VCU Health
Pauley Heart Center

Diseases of the Aorta: How to Deal with Different Multi-Modal Measurements

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Class I (IIa) recommendations

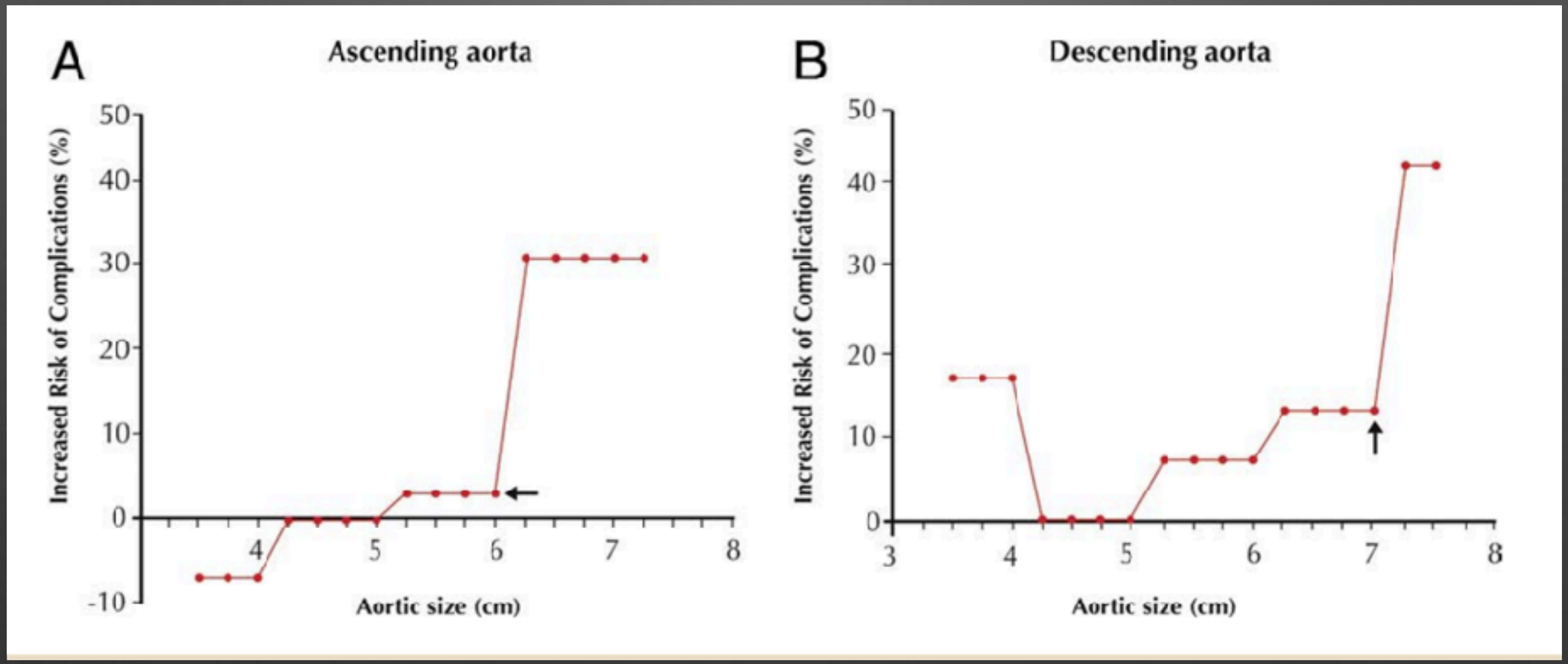
Degenerative AA	Bicuspid AA	Marfan AA
Size ≥ 55mm Growth rate ≥ 5mm/yr	Size ≥ 55mm Growth rate ≥ 5mm/yr Size ≥ 50mm + risk	Size > 50mm Size > 45 + risk

RISK
Aortic coarctation
FH dissection/SCD
Growth >3mm/year
HTN

RISK
FH dissection/SCD
Growth >3mm/year
Severe AI/MR
Desire pregnancy

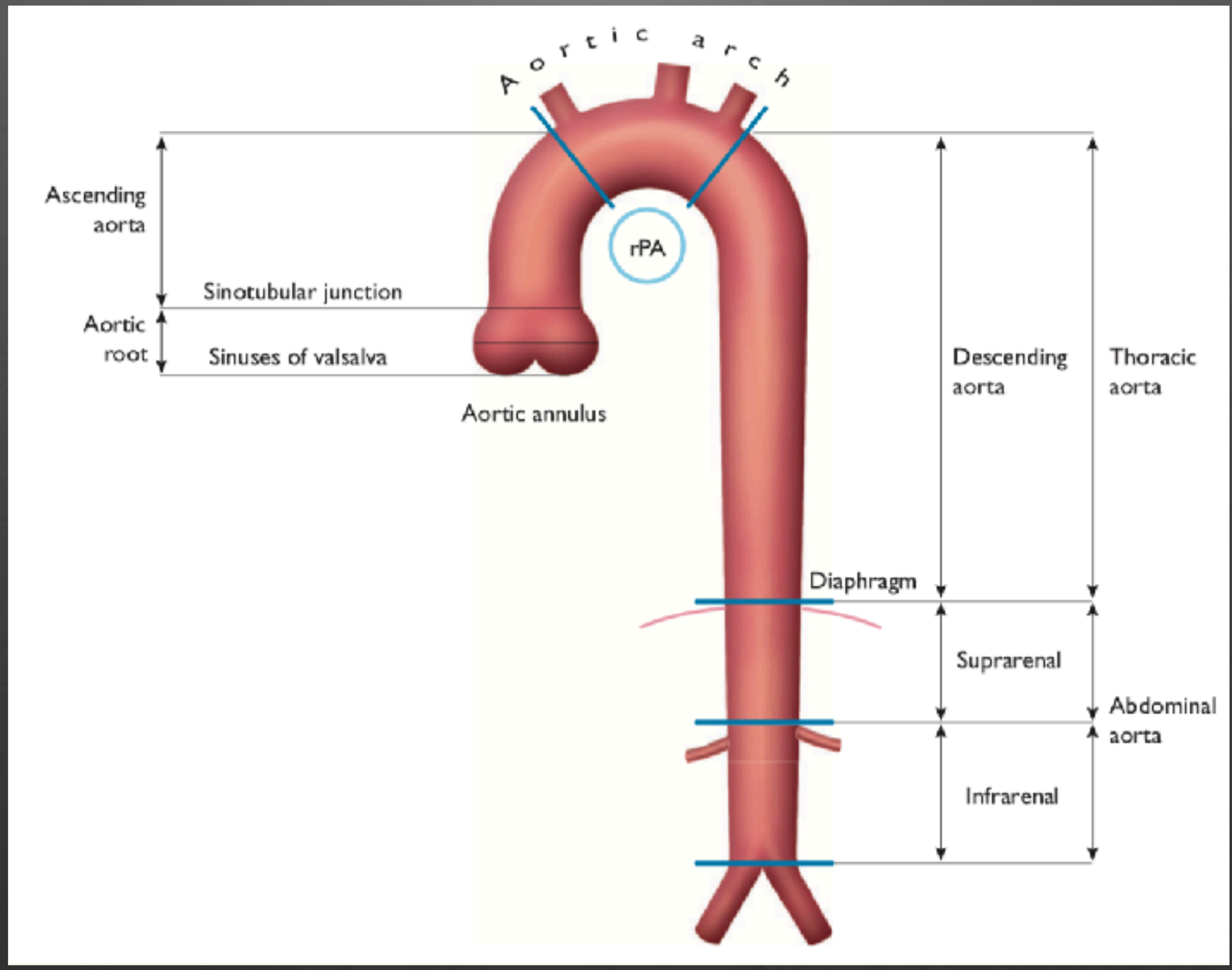
J Thorac Cardiovasc Surgery 2019
ESC Guidelines 2014

Size and outcome



Normal and How to Measure

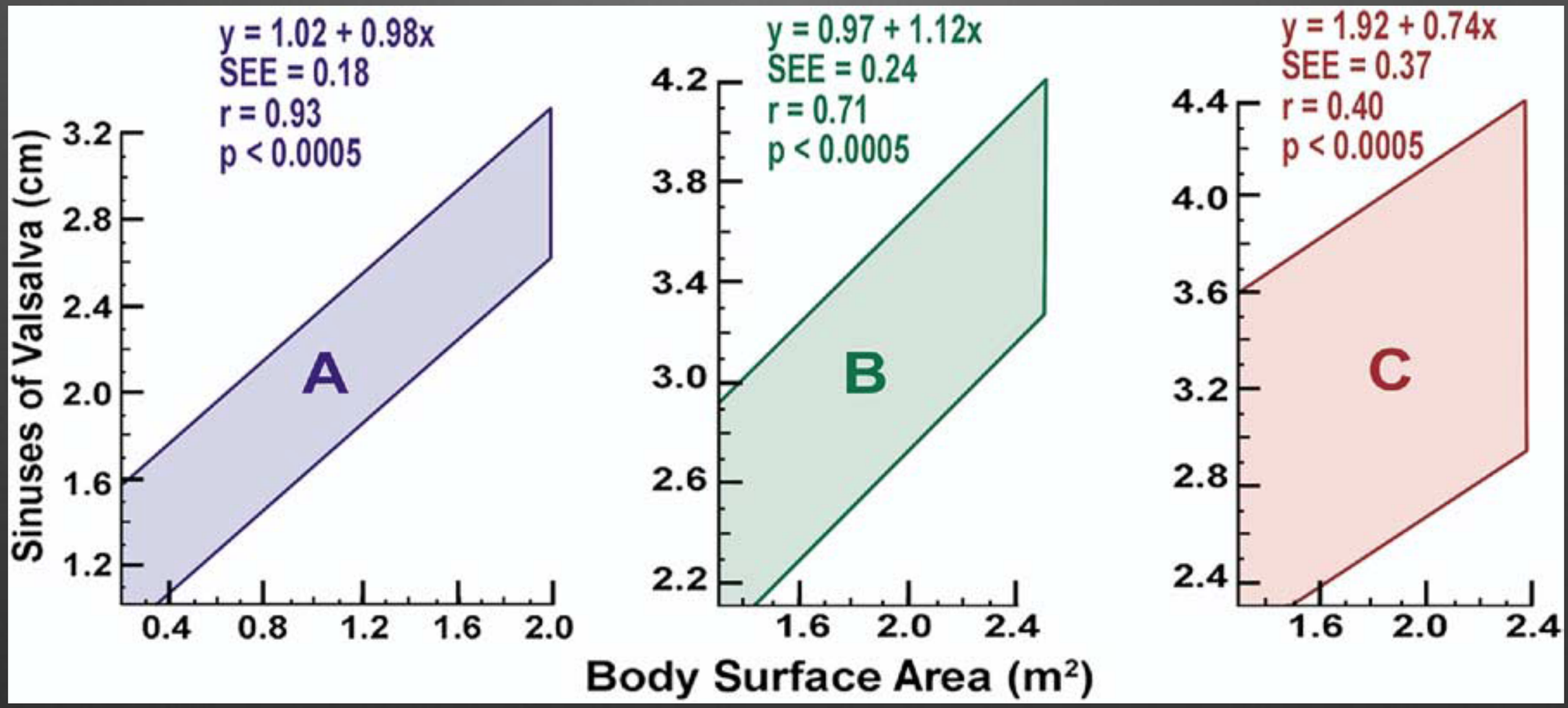
Anatomy



Erbel. 2014 ESC Guidelines

What is normal?
Aortic ROOT

Children & Adolescent 20-39 years >40 years



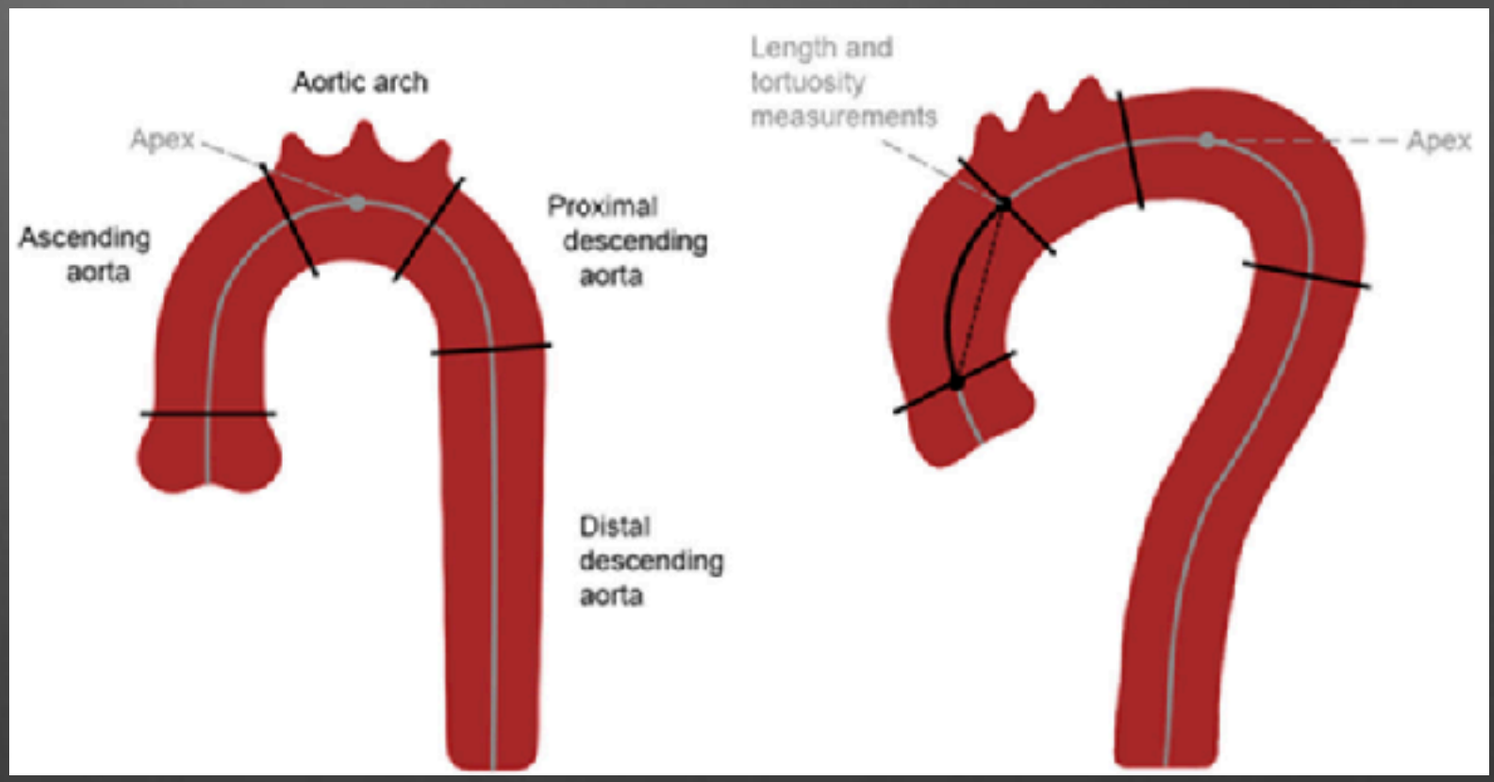
Roman. Am J Cardiology 1989; 64: 507-12

Normal by location

	GENERAL
AORTIC ROOT	3.7cm
ASCENDING	3.6 cm
DESCENDING	2.5 cm

Changing aorta

- Elongate
- Tortuous

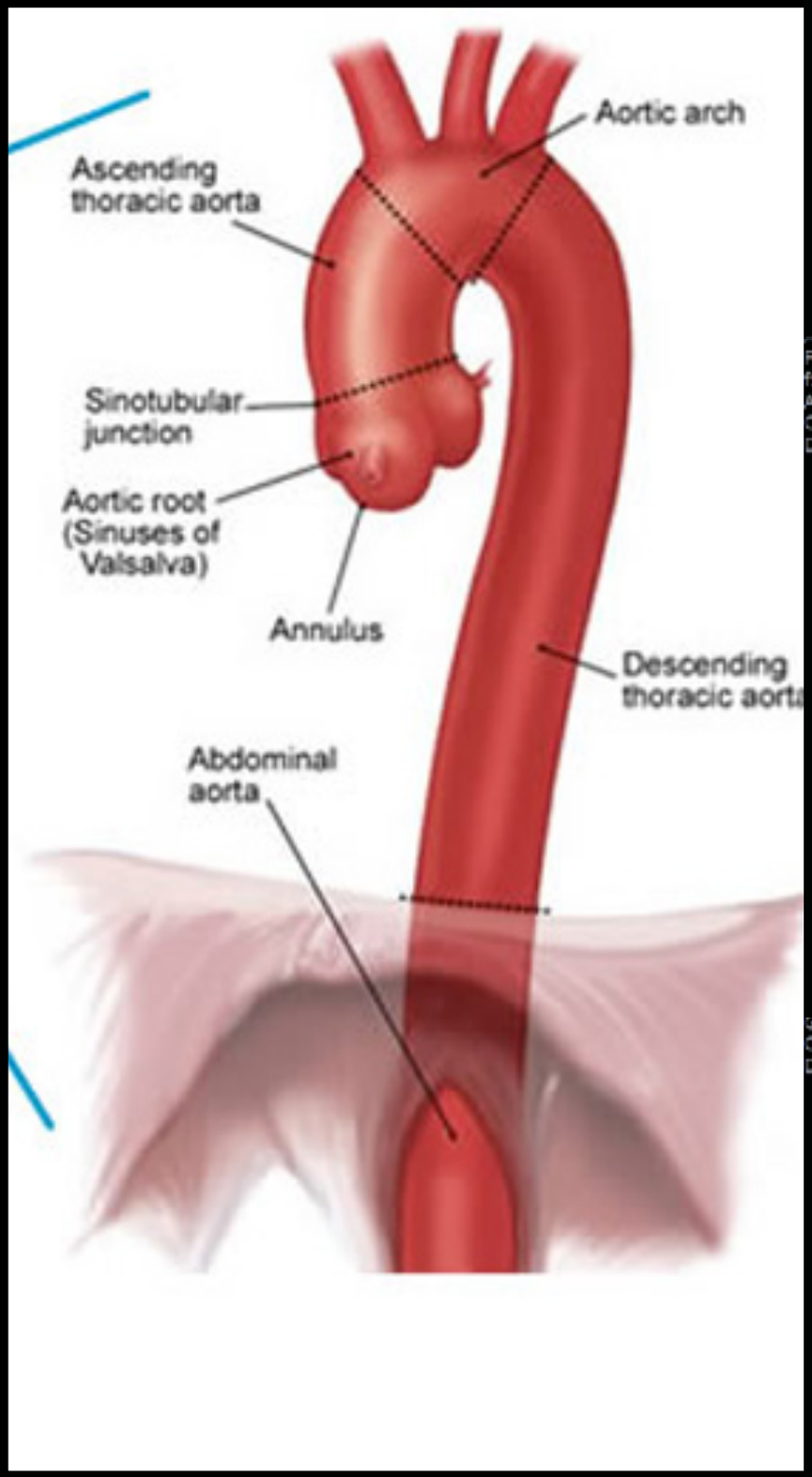


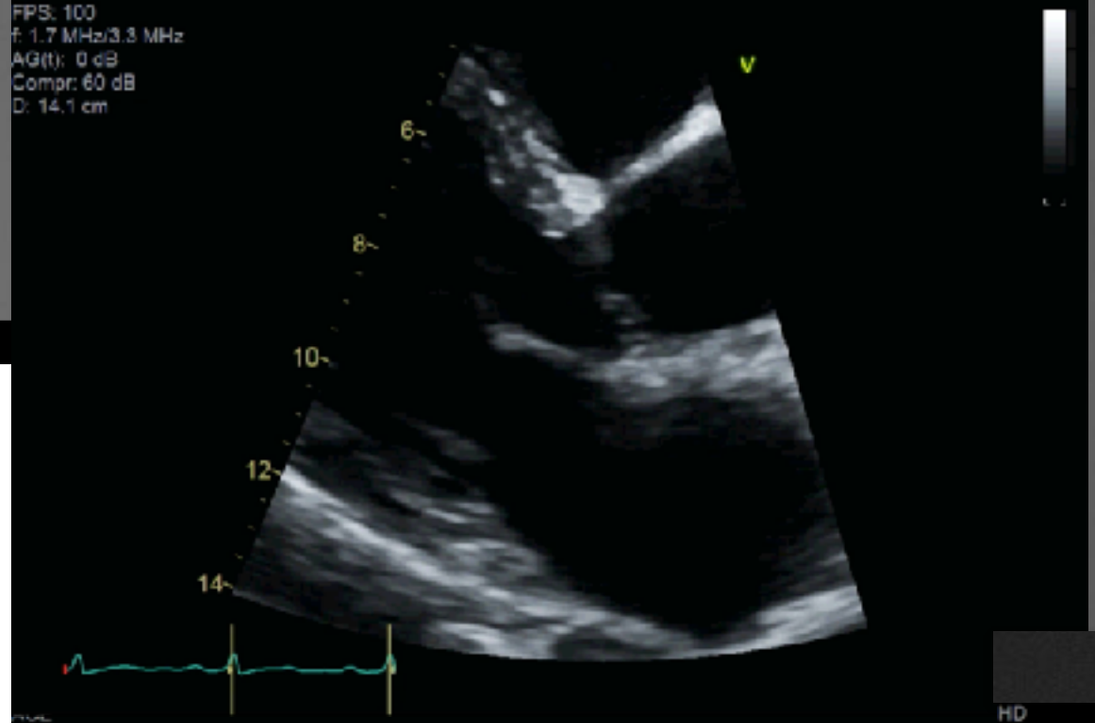
Adriaans BP, et al. Heart 2018;104:1772–1777. doi:10.1136/heartjnl-2017

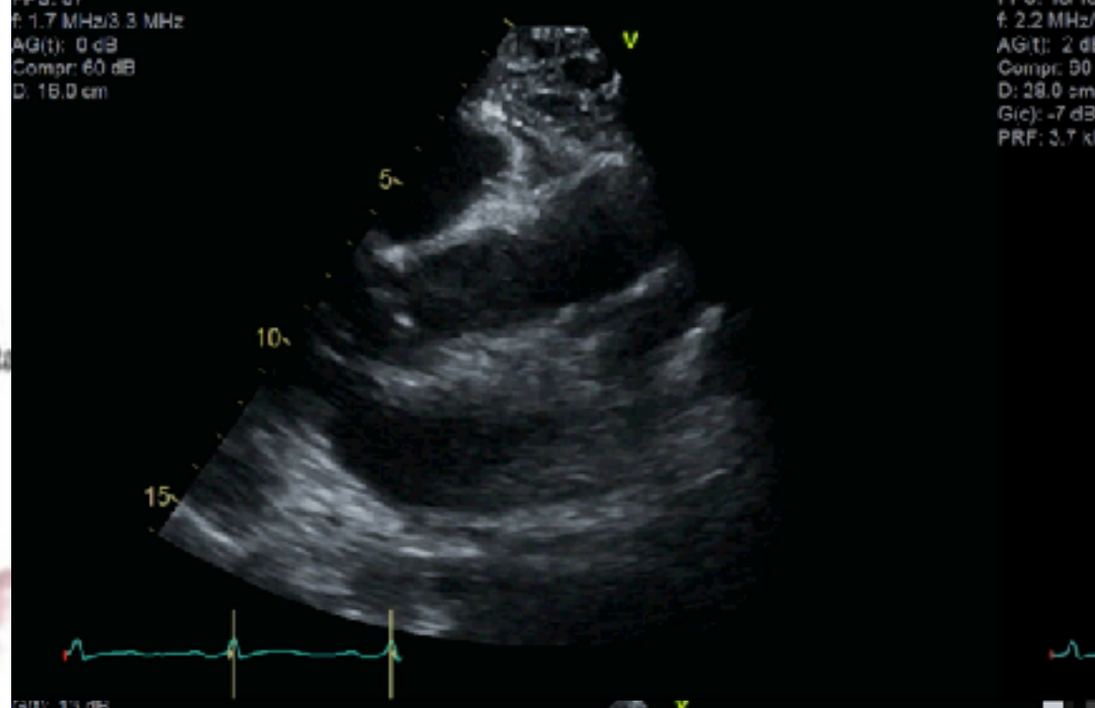
Understand modalities

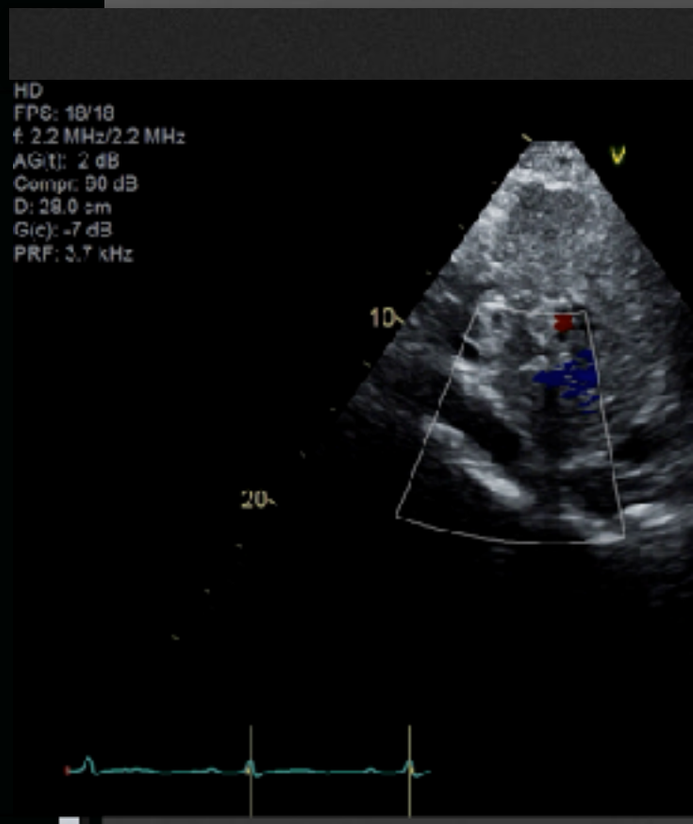
- 2D or 3D
- Contraindication to the modality
- Blind spots
- Other information obtained during study
- Availability and expertise at YOUR centre

TTE


Aortic arch
Ascending thoracic aorta
Sinotubular junction
Aortic root (Sinuses of Valsalva)
Annulus
Descending thoracic aorta
Abdominal aorta

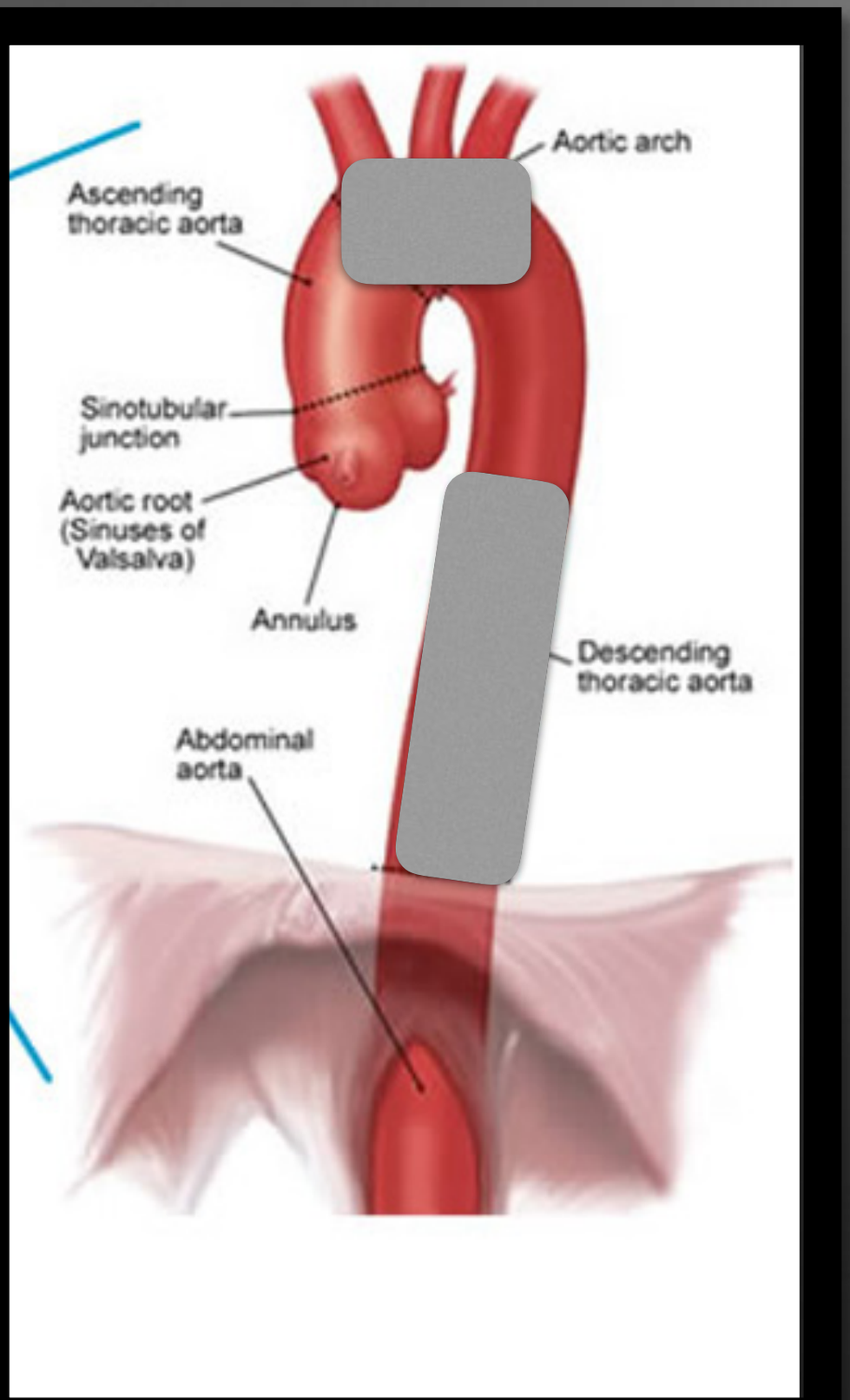

FPS: 100
f: 1.7 MHz/3.3 MHz
AG(t): 0 dB
Compr: 60 dB
D: 14.1 cm


FPS: 57
f: 1.7 MHz/3.3 MHz
AG(t): 0 dB
Compr: 60 dB
D: 16.0 cm


HD
FPS: 16/16
f: 2.2 MHz/2.2 MHz
AG(t): 2 dB
Compr: 50 dB
D: 28.0 cm
G(c): -7 dB
PRF: 3.7 kHz


Compr: 60 dB
D: 13.0 cm

TTE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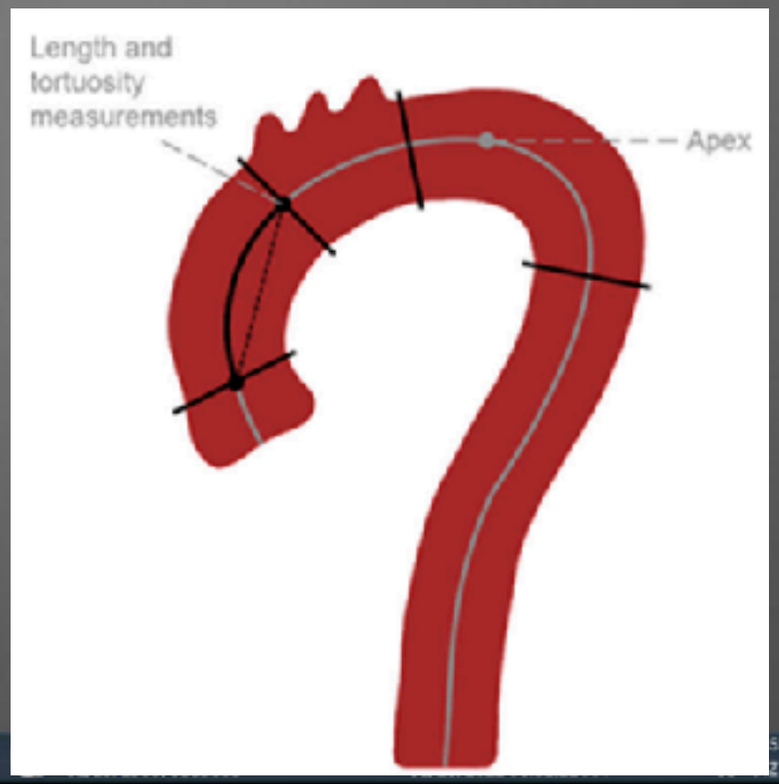
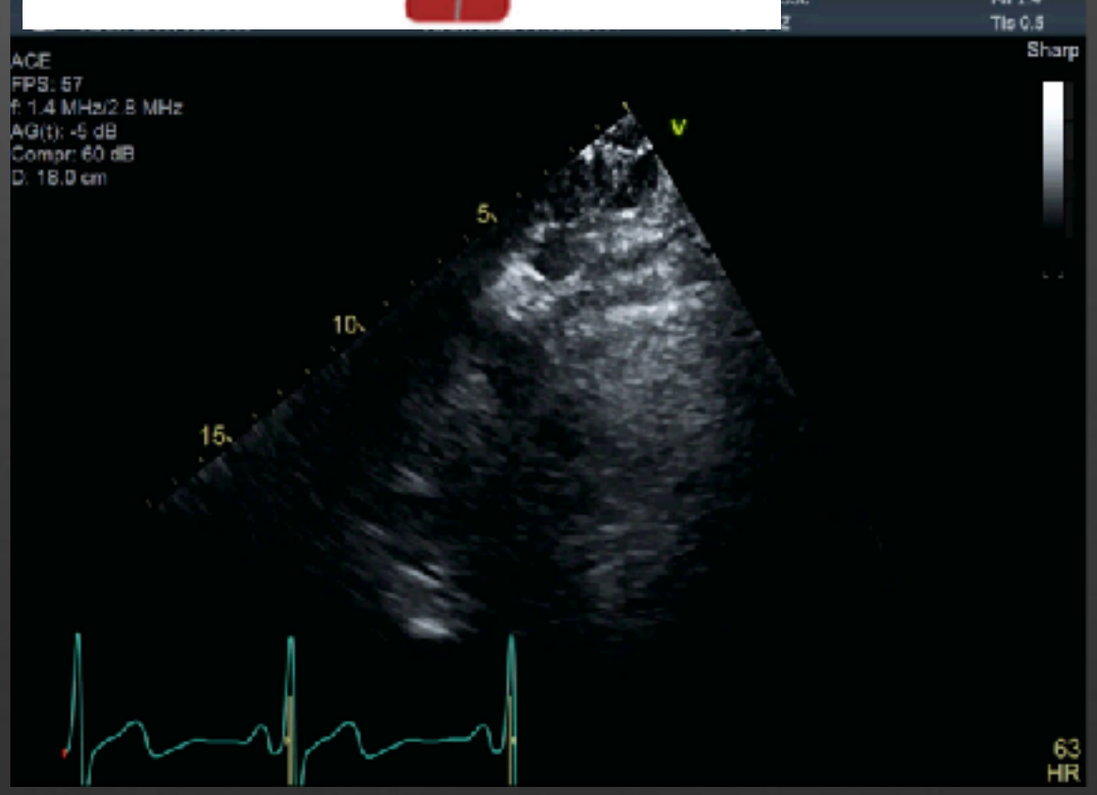
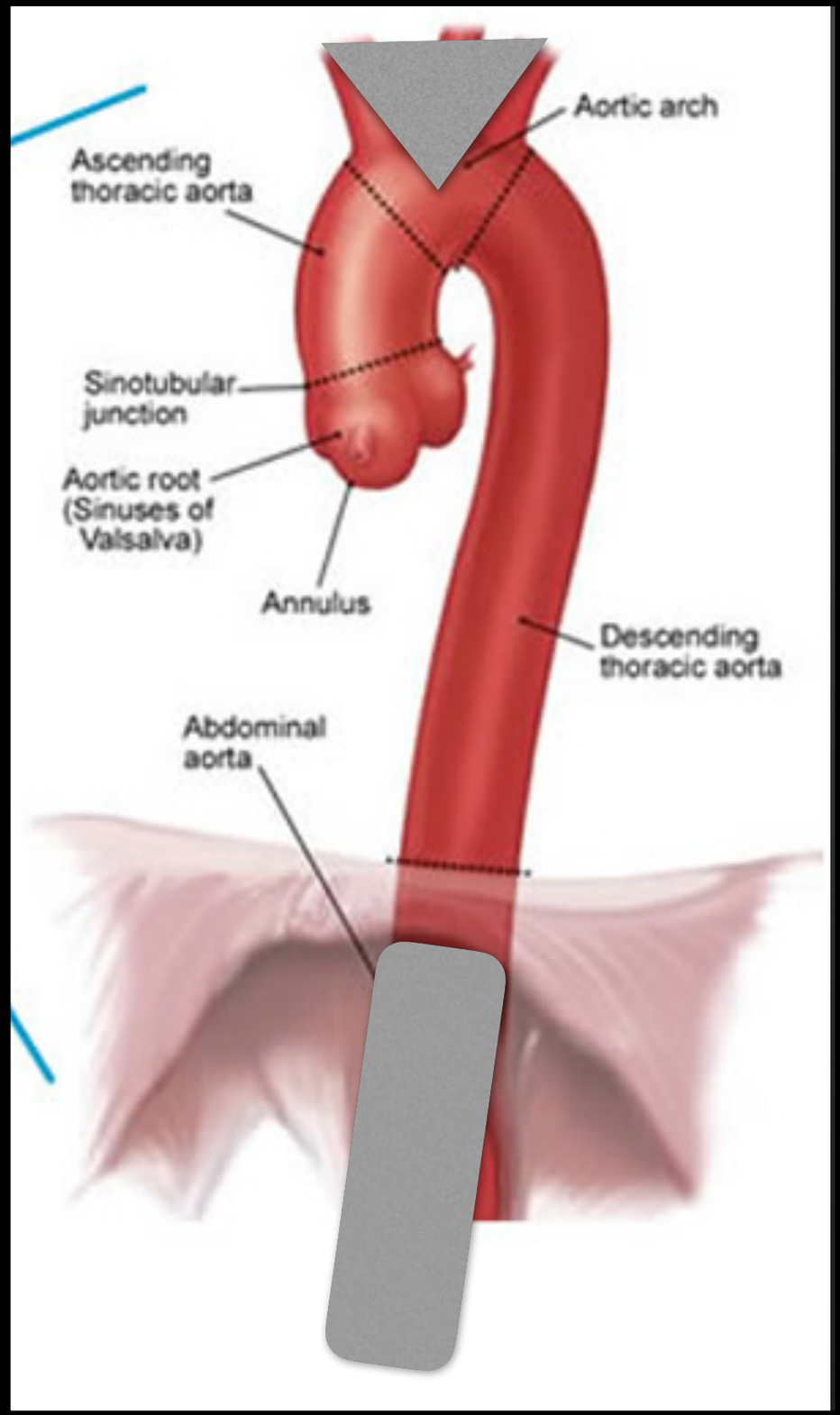

Length and tortuosity measurements
Apex


ACE
FPS: 57
f: 1.4 MHz/2.8 MHz
AG(t): -5 dB
Compr: 60 dB
D: 18.0 cm
Sharp
5
10
15
63
HR

TEE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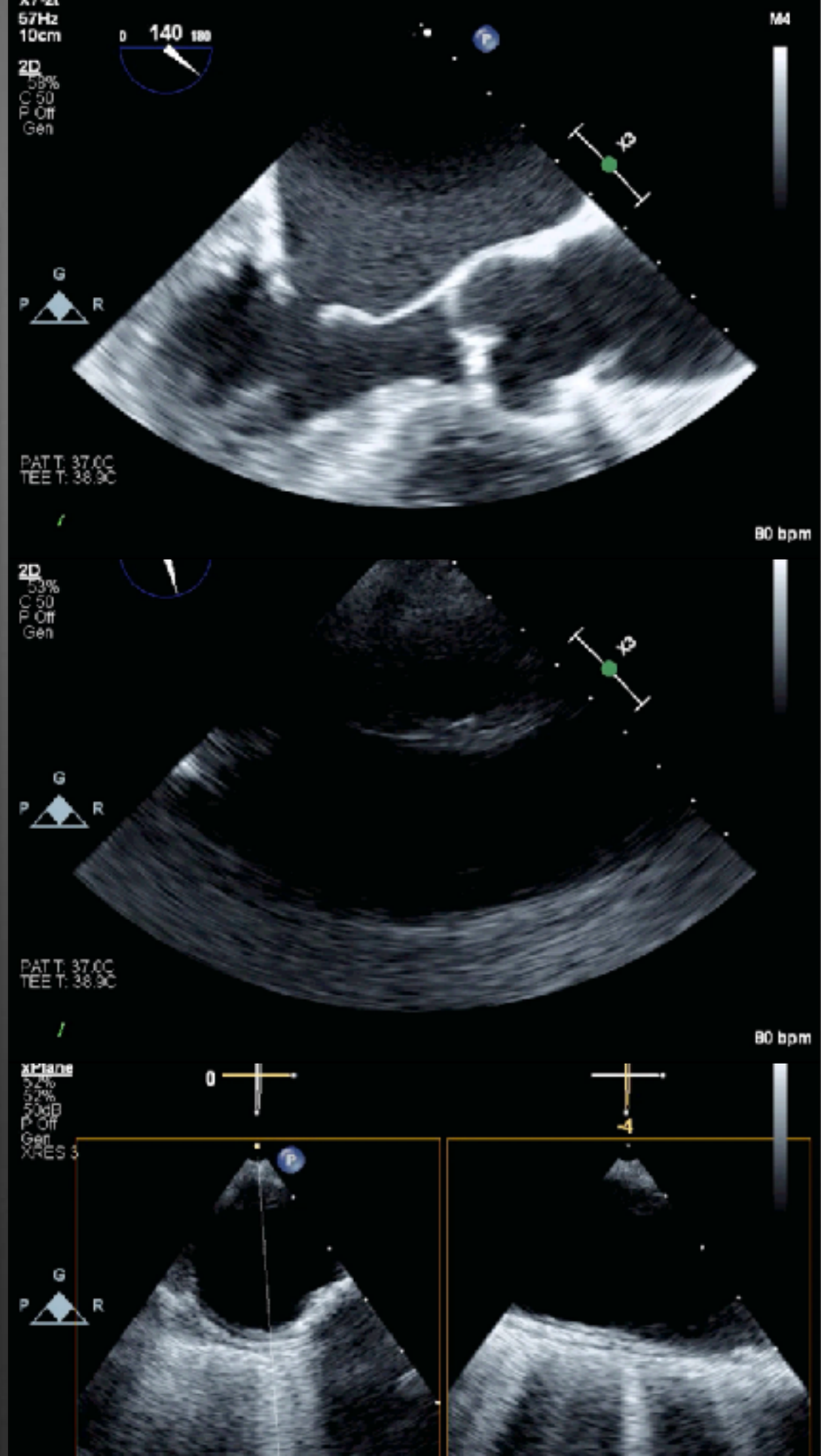
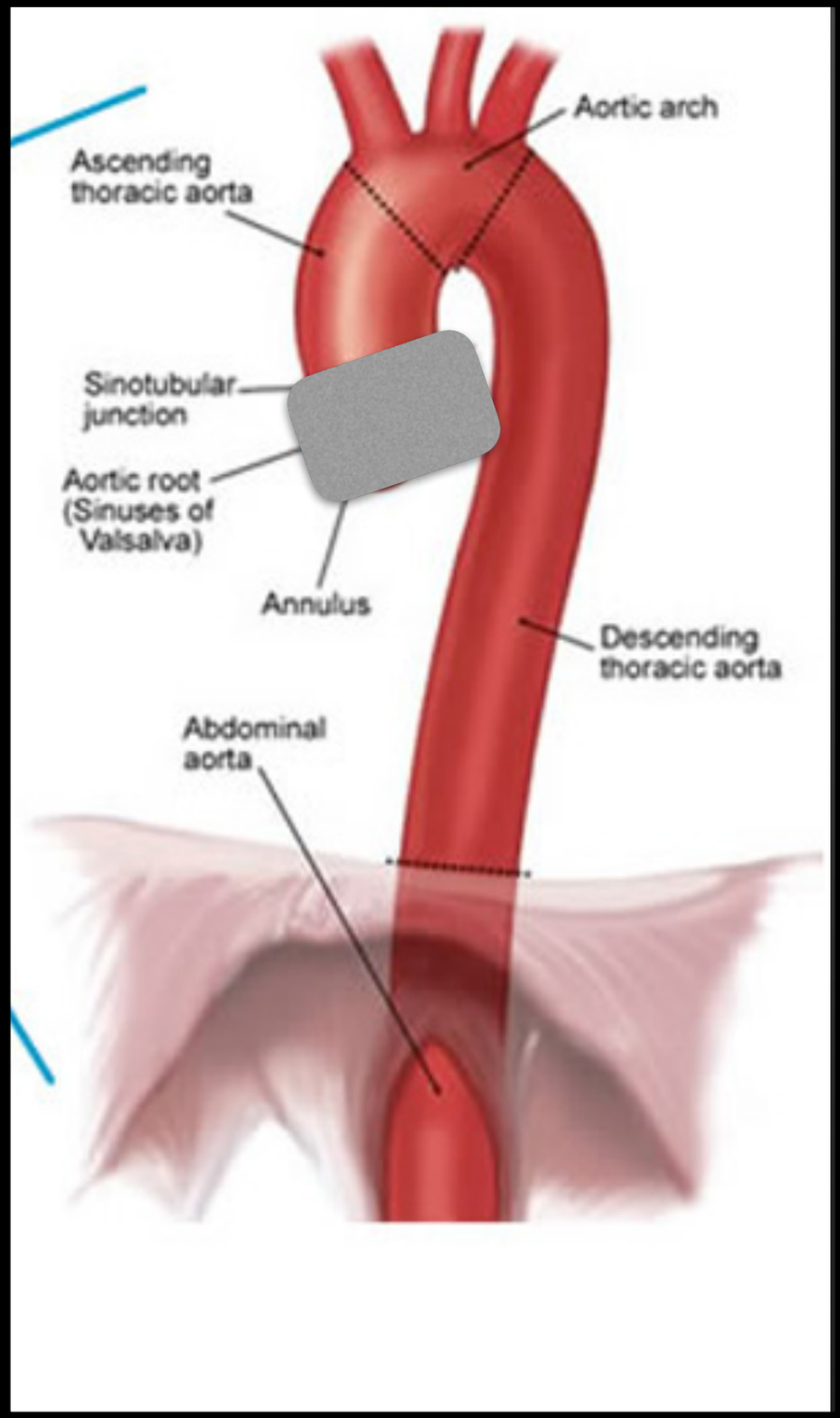

57Hz
10cm
140
2D
53%
C 50
P Off
Gen
M4
G
P
R
PAT T: 37.0C
TEE T: 38.9C
80 bpm
2D
53%
C 50
P Off
Gen
G
P
R
PAT T: 37.0C
TEE T: 38.9C
80 bpm
XPlane
52%
52%
50dB
P Off
Gen
XRES 3
0
-4
G
P
R

CT/MRI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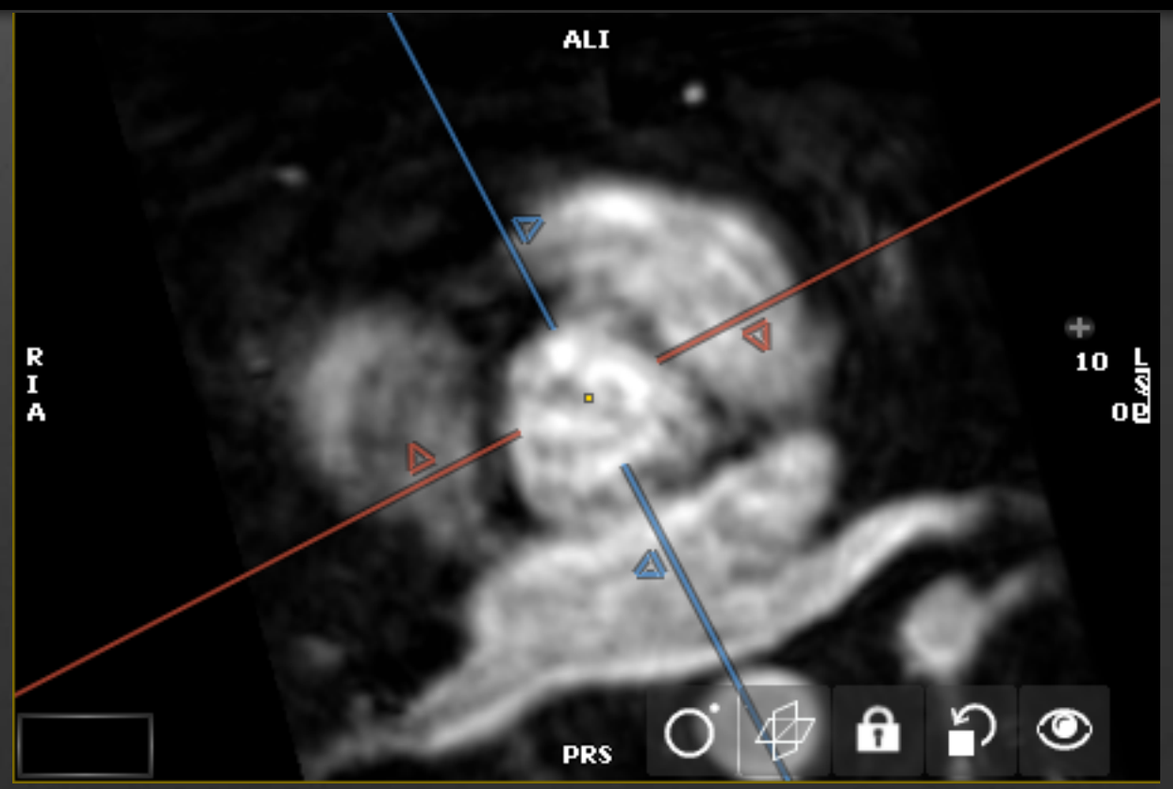
2021-10-07
HR 0
LAO 3
CRA 6
S
R
L
A


ALI
R
I
A
10
0
PRS

Measurements

- Method
  - Leading Edge to Leading Edge
  - Outer Edge to Outer Edge
  - Inner Edge to Inner Edge
- EKG gated/ non gated
  - Systole/Diastole/largest
- Contrast or Noncontrast
- Axial or MPR (Double Oblique)

Methods

Leading edge to Leading edge

Inner edge to Inner edge

Outer edge to Outer edge

Normal Values and Differences in Ascending Aortic Diameter in a Healthy Population of Adults as Measured by the Pediatric versus Adult American Society of Echocardiography Guidelines

Eduardo Bossone, MD, PhD, Eugene Yuriditsky, MD, Sameer Desale, MS, Francesco Ferrara, MD, Olga Vriz, MD, and Federico M. Asch, MD, *Salerno and Udine, Italy; and Washington, District of Columbia*

Table 2 Comparison of thoracic aortic diameter at each aortic segment measured by the DLE and SIE technique with absolute measures, mean of absolute differences, and ICC

Aortic segment	*n*	DLE dimension (mm)	SIE dimension (mm)	DLE – SIE difference (mm)	*P* value (*t* test)	ICC
Aortic annulus	1,142	19.8 ± 2.1	20.0 ± 2.1	−0.21 ± 1.02	<.001	0.88
Sinuses of Valsalva	1,144	30.1 ± 3.6	29.8 ± 3.7	0.21 ± 1.35	<.001	0.93
Sinotubular junction	1,138	25.6 ± 3.3	25.1 ± 3.2	0.43 ± 1.44	<.001	0.90
Ascending aorta	1,113	28.2 ± 3.7	28.5 ± 3.5	−0.26 ± 0.98	<.001	0.96

Data are expressed as mean ± SD. *P* values indicate differences between the two methods.

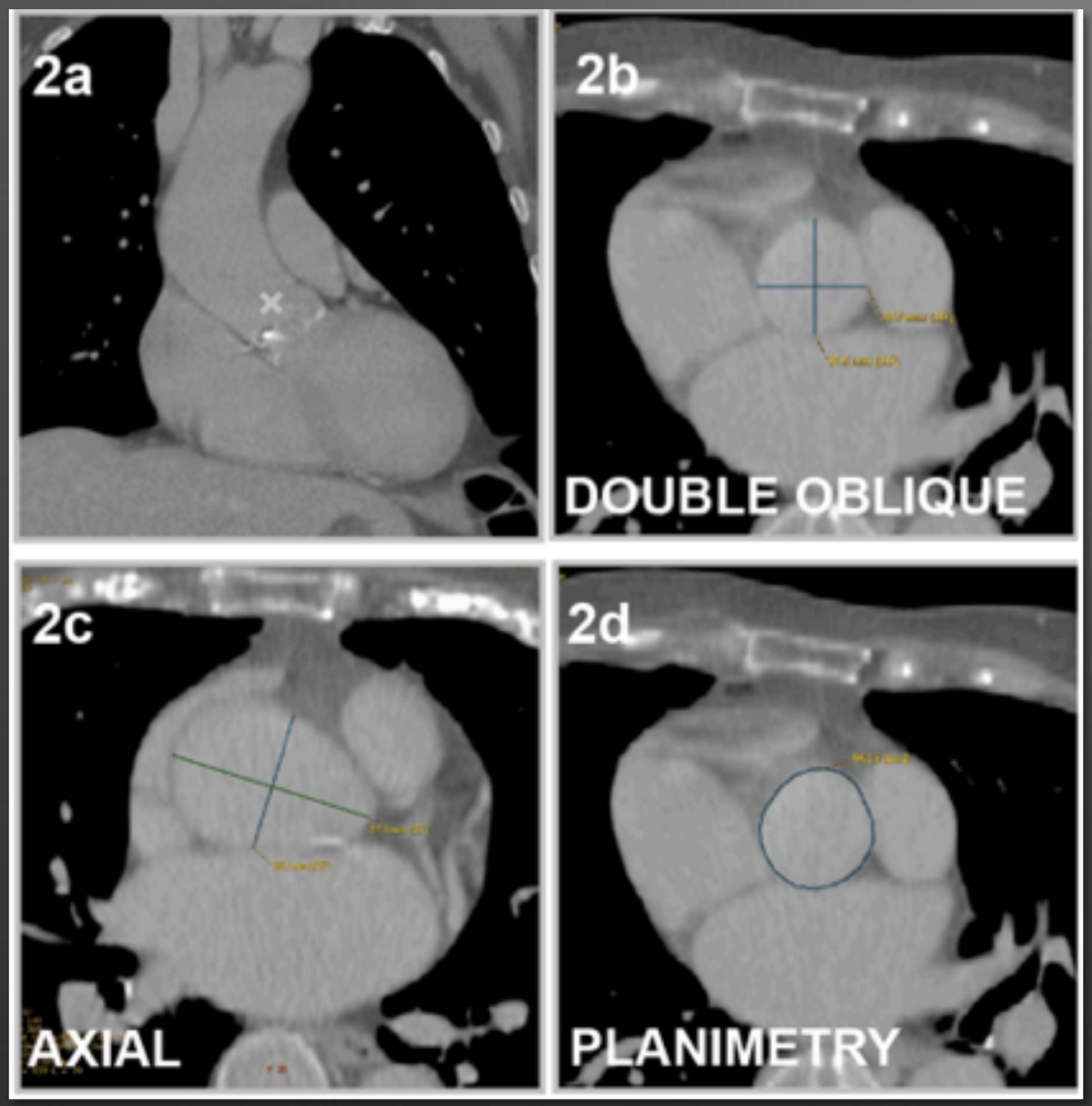
- 1148 healthy adults
- Median age 45, range 16-92 y.o.
- 53% women
- Mean BP 124mmHg

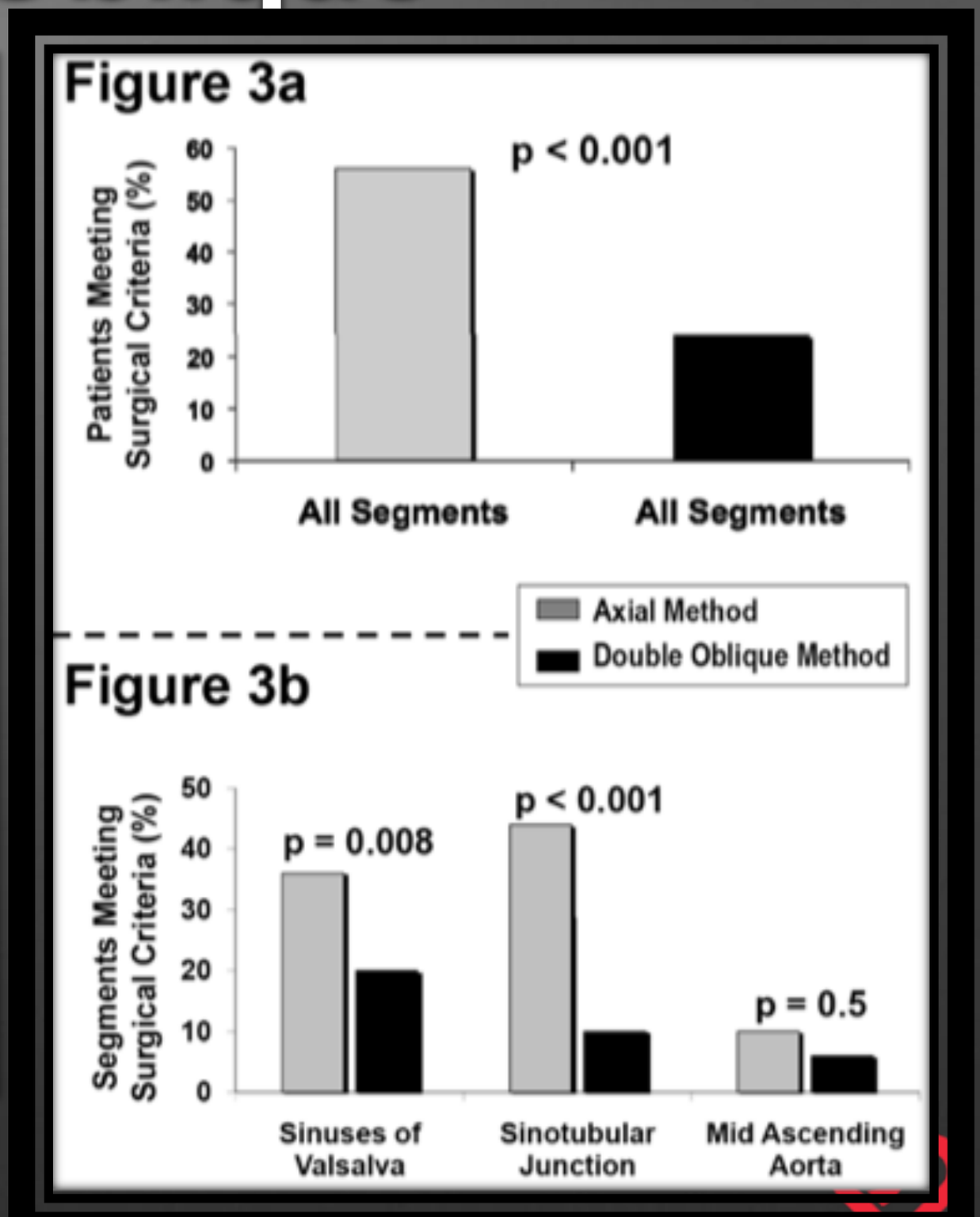
JASE 2016;29:166-72

Measurements

- Method
  - Leading Edge to Leading Edge
  - Outer Edge to Outer Edge
  - Inner Edge to Inner Edge
- EKG gated/ non gated
  - Systole/Diastole/largest
- Contrast or Noncontrast
  - Axial or MPR (Double Oblique)

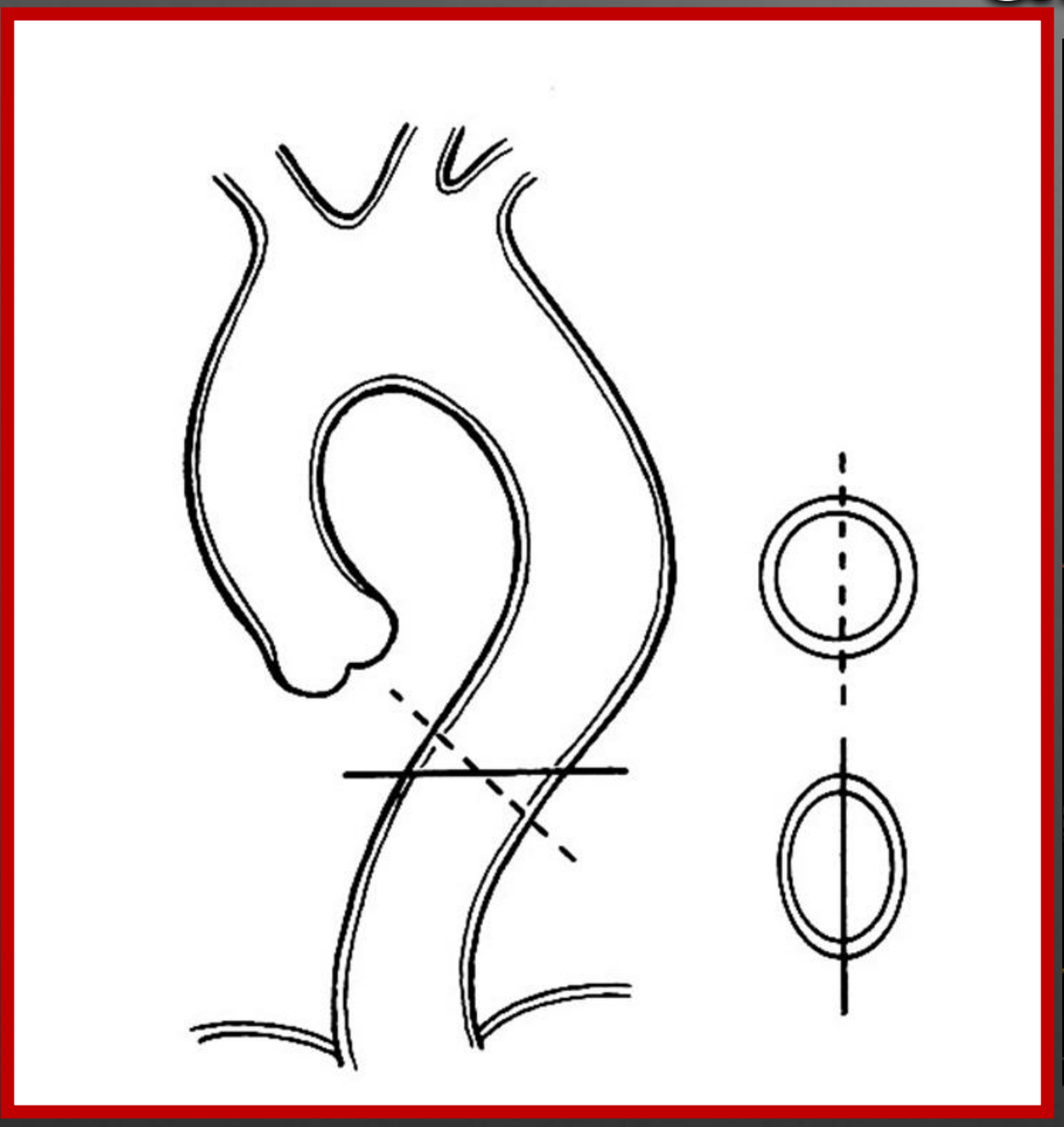
Double Oblique

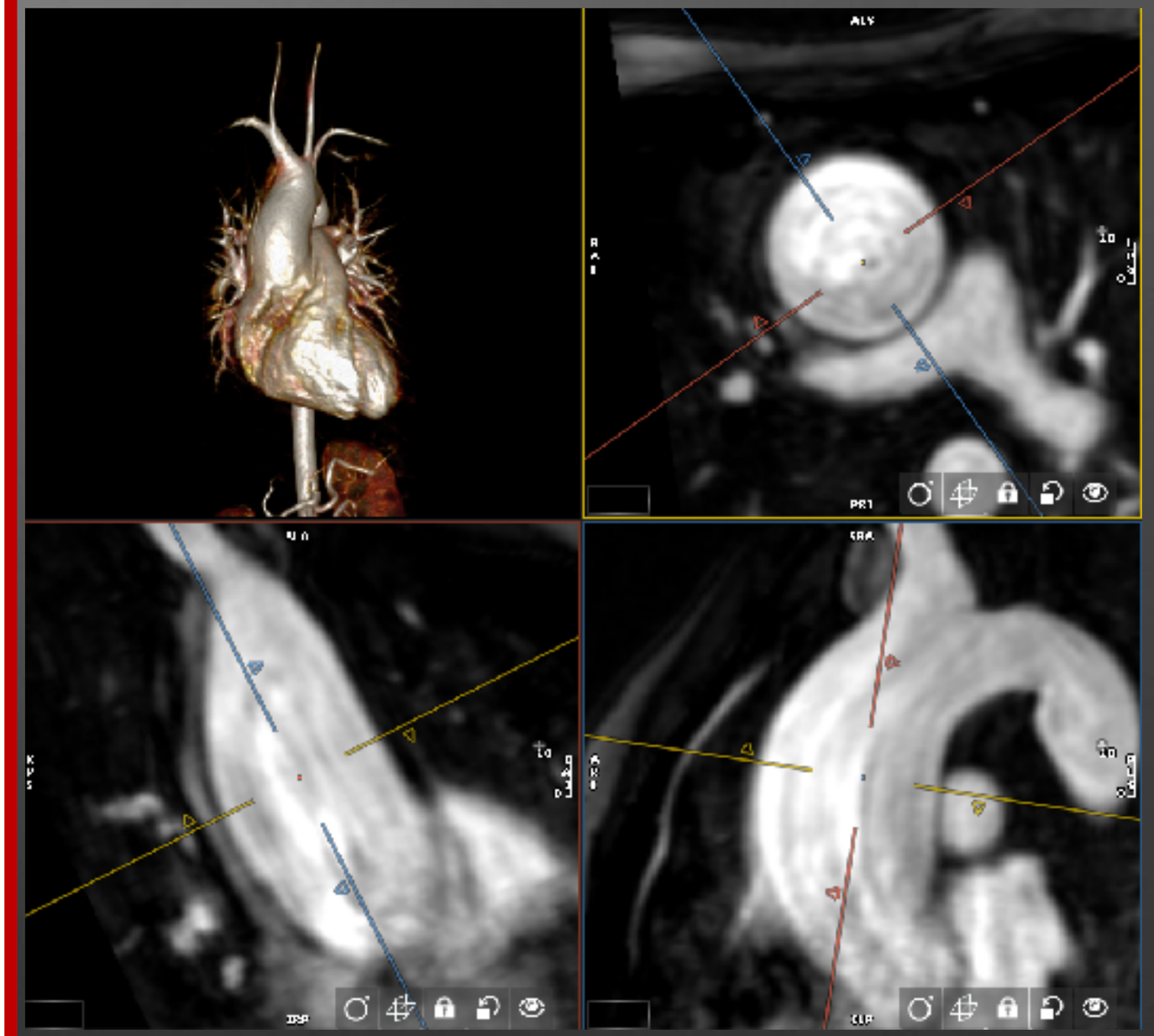




Mendoza D, Weinsaft J et al. Ann Thorac Surg, 2011;92:904

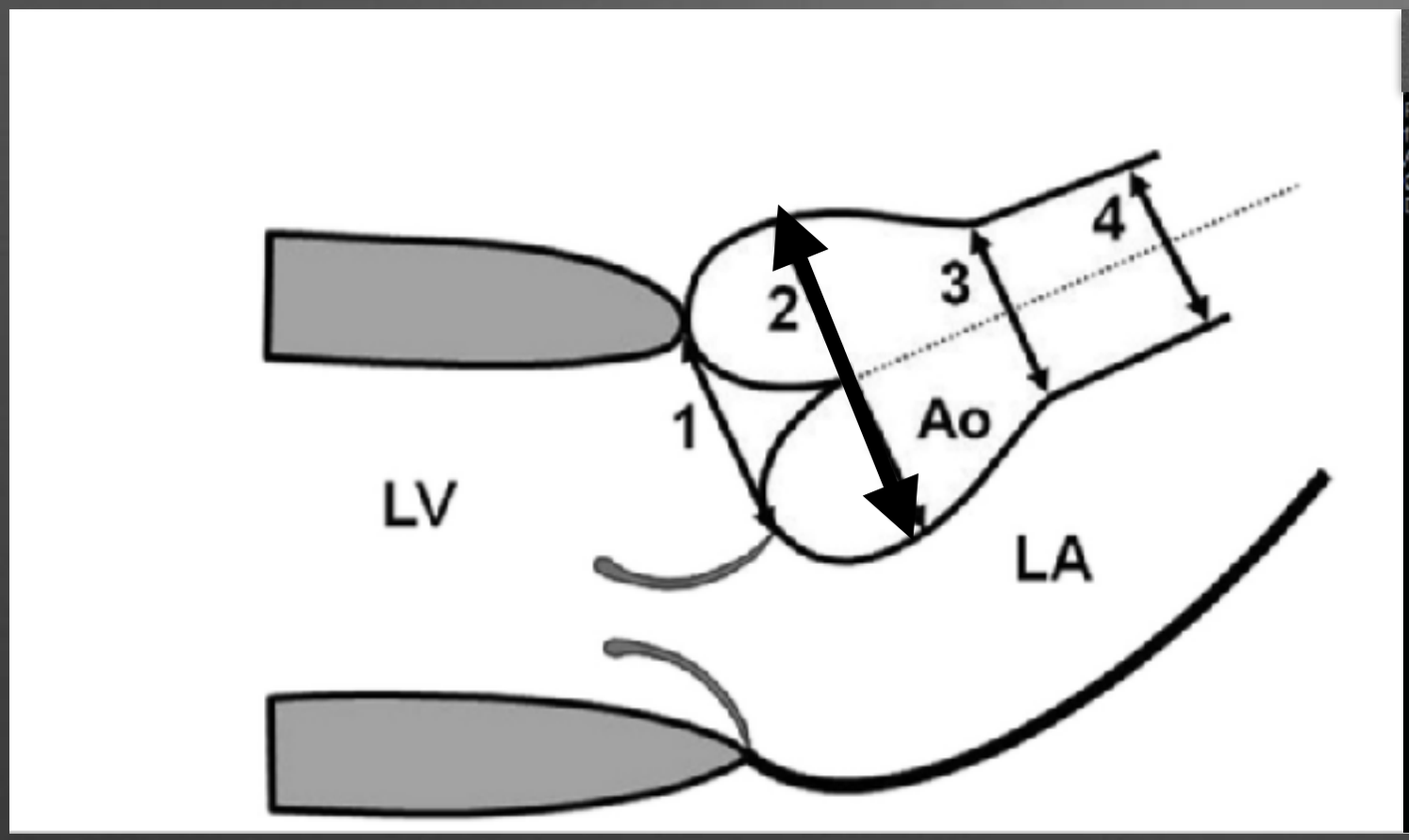
Measure perdenicular to long axis

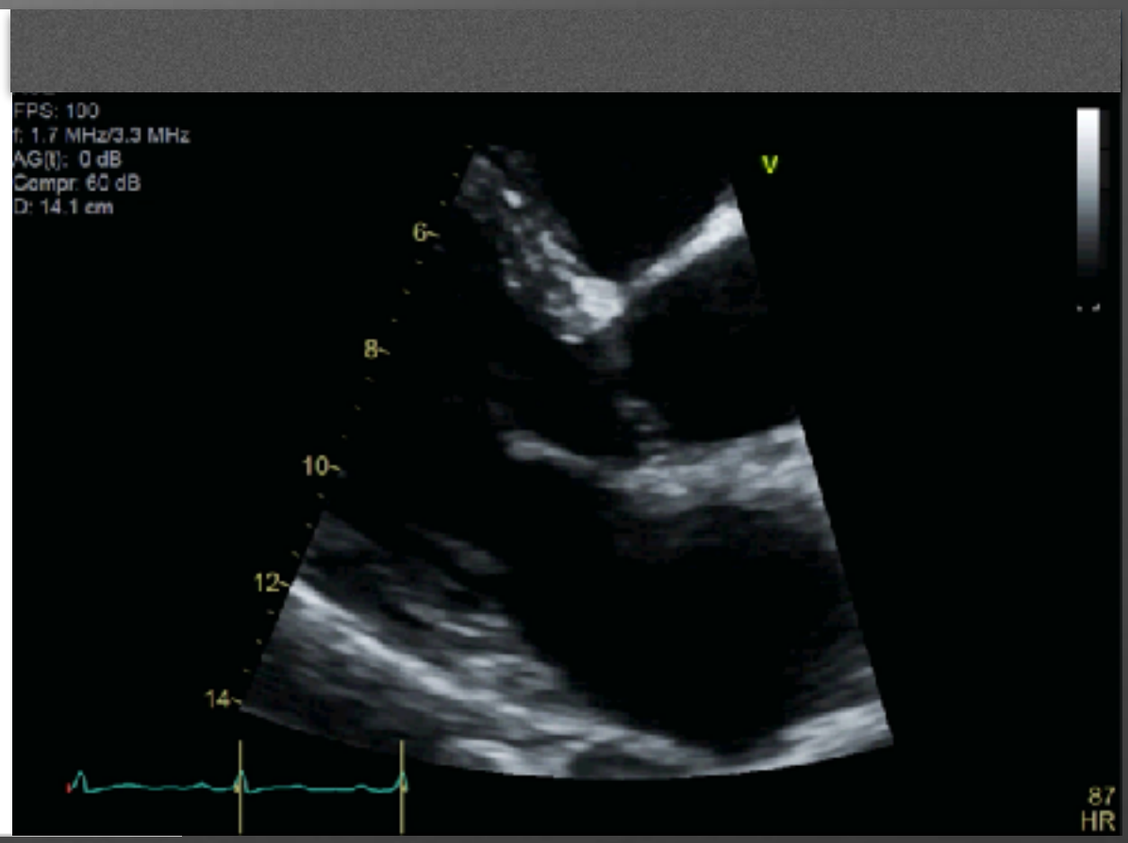




2015 JASE Aorta Guidelines

Aortic Root -Echo

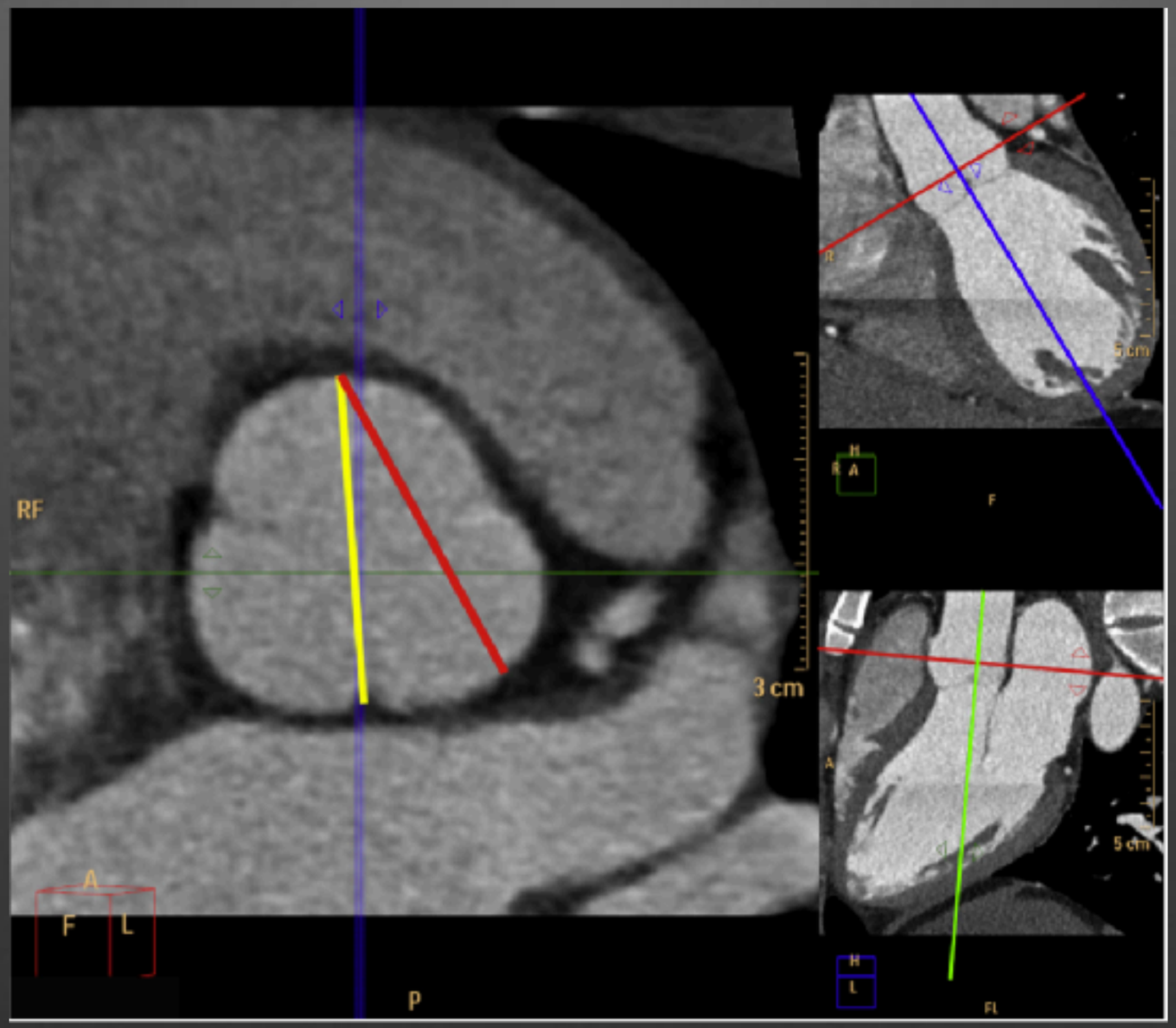




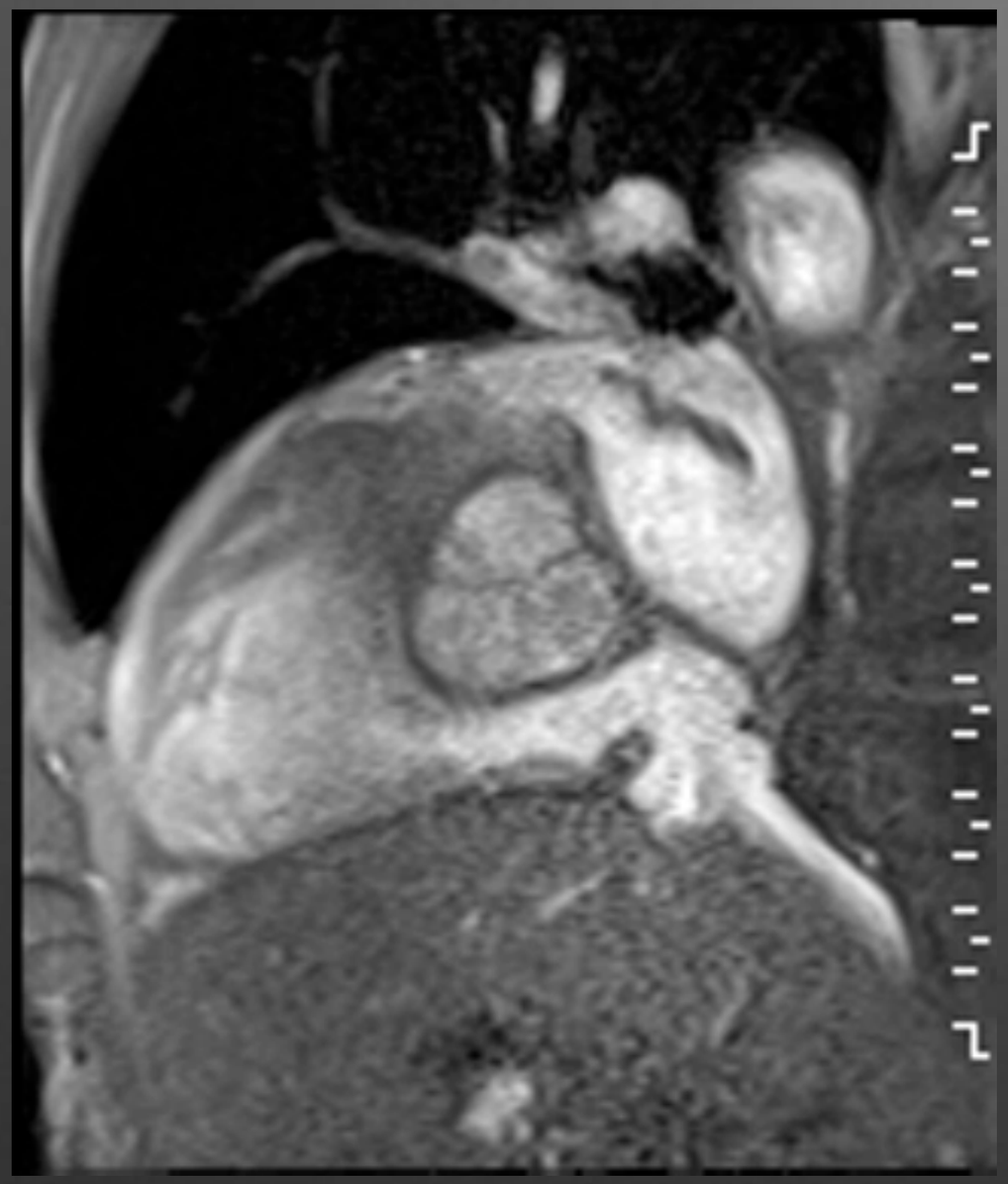
Measurement at end -diastole

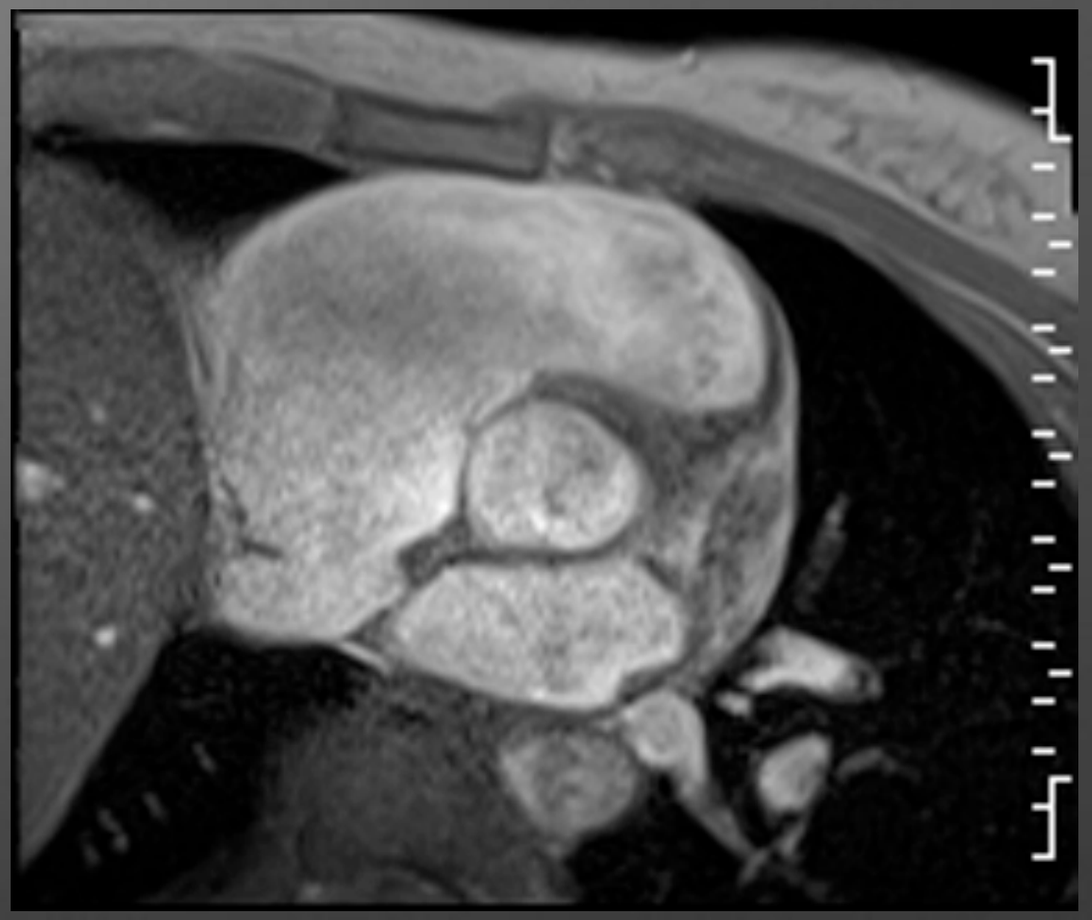
2015 JASE MMI Thoracic Aortic Guidelines

Aortic ROOT- CT/MR



Aortic Root Gated CT/MRI





Imaging Modalities

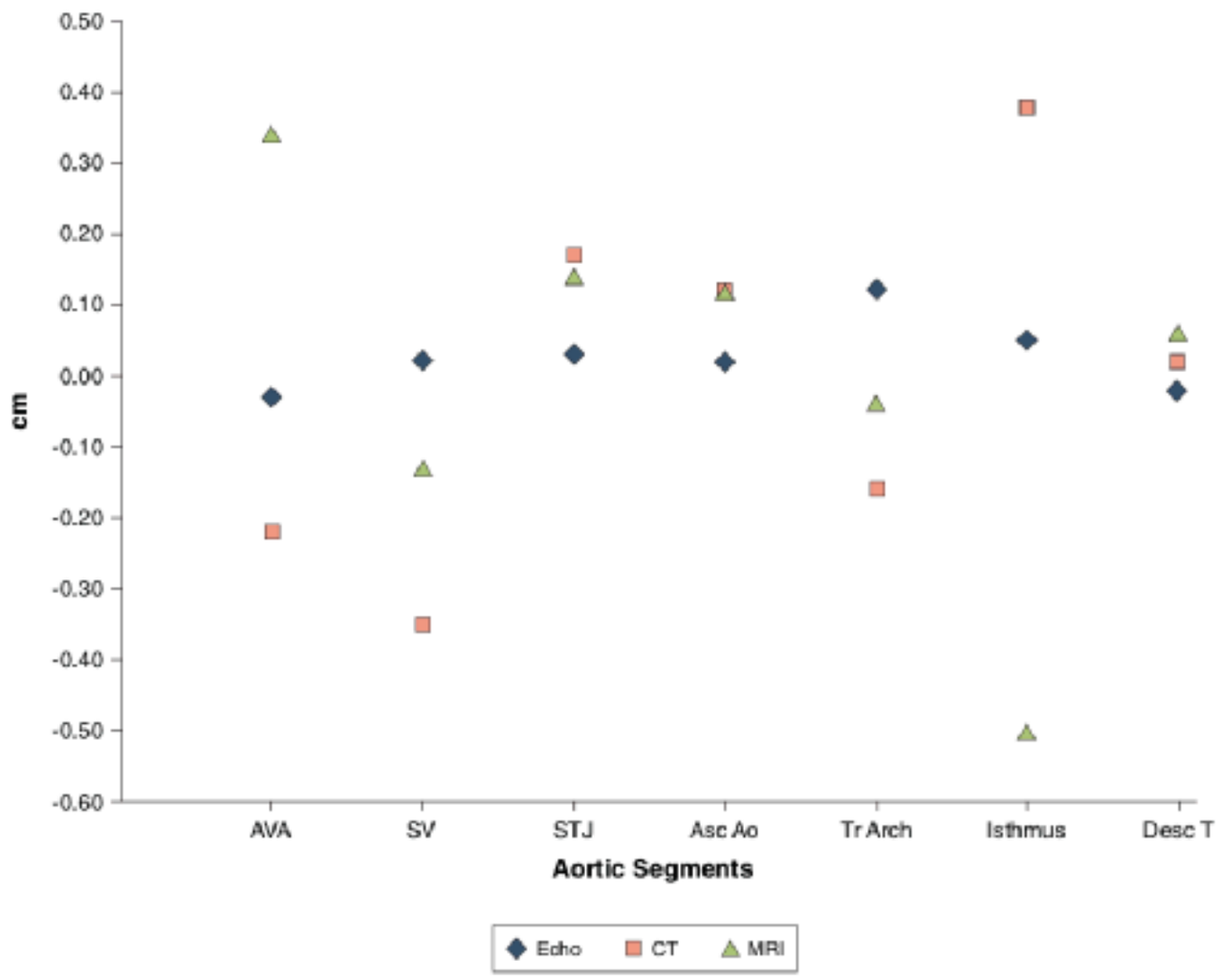
- 3mm change is ***not*** reflective of a significant change
- Understand the style of your MRI/CT ***acquisition*** and ***reader***
- Compare serial measurement of change (>1)
- Ensure the measurements are at the same location
- Select modality based on area of dilation and need for other information
- Should have a CT/MRI with 3D at least once

JACC: CARDIOVASCULAR IMAGING, VOL. 9, NO. 3, 2016
MARCH 2016:219–26

The Need for Standardized Methods for Measuring the Aorta

Multimodality Core Lab Experience From the GenTAC Registry

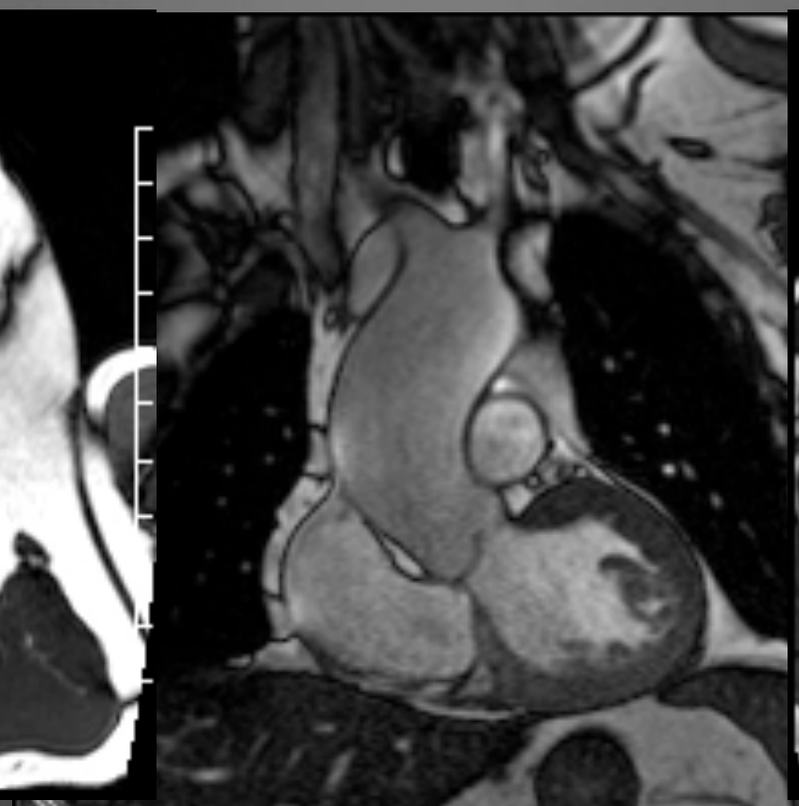
FIGURE 1 Adjusted Mean of Differences (in cm) by Imaging Modality at Each Aortic Segment

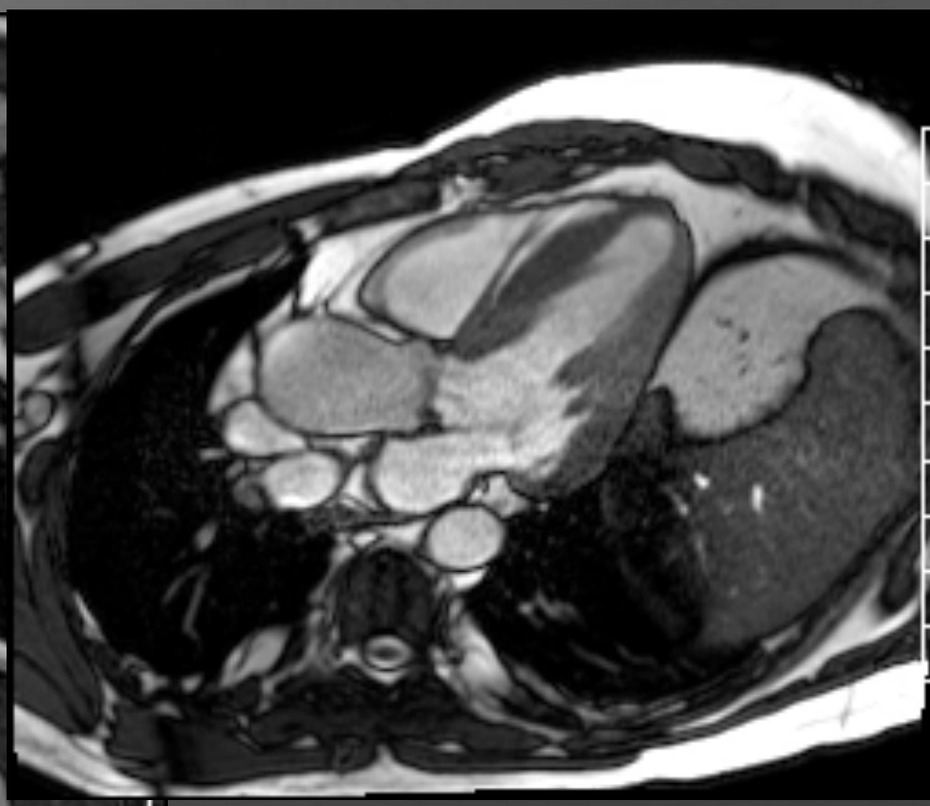


Beyond Degenerative AA

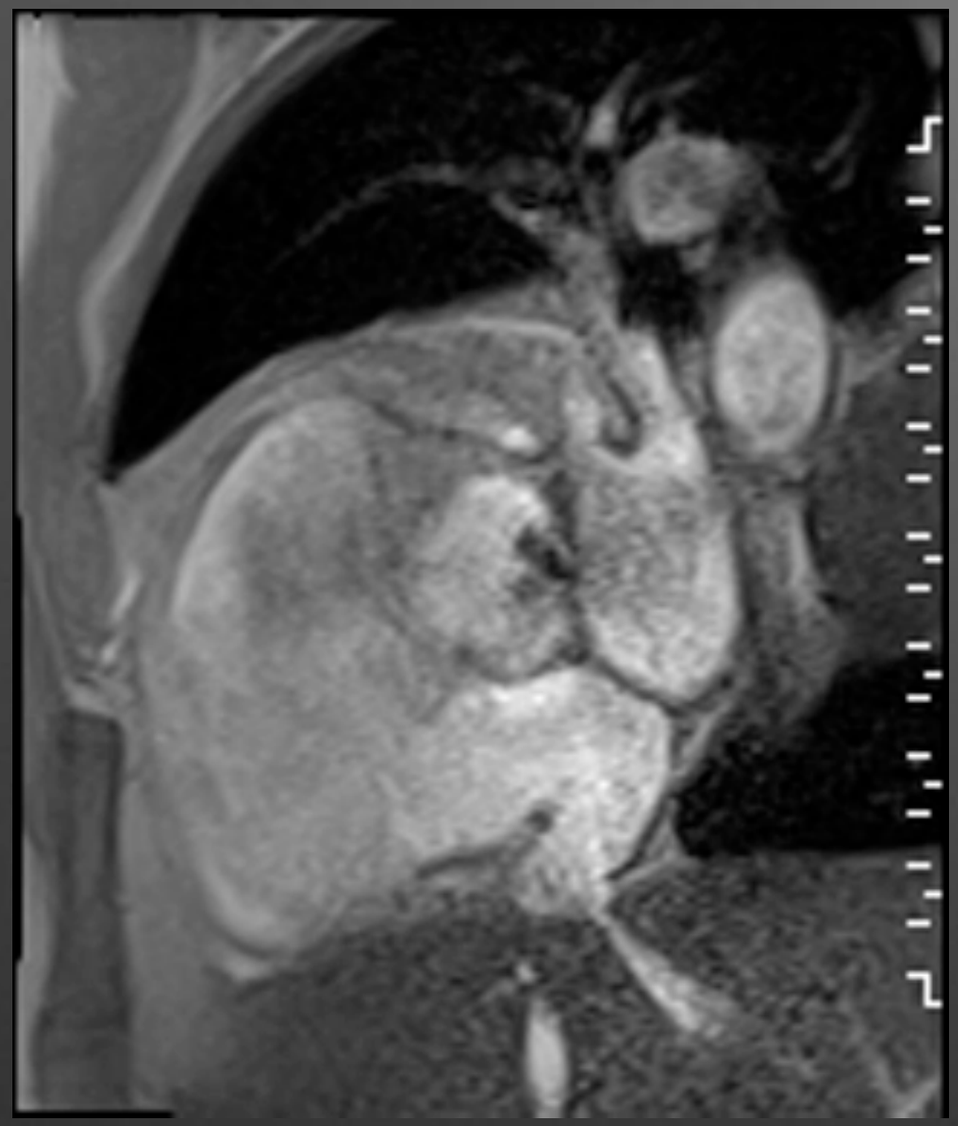
Case 1

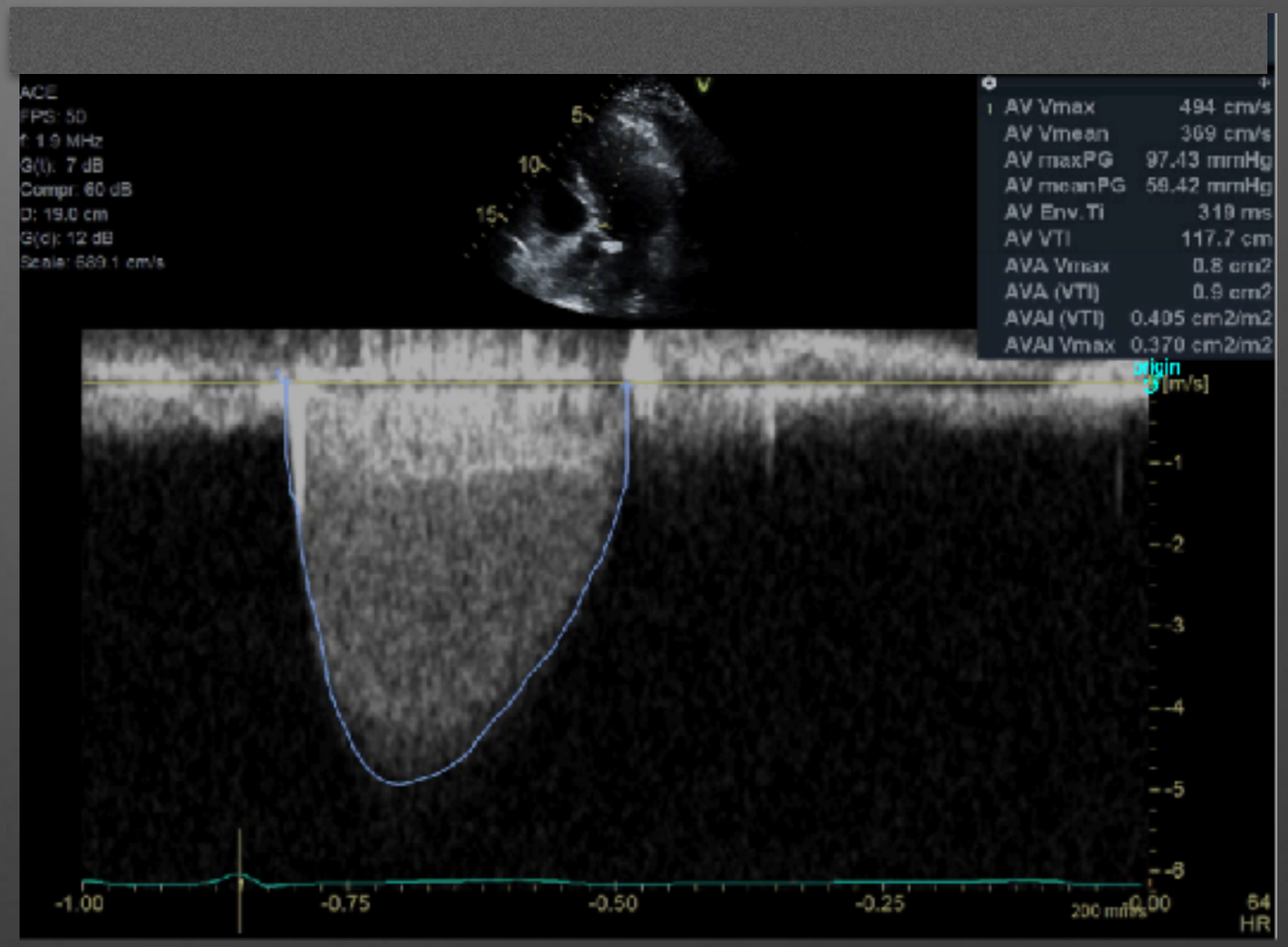
- 45 y.o. male with worsening dyspnea known to have a bicuspid AV



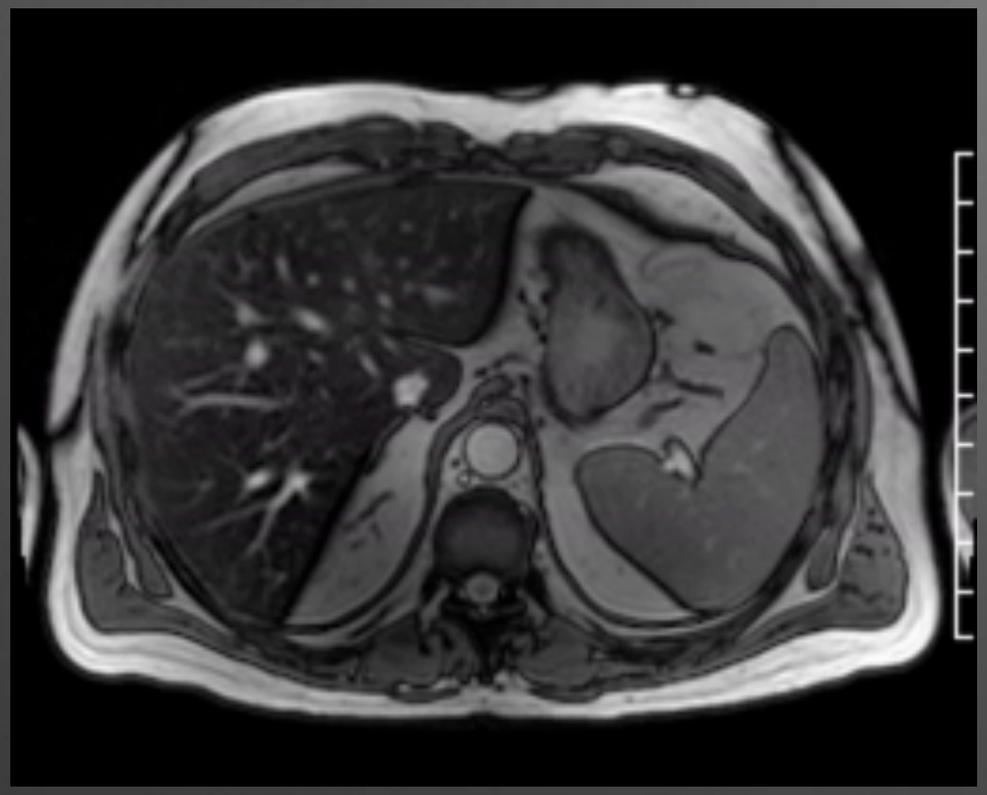


Bicuspid with right/NC fusion

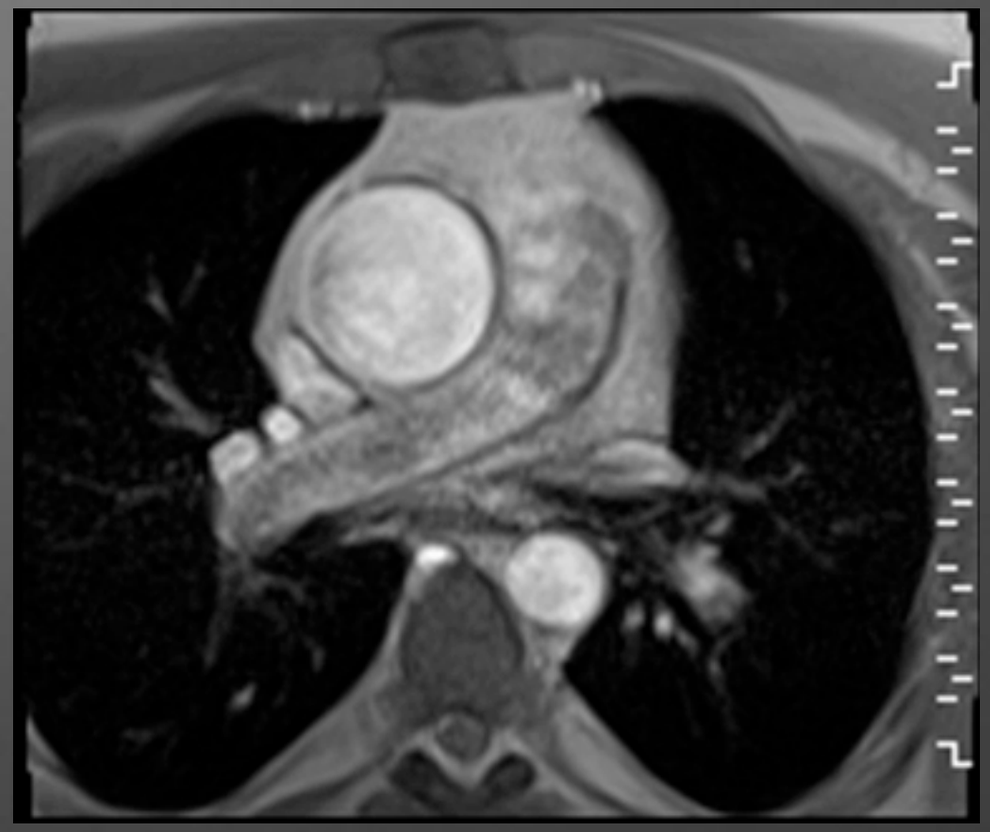




Aorta

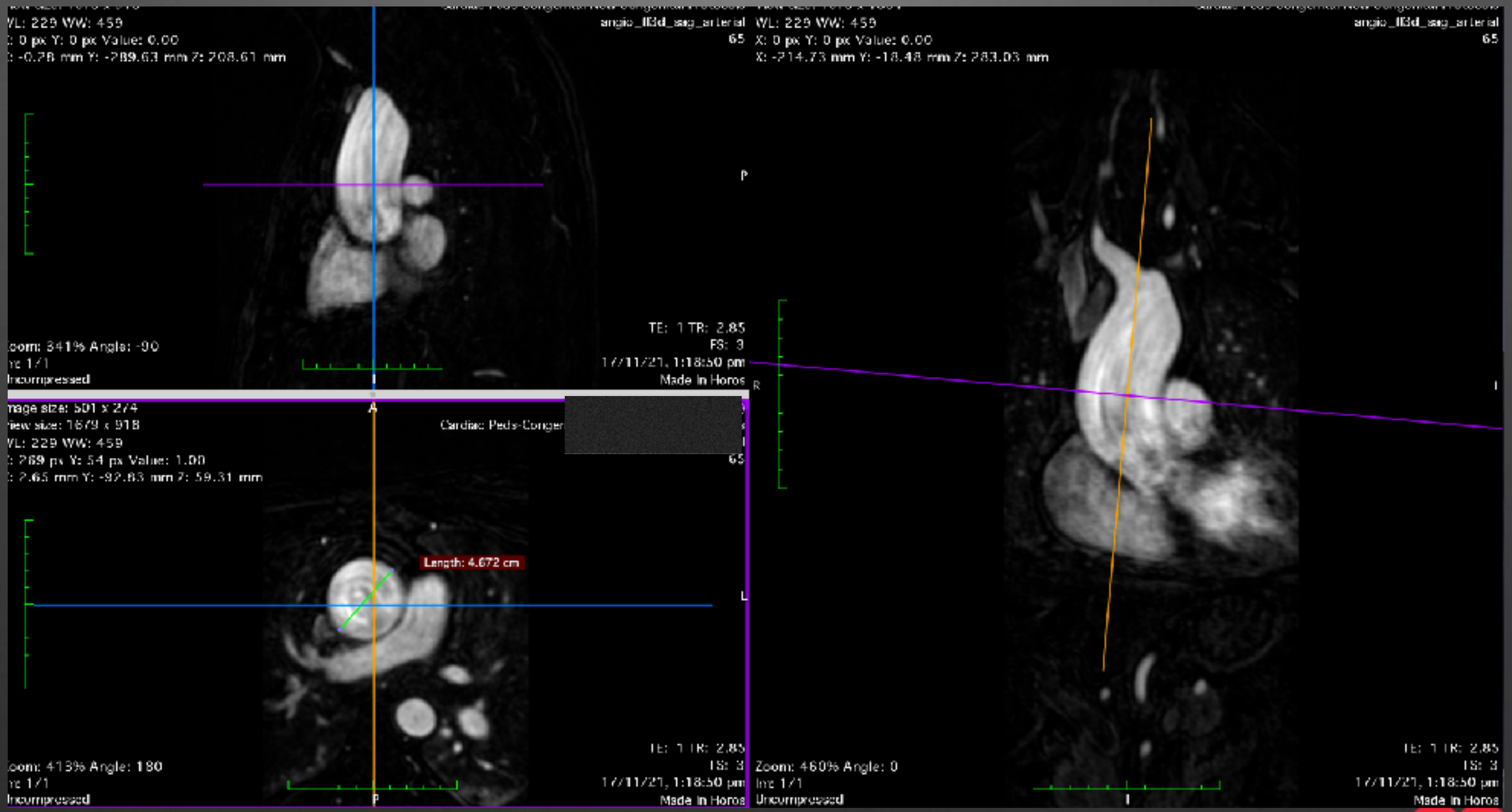


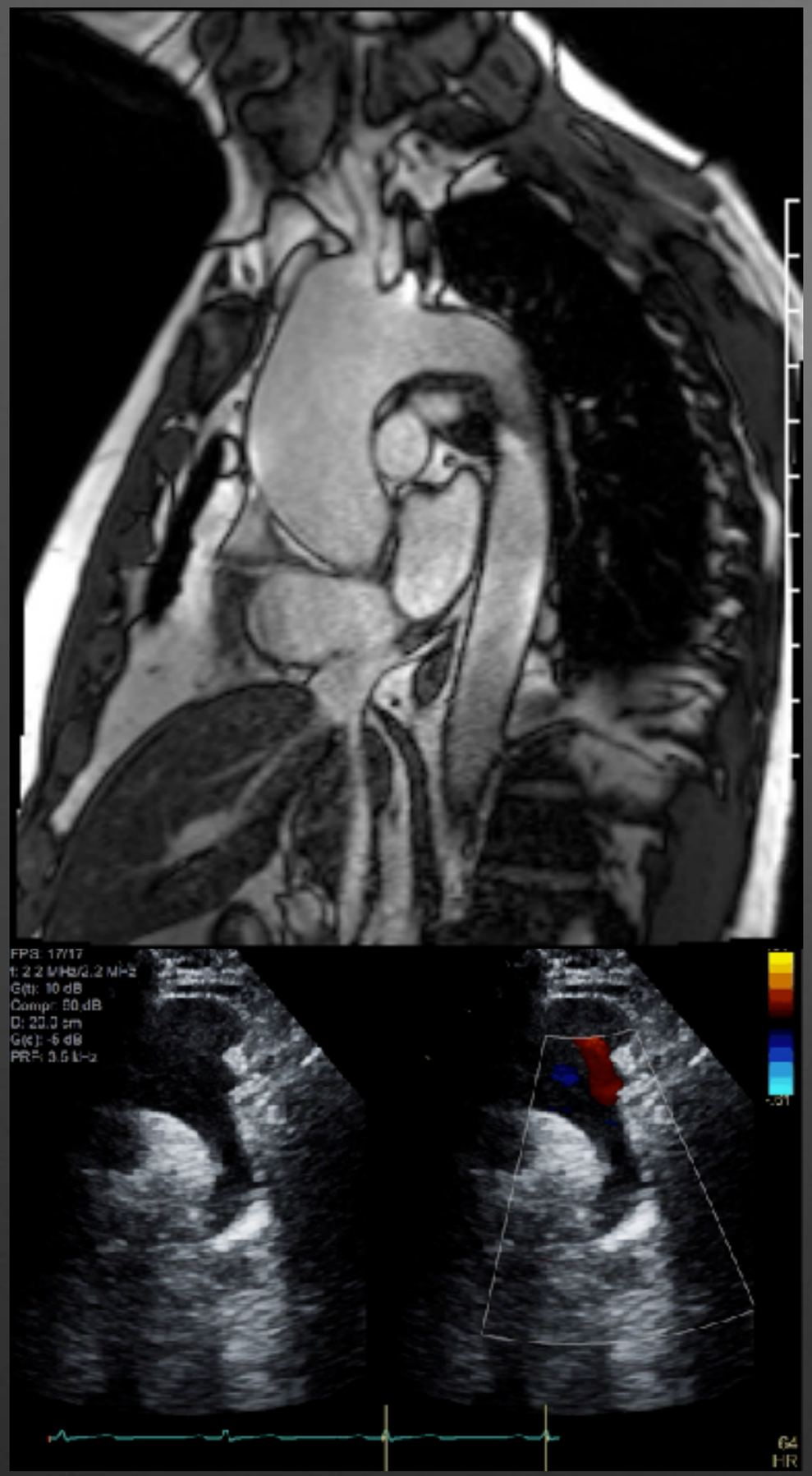
Axial stack 44mm



Oblique cine 47mm

Double Oblique- 47mm






X
OSIRIX

VCU MRI Technique

- EKG gated cine measurements
  - Especially for aorta root but also for ascending aorta
- Largest measurements
- Double Oblique/MPR with contrast
- Addition of 4D flow

Class I and IIa recommendations

Bicuspid AA

Size ≥ 55mm
Growth rate ≥ 5mm/yr
Size ≥ 50mm + risk

Size ≥ 45mm
Severe AS

RISK
Aortic coarctation
FH dissection/SCD
Growth >3mm/year
HTN

J Thorac Cardiovasc Surgery 2019
ESC Guidelines 2014
ACC Valvular Update 2016

Case 2

- 35 y.o. female with Marfan's syndrome presents for her annual physical exam and discussion for pregnancy

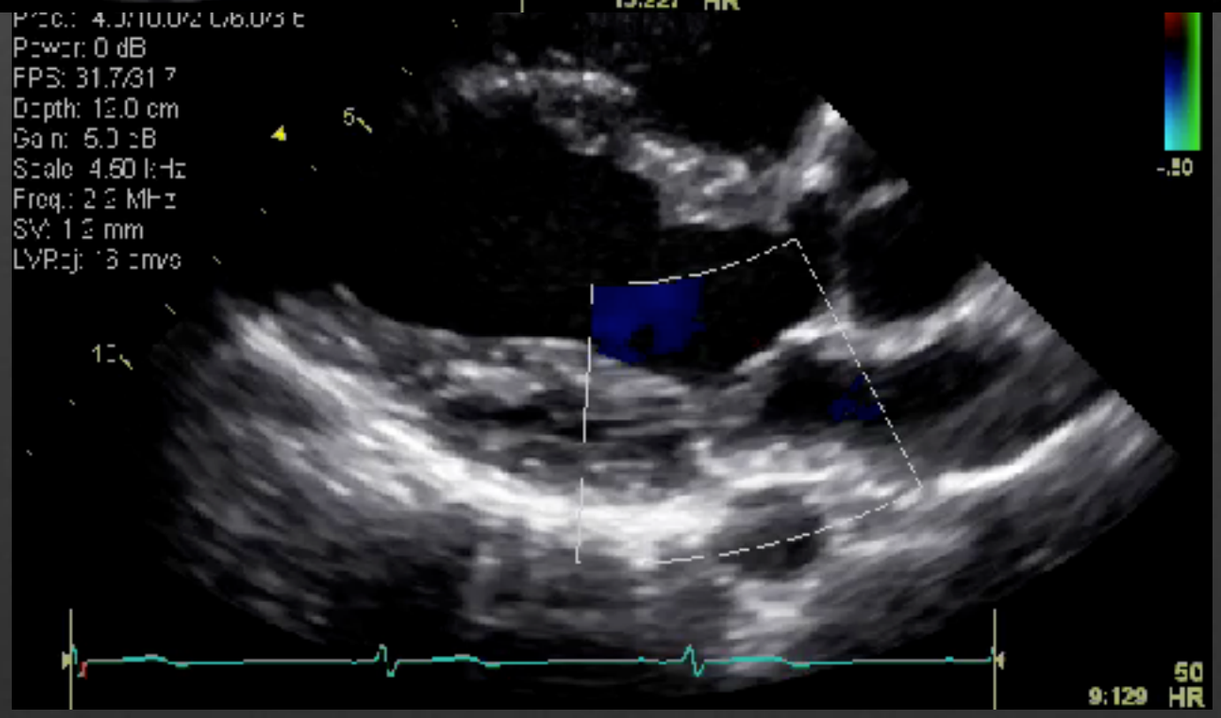
- Physical Exam
  - BP 130/80 HR of 80 bpm; height 66 in; weight 105lbs; BSA 1.56 m2

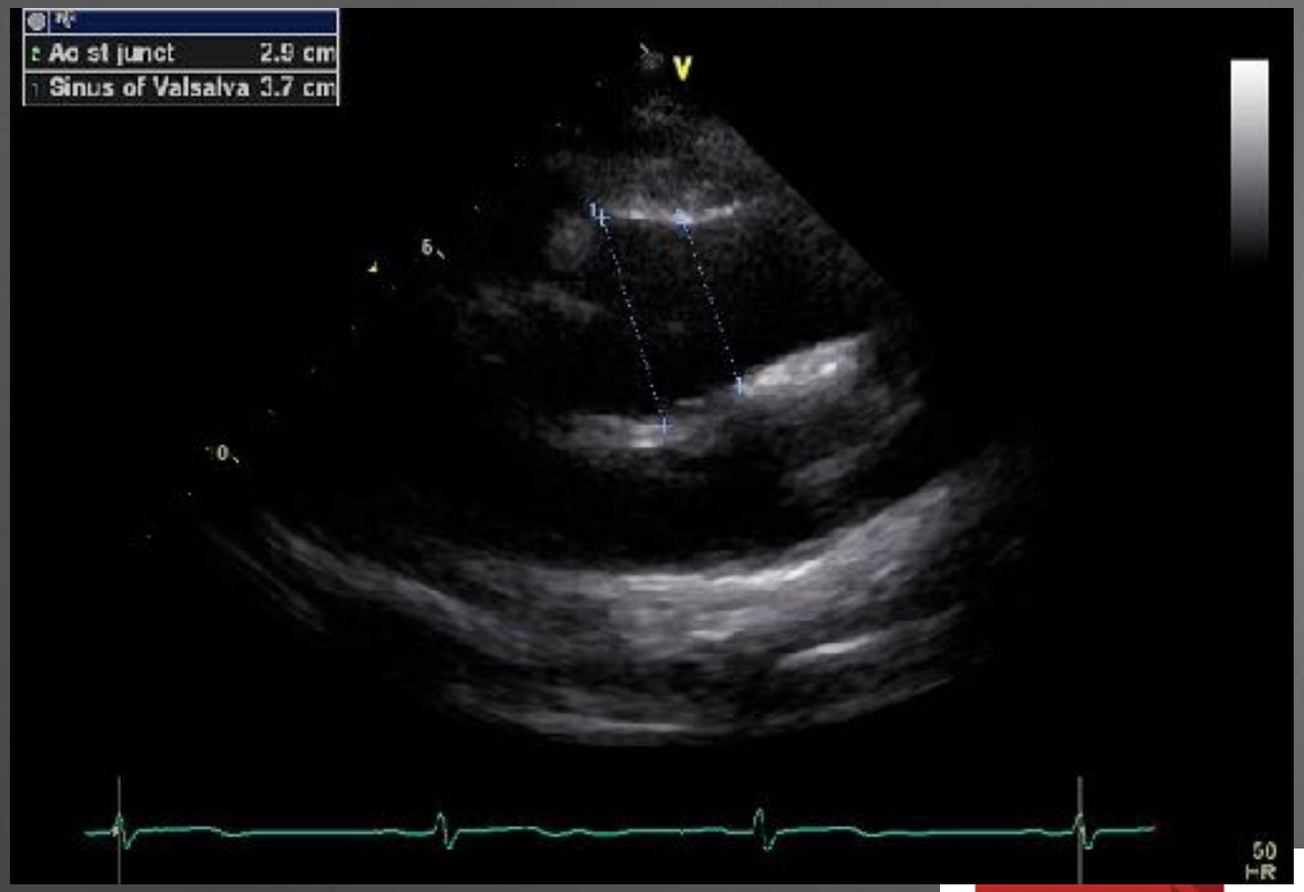
- HEENT: arched palate

- Chest: Mild pectus excavatum with normal BS

- CV: normal S1 S2 RRR


Power: 0 dB
Depth: 12.0 cm
50 HR
50 HR


Power: 0 dB
FPS: 31.7/31.7
Depth: 12.0 cm
Freq.: 2.2 MHz
50 HR



DX HOME

CRITERIA

SYSTEMIC CALCULATOR

Z-SCORE

TESTING INFO

DIFFERENTIAL DIAGNOSIS

RELATED DISORDERS

RESOURCES

Z-SCORE CALCULATION

Different methods are used for aortic root dilatation in different publications (eg,diastolic versus systolic measurement, inner to inner or leading edge to leading edge diameters). One should take into account these differences when choosing a formula to calculate Z-scores. Aortic root refers to the measurement at the sinuses of Valsalva.

Children | Adults

Aortic Root Z-Scores for Adults

For patients > 15 years of age through adulthood utilizing diastole and leading edge to leading edge measurement of the sinuses of valsalva according to Devereux RB et al. Am J Cardiol 2012;110:1189 –1194).

○ Male ◉ Female

Height (cm) : 168

Weight (kg) : 47.6

Age (years) : 35

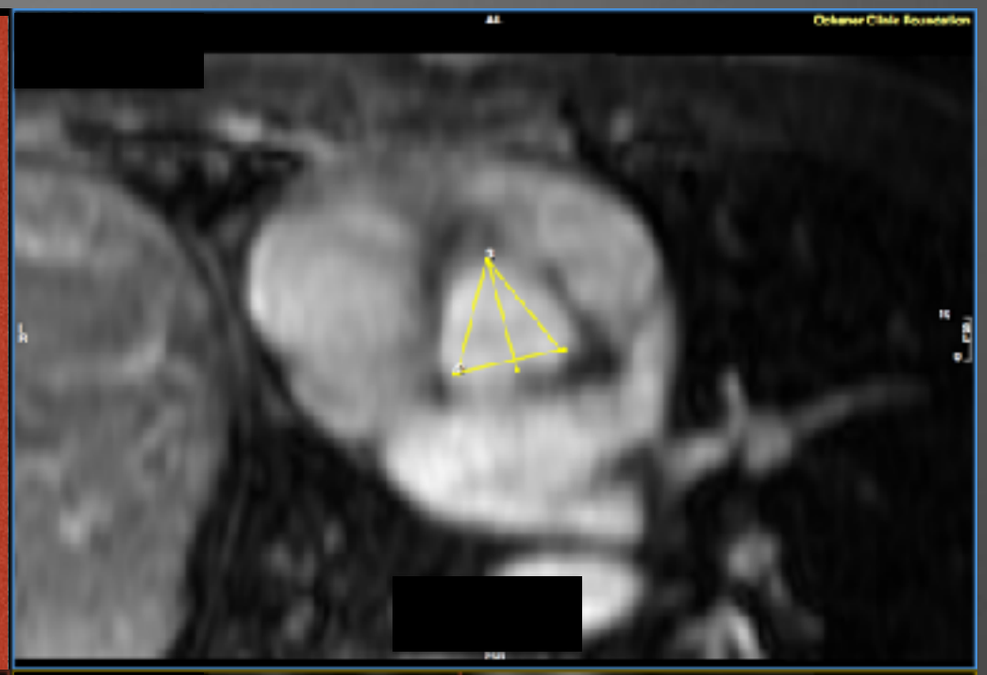
BSA : 1.52

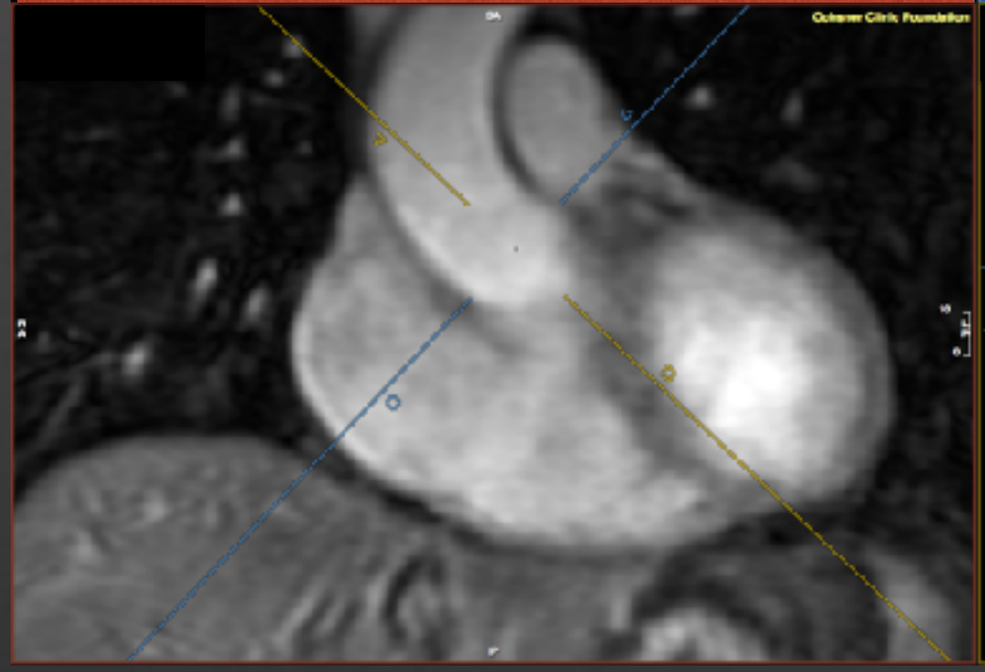
Ao Root at sinuses of Valsalva (in cm) : 3.7

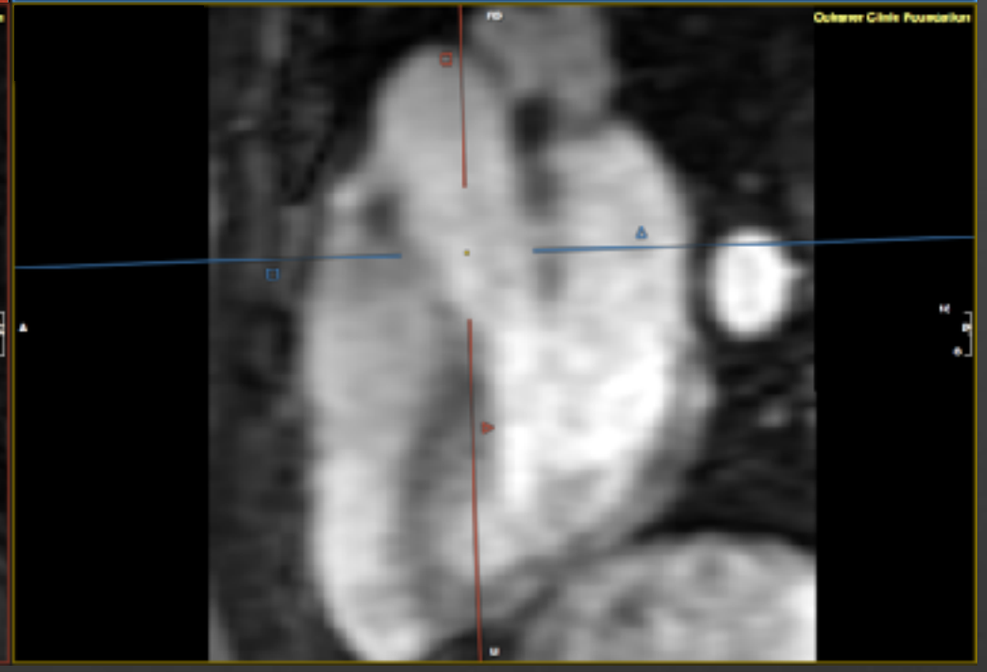
Calculate | Print Result | Clear Entries

Z-Score: 3.05

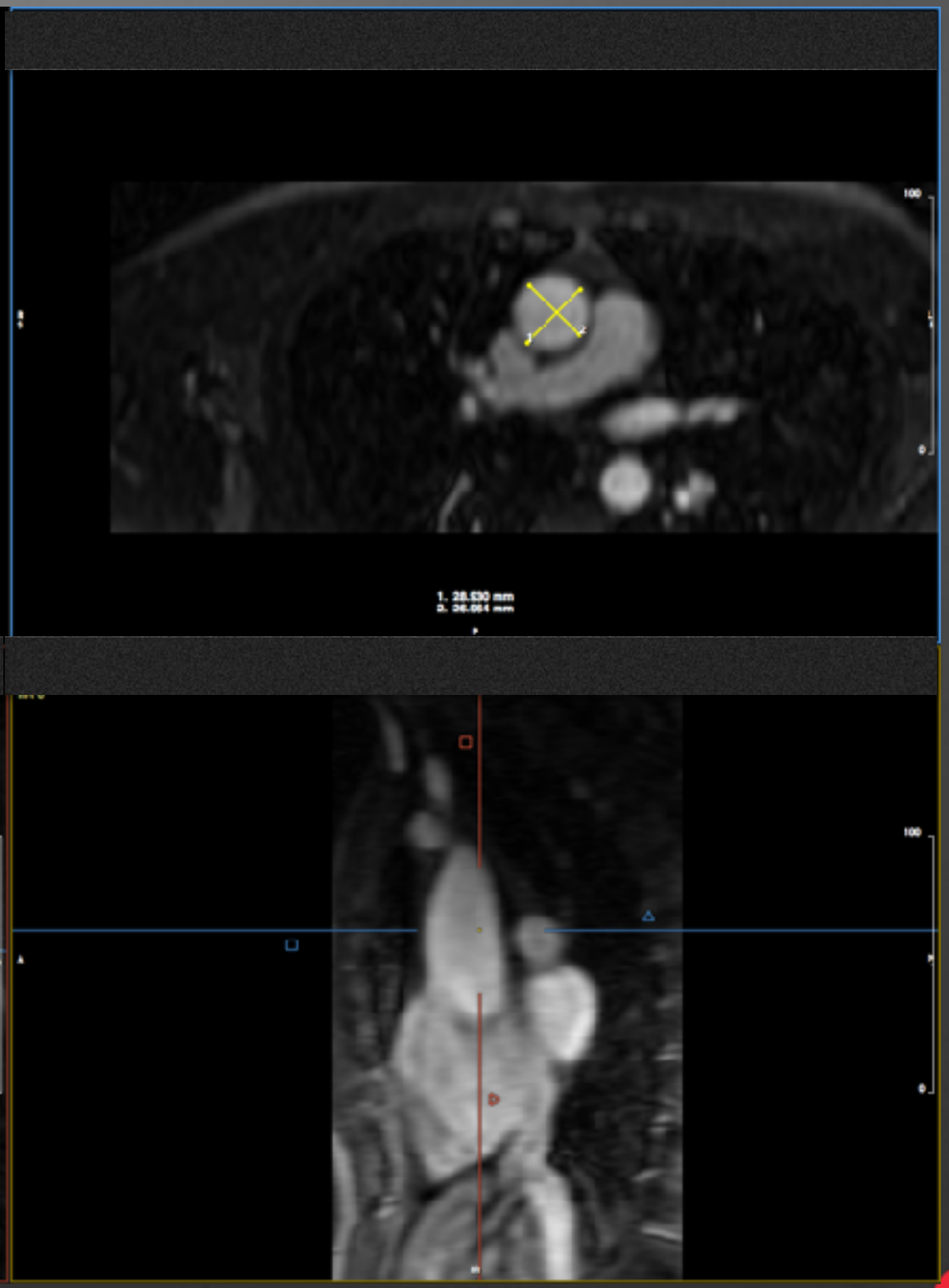
MRI: sinus of valsalva:
3.6 cm x 3.1cm x 3.8 cm

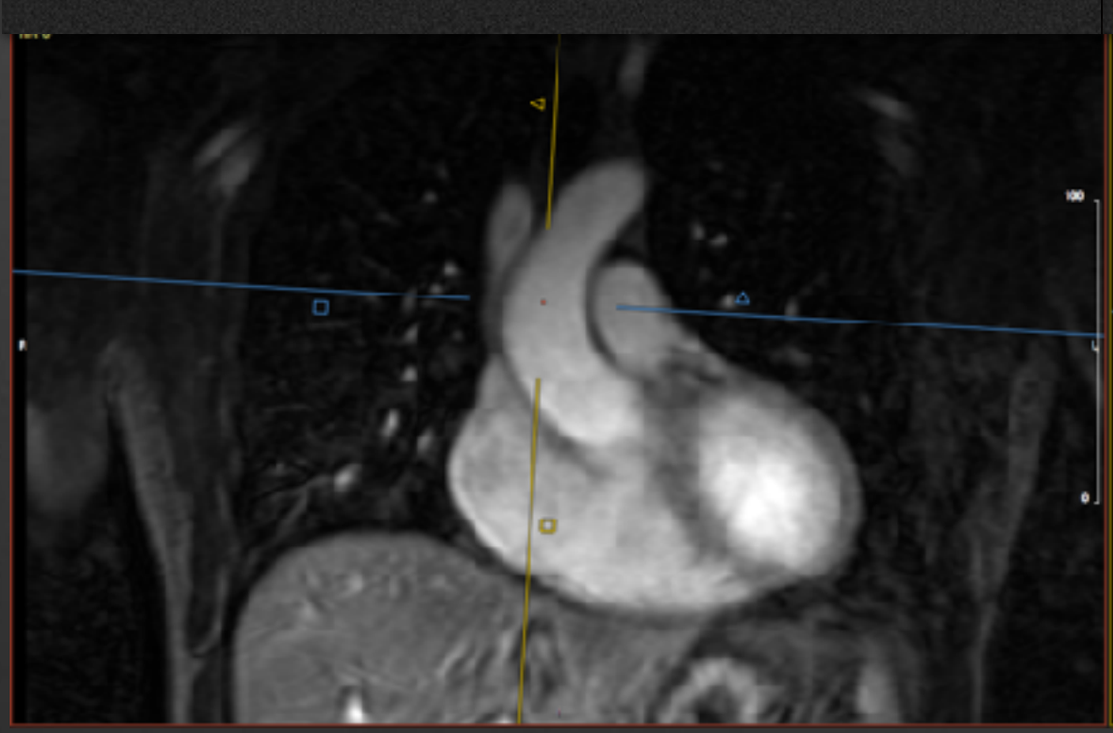






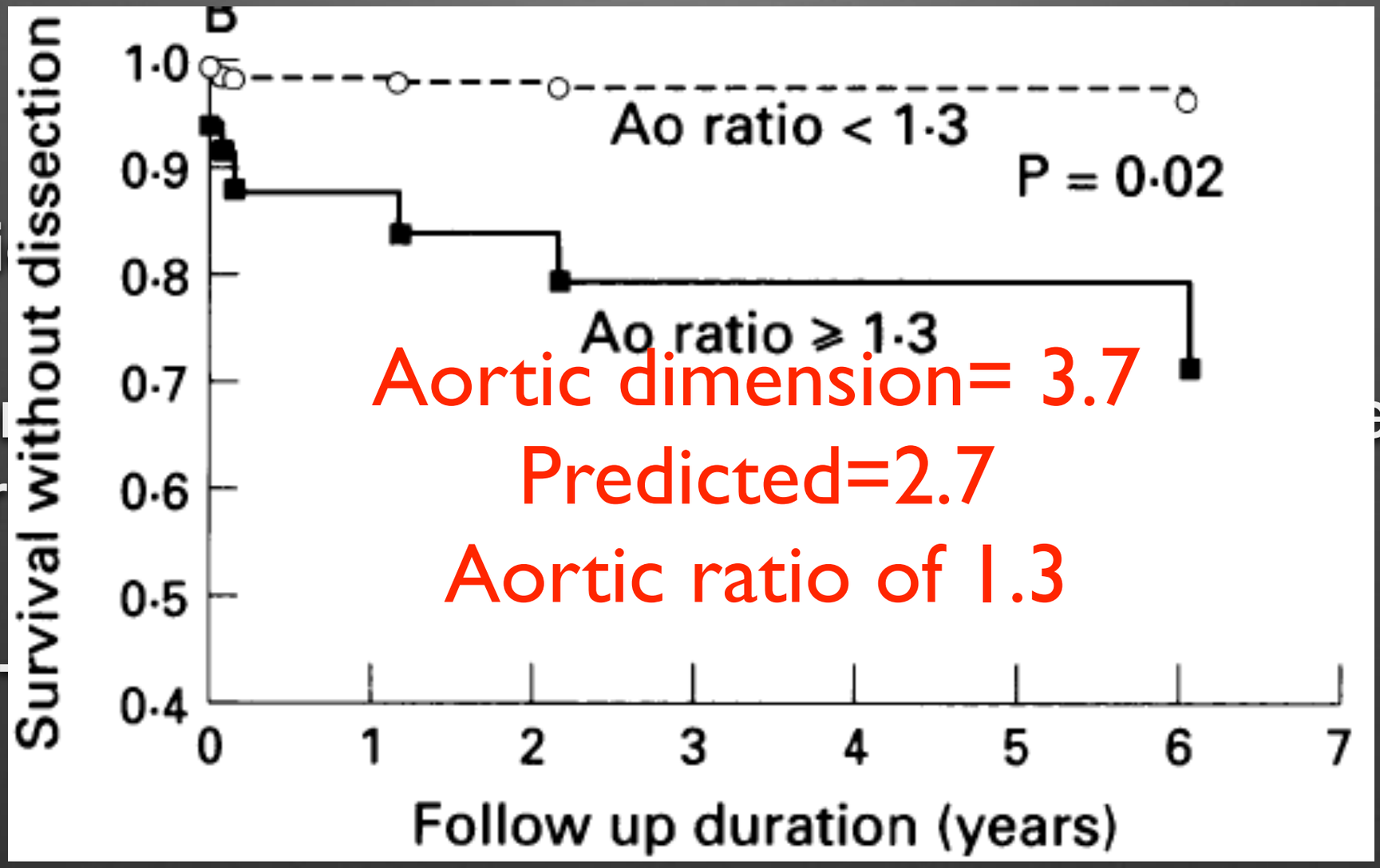
MRI: Ascending Aorta 2.6 x 2.8cm





Identification of Risk in Marfan's

- Aorti
- co ement for
- 18-



Legget. Heart 1996;75:389-395

Class I recommendations

Marfan AA

Size > 50mm
Size > 45mm + risk

RISK
FH dissection/SCD
Growth >3mm/year
Severe AI/MR
Desire pregnancy

J Thorac Cardiovasc Surgery 2019
ESC Guidelines 2014

Understand modalities

- 2D or 3D
- Contraindication to the modality
- Blind spots
- Other information obtained during study
- Availability and expertise at YOUR centre
- Consistent place and modality

Case 1