


PDA ligation of Left Main Bronchus

Airway evaluation with an adjacent clip

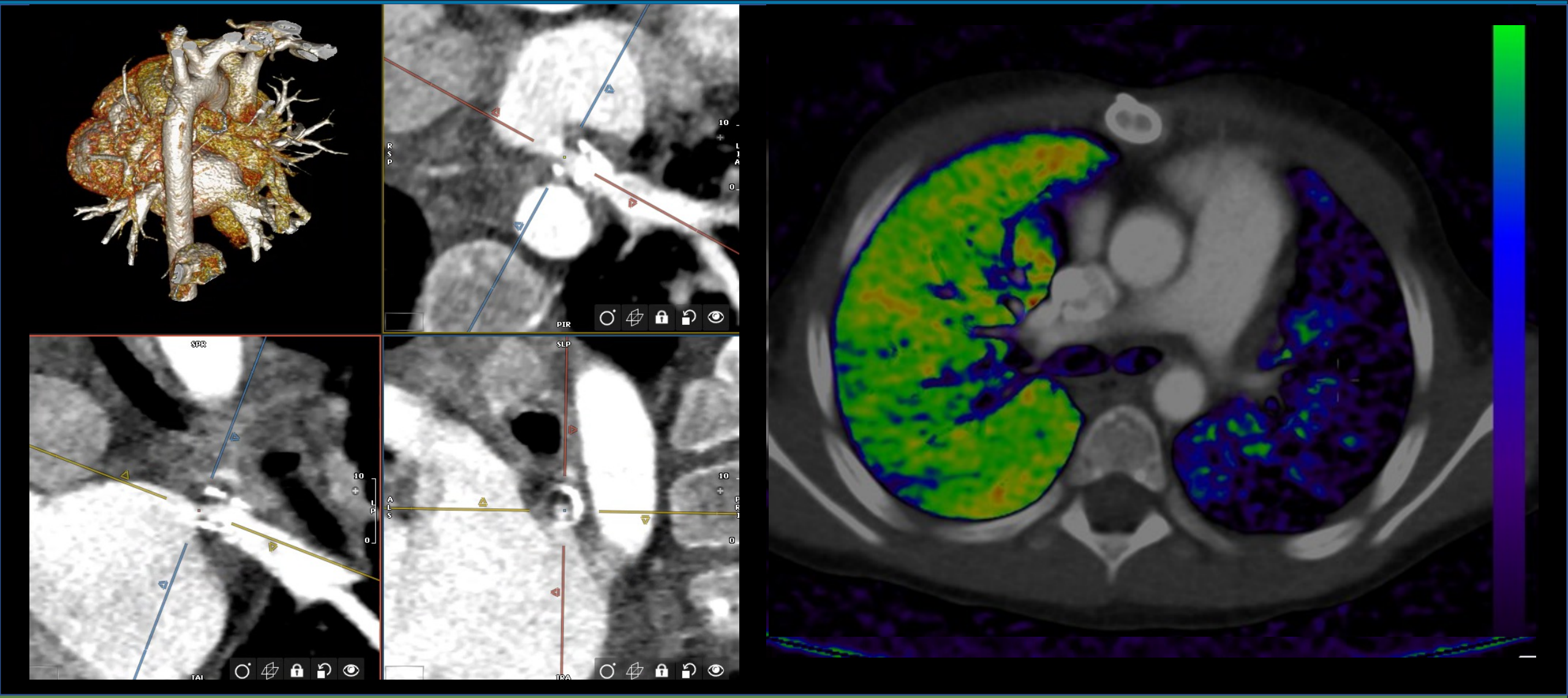
4 mo old w/ TOF s/p stent. Concern for airway compression





Dynamic airway evaluation in the presence of a stent

5 yo w/ LUPV atresia and LLPV stenosis.



Conclusion

- Cardiac CT has an important role in the evaluation of CHD
  - Fast, less need for sedation with high spatial resolution
  - Better with artifacts, stents
  - Important for evaluation of extra-cardiac structures

Cardiac CTA is an essential tool that aids presurgical and postsurgical evaluation of cardiac disease

Acknowledgements – Cardiac Imaging Team

Mark Fogel, MD
Matt Harris, MD
Kevin Whitehead, MD
Sara Partington, MD
Danish Vaiyani, MD

Hansel Otero, MD
Ammie White, MD
Jordan Rapp, MD
Seth Vatsky, DO

<u>MR Technologists</u>
Justine Wilson
Brian Brazinski
George Englehardt
Shaun Hoffacker
Mallory Mueller

<u>CT Technologists</u>
Felicia Williams
Mintu Alexander
Angel Guzman

Thank you!

Questions?

bikod@chop.edu
@biko_md