



Anatomy for 3D Echocardiography

Toronto Perioperative TEE Symposium - Hands on 3D TEE Course
3D TEE Course | 4 November 2022

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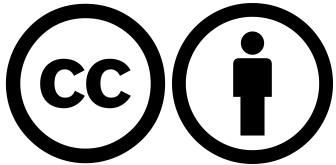
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Research & Salary Support:

- UHN-SHS Anesthesia Association
- UHN-SHS Academic Medical Organization
- UHN Foundation
- Ontario Centers of Excellence (with TME Inc)
- NSERC (with MIE, U of T), SSHRC (With Synlab, TMU)

Speakers Bureau/Honoraria: No financial compensation. See <https://apil.ca/publications-media>

Consulting Fees: Pro bono consulting Glia Inc, Thornhill Medical Inc.

Other relationships:

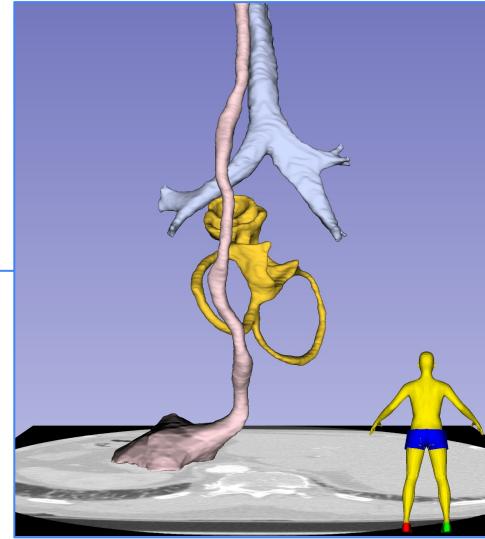
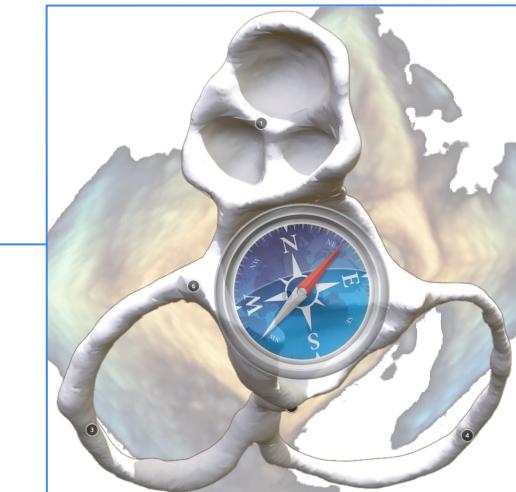
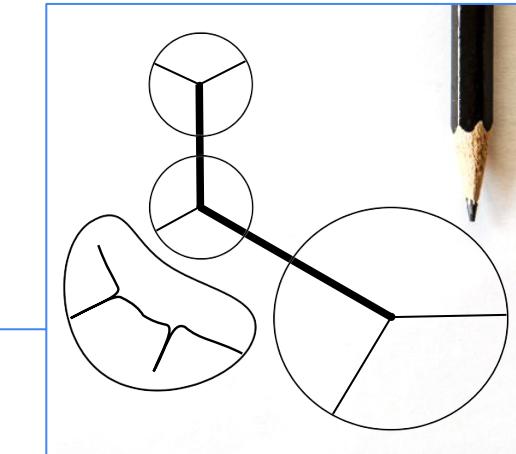
- Standards Council of Canada (MC121)
- International Organization for Standardization (ISO, Canadian delegate TC121)
- Glia Inc. (Research)
- Thornhill Medical Inc. (Research)

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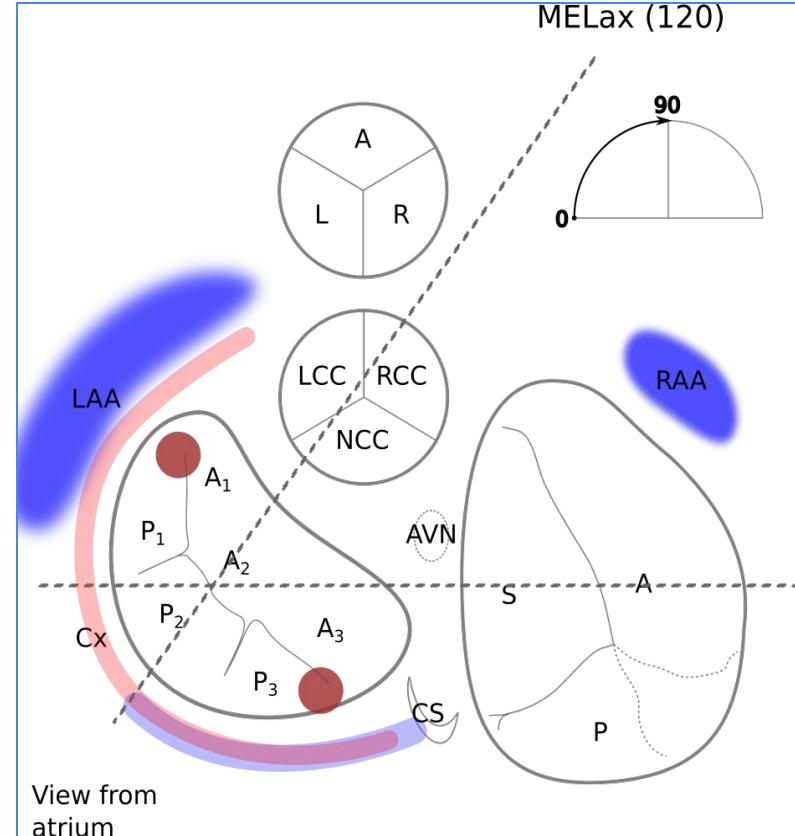
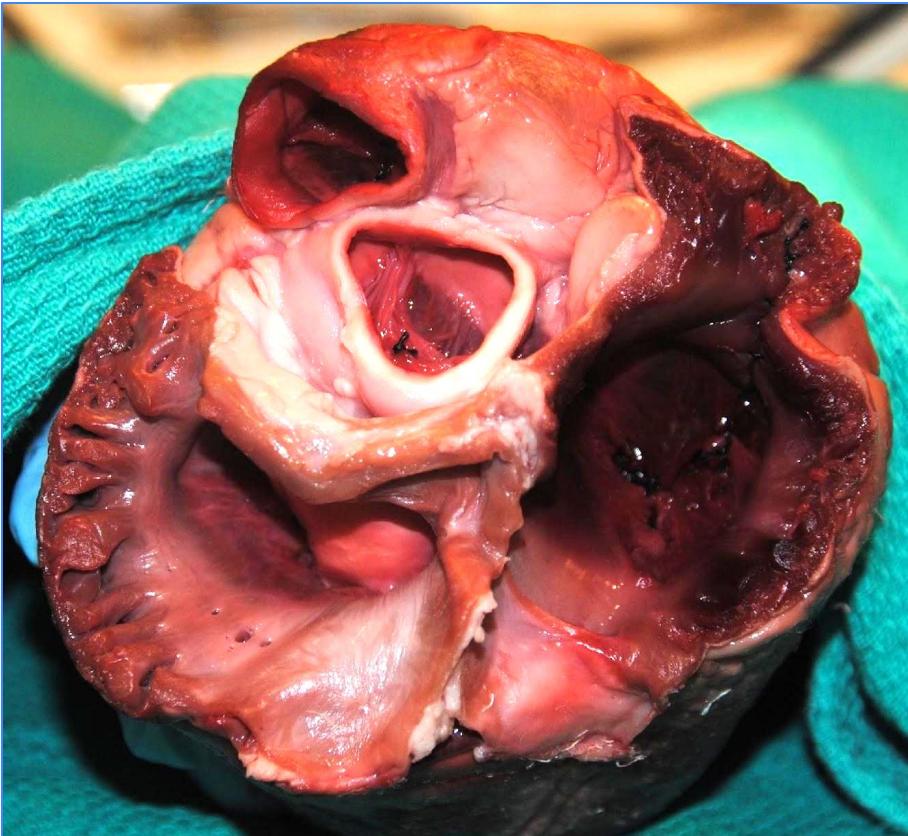
Objectives & Outline

After active participation in this session participants will be able to

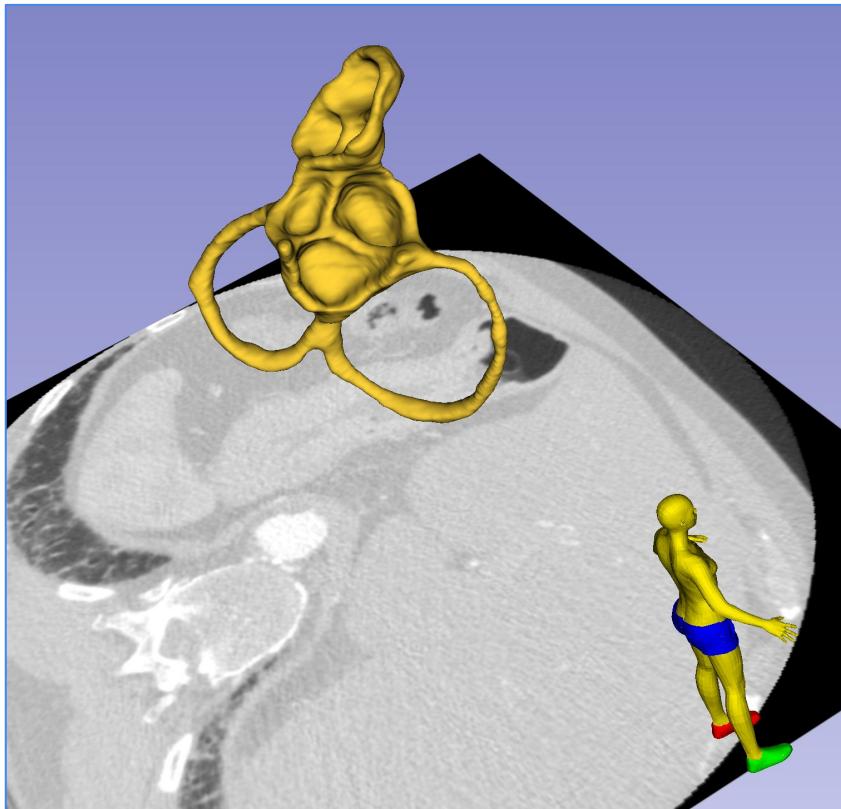
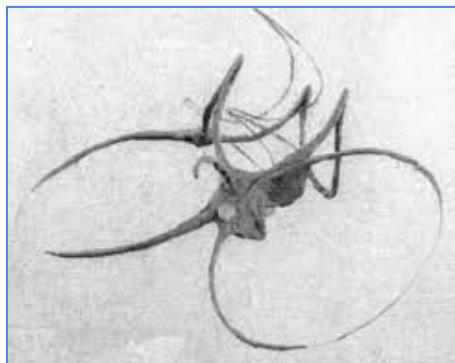
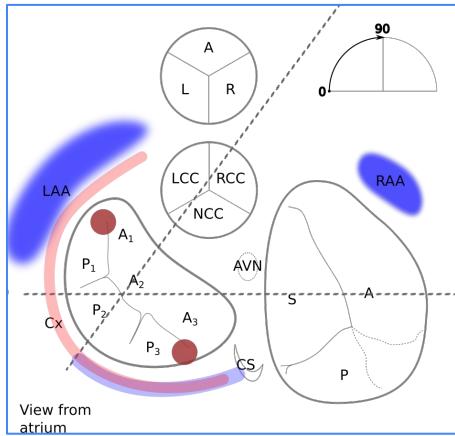
1. Visualize & draw a detailed schematic of the **heart base**
2. Visualize the heart base in 3D, its **position** in the thorax & its **relationships** to the esophagus and trachea
3. Assemble **all major cardiac structures** around the heart base
4. Use the **heart base as a compass** to navigate during the live 3D imaging & adjust probe position to optimize image



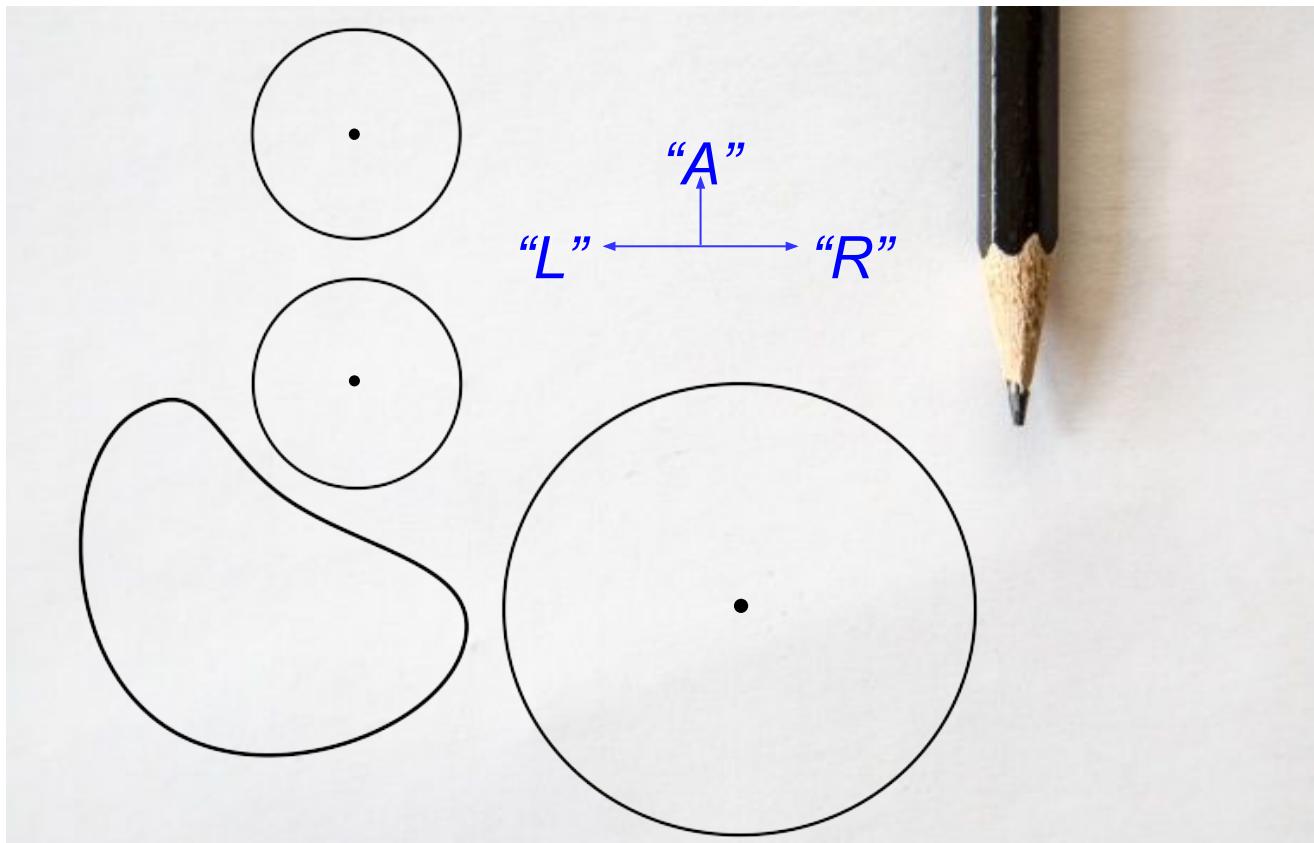
Heart Base



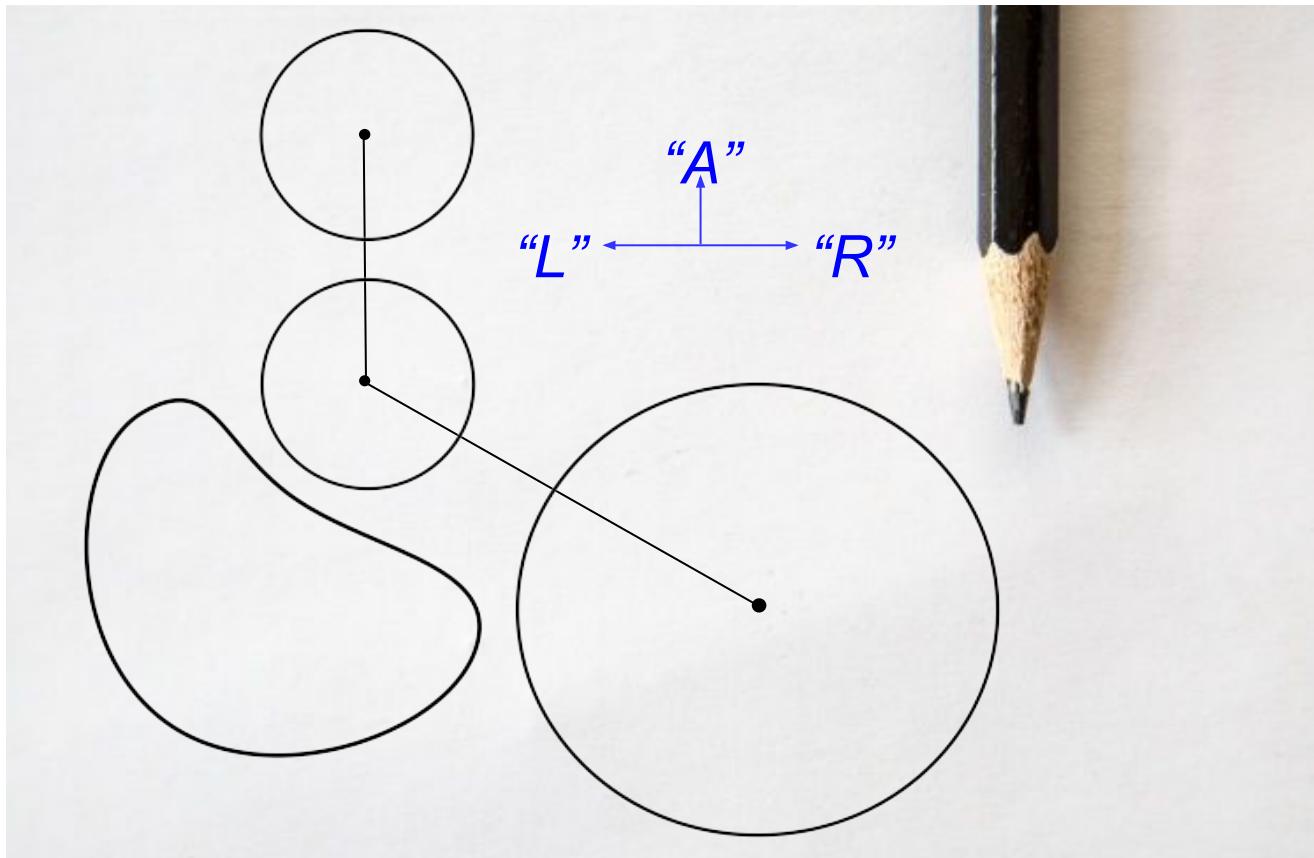
Heart Base: Schematic & CT Model



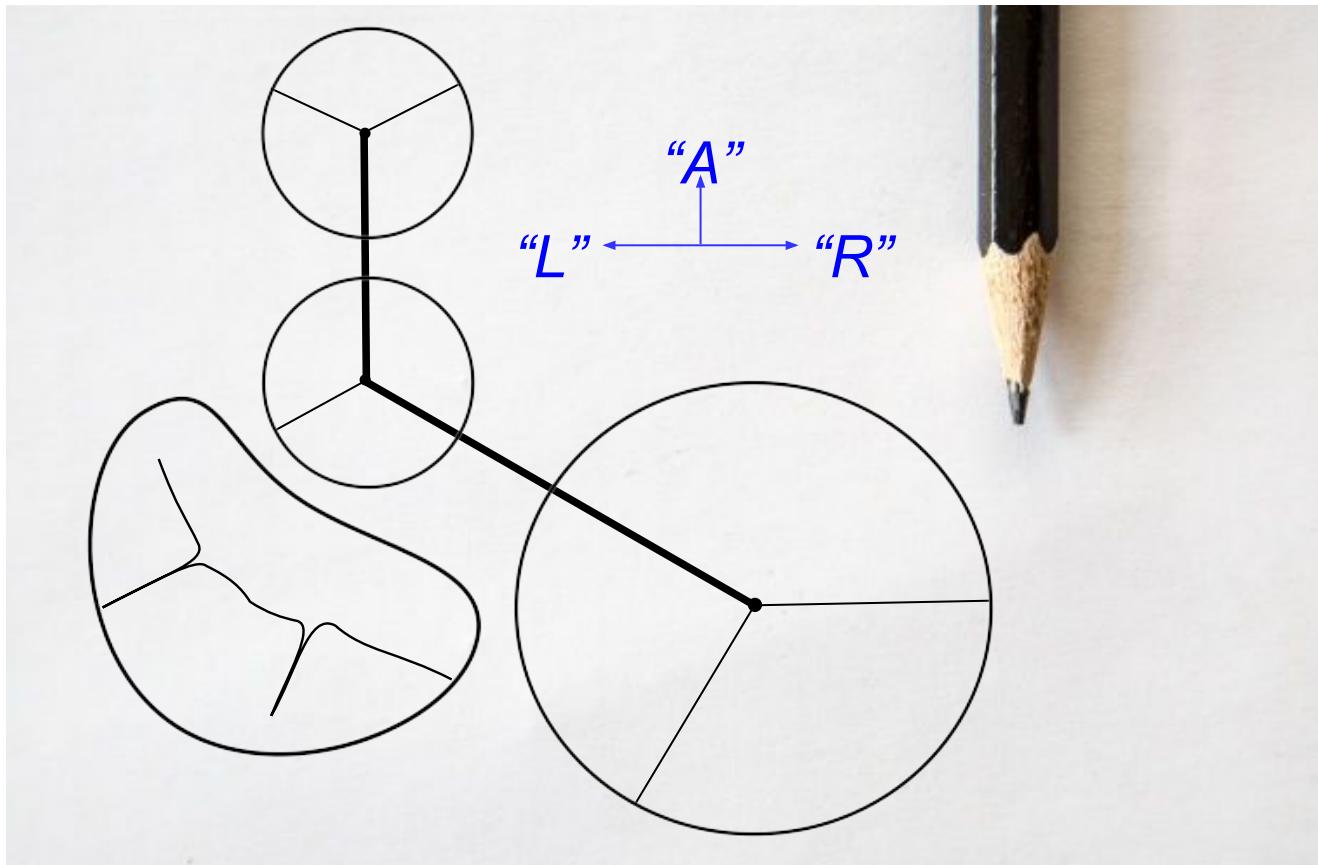
Drawing the Heart Base: Step 1



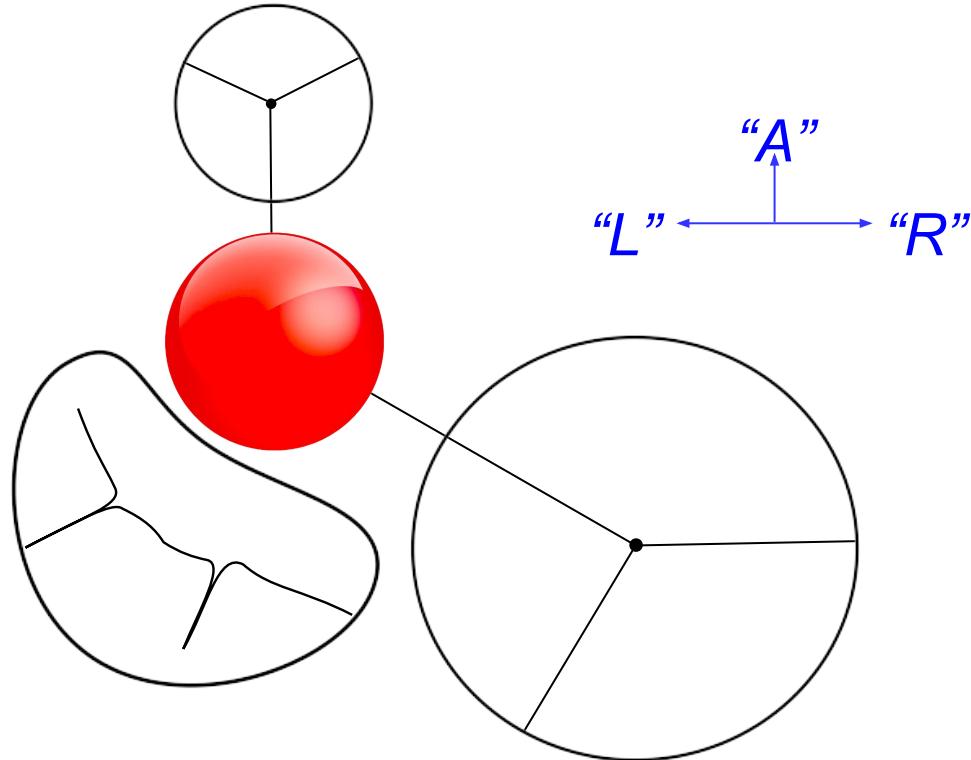
Heart Base: Step 2



Heart Base: Step 3

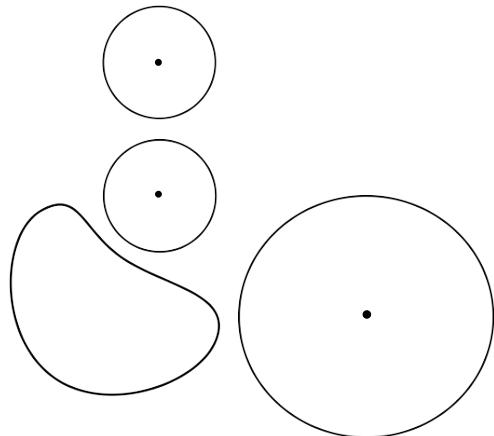


Heart Base: Tears of a ...

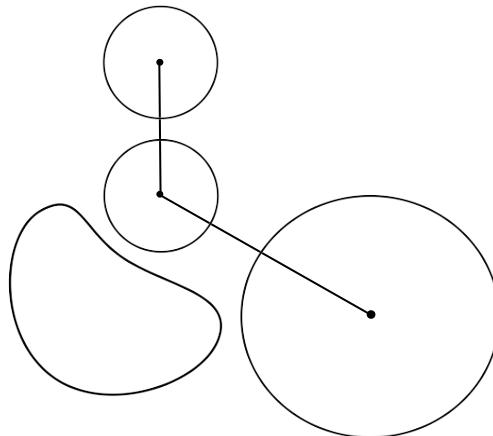


Heart Base

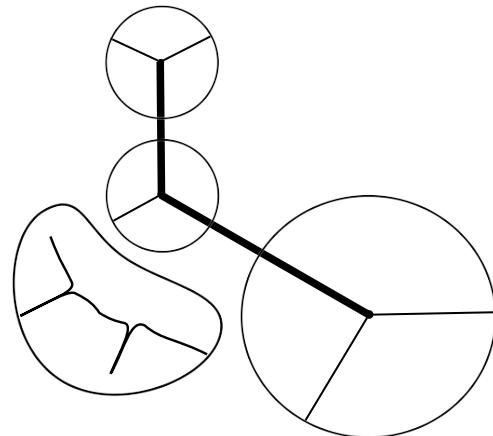
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2



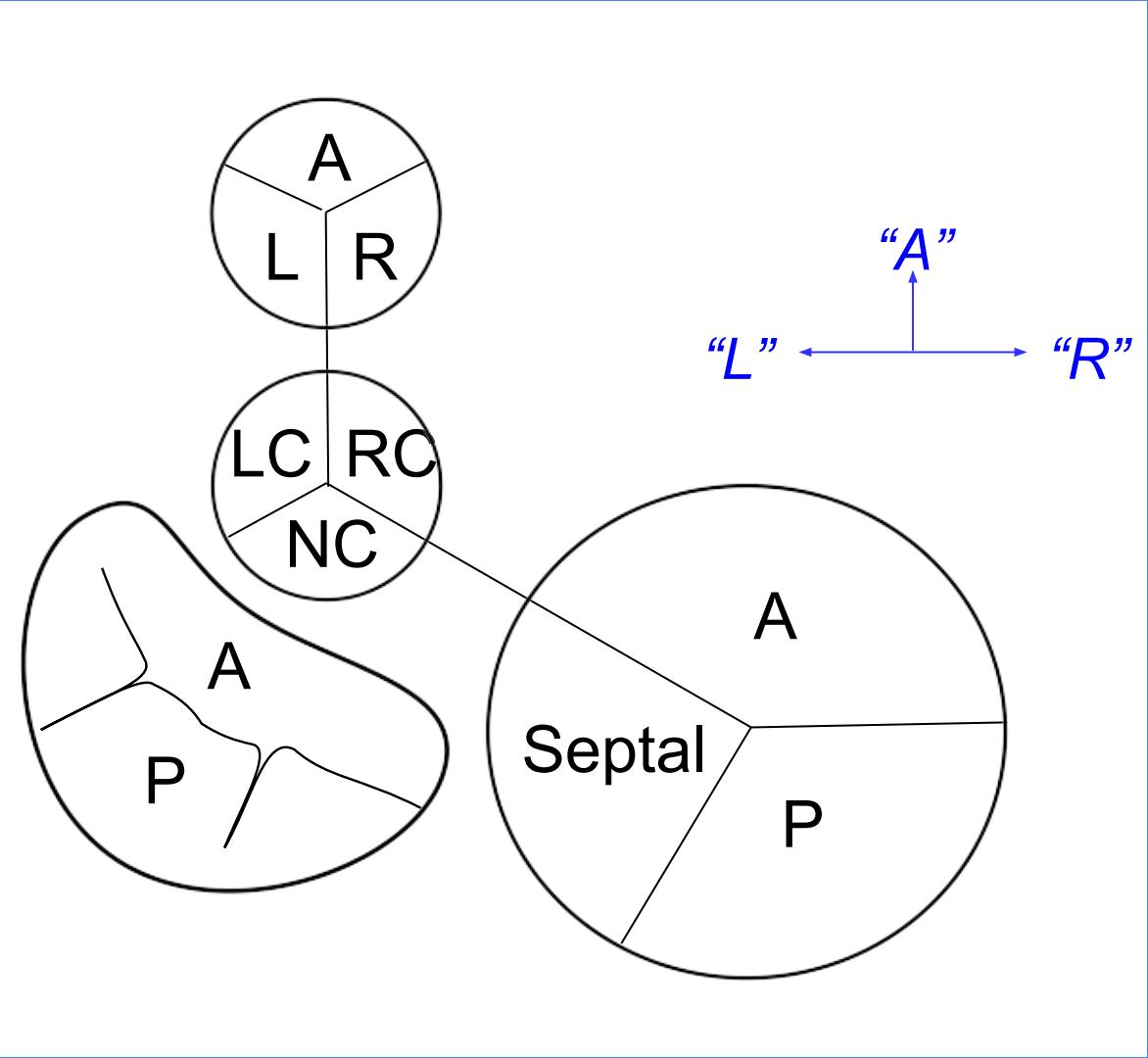
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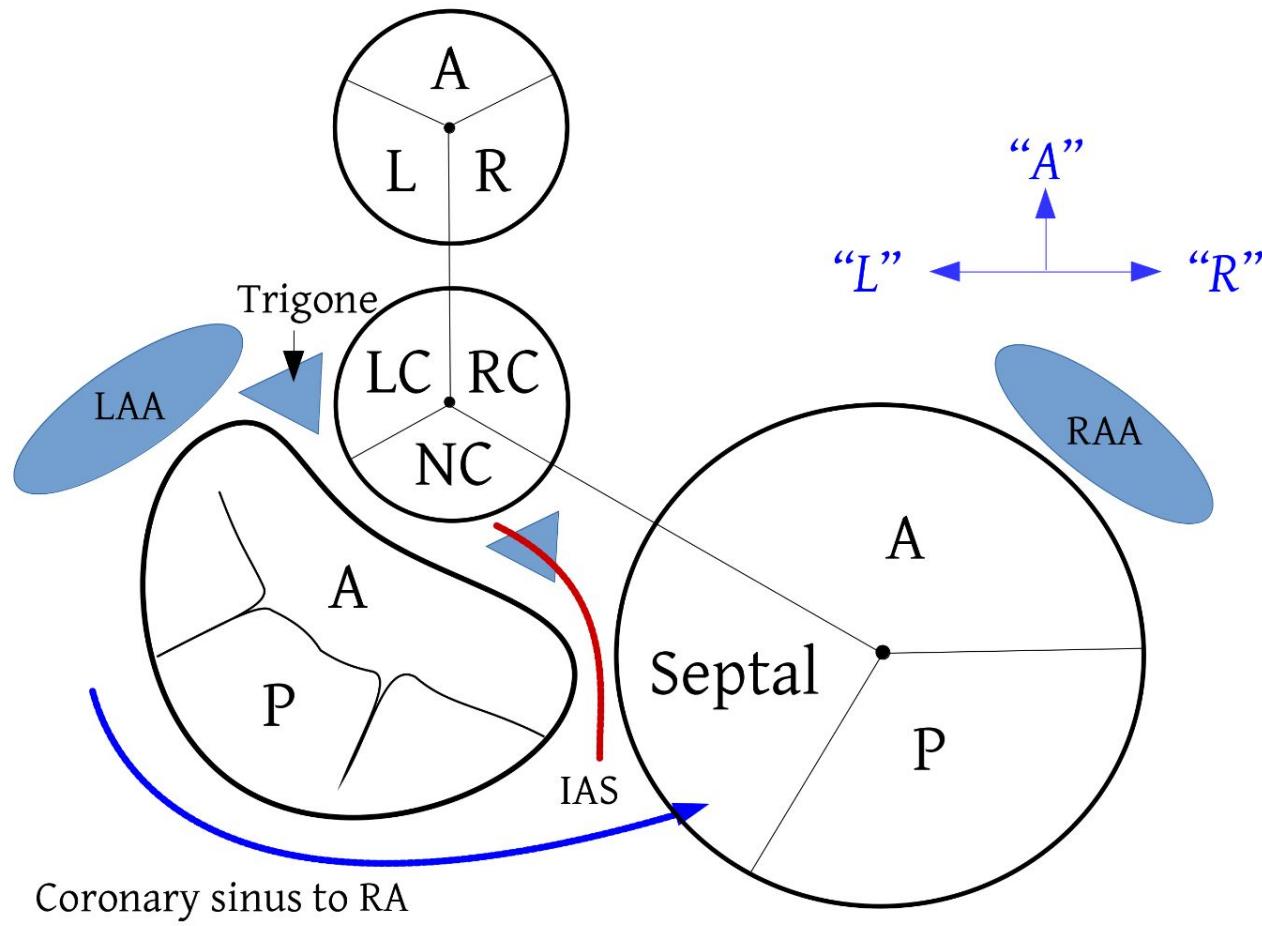


Heart Base

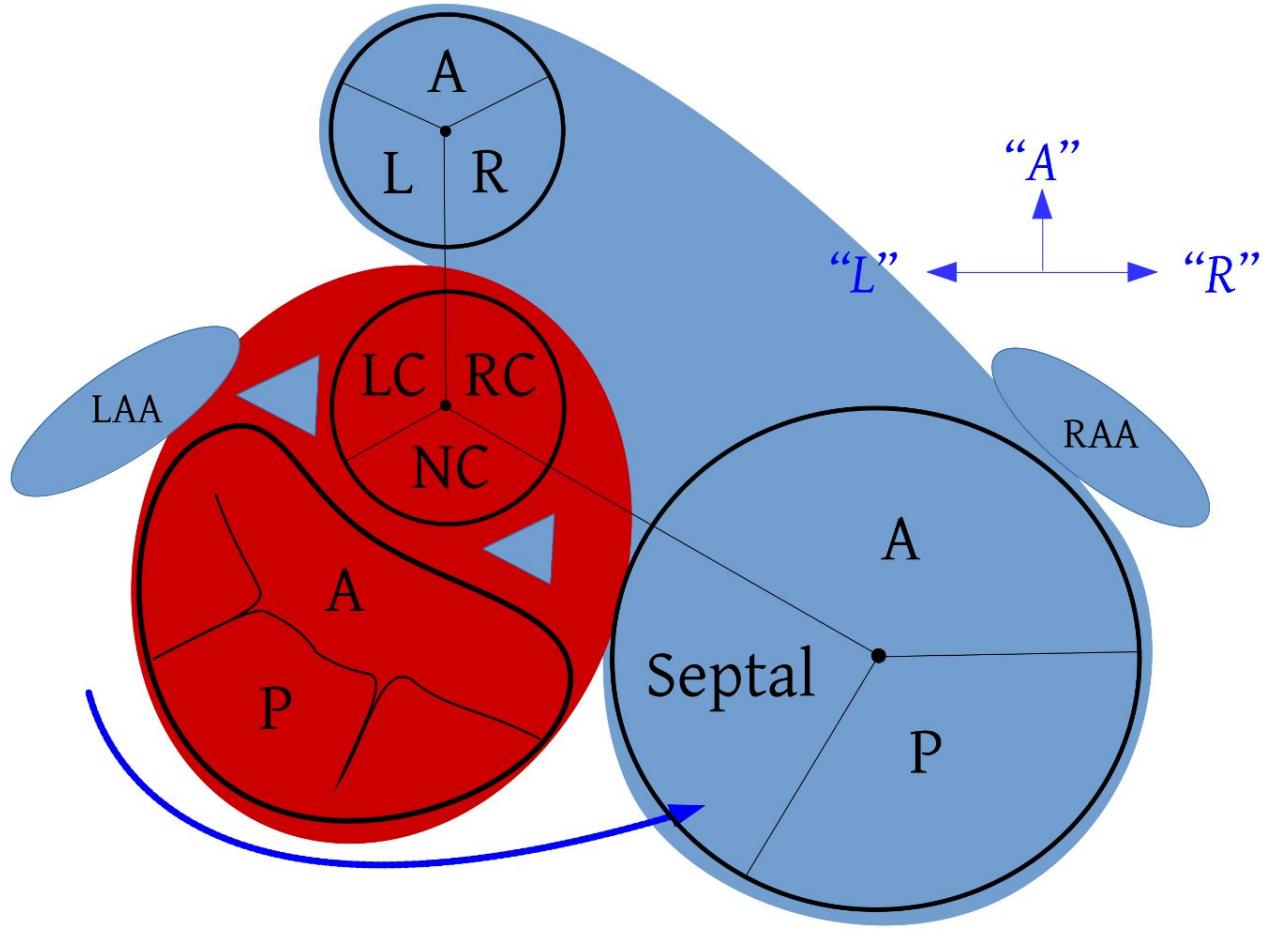
Identify approximate location of

- Inter-atrial Septum
- Right Atrial Appendage
- Left Atrial Appendage
- Coronary Sinus





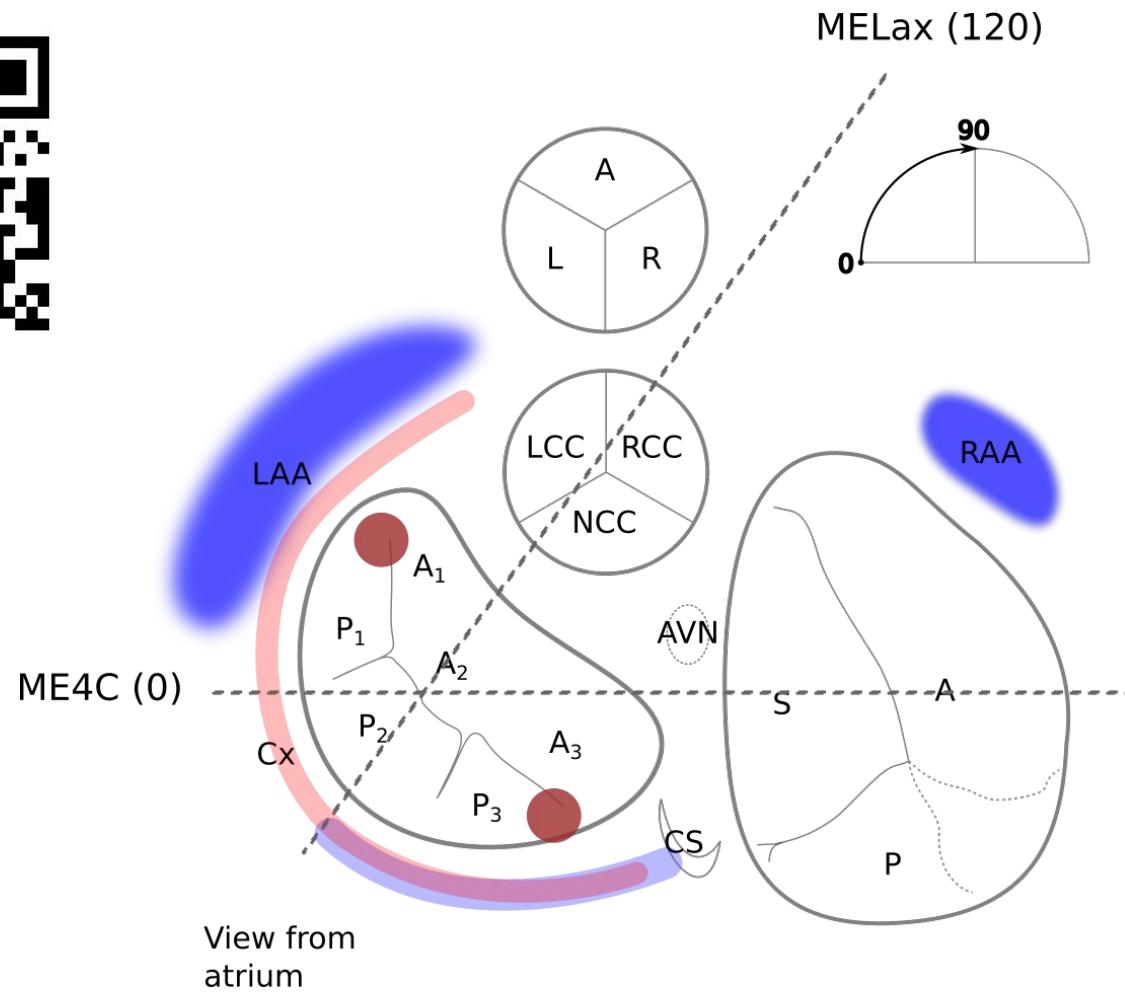
→ Next: Outline of RV and LV



"A"
"L" "R"

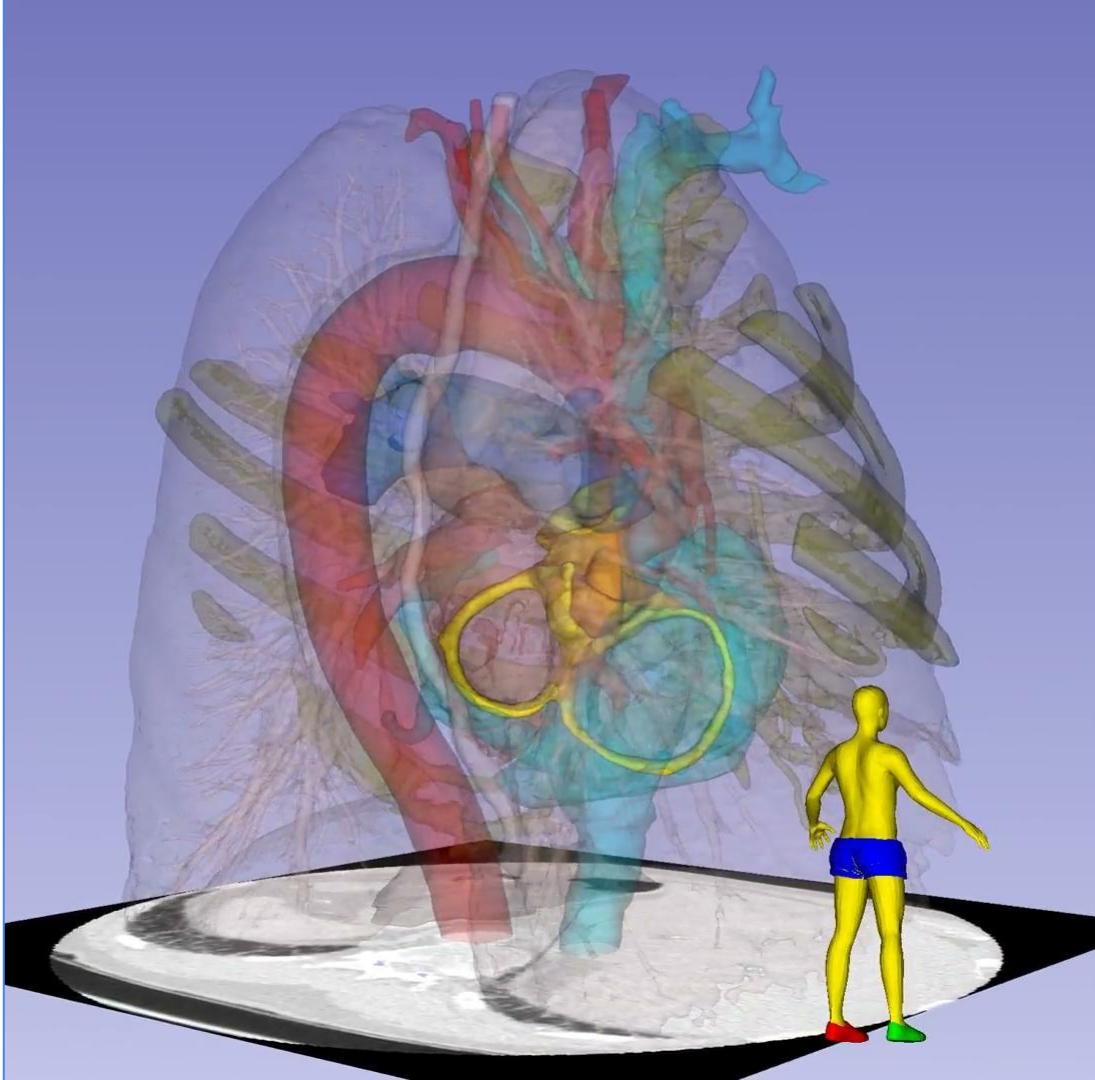
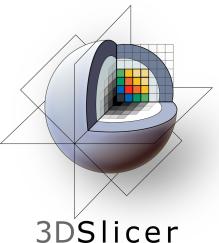


CT-based Model: <https://skfb.ly/6LGwF>



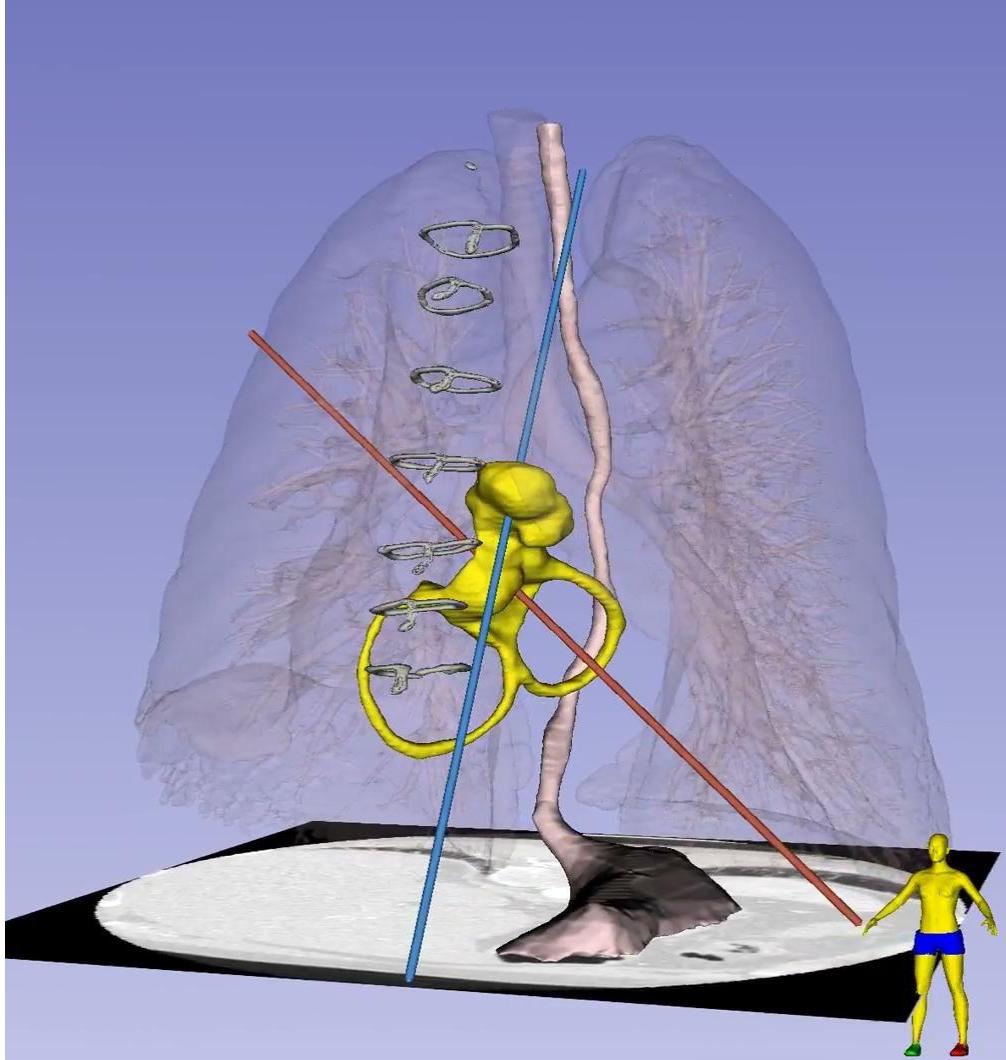
3D Model

- Cardiac-gated CT (3DSlicer - FLOSS)
- Blood volumes inside chambers & vessels (*walls removed*)
- Little man & CT Slice for orientation
- Normal anatomy
- Pt. History of Aorto-Coronary Bypass (ACB/CABG)

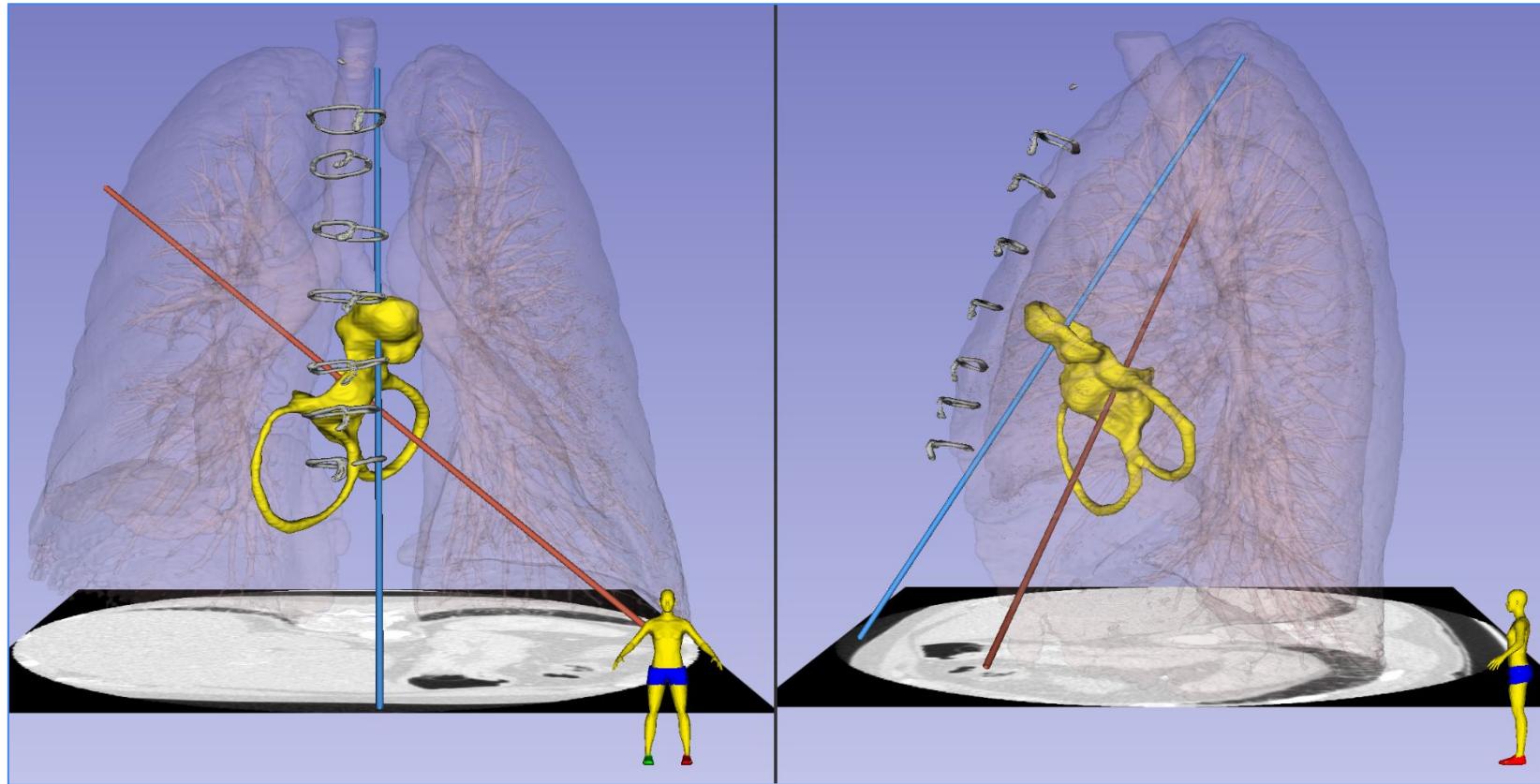


Heart Base: Morphology & Position

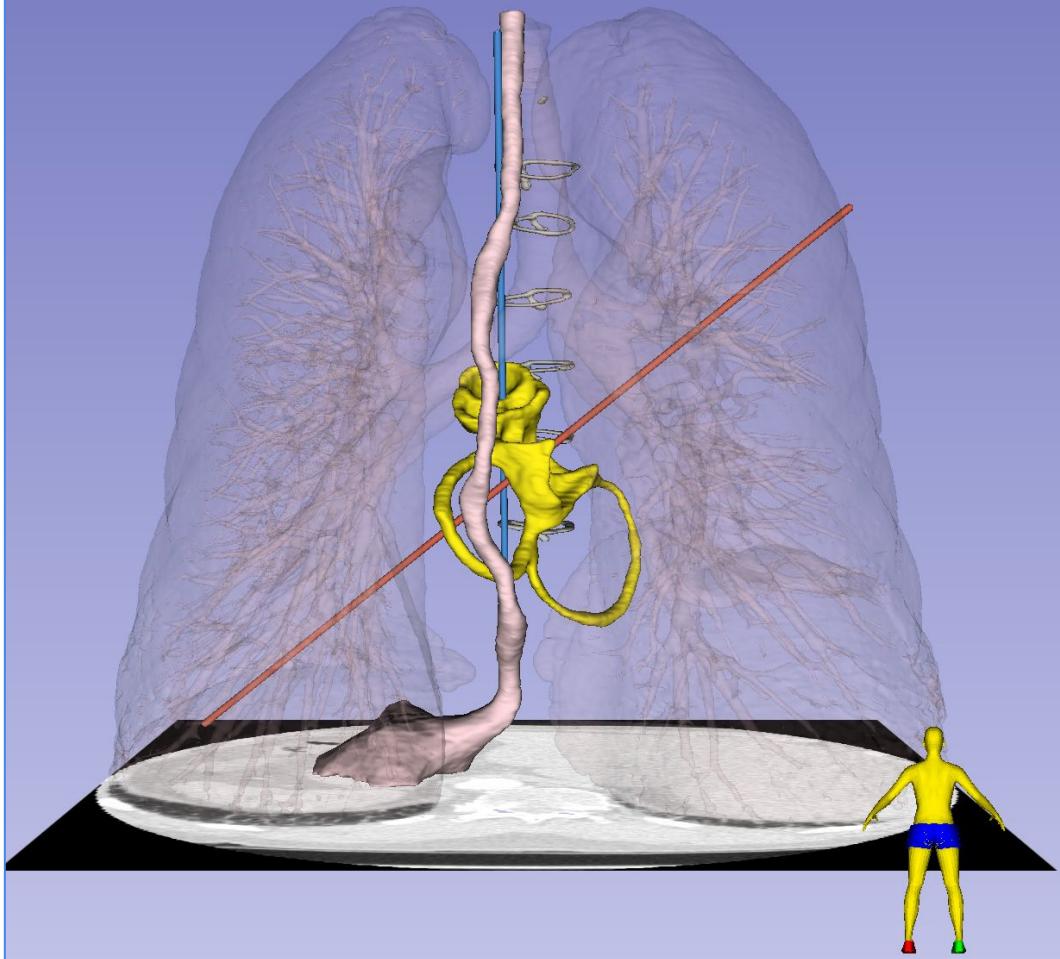
- AV Midline Behind Sternum
- Pulmonary Valve: Most Anterior + Superior
- **Long Axis of AV:** from humeral head to apex
- **Long Axis of PV:** In midsagittal plane from Xiphoid to Lower C-spine
- MV and TV planes are nearly vertical



Heart Base: Morphology & Position

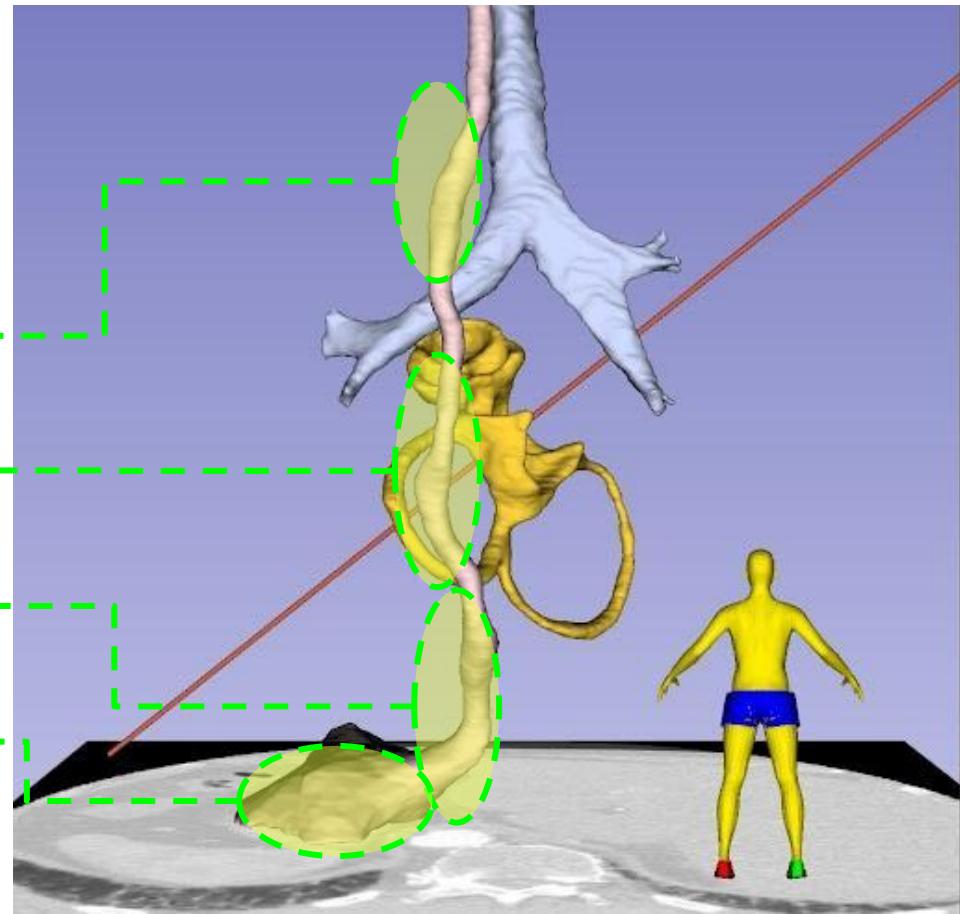


Heart Base: Morphology & Position



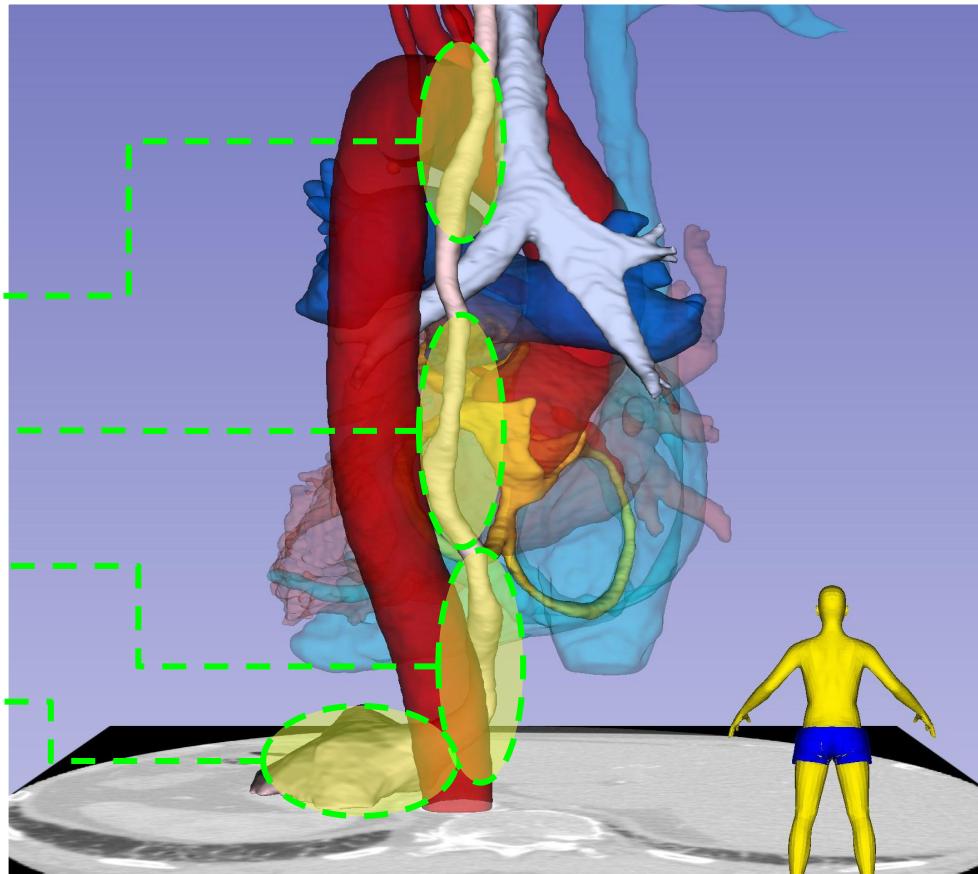
Esophagus – Airway = TEE Windows

- Upper Esophageal (UE) Window
- Mid-Esophageal (ME) Window
- Lower Esophageal (LE) Window
- Trans-gastric (TG) Window

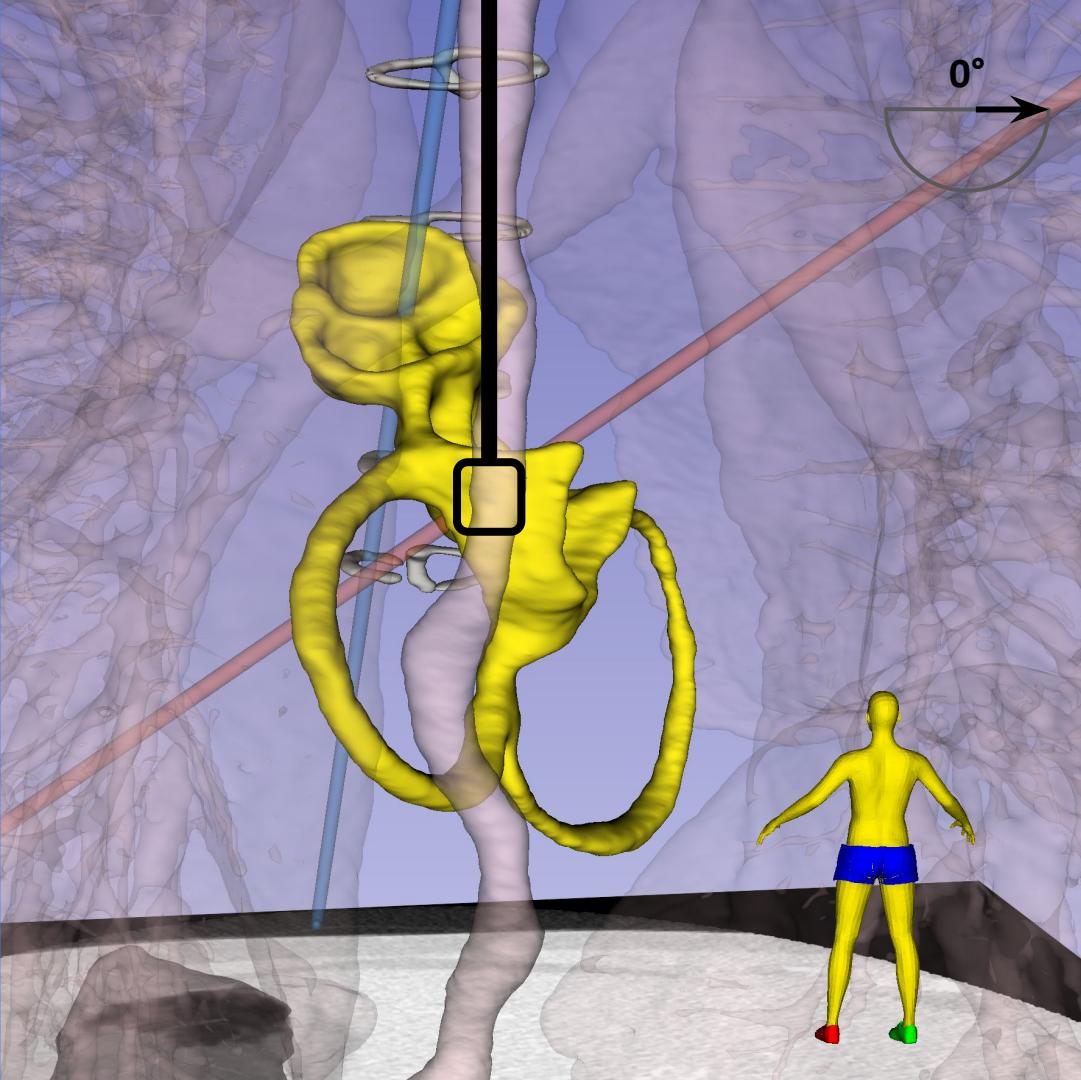


Esophagus – Airway = TEE Windows

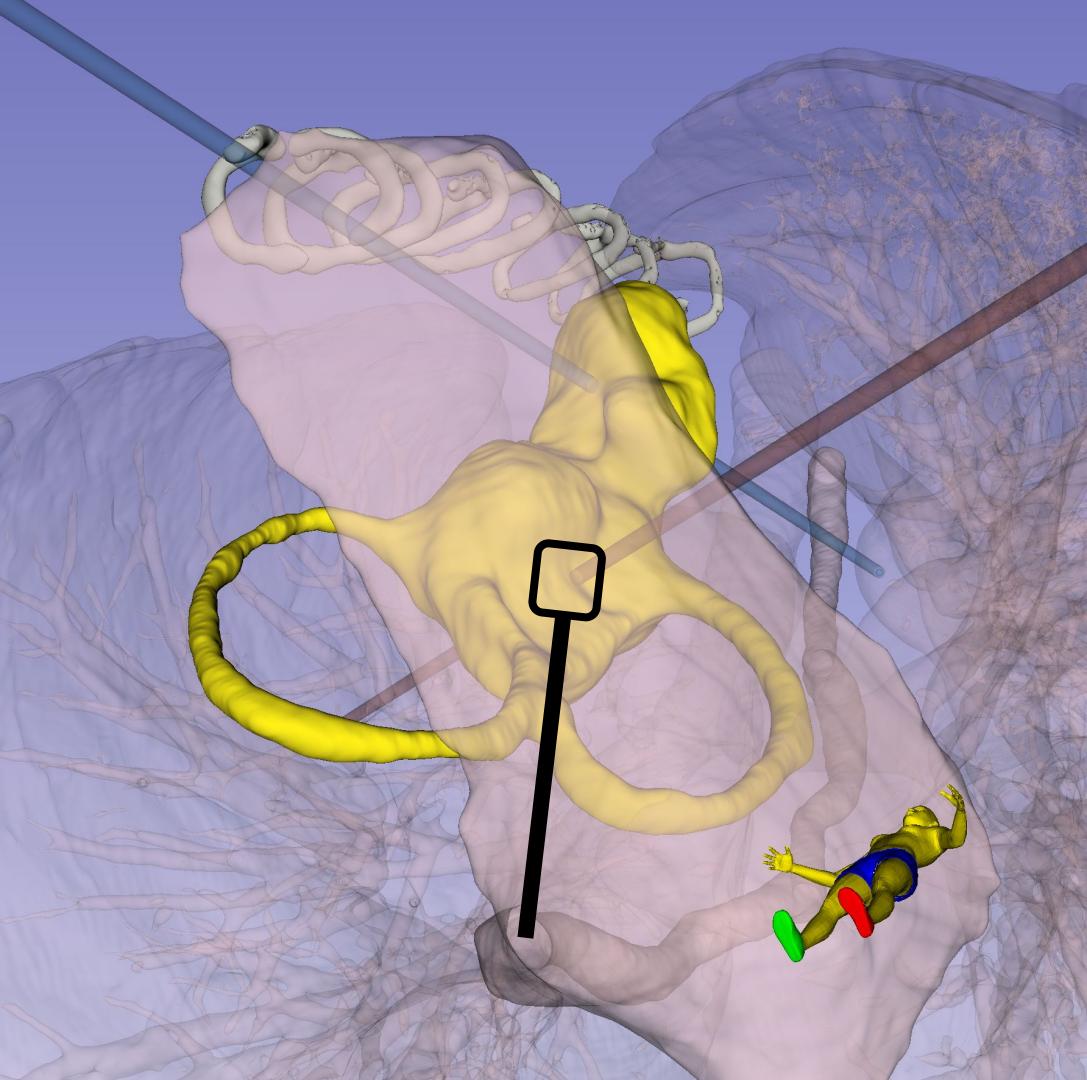
- Upper Esophageal (UE) Window
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- Lower Esophageal (LE) Window
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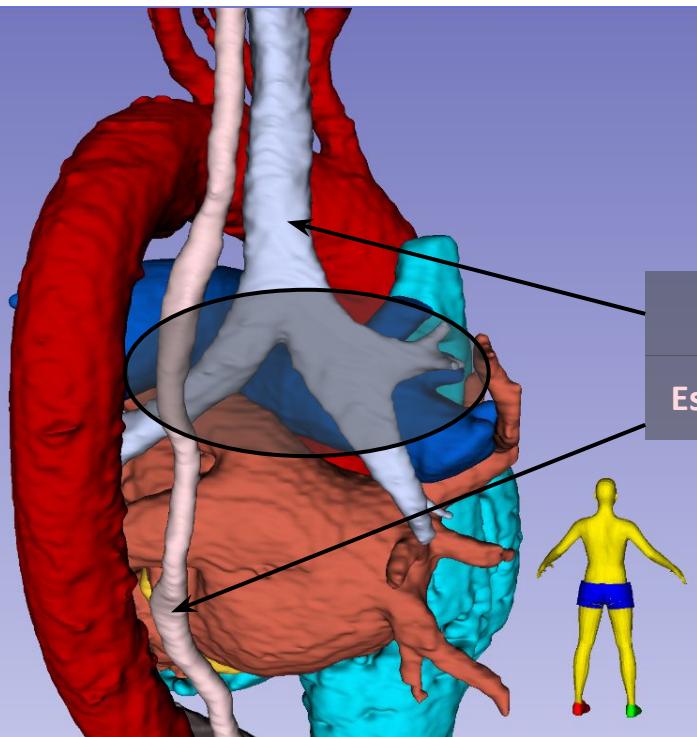
Heartbase: Mid-Esophageal View



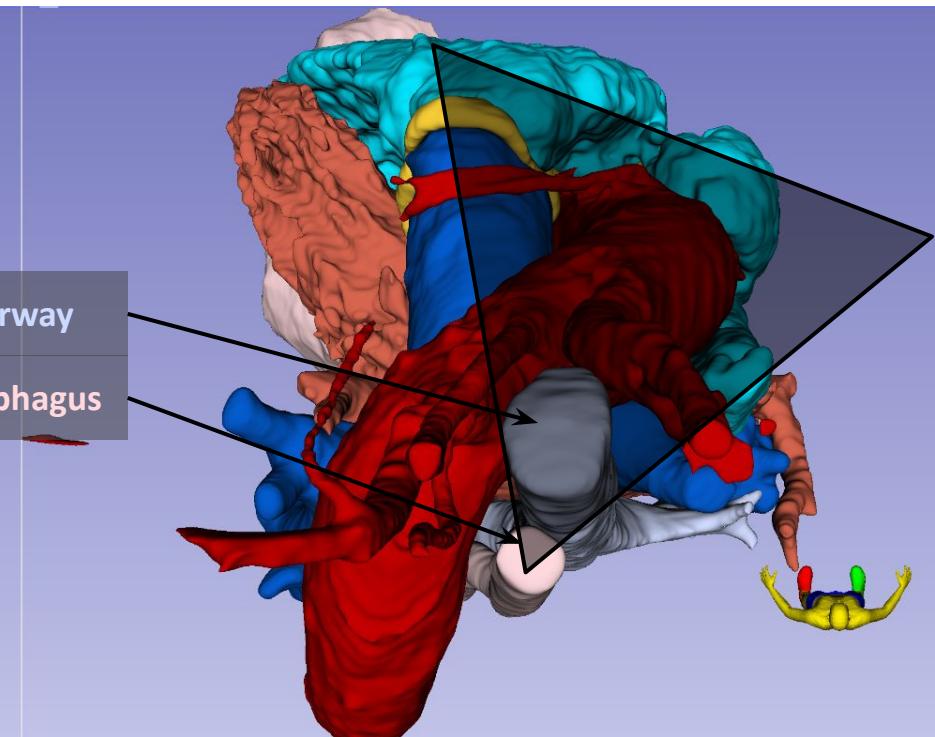
Heartbase: Gastric View



TEE Blindspots



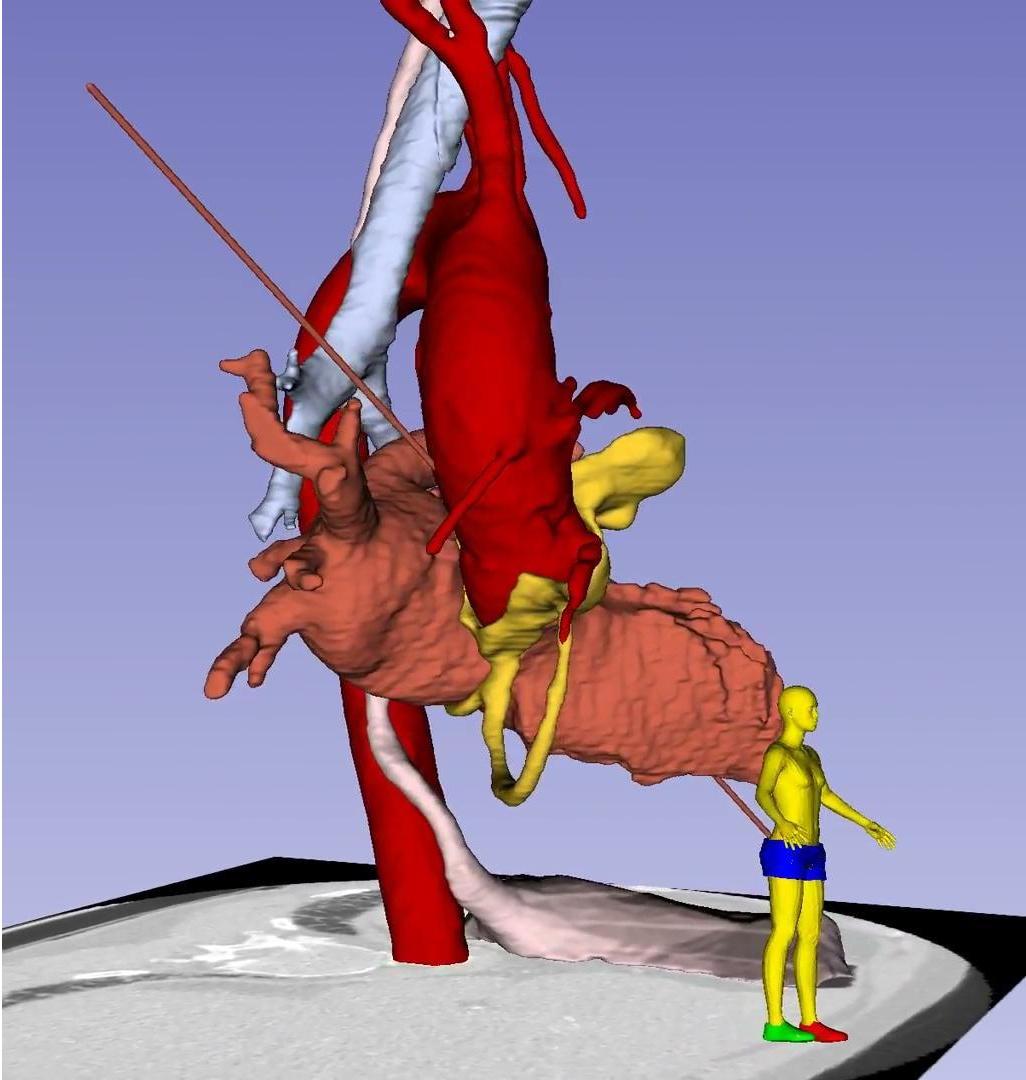
Airway
Esophagus



Left Heart Blood Pool & Aorta

Identify:

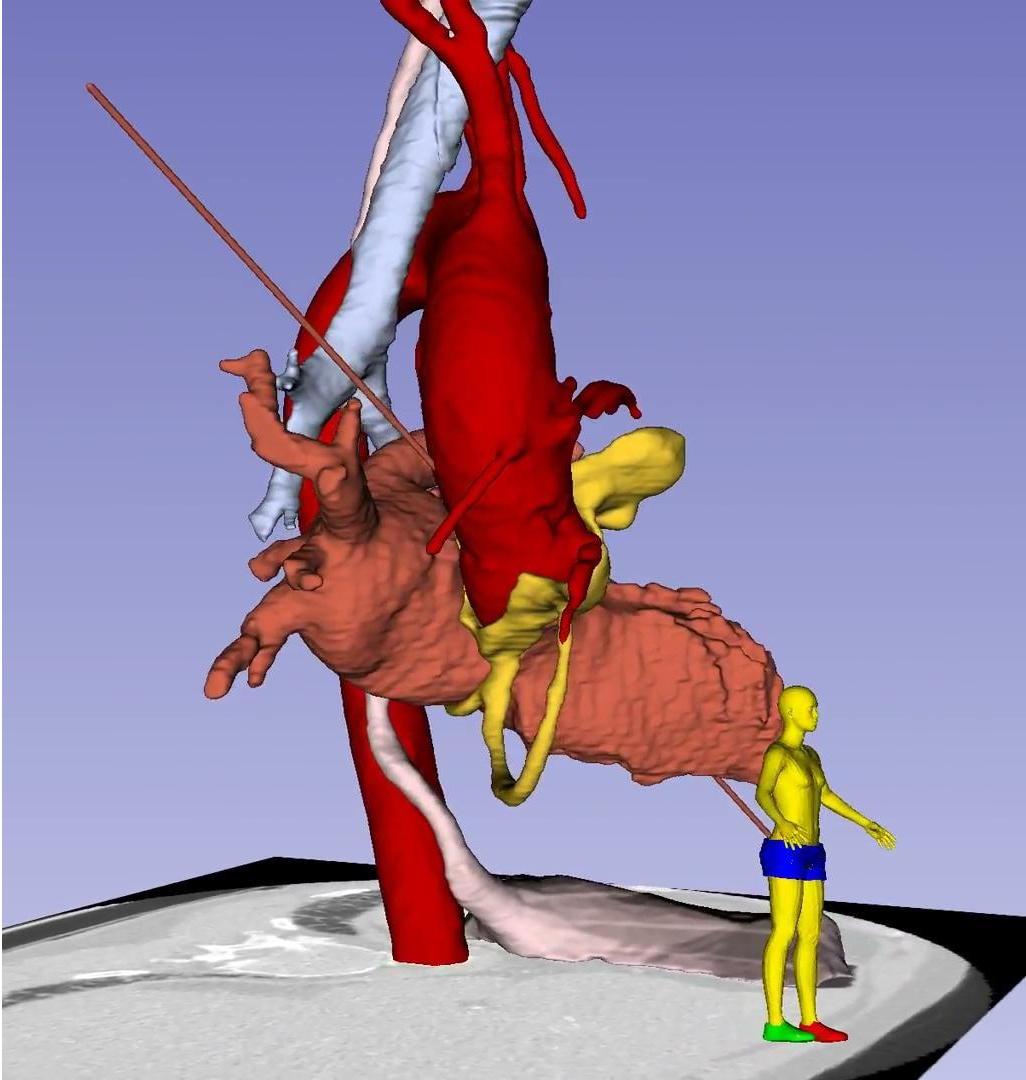
- Left Atrium
 - Pulmonary veins
 - Left Atrial Appendage
- Left Ventricle
 - LVOT
 - Septal surface
 - Free-wall surface
 - Antero-lateral papillary muscle (cavity)



Left Heart Blood Pool & Aorta

Identify:

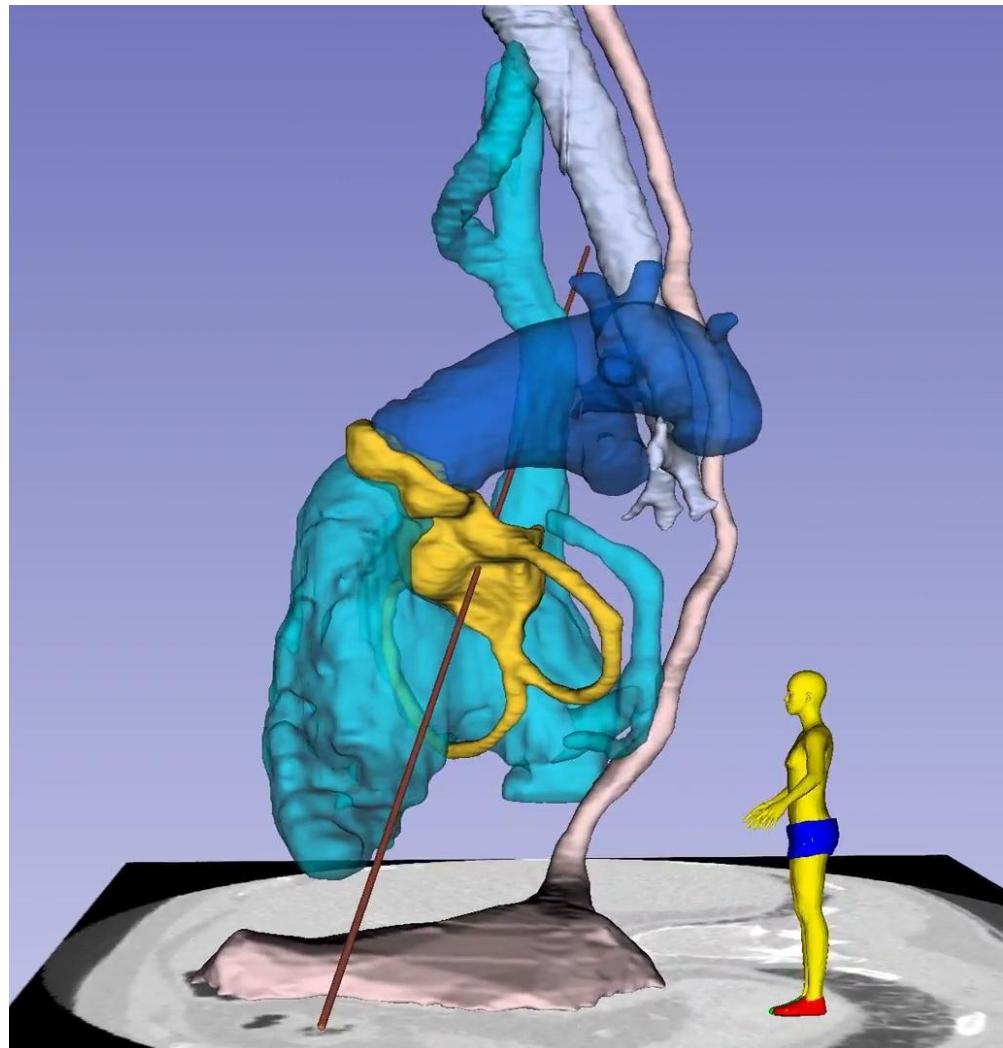
- Aortic root
 - RCA
 - LMCA
- Ascending Aorta
- Aortic Arch & Branches
 - Brachiocephalic (innominate)
 - Left Common Carotid
 - Left Subclavian Artery
- Descending Aorta



Right Heart Blood Pool & PA

Identify:

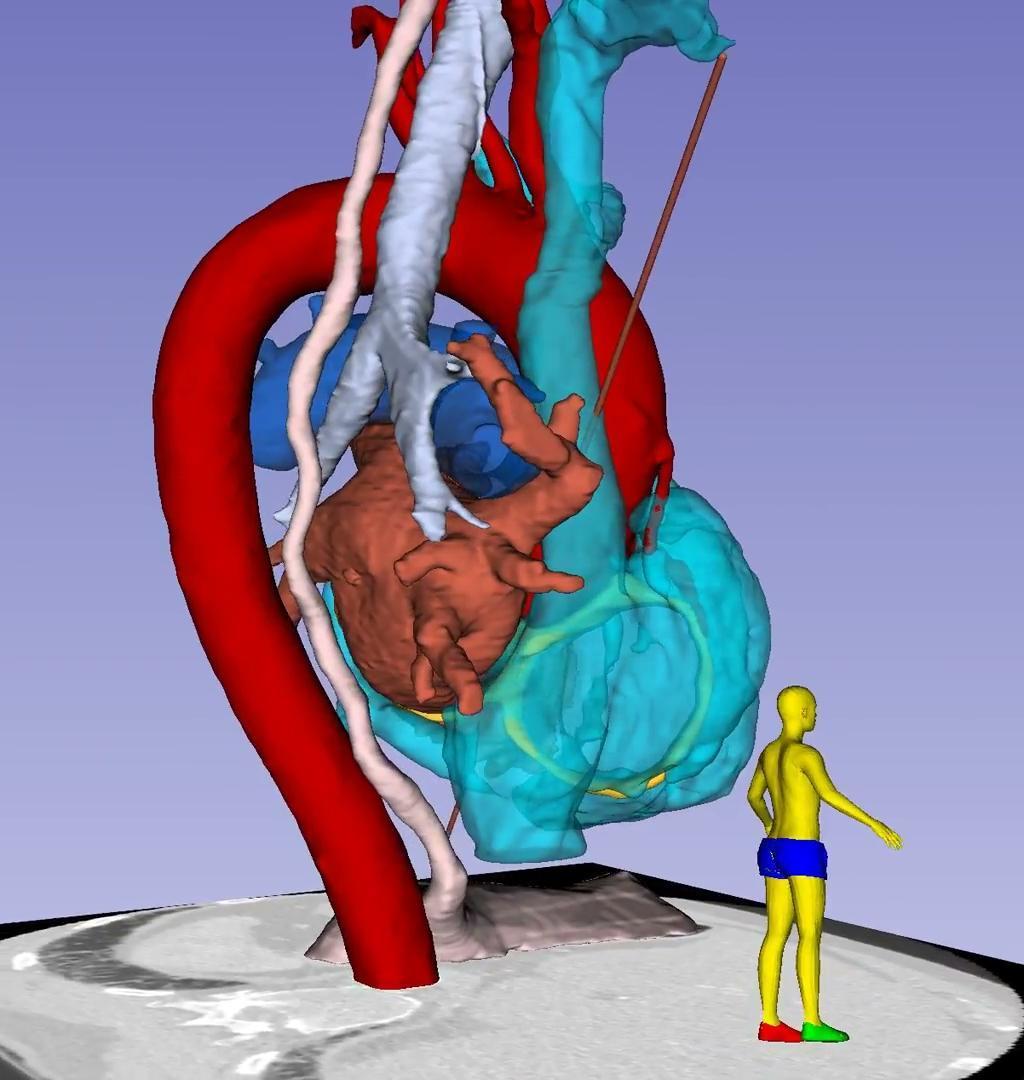
- Right Atrium
- Right Ventricle
 - Septal surface
 - Free Wall
 - Outflow tract
- Coronary Sinus
- IVC
- Right Pulmonary Artery



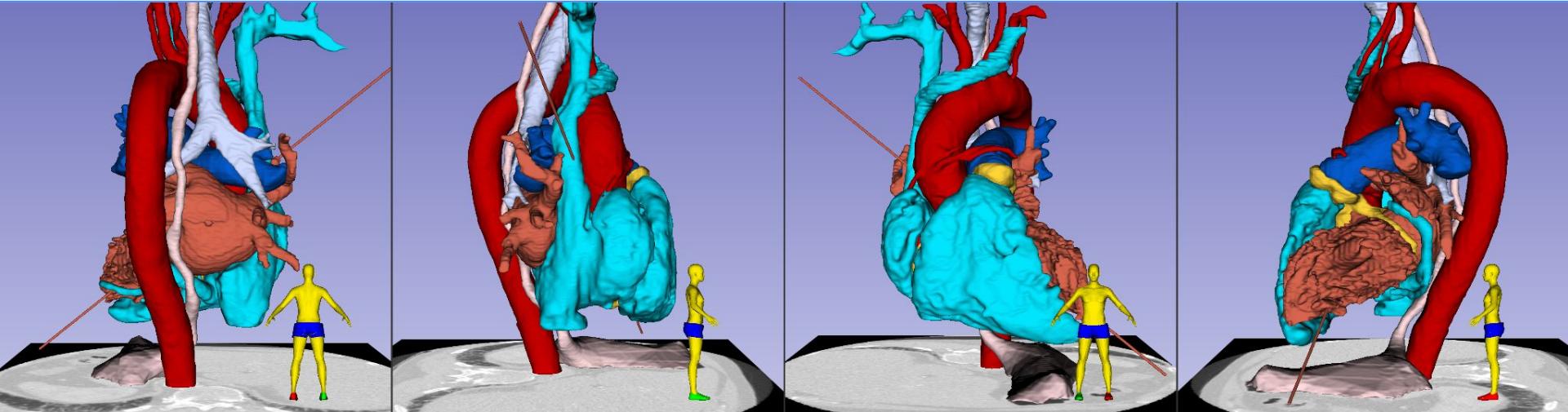
Base + Left & Right Blood Pools

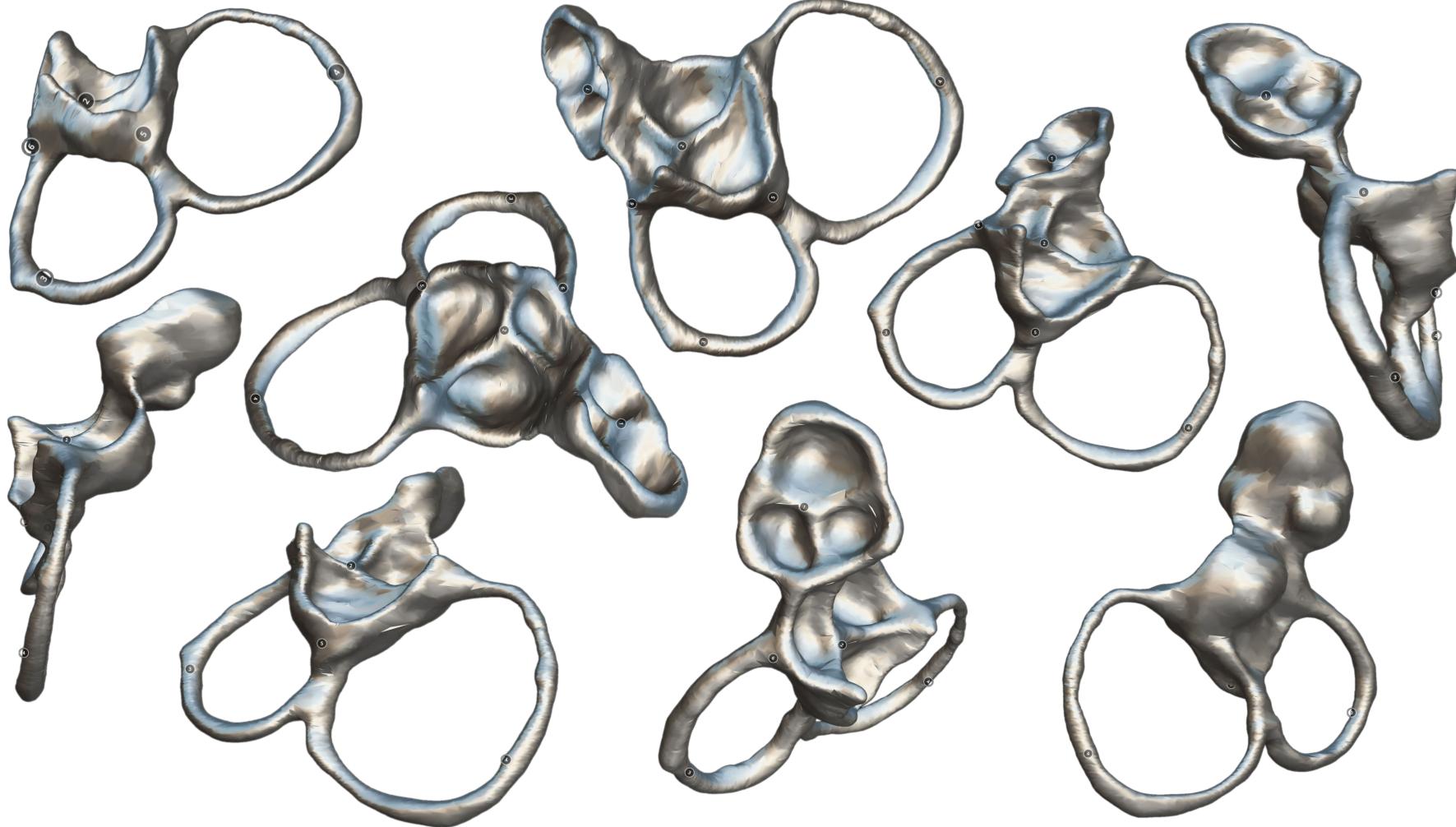
Identify

- Esophagus
- Stomach
- Trachea and Main Bronchi

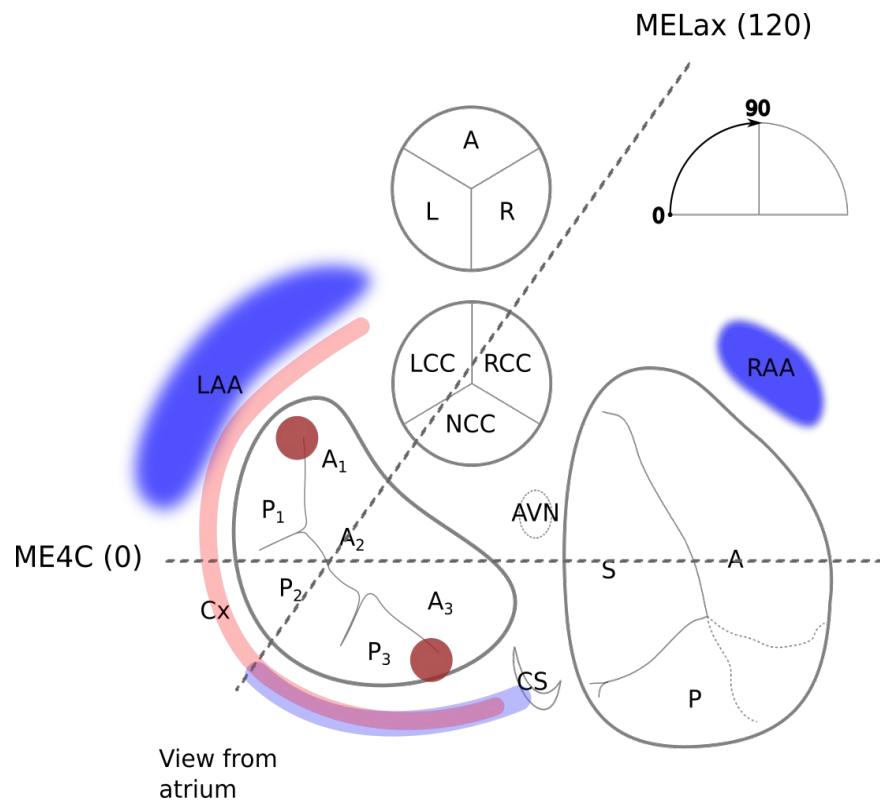
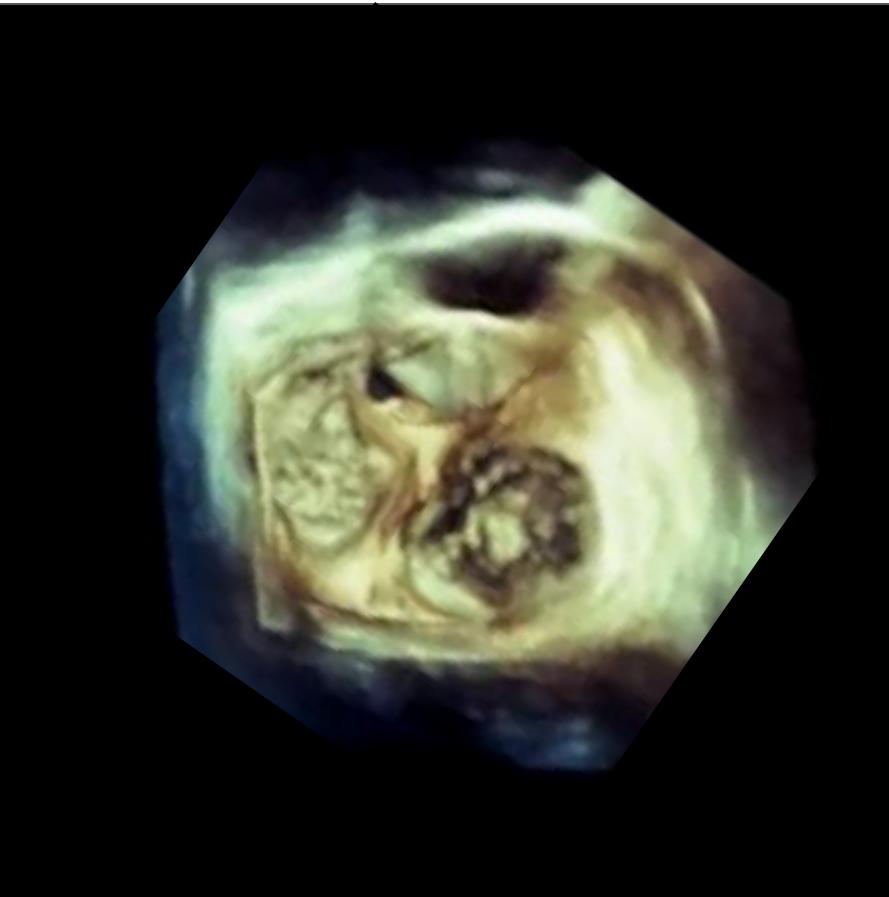


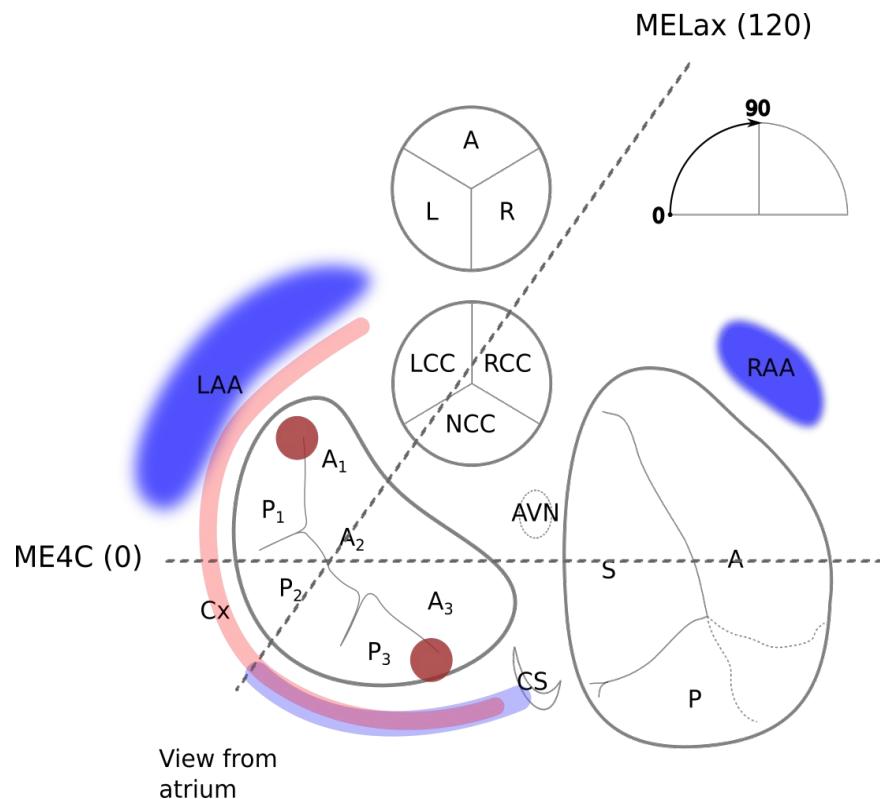
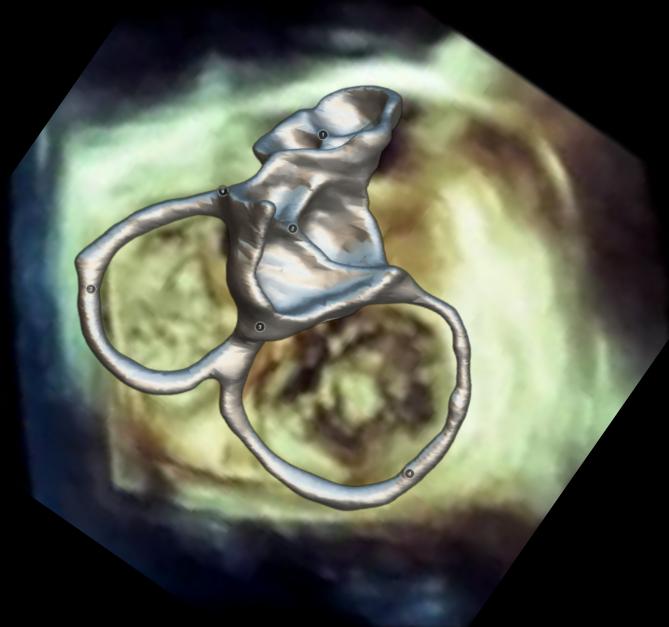
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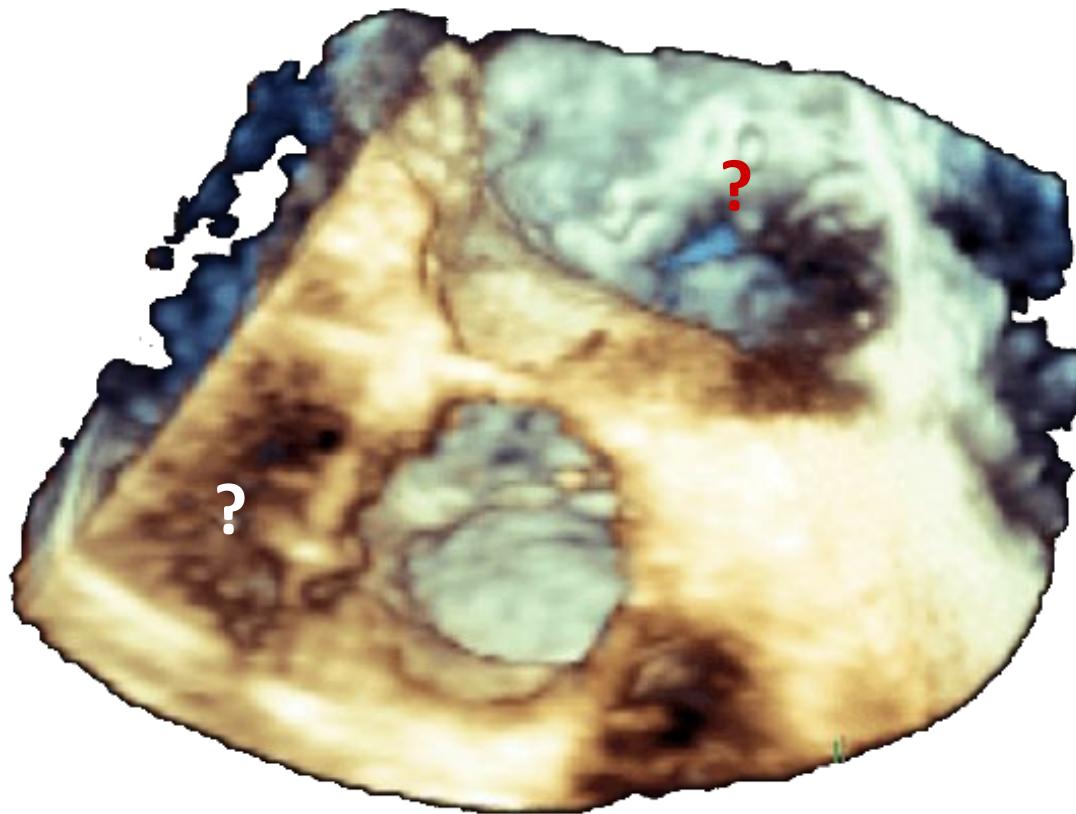




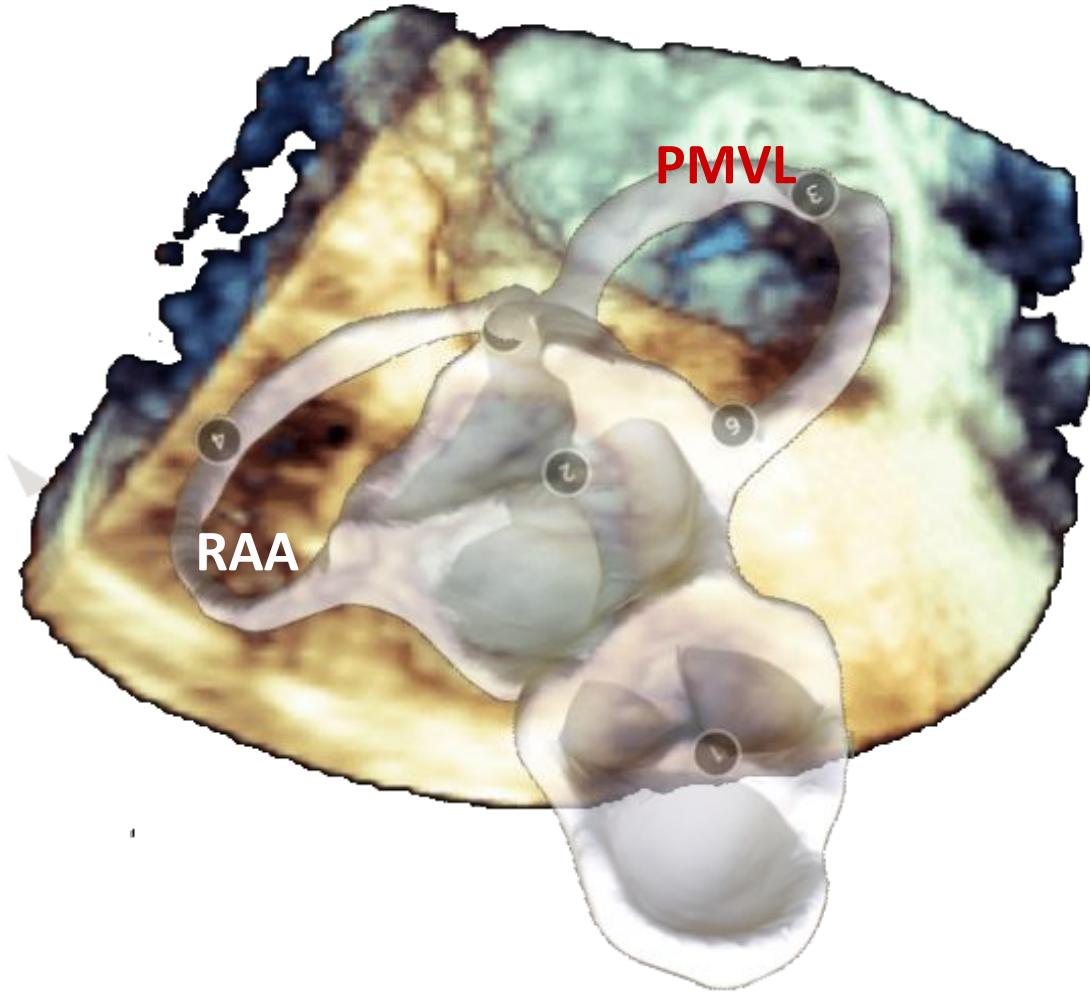


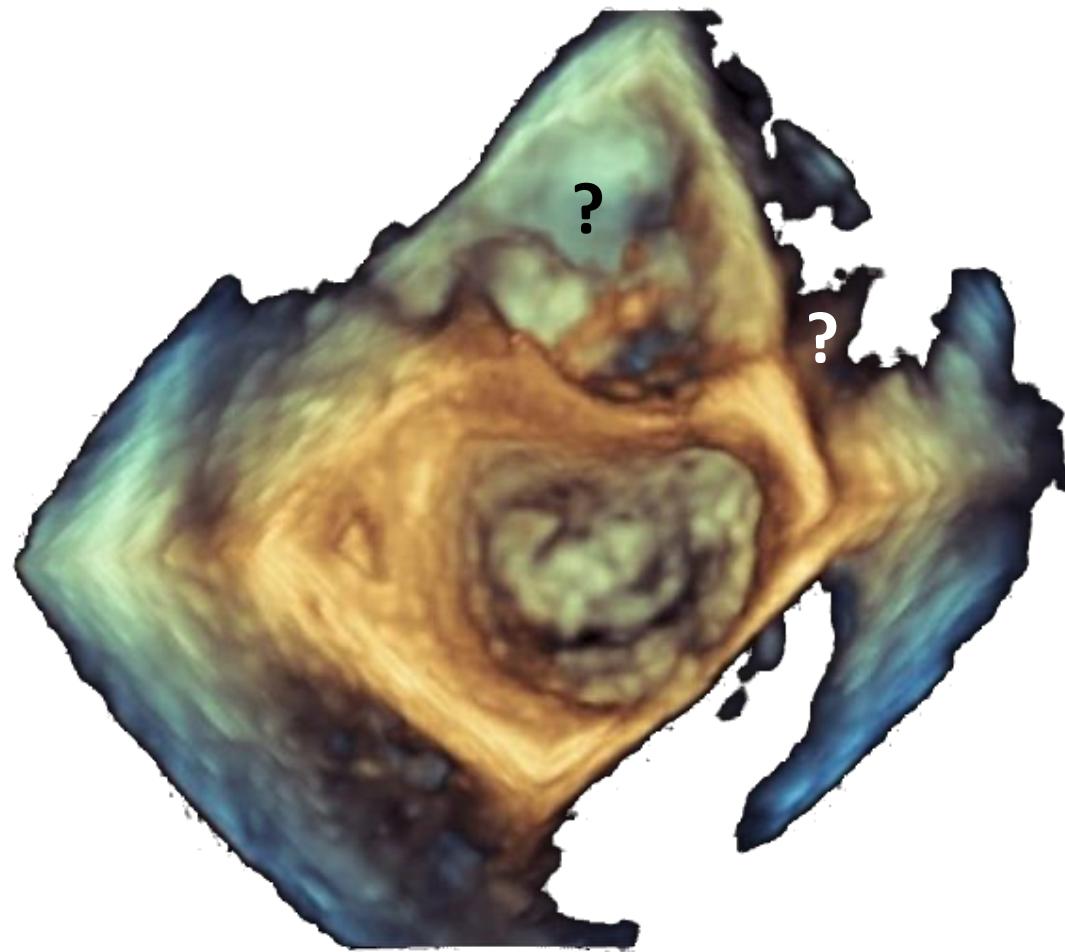


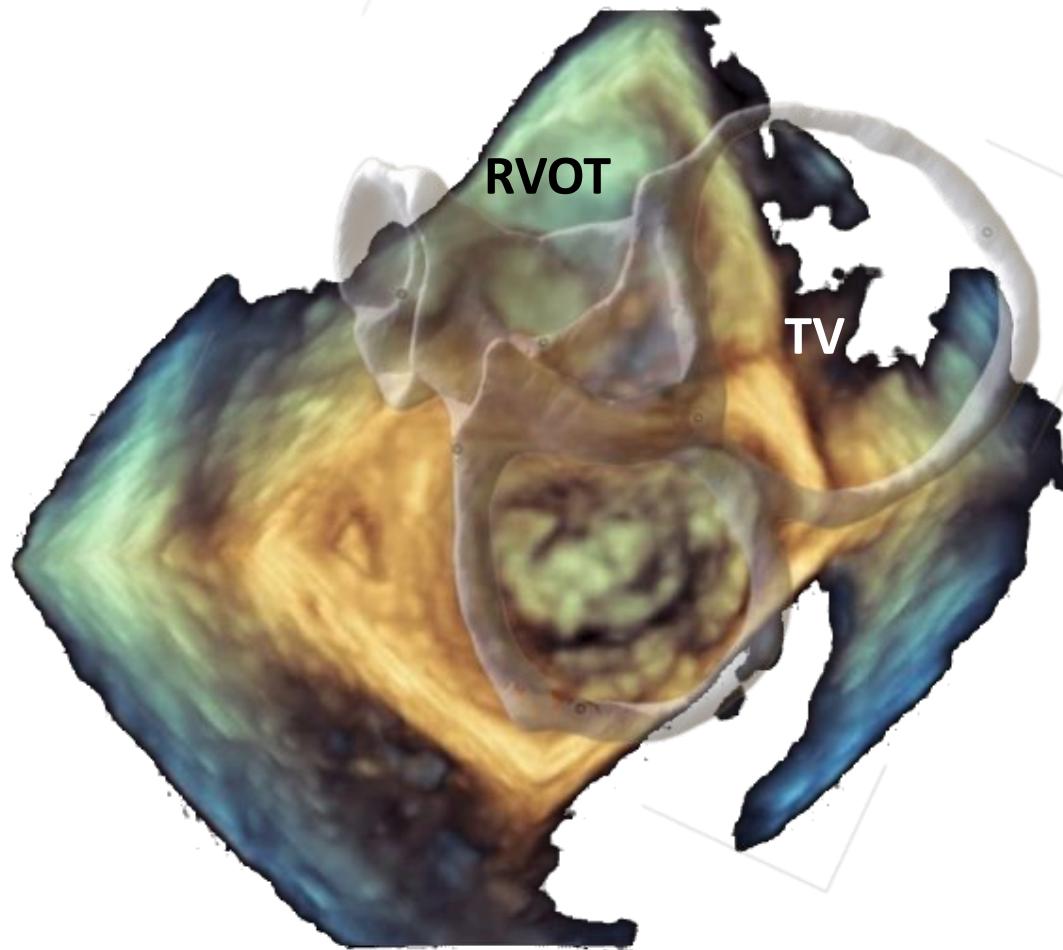




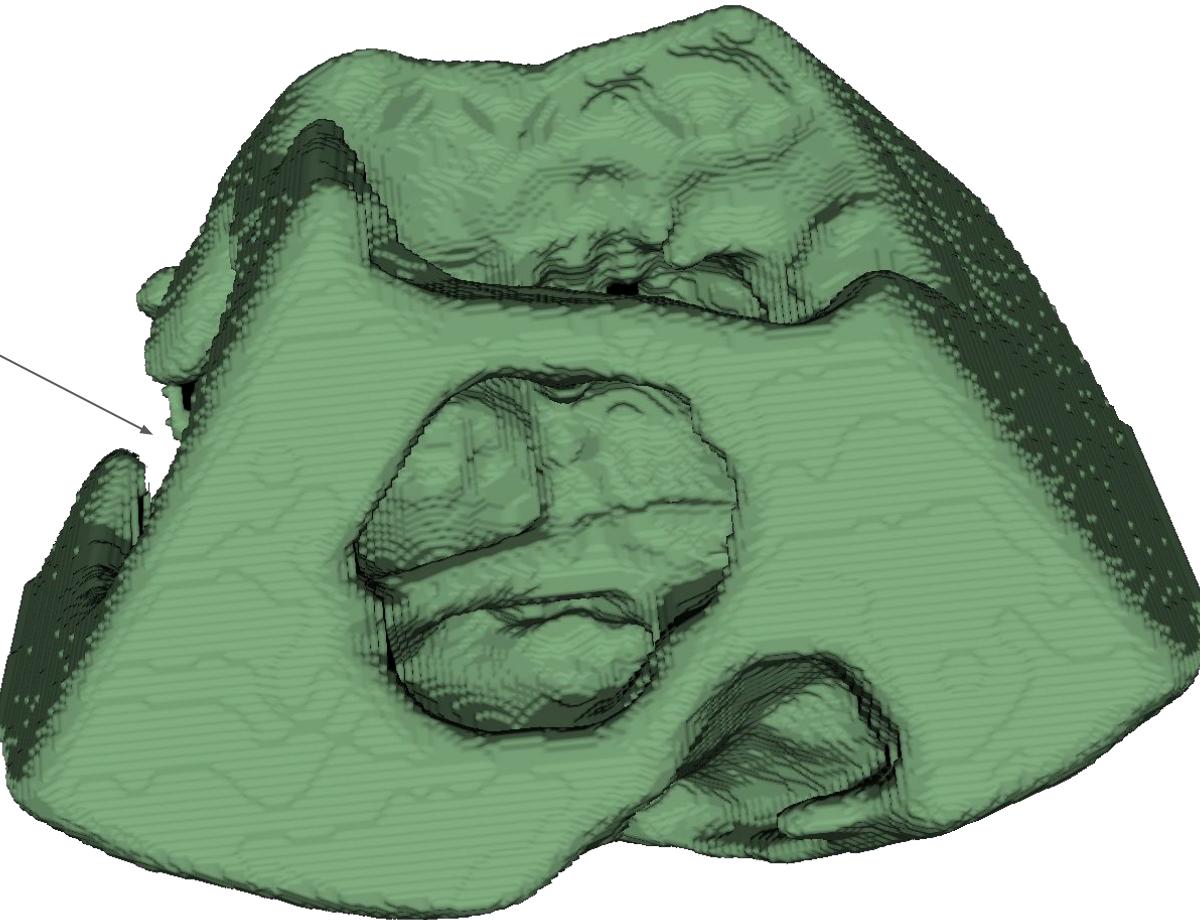
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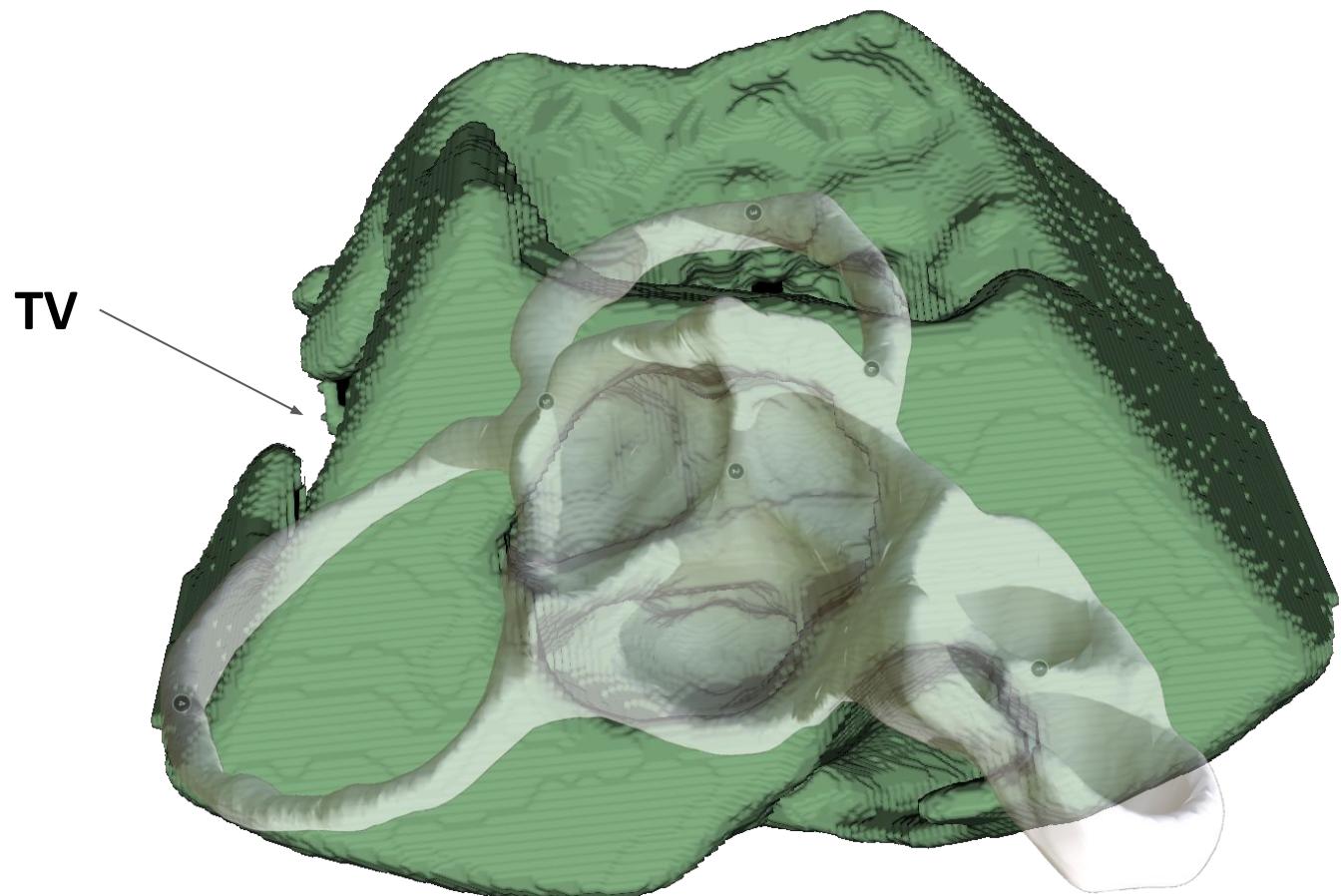






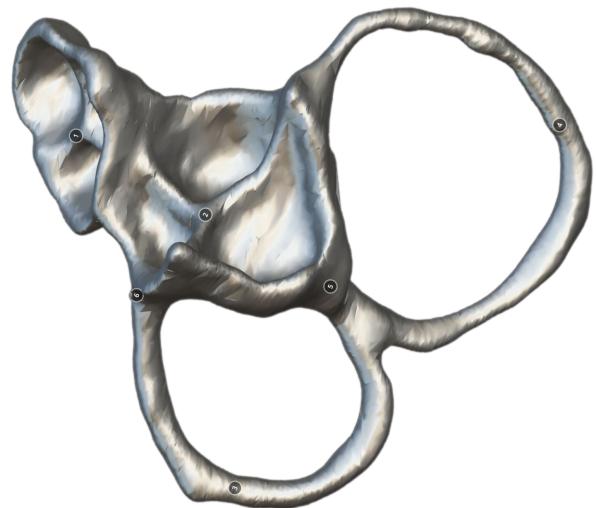
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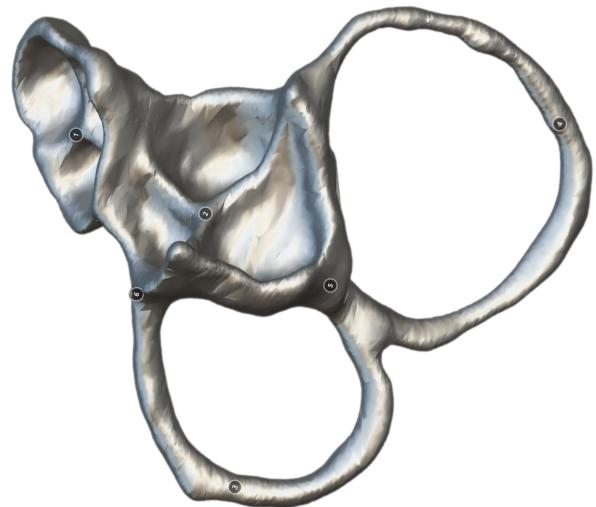




TV



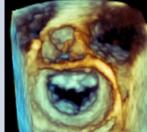
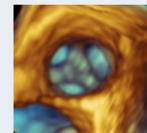




ASE GUIDELINES AND STANDARDS

Guidelines for Performing a Comprehensive Transesophageal Echocardiographic Examination: Recommendations from the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists

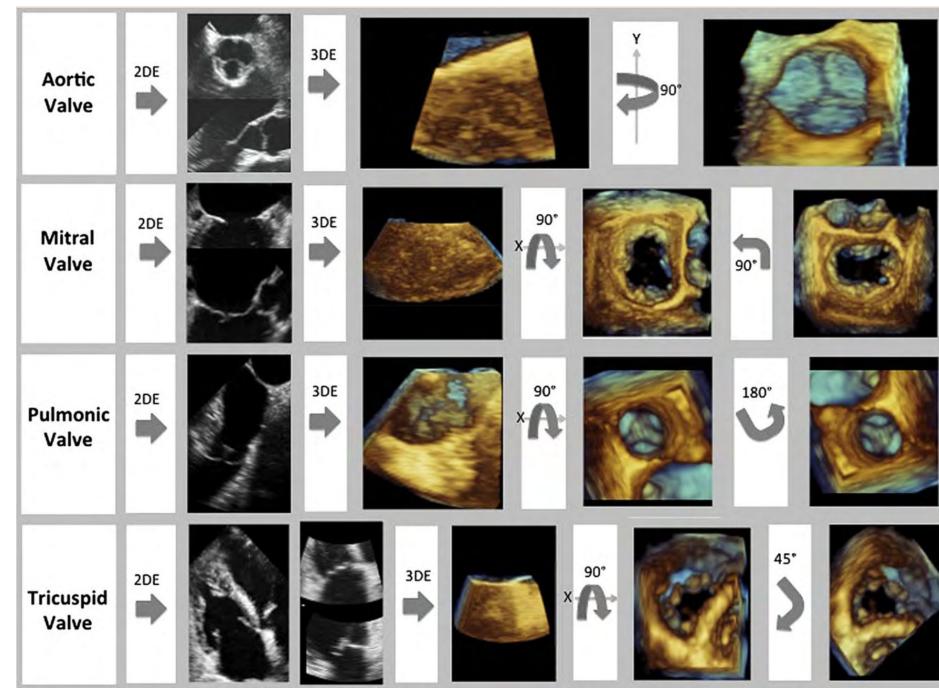
(J Am Soc Echocardiogr 2013;26:921-64.)

Aortic Valve	<ol style="list-style-type: none"> Obtain a view of the aortic valve from either the 60° mid-esophageal, short-axis view or the 120° mid-esophageal, long-axis view Acquire using either the narrow-angle, single-beat or the wide-angle, multi-beat modes 	
Mitral Valve	<ol style="list-style-type: none"> Obtain a view of the mitral valve from the 0°, 60°, 90° or 120° mid-esophageal views Use the biplane mode to check that the mitral valve annulus is centered with the acquisition plane in a second view 90° to the original. Acquire using narrow-angle, single-beat mode 	
Pulmonic Valve	<ol style="list-style-type: none"> Obtain a view of the pulmonic valve from either the 90° high-esophageal view or the 120° mid-esophageal, 3-chamber view rotated to center the pulmonic valve Acquire using narrow-angle, single-beat mode 	
Tricuspid Valve	<ol style="list-style-type: none"> Obtain a view of the tricuspid valve from either the 0° to 30° mid-esophageal, 4-chamber view tilted so that the valve is centered in the imaging plane or the 40° transgastric view with anteflexion Acquire using a narrow-angle, single-beat mode 	

GUIDELINES AND STANDARDS

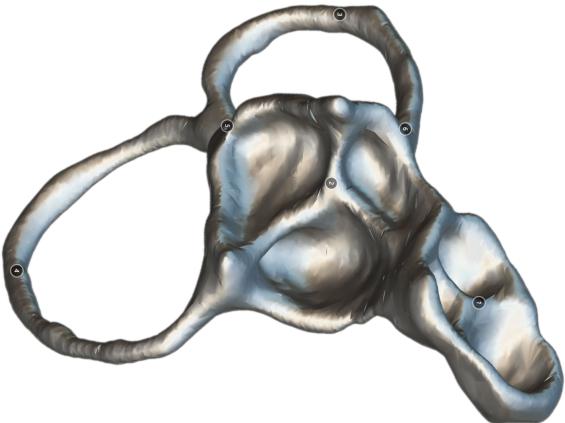
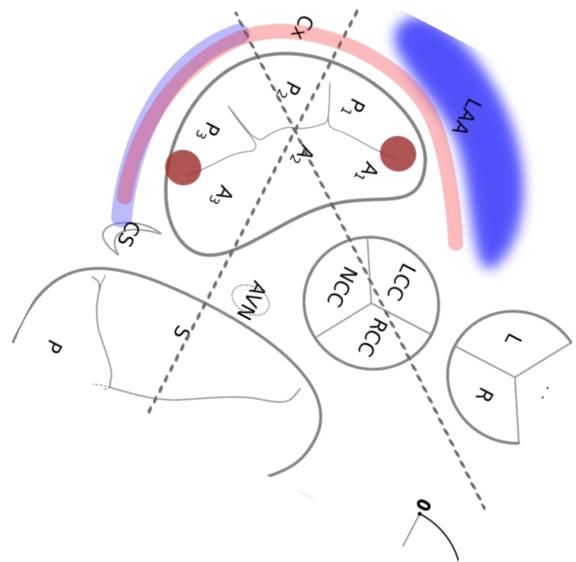
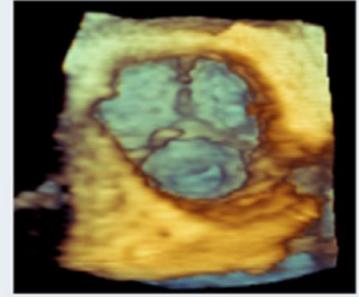
EAE/ASE Recommendations for Image Acquisition and Display Using Three-Dimensional Echocardiography

(J Am Soc Echocardiogr 2012;25:3-46.)



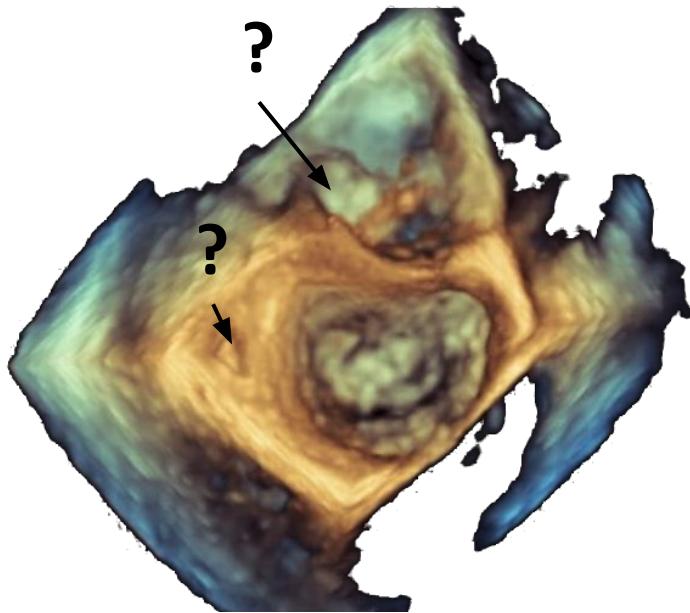
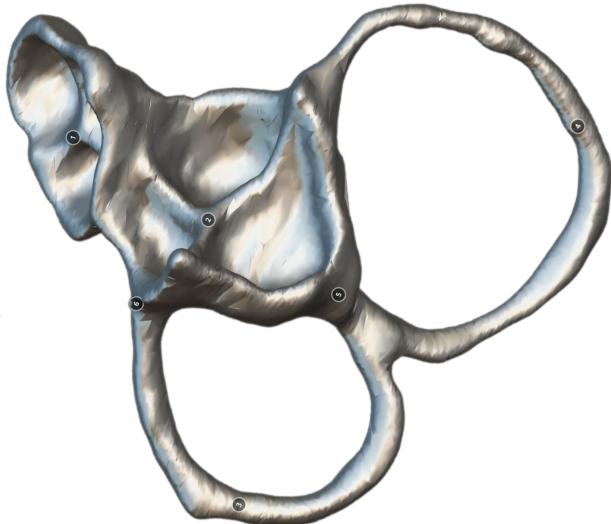
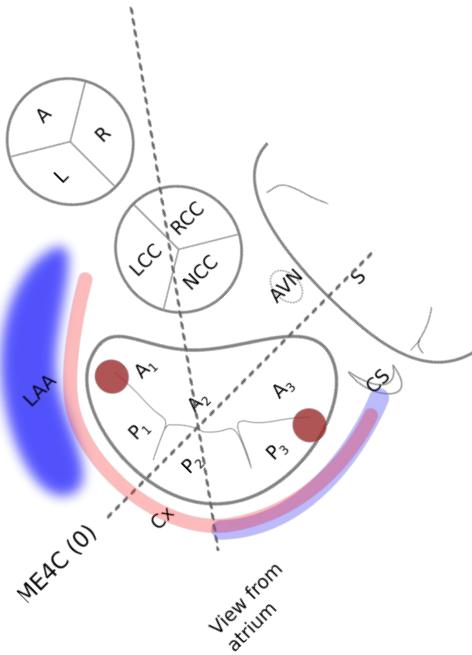
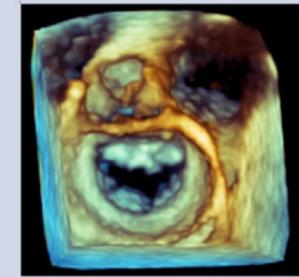
Aortic Valve

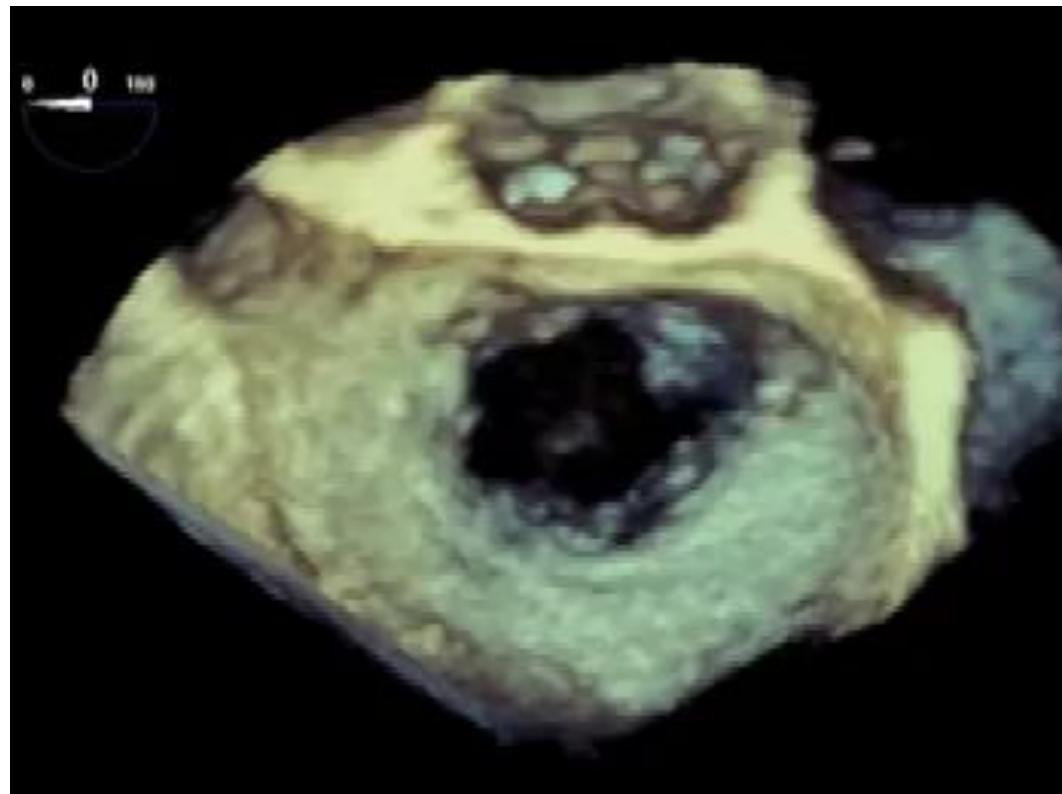
1. Obtain a view of the aortic valve from either the 60° mid-esophageal, short-axis view or the 120° mid-esophageal, long-axis view
2. Acquire using either the narrow-angle, single-beat or the wide-angle, multi-beat modes



Mitral Valve

1. Obtain a view of the mitral valve from the 0° , 60° , 90° or 120° mid-esophageal views
2. Use the biplane mode to check that the mitral valve annulus is centered with the acquisition plane in a second view 90° to the original.
3. Acquire using narrow-angle, single-beat mode

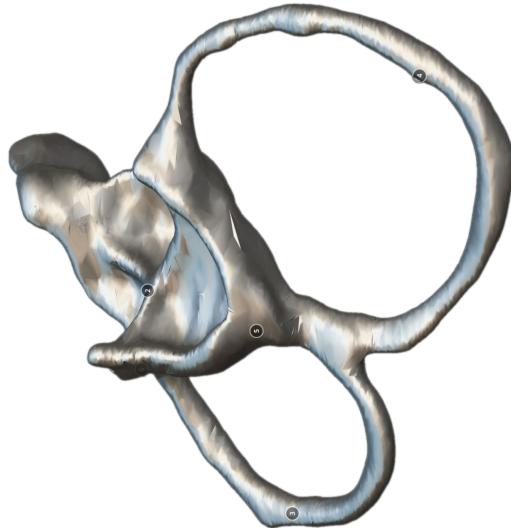
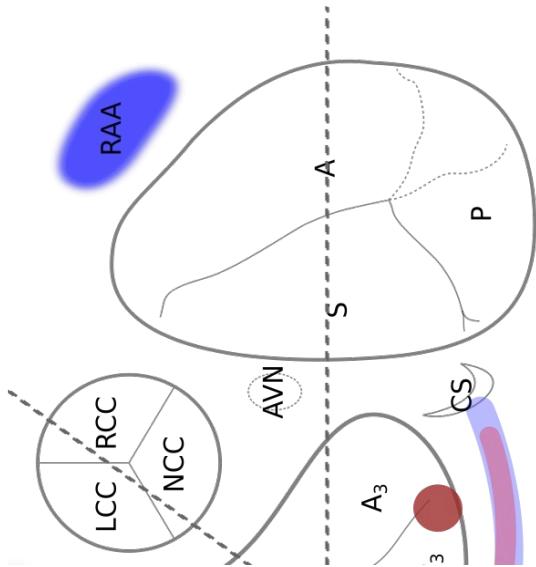






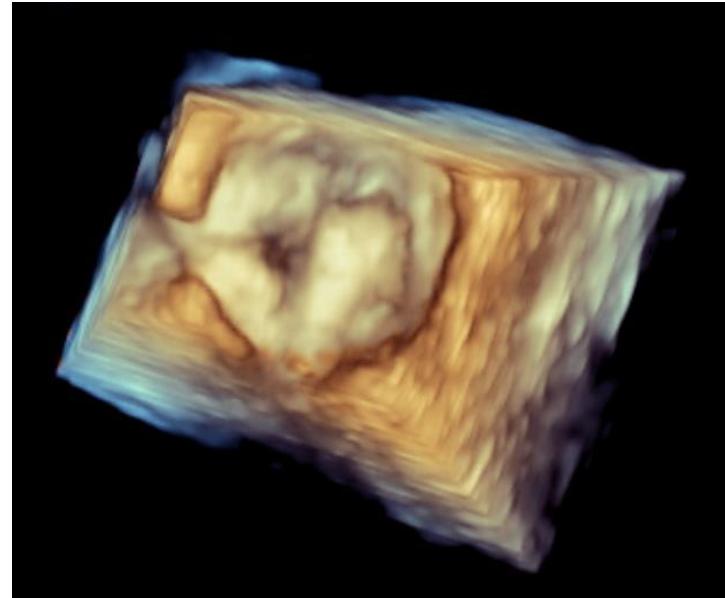
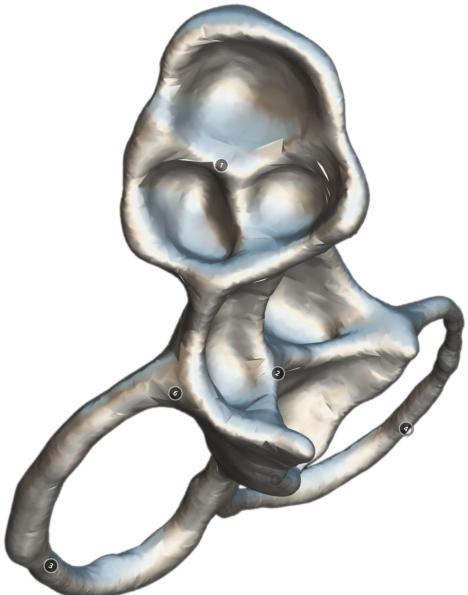
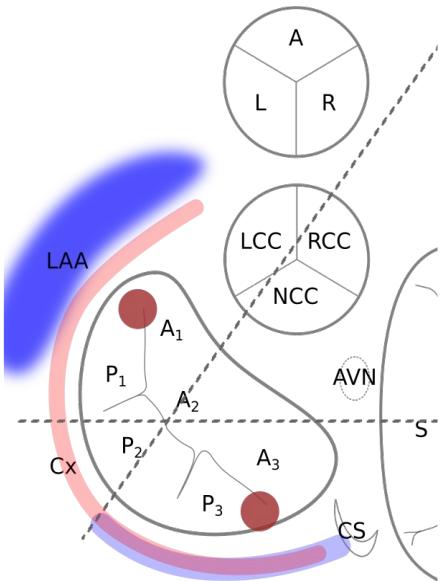
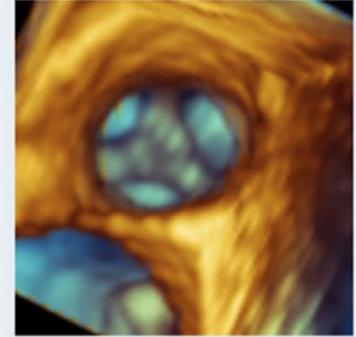
Tricuspid Valve

1. Obtain a view of the tricuspid valve from either the 0° to 30° mid-esophageal, 4-chamber view tilted so that the valve is centered in the imaging plane or the 40° transgastric view with anteflexion
2. Acquire using a narrow-angle, single-beat mode

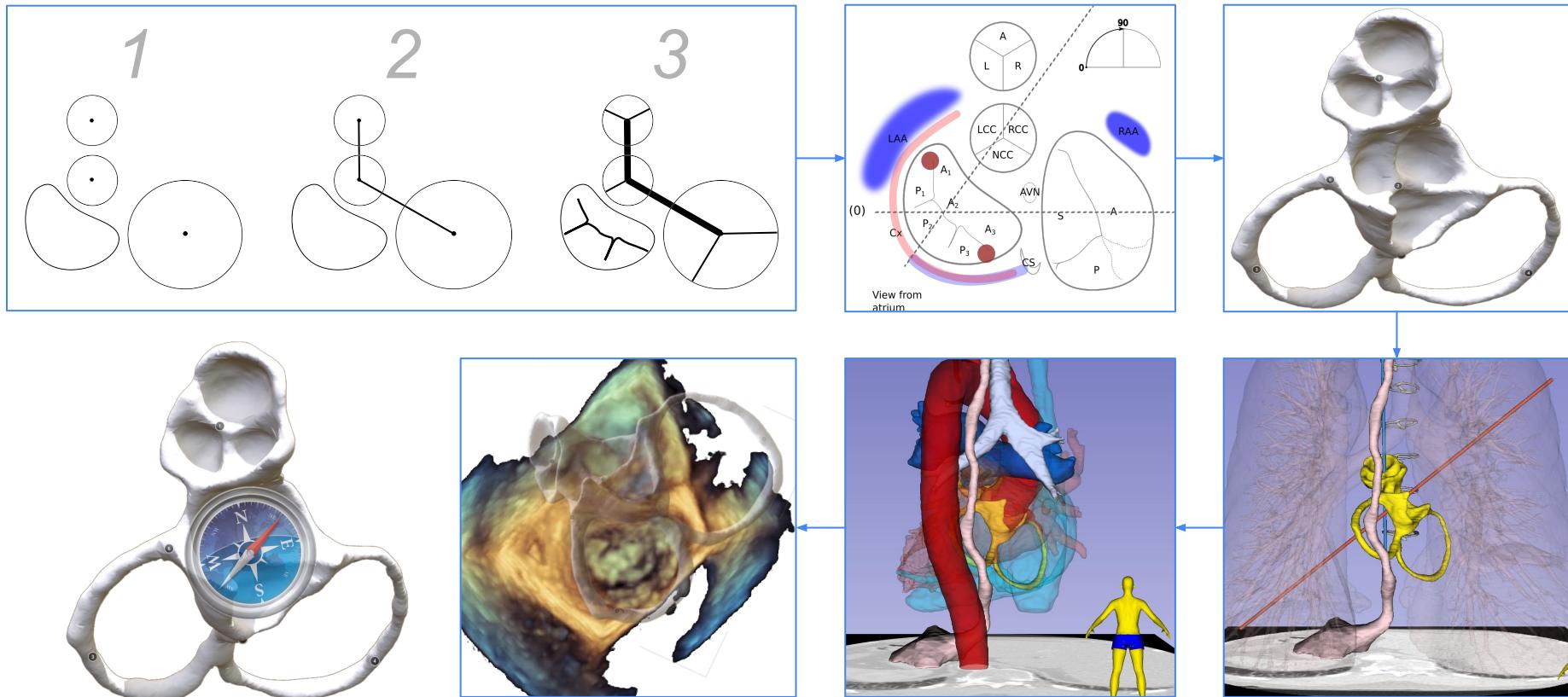


Pulmonic Valve

1. Obtain a view of the pulmonic valve from either the 90° high-esophageal view or the 120° mid-esophageal, 3-chamber view rotated to center the pulmonic valve
2. Acquire using narrow-angle, single-beat mode



Review



Thank you!

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